Table: Summary of Direct Assessment Instruments by Program. Rubrics and examples of student work follow this table in alphabetical order by program.

Program	Type of Direct Assessment Instrument	Example student work provided?	Rubric used?	Rubric provided?	Year or level of students assessed
American Studies Minor	Not assessed - low enrollment (< 5 students)				
Anthroplogy, BA & Minor	Final paper in required upper division course	Yes	Yes	Yes	Sophomore to senior
Applied Mathematics, BS & Minor	Two embedded questions, one homework and one final exam, from two required upper division courses	Yes	Yes	Yes	Sophomores and juniors
Bioengineering, BS	No assessment reported				
Biological Sciences, BS	Embedded final exam question from required upper division course	Yes	Yes	Yes	Majority seniors
Chemical Sciences, BS	Embedded final exam questions; lab reports; student independent research reports from upper division courses	Yes - research reports	No	No	Upper division
Cognitive Science, BA & Minor	Mock research proposal, a culminating project in a required course	Yes	Yes	Yes	Sophomores and juniors
Computer Science and Engineering, BS	Student assignments from multiple offerings of 3 core CSE courses, including problem solving homework assignments, exams and projects	No	No		Upper division
Core 1	Final cummulative essay	Yes	Yes	Yes	Freshman
Earth Systems Science, BS	Used indirect instrument				
Economics, BA & Minor	No assessment reported				
Environmental Engineering, BS	Student assignments from three of five required courses	Yes	Yes, to judge alignment of assignment with the PLO	Yes	Upper division
Environmental Systems, MS and PhD	Required project report and presentation	Yes	No	No	Required graduate course
Global Arts Studies Program, Arts Minor	Course work		No		
History, BA & Minor	Senior thesis	Yes	Yes	Yes	Senior
Literatures and Cultures, BA & Minor	Writing samples from across the major	Yes	Yes	Yes	Upper division
Management, BA & Minor	No assessment reported				
Materials Science and Engineering, BS	No assessment reported				

[1] Not Applicable

Table: Summary of Direct Assessment Instruments by Program. Rubrics and examples of student work follow this table in alphabetical order by program.

Program	Type of Direct Assessment Instrument	Example student work provided?	Rubric used?	Rubric provided?	Year or level of students assessed
Mechanical Engineering, BS	Student assignments from multiple offerings of 3 core ME courses, including problem solving homework assignments, exams and projects	Hard copies, upon request	Yes, to judge alignment of assignment with the PLO	Yes	Upper division
Media Arts Program, Arts Minor	Embedded questions in all courses	No - too diverse	No	No	
Merrtitt Writing Program	Portfolio	Yes	Yes	Yes	Lower and upper division
Natural Sciences Education Minor	Embedded questions in two courses	No	N/A[1]		Targeted lower and upper division
Philosophy Minor	Final exams questions in required course	Yes	No		Various, lower division in minor
Physics, BS & Minor	Two questions from each of four final exams, representing core upper division physics courses	Yes	Yes	Yes	Upper division
Political Science, BA	Embedded questions in final exam in required upper division course	Yes	No		Sophomore to senior
Psychology, BA & Minor	ETS Major Test	N/A	N/A		Graduating seniors
Services Science Minor	Not assessed - low enrollment (< 5 students)				
Sociology, BA & Minor	Student research paper	Yes	Yes	Yes	Senior
Spanish Minor	Portfolio	Yes	Yes	Yes	Upper division

[1] Not Applicable

Appendix A
Assignment Instructions

Anthropology 100 Research Paper

Each student should complete a paper of 15 to 20 pages (double spaced, 12 point type).

In the paper, each student should do ONE of the following:

- **Analyze the work of one anthropologist**
  - This could be an anthropologist discussed in class materials or one we have not mentioned in class. You could also analyze how the work of a particular anthropologist fits into a specific school of thought: for example you could look at the work of Eric Wolf on Mexican peasants and its influence on Marxist approaches to anthropology

OR

- **Analyze one anthropological school of thought**
  - One discussed in class, or one not covered
  - This could be a theoretical school like cultural materialism, psychological anthropology, structural functionalism, or it could be the anthropology of a particular part of the world. You could also describe and evaluate the anthropological output of theorists from a particular country: Japanese archaeologists, or Brazilian cultural anthropologists.
  - You could describe the development of new subfields: medical anthropology, legal anthropology, applied anthropology, etc.

OR

- **Analyze the development of a central concept in anthropology**
  - for example, you could examine the historical development of anthropological approaches to gender, to kinship, to race, etc.
  - You could take one major journal such as *American Anthropologist, Man, L'Homme, Current Anthropology,* etc, and produce a historical biography of the development, publications, and influence of the journal.
  -

OR

  - You could look at the development of ethical ideas in the practice of anthropological research and publication.
  - You could trace the development of anthropological methods in any of the subfields

    - You could discuss attempts at creating cross-subfield connections within anthropology: how has cultural anthropological theory affected archaeological approaches? How has medical anthropology tried to integrate biological and cultural approaches?

OR

- **Discuss a debate in contemporary anthropological theory**
    - This could include a consideration of a broad topic such as the utility of Marxist theory for contemporary anthropology or a narrower topic like the controversy over Derick Freeman's attack on the work of Margaret Mead

Students should go beyond the readings and discussions of the class in their paper.

In discussing your theorist, school, concept, or debate, consider:

- What are the main ideas and burning issues of this subject?
- How does your topic fit in to broad trends in the history of anthropology?
- Who are the theorists most influential in the training of the individual or the development of the school, concept, or debate?
    - What was the training of these theorists: which previous schools of thought or ideas shaped this theorist, school, concept or debate?
    - How widely influential was this theorist, school, debate, or concept inside the field of anthropology and in the broader world of policy or academe?
    - How has anthropology been changed by the theorist, school, concept, or debate you discuss?
- What methods were used by this theorist, school, or in the development of the concept or debate?
- What are some ethical issues raised by your topic?

Ten Steps to a Coherent Paper*

If you answer no to any of these questions, revise until you can say yes.

1. To be sure you have framed your argument clearly, draw a line right after your introduction and a line before your conclusion.
    - Does the body of your argument begin with a new paragraph?
    - Does the conclusion begin with a new paragraph?
2. To be sure your readers care about your claim, underline the sentences in your introduction that state the problem or question.
    - Have you told your readers why it should matter to them?
    - If not, will they think it matters for the same reason as you do?
3. To be sure your readers grasp your claim, box the sentence that states the main point of your argument.
    - Does it make an arguable claim that responds directly to the problem or question?
    - Is it at or near the end of the introduction or in the conclusion?
    - If your main point is in both your introduction and conclusion, is the one in the conclusion more specific, more informative?
4. To be sure your readers think your argument is coherent, circle the key words in the last two sentences of the introduction and in the most important sentence in your conclusion.
    - Then circle these same words throughout the paper.
    - Then bracket words that refer to roughly the same concepts as the circled words or to concepts clearly related to them.
    - Are there two or more circled or bracketed words per paragraph?
5. To be sure your readers know your key concepts, circle key words in the title.
    - Are those words the same as those you circled in the introduction and conclusion?
    - Are they words that you thought up, not words from the assignment?
6. To be sure your readers grasp the structure of your argument, draw a line between each major section of your paper.
    - In each section, box the sentence that states the main point.
    - Does it make an arguable sub-claim?
    - Does it support the main point/claim?
    - Do most of these main points appear at the beginnings of their respective sections?
7. To be sure your readers understand the organizing principle of your argument, look at the beginning words of each section.

- Do many sections begin with words that signal why the sections and paragraphs come in the order they do, words such as *first, second, on the other hand, however, therefore, in conclusion,* and so on?

8. To be sure your readers judge your claim to be sound, underline every sentence in a paragraph that reports evidence supporting the point/claim of the paragraph.
    - Have you underlined at least half of the paragraph?
9. To be sure your readers can move from paragraph to paragraph easily, underline the first half of the first sentence in each paragraph.
    - Do the words you have underlined refer back to something already mentioned earlier in the essay?
10. To be sure your readers think your prose style is clear and direct, underline the first six words in each sentence.
    - If you listed those subjects, would they seem to your readers to constitute a relatively limited set of concepts?
    - Do those words refer to information that would be familiar to readers, or at least not surprise them?

*Adapted from: Williams, Joseph M. and Colom, Gregory G. 2003. *The Craft of Argument Concise Edition.* New York: Longman.

Due Dates:

Abstract:	Sept. 17
Provisional Outline and Bibliography:	Oct. 29
Paper:	December 8

Appendix B

Assessment Rubric

ANTH 100 Final Paper Assessment Rubric for Program Learning Outcome #1

	Adequate	Proficient	Mastery
Address key concepts applied in either historical or contemporary anthropological studies	Student identifies and defines important terms and concepts relevant to the thesis/topic of his/her paper, relying on language presented in readings or lectures rather than translating into one's own words	In addition, student explains these terms and concepts in his/her own words and uses concepts and terms in the paper in such a way as to demonstrate clear comprehension of their meaning	In addition, student evaluates the relevance of key concepts to the thesis/topic of the paper through comparison with other concepts or through analysis and critique of concepts in their own right
Discuss the major theoretical approaches that have shaped the discipline of anthropology over time	Student identifies and defines theoretical approach(es) relevant to the thesis/topic of his/her paper, relying on language presented in readings or lectures rather than translating into one's own words	In addition, student explains these approaches in his/her own words and refers to theoretical approaches in the paper in such a way as to demonstrate clear comprehension of them	In addition, student compares and contrasts one or more theoretical approaches, and critiques such approaches as an element of such analysis
Address how and why anthropological perspectives and practices have changed over time	Student identifies, and defines major trends in anthropological thought through time relevant to the thesis/topic of his/her paper, relying on language presented in readings or lectures rather than translating into one's own words	In addition, student explains how and why such change occurred in his/her own words and demonstrates clear comprehension by correctly situating their topic within this history of thought	In addition, student evaluates how and why the topic/thesis of the paper connects to a moment or period in the history of anthropology, including comparing and contrasting this moment/period with others
Address how anthropological thought has influenced or been influenced by other disciplines in the social sciences, natural sciences, and humanities	Student identifies and defines which and how other disciplines relate to the thesis/topic of his/her paper, relying on language presented in readings of lectures rather than translating into one's own words	In addition, student explains how and why other disciplines are relevant in his/her own words	In addition, student evaluates disciplinary connections by providing original critique or speculating on the importance of such connections to the topic/thesis
Appraise anthropology as a dynamic and self-reflexive discipline	Student identifies and defines who within, and/or how, anthropology has reflected upon or critiqued the discipline relevant to the topic/thesis of the paper, relying on language presented in readings or lectures rather than translating into one's own words	In addition, student explains in his/her own words why such self-reflection or critique occurred in the discipline's history	In addition, student provides original critique and/or synthesizes the perspectives of others to assess the value of such disciplinary self-reflection

Appendix C
Sample Student Work

Term Paper

Biological Anthropology

[Student ID 2]

Anthropology 100

Linda-Anne Rebhun

Fall 2009

When analyzing Biological Anthropology there is an essential distinction between the uses and abuses of the discipline. Throughout my paper I will analyze the use and abuse of biological anthropology, specifically concerning the issues of medical apartheid, justification of discrimination as well as the various advancements in contemporary theories of human evolution based on current discoveries.

Medical apartheid is something that went without chastisement for decades, because of the lack of the acknowledgement that all races are equal and should be treated equally as well. According to Elliot Washington's book titled *Medical Apartheid*, she has provided an extensive history of discrimination in science and the abuse of African American people who were not provided with any information concerning the potential risks of any studies they participated in. An example of a contemporary medical apartheid is the Tuskegee Syphilis Experiment, which took place in the 1930's. The Tuskegee study was especially horrific, "scientists had long claimed that the venereal disease manifested differently in blacks than in whites, and the United States PHS (Public Health Service) scientists decided to document this by finding a pool of infected black men, withholding treatment from them, and then charting the progression of symptoms and disorders" (Washington, 156). The PHS kept essential information from the men who were being studied, for example the scientists didn't tell them they were a part of a study instead they told them that they were being given free medical care. The ultimate goal for this study was to examine the after effects of syphilis on the human body and if it was actually less potent to African American men than it was to White men.

Another issue Washington mentions in Medical Apartheid is that African Americans were victims in research as caged subjects while in prison. Such experiments were conducted at Holmesburg Prison during the 1960's and 1970's (Washington, 245). The medical experiments include, but are not limited to radiation and sulfuric acids burns on various parts of the body including the scrotum ($3 a session), sweat glands studies by cutting the armpits, whipped their backs to prepared for poison ivy exposure and cadaveric tissue and forced to inhale viral vapors. "Williams [a prisoner] had offered himself up for as many as twelve experiments at once, bringing in from thirty to fifty dollars for each multisession research

study. Yet, he said, 'we were never told what was going on. We never had witnesses of a receipt for [copy of] anything we signed,'" (Washington, 245). These are only a few examples from Washington's book, but her research covers the extensive history of the abuse of African Americans who were left in the hands of doctors and scientists with cruel intentions.

Another example of a form of medical apartheid was the widespread feelings of Anti-Semitism that ran rampant during the 1940's. A very successful American entrepreneur and founder of the Ford automobile company, Henry Ford was an indirect leader in contributing to the propaganda concerning Jewish people. " Ford declared the World War I had been started by "German-Jewish bankers" in order to enrich themselves. He also claimed that "one of the great factors that brought on the Civil War and made full settlement of the issues impossible was the Jew."(Brace, 197). Ford had an assistant; W. J. Cameron, write a section of the Dearborn *Independent* [a newspaper] for him, which included all of his anti-Semitic thoughts and opinions. This was something that he kept hidden from the public since he was a well-known businessman, hence the use of another persons name in the newspaper. "Ford disliked the British and admired Hitler and the Germans. As World War II, approached, he refused to make aircraft engines for Britain while providing Germany with five-ton trucks. He opposed American entry into the war and continued to sell engines and vehicles to the Nazis until 1941," (Brace, 201). This was evident when reading his sections in the newspaper since he constantly blamed Jewish people for world problems and issues within the economy. "Although Henry Ford could hardly have known that his own parochial bigotry would contribute to the events that led to the murder of over 6 million Europeans, one of the most thorough treatments of the fraudulent document concluded that "the Protocols were a warrant for genocide," (Brace, 203). The document, *The Protocols*, that Ford mentions is a document that claims come with many titles one of them being the *Protocols of the Elders of Zion*, this alleged text proposes a plan to achieve global domination by the Jewish people. This came to Ford as a threat and as an excuse to continue forth with supporting Hitler's agenda. Like the men who suffered in the Tuskegee Syphilis experiment, there was mass experimentation on the concentration camps, which went without consent or without any shape or form of explanation as why they were torturing so many innocent people.

While many people were being experimented on and tortured in the name of science, other scientists were continuing to prove that it was okay to do so, since there were obvious differences between races. According to the book "The Mismeasure of Man" written by Stephen Jay Gould there were methods of measurement of the head, specifically jaw and brain size. This was one of the many different ways White men would be able to continue to claim that the White race is more superior than that of any other ethnic background. "No rational man, cognizant of the facts, believes that the average Negro is the equal, still less the superior, of the average white man. An, if this be true, it is simply incredible that, when all his disabilities are removed, and out prognathous relative has a fair field and no favor, as well as no oppressor, he will be able to compete successfully with his bigger-brained and smaller-jawed rival, in a contest which is to be carried on by thought and not by bites." -T.H. Huxley (Gould, 73). Gould took this quote to prove that many early scientists studying the concept of race were stuck in the outdated stigma that there was a hierarchy among the different types of people.

The chapter titled "Measuring Heads" mainly focuses on issues with the use of Biology to explain why the white race is superior. Gould also states a very important fact when comparing evolutionary theories. With the help of new discoveries, monogenists established the idea that there was a hierarchy of races, while polygenists established the belief that each race evolved separately, hence "the evolution of major inherited differences in talent and intelligence" (Gould, 55). Another study termed craniometry is included in Gould's book, "The leaders of craniometry were not conscious political ideologues. They regarded themselves as servants of their numbers, apostles of objectivity. And they confirmed all the common prejudices of comfortable white males- that blacks, women and poor people occupy their subordinate roles by the harsh dictated of nature" (Gould, 74).

Another craniometrist name Paul Broca decided to include the comparison of women brain size to men's brain size. "We are therefore permitted to suppose that the relatively small size of the female brain depends on part upon her physical inferiority and upon her intellectual inferiority" (Gould, 104). Another appalling statement by Broca "A desire to give them the same education, and, as a consequence, to propose the same goals for the, is a dangerous chimera… The day when, women leave the home and

take part in our battles; on this day a social revolution will begin, and everything that maintains the sacred ties of the family will disappear," (Gould, 105). It is quite apparent that there were many scientists that searched for different means to prove that white men were superior and that it was acceptable to discriminate against all minorities.

When a Virginia physician named Robert Bean decided to publish a journal on craniometry in 1906, he states the following in his conclusion: "We all know that blacks have a keener sense of smell than whites; hence we might have expected larger sense of smell than whites; we might have expected larger genus in blacks if intelligence did not differ substantially between races. Yet black genus are smaller despite their olfactory predominance; hence, blacks must really suffer from a paucity of intelligence" (Gould, 77). After a few journals were published in well-known editorials of American Medicine, Bean's mentor at John Hopkins decided to review and repeat Bean's studies due to suspicion of rate of experimental error, "for a sample of 106 brains, using Beans method of measurement, he found no difference between white and blacks in the relative sizes of genu [anterior end of the human brain] and splenium [posterior end of the human brain]" (Gould, 93). Many careless mistakes were made due to the expected proof of their hypothesis, but ultimately flaws and experimental errors were discovered when skeptics investigated their studies.

Attempts to prove that discrimination and racism was scientifically prove correct continued through many scientist, but have been investigated by Jonathan Marks, Stephen Jay Gould, Rachel Caspari, and C. Loring Brace. In addition to the past and recent studies in Anthropological neuroscience and comparative research with human and primate brains, Jonathan Marks provides insight into the immense changes in Anthropology in his journal titled: *Anthropological Taxonomy as Subject and Object: the consequences of descent from Darwin and Durkheim*. There has been progress in building a better understanding of the relationship between humans and primates. This form of Anthropology was formerly known as 'molecular anthropology' (Marks, 7). When Marks refers to a journal written by Emile Zuckerkandl concerning the differences in the structure of hemoglobin in humans versus gorillas Zuckerkandl states, "…it appears that gorilla is just an abnormal human, or man an abnormal gorilla, an

the two species form actually one continuous population." Marks refers to hominoids and finds that there are more species of primates than originally defined. Also Malone briefly mentions that the relationship between the human species and primates has been rejected simply because most people do not like the idea of being related to primates. "Nevertheless, this process of 'naturalizing different' is at the heart of subspecific taxonomy of Homo sapiens. It is again a cultural act, assigning people to qualitative categories on the basis of diverse criteria," (Marks, 12).

Finally, Marks states something that all Anthropologists are continuing to work towards after establishing more concrete Anthropological research standards, by articulating on collaborating with experts in both disciplinary fields; Biology and Anthropology, because it simply helps in establishing better arguments within studies that include culture and science.

In Gould's, *The Mismeasure of Man* he finds that there are many scientists has been misinforming the scientific community as well as the public. An excerpt "The ape in some of us" which concerns criminal anthropology is taken from Cesare Lombroso's theory on criminals born as a "savage." He identified the criminality abnormal behavior among inferior people. "They display apish stigmata as normal parts of their anatomy: "their nose…is not only flattened, but trilobed, resembling that of monkeys," (Gould, 125). This mentality would further the mistreatment of African Americans since many scientists tried to prove that they were more "apeish," relatives of primates; therefore it was acceptable to discriminate against African Americans.

Gould elaborates on this issues by stating that it is important to realize that if a person has long arms then they are inferior because chimps have longer are does not necessarily mean that they are genetically similar. Genetic variation is something that needed to be studied on a a more technical level. "Lombroso's anatomical stigmata were, for the most part, neither pathologies not discontinuous variations, but extreme values on normal cure that approach average measures for the same trait in great apes" (Gould, 127). Another issue concerning racism is a term called "Mongolian idiocy," or "mongolism" for the chromosomal disorder properly known as "Down Syndrome": this was identified on paper entitled: Observations on an ethnic classification of idiots" (Gould, 134). This is one of many

unwise examples of the justification of discrimination against minorities. This was a part of the great effort to provide information for the public to follow in the example of white male scientist's methodologies of prejudice and racism. It is ridiculous to see that many scientists tried in so many different ways to prove that white males are superior to black males.

Marks states that all Anthropologists are continuing to work towards after establishing more concrete Anthropological research standards, by articulating on collaborating with experts in both disciplinary fields; Biology and Anthropology, because it simply helps in establishing better arguments within studies that include culture and science.

Furthermore, a book written by C. Loring Brace, "Race" is a Four-Letter Word" goes into great detail as to how race was a socially invented concept. Although race and variation among humans has always been a topic of curiosity since the beginning of civilization; Brace provides an extensive list of concepts outlining the history of race concept. Some of the most insightful information is included in the excerpt concerning the Renaissance, where it states that there was a change in the way people classify differences, " human variation began to be described in terms of categories instead of gradients" (Brace, 21). While this was true in the Old world, the race concept was thought of differently in the New World, where the Roman Catholic Church has most of the authority. "Even within the Church itself there was a split between those who regarded all the Native Americans as the descendents of Adam and Eve and those who regarded them as belonging to Aristotle's category of people who were born to be slaves," (Brace, 21). The disappointing truth of the how people justified horrible treatment of others is something that new age Anthropology aims to prevent in the future.

Approximately two decades after the Renaissance a man named Carolus Linnaeus devised a method of naming all species of animals using Latin because it did not have any dialects. This type of terminology was not limited to animals but Linnaeus included humans as well. "In the famous tenth edition of his Systema Naturae, Linnaeus placed Homo sapiens in the order Primates, where it has remained ever since. He did this strictly on the grounds of shared anatomical characteristics, a procedure that has been followed by natural scientists ever since. Linnaeus's perception of the nature of geography

was made up of four varieties of human beings that he recognized were *Homo sapiens europaeus*, H. sapiens asiaticus, H. sapiens americanus, and H. sapiens after, representing Europe, Asia, America, and Africa respectively" (Brace, 27). Linnaeus also incorporated the use of the four humans since during his lifetime there was a huge emphasis on Greek philosophy etc. There were many faults in the beginning stages of Anthropological thought and practice, but modern Anthropologists have endeavored to learn from the vanguard anthropologists' mistakes and avert from repeating them.

Fortunately there has been much development in Anthropology specifically in the Biological field of Anthropology. It can be said that Anthropology is very updated on the concepts of race and evolution.

According to Rachel Caspari's journal: *Four Types to Populations: A Century of Race, Physical Anthropology, and the American Anthropological Association* concerns the progress of Anthropology over the years and the development of the American Anthropological Association (AAA). Caspari analyzes the issues that come with scientific and social manipulation on Biological Anthropology, mainly concerning race concepts. The AAA; although founded in 1902, changed drastically in the 1960's resulting in such concepts that changed the paradigm at the time. Essentialism, cladistic thinking and Biological determinism are three main aspects affecting race ideals.

Biological determinism is one out of the three concepts that has been questioned and rejected due to progressions in Anthropological theory. Essentialism has been taken into consideration when analyzing variations in phenotypes, for example genetic variations in skin color. Cladistic thinking may eventually be discarded because evolutionary essentialism insinuates that different races derived from multiple ancestors, termed polygenism. This may become problematic because people might use it to justify discrimination or racism. Therefore, establishing "interracial competition" (Caspari, 67) and biological inferiority. "The link between Biological determinism and racial determinism depends on races being natural categories, and physical anthropologists no longer support the notion that races are subspecies," (Caspari, 74). Franz Boas was a vanguard in progressing Anthropological thought because he changed the archetype of Biological determinism. He did so by separating cultural anthropology and

Biological Anthropology so that it could be seen in through different perspectives. Therefore eliminating outdated hierarchical ideas among cultural groups.

Boas is seen as the father of what Anthropology is today, mainly because he got off his "armchair" and became a participant observer among various cultural groups. Thus, building better and closer relationships based on primary interaction and not just explorer and missionary journals. The concept of race has been a social invention that may be difficult for certain people to look passed, but ultimately it is necessary to focus on how to avoid ethnocentrism. Because without it, there would not be a need to prove that certain "races" or cultural groups are more superior or inferior to others.

Franz Boas on "the instability of human types," evidently explains that diets play a part in establishing variation among human beings. "The characteristic of food-stuffs by different tribes, such as the exclusive meat diet of some tribes- most pronounced among the Eskimo- and the exclusive vegetable diet of others- well developed, for instance, in Southern Asia. Both of there have, in all probability, a far-reaching effect upon the bodily form of these races" (Boas, 83). Boas has tried to look at human types and variation with a different perspective. He looks more closely at the environment that people are exposed to as well as their daily tasks and duties within a group.

Instead of looking for reasons to blame the problems of society on those with different skin color, Boas took a profound look at logical reasons for variation among human beings. "The distinguishing traits of human races are in many cases analogous to those by which domesticated animals are characterized. Melanism that is a strong increase of pigment, and leucism, that is marked loss of pigment, belongs here. The black bear, the black panther and the mole have black coat color, but on the whole black hair are found in various species" (Boas, 86). Boas is referring to phenotype variation based on a genetic outlook, while the effects of different environments may influence skin. Color pigmentation within an organism. "It is obvious that in all cases we are comparing groups of the same descent, but living in distinct geographic, economic, social and other environmental conditions. If we find differences among them, they can only be due, directly or indirectly to environment. Thus the fundamental problem presents itself, in how far are human types stable, in how far variable under the influences of

environment" (Boas, 89). Boas does not cease to impress the Anthropological community since he provides a good standpoint on human variations by comparing it to animals alike in the same environments that people may reside in.

Nicholas Malone wrote "*The State of Biological Anthropology in 2008: Is Our Discipline Strong and Our Cause Just?"* which analyzes the status of Anthropology and the direction it may be going into in the future. This subject is mainly made up of evolutionary history of the human species. Some of the disciplines described by Malone include: Forensic Anthropology, Evolutionary Medical Anthropology, Anthropological Neuroscience, Primatology, and Paleoanthropology. Evolutionary medical Anthropology and Anthropological Neuroscience are two the significant "sub subdisciplines" that Malone has investigated. Furthermore, Anthropology has helped contribute to current academia. "The overarching goals of our inquiries are slightly less than modest: understanding where our species came from, how we got from there to here, why we behave the way we do, and what is (are) our nature(s)," (Malone, 151). Taking theories and discoveries from early Anthropological studies have helped shape Anthropology for what it is today. Since Modern Anthropologists strive to keep their legitimacy in today's society, it has worked in partnership with other fields of study to have better perspectives on current issues. For example, when Political Scientists and Sociologists work with Anthropologists to understand non-western cultural groups that may have complex social systems of kinship.

Due to the great advances in Anthropology many mistakes have been recognized such as the issues concerning racism ultimately leading to inequality. Ethnocentrism was a huge contributor to anthropologically based discrimination. Bio-cultural anthropology is no longer obsolete, but there are more progressive ideas that help eliminate the stigma of "arm chair anthropologists." Malone restates something that all Anthropologists should reflect on, just as schools or organizations reflect on their mission statements. This "mission statement" takes account of the importance of working with the nonprofessional community and to combine university level thought with "street" or common person thought, as well as combining general ideas with specific ones.

When Malone briefly introduces some sub subdisciplines of Anthropology, he mentions evolutionary medical anthropology and anthropological neuroscience. These two subjects were described vividly when Malone mentioned that evolutionary medical anthropology would help create a more useful health care system. The use of ethnography and epidemiology helped to build a stronger connection between evolutionary and sociocultural progression. When taking anthropological neuroscience into consideration, Malone includes perceptive information concerning neuroscience and how it is related to social behavior since the brain is responsible for the control of human behavior. There is also the insinuation that the boundary between dorsal and ventral brain structures may have been shifted in human evolution when comparing the function of human and primate brains.

> "Statements that human hybrids show undesirable traits, both physically and mentally, physical disharmonies and mental degeneracies, are not supported by the facts. There is, therefore, no biological justification for prohibiting intermarriage between persons of different ethnic groups… intelligence tests do not enable us to differentiate safely between what is due to innate capacity and what is the result of environmental influences, training and education… there is no proof that the groups of mankind differ in their innate mental characteristics, whether in respect to intelligence or temperament… for all practical social purposes "race" is not so much a biological phenomenon as a social myth" -Montagu (Brace, 238).

Some may find that the sub-discipline of Medical Anthropology as a subject to combines Biology and Cultural Anthropology in a bracing way, since outdated Bio-Anthropological concepts have been reject. An example of such partnerships is that now, Public Health Specialists and Ethnographers can focus on social issues that prevent cultural groups from understanding Western medicine or the politics of a country they may have recently moved into. It brings the latest research discoveries into collaboration with ancient remedies, creating a new culture of medicine.

It can be overwhelming to see how wide the field of Anthropology really is; from the textbook titled A History of Anthropology written by Paul Erickson and Liam Murphy, there are general descriptions of the Biology of behavior, new Physical Anthropology Ethology and Behavioral Genetics

and finally Sociobiology. All of these disciplines of Anthropology have led to the effort to continue to progress the field of study to help others recognize that is more applicable to other fields than expected.

Resources

Boas, Franz. 1938. The Mind of Primitive Man The MacMillan Company New York: 242 pages.

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Student ID 4

Modern Social and Cultural Attraction:

An evolutionary perspective

ANTH 100: History of Anthropological Thought and Practice

Professor Rebhun

Fall 2009

Introduction

Every human endeavor is governed by culture and evolution; behaviors, for the most part, reflect our biological predisposition, but there are also times in which we think and do the exact opposite. As members of the human~~s~~ species, that we have evolved over millions of years through what can be seen as successful ~~copulation and~~ reproduction processes. There are many theories behind how and why we choose certain mates over others, but it is certain that for the survival of the human species, we must ensure that our genes live on. This selection process has been attributed to biological drives that control what men and women find attractive in a mate, overriding all psychological and social desires. Therefore, although the modern human has the ability to make rational decision, sexual attraction is still the driving force behind partner choice.

This, however, has come into question in recent years when taking modern culture and thought into consideration. In writing this I will attempt to bring to light the major concepts of evolutionary theory and question their applicability to modern world. In short, are the laws of sexual attractiveness and evolution as put forth by past researchers as applicable to modern humans as they are to modern animals or have we evolved past our animalistic tendencies.

interesting question

Charles Darwin's Theory of Evolution and it's Applicability to the Modern Man

In the late 1800s, Charles Darwin proposed a theory of evolution that has been a topic of controversy since it was published. It's tenets remaining strong till this day as countless studies

from many related and unrelated fields have come to conclusions that support his hypothesis; three of the most pertinence to this paper being the process of natural selection or survival of the fittest, the preservation of favorable individual differences and variations, and the death of those that are unfit. Darwin's theory of evolutionary change and process of natural selection surmises that variations exist in every population of species. Organisms compete for the limited resources available to them, and may produce more offspring that can naturally survive, therefore, only a few organisms are successful in leaving progeny. Each organism passes on genetic traits and characteristics to their offspring, and the organisms that inherit the most beneficial traits are more likely to survive and reproduce. You should have in-text references

In modern society, it isn't hard to see how Darwin's theory of evolution is becoming questionable or less applicable. Humans have adapted to this planet to the point where there is not much of a threat of extinction or threat to survival, unless we so damage the environment... and with reasonable effort we are able to support multitudes of people (The population of the human species nearing 7 billion being proof). although the majority barely subsist This leaves us with much leeway in terms of mate choice for two reasons: biologically handicapped peoples do not just perish (instead they survive through medical and social programs when applicable), and though there are distinctions between the more fit and the less fit, there is less of an urgency to choose to mate with those that are more fit because almost all offspring survive whether mating with the fit or the unfit in the middle & upper classes. This environment, which I dare say has too high to a survival rate, is what makes humans less likely to exhibit animalistic behaviors; and has created a culture that allows for the acceptance of more sexual variety beyond a select group of attractive, fit individuals.

The Evolution of Human Mating

Mate choice is an important evolutionary process that imposes sexual selection on the other sex and accounts for spectacular ornaments that would otherwise remain unexplained by natural selection (Darwin 1871; Andersson 1994). How and why mate choice evolves has been vigorously debated for much of the history of evolutionary biology and anthropology, and particularly so in the past 25 years (Kirkpatrick & Ryan 1991; Andersson 1994). It is only in recent times that the importance of mating biases other than conventional 'choice' (conventional choice being a reference to fitness) has been recognized.

Mating is the engine of the evolutionary process, or very close to it. As descendants of reproductively successful ancestors, modern humans have inherited the mating strategies that led to our ancestor's success. "These strategies include long-term committed mating (e.g., marriage), short-term mating (e.g., a brief sexual encounter), extra-pair mating (e.g., infidelity), mate poaching (luring another person's mate), and mate guarding (effort devoted to keeping a mate)." (Buss 2007) Since men and women historically confronted different adaptive problems in the mating domain, the sexes differ profoundly in evolved psychology of mating solutions. These psychological sex differences include possessing distinct mate preferences, dissimilar desires for short-term mating, and distinct triggers that evoke sexual jealousy.

Modern courting habits are a direct result of culture intercepting genetic dispositions. One such example is the social pressures from the outside that modern couples must deal with that defy

the laws of nature and the survival of the fittest assertions put forth by Darwin. This isn't to say that his theories are inadequate because at the primitive level they have been proven to be incredibly applicable; however, it does mean that his theories are somewhat outdated and thus are much "less applicable to the modern man than other animals in nature who clearly remain reliant on biology and genetics for courting, mating, and reproduction behavior". (Adams 2008)

Social Comparison as the Primary Mating Method for Choosing a Mate

it's means it is. The possessive has no apostrophe

In attempting to answer how a modern mate is chosen, I turn to social comparison, which rather than finding it's roots in our biological programming, finds it's roots in the social interactions between individuals and groups. The following considers the evolution of human competency to make social comparisons with others in order to judge sexual attractiveness, and in turn, choose a suitable mate. Darwin pointed out that alongside natural selection, a social process was operating within species to determine which individuals in each generation reproduce and at what rate. (Gilbert & Price & Allan 1995) This phenomenon was termed by Darwin as sexual selection and subdivided it into intersexual selection, in which one sex chooses and attracts the other for mating, and intrasexual selection in which one sex competes with and prevents other members of the same sex from having free access to breeding resources (Krebs & Davies, 1993; Trivets, 1985). This however has implications in that when looking within a generation of peoples there will be two groups; those who are successful at reproduction, and those that are not. Thus, it is only natural that we see major differences in the behavior of the two different groups.

Gilbert/Price/Allan summarize the different strategies employed to make social comparisons. They state that "social comparisons can be pair wise (one individual to another, as in a boxing match), triangular (as in various competitions where the desired outcome is a preferential relationship with a parent or other authority figure, electorate or lover) and group (involving comparisons of self to the group in general; being like or unlike "them," and whether one's group/team is superior or inferior to other groups/teams)." (Gilbert & Price & Allan 1995) They have found that the following form of comparisons have evolutionary roots in humans:

Stronger/weaker: This is likely to be the oldest form of social comparison. This involves the ability of an individual to make successful challenges and "stand one's ground". (Gilbert & Price & Allan 1995) Examples of contests that display strength or weakness are ritualized contests such as sports (primarily friendly challenge not involving death), or unritualized contests such as in war (primarily unfriendly challenge involving complete dominance or death). e.g. Adam is the most capable of jumping high enough to reach an apple. Thus Eve is impressed and finds attraction in Adam. , she didnt have a whole lot of choice, did she?

More/less attractive: In the domain of sexual attractiveness there is evidence that males and females follow different intersexual strategies and compare in different ways. Males are more concerned with physical beauty while females are more concerned with power and status (Buss, 1989). e.g. Adam has been

designated big boss and given the power to manage as he sees fit. Eve is more beautiful than the sun, the moon, and the stars. They are both mutually attracted to each other.

More/less favored by authority figure: This involves a comparison of third party investment in the individual. It is thus assumed that higher investment in the individual is evidence of group interest in that individual, and lower investment is evidence of lack of group interest in that individual. (Gilbert & Price & Allan 1995) e.g. Adam is often allowed to have afternoon tea with his creator, while no one else ever has afternoon tea. Eve sees that there must be something special about Adam if his creator is investing so much time, thus she is attracted to him.

where did you get these Adam Eve scenarios?

More/less attractive when compared to reference group: Attractiveness to a reference group is an assessment of the "relative social attention holding power" (Gilbert & Price & Allan 1995) of an individual, and can be summarized by two types of comparisons: the comparison of one's own display of attractiveness (talent, abilities, etc.) with the displays of others, and the comparison of the response of the group to those displays. (Gilbert & Price & Allan 1995) e.g. Adam and Eve are at a party. Adam shows off his ability to resist eating apples, and the attendees of the soiree are very impressed. Eve doesn't know what is going on, but she notices everyone complimenting Adam, thus she becomes attracted to him.

Creditor/debtor: "This ledger of favors given and received is an essential part of reciprocal exchange. The comfort one feels in giving and receiving may depend on social comparisons of superiority-inferiority, or weak-strong and fears of (and being seen as) exploiting and being exploited." (Gilbert & Price & Allan 1995) A rather hard concept to wrap one's head around, this involves the comparisons two individuals make about themselves and each other involving exchange. In other words, what kind of feelings does the creditor and debtor have about the other individual, what kind of feelings do they have about themselves, and most important what notions do the event post-exchange. e.g. Adam gives Eve a gift of a single apple tree. Eve is grateful, however, she feel inferior in that she cannot give anything back. Adam has demonstrated his attraction to Eve by giving an irreplaceable apple tree, however, Eve feels inadequate to be Adam's partner and does not feel any attraction to Adam.

In this section I can't tell which are your words & which come straight from the book. You need to be very careful to source all information.

In-group/out-group: "This type of comparison is one of similarity--difference. Apart from its obvious role in group cohesion and differentiation, it is important for the evaluation of relative attractiveness, because it defines an in-group of evaluators whose social attention is desired, and whose judgements of the performer's display have the power to raise and lower social attention holding power. This comparison may not only involve judgements of same-different and group membership (being like or unlike, or belonging to), but also the relative

superiority-inferiority of the group one feels a member of, in comparison to other groups." (Gilbert & Price & Allan 1995) e.g. Adam is a social outcast and holds no membership in any group. Eve sees his lack of acceptance in any group as an indication of rejection from group because of inadequacies. Eve is not attracted.

Here you just list G.P.&A's scenarios without commenting on them or giving examples other than the fictional Adam & Eve ones. Apply these typologies to examples from other sources.

In concluding this section on social selection, it is important to note the large role that culture (which in this case is a shared set of beliefs that determine the traits one views as attractive or fit) has on social comparisons. The paper written by Gilbert/Price/Allan primarily focused on the evolved methods that modern humans employ in order to compare and make judgements of attractiveness or fitness of a target individual. In essence, the paper is an analysis of methods; methods that the author assumes the reader knows have evolved to complement the modern human mindset and his/her environment.

Human Evolution, Modern Culture, and Sexual Attraction

The modern human thinks differently and lives in an immensely different environment that his/her ancestors. Finding the right partner in a primitive society made the difference between life and death of the offspring. Modern society is far less harsh, and as I am mentioned before, far more accommodating in terms of fitness. This has undoubtedly led to many behaviors that contradict Darwin's Theory of Evolution.

maybe, but most murders are committed by family members. People mate, marry, have kids, & then kill them. That's pretty harsh.

In looking at the evolution of human mate preference and behavior, there are both similarities and differences. However, even Darwin theorized that "sexual admiration could interfere tremendously with the struggle for survival", seemingly forecasting current research into the applicability of his own Theory of Evolution. Darwin seemed to have been spot on in his statement about sexual admiration (a.k.a love), as it is a modern concept that seems to accept blemishing traits in one's partner, and even possibly overlooking any evaluation of a partner's ability to contribute to the successful reproduction of healthy offspring.

or maybe they are a mechanism to create social cohesion.

There is another strategy - freeze & hide. People often freeze in an emergency & thus fail to escape

Love, emotion, and general caring for others are some of the many things that seem to contradict the nature of our being. The behavioral traits we have now evolved during various adaptations through mating, hunting, means of cooperation, and methods of escaping predators. An example of this behavioral evolutionary process is the "fight or flight" response that humans have been genetically disposed to in order for early man to be able to escape dangerous predators. This stress response filled the human body with strength, stamina, and speed to escape a hazardous situation, and those who fought and won, or fled and lived, were the fittest and survived. In Western civilization today, this response is no longer needed for survival, in most cases. But there is violent crime, war .... disaster to respond to as well, however, the body still responds to stressors with this "fight or flight" response. Therefore, the behavior this response is meant to coincide with has evolved into one in which modern day stress is the "predator", rather than a wild animal or a competing tribe. (Adams 2008) The very definition of fitness has evolved to the point that being able to survive the stressful climb up the corporate ladder and increase wealth is considered fit for men, at least because of the increased ability to provide for one's family. As we see often in today's society, wealth is one of the many traits

that seem to trump most other biological deficiencies, allowing the procreation of generations of humans that may be biologically unfit.

Darwin postulated that "females choose their male partners carefully; evaluating which males will provide the best genes to contribute to successful reproduction and healthy offspring." As I have demonstrated in the prior paragraph, this was true at one point in our evolutionary road, but it seems now that culture has created a legacy of humans incapable of determining the biological fitness of partner. Or, is it that humans now value a different definition of fitness contradictory to that of our past and that of every other organism on this planet. It is too early to tell where this course of evolution will take us, but our mating methods have yet to fail the test of time.

favor health

most studies of beauty show that standards of beauty although men tend to find attractive in ♀ traits that suggest good reproductive potential such as youth + ♀ tend to overlook youth + beauty in favor of men with wealth + status.

Homosexuality and Evolution

The idea of homosexuality is gradually becoming more accepted in modern times, but many have debated whether this is a conscious choice or a biological determinant. One great point can be seen in nature as many who support the idea that homosexuality is a choice assert that animals do not engage in such practices because, per Darwin's Theory of Evolution, such behavior does not result in successful reproduction. In defense of homosexuality as being of biologically basis, BBC reported in an article entitled Oslo gay animal show draws crowds, a claim was made that "homosexuality has been observed among 1,500 species, and… Homosexuality is a common and widespread phenomenon in the animal world…Not only

In modern society, many people identify as exclusively homosexual. But cross culturally homosexual behavior does not nec. prevent reproduction because it is not exclusive

short-lived sexual relationships, but even long-lasting partnerships; partnerships that may last a lifetime." If true, this would, according to Darwin, mean that there is some sort of purpose to homosexuality that is not yet known. McKnight writes in his book, Straight Science? Homosexuality, Evolution and Adaptation, "Homosexuality is a major puzzle for evolutionary theory, for if evolution has a purpose it is reproductive fitness, the passing of genes to our children."

If natural selection filters for the fittest of a species, and if there was indeed as gay gene, then homosexual males and females would not be producing offspring. Thus, in modern times, after generations of of this filtering in place, there should not exist~~s~~ any more homosexuals; however, their existence is unquestionable. Thus, we can deduce from this that because homosexuality is in existence today, that there must be some function that allows for it to continue to be passed on through the gene pool. If you assume exclusive homosexuality. In many cultures men often have sex with youths but also many women.

In order to take a closer look at homosexuality and its biological precepts, a study in 2004 by Hahn titled, A unique theory on population control: With the population growing, homosexuals may save the world, found that "Homosexuality may be partly influenced by genetics. As Hahn indicates, the same genes that are proposed to predispose to homosexuality [in men] may also boost reproduction in women." What he is trying to imply in his article is that if one of the sexes is producing, then the other is not obligated to do so. An example would be that if a family had a son and a daughter, and that daughter was fit as defined by the Theory of Evolution, then the son may be left to pursue other (homosexual) interests. Hahn further states that heterosexuality often produces more offspring than is needed, and thus, homosexuality, may be considered a form of population control.

According to theorists such as Stephen Jay Gould, not all traits nec. confer advantage. Some may be accidental by products of other factors.

Conclusion

Humans have evolved to become the most complex organisms on this planet. Darwin's theories suggest that natural selection, not culture, has shaped how we choose and court a mate; that is to say, how we have chosen our own evolutionary path. Therefore, over hundreds of thousands of years, evolution has been the driving force, which has molded everything from our anatomy to the human psyche. This is to ensure that certain behaviors are favored and certain states of mind promote reproductive success resulting in the survival of the species. "However, many question whether romance is guided by evolutionary, biological and genetic mechanisms. Darwin's theories appear to remove emotion, love, and caring from the aspect of human relationships and inserts cold, hard scientific necessity in its place. Unfortunately, Darwin did not take into consideration the modern human brain, social pressures, mating and relationships when he presented his theories." (Adams 2008)

Modern romance has presented researchers with many puzzling behaviors that are not accounted for in theories of the old. This is not to say that the theories of the past are to be discounted with just a few anomalies, but as researchers are currently doing, we must make an earnest effort to revise and improve upon them. As we are not bound anymore to many of the animalistic urges that once determined the life and death of our ancestors, modern humans are expressing themselves in ways unheard of in the animal world; a world with which we once shared many commonalities.

We must ~~not~~ delve deeper to understand things that were once discredited as having no effect on the evolution of our species such as homosexuality, modern sexual attractiveness, modern

physical attractiveness, and even broader concepts such as religion. These are things that shape the way in which the modern human thinks and behaves, and these are the things that set us apart from being animals. In doing so, we may be able to understand the effect this has on our evolutionary path and progress. Are we headed towards evolutionary destruction? Or are these complexities just another side of what allows humans to be the undisputed rulers of this earth.

Some theorists such as Sarah Hrdy, point out that successful reproduction does not simply produce offspring but also creates conditions to allow those offspring to live to reproductive maturity. Something like a clam produces thousands of gametes, so that a few will survive. Humans, like most mammals, produce a smaller # of offspring & then nurture them to maturity. Humans have a long infancy. Perhaps love evolved to hold couples together long enough to cooperate in providing & caring for the children until they grow up.

I find the kind of theory you survey here simplistic. Look up deeper thinkers like Hrdy, Stephen Jay Gould, & Jonathan Marks.

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2 Assessment methods

The procedure for assessing achievement of the first and second program learning outcomes utilized both a direct (embedded questions) and an indirect (focus group discussions) method.

2.1. Embedded Homework and Final Exam Questions

The following questions were embedded in the Math 121 and Math 131 courses. For Math 121, the faculty is assessing PLO 1 and for Math 131, the faculty is assessing PLO 2. Each of the solutions for the embedded questions was assessed using the rubric agreed upon by the applied mathematics faculty (see Sections 7.4 and 7.5 for the initial rubrics used in this assessment exercise). Each faculty member performed this initial assessment individually. After this initial assessment exercise, the applied mathematics faculty met as a group to discuss the collective results. In addition, the applied mathematics faculty discussed the re-evaluation and revision of their original rubric based on this initial assessment experience.

The applied mathematics faculty chose two problems to embed in the Math 121 course to provide an assessment of PLO 1. The Math 121 embedded homework question is given by the following.

> Consider the heat equation
> $$\frac{\partial u}{\partial t} = c\frac{\partial^2 u}{\partial x^2}$$
> on the interval $[0, L]$ with mixed boundary conditions $u(0,t) = 0$ and $\frac{\partial u}{\partial x}(L,t) = 0$. Suppose we tell you that the initial condition is
> $$u(x,0) = h(x),$$
> where $h(x)$ is a smooth function of x that satisfies the boundary conditions $h(0) = 0$ and $h'(L) = 0$. Describe the full solution $u(x,t)$ of the heat equation, using the tools of separation of variables and a Fourier-type expansion in an appropriate set of eigenfunctions.

The Math 121 embedded final exam question is given by the following.

> Consider the ordinary differential equation
> $$u'' - 2xu' + 2pu = 0,$$
> where p is a positive integer and $u(x)$ is an unknown function of x.
>
> 1. Use power series to construct the solution $u(x)$. You should find a recurrence relation, but you do *not* need to solve the recurrence relation in closed form.
> 2. Show that it is always possible to choose the first two constants in the power series solution in such a way that the series terminates and the overall solution is a polynomial.

The applied mathematics faculty chose two problems to embed in the Math 131 course to provide an assessment of PLO 2. The Math 131 embedded homework question is given by the following.

[In previous problems, students were asked first to implement the second order and fouth order Runge-Kutta schemes] Use the two programs you wrote to solve

$$\frac{dx}{dt} = -x, \quad x(0) = 5.$$

1. Calculate $x(1)$ and $x(8)$ using $h = 0.001$, 0.01, 0.1, 1, 2 and 4.
2. Find the rate of convergence (big "oh") of the absolute error of your solution as $h \to 0$.

The Math 131 embedded final exam question is given by the following.

Find the order of the following differentiation formula using any method you like.

$$f'(x_0) \approx \frac{-(3/2)f(x_0) + 2f(x_0 + h) - (1/2)f(x_0 + 2h)}{h}$$

Using **another** differentiation formula that you know to be of order 3, you found using $h = 0.2$, $D_{0.2} = 4.25$, and using $h = 0.1$, $D_{0.1} = 4.11$. Estimate the error made when using $h = 0.1$.

2.2. Student Focus Group Questions and Activities

With the assistance of Anne Zanzucchi and Adriana Signorini from the Center for Research and Teaching Excellence, the applied mathematics faculty conducted a focus group discussion with several students that took both Math 121 and Math 131 in Fall Semester 2008. The purpose of this student focus group was to hold a conversational and informal discussion about the major with the purpose of identifying the following items.

- Key aspects of your learning experience,
- What has been of most value to you and why,
- What has been challenging for you and why, and
- Strategies for improving the program.

Below is a description of the Focus Group Questions and Activities. The applied mathematics faculty credits Anne Zanzucchi for developing this plan and Adriana Signorini for coordinating the actual group meeting.

Goal: The focus of this session is to determine key responses to students' learning experiences in the major program. The interview concludes with a problem-solving opportunity to ensure constructive and applicable feedback.

Topics of Interest: Program Learning Outcomes

Brainstorming (15 minutes)

For indirect evidence, faculty could be asked to describe their expectations of what students are able to do with this PLO before rating samples. Then, they could reflect on whether there are any differences in their expectations after reading samples.

Students in MATH 131 / 121 could complete a survey asking for their responses to the PLO. A focus group could be conducted in March 2010 to see the extent to which their predictions about how the courses would apply to their major were accurate. A sample focus group session script is attached.

7.3 Agenda of Applied Mathematics Faculty Meeting on December 7, 2009

1. Announcements [5 min]
2. Reports
    a. Hiring (Arnold) [10 min]
    b. Graduate Program (Mike) [10 min]
    c. Undergraduate Program (Francois) [10 min]
    d. Lower-division service (Lei, Yue and Arnold) [10 min]
3. Assessment for WASC [15 min]
4. University Program Review [20 min]
5. New Business [5 min]
6. Adjourn

No meeting minutes are available to include in this report.

7.4 Initial Rubric for Assessing PLO 1 for Math 121 Embedded Homework and Final Exam Problems

Poor	• Little evidence of drawing on relevant previous knowledge is present, showing little relevant engagement in the task • Some correct reasoning or justification for reasoning is present with trial and error, or non-systematic trying of several cases • There is an incomplete explanation, it may not be presented clearly • The solution is not complete indicating that parts of the problem are not understood
Fair	• Evidence of drawing on some relevant previous knowledge is present, showing some relevant engagement in the task • Planning or monitoring of strategy is evident, which leads to a solution of the problem • There is a clear explanation and appropriate use of accurate mathematical representation with few errors • The solution shows the student has a broad understanding of the problem and major concepts. Arguments are constructed systematically
Good	• Adjustments in strategy, if necessary, are made along the way and/or alternative strategies are considered • As systematic approach and/or justification of correct reasoning is present. This may lead to 1) clarification of the task, 2) exploration of mathematical phenomena and 3) noting patterns and structures • Appropriate and accurate mathematical representations are constructed and refined to solve problems or communicate the solution

7.5 Initial Rubric for Assessing PLO 2 for Math 131 Embedded Homework and Final Exam Problems

Poor	• Little evidence of drawing on relevant previous knowledge is present, showing little relevant engagement in the task • Some correct reasoning or justification for reasoning is present with trial and error, or non-systematic trying of several cases • Unsuccessful or incomplete transfer analytical knowledge to algorithm development, implementation and testing • There is an incomplete explanation, it may not be presented clearly • The solution is not complete indicating that parts of the problem are not understood
Fair	• Evidence of drawing on some relevant previous knowledge is present, showing some relevant engagement in the task • Planning or monitoring of strategy is evident, which leads to a solution of the problem • Successful and complete transfer analytical knowledge to algorithm development, implementation and testing • There is a clear explanation and appropriate use of accurate mathematical representation with few errors • The solution shows the student has a broad understanding of the problem and major concepts. Arguments are constructed systematically
Good	• Adjustments in strategy, if necessary, are made along the way and/or alternative strategies are considered • Attention paid to gaining efficiency in algorithm implementation through testing and validation • As systematic approach and/or justification of correct reasoning is present. This may lead to 1) clarification of the task, 2) exploration of mathematical phenomena and 3) noting patterns and structures • Appropriate and accurate mathematical representations are constructed and refined to solve problems or communicate the solution

7.6 Summary Report of Student Focus Group Discussion held on January 19, 2010

Number of Participants: 6 students

Goal: The focus of this session is to determine key responses to students' learning experiences in the major program. The interview concludes with a problem-solving opportunity to ensure constructive and applicable feedback.

Brainstorming

Take about 2-3 minutes to list or write a brief paragraph about your primary experiences as an Applied Mathematics student. What are the immediate images, concepts, or phrases that come to mind?

Illustrations and Applications:

The students agreed that there should be more illustrations and interactive applications of the concepts they were studying in the math class. They suggested having an assignment/ a class focused solely on connecting the math to real life situations, such as a long term project. One student stated, "it is hard to

7.9 Student Work: PLO 1 Embedded Homework Questions

(A)

MATH 121 HW # 8

1. $\frac{\partial u}{\partial t} = c\frac{\partial^2 u}{\partial x^2}$ for $(-\infty < x < \infty)$

$$u(x,t) = \frac{1}{\sqrt{4\pi c t}}\int_{y=-\infty}^{\infty} e^{-(x-y)^2/(4ct)}\, u(y,0)\, dy$$

$$u(x,0) = \begin{cases} 1 & |x| \le 1 \\ 0 & |x| > 1 \end{cases}$$

Let $\epsilon > 0$, at $t = \epsilon$

$$u(x,\epsilon) = \frac{1}{\sqrt{4\pi c \epsilon}}\int_{y=-1}^{y=1} e^{-(x-y)^2/(4c\epsilon)}\, u(x,0)\, dy$$

$e^{-(x-y)^2/(4c\epsilon)}$ is always positive, and the integral is integrating a positive value, so $u(x,\epsilon) > 0$ for $(-\infty < x < \infty)$. The physical interpretation is that at any value of x, heat is instantaneously transfer at time $t = \epsilon$.

2. $\frac{\partial u}{\partial t} = c\frac{\partial^2 u}{\partial x^2}$, $x \in [0, L]$, $u(0,t) = 0$, $\frac{\partial u}{\partial x}(L,t) =$

initial conditions: $u(x,0) = h(x)$, $h(0) = 0$, $h'(L) = 0$

separation of variables:

$u(x,t) = f(x)\,g(t)$

$\frac{\partial u}{\partial x} = \frac{\partial f}{\partial x} g(t)$, $\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 f}{\partial x^2} g(t)$, $\frac{\partial u}{\partial t} = f(x)\frac{dg}{dt}$

2. $\Rightarrow f(x)\frac{dg}{dt} = c\frac{\partial^2 f}{\partial x^2} g(t)$ divide both sides by $f(x)g(t)c$

$\Rightarrow \frac{1}{g(t)c}\frac{dg}{dt} = \frac{1}{f(x)}\frac{\partial^2 f}{\partial x^2}$ set equation equal to separation constant $-\lambda$

$= -\lambda$

$\Rightarrow \frac{dg}{dt} = -\lambda c g(t) \Rightarrow \int \frac{dg}{g(t)} = -\int \lambda c\, dt \Rightarrow g(t) = e^{-\lambda c t} g$

$\frac{\partial^2 f}{\partial x^2} = -\lambda f(x) \Rightarrow f(x) = A\cos\sqrt{\lambda}x + B\sin\sqrt{\lambda}x$
$(= e^{\pm i\sqrt{\lambda}x})$

$\Rightarrow u(x,t) = [A\cos\sqrt{\lambda}x + B\sin\sqrt{\lambda}x]e^{-\lambda c t}g(0)$

Apply Boundary conditions:

$u(0,t) = Ae^{-\lambda c t}g(0) = 0 \Rightarrow A = 0$

$\frac{\partial u}{\partial x}(L,t) = (B\sqrt{\lambda}\cos\sqrt{\lambda}L)e^{-\lambda c t}g(0) = 0$

$\Rightarrow \lambda = \left(\frac{2n\pi}{L}\right)^2,\ n = 1, 2, 3, \ldots \Rightarrow f_n(x) = B\sin\left(\frac{2\pi n}{L}\right.$

Apply initial conditions: $u(x,0) = h(x)$
$\Rightarrow f(x)g(0) = h(x),\ g(0) = 1$

$f(0) = B\sin\left(\frac{2\pi n(0)}{L}\right) = 0 = h(0)$

$f'(L) = \frac{BL}{2\pi n}\cos(2\pi n) = \frac{BL}{2\pi n} \neq h'(L) = 0$

2. So, $h(x) = \sum_{n=0}^{\infty} \beta \sin\left(\frac{2\pi n x}{L}\right)$ Fourier expansion

$\Rightarrow u(x,t) = \sum_{n=0}^{\infty} \beta \sin\left(\frac{2\pi n x}{L}\right) e^{-\left(\frac{2\pi n}{L}\right)ct} g(0)$

3. $f(t) = \begin{cases} 1 & 0 \le t < \pi \\ -1 & \pi \le t < 2\pi \end{cases}$

$f(t) = 0$ for $t < 0$, $f(t+2\pi) = f(t)$ for $t \ge 0$

$\therefore P = 2\pi$

ODE: $\frac{d^2x}{dt^2} + 8\frac{dx}{dt} + 16x(t) = 10f(t)$

I.C.'s: $x(0) = 0$, $\frac{dx}{dt}(0) = 0$

R.H.S.: $\mathcal{L}[f(t)] = \frac{1}{1-e^{-2\pi s}} \int_0^{2\pi} e^{-st} f(t)\,dt$ Laplace transform notes Section 6.6.

$= \frac{1}{1-e^{-2\pi s}} \left[\int_0^{\pi} e^{-st}\,dt + \int_{\pi}^{2\pi} e^{-st}(-1)\,dt \right]$

$f(t)$ is a piecewise function, so it is best to integrate over each domain separately, then add the integrals.

$\mathcal{L}[f(t)] = \frac{1}{1-e^{-2\pi s}} \left[-\frac{1}{s} e^{-st} \Big|_0^{\pi} - \frac{1}{s} e^{-st} \Big|_{\pi}^{2\pi} \right]$

$= \frac{1}{1-e^{-2\pi s}} \left[-\frac{1}{s}\left(e^{-\pi s} - 1\right) - \frac{1}{s}\left(e^{-2\pi s} - e^{-\pi s}\right) \right]$

$= \frac{1}{1-e^{-2\pi s}} \left[\frac{1 - e^{-2\pi s}}{s} \right] = \frac{1}{s}$

(B)

Homework 8

1. $u(x,t) = \frac{1}{\sqrt{4\pi c t}} \int_{y=-\infty}^{\infty} e^{-(x-y)^2/4ct}\, u(y,0)\, dy$ I.C. $u(x,0) = \begin{cases} 1 & |x| \le 1 \\ 0 & |x| > 1 \end{cases}$

plug in $u(y,0)$ initial condition

$u(x,t) = \frac{1}{\sqrt{4\pi c t}} \left[\int_{-\infty}^{-1} 0\, dy + \int_{-1}^{1} e^{-(x-y)^2/4ct} (1)\, dy + \int_{1}^{\infty} 0\, dy \right]$

$u(x,t) = \frac{1}{\sqrt{4\pi c t}} \int_{-1}^{1} e^{-(x-y)^2/4ct}\, dy$

let ε $\varepsilon > 0$ ε is always positive

$u(x,\varepsilon) = \frac{1}{\sqrt{4\pi c \varepsilon}} \int_{-1}^{1} e^{-(x-y)^2/4c\varepsilon}\, dy$

because ε is always positive $\sqrt{4\pi c \varepsilon}$ is always [illegible] and $e^{-(x-y)^2/4c\varepsilon}$ is always positive therefore $u(x,t)$ is non-zero for all values of x. A physical interpretation could possibly be that heat transfer is instantaneous?

2. [illegible] $[0,L]$ BC's $u(0,t) = 0$ $\frac{\partial u}{\partial x}(L,t) = 0$

T [illegible] $u(x,0) = h(x)$ h's BC's $h(0) = 0$ $h'(L) = 0$

[illegible] $\phi(x)\sigma(t)$

$\phi(x)\sigma''(t) = c\,\sigma(t)\,\phi''(x)$

$\frac{\sigma''(t)}{c\,\sigma(t)} = \frac{\phi''(x)}{\phi(x)} = -\lambda$ ← separation constant — both sides must be constant

$\phi''(x) = \lambda\,\phi(x)$ $\phi(x) = A\cos\sqrt{\lambda}x + B\sin\sqrt{\lambda}x$

[illegible] from BC's $\phi(0) = A\cos 0 + B\sin 0 = 0 \Rightarrow A = 0$

[illegible] $\phi'(L) = B\sqrt{\lambda}\cos\sqrt{\lambda}L = 0$

[illegible] $\lambda\,\sigma(t)$ $\cos\sqrt{\lambda}L = 0$

[illegible] $e^{-\lambda_n c t}$ $\sqrt{\lambda}L = n\pi + \pi/2$

$\lambda_n = \left(\frac{2n\pi+\pi}{2L}\right)^2$ eigenvalues

$\phi_n(x) = \sin\left(\frac{(2n\pi+\pi)x}{2L}\right)$ eigenfunctions

[illegible] $= \sum_{n=1}^{\infty} a_n \sin\left(\frac{(2n\pi+\pi)x}{2L}\right)$

[illegible] $a_n \sin\left(\frac{(2n\pi+\pi)x}{2L}\right) e^{-\lambda_n c t}$

(c)

2.) $\frac{\partial u}{\partial t} = c\frac{\partial^2 u}{\partial x^2}$ on the interval $[0,L]$

BC) $u(0,t) = 0 \qquad \frac{\partial u}{\partial x}(L,t) = 0$

IC: $u(x,0) = h(x) \qquad h(0) = 0$
$h'(L) = 0$

Describe the full solution $u(x,t)$ of heat equation, using tools of separation of variables + Fourier-type expansion in an appropriate set of eigenfunctions.

$u(x,t) = f(x)g(t)$

$\frac{\partial u}{\partial t}(x,t) = \frac{\partial f}{\partial x}(x)g(t)$

$\frac{\partial u}{\partial x}(0,t) = \frac{\partial f}{\partial x}(0)\cdot g(t) = 0$

$\frac{\partial^2 f}{\partial x^2} = \lambda f(x)$

$\frac{\partial f}{\partial x}(L) = 0 \qquad f(x) = A\cos\sqrt{\lambda}x + B\sin\sqrt{\lambda}x$

$h(0) = 0$, we find $A = 0$

$f(x) = B\sin(\sqrt{\lambda}x)$

$f'(x) = B\sqrt{\lambda}\cos(\sqrt{\lambda}x)$

$f'(L) = B\sqrt{\lambda}\cos(\sqrt{\lambda}L)$

$\Rightarrow \sqrt{\lambda}L = \pi/2 + n\pi = (n+1/2)\pi$

$\lambda_n = \left(\frac{(n+1/2)\pi}{L}\right)^2 \qquad f_n(x) = \frac{\sin(n+1/2)\pi x}{L}$

Since $u(x,0) = h(x)$

$h(x) = \sum_{n=0} B_n \sin\frac{(n+1/2)\pi x}{L}$

$u(x,t) = \sum_{n=0}^{\infty} B_n \sin\frac{(n+1/2)\pi x}{L}\, e^{-((n+1/2)\pi/L)^2 ct}$

Calculate B_n with inner product

$$\langle h(x), \sin((n+1/2)\pi/L) \rangle = B_n \quad \int_0^{L/2} \text{[redacted]} \quad \text{if } m \geq 1$$

D

2 $\frac{\partial u}{\partial t} = c\frac{\partial^2 u}{\partial x^2}$, $[0, L]$ BC: $u(0,t) = 0$

$\frac{\partial u}{\partial x}(L,t) = 0$

I.C: $u(x,0) = h(x)$

$\Rightarrow$ $u(x,t) = f(x)g(t)$

$\frac{\partial u}{\partial x}(x,t) = \frac{df}{dx}(x)g(t) \Rightarrow \frac{\partial u}{\partial x}(L,t) = \frac{df}{dx}(L)\cdot g(t) = 0$

$u(0,t) = f(0)\cdot g(t) = 0$

$\frac{d^2 f}{dx^2} = -\lambda f(x)$

$\frac{df}{dx}(L) = 0$ & $f(0) = 0$

$f(x) = A\cos(\sqrt{\lambda}x) + B\sin(\sqrt{\lambda}x)$

$f(0) = A\cos(0) + B\sin(0) = 0 \Rightarrow A = 0$

$f(x) = B\sin(\sqrt{\lambda}x)$

$\frac{df}{dx} = B\sqrt{\lambda}\cos(\sqrt{\lambda}x)$

$\frac{df}{dx}(L) = B\sqrt{\lambda}\cos(\sqrt{\lambda}L) = 0$

$\Rightarrow \cos(\sqrt{\lambda}L) = 0 \Rightarrow \sqrt{\lambda}L = (n+\frac{1}{2})\pi \Rightarrow \lambda = \left(\frac{(n+\frac{1}{2})\pi}{L}\right)^2$

$f_n(x) = \sin\left(\left[\frac{(n+\frac{1}{2})\pi}{L}\right]^2\right)$

$u(x,0) = h(x)$ BC: $h(0) = 0$ $h'(L) = 0$

$h(x) = f(x)g(0)$

using a Fourier-type expansion we get:

$h(x) = \sum_{n=1}^{\infty} a_n \sin\left(\left(\frac{n\pi + \frac{\pi}{2}}{L}x\right)^2\right)$

The solution to the heat equation with BC's is:

$$u(x,t) = \sum_{n=1}^{\infty} a_n \sin\left(\left(\frac{n+\frac{1}{2}}{L}\pi x\right)^2\right) e^{-\left(\frac{(n+\frac{1}{2})}{L}\pi x\right)^2 ct}$$

E

2) $\frac{\partial u}{\partial t} = c\frac{\partial^2 u}{\partial x^2}$ on $[0, L]$

$u(x,0) = h(x)$

$u(x,t) = f(x)g(t)$

Taking our first derivative of $u(x,t)$ with respect to t, we get:

$\frac{\partial u}{\partial t} = f(x)g'(t)$

Taking the 2nd derivative of $u(x,t)$ w/ respect to x, we get:

$\frac{\partial^2 u}{\partial x^2} = f''(x)g(t)$

We then plug those in to the heat equation.

$f(x)g'(t) = cf''(x)g(t)$

$\frac{g'(t)}{cg(t)} = \left[\frac{f''(x)}{f(x)} = -\lambda\right]$ ← seperation constant

$f''(x) = -\lambda f(x)$

If we make our BC's for the above the same for $f(x)$ as $h(x)$, in the end, we will find that $h(x)$ is an expansion of $f(x)$. this allows us to plug in $h(x)$ for $f(x)$.

BC's: $f(0) = 0$, $f'(L) = 0$

$f(x) = A\cos(\sqrt{\lambda}x) + B\sin(\sqrt{\lambda}x)$

Plugging in 1st B.C:

$f(0) = A\cos(0) + B\sin(0) = 0$

$A = 0$

$f(x) = B\sin(\sqrt{\lambda}x)$

Plugging in 2nd BC:

$f'(x) = \sqrt{\lambda}B\cos(\sqrt{\lambda}x)$

$f'(L) = \sqrt{\lambda}B\cos(\sqrt{\lambda}L) = 0$

$\cos(\sqrt{\lambda}L) = 0$

$\sqrt{\lambda}L = (n+\frac{1}{2})\pi$

$\lambda_n = \left(\frac{(n+\frac{1}{2})\pi}{L}\right)^2$

$f_n(x) = \sin\left(\frac{(n+\frac{1}{2})\pi}{L}x\right)$ $n = 1, 2, 3, \ldots$

$h(x) = \sum_{n=1}^{\infty} a_n \sin\left(\frac{(n+\frac{1}{2})\pi x}{L}\right)$

Doing the same for $\frac{g'(t)}{cg(t)} = -\lambda \Rightarrow g'(t) = -\lambda c g(t)$, we get:

$g(t) = e^{-\lambda ct}g(0)$

Plugging what we got for $f(x)$ and $g(t)$ into $u(x,t) = f(x)g(t)$:

$u(x,t) = \sum_{n=1}^{\infty} a_n \sin\left(\frac{(n+\frac{1}{2})\pi x}{L}\right) e^{-\left(\frac{(n+1/2)\pi}{L}\right)^2 ct}$

Checking our mixed BC's:

$$u(0,t) = \sum_{n=1}^{\infty} a_n \sin(0)\, e^{-\left(\frac{(n+\frac{1}{2})\pi}{L}\right)^2} = 0 \checkmark$$

$$\frac{\partial u}{\partial x}(L,t) = \sum_{n=1}^{\infty} a_n \left(\frac{(n+\frac{1}{2})\pi}{L}\right) \cos\left(\frac{(n+\frac{1}{2})\pi}{L}\right) e^{-\left(\frac{(n+\frac{1}{2})\pi}{L}\right)^2}$$

$$\frac{\partial u}{\partial x}(0,t) = \sum_{n=1}^{\infty} a_n \left(\frac{(n+\frac{1}{2})\pi}{L}\right) \cos\left((n+\tfrac{1}{2})\pi\right) e^{-\left(\frac{(n+\frac{1}{2})\pi}{L}\right)^2} = 0 \checkmark$$

Our solution agrees with the mixed BC's

3) $f(t) = \begin{cases} 1 & 0 \le t < \pi \\ -1 & \pi \le t < 2\pi \end{cases}$

$$\frac{d^2x}{dt^2} + 8\frac{dx}{dt} + 16x(t) = 10f(t)$$

Taking the Laplace Transform of both sides

$$s^2X(s) + bsX(s) + \omega^2X(s) = F(s) \Rightarrow s^2X(s) + 8sX(s) + 16X(s) = 10F(s)$$

$$X(s) = \frac{1}{s^2+bs+\omega^2}F(s) \qquad \Rightarrow X(s) = \frac{1}{s^2+8s+16}10F(s)$$

$f(s)$: $\mathcal{L}[f(t)] = \frac{1}{1-e^{-sp}}\int_0^p e^{-st} f(t)\,dt$

since $f(t) = f(t+2\pi)$, $p = 2\pi$

$$\therefore \mathcal{L}[f(t)] = \frac{1}{1-e^{-2\pi s}}\int_0^{2\pi} e^{-st} f(t)\,dt$$

$$= \frac{1}{1-e^{-2\pi s}}\left(\int_0^{\pi} e^{-st} f(t)\,dt + \int_{\pi}^{2\pi} e^{-st} f(t)\,dt\right)$$

$f(t)$ on $[0,\pi) = 1$ and $f(t)$ on $[\pi, 2\pi) = -1$

$$\therefore \mathcal{L}[f(t)] = \frac{1}{1-e^{-2\pi s}}\left(\int_0^{\pi} e^{-st}\,dt - \int_{\pi}^{2\pi} e^{-st}\,dt\right)$$

$$= \frac{1}{1-e^{-2\pi s}}\left(\frac{-1}{s}e^{-st}\Big|_0^{\pi} + \frac{1}{s}e^{-st}\Big|_{\pi}^{2\pi}\right)$$

$$= \frac{1}{1-e^{-2\pi s}}\left[\frac{-1}{s}\left(e^{-\pi s}-1\right) + \frac{1}{s}\left(e^{-2\pi s} - e^{-\pi s}\right)\right]$$

$$= \frac{1}{1-e^{-2\pi s}}\left(\frac{-1}{s}e^{-\pi s} + \frac{1}{s} + \frac{1}{s}e^{-2\pi s} - \frac{1}{s}e^{-\pi s}\right)$$

$$= \frac{1}{1-e^{-2\pi s}}\cdot\frac{1}{s}\left(-e^{-\pi s} + 1 + e^{-2\pi s} - e^{-\pi s}\right)$$

Plugging $F(s)$ back into $X(s)$:

$$X(s) = \frac{1}{(s+4)^2}\cdot 10\left[\frac{1}{1-e^{-2\pi s}}\cdot\frac{1}{s}\left(-e^{-\pi s} + 1 + e^{-2\pi s} - e^{-\pi s}\right)\right]$$

$$= \frac{1}{(s+4)^2}\cdot 10\left[\frac{1}{1-e^{-2\pi s}}\cdot\frac{1}{s}\left(e^{-2\pi s} - 2e^{-\pi s} + 1\right)\right]$$

$$= \frac{1}{(s+4)^2}\cdot 10\left[\frac{1}{1-e^{-2\pi s}}\cdot\frac{1}{s}\left(e^{-\pi s}-1\right)^2\right]$$

$$= \frac{1}{(s+4)^2}\cdot 10\left[\frac{1}{s}\cdot\frac{-1(1-e^{-\pi s})(e^{-\pi s}-1)}{(1+e^{-\pi s})(1-e^{-\pi s})}\right]$$

$$= \frac{1}{(s+4)^2}\cdot 10\left[\frac{1}{s}\cdot\frac{1-e^{-\pi s}}{1+e^{-\pi s}}\right]$$

Turning $X(s)$ to $x(t)$ using Table 6.1 from Laplace notes:

$$\therefore te^{-4t}\cdot 10\,\delta(t)\left[\left(\delta(t) - \delta(t-2\pi)\right) / \left(\delta(t) + \delta(t-2\pi)\right)\right]$$

(F)

Problem 2

$$\frac{\partial u}{\partial t} = c\,\frac{\partial^2 u}{\partial x^2} \qquad \text{interval } [0, L]$$

$$u(0,t) = 0 \qquad \frac{\partial u}{\partial x}(L, t) = 0$$

$$u(x,0) = h(x)$$

$$h(0) = 0 \qquad h'(L) = 0$$

Let $u(x,t) = \phi(x)\,\sigma(t)$ $\qquad \frac{\partial^2 u}{\partial x^2} = \phi''(x)\,\sigma(t) \qquad \frac{\partial u}{\partial t} = \phi(x)\,\sigma'(t)$

$$\frac{\partial u}{\partial t} = c\,\frac{\partial^2 u}{\partial x^2}$$

$$\phi(x)\,\sigma'(t) = c\,\sigma(t)\,\phi''(x) \Rightarrow \frac{\sigma'(t)}{c\,\sigma(t)} = \frac{\phi''(x)}{\phi(x)} = -\lambda$$

choose $-\lambda$ to be separation constant

$$\phi''(x) = -\lambda\,\phi(x)$$

$$\phi(x) = \alpha\cos\sqrt{\lambda}\,x + \beta\sin\sqrt{\lambda}\,x$$

$$\phi(0) = 0 \longrightarrow \phi(x) = \beta\sin\sqrt{\lambda}\,x$$

$$\phi'(L) = 0 \longrightarrow \phi'(x) = \beta\sqrt{\lambda}\cos\sqrt{\lambda}\,x$$

$$\phi'(L) = \beta\sqrt{\lambda}\cos\sqrt{\lambda}\,L = 0$$

$$\sqrt{\lambda}\,L = \left(n + \tfrac{1}{2}\right)\pi$$

$$\lambda_n = \left(\frac{(n+\frac{1}{2})\pi}{L}\right)^2 \quad n = 1, 2, 3, \ldots$$

$$\phi_n(x) = \beta\sin\left(\frac{(n+\frac{1}{2})\pi x}{L}\right) \quad n = 1, 2, 3, \ldots$$

$$\phi_m(x) = \beta\sin\left(\frac{(m+\frac{1}{2})\pi x}{L}\right)$$

$$h(x) = \sum_{n=1}^{\infty} \beta_n \sin\left(\frac{(n+\frac{1}{2})\pi x}{L}\right)$$

$$\int_0^L \phi_n(x)\,\phi_m(x)\,dx = 0$$

$$\int_0^L \sin\frac{(n+\frac{1}{2})\pi x}{L}\,\sin\frac{(m+\frac{1}{2})\pi x}{L}\,dx$$

$$\int_0^L \sin\frac{(n+m+1)\pi x}{L}\,dx$$

$$\left[\frac{L}{(n+m+1)\pi}\sin\frac{(n+m+1)\pi x}{L}\right]_0^L$$

$$\left[0 - 0\right] = 0$$

normal

$$\frac{\sigma'(t)}{c\,\sigma(t)} = -\lambda_n \Rightarrow \frac{d\sigma}{dt}\,\frac{1}{\sigma(t)} = -\lambda_n c$$

$$\Rightarrow \frac{d\sigma}{\sigma(t)} = -\lambda_n c\,dt$$

$$\log(\sigma(t)) = -\lambda_n c\,t$$

$$\sigma(t) = e^{-\lambda_n c t}$$

Did separation of variables to find $\sigma(t)$

$$\frac{\partial u}{\partial x}(x,t) = \sum_{n=1}^{\infty} \beta_n \frac{(n+\frac{1}{2})\pi}{L} \cos\left(\frac{(n-\frac{1}{2})\pi x}{L}\right) e^{-\lambda_n c t}$$

$$u(x,t) = \sum_{n=1}^{\infty} \beta_n \sin\left(\frac{(n+\frac{1}{2})\pi x}{L}\right) e^{-\lambda_n c t}$$

$$u(0,t) = \sum_{n=1}^{\infty} \beta_n \sin\left(\frac{(n+\frac{1}{2})\pi}{L}(0)\right) e^{-\lambda_n c t} = 0$$

$$\frac{\partial u}{\partial x}(L,t) = \sum_{n=1}^{\infty} \beta_n \frac{(n+\frac{1}{2})\pi}{L} \cos\left(\frac{(n+\frac{1}{2})\pi(L)}{L}\right) e^{-\lambda_n c t} = 0$$

Satisfy conditions

1 1) $\frac{\partial u}{\partial t} = c\frac{\partial^2 u}{\partial x^2}$ yields us the solution: $u(x,t) = -\frac{1}{\sqrt{4\pi c t}}\int_{-\infty}^{\infty} e \quad u(y,0)\,dy$

Applying initial conditions: $u(x,0) = \begin{cases} 1 ; |x| \le 1 \\ 0 ; |x| > 1 \end{cases}$

b) Now show that at some small positive amount of time later $(t = \varepsilon)$, our $u(x,\varepsilon) > 0$ for all values of x...

- ... logically realize that by plugging our initial condition in to the solution, our bounds of integration can be reduced:

$$u(x,t) = \frac{1}{\sqrt{4\pi c t}}\int_{-1}^{+1} e^{-(x-y)^2/(4ct)}\,dy$$

- At $t = \varepsilon$, we can now determine: $u(x,\varepsilon) = \frac{1}{\sqrt{4\pi c \varepsilon}}\int_{-1}^{1} e^{-\frac{(x-y)^2}{(4c\varepsilon)}}\,dy$

- By consideration of each part of the integral, we discover:

$$u(x,\varepsilon) = \frac{1}{\sqrt{4\pi c \varepsilon}}\int_{-1}^{1} e^{-(x-y)^2/(4c\varepsilon)}\,dy$$

always either zero or positive.
always positive.
zero when $x = y$; positive otherwise.
always positive. always positive but less than 1

... $(x-y)^2 = -x^2 + 2xy - y^2$ and y would be within $-1 \le y \le 1$ when calculation ... integral occurs our bounds of integration $(-1 \le y \le 1)$ should not allow the calculation to result in a value less than zero.

- Since the integral will not result in a zero (or less than zero) value and the terms outside will not either; the $u(x,\varepsilon)$ with $0 < \varepsilon \ll 1$ will always be positive for any x-value.

(2) ... $\frac{\partial u}{\partial t} = c\frac{\partial^2 u}{\partial x^2}$ on $[0,L]$ w/ BC: $u(0,t) = 0$, $\frac{\partial u}{\partial x}(L,t) = 0$ w/ IC: $u(x,0) = h(x)$, $(h(0) = 0 ; h'(L) = 0)$

- ... the educated assumption: $u(x,t) = \phi(x)\sigma(t)$

$u_t(x,t) = \phi'(x)\sigma(t)$ $\quad u_{xx}(x,t) = \phi''(x)\sigma(t)$ $\quad u_t(x,t) = \phi(x)\sigma'(t)$

... our DE: $u_t(x,t) = c\,u_{xx}(x,t)$ $\quad \phi(x)\sigma'(t) = c\phi''(x)\sigma(t)$

... rearrange, we find: $\frac{\phi''(x)}{\phi(x)} = \frac{\sigma'(t)}{c\,\sigma(t)} = -\lambda$

... left with 2 ODE's for ... our separable PDE:

- $c\lambda\sigma(t)$
- $\lambda\phi(x)$

• The first-order ODE is simple enough to solve:

$\sigma(t) = e^{-c\lambda t}\sigma(0)$ but since $u(x,0) = \phi(x)\sigma(0) = h(x)$ then we can assume $\sigma(0) = 1$ so...

$$\sigma(t) = e^{-c\lambda t}$$

• The 2nd order ODE involves a harmonic osc. solution:

$$\phi(x) = A\cos(\sqrt{\lambda}x) + B\sin(\sqrt{\lambda}x)$$
$$\phi'(x) = -A\sqrt{\lambda}\sin(\sqrt{\lambda}x) + B\sqrt{\lambda}\cos(\sqrt{\lambda}x)$$
$$\phi''(x) = -A\lambda\cos(\sqrt{\lambda}x) - B\lambda\sin(\sqrt{\lambda}x) \rightsquigarrow \text{satisfies } \phi''(x) = -\lambda\phi(x)$$

• Looking, again, at our BC's:

$u(0,t) = \phi(0)\sigma(t) = 0$ (so $u(0,0) = h(0)$)

since $u(0,0) = h(0) = 0$ then we can say:

$\phi(0) = A\cos(0) + B\sin(0) = A\cos(0) \rightsquigarrow$ allowing only cosine terms to survive.

$$\phi'(L) = h'(L) = 0 = -A\sqrt{\lambda}\sin(\sqrt{\lambda}L) + \cancel{B\sqrt{\lambda}\cos(\sqrt{\lambda}L)} = 0$$

Thus: $\sqrt{\lambda}L = n\pi \rightsquigarrow \lambda = \left(\frac{n\pi}{L}\right)^2$

• We have end up with the following eigen-"solutions"

$$\left.\begin{aligned}\sigma_n(t) &= e^{-c\lambda_n t}\\ \phi_n(x) &= \cos\left(\frac{n\pi x}{L}\right)\end{aligned}\right\} \lambda_n = \left(\frac{n\pi}{L}\right)^2$$

• Now we'll look at $h(x)$ as a fourier series:

$$h(x) = \sum_{n=0}^{\infty} \underbrace{a_n\phi_n(x)}_{\text{(since cos)}} = \sum_{n=0}^{\infty} a_n\cos\left(\frac{n\pi x}{L}\right)$$

Using orthogonality, we can find the a_n coefs:

$$a_n = \frac{\left\langle h(x), \cos\left(\frac{n\pi x}{L}\right)\right\rangle}{\left\langle \cos\left(\frac{n\pi x}{L}\right), \cos\left(\frac{n\pi x}{L}\right)\right\rangle} = \frac{\int_0^L h(x)\cos\left(\frac{n\pi x}{L}\right)dx}{\int_0^L \cos^2\left(\frac{n\pi x}{L}\right)dx}$$

$\theta = \frac{n\pi x}{L} \Rightarrow x = \frac{\theta L}{n\pi} \rightsquigarrow dx = \frac{L}{n\pi}d\theta$

$$\int_{\theta=0}^{\theta=n\pi} \cos^2(\theta)\cdot\frac{L}{n\pi}d\theta = \frac{L}{n\pi}\int_{\theta=0}^{\theta=n\pi}\cos^2(\theta)d\theta = \frac{L}{2} \quad \text{when } n \neq 0$$

when $n = 0$: $\int_0^L \cos^2(0)dx = L$

$$a_n = \begin{cases} L\langle h(x), 1\rangle & \text{when } n = 0 \rightsquigarrow \text{all} = 0 \text{ since } \langle h(x), 1\rangle = 0 \\ \frac{L}{2}\left\langle h(x), \cos\left(\frac{n\pi x}{L}\right)\right\rangle & \text{when } n \neq 0 \end{cases}$$

1) • Thus, we come to our solution:

$$u(x,t) = \sum_{n=1}^{\infty} \frac{L}{2} \underbrace{\left\langle h(x), \cos\left(\frac{n\pi x}{L}\right)\right\rangle}_{= \cos\left(\frac{n\pi x}{L}\right) = \phi_n(x)} e^{-c\lambda_n t} = \boxed{\sum_{n=1}^{\infty} \frac{L}{2} \cos\left(\frac{n\pi x}{L}\right) e^{-c\lambda_n t}}$$

3) $f(t) = \begin{cases} 1 & 0 \le t < \pi \\ -1 & \pi \le t < 2\pi \end{cases}$ $f(t) = 0$ when $t < 0$ and $f(t) = f(t + 2\pi)$ when $t > 0$

Solve: $\frac{d^2x}{dt^2} + 8\frac{dx}{dt} + 16x(t) = 10f(t)$ w/ IC: $x(0) = 0$, $x'(0) = 0$

• Taking the Laplacian of both sides:

$$\mathcal{L}\left[\frac{d^2x}{dt^2}\right] = s^2X(s) - s\,x(0) - \frac{dx}{dt}(0) = s^2X(s) - s\cdot 0 - x'(0) = s^2X(s)$$

$$\mathcal{L}\left[8\frac{dx}{dt}\right] = 8(x(0) - sX(s)) = 8(0 - sX(s)) = -8sX(s)$$

$$\mathcal{L}\left[16x(t)\right] = \int_0^{\infty} 16e^{-st}x(t)\,dt = 16X(s)$$

$$\mathcal{L}\left[f(t)\right] = \int_0^{\infty} e^{-st}f(t)\,dt = \int_0^{T} e^{-st}f(t)\,dt + \int_T^{\infty} e^{-st}f(t)\,dt$$ (for periodic functions)

• Let: $t = u + T$ in the 2nd integral (with bounds $T \to \infty$) so that

$$\int_T^{\infty} e^{-st}f(t)\,dt = \int_0^{\infty} e^{-s(u+T)}f(u+T)\,du = e^{-sT}\int_0^{\infty} e^{-su}f(u)\,du$$

Thus:

$$\mathcal{L}\left[10f(t)\right] = 10\int_0^{T} e^{-st}f(t)\,dt + 10e^{-sT}F(s)$$

$$= 10\int_0^{\pi} e^{-st}(1)\,dt + 10\int_{\pi}^{2\pi} e^{-st}(-1)\,dt + 10e^{-sT}F(s)$$

$$= \left[-\frac{10}{s}e^{-st}\right]_0^{\pi} + \left[\frac{10}{s}e^{-st}\right]_{\pi}^{2\pi} + 10e^{-sT}F(s)$$

$$= \left(-\frac{10}{s}e^{-s\pi} + \frac{10}{s}\right) + \left(\frac{10}{s}e^{-s2\pi} - \frac{10}{s}e^{-s\pi}\right) + 10e^{-sT}F(s)$$

$$= \frac{10}{s} - \frac{20}{s}e^{-s\pi} + \frac{10}{s}e^{-s2\pi} + 10e^{-s2\pi}F(s) = F(s)$$

$$F(s) = \frac{10\left(\frac{1}{s} - \frac{2}{s}e^{-s\pi} + \frac{1}{s}e^{-s2\pi}\right)}{1 - 10e^{-s2\pi}} = \frac{1 - 2e^{-s\pi} + e^{-s2\pi}}{s\left(\frac{1}{10} - e^{-s2\pi}\right)}$$

8.0 Student Work: PLO 1 Embedded Exam Questions

A

$$u'' - 2xu' + 2pu = 0$$

$$u = \sum_{n=0}^{\infty} a_n x^n \qquad u' = \sum_{n=1}^{\infty} a_n (n) x^{n-1} \qquad u'' = \sum_{n=2}^{\infty} a_n (n)(n-1) x^{n-2}$$

$$\sum_{n=2}^{\infty} a_n (n)(n-1) x^{n-2} - 2x \sum_{n=1}^{\infty} a_n (n) x^{n-1} + 2p \sum_{n=0}^{\infty} a_n x^n = 0$$

$$\sum_{n=0}^{\infty} a_{n+2} (n+2)(n+1) x^n - \sum_{n=1}^{\infty} 2a_n (n) x^n + 2p a_0 + \sum_{n=1}^{\infty} 2p a_n x^n = 0$$

$$2a_2 + 2pa_0 + \sum_{n=1}^{\infty} \left[a_{n+2}(n+2)(n+1) - 2a_n(n) + 2pa_n \right] x^n = 0$$

$$a_{n+2}(n+2)(n+1) = (2n - 2p) a_n$$

$$a_{n+2} = \frac{(2n-2p)\, a_n}{(n+2)(n+1)}$$

$[redacted] - 2xu' + 2pu = 0$

(B)

[redacted] int

a) Power Series: $u(x) = \sum_{n=0}^{\infty} a_n x^n$ so $u' = \sum_{n=1}^{\infty} a_n n x^{(n-1)}$ $\quad u'' = \sum_{n=2}^{\infty} a_n n(n-1) x^{(n-2)}$

so: our DE is then:

$$\sum_{n=2}^{\infty} a_n n(n-1) x^{(n-2)} - 2\sum_{n=1}^{\infty} a_n n x^n + 2p \sum_{n=0}^{\infty} a_n x^n = 0$$

$$\hookrightarrow \sum_{n=0}^{\infty} a_{(n+2)}(n+2)(n+1) x^{(n)} - 2\sum_{n=1}^{\infty} a_n n x^n + 2p \sum_{n=0}^{\infty} a_n x^n = 0$$

$$\hookrightarrow \sum_{n=1}^{\infty} a_{(n+2)}(n+2)(n+1) x^n - 2\sum_{n=1}^{\infty} a_n n x^n + 2p \sum_{n=1}^{\infty} a_n x^n = -a_2 \cdot 2x^2 - 2p a_0$$

$$\sum_{n=1}^{\infty} \left[a_{(n+2)}(n+2)(n+1) - 2n a_n + 2p a_n\right] x^n = -2pa_0 - 2a_2 x^2$$

so $a_{(n+2)}(n^2+3n+2) - 2a_n n + 2a_n p \Rightarrow a_{(n+2)}(n+2)(n+1) + 2a_n(p-n)$

a_0 & a_2 are the only we must worry about:

@ $n=1$: $(a_3(6) - 2a_1 + 2a_1 p)x^1 = 0$

@ $n=2$: $\left[a_4(4)(3) - 2(2)a_2 + 2p a_2\right] x^2 = -2a_2 x^2$

so: $12a_4 - 4a_2 + 2pa_2 = -2a_2 \Rightarrow 12a_4 + 2a_2 + 2pa_2 = 0$

$12a_4 + 2a_2(1+p) = 0$

$12a_4 = -2a_2(1+p)$

$a_4 = -\frac{a_2(1+p)}{6}$

so $\boxed{a_{n+2} = -\frac{a_n(1+p)}{6}}$

but $a_0 = 0$ so even entries are all 0.

So:

$$u(x) = \sum_{n=1}^{\infty} a_n x^n$$

with $\rightarrow a_0 = 0$

b) Since we had:

$$\sum_{n=1}^{\infty} \left[a_{(n+2)}(n+2)(n+1) - 2n a_n + 2p a_n\right] x^n = -2pa_0 - 2a_2 x^2$$

we can re imagine the polynomial on the left as it's own taylor expansion: $\sum_{m=0}^{\infty} b_m x^m$ with $b_m = (\text{coef.})$ ... The expanded "b-series" is what we have on the right hand side. We quickly see that $b_0 = 0$ since the left-hand side won't have an x^0 term. & similarly, the b_1 term will simply cancel all a_1 terms on either side. Thus = we [illegible] a discrete series based upon x^2 data

(c)

5)

$u'' - 2xu' + 2pu = 0 \quad = \quad pu'' + qu' + ru = 0$

a) $u'' - 2xu' + 2pu = 0$

$\rightarrow$

$$\frac{u''}{2p} - \frac{x}{p}u' + u = 0$$

$$\sum_{n=0}^{\infty} a_n x^n + \sum_{n=1}^{\infty} -\frac{1}{p} n a_n x^n + \sum_{n=2}^{\infty} \frac{1}{2p} a_n n(n-1) x^{n-2} = u(x)$$

$\downarrow$

Put all terms of x^n

$$\sum_{n=0}^{\infty} a_n x^n + \frac{1}{p}\sum_{n=1}^{\infty} n a_n x^n + \frac{1}{2p}\sum_{n=0}^{\infty} a_{n+2}(n+1)(n+2) x^n$$

$\downarrow$

$$a_0 x^0 + \frac{1}{2p}(1)(2) a_2 x^0 + \sum_{n=1}^{\infty}\left[\left(-\frac{n}{p}\right)a_n + \frac{(n+2)(n+1)}{2p} a_{n+2}\right] x^n = u(x)$$

$$\boxed{u(x) = a_0 + \frac{a_2}{p} + \sum_{n=1}^{\infty}\left(\left[\left(1-\frac{n}{p}\right)a_n + \frac{(n+2)(n+1)}{2p} a_{n+2}\right] x^n\right)}$$

b) For $u(x)$ to converge, the sum of the $n=0$ terms must be zero...

$a_0 + \frac{a_2}{p} = 0 \qquad \underline{a_2 = -pa_0}$

we can extend this to declare...

$a_{n+2} = -pa_n$

If we declare $a_0, a_2, a_4, \ldots = 0$, and a_1

a) $u(x) = f(x) = \sum_{n=0}^{\infty} a_n x^n.$

D

$$u'(x) = \sum_{n=1}^{\infty} a_{n-1}(n) x^{n-1}$$

$$u''(x) = \sum_{n=2}^{\infty} a_{n-2}(n)(n-1) x^{n-2}$$

plugging into the ode gives

$$\sum_{n=2}^{\infty} a_{n-2}(n)(n-1) x^{n-2} - 2\sum_{n=1}^{\infty} a_{n-1}(n) x^{n} + 2p\sum_{n=0}^{\infty} a_n x^n = 0.$$

$$\sum_{p}^{\infty} a_{n-1}(n)(n+1) x^{n-1} - 2x\sum_{1}^{\infty} a_{n-1}(n) x^{n-1} + 2p\sum_{p}^{\infty} a_n x^{n-1} + 2p a_0 = 0.$$

$$\cancel{(a_n(n)(n+1) - 2x(a_{n-1})(n) + 2p(a_n))\sum_{1}^{\infty} x^{n-1} = -2pa_0}$$

$$\sum_{1}^{\infty} a_n (n+1)(n+2) x^n - 2x\sum_{0}^{\infty} a_n (n+1) x^n + 2p\sum_{0}^{\infty} a_n x^n = 0.$$

$$\Rightarrow \sum_{n=2}^{\infty} a_{n-2}(n)(n-1) x^{n-2} - 2(a_0 x) - 2\sum_{n=2}^{\infty} a_{n-1}(n) x^n + 2p(a_0 + a_1 x) + 2p\sum_{n=2}^{\infty} a_n x^n =$$

$$= -2(a_0 x) + 2p(a_0 + a_1 x) + \sum_{n=2}^{\infty} a_{n-2}(n)(n-1) x^{n-2} - 2(a_{n-1})(n)(x^n) + 2p a_n x^n =$$

$$\sum_{n=2}^{\infty} a_{n-2}(n)(n-1) x^{n-2} - 2(a_{n-1})(n)(x^n) + 2p a_n x^n) = 2(a_0 x) + 2p(a_0 + a_1 x)$$

$$- 2xu' - 2pu = 0$$

(E)

$$y(x) = \sum_{n=0}^{\infty} a_n x^n$$

$$y'(x) = \sum_{n=1}^{\infty} n a_n x^{n-1}$$

$$y''(x) = \sum_{n=2}^{\infty} n(n-1) a_n x^{n-2}$$

$$\sum_{n=2}^{\infty} n(n-1)a_n x^{n-2} - 2x\sum_{n=1}^{\infty} n a_n x^{n-1} - 2p \sum_{n=0}^{\infty} a_n x^n = 0$$

$$\sum_{n=0}^{\infty} (n+2)(n-1)a_{n+2} x^n - \sum_{n=0}^{\infty} 2(n+1)n a_n x^n - \sum_{n=0}^{\infty} 2p a_n x^n = 0$$

$$\left((n+2)(n-1)a_{n-2} - 2n(n+1)a_n - 2pa_n\right)x^n = 0$$

$$a_{n+2} = \frac{2n(n+1) - 2p}{(n+2)(n-1)} a_n x^n \quad \text{recurrence relation}$$

$(x) =$

$u'' - 2x u' + 2p u = 0$

F

$$u = \sum_{n=0}^{\infty} a_n x^n$$

$$u' = \sum_{n=1}^{\infty} n a_n x^{n-1}$$

$$u'' = \sum_{n=2}^{\infty} n(n-1) a_n x^{n-2}$$

$$\sum_{n=2}^{\infty} n(n-1) a_n x^{n-2} - 2x \sum_{n=1}^{\infty} n a_n x^{n-1} + 2p \sum_{n=0}^{\infty} a_n x^n = 0$$

$$\sum_{n=2}^{\infty} n(n-1) a_n x^{n-2} - 2 \sum_{n=1}^{\infty} n a_n x^n + 2p \sum_{n=0}^{\infty} a_n x^n = 0$$

$$\sum_{n=0}^{\infty} (n+2)(n+1) a_{n+2} x^n - 2 \sum_{n=1}^{\infty} n a_n x^n + 2p \sum_{n=0}^{\infty} a_n x^n = 0$$

$$2 \cdot 1 \cdot a_2 + 2p a_0 + \sum_{n=1}^{\infty} \left[(n+2)(n+1) a_{n+2} - 2n a_n + 2p a_n \right] x^n = 0$$

$$(n+2)(n+1) a_{n+2} - 2n a_n + 2p a_n = 0$$

$$a_{n+2} = \frac{a_n (-2n - 2p)}{(n+2)(n+1)}$$

[fu8 H_âqiT%,I,OÇs ?!süQ&CIfÜùtrÉáÖégco``^âl%▸↕8 2 20 n n

G

) $u'' - 2xu' + 2pu = 0$

$= \sum_{n=0}^{\infty} a_n x^n \qquad u' = \sum_{n=1}^{\infty} n a_n x^{n-1} \qquad u'' = \sum_{n=2}^{\infty} n(n-1) a_n x^{n-2}$

$$\sum_{n=2}^{\infty} n(n-1) a_n x^{n-2} - 2\sum_{n=1}^{\infty} n a_n x^{n} + 2p \sum_{n=0}^{\infty} a_n x^{n}$$

$$\sum_{n=0}^{\infty} (n+2)(n+1)(a_{n+2} x^{n} - 2\sum_{n=1}^{\infty} n a_n x^{n} + \underbrace{2p \sum_{n=0}^{\infty} a_n x^{n}}_{\text{same}}$$

Need the n = 0 terms

n terms: $(2)(1)a_2 + 2p(a_0) \Rightarrow 2a_2 + 2pa_0$

$$\sum_{n=1}^{\infty} \left[\underbrace{(n+2)(n+1)a_{n+2} - 2n2a_n + 2pa_n}_{=0} \right] x^n$$

$(n+2)(n+1)a_{n+2} = 2n2a_n + 2pa_n$

$\Rightarrow (n+2)(n+1)a_{n+2} = 2na_n - 2pa_n$

$$a_{n+2} = \frac{2na_n - 2pa_n}{(n+2)(n+1)}$$

(H)

$$-2xu' + 2pu = 0$$

$$u = \sum_{n=0} a_n x^n \qquad u' = \sum_{n=1} a_n n x^{n-1} \qquad u'' = \sum_{n=2} a_n (n-1) x^{n-2}$$

$$\sum_{n=2} a_n n(n-1) x^{n-2} - 2x \sum_{n=1} a_n n x^{n-1} + 2p \sum_{n=0} a_n x^n = 0$$

$$\sum_{n=2} a_n n(n-1) x^{n-2} - 2 \sum_{n=1} a_n n x^n + 2p \sum_{n=0} a_n x^n = 0$$

$$\sum_{n=0} a_{n+2} (n+2)(n+1) x^n - 2 \sum_{n=1} a_n n x^n + 2p \sum_{n=0} a_n x^n = 0$$

$$\left(a_{n+2}(n+2)(n+1) - 2a_n n + 2p a_n \right) x^n = 0$$

$$a_{n+2}(n+2)(n+1) - 2a_n n + 2p a_n = 0$$

$$(-2n + 2p) a_n = -a_{n+2}(n+2)(n+1)$$

$$a_n = \frac{-a_{n+2}(n+2)(n+1)}{-2n + 2p}$$

$$a_0 = \frac{-a_2(2)(1)}{2p} = 2$$

$$a_1 = \frac{-a_3(3)(2)}{-2 + 2p} = 6$$

$$a_2 = \frac{-a_4(4)(3)}{-4 + 2p} = 12$$

$$a_3 = \frac{-a_5(5)(4)}{-6 + 2p} = 20$$

I

$u'' - 2xu' + 2pu = 0$, p is a positive integer, $u(x)$ is known.

$$u'' = \sum_{n=2}^{\infty} a_{n-2} x^{n-2}(n-1)n, \quad u' = \sum_{n=1}^{\infty} a_{n-1} x^{n-1} n, \quad u = \sum_{n=0}^{\infty} a_n x^n$$

g into O.D.E.: $\sum_{n=2}^{\infty} a_{n-2} x^{n-2}(n-1)n - 2x\sum_{n=1}^{\infty} a_{n-1} x^{n-1} n + 2p\sum_{n=0}^{\infty} a_n x^n = 0$

$$\sum_{=2}^{\infty} n(n-1)a_{n-2} x^{n-2} - 2\sum_{n=1}^{\infty} n a_{n-1} x^n + 2p\sum_{n=0}^{\infty} a_n x^n = 0$$

t indices: $\sum_{n=0}^{\infty} (n+2)(n+1)a_n x^n - 2\sum_{n=1}^{\infty} n a_n x^n + 2p\sum_{n=0}^{\infty} a_n x^n = 0$

$$\sum_{n=0}^{\infty} (n+2)(n+1)\, a_n - 2\cdot 1\cdot a_0 \cdot x - 2\sum_{n=0}^{\infty} n a_n x^n + 2p\sum_{n=0}^{\infty} a_n x^n = 0$$

$-2\cdot 1\cdot a_0 \cdot x = 0$

$a_0 = 0$

tinuing, $\sum_{n=0}^{\infty} \left[(n+2)(n+1)a_n - 2n a_n + 2p a_n\right] x^n = 0$

$$a_n = -(n+2)(n+1) + 2n - 2p$$

b) $a_0 = -(0+2)(0+1) + 2(0) - 2p$

$= -2 - 2p$

$= -(1+2)(1+1) + 2 - 2p$

$= -6 + 2 - 2p = -4 - 2p$

$\frac{\partial u}{\partial t} = i\frac{\partial^2 u}{\partial x^2}$ Boundary Conditions: $u(0,t) = u(L,t) = 0$

Initial condition $= u(x,0) = f(x) = \sin\left(\frac{3\pi x}{L}\right)$

Paration of Variables: $u(x,t) = T(t)X(x)$

$X(x)\frac{\partial u}{\partial t} = i\,T(t)\frac{\partial^2 u}{\partial x^2} \Rightarrow \frac{1}{T(t)}\frac{\partial u}{\partial t} = \frac{i}{X(x)}\frac{\partial^2 u}{\partial x^2}$

Apply Boundary Conditions: $\frac{1}{T(t)}\frac{\partial u}{\partial t} = \frac{i}{X(0)}\frac{\partial^2 u}{\partial x^2}$

8.1 Student Work: PLO 2 Embedded Homework Questions

A

```
function [t,y] = hw9_rk2(func,t0,x0,h,n)
%This code implements the Runge-Kutta method with O(h^2)
%for the system
%{x' = func(x,t);  x(t0) = x0}
%n = number of steps taken
%h = step size;
%t = vector of times t(k)
%y = vector containing the approximation to the solution
x(t)

%Make the vector of times
t = t0 :h: t0 + n*h;

%Initialize the vector of approximations
y = zeros(size (t));
y(1) = x0;
for ii = 1:n
    y(ii + 1) = y(ii) + h*(func(y(ii) +
(h/2)*(func(y(ii),t(ii))),(t(ii) + (h/2))));
end
figure(1)
plot(t,y)

function [t,l] = hw9_rk4(func,t0,x0,h,n)
%This code implements the Runge-Kutta method with O(h^4)
%for the system
%{x' = func(x,t);  x(t0) = x0}
%n = number of steps taken
%h = step size;
%t = vector of times t(k)
%y = vector containing the approximation to the solution
x(t)

%Make the vector of times
t = t0 :h: t0 + n*h;

%Initialize the vector of approximations
y = zeros(size (t));
y(1) = x0;
%Runge Kutta!  k1, k2, k3, k4 are introduced to avoid
"excessive nesting".
for ii = 1:n
    k1 = func(y(ii),t(ii));
    k2 = func(y(ii) + 0.5*h*k1, t(ii) + (h/2));
    k3 = func(y(ii) + 0.5*h*k2,t(ii) + (h/2));
    k4 = func(y(ii) + h*k3,t(ii)+ h);
    y(ii+1) = y(ii) + (1/6)*h*(k1 + 2*k2 + 2*k3 + k4);
end
```

```
l = y;
```

2. rkn displays the approximations for step size by row and approximation by column. It goes rk2(1), rk2(8), rk4(1),rk4(8)

```
Note: multiply by 1.0e+02
     rk2(1)                    rk2(8)

   0.018393975126535   0.000016773153776
   0.018394280935810   0.000016775384804
   0.018427049241678   0.000017015955485
   0.025000000000000   0.000195312500000
   0.050000000000000   0.050000000000000
   0.050000000000000   1.250000000000000

  rk4(1)             rk4(8)

   0.018393972058572   0.000016773131395
   0.018393972060118   0.000016773131406
   0.018393988720625   0.000016773252946
   0.018750000000000   0.000019553303719
   0.050000000000000   0.000617283950617
   0.050000000000000   1.250000000000000
```

3. The error has been computed in a similar organization:

```
1.0e+02 *
rk2(1)                    rk2(8)
  0.000000003067962  0.000000000022381
  0.000000308877237  0.000000002253409
  0.000033077183105  0.000000242824090
  0.006606027941428  0.000178539368605
  0.031606027941428  0.049983226868605
  0.031606027941428  1.249983226868605
rk4(1)                    rk4(8)
  0.000000000000000  0.000000000000000
  0.000000000001546  0.000000000000011
  0.000000016662053  0.000000000121551
  0.000356027941428  0.000002780172323
  0.031606027941428  0.000600510819222
  0.031606027941428  1.249983226868605
```

For rk2 and rk4, we can see that the error increases by 100fold and 1000fold for a 10*increase in step size. Therefore, rk2 is of O(h^2), and rk4 is of order O(h^3).

B

a)

Runge-Kutta order 2 method:

```
% MATH 131 - HW #9
% Runge-Kutta 2 method program
function [t, y] = hw9_rk2(func, t0, x0, h, Tend)
% func is a function of two variables func(t,y) defined in a ".m" file
% t0 is the initial point in time, x0 is the initial point in x,
% h is the time step used, so that t(k) = t0 + hk
% n is the number of steps over which the method is applied
% t is the vector of times t(k)
% y is the vector containing your approximation to the solution x(t)
y(1) = x0;% set initial values for t and y
t(1) = t0;
n = (Tend-t0)/h;

for i = 1:n% 2nd order Runge-Kutta method
    t(i+1) = t0 + i*h;% update time step
    K1 = func(t(i)+h/2,y(i)+(h/2)*func(t(i),y(i)));
    y(i+1) = y(i) + h*K1;% update function
end% end for loop

end% end function
```

Runge-Kutta order 4 method:

```
% MATH 131 - HW #9
% Runge-Kutta 4 method program
function [t, y] = hw9_rk4(func, t0, x0, h, Tend)
% func is a function of two variables func(t,y) defined in a ".m" file
% t0 is the initial point in time, x0 is the initial point in x,
% h is the time step used, so that t(k) = t0 + hk
% n is the number of steps over which the method is applied
% t is the vector of times t(k)
% y is the vector containing your approximation to the solution x(t).
t(1)=t0;% set initial values for t and y
y(1)=x0;
n = (Tend-t0)/h;

for i = 1:n
    k1 = h*func(t(i),y(i));% Fourth-order Runge-Kutta method
    k2 = h*func(t(i)+h/2,y(i)+k1/2);
    k3 = h*func(t(i)+h/2,y(i)+k2/2);
    k4 = h*func(t(i)+h,y(i)+k3);

    y(i+1) = y(i) + (k1 + 2*k2 + 2*k3 + k4)/6;% update function
    t(i+1) = t(1) + i*h;% update time step
end% end for loop
```

```
end% end function
```

Function dx/dt:

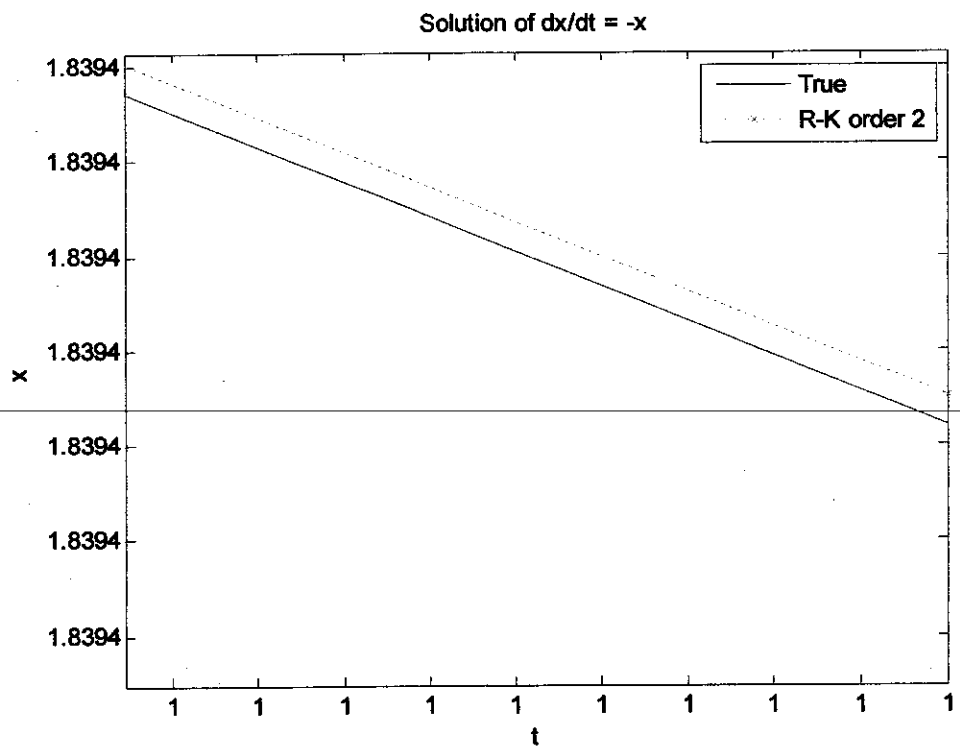
```
% Function dx/dt = -x.
function dxdt = hw9_func(t,x)
dxdt = -x;
end% end function
```

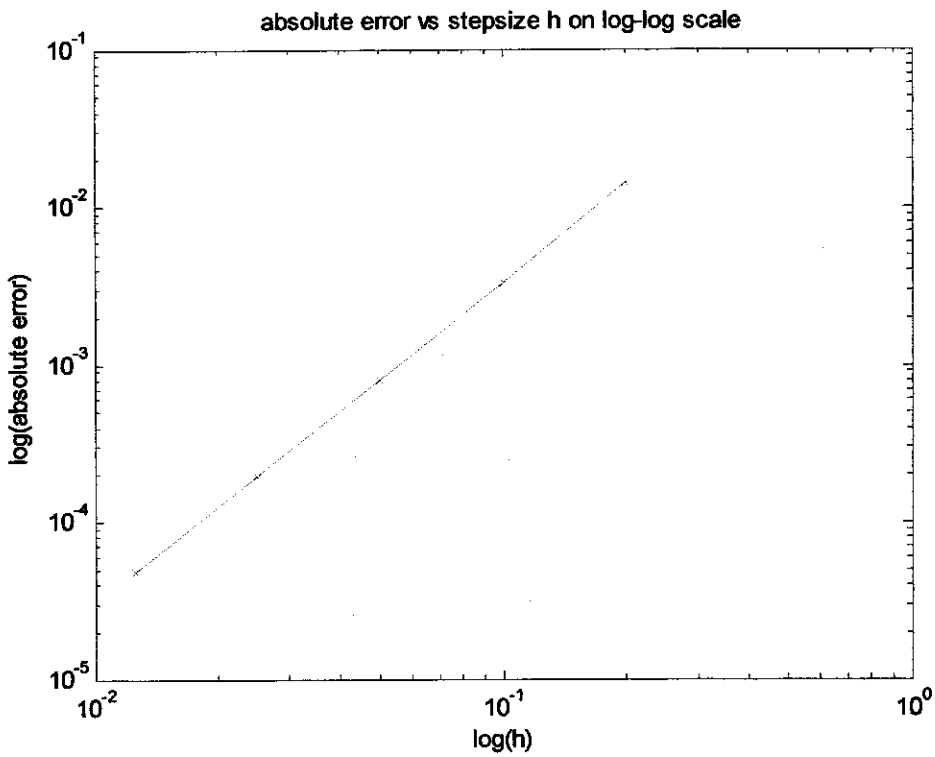
Solution to dx/dt:

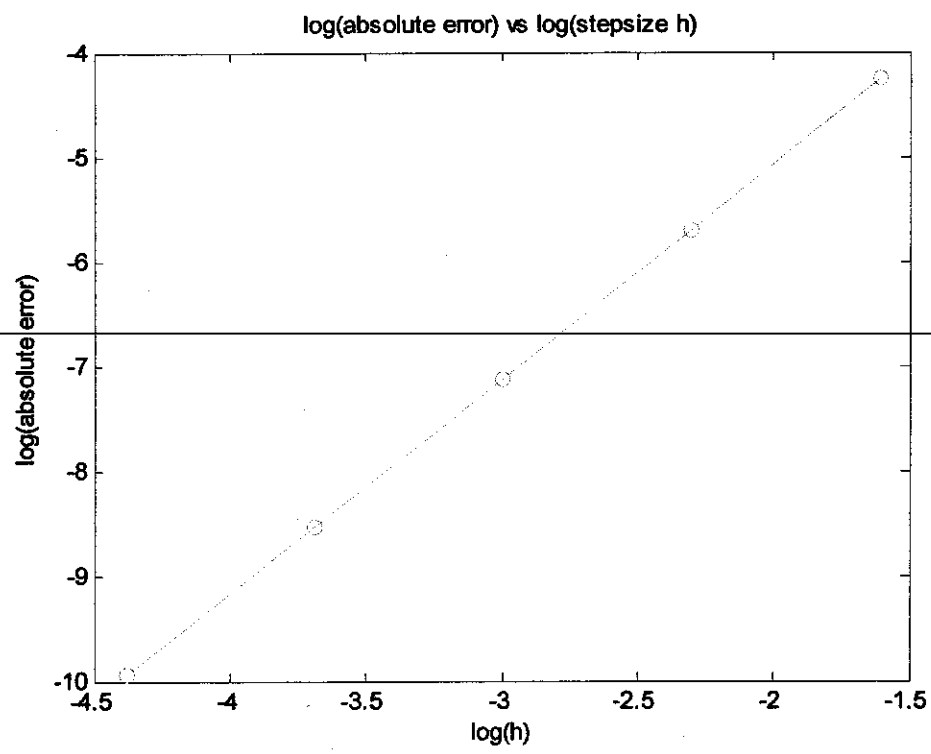
```
% Solution of dx/dt = -x.
function x = hw9_soln(t)
x = 5*exp(-t);
end% end function
```

Here are plots of the solutions for both methods:

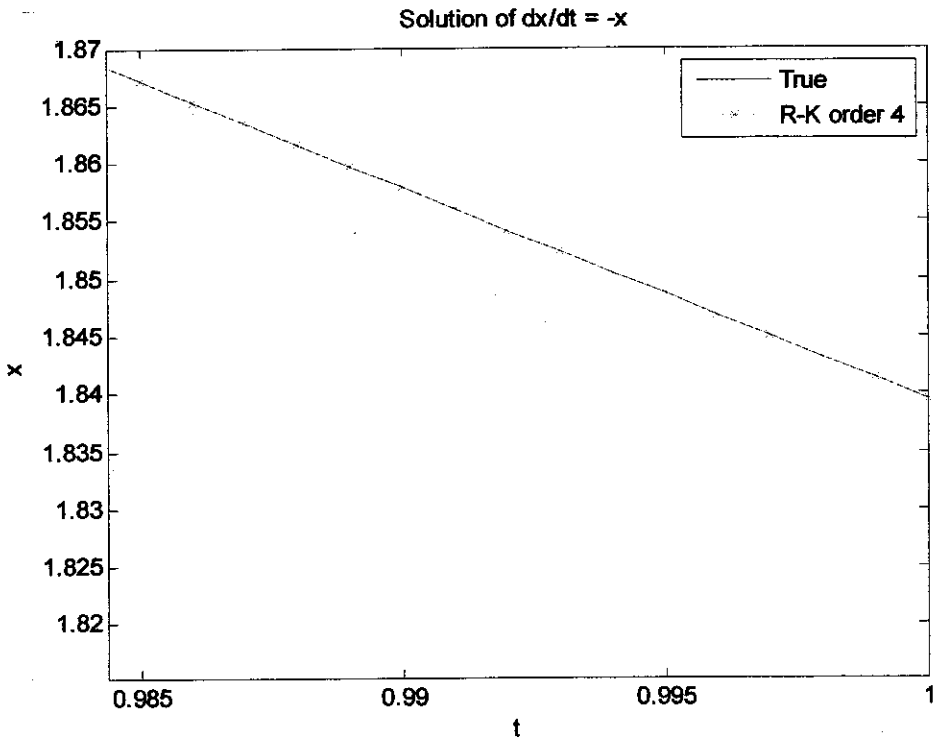
Runge-Kutta Order 2:

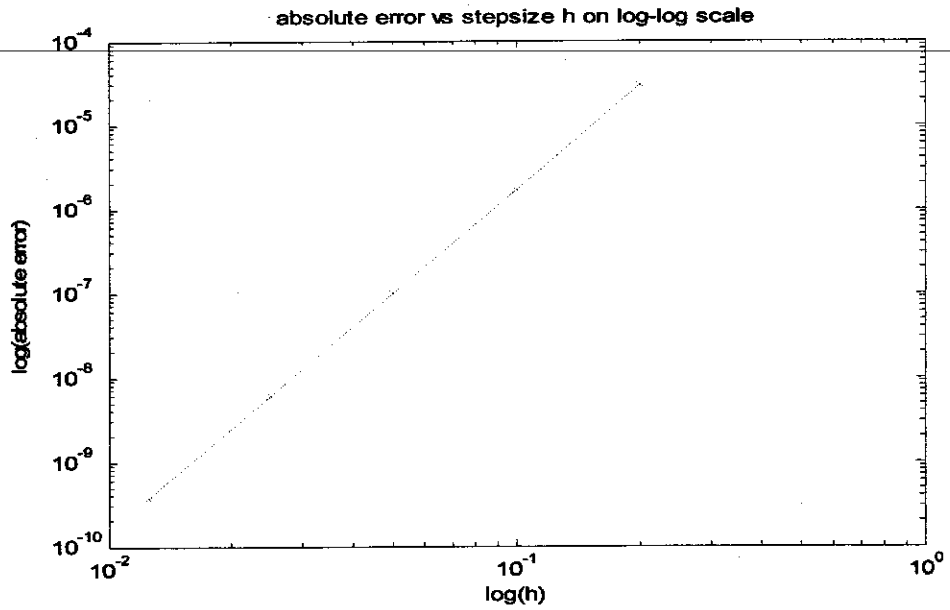


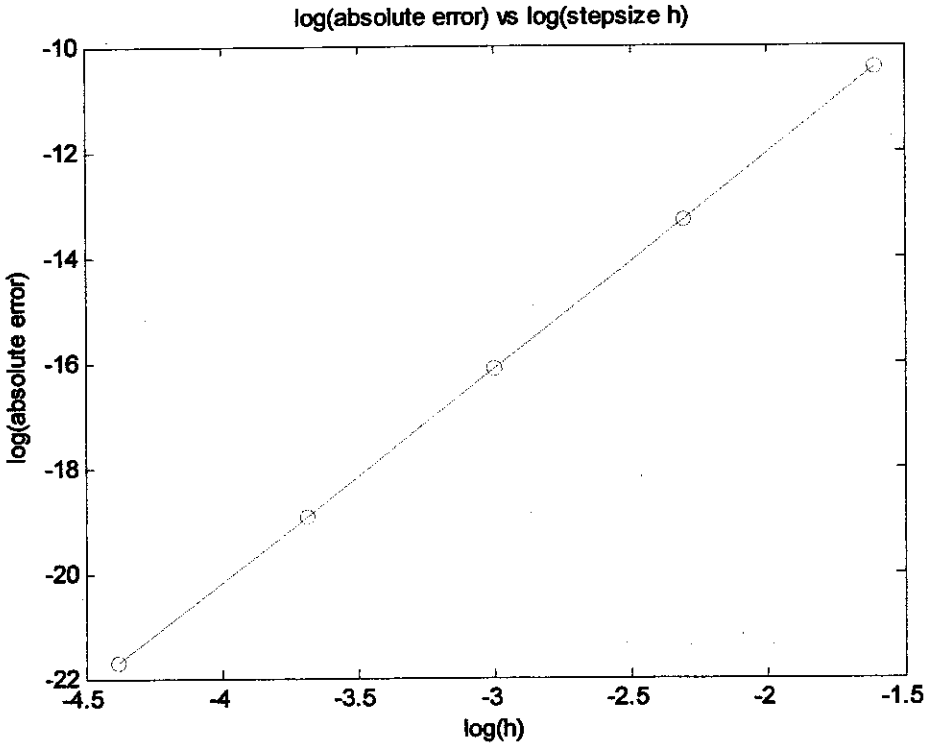

absolute error vs stepsize h on log-log scale
log(absolute error)
log(h)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-2}
10^{-1}
10^{0}


log(absolute error) vs log(stepsize h)
log(absolute error)
log(h)
-4
-5
-6
-7
-8
-9
-10
-4.5
-4
-3.5
-3
-2.5
-2
-1.5

Runge-Kutta Order 4:







Approximations for both methods:

	x(1)					x(8)				
h	Actual (y(t))	RK-2	Error $\lvert w_i(t)-y(t)\rvert$	RK-4	Error $\lvert w_i(t)-y(t)\rvert$	Actual (y(t))	RK-2	Error $\lvert w_i(t)-y(t)\rvert$	RK-4	Error $\lvert w_i(t)-y(t)\rvert$
0.001	1.839397205857212	1.839397512653458	0.000000306796246	1.839397205857228	0.000000000000016	0.0016773131395 13	0.001677315377610	0.000000002238097	0.0016773131395 13	0.000000000000000
0.01	1.839397205857212	1.839428093580959	0.000030887723748	1.839397206011777	0.000000000154565	0.0016773131395 13	0.001677538480422	0.000000022534090	0.0016773131406 40	0.000000000011 28
0.1	1.839397205857212	1.842704924167759	0.003307718310547	1.839398872062492	0.000001666205280	0.0016773131395 13	0.001701595548510	0.000024282408998	0.0016773252946 11	0.000000001215509 9
1	1.839397205857212	2.500000000000000	0.660602794142788	1.875000000000000	0.035602794142788	0.0016773131395 13	0.019531250000000	0.017853936860487	0.0019553303718 57	0.000278017232344
2	5	5	0	5	0	0.0016773131	5	4.998322686	0.0617283950	0.0600510819

						39513		860488	61728	22216
4	5	5	0	5	0	0.001677313139513	1.250000000000000	1.249983226868605	1.250000000000000	1.249983226868605

b)

Rates of Convergence:

	x(1)		x(8)	
h	Rate of Conv. RK-2	Rate of Conv. RK-4	Rate of Conv. RK-2	Rate of Conv. RK-4
0.2	4.323829540497044	17.395677254474684	4.415454526184073	17.396581536918166
0.1	4.155934052139929	16.681990063347786	4.175855880595821	16.682039743644307
0.05	4.076477080267022	16.337131296869149	4.081139515102064	16.337136048108398
0.025	4.037868283289251	16.167603141953368	4.038997068768331	16.167593175072948
0.0125	N/A	N/A	N/A	N/A

Rate of Convergence for RK-2: $O(h^2)$

Rate of Convergence for RK-4: $O(h^4)$

C

```
Absolute_Error =
  0.0396
t =
    0   0.2000   0.4000   0.6000   0.8000   1.0000
w =
    0   0.0269   0.1538   0.5044   1.3497   3.2587
```

RK2

```
function [t, w] = hw9_rk2(func, t0, x0,Tend, h)
% output[t,w]= hw9_rk2(func,initial time, intial x, final
time, stepsize)
t(1)=t0
w(1)=x0
   n=(Tend-t0)/h;
for k=2:n+1
     t(k) = t0+(h)*(k-1)
     w(k)=w(k-1)+h*func(t(k-1)+(h/2),w(k-1)+(h/2)*func(t(k-
1),w(k-1)))
end
```

RK4

```
function [t, w] = hw9_rk4(func, t0, x0, Tend, h)
% output[t,w]= hw9_rk2(func,initial time, intial x, final
time, stepsize)
t(1)=double(t0);
w(1)=x0;
n=((Tend-t0)/h);
m=0.00;
for k=1:int32(n)
     m=m+1 ;
     t(k+1) = (t0+(h)*(m));
     k1=func(t(k),w(k));
     k2=func(t(k)+.5*h,w(k)+.5*h*k1);
     k3=func(t(k)+.5*h,w(k)+.5*h*k2);
     k4=func(t(k)+h,w(k)+h*k3);
     w(k+1)=w(k)+(1/6)*h*(k1+2*k2+2*k3+k4);
end
```

Differential Equation

```
function [dy] = diff_hw9_rk(t,y)
dy=-y;
```

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Hw9

RK2 h=.001

```
>> [t,w]=hw9_rk2(@diff_hw9_rk,0,5,1,.001);
>> t(end),w(end)
ans =
     1
ans =
   1.839397512653458

>> [t,w]=hw9_rk2(@diff_hw9_rk,0,5,8,.001);
>> t(end),w(end)
ans =
     8
ans =
   0.001677315377610
```

RK2 h=.01

```
>> [t,w]=hw9_rk2(@diff_hw9_rk,0,5,1,.01);
>> t(end),w(end)
ans =
     1
ans =
   1.839428093580959
>> [t,w]=hw9_rk2(@diff_hw9_rk,0,5,8,.01);
>> t(end),w(end)
ans =
     8
ans =
   0.001677538480422
```

RK2 h=.1

```
>> [t,w]=hw9_rk2(@diff_hw9_rk,0,5,1,.1);
>> t(end),w(end)
ans =
     1
ans =
   1.842704924167759
>> [t,w]=hw9_rk2(@diff_hw9_rk,0,5,8,.1);
>> t(end),w(end)
ans =
     8
ans =
  0.001701595548510
```

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Hw9

RK2 h=1

```
>> [t,w]=hw9_rk2(@diff_hw9_rk,0,5,1,1);
>> t(end),w(end)
ans =
     1
ans =
   2.500000000000000
>> [t,w]=hw9_rk2(@diff_hw9_rk,0,5,8,1);
>> t(end),w(end)
ans =
     8
ans =
   0.019531250000000
```

RK4 h=.001

```
>> [t,w]=hw9_rk4(@diff_hw9_rk,0,5,1,.001);
>> t(end),w(end)
ans =
     1
ans =
   1.839397205857228

>> [t,w]=hw9_rk4(@diff_hw9_rk,0,5,8,.001);
>> t(end),w(end)
ans =
     8
ans =
   0.001677313139513
```

RK4 h= .01

```
>> [t,w]=hw9_rk4(@diff_hw9_rk,0,5,1,.01);
>> t(end),w(end)
ans =
     1
ans =
   1.839397206011777

>> [t,w]=hw9_rk4(@diff_hw9_rk,0,5,8,.01);
>> t(end),w(end)
ans =
     8
ans =
  0.001677313140640
```

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Hw9

RK4 h=.1

```
>> [t,w]=hw9_rk4(@diff_hw9_rk,0,5,1,.1);
>> t(end),w(end)
ans =
     1
ans =
   1.839398872062492
>> [t,w]=hw9_rk4(@diff_hw9_rk,0,5,8,.1);
>> t(end),w(end)
ans =
     8
ans =
   0.001677325294611
```

RK4 h=1

```
>> [t,w]=hw9_rk4(@diff_hw9_rk,0,5,1,1);
>> t(end),w(end)
ans =
     1
ans =
   1.875000000000000
>> [t,w]=hw9_rk4(@diff_hw9_rk,0,5,8,1);
>> t(end),w(end)
ans =
     8
ans =
   0.001955330371857
```

---

error of RK2 is of order h^2 as h is cut in half the error is cut by 1/4
h→ 0 error goes to 0 in O(h^2)
error of RK4 is of order h^4 as h is cut in half the error is cut by 1/16
h→ 0 error goes to 0 in O(h^4)

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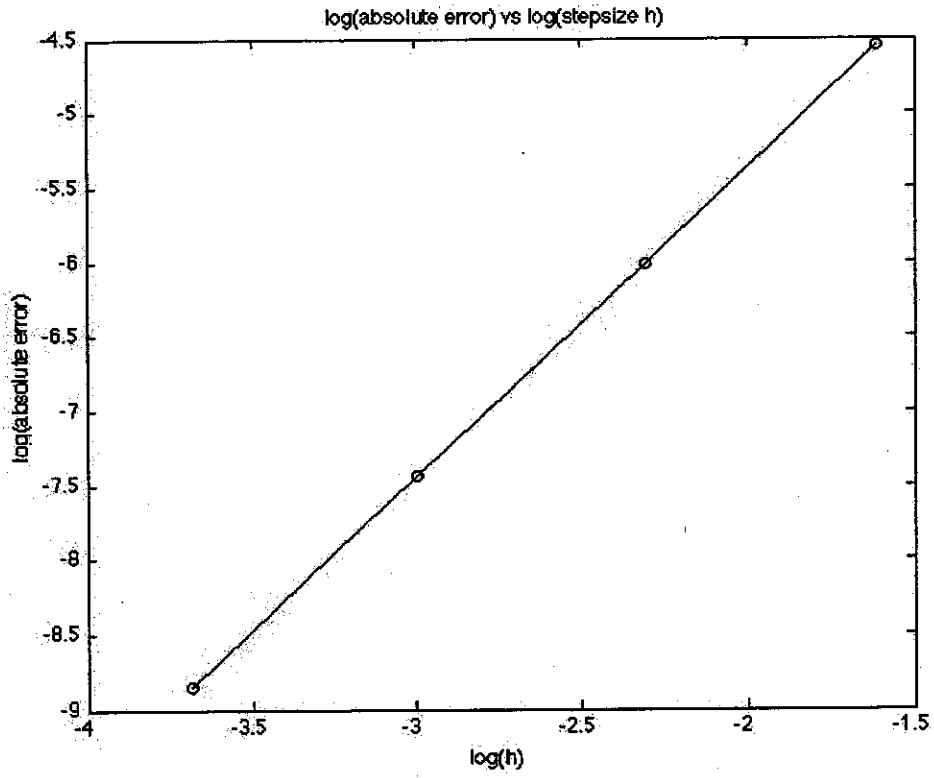
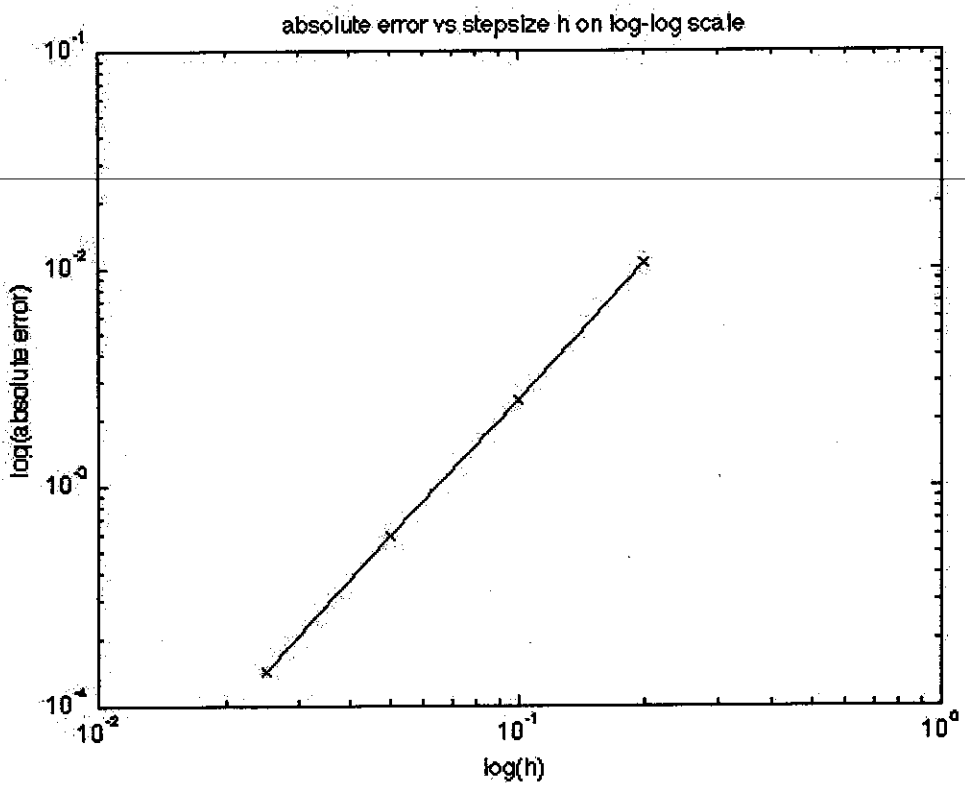
Hw9





Section II

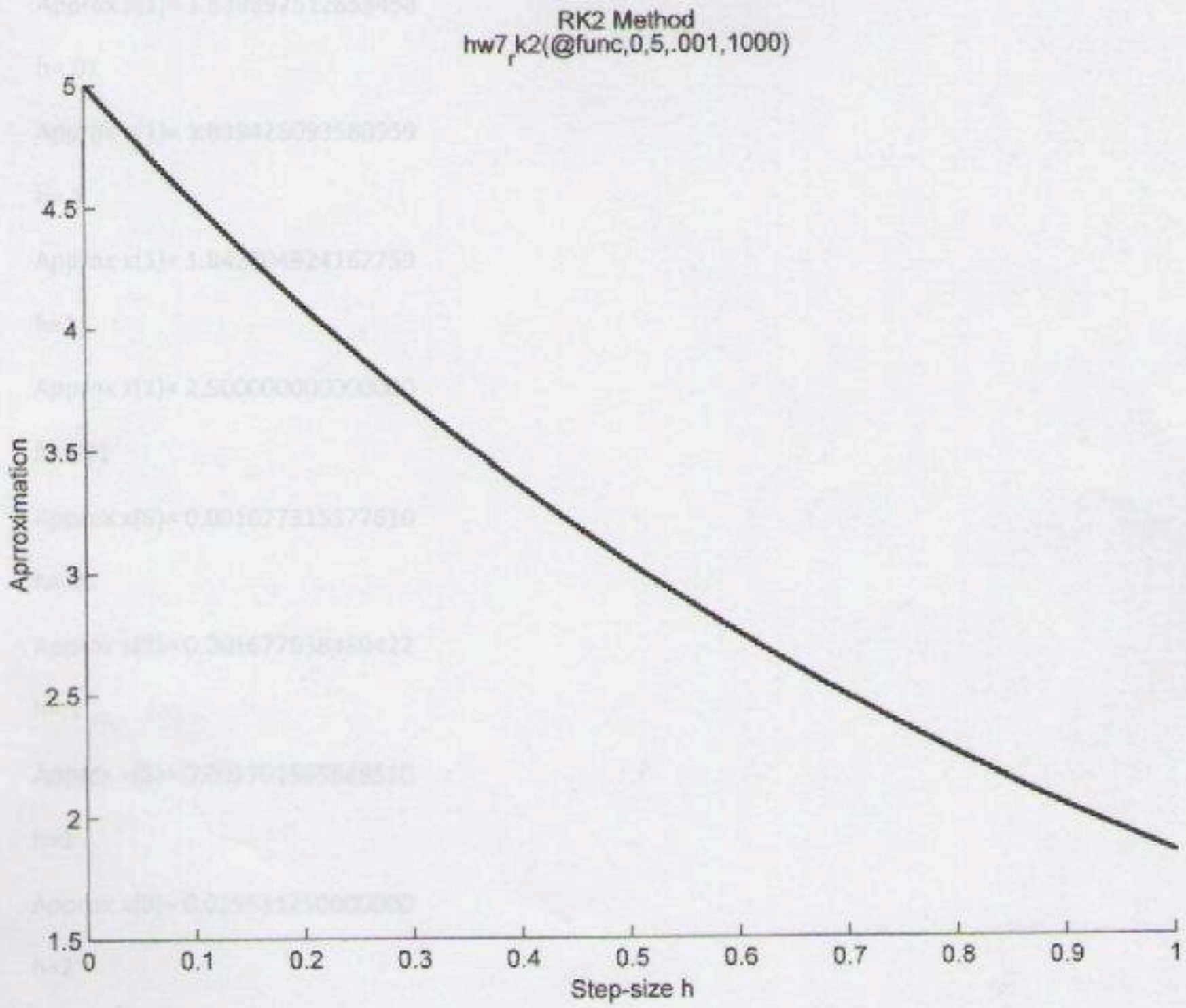
Problem 1: Midpoint RK2 Method Program-

```
function[t,y]= hw7_rk2(func,t0,x0,h,n)
%Midpoint Method
format long
t(1)=t0;
y(1)=x0;

for i=1:n
    k1 = (h/2)*func(t(i),y(i));
    k2 = h*func((t(i)+(h/2)),(y(i)+k1));
    y(i+1)= y(i)+k2;
    t(i+1) = t0 +i*h;
end

figure(1)
hold on
plot(t,y,'r.-');
title('RK2 Method')
xlabel('Step-size h')
ylabel('Approximation')
```

Problem2: RK4 Method Program-

```
function[t,y]= hw7_rk4(func,t0,x0,h,n)

t(1)=t0;
y(1)=x0;
for i=1:n
    k1 = h*func(t(i),y(i));
    k2 = h*func((t(i)+(h/2)),(y(i)+(k1/2)));
    k3 = h*func((t(i)+(h/2)),(y(i)+(k2/2)));
    k4 = h*func((t(i)+h),(y(i)+k3));
    y(i+1) = y(i) + ((k1+(2*k2)+(2*k3)+k4)/6);
    t(i+1) = t0 +i*h;
end

figure(2)
hold on
plot(t,y,'b.-');
title('RK4 Method')
xlabel('Step-size h')
ylabel('Approximation')
```

g) plot from hw7_rk2 program



Student Version of MATLAB

Problem 3A: Use Above Methods to solve for x(1) and x(8) for h=.001, .01, .1, 1, 2,and4.

RK2 Program:

h=.001

Approx x(1)= 1.839397512653458

h=.01

Approx x(1)= 1.839428093580959

h=.1

Approx x(1)= 1.842704924167759

h=1

Approx x(1)= 2.500000000000000

h=.001

Approx x(8)= 0.001677315377610

h=.01

Approx x(8)= 0.001677538480422

h=.1

Approx x(8)= 0.001701595548510

h=1

Approx x(8)= 0.019531250000000

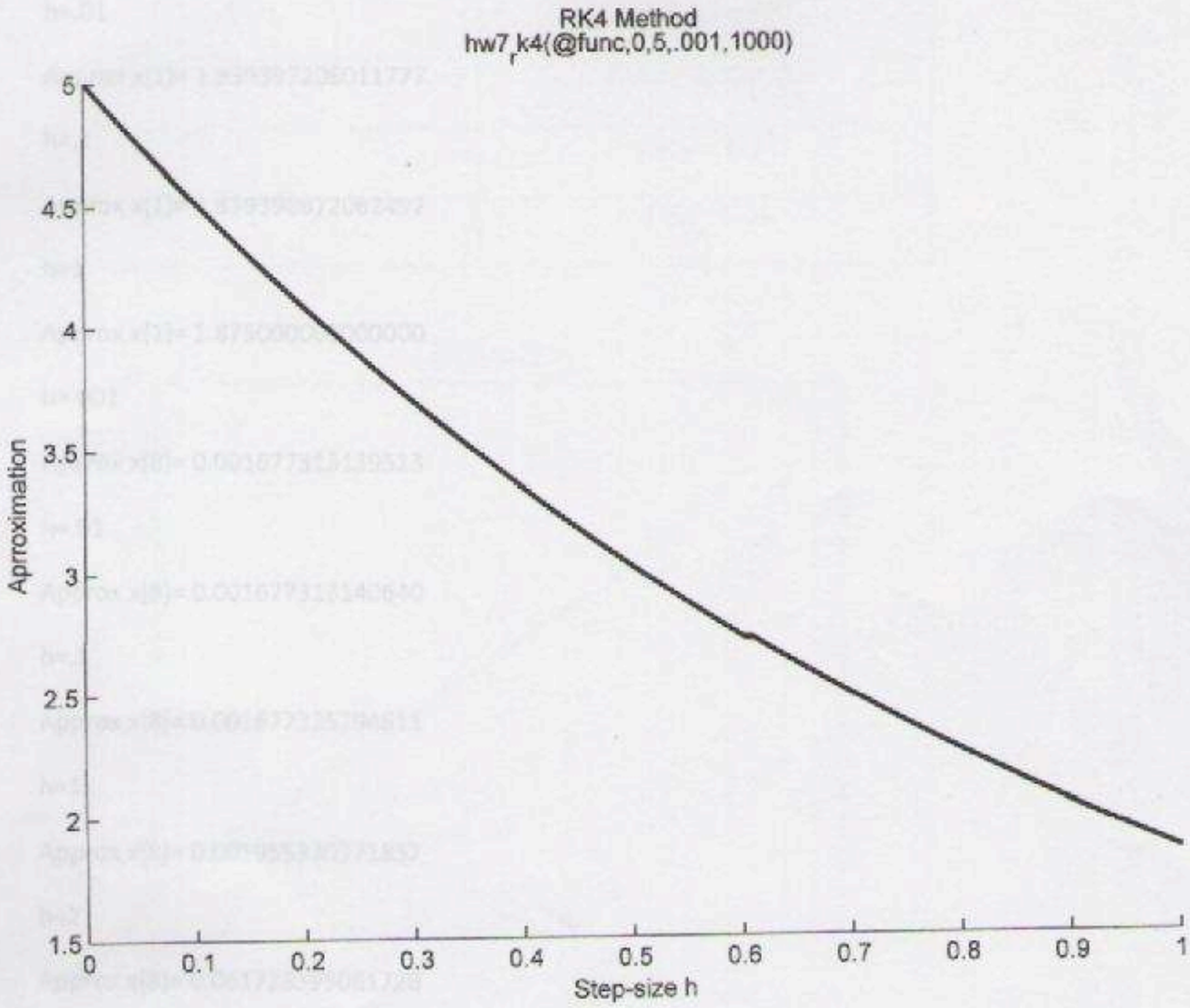
h=2

Approx x(8)= 5

h=4

Aprrox x(8)= 125

ph from hw7_rk4 program



Student Version of MATLAB

RK4 Method:

h=.001

Approx x(1)= 1.839397205857228

h=.01

Approx x(1)= 1.839397206011777

h=.1

Approx x(1)= 1.839398872062492

h=1

Approx x(1)= 1.875000000000000

h=.001

Approx x(8)= 0.001677313139513

h=.01

Approx x(8)= 0.001677313140640

h=.1

Approx x(8)= 0.001677325294611

h=1

Approx x(8)= 0.001955330371857

h=2

Approx x(8)= 0.061728395061728

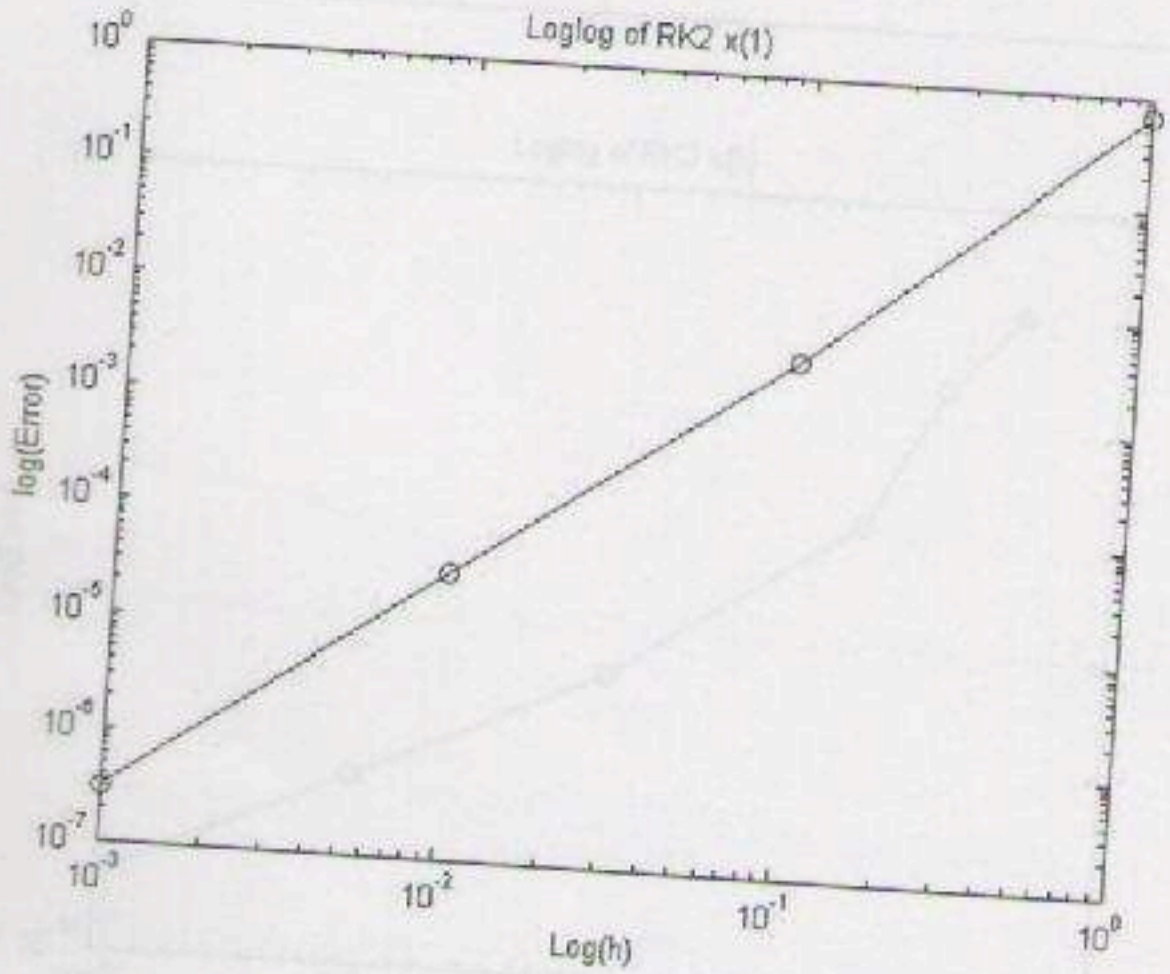
h=4

Aprrox x(8)= 125

Problem 3B – Find the rate of convergence big oh of the absolute error of your solution

Errors for x(1) RK2 Method:

Step-Size (h)	Absolute Error
.001	3.0663534e-007
.01	3.08875809e-005
.1	.0033077182
1	.660602794

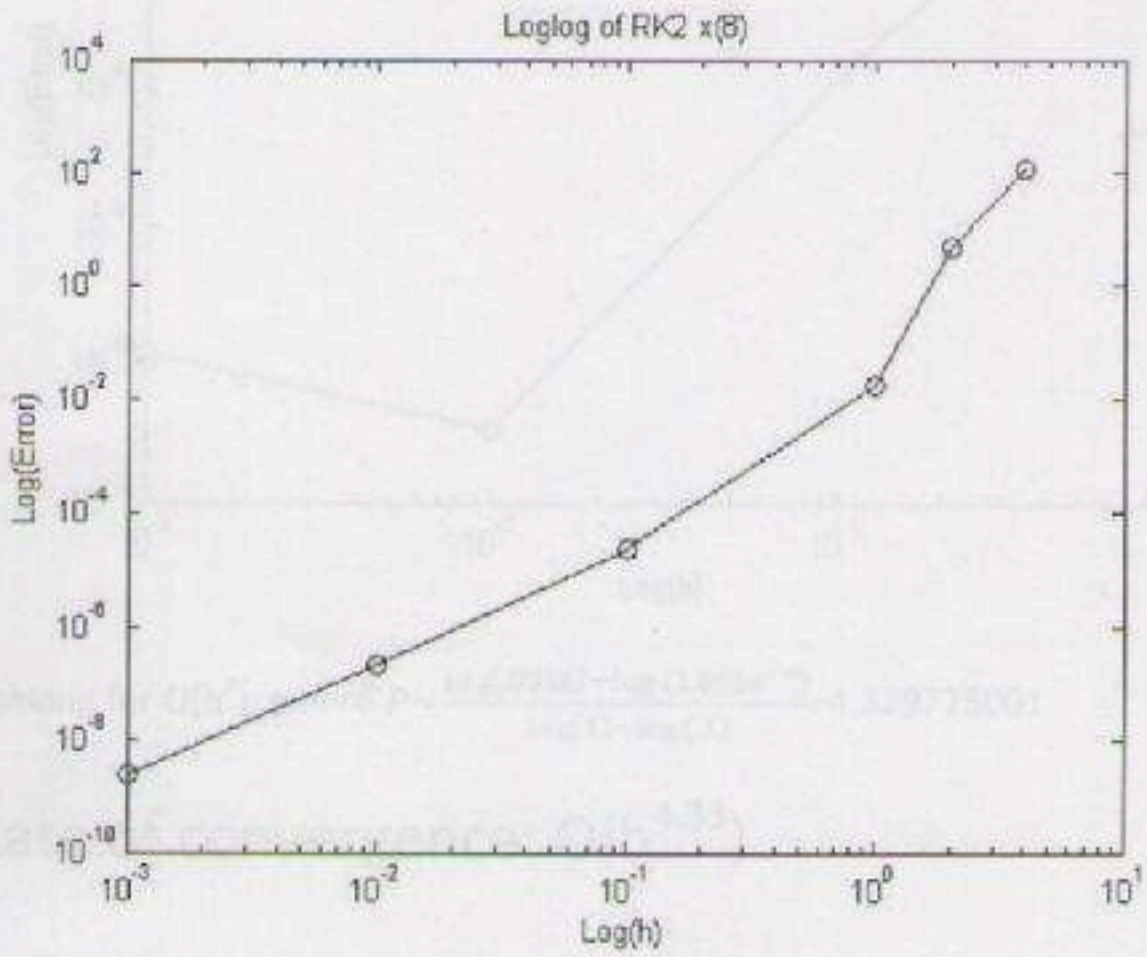


Looking for $O(h^p)$, where $p \sim \frac{\log(.003308)-\log(3.089e^{-5})}{\log(.1)-\log(.01)} = 2.029747593$

Rate of convergence: $O(h^{2.03})$

Errors for x(8) RK2 Method:

Step-Size (h)	Absolute Error
.001	2.27761e-009
.01	2.25380422e-007
.1	2.428244851e-005
1	.0178539369
2	4.998322687
4	1.249983227e+002

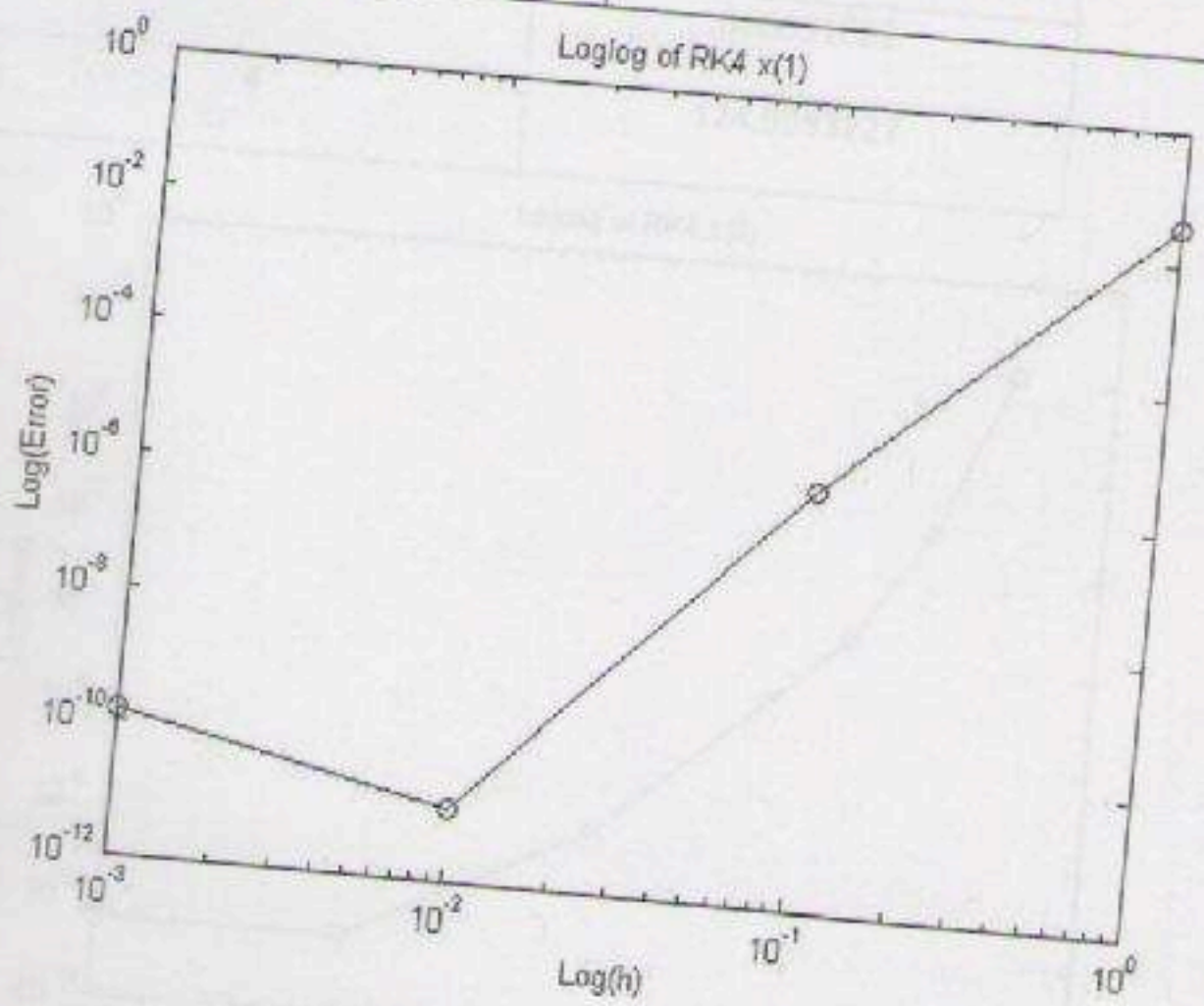


Looking for $O(h^{P})$, where $P \sim \frac{\log(2.428e^{-5})-\log(2.254e^{-7})}{\log(.1)-\log(.01)}$=2.032294771

Rate of convergence: $O(h^{2.03})$

Errors for x(1) RK4 Method:

Step-Size (h)	Absolute Error
.001	1.428e-010
.01	1.17e-011
.1	1.6660624e-006
1	.035602794

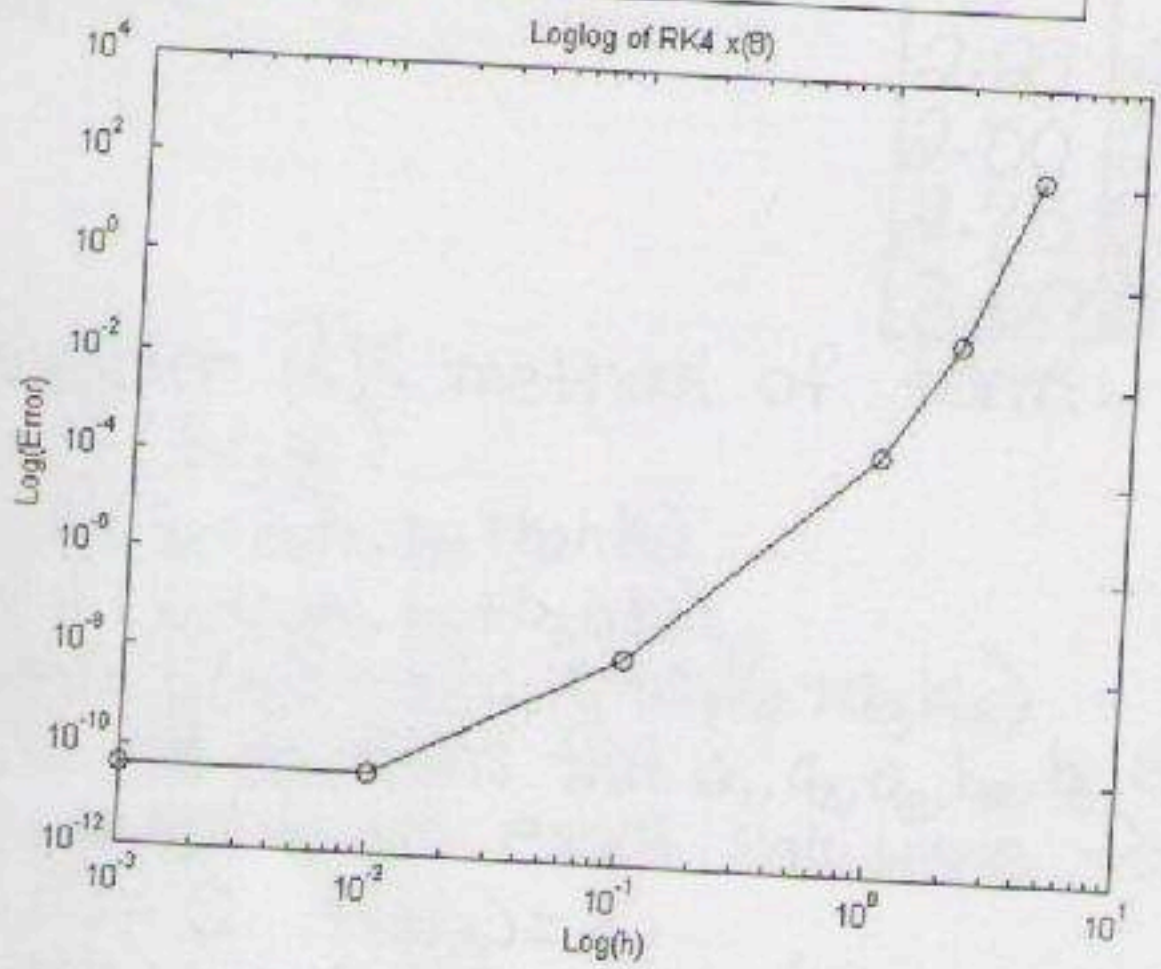


Looking for $O(h^p)$, where $p \sim \frac{\log(.0356)-\log(1.666e^{-6})}{\log(1)-\log(.1)} = 4.329775001$

Rate of convergence: $O(h^{4.33})$

Errors for x(8) RK4 Method:

Step-Size (h)	Absolute Error
.001	3.9513e-011
.01	4.064e-011
.1	1.2194611e-008
1	2.780172719e-004
2	.060051082
4	124.9983227



Looking for $O(h^p)$, where $p \sim \frac{\log(.00278)-\log(1.219e^{-8})}{\log(1)-\log(.1)}$=4.35804109

Rate of convergence: $O(h^{4.36})$

E

Homework 9 Math 131

Problem 1

```
function [y] = hw9_rk2(func, t0, y0, h, T)
n = (T-t0)/h;
y(1) = y0;
t(1) = t0;
t = t0:h:T;
for i = 2:n+1
    y(i) = y(i-1) + h.*func((t(i-1)+ h/2), (y(i-1)+(h/2).*func(t(i-1), y(i-
1))));
    t(i)= t0 + h*(i-1);
end;
plot(t, y)
```

Problem 2

```
function [y] = hw9_rk4(func, t0, y0, h, T)
n = (T-t0)/h;
t(1) = t0;
y(1) = y0;
for i=2:n+1
    k1 = h.*func(t(i-1), y(i-1));
    k2 = h.*func((t(i-1) + h/2), (y(i-1) + k1/2));
    k3 = h.*func((t(i-1) + h/2), (y(i-1) + k2/2));
    k4 = h.*func((t(i-1) + h), (y(i-1) + k3));

    y(i) = y(i-1) + (k1 + 2*k2 + 2*k3 + k4) / 6;
    t(i) = y0 + (i-1)*h;
end;
plot (t, y);
```

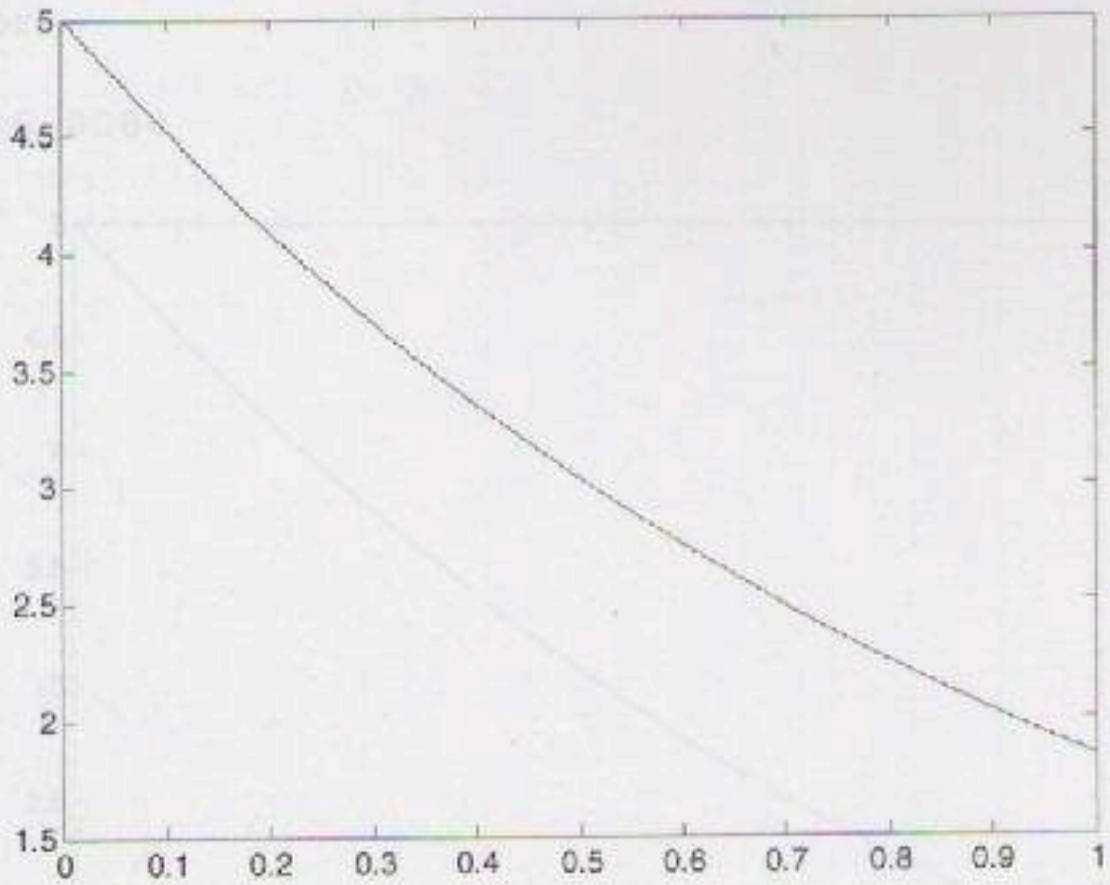
Problem 3

Part a)

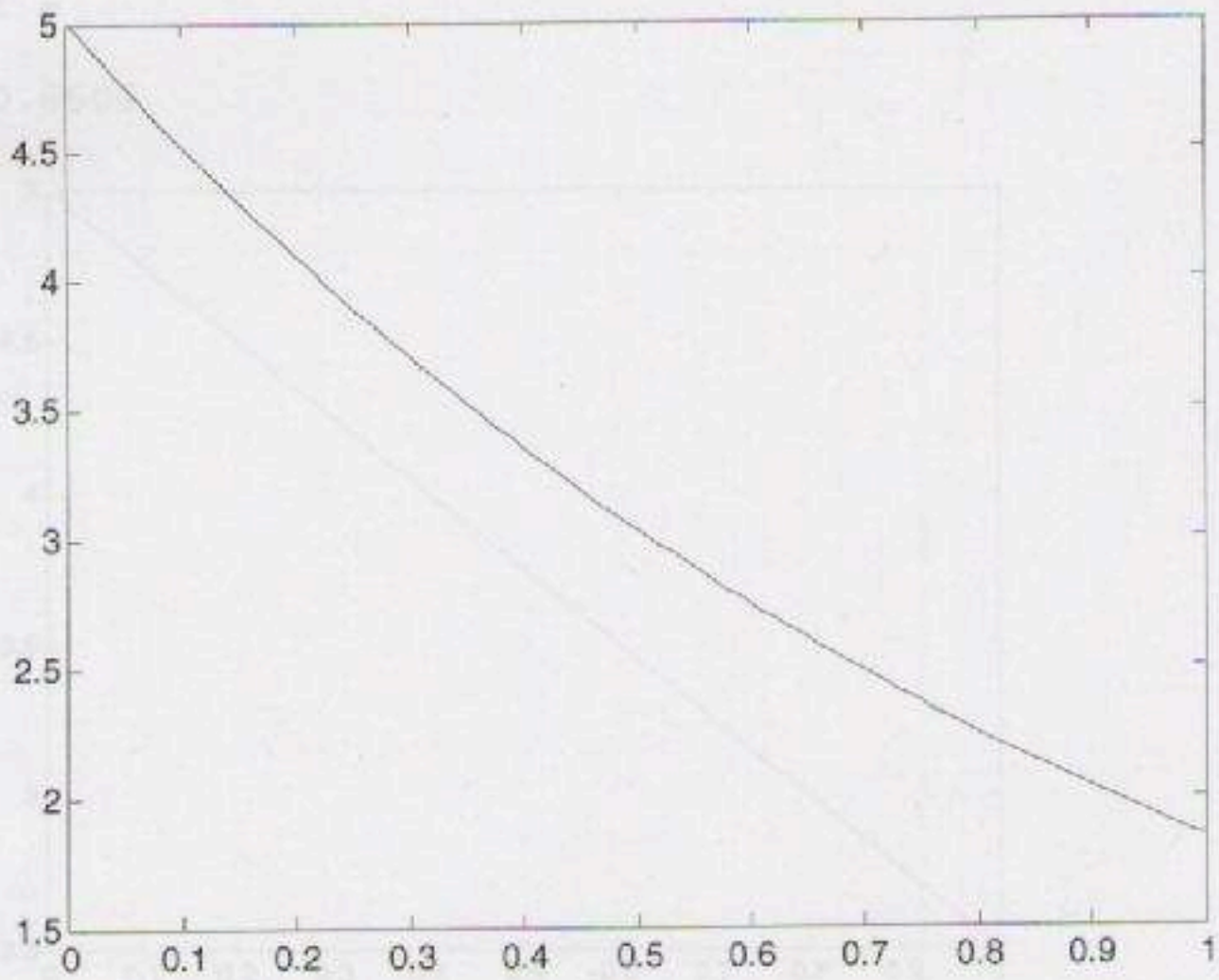
Midpoint Method:

For x(1)

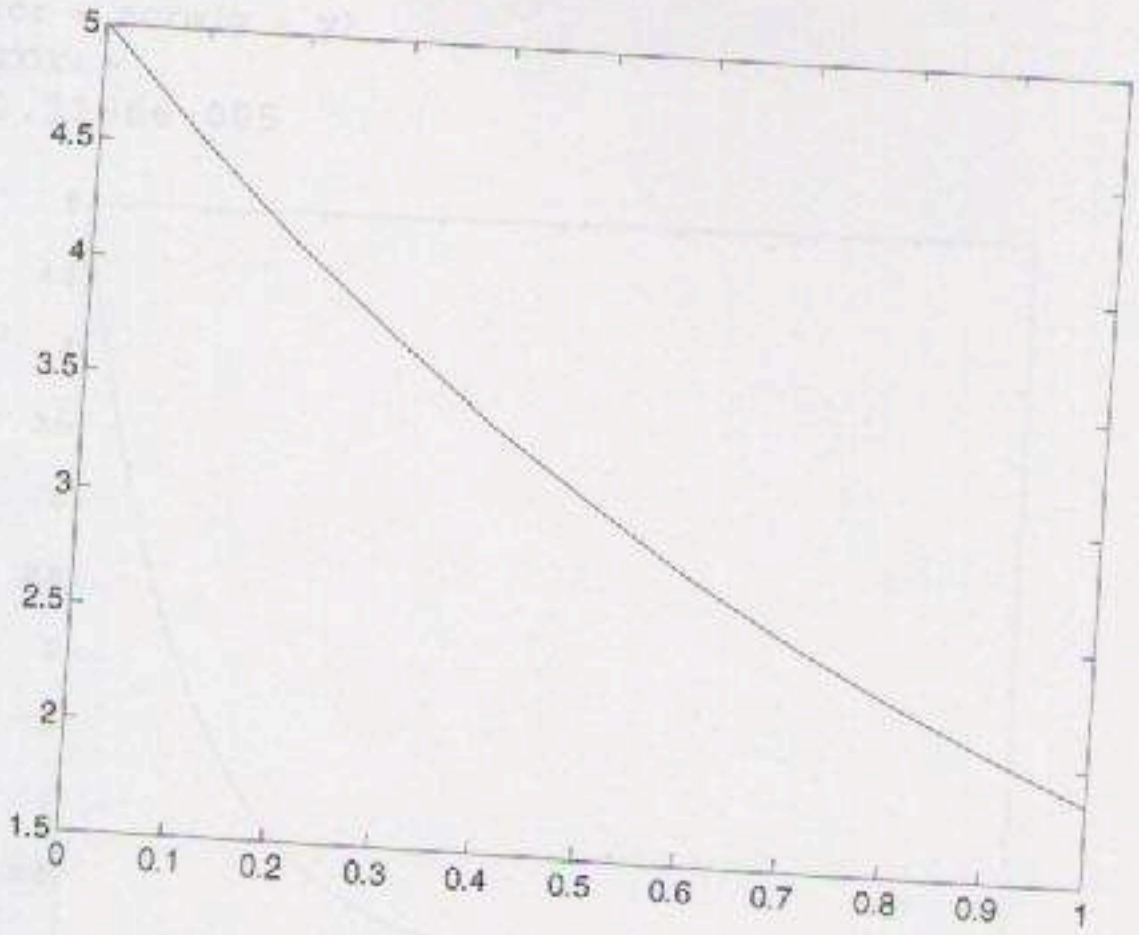
```
h = .001;
T = 1;
y = hw9_rk2(@func9, 0, 5, h, T);
t = 0: h: T;
g = 5*exp(-t);
error = norm(g - y)
error =

   7.5009e-006
```



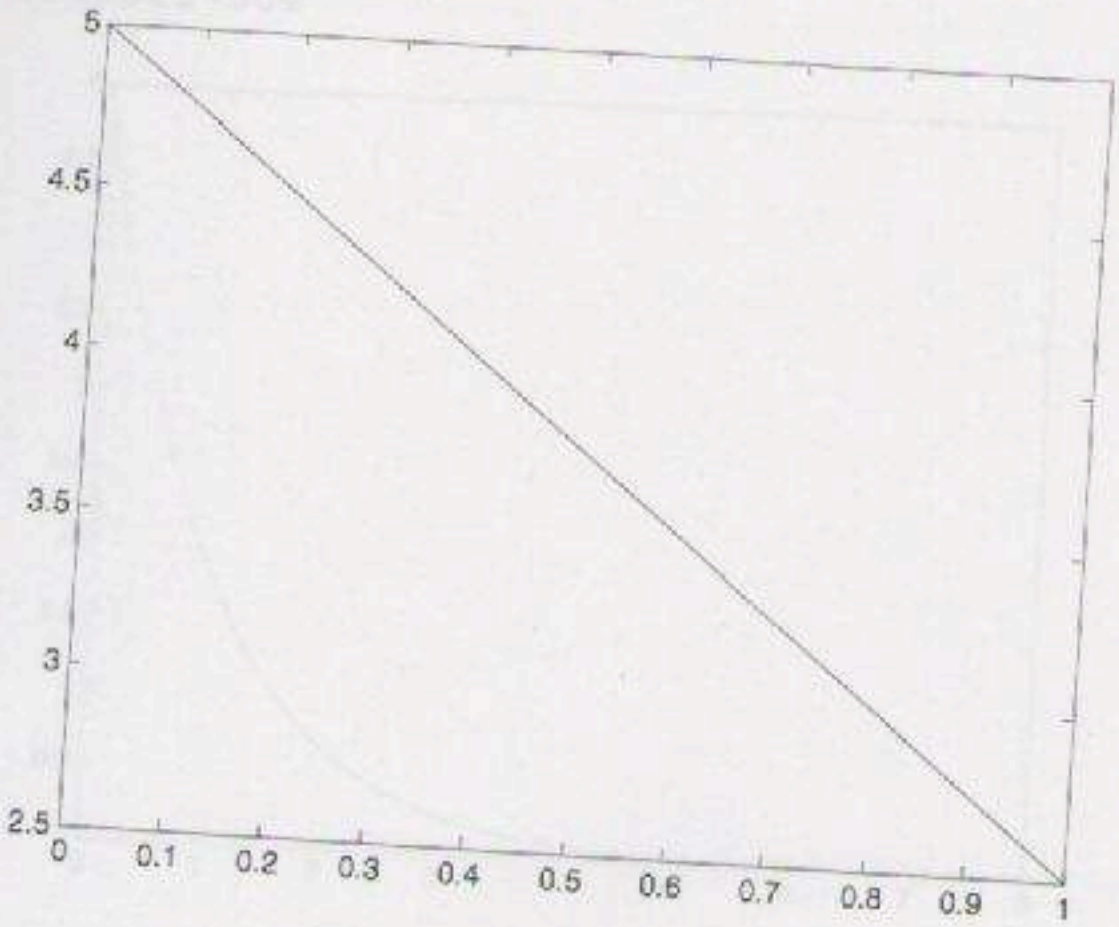

```
h = .01
error =

  2.3971e-004
```



```
h = .1
error =

    0.0084
```

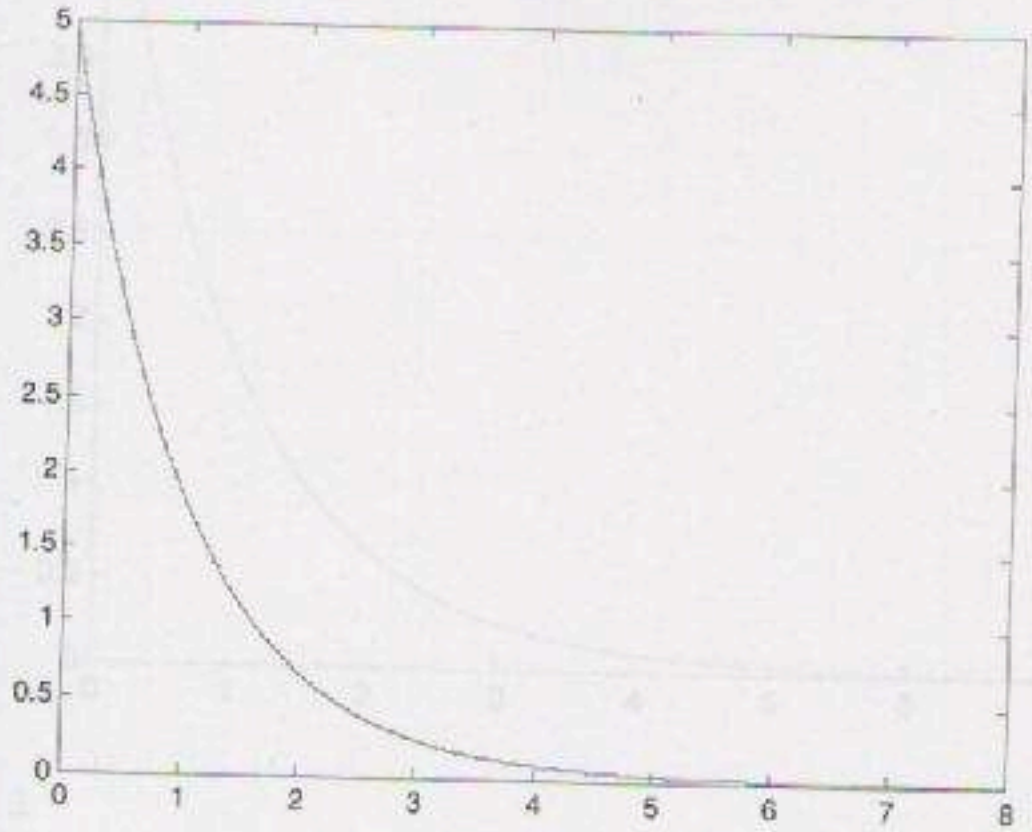



```
h = 1
error =

    0.6606
```

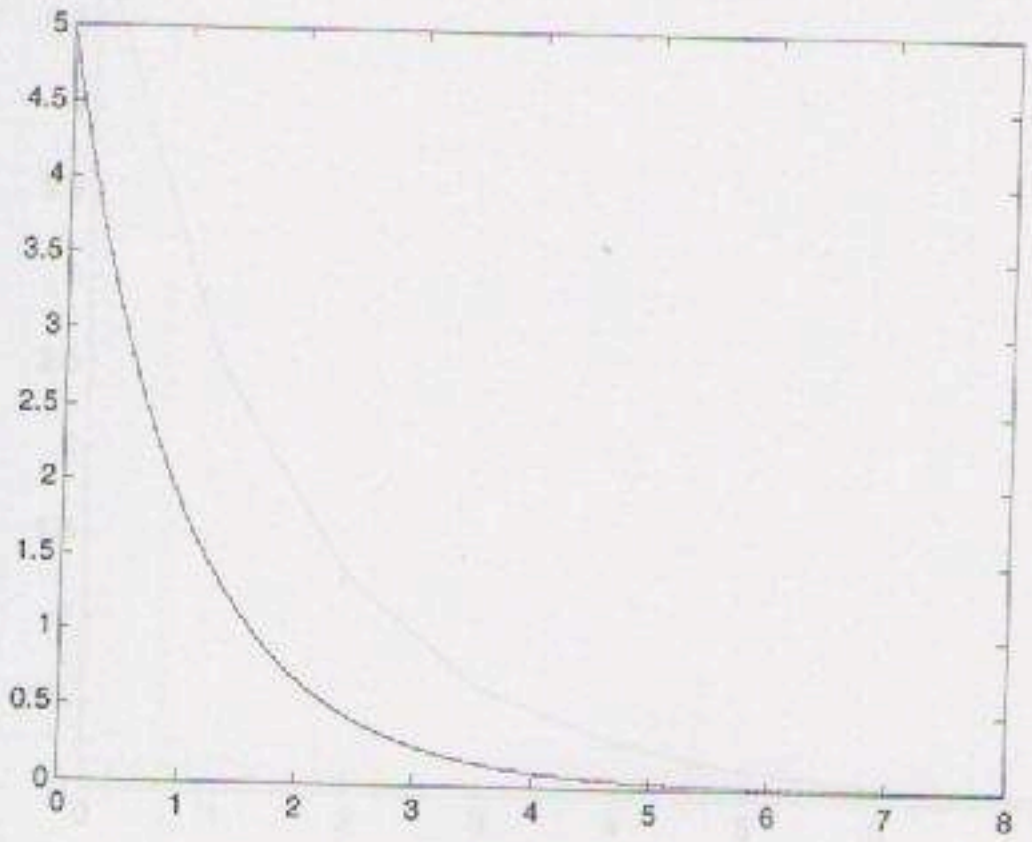


For x(8)

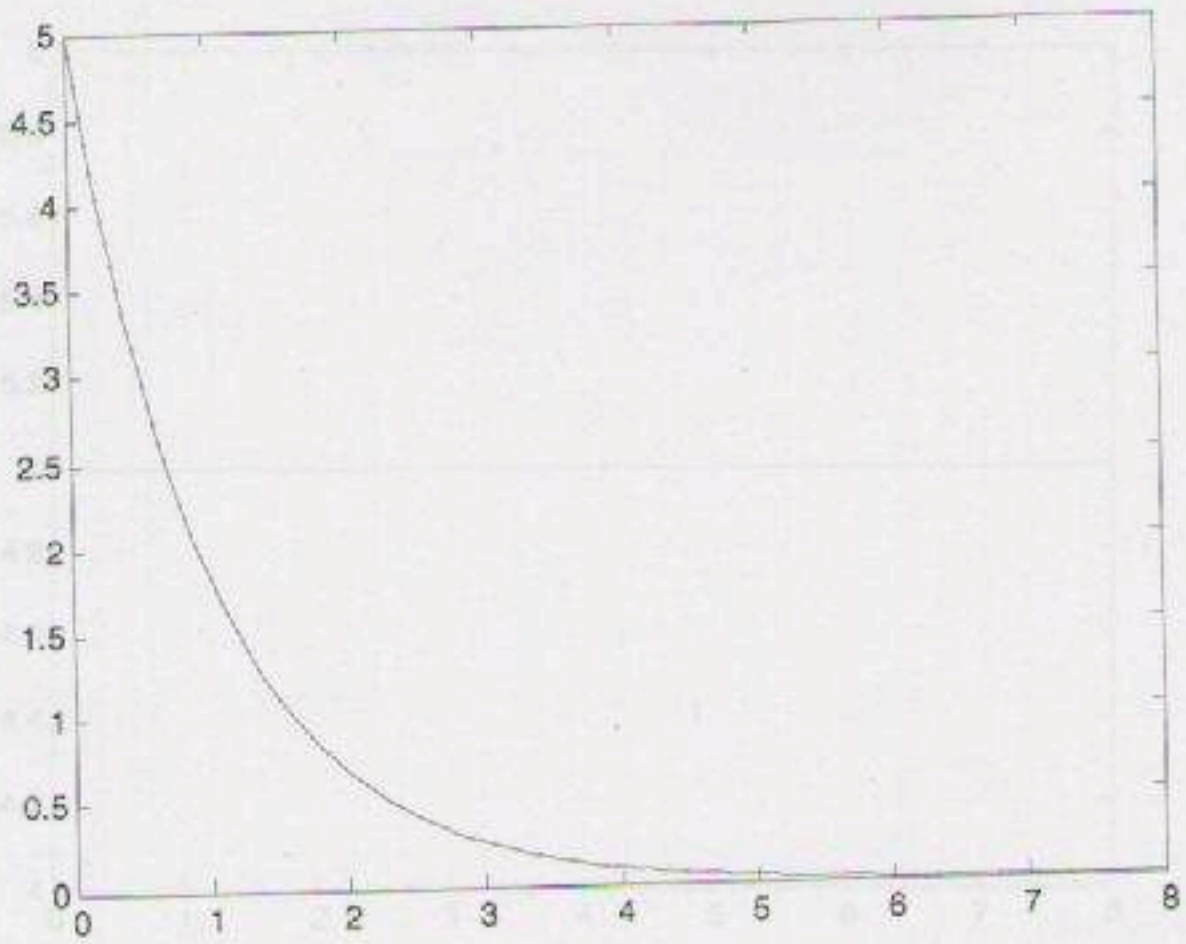
```
h = .001;
T = 8;
y = hw9_rk2(@func9, 0, 5, h, T);
t = 0: h: T;
g = 5*exp(-t);
error = norm(g - y)
error =
  1.3186e-005
```



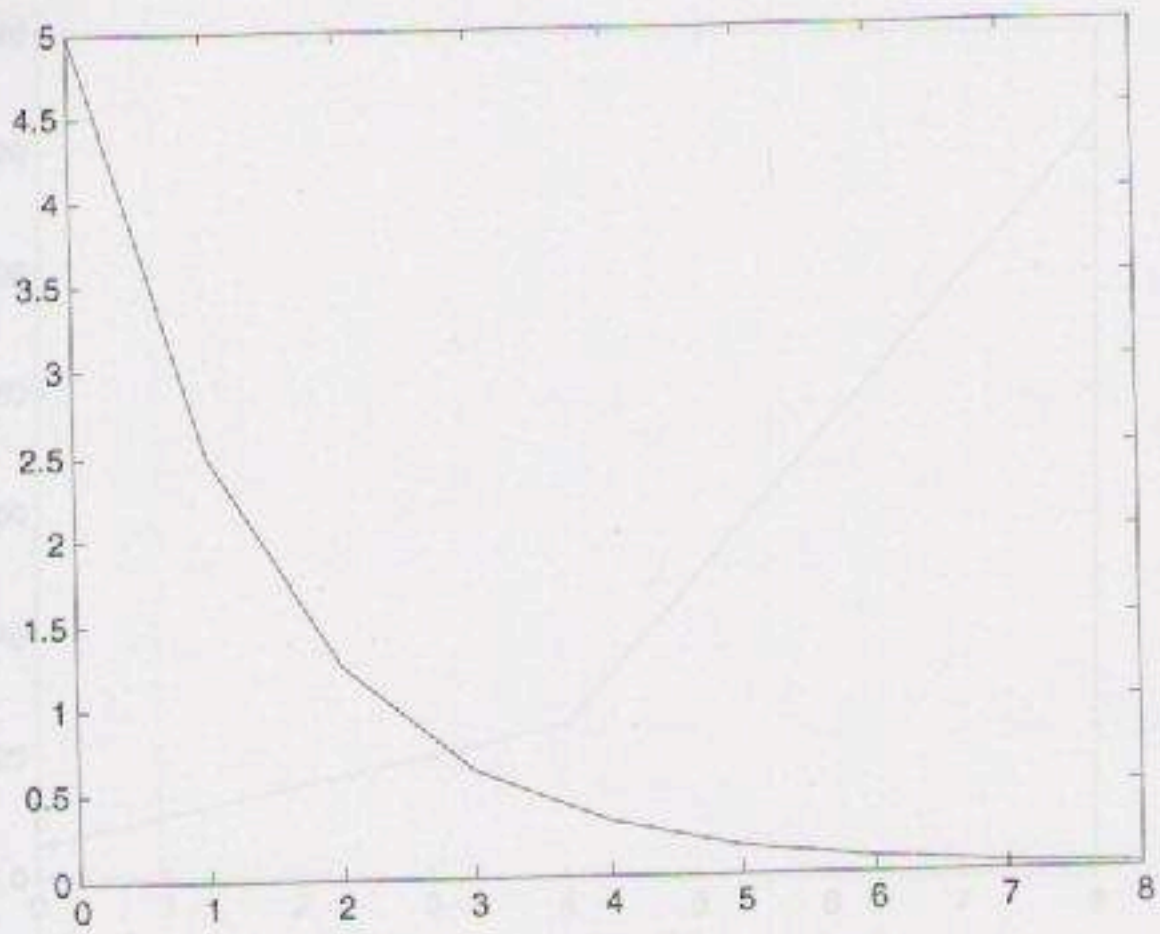

```
h = .01
error =
  4.1981e-004
```



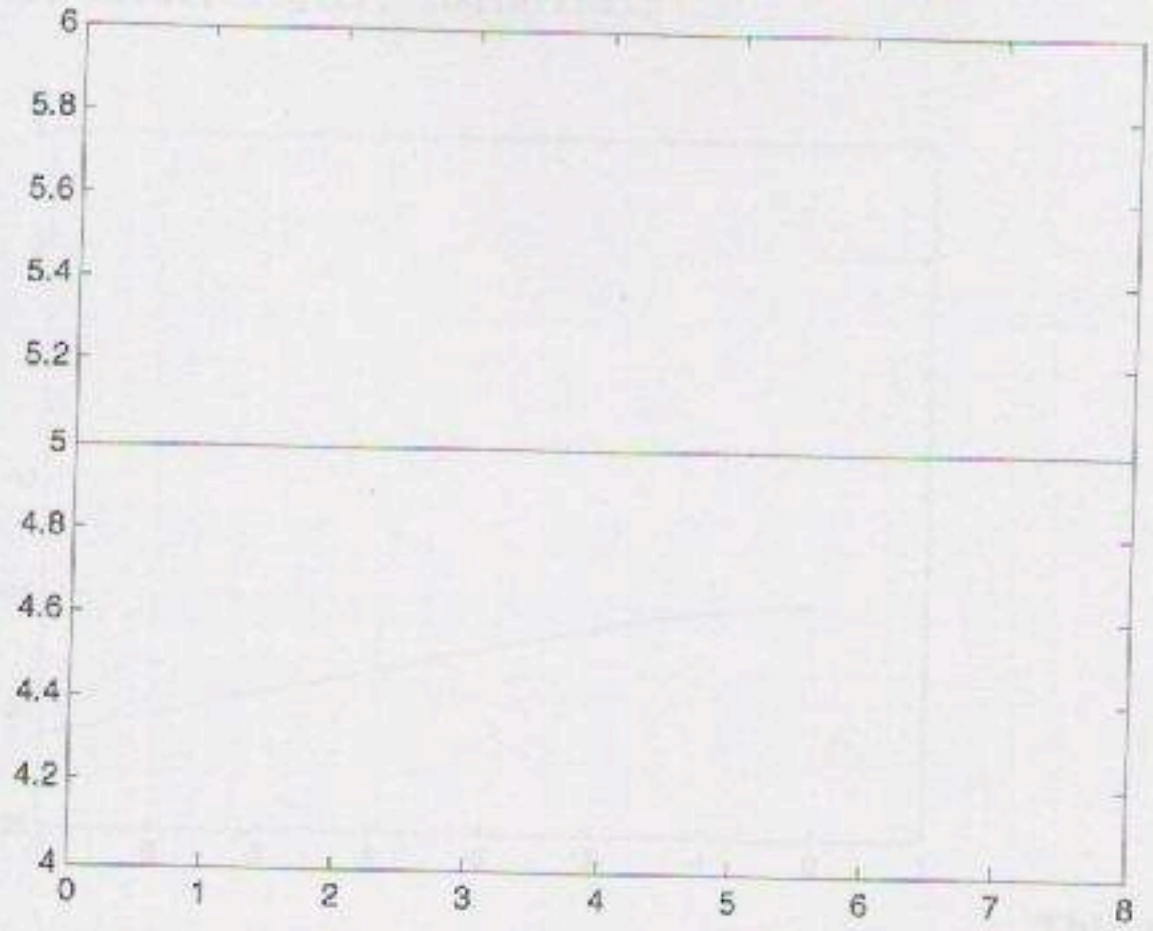
```
h = .1
error =
    0.0142
```



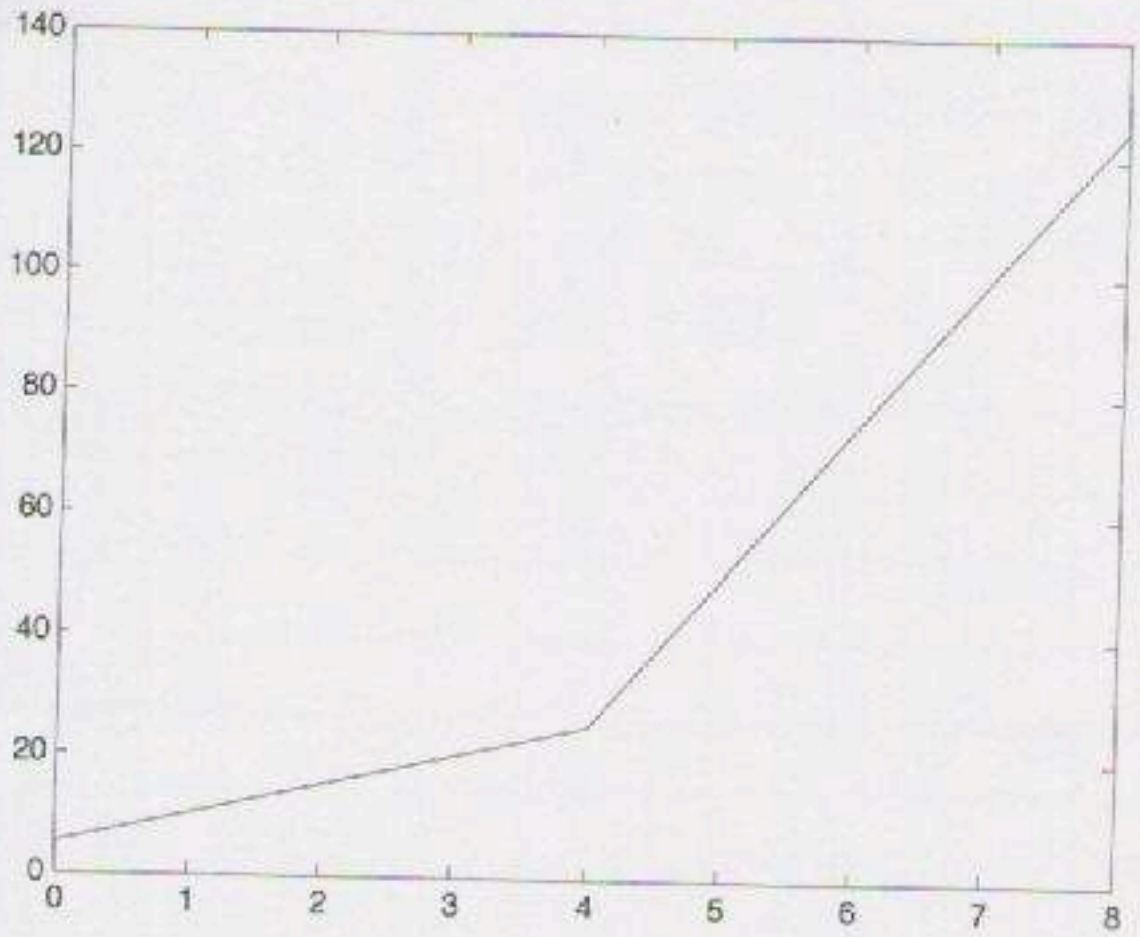

```
h = 1
error =
    0.9880
```



```
h = 2
error =
    9.6251
```

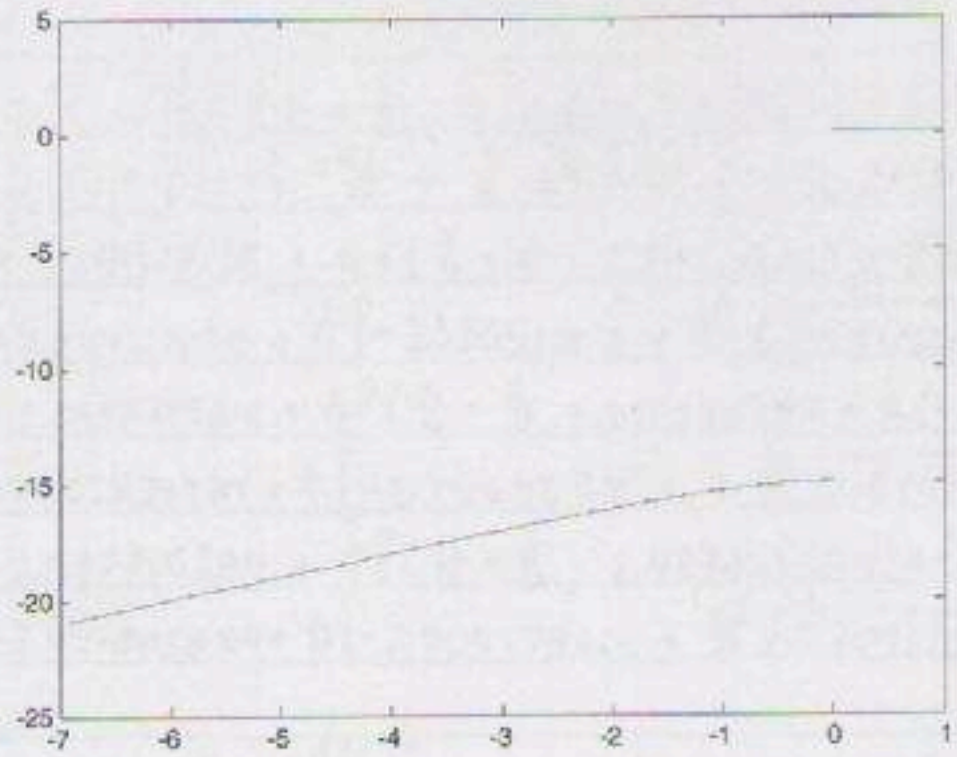



```
h =4
error =
 127.4559
```



Part b)

```
for j = 1: T/h +1
error(j) = norm(g(j) - y(j));
end;
plot(t, error, log(t), log(error))
```



This gave slope=1

AHH matlab crashed!

F

1)

```
function [t, y] = hw9_rk2(func, t0, x0, h, n)
y(1) = x0;
for i = 2:n+1;
    w = y(i-1) + (h/2)*func(y(i-1));
    y(i) = y(i-1) + h*func(w);
    t(i) = t0 + (i-1)*h;
end
y
plot(t,y)
return
```

2)

```
function [t, y] = hw9_rk4(func, t0, x0, h, n)
y(1) = x0;
for i = 2:n+1;
    k1 = h*func(y(i-1));
    k2 = h*func((y(i-1) + (1/2)*k1));
    k3 = h*func((y(i-1) + (1/2)*k2));
    k4 = h*func((y(i-1) + k3));
    y(i) = y(i-1) + (1/6)*(k1 + 2*k2 + 2*k3 + k4);
    t(i) = t0 + (i-1)*h;
end
y
plot(t,y)
return
```

3a) RK2

h=0.001; x(1) = 1.8394

h=0.01; x(1) = 1.8394

h=0.1; x(1) = 1.8427

h=1; x(1) = 2.5

h=0.001; x(8) = 0.0017

h=0.01; x(8) = 0.0017

h=0.1; x(8) = 0.0017

h=1; x(8) = 0.195

h=2; x(8) = 5

h=4; x(8) = 125

RK4

h=0.001; x(1) = 1.8394

h=0.01; x(1) = 1.8394

h=0.1; x(1) = 1.8394

h=1; x(1) = 1.875

h=0.001; x(8) = 0.0017

h=0.01; x(8) = 0.0017

h=0.1; x(8) = 0.0017

h=1; x(8) = 0.002

h=2; x(8) = 0.0617

h=4; x(8) = 125

G

1.

```
function [x] = hw9_rk2(tnot,xnot,h,T)
% clear all
% clc
% T = 8;
% xnot =5;
% tnot = 0;
% h = 1;
t =  tnot:h:T;
x = zeros(1,max(size(t)));
x(1) = xnot;
for ii = 2:max(size(t))
   x(ii) = x(ii-1) + h*hw8_func(t(ii-1) + h/2,x(ii-1) + (h/
2)*hw8_func(t(ii-1),x(ii-1)));
end
% g = 5*exp(-t);
% norm(g-x)
```

2.

```
function [x] = hw9_rk4(tnot,xnot,h,T)
func = @hw8_func;
% T = 1;
% h = .001;
% tnot = 0;
% xnot = 5;
x(1) = xnot;
t = tnot:h:T;
for ii = 2:(max(size(t)))
k1 = h*func(t(ii-1),x(ii-1));
k2 = h*func(t(ii-1) +h/2, x(ii-1) + .5*k1);
```

```
k3 = h*func(t(ii-1) + h/2, x(ii-1) + .5*k2);
k4 = h*func(t(ii), x(ii-1) + k3);
x(ii) = x(ii-1) + (k1 + 2*k2 + 2*k3 + k4)/6;
end
```

3.
a)
For RK2:

```
function [xk] = calcrk2(T,h)
tnot = 0;
xnot = 5;
x = hw9_rk2(tnot,xnot,h,T);
xk = x(end);
```

```
>> calcrk2(1,.001)

ans =

   1.8394

>> calcrk2(1,.01)

ans =

   1.8394

>> calcrk2(1,.1)

ans =

   1.8427

>> calcrk2(1,1)

ans =

   2.5000

>> calcrk2(8,.001)
```

```
ans =

   0.0017

>> calcrk2(8,.01)

ans =

   0.0017

>> calcrk2(8,.1)

ans =

   0.0017

>> calcrk2(8,1)

ans =

   0.0195

>> calcrk2(8,2)

ans =

    5

>> calcrk2(8,4)

ans =

   125
```

for RK4

```
function [xk] = calcrk4(T,h)
tnot = 0;
xnot = 5;
x = hw9_rk4(tnot,xnot,h,T);
xk = x(end);
```

```
>> calcrk4(1,.001)
```

```
ans =

  1.839397205857228

>> calcrk4(1,.01)

ans =

  1.839397206011777

>> calcrk4(1,.1)

ans =

  1.839398872062492

>> calcrk4(1,1)

ans =

  1.875000000000000


>> calcrk4(8,.001)

ans =

  0.001677313139513

>> calcrk4(8,.01)

ans =

  0.001677313140640

>> calcrk4(8,.1)

ans =

  0.001677325294611

>> calcrk4(8,1)

ans =
```

```
0.0019553303718 57

>> calcrk4(8,2)

ans =

0.061728395061728

>> calcrk4(8,4)

ans =

125
```

b)

For RK2

```
clear all
clc
n = 1000;
T = 8;
tnot = 0;
xnot = 5;
hold on
h = linspace(.001,1,n);
for jj = 1:n;
    t = tnot:h(jj):T;
    g = 5*exp(-t);
    x = hw9_rk2(tnot, xnot, h(jj),T);
    err(jj) = norm(g-x);
end
plot(h,err,log(h),log(err))

>> m = log(err(10)) - log(err(9));
```

```
>> m = m/(log(h(10))-log(h(9)))

m =

   1.507145520173076
```

since RK2 is supposed to be of O(h^2) this is not expected, since this slope m tells us the RK2 converges at a rate O(h^m). This could have happened a, becuase of some minor error in the code, or b, because the function f(t,y) was not best suited to be dealt with using RK2.

For RK4

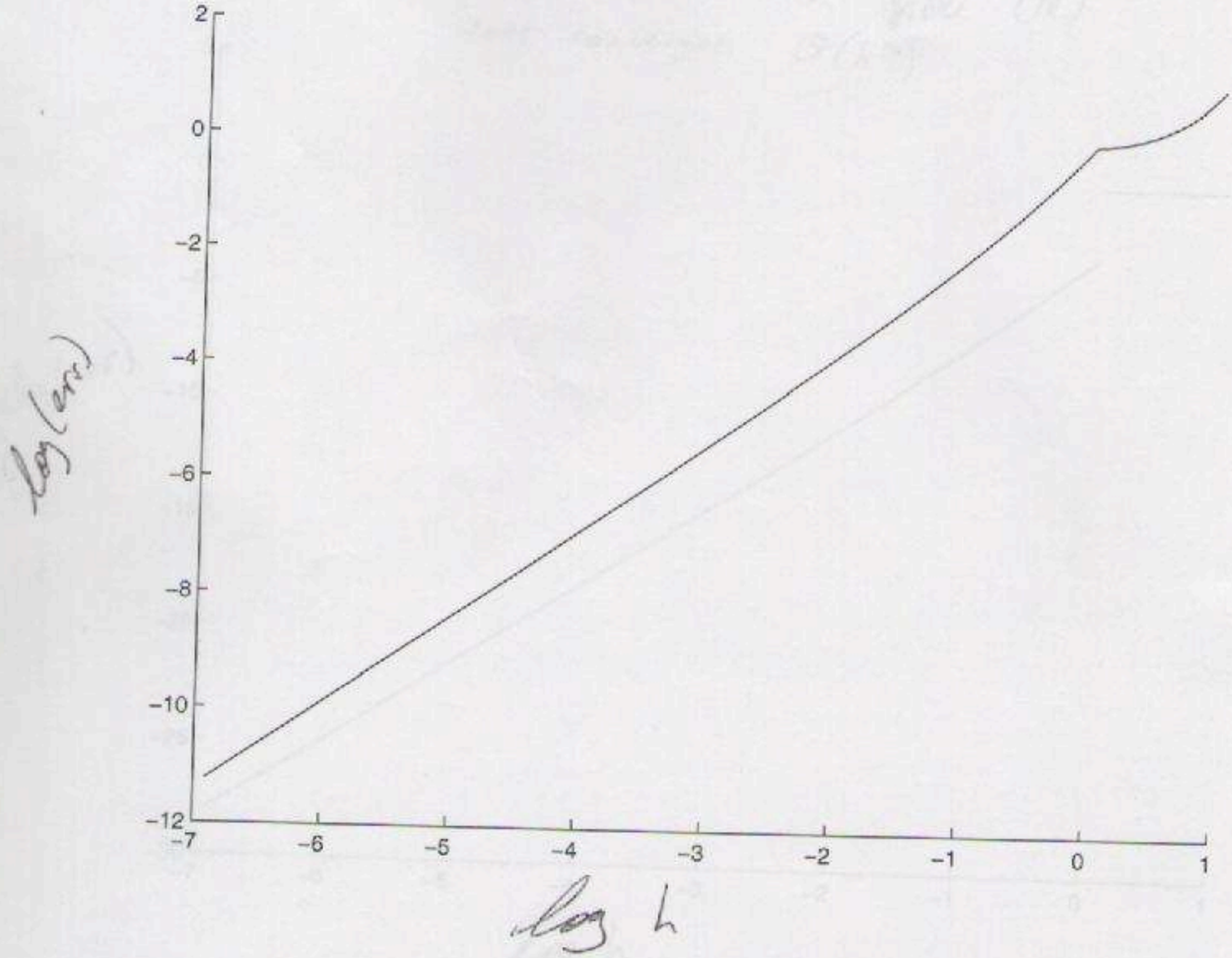
```
clear all
clc
n = 1000;
T = 8;
tnot = 0;
xnot = 5;
hold on
h = linspace(.001,1,n);
for jj = 1:n;
    t = tnot:h(jj):T;
    g = 5*exp(-t);
    x = hw9_rk4(tnot, xnot, h(jj),T);
    err(jj) = norm(g-x);
end
plot(h,err,log(h),log(err))

>> m = log(err(10))-log(err(9));
>> m = m/(log(h(10))-log(h(9)))

m =

   3.507799347157688
```

Similar case here as before. I expect this slope to be closer to 4 since RK4

converges of O(h^4). It seems that whatever mistake has carried over (for RK2 the difference between expected and actual power p from the O(h^p) was about .5 for both), which makes me think that this is happening based on the given function f(t,y not my code.

Order of Convergence for RK2

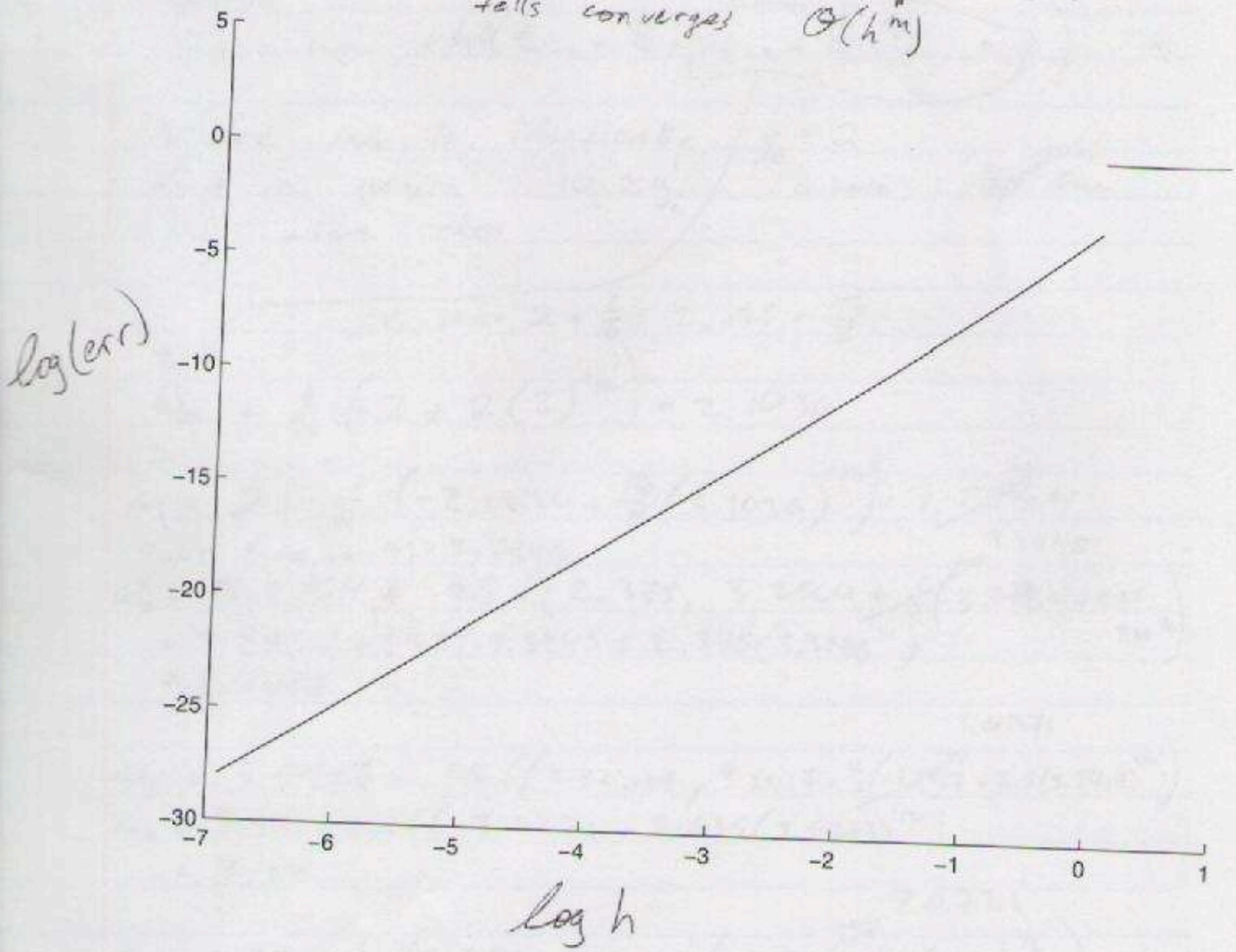
Slope of this line (m) tells that RK2 converges $\Theta(h^m)$



Order of Convergence for RKH

Slope of this line (m)

tells converges $O(h^m)$



8.2 Student Work: PLO 2 Embedded Exam Questions

Exam Student A

4) Differentiation

Consider the differentiation formula

$$f'(x_0) \approx \frac{-3/2\, f(x_0) + 2 f(x_0+h) - 1/2\, f(x_0+2h)}{h}$$

A.) Determine the order (exponent of h) of this formula.

$f(x) = 1 \quad f'(x) = 0$

$f'(0) = \frac{-3/2 + 2 - 1/2}{h} = \frac{0}{h} = 0$ consistent go on

$f(x) = x \quad f'(x) = 1$

$f'(0) = \frac{2h - h}{h} = \frac{h}{h} = 1$ consistent go on

$f(x) = x^2 \quad f'(x) = 2x$

$f'(0) = \frac{2h^2 - 2h^2}{h} = 0$ not consistent

$\Rightarrow$ $\boxed{\text{order } \alpha \leq 1}$

B.)

$h = .1 \quad D_{.1} = 4.11$

$h = .2 \quad D_{.2} = 4.25$

$M_{.1} = 4.11 + O(h/2)$

$M_{.2} = 4.25 \quad O(h/2)^2$

$M_{h/2} = M_{exact} + O(h/2)$

$M_{h/4} = M_{exact} + O(h/2)$

$$\frac{|I - I_{.2}|}{|I - I_{.1}|} = \frac{(1/5)^4}{(1/10)^4} = 2^4 = 16$$

$16|I - I_{.1}| = |I - I_{.2}|$

$16I - 64.5 = I - 4.25$

$I = \frac{60.3}{15.0} \approx 4.00$

$|4.00 - 4.11| = \boxed{.11}$

Exam Student B

Problem 3

c) $S_2''(1) = 4 \Rightarrow S_2''(1) \neq S_1''(1)$

Cubic Spline is not valid.

Problem 4

a) Taylor Series: $f(x_0) = \sum_{n=0}^{\infty} \frac{f^n(x_0)}{n!}(x-x_0)^n = f(x_0) + \frac{f'(x_0)}{1!} + \dots$

$= f(x_0)$

$f(x_0+h) = \sum_{n=0}^{\infty} \frac{f^n(x_0)}{n!}(x-(x_0+h))^n = f(x_0) + \frac{f'(x_0)}{1!}(x \dots + \dots$

$= f(x_0) + \frac{f'(x_0)}{1!}(-h) + \frac{f''(x_0)}{2!}(h^2) + \dots$

$f(x_0+2h) = f(x_0) + \frac{f'(x_0)}{1!}(-2h) + \frac{f''(x_0)}{2!}(4h^2) + \dots$

Plug in: $\frac{-3/2 f(x_0) + 2\left[f(x_0) + \frac{f'(x_0)}{1!}(-h) + \dots\right] - \frac{1}{2}\left[\dots\right]}{h}$

$h^2 - (2h^2) = -h^2$

$\approx f'(x_0) \approx \frac{\frac{f'(x_0)}{1!}(-\cancel{h}) + \frac{f''(x_0)}{2!}(-\cancel{h}^2) + \dots}{\cancel{h}}$

$\approx \frac{f'(x_0)}{1!} - \frac{f''(x_0)(h)}{2!} + \dots$

$\boxed{\text{Order: } O(h)}$

b) $h = 0.1$ $\quad h = 0.2$

$D_{0.1} = 4.11$ $\quad D_{0.2} = 4.25$

Absolute error: $|D_{0.2} - D_{0.1}| \approx |4.25 - 4.11| \approx .14$

$|h_2 - h_1| = |0.2 - 0.1| = 0.1$

Problem 5

a) $\int_{-h}^{h} f(x)\,dx = h[f(h/2) + f(-h/2)] + \text{error}$

$f(x) = x^2 \Rightarrow \int_{-h}^{h} f(x)dx = h\left[\left(\frac{h}{2}\right)^2 + \left(-\frac{h}{2}\right)^2\right] + \text{error}$

b)

Exame Student C

4 if $O(h^2)$ then $f(x)=x$ should be solved exactly.

$$f'(x_0) = \frac{-\frac{3}{2}(x_0) + 2(x_0+h) - \frac{1}{2}(x_0+2h)}{h}$$

$$= \frac{-\frac{3}{2}x_0 + 2x_0 + 2h - \frac{1}{2}x_0 - h}{h} = \frac{-2x_0 + 2x_0 + 2h - h}{h} = 1$$

if $O(h^3)$ it should solve $f(x)=x^2$ exactly

$$f'(x_0) = \frac{-\frac{3}{2}(x_0)^2 + 2(x_0+h)^2 - \frac{1}{2}(x_0+2h)^2}{h}$$

$$= \frac{\left[-\frac{3}{2}x_0^2 + 2(x_0^2 + 2x_0h + h^2) - \frac{1}{2}(x_0^2 + 4x_0h + 4h^2)\right]}{h}$$

$$= \frac{\left[-\cancel{\frac{3}{2}x_0^2} + \cancel{2x_0^2} + \cancel{4x_0h} + \cancel{2h^2} - \cancel{\frac{1}{2}x_0^2} - \cancel{2x_0h} - \cancel{2h^2}\right]}{h}$$

$$\left[-\cancel{2x_0^2} + 2x_0^2 + 2x_0h\right]\frac{1}{h} = 2x_0$$

if $O(h^4)$ then $f(x)=(x-h)^3$ should be exact

$$\frac{-\frac{3}{2}(x_0-h)^3 + 2(x)^3 - \frac{1}{2}(x_0+h)^3}{h}$$

$$= \frac{-\frac{3}{2}(x_0^3 - 3x_0^2h + 3x_0h^2 - h^3) + 2x_0^3 - \frac{1}{2}(x_0^3 + 3x_0^2h + 3x_0h^2 + h^3)}{h}$$

$$\frac{-\frac{3}{2}(x_0^3 - 3x_0^2h + 3x_0h^2 - h^3 - x_0^3 - \cancel{(x_0^3 + 3x_0^2h + 3x_0h^2 + x_0^3h + 2x_0h^3}}{}$$

$$\cancel{-2x_0 - 3x_0^2h - \frac{3}{2}h^2 x_0 + \frac{3}{2}x_0h^2 - \frac{1}{2}h^3 + 2x_0^3 - \frac{1}{2}h - \frac{1}{2}x_0^2 - x_0h^2 - x_0h^3}$$

$$= \frac{\frac{1}{2}h^3 - 3x_0^2h + 2x_0h^2}{h} = \frac{1}{2}h^2 - 3x_0^2 + 2x_0h \quad \times$$

they are not equal $O(h^4)$ $f'(x) = 3(x-h)^2 = 3(x^2 - 2xh - h^2) = 3x^2$

4.b $h = .1$

$A = D_{0.1} + \mathcal{O}(h^3)\left(\frac{1}{2}\right)^3$ $\qquad \frac{2}{10} \cdot \frac{1}{8} = \frac{1}{10}$

$A = D_{0.2} + \mathcal{O}(h^3)$

$8A - A = 8D_{0.1} + \mathcal{O}(h^3) - D_{0.2} - \mathcal{O}(h^3)$

$8A - A = 8(D_{0.1}) - D_{0.2})$

$7A = 8D_{0.1} - D_{0.2}$

$A = \frac{8D_{0.1} - D_{0.2}}{7}$

$A = \frac{8(4.11) - 4.25}{7}$

$\frac{8(4.11) - 4.25}{7} = 4.11 - E_{0.1}$

$E_{0.1} = 4.11 - \frac{8(4.11) - 4.25}{7}$

Exam Student D

3. a) $f(x) = \dfrac{x(x-1)(x-2)}{3(3-1)(3-2)}$

$= \dfrac{x(x-1)(x-2)}{6}$

b) $f(x) = L_0 + L_1 + L_2 + L_4$

$= \dfrac{32 \cdot (x-1)(x-2)(x-3)}{(-1)(-2)(-3)}$

$+ \dfrac{(-3)(x)(x-2)(x-3)}{1 \cdot (1-2)(1-3)}$

$+ 0$

$+ \dfrac{41 \cdot (x)(x-1)(x-2)}{3 \cdot (3-1)(3-2)}$

And that's how we do it in the hood.

c) $S_1(1) = 1$, $S_2(1) = 1$ ✓

$S_1'(1) = 3$, $S_2'(1) = 3$ ✓

$S_1''(1) = 6$, $S_2''(1) = 4$ ✗

$S_1''(1)$ & $S_2''(1)$ do not match up, $f(x)$ is not twice differentiable. ✓

4. a) $f(x) = x^2 \rightarrow f'(1) = 2$

$f'(1) = \dfrac{-3/2\,(1) + 2(1+h)^2 - 1/2\,(1+2h)^2}{h}$

$= \dfrac{-3/2 + 2(1+2h+h^2) - 1/2\,(1+4h+4h^2)}{h}$

$= \dfrac{\cancel{-3/2} + 2 + 4h + 2h^2 - 1/2 - 2h - 2h^2}{h}$

$= \dfrac{2h}{h} = 2$ ✓

$\boxed{\text{The method is of order 2}}$

b) $A = D_{0.1} + \left(\frac{h}{2}\right)^3$

$A = D_{0.2} + (h)^3$

$4.11 + \frac{h^3}{8} = 4.25 + h^3$

$\frac{.04}{8} = \boxed{.005}$

5. a) The highest order is one.

$\int_{-h}^{h} x \, dx = h\left(\frac{h}{2} - \frac{h}{2}\right) = 0$ ✓

$\int_{-h}^{h} x^2 dx = \frac{h^3}{3} - \frac{h^3}{3} \neq \frac{h^3}{3}$ ✗

b) error $= O(h^2)$

Exame Student E

4) a. $f'(x_0) \approx \dfrac{-3/2\ f(x_0) + 2\ f(x_0+h) - 1/2\ f(x_0+2h)}{h}$

$$\frac{-3/2\ x_0 + 2(x_0+h) - 1/2\,(x_0+2h)}{h} = \frac{-3/2\,x_0 + 2x_0 + h - 1/2\ x_0 - h}{h}$$

$$= 0$$

$$\frac{-3/2\ x_0^2 + 2(x_0+h)^2 - 1/2\,(x_0+2h)^2}{h} = \frac{-3/2\,x_0^2 + 2(x_0^2+2hx_0+h^2) - 1/2\,(x_0^2+4hx_0+4h^2)}{h}$$

$$= \frac{\cancel{-3/2\,x_0^2 + 2x_0^2} + 4hx_0 + \cancel{2h^2} \cancel{-1/2\,x_0^2} - 2hx_0 - \cancel{2h^2}}{h}$$

$$= \frac{2hx_0}{h}$$

$\boxed{\text{order} = 1}$

b. $D_{0.1} = 4.11$ $\quad E_{0.1} = D - D_{0.1} = D - 4.11$

$D_{0.2} = 4.25$ $\quad E_{0.2} = D - D_{0.2} = D - 4.25$

$$\frac{|E_{0.1}|}{|E_{0.2}|} = \frac{|D-4.11|}{|D-4.25|} = \frac{|0.1|^3}{|0.2|^3} = \left|\tfrac{1}{2}\right|^3 = \frac{1}{8}$$

$$8(D-4.11) = D - 4.25$$

$$8D - 32.88 = D - 4.25$$

$$7D = 28.63$$

$$D = 4.09$$

$$E_{0.1} = 4.09 - 4.11$$

$$\boxed{E_{0.1} = -.02}$$

$$\begin{array}{r} -4.11 \\ \underline{\ \ 8} \\ 32.88 \end{array}$$

$$\begin{array}{r} 2\ 8\ 2.88 \\ -\ 4.25 \\ \hline 28.63 \end{array}$$

$$\begin{array}{r} 4.09 \\ 1\overline{)28.63} \\ -28 \\ \hline 06 \\ -0 \\ \hline 63 \\ -63 \\ \hline 0 \end{array}$$

Exam student F

Problem 4

$$f'(x_0) = \frac{-\frac{3}{2} f(x_0) + 2 f(x_0+h) - \frac{1}{2} f(x_0+2h)}{h}$$

a) Remainder method

$$R_n = \frac{f^{(n+1)}(\xi)}{(n+1)!}(x-x_0)^{n+1} \qquad \max f(\xi) \text{ when } \xi =$$

hmm.. not sure how this works

okay $\lim_{h \to \infty} \frac{2h - \frac{1}{2}(2h)}{h} = \frac{h}{h} = 1$ so the order $= \boxed{1}$?

b) Richardson's extrapolation

$$M_{exact} = M_h + K(h)^{\alpha} \qquad \alpha = 3$$

$$M_{exact} = M_{h/2} + K\left(\frac{1}{h}\right)^{\alpha}$$

$$\left(M = 4.11 + K\left(\frac{1}{10}\right)^3\right) - \left(2^3\right)$$

$$M = 4.25 + K\left(\frac{2}{10}\right)^3$$

$$M - 8M = 4.25 - 8(4.11) \qquad M(1-8) = 4.25 - 32.88$$

$$M = \frac{4.25 - 32.88}{-7}$$

$$\begin{array}{r} 4.11 \\ \times\ 8 \\ \hline 32.88 \end{array}$$

Now $\frac{4.25 - 32.88}{-7} = 4.25 + \text{error}$

$$\text{error} = \frac{4.25 - 32.88}{-7} - 4.25$$

Exam Student G

(4) a) works up to x^2 so error $= h^3$

$f(x) = 1$

$f'(x) = 0$ $\quad \dfrac{-\frac{3}{2} + 2 - \frac{1}{2}}{h} = 0$

$f(x) = x$

$f'(x) = 1$

$$\frac{-\frac{3}{2}x_0 + 2(x_0+h) - \frac{1}{2}(x_0-2h)}{h}$$

$$\frac{\cancel{-\frac{3}{2}x_0} + \cancel{2x_0} + 2h - \cancel{\frac{1}{2}x_0} - h}{h} = \frac{h}{h} = 1$$

$f(x) = x^2$

$f'(x) = 2x$

$$\frac{-\frac{3}{2}x_0^2 + 2(x_0+h)^2 - \frac{1}{2}(x_0-2h)^2}{h}$$

$$\frac{\cancel{-\frac{3}{2}x_0^2} + \cancel{2x_0^2} + 4x_0h + \cancel{2h^2} - \cancel{\frac{1}{2}x_0^2} - 2x_0h - \cancel{2h^2}}{h}$$

$$\frac{2x_0\cancel{h}}{\cancel{h}}$$

$x_0^2 + 2x_0h + h^2$

$(x_0+2h)(x_0+2h)$

$x_0^2 + 4x_0h + 4h^2$

$f(x) = x^3$

$f'(x) = 3x^2$

$$\frac{-\frac{3}{2}x_0^3 + 2(x_0+h)^3 - \frac{1}{2}(x_0-2h)^3}{h}$$

$$\frac{-\frac{3}{2}x_0^3 + \cancel{2x_0^3} + \cancel{6x_0^2h} + 6x_0h^2 + 2h^3 - \frac{1}{2}x_0^3 + 3x_0^2h - 6x_0h^2 - 4h^3}{h}$$

$3x_0^2h - 2h^3$

$h^2 \quad 3x_0^2$

$h(3x_0^2 - \ldots$

$x_0^2 + 2x_0h + h^2 \quad (x_0+h)$

$x_0^3 + \cancel{2x_0^2h} + \cancel{x_0^2h} + \cancel{2x_0h^2} + \cancel{x_0h^2} + h^3$

$(x_0^2 + 4x_0h + 4h^2)(x_0+2h)$

$x_0^3 + 4x_0^2h + 4x_0h^2 + 2x_0^2h + 8x_0h^2 + 8h^3$

Exam Student H

4. a) $f(x) = f(x_0) + f'(x_0)(x - x_0) + \frac{f''(x_0)(x-x_0)^2}{2}$

$-3/2\left(f(x_0) = f(x_0)\right)$

$2\left[f(x_0+h) = f(x_0) + f'(x_0)(h) + \frac{f''(x_0)h^2}{2} + \frac{f'''(\xi)h^3}{6}\right.$

$-\frac{1}{2}\left[f(x_0+2h) = f(x_0) + f'(x_0)(2h) + \frac{f''(x_0)4h^2}{2} + \frac{f'''(\xi)8h^3}{6}\right]$

$-\frac{3}{2}f(x_0) + 2f'(x_0) - \frac{1}{2}f(x_0) = 0$

$2f'(x_0)h - \frac{1}{2}f'(x_0)(2h) = f'(x_0)\cdot h$

$\frac{2\cdot f''(x_0)h^2}{2} - \frac{1}{2}\frac{f''(x_0)4h^2}{2}$

$f''(x_0)h^2 - f''(x_0)h^2 = 0$

$\frac{2\cdot f'''(\xi_0)h^3}{6} - \frac{1}{2}\frac{f'''(\xi_0)8h^3}{6}$

$\frac{f'''(\xi_0)h^3}{3} - \frac{2}{3}\frac{f'''(\xi_0)h^3}{1} = -\frac{1}{3}f'''(\xi_0)h^3$

all this crap $= 0 + f'(x_0)\cdot h + 0 - \frac{1}{3}f'''(\xi)\cdot h^3$

divide everything by h

$\Rightarrow f'(x_0) = \frac{-3/2\, f(x_0) + 2f(x_0+h) - \frac{1}{2}f(x_0+2h)}{h}$

$O\left(\frac{1}{3}f'''(\xi)h^2\right)$

b) $O(h^3)$

4.11 is actual answer

$$8\left[M = 4.11 + K\cdot(.1)^3\right]$$
$$-\quad M = 4.25 + K(.2)^3$$

$(.1)^3 = \left(\frac{1}{10}\right)^3 = \frac{1}{1000}$

$\frac{8}{1000}$

$$8M = 32.88 + K\cdot\frac{8}{1000}$$
$$-\quad M = 4.25 + K\cdot\frac{5}{1000}$$

$$\begin{array}{r} 32.88 \\ 4.25 \\ \hline 28.63 \end{array}$$

$$7M = 28.63$$
$$M = \frac{28.63}{7}$$

(not exact but more accurate)

$$\frac{28.63}{7} - 4.11 = \text{error from } h = .1$$

MADE
0 709

Exam Student I

4) Differentiation

Consider the differentiation formula

$$f'(x_0) \approx \frac{-3/2\, f(x_0) + 2 f(x_0+h) - 1/2\, f(x_0+2h)}{h}$$

A.) Determine the order (exponent of h) of this formula.

$f(x) = 1 \quad f'(x) = 0$

$f'(0) = \frac{-3/2 + 2 - 1/2}{h} = \frac{0}{h} = 0$ consistent go on

$f(x) = x \quad f'(x) = 1$

$f'(0) = \frac{2h - h}{h} = \frac{h}{h} = 1$ consistent go on

$f(x) = x^2 \quad f'(x) = 2x$

$f'(0) = \frac{2h^2 - 2h^2}{h} = 0$ not consistent

$\Rightarrow$ $\boxed{\text{order } \alpha \leq 1}$

B.)

$h = .1 \quad D_{.1} = 4.11$

$h = .2 \quad D_{.2} = 4.25$

$M_{.1} = 4.11 + O(h/2)$

$M_{.2} = 4.25 \quad O(h/2)^2$

$M_{h/2} = M_{exact} + O(h/2)$

$M_{h/2} = M_{exact} + O(h/2)$

$$\frac{|I - I_{.2}|}{|I - I_{.1}|} = \frac{(1/5)^4}{(1/10)^4} = 2^4 = 16$$

$16|I - I_{.1}| = |I - I_{.2}|$

$16I - 65 = I - 4.25$

$I = \frac{60.3}{15.0} \approx 4.00$

$|4.00 - 4.11| = \boxed{.11}$

Appendix 2: Assessment Rubric

Reviewer Initials: _____ **Code: _____**

	High Proficiency	Medium Proficiency	Low Proficiency
Comprehensiveness of Response	Addresses all aspects of the question completely and in depth using scientific descriptions and terminology. Level of detail well matched to question and scope of response.	May fail to address a few elements of the question, but includes appropriately detailed descriptions. Or, addresses all elements of the question but detail is somewhat limited.	Addresses few to no elements of the question; does not answer what was asked.
Composition	Narrative is organized with appropriate paragraphing and topic sentences and is focused and concise. Assertions are supported by relevant and specific examples as appropriate. Connections between assertions and supporting examples are direct and explicit.	Mostly focused with use of topic sentences and paragraphing as appropriate. Most assertions are supported with relevant examples as appropriate. Occasionally, a supporting example may seem inappropriate or its connection to an assertion unclear.	Narrative lacks focus and appropriate paragraphing. Lists rather than composes. Fails to support assertions with examples as needed or examples do not seem connected to assertions.
Professional Communication or Sense of Audience	Sufficiently legible so that text easily read and interpreted. Able to focus on quality of narrative rather than deciphering words. Minimal spelling errors.	Legible but sloppy so as to mildly distract reader from attending to content of narrative. Some text difficult to decipher. Some spelling errors.	Response illegible. Carelessly crafted.
Synthesis/Integration	Narrative explicitly connects all elements of the response to each other and to the question being addressed. No extraneous information.	Narrative slightly disjointed in that relationships of response elements to each other and/or to the question are occasionally unclear. Appears to include some extraneous information.	Collection of assertions or facts that are not related to each other or to the question being addressed.
Scientific Accuracy/Vocabulary	Assertions constitute biologically accurate responses to the question. Consistently uses appropriate and precise scientific vocabulary and language to describe biological processes, structures and concepts. Narrative illustrates command of biological concepts and the facts supporting those concepts. Is biologically logical.	Almost all assertions constitute biologically accurate responses to question. Mostly uses appropriate biological terms and language to describe concepts and processes to show accurate knowledge of concepts and supporting facts. Rarely describes biological phenomena using general, vague or metaphorical statements or everyday language. Occasional incorrect use of vocabulary.	Assertions are off-topic, biologically incorrect or irrelevant to question. Describes biological processes or concepts using vague, imprecise language or everyday English, revealing little scientific knowledge. May rely on metaphorical rather than scientific descriptions of phenomena. Does not use scientific vocabulary or uses it inaccurately.

Reviewer Initials: _____ **Code: _____**

	Explanations/Comments
Comprehensiveness of Response	
Composition	
Professional Communication or Sense of Audience	
Synthesis/Integration	
Scientific Accuracy/Vocabulary	

Appendix 3: Examples of Student Work - High, Medium and Low Proficiency

High Proficiency

Name: _____

15. Explain why cells developed internal membranes surrounding organelles and what was the selective advantage of doing so. Your answer should mention specific organelles and specific functions occurring at such organelles. You have to contrast what would occur if the membrane were not present. **(25 points)**

Cells have developed internal membranes surrounding organelles to separate the two different environments, the cytoplasm and the inner organelle environment. The advantages are most apparent in the mitochondria and sarcoplasmic reticulum. Mitochondria is a double membrane bound organelle. By creating a barrier between the intra- and extra-organelle environment, the mitochondria is able to create a proton electrochemical gradient that is vital to synthesis of ATP in the cell. In addition to this, it is also able to enclose its own sets DNA, RNA, and ribosomes, ensuring that it receives its mitochondria-specific proteins.

The sarcoplasmic reticulum (SR) is found in muscle cells in the body. It has an enclosed membrane with Ca^{2+} pumps that pump Ca^{2+} inside the SR, creating a gradient. Upon receiving a signal, the SR releases Ca^{2+}, which bind to tropomyosin, changing the conformation and allowing myosin attach to actin, a vital step in muscle contraction. With this, the cell is able to selectively choose when to release Ca^{2+} and begin muscle contraction.

If no such membrane surrounded organelles, organelles could not exist, limiting the cell's functional abilities. There would be no difference in intracellular environment. As a result, there cannot a specific, designated area for certain processes, such as protein synthesis or DNA replication, resulting in disorganization and slower responses to the extracellular environment.

Medium Proficiency

2

Name: _____

15. Explain why cells developed internal membranes surrounding organelles and what was the selective advantage of doing so. Your answer should mention specific organelles and specific functions occurring at such organelles. You have to contrast what would occur if the membrane were not present. **(25 points)**

There exists two reasons as to why the organelles have ~~Intracellular membranes. In terms of the~~ chloroplasts and mitochondria, they were originally bacterial cells engulfed by an ancestral eukaryotic cell. When engulfed, produce a membrane around them (double, actually), so that is why they have them.

It is very important that all intracellular organelles have membranes to protect them from the harsh pH of the cytosol, & to preserve their specific function & contain their reactions in a closed space. The lysosome, for example, is responsible for degrading toxins & unused portions of the cell exterior. If these destructive enzymes were let loose within the cell, they would destroy all the organelles & would end up killing the cell. The function of the mitochondria is to produce the major source of energy for the cell. It houses rxns important for the survival of the cell. If it didn't have a double membrane, the electron transport chain nor the Krebb cycle could take place, because the electron transport chain needs to pump H^+ into the intermembrane space & then have H^+ come back into the matrix to couple it to ATP synthesis. With no membrane, the H^+ would diffuse into the cytosol & not be able to be coupled to ATP synthesis.

Low Proficiency

3

Name: _____

15. Explain why cells developed internal membranes surrounding organelles and what was the selective advantage of doing so. Your answer should mention specific organelles and specific functions occurring at such organelles. You have to contrast what would occur if the membrane were not present. **(25 points)**

We have organelles because each organelle has a special task that it has to carry out. For example mitochondria, is where most of our ATP is produced, which is used energy. If we didn't have a mitochondria, there would be little energy that would be supplied and we wouldn't be able to perform everyday activities. ER is where proteins are synthesized, golgi is where they modified and sorted then they transported by vesicles to their correct location. The cytoplasm is like a post office. If we were missing some of the organelles, the process couldn't be able to continue. If there was no golgi, then we wouldn't have anything to modify the proteins and send the correct proteins, which could affect mRNA and anti transcription & translation, leading to mutation. If there was no lysosomes then we wouldn't be able to degarde toxic materials that could be running around in our body, which could kill us. Also, each organelle is specialized because it's only let in certain things that it needs. It composed of different channels proteins that allow certain ions, molecules to go in. Also, nucleus which is important for gene & RNA and is also center of everything. without the nucleus there would be no gene's and probably we wouldn't exist either.

Chemistry

CHEM 195 report rated Excellent by both evaluators

Controlling the Number of DNA Strands Attached to a Nanoparticle through Gel Electrophoresis

Research on gold nanoparticles is widespread throughout the scientific community. With their well-defined surface chemistries and their ability to accommodate different functional groups and various oligonucleotides, these gold nanoparticles have been valuable commodities in a variety of fields like biochemistry, genetic therapy, and nanomedicine[1]. These gold nanoparticles can be easily attached with alkanethiols of variable length because of the high affinity of the sulfur group onto the gold surface. My goal for this semester was to be able to experimentally find the ideal DNA to nanoparticle ratio in order to maximize the product of having one ssDNA strand attached to a single nanoparticle.

I have worked on conjugating gold nanoparticles (AuNPs) with single stranded DNA (ssDNA) as a prerequisite to building bottom up fabricated nanostructures[2]. The specific base pairing feature of DNA allows one to easily manipulate and therefore easily predict the connectivity that it is going to form. I phosphinated Ted Pella gold nanoparticles to ensure their stability as high salt concentrations and high temperatures which are both required to hybridize DNA strands.

In order to make sure the Ted Pella nanoparticles agreed with its specifications, we imaged them through Atomic Force Microscopy (AFM). AFM is a powerful imaging tool that uses a very sharp tip to scan a region topographically. This allows a three dimensional image of a certain sample. Fig. 1a shows the AFM image of the 5 nm Ted Pella nanoparticles. The raised dots are the nanoparticles against the gold surface. Fig. 1b shows the individual heights corresponding to the numbered dots. The average height of the nanoparticles is ~5nm which, indeed, agreed with Ted Pella's specifications.

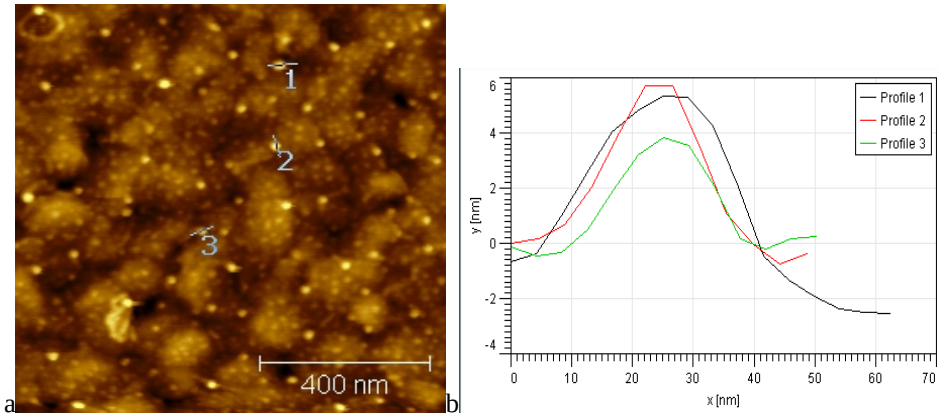


Fig. 1 a) AFM image of Ted Pella nanopartices **b)** Profile heights of nanoparticles

I have confirmed the conjugation of AuNP-DNA through running gel electrophoresis. Mixing DNA and AuNPs and leaving them overnight is sufficient to guarantee stable conjugation. When performing electrophoresis on DNA-NP conjugates, the bands produced correspond to the number of ssDNA strands that are attached to a single nanoparticle. In Fig. 2, the farthest band that migrated corresponds to the nanoparticle by itself; the second farthest corresponds to nanoparticles with one ssDNA

attached; the third farthest band corresponds to nanoparticles with two ssDNA strands attached, and so on. In Fig. 2, the fourth lane only has two bands which indicates that it has about 50% yield of the 1:1 DNA-Nanoparticle conjugation. Based on the results, 1:1 DNA-Nanoparticle concentrations would yield 1:1 DNA-Nanoparticle conjugation.

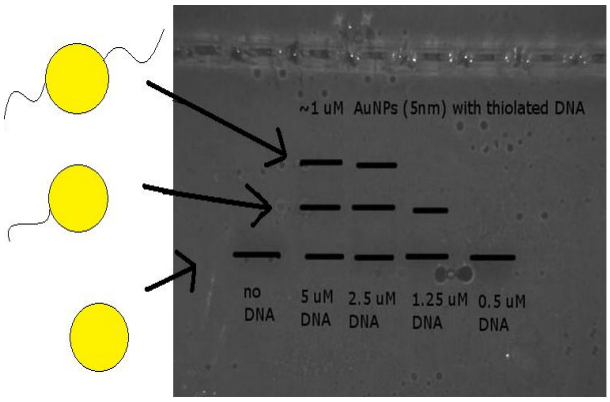


Fig.2 Gel Electrophoresis of conjugated DNA-NP with different concentrations of DNA. Bands were highlighted for better visibility.

By doing these experiments, I have concluded that the number of DNA strands attached to a single nanoparticle can be easily controlled through gel electrophoresis. Future work will be to hybridize DNA-thiolated NPs with complementary unconjugated DNA (Fig. 3a) then hybridize two complementary DNA-thiolated NPs (Fig. 3b). Consequently, I plan to attach two different DNA strands, one serving as an anchor to the gold surface, while the other one links to other complementary DNA-thiolated NPs (Fig. 3c). This should lead to building three dimensional nanostructures that would have a number of potential applications in the areas of optical imaging and electronic properties.

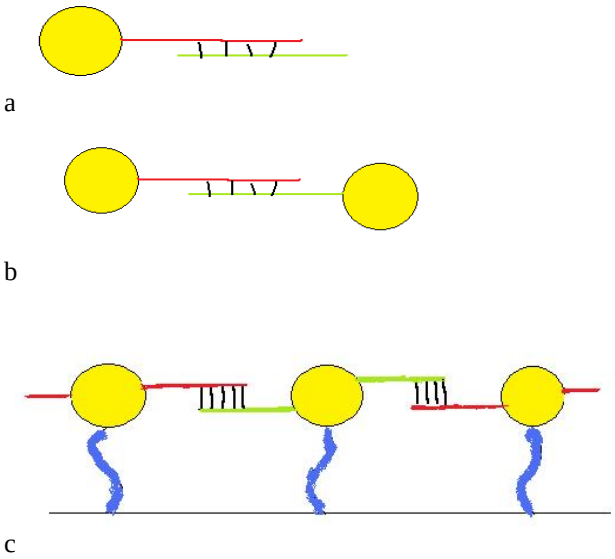


Fig. 3 a) DNA-thiolated nanoparticle hybridized with a complementary DNA strand **b)** DNA – thiolated nanoparticle hybridized with a complementary DNA-thiolated nanoparticle **c)** Hybridized DNA-thiolated nanoparticles (red and green) with a support strand attached to gold surface (blue)

References

1Boisselier, E.; Astruc, D. *Chem. Soc. Rev.* **2009**, *38*, 1759-1782.
[2]Storhoff, J.J.; Mirkin, C.A. *Chem. Rev.* **1999**, *99*,1849-1862.

Acknowledgment

Thompson Lu

High-Resolution Multi-Dimensional NMR Spectroscopy of Proteins in Human Cells

In this *Nature*, Kohsuke Inomata and his group reported high-resolution in-cell NMR spectroscopy of proteins. The high-resolution spectroscopy enable the study of the structures, functions and folding stabilities of specific proteins using human cells in an intracellular environment. They delivered the proteins into the cytosol by the pyrenebutyrate-mediated action of cell-penetrating peptide linked covalently to the proteins. The heteronuclear 2D NMR spectra of these proteins inside the human cells allow researcher to study the broad application involving the interaction and protein processing. The developed method can be use in the application of drug delivery, where the in-cell NMR spectra of FKBP12 shows the formation of specific complexes between the protein and extracellular administered immunosuppressant. In additional study, they found that in-cell NMR spectra of ubiquitin show a much higher hydrogen exchange rates in the intracellular environment possibly due to multiple interactions with endogenous proteins.

The method they used in-cell NMR is by using ^{15}N-labelled proteins and delivered to cells by cell-penetrating peptides (CPPs). The CPP fused to the carboxyl terminus of a human ubiquitin derivative containing alanine substitution at Leu8, Il244 and Val 70. The uniform ^{15}N labeled fusion protein is then incubated with human HeLa cells in the presence of pyrenebutyrate, which mediates the direct translocation of CPP-linked proteins into the cytosol. The 2D ^{1}H-^{15}N spectra gave well-resolved cross-peaks, showing a pattern typical of a stably folded and homogeneously dispersed protein. When this compared to the reference in vitro, they found an intense signal at a position corresponding to the c-terminal Gly 76 of mature ubiquitin, suggesting a cleaved between Gly 76 and Asp 77 by a protease. Additional electrophoresis analytic confirmed the cleavage. They stained the cell with 0.2% (w/v) trypan blue and found that more than 90% of cell s were resistant to trypan blue uptake indicating high level of

cell viability resulting from a low toxicity of pyrenebutyrate/CPP_{Tat} treatment. They found that Ub-3A-CPP_{Tat} undergoes intracellular cleavage because the mutated Ub-3A-G75A/G76A-CPP_{Tat} resistant to cleavage in cells and confirmed by an aggregation of protein from in-cell NMR. For specific protein, they linked the CPPs to cargo proteins by means of disulphide bonds. The breakage of disulphide bond can be seen through the use of in-cell NMR and compared to the reference from in vitro spectrum. They also performed the same experiment on monkey's cell to confirmed the universality of this method.

In-cell NMR has the potential in the field of protein conformational changes, dynamic and functionality of proteins in the intracellular environment. The comparison of the intensity of main-chain amide signals at particular sequence give insight to cleavage and cell-protein transduction. In-cell NMR spectroscopy can also applied in the field of protein interactions with small compound, such as drug delivery. It gives information on the efficiency of the drug delivery and protein interaction which can be apply in drug screening. This method can be used to detect the stability of the protein folding by measuring the rate of hydrogen exchange between folded and unfolded states of proteins. Overall, in-cell NMR open new method in the study of protein interaction in intracellular environment that can be apply in living animals.

Source: Kohsuke I., Ayako O., Hidehito T., Shin I., Takeshi T., Ikuhiko N., Toshihide T., Shiroh F., Yutaka I., Hidekaze H., Masahiro S., *High-resolution multi-dimensional NMR spectroscopy of proteins in human cells* Nature, Vol 458, 5, 106-109 (2009)

Appendix 2: Assignment

Our final writing assignment is to write a mock research proposal. The overall idea is to come up with an experiment or computer simulation or robot design that would be interesting and informative to cognitive science. To guide you to a topic area, here are some choices for you to make, in order.
First, the COGS 101 overview from the syllabus posed three questions that framed the content of the course, reprinted below. Choose one of these questions as your topic area.
What are the cognitive functions that work together to create the human mind? We learned about functions of vision, language, and emotion, for instance, but also more general principles such as coordination of functional components, and adaptive optimization of functions. You can propose an experiment that demonstrates one of these functions or principles, and tests some aspect of it.
What are the bodily and neural mechanisms critical to understanding cognitive functions? We learned about the foundational role of the body in cognition, and about various brain areas and how they work together to guide behavior. You can propose to build a robot that implements some kind of embodied cognitive, language, or perceptual function. Or, you can propose a brain experiment to test a hypothesized function of some brain area or mechanism.
What are the computations that comprise these functions and mechanisms? We learned about symbolic and neural network models of cognitive function. You can propose a computer simulation that implements and tests some hypothesized mechanism of cognition, perception, language, etc.
Next, look over the following list of hypotheses and theoretical principles that we learned about (also from the syllabus). Connect your proposed experiment or robot or computer simulation with one or more of these hypotheses. Your proposal can test or demonstrate one or more of these hypotheses, or it can be motivated by one or more of these hypotheses.

- Cognitive functions are flexible and adaptive at all levels of analysis
- Cognitive functions have symbolic qualities that arise from subsymbolic processes
- Cognitive functions are theorized as emergent properties of neural systems
- Functional aspects of neural systems are defined in terms of their bodily, behavioral, and environmental (both physical and social) contexts
- Neural activity is constant and provides a dynamic background from which cognitive functions are shaped
- Learning in neural systems occurs over multiple time scales, through many different mechanisms of plasticity
- Computations in the brain are hierarchical, from task-general and sensorimotor-specific to task-specific and sensorimotor-general
- Computations in the brain are not like computer programs, yet computer programs can be used to simulate neural computations

- Computations in the brain reflect a balance of segregation versus integration of information, and independence versus interdependence of subsystems

Your proposal should have the following sections, labeled and in this order:

1. **Introduction and Background.** (about 2-3 pages) Tell the reader about your topic, and emphasize what is interesting and challenging about work in this area. Do some research to find three studies that illustrate what is known about your topic. You should also use these studies to explain to the reader what is NOT YET known about your topic.
2. **Proposed Project.** (1 page or less) Explain the basic idea behind your project, without details. Express what is interesting / cool / challenging about the project, and what we would learn from it.
3. **Project Methods.** (about 2 pages) Give as much detail as you can about how you would carry out the project. Pretend that you have as much money and technology as you need, sky's the limit! Some details will necessarily be left out, but you want to give the reader the impression that, with enough time, money, and help, the project could be done well.
4. **Potential Results and Impact.** (about 1-2 pages) Describe the possible results of the project, both good outcomes (such as it works, you learn something, your hypothesis is confirmed, etc.) and bad outcomes (possible roadblocks, results that would be less interesting and informative, etc.). For the good outcomes, explain how they would impact cognitive science and/or whoever's lives would be positively affected. Note that just discovering a new fact or phenomenon about the brain or mind would have impact on other cognitive scientists, so that counts. For the bad outcomes, briefly explain what you might do to address them (for example, try a slightly different method or approach, try your method on different people, or a different brain area, etc.)

You are welcome to write on the topic you presented in class, if you like, or you can write on something new to you. However, you may NOT write on a topic that is directly related to either of the first two writing assignments. Formatting etc. is the same as for the first two writing assignments.

Appendix 3: Inter-rater reliability

A) Ability to interpret / evaluate / synthesize information in research papers
B) Ability to design a cognitive science research project
C) Ability to write clearly and scientifically

In assessing PLO 2, we were particularly interested in determining whether mid-level cognitive science majors (i.e. second semester sophomores and juniors) are beginning to synthesize these skills by the end of COGS 101. We also wanted feedback on how to improve the curricula to get students to the point of synthesizing these skills by their junior or senior year.

III. Assessment Methods

The three components of PLO 2 are represented in the mock research proposal for COGS 105. Specifically, component A is aligned with the Introduction section, component B is aligned with the Methods section, and component C is aligned with the Results and Discussion sections (although component C also spans the entire proposal).

Based on these alignments, cognitive science faculty collaborated in the Fall of 2009 to formulate a rubric to assess PLO 2. There were four levels of ability with corresponding scores of 1-4:

1. Student shows full mastery of the ability.
2. Student exhibits some degree of the ability.
3. Student exhibits the ability to a limited degree.
4. Student does not demonstrate this ability.

Each level of ability was applied to each of the three PLO components as follows:

	1: Student shows full mastery of the ability.	2: Student exhibits some degree of the ability.	3: Student exhibits the ability to a limited degree.	4: Student does not demonstrate this ability.

a: Ability to design an experiment	Clear alternative hypotheses and predictions; apt methods for testing predictions; comprehensive mitigation of confounds and other potential design flaws	Some alternative hypotheses and predictions; some methods for testing predictions; some mitigation of confounds and other potential design flaws.	An experiment is described but no alternative hypotheses are described, no method of testing is given, and no mitigation of confounds is presented.	A brief narrative description of a possible study is given, but little more.
b: Ability to interpret / evaluate / synthesize information in research papers	Cites several studies from reputable sources and accurately describes results.	Some studies are cited and results are accurately described. Some irrelevant results; errors in description; poor quality sources.	Very few studies cited from poor sources. Errors in description.	Few studies are cited and those that are not associated with a citation or are from a poor quality source. Irrelevant studies. Errors in description or very quickly paraphrased (or plagiarized) results.
c: Ability to write clearly and scientifically	Clear, direct prose, similar in quality to what one find in a published study.	Minimal grammar and spelling errors but problems in overall presentation and organization.	Some grammar and spelling errors; problem in organization.	Numerous grammar and spelling errors.

Assessment materials were 51 mock research proposals that were submitted as final writing assignments for COGS 101 in Spring of 2009. The assignment (see Appendix 2) was to write a mock research proposal for either a cognitive science experiment or computational model.

Two raters (Spivey and Matlock) who did not teach COGS 101 volunteered to rate the assignments. A random sample of half of the students were selected and rated independently by both raters (see Appendix 1 for individual ratings). To assist with rating, relevant sections of student papers were extracted and concatenated.

Appendix 4: Example Student Work

Student F - Example of "full mastery"

[redacted]

5/15/09

COGS 101

Final Paper

The Split Brain

1. Introduction and Background.

Through various studies over the years, much has been learned about the cognitive processes of the human brain. This paper will focus on what is known as the "split brain", the splitting of the two hemispheres of the brain by severing the corpus callosum, usually done to help epileptic patients. Splitting the two hemispheres by severing the corpus callosum cripples communication between and, if completely severed, can block any communication between the two hemispheres.

According to www.nobelprize.org, researchers in the 19th century suspected that the two hemispheres of the brain operated for different functions due to studies they had of individuals with brain injuries. One thing in particular that they suspected was that the left hemisphere was designated for language functions. This was shown through patients who had had injuries to the left side of their brains losing the ability to talk. Suspicions were ended in the 1960s when Roger Sperry and his colleagues revealed that there were in fact specialized areas of the brain used for language functions: the left hemisphere showed to be more specialized towards analytical and verbal tasks, while the right hemisphere deals with space perception tasks, music, and even contributes emotional context to language. These studies looked at how the left visual field is connected to the right hemisphere while the right visual field is connected to the left hemisphere. Since each side is specialized, they were able to show that someone seeing a word would be able

to read it, but would not be able to attribute any meaning to it. They tested this by studying individuals who had their corpus callosum cut, and then presenting information to one side. This would isolate the side that they wanted to focus on. Further studies showed that a person could even be touching an object that they recognize with their left hand, and recognize it with their right brain, but if at the same time a word were placed in their left visual field and they had damage, they would not be able to recognize the word. {artsci.wustl.edu/~msommers/syllabus/bio.ppt} Another study confirmed this as well when a compound word, hatband, was presented to the individuals, but split apart so that only the left visual field could read hat, and the right visual field could read band. Due to the brain's wiring, the patient would respond to what they said they saw with "band", yet if they are asked to pick out the object they saw they will pick out a hat.

These studies clearly showed how the brain is split in terms of what each hemisphere can do, but these studies strictly examined the cross-wiring of the visual system. Although research has allowed even medical purposes of severing the brain to be altered so that only parts of the corpus callosum need to be cut, splitting the brain this way will only affect certain functions of the brain. An area not mentioned in these studies of the "split brain" are how the audio nerves are attached to the two hemispheres of the brain, and whether or not there can be a split brain in terms of severing these connections.

2. Proposed Project.

Following the premise that "cognitive functions are flexible and adaptive at all levels of analysis", I propose that an experiment could be set up to split the brain by splitting the audio nerves that run between the ears and the corresponding hemispheres. Unlike the visual system,

which connects the left side of the brain to the right visual field and the right side of the brain with the left visual field, the ears are connected to their corresponding hemisphere: the left ear connects with the left hemisphere, and the right ear connects with the right hemisphere. Although there are specialized areas for processing what is heard, these connections are still appropriately connected this way. Thus, what would happen if the brain could be split in such a way that what is received in one ear would only be interpreted by one side while the other side could process something completely different. This would test the flexibilty of the brain and the cognitive functions of the human mind to see how it would adapt to such a situation. Challenges would involve the ethics of severing the patient's brain and/or audio nerves, potentially crippling them in some way. Also, not much research has been proposed in such a way to study this, so there is not much information to back up any claims.

3. **Project Methods**.

Further studying of the brain's cognitive abilities and it's flexibility in adapting to damage is necessary, including in an area such as this where understanding the audio functions of the brain could be used for medical purposes. This study, if funded, would be carried out by finding volunteer patients with a “split brain” and isolating the audio nerves and processes of the brain. Due to advances in technology, the study could track which areas of the brain are being activated with a stimulus of sound, examining the effects of differing which ear has the input. Also, further studies would need to be placed to research what would happen if both ears are receiving separate audio inputs with a severed corpus callosum. Much like studies already done on the split brain, further understanding of the audio system and how the nerves are wired to the human brain would be necessary to see which areas of the brain would need to be stimulated. For

instance, if the split brain will “not see” something that the patient obviously sees but does not process, a set up would need to be put in place that would determine if the patient would not distinguish sound, or if only certain sounds could be interpreted based on the side of the brain being affected by the sound. Thus, the study would look for specialization within the audio functions of the human brain.

4. **Potential Results and Impact**.

Potential results from a study of the split brain, specifically with hearing and the audio system, could show that the brain is specialized in what is heard and then understood. Results may prove my hypothesis, that the brain is flexible enough in its processes to undergo severe separation and still function in such a way that the individual can maintain processes such as hearing in their completeness.

Other potential results may show that the human brain requires both hemispheres to process hearing and allow an individual to understand what they heard. If this is so, then those placed within the experiment would need to be taken care of to see if hearing could be restored once a nerve has been severed. This would definitely pose as a roadblock on studying humans, and thus animal testing will be necessary as well to understand basic properties of brains. Results from this study would benefit cognitive science as a whole because it would allow for more understanding of the split brain and the ability of the brain to adapt to damage. This method could be enhanced by expanding the research out on to more people, increasing the test group size and allowing research to be done on the audio system on a healthy brain. Individuals without a split brain could be put to the same tests as those who do have it, with computers monitoring the activity as

well. This would create more information regarding which areas of the brain are stimulated by sound, and furthermore how opposing sounds affect what the brain interprets. Also, if there were a way of not completely severing a nerve but simply blocking it, this experiment could be used without the worries of damaging the human brain, bringing ethics back into the project. Ultimately, further studies of the brain are needed in understanding its functions and flexibility, and more specifically in understanding how it works with split brain patients.

Student H - Example of "full mastery"

Robot Linguistics

COGS 101

[redacted]

May 15th, 2009

Robot Linguistics

Introduction and Background

The topic that I am writing about is bodily and neutral mechanisms that is critical to understanding cognitive functions. I am planning on building a robot that studies the cognitive language and cognition integration to demonstrate how the language acquired by robotic agents can be directly grounded in action representation.

In the article, "Grounded Situation Models for Robots: Where words and percepts meet," the long-term objective is to develop robots that engage in natural language-mediated cooperative tasks with humans. The primary obstacle towards effective human-robot communication in natural language lies in the traditional separation of language from sensing and acting. The main thesis is that special amodal knowledge structures representing situations are needed as bridges. Presented the design and implementation of such a structure, namely a grounded situation model, which serves as a bridge for an interactive conversational robot and it resides in a centrally located module in the implemented modular architecture. The overall design of the grounded situation model was driven by two desiderata, and the design was later refined through a set of behavioral goals that were explicated. All the behavior goals have been achieved. The robot is currently able to pass the first two parts of the Token test, standard test used to assess early situated language skills. The robot is able to answer questions about the present and past, act on objects, and locations, and integrate verbal with sensory information about the world. The suggested grounded situation model design, provided an important step towards providing robots with physically and socially grounded language skills and finally towards truly cooperative conversational robots (Mavridis & Deb,).

Interacting and communication with another person is a complicated set of processes in real life. Humans learn and master the linguistic and social skills necessary to perform this accomplishment with seemingly little effort. The focus is on two main research areas that facilitate cooperation and collaboration in a team of robots. The fist area focuses on context predicates, linguistically motivated constructs that contain semantic and goal information. Using context predicates, the teams of robots share information about the goal status and act accordingly to them. The second research area is our expansion of the spatial reasoning component so that robots reason about their physical environment and share information about the environment, objects, and locations. The purpose is to enhance team formation and dynamic autonomy, so that robots interact with each other and human intervention occurs only as needed (Skubic & M,).

Engagement is the process by which two or participants establish, maintain and end their perceived connection during interactions they jointly undertake. It is supported by the use of conversation, ability to collaborate on a task and gestural behavior that conveys connection between the participants. Collaborative conversations cover a vast range of activities. Conversational gestures generally concern away from the observational partner, pointing behavior, bodily addressing the conversational participants and other objects in the environment. The nature of engagement in human-robot interaction, and outlined our methods for investigating rules for engagement for the robot. The report analysis of the human-human look tracking showed that the humans do not always track the changes in looks by their conversational interlocutors. It was concluded that such tracking failures indicated both the default behavior for a robot and when it can fail to track without its human conversational partner inferring that it wishes to disengage from the interaction. In order to create a robot that can converse,

collaborate, and engage with human interactor, a number of different communicative capabilities must be included in the robot's collection. Majority of the capabilities are linguistic, but some make use of physical gestures as well (Sidner & C,2003).

Proposed Project

Neural networks have been proposed as an ideal cognitive modeling methodology to deal with the symbol grounding problem. The connectionist models have been incorporated based on the agent and the robots. Two cognitive robotic models will be presented to demonstrate the mechanism of action grounding of language and the symbol grounding transfer in agents that acquire a lexicon via imitation and linguistic instructions. The models are based on the combination of cognitive robotics with neural modeling methods, such as connectionist models and field theory modeling.

Project Method

This robotic model consists of two simulated agents, teacher and learner, embedded within a virtual simulated environment. Each of the robots consists of two three-segment arms attached to a torso; this robot has 6 Degrees of Freedom. This is further connected to a base with four wheels. The robots will be able to interact with the environment and manipulate objects that are placed in front of them through the two arms. In this simulation three objects will be used: a cube, a horizontal plane and a vertical bar. The agents input retina will be able to receive different views of each object. The agent will have to learn six basic actions: lower right shoulder, lower left shoulder, close right upper arm, close left upper arm, close right elbow, and close left elbow. Another thing that they will also learn is the name of such basic actions: "LOWER_RIGHT_SHOULDER," "LOWER_LEFT_SHOULDER," "CLOSE_RIGHT_UPPER ARM," "CLOSE_LEFT_UPPER ARM," "CLOSE_RIGHT_ELBOW," AND

"CLOSE_LEFT_ELBOW." Each of the action will be associated with some of the above objects that are put in front of the agent (Cangelos et al, 2004). The close left and close right shoulder actions are associated with different views of the cube.

The system is implemented using open dynamic engine, an open source, high performance library for simulating rigid body dynamics. The open dynamic engine is useful for simulating vehicles, objects in virtual reality environments and virtual creatures, and it is being increasingly used for simulation studies on autonomous cognitive.

The first agent, the teacher, is pre-programmed to perform and demonstrate a variety of basic actions, each associated with a linguistic signal. These are demonstrated to the second robot, the learner, which attempts to reproduce the actions by coping them. First, the agent acquires basic actions by observing the teacher. Then, it learns the basic action names, direct grounding. Next, it autonomously uses the linguistic symbols that were grounded in the previous learning stage to acquire new higher-order actions, symbol grounding transfer.

In the neural network controller and training procedure, the imitator robot is given the multilayer perception neural network with input units for vision proprioceptive and linguistic input and output units for motor control and linguistic output. For the robot motor control, the motor output units encode the force that is being applied on each joint. Each action consists of sequence of ten steps of motor activation. In order to attain the grounding transfer, we use a three stage training process: basic action learning, entry level naming, and higher-order learning.

In the basic action learning stage, the agent learns to execute all six basic actions in association with the view of the different objects. There are no linguistic elements used at this stage. By using imitation algorithm it adjusts the weights contributing to the activation of the motor units using supervised learning.

The second learning state which is the entry level naming is concerned with associating the previously acquired behaviors to linguistics signals. There are three features of the sequential activation cycles. The first cycle is the objects view information which is given in the input to the network. The agent learns how to activate the output linguistic nodes corresponding to the basic action names. The linguistic production cycle implements, the process of basic symbol grounding, by which the symbols the agents are learning, are directly grounded on its own perceptual and sensorimotor experience. In the second cycle, linguistic comprehension, the learn learner agents are taught to correctly respond to a linguistics signal consisting of the name of the action, without having the ability to perceive the object associated to the action. In order to accomplish this, the retinal units in the network were set to 0, while activate the input units corresponding to the action name. The final cycle, imitation, both motor and linguistic inputs were activated in input, and the network learns to reproduce the action in output and activate the corresponding action name unit. This last cycle is necessary to permit the linking of the production and the comprehension tasks in the hidden units' activation pattern (Cangelos et al, 2004). .

The final training stage, higher-level learning, allows the learner agents to autonomously acquire higher-order actions without the need of a demonstration from the teacher. This is achieved only through a linguistic instruction strategy. The Higher-Order stage permits the implementation of a purely autonomous way to acquire new actions through the linguistic combination of previously-learned basic action names. The role of the teacher in this stage is only that of providing a linguistic instruction, without the need to give a perceptual demonstration of the new action.

Results and Impact

The simulation was replicated with five agents. Each of the agents had a different set of random weights initialized in the range of negative one to positive one. The three step learning stages are basic action, entry-level and higher level learning. It lasted from 1000, 3000, and 1500 epochs. These were the approximate minimum number of epochs necessary to reach a good learning performance. The parameters of the back propagation algorithm were set as follows: basic action stage, momentum 06 and learning rate 0.2; entry-level, momentum 0.6, and learning rate 0.3; higher level learning, momentum 08 and learning rate 0.2. The weights were updated at the end of every action (Cangelos et al, 2004). .

The overall results indicated that all agents were able to learn successfully the six basic actions and the three higher-order behaviors. During the end of the stage, the imitator was able to execute all actions flawlessly when presented with an object, with a final error of 0.004. The overall range error on the final epoch of the entry-level stage was 0.03. Finally, in the grounding transfer test, the agent was requested to perform a new composite action by giving input of only the new action name or the new name together with the basic action names, with an error of 0.018 (Cangelos et al, 2004). These results confirm our hypothesis that previously grounded symbols are transferred to the new behaviors.

Adaptive agent models and the evolutionary and epigenetic robots can significantly contribute to be a better understanding of the strict interdependence between language and perceptual, motor and cognitive capabilities. Models of language emergence have important scientific and technological implications for research in language and communication. In robotics and artificial intelligence, they provide new approaches and algorithms for the

development of autonomous interactive systems. In cognitive science, these models permit a deeper understanding of the psychological and cognitive bases of language and its grounding in perceptual and sensor motor abilities (Cangelos et al, 2004). Finally in linguistics and other disciplines interested in language origins, agent and robotics models allow the simulation of evolutionary emergence of language the test of language origin hypothesis.

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Student A - Example of "some degree of ability"

[redacted]

Cogs 101

Research Proposal

5-15-09

Learning: Rules vs. Fluidity

"Every day you learn something new." While a common adage, few people stop think about what it really means to learn something new, and at best every day. The learning process can be complicated and difficult to handle at times, but considering how small children learn new information so young, we take for granted the true complexity of the learning process. Another aspect to address about a human's ability to learn is how exactly we do learn. Some people will argue that learning is nothing more than a serious of rule-based computations with a specific task. Others will argue that the brain is capable of flexible communications within itself allowing it to adapt and change after learning new information. The experiment I am proposing aims to show that "cognitive functions are flexible and adaptive at all level of analysis," and that "computations in the brain are not like computer programs, yet computer programs can be used to stimulate neural computations."

Following a previous study with two other researchers in 1986, Connie Juel performed a research study focusing on the literacy development of children from first grade to fourth grade in 1988. Juel focused on testing if children remain poor readers and writers year after year, and found that probability of a child remaining a poor reader until fourth grade was .88 (1988). It was also found that reading done in school as well as outside of school influenced a student's performance level. This is key insight into how the brain may work for reading and writing, but

it is interesting to see if how you teach the child these concepts would approve their skills as well. If you only taught them using rules would they be better readers?

Nancy Katz, Erica Baker, and John Macnamara were interested in how children learn common and proper names. In 1974, they conducted research on eighty infants to see what "processes whereby small children learn common and proper nouns and learn how English distinguishes between them" (Katz, Baker, Macnamara). This is an interesting study because it will show whether the processes used by the infants are more rule-based or whether they are more fluid. The study concluded that people the children differentiate individuals and then learn their names, but with common objects, like a ball or table, they did not separate individuals and learn names only for the class (Katz, Baker, Macnamara, 1974). According to this study it seems that there are set rules for how to classify objects in order to identify.

The last study I would like to focus on is closer to home to my own experiment than the previous two. Roschelle, et al. (2000) conducted a study titled, "Changing How and What Children Learn in School with Computer-Based Technologies," that focused on helping students become better prepared for the real world with the help of computer programs. "Research indicates that computer technology can help…develop the higher-order skills of critical thinking, analysis, and scientific inquiry" and the research found that multiple factors including being engaged in the program contribute to the success of computer based programs (Roschelle, et al. 2000). However, the computer cannot do it alone; this system would need to be coupled with better teaching skills and student assessments.

From these three studies we can draw a few conclusions about how humans learn. First, some learning is rule-based. There is a formula to follow that will lead to a solution. From the first study, it was shown that poor readers have the tendency to remain poor readers. Thus I come

to the conclusion that you can't teach all rule based because if someone doesn't understand the "rules" how can they ever progress? Lastly, computer technologies have been shown to improve learning. While computers are not necessarily free thinkers, can this success be contributed to rule-based computations? What we don't know is which is a more effective way to learn; fluidity vs. rule-based. Also it has yet to be determined which process has more lasting effects.

I am proposing an experiment that will test two aspects of learning. The first will concern whether children learn and perform better with rule-based teaching tactics or with less traditional teaching methods like Montessori. The second aspect concerns learning with computers. If rule-based learning is really the key to learning, then we should be able to program computers using the same rules and the machine should exhibit the same results. It would be spectacular to find evidence that showed increased learning in students so that the education system could better be reformed than it is now. Particularly in California, the public juvenile education system is getting more and more run into the ground with budget cuts, layoffs, and increased class enrollment. It is my hopes that this project will help to turn around some of the problems we face with straight forward solutions.

The challenge here will be to take the results from the study and apply them to a more general audience. There really can't be any uniform solution that can be applied due to differences in socioeconomic groups and other related aspects. Not only would it be hard to come up with a solution for the country, but even just within California there are so many regional differences that need to be taken into account. If anything, from this project we can learn basic strategies to help assist our youth in achieving the best education possible.

My experiment will need to begin at the beginning of the school year. Phase one will be comprised of three different classrooms comprised of fourth grades students with twenty five

students in each class. Class A will be a traditional ran classroom, also known as the control group. The instruction in this class will be unanimous with the way that most teachers instruct due to the No Child Left Behind Act. The instruction will be focused on the end of the year test, and most lessons will be spent teaching strategies to pass the test and hardly and science, art, or history. Class B will be the rule-based instruction group. Instruction in this group will be all about equation leading to results. Everything has a formula and a certain way of arriving at the solution; A+B=C. Class C will be the Montessori run classroom, the group with more fluidity in the instruction process. Montessori is an educational program focused more on hands-on learning and students having more freedom to come up with their own solutions to problems. Students have more freedom in the classroom and work at their own pace, in their own order. Montessori offers more than one explanation of performing a task and will be a sufficient teaching style to represent a less traditional classroom.

The basic layout for each classroom will be the same. Each classroom will consist of two whiteboards, four computers, and a class posting wall. How the teachers incorporate the layout into their teaching strategies will be left to their discretion. The week before instruction starts every student in the fourth grade at this particular elementary school will be tested. It is vital to ensure that each classroom contains around the same assortment of educational levels, and children from an assortment of backgrounds. There will be a scholarship incentive for students to stay with the experiment through the whole year in order for test results not to be biased. The amount still has yet to be decided. The students will periodically be tested every month using standardized tests reflecting what the fourth grade standards outline to be taught. Also monthly each of the teachers along with the researchers will sit down to discuss the progress witnessed within each student and within the classroom as a whole. At the end of the year we the

researchers will assess the improvement made by each class and decide which teaching strategy is most effective based on the averaging of the standardized test results.

Phase two will begin the following year. This part of the experiment will be sufficiently different from the first phase. This part of the experiment will be laboratory based and consist of experimenting with learning techniques on a computer based program. Fundamentally this experiment will attempt to prove that if learning truly is rule based, a computer fed the same instructions should be able to perform at the same level as a child of equivalent intelligence. This experiment requires five children of age four and five computer programs that are programmed to function at a four year old's thinking capacity.

This will only be a six month phase. Every two weeks the children as well as the computers will be assessed for progressed on individual levels and against each other to see how they measure up. For the duration of this study the children will have to live in the laboratory to ensure that they are not getting outside learning assistance. It seems like this may stunt their intellectual growth but no evidence has thus been presented to the advisory team restricting us to follow with this project. All in all a psychiatrist will be in the lab to monitor the well-beings of the five children. If the program actually does function in the computer programs they could possibly used for the military to make smart machines that help to train soldiers many, many years from now.

I believe the results of this two-phase study will give us better information about how children learn, and how we can use this information to reevaluate teaching strategies inside of the classroom. Learning is not completely rule-based which will be proved by the fact that the computers in phase two were unable to perform at the same level as the four year olds. However, part of learning is based off of rules and so there is no completely straight cut line in

how we learn. This experiment would open up a new window for Cognitive Science because it is totally based on how we learn and that can always be an asset to researchers later down the road. In the long term I hope that the results of this study will be able to help California reform its education system and increase the productivity of students. If the productivity is increased maybe it could lead to an increase of students attending and completing higher education.

The biggest roadblock will be interpreting the results and finding a conclusive result. I believe that this experiment would need to be ran more than one time. With enough funding we could increase the time length of phase one through middle school to see how they are still progressing. Also testing the kids after they graduate to see if their scores correlate with previous patterns of learning achievement could give insight on the learning process that is most effective on education.

I believe that addressing the problems faced in our education system is important because children are our future. Also, if we start doing something now we can prevent more damage in the future. Our education system definitely needs some strengthening and it begins with the brain. Until we really have a grip on how we learn, we won’t be able to help our children progress to be the best they can be.

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Student P - Example of "ability to a limited degree"

Research Proposal: AJ

[redacted]

University of California, Merced

Introduction and Background

The human mind it a beautiful thing. It is able to register different stimuli the body comes to contact with and convert it into images to identify the stimuli. It is able to look at objects and evaluate them by forming functional and coherent thoughts. It is also able to story information given to it, and recall these memories for later use. Yes the brain is a great machine that allows for humans to separate ones selves from animals. Now although this entire contraption seems magnanimous, the challenge of actually testing these theories is where the problem lies. The thought if being able to truly know, or experience, the exact feeling occurring in another persons brain is something that to this day is still impossible, but not exactly something that cannot be tested. In all honestly something of this magnitude would take extensive research or trial and errors, but in the end the final product would be so rewarding and valuable in its self. Developing an actual serious of experiments that could entirely put the human brain clearly in perspective to others would a grand discovery proving that functional aspects of neural systems are defined in terms of their bodily, behavioral, and environmental (both physical and social) contexts.

First and foremost a grand portion of the human brain that gives insight into the being, as a whole, is the emotions that people portray. The process of emotion is one that, although the brain can work and knows how to alter, isn’t always necessarily is something that can be measured. Throughout the years the most common way to explain what emotions are being shown on someone’s face is by reading the expressions on someone’s face, ultimately being given specific meaning by peoples opinions and words.

(Barrett, Lindquist, and Gendron, 2007) Yet although this can give much insight, the immense meanings of the emotion being portrayed at time, are limited by the words that the experimenter can give the emotion. Another problem encountered is that a single emotion can correctly have multiple outcomes, which can all be true, or at the same time all falsely wrong. “Consider the fact that 60%–75% of the time, people see facial portrayals of fear as ‘angry’ when the images are paired with contextual information typically associated with anger. You can imagine the consequences when, in war, a soldier enters a house and see a civilian as angry instead of fearful (or vice versa). These examples illustrate the importance of context in emotion perception” (Barrett, Lindquist, and Gendron, 2007) Clearly if a single way was established to better understand every different person’s brain, common mistakes, such as these, wouldn’t be made, and ultimately a single “correct” answer would exist.

Another identity that gives specific meaning and perception to the brain is the thoughts each and everyone has. Thoughts are precise feelings, emotion, and senses that a person can have form towards anything, like a single object, or a population as a whole. “All of the mental functions that we label with a word, such as perception, memory, reasoning, and imagery, are accomplished by systems of processes in the brain” (Kosslyn, 2005) Evidently this entire task of clearly labeling each thought and sorting out in the brain, is something that is easier said than seen. It becomes obvious that storing a single memory isn’t something that can be easily explained without an exact rubric to follow. Also “One of the advances of research on memory is the finding that different types of memories are often stored in different regions of the brain” (Kosslyn, 2005) the exact criteria to know where everything goes, and why, is another thing we do not

understand that the brain does. If an experiment was developed to see exactly what the brain needs to do and identify in order to categorize the thoughts, the wonder of what each person experiences in his or her own head would no longer exist, and a standardized way of measuring and knowing all this would be developed.

Lastly, a major characteristic of the brain that is challenging to actually see and experience in other people other than ones self is the working memory. “Although brain changes associated with the acquisition of cognitive abilities in early childhood involve increasing localized specialization, little is known about the brain changes associated with the refinement of existing cognitive abilities that reach maturity in adolescence.” (Scherf, Sweeney, and Luna, 2006) A basic understanding of how the brain develops and changes as a person grows has been obvious through the years, seeing as not only does the exterior of a person changes. Yet once it reaches its prime stage the idea of measuring and being able to see the stages it goes though while processing tasks. “Although the acquisition of skills in childhood appears to involve functional specialization within brain regions, little is known about the neural changes that support adolescents’ increasing cognitive efficiency. (Scherf, Sweeney, and Luna, 2006) An ultimate experiment would need to be developed in order to close this gap of missing knowledge. If it was developed and put underway the infamous amount of data that could be collected from it would greatly make a difference in this cognitive study giving more insight on the brain and how it all works.

Proposed Project

What if all these questions could be answered? What if a method of actually performing and collecting this data was possible? Say hello to AJ. A machine that reads

the brain while the subject participates in an experiment that involves a series of: questions and answers, mathematical problems, word quizzes, memorization, everyday routine tasks, visual images, and physical activities, all being monitored by neuroimaging techniques, primarily positron emission tomography (PET) and functional magnetic imaging (fMRI). Now unlike traditional neuroimaging techniques, PETs, and fMRIs, the subject would have to agree to undergo this study with a twist. AJ is not only a traditional computer, for she also is an artificial intelligence life form put together by expert scientist. AJ monitors the subjects for a span of thirty days and nights, while the subjects live within a close proximity of her hard drive via a chip placed within the subjects. The challenge lies not only within the chip, but also in trying to keep the subjects doing their normal everyday activities while still undergoing the experiment. In the end we hope to be able to do three different cycles with different subjects every year. With all this information we hope to accumulate enough information to better understand the brain and all its components. All the information gathered would immensely help the cognitive science departments everywhere and offer so much insight for the future generations to come.

Project Methods

After being approved, AJ would require a large facility to carry out the proposed experiments. AJ would require facility that contains labs, classrooms, a large physical education area, dormitories, and a dinning center. At the center of it all AJ would be set up within three rooms for her hard drive, and five control rooms where the experimenters working within the five rooms would closely monitor the three hard drive rooms. The entire facility would be kept under surveillance, not in case the subjects try to escape, but

rather for the research purpose. AJ would be dealing with all the state of the art technology, with a great lithium based back up battery in case the electricity was to malfunction.

The core to AJ would be the microchip she uses, and would be based within in each human subject. The ultra slim microchip would be attached at the base of the cranium of each subject and is un-sensed by the subject. The process of actually implanting the chip within the subjects seems extensively tedious and complicated, but the process itself is virtually simple, and trouble free. All that is required is some local anesthesia for the insertion; the experience afterwards would be as if the chip in question was none existent. These chips would be wirelessly connected to AJ, and would be able to send all the data of the subject back to her. The chip would measure the brainwaves of each subject put to work on each task at different times. AJ would then record the data and store it for the experimenters to evaluate and work through. Using her artificial intelligence AJ would also be able to deduce certain aspects of the mind once enough data is collected, producing standard deviations and percentages of occurrence within brainwaves. The chip in its self would be the most important aspect of the experiment, and with it could come great data results after a few cycles of subjects. At the end of the experiment the chip would then be removed from the participants and the subject would be released to go on back to their everyday life before the thirty-day experiment.

Lastly the subjects would play their roles in the experiment. The goal of the experiment would be to obtain all types of volunteers ranging from race, age, and sex, whom would not mind being watched under close proximity for a span of a month. Men and woman from all over would be asked for first undergo a preliminary evaluation to

ensure the safety of others. Once the subjects were acquired they would then be transported to the AJ facility and assigned rooms. After that they would only we asked to participate in a number of smaller experiments throughout the day that would be proctored. Afterwards the experiment would hope for the subjects to try to engage in everyday normal activates so they would feel like they were not being watched. When the subjects go off and do trivial things such as the act of brushing their teeth or watching a TV soap opera, their brains would normally go to work without the subject feeling he or she is having to perform at a certain level. Both the “experimental” and “non-experimental” portions of the thirty-day stay would be closely monitored and researched by the experimenters and the conductors. With multiple cycles of the experiment being conducted enough data would be collected to exactly pinpoint what occurs in the brain during different tasks, thoughts, memories, excreta.

Potential Results and Impact

Once Project AJ ran its course an extent amount of research and data become available for researchers to process and ultimately provide great results. The entire subjects participated well in the experiment and for the most part the results were vast and enormous. At the beginning the subjects had some trouble becoming accustomed to living in the dormitories and having to repeat multiple experiments a few times a week, but with time they became more relaxed and had less of an experiment feel, causing the results to be better and more precise. With the subjects growing comfortable with their surroundings and better results being brought forth, the conductors were able to localize and realize what parts of the brain exactly corresponded with what. If a subject became saddened because they missed home, the exact location within the brain was found,

showing that being saddened for a personal reason and being sad for others, although they shared a region within the brain, didn't exactly come from the same spot. Advances such as these gave way in the cognitive field showing cognitive scientist isolated locations of the brain to where about 80% of all actions of a human being can be categorized. With that in mind, the experiment also opened key areas within the field of psychology. Once psychologist were able to exactly see where the occurrences of emotions such as aggression or sadness occurred exactly, they were able to more clearly help patients whom were suffering from all kinds of mental problems such as, depression, or whom were bipolar. Also the extensive amount of information helps shed more light on work for brain surgeons. The risk of undergoing in a brain surgery is always high, but the chances of it going array or damaging another part of the brain has become less frequent thanks the discoveries and findings of AJ. Clearly having AJ and her findings was a great-added bonus to many of these health and biological fields directly dealing with the a cognitive link.

As in any experiment some mishaps are bound to occur. While running experiment AJ we came across a few roadblocks that should not be overlooked and should be taken care of for next time the experiment is ran. One of our first problems we encountered was the range we were expecting in subjects. We were unable to incorporate many mentally disabled subjects due to the fact that we did not meet the requirements needed to facilitate them. In the future a section of the AJ test site should be blocked off to accommodate subjects of that caliber. Possibly holding more insight for patients such as them. Also no kids partook in the experiment due to age restrictions and the fact that the entire brain isn't developed to it's full capacity. Children should either be omitted

from the study altogether or found a way to test as well. Lastly, some data went missing while AJ experienced an information overload. To avoid this next time AJ's ram and hard drive need to increase a bit in size to accommodate more information being submitted at all times.

As whole AJ was a success and with more years to come she will be able to provide more information as more versions of her are made. Many trials need to be made in order to succeed in the end, but developing an actual serious of experiments that could entirely put the human brain clearly in perspective to others would a majestic finding involving functional aspects of neural systems and being able to defined in terms of their behavioral context.

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Student Y - Example of "does not demonstrate ability"

Running head: The Neural Mechanisms in a Robot

The Neural Mechanisms in Robot

In APA Style

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University of California, Merced

Introduction and Background

The subject of artificial intelligence is a term linking the cognitive science and computer science worlds together. We use technologies amazing abilities to form replicas of the human brain in order to create things that might be able to function like a human are able to do. Artificial neural networks were created in the 1960s and were an early version of the cognitive approach of perception. (Arbib p. 22) All which are now the apart of the foundation for Artificial Intelligence. With what we have learned about the human mind over the recent centuries, that cognitive functions are theorized as emergent properties of neural systems.

Our goals as cognitive scientists are to try and figure out how the brain works so we can reproduce it. By using computers and machines we have been able to experiment and design schemas and patterns of how the brain and mind work. Neural networks are scientists attempt to recreate how the brain models information and what biological systems such as parallel processing. Parallel processing uses sensory memory to control output data.

Neural networks through out the brain are responsible for the interconnected elements which process information, while adapting and learning from past behaviors. It is with these networks that we are able to learn through experiences that we have and behave accordingly. With the embodied approach we are able to use our cognitive abilities proceeding accordingly. Weighted connections and hidden unites create input nodes. Input nodes and output nodes attach to each other by weighted connections. Animals (including humans mostly learn from experience, not rule-based

instruction. Connectionist networks also learn from experience. Learning occurs by modifying connection weights between units.

Another approach that uses the connectionist approach is the Hebbian-like learning approach. This approach stores multiple patterns within the brain's complex structure. It also completes patterns from missing or noisy inputs. It is considered another kind of content addressable memory. (Marcus, p. 422) Hebbian unsupervised learning concludes that "cells that fire together wire together". He believes that if two units are correlated then their connection weight will automatically increase. Another approach that is used by a study at brown touches on behavior based robotics.

This research creates their robots that are situated in the sense of needing to respond now to the environment and that have embodied meaning that the agents have bodies that are constant, dynamic relationship with the world. They used optic control in order to control their "animal's" actions. During our brain's process of learning input and output pairings of units, one has to understand what something is to learn its actions and behaviors. This learning approach also adjusts weights to minimize error. We are able to use these connections in order to create a robot that can do what we tell its brain to learn how to do. For example, if we were able to create a robot that can navigate through all different terrains and be able to video tape something bad that is happening through out a city then we would be able to decrease the amount of police that we have for patrolling the streets. The robot would be able to detect warm blood levels of humans and high heart rate increase do to stressful situations, it would also be able to read mouths, and would be able to distinguish words like "help" and "police".

There is a study done by scientists on the genetic neural network of a driven robot.

With these structures it would be amazing to be able to create a robot that would be able to teach itself what to do. In a study done by Dario Floreano and Francesco Mondada, we can provide the robot with a set of simple behaviors further behavior-modules can be added on the top of these primitives and connected to them via simple excitatory or inhibitory skills. (Floreano & Mondada, 1994) Using the robots cognitive abilities we would be able to teach it a set of skills, which it would react to through it's neural activity. The best way, this study uses in order for robots to navigate is using optimal solutions for robots to adapt to. This gives their robot the ability to develop suitable control system, define their own goals, and possibly, perform self-monitoring.

Proposed Project

The basic idea of this project is to use situated approaches in order to create a robot that can help protect people. It would be able to navigate around different terrains using the connectionist approach of cognitive behavior. The robot would be able to sense when something bad was happening and notify the authorities. They would know of its location because the robot would have a GPS tracking device installed in it. What is interesting about this is if we were actually able to make a robot be able to sense and behave like a human does cognitively then would have limitless possibilities of what we would be able to have robots do.

We could have them become civil servants, picking up litter around cities and parks, helping authorities, possibly monitoring traffic even. The subject of Artificial Intelligence is vast and if we can succeed in conquering the blocks that are in place now technologically then we would be doing society a favor. For robots to have the ability to

learn from their experiences gives them many options of behavioral results through their cognitive intelligence. Without understanding how the brain works scientists would have no been able to take the steps in creating neural networks and algorithms, which represent human brain activity. We would learn from this experiment that Artificial Intelligence could be used to benefit the world socially, economically, and medically.

Project Methods

This experiment is going to start off by paying the best scientists in the cognitive intelligence and artificial intelligence worlds. They will then map out how our robot is going to function. The will use steel reinforced titanium for its skeleton and shape. The activity of one neuron from a certain stimuli can create change within the entire brain. With this fact we can deduct that our robot will act the same. It will react to everything that it comes into contact with by means acquisition. Our robot will see its stimuli, decide what it is and if it can learn from it first. Our robot will be able to decipher language through natural language descriptions of spatial situations, which can be viewed as mental and internal representations of actions.

Using the Three Laws of Robotics I will guarantee that our cognitive thinking robot will never use its powers to harm humans. He will serve as a means to protect them and only help them when necessary. Every time that our robot thinks cognitively it will be using its neural networks. The neural network receives a number of inputs from original data. Then each input weighs a different amount because each experience is different. After the neurons are places through a post-synthetic potential the activation function is

passed to produce the output neurons.

Our robot is going to have the cognitive abilities much like a human, capable of seeing and understanding what it sees. It will be able to tell in what emotions and actions signify panic and fear, so it can determine if someone needs his help or not. Our robot will have a design with the ability to navigate itself around making it mobile. It will have 6-8 wheels making traveling easy on multiple terrains. Our robot will also be designed to understand traffic signals, making it an educated pedestrian. Also, this robot will have to be fast, and have a defense mechanism for people who would want to destroy it.

With this in mind the robot will use what it reads about a person to understand them and what it that person wants from the robot. Our robots cognitive abilities are going to be similar to that structured in the human brain. It will have the ability to store short-term memory and long-term memory using the biggest part of the brain, the cerebrum. The brain controls your voluntary muscles, which is very important in our robot. “While psychologists and biologists are concerned with understanding the mechanisms that enable humans and other organisms to navigate, the goals in robotics research are to provide robust and efficient means to achieve navigational skills in technical applications. (Werner et al, 1997) Therefore, if our robot can navigate around without the help of human support then our goal will be succeeded.

Potential Results and Impact

The results of this project could go either way. Our robot might be able to use the connectionist approach in order to learn how to maneuver throughout the streets and

protect citizens. However, we cannot be sure that our replicas of the human brain will work the same because it is not a human brain it is artificial. It is also challenging to determine if it will be able to do this successfully. Creating the brain structure with of this robot using input and output neurons we are able to say that our robot uses cognitive functions which we are learning more about and more everyday. These cognitive functions are translated in neural networks. If our robot works properly cognitively, then it proves that these neural networks are valid and that they can be created in order to replace the human mind.

This robot if created would be like a RoboCop, but without the ability to harm people. It would be a peaceful member of the armed forces, only seeking to aid victims in need and keep equilibrium within cities. Problems with Artificial Intelligence and this experiment are complex. We are still unable to make a robot learn and function with cognitive abilities. Every human mind observes things and reacts to them differently. Which is why it is so challenging to determine how one brain is structured because all brains are different because of the different stimuli and experiences that they have gone through.

Robots are challenging to make function properly because the human mind is so complex. “Most of available robots tend to break down in these conditions and are not capable of self-repair, as biological organisms often due, so in the eyes of evolution they will not last. (Floreano & Mondada, 1994) A positive outcome from having a robot like this would mean less money training and employing police, the robot will be doing its work for free. Also, the number of accidental police deaths might decrease because of the robot’s existence. With the robot we would be able to help innocent victims of crime and

gang violence city streets would be well looked after by a peaceful subject. Scientifically, creating a robot with these abilities would change how our world functions. Artificial intelligence is the next step in evolution, creating servants, which are expendable and that have no meaning of life.

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VIII. APPENDICES

APPENDIX 1: CUMULATIVE ESSAY ASSIGNMENT PROMPT

Core 1: The World at Home Cumulative Essay Assignment

Due Date: Week of 5/11

To guarantee it's your own work, don't forget to submit your work to turnitin.com.

The Cumulative Writing Assignment is an integrative "capstone" essay in which you'll address a common theme (or thread) in the course and trace it through examples from across term. **The Cumulative Essay should be about 1800 words (roughly 6-8 pages), with at least 2/3 of a page devoted to each example/focus. It must *examine SIX examples/foci from at least FOUR different modules*, must be guided by *a thesis paragraph* that elaborates your theme/thread and gives an overview of your essay, and must *conclude gracefully* (with a well-elaborated parting comment).**

Specify a thread that you see running through the course. This could reflect a combination of a few lectures and readings, or a common idea that appears in each module. (A topic might be, for example, "the unintended consequences of innovation," or the extent to which a series of lectures/readings relate to a specific place, time, item, artwork, etc.) Because of the distinct challenge of such an assignment—in a sense, your job is to connect human history from its origins to its uncertain future—you are encouraged to start looking for and developing threads as soon as possible. The following are some suggestions for how you might brainstorm a thread to explore in your essay:

- Browse through your reflection papers: Are there any interesting patterns of thought, connections between materials, and/or implicit themes between entries?
- Check out the Core 1 syllabus and the "Topics Synopses" document on CROPS for brief descriptions of the modules and lectures (see Resources Folder). What recurring themes do you see?
- Look over your weekly assignments. Which ideas or assignments interested you the most? Is there a way to expand a smaller project into a larger one? Do any of the projects fit together in some way?
- Look over the "Recipes for Theses" in Tom's "Zany Miscellany of Essay Wisdom" (#s 8-11). Consider how you might build an essay "from the ground up," or, alternatively, "from the top down." (see overleaf)

Note: As long as it is germane to your theme, you may draw upon (and/or integrate material from) your previous writings in Core 1.

Support your thesis/theme with specific discussions of documented examples. Avoid making blanket statements; use the body of the essay to elaborate particular foci in depth—using quotes, data, and concepts that are fluidly explained.

Core 1 Cumulative Essay Rubric (50 points possible)

Name:_____ Section: _____ Date: _____ ____ Meets Length Requirement
____ On time: paper & turnitin
____# Drafts ____ Proper formatting/citing

CRITERIA	"A" (10–9) > outcomes "B" (8–9) = outcomes "C" (7–8) ≤ outcomes "D/F" (<7) < outcomes
SYNTHESIS (making connections): Writing includes thesis (controlling argument), specific claim(s), development of ideas, and appropriate evidence from all required sources (foci, modules); integrates and relates diverse, cross-disciplinary perspectives ranging from the sciences to the arts (10pts = 20%) COMMENTS:	
ANALYSIS (critical thinking): Writing includes logical reasoning; critique and interpretation of relevant sources; balance of evidence and explanation; demonstrates understanding of scientific, historical, and/or artistic course material (10pts = 20%) COMMENTS:	
ORGANIZATION (fluency/form): Writing shows logical, progressive coherence (ease of understanding), orderly cohesion (arrangement of parts; transitions), effective introduction and conclusion (10 pts = 20%) COMMENTS:	
PRESENTATION (style): Writing conveys clear purpose; shows effective word choice; negotiates brevity and explanation (tightening or expanding as necessary to produce clarity), awareness of critical method and academic audience (10 pts = 20 %) COMMENTS:	
RHETORICAL CONVENTIONS (mechanics, documentation): Text is free from errors in grammar, punctuation, spelling, and usage; smoothly integrates evidence and incorporates in-text documentation; incorporates advice for revision; includes correctly formatted Works Cited page (10 pts = 20%) COMMENTS:	
GENERAL COMMENTS:	**TOTAL:**

APPENDIX 4: EXAMPLE STUDENT WORK

High

ESSAY F: Boundless Knowledge

The names of which we classify people, animals, and all things often act as clear reflections of us, rather than providing a clear representation for them---such that our systems of classification, though extremely comprehensive, may excessively objectify things, unfortunately hindering instead of helping society. Within the many voyages of understanding the many knowledgeable concepts and ideas of the world people inevitably begin to categorize and correlate common foundations of conventional knowledge based on highly objective standards and viewpoints. One essential danger of classification is the ramifications that so often cause indispensable abstractions of knowledge to be found unimportant, bounded to ignorant barriers of the personal inclusive or exclusive limits of knowledge people individually construct.

Taxonomy, known as the science of classifications, represents a key illustration of how failing classification systems inadequately diversify information in ways that exclude other forms of essential information, causing the classification system to be incredibly inaccurate. Linnaean taxonomy is biological classification, which utilizes the taxonomic ranks of kingdom, phylum, class, order, family, genus, and species to categorize and classify life systems. Many issues arise within the action of classifying due to the extreme inaccuracy that can possibly transpire. Carl Linnaeus, Sweden botanist, physician, and zoologist of the 1700's, scientifically classified different species according to their physical features. Linnaeus's classification system and his formal system of naming species, technically known as binomial nomenclature, is in continuance revision because of it's inaccuracy of biological classifications. Linnaeus writes in his *Introduction to Systema Naturae* that " the science of nature supposes an exact knowledge of the nomenclature, and a systematic arrangement of all natural bodies" (p.2). To be accurate and thus valid, Linnaean classification must solidify classification in general—that is, it must

reflect/represent all other classification schemes.

Linnaeus's knowledge was inherently limited because he did not have access to such scientific concepts as DNA (Deoxyribonucleic acid) sequencing, nor did he travel very far. So his classification system was actually quite subjective. An instance of subjective, cultural classification resulting in controversy and inaccuracy occurred within the San Juan Puerto Rico, within the easternmost Caribbean Island of Barbados. The world's tiniest snake, claimed to be discovered by a U.S scientist who later named the snake after his wife, classifying it as, " *Leptotyphlops Carlae,"* the world's smallest snake. Soon after this "discovery" a forty three year old Barbadian claims to have seen the snake in his early childhood, and stated that this newly discovered snake was in fact a well known snake to locals, identified as the "Thread Snake." Linnaeus states that we "form just conclusion from things as they present themselves to our senses" (3). Though, our senses alone cannot be definitive, resulting in confusion, and inaccuracy, similar to what occurred within the Barbadian Snake situation. As a result, the systems by which people categorize complex species are inaccurate due to the high variance of the organisms being classified and, moreover, the limitations of the classification system. This is particularly clear when Linnaeus attempts to classify Homo sapiens. Using and extremely biased and extremely subjective system of classifying Linnaeus writes concerning his observations of different racial features, which sound quite discriminatory and biased. He writes, "*Holientots*" (Black people), appear to be less fertile, while supposedly appearing negligent, governed by caprice and also appear to be quite "crafty" (Hothem). Just as the biological classification system of Linnaeus, which functions solely off physical characteristics and general, "obvious" commonalities, people of different cultural and sociological characteristics are commonly and inaccurately classified.

Well known sociologist Kevin Browne, writes within his article *Introducing Sociology*, concerning the true meaning of the trade, " sociology is the systematic (or planned and organized) study of human groups and social life in modern societies…sociological research has shown many widely held 'common-sense' ideas and explanations to be false (p.2)." With this, Browne defines the study of sociology to be more than the mere study of the social aspects of people; he exemplifies this type of educational focus to be closely examining the different conventional concepts of knowledge in relation to all different types of people, cultures, and diverse characteristics. As living members of society, people all share conventional foundations of knowledge towards various social institutions such as, family life, the education system, and religion. With possessing these common strains of knowledge, people constantly overuse the purpose of classification and categorization. After making different forms of knowledge concerning different types of people and concepts easier to understand and more relatable to people, classification shifts into a negative and powerful force, known as stereotyping. From, "Ideas such as, that there is no real poverty left in modern Britain; that the poor and unemployed are inadequate and lazy; that everyone has equal chances in life …" Classification construes into complete, inaccurate stereotyping of different types of people who share many commonalities along with dissimilarities. The invalidity of the "common-sense ideas" people characterize others according to, "constantly change over time in different societies (Browne)." Due to this continuous shifting of ideal and outlook, accurate, solid grounds of classification according to people, can never truly be accomplished. From a sociological viewpoint, one must look at sociological concepts using the "sociological imagination," observing different forms of knowledge and people in unfamiliar ways, from different angles, outside of the conventional viewpoint.

Media companies act as effective outlets of information concerning the world we live in, though too often this information is communicated at the expense of objectifying people, further distancing us from one another. The illusion given from another concerning a knowledgeable subject can ignorantly control a whole society's personal opinion and viewpoint. Through different strains of media, mainly those that involve visual display, people are constantly misled and falsely educated concerning the world around them. For instance, one stereotypical, classification extremity, which empowers much controversy and discriminatory attitude within America, is "Terrorism." People classify groups of individuals as villainous, terrifying, evildoers because of what they are shown on television screens through heavily biased communication strains of media. Academic novelist and critic Raymond Williams, effectively illustrates the social ramifications of society falsely feeling at distance from the global horrors and disasters taking place within their midst, " deprived of its actualities, television stood its reporters in the streets outside closed doors, constructed models and panels in its studios, and showed film from Argentina." Williams writes concerning the disturbing and heavily filtered images people view on the television screen. These images create illusions of extreme distance to viewers, causing all personal responsibility and true knowledge of the falsely depicted events to be nonexistent. So simply, the horrifying devastations of war caused by a nation of people can be "on a comparatively small scale" because of falsely classified righteousness and illusionary "distance." Screens dramatize how separate people truly are from what occurs around the world. The dreadful global disasters and kidnappings of children on television are not actually taken account of until the missing child becomes the next-door neighbor's son or one's younger sibling. When one classifies a race or certain type of individual on the basis of heavily biased representations, an essential sense of reality is lost. Building a solid perception upon cracked foundations of

inaccurate and filtered perceptions further falsifies the knowledge being established.

Classification can possibly make complex concepts, ideas, and forms of knowledge easier to comprehend, though it also misconstrues such large concepts into inaccurate summations of conventionalized knowledge. During the filtering process of classification, many essential details and contributing factors are lost and unaccredited while people classify and seek to isolate personal ideas. Often with trying to achieve simplification of an idea or visual complexity, people disregard imperative truths. Classification further devalues and simplifies essential contributing factors concerning certain bodies of knowledge about people, cultures, and ideologies. Subcultures constantly face this disadvantage with being understood within society because their foundations that they exist upon themselves are rarely understood or acknowledged. Subculture exemplifies a group of people with a culture that differentiates from a larger culture, which then causes the subculture to be alienated, and conventionally classified into a certain "group of individuals" or category. 1950's media theorist and sociologist Dick Hebdige, writes so congruently concerning the connection between the hybrid music and culture form of Punk in relation to Reggae music origins of the West Indies. Within *Meaning of Style*, Hebdige writes concerning the many inaccuracies people attribute to the punk sub-culture and music form, classifying the music form as strictly white and just another "post-war subculture." From, "Indeed, even punk's epiphanies were hybrid affairs, representing the awkward and unsteady confluence of the two radically dissimilar languages of reggae and rock," the clear hybrid elements of punk cannot be ignored, neither back shelved as insignificant factors in the creation of the punk art form. The fusing of such dissimilar music forms causes ultimate classification to be unachievable due to the many different contributing origins that created he Punk music form. Concerning the open alienation punk received, Hebdige writes, " In punk,

alienation assumed an almost tangible quality. It gave itself up to the camera in ‘blankness’, the removal of expression, the refusal to speak and be positioned (p.29).” In attempt to solely classify and stereotype this vivid, hybrid art form into only “punk,” society encounters great difficulty due to it’s openness and faceless identity. Punk exists to be more than “white” music, characterized as solely rock and roll based and influenced. Hebdige concludes the essentiality of the two art forms intertwined as, “punk and the black British subcultures with which reggae is associated and connected.” He writes, “The dialogue between the two forms cannot properly be decoded until the internal composition and significance of both reggae and the British working-class youth cultures” are understood (p.29). Assertion of the necessary essentials of possessing every contributing element during the attempt to classify a hybrid form of music is clearly evident. Hebdige illustrates that proper inference to simplify such a complex structure as the “Punk” sub-culture, cannot be valid unless all origin, history, and contributing factors are included and evaluated.

The dangers of classification truly lie within the biases of the individuals classifying. According to one individual or groups of individuals, certain knowledge is deemed important, insignificant, false, true, “good,” and “bad.” Often times the knowledge that is socially unacceptable and shushed within many learning communities illustrates the truly essential knowledge people falsely isolate as inappropriate or useless. For instance, University of California Merced Natural Sciences Professor, David M. Ojcius writes within a lecture concerning the many infectious sexually transmitted diseases within the Northern California Central Valley. Ojcius effectively illustrates the many infectious diseases being spread within the youth communities of local residential and educational areas, and also points out the lack of education and knowledge being provided concerning such serious conditions. He writes,

"Infectious diseases are still with us," following with, " Human behavior is responsible for many old and emerging diseases." From this, one immediately understands the important roles people play in the spreading of infectious disease. Classifying certain types of knowledge as harmful, unimportant, or unnecessary creates and implicit danger upon those who do not receive vital knowledge. Classifying certain types of knowledge into bounds of inclusive and exclusive exposure to specific individuals constrains helpful information and often destroys the advantages of possessing such knowledge.

The ability to wonder if such a concept and aspect such as knowledge can every be fully known and receive accurate classifications among its many complexities, exemplifies the beauty of knowledge without bounds of socially classified constraints that manage the different ways one must think and view knowledgeable concepts. Within Carl Sagan's *Can We Know the Universe?* The innumerable abilities and inabilities of humanity are exemplified, concerning the possibility or impossibility of human kind ever truly knowing all complexities of knowledge about the universe. In relation to the dangers of classification, Sagan illustrates concerning the potential mental and social barriers of "conventional wisdom," writing that knowledge "requires courage—at the very least the courage to question the conventional wisdom." Like sociological analysis, Sagan writes one must think scientifically, examining the world critically "as if many alternative worlds might exist, as if other things might be here which are not." Sagan writes so clearly concerning the importance of stepping outside the mental boundaries people within society create and enslave intellectual capacities to. The conventional knowledge masks itself as a helpful tool to understand the world and social concepts within it, while it deceivingly constrains people into mental biases, which clouds one's vision and causes essential details to never be recognized or sighted. Classification implies that people have some absolute knowledge

concerning the universe and those functioning within it. Sagan writes, “ Understanding is a kind of ecstasy. But to what extent can we really know the universe around us?” People yearn to understand and possess the right to curiosity, to gain any extent of possible knowledge, though the true dilemma dismisses any faulty attempts to classify such unknown capacities of knowledge due to the fact that such complexities can never be solidly known. “So in this sense the universe is intractable, astonishingly immune to any human attempt at full knowledge. We cannot on this level understand a grain of salt, much less the universe (p.2).” As Sagan gracefully explains, I myself,“ like a universe that includes much that is unknown and, at the same time much that is knowable (p.3).”

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Middle

ESSAY L

Evolution can be related to almost anything because the term evolution has multiple definitions. Whether discussing the gradual change of a species over time or relating the theory to simple ideas like the creation of the universe, infectious diseases, or the way people function in society, evolution can be looked at as a correlation connecting all of these ideas. It can explain how a species evolves over time, how ideas become developed, how a disease can be spread and how the progression of society's ideas can be advanced.

There are many theories on how the universe was created and over time the theories have changed and become more advanced. The theory of evolution is introduced in the "Origins of the Universe" in the sense that the definition of evolution is "the process of working out or developing an idea" (Merriam Webster). In Steven Hawking's article "Our Picture of the Universe" Hawking writes about the evidence that different philosophers have come across in order to develop their own ideas on the structure of the universe. "As long ago as 340 B.C. the Greek philosopher Aristotle, in his book *On the Heavens*, was able to put forward two good arguments for believing that the earth was a round sphere rather than flat" (Hawking, 725). Aristotle was one of the first people to develop the idea that the earth was spherical and not flat and that the earth was the center of the universe. "Aristotle thought that the earth was stationary and that the sun, the moon, the planets, and the stars moved in circular orbits about the earth" (Hawking, 725).

Theories are always subject to change for betterment, but they are not facts so throughout different centuries if new evidence is discovered than the theory is subject to change and is advanced, so in a sense it evolves. Over time Aristotle's ideas were expanded upon and were further developed. "This idea was elaborated by Ptolemy in the second century A.D, into a

complete cosmological model. The earth stood at the center, surrounded by eight spheres…" (Hawking, 275). Aristotle's idea was further developed by Ptolemy when Ptolemy built a cosmological structure explaining and illustrating how the earth was the center of the universe, Aristotle's idea was evolving because over time it was becoming more developed and details were getting worked out. The idea was further evolved when Nicolas Copernicus entered the picture, "A simpler model, however, was proposed in 1514 by a Polish priest, Nicolas Copernicus….His idea was that the sun was stationary at the center and that the earth and planets moved in circular orbits around the sun" (Hawking, 726). Copernicus developed a different notion based on Aristotle's original idea but his concept was different than Aristotle's and was later proven to actually be true. The idea of the earth being the center of the universe developed based on the contributions of Aristotle and Ptolemy's ideas and later evolved to the actual revolution of the universe around the sun based on Copernicus's findings.

The concept of the universe can be thought of in different stages. In Edward Harrison's article "Creation of the Universe," Harrison describes the universe in a variety of steps similar to the human life cycle and explains how cultures have different myths on how the universe was created. The universe is born (cosmogenesis), it goes through infancy (cosmogony), senility (eschatology) and later dies (cosmothanatos). "Cosmogony (evolution of the early universe and the formation of structure) and eschatology (evolution of the dying universe and the dissolution of structure) are long-established subjects of scientific inquiry…" (Harrison, 515). Throughout time the universe will evolve into these different stages and will eventually die. This exhibits evolution because the universe has gradually gone through different stages and has grown older. "In the myths of later ages, the living and nonliving things tended to be distinguished, and creation occurred as a sequential process, often as a twofold act, in which living and nonliving

worlds were created separately" (Harrison, 515). This exhibits evolution by the definition of evolution being "the process in which the whole universe is a progression of interrelated phenomena" (Merriam Webster). In time as the universe evolved living and nonliving things became distinctly separated, and because of this evolvement, humans and life forms have also evolved.

The gradual change in a species over time is the most fundamental definition of evolution. In the origins of species the theory of evolution doesn't change but it explains the change that takes place from generation to generation in life forms. Over millions of years, organisms evolve and their evolution presents different species that exist with favorable traits in environment that they need to survive. This can be thought of in terms of natural selection and can explain "The Origins of Life." In "Natural Selection and Variation," chapter 4 in Charles Darwin's book *The Origins of Species,* Darwin writes the correlation of natural selection and evolution. "Natural selection drives evolutionary change and generates adaptation" (Darwin, 75). Many organisms have become adapted to their environment through evolution and have to compete with different species in order to survive and those with the most favorable traits will reproduce and pass genes on to offspring. "In summary, organisms produce more offspring than given the limited amounts of resources-can ever survive, and organisms therefore compete for survival. Only the successful competitors will reproduce themselves" (Darwin, 74). Through natural selection organisms with favorable traits and high survival rates are able to reproduce and pass genes throughout generations. This happens due to evolution because the organisms over time are able to evolve into more complex organisms and have a higher chance of survival. Variation is the different attributes that a species has in a population that gives the species a range of diverse characteristics like different body sizes, shapes, or color. "The extent of

variation, particularly in fitness, matters for understanding evolution" (Darwin, 81). Understanding variation in a population helps to understand evolution because they are associated with one another. In biology everything is said to have evolved from one simple organism into more complex forms, and if this is so then variation has come about through evolution. When organisms evolve over time the organisms become more advanced and began to show variation in traits and characteristics, thus relating variation to evolution.

Apart from describing the creation of the universe and the origins of species, evolution can also be correlated with the "Origins of Societies and Culture." In a social context, evolution can be defined as "the process of gradual and relatively peaceful social, political, and economic advance" (Merriam Webster). In society people act or behave a certain way depending on the environment around them. People's attitudes and behaviors evolve based on the era that they are living in and change over periods of time. In Dick Hebdige's article, "Subculture: The Meaning of Style," Hebdidge discusses the role that the evolution of rock punk music played on the lives of London youth. Punk music was an evolvement of different types of music ranging from glitter-rock, London pub-rock and different bands like the Ramones, Heartbreakers, David Bowie and others. "Not surprisingly, the resulting mix was somewhat unstable: all these elements constantly threatened to separate and return to their original sources" (Hebdige, 25). Different genres of music all evolved into one type of music, punk, and from this mixture people's attitudes started to change and they developed a subculture.

Another evolution of society is when people form social movements. Like the social definition of evolution states, people want to advance socially, so they protest to reach common goals in society. Throughout the years different protests have been established for unique reasons and these reasons have evolved throughout the decades. In Simon Weffer's lecture, "Social

Movements," Weffer discusses how social movements are formed, why they are formed and different reasons why they come about. "In the 18th century we see the rise of three new types of protest that change social movements; Boycott in America: Boston Tea Party, petitions in England, and the urban insurrection in France" (Weffer). Over these different decades the reasons for protesting have changed, and protesting has evolved in the sense that throughout time distinct needs were changed from generation to generation so common goals protested, changed as well.

The evolution of social movements can explain why people protest for different issues. In individual decades, problems are relevant pertaining to society at the time. In the 18th century individuals in America boycotted and formed the Boston Tea Party in which people petitioned taxes. However, throughout different decades and years, issues have changed according to people's attitudes. For instance, in present day taxes aren't protested as much, and some common issues include advocating pro-life and rights for homosexuals.

Evolution can also describe how some diseases and infections can spread and get worse. In the module "Individuals and Societies," there is an article called "Can Chlamydia Be Stopped?" written by David Ojcius, in which he discusses the STD Chlamydia. "This illness caused by a strain of Chlamydia trachomatis (the species that also causes STD's)- can lead to trachoma, a potentially blinding disease"(Ojcius, 1). The disease Chlamydia starts as a simple form and later adapts and evolves to something more fatal if not cured. This is why individuals have to evolve in a way so that they don't catch the disease or any disease for that matter. Vaccination is the most common way to avoid most sicknesses and in a way can be considered an evolution because individuals are able to change their original body functions to a function more favorable to fight disease. "Vaccines prevent illness by priming the immune system to react

strongly to specific disease-causing agents, but in this case, the inflammatory component of such a response could do more harm than good"(Ojcius, 2). However, in the case of Chlamydia vaccines cannot be used so individuals turn to another solution, and are introduced to antibiotics. In Bruce Seeman's article "Texas Flu Researchers Test 'Herd Immunity' Theory," Seeman writes about the usefulness of vaccinations and how effective they can be against the spread of disease. Disease evolves by being spread from one individual to another individual in a society. "'Once flu is introduced into a school, the virus will spread very readily, and the kids will take it home,' Glezen said. 'It is well established that this is the way flu is spread'" (Seeman, 1). Because of spread from human to human the flu is able to survive and reproduce causing more and more people to get sick and causing different variations by evolution. "Different flu strains move through the population each year, so vaccinations would need to occur annually unless scientist can figure out a way to make vaccinations longer lasting" (Seeman, 2). Unlike Chlamydia, there is a vaccination for the flu, but because there are different variations of the flu it can evolve rapidly so scientist need to find a long lasting vaccine to protect against the infection. If the vaccine doesn't last long enough then flu will evolve into another form and a new vaccine will have to be introduced each time that happens.

"Evolution is a gradual process in which something changes into something different and usually a more complex and better form" (Merriam Webster). Evolution is a concept that can be related to almost anything in the universe because after a while things eventually began to change. This change can be brought about through different theories, social events and diseases like discussed earlier in this paper. In this course evolution is a common thread that can be correlated to each of the modules because everything seems to evolve one way or another. Whether a theory is being advanced over time, an organism has evolved into a more complex

form, the goals and ideas of social movements have been subject to change over decades, or the way a disease is spread due to different strains brought about through evolutionary change, evolution is a common concept of each of these subject matters and seems as if it can be correlated to anything.

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Low

ESSAY I

Religion brought and brings irrational relief to the naive. When humans began to roam the earth they questioned their origins. These were also humans that didn't understand the way the universe and earth worked. When early minds started to understand how things worked they didn't understand where things originally came from and why they were there to begin with. It wasn't until the renaissance that hard evidence was presented about how and why things worked or why they even happened in the first place. Some cultures base their entire structure on respecting the unknown. Some scientists acknowledge the values of religion but they don't practice the religious conviction.

It is not difficult to imagine what early human beings though about. Many of the ideas they had are ideas that we still ponder about. The common questioning idea would be that of our origins. In today's modern society there are two theories that try to explain our origins. There is the theory described by the bible and Sunday school teachers. There is also the Big Bang theory proposed by scientists. These two theories are considered plausible by the two different types of people, each one with flawed arguments. The theory of origins explained by the bible is based on stories told by a third party. The person that wrote the bible claims to have heard the word of god and of his only son Jesus. It tells the stories of holy men and apostles following the word of god. At the beginning of the bible, Genesis, it says that God created everything in 6 days and made the seventh day a day of resting. He created man under his own image. People had blind faith that this was true even though there was no hard evidence to prove the bible correct. A similar explanation of origins would be that of the Egyptians. According to the Heliopolitans, Atem, or Tem, and at a later period Ra, was the Creator; according to Memphite theology he was Ptah; according to the Hermopolitans he was Thoth; and according to the Thebans he was Ammon.

From our lecture about creationism about “What is life and where it is” Judaism used a similar origins story to that of the Christians. That same lecture puts both theories in a set of categories, spontaneous creation and biochemical creation. The spontaneous is the same as that of the bible or the folklore stories of origin. The biochemical creation category is for scientists that believe life came from chemical interactions and correct local settings to allow for complex chemical life. People have organized the way to think about our origins.

People son developed philosophy. Philosophy is about “rational examination about un-testable claims” (God, science, and the Big Questions). Philosophy is a subcategory of knowledge. There is science, philosophy, and the purely subjective. According to Popper, science can be proven wring and therefore its theory of creation is more plausible than that of Gods. Some people might not believe that chemicals and natural laws created the whole universe and think that it was created by an intelligent maker. The design argument simply states the complexity of the universe is enough evidence to prove it true. The thing about religion and their teachings is that they are not all radical.

The religious community taught good morals. The one thing that the bible, in my opinion, that is worth noting is its moral stories. The bible, Qur’an, and other religious books have short stories that are meant to portray a strong message to the reader. It can convey strong will, to have patience, not to hate, and to not be judgmental. These are values that we are taught when we are young. We don’t need to from a religious background to know that it is wrong to accuse someone on false pretenses or to be hasty when something delicate is involved. These have become universal teachings. These are traits that we look for in people. We want scientists, politicians, clergymen, and doctors to have the same personal characteristics because then we could have soothing to relate to. It also gives off the sense that they are good people. From the

moral teachings of any religion, whether church or synagogue, they have taught that human lives should be preserved at all costs. The main reason for this is because they can be forgiven of their offenses or sins by the creator. The Christians and Catholics believe that being baptized will rid you of original sin and be pure in the eyes of god for as long as you live.

This is why there are people trying to cure diseases. This is the one area where scientists and the church agree on. That people should live healthy lives. They shouldn't worry about diseases and that their children will die early from an incurable virus. Researchers are always looking for ways to prevent diseases like malaria, chicken pox, different cancers, and the flu. Another thing that they both share is that they work for the people. They both work under a code of ethics. The scientist's code of ethics has been written by the public while the code of ethics for reverends, bishops, and priests are written in the bible. Although they have different ideals they are very similar in almost every aspect.

The oldest debate known to man is that of science and religion. It is argument that can't be won by either side because there are too many holes in either party argument. Religion has had the higher ground for several centuries. People only believed prophets and everything they said was true. People were punished if they strayed too far from the word of their creator either by exile or death. Science has and will always be the enemy of religion. It is true that there are several denominations where they trying to incorporate the truth of science with the philosophy of religion. Galileo Galilei was a well documented example. He suggested that the earth was the one that orbited the sun and that the earth was not the center of the universe. The Roman Catholic Church had astronomers that proved that the earth was center of the universe. Maps were drawn that followed the Catholic Church's teachings. Schools, ranging from grade to universities, taught what the Roman Catholic Church told them to. It wasn't until Galileo found

evidence that other planetary systems did the same as well. The sun was the center of this galaxy. It was blasphemous to prove official astronomers were wrong. He was trialed and Galileo gave up the fight in order to keep living a peaceful life and making new discoveries although he did become blind from staring at the sun through a telescope. It is difficult to tell whether either side will fully accept the other side's arguments for life.

Religion is going to be around for a very long time. It was created a long time ago to give people comfort. Everyone isn't a scientist and therefore won't be able to see things as a physicist would or a chemist and therefore they seek understanding from a higher being. Religion fills in the gaps that science hasn't solved yet or hasn't been discovered yet. What we do know is that the future will have advance medical technology that we probably wouldn't be able to fathom today. When they see a person on the verge of death and doctors have done everything they can but he manages to live they will be in awe. They won't know how to explain it even though they have done tests on the patient. They will "It's a miracle that this person has survived their ordeal". They don't and probably won't understand what happened in the patients bodied that allowed to them live.

Religion has proven a sturdy ideal through the centuries. Before the first coming of Jesus of Nazareth people praised other supernatural beings. Some cultures praised several gods that were rational like the rain god and sky god. There were some other unusual gods but they were created and prayed to every day because it explained something in the natural world that couldn't be scientifically explained. Religion influenced cultures from around the world. They took the words of their creator to heart and made sure they followed them. The past could have been better than today's society because they were under constant fear the god would ruin their lives and punish them if they didn't follow the Ten Commandments as told by the Old Testament.

People today have no respect for anything and have this idea that religion doesn’t have to do anything in their lives. Everyone has followed some religious moral value and will continue to do so in the future. As for the future, religion will be there as well. People will go to their churches and pray and have faith in a being that has no trace of existence. Scientists also want comfort and peace in their lives and they know that they can find it in god. Religion is in every nook and cranny of earth. I personally the scientific theories because I agree with what Popper says. The scientific theories can be disproven while the spontaneous theories you can’t. I prefer the having faith in an idea that can be disproven than in a theory that is based on short stories.

Appendix 1 – Rubric for evaluating EnvE course assignment relevant to assessing EnvE PLO 2

Criterion → PLO 2 component	Irrelevant 1	Some relevance 2	Relevant 3	Highly relevant 4
Critical thinking	Assignment is straightforward problem solving (e.g., self-contained problems)	Assignment is reasonably straightforward but requires some purposeful thinking or judgment to complete	Assignment requires purposeful thinking (e.g., reasoned assumptions) and interpretation of given information to complete	Assignment requires independent research and interpretation to gather information as well as purposeful thinking to complete
Problem solving engineering principles & reasoning	Problems are self-contained, require only one or two basic steps or operations, and solution is independent of prior knowledge	Problems are self-contained but require multiple steps or operations, and some prior knowledge from the current course	Problems are self-contained, require multiple steps or operations, and in-depth knowledge from the current course	Problems are open-ended, require critical selection of solution technique, and build upon prior knowledge from both current and previous courses
Scientific method	Assignment is self-contained and based on well-understood scientific principles	Assignment is self-contained and based primarily on sound principles, and/or scientific literature provided by the instructor	Assignment requires hypothesis formulation and testing using given observations or literature research, but does not require data collection	Assignment requires hypothesis formulation and testing using experimental design and data collection
Teamwork to solve environmental resource problems	Assignment is completed by individual	Assignments is completed individually but with at least one formal peer or instructor interaction or "check in"	Assignment is completed by a team and requires significant group organization, but no synthesis	Assignment is completed by a team and requires significant group organization, and synthesis

Appendix 2 - EnvE PLO-2 Faculty Course Assessment Reports

Faculty Course Assessment Report
EnvE 110 - Hydrology and Climate
Instructor: Dr. Robert Rice, Lecturer)
Fall 2009

Overview
ENVE 110 is an introductory course introducing Junior and Senior environmental engineering majors to the basics of the hydrological cycle and the global climate system. The fundamentals of surface water hydrology, groundwater hydrology, hydrometeorology, evaporation, precipitation, statistical and probabilistic methods, unit hydrograph, and flood routing.

Four undergraduates enrolled in the course during the Fall of 2009. Students were graded on a combination of class participation and in-class problem sets (20%), homework (30%), and exams (50%).

PLO – 2. *Critical Thinking: ENVE graduates will be adept at applying critical thinking, problem solving, engineering principles and reasoning, the scientific method, and teamwork to solve environmental resource problems and to restore and sustain the global environment.*

Appendix 1: *
Homework 5:
Average: 85%
Standard deviation: 5.77

Appendix 2:*
Exam 2-Question 5 (25 pts)
Average: 19
Standard Deviation: 4.8
Exam average: 84
Standard deviation: 9

Faculty Course Assessment Report
EnvE 130 – Meteorology and Air Pollution; 4 credits
Fall 2009
Instructor: Wolfgang F. Rogge

Catalog Description: Basic physics and thermodynamics of the atmosphere; fundamentals of atmospheric sciences important to environmental problems; chemistry and physics of atmospheric pollutants; visibility; air quality modeling; emissions; and air pollution control strategies.

EnvE 130 is a technical elective for undergraduate students in Environmental Engineering. In order to complete this course, students were required to do homework, multiple choice tests,

exams, and a mini project with presentation. Grade distribution was as follows: Two multiple choice tests, each could earn up to 10% of the total points possible. The mid-term exam could earn up to 20% of the total, the final exam 30%, homework 20%, and mini-project together with presentation up to10%.

PLO – 2. *Critical Thinking: EnvE graduates will be adept at applying critical thinking, problem solving, engineering principles and reasoning, the scientific method, and teamwork to solve environmental resource problems and to restore and sustain the global environment.*

Program Learning Objective 2 corresponds to five ABET based Course Learning Outcomes (CLO) of which three are directly assessed in the course by the instructor. These SLOs/ABET outcomes are:

a. Understand and apply the basic mathematical and scientific concepts that underline the modern field of Environmental Engineering;

b. Possess the ability to design and conduct experiments and to analyze and interpret data

c. Possess critical thinking skills, problem solving ability, and familiarity with the computational procedures essential to the field.

Grade Distribution:

A	B	C	D	F	W	Total
3	2	1	0	1	2	9

Course Assessment:

E (excellent) is scoring 90% or better of the total points possible, A (acceptable) is from 90-70%, M (minimal) is from 70-60%, and U (unsatisfactory) is anything below 60%.

CLO	Assessment Tool	E	A	M	U	Avg %	PLO	Type
a.	Short Test 1, question 1, math	6	0	0	1	86	2	Ex
	Short Test 2, question 7, chem.	2			5	36	2	Ex
	Short Test 2, question 20, chem.	5			2	86	2	Ex
	Midterm, Problem 2, ideal gas law	3	0	1	3	67	2	Ex
b.	Final, Problem 2, data interpretation	5	1		1	90	2	Ex
c.	Midterm, Problem 1, mass balance	1	0	2	4	64	2	Ex
	Midterm, Problem 4, mass balance, diffusion	1	1	2	3	63	2	Ex
	Midterm, Problem 5, light extinction	5	0	0	2	71	2	Ex
	Final, Problem 3, complex chem. reaction	3	2	1	1	85	2	Ex
	Final, Problem 4, critical thinking	3	0	0	4	57	2	Ex
	Final, Problem 5, mass balance, chem reaction	5	0	0	2	79	2	Ex

Assessment of Program Learning Outcomes for the B.S. in Environmental Engineering

Course: EnvE 160 Sustainable Energy
Instructor: Elliott Campbell
Semester: Fall 2009

Overview

The course EnvE 160 Sustainable Energy is a technical elective for the B.S. in Environmental Engineering (EnvE) and a recommended course for students in the Sustainable Energy track. Eleven undergraduates enrolled in the course during the Fall of 2009. Student work included homework, exams, online research presentations and a research report. Digital copies of all student work have been archived. Student performance on these assignments provides lines of evidence showing that the Fall 2009 semester of EnvE 160 has contributed to meeting Program Learning Outcomes for the B.S. in EnvE as discussed below.

PLO – 2. *Critical Thinking: EnvE graduates will be adept at applying critical thinking, problem solving, engineering principles and reasoning, the scientific method, and teamwork to solve environmental resource problems and to restore and sustain the global environment.*

Students applied critical thinking skills by creating and solving a quantitative problem that integrated their review of the literature on a sustainable energy topic with the fundamental problem solving skills they developed through homework and exams. Examples of high, medium, and low scores were provided to the EnvE Faculty Assessment Officer.* The grading on the quantitative problem was based on the problem set-up, presented solution, and format ting. The **high score (9/9)** has a set-up that integrates the problem, research paper and course material (capacity factor, fixed/variable cost, etc.), a solution that details all required calculations and units, and the formatting in Excel is clear. The **medium score (7/9)** has a set-up that is a good integration of material, a well-documented solution, but has some errors in assumptions and calculations. The **low score (5/9)** has a well-integrated problem but provides the problem set-up in the oral presentation and the solution steps are not well defined.

Appendix 3 – Example Student Work

Hydrology and Climate
ENVE 110
Fall 2009

Overview

ENVE 110 is an introductory course introducing Junior and Senior environmental engineering majors to the basics of the hydrological cycle and the global climate system. The fundamentals of surface water hydrology, groundwater hydrology, hydrometeorology, evaporation, precipitation, statistical and probabilistic methods, unit hydrograph, and flood routing.

Four undergraduates enrolled in the course during the Fall of 2009. Students were graded on a combination of class participation and in-class problem sets (20%), homework (30%), and exams (50%).

PLO – 2. *Critical Thinking: ENVE graduates will be adept at applying critical thinking, problem solving, engineering principles and reasoning, the scientific method, and teamwork to solve environmental resource problems and to restore and sustain the global environment.*

Appendix 1:

Homework 5:

Average: 85%
Standard deviation: 5.77

Appendix 2:

Exam 2-Question 5 (25 pts).
Average: 19
Standard Deviation: 4.8

Exam average: 84
Standard deviation: 9

Homework 5

You are a researcher at **I Am So Smart University**. You have read some recent journal articles that indicate that the seasonal snowfall has been decreasing across the Western U.S. Given this new information you are interested if this hypothesis holds across the Sierra Nevada.

To initiate your investigations you decide to examine the historical April 1 snow course records along a latitudinal and elevation transect, which extends from the Feather River to Kaweah Basins.

In order to begin your analysis you need to download the April 1 SWE for the entire period of record for each snowcourse site (listed below) from CDEC.

Feather River
Chester Flat (CHF)
Harkness Flat (HRF)
Mount Dryer (MDY)

American River Basin
Robbs Valley (RBV)
Upper Carson Pass (UCP)
Lyons Creek (LYN)

Merced and Tuolumne River Basins
Gin Flat (GFL)
Snowflat (SNF)
Beehive Meadow (BHV)

Kaweah Basin
Panther Meadow (PTM)
Giant Forest (GFR)
Mineral King (MNK)

Tasks:
Let's learn about snow distribution patterns.
1) Calculate the historical mean, standard deviation, and coefficient of variation for each site.
2) Plot the historical April 1 SWE mean for each snow course versus elevation within each basin, as well as the coefficient of variation. This will give you an elevational perspective for each basin.
3) Plot the historical basin April 1 SWE mean for all the locations across the Sierra to gain a perspective of the latitudinal distribution of SWE.

Is the April 1 snowpack declining across the Sierra Nevada?

1) In order to perform this analysis you need to examine each individual April 1 SWE measurement for each snowcourse for each year during the period of record by plotting April 1 SWE versus year.
2) Finally, write-up your analysis using the data you have analyzed. Does your analysis support the hypothesis of a decreasing snowpack?

In order to perform an adequate analysis you need to draw upon your knowledge of climate, climate change and the Sierra Nevada. In addition, draw some conclusions about the current and future state of the Sierra snowpack and the impact it will have on water resources across the State of California.

High

Analysis of Decreasing Snow Pack Hypothesis in the Sierra Nevada

Results

Feather River Basin:

The Feather River basin April 1 SWE was analyzed using the following stations and elevations from approximately 1930-2008; Chester Flat at 4600', Harkness Flat at 6200' and Mount Dyer at 7100'. The most significant decline was noted at Chester Flat, with a significantly smaller decline at Harkness Flat and an observed increase at Mount Dyer. The coefficient of variation for Harkness Flat and Mount Dyer was approximately .40 (40%) for the former and .43 (43%) for the later. This indicates a low variance for those sites. However, Chester Flat in the lowest elevation was 1.15 (115%) showing a high degree in variance for the site. This variability is important because it shows how the lower elevation site is particularly impacted by changes in rain vs. snow with each storm. This affects its overall SWE.

American River Basin:

The American River basin April 1 SWE was analyzed using the following stations and elevation; Robbs Valley at 5600', Lyons Creek at 6700' and Upper Carson at 8500'. Robbs Valley shows the most significant decrease, with Lyons Creek and Upper Carson experiencing very slight decrease in April 1 SWE. The coefficient of variation for Lyons Creek was .39 (39%), and Upper Carson was .39 (39%). These two sites are located at higher elevations and show low variance in the SWE. The value of coefficient of variation at the lower elevation site Robbs Valley was much higher, at .67 (67%). This is consistent with the Feather River Basin lower elevation site as well, showing that the lower elevation sites are more variable in their SWE.

Merced/Tuolumne Basins:

The Tuolumne and Merced Basins were represented by three stations; Beehive Meadows at 6500', Gin Flat at 7000' and Snow Flat at 8700'. The April 1 SWE was analyzed for the time period of 1930-2008. Beehive Meadow had the largest decline in SWE, followed by slightly less at Gin Flat. Snow Flat experienced a slight increase in SWE during the data period. The coefficient of variation for Beehive Meadow was .49 (49%) and Gin Flat was .46 (46%). The highest elevation Snow Flat was .38 (38%). The two lower elevation sites showed more variance than the highest site.

Kaweah Basin:

The Kaweah Basin in the Southern Sierra Nevada was analyzed using the following stations; Giant Forest at 6400', Mineral King at 8000' and Panther Meadow at 8600'. The April 1 SWE was used to analyze overall increase or decline during the time period 1930-2008. Giant Forest experienced a decline in SWE, while Mineral King increased in SWE. Panther Meadow appeared to stable over time. The coefficient of variation for Giant Forest at the lowest elevation was .73 (73%) and Mineral King was .64 (64%) and the highest elevation site has the lowest coefficient of variation, .44 (44%).

Analysis

The hypothesis proposes that the overall April 1 snowpack is declining in the Sierra Nevada. By looking at the elevational gradient in the Sierra Nevada , it is apparent that not all elevations are in particular decline. The lowest elevations, evidence by Chester Flat (4600ft) in the northern Sierra Nevada, Robbs Valley (5600ft) and Beehive Meadow (6500') in the central Sierra Nevada and Giant Forest (6400') in the southern Sierra Nevada, are in significant decline in the April 1 SWE. However the higher elevation sites such as Mount Dyer (7100)', Mineral King (8000'), and Snow Flat (8700') are all showing an increase in overall April 1 SWE. By looking at the coefficient of variation for each site across the range, there is a pattern of increasing variance at the lowest elevations, with the variance at its lowest at the highest elevations. This is indicative of a changing precipitation regime that is delivering more rain instead of snow at the lower elevations.

As temperatures are warming throughout the world, the impacts upon regional climate becomes readily apparent in the mountain regions. Warming temperatures cause the timing of the peak snowmelt to begin earlier than it has in the past. This timing is part of the reason lower elevations are experiencing a significant decline in April 1 SWE. Another reason could potentially be the shift in weather patterns that bring warmer air from the South, causing the rain-snow transition line to migrate upwards in elevations. This would decrease the overall snowpack in the lower elevations on April 1 as well. This trend is of critical concern in California due to the reliance of the state on the annual snowpack for water supply throughout the year. As the timing of the spring melt moves earlier in the year, the amount of water available for use will be significantly reduced in the late summer. Another impact is the ability of the state's water infrastructure to be able to adequately store the water from the earlier snowmelt without losing a significant portion of the water to the ocean.

The hypothesis that the Sierra Nevada snowpack is in decline has been validated by this analysis. Even though April 1 SWE is increasing in the upper elevations, the lower elevations are showing significant decline. This is troublesome due to the fact that if more storms deliver rain instead of snow, the overall snow water equivalent declines across the range and there might not be enough water to support agriculture, industry and residential applications in California throughout the year. The current snowpack in the Sierra Nevada varies from year to year, influenced by several larger scale factors, such as ENSO and PDO, and little is known about how these larger scale patterns may adjust to increasing global temperatures. Californians should be concerned about water resources and how the state is adapting to the changing conditions in the Sierra Nevada.

Feather River Basin

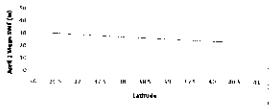
Harkness Flat	6200'		4800'		7100'				
	4/1 swe	Chesterfie	4/1 swe	Mt. Dyer	4/1 swe	elevation	Mean SWE	C of V	
1930	20.8	1930	8.1	1930	17.4	4600	6.35	116.33	
1931	11.3	1931	0	1931	4.2	6200	28.15	40.41	
1932	28.6	1932	8.5	1932	27.5	7100	25.45	43.85	
1933	28.6	1933	8.7	1933	19.6				
1934	10.6	1934	0.5	1934	2.7				
1935	52	1935	16.3	1935	26.2				
1936	26.7	1936	1.6	1936	21.7				
1937	13.2	1937	17.2	1937	31.4				
1938	54	1938	21.2	1938	51.2				
1939	18.4	1939	1.7	1939	11.9				
1940	37.9	1940	6.7	1940	25.7				
1941	32.2	1941	7.9	1941	35.2				
1942	28.3	1942	9.6	1942	26				
1943	33.9	1943	4.3	1943	28.4				
1944	25.3	1944	10.3	1944	23.3				
1945	26.9	1945	4.3	1945	20				
1946	37	1946	0.5	1946	28.4				
1947	11.2	1947	0	1947	9.7				
1948	21.1	1948	7.3	1948	19.7				
1949	29.9	1949	7.3	1949	23.7				
1950	31.1	1950	10.6	1950	27.7				
1951	29.8	1951	2.4	1951	18.9				
1952	33.1	1952	29.1	1952	32.1				
1953	34.1	1953	0	1953	28				
1954	30.3	1954	8.7	1954	27.6				
1955	17.3	1955	0	1955	17.1				
1956	47.9	1956	15.5	1956	42.7				
1957	22.5	1957	0	1957	18				
1958	42.2	1958	34.8	1958	37.4				
1959	21.2	1959	0.1	1959	19.2				
1960	24.4	1960	0	1960	15				
1961	28.2	1961	0	1961	23.2				
1962	36.5	1962	20.6	1962	35.8				
1963	6.3	1963	2.1	1963	8.4				
1964	21.4	1964	4.3	1964	18.2				
1965	28.5	1965	0	1965	26				
1966	27.3	1966	5.4	1966	25.1				
1967	33.4	1967	13.9	1967	30.8				
1968	24.5	1968	7	1968	20.8				
1969	42.5	1969	25.8	1969	43.7				
1970	24.1	1970	0	1970	23.6				
1971	39.8	1971	7.8	1971	37.7				
1972	25.8	1972	0	1972	16.7				
1973	31.6	1973	20.2	1973	29.8				
1974	38.6	1974	14	1974	39.8				
1975	46.3	1975	17.2	1975	33.8				
1976	24.2	1976	0.7	1976	9.1				
1977	6	1977	0	1977	5.9				
1978	41.3	1978	8.7	1978	40.1				
1979	26.2	1980	0	1979	22.4				
1980	24.3	1981	0	1980	28.9				
1981	19.8	1982	6.7	1981	18.6				
1982	54.4	1983	14.7	1982	57.8				
1983	28.7	1984	0	1983	24.2				
1984	24.8	1985	2.4	1984	21.5				
1985	29.7	1986	0	1985	14				
1986	21.5	1987	1.2	1986	18.1				
1987	9.1	1988	0	1987	9.7				
1988	25	1989	0.1	1988	21.1				
1989	13.1	1990	0.8	1989	9.7				
1990	20.1	1991	5.5	1990	19.4				
1991	15.1	1992	0	1991	15				
1992	39.1	1993	15	1992	42.5				
1993	15.3	1994	0	1993	15.4				
1994	49.4	1995	15.1	1994	45.3				
1995	23.4	1996	0	1995	19.7				
1996	39.6	1997	0	1996	22.1				
1997	40.7	1998	9.2	1997	43.4				
1998	31.1	1999	2.8	1998	35.7				
1999	28	2000	0.4	1999	33.5				
2000	15.3	Mean	8.154286	2000	17				
2001	29.8	S.D.	7.318497	2001	25.6				
2002	24	C of V	119.3314	2002	22.9				
2003	34.4			2003	34.2				
2004	23.4			2004	34.8				
2005	51.2			2005	34.7				
2006	30.2			2006	12.2				
2007	29.6			2007	18.1				
2008				2008					
Mean	28.15513			Mean	25.44872				
S.D.	11.87179			S.D.	11.1989				
C of V	42.40894			C of V	43.84856				

American I	5600'		5500		6700'				
Robbs Vall	4/1 swe	Upper Car	4/1 swe	Lyons Cree	4/1 swe	Elevation	Mean SWE	C of V	
1932	36.3	1930	30.7	1937	40.4	5400	17.95	67.69	
1933	32.2	1931	17.2	1938	47.2	6700	31.81	38.08	
1934	32.4	1932	43.7	1939	23	5500	34.35	39.26	
1937	37.4	1933	25	1940	30.8				
1938	49	1934	16.8	1941	32				
1939	19.9	1935	28.7	1942	37.6				
1940	13	1936	47	1943	35.5				
1941	22.5	1937	37.8	1944	24.8				
1942	22	1938	47.3	1945	26.8				
1943	25.5	1939	21	1946	42.3				
1944	24.2	1940	43.4	1947	19.9				
1945	23.3	1941	34.6	1948	22.7				
1946	30	1942	38.3	1949	37.1				
1947	4.8	1943	46.8	1950	32.2				
1948	19.7	1944	27.9	1951	51.7				
1949	23.6	1945	38.3	1960	22.4				
1950	11.9	1946	40.7	1961	19.8				
1951	12.1	1947	28.1	1962	41.4				
1952	8.9	1948	29.1	1963	9.8				
1953	20.8	1949	32.3	1964	21.7				
1954	8.3	1950	39.8	1965	17.3				
1955	17.7	1951	20.8	1966	23.8				
1956	17.8	1952	37	1967	38.5				
1957	28.2	1953	30.1	1968	22.3				
1958	18.5	1954	31.4	1969	39.5				
1959	44.4	1955	26.8	1970	28.2				
1960	4.8	1956	46.2	1971	34.6				
1961	27.3	1957	31.8	1972	24.4				
1962	6.1	1958	43.8	1973	39.6				
1963	35.7	1959	26.9	1974	34.6				
1964	13.9	1960	25.9	1975	47.6				
1965	28.6	1961	20.2	1976	18.4				
1966	4.2	1962	44.2	1977	16.8				
1967	4.1	1963	23.7	1978	40.7				
1968	16.9	1964	21.8	1979	34.2				
1969	11.7	1965	44.7	1980	47.5				
1970	2.1	1966	37.8	1981	24.8				
1971	34.2	1967	49.4	1982	76.4				
1972	4.5	1968	28.7	1983	26				
1973	26.4	1969	32.8	1984	34.4				
1974	4.1	1970	32.1	1985	36.1				
1975	27.2	1971	40.5	1986	20.4				
1976	15.1	1972	52	1987	8.2				
1977	0.6	1973	55.5	1988	28.6				
1978	12.8	1974	31	1989	19.3				
1979	14.1	1975	43.2	1990	15.2				
1980	8.1	1976	24.2	1991	18.2				
1981	25	1977	6	1992	46.9				
1982	13.1	1978	57.4	1993	18.5				
1983	0.1	1979	44.8	1994	53.3				
1984	25.6	1980	44.4	1995	34.7				
1985	23.8	1981	25.8	1996	19.8				
1986	0.7	1982	86	1997	46.6				
1987	17.8	1983	36.3	1998	47.5				
Mean	17.95079	1984	54.6	Mean	31.81179				
S.D.	12.15053	1985	15.8	S.D.	12.43193				
C of V.	67.68887	1986	65.1	C of V	38.90824				
		1987	23.5						
		1988	10.4						
		1989	37.2						
		1990	20.1						
		1991	26.3						
		1992	21						
		1993	54.6						
		1994	15.8						
		1995	65.1						
		1996	41.3						
		1997	33.9						
		1998	53.1						
		1999	14.4						
		2000	30.8						
		2001	13.5						
		2002	30.8						
		2003	25.3						
		2004	26.5						
		2005	46						
		2006	43.5						
		2007	15						
		2008	28						
		Mean	34.35513						
		S.D.	13.48195						
		C of V	38.15748						

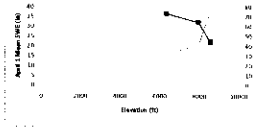
Merced Ri	7000'		8700'		5500'				
Gin Flat	4/1 swe	Snow Flat	4/1 swe	Beehive Me	4/1 swe	elevation	Mean swe	C of V	
1930	25.6	1930	35.7	1930	18.1	6500	25.27	49.25	
1931	24.1	1931	20.4	1931	34.9	7000	33.77	46.77	
1932	57.1	1932	51.7	1933	28.3	8700	46.56	38.7	
1933	37	1933	38.1	1934	14.9				
1934	13.1	1935	33.9	1935	17.9				
1935	43.7	1936	41.6	1936	18.4				
1936	43.1	1937	57.1	1937	38.4				
1937	48.7	1938	54.5	1938	41.3				
1938	62.1	1939	25.6	1939	17.8				
1939	22.6	1940	56	1940	27.5				
1940	39.7	1941	64.2	1941	31.9				
1941	45.6	1942	50.4	1942	32.7				
1942	41.2	1943	53.8	1943	24.5				
1943	27.9	1944	35.4	1944	26.1				
1944	32.8	1945	50.8	1945	33.7				
1945	37.9	1946	46.7	1946	28.8				
1946	34.7	1947	34.2	1947	11.4				
1947	19.9	1948	27.4	1948	20.9				
1948	22	1949	38.4	1949	36.4				
1949	47.2	1950	42.5	1950	29.6				
1950	36.3	1951	32.4	1951	15.4				
1951	24.1	1952	37.3	1952	62.9				
1952	73.8	1953	35.3	1953	27.6				
1953	31.5	1954	38.4	1954	33.2				
1954	34.2	1955	31.9	1955	16.3				
1955	19.6	1956	60	1956	14.5				
1956	33.2	1957	35.9	1957	13.7				
1957	19.8	1958	54.7	1958	37.5				
1958	53.1	1959	31.2	1959	15.4				
1959	17.9	1960	39.6	1960	18.5				
1960	28.1	1961	21.3	1961	13.3				
1961	15.4	1962	55.6	1962	40				
1962	59	1963	25.8	1963	7.8				
1963	11	1964	22	1964	15.3				
1964	18.9	1965	49.1	1965	31.4				
1965	39.2	1966	41.8	1966	12.1				
1966	21.2	1967	52.9	1967	28.2				
1967	33.9	1968	37.4	1968	16.5				
1968	19.8	1969	65.7	1969	37.4				
1969	46.7	1971	40.5	1970	12.2				
1971	30.5	1972	32	1971	22.8				
1972	16	1973	52	1972	7.7				
1973	55.5	1974	49.9	1973	35				
1974	36.1	1975	47.4	1974	25.9				
1975	43.2	1976	14.9	1975	34.3				
1976	30.2	1977	14.8	1976	20.6				
1977	6	1978	72.6	1977	6.3				
1978	57.4	1979	45	1978	42.3				
1979	44.8	1980	54.9	1979	29.8				
1980	44.2	1982	64.2	1980	29.1				
1982	36.5	1984	92.9	1981	21.1				
1983	75.7	1985	38.1	1982	29.1				
1984	24.8	1986	82.7	1983	55.8				
1985	35.1	1987	22.1	1984	7.6				
1986	40.1	1988	23.5	1985	25.6				
1987	16.8	1989	41.6	1986	19				
1988	5.1	1990	34.2	1987	21				
1989	24.3	1991	31.1	1988	3.3				
1990	17.9	1992	25.2	1989	22.1				
1991	30	1993	72.9	1990	9.1				
1992	27.8	1994	22.4	1991	19.0				
1993	59.6	1995	25.1	1992	13.2				
1994	46.8	1996	53.1	1993	36.1				
1995	43.4	1997	23.9	1994	15.9				
1996	26.4	1998	64.5	1995	19.2				
1997	31.9	1999	50.1	1996	29.9				
1998	50.1	2000	43.3	1997	11.9				
1999	31.5	2001	9.7	1998	39.4				
2000	37.7	2002	43.9	1999	44.9				
2001	28.8	2003	37.2	2000	18.2				
2002	35	2004	45.5	2001	16.8				
2003	39.1	2005	54.9	2002	21.5				
2004	26.5	2006	18.5	2003	9.4				
2005	54.4	2007	31.2	2004	19.5				
2006	39.2	2008	43	2005	48				
2007	31.4	Mean	43.56333	2006	28.1				
2008	33.8	S.D.	16.63963	2007	9.8				
Mean	33.77403	C of V	38.19725	2008	25.9				
S.D.	15.79515			Mean	26.27166				
C of V	46.76714			S.D.	11.4482				
				C of V	43.25477				

Kaweah R	8600'		6400		8000'				
Panther M	4/1 swe	Giant Fore	4/1 swe	Mineral Ki	4/1 swe	elevation	Mean swe	C of V	
1930	28.8	1930	12.9	1948	18.9	6400	15.89	73.21	
1931	16	1931	3.1	1949	23.5	8000	20.72	64.31	Station
1932	52.8	1932	37.7	1950	12.4	8600	37.33	44.6	Giant Fo
1933	24.5	1933	26.9	1951	4.4				Harness
1934	22.4	1934	1.4	1952	46.9				Mt. Dye
1935	32.8	1935	21.6	1953	14.2				Robbs v
1936	32.3	1936	27.9	1954	24.4				Lyons C
1937	63.6	1937	30.8	1955	13				Upper C
1938	58.6	1938	30.2	1956	16.8				Beehive
1939	19.6	1939	11.8	1957	15.4				Gin Fla
1940	43.2	1940	20.7	1958	36.5				Snow F
1941	49.5	1941	19.6	1959	8.3				Giant F
1942	43	1942	25.8	1960	11				Mineral
1943	52.9	1943	8.1	1961	0.9				Panther
1944	35.4	1944	21.4	1962	32.6				
1945	51.4	1945	27.4	1963	3.4				
1946	34.7	1946	15.3	1964	31.7				
1947	19.7	1947	0	1965	19.2				
1948	19.6	1948	16	1966	9.7				
1949	30.1	1949	25.6	1967	25.9				
1950	34.1	1950	16.3	1968	16.8				
1951	18.7	1951	8.7	1969	46				
1952	71.8	1952	46.7	1970	14.2				
1953	31.1	1953	14.7	1971	17.6				
1954	33.3	1954	21.6	1972	2.6				
1955	30.7	1955	10.3	1973	46.8				
1956	33.8	1956	1	1974	22.7				
1957	24.4	1957	5.8	1975	23.8				
1958	41.3	1958	23.8	1976	6.7				
1959	21.9	1959	1.5	1977	1.8				
1960	25.8	1960	11.4	1978	38.4				
1961	15.2	1961	3.7	1979	21.2				
1962	44.5	1962	29.1	1980	30.4				
1963	13.2	1963	4.7	1981	16.5				
1964	24.7	1964	16	1982	29				
1965	45	1965	18.5	1983	43.7				
1966	30.1	1966	5.4	1984	15.1				
1967	47.1	1967	13	1985	20.4				
1968	23.8	1968	11.4	1986	34.2				
1969	88.8	1969	49.9	1987	12.3				
1970	26	1970	8	1988	3.2				
1971	28.8	1971	18.4	1989	13.4				
1972	46.8	1972	2.6	1990	7.9				
1973	57.2	1973	42.7	1991	16.7				
1974	45	1974	17.3	1992	11.7				
1975	40.2	1975	22.1	1993	31.7				
1976	13.8	1976	9.4	1994	11.5				
1977	8.8	1977	1.6	1995	34.3				
1978	73.2	1978	26.9	1996	22.7				
1979	44.1	1979	26.4	1997	19.8				
1980	38.9	1980	23.4	1998	38.5				
1981	31.7	1981	13.1	1999	18.1				
1982	50.1	1982	23.3	2000	22.9				
1983	74.2	1983	57.3	2001	15.9				
1984	29.4	1984	9	2002	23.2				
1985	46.9	1985	16.5	2003	8.8				
1986	67.8	1986	5	2004	17				
1987	18.7	1987	3.5	2005	31.3				
1988	15.8	1988	0	2006	27.5				
1989	26.2	1989	11.6	2007	5.8				
1990	27.3	1990	4.7	2008	28.1				
1991	31.5	1991	3	Mean	22.71967				
1992	23.8	1992	11.2	S.D.	13.38506				
1993	58.1	1993	50.3	C of V	64.13812				
1994	25.4	1994	4.7						
1995	33.6	1995	28.5						
1996	44.6	1996	11.4						
1997	48.5	1997	1.1						
1998	50.8	1998	34.5						
1999	23.5	1999	5.3						
2000	36.6	2000	12.3						
2001	30.8	2001	13.1						
2002	27.9	2002	14.3						
2003	24.8	2003	3.4						
2004	31.3	2004	2.2						
2005	54.1	2005	28.6						
2006	51.5	2006	14.4						
2007	21.8	2007	4.4						
2008	43.3	2008	19.4						
Mean	37.32911	Mean	13.69114						
S.D.	16.50435	S.D.	11.63409						
C of V	44.35601	C of V	84.91139						

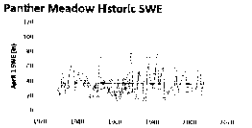
Distribution of SWE by Latitude in the Sierra Nevada



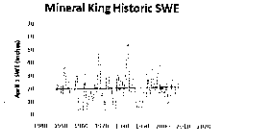
Kaweah Basin SWE



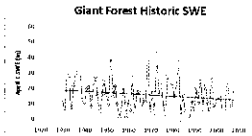
Panther Meadow Historic SWE



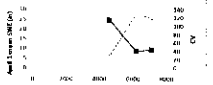
Mineral King Historic SWE



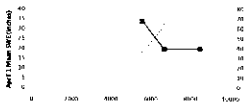
Giant Forest Historic SWE



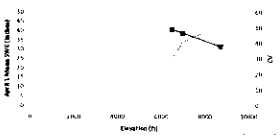
Feather River SWE



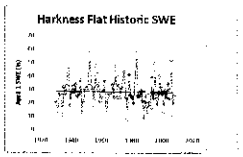
American River SWE



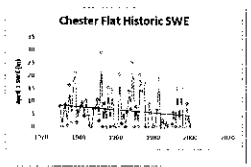
Merced SWE



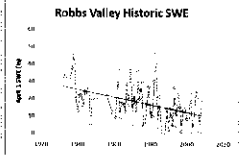
Harkness Flat Historic SWE



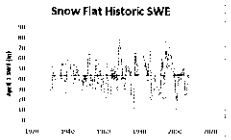
Chester Flat Historic SWE



Robbs Valley Historic SWE

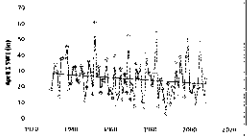


Snow Flat Historic SWE

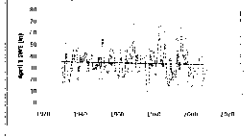


Mount Dyer Historic SWE

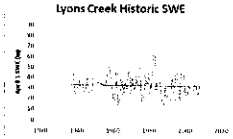
Beehive Meadow Historic SWE



Upper Carson Historic SWE



Lyons Creek Historic SWE



Gin Flat Historic SWE

High

Climate and Hydrology *Fall 2009* *Name:* *Date:*

Question #5 (25 Points):

Assume that you are working together with a professor to develop a research proposal on watershed hydrology. One of the tasks is to show how to calculate evaporation using the mass transfer approach. We learned from this course that it is critical to calculate latent and sensible heat fluxes in order to calculate evaporation. We also know the equations for latent (*LE*) and sensible heat (*H*) fluxes:

$$LE = -\lambda_v \cdot \frac{0.622 \cdot \rho_a}{P_a \cdot \Phi_M \cdot \Phi_V} \cdot \frac{k^2}{\left[\ln\left(\frac{z_2 - z_d}{z_1 - z_d}\right)\right]^2} \cdot (v_2 - v_1) \cdot (e_2 - e_1) \qquad (1)$$

$$H = -\frac{\rho_a \cdot c_a}{\Phi_M \cdot \Phi_H} \cdot \frac{k^2}{\left[\ln\left(\frac{z_2 - z_d}{z_1 - z_d}\right)\right]^2} \cdot (v_2 - v_1) \cdot (T_2 - T_1) \qquad (2)$$

Write an essay to show your work plan how you calculate latent and sensible heat fluxes and how to get data needed for your calculation. Be sure to address:

(a) In which situation(s), do latent and sensible heat occur?
(b) What are the major factors controlling latent and sensible heat?
(c) Explain terms and symbols in the equations above if these equations are part of your proposal.
(d) What meteorological data and additional equations (other than the equations for correction factors of atmospheric conditions) do you think you need for calculating latent and sensible heat fluxes and why?
(e) What is your field strategy to get the data?

Latent heat transfer occurs in water when there is phase change, and sensible heat transfer occurs in water when there is a temperature change of the water. Latent heat is transferred in a watershed when water or ice or snow evaporates or is sublimated. ~~It also occurs when water condenses in clouds or freezes.~~ The latent heat flux and sensible heat flux can be used to calculate the amount of water that evaporates.

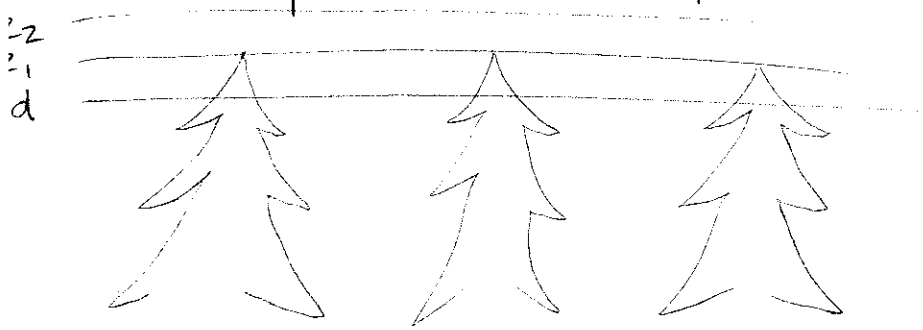
(Continued work space for Question #5)

For evaporation to occur in liquid water, for example, the relative humidity must be less than 100%, (i.e. the vapor pressure must be below the saturation vapor pressure.). Warmer water has a higher vapor pressure, and ~~a~~ sensible heat changes the temperature of the water. This is how both latent and sensible heat affect the evaporation of water.

Equations 1 and 2 above can be used to calculate the evaporation of water.

λ_v = latent heat of vaporization $[\frac{J}{g}]$ ✓
ρ_a = ~~the~~ the density of air $[\frac{kg}{m^3}]$ ✓
P_a = atmospheric pressure [Pa] or $[\frac{N}{m^2}]$ ✓
K = experimental constant ✓
V_2 = wind speed at z_2 ✓
V_1 = wind speed at z_1 ✓
e_2 = vapor pressure at z_2 ✓
e_1 = vapor pressure at z_1 ✓
Φ_M = experimental constant ✓
Φ_V = experimental constant ✓
z_2 =
z_1 =
z_d = } three heights which represent height above the boundary layer. ~~At the I~~ I would need the relationship between these vertical velocity is

C_a = heat capacity of air $[\frac{J}{gK}]$ ✓
T_2 = temperature at z_2 ✓
T_1 = temperature at z_1 ✓



λ_v, ρ_a, and c_a are all approximately constant, but if we measure the temperature, we can find more precise values for them.

We could use thermometers to measure the temperatures, or if we wanted to store the data in a data logger or transmit it, we could use temperature transmitters or thermocouples.

The atmospheric pressure can be measured with a barometer, but it is also relatively constant.

Vapor pressure and wind speed matter the most. Wind speed can be measured with a tachometer some type of piezoelectric sensor. And we can use a device to measure vapor pressure which ~~cools~~ captures a parcel of air, cools it, records the temperature at which it condenses, ~~and~~ the dew point, and calculates vapor pressure from that. Or you could

MED

Climate and Hydrology *Fall 2009* *Name:* *Date:*

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Assume that you are working together with a professor to develop a research proposal on watershed hydrology. One of the tasks is to show how to calculate evaporation using the mass transfer approach. We learned from this course that it is critical to calculate latent and sensible heat fluxes in order to calculate evaporation. We also know the equations for latent (LE) and sensible heat (H) fluxes:

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$$H = -\frac{\rho_a \cdot c_a}{\Phi_M \cdot \Phi_H} \cdot \frac{k^2}{\left[\ln\left(\frac{z_2 - z_d}{z_1 - z_d}\right)\right]^2} \cdot (v_2 - v_1) \cdot (T_2 - T_1) \qquad (2)$$

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(e) What is your field strategy to get the data?

a.) Sensible heat occurs when there is a temp difference from the ground and the air
Latent heat occurs when there is a vapor pressure difference from the ground and the air

b.) The major factors controlling Latent heat ~~and~~ wind velocity, ~~Major~~ and Pressure. For sensible heat temp is very important as well as wind velocity.

c.) λ_v = latent heat transfer
P_a = Pressure of the Air
ρ_a = density of Air
z = distance from ground to wind Flow
v = wind velocity
e = conductivity vapor pressure

(Continued work space for Question #5)

d. metalogical Data, Temp, Wind speed, conductivity pressure.

$i - o = \Delta V$ this is water balance equation!

$\Delta e = W_{precent} + SW_{in} + G_{water} - S_{wout} - G_{wout} - \Delta V$

Would need all equation relation to heat of vaporasation, temp, pressure, wind speed, and conduction to get the best results.

e. Field strategy for sensible heat would be to measure temp data for sure and wind velocity.

For Latent heat it would be to measure pressure, most importantly and also wind velocity and conductivity. I would get as many measurments as I could and use the equations for the rest to get the lowest possible error I could.

-5

Low

Climate and Hydrology *Fall 2009* *Name:* *Date:*

Question #5 (25 Points):

Assume that you are working together with a professor to develop a research proposal on watershed hydrology. One of the tasks is to show how to calculate evaporation using the mass transfer approach. We learned from this course that it is critical to calculate latent and sensible heat fluxes in order to calculate evaporation. We also know the equations for latent (LE) and sensible heat (H) fluxes:

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$$H = -\frac{\rho_a \cdot c_a}{\Phi_M \cdot \Phi_H} \cdot \frac{k^2}{\left[\ln\left(\frac{z_2 - z_d}{z_1 - z_d}\right)\right]^2} \cdot (v_2 - v_1) \cdot (T_2 - T_1) \qquad (2)$$

Write an essay to show your work plan how you calculate latent and sensible heat fluxes and how to get data needed for your calculation. Be sure to address:

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(d) What meteorological data and additional equations (other than the equations for correction factors of atmospheric conditions) do you think you need for calculating latent and sensible heat fluxes and why?
(e) What is your field strategy to get the data?

Latent heat occurs [illegible] occurs because of the excess heat released as water evaporates. Sensible heat is the warmth due to evaporation of liquid water.

Factors that drive latent and sensible heat are [illegible], temperature, wind velocity and atmospheric pressure. ρ_a = [illegible] pressure of air, ρ_a = density of air, v = wind velocity [illegible] time increment, z = height of [illegible] T = [illegible], C_a = [illegible] factor for air, d_L = [illegible]

(Continued work space for Question #5)

It would be important to note the locations of each measurement the constants for LE & H equations. Need $Q_\perp$, temperature, dew point, Pa.

I would start by picking a location and have initial readings for each instrument. I would also check to make sure there are no instrumental errors, and make a time based measurement on 24-hours. After completing the experiment process, I would check data and repeat to ensure accuracy. Of course there would be different conditions but certain approximations can be made for different atmospheric conditions if data is continuously collected.

-10

Faculty Course Assessment Report

EnvE 130 – Meteorology and Air Pollution; 4 credits

Fall 2009

Instructor: Wolfgang F. Rogge

Catalog Description: Basic physics and thermodynamics of the atmosphere; fundamentals of atmospheric sciences important to environmental problems; chemistry and physics of atmospheric pollutants; visibility; air quality modeling; emissions; and air pollution control strategies.

EnvE 130 is a technical elective for undergraduate students in Environmental Engineering. In order to complete this course, students were required to do homework, multiple choice tests, exams, and a mini project with presentation. Grade distribution was as follows: Two multiple choice tests, each could earn up to 10% of the total points possible. The mid-term exam could earn up to 20% of the total, the final exam 30%, homework 20%, and mini-project together with presentation up to10%.

PLO – 2. *Critical Thinking: EnvE graduates will be adept at applying critical thinking, problem solving, engineering principles and reasoning, the scientific method, and teamwork to solve environmental resource problems and to restore and sustain the global environment.*

Program Learning Objective 2 corresponds to five ABET based Course Learning Outcomes (CLO) of which three are directly assessed in the course by the instructor. These SLOs/ABET outcomes are:

a. Understand and apply the basic mathematical and scientific concepts that underline the modern field of Environmental Engineering;
b. Possess the ability to design and conduct experiments and to analyze and interpret data
c. Possess critical thinking skills, problem solving ability, and familiarity with the computational procedures essential to the field.

Grade Distribution:

A	B	C	D	F	W	Total
3	2	1	0	1	2	9

Course Assessment:

E (excellent) is scoring 90% or better of the total points possible, A (acceptable) is from 90-70%, M (minimal) is from 70-60%, and U (unsatisfactory) is anything below 60%.

CLO	Assessment Tool	E	A	M	U	Avg %	PLO	Type
a.	Short Test 1, question 1, math	6	0	0	1	86	2	Ex
	Short Test 2, question 7, chem	2			5	36	2	Ex
	Short Test 2, question 20, chem	5			2	86	2	Ex
	Midterm, Problem 2, ideal gas law	3	0	1	3	67	2	Ex
b.	Final, Problem 2, data interpretation	5	1		1	90	2	Ex
c.	Midterm, Problem 1, mass balance	1	0	2	4	64	2	Ex

	Midterm, Problem 4, mass balance, diffusion	1	1	2	3	63	2	Ex
	Midterm, Problem 5, light extinction	5	0	0	2	71	2	Ex
	Final, Problem 3, complex chem. reaction	3	2	1	1	85	2	Ex
	Final, Problem 4, critical thinking	3	0	0	4	57	2	Ex
	Final, Problem 5, mass balance, chem reaction	5	0	0	2	79	2	Ex

1) (10 Pts) In one m^3 of air, 6 cm^3 where determined to be SO_2. What is the concentration?

- ☐ 60 ppb
- ☐ 600 ppt
- ☑ 6 ppm

$\frac{6\,cm^3}{1\,m^3}\left(\frac{1\,m}{100\,cm}\right)^3 = 6\,ppm$

$\frac{10}{10}$ ✓

$6\ cm^3 / 100$

$\frac{1\,m^3}{(100\,cm)^3}$

$\frac{0\,cm}{100{,}000}$

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- ☐ 60 ppb
- ☑ 600 ppt
- ☐ 6 ppm

$\frac{0}{10}$

f

✓

5) (10 Pts) The main source of nitrous oxide to the global atmosphere is:

- [ ] automobile exhaust
- [ ] fossil fuel combustion
- [x] volcanic eruption
- [ ] denitrification by soil bacteria
- [ ] ocean out gassing

0/10

6) (10 Pts) Which of the statement(s) is (are) correct?

- [x] NO is a highly toxic pollutant.
- [x] NO_2 is a brownish colored gas that contributes to visibility reduction.
- [ ] NO_2 is formed mainly via atmospheric chemistry from precursor NO.
- [ ] NO_3 leads during daytime with NO_2 to stable N_2O_5 formation.

5/10

7) (10 Pts) In the lower troposphere, there is only one single set of reactions that leads to ozone formation. Write down this set.

$$NO_2 \xrightarrow{h\nu} O + NO$$

$$O + O_2 + M \rightarrow O_3 + M$$

10/10

8) (10 Pts) Why is the ozone concentration measured in urbanized areas often much higher than predicted by the primary ozone formation reaction?

- [ ] OH radicals oxidize NO to NO_2.
- [ ] OH radicals react with hydrocarbons upon which eventually peroxy-radicals are formed that can oxidize NO to NO_2.
- [x] formaldehyde decays due to hν, yielding a fast secondary methylhydroperoxide reaction pathway.

0/10

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10/10

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0/10

$H_2O + O_2 + h\nu \rightarrow O_3 + H_2$ No!

$NO_2 + h\nu \rightarrow O + NO$

$O + O_2 + M \rightarrow O_3 + M$

8) (10 Pts) Why is the ozone concentration measured in urbanized areas often much higher than predicted by the primary ozone formation reaction?

10/10

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- ☐ formaldehyde decays due to hν, yielding a fast secondary methylhydroperoxide reaction pathway.

19) (10 Pts) In the stratosphere, ozone is in contrast to the troposphere mainly

10/10

- [x] formed by the photolysis of O_2
- [ ] formed by cosmic rays hitting the earth surface
- [ ] formed by the photolysis of NO_3

20) (20 Pts) Tropospheric Ozone

For the city of Riverbank, the NOx concentration is 60 ppb and the VOC concentration is 2000 ppb (see Figure below).

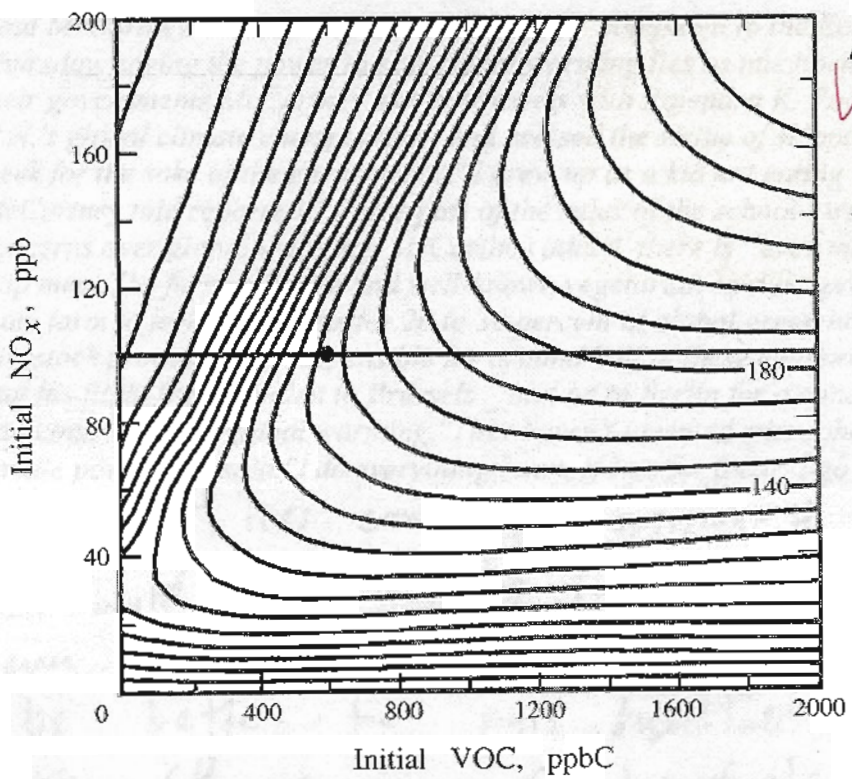
a) What is the respective ozone concentration?

140 ppb

20/20

b) Are told that founds are only available to control either NOx or VOCs. Would NOx reduction or VOC reduction substantially reduce ambient ozone levels, say by 50%?

Reduce NOx by 50%, O_3 = 90 ppb
Reduce VOCs by 50%, O_3 = 140 ppb



NOx reduction shows a much larger reduction of O_3 than a reduction of VOC does. In fact below about 80 ppb NOx changing VOC does nothing to [O_3]

FIGURE 5.15 Ozone isopleth plot based on simulations of chemistry along air trajectories in Atlanta (Jeffries and Crouse, 1990). Each isopleth is 10 ppb higher in O_3 as one moves upward and to the right.

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The reduction of VOC assuming $NO_x > 100$ ppb

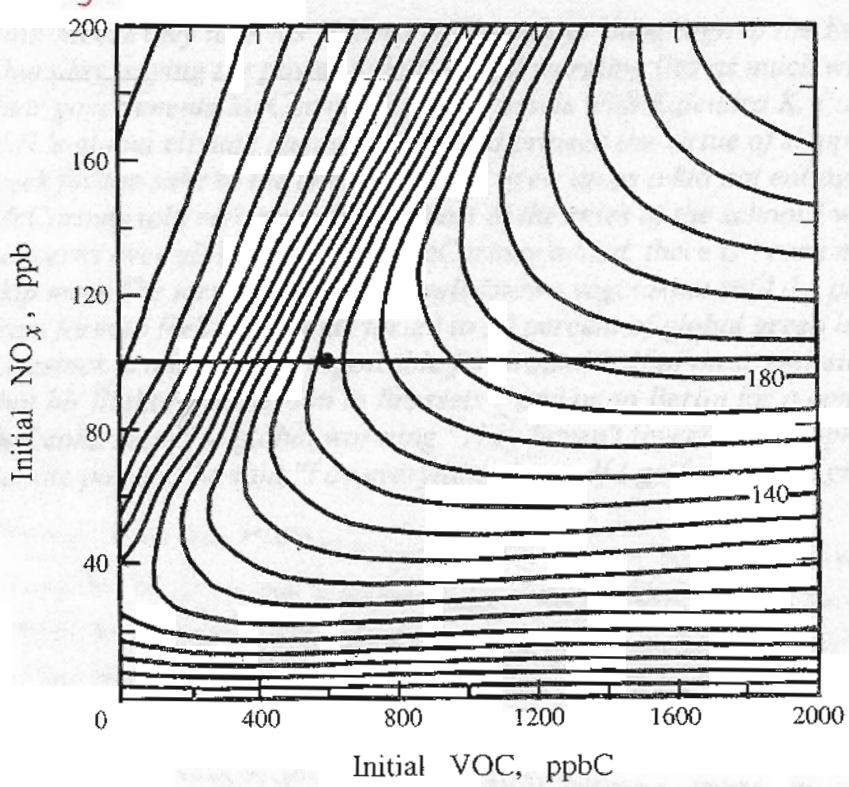


FIGURE 5.15 Ozone isopleth plot based on simulations of chemistry along air trajectories in Atlanta (Jeffries and Crouse, 1990). Each isopleth is 10 ppb higher in O_3 as one moves upward and to the right.

Problem 2:
(30 Points) A typical global concentration of hydroxyl (OH) radicals is about 10^6 molecules cm^{-3}. What is the mixing ratio corresponding to this concentration at sea level and 298K?

$10^6 \frac{\text{molecules}}{cm^3}$ $\qquad T = 298$

$PV = nRT$ $\qquad PV = nRT$

$n_{OH} = \frac{PV}{RT}$ $\qquad n_{air} = \frac{PV}{RT}$

$n_X = C_X n_a$ $\qquad M_a = 28.96 \times 10^{-3} \frac{kg}{mol}$

$$n_a = \frac{N_A P}{RT} = \frac{6.022 \times 10^{23} (1.013 \times 10^5)}{8.31 \cdot 298}$$

$$= 2.69 \times 10^{25} \frac{\text{molecules}}{m^3} \left| \left(\frac{1\,m}{100\,cm}\right)^3 \right.$$

$$= \cancel{2.69 \times 10^{19} \frac{\text{molecules}}{cm^3}}$$

$$= 2.46 \times 10^{25} \frac{\text{molecules}}{m^3} \left(\frac{1\,m}{100\,cm}\right)^3$$

$$= 2.46 \times 10^{19} \frac{\text{molecules}}{cm^3}$$

30/30

$N_X = C_X N_a$

$$C_X = \frac{N_X}{N_a} = \frac{10^6 \text{ molecules}}{2.46 \times 10^{19}} =$$

$$\boxed{C_X = 4.065 \times 10^{-14}}$$ or $4.06 \cdot 10^{-8}$ ppm

Problem 2:
(30 Points) A typical global concentration of hydroxyl (OH) radicals is about 10^6 molecules cm^{-3}. What is the mixing ratio corresponding to this concentration at sea level and 298K?

$10^6 \frac{\text{molecules}}{cm^3}$

$$n_a = \frac{A_v P}{RT} = \frac{(6.022\times10^{23})(1.013\times10^5)}{(8.31)(298)} = 2.46\times10^{25} \frac{\text{molecules}}{m^3}$$

$$n_a = 2.46\times10^{19} \frac{\text{molecules}}{cm^3}$$

$4.06\cdot10^{-14}$

$$\xi_{OH} = \frac{n_{OH}}{n_a} = \frac{10^6 \text{ molecules}\cdot cm^{-3}}{2.46\times10^{25} \text{ molecules}\cdot \cancel{cm^{-3}}\ m^{-3}} = \boxed{4.065\times10^{-20} \frac{\text{molecules}\cdot cm^{-3}}{\text{molecules}\cdot cm^{-3}}}$$

No

I don't know what parts per X is. Mixing ratio is usually unitless, $\frac{mol}{mol}$ or $\frac{v}{v}$ but it can also be expressed in terms of ppm, ppb, or ppt. The textbook uses the ratio of $\frac{\text{molecules}\cdot cm^3}{\text{molecules}\cdot cm^3}$, but their answer is conveniently in 10^{-6}.

$1m^3 = 10^6 cm^3$

$\frac{15}{30}$

Problem 2:

(30 Points) A typical global concentration of hydroxyl (OH) radicals is about 10^6 molecules cm^{-3}. What is the mixing ratio corresponding to this concentration at sea level and 298K?

$n_a = \frac{10^6 \text{ molecules}}{cm^3} = \frac{A_v P}{RT}$ 1 ATM

$T = 298k$

$R = 8.31$

Density $\Rightarrow$?

$35 \times 10^2 m = \frac{100 cm}{1 m}$

$\frac{10^6 \text{ molecules}}{cm^3} = \frac{A_v \, 1ATM}{8.31(298k)}$

A_v = Avaga Dros

want $\rightarrow$? $\rightarrow$ $P_x = C_x P$ (1ATM)

$A_v = \frac{RT n_a}{P}$

$n_x = C_x n_a$

$\Rightarrow \frac{8.31(298)(10^6 \text{ molecules}/cm^3)}{1ATM \times 6.022 \times 10^{23} \text{ molecules/mol}}$

$\frac{10^6 \text{ molecules}}{cm^3} \Big| \frac{\text{mole}}{6.022 \times 10^{23} \text{ molecules}}$

$\frac{0}{30}$

$\frac{1.66 \times 10^{-18} \text{ moles}}{cm^3} =$

$P_x = \frac{n_x}{A_v} RT$

$P_x = \frac{n_x M_x}{A_v}$

$n_x = \frac{A_v P}{RT} C_x$ $\rightarrow n_a$ molecules/cm^3

$n_x = \frac{10^6 \text{ molecules}}{cm^3} C_x$

$[OH]_{ppm} = \frac{1.66 \cdot 10^{-12}}{40.88} \cdot 10^6 = 4.06 \cdot 10^{-8}$ ppm

$[OH] = 10^6 \text{ molecules}/cm^3 \triangleq 10^{12} \text{ molecules}/m^3$

$= \frac{10^{12} \text{ molecules}/m^3}{6.023 \cdot 10^{23} \frac{\text{molecules}}{\text{mol}}} = 1.667 \cdot 10^{-12} \text{ mol}/m^3$

$\frac{n}{V} = \frac{P}{RT} = \frac{1.0133 \cdot 10^5}{8.314 \cdot 298} = 40.88 \text{ mol}/m^3$

It resonds to The amount of molecules of OH radicals in cm^3 volume. Its essentially a Density function. I tried to figure out C_x But I forgot Book and my Brain is not working! Still a Little sick...

Problem 2:

(30 Points) Find the lifetime of NO_2 at night at altitudes z = 0, 5, 10 km. Please comment your results.

$$NO_2 + O_3 \rightarrow NO_3 + O_2$$

Assume an O_3 mixing ratio of 50 ppb and

$k = 1.2 \times 10^{-13} \exp(-2450/T)$ cm^3 molecule^{-1} s^{-1}

$5 \times \frac{1\,min}{60\,s} \times \frac{1\,hr}{60\,min} \times \frac{1\,day}{24\,hr}$

$\tau_{NO_2} = \frac{1}{k[O_3]}$ $[O_3] = f_{O_3}[M]$

Record your calculation steps by filling in all blanks in the table provided!

Z [km]	T [K]	[M]	k	O_3 [#/s]	τ_{NO2} [s]	τ_{NO2} [days]
0	288	2.5 10^{19}	2.42×10^{-17}	1.25×10^{12}	3.31×10^{4}	0.383
5	256	1.3 10^{19}	8.37×10^{-18}	6.5×10^{11}	1.84×10^{5}	2.13
10	223	0.65 10^{19}	2.03×10^{-18}	3.25×10^{11}	1.52×10^{6}	17.5

30/30

$k = 1.2 \times 10^{-13} \exp(-2450/288)$

$= 2.42 \times 10^{-17}$ @ 0 km, 288 K

$= 8.37 \times 10^{-18}$ @ 5 km, 256 K

$= 2.03 \times 10^{-18}$ @ 10 km, 223 K

$[O_3]_0 = 2.5 \times 10^{19} \frac{molecules}{cm^3} \times 50 \times 10^{-9}$

$= 1.25 \times 10^{12}$ @ 0 km

$[O_3]_5 = 1.3 \times 10^{19} \times 50 \times 10^{-9}$

$= 6.5 \times 10^{11}$ @ 5 km

$[O_3]_{10} = 0.65 \times 10^{19} \times 50 \times 10^{-9}$

$= 3.25 \times 10^{11}$ @ 10 km

$\tau_{NO_2} = \frac{1}{k[O_3]}$

$= \frac{1}{2.42 \times 10^{-17} \frac{cm^3}{molecules \cdot s} \left(1.25 \times 10^{12} \frac{molecules}{cm^3}\right)}$

$= 3.31 \times 10^{4}$ s @ 0 km

(back)

Sorry for the sloppy units! ran out of time

Problem 2:

(30 Points) Find the lifetime of NO_2 at night at altitudes z = 0, 5, 10 km. Please comment your results.

$$NO_2 + O_3 \rightarrow NO_3 + O_2$$

$J = \frac{Kg\, m^2}{s^2}$

Assume an O_3 mixing ratio of 50 ppb and

$k = 1.2 \times 10^{-13} \exp(-2450/T)$ cm^3 molecule^{-1} s^{-1}

$$\tau_{NO_2} = \frac{1}{k[O_3]}$$

Record your calculation steps by filling in all blanks in the table provided!

Z [km]	T [K]	[M]	k [cm^3 molecule^{-1} s^{-1}]	O_3 [#/s]	τ_{NO2} [s]	τ_{NO2} [days]
0	288	2.5 10^{19}	2.4×10^{-17}	30.6	0.03	3.8×10^{-7}
5	256	1.3 10^{19}	8.37×10^{-18}	6.16	0.16	1.88×10^{-6}
10	223	0.65 10^{19}	2.03×10^{-18}	1.74	0.58	6.66×10^{-6}

15/30

N_0

0 km: $n_a = \frac{A_v P}{RT} = \frac{(6.022\times10^{23})(1.013\times10^5)}{8.31\cdot 288} = 2.55\times10^{25}$ molecules/cm^3

$H = \frac{RT}{M_a g} = \frac{(8.31)(288)}{(28.96)(9.8)} = 8.4$ km

$P(0\text{ km}) = P(0)e^0 = 1.013\times10^5$

$f_{O_3} = \frac{n_{O_3}}{n_a} \Rightarrow n_{O_3} = f_{O_3}\cdot n_a = (50\times10^{-9})(2.55\times10^{25}\ \frac{\text{molecule}}{\text{cm}^3}) = 1.275\times10^{18}$

$\tau_{NO_2} = \frac{1}{(2.4\times10^{-17}\ \text{cm}^3\cdot\text{molecule}^{-1}\cdot s^{-1})(1.275\times10^{18}\ \text{molecule}\cdot\text{cm}^{-3})} = \frac{0.03\ s}{(3600\times24)}$

You must have messed up your units along the way, the relative lifetimes at the different altitudes are mostly correct, except for z=10km

5 km: $H = \frac{RT}{M_a g} = \frac{(8.31\ J\cdot K^{-1}\cdot mol^{-1})(256\ K)}{(28.96\ g\cdot mol^{-1})(9.8\ m\cdot s^{-2})} = \frac{(8.31\ \cancel{Kg}\, m^2\cdot s^{-2}\cdot \cancel{K^{-1}}\cdot \cancel{mol^{-1}})(256\ \cancel{K})}{(28.96\ g\cdot \cancel{mol})(9.8\ \cancel{m}\cdot \cancel{s^{-2}})} = 7.5$ km

$P(5\text{ km}) = P(0)e^{-5/7.5} = 5.2\times10^4$ Pa

$n_a = \frac{A_v P}{RT} = \frac{(6.022\times10^{23})(5.2\times10^4\ Pa)}{8.31\times256} = 1.47\times10^{25}$ molecules$\cdot$cm^{-3}

$n_{O_3} = f_{O_3}\cdot n_a = (50\times10^{-9})(1.47\times10^{25}\ \text{molecules}\cdot\text{cm}^{-3}) = 7.4\times10^{17}$

$\tau_{NO_2} = \frac{1}{(8.37\times10^{-18}\ \text{cm}^3\cdot\text{molecule}^{-1}\ s^{-1})(7.4\times10^{17}\ \text{molecule}\cdot s^{-1})} = 0.16\ s$

Problem 1:

You do not drive too much using your car. But you do consume 500 gallons of gasoline per year in your car (1 gal = 3.7879 L). Assume that gasoline can be represented as C_8H_{18}. Gasoline has a density of 0.85 g cm^{-1}. Assume further that combustion of C_8H_{18} is complete and leads to CO_2 and H_2O only.

a) (15 Pts) Balance the combustion reaction of C_8H_{18} by filling in the blanks.

9?

15/15 ✓ $2\ C_8H_{18} + 25?O_2 \rightarrow 16CO_2 + 18?H_2O$

50 32 $\xrightarrow{+}$ 18 = 50

b) (30 Pts) How many kilograms of CO_2 does your personal driving contribute to the atmosphere each year?

500 gal = 1893.5 L

= 1.8935 m^3

= 1893500 cm^3

$D = .85\ g\ cm^3 = \frac{M}{V}$

$C_8H_{18} = 114\ g/mol$

$CO_2 = 44\ g/mol$

30/30

$$\frac{.85\ g\ C_8H_{18}}{cm^3} \left| \frac{1893500\ cm^3}{} \right| \frac{1\ mol\ C_8H_{18}}{114\ g\ C_8H_{18}} \left| \frac{16\ mol\ CO_2}{2\ mol\ C_8H_{18}} \right| \frac{44\ g\ CO_2}{1\ mol\ CO_2}$$

=> 4.9696×10^6 g CO_2/yr ✓

4970 kg CO_2/yr

Problem 1:

You do not drive too much using your car. But you do consume 500 gallons of gasoline per year in your car (1 gal = 3.7879 L). Assume that gasoline can be represented as C_8H_{18}. Gasoline has a density of 0.85 g cm^{-3}. Assume further that combustion of C_8H_{18} is complete and leads to CO_2 and H_2O only.

a) (15 Pts) Balance the combustion reaction of C_8H_{18} by filling in the blanks.

15/15

$$\sqrt{}\ C_8H_{18} + \overset{12.5}{?O_2} \longrightarrow \overset{8}{?CO_2} + \overset{9}{?H_2O}$$

b) (30 Pts) How many kilograms of CO_2 does your personal driving contribute to the atmosphere each year?

$$500\ \text{gal}\ C_8H_{18}\left(\frac{3.7879\ L}{1\ \text{gal}}\right)\left(\frac{(8\times12+18\times1)\ g/mol}{1\ mol\ C_8H_{18}}\right)\left(\frac{8\ mol\ CO_2}{(12+32)\ g/mol}\right)$$

$$\times\left(0.85\ \frac{g}{cm^3}\right)\left(\frac{10^6\ cm^3}{1\ m^3}\right)\left(\frac{1\ m^3}{24.465\ L}\right)$$

$1\ m^3 \neq 24.465\ L$

No way!

10/30

$$m_{CO_2} = 1.36391\times10^9\ g$$

$$= 1.36\times10^6\ kg\ CO_2$$

NO!

4966 kg CO_2/yr

Problem 1:

You do not drive too much using your car. But you do consume 500 gallons of gasoline per year in your car (1 gal = 3.7879 L). Assume that gasoline can be represented as C_8H_{18}. Gasoline has a density of 0.85 g cm^{-3}. Assume further that combustion of C_8H_{18} is complete and leads to CO_2 and H_2O only.

a) (15 Pts) Balance the combustion reaction of C_8H_{18} by filling in the blanks.

15/15

$$C_8H_{18} + 12.5\,O_2 \longrightarrow 8\,CO_2 + 9\,H_2O$$

b) (30 Pts) How many kilograms of CO_2 does your personal driving contribute to the atmosphere each year?

$V = 500$ gallons/yr, 1 gal = 3.7892 L.

$\rho = 0.85$ g cm^{-3}

Amount of CO_2 produced during combustion of C_8H_{18} is = $8 \times 12 + 2 \times 16 = 96 + 32 = 128$ amu.

0/30

In grams it will be $= \dfrac{128}{6.023 \times 10^{23} \times 1000}$ g.

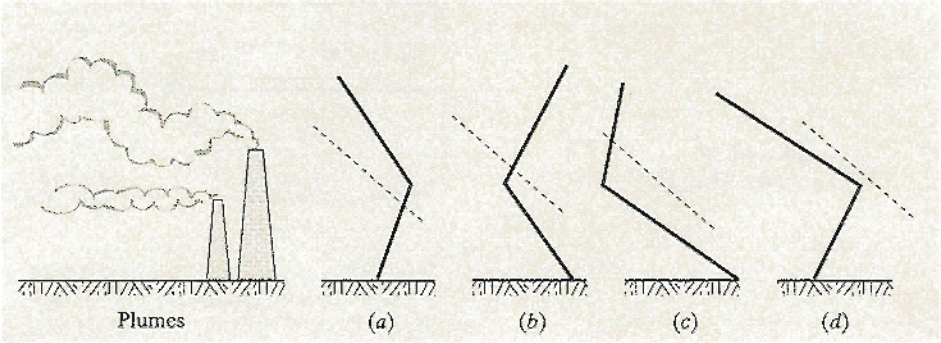
$= 2.125 \times 10^{-25}$ g. No?

4960 kg CO_2/yr

Look at the balance in (a), you should get more CO_2 than fuel used?

Problem 3:

(10 Pts) A tall stack and a nearby short stack have plumes as shown in the Figure below. Which atmospheric temperature profile would be most likely to cause that pair of plumes? The dotted lines represent the dry adiabatic lapse rate.



10/10

- [ ] (a)
- [ ] (b)
- [ ] (c)
- [x] (d)

Problem 4:

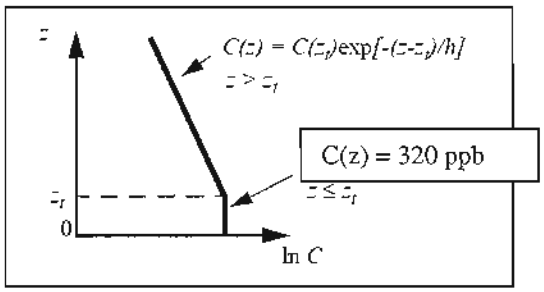
Emission of nitrous oxide (N_2O) to the atmosphere is largely biogenic and heavily impacted by anthropogenic agricultural activities. The individual sources are difficult to quantify. However, one can use a simple mass balance approach to calculate the global source.

a) (10 Pts) Nitrous oxide is inert in the troposphere and has to reach first the stratosphere before photodissociation (90%) and reaction with excited oxygen atoms (10%) can effectively convert it to N_2 (photodissociation) and NO. The corresponding lifetime of N_2O is known to be about 120 years. Based on this lifetime, would you expect nitrous oxide to be well mixed in the troposphere? Briefly explain.

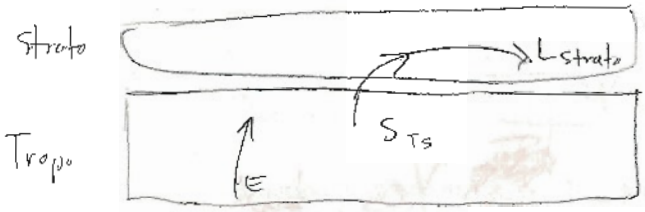
✓ 10/10

Yes, because the lifetime is very long, N_2O must be well mixed in the troposphere. If it were not all N_2O would be concentrated in one place having a much less lifetime as it is easier for it to decay and be broken down.

b) (40 Pts) The present-day N_2O concentration in the troposphere is 320 ppb. There are no known losses of N_2O in the troposphere. The only loss of N_2O occurs as mentioned before in the stratosphere. Assume that the N_2O concentration in the stratosphere can be described by the relationship shown in the graph and that the scale height h = 20 km.



Find the annual emission rate E (Tg/yr) for N_2O by assuming that the annual losses to the stratosphere (L_{strat}) are equal to the emissions (E) (steady-state). The turbulent diffusion coefficient $K_z = 5\times10^3\ cm^2s^{-1}$ and number concentration of air molecules just above the tropopause is $n_a = 5\times10^{18}$ molecules cm^3. Hint: Remember how we did problem 4.8.3.2?



$S_{TS} = L_{strato}$

$$E = L_{strato}$$

$\frac{40}{40}$

$$L_{strato} = S_{TS} = A \times F_{TS}$$

from eddy diff: $F_{TS} = -n_a k_z \cdot \left.\frac{dC_{N_2O}}{dz}\right|_{tropo}$

$$C_{N_2O}^{(z)} = C_{N_2O}^{(z_t)} \cdot \exp\left[-\frac{(z-z_t)}{h}\right]$$

derivative: $\frac{dC_{N_2O}^{(z)}}{dz} = C_{N_2O}^{(z_t)} \cdot \left(-\frac{1}{h}\right) \cdot \exp\left[-\frac{(z-z_t)}{h}\right]$

@ the height between strato and tropo $z = z_t$

$$\frac{dC_{N_2O}^{(z_t)}}{dz} = -\frac{C_{N_2O}^{(z_t)}}{h}$$

$L_{strato} = S_{TS} = A \cdot -n_a k_z \cdot -\frac{C_{N_2O}^{(z_t)}}{h}$; $A = 4\pi R^2$
$= 4\pi(6400\ km)^2$
$= 5.1472\times10^8\ km^2$

$= 5.15\times10^8\ \cancel{km^2}\left(-5.\times10^{18}\ \frac{molecules}{cm^3} \times \frac{10^6\ cm^3}{1\ m^3} \times \frac{10^9\ m^3}{1\ \cancel{km^3}}\right)$

$\cdot\left(5\times10^3\ \frac{cm^2}{s} \times \frac{1\ m^2}{10^4\ cm^2} \times \frac{1\ \cancel{km^2}}{10^6\ m^2}\right) \cdot \left(-\frac{320\times10^{-9}}{20\ \cancel{km}}\ 5\right)$

*continue on back

$L_{strato} = 2.05887 \times 10^{28}$ molecules/yr

$E = L_{strato}$

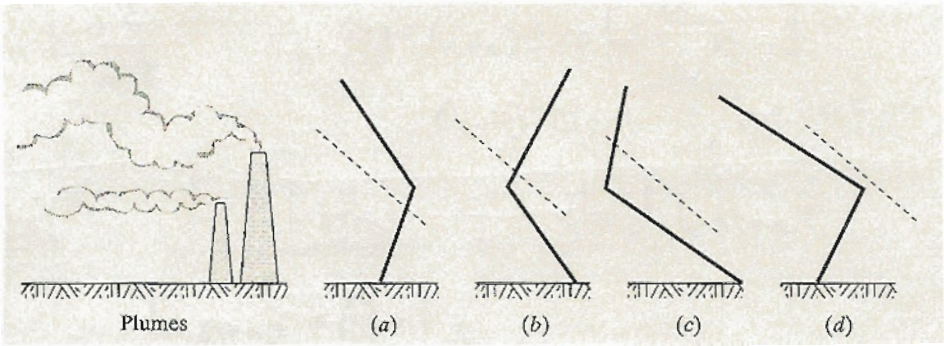
$= 2.06 \times 10^{28}$ molecules/yr

Yes, but it would have been nice to get it in Tg/yr

$E = 49$ Tg/yr

Problem 3:

(10 Pts) A tall stack and a nearby short stack have plumes as shown in the Figure below. Which atmospheric temperature profile would be most likely to cause that pair of plumes? The dotted lines represent the dry adiabatic lapse rate.



10/10

- ☐ (a)
- ☐ (b)
- ☐ (c)
- ☑ (d)

$N_2O \rightarrow N_2$ (glol) N_2O

Problem 4:

Emission of nitrous oxide (N_2O) to the atmosphere is largely biogenic and heavily impacted by anthropogenic agricultural activities. The individual sources are difficult to quantify. However, one can use a simple mass balance approach to calculate the global source.

$\tau_{N_2O} = 120 yr$

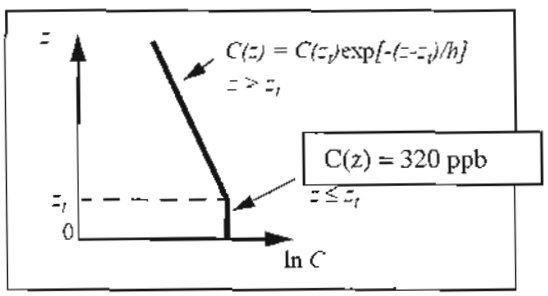
0/10 f

a) (10 Pts) Nitrous oxide is inert in the troposphere and has to reach first the stratosphere before photodissociation (90%) and reaction with excited oxygen atoms (10%) can effectively convert it to N_2 (photodissociation) and NO. The corresponding lifetime of N_2O is known to be about 120 years. Based on this lifetime, would you expect nitrous oxide to be well mixed in the troposphere? Briefly explain.

no, if we assume the output of N_2O increases over the years the NO_2 concentration at the upper troposphere would be lower than the lower troposphere, because the vertical transfer is very slow, and the lower troposphere holds greater amount of N_2O from the growing emission over the recent years

F_{ST} E L T

b) (40 Pts) The present-day N_2O concentration in the troposphere is 320 ppb. There are no known losses of N_2O in the troposphere. The only loss of N_2O occurs as mentioned before in the stratosphere. Assume that the N_2O concentration in the stratosphere can be described by the relationship shown in the graph and that the scale height h = 20 km.

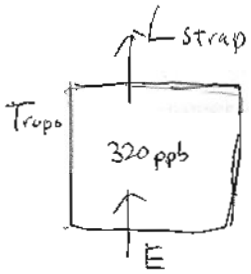


$10^{12}g$

Find the annual emission rate E (Tg/yr) for N_2O by assuming that the annual losses to the stratosphere (L_{strat}) are equal to the emissions (E) (steady-state). The turbulent diffusion coefficient $K_z = 5x10^3\ cm^2s^{-1}$ and number concentration of air molecules just above the tropopause is $n_a = 5x10^{18}$ molecules cm^3. Hint: Remember how we did problem 4.8.3.2?

$$\bar{F} = -n_a K_z \frac{\partial \bar{C}}{\partial z} \quad , \quad C(z) = C(z_t)\exp\left[-\frac{(z-z_t)}{h}\right]$$

$C_z = 320\,ppb$, $h = 20\,km$



$E = L_{strat}$ find L_{strat}

$L_{strat} = A \cdot F_s$

$$\frac{d\xi_{N_2O}(z)}{dz} = \xi_{N_2O}(z_t)e^{\left(-\frac{(z-z_t)}{h}\right)}\left(-\frac{1}{h}\right) \quad \text{set. } z = z_t$$

$$= \xi_{N_2O}(z_t)\left(-\frac{1}{h}\right)$$

$$L_{STRAT} = A \cdot F = A \cdot \left(-n_a K_z \frac{d\xi}{dz}\right) = A\left(-n_a K_z \xi_{N_2O}(z_t)\left(-\frac{1}{h}\right)\right)$$

$$= 5.1\times10^{14} m^2 \left(-5\times10^{18}\frac{mol}{cm^3} \cdot 5\cdot10^3 \frac{cm^2}{s} \cdot \frac{100cm}{m}\right)\left(320\cdot10^{-9}\right)\left(-\frac{1}{20\cdot10^3 m}\right)$$

$$= 2.04\cdot10^{28}\frac{mol}{s}$$

$$\frac{2.04\cdot10^{28}\frac{mol}{s} \times \frac{3600s}{hr} \times \frac{24hr}{day} \times \frac{365\,day}{yr}}{6.022\times10^{23}\frac{mol}{mol}} = 1.068\times10^{12}\frac{mol}{yr}$$

$$(N_2O)\ 1.068\times10^{12}\frac{mol}{yr} \times N_2O\ \frac{44g}{mol} \times \frac{Tg}{10^{12}g} = 46.992\frac{Tg}{yr} = E$$

40/40

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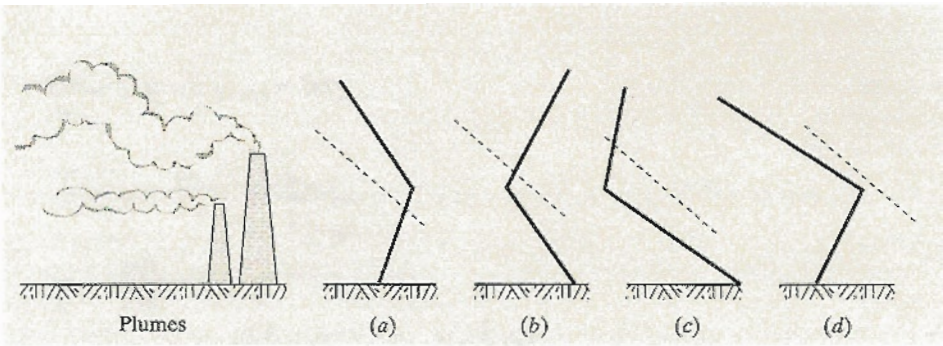


10/10

- [ ] (a)
- [ ] (b)
- [ ] (c)
- [x] (d) ✓

Problem 4:

Emission of nitrous oxide (N_2O) to the atmosphere is largely biogenic and heavily impacted by anthropogenic agricultural activities. The individual sources are difficult to quantify. However, one can use a simple mass balance approach to calculate the global source.

a) (10 Pts) Nitrous oxide is inert in the troposphere and has to reach first the stratosphere before photodissociation (90%) and reaction with excited oxygen atoms (10%) can effectively convert it to N_2 (photodissociation) and NO. The corresponding lifetime of N_2O is known to be about 120 years. Based on this lifetime, would you expect nitrous oxide to be well mixed in the troposphere? Briefly explain.

10/10

✓ Yes, this is a very long lifetime N_2O will be able to mix well in the atmosphere

$\frac{dN}{dt} = E - L_{trop} - S_{TS}$

$N = E_{N_2O} \cdot N_A \cdot f$

$\frac{dN}{dt} = f \cdot N_A \cdot \frac{dE_{N_2O}}{dt}$

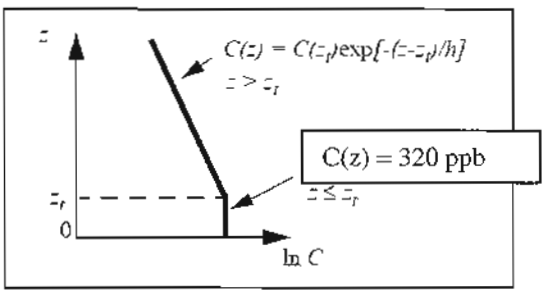
N-total # of moles of N_2O in troposphere

$f = .85$

N: 114 0.16 mol/m!

$\frac{dE_{N_2O}}{dt}$ 10 pb/yr

b) (40 Pts) The present-day N_2O concentration in the troposphere is 320 ppb. There are no known losses of N_2O in the troposphere. The only loss of N_2O occurs as mentioned before in the stratosphere. Assume that the N_2O concentration in the stratosphere can be described by the relationship shown in the graph and that the scale height h = 20 km.



Find the annual emission rate E (Tg/yr) for N_2O by assuming that the annual losses to the stratosphere (L_{strat}) are equal to the emissions (E) (steady-state). The turbulent diffusion coefficient $K_z = 5x10^3$ cm^2s^{-1} and number concentration of air molecules just above the tropopause is $n_a = 5x10^{18}$ molecules cm^3. Hint: Remember how we did problem 4.8.3.2?

$$\frac{dN}{dt} = E - L_{trop} - S_{TS}$$

$$\tau_{trop} = \frac{m}{L_{trop}} \cdot \frac{N_{N_2O}}{L_{trop}}$$

$$E = \frac{dN}{dt} + L_{trop}$$

$$E = f\, N_a \cdot \frac{d\varepsilon_{N_2O}}{dt} + \frac{f \cdot N_a \varepsilon_{N_2O}}{\tau_{trop}}$$

$$E = .85 \cdot 5\times10^{18} \cdot 1.6\times10^{-14} \cdot \left(.85 \cdot \frac{15.\times10^{14}\ (1.6\times10^{-14})}{12} \right)$$

$$E \sim 3.5\times10^{13} \text{ moles/yr}$$

$$L_{STS} = A F_{TS}$$

$$F_{TS} = -n_a K_z \cdot \frac{d\varepsilon_{N_2O}}{dz}$$

$$\frac{d\varepsilon_{N_2O}}{dz} = e^{-\frac{(z - z_t)}{h}}$$

6.37×10^6

$$L_{strat} = S_{TS} = -A \cdot n_a \cdot K_z \left(\frac{\varepsilon(z_t)}{h} \right)$$

$$= \pi r^2 \cdot$$

$$= \pi (6.37\times10^6)^2 \cdot 5\times10^{18} \cdot 5\times10^3 \left(\frac{320\times10^{-9}}{10\,km} \right)$$

$$= 5.1\times10^{12} \text{ mol/yr}$$

$E = L_{strat}$

so get E from L_{strat}

$$L_{strat} = \frac{A \cdot k_z \cdot n_a \cdot C(z)}{h}$$

you should have checked your units

$$E = 2\times10^{13} \text{ mol/yr } (144 g/mol) = 8.8\times10^{15}$$

8.8 Tg/yr NO!

47 Tg/yr

15/40

Problem 5:

(30 points) Light scattering and light absorption of especially ambient fine particulate matter can be substantial as we can see in the San Joaquin Valley. A simple relationship called the Koschmeider Eq. can be used to determine the visual range (distance one can see, X_v [m]).

$$x_v = \frac{3.912}{b_{ext}}$$

The light extinction coefficient is $b_{ext} = b_{scat} + b_{abs}$; [$m^{-1}$]. A simple way to determine b_{ext} has been suggested by Seinfeld and Pandis. Here,

$b_{scat} = \sigma_{sulfate}$[sulfate] + $\sigma_{nitrate}$[nitrate]+ $\sigma_{organic\ carbon}$ [organic carbon]; here $\sigma[m^2g^{-1}]$

$b_{abs} = \sigma_{black\ carbon}$[carbon]

$\sigma_{sulfate} = 2.7\ m^2g^{-1}$; $\sigma_{nitrate} = 3\ m^2g^{-1}$; $\sigma_{organic\ carbon} = 4\ m^2g^{-1}$; and $\sigma_{black\ carbon} = 7.5\ m^2g^{-1}$

Scat abs

At a typical day in summer, the following concentrations of particulate constituents have been measured:

[sulfate] = 11 μg m^{-3}
[nitrate] = 32 μg m^{-3}
[organic carbon] = 42 μg m^{-3}
[black carbon] = 12.5 μg m^{-3}

30/30

Find the visual range (distance one can see) in km.

$$b_{scat} = 2.7\frac{m^2}{g}\left(11\cdot10^{-6}\frac{g}{m^3}\right) + 3\frac{m^2}{g}\left(32\cdot10^{-6}\frac{g}{m^3}\right) + \frac{4\ m^2}{g}\left(42\cdot10^{-6}\frac{g}{m^3}\right)$$

$$= 2.97\times10^{-5}\frac{1}{m} + 9.6\times10^{-5}\frac{1}{m} + 1.68\times10^{-4}\frac{1}{m}$$

$$= 2.937\times10^{-4}\frac{1}{m}$$

$$b_{abs} = 7.5\frac{m^2}{g}\left(12.5\times10^{-6}\frac{g}{m^3}\right) = 9.375\times10^{-5}\frac{1}{m}$$

$$b_{ext} = b_{scat} + b_{abs} = 2.937\times10^{-4}\frac{1}{m} + 9.375\times10^{-5}\frac{1}{m}$$

$$= 3.8745\times10^{-4}\frac{1}{m}$$

$$X_v = \frac{3.912}{b_{ext}} = \frac{3.912}{3.8745\times10^{-4}\frac{1}{m}} = 10096.787\ m$$

$$= \underline{\underline{10.1\ Km}}$$

Problem 5:

(30 points) Light scattering and light absorption of especially ambient fine particulate matter can be substantial as we can see in the San Joaquin Valley. A simple relationship called the Koschmeider Eq. can be used to determine the visual range (distance one can see, X_v [m]).

$$x_v = \frac{3.912}{b_{ext}}$$

The light extinction coefficient is $b_{ext} = b_{scat} + b_{abs}$; [$m^{-1}$]. A simple way to determine b_{ext} has been suggested by Seinfeld and Pandis. Here,

$b_{scat} = \sigma_{sulfate}$[sulfate] + $\sigma_{nitrate}$[nitrate]+ $\sigma_{organic\ carbon}$ [organic carbon]; here $\sigma[m^2g^{-1}]$

$b_{abs} = \sigma_{black\ carbon}$[carbon]

$\sigma_{sulfate} = 2.7\ m^2g^{-1}$; $\sigma_{nitrate} = 3\ m^2g^{-1}$; $\sigma_{organic\ carbon} = 4\ m^2g^{-1}$; and $\sigma_{black\ carbon} = 7.5\ m^2g^{-1}$

At a typical day in summer, the following concentrations of particulate constituents have been measured:

[sulfate] = 11 μg m^{-3}
[nitrate] = 32 μg m^{-3}
[organic carbon] = 42 μg m^{-3}
[black carbon] = 12.5 μg m^{-3}

Find the visual range (distance one can see) in km.

$$b_{scat} = 2.7\frac{m^2}{g}\left(\frac{11\times10^{-6}g}{m^3}\right) + 3\frac{m^2}{g}\left(\frac{32\times10^{-6}g}{m^3}\right) + 4\frac{m^2}{g}\left(\frac{42\times10^{-6}g}{g}\right)$$

0/30

$$b_{abs} = 7.5\frac{m^2}{g}\left(\frac{12.5\times10^{-6}g}{m^3}\right)$$

$$b_{scat} = \frac{.000294\ m}{g}\left|\frac{km}{10^3 m}\right. \Rightarrow \cancel{2.937\times10^{-7}\ km/g}$$

$$b_{abs} = \frac{9.375\times10^{-5}\ m}{g}\left|\frac{km}{10^3 m}\right. = \cancel{9.375\times10^{-8}\ km/g}$$

$$B_{ext} = .000294 + 9.375\times10^{-5} \Rightarrow 3.87\times10^{-4}\ m/g$$

$$X_v = \frac{3.912\ g}{3.87\times10^{-4}\ m} \Rightarrow 10096.8\ g/m \times \frac{10^3 m}{km}$$

OR

$$\Rightarrow 1\times10^7\ g/km$$

No!

$X_v = 10.09$ km

Problem 5:

(30 points) Light scattering and light absorption of especially ambient fine particulate matter can be substantial as we can see in the San Joaquin Valley. A simple relationship called the Koschmeider Eq. can be used to determine the visual range (distance one can see, X_v [m]).

$$x_v = \frac{3.912}{b_{ext}}$$

The light extinction coefficient is $b_{ext} = b_{scat} + b_{abs}$; [$m^{-1}$]. A simple way to determine b_{ext} has been suggested by Seinfeld and Pandis. Here,

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$b_{abs} = \sigma_{black\ carbon}$[carbon]

$\sigma_{sulfate} = 2.7\ m^2g^{-1}$; $\sigma_{nitrate} = 3\ m^2g^{-1}$; $\sigma_{organic\ carbon} = 4\ m^2g^{-1}$; and $\sigma_{black\ carbon} = 7.5\ m^2g^{-1}$

At a typical day in summer, the following concentrations of particulate constituents have been measured:

[sulfate] = 11 μg m^{-3}
[nitrate] = 32 μg m^{-3}
[organic carbon] = 42 μg m^{-3}
[black carbon] = 12.5 μg m^{-3}

29.7
96
168
93.75

Find the visual range (distance one can see) in km.

$b_{ext} = b_{scat} + b_{abs}$

$= \sigma_{sulfate}$[sulfate] + $\sigma_{nitrate}$[nitrate] + $\sigma_{organic\ carbon}$[organic carbon] + $\sigma_{black\ carbon}$[carbon]

$= 2.7 \times 11 + 3 \times 32 + 4 \times 42 + 7.5 \times 12.5$

$= 387.45.$

$x_v = \frac{3.912}{b_{ext}} = \frac{3.912}{387.45} = 0.01009$ m.

No!

$X_v = 10.09$ km

10/30

Problem 3:

(30 Points) A pathway for production of H_2SO_4 in clouds is by dissolution of SO_2 in cloud droplets followed by reaction of SO_3^{2-} with $O_3(aq)$:

$$SO_3^{2-} - O_3(aq) \rightarrow SO_4^{2-} + O_2(aq) \qquad (1)$$

with rate constant $k_1 = 1.0\text{x}10^9\ M^{-1}\ s^{-1}$. Relevant equilibria are

$$SO_2(g) \Leftrightarrow SO_2 \cdot H_2O \qquad (2)$$

$$SO_2 \cdot H_2O \Leftrightarrow HSO_3^- + H^+ \qquad (3)$$

$$HSO_3^- \Leftrightarrow SO_3^{2-} + H^+ \qquad (4)$$

$$O_3(g) \Leftrightarrow O_3(aq) \qquad (5)$$

$\frac{30}{30}$

Check back for answer

with equilibrium constants $K_2 = 1.2\ M\ atm^{-1}$, $K_3 = 1.3\text{x}10^{-2}\ M$, $K_4 = 6.3\text{x}10^{-8}\ M$, $K_5 = 1.1\text{x}10^{-2}\ M\ atm^{-1}$.

For an atmosphere containing 2 ppb SO_2 and 50 ppb O_3, calculate the rate of sulfate production $d[SO_4^{2-}]/dt$ by reaction (1) for a pH = 4.5.

$$\frac{d[SO_4^{2-}]}{dt} = K_1 [SO_3^{2-}][O_3(aq)]$$

$$K_5 = \frac{[O_3(aq)]}{[O_3(g)]}$$

$$K_4 = \frac{[SO_3^{2-}][H^+]}{[HSO_3^-]} \Rightarrow [SO_3^{2-}] = \frac{K_4[HSO_3^-]}{[H^+]}$$

$$[O_3(aq)] = K_5[O_3(g)]$$

$$[O_3(g)] = \xi_{O_3} \cdot P_{atm}$$

$$K_3 = \frac{[HSO_3^-][H^+]}{[SO_2 \cdot H_2O]} \Rightarrow [HSO_3^-] = \frac{K_3[SO_2 \cdot H_2O]}{[H^+]}$$

$$[SO_2(g)] = \xi_{SO_2} \cdot P_{atm}$$

$$K_2 = \frac{[SO_2 \cdot H_2O]}{[SO_2(g)]} \Rightarrow [SO_2 \cdot H_2O] = K_2[SO_2(g)]$$

$$pH = -\log[H^+]$$

$$[H^+] = 10^{-pH}$$

$$[SO_3^{2-}] = \frac{K_4K_3[SO_2 \cdot H_2O]}{[H^+]^2} = \frac{K_4K_3K_2[SO_2(g)]}{[H^+]^2}$$

$$[H^+] = 10^{-4.5} = 3.2\times10^{-5}$$

Assume $P_{atm} = 1\ atm$

$$\frac{d[SO_4^{2-}]}{dt} = \frac{K_1K_2K_3K_4[SO_2(g)]}{[H^+]^2}[O_3(aq)] = \frac{K_1K_2K_3K_4K_5\,\xi_{O_3} \cdot P_{atm} \cdot \xi_{SO_2} \cdot P_{atm}}{[H^+]^2}$$

$$\frac{d[SO_4^{2-}]}{dt} = \frac{(1.0\times10^9\ M^{-1}s^{-1})(1.2\ M \cdot atm^{-1})(1.3\times10^{-2}\ M)(6.3\times10^{-8}\ M)(1.1\times10^{-2}\ M \cdot atm^{-1})(50\times10^{-9}\ atm)(2\times10^{-9}\ atm)}{(3.2\times10^{-5}\ M)^2}$$

$$\frac{d[SO_4^{2-}]}{dt} = \frac{1.08108 \times 10^{-18}\ M^3 \cdot s^{-1}}{1 \times 10^{-9}\ M^2}$$

$$= 1.08 \times 10^{-9}\ \frac{M}{s}$$

✓ perfect!

Problem 3:

(30 Points) A pathway for production of H_2SO_4 in clouds is by dissolution of SO_2 in cloud droplets followed by reaction of SO_3^{2-} with $O_3(aq)$:

$$SO_3^{2-} + O_3(aq) \rightarrow SO_4^{2-} + O_2(aq) \qquad k_1 \qquad (1)$$

with rate constant $k_1 = 1.0\text{x}10^9\ M^{-1}\ s^{-1}$. Relevant equilibria are

$$SO_2(g) \Leftrightarrow SO_2 \cdot H_2O \qquad K_2 \qquad (2)$$

$$SO_2 \cdot H_2O \Leftrightarrow HSO_3^- + H^+ \qquad k_3 \qquad (3)$$

$$HSO_3^- \Leftrightarrow SO_3^{2-} + H^+ \qquad k_4 \qquad (4)$$

$$O_3(g) \Leftrightarrow O_3(aq) \qquad k_5 \qquad (5)$$

$k = \frac{[\text{product}]}{[\text{react.}]}$

$pH = -\log[H^+]$

$[H^+] = 10^{-pH}$

25/30

with equilibrium constants $K_2 = 1.2\ M\ atm^{-1}$. $K_3 = 1.3\text{x}10^{-2}\ M$, $K_4 = 6.3\text{x}10^{-8}\ M$, $K_5 = 1.1\text{x}10^{-2}\ M\ atm^{-1}$.

$P_{SO_2} = 2 \times 10^{-9}$

$P_{O_3} = 50 \times 10^{-9}$

For an atmosphere containing 2 ppb SO_2 and 50 ppb O_3, calculate the rate of sulfate production $d[SO_4^{2-}]/dt$ by reaction (1) for a pH = 4.5.

$$\frac{d[SO_4^{2-}]}{dt} = k_1 [SO_3^{2-}][O_3(aq)]$$

$$[O_3(aq)] = k_5 \cdot P_{O_3}$$

$$k_2 = \frac{[SO_2 \times H_2O]}{P_{SO_2}} \quad ; \quad k_3 = \frac{[HSO_3^-][H^+]}{[SO_2 \times H_2O]}$$

$$k_4 = \frac{[SO_3^{2-}][H^+]}{[HSO_3^-]} \Rightarrow [SO_3^{2-}] = \frac{k_4 [HSO_3^-]}{[H^+]}$$

$$[SO_3^{2-}] = \frac{k_4 k_3 [SO_2 \times H_2O]}{[H^+]^2}$$

$$= \frac{k_2 k_3 k_4 P_{SO_2}}{[H^+]^2}$$

(back)

$$\frac{d[SO_4^{2-}]}{dt} = \frac{k_1 k_2 k_3 k_4 k_5 P_{O_3} \cdot P_{SO_2}}{[H^+]^2}$$

$$= \frac{\left(1.\times10^{9}\ \frac{1}{Ms}\right)\left(1.2\ \frac{M}{atm}\right)\left(1.3\times10^{-2}\ M\right)\left(6.3\times10^{-8}\ M\right)\left(1.1\times10^{-2}\ \frac{M}{atm}\right)\times\left(2\times10^{-9}\ atm\right)\times\left(50\times10^{-9}\ atm\right)}{\left[10^{-5}\ M\right]^2}$$

$$\frac{d[SO_4^{2-}]}{dt} = \frac{1.08\times10^{-18}\ \frac{M^3}{s}}{\left[10^{-5}\ M\right]^2}$$

-4,5

-4,5

$$= 1.08\times10^{-8}\ \frac{M}{s}$$

$$1.08\cdot10^{-9}\ \frac{M}{s}$$

Problem 3:

(30 Points) A pathway for production of H_2SO_4 in clouds is by dissolution of SO_2 in cloud droplets followed by reaction of SO_3^{2-} with O_3(aq):

$$SO_3^{2-} - O_3(aq) \rightarrow SO_4^{2-} + O_2(aq) \qquad (1)$$

with rate constant $k_1 = 1.0\text{x}10^9\ M^{-1}\ s^{-1}$. Relevant equilibria are

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$$O_3(g) \Leftrightarrow O_3(aq) \qquad (5)$$

with equilibrium constants $K_2 = 1.2\ M\ atm^{-1}$, $K_3 = 1.3\text{x}10^{-2}\ M$, $K_4 = 6.3\text{x}10^{-8}\ M$, $K_5 = 1.1\text{x}10^{-2}\ M\ atm^{-1}$.

For an atmosphere containing 2 ppb SO_2 and 50 ppb O_3, calculate the rate of sulfate production $d[SO_4^{2-}]/dt$ by reaction (1) for a pH = 4.5.

$$\frac{d[SO_4^{2-}]}{dt} = k_1[SO_3^{2-}][O_3](aq)$$

$$\frac{[SO_4^{2-}][O_2]}{[SO_3^{2-}][O_3]} = k_1$$

18/30

$$[O_3](aq) = k_5[O_3](g)$$

$$[SO_3^{2-}] = \frac{k_4[HSO_3^-]}{[H^+]}$$

$$[SO_3^{2-}] = \frac{k_4k_3[SO_2][H_2O]}{[H^+]}$$

$$[SO_3^{2-}] = \frac{k_4k_3k_2[SO_2]g}{[H^+]^2}$$

$$[SO_3^{2-}] = \frac{k_4k_3k_2 P_{SO_2}}{[H^+]^2}$$

for pH = 4.5 $[H^+] = 10^{-4.5}M$

$$\frac{d[SO_4^{2-}]}{dt} = \frac{1.08108\times10^{-16}}{10^{-4.5}}$$

$$= 3.41464\times10^{-9}\ M/s$$

$$\rightarrow 2.95\times10^{-4}\ M/d$$

$$pH = -\log[H^+]$$

$$[H^+] = 10^{-pH}$$

$$\frac{d[SO_4^{2-}]}{dt} = \frac{k_1k_2k_3k_4k_5P_{O_3}P_{SO_2}}{[H^+]^2}$$

you can cale everything!

$$\frac{d[SO_4^{2-}]}{dt} = \frac{(1.0\times10^9\ M^{-1}s^{-1})(1.2\ M\ atm^{-1})(1.3\times10^{-2}\ M)(6.3\times10^{-8}\ M)(1.1\times10^{-2}\ M/atm)(50\times10^{-9}\ atm)(2\times10^{-9}\ atm)}{[H^+]^2}$$

$$= \frac{1.08108\times10^{-16}}{[H^+]^2}$$

Problem 4:

(20 points) The ambient fine-particle concentration of cholesterol in West Los Angeles was found to be 14.6 ng/m3. Likewise, the total organic matter concentration associated with this particulate matter was 7.5 µg/m3. The emission rates from meat cooking (charbroiling and frying) in that area were for Cholesterol 15.3 kg/day and for fine-particulate organic matter 1400 kg/day.

What fraction of the organic matter in West Los Angeles, based on the measured concentrations, is due to meat cooking? (Hint: This is a very simple problem, so do not think complicated!)

14.6 ng/m3 - cholesterol 15.3 kg/day

7.3 µg/m3 - organic matter 1400 kg/day

7.5×10^{-6} g/m3 1400000 g/day

$$\frac{1.4 \times 10^{6} \text{ g/day}}{7.5 \times 10^{-6} \text{ g/m}^3} = 1.56667 \times 10^{11} \text{ m}^3/\text{day}$$

$$\frac{15.3 \times 10^{3} \text{ g/day}}{14.6 \times 10^{-9} \text{ g/m}^3} = 1.04795 \times 10^{15} \text{ m}^3/\text{day}$$

20/20

$$\frac{1.56667 \times 10^{11} \text{ m}^3/\text{day}}{1.04795 \times 10^{15} \text{ m}^3/\text{day}} = \boxed{.117813}$$

18% ✓

Problem 4:

(20 points) The ambient fine-particle concentration of cholesterol in West Los Angeles was found to be 14.6 ng/m3. Likewise, the total organic matter concentration associated with this particulate matter was 7.5 μg/m3. The emission rates from meat cooking (charbroiling and frying) in that area were for Cholesterol 15.3 kg/day and for fine-particulate organic matter 1400 kg/day.

What fraction of the organic matter in West Los Angeles, based on the measured concentrations, is due to meat cooking? (Hint: This is a very simple problem, so do not think complicated!)

$$f = \frac{(7.5 \times 10^{-6}\ g/m^3 \times 1400 \times 10^3\ g/day)}{(14.6 \times 10^{-9}\ g/m^3 \times 15.3 \times 10^3\ g/day + 7.5 \times 10^{-6}\ g/m^3 \times 1400 \times 10^3\ g/day)}$$

$$= 0.999$$

or

$\frac{5}{20}$

99.9 % organic matter due to meat cooking based on measured conc. No

$$f = \frac{1400\ kg/day}{(15.3 + 1400)\ kg/day}$$

$$= 0.989$$

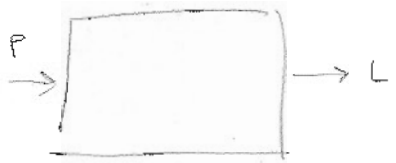
or

98.9% org. matter from meat cooking

only 18%

Problem 5:

(20 points) Consider an air parcel ventilated from a city at time t=0 and subsequently transported for 10 days without exchanging air with its surroundings. We want to examine the fate of NOx as the air parcel ages. The air parcel contains initially 100 ppb NO_x and zero HNO_3. The lifetime of NO_x against conversion to HNO_3 is 1 day. We assume that HNO_3 is removed rapidly by deposition and cannot recycled back to NO_x. Find the NO_x concentration after a transport of 10 days?



principal daytime removal path for NOx

$OH + NO_2 + M \rightarrow HNO_3 + M$ (1) $k = \frac{1}{1\,day}$?

~~$HNO_3 + h\nu \rightarrow NO_2 + OH$~~

$HNO_3 + OH \rightarrow NO_3 + H_2O$

at night loss to HNO_3

$NO_2 + O_3 \rightarrow NO_3 + O_2$ (2)

$NO_3 + NO_2 + M \rightarrow N_2O_5 + M$ (3)

$N_2O_5 + H_2O \longrightarrow 2HNO_3$ (4)

lifetime of NOx

Using $[M] = 3.1 \times 10^{17}$ molecules/cm^3

$\tau_{NOx} = 1\,day$

$$= \int \frac{\frac{d}{dt}[NO_x]}{[NOx]} = \int -k_{NOx}\,dt$$

$$= [NO_x]_0 e^{-k_{NOx} t}$$

$$= (100 \times 10^{-9}) e^{-1/day\,(10\,days)}$$

$$= 4.539 \times 10^{-12}$$

$$\boxed{= 4.5\ ppt\,V}$$

20/20

Problem 5:

(20 points) Consider an air parcel ventilated from a city at time t=0 and subsequently transported for 10 days without exchanging air with its surroundings. We want to examine the fate of NOx as the air parcel ages. The air parcel contains initially 100 ppb NO_x and zero HNO_3. The lifetime of NO_x against conversion to HNO_3 is 1 day. We assume that HNO_3 is removed rapidly by deposition and cannot recycled back to NO_x. Find the NO_x concentration after a transport of 10 days?

$$NO_x \longrightarrow HNO_3 \; ; \; k =$$

$$\tau_{NOx \Rightarrow HNO_3} = 1 \text{ day}$$

$$[NO_x] = 100 \text{ ppb} = 100 \times 10^{-9}$$

$$[HNO_3] = 0$$

$$t = 10 \text{ days} = 864000 \text{ s}$$

5/20

$$\frac{d[NO_x]}{dt} = -k[HNO_3]$$

$$\frac{d[NO_x]}{[NO_x]} = -k \, dt$$

$$= -k \int_0^{10} t$$

$$= -k \; 10 \text{ days}$$

integrate $[NO_x]_t = [NO]_0 \cdot e^{-kt}$

plug in # & get $4{,}5 \cdot 10^{-3}$ ppb

Assessment of Program Learning Outcomes for the B.S. in Environmental Engineering

Course: EnvE 160 Sustainable Energy
Instructor: Elliott Campbell
Semester: Fall 2009

Overview

The course EnvE 160 Sustainable Energy is a technical elective for the B.S. in Environmental Engineering (EnvE) and a recommended course for students in the Sustainable Energy track. Eleven undergraduates enrolled in the course during the Fall of 2009. Student work included homework, exams, online research presentations and a research report. Digital copies of all student work have been archived. Student performance on these assignments provides lines of evidence showing that the Fall 2009 semester of EnvE 160 has contributed to meeting Program Learning Outcomes for the B.S. in EnvE as discussed below.

PLO – 1. *Fundamental Knowledge: EnvE graduates will have gained a strong foundation in basic mathematics, science, social science, humanities and arts, along with engineering principles, enabling active engagement as citizens in their communities.*

Students learned mathematics and engineering principles and applied these to work sustainable energy problems on homework assignments and exams. For example, integral calculus and wind power engineering principles were applied to calculate the average power in the winds. In Appendix I, two different student solutions of this type of problem are presented, one by hand and one using spreadsheet software. The average score on this particular problem was 3 out of 4 points. Students learned to apply thermodynamics and basic math to more conventional energy sources as shown in the student sample midterm in Appendix II (average 20/30).

PLO – 2. *Critical Thinking: EnvE graduates will be adept at applying critical thinking, problem solving, engineering principles and reasoning, the scientific method, and teamwork to solve environmental resource problems and to restore and sustain the global environment.*

Students applied critical thinking skills by creating and solving a quantitative problem that integrated their review of the literature on a sustainable energy topic with the fundamental problem solving skills they developed through homework and exams (see end of Appendix III).

PLO – 3. *Design Skills: EnvE graduates will be prepared for advanced studies and research and/or employment advancement in a broad spectrum of industries and government agencies.*

Students learned advanced research skills by working with the ISI Web of Science search engine, summarizing the literature, and reflecting on existing research challenges (see example paper in

Appendix III). Students were able to obtain and summarize relevant papers from specialized journals as well as high-profile publications from multi-disciplinary journals, National Academy reports, and government agencies.

PLO – 4. *EnvE graduates will communicate effectively in written, spoken, and visual formats with technical, professional, and broader communities.*

Students delivered practice presentations using an online meeting platform and after critical feedback delivered final presentations that were followed by a Q&A period. A video recording example of a final student presentation on geothermal energy is posted here, https://admin.na4.acrobat.com/_a837488306/p98613719/

This sample student presentation has concise slides, excellent vocal delivery, detailed responses to questions, as well as a presentation of a quantitative problem that applies thermodynamic fundamentals and energy economic analysis.

PLO – 5. *EnvE graduates will practice engineering according to the highest professional standards, demonstrating respect for social, ethical, cultural, environmental, economic, and regulatory concerns.*

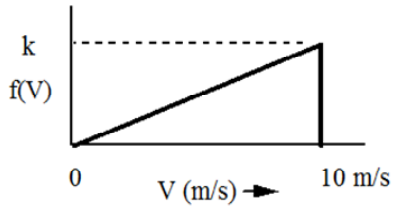
Student developed advanced technical and professional skills with an online meeting tool as well as a respect for the sustainability advantages of online meetings as an approach to offsetting travel needs and thus reducing the carbon footprint of professional communication. A video recording example of students demonstrating exceptional competency with this online platform for communication is shown here, https://admin.na4.acrobat.com/_a837488306/p98613719/

PLO – 6. *EnvE graduates will be instilled with a desire to pursue life-long learning opportunities including continued education, professional licensure, challenging professional experiences and active participation in professional organizations.*

After the completion of the course, multiple students engaged with the instructor in scholarly work, exhibiting a strong interest in pursuing learning opportunities beyond the classroom. An exceptional student joined my lab group as a research assistant showing continued interest in bioenergy research that was covered in class. Three other students approached me to mentor them in a student sustainable energy project. We developed a student-led grant proposal to the U.S. EPA's annual student sustainability design challenge (http://www.epa.gov/P3/). The proposal was submitted and is included in Appendix IV.

Appendix 1: Homework

6.3 Consider the following probability density function for wind speed:



a. What is an appropriate value of k for this to be a legitimate probability density function?

b. What is the average power in these winds (W/m²) under standard (15°C, 1 atm) conditions?

3. A) $\int_0^{10} \frac{k}{10}(v\,dv) = 1$

$\Rightarrow \frac{k}{10} v^2 \Big|_0^{10} = 1$

$\Rightarrow \frac{k}{20}(100) = 1$

$\Rightarrow 5k = 1$

$\Rightarrow k = \frac{1}{5} = \boxed{.2}$

B) $f(v) = \frac{k}{10}(v)$

$\Rightarrow f(v) = \frac{1}{10(5)}(v) = \frac{1}{50}(v)$

$V^3_{average} = \int_0^{10} (2v)(v^3)\,dv$

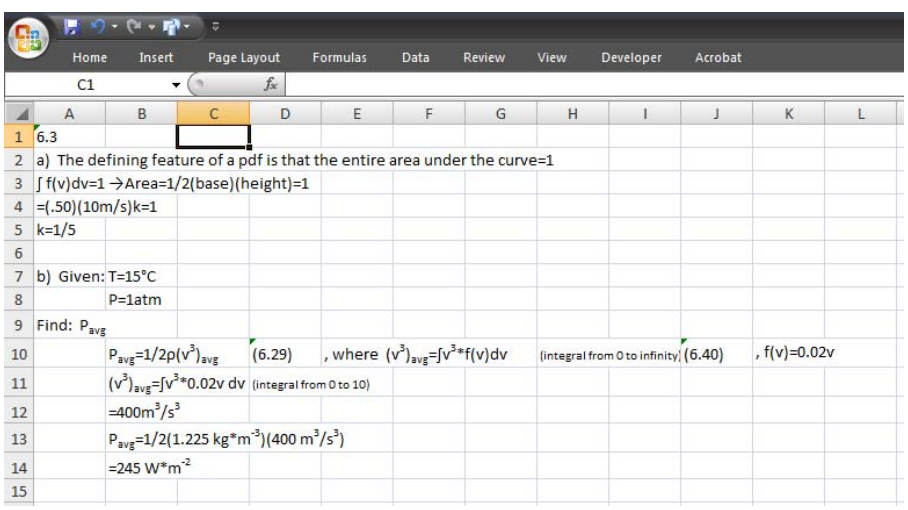
$\Rightarrow \int_0^{10} \frac{1}{50} v^4\,dv$

$\Rightarrow \frac{1}{50(5)} v^5 \Big|_0^{10}$

$= V^3_{average} = \frac{1}{250}(10^5) = 400\ m^3/s^3$

$P_{10} = P_{avg}$ $\quad P_{10} = \frac{1}{2}\rho A(\bar{v}^3)$

$\Rightarrow .5(1.225)(m^{-2})(400 m^3/s^3) = \boxed{245\ W/m^2}$



Home Insert Page Layout Formulas Data Review View Developer Acrobat

C1

	A	B	C	D	E	F	G	H	I	J	K	L
1	6.3											
2	a) The defining feature of a pdf is that the entire area under the curve=1											
3	∫ f(v)dv=1 →Area=1/2(base)(height)=1											
4	=(.50)(10m/s)k=1											
5	k=1/5											
6												
7	b) Given:	T=15°C										
8		P=1atm										
9	Find: P_{avg}											
10		$P_{avg}=1/2\rho(v^3)_{avg}$		(6.29)	, where $(v^3)_{avg}=\int v^3 * f(v)dv$			(integral from 0 to infinity)		(6.40)	, f(v)=0.02v	
11		$(v^3)_{avg}=\int v^3 * 0.02v\ dv$		(integral from 0 to 10)								
12		$=400 m^3/s^3$										
13		$P_{avg}=1/2(1.225\ kg*m^{-3})(400\ m^3/s^3)$										
14		$=245\ W*m^{-2}$										
15												

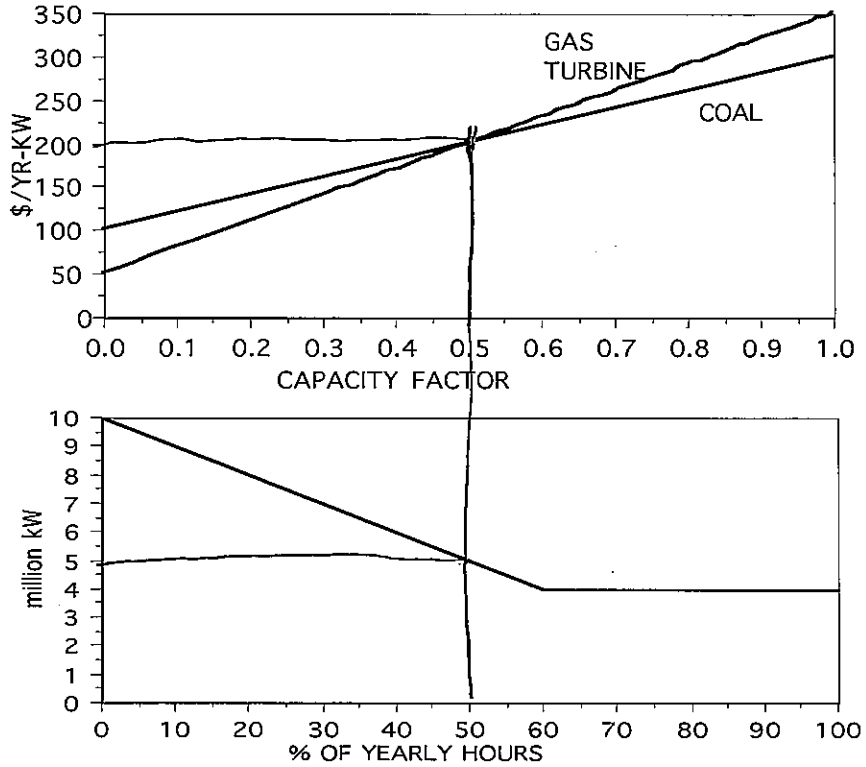
Appendix II: Exam

Josh O'Rourke

Midterm: ENVE 160/260

1) A heat engine supposedly receives 500 kJ/s of heat from an 1100 K source and rejects 300 kJ/s to a low-temperature sink at 300 K. A) Is this possible or impossible? B) What would be the rate of change of entropy change for the source, sink, and system?

2) Consider screening curves for gas turbines and coal-fired power plants given below along with a load duration curve for a hypothetical utility. A) For a least-cost combination, how many MW should each power plant type have? B) What would the cost of electricity be ($/kWh) for the gas turbines sized in (a)?



3) For a methanol fuel cell forms liquid water during its operation at STP conditions. A) What minimum amount of heat must be rejected in order to satisfy entropy constraints (kJ/mol)? B) What maximum efficiency could the fuel cell have using the calculation in part A? C) What maximum efficiency could the fuel cell have using the Gibbs free energy approach?

4) Better windows for a building adds $3 per square foot of window but saves $0.55/ft2 per year in reduced heating, cooling and lighting costs. With a discount rate of 12 percent:
A) What is the net present value (NPV) of the better windows over a 30-year period with no escalation in the value of the annual savings? B) What is the internal rate of return (IRR) with no escalation rate? C) What is the NPV if the savings escalates at 7%/yr due to fuel savings?
D) What is the IRR with that fuel escalation rate?

5) Based on the information from our tour with John Elliott: A) What is UC Merced's triple zero commitment? B) Describe the UC Merced approach to cooling buildings? C) Which campus building has the best passive solar design and describe two features of this general approach.

1) receives 500 kJ/s heat from 1100K source Josh O'Rourke

4/4 rejects 300 kJ/s low temp sink at 300K

A) $\frac{Q_c}{Q_H} \geq \frac{T_c}{T_H} \Rightarrow \frac{300\ kJ/s}{500\ kJ/s} \geq \frac{300K}{1100K} \Rightarrow .6 \geq .27\bar{2}$

$\boxed{\text{yes possible}}$

B) $\Delta S_{loss} = \frac{Q_H}{T_H} = \frac{500 \times 10^3\ J/s}{1100K} \Rightarrow \boxed{454.545\ J/s \cdot K}$

$\Delta S_{gain} = \frac{Q_c}{T_c} = \frac{300 \times 10^3\ J/s}{300\ K} \Rightarrow \boxed{1000\ J/s \cdot K}$

$\Delta S_{TOT} = -454.545\ J/s \cdot K + 1000\ J/s \cdot K = \boxed{545.455\ J/s\ K}$

2) A) least-cost combination, how many MW

3/3

gas Turbine	coal
Cap cost = 50	Cap cost = 100
~~ideal Peaking power~~	ideal Baseload
$\boxed{MW \leq 5 \times 10^6\ KW}$	$\boxed{MW \geq 5 \times 10^6\ KW}$

coal will be cheaper if plant runs at CF $\geq .5$ and at least 50% of yearly hours.

Where as the gass turbine will be cheaper if CF $\leq .5$ with operation time less than 50% yearly hours.

B) gas Turbine with max output of 5.0×10^6 KW

0/3

Fixed = 50 \$/yr-kW

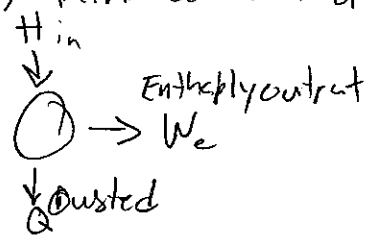
Variable = ¢.5/kWh = $.005 \frac{\$}{kWh} \times \frac{8760 hr}{yr} = 43.8$ \$/kW-yr

$\text{Price} = 5 \times 10^6\ kW \frac{(50 + 43.8)\ \$/kW\text{-}yr}{2.19 \times 10^{10}\ kWh/yr} \Rightarrow \boxed{\$.0214/kWh}$

Annual output = 5×10^6 kW $\times$ 8760 h/yr $\times$ .5
= 2.19×10^{10} kWh/yr

2) ... liquid water at 91 P ... O'Rourke

A) min amount of heat must be ousted to satisfy entropy



$$CH_3OH + \frac{3}{2}O_2 \rightarrow CO_2 + 2H_2O(l)$$

ΔH	(-238.7)	0	(-393.5)	$2(-285.8)$
ΔS	$1(.1268)$	$\frac{3}{2}(.205)$	$(.213)$	$2(.0699)$

$\Delta H = [-393.5 + 2 \times -285.8] - [-238.7]$

$\Delta H = -726.4$

$\Delta S = -(.213 + 2(.0699)) + [.1268 + \frac{3}{2}(.205)]$

$= .4343 - .3708$

$\Rightarrow .0635$ kJ/K

$\frac{1.5}{2}$

$Q_{min} = T(\Sigma S_{reactants} - \Sigma S_{products})$

$= 273K(.0635 \text{ kJ/K})$

$\boxed{Q \Rightarrow 17.33 \text{ kJ's per mol of methanol}}$

B) max efficiency

$\frac{2}{2}$

$\eta_{max} = 1 - \frac{Q_{min}}{|\Delta H|}$ $\quad \Delta H = -726.4$, $Q = 17.33$

$\Rightarrow 1 - \frac{17.33}{726.4} \Rightarrow .97614 = \boxed{97.614\%}$

C) $\eta_{max} = \frac{\Delta G}{\Delta H}$

$\Delta G = \Sigma G_{products} - \Sigma G_{reactants}$

$\Rightarrow [-394.4 + 2 \times -237.2] - [-166.4 + \frac{3}{2}(0)]$

$= -702.4$

$\frac{2}{2}$

$\Rightarrow \frac{702.4}{726.4}$

$= .96696 \Rightarrow \boxed{96.696\%}$

4) \$3/ft² of window but saves [illegible]/ft [illegible]

Josh O'Rourke

Discount Rate 12%

A) net present value (NPV) $n = 30$ years

2/2

$$PVF(d,n) = \frac{(1+d)^n - 1}{d(1+d)^n} \Rightarrow \frac{(1+.12)^{30} - 1}{.12(1+.12)^{30}} \Rightarrow 8.055\ yr$$

ΔP = cost of more efficient product

ΔA = Savings

$$NPV = \Delta A \times PVF(d,n) - P$$

$\Delta A = \$.55/ft^2$

$\Delta P = \$3/ft^2$

$$\Rightarrow .55 \times 8.055\ yr - 3$$

$$\boxed{\Rightarrow \$1.43/ft\ yr}$$

B) What is the $\boxed{IRR_0}$

2/2

$$PVF(IRR, n) = \frac{\Delta P}{\Delta A} \Rightarrow$$

$$\Rightarrow PVF(IRR, 30) = 5.45\%$$

$$\boxed{IRR \text{ is } \approx 19\%}$$

c) NPV if $e = 7\%/yr$ due to fuel savings

2/2

$$d' = \frac{d-e}{1+e} \Rightarrow \frac{.12 - .07}{1 + .07} = .0467$$

$$PVF(d',n) \Rightarrow \frac{(1+d')^n - 1}{d'(1+d')^n} \Rightarrow \frac{2.93}{.183} \Rightarrow 15.968$$

$$NPV = \Delta A \times PVF(d',n) - P$$

$$\Rightarrow .55 \times 15.968 - 3 \Rightarrow \boxed{5.7824}$$

D) 2/2

$IRR_0 = 19\%$

$$IRR_e = IRR_0(1+e) + e$$

$$\Rightarrow .19(1 + .07) + .07$$

$$\boxed{\Rightarrow .2733}$$

5) A) ① to consume zero net energy

2/2

② To produce zero landfill waste

③ To produce zero net carbon emissions

B) They have very large water towers that hold ~~cto~~ cold water at night and a mix During the Day. The cold water is sent out to each Building for cooling. Then warm water is returned to the water tower where it will be cooled again that night. This ~~e~~ is efficient Because peak power usage is at night off peak ~~Pe~~ Demand cost.

2/2

C) The Best Building is the Childcare Building.

2/2

2 features are

① that's its North facing Recieving less sun.

② that trees Block most of sun During Peak of the Day until sun set.

③ Its Being Lite By optics.

Appendix III: Student Research Report

The Sustainability of Waste-to-Energy Plants and its Future

Ruth Xochihua

UC Merced: ENVE 160-Sustainable Energy

"Waste is Our Energy"

The first time the importance of utilizing Municipal Solid Waste was recognized was in 1991 by the U.S. National Energy Strategy and little progress has been made since then (5) Many people would agree that "waste is defined as anything rejected as worthless or in excess of what is required" (20). But it is possible to turn unwanted waste into something we need and that is required for our everyday function. Waste to energy (WTE) is the term used to describe the conversion of waste by-products into useful steam or steam-generated electricity (15). Most WTE processes thermally treat or use combustion to produce this electricity. This is a type of energy recovery or technique that exchanges energy from one sub system of an overall system with another. It is this waste in concordance with other types of renewable types of fuel, which can lead cities all over the world onto a more sustainable road for the future.

The Positive Effects of WTE plants

Environmental Benefits

Some of the pros associated with WTE are that chemical and biological pollutants are reduced, waste volume is cut by more than 90%, and renewable energy contained in waste is utilized and therefore replacing fossil fuels such as oil, gas and coal (16). One of the main benefits associated with the implementation of WTE plants is the reduction of landfill use and landfill emissions. Landfill's are much more than a waste of space, an aesthetic eyesore, and a bad stench. They can cause harm to the environment by polluting clean nearby sources of water and ground water and are one of the main causes of greenhouse gas emissions. For example, about 46 Nm^3 of both methane and carbon dioxide per ton of municipal solid waste are emitted annually in the United States because of landfills (6). Compared with other types of carbon dioxide emitters such as automobiles and factories, landfill gas leakage is definitely on the high end of the spectrum. Another threat that land filling poses is the amount of heavy metals such as mercury and lead that are disposed in these landfills on an annual basis. One heavy metal, mercury, is elevated to dangerous concentrations that reach about 120 tons per year which is about one-fourth of all U.S. consumption and comes from waste such as fluorescent lamps and thermometers. One last environmental benefit is that with recent technology, that I will discuss later in the "Future of WTE plants", some plants are able to create ethanol from waste due to a Biofuels subsidiary founded in 2006 (4). This could help

minimize deforestation for monoculture crops needed in the production of biofuels while creating another form of sustainable fuel at the same time.

The Negative Effects associated with WTE plants

Cost

Although there are plenty of environmental benefits that seem to encourage our need to implement WTE plants, there are some setbacks that have influenced our lack of action in this field of energy production and waste management. Cost is one of the main issues that has prevented the spread of these plants, especially now, during economic hardships. WTE costs are divided into five components: capital cost, operation and maintenance cost, revenue from electricity generation and revenue from ferrous recovery(19). Some examples that illustrate the high costs is the size, percentage of excess air used, and the volume of process gas are much larger than that of a coal-fired power plant of the same combustion capacity. Also, the capital and maintenance costs of WTE facilities are nearly three times higher than that for a coal fired power plant generating the same amount of electricity (6). So it basically boils down to, money versus the overall health of our planet.

How do WTE plants work?

Process

WTE facilities can be divided into two process types: mass burn and refuse-derived fuel (RDF). (15) I will be discussing the technical process of the latter. In simple terms, A WTE plant is like a coal plant, but instead of burning coal, garbage is used as the main fuel source. Four processes include: 1)Waste is burned and thus heat is released. 2) the heat is used in a boiler to convert water into steam. 3) The steam is used to move the blades of a turbine to generate electricity. 4) The generated electricity is sent, along power lines, to the consumers. (1) In more detail, municipal solid waste is delivered to the thermal treatment plant where it is weighed, registered and tipped into the refuse pit for mixing. The second process involves a crane system which lifts the waste from the refuse pit and transports it to the feed chute. (7) After the waste is fed into the chute, it is incinerated. It is here where air supply is controlled to specific zones of the grate. It is around this process as well that gas emissions from the combustion of waste is treats. The flue gas is treated with a few or all of the following systems such as electrostatic precipitators, fabric filters, spray absorbers, scrubbers, activated coke processes and SCR or SNCR systems (7). What makes this type of energy production facility a “green” one is that the separation of pollutants from the flue gas in the scrubber is carried out by absorption with chemical reactions (18). The final step involves energy recovery. Steam produced in an evaporator drives a thermodynamic expansion machine constructed as a turbine which is connected via a shaft with a non-wound rotor of a synchronous machine

which operates as a generator and by which a major portion of the thermal energy contained in the cooling water and the exhaust gases is converted into electrical energy (14). A few types of energy recovery include electricity, district heating and even district cooling which is then sent to homes, schools and businesses.

The Future of WTE

In the United States WTE plants are not as prevalent due to misconceptions, lack of understanding and environmental policies. In many parts of Europe such as Sweden and Denmark, however, thermal treatment is a requirement. An EU waste framework directive stipulates recovery as the second priority after avoidance of waste. The EU landfill Directive and its respective national implementations have generated a driving force away from landfilling and towards waste management solutions involving thermal treatment processes (17). Although WTE is costly there is research being done to make the facilities more efficient. Recycling is usually done before combustion because if not a "high rate of corrosion" within the main components of the plant will take place due to high amounts of chlorine content (13). This corrosion increases the cost needed for maintenance and thus the overall cost. New innovations involving the production of biofuels and greenhouse heating is from waste to energy technology. For example, in both paper and olive oil processing plants they are using the pulp and sludge waste to make biofuel through combustion (11 & 8). Efficiencies for longer term application such as the whole tree energy concept has also been studied to create biofuels. (4) Technology such as St1's creates biofuels from this type of waste through the dehydration (combustion) and then addition of an alcohol. Their plant specifically produces ethanol from bakery waste which is then used for commercial use in motor fuel. (2) So much research is being done involving other forms of renewable and sustainable fuels which is very exciting.

Conclusion

Waste is a source of fuel that is more reliable than fossil fuels and is definitely sustainable. I believe that implementing WTE technologies along with other types of renewable and sustainable energies will lead us onto a more environmentally road for the future and thus make the world a better place for future generations.

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Quantiative Problem

A WTE plant has a theoretical efficiency of about 90% but an actual efficiency of about 33%. If the energy content of refuse is 7.25MJ/kg or 7250kj/kg and has about 66.6% carbon

a) What is the heat rate of this plant using its theoretical and actual efficiency in kJ/kwh and BTU/kwh?

   ACTUAL EFFICIENCY

   Heat Rate: $\frac{1kj/s}{kw} \times \frac{3600s}{h} \times \frac{1}{\eta}$ ➔ $\frac{3600kJ/kwh}{.33}$ ➔ 10,909 kJ/kwh

   Heat Rate: $\frac{10{,}909kJ/kwh}{1.055kJ/Btu}$ ➔ 10,340.4 Btu/kwh

   THEORETICAL EFFICIENCY

   Heat Rate: $\frac{1kj/s}{kw} \times \frac{3600s}{h} \times \frac{1}{\eta}$ ➔ $\frac{3600kJ/kwh}{.90}$ ➔ 4000 kJ/kwh

   Heat Rate: $\frac{4000kJ/kwh}{1.055kJ/Btu}$ ➔ 3791.4 Btu/kwh

b) If Merced County produces a total of 1672 tons of garbage per day how much electricity would be produced for the city in a year using the previous information:

   Garbage per year: 1672(365) = 610,280 tons per year

   610,280 tons per year (7250kj/kg and)

   WTE KWh/ton = Heating Value(2000lb/ton) / Heat Rate

   10,340Btu/kwh(2000lb/ton) / (.33) (610,280 tons) ➔102.68KWh/ton

Appendix IV: Student Design Proposal

Abstract

Funding Opportunity Number(s) and Research Area(s): P3 Awards: A National Student Design Competition for Sustainability Focusing on People, Prosperity and the Planet. EPA-G2010-P3-Q3, Materials and Chemicals; EPA-G2010-P3-Q1, Energy (additional research area).

Title: Anaerobic digestion of wastewater algae harvested using low-tech electrochemical processes**.**

Principle Investigator (primary advisor): J. Elliott Campbell, ecampbell3@ucmerced.edu.

Student Investigators: Danny Lu (undergraduate), Brandi McKuin (undergraduate), Edward Tang (undergraduate), Patrick Wiley (student lead, graduate), Ruth Xochihua (undergraduate).

Institution: University of California, Merced Sponsored Projects Office, Merced, CA.

Student Represented Departments and Institutions: Environmental Engineering, University of California, Merced; Environmental Engineering Student Organization, UC Merced.

Project Period (Phase 1): August 15, 2010 to August 14, 2011

Project Amount (EPA, Phase I): $10,000 **Total Project Amount (Phase I):** $10,000

Project Summary: Algal biomass grown wastewater pond systems can be used to produce methane gas through anaerobic digestion, creating a synergistic relationship between sanitation (***People***) and sustainable energy production (***Planet***). However, this process is rarely implemented due to the lack of an affordable harvesting technology. Current algae harvesting systems are highly mechanized and require expensive chemical coagulants. Thus, an effective and inexpensive algae harvesting system (***Prosperity***) must be developed to improve the viability of algae digestion processes.

Our proposed solution is to develop an inexpensive algal harvesting process that generates necessary coagulating species *in situ* through the electrochemical oxidation of consumable aluminum electrodes. This process, referred to as electrocoagulation / electroflotation (EC/EF), requires only electricity as an input, and itself can be powered with renewable forms of energy, such as photovoltaic modules. We propose to design (Period I), build (Period II) and evaluate (Period III) the performance of an EC/EF reactor for the removal efficiency and energy consumption relative to existing harvesting technologies. Algal slurry collected from the EC/EF unit will be placed in an anaerobic digester and gas chromatography will be used to assess sustainable energy output. Results will be presented on campus (ENVE160, ENVE176, ES-Seminar), at wastewater conferences, and submitted to *ES&T*.

Our proposed project will enable small communities to protect their water resources while simultaneously producing renewable energy in the form of methane gas. Combining energy production and wastewater treatment will have positive implications for the development of sustainable communities. It also creates unique opportunities for collaboration between UC Merced students and local wastewater treatment facilities that may benefit from this effort.

Contribution to Pollution Prevention and Control: Development of an efficient and inexpensive algal harvesting system such as EC/EF would enable wastewater treatment plant operators to reduce the TSS content of final effluents and decrease the solids discharged into receiving waters. Recovery of algal biomass and other material from wastewater pond effluents can be used to produce energy through anaerobic digestion. The methane gas collected from this process can be used for heating or can be combusted in a generator to produce electricity, reducing the demand for non-renewable sources of energy.

Supplemental Keywords: *methanogens, Chlorella, Scenedemus, unicellular algae, sewage, high-rate oxidation ponds, lagoons*

Research Plan

Anaerobic Digestion of Wastewater Algae Harvested using Low-tech Electrochemical Processes

1. Project Description

Proposed Project

Wastewater oxidation ponds are simple to operate treatment systems that effectively reduce biochemical oxygen demand (BOD) and eliminate enteric bacteria and viruses (Kivaisi, 2001; Bahlaoui et al., 1996; Hosetti and Frost, 1995). The low cost of installation and operation of wastewater oxidation ponds makes them ideal for small communities with limited financial and material resources (Hosetti and Frost, 1995). Wastewater pond systems are inexpensive to operate because they require few electrical inputs for secondary biological treatment. Algae produce dissolved oxygen naturally through photosynthesis, which becomes available to bacteria for the oxidation of wastes (Shilton et al., 2008; Oswald et al., 1978). In contrast, high rate systems, such as activated sludge, generally require between 0.4-1.1 kWh of electricity to introduce 1 kg of dissolved oxygen (Shilton et al., 2008).

Unicellular algae in the *Chlorella* and *Scenedesmus* genera commonly dominate wastewater pond ecosystems (Woertz et al., 2009; Oswald et al., 1978). These algae have a high level of photosynthetic efficiency compared to terrestrial crops, and are capable of producing 10-20 g/m^2/day of biomass depending on the environmental conditions and design of the system (Lardon et al., 2009; Mandal and Mallick, 2009; Oswald, 1995). Algal biomass collected from wastewater treatment ponds can be used to produce methane gas through anaerobic digestion. This is an attractive reuse application because anaerobic digesters are inexpensive to operate and can tolerate solids with high water content. However, anaerobic digestion of algal biomass is inhibited by the lack of an affordable harvesting technology. The goals of this project are to design a low-tech, effective and inexpensive electrochemical process for harvesting algae from wastewater, and to estimate energy yields when the algal biomass is anaerobically digested.

Our project will have positive implications for pollution prevention because it will protect water quality and enable beneficial reuse of algal biomass for the production of renewable energy. For example, excessive algae accumulation in wastewater pond effluent may prevent treatment facilities from meeting TSS standards outlined in the Federal Water Pollution Control Amendments (Naghavi and Malone, 1986). Our proposed project will enable wastewater treatment plant operators to reduce the TSS content of final effluents and decrease the solids discharged into receiving waters. The recovery of algal biomass and other material from wastewater pond effluents can be used to produce energy through anaerobic digestion. The methane gas collected from this process can be used for heating or can be combusted in a generator to produce electricity, reducing the demand for non-renewable

sources of energy. While our proposed project focuses on harvesting wastewater algae, we believe that this method will also effectively remove contaminants from drinking water supplies, potentially increasing the efficiency of water treatment processes.

Algae found in wastewater ponds are difficult to remove due to their small size (3-30 μm) and low specific gravity (Craggs et al., 1997; Oswald et al., 1978; Bare et al., 1975). Additionally, algae have a high zeta potential due to negative surface charges, resulting in stable suspensions throughout the water column (Teixeira and Rosa, 2006; Molina Grima et al., 2003; Craggs et al., 1997; Bare et al., 1975). Thus, coagulating agents, such as metal salts or cationic polymers, must be added to neutralize surface charges, enabling the formation of large algal aggregates that facilitate solid-liquid separation (Stechemesser and Dobiás, 2005; Tansel and Pascual, 2004). Previous research has identified flotation technology as the most efficient harvesting technology for algal biomass (Teixeira and Rosa, 2006; French et al., 2000; Green et al., 1996; Bunker et al., 1995). Flotation processes generate small bubbles, which are released into a vessel containing the coagulated algal aggregates. As the bubbles rise through the water column, they adhere to the algal aggregates, forcing them to the surface. A thick algal mat accumulates at the surface, where it is removed as thick slurry.

We propose to design and develop and electrochemical process known as electrocoagulation / electroflotation (EC/EF) for the removal of algal from wastewater. EC/EF is a flotation technology that generates coagulating species for destabilizing algal suspensions *in situ* through the electrochemical oxidation of consumable metal electrodes (Rodriguez et al., 2007; Chen, 2004; Mollah et al., 2004; Jiang et al., 2002; Mollah et al., 2001). Electrodes comprised of aluminum release charged ions into solution when direct current (DC) is applied to the system (Holt et al., 2005; Mollah et al., 2004). The ions immediately hydrolyze to aluminum hydroxide, which is an excellent coagulating agent (Mollah et al., 2004). Hydrogen and oxygen bubbles are produced during this process at the anode and cathode, respectively, which float the sample to the surface of the flotation cell where it is removed by a skimming mechanism (Mollah et al., 2004). The oxidation reaction at the anode is demonstrated by Reaction (1), while the reduction reaction at the cathode is described by Reaction (2) (Mollah et al. 2004).

Reaction (1)

$$M_{(s)} \rightarrow M_{(aq)}^{n+} + \eta e^{-}$$

$$2H_2O_{(l)} \rightarrow 4H_{(aq)}^{+} + O_{2(g)} + 4e^{-}$$

Reaction (2)

$$M_{(aq)}^{n+} + \eta e^{-} \rightarrow M_{(s)}$$

$$2H_2O + 2e^{-} \rightarrow H_{2(g)} + 2OH^{-}$$

Where:

M = Electrode material;

s = Solid phase;

aq = Aqueous phase;

l = Liquid phase;

n^+ = Oxidation state of the ions released;

ηe^- = Number of electrons transferred

The only operating parameter is of EC/EF current density, which determines the volume of bubbles released into solution. Burns et al. (1997) noted that the bubbles generated by EC/EF ranged in size from 17-40 microns, which is adequate for efficient flotation. Current density also dictates the concentration of coagulating species released by the electrodes during electrochemical oxidation. The concentration is quantified using Faraday's Law, which is explained in Equation (1).

Equation (1) $$n(M) = \frac{It}{zF}$$

Where:

z = oxidation state of oxidized electrode material;

I = Current density, A cm^{-2};

t = Time, seconds;

M = Electrode material;

n = moles of metal dissolved into solution;

F = Faraday's constant, 96,485 C mol^{-1}.

EC/EF has few moving parts and only requires electricity as an input, eliminating costs associated with purchasing, transporting, storing and handling chemicals (Abuzaid et al., 2002; Mollah et al., 2001). This process requires little maintenance, with the exception of periodically replacing the sacrificial electrodes, and can be powered with renewable sources of energy (Mollah et al., 2004; Rodriguez et al., 2007). This process has tremendous potential to reduce the operating and maintenance costs of flotation when compared to existing methods. EC/EF represents an appropriate technology for less developed areas, as it requires materials that have wide availability.

Our completed EC/EF unit will be used to harvest algae from the effluent of a local wastewater treatment pond. The unit will be monitored to evaluate energy consumption, electrode erosion rates, loading rates, removal efficiency and total solids concentration of the harvested biomass. The harvested algae will then be placed in a bench-scale anaerobic digester. The gas produced during the digestion process will be analyzed to estimate methane production and energy yield. Our design and application of EC/EF is innovative because it has not been used to harvest algae from wastewater systems. Our design is novel because coagulation and flotation will occur in separate vessels, which will increase electrode longevity. Our research will also address the knowledge gaps pertaining to the following process control parameters:

1. Determination of optimal current density for harvesting algae from wastewater treatment ponds;
2. Identification of ideal electrode orientation and spacing;
3. The role automation and programmable logic controllers (PLCs) can play in optimizing system performance;
4. Feasibility of powering the EC/EF with photovoltaic modules.

Our P3 team is comprised of students from the UC Merced Department of Engineering with expertise in wastewater treatment plant operations, energy systems, civil engineering, environmental engineering and energy policy. We also have support from established wastewater engineers and faculty at UC Merced. We believe that our team is sufficiently qualified to achieve the project goals with EPA P3 funding during the project period.

Challenge Definition

Utilization of algal biomass from wastewater treatment ponds for energy production is inhibited by the lack of affordable harvesting processes. Our solution is appropriate for most areas because it does not require the use of expensive chemical coagulants and can be operated using locally available resources. This will enable communities to improve water quality by removing algal biomass from wastewater pond effluent. The collected material can then be anaerobically digested to produce a renewable fuel

that can offset wastewater treatment operating costs. Localized energy production from an otherwise wasted resource can enable the development of sustainable communities.

Common techniques presently employed to remove algae from wastewater include dissolved air flotation (DAF) and suspended air flotation (SAF). These systems both require the addition of chemical coagulants that are expensive, and may not be readily available in some areas. Both systems have more mechanized components than the proposed alternative, which may result in greater maintenance requirements. This section describes the operating principles of DAF and SAF.

DAF units consist of a compressor, saturator and a flotation cell. Clean water, referred to as flotation water, is pressurized in the saturator using the compressor (Haarhoff and Steinbach, 1997). The increased pressure in the saturator increases the solubility of air in the flotation water in accordance with Henry's Law. The flotation water is then released into the flotation cell containing the coagulated algal agglomerates at atmospheric pressure. The sudden drop in pressure causes small bubbles to precipitate from the flotation water. These bubbles adhere to the flocculated algal particles, forcing them to the surface of the flotation cell as bubble rise through the water column (Lundh et al., 2000; Al-Shamrani et al., 2002). An algal mat accumulates at the surface of the flotation cell and is removed by a skimming mechanism (Chung et al., 2000). Green et al. (1996) noted that DAF systems are capable of achieving algae removal efficiencies of 99%.

The size of bubbles released in the flotation cell strongly impacts the flotation efficiency. Several authors (Féris and Rubio, 1999; Al-Shamrani et al., 2002; French, et al., 2000; Chung et al., 2000) have noted that bubble diameters between 10-100 microns are needed to optimize flotation efficiency. Smaller bubbles are required for efficient separation because they have more surface area and a greater rising velocity than larger bubbles (Al-Shamrani et al., 2002). Bubble size is a function of pressure in the saturator, necessitating high operating pressures. Al-Shamrani et al. (2002) noted that a pressure of 55 psig is needed in the saturator to produce bubbles of optimal diameter. The operating pressures needed result in high electrical usage, which is responsible for nearly 50% of the operating cost. The advantage of DAF units is that they have high removal efficiency for algae removal. The disadvantages are the high operating costs associated with the need for high pressure in the saturator.

SAF is a process similar to DAF in that it utilizes small bubbles that force algal agglomerates to the surface of a flotation cell. The major distinction from DAF is that SAF generates microbubbles with surfactants instead of pressure, eliminating the need for a compressor. Wiley et al. (2009) reported that SAF had higher solids and hydraulic loading rates when compared to DAF for the removal of algae from wastewater. This is most likely attributed to the faster bubble rising velocity in the water column

induced by the reduced interfacial tension between the water and the bubbles caused by the surfactant. The SAF system also required a much lower ratio of flotation water to sample when compared to DAF (120:1 compared to 2:1, respectively). The characteristics enable SAF units to process more sample per unit time, with significantly less energy consumption due to the elimination of the compression step. SAF units have fewer mechanical components compared to DAF, and will required less space due to the decreased volume of flotation water needed to process a given volume of sample. A disadvantage of SAF is that it requires more chemical inputs than DAF.

Relationship of Challenge to Sustainability

Our proposal meets the objectives defined by the EPA by developing a technology that will support the continuing prosperity of people and the planet. Our research plan will produce a technology enabling communities to improve the quality of wastewater effluent, while generating renewable energy from an otherwise wasted by-product of sewage treatment. Thus, successful implementation of our technology will protect water resources, allow localized production of renewable energy and reduce operating costs associated with wastewater treatment.

With respect to "People"

Our group intends to anaerobically digest algal biomass harvested from wastewater treatment plant effluent using our novel EC/EF design. We will be working closely with operators at a local wastewater treatment plant to implement our technology. Development and implementation of EC/EF will enable our local wastewater treatment facility to improve the quality of effluent discharged into receiving waters. Our project provides societal benefit by increasing the efficiency of wastewater treatment processes.

With respect to "Prosperity"

Implementation of EC/EF technology for the removal of algae from wastewater pond effluent can provide economic advantages when compared to existing technologies. For example, DAF and SAF both require the addition of chemical coagulants. The costs associated with purchasing, storing, pumping and handling these materials can be significant. In contrast, EC/EF generates coagulating species *in situ* from aluminum electrodes, eliminating all costs incurred by using chemical coagulants. Additionally, DAF and SAF are highly mechanized, while EC/EF has few moving parts. Thus, the only routine maintenance associated with EC/EF is the periodic replacement of the electrodes. The use of EC/EF will reduce the organic matter contained in wastewater effluent, reducing the demand for disinfecting agents like chlorine gas or sodium hypochlorite. Furthermore, anaerobic digestion of algal biomass will produce renewable energy that can be used to reduce energy costs associated with wastewater treatment.

With respect to "Planet"

Development of EC/EF technology proposed in our research plan would have positive impacts on environmental health by improving the quality of wastewater effluent discharged into receiving waters. Successful implementation of our EC/EF device would also eliminate pollution associated with the manufacture and transport of chemical coagulants. Additionally, the reduced organic matter content of wastewater effluent processed with our technology will decrease the demand for chemical disinfecting agents. And finally, our technology will enable the anaerobic digestion of harvested algal biomass for

the production of methane gas. Use of this resource can displace energy needs otherwise satisfied with non-renewable sources of energy.

Results (outputs/outcomes), Evaluation and Demonstration

Our expected deliverables for phase I of our project will be a functional EC/EF unit for harvesting algae from wastewater oxidation pond effluent. We expect this unit to provide comparable performance to existing technologies less expensively. We also expect that energy recovered from anaerobic digestion of collected algal biomass will reduce the demand for non-renewable sources of energy needed for the wastewater treatment process. The following quantitative measures will be evaluated to assess the success of our project:

1. Energy consumed during the EC/EF process;
2. Removal efficiency, solids loading rates, hydraulic loading rates and total solids concentration of algae harvested with EC/EF will be determined;
3. Performance of the EC/EF unit will be compared to existing technologies to determine feasibility;
4. The amount of gas produced during anaerobic digestion will be determined using gas chromatography. This information will be used to determine expected energy production from digester gas.

We expect that this technology will be easily transferrable because it uses inexpensive materials that are widely available. Our proposed EC/EF unit will be easy to operate, as current density is the only operational parameter. We expect the design and implementation of our proposed technology will improve the efficiency of wastewater treatment processes and improve sanitation. Funding for our research parallels objectives detailed in the Clean Water Act (CWA), Section 104.

Integration of P3 Concepts ad an Educational Tool

Education is an important component of our research plan, benefiting members of our design team, the campus community and the wastewater industry. Our design team will have the opportunity to gain experience designing and implementing a solution to real-world engineering challenges, and to interact with wastewater professionals. We plan to present our results on campus (ENVE160/260 Sustainable Energy, ENVE176 Wastewater Treatment, ES-Seminar), at wastewater conferences and submit for publication in an environmental peer-reviewed journal, such as *Environmental Science & Technology*. We also expect our technology to improve the sustainability of local wastewater treatment plants by enabling the beneficial reuse of algal biomass for the production of renewable energy.

2. Project Schedule

Our proposed project schedule is a 1-year time frame divided into 3 time segments. The project is scheduled to begin on August 15, 2010 and concludes on or about August 14, 2011. At the conclusion of Phase I, an EC/EF prototype will be designed and constructed for small-scale application, evaluated with respect to the quantitative measures described above, described in a manuscript submitted for peer-

review, and presented on campus and at wastewater conferences. Phase II funding will be pursued to refine the design and construction of an EC/EF for large-scale application. Phase I activities are outlined in Table 1.

Table 1. Phase I Schedule of Activities

Month	Activity
August, 2010	Receive funds from EPA
August - November, 2010	Initial design phase; finalize anticipated partnerships; request feedback from faculty experts and engineers regarding the proposed design.
December 2010- March, 2011	Begin assembly of EC/EF cell; install electrical components; fabricate electrodes; initial unit testing; revise design if necessary.
April -August, 2011	Field test unit at wastewater treatment facility; evaluate performance; anaerobic digestion experiments; write phase II proposal; submit findings for publication in peer-reviewed journal.

While formal partnerships for Phase I are still being finalized, anticipated partnerships include the following:

1. City of Delhi, CA and City of Stockton, CA Wastewater Treatment Facilities, Municipal Partners;
2. Russell Adams, P.E., wastewater engineer, private industry;
3. MuniEquip Inc, wastewater engineering and consulting, private industry;
4. Arthur Engineering, electrical engineers, private industry.

The project work to be completed will follow a design, build, test, and revise cycle to find the best possible option.

1. **Design Phase (**August - November, 2010)
   - Determine the most effective electrode configuration and cell design.

- Design electrical system, including components controlled by PLCs. Ensure that electrical components are suitable for industrial settings.
- Obtain feedback regarding the proposed design from UC Merced faculty experts and professional partners from the private engineering industry.

2. **Construction and Initial Testing (**December 2010- March, 2011)
   - Order parts and equipment needed to construct the EC/EF unit.
   - Begin assembling the unit, fabricate electrodes and install control panel and electrical components.
   - Write PLC program for automated components of the system.
   - Initial unit testing. Determine deficiencies and consult with partnering organizations if design revisions are needed.

3. **Field Test Unit at Wastewater Treatment Facility (**April -August, 2011)
   - Setup EC/EF unit at wastewater treatment facility. Make necessary electrical and plumbing connections to enable unit operation.
   - Operate unit, calculate solids and hydraulic loading rates, electrical consumption, solids capture efficiency, and total solids concentration of harvested algal biomass.
   - Anaerobically digest samples and analyze the digester gas with a gas chromatograph. Estimate gas production and the amount of energy supplied by digesting algal biomass.
   - Prepare results for publication in peer-reviewed journal, present results to wastewater professionals and the UC Merced campus community.
   - Prepare phase II proposal.

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Assessment of Program Learning Outcomes for the B.S. in Environmental Engineering

Course: EnvE 160 Sustainable Energy
Instructor: Elliott Campbell
Semester: Fall 2009

Overview

The course EnvE 160 Sustainable Energy is a technical elective for the B.S. in Environmental Engineering (EnvE) and a recommended course for students in the Sustainable Energy track. Eleven undergraduates enrolled in the course during the Fall of 2009. Student work included homework, exams, online research presentations and a research report. Digital copies of all student work have been archived. Student performance on these assignments provides lines of evidence showing that the Fall 2009 semester of EnvE 160 has contributed to meeting Program Learning Outcomes for the B.S. in EnvE as discussed below.

PLO – 2. *Critical Thinking: EnvE graduates will be adept at applying critical thinking, problem solving, engineering principles and reasoning, the scientific method, and teamwork to solve environmental resource problems and to restore and sustain the global environment.*

Students applied critical thinking skills by creating and solving a quantitative problem that integrated their review of the literature on a sustainable energy topic with the fundamental problem solving skills they developed through homework and exams. An example of high, medium, and low scores are shown in Appendix I, Appendix II, Appendix III, and respectively. The grading on the quantitative problem was based on the problem set-up, presented solution, and format ting. The high score (9/9) has a set-up that integrates the problem, research paper and course material (capacity factor, fixed/variable cost, etc.), a solution that details all required calculations and units, and the formatting in Excel is clear. The medium score (7/9) has a set-up that is a good integration of material, a well-documented solution, but has some errors in assumptions and calculations. The low score (5/9) has a well-integrated problem but provides the problem set-up in the oral presentation and the solution steps are not well defined.

Appendix I: High Score

Sydney Montroy

EnvE 160

Geothermal Energy Review

Renewable energy is rapidly becoming a necessary point of interest with the current depletion rate of the world's primary energy resources (1). Of all types of renewable energy such as wind power, hydropower, solar power, etc, geothermal power has a significant advantage in that it is reliable and produces very few greenhouse gas emissions (2). This review will begin by introducing the topic of geothermal energy and its applications, discuss its cost, efficiency and environmental impacts, present current related scientific literature, and propose remaining research challenges.

The technical definition of geothermal energy is heat in the form of steam or water that is harnessed from beneath the Earth's surface (1). Geothermal energy is considered limitless on the human time scale due to the copious amount of energy stored in the Earth's core and is available on any land surface, although certain areas have more easily accessible energy sources than others (2). These areas are more easily accessible because of the presence of a high temperature geothermal reservoir, which is hot water or steam that is greater than 240°C in a permeable layer that is trapped beneath an impermeable layer of rock (3). Geothermal energy is classified as having three applications: direct heating, geothermal heat pumps, and electricity production (2). Direct heating is where hot water or steam from a geothermal reservoir is brought to the surface through a production well, used in a building, and then re-injected back into the ground (2). It can be used for space heating or cooling, food preparation, industrial processes, agriculture, aquaculture, and greenhouses (1). Geothermal heat pumps circulate water from a building to an underground pipe in a continuous loop and do not require a reservoir (2). They can be used basically anywhere on land due to the Earth's moderately constant temperature ten to three hundred feet below the surface (2). These pumps can provide both heating

and cooling and use thirty to sixty percent less electricity than an average heating and cooling system (2). Electricity is produced by using wells drilled into geothermal reservoirs to carry hot water to the surface where the heat energy is converted into electricity at a geothermal power plant (3). Currently, there exist four different types of power plants: flash, dry steam, binary, and flash/binary combined cycle power plants (3).

The cost of a geothermal power plant is an important factor to be considered when deciding on the implementation of a new sustainable energy plant. A geothermal power plant has a high capital cost, making up approximately two-thirds of the total cost, and a low operations and maintenance cost (4). The high capital investment is due to the cost of exploration, drilling, and plant construction (2). In the long term, levelized costs of geothermal plants are actually less than that of other forms of renewable energy (4). One disadvantage of geothermal power plants is that they have very low efficiencies of roughly five to ten percent (5). These energy losses occur primarily in the vaporizer-preheater, turbine-pump, heat exchanger, condenser, and brine reinjection stages (5, 6). On the other hand, these power plants generally have capacity factors of over ninety percent (7). Another significant factor to consider is the impacts these plants have on the environment. The benefits that geothermal power plants have in comparison to other renewable resources is that they use less land per unit energy, expend little or no fresh water, do not contribute to acid rain, and have extremely low greenhouse gas emissions, which in turn help offset certain greenhouse gases (4). Disadvantages of these power plants include seismic reactions caused by enhanced geothermal systems, the atmospheric release of hydrogen sulfide, mercury, arsenic, boron, and antimony, and the fact that ideal geothermal plant locations tend to be in wild, eco-sensitive areas (8-10).

Currently, there are new methods being researched to improve heat transfer efficiencies and expand the area in which geothermal energy can be used (4). One such method involves implementing

a secondary fluid with a low boiling point, such as ammonia, in a power plant using the binary Organic Rankine System (4). This method increases the heat transfer efficiency and allows heat from low temperature reservoirs ranging from 100°C to 160°C to be converted into electricity (4). Another such method being researched is the previously mentioned enhanced geothermal system (11). They work by fracturing rock deep in the ground to create a reservoir, injecting fluid into the reservoir to be heated, drawing the heat up to the surface to be converted into electricity, and re-injecting the cool fluid back into the reservoir (12). These systems allow the use of geothermal energy in places that lack a naturally occurring geothermal reservoir (11). A potential improvement to this system is the use of carbon dioxide as the heat transmission fluid (13). Carbon dioxide's thermal and chemical properties allow fluid circulation with little or no pumping, an increase in heat transfer efficiency and heat extraction rate, applications in both heat and electricity generation, and aid in the sequestration of carbon (13). Another idea currently being researched is the use of abandoned oil wells to produce geothermal energy (14). This system would greatly reduce the capital cost of geothermal energy by removing the cost of exploration and drilling (14). It also would not be detrimental to the surrounding environment because of its location and the existing oil wells (14).

Although numerous advances have been made in the world of geothermal energy, further research is necessary to improve the sustainability of this resource (11). One such necessary improvement is to reduce power plant costs so that they are competitive with fossil fuels (14). This can be achieved by decreasing operations and maintenance costs through improved emission control and material usage (14). Plant revenue can also be increased by producing a useful by product (14). Further research is essential to improve efficiency by reducing heat losses and developing cycles (14). If this progress is made, it has the potential to reduce electricity costs by approximately eighteen to twenty-five percent (14).

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Quantitative problem:

A 50MW enhanced geothermal system is built in the Central Valley as an additional renewable energy source.

a) If the power plant operates 8322 hours per year, what would its capacity factor be?

b) What would its annual electricity output be?

c) If the plant has a capital cost of $3600/kW, a fixed charge rate of 0.18/yr, and an operations and maintenance cost of 0.2¢/kWh, what would be the price of the electricity?

d) How many houses (500kWh per 30-day month) could be powered by this plant?

	A	B	C	D	E	F	G	H	I	J	K
1	**Quantitative Problem Solutions**										
2											
3	a)	CF = Average Hours / Rated Hours = 8322h/yr / 8760h/yr = **0.95**									
4											
5	b)	Annual electricity output = CF * Rated Power = 0.95 * 50MW = **47.5MW**									
6											
7	c)	Fixed costs = $3600/kW * 0.18/yr = $648/kW-yr									
8		Variable = $0.002/kWh * 8322h/yr = $16.644/kW-yr									
9		Price = 47,500kW * (($648/kW-yr + $16.644/kW-yr) / (47,500kW * 8322h/yr)) = **7.987¢/kWh**									
10											
11	d)	Electricity generated = 50,000kW * 8322h/yr = 4.161*10^8 kWh/yr									
12		Number of houses powered = 4.161*10^8 kWh/yr / (500kWh/mo * 12mo/yr) = **69,350 houses**									

Appendix II: Medium Score

Danny Lu

The Effects of Biofuels

Biofuels have been gaining a lot of press lately in the United States due to its benefits on: fuel dependency, national security and being a form of renewable energy. Due to the benefits of biofuels; the United States has called for 36 billion gallons of biofuels nationwide by 2022, in the national Renewable Fuels Standard in the U.S. Energy Independence and Security Act.[1] But at the same time the growth of "first generation" biofuels has contributed to an increase in sugar crops, oilseed crops and starch crops prices especially corn as well as environmental backlash. There are worries that the N_2O emissions will offset the gains from the reduction of CO_2 emissions. The farming of these crops will not only affect air quality but also water supply. A report from the U.S National Academy of Sciences concludes that producing up to 15 billion gallons of corn ethanol annually will result in considerable harm to the nation's water quality, mainly from the increase of nitrogen and phosphorous pollution.[2]

First generation biofuels are the most widely available type of biofuels. These biofuels are mostly made up from three different kinds of agricultural feedstock: sugar crop, starch crops and oilseed crops.[1] In the United States the most widely available first generation biofuel falls under starch crops, specifically corn. Many studies have concluded that there are negative impacts on climate, land, soil, water and air when farming for biofuels.[1 2 3] Corn ethanol is very water intensive, each gallon of fuel produced requires 3 to 4 gallons of water.[4] Emissions of N_2O and CO_2 from farming comes from cultivation, fertilization, herbicide usage, transportation, and the refinery stage.[1]

N_2O is considered as a greenhouse gas that has a global warming potential of 310 times that of CO2. The reason for N_2O being harmful for the atmosphere is that one N_2O produces 2 NO species. NO has a negative impact in the atmosphere because it reacts with O_3 in the stratosphere thus creating the ozone hole leading to global warming.[5] To reduce N_2O that is being emitted into the atmosphere, a few

simple steps can be taken. Conservation tillage, when corn is ready for harvesting, the farmer can consider leaving in 30 percent or more of crop residue. This will improve soil quality which reduces the amount of N_2O and CO_2 emitted from the soil, improve water quality and prevent soil erosion.[6]

The refinery stage of producing biofuels also plays a big part in the emissions of greenhouse gases. A refinery can either be power by natural gas or coal, if powered by coal this will offset any reduction that was achieved from replacing fossil fuels. With this in mind refineries should use the cleanest source of energy available. Even with refineries powered by natural gas this can account for 90 percent of the lifecycle of greenhouse gases.[7]

Ethanol might not be as environmentally friendly as people would like it to be. Research has shown that the potential benefits of corn ethanol over fossil fuels to be only a 12 to 18 percent reduction in emissions compare to fossil fuels. Each acre of corn corps produces an equivalent of 2.7 tons of carbon dioxide. [7] One acre of corn ethanol can produce roughly 439 gallons of biofuel. The outlook for biofuels does not seem too great when using corn as the main source.

This is where "second generation" biofuels come into play. Second generation biofuels which can also be called cellusic biofuels, which are biofuels that do not relay on food crops but on cellulose plants (i.e. perennial grasses), algae, fat, manure, and other organic matter.[8] [9] The benefits of second generation biofuels over first generation biofuels is quite overwhelming.

Switchgrass a perennial grass can produce up to 1200 gallons per acre of biofuel in an ideal farming situation and up to 500 gallons per acre of biofuel in rougher conditions annually compared with the 439 gallons per acre of biofuel from corn. [10] The required energy input for Switchgrass is very minimal much less than that of corn ethanol. In general second generation biofuels can generate from 4 to 10 times more energy than first generation biofuels accounting for the energy invested production

and the gains in energy from each form of biofuel. Second generation biofuels are estimated to reduce greenhouse gas emission by 86 to 94 percent when compare to fossil fuel emissions.[11]

Second generation biofuels in every sense is more environmentally beneficial when compared to first generation biofuels so why is it not being mass produce at the moment? Most of the data on second generation biofuels are estimates done in ideal situation, there are no real time data. The technology is still relatively new, there are very few operating refineries and none of them are commercially producing biofuels. As technology advances people can expect to see more efficient forms of biofuels.

It is important to diversify the way energy is produced to prevent and stop global warming. Biofuels is not to sole solution to reducing greenhouse gas emission; vehicles can become more efficient by having higher miles per a gallon. Biofuels can be converted into heat or electricity, there are researches that suggest this method can offer an efficiency of up to 90 percent as compare to 35 percent for the conversion to biofuels.[12] With the efficiency of converting biomass to electricity being high, it is in peoples interest to use the electricity to power electric cars instead of turning the biomass to biofuels. A study has shown a that a car running on biofuels can get 8000 miles per acre while a car running on electricity converted from biomass can travel 15000 miles per acre.[13]

In order for there to be advancements in biofuels, policies must be adjusted to meet current technologies. Current polices, for instance requires corn ethanol to achieve at least 20 percent reduction in lifecycle emissions compared to gasoline and 60 percent reduction for cellulosic biofuels.[15] There should be a increase in the percent reduction for corn ethanol. As of now there are not many incentives in growing cellulosic such as Switchgrass or Miscanthus, once there are more incentives farmers will move towards cellulosic plants.[14] Most important of all standards need to be set for biofuels. It is pointless to grow corn and use it as a biofuel while achieving no reduction greenhouse gas

emissions to the atmosphere. Biofuel policies need to be efficient, such as: banning the conversion of protected land for biofuel corps, the usage of sustainable agricultural practices, promoting the most effective type of feedstock.[16]

Biofuels is not only the solution to the energy crisis the United States currently faces. The United States has the lowest fuel efficiency standards and the most permissible standards for tail pope greenhouse gas emissions when compared to most developed countries.[17] The potential of ethanol to displace fossil fuel is unlikely; there is not enough of land or water to produce ethanol needed. Estimates place that biofuels including first and second generation can replace only a fourth to a third of transport-related consumption.[18] If all of the nation's corn was harvested as ethanol it would only displace less than 15 percent of the nation's oil usage.[19] Transportation is the biggest consumption of the nation's fossil fuel, nearly two-thirds.[20] Biofuels are just part of the transition to a more sustainable future.

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Quantitative Problem

	A	B	C	D	E	F	G	H	I	J	K
1	The Cattracks makes 5 trips to Castle daily around 22 miles a trip. The bus gets on average 23 mpg.										
2	If this gas power minibus was to be converted to biodiesel, getting 20 miles per gallon										
3	how much land would be needed to grow one days worth of biodiesel?										
4											
5											
6		approx. 439 gallons per acre									
7											
8		Cattracks:									
9		5x22	110	miles/day							
10											
11		(110 miles/day)/(20 miles/gal)=			5.5	gals/day					
12											
13		(5.5 gals/day)/(439 gals/acre)=			0.012528	acres					
14											

Appendix III: Low Score

Adam Mazzotti
ENVE 160
Final Report
California Biofuels

Most studies show that a reduction in GHGs is achieved when ethanol and more prominently when replaced with sugarcane or cellulose replace gasoline. Biofuels can be produced from several different sources including dedicated crops, municipal solid waste and wastewater, industrial waste, algae, agricultural waste and forest thinnings. With limited resources and an ever-growing concern of pollution and green house gas emissions, alternative energy sources are researched in order to mitigate, hinder and ultimately supply the planet with cleaner and renewable energy. Biofuels is just one of several methods aimed at reducing GHG emissions, but because of its expenses, is one of the most viable.

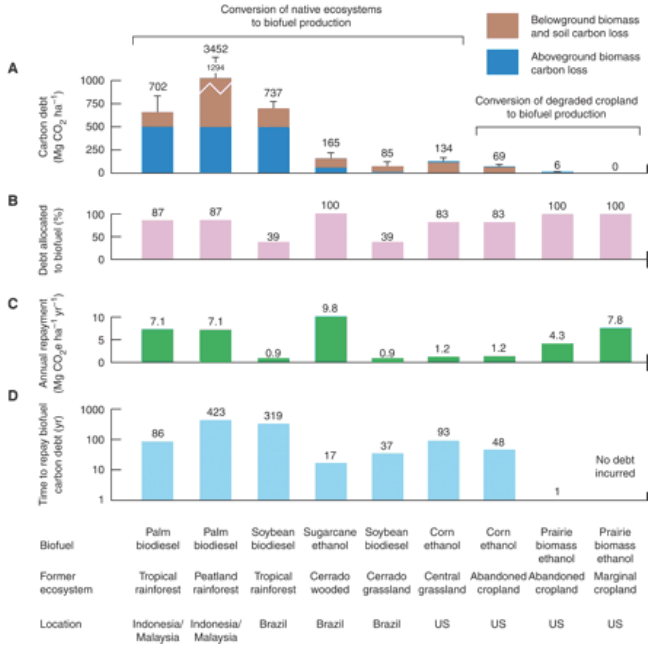

Figure 1: Carbon Debt Repayment. (Fargione)

California consists of many topographic features and climate regions and holds dense populations in urban sprawls, generally along the coast. It holds an agricultural community primarily located in the central valley of the state. As the states population increases and population expand further away from major cities, agricultural lands natural habitats may be cutback to make room for housing developments. Aside from loss of food crop, the transition from food to biofuel crops has been examined to have indirect land-use impacts. The result of removing vegetation in place of another releases carbon stores into the atmosphere. Time to repay this carbon debt varies depending on the type of vegetation removed and the type planted afterwards.

Project Goals

Focusing on issues primarily in California, the goal of the project was to assess the effect of a growing population within the state on the production of biomass for biofuels.

Project

Biomass' looked at originally encompassed all the possibilities that exist in the state. These included:

1.) Agricultural residue biomass (orchard and vineyard crops, field and seed crops, vegetable crops, food processing residues, animal manures, dedicated biomass crop)

2.) Forest residues and thinnings (forest thinnings and slash, shrubland biomass, mill residues)

3.) Municipal wastes (biomass fraction of municipal solid waste (MSW), paper and cardboard, food wastes, green wastes including leaves, grass, prunings, stumps, other biogenic organics, biosolids from waste water treatment operations, landfill gas, sewage digester gas)

4.) Dedicated biomass crop

Much of the original data used for the power point and basis for the rest of the research for the project was drawn from the 2008 California Biomass Collaborative Report. As it turned out, much of the work put forth by the CBC had touched on a lot of the key issues that I had wanted to address in my project. Their detailed analysis included current populations of California's counties as well as their projected mean growth rates, growth factors and populations from 2007 to 2020.

County	2007	2010	2017	2020
ALAMEDA	1,526,148	1,580,133	1,630,730	1,663,481
ALPINE	1,251	1,369	1,405	1,453
AMADOR	38,435	40,337	45,303	47,593
BUTTE	218,069	230,116	265,351	281,442
CALAVERAS	46,028	47,750	53,756	56,318
COLUSA	21,951	23,787	27,618	29,586
CONTRA COSTA	1,042,341	1,075,931	1,189,479	1,237,544
DEL NORTE	29,341	30,983	34,397	36,077
EL DORADO	178,674	189,308	210,522	221,140
FRESNO	917,515	983,478	1,129,222	1,201,792
GLENN	28,915	30,880	35,648	37,959
HUMBOLDT	131,959	134,785	139,743	142,167
IMPERIAL	172,672	189,675	221,833	239,149
INYO	18,363	19,183	19,967	20,495
KERN	801,648	871,728	1,012,601	1,086,113
KINGS	151,381	164,535	191,653	205,707
LAKE	64,276	67,530	74,528	77,912
LASSEN	36,375	37,918	40,922	42,394
LOS ANGELES	10,331,939	10,514,663	11,004,166	11,214,237
MADERA	148,721	162,114	195,966	212,874
MARIN	255,982	253,682	259,301	260,305
MARIPOSA	18,254	19,108	20,883	21,743
MENDOCINO	90,291	93,165	99,183	102,017
MERCED	251,510	273,935	323,368	348,690
MODOC	9,721	10,809	12,253	13,134
MONO	13,985	14,833	17,040	18,080
MONTEREY	425,960	433,283	454,435	476,642
NAPA	135,959	142,767	158,371	166,786
NEVADA	99,766	102,649	110,861	114,451
ORANGE	3,098,121	3,227,836	3,418,007	3,520,265
PLACER	324,495	347,543	401,897	428,535
PLUMAS	21,128	21,824	22,504	22,934
RIVERSIDE	2,031,625	2,239,053	2,674,789	2,904,848
SACRAMENTO	1,406,604	1,451,866	1,569,815	1,622,306
SAN BENITO	57,603	64,230	76,911	83,792
SAN BERNARDINO	2,028,013	2,177,596	2,441,577	2,581,371
SAN DIEGO	3,098,259	3,199,706	3,440,764	3,550,714
SAN FRANCISCO	808,844	818,163	836,109	844,466
SAN JOAQUIN	679,687	741,417	890,087	965,094
SAN LUIS OBISPO	264,900	269,734	286,667	293,540
SAN MATEO	733,496	736,667	754,910	761,455
SANTA BARBARA	424,425	434,497	451,155	459,498
SANTA CLARA	1,808,056	1,837,361	1,948,562	1,992,805
SANTA CRUZ	264,125	268,016	281,913	287,480
SHASTA	181,401	191,722	213,640	224,386
SIERRA	3,485	3,628	3,503	3,508
SISKIYOU	45,953	47,109	50,001	51,283
SOLANO	424,823	441,061	483,953	503,248
SONOMA	481,765	495,412	530,568	546,151
STANISLAUS	521,497	559,708	653,411	699,144
SUTTER	93,919	102,326	128,491	141,159
TEHAMA	61,774	65,593	74,992	79,484
TRINITY	14,171	15,172	17,205	18,236
TULARE	429,006	466,893	554,675	599,117
TUOLUMNE	57,223	58,721	62,489	64,161
VENTURA	825,512	855,876	924,457	956,392
YOLO	193,983	206,100	232,186	245,052
YUBA	70,745	80,411	98,802	109,216
CALIFORNIA	37,662,818	39,135,676	42,514,589	44,135,923

Figure 2: CA Projected Population. (CBC)

Growth rates were factored into their projection models of available biomass across the four sources in BDT/yr.

Eventually, focus shifted to the effect that a growing population would have on just forest thinnings and municipal waste, two of the naturally occurring sources of biomass within the state. The plan had then became to adjust projected growth rates, simulating high and low end population increases and relating it to the amount of biomass that could be produced from these two sources. This would be done by dealing with technical biomass resource potential data provided to determine the energy generation

potential from biomass (GWH/yr) in California from 2007 to 2020. Technical potential is the fraction of NPP that can be harvested sustainably. But without proper knowledge of the model, or sufficient time to develop my own, the planned project hit an insurmountable roadblock. A presentation was given on the original topic, focusing on California biofuel production potential, but a different qualitative problem was selected.

Qualitative

A large (40MW) solar photovoltaic power station is constructed in CA central valley as an alternative to hydrologic power systems already in place. The station will operate during peak summer months (May-August) for a total of approximately 3,950 hours/year) and is 80% efficient.

a.) How much energy can it produce in this time span?

b.) What is the price of electricity generated for the public if there is a maintenance cost of 1.0cent/KWh, a capital cost of $4,000/KWh and a FC rate of 0.40/year? (an expensive station)

c.) Total Electricity Produced

*See Excel SpreadsheetConclusions

With growing concern of GHG emission worldwide and with California growing population it seems inevitable that some agricultural land will be cultivated for biofuel crops. This can be mitigated by a larger dependency on solid waste and waste-water conversion to fuel. This can help slow the growing need of reduction of cropland and also avoid a carbon debt that in some cases would take almost a century to repay. However the state should also look to other renewable energy sources aside from hydrological (which can generate political and social issues all its own) such as solar. Solar arrays can be built on land that isn't already relied upon for food and would not place an added strain on the local food supplies and can be offset by wind generated electricity, which can help supply energy when the sun isn't always shining. These renewable sources of energy will help decrease the need to import energy from other states and fuels from other countries.

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Quantitative Problem

	A	B
1	Fixed Cost: $4,000/KW*(0.8)	$3200/KW-4Months
2	Variable Cost: $0.01/KWh*(2952hours)	$29.52/KW-4Months
3	Price of Electricity: 32,000KW*(3,200/KW-4Months+$29.52/KW-4Months)/(32,000KW*2952hrs-4 Months)	1.09cents/KWh
4		

Appendix 4 – Example Student Work

Dynamic estimation of water and sediment load in man-made reservoirs using Stella

Introduction

Very nice model. A relatively simple application, but it nicely shows the applicability of STELLA to systems of this type. It would be nice to show how this model can be used to calculate the maximum lifetime of this damn based on the set of assumptions that you made. **A**

A large number of dams have been built for the purpose to provide water for agriculture irrigation, generate hydroelectric power, minimize the risk of floods during rain seasons, retain water during dry seasons and so on. When human enjoy the benefits arising from dams, a lot of problems also caused by using dams. Dams affect many ecological aspects of a river, dams slow down the current of river and this disturbance might damage the pattern of ecology, for example, after a heavy rain, a lot of soil particles are moved and enter into rivers, it will deposit and accumulate at river floor cause the current slow down by dams, in mean while, a lot of chemical elements (i.e N,P,K) fertilized by human are also accumulated at reservoirs so that alga and other water plants blooms, this would cause fish and other animals death in the dams; and also, it was reported the water salinity also increased as the soil particles stay in the reservoirs.

As an attempt to better solve the environmental impacts of dams, knowing the amounts of sediment load and water quantitatively in reservoirs is required for people(Simons 1992). Because this can help people to decide the polices to drain out water or retain, this can dramatically change soil particles as well as sediment load in reservoirs. As a try to do this, in this study, a simple model was designed and developed to understand how the water and sediment load changes in reservoir with a dam. The idea is assuming that a dam is built at the exit in a watershed, the revised universal soil loss equation (RUSLE) model was conducted to estimate how much soil would be moved into reservoir, a water cycle model for the reservoir was described and used for the water input and output, as well as the soil particles movement was also simulated.

Modeling

RUSLE model

Soil is naturally removed to new location where it is deposited by the action of water or wind, this process is called soil erosion. Soil erosion by water is caused by rain detaching and transporting soils, either directly by means of rainsplash or indirectly by rill and gully erosion(Fig.1). Rain splash erosion is the result of the influence of water striking the soil surface, rill erosion is caused by concentrated water running through little streamlets, and gullies develop because of a decrease in the erosional resistance of the land surface or an increase in the erosional forces acting on the land surface(Morgan 1988).

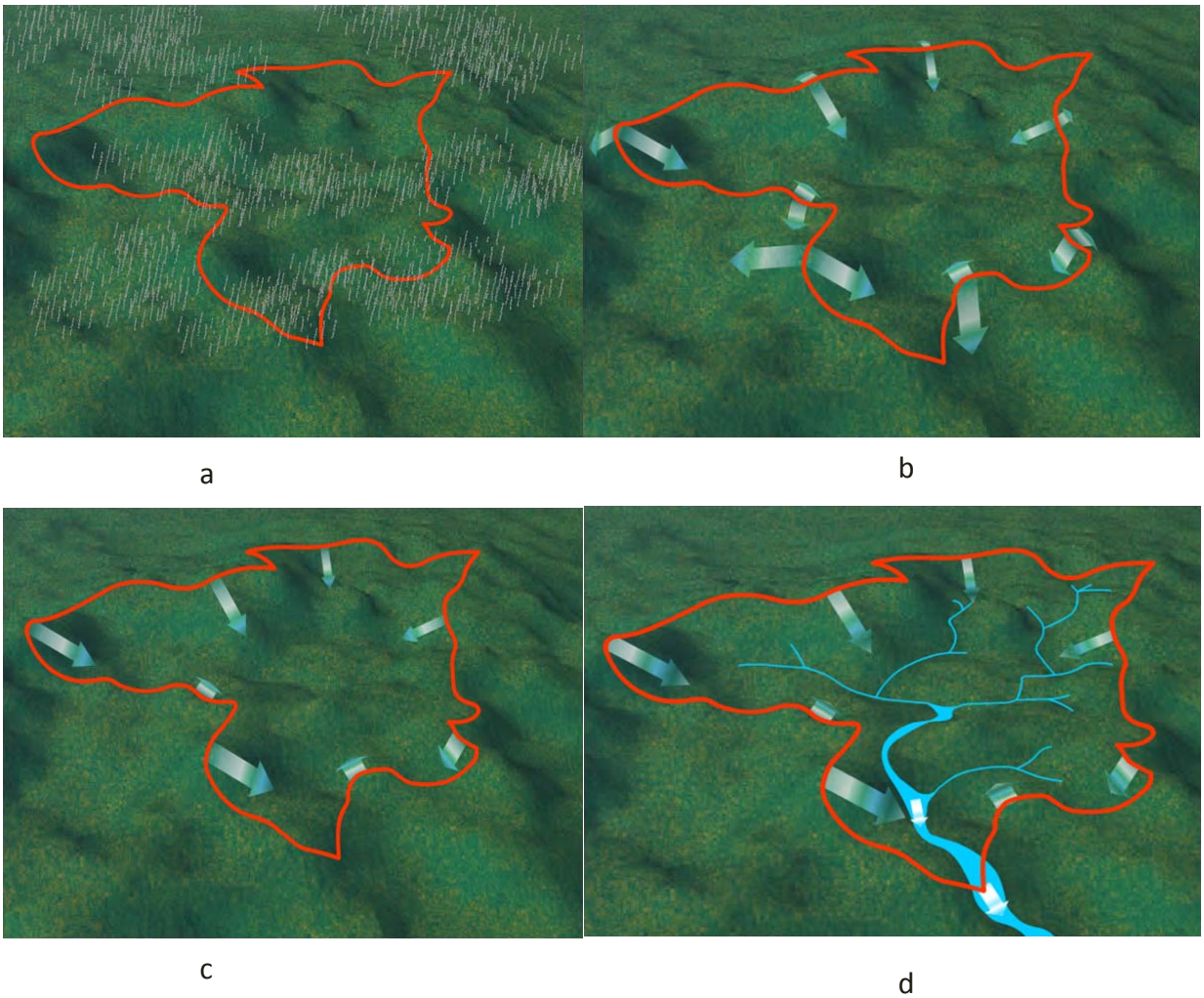

Fig.1 Soil erosion in a watershed

Erosion models are empirical, conceptual or physically based. The application of process-based numerical models is often problematic because of the often low quality of available input data. Empirical models have generally a much simpler structure, require less input parameters and often show similar performance in terms of prediction accuracy than deterministic models when considering yearly averages. Reducing model complexity will generally lead to a minimization of the error propagation of erosion models. Comparisons between empirical and process-based models showed that the average error and model efficiency in soil loss prediction was similar.

One of the most widely used empirical models is the Revised Universal Soil Loss Equation (RUSLE)(Renard et al. 1997), it has been verified the feasibility on assessing soil erosion. Therefore, RUSLE model was introduced in this study to estimate the potential soil loss, the RUSLE model is expressed as follow:

$$A = 224 \cdot R \cdot K \cdot L \cdot S \cdot C \cdot P \qquad (1)$$

Where A is the soil loss in one year (t/km^2.a), R is the precipitation erosionl factor, K is the soil erodibility factor, LS is the slope length and steepness factor, C is the management factor and P is the erosion-control factor. In order to calculate the soil loss, for the supposed watershed, R would change over time which was determined from monthly precipitation, erosivity factor, R was obtained by the equation (2), where P_i is precipitation of month i, and the P is the annual precipitation.

$$R_i = 1.735 \times 10^{(1.5\lg \frac{P_i^2}{P} - 0.8188)} \qquad (2)$$

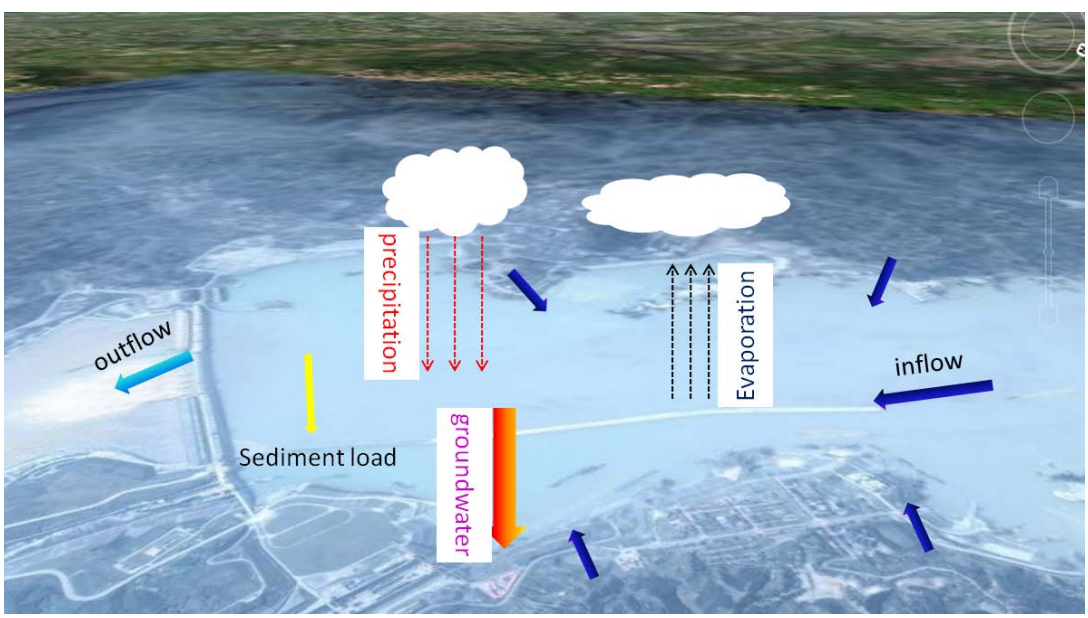

Fig.2 water cycle at a man-made reservoir

When the rain falls down into a watershed, the surface soil is moved with water flows, both water and soil will finally enter into rivers as a source for the reservoir which is blocked by a dam as show in Fig.2, as water is slowed down by dam, some soil particles sink into river floor as a form of sediment load, some soil particles moves away from the reservoir with the water flow out through the dam, after a long time, the river bed would be uplifted and reduce the reservoir's capacity for water. Another input water is from the precipitation over the water surface which can be observed by weather stations; water released from water surface into air forms as vapor, this part is also a main loss for reservoir water, the evaporation can be obtained by a temperature based model (the Blaney-Criddle equation) which is repressed as equ.3(Xu and Singh 2002):

$$ET = Kp(0.46 * T_a + 8.13) \tag{3}$$

Where ET is the potential evaporation, Ta is the temperature in ^{o}c , and Kp is determined by different moth in a year.

Stella model

As discussed above, we described the water movements flow into and out from reservoir, a sub-model for water movement was developed by Stella(Fig.3), the input water included the inflow from watershed which was originated from precipitation, a inflow rate was set to estimate how much water would enter into the reservoir from precipitation in watershed; another input water was the precipitation over the reservoirs, this water will totally enter into water reservoir. There are three main ways for water leaving from reservoir, the first is the water pours out from the dam or some side channels for hydroelectric power generation and crop irrigation, the second is that water infiltrates and flows away through ground water and the third is the water vapors into air.

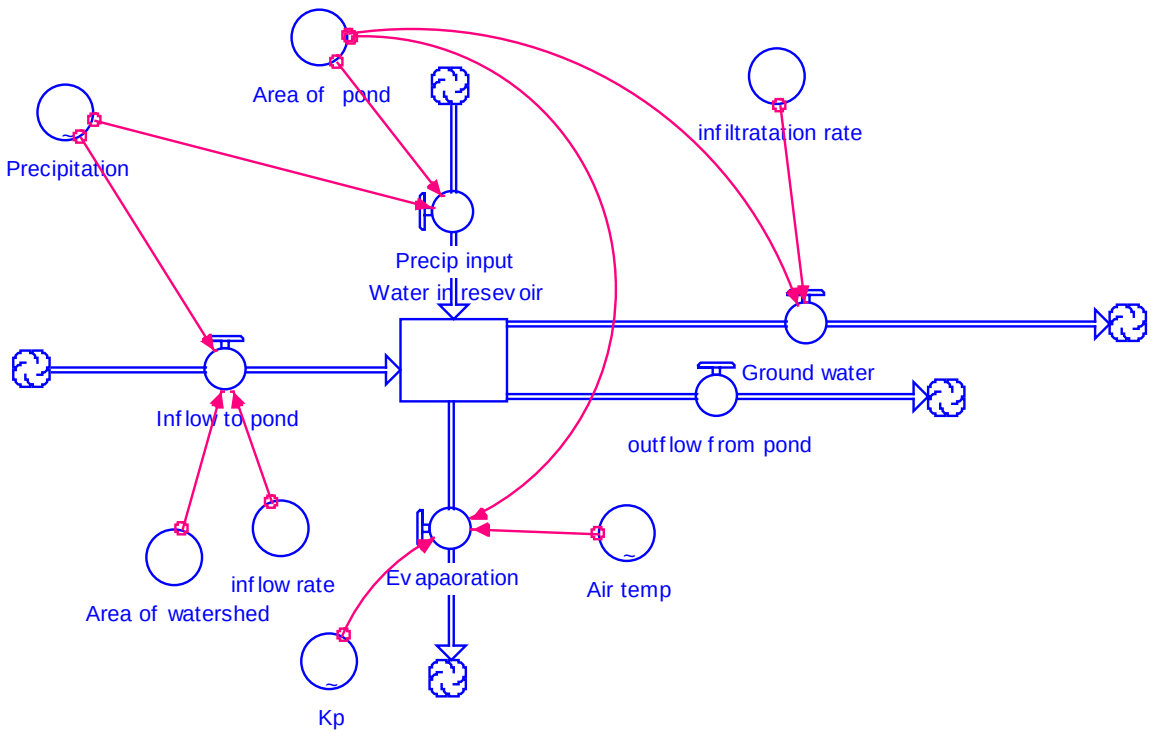

Fig.3 water movements through a reservoir

The Fig.4 shows the soil transportation through reservoir, the potential soil loss in the watershed is estimated by RUSLE model, after the soil particles enter into reservoir, a part of them sink into floor of the reservoir, another part would leave away through the dam, for the ground water, there may exist soil particles, however, I did not consider it due to the concentration is much smaller than that in the outflow water; there is no soil particles leave out with the evaporated water.

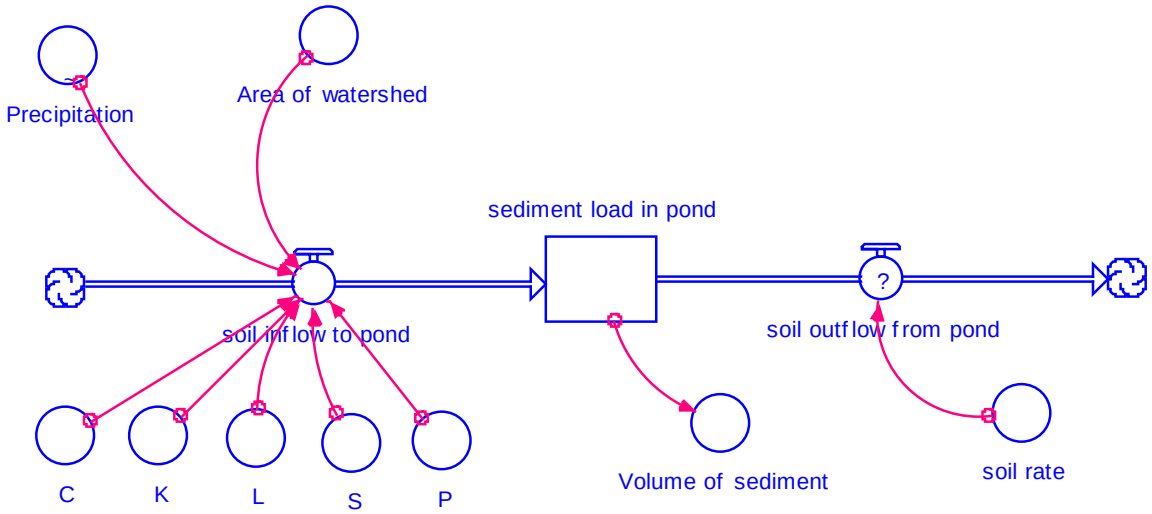

Fig.4 soil movements

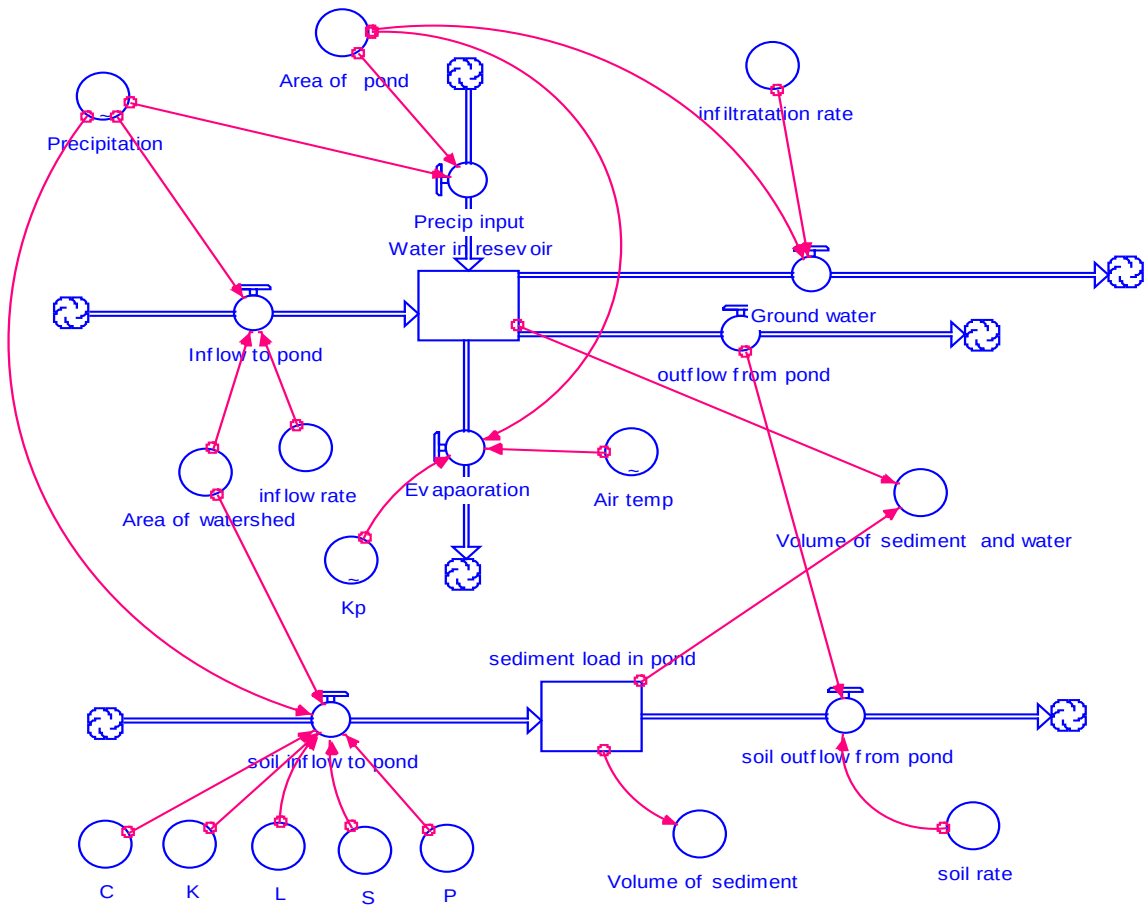

Fig.5 Stella model for simulating movement of the water and soil particles

Finally, the water movement and soil particles movement were combined together into a model shown in Fig.5, this model clearly shows the transportation for soil and water. In order to operate the model, the parameters for the model were set reasonably referred to common sense, published literatures, experienced data as well as a typical temperature and precipitation in a southern region in China. Two time scales were used for the model operation, the first is 12 months in a year to display the water and soil movements, and the second is the model repeated 3 times (three year) . For more detail of the parameters, see appendix part.

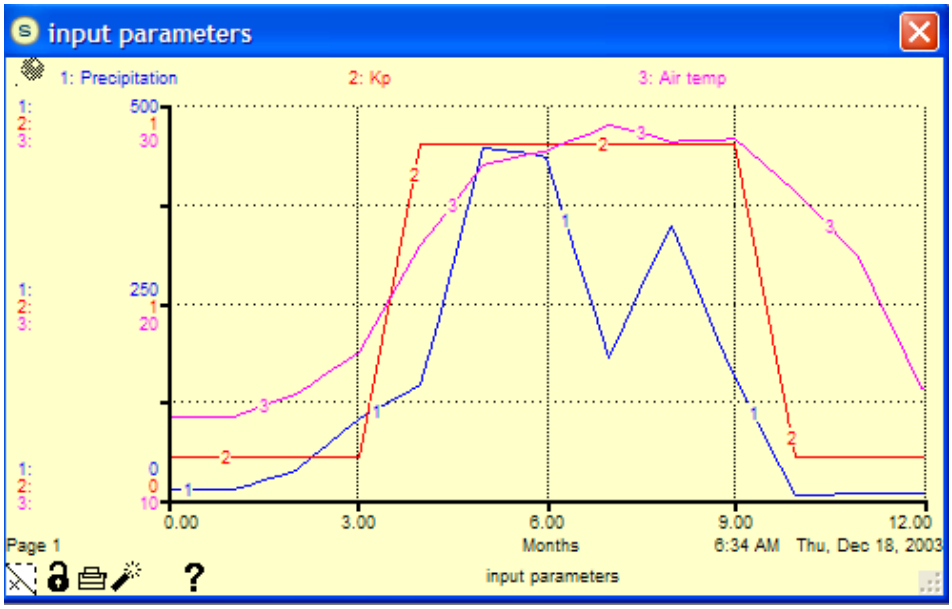

Fig.6 This figure shows the input data including air temperature, precipitation and Kp which is a evaporation factor.

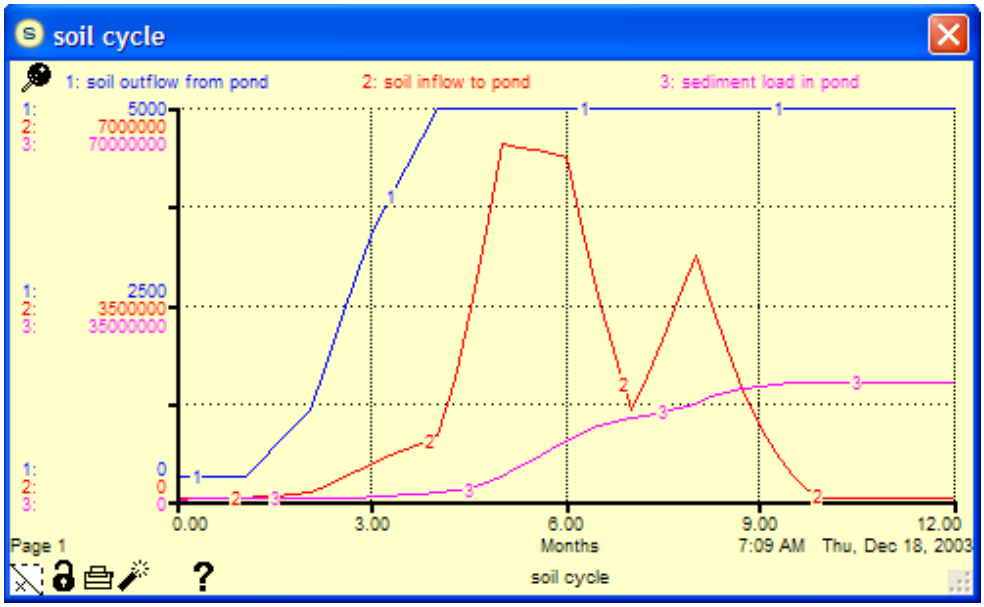

Fig.7 This figure shows the soil particles input to the reservoir, sediment load and loss from reservoir. The soil particles enter into the reservoir depends on the precipitation on watershed.

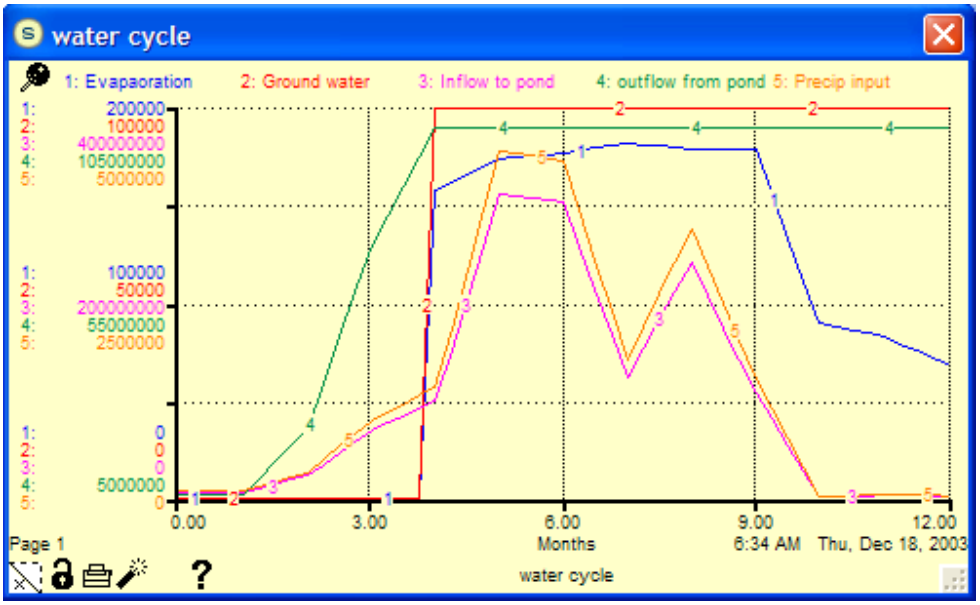

Fig.8 The water movements through reservoir, the amounts of water flowing out and infiltrating out are constant, the precipitation water into reservoir, evaporation water and inflow water depends on the temperature and precipitation.

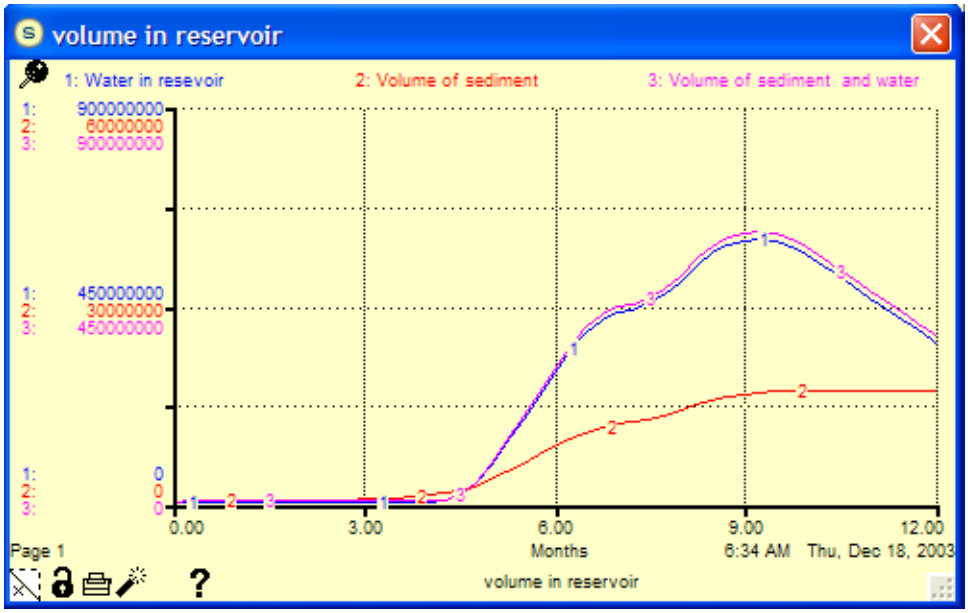

Fig.9 This figure shows the water and sediment load volume in the reservoir.

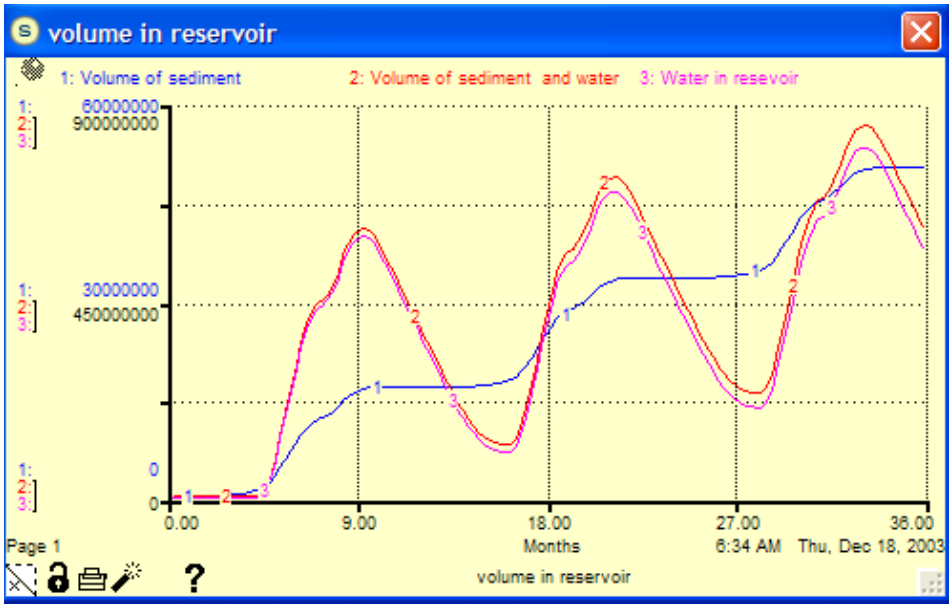

Fig.10 This figure shows the changes of water and sediment volume over three years, the input data kept constant for the same month in different year.

Conclusion

This study focused on using a very simple water cycle and corresponding soil particles concentration to tracing the changes of water and load sediment in man-made reservoir, the model is very easy to understand and the parameters are easily to obtain. The results showed the water and sediment in reservoir changes seasonally, in rain seasons the water and soil accumulated rapid, in dry season, the water in reservoir decreased cause the input flow reduced dramatically however the output still was same as rain season; the sediment load increased fast as the precipitation increased, however, it changed very little during dry seasons.

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Appendix

- Soil_in_pond(t) = Soil_in_pond(t - dt) + (soil_inflow_to_pond - soil_outflow_from_pond) * dt
- INIT Soil_in_pond = 0
- INFLOWS:
- soil_inflow_to_pond = 1.735*10^(1.5*LOG10(Precipitation^2/SUM(Precipitation)))*K*C*P*L*S*Area_of_watershed/1000000
- OUTFLOWS:
- soil_outflow_from_pond = soil_rate*outflow_from_pond
- Water_in_resevoir(t) = Water_in_resevoir(t - dt) + (Inflow_to_pond + Precip_input - outflow_from_pond - Evapaoration - Ground_water) * dt
- INIT Water_in_resevoir = 0
- INFLOWS:

- Inflow_to_pond = Area_of_watershed*Precipitation*inflow_rate*0.001
- Precip_input = Precipitation*Area_of__pond*0.001
- OUTFLOWS:
- outflow_from_pond = 100000000
- Evapaoration = Kp*(0.46*Air_temp+8.13)*Area_of__pond*0.001
- Ground_water = Area_of__pond*infiltratation_rate
- Area_of__pond = 10000000
- Area_of_watershed = 1000000000
- C = 0.5
- infiltratation_rate = 0.01
- inflow_rate = 0.7
- K = 0.02
- L = 0.5
- P = 0.7
- S = 0.5
- soil_rate = 0.00005
- Volume_of_soil__and_water = Soil_in_pond*800+Water_in_resevoir
- Air_temp = GRAPH(TIME)
- (1.00, 14.0), (2.00, 15.2), (3.00, 17.3), (4.00, 22.8), (5.00, 26.9), (6.00, 27.6), (7.00, 28.9), (8.00, 28.1), (9.00, 28.2), (10.0, 25.5), (11.0, 22.2), (12.0, 15.5), (13.0, 14.0), (14.0, 15.2), (15.0, 17.3), (16.0, 22.8), (17.0, 26.9), (18.0, 27.6), (19.0, 28.9), (20.0, 28.1), (21.0, 28.2), (22.0, 25.5), (23.0, 22.2), (24.0, 15.5), (25.0, 14.0), (26.0, 15.2), (27.0, 17.3), (28.0, 22.8), (29.0, 26.9), (30.0, 27.6), (31.0, 28.9), (32.0, 28.1), (33.0, 28.2), (34.0, 25.5), (35.0, 22.2), (36.0, 15.5)
- Kp = GRAPH(TIME)
- (1.00, 0.45), (2.00, 0.45), (3.00, 0.45), (4.00, 0.85), (5.00, 0.85), (6.00, 0.85), (7.00, 0.85), (8.00, 0.85), (9.00, 0.85), (10.0, 0.45), (11.0, 0.45), (12.0, 0.45), (13.0, 0.45), (14.0, 0.45), (15.0, 0.45), (16.0, 0.85), (17.0, 0.85), (18.0, 0.85), (19.0, 0.85), (20.0, 0.85), (21.0, 0.85),

(22.0, 0.45), (23.0, 0.45), (24.0, 0.45), (25.0, 0.45), (26.0, 0.45), (27.0, 0.45), (28.0, 0.85), (29.0, 0.85), (30.0, 0.85), (31.0, 0.85), (32.0, 0.85), (33.0, 0.85), (34.0, 0.45), (35.0, 0.45), (36.0, 0.45)

Nitrate in polar snowpack: for a better ice core interpretation

Abstract

From the beginning of ice core analysis until nowadays, nitrate has always been used as a simple annual marker when this chemical and almost all short-lived photochemically active species present a great potential in reconstituting the past atmosphere. The project presented in this proposal aims at filling some gaps in our knowledge of nitrate cycle that limit the actual use of nitrate in ice core interpretation. Based on an Antarctic field campaign during which atmosphere and snow at different depth will be sampled, the main objectives will be:

- to complete our knowledge about atmospheric chemistry in the western Antarctic in interaction with snowpack, by quantifying the different sources and products of nitrate photolysis;
- to improve our understanding on the air-snow transfer function of these active species by studying their (re)mobilization with snow depth;
- to provide data hat will improve the present models of global climate, atmospheric chemistry and air-snow interaction;
- to propose a new tool that can be used as a proxy of the past atmospheric oxidative capacity for WAIS-Divide ice core interpretation.

Background:

Polar ice represents certainly the most important archive for past atmospheric composition, recording past greenhouse gases, aerosols and photo-chemically active species that are proxies of the evolution of the climate system. Past temperatures, accumulation rate, sea-ice extent, atmospheric and oceanic circulation, natural and anthropogenic emissions are become common data extracted from ice cores. Glaciology has improved considerably since the last 50 years and some records as carbon dioxide, methane or nitrous oxide [8; 9; 18] are now well understood so that the respective gas concentrations, temperature profile, glacial periods and the global climatic system were determined for the past over 800 000 years. However, large uncertainties and gaps in our knowledge still exist in the interpretation of photochemically active species with regard to past climate, atmospheric composition and feedbacks between the two [6; 7]. Chemical and physical processes from the firn to the ice crystals are an essential knowledge to acquire for the scientific community to fully interpret the climatic archives recorded in the polar ice [11].

Antarctic tropospheric chemistry represents a major scientific field to understand for at least three essential reasons. Firstly, Antarctica is certainly the only last clean environment on Earth where natural atmospheric and snowpack's processes can be studied without any anthropogenic artifacts. Secondly, specific conditions of sunlight and temperature make this continent an ideal laboratory for studying photochemical processes in the atmosphere. A good illustration is the role of the snowpack, which can be considered as a chemical reactor that influences the atmospheric boundary layer. Finally, since a lot of knowledge is still missing to interpret integrally ice cores for past climate

reconstitution, an effort has to be done in better understanding the air-snow transfer of greenhouse gases and short-lived photochemically active species. This third reason is the main point of this proposal.

Use of these species as climate or atmospheric changes proxies has not been widespread yet due to the complexity of the processes and the present scientific knowledge. For example, nitrate, NO_3^-, has been analyzed in many ice cores [8; 9; 16;17] and interpreted as an annual indicator but uncertainties in how to relate it to past atmospheric chemistry remains [11; 22]. While it seems unlikely that a climate signal can be developed from the nitrate in ice at low accumulation sites [17], high accumulation sites like WAIS Divide present less post-depositional signal loss [3]. Nitrate from this ice core could be then used as a proxy of past atmosphere. Another point concerns the quantification of nitrate sources. Sedimentation of Polar Stratospheric Clouds, PSCs, tropical lightening and nitric acid, HNO_3, produced by nitrate photolysis in the snowpack are now thought to be the major sources of nitrate in snow [13; 14; 15; 16; 20], but other potential sources as continental and oceanic emissions have to be taken into account too. With the ability to know and quantify these sources, account for temperature and accumulation changes, it should be possible to infer a tropospheric and stratospheric climate signal form nitrate record [15; 17].

Statement of need

Since the last decade, high Troposphere and Stratosphere have been identified as major sources of nitrate in polar areas: Tropical lightening and annual sedimentation of the PSCs after each ozone depletion event are mostly the involved processes [14; 15; 20]. However, no real quantification has been yet estimated for these sources, which represents a real need to interpret nitrate as a proxy of tropospheric and stratospheric changes. Using the atmospheric nitrate's oxygen isotopic composition ($\Delta^{17}O\text{-}NO_3^-$) as described by *McCabe et al (2007)* should provide a better pattern of the tropospheric and stratospheric sources of nitrate. Furthermore, other sources like oceanic and continental contributions have also to be determined and quantified [5] for each site so that a precise signal can be extracted from the assimilated nitrate in the ice.

In the same time, it is also essential to improve our knowledge on the nitrate photolysis. It is clear now that nitrate from the snowpack is recognized as the major producer of NOx and radical oxidants, mainly OH, in the polar troposphere [12; 13]. But nitrate photolysis and post-depositional processes are not well understood yet despite several physical and chemical studies on the air-snow chemistry [2; 4; 6; 19; 21]. Using nitrate as a past atmospheric proxy requires to define each parameter (pH, snow accumulation, temperature, specific wavelength, location within snow crystals/grains, specific surface area). In situ measurements are the first and necessary step before improving the existing models of global climate and air-snow interactions and atmospheric chemistry for polar region.

Project description

Field

At least one field season in Antarctica is required for this study in order to collect all the samples needed to define the local atmosphere. Because of its high snow accumulation [1] and the fact it's a little summer campsite, WAIS-Divide is an optimal place to measure the nitrate cycle, using the possibility to set up a lab tent far enough from the camp to avoid any local contamination.

Focusing on the air-snow interactions as described in Figure 1, snow and atmospheric samples will be done simultaneously. Given the importance of nitrate photolysis and the transfer function, nitrate concentration in snow will be measured at different depth. Surface snow will be sampled once or twice a day to correlate directly the nitrate concentration with the continuous atmospheric measurements. One or two snowpits, shallow (30 cm depth) and deep (1 to 2 m depth), will be also made to follow the transfer function of nitrate from neve to firn ice. All these samples will be also analyzed for formaldehyde (HCHO), hydrogen peroxide (H_2O_2) and methyl hydroperoxide (CH_3OOH), which are intermediate species in oxidation reactions initiated by OH that is produced by nitrate photolysis. If a collaboration can be made with Joel Savarino from the Laboratoire de Glaciologie et Geophysique de l'Environnement (Universite Joseph Fourier, Grenoble, France) or with Mark Thiemens from the Department of Chemistry and Biochemistry (University of California San Diego, USA), all these sample will be doubled so half of them will be analyzed for $\Delta^{17}O\text{-}NO_3^-$ measurements.
The same measurements are planned to be done with a shallow ice core (about 100 m) that will be drilled during the field. These data will then complete the air-snow system giving information about the transfer of the reversibly deposited species (nitrate, formaldehyde, peroxides) into the ice.

Atmospheric sampling will be made continuously during all the season without interruption. Diverse gases produced directly or indirectly by the nitrate photolysis will be studied. Formaldehyde and peroxides will be measured using the 2-channel detector deployed on previous past projects and described in *Frey et al. (2005)*. A commercial ozone (O_3) detector (2B Technologies, model 202) and a nitric oxide (NO) detector made by G. Huey's team will be used to measure O_3 and NO that can be used indirectly with HCHO, H_2O_2 and CH_3OOH to determine NO_2 and the other photolytic products via a photochemical model.

Finally, meteorological conditions will be recorded for interpretation and modeling of our results. Data and observations of the mean weather station of the campsite will be used also as local data recorded by a standard weather station setup close to the lab. Combining these 2 sets of data should give us enough information to suppress any anthropogenic artifacts in our measures.

Lab

Half of the snow samples will be shipped out from the field to UC Merced where they will be analyzed. Nitrate, converted in nitrite via a reduction column, will be analyzed by spectrometry while the same snow sample will be used to measure the

conductivity but also formaldehyde and peroxides concentrations using the 2-channel detector.
The other half will be ship to UC San Diego or Grenoble to measure the spatial and temporal variations of the nitrate's oxygen composition.

Outcomes

The first main point of this proposal will be to determine precisely the sources of nitrate in WAIS-Divide using the isotopic $\Delta^{17}O\text{-}NO_3^-$ measurements [7]. Adding these results and the ones obtained with the atmospheric measures to a global climate model, one expects to extent the quantification of these sources to all the inner part of the western Antarctica.

The different concentrations measured during this field would be integrated into a global climate model and an air-snow transfer model to improve the present knowledge on the nitrate photolysis, its transfer function into the ice, and its resulting consequence inside the atmospheric boundary layer. A particular point will be then to use these models to improve also the quantification of the nitrate sources: the production of nitric acid via NO_3^- photolysis can be estimated and subtracted to the total amount of HNO_3; the difference representing the nitric acid coming from the sedimentation of PSCs.

In a general point of view, the overall aim of this project will result first in a better understanding of the atmospheric chemistry of west Antarctica with its bi-directionnal linkages with the snowpack, and how it responds to regional influences. Secondly, it will extend the knowledge of the effects of post-depositional air-snow exchange on firn and ice records of various species at this site, so it can serve as an important tool for the future interpretations of WAIS-Divide ice core.

Nicely written and well conceived. However, the goal was to use the Stella Model. I realize that you could not get this one to work. It would have been better to use a small portion of this total problem so you could perform a useful calculation.

Exercise grade = A-

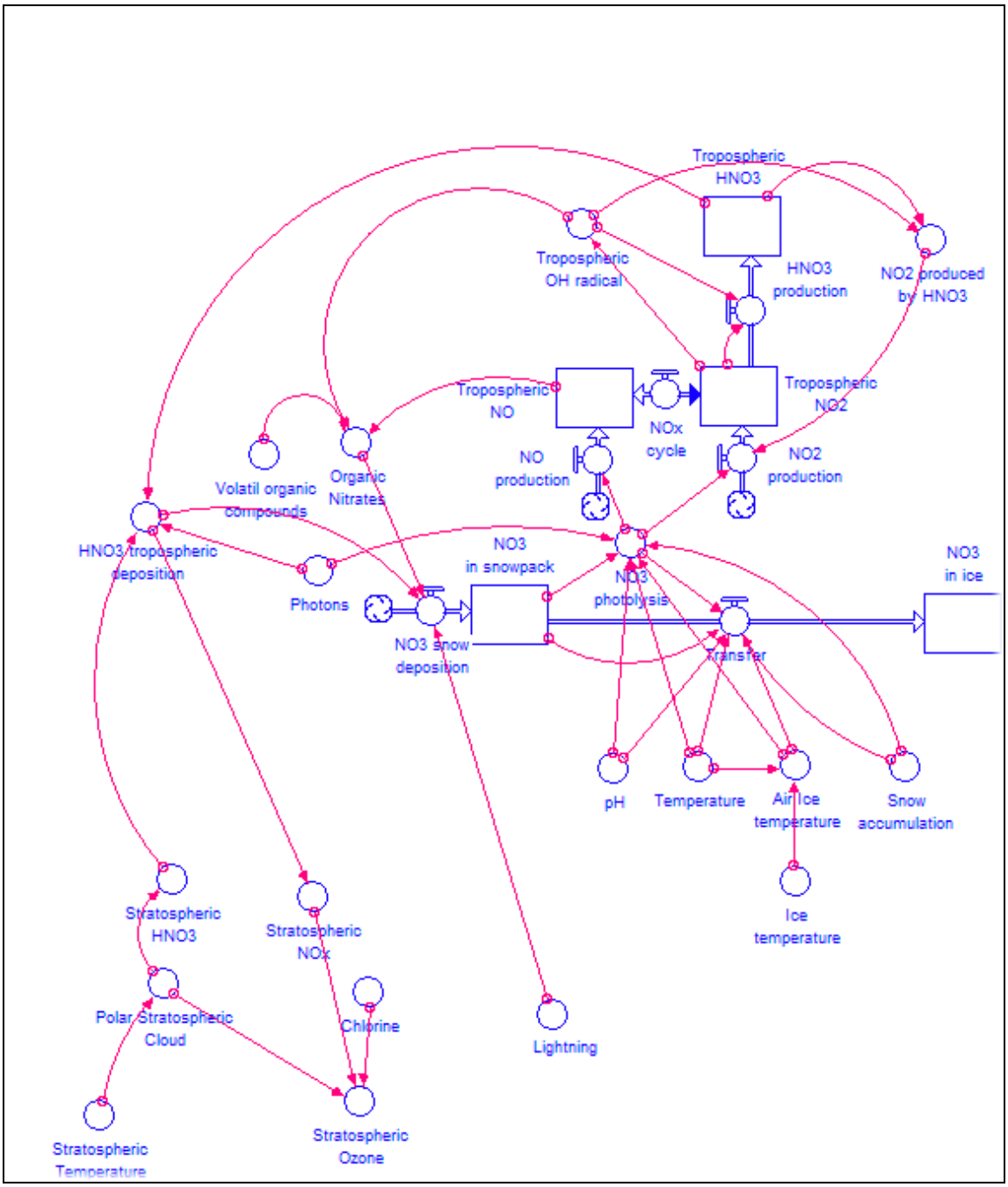

Figure 1: STELLA Model representing the present knowledge of a simplified Nitrate cycle into polar atmosphere and snowpack.

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Optimizing center pivot controller, to maximize water use efficiency.

PROJECT PROPOSAL

Submitted to:

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&
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ESS 200

MAY 12, 2009

by

[redacted]

[redacted] **of California Merced**

Project Title: Optimizing center pivot controller, to maximize water use efficiency.

Abstract

In a time of continued water shortage, the capacity to manage irrigation is a critical compoent of ground water protection.Sound water resources management, which emphasizes careful and efficient use of water, is essential in order to achieve these objectives (USDA, 1994; U.S.EPA, 2002). Efficient water use in agricultural production is particularly important in arid or semi-arid climates, such as in California. The objective of the proposed research is to create an autonomous, closed-loop variable-rate irrigation system to support sustainable agriculture by maximizing water conservation while minimizing soil salinization and groundwater quality degradation without loss in yeild.

The project offers a method of integrating input from a range of irrigation sciences involved in water management so as to maximize irrigation effectiveness and efficiency. There are an estimated 28 million center pivots operating in the United States and an improvement of 25 to 35% in efficiency, which is quite feasible via the proposed approach, translates to a huge reduction in water use. In addition, the project will move beyond water conservation objectives to begin to address other environmental resource management issues, namely soil salinization and groundwater quality. This is a rich area for research upon which the sustainability of agriculture in the San Joaquin and Imperial Valleys of California, and other regions of the arid and semi-arid world, depends.

From a practical standpoint, the irrigation control technology developed in this research will be engineered into the software driving center pivot systems to enable user-friendly automation of the management schemes developed here. These and future developments may stimulate economic developments in the form of new ventures or technology transfer to current irrigation technology support firms.

Project Title: Optimizing center pivot controller, to maximize water use efficiency.

1. **Background:**

In order to meet the needs of existing and future populations and ensure that habitats and ecosystems are protected, the nation's water must be sustainable and renewable. Sound water resource management, which emphasizes careful and efficient use of water is essential in order to achieve these objectives ((USDA, 1994 & U.S.EPA, 2002).The role of efficient water use for agricultural and turf-grass production forms a critical relationship, particularly in areas prone to periodic or prolonged drought. Therefore, the challenge to the irrigation industry is to provide SMART irrigation systems for the consumer. "SMART" as defined by Irrigation Association is an irrigation system that functions without human intervention over the life cycle of the crop. There are many SMART products available in the marketplace. These devices include soil moisture sensor based controllers and evapotranspiration (ET) based controllers among others. The primary motivation for the development of SMART system has been the need to improve water application efficiency and anticipated government regulation of water supplies. Critical to the concept is the availability of controllable irrigation systems that apply water in a uniform manner. Center pivots, drip and micro-jet irrigation and solid set sprinkler systems all have demonstrated this capability. Also critical to the concept is the availability of online accessible climatic data. This need is admirably met by DWR's (Department of Water Resources) CIMIS (California Irrigation Management Information System) program. The SMART controller will access on a daily basis, evapotransportation and rainfall data from stations strategically located to represent the field being controlled. In some situations, onsite package weather stations could be appropriate. This last development critical to the concept is the availability of computers and their ability to receive and transmit operating data in a wireless manner. Automation through instrumentation is feasible is demonstrated by the availability of the homeowner SMART controller.

The successful development of the agricultural SMART controller would also finally close the loop relative to getting scientific data thru to the farmer and ultimately beneficial to the crop. Agricultural scientists have a wealth of scientific data available to favorably impact water management decisions. Unfortunately there is a significant disconnect between the available data and its effect on the irrigation system operation.

The agricultural scientist of the future will then be involved in the development of software that integrates the latest developments. The scientists involved will include climatologists, agronomists, soil specialists, instrumentation engineers and irrigation engineers. The farmer will make the cropping decisions, purchase the appropriate software and install it in his SMART controller. There are an estimated 28 million center pivots operating in the United States, a significant improvement of even 10% efficiency will lead to a significant reduction of water use. With this controller development background, water management should move closer to the objective of maximizing water use efficiency.

2. Statement of Need:

The plant water requirements change with season, growth stage and physiological state of the crop (Allen et al. 1998). Additionally, external factors like soil type, soil hydraulic conductivity/infiltration rate and spatial variabilty of the soil also account for irrigation inefficiency. In order to significantly conserve water, irrigation requirements have to be matched with real plant water needs and the external environment. Center pivots apply constant rate of water and does not take into account these variables and hence are not very efficient. The objective of this study is to improve the irrigation efficiency and effectiveness of a center pivot.

Soil moisture sensor based controllers and ET based controllers can help close this gap. However both these systems have their own biases and were mainly designed for homeowners, golf-courses and the turf industry, and are not very suitable for direct plug and play into an agricultural setup. ET based controllers schedule irrigation based on historic and real time ET data from local weather stations without taking into account external variables like plant growth phase and agronomic practices. On the other hand, soil moisture sensor based controllers based to irrigate keep the soil moisture within an upper and lower threshold (normally between field capacity and welting point), wasting potential water during the dormant phases of the plant growth. A current CSU-ARI (California State University -Agriculture Research Initiative) grant is helping us develop a realtime feedback loop system for drip irrigated crops which takes into account the real plant water requirement, the external variables like soil type, runoff due to slope and the seasonal adjustement to ET requirements. This feedback system helps integrate these controllers to the agricultural environment and bridge the gap, but is mainly capable of controlling drip or micro-sprinkler based hardware and is not capable of controlling a center pivot.

3. Project Description

In-order to improve the efficiency of the center pivot, we will need to modify our existing feedback system to adapt it to the center pivot and test the outcome on a 27 acre field at Fresno State. The field will be suveyed with a VERIS soil EC monitoring system to capture the variabilty and the salinity in the soil. Additionally, hydraulic conductivity measurements will be taken on specific location in the field. Based on the variability and the hydraulic conductivity, wireless soil moisture sensors will be installed at various location and depths across the field. Center pivot application uniformity tends to detiorate with wind-speed, hence a wireless wind monitor will also me installed on site.

Traditionally most center pivots operate by moving a few degrees in circular motion and then stops for a fixed amount of time at a point while the water is still on at a constant rate, and then moves a fixed distance again and stops until it completes the full run. This move and stop motion may cover the whole field in one day or in several days based on application rate. But the distance travelled and time for which it stops at a point and flow rate is always constant through out the whole pass. This leads to in-efficiency, as the water requirement is not constant and hence the application rate should not be constant and should be varied based on the above stated conditions of water requirement.

The SMART-AG controller will be developed by modifying our current drip/micro sprinkler feedback system. This will involve writing additional codes to drive a PLC (Programmable Logic Controller) that will control the flow rate and speed of the pivot to achieve variable rate application. The onsite soil wireless soil moisture sensors will help varify application rate and requirements, while the wireless wind monitor may stop the pivot if the wind speed is above a certain threshold. Before the start of any run the moisture sensor will help decide the amount of water required based on root zone moisture balance and the ET requirement of the day and will also help modify the speed of the pivot if the computer calculated flow rate does not help reach the required root zone water content.

Scheduled for the 1st half of the season is an audit of the pivot operation as currently scheduled by the farm manager. During the second part of the season SMART controller will assume operational duties. The operation will be monitor using protocols currently in-place for the Irrigation Association home owner project. Evaluation parameters include system adequacy and efficiency. By incorporating the best agricultural science available into the development of the SMART agricultural controller, these evaluation parameters will result in characterizing the maximum yield potential and water application efficiency. A second season will be used to evaluate the controller's performance after incorporating the 1st season's experience.

Additionally the portal developed as part of the existing feedback system will be modified to monitor and control the center pivot remotely. The portal will have capabilities to log application rate, current soil moisture and also have supervisory control to inhibit pivot from operating in case current agronomic practice demands so (for example the farm equiptments need to go into the field).

4. Expected Outcome:

The project offers for the first time, a method of integrating the range of irrigation sciences involved in water management so as to maximize irrigation effectiveness and efficiency. The new irrigation paradigm results in a synergistic effect that focuses agricultural sciences on the single objective of most productive water management. To this point in time, the farmer has been left to make the judgments on his own. With a successful development, irrigation control will be engineered into the hardware.

Potential benefits from the successful development of a SMART Center Pivot controller include:

1. A realization of the improvement in water application uniformity and efficiency currently engineered into modern enter pivots.
2. Improvements in crop production offered by the incorporation of crop and soil science with irrigation engineering into a system that automatically controls the pivot.
3. Fundamental reductions in the irrigation supply flows required while still meeting the farmers cropping requirements.

The Internet will be monitored for location and dates for conferences, workshops, seminars and continuing education classes at which the findings and research progress can be reported.

Finally, scientific papers will be published in refereed journals, and the findings and research progress will be presented at one of the Annual ASA/CSSA/SSSA meetings and the IA show, which are normally held in October or November of each year.

5. **Budget:**

Funding is requested through this grant to procure hardware to retrofit and modify our current system (drip/micro sprinkler controller system) to adapt it to Center Pivot. List of hardware and equiptments to be brought through this project includes:

a)	Xtend 900 MHz radio and transmitter	$600
b)	Campbell Logger CR1000	$1450
c)	Allen Bradley Micrologix PLC 1500 series	$4500
d)	Wind Monitor	$400
e)	Computer Server system	$3000
f)	Development of the web based portal	$5000
g)	Cost of maintaining the pivot	$5000
h)	Cellular/Wifi charges	$1000
	Total:	**$21,000**

The 900MHz radio will help with the wireless communication to and fro from the center pivot as daily variable rate data is sent to the field PLC unit from the our remote server (the remote server is part of our existing system that calculates the daily ET requirement).

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Modeling Nickel Adsorption on Ferrihydrite in Serpentine Regions: Understanding Serpentine Soil Chemistry

[redacted]

ES 200

B+ [redacted]his is a nice job but it missed in a couple of areas. This is actually a significant amount of literature on the sorption of Ni by ferrihydrite. It would have been nice to compare your results to the Phreeq model. The actual exercise called for you to use Stella. It would have been possible to fit literature data to a polynomial equation that described the pH dependence of Ni sorption and this could easily have been built into Stella. Nevertheless, this was reasonable job.

Background

The ubiquity of nickel in the environment and its common presence in food and water mean that humans are constantly exposed to nickel. Although nickel is not acutely toxic at low levels, it is a carcinogen and has been linked to cellular oxidative stress [1]. Soils that develop on serpentinite, a metamorphic rock type derived from ultramafic igneous rocks (and the state rock of California), are well known for their elevated concentrations of nickel and chromium [2]. The degree of nickel accumulation in serpentinite soil horizons, thus its bioavailability to plants, is controlled by soil characteristics such as pH, amount of organic matter, clay and iron oxide content, and competitive adsorption with other dissolved species [3-7]. These biogeochemical factors are influenced strongly by climate, rainfall, vegetation, and weathering of primary ultramafic minerals. In locations where serpentinite and ultramafic soils have been used for agriculture, nickel transfer to plants has been documented [8], with potential transfer through the food chain to humans. We hypothesize that soil

pH has a major influence on the bioavailable nickel found in the root zones of most plants.

Our areas of study were focused on two sites: the Red Hills Management Area (RHMA), in Tuolumne County, California, and Bagby, near Coulterville, California. The RHMA and Bagby are unique areas to study because they represent exposed serpentinite terrains in a semi-arid climate with low rainfall, no urban or agricultural development, and limited grazing. Previous studies in the RHMA have examined plant species and nickel accumulation in arthropods), but other than regional geologic studies, no work has looked specifically at metal mobilization in the RHMA. To gain insight into the mechanisms of metal mobilization in serpentine regions, we utilized previous sequential extraction data to determine an approximate amount of ferrihydrite, a ubiquitous iron-containing mineral. Due to relatively high surface area, and relatively high reactivity of ferrihydrite, it often interacts with its surroundings through surface adsorption. By constructing an equilibrium adsorption model utilizing PHREEQC software, we were able to model nickel adsorption to ferrihydrite over a large pH range. Utilizing the diffuse double-layer proposed by Stumm and his associates (Stumm et al., 1970), PHREEQC considers two individual layers of charge: a surface layer and a layer of counterions found in solution. PHREEQC is a program constructed by the United States Geological Survey (USGS), to model aqueous geochemical situations from a thermodynamic standpoint. By utilizing various thermodynamic databases, PHREEQC quickly and efficiently calculates the various concentrations of the species present in the given system. Using experimental data from previous studies we have conducted, we will attempt to model nickel adsorption and desorption on ferrihydrite to determine the mobile concentration of nickel across a range of pH.

Statement of Need

The proposed project was founded on protecting human health. Serpentine regions are found in many areas across the globe, with large populations in the surrounding areas. The unique chemical composition of serpentine soils is cause for concern in regions where

agriculture is present. An example of the potential dangers caused by serpentine regions was found in the Spanish state of Galicia, in northwest Spain. Cattle grazed on the flora grown on the serpentine region, and high levels of Ni accumulated in the tissue of the cattle. As the cattle were milked and slaughtered for meat, Ni began accumulating in the Galician population. High levels of Ni were found in human mother's milk, which can potentially be dangerous for the mother, and the feeding infant. Due to the unique characteristics of serpentine soil, the mechanisms of metal adsorption/desorption, bioavailability, and plant metal accumulation will provide local land management with the knowledge to make better-informed decisions. By intitially utilizing a model of the system of interest, many different experiments can be carried out on a computer. The results of these models will give a proof of concept that can be utilized to design more efficient experiments.

Model Methods

PHREEQC, an aqueous chemical equilibrium modeling program, was utilized to simulate an adsorption experiment. The following parameters were entered into the program: surface area of the ferrihydrite is 600 m^2 /gram, the number of surface sites is 10 sites/nm^2, and the weight of ferrihydrite in a soil sample. Determination of each parameter will be explained within the results section of this paper. The source of nickel in the PHREEQC model is Ni^{+2}, which will simulate a product of the weathering of serpentine minerals. Two different concentrations of nickel (II) were modeled, 1 μmol, and 10 μmol, in order to model the variation in adsorption due to concentration. By programming the data into PHREEQC and utilizing the Minteq thermodynamic database, the soil solution was then stepped through the range of pH. The range of pH utilized was 4 to 13.

Model Results

By utilizing data from a sequential extraction performed on a soil sample from the RHMA, an approximate amount of ferrihydrite was determined. Table 1 shows each extraction step, and the amount of iron in parts per million (ppm). Steps 1 through 3 will be summed to get an approximate concentration of labile iron. Steps 1 through 3 will extract everything from exchangeable ions to poorly crystalline iron oxides, which will provide the approximation of labile iron. Step one of the sequential extraction utilizes an $MgCl_2$ extraction, which targets easily exchangeable ions. Step 2 of the sequential extraction utilizes a diethylene triamine pentaacetic acid (DTPA) extraction, which targets strongly bound divalent cations. Step 3 of the sequential extraction utilizes a ammonium oxalate extraction, which targets poorly crystalline aluminum oxides and iron oxides. The weight of iron will be converted to moles of iron, utilizing the molar mass of iron, 55.85 g/mol. The moles of iron present will be set equal to the moles of ferrihydrite present, due to the molecular formula of ferrihydrite, $Fe(OH)_3$. The number of moles of sites within a unit of soil was computed by utilizing the volume of soil taken in a sample (~250cm^3) and multiplying by the density of quartz (2.65 g/cm^3) to obtain the mass of soil. The porosity of the soil was estimated to be approximately 0.30, due to the rocky nature of the soil. As 70% of the soil sample was actually soil, the remaining 30% was water, and dissolved ions and compounds. PHREEQC requires the "moles of sites" parameter to be in units of moles of sites per kilogram of solution. The ppm value of iron was converted to moles, which was utilized as the moles of ferrihydrite, which was calculated to be 0.051 moles of ferrihydrite. The mass of ferrihydrite was then found to be 5.45g, by utilizing the molar mass of ferrihydrite (106.85 g/mol). The mass of ferrihydrite was multiplied by the surface area of ferrihydrite (600 m^2/g). The area of the ferrihydrite was then multiplied by the number of sites per nm^2 (10

sites/nm^2). By dividing the number of sites by Avogadro's number, 6.022 x 10^{23}, the number of moles of sites is found. As the moles of sites is per kilogram of soil, PHREEQC requires the parameter to be in moles of sites per kilogram of solution, so the ratio of soil to solution was found to be .464 kg soil per .075 kilograms of water. To account for the sorption stoichiometrty found in the adsorption equation, the moles of sites per kg solution will be halved. The following value was found for a 250 cm^3 sample volume: 0.167 moles of sites per kilogram solution.

	1 MgCl2 (+rinse)	2 DTPA (+rinse)	3 AmOx (+rinse)	4 NaCit(+rinse)	Total	Fe (ppm)	%
Total Digest 421-006-1	149.96	78.18	2602.97	10349.38	78941.3 13180.50	2831.111	0.2831

Table 1: Sequential extraction results for iron, in ppm. Steps 1 through 3 were summed to find the approximate amount of ferrihydrite.

The surface area (600 m^2/g) and surface site density (10 sites/nm^2) were taken from the literature [27,28, 29]. The chemical equation utilized for the adsorptive process is as follows:

$$\mathbf{2Hfo_OH + Ni^{+2} = (Hfo_ONi)_2^{+} + H^{+}}$$

Figure 1 illustrates the percent sorbed to ferrihydrite, in regards to two separate nickel concentrations.

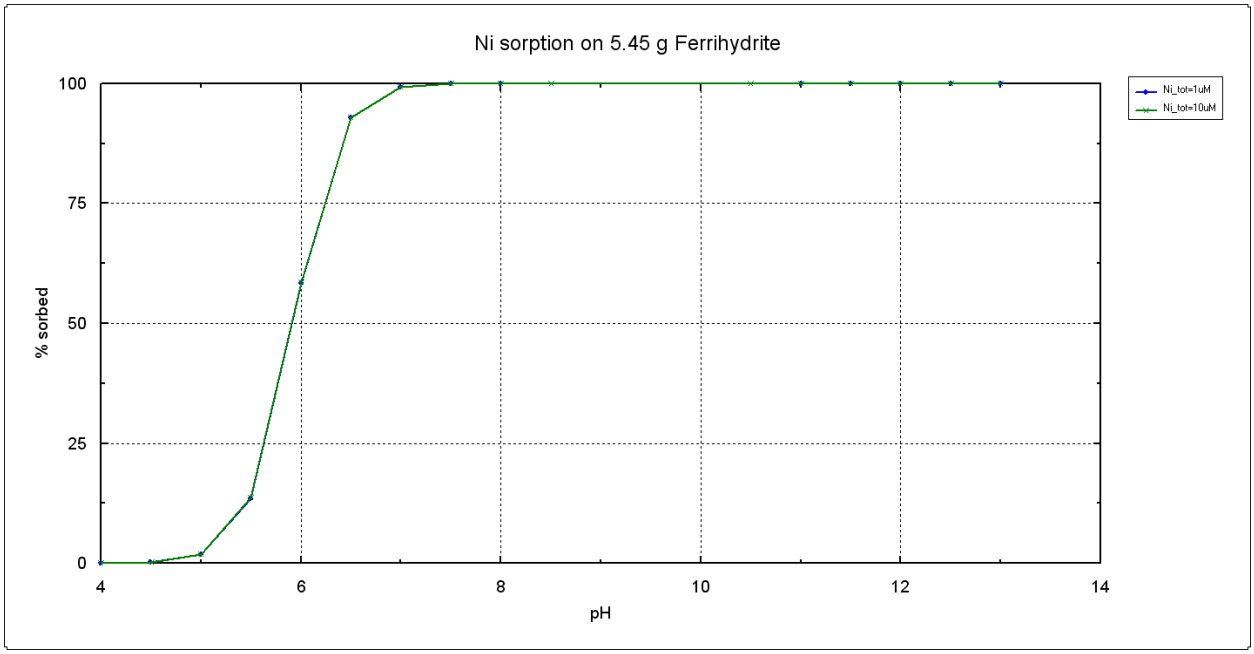

Figure 1: Ni sorption on ferrihydrite. By pH 8, 100% of the Ni has adsorbed to the ferrihydrite.

Figure 2 illustrates the effect of a competing cation, magnesium, commonly found in high concentrations in serpentine soils. The model utilized to create Figure 2 was identical to the solution utilized for Figure 1, with the addition of an equivalent concentration of magnesium

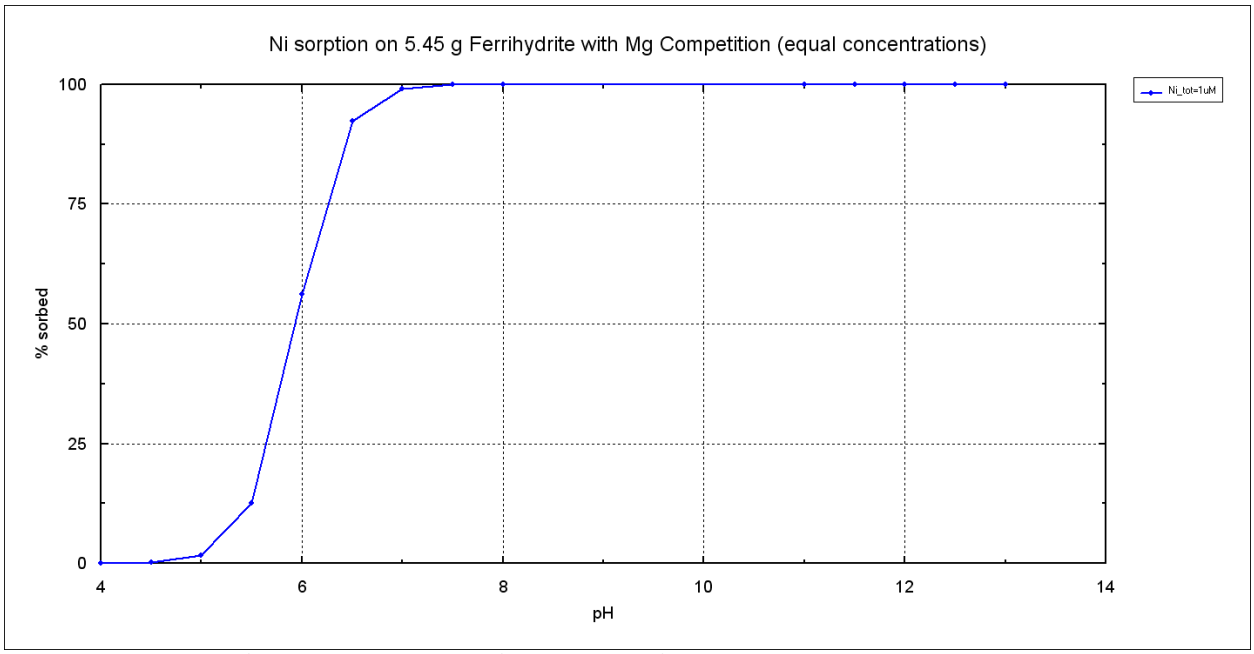

Figure 2: Ni adsorption on ferrihydrite with competition from magnesium of equal concentration.

Discussion & Conclusion

Most of the soils sampled at the RHMA and Bagby sites range in pH from 5.8-7.5. The range of soil pH sampled falls within the range of "free" nickel, or desorbed nickel. Nickel that is not adsorbed to the surface of ferrihydrite is available for biological uptake, specifically plant uptake. The pH of the soil solution is the main driver of metal adsorption. As the pH becomes basic, the ferrihydrite adsorbs the nickel very readily, and by pH 8, all of the nickel has adsorbed to the surface of the ferrihydrite. As rain falls upon the soil, the pH of the soil will drop, therefore the model predicts that Ni will desorb from the surface of ferrihydrite and become potentially available.

It should be noted that the model created has many limitations, as the complexity of a real system is quite difficult to conceptualize. As serpentine soil systems have not been extensively modeled, a simplistic approach was taken. Possible future models could include an ionic composition of rainfall to give an extra dimension to surface complexation. Also, temperature effects on surface complexation could be accounted for. As serpentine systems have some unique plant life, such as hyperaccumulators that uptake large concentrations of metals, modeling the soil plant interactions could prove useful to land management decision-making. The modeling approach utilized in this paper is useful, as it allows the researcher the freedom to manipulate the model to their own specifications with little monetary and temporal cost.

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ES 200 Final Project: Research Proposal & Research Report

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Research Proposal: Modeling Global Carbon Cycle with STELLA

The increase of CO_2 in the atmosphere has been observed recently by scientists. This phenomenon calls for global concern and has been a research hot topic because of the greenhouse effect of CO_2 which might account for the global warming (Falkowski, 2000) and climate change, which will significantly affect life on Earth. The objective of this study is to investigate the processes of carbon cycle in Earth system and the effects of fossil fuels emission on carbon cycle.

Specifically, by modeling the global carbon cycle with STELLA, I try to answer these questions: 1) ~~is~~ will the increasing combustion of fossil fuels ~~will~~ result in the increase of CO_2 in the atmosphere? 2) How does carbon move~~s~~ among different reservoirs? 3) At what level do human activities affect the global carbon cycle? 4) What is the consequent result from human disruptions? 5) What actions can we take to reduce the CO_2 in the atmosphere? The carbon cycle model simulates the movement of carbon from sources to sinks through chemical and physical transfers, which can provide important insight into the geochemical cycling of carbon in Earth system and provide useful information for decision makers.

Keywords: global carbon cycle, fossil fuel emission, STELLA

1. Introduction

Since the late 1950s, scientists have regularly measured CO_2 in the atmosphere from observatories in Hawaii and Antarctica. CO_2 concentration rises and falls about the same amount each year due to seasonal changes in photosynthetic rates. However, the total amount of atmospheric CO_2 is increasing steadily each year (figure 1). The future effect of increasing atmospheric CO_2 worries many people because of its greenhouse effect which might account for the global warming (Falkowski, 2000). The recent increase of CO_2 in the atmosphere may be due to human activities. The dramatic increasing of CO_2 emission started in the early nineteenth century, with the Industrial Revolution (figure 2). Combustion of fossil fuels such as coal, oil and natural gas can release carbon into atmosphere mostly in the form of CO_2.

~~Is~~ Will the increasing combustion of fossil fuels ~~will~~ result in the increase of CO_2 in the atmosphere? How does carbon moves among different reservoirs? At

what level do human activities affect the global carbon cycle? What is the consequent result from human disruptions? What actions can we take to reduce the CO_2 in the atmosphere? To answer these questions, models are needed to help us better understand the geochemical cycling of carbon in Earth system and provide useful information for decision makers. The carbon cycle model simulates the movement of carbon from sources to sinks through chemical and physical transfers, which is described in the following section.

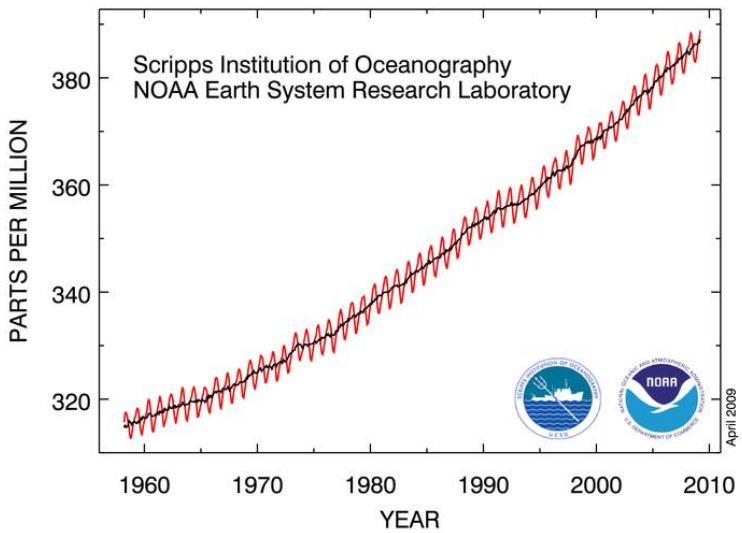

Figure 1. Atmospheric CO_2 at Mauna Loa Observatory. Dr. Pieter Tans, NOAA/ESRL (*www.esrl.noaa.gov/gmd/ccgg/trends*)

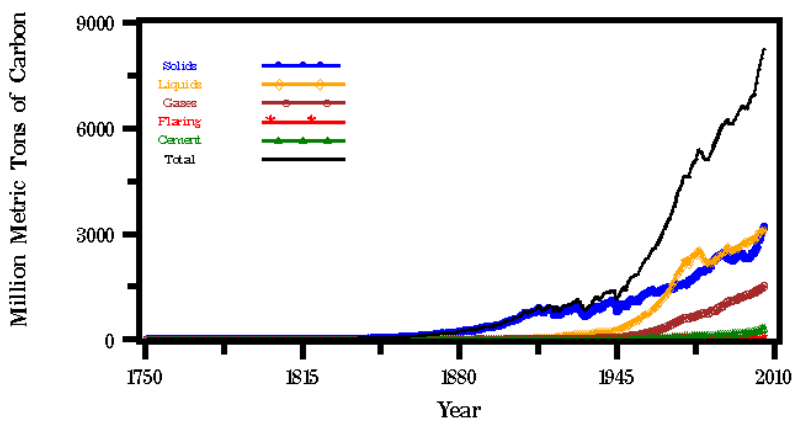

Figure 2. Total carbon emission by fossil fuel combustion. Carbon Dioxide Information Analysis Center (http://cdiac.ornl.gov)

2. Modeling of Global Carbon Cycle

STELLA models were developed to simulate the cycling of carbon in Earth system (Bice, 2001). First, in order to understand the natural cycle of carbon in Earth system, a model without fossil fuel combustion and carbon emission was ~~build~~ built (figure 3). Second, a stock representing fossil fuel reservoir of carbon and a flow representing carbon emission from fossil fuel combustion were added to the previous carbon model (figure 5). These models will help us to understand the processes of carbon cycle and the effects of human disruptions at the global scale.

2.1 Natural Global Carbon Cycle

A natural global carbon cycle model is shown in figure 3. The equations are described in following:

ATMOSPHERE(t) = ATMOSPHERE(t - dt) + (Terrestrial Respiration + Marine Respiration + Terrestrial Decomposition + Marine Decomposition + Emissions – Terrestrial Photosynthesis – Marine Photosynthesis) *dt
INIT ATMOSPHERE = 690 (Gt)

MARINE(t) = MARINE(t - dt) + (Marine Photosynthesis – Marine Respiration – Marine Death) *dt
INIT MARINE = 7 (Gt)

M_DEAD_ORGANIC(t) = M_DEAD_ORGANIC(t - dt) + (Marine Death – Marine Decomposition) *dt
INIT M_DEAD_ORGANIC = 3000 (Gt)

TERRESTRIAL(t) = TERRESTRIAL(t - dt) + (Terrestrial Photosynthesis – Terrestrial Respiration – Terrestrial Death) *dt
INIT TERRESTRIAL = 450 (Gt)

T_DEAD_ORGANIC(t) = T_DEAD_ORGANIC(t - dt) + (Terrestrial Death – Terrestrial Decomposition) *dt
INIT T_DEAD_ORGANIC = 700 (Gt)

T_Res = 23*(TERRESTRIAL/450)
T_Photo = 48*(ATMOSPHERE/690)
T_Decomp = 25*(T_DEAD_ORGANIC/700)
T_Death = 25*(TERRESTRIAL/450)
M_Res = 5*(MARINE/7)
M_Photo = 35*(ATMOSPHERE/690)

M_Decomp = 30*(M_DEAD_ORGANIC/3000)
M_Death = 30*(MARINE/7)

By running the STELLA model we found that the carbon in marine dead organic decreased, while the carbon~~s~~ in atmosphere, terrestrial biosphere, marine biosphere and terrestrial dead organic increased. However, the carbon~~s~~ in these reservoirs ~~keep~~ remains constant when the model reached the equilibrium state. The data in initial time step represent the carbons constant in 1970. Result was shown in figure 4.

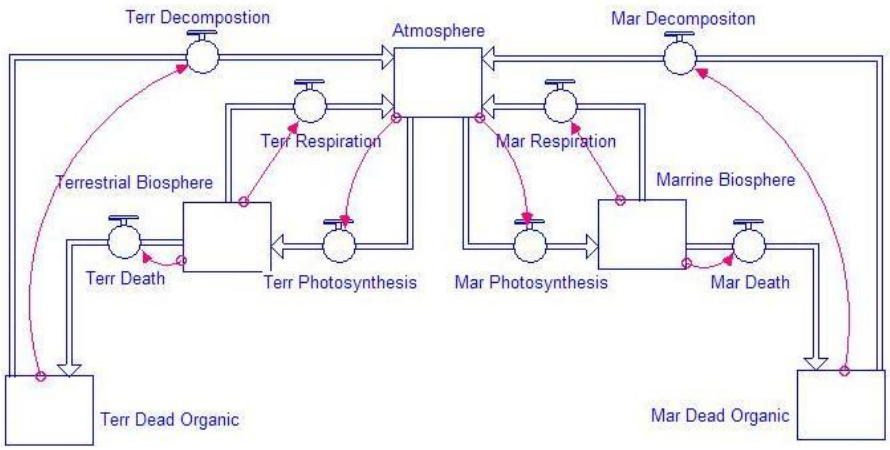

Figure 3. A natural global carbon cycle model

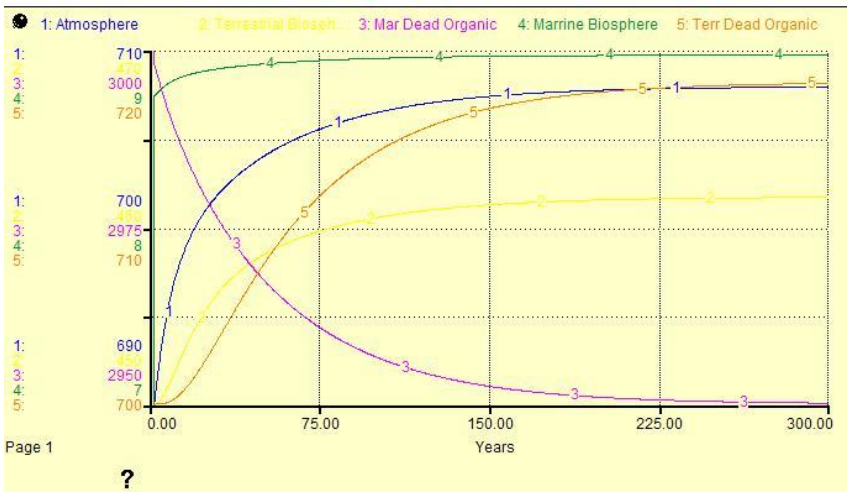

Figure 4. Carbon content in different reservoirs (Gt)

2.2 Human Disruptions to Carbon Cycle

A global carbon cycle with human disruptions is shown in figure. The equations are similar to the previous model, but a few modifications should be made to account for the fossil fuels and emission, which are shown in following:

ATMOSPHERE(t) = ATMOSPHERE(t - dt) + (Terrestrial Respiration + Marine Respiration + Terrestrial Decomposition + Marine Decomposition + Emissions – Terrestrial Photosynthesis – Marine Photosynthesis) *dt

FOSSIL_FUELS(t) = FOSSIL_FUELS(t - dt) + (- Emissions) *dt
INIT FOSSIL_FUELS = 10000
Emissions=5.5 (GT/Yr)

After the fossil fuel and emissions were added to the STELLA model, we found that the model wasn't able to reach an equilibrium state. Carbon~~s~~ in marine dead organic, atmosphere, terrestrial biosphere, marine biosphere and terrestrial dead organic tended to increase over time. This illustrated that human activities can disrupt the carbon cycle and destroy the equilibrium state in Earth system. Result was shown in figure 6.

A comparison of carbon~~s~~ in the atmosphere with and without human disruption was show in figure 7. We can see if there is no emission from burning fossil fuel, carbon in atmosphere will increase for the first 150 year, and then keep constant around 708 Gt in the coming years because an equilibrium state is reached. However, the carbon keeps increasing if there are fossil fuel emissions at the rate of 5.5 Gt/yr. In 300 years, the carbon in atmosphere will reach about 1000 Gt.

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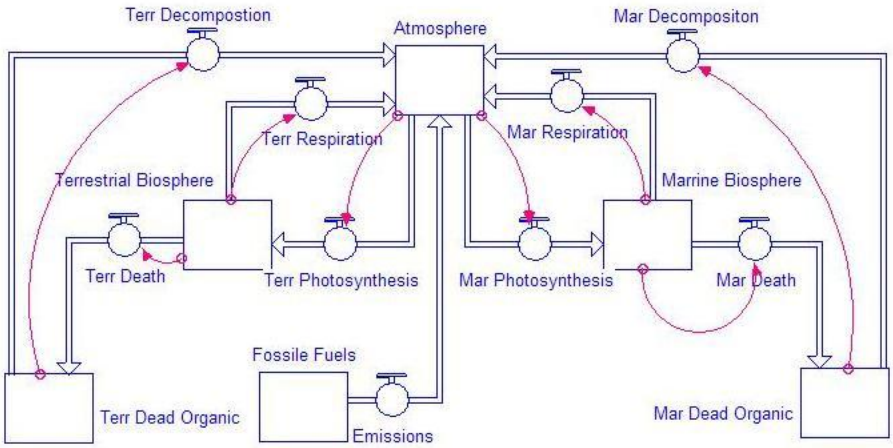
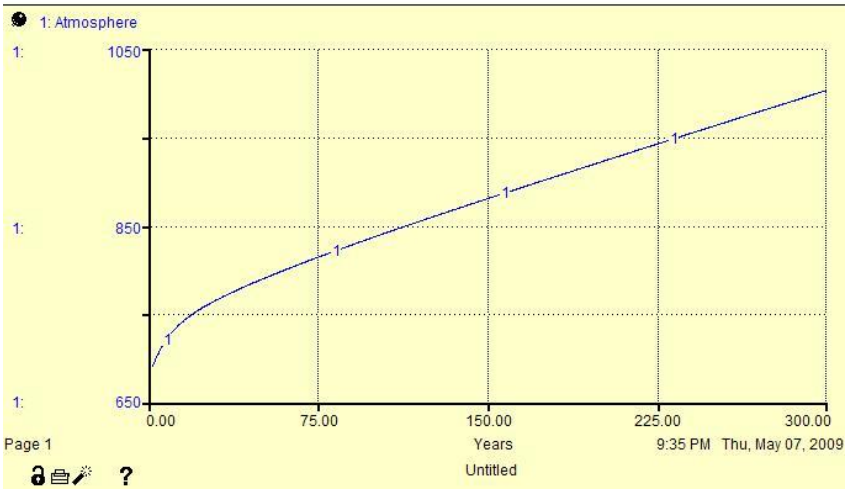


Figure 5. A global carbon cycle model with fossil fuel emissions

Figure 6. Carbon content in different reservoirs (Gt)

(a)



(b)

Figure 7. Atmospheric Carbon (Gt): (a) natural carbon cycle model, (b) carbon cycle model with fossil fuel emission

3. Sensitivity Analysis

As we can see from the model, there are a lot of factors which can affect the output and equilibrium state of the model. In this study, only three of the factors are selected to for sensitivity analysis: fossil fuel emission, terrestrial photosynthesis and marine photosynthesis. This will help us to understand how

these factors will affect the carbon accumulation in atmosphere. Generally, an increase of emission will result in an increase of atmospheric carbon, while the increase of terrestrial photosynthesis and marine photosynthesis will follow by consequent decrease of atmospheric carbon. The effects of factor on the atmospheric carbon in year 2270 were show in table 1. It seemed that marine photosynthesis is the most sensitive factor, followed by emission and terrestrial photosynthesis.

Table 1. Percentage change in atmospheric carbon in 2270 and coefficient of sensitivity (CS) resulting from adjustment of factors

Factors	Atmospheric carbon	CS
Emission (+-10%)	+-3.0%	0.29
Terrestrial photosynthesis (+-10%)	-+2.5%	0.25
Marine photosynthesis (+-10%)	-+5.6%	0.56

4. Scenarios Analysis

Researchers called for reduction of global CO_2 emission to decrease the effects of greenhouse and consequent global warming. Forth scenarios analyses were conducted in this study, which can provide helpful information for decision makers in terms of reduction of CO_2 emission.

Scenario 1

The Kyoto Protocol, signed in November 1998, calls for an overall reduction of emissions of greenhouse gases. In the United States, the goal is to have emission levels ten years from now be 7 percent less than they were in 1990. Assuming that the emission rate is 5.5 Gt/yr during 1970 to 2000, and decreased to 5.1 Gt/yr by 2010 (figure 8), the effect of a seven percent reduction in fossil fuel emissions on the atmospheric carbon was illustrated in figure 9. The atmospheric carbon keeps rising and reaches about 983.7 Gt in 2270.

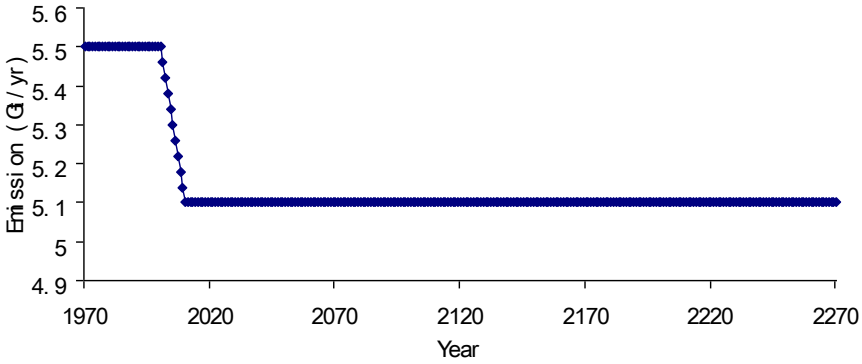


Figure 8. Total carbon emission by fossil fuel combustion

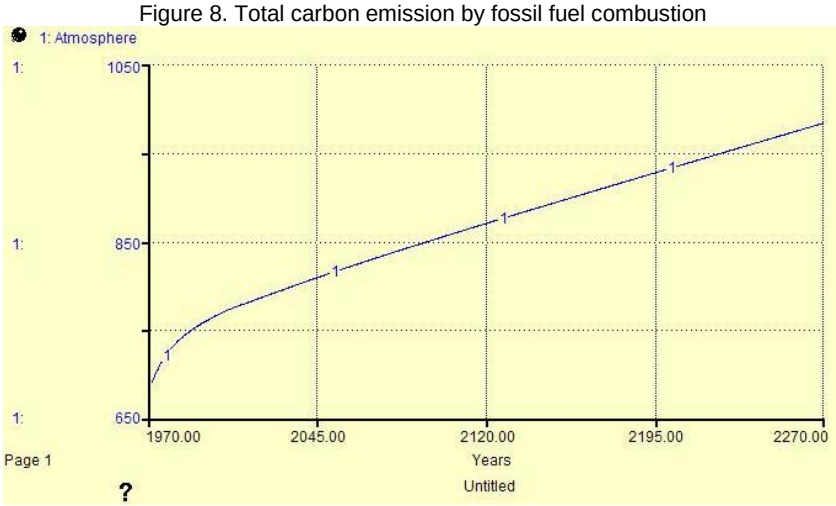


Figure 9. Atmospheric carbon content in each year (Gt)

Scenario 2

Assuming that the emission rate is 5.5 Gt/yr during 1970 to 2000, and a 5% annual reduction is reached for each coming year (figure 10), the effect of the reduction in fossil fuel emissions on carbon accumulation in different reservoirs was illustrated in figure 11. We can see that the model reaches equilibrium and the carbons in reservoirs are constant after the year 2195. The change of atmospheric carbon is shown separately in figure 12. The atmospheric carbon in 2270 is about 748.26 Gt.

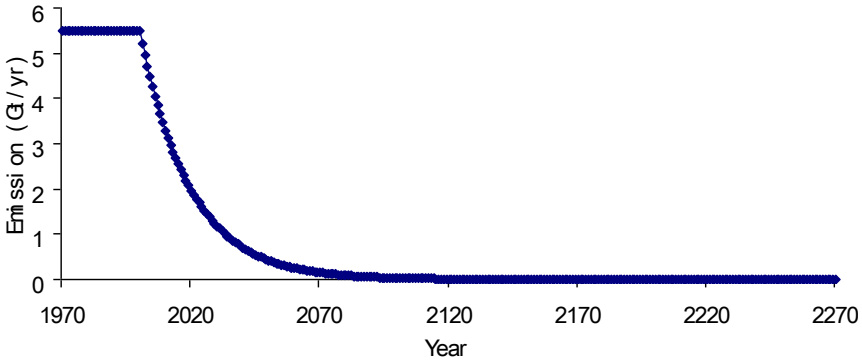


Figure 10. Total carbon emission by fossil fuel combustion

Figure 11. Carbon content in different reservoirs (Gt)

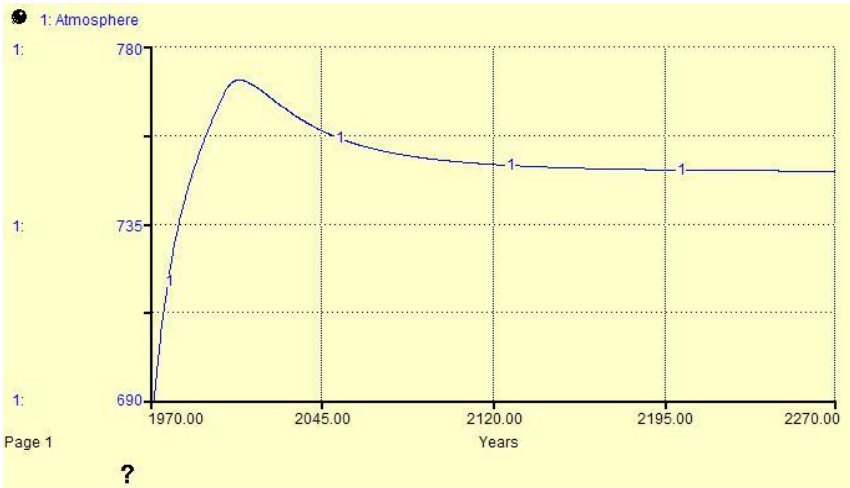


Figure 12. Atmospheric carbon content in each year (Gt)

Scenario 3

Assuming that the emission rate is 5.5 Gt/yr during 1970 to 2000, and a 10% annual reduction is reached for each coming year (figure 13), the effect of the reduction in fossil fuel emissions on carbon accumulation in different reservoirs was illustrated in figure 14. We can see that the model reaches equilibrium and the carbons in reservoirs are constant after the year 2195. The change of atmospheric carbon is shown separately in figure 15. The atmospheric carbon in 2270 is about 740.54 Gt.

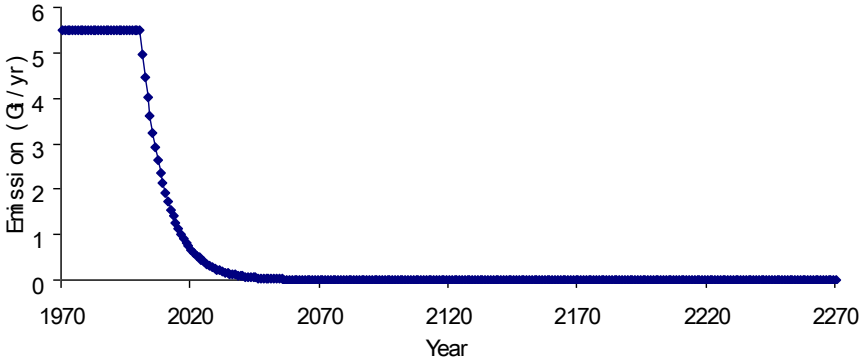


Figure 13. Total carbon emission by fossil fuel combustion

Figure 14. Carbon content in different reservoirs (Gt)

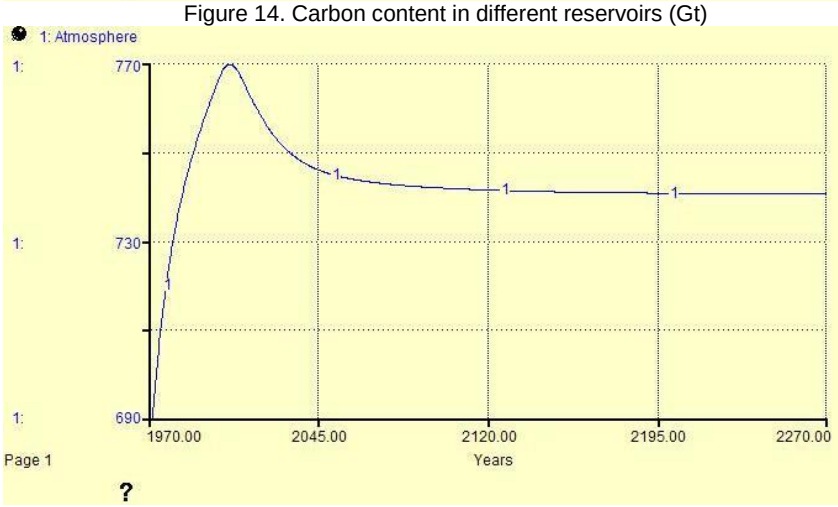


Figure 15. Atmospheric carbon content in each year (Gt)

Scenario 4

1) Assume that the emission rate is 5.5 Gt/yr during 1970 to 2000, and a 10% annual reduction is reached for each coming year (figure 13), and 2) assume that terrestrial and marine photosynthesis rates are increased by 10%. We can see that the model reaches equilibrium and the carbons in reservoirs are constant after the year 2195 (figure 16). The atmospheric carbon in 2270 is about 682.29 Gt. An important finding is a decrease of atmospheric carbon was observed after 2010, and the carbon in 2270 is about 685 Gt, which is close to its initial level in 1970.

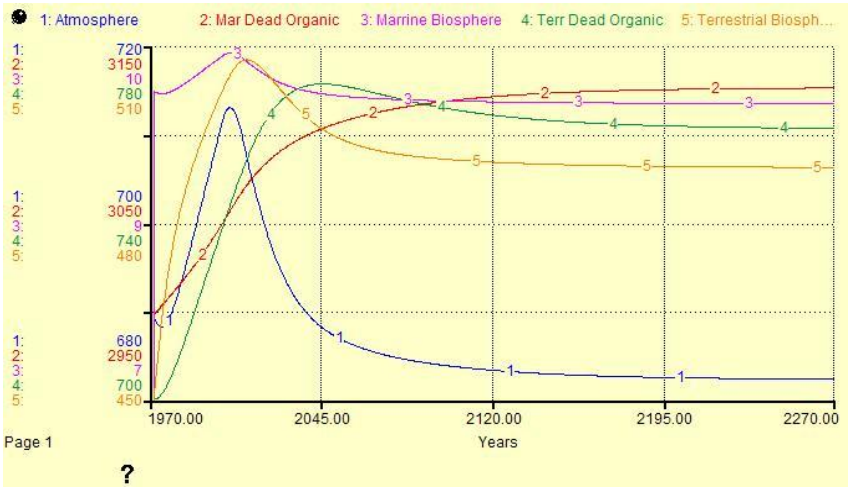


Figure 16. Carbon content in different reservoirs (Gt)

5. Discussion & Summary

Although the geochemical processes of carbon cycle in Earth system are highly complex, the STELLA models in this study provide better understanding of carbon cycle. Without disruptions, the natural cycle of carbon tends to reach an equilibrium state over a time period. However, this equilibrium state has been destroyed by human activities, particularly the increasing fossil fuel emission since the Industry Revolution. Consequent CO_2 accumulations in atmosphere and global warming have been reported by researcher in recent years. Therefore, CO_2 emission reductions are called for by researchers.

According to the scenario analysis, the CO_2 in atmosphere will keep increasing even though the fossil fuel emission is reduced to a lower lever, which can be seen from scenario 1. The system is not able to restore to new equilibrium state unless the disruption stops. If we want to stop the current increasing accumulation of CO_2 in atmosphere, the emission should be reduced closely to zero. However, even the zero emission is reached, the carbon concentration in the new equilibrium state is not able to restore to its previous level, but keep a certain higher lever, which is illustrated in scenarios 2 and 3. By controlling the emission and adjusting the photosynthesis rate at the same, new equilibrium is reached and the carbon concentration in atmosphere is able to restore to its initial value, which is the case in scenario 4.

The results of the carbon models indicate that if we want to control the increasing CO_2 in atmosphere and prevent the global warming, efforts should be taken through international cooperation to reduce the CO_2 emission as much as possible. Meanwhile, other offset mechanism, such as photosynthesis, should be

provided to lower down the level of CO_2 concentration in the atmosphere. However, the geochemical processes in Earth system are much more complex than we can expect. For example, some research on the carbon budget in atmosphere showed that there is an imbalance of carbon mass and part of carbon is missing (Gifford, 1994), which indicates that our current understanding of carbon cycle is incomplete. Therefore, further research in global carbon cycle is highly required.

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Dr. Pieter Tans, NOAA/ESRL (*www.esrl.noaa.gov/gmd/ccgg/trends*)

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Shaffer, D. & Wallace, K. (*http://mvhs1.mbhs.edu/mvhsproj/carbon/carbon.html*)

PROPOSAL FOR SIERRA NEVADA MONTANE MEADOW ASSESSMENT

[redacted]
Graduate Student Researcher
University of California, Merced

Hypothesis

Parameters defining a Sierra Nevada montane meadow—including surface area, depth, vegetation distribution, groundwater recharge/discharge rates, and presence or lack of cattle grazing—significantly impact the role montane meadows play in Sierra Nevada watersheds. Large, deep meadows with low degradation act as storage reservoirs for near surface water.

Background

Montane meadows in the Sierra Nevada Mountains lie in gently sloping terrain. They are generally comprised of decomposed granite, fine sediment, and organic matter. The water table tends to be relatively shallow and fluctuates on a diurnal cycle due to evapotranspiration (ET) and snow melt processes (Wood 1975)—snow melt processes dominate the fluctuations at the onset of spring flow through early summer, ET dominates the fluctuations from mid-summer until the stream stops flowing or first snowfall. Groundwater is recharged by snowmelt. Although meadows are often assumed to act as groundwater recharge points (Wood 1975), we have shown that meadows also act as a groundwater upwelling point—recharging the stream.

Sierra Nevada montane meadows vary greatly in surface area, depth of sediment, and distribution of vegetation. Meadow landscapes are found in both glaciated and non-glaciated terrain. Meadows act as both groundwater recharge and discharge locations. In the National Forests of the Sierra Nevada are frequently used as pasture for cattle. Although historically grazed by cattle and sheep, meadows in Sequoia, Kings Canyon, and Yosemite National Parks are currently protected and not used for livestock grazing. (Wood 1975). Meadows exist in near natural states and in varying degrees of degradation; due to land use changes, many meadows are deeply incised by the respective stream channels.

In a previous study in Long Meadow, Sequoia National Park, a water balance was calculated for a 24 hour period. The water balance was calculated by measuring incoming and outgoing stream flows and evapotranspiration (ET). Stream flow was measured by utilizing salt dilutions. Stream stage was measure with logging pressure transducers. Stage and flow data were correlated to establish a rating curve. ET was measure using a large geodesic dome as described by Garcia et al 2008 and Arnone and Obrist 2003.

Workplan

The project will be conducted in two stages: 1) GIS data gathering and analysis and 2) field deployments, data collection and analysis.

GIS data gathering will consist of acquiring DEM, vegetation, and lithology layers for montane forests in the Sierra Nevada. Individual National Forests in the Sierra Nevada, comprised of Eldorado, Inyo, Lassen, Sequoia, Sierra, Stanislaus, and Tahoe,

Toiyabe National Forests, will be targeted for data. Additional agencies that may be contacted to obtain data are Sequoia/Kings Canyon and Yosemite National Parks.

GIS layers will be analyzed for meadow size, percent of watershed, depth of sediment, lithology, vegetation distribution, location, degree degradation, and any other parameters that may become prevalent in the analysis process. Results from GIS analysis will lead to the selection of 2-10 Sierra Nevada meadows for stage 2 of the project. Preference will be shown for meadows located in instrumented watersheds in order to compare meadow hydrology to the overall watershed hydrology.

Stage 2 will involve intensive field work in meadows selected by the GIS analysis process. Field work will involve collecting measurements for obtaining water balances for the selected meadows. Surface water flows will be measured by utilizing pressure transducers for stream stage, conducting salt dilutions for flow measurements, and using the flow and stage data to establish rating curves. ET will be measured using large chamber measurements. ET measurements will be validated by calculating potential evapotranspiration (PET) using the Penman-Monteith equation. Environmental parameters for the Penmen-Monteith equation will be measured by a mobile meteorolgical station and taken from literature. Water balances for the selected meadows will be calculated 3-6 times in each meadow to account for seasonal variation.

Water balance data will be used to compare variation from meadow to meadow and for significance of meadow hydrology in the overall hydrologic processes of Sierra watersheds. Analysis of meadows will focus on the storage capacity for near surface water in the varying meadow landscapes.

Montane Meadow Assessment Budget

Existing Equipment, Instruments, and Data

Description	Quantity
Met Station Tri Pod	30
Rock Salt	1
Handheld EC Meter	1
GIS Data	1

Additional Equipment and Instruments

Description	Quantity	Unti Price	Total
WXT520 Weather Transmitter	1	$2,500	$2,500
Kip and Zonen NR-Lite	1	$1,404	$1,404
Plexiglass Dome	1	$500	$500
Vaisala HM70 Hygrometer	1	$1,850	$1,850
Fan	2	$40	$80
Battery	1	$50	$50
CR 1000 Data Logger	1	$1,382	$1,382
10 W solar panel	1	$221	$221
Battery w/ charge controller	1	$235.20	$235
		equip subtotal	$8,223

Personnel

Description	Rate	Hrs./Yrs.	Total
Co-Principal Investigator (hrs)	$150	200	$30,000
Staff (yrs)	$46,000	0.5	$23,000
		Labor Subtotal	$53,000

Food, Lodging, Travel

Description	Rate	Quntity	Total
Food/Lodging (/day/person)	$150	150	$22,500
Travel (miles)	$0.505	10000	$5,050
		FLT Subtotal	$27,550
	Overhead	0.52	$14,326
		Total Cost	**$103,099**

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Changes in the Carbon Budget of a Sierran Meadow with Conifer Encroachment: An Impetus for Restoration?

[redacted]

Nice Job, A

During the past 150 years, woody species have been encroaching into a variety of semi-arid grassland ecosystems (e.g., Humphrey and Mehrhoff 1958; Archer 1989; Brown and Archer 1989; Higgins and Richardson 1998; Van Auken 2000). A number of factors have been implicated, including fire suppression (e.g., Van Auken and Bush 1997; Takoaka and Swanson 2008), grazing (e.g., Brown and Archer 1989; Shlesinger et al. 1990; Miller and Halpern 1998), climate change (e.g., Archer et al 1995; Miller and Halpern 1998; Bauer et al 2002), increased CO_2 levels (Archer et al 1995; Bond and Midgley 2000), and other local factors such as rodent activity (e.g., Tilman 1983; Berlow et al 2002). Among other grasslands, mountain meadows are experiencing woody species encroachment. In meadows, encroachment could be caused by any of the anthropogenic factors listed above, or could be the result of a natural succession process following the traditional series from lake to meadow to forest (Benedict 1982).

Regardless of the cause of encroachment, the loss of mountain meadows means the loss of important ecosystem services that they provide. A careful examination of ecosystem services that are lost with woody encroachment would enable managers to better plan and monitor the effectiveness of restoration projects. Many ongoing restoration projects are currently attempting to remove woody encroachers and restore meadows to their original vegetation (ex. removal of lodgepole pine from Tuolumne Meadows, Yosemite National Park). While some meadows like Tuolumne Meadows are restored for the sake of the meadow alone, it is important to have specific objectives that restoration will accomplish. It is this that a study of how ecosystem services change as a meadow is encroached will provide.

One ecosystem service provided by mountain meadows is carbon sequestration, which is becoming increasingly important in the face of ever rising CO_2 levels. As yet, I know of no studies that have conclusively shown how a meadow's carbon budget varies as it is encroached by woody species. Therefore, I propose to examine the carbon budget within subalpine meadows in the Sierra Nevada at different stages of conifer encroachment.

An initial estimation was obtained using the following conceptual model and various values obtained from the literature.

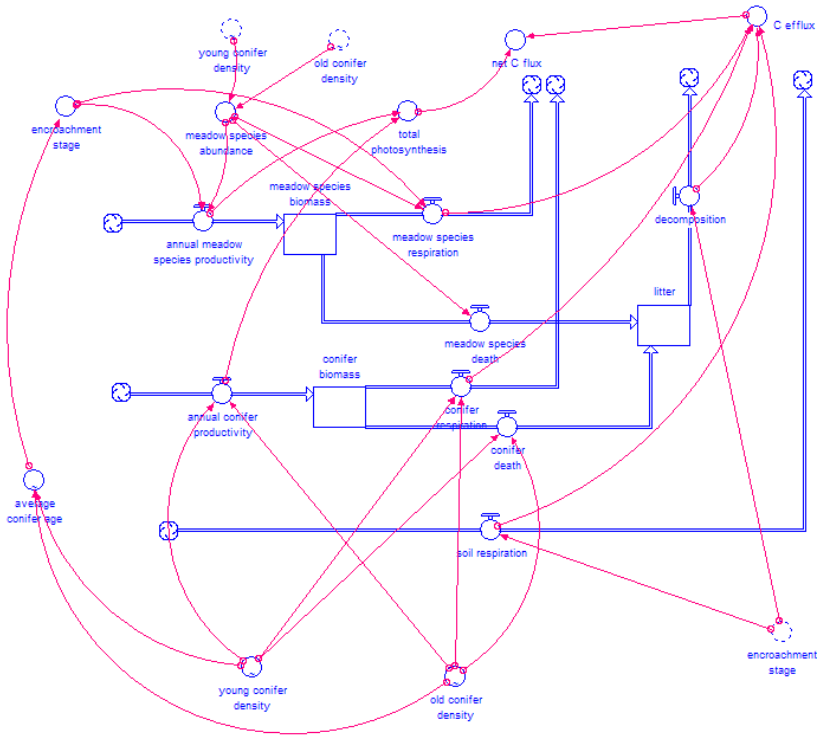

Figure 1. Simplified conceptual model for calculating the carbon budget in a meadow at different stages of conifer encroachment. This model was used for a preliminary examination of the carbon budget, using values from the literature.

The model was simplified to consider only "young" (<50 yr) and "old" (>50 yr) trees, and 3 distinct stages of encroachment (uninvaded, transition, fully invaded). Estimates of annual productivity of meadow species were obtained from Stolhgren et al (1989), who calculated average annual productivity for several high-sierra meadows. Their results differed depending on the hydrologic regime, providing reasonable estimates for carbon uptake of meadow herbs at different stages of encroachment. Carbon fluxes of "young" versus "old" conifers were obtained from Law et al (2001). Unfortunately, these were for ponderosa pine rather than lodgepole pine. Soil respiration and litter decomposition rates were obtained from Griffiths et al (2005), who studied soil properties at various stages of conifer encroachment into meadows in the Pacific Northwest. Conifer

abundance was estimated based on age patterns found by Haugo and Halpern (2007), and meadow species abundance was set to vary inversely with conifer abundance.

Based on these values from the literature, encroachment stage had a strong influence on the overall flux of carbon through the system (Figure 2a). In the early, uninvaded, stage the meadow was a net source of carbon, while in the final, fully invaded, stage it was a substantial carbon sink. This occurred because of the extremely low photosynthesis rates of the herbaceous meadow vegetation (Figure 2b). While respiration rates increased as the meadow became more heavily invaded, photosynthesis rates increased more dramatically making the overall flux negative (Figure 2b).

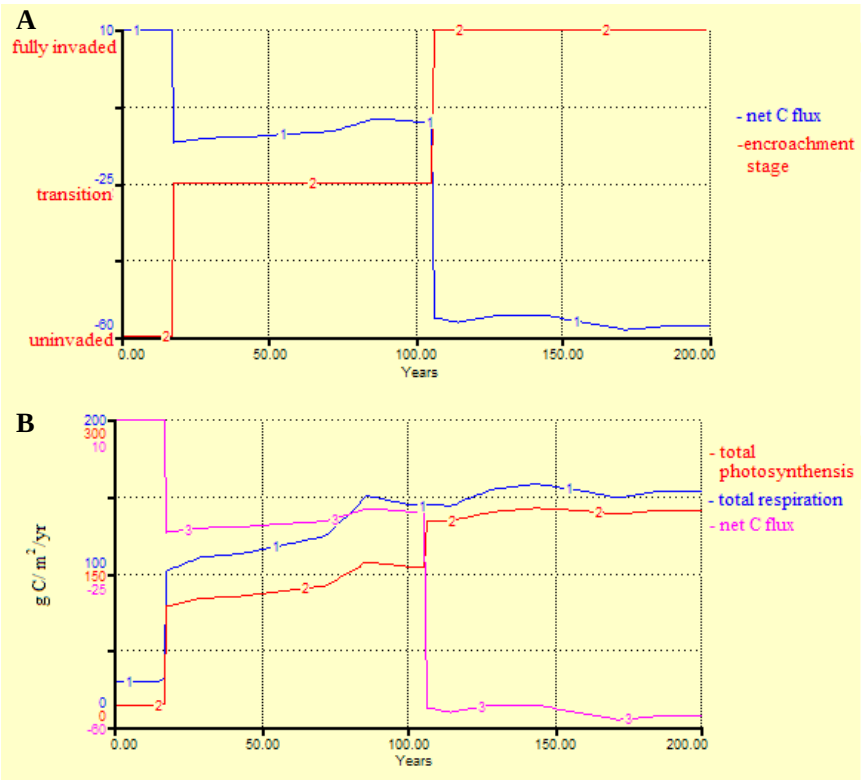

Figure 2. Net carbon flux through the meadow at different encroachment stages (A), and variations in photosynthesis, respiration, and overall flux (B) as the meadow becomes more heavily encroached. This initial model makes it appear that meadows are a net carbon source, and become a sink when encroached by woody species.

Initially, this model makes it appear that far from being beneficial in terms of carbon sequestration, meadow restoration would actually result in turning the meadow from a sink into a source. This does not hold with other studies, which have shown that mountain meadows are a net carbon sink (Kato et al 2004). However, this initial model was based on literature values from different systems measured using different techniques. In order to get a more accurate picture, it is imperative that we measure all fluxes within a single system.

A chronosequence approach would be difficult, because similar meadows are often encroached synchronously (Takaoka and Swanson 2008). Instead, I plan to study the carbon budget at various points along a transect from the uninvaded interior of the meadow through the transition zone and into the mature forest surrounding the meadow. An appropriate meadow will be chosen using historical aerial photos to identify a meadow undergoing encroachment. I will specifically focus on a meadow experiencing lodgepole pine (*Pinus contorta* var *murrayana*) encroachment since lodgepole pine is one of the most common encroachers throughout the Sierra Nevada (Helms and Ratliff 1987; Eric Berlow, personal communication).

In order to assess the carbon budget, carbon sinks into and out of the herbaceous meadow species versus conifers will be measured. This will include a measurement of photosynthesis and respiration rates for both herbaceous species and conifers, as well as measurements of soil respiration. Additionally, litter production and decomposition will be measured.

This study should allow us to get a better understanding of the ecosystem C flux in meadows experiencing lodgepole pine encroachement. Hopefully, it will show that pristine, uninvaded meadows are a stronger carbon sink than are invaded meadows. This would provide an important impetus for managers to carry out/fund meadow restoration projects that target encroached meadows. This sort of focused restoration project would have clear goals, and clearly ieasurable parameters to be used for gauging its success.

Comment [ST1]: [redacted]f you start this work hoping that you will find a particular outcome, it may bias your interpretation of your results. This would be a killer statement in a real proposal. You might instead say, "This study will evaluate if univaded meadows are indeed strong carbon sinks than invaded meadows".

Sam

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Ecosystem Feedback to Climate Change in Boreal Forest

[redacted]

Comment [ST1]: Overall, a nice job. You could probably make more realistic model if you allowed for a more gradual afforestation. As it is now your output is very binary and produces a pretty bimodal distribution. The grade on this exercise is A.

Comment [ST2]: It is good to us a consistent font throughout.

Project Goal

The world~~wide~~'s ~~respond~~ response to the climate change includes ~~the~~ increasing sea level, diminishing of snow covered areas ~~are~~ has been validated by both in-suit observation and remote sensing data. One of the most complex responses to climate change lies in ecosystems. Changes in climate may have a profound impact on terrestrial ecosystems worldwide. Climate conditions, including rainfall, seasonal water balance, the length of growing seasons and winter temperatures, can strongly influence plant and animal species (Prentice et al. 1992; Woodward et al. 1995). On the other hand, change of terrestrial ecosystem, such as shift of vegetation species, could affect climate from both biophysical and biochemical aspects. The albedo change due to land use and cover shift is a main factor considered in biophysical feedback. The biogeochemical feedback mainly focused on the ability of carbon storage in biomass and soil organic matter as increasing temperature.

This proposed research addresses the boreal ecosystem feedback to climate change from biophysical and biogeochemical aspects. The warming allowed an expanding of suitable climate zone for forest growth to the northern area, which was previously covered by snow or glacier. Replacing of snow by forest could resulted a positive warming feedback by absorbing more solar energy as significant albedo diminish (Levis et al. 1999,2000). On the other hand, global warming could affect the ability of terrestrial ecosystems to process C through photosynthesis and respiration and store it in biomass and soil organic matter. Such climate induced changes in terrestrial C storage may affect the amount of CO_2 in the atmosphere and, as a result, create a feedback effect on the climate.

The three interrelated goals of the proposed work are the following:

1) To investigate the net effect ~~under considering~~ the biophysical and biogeochemical process together.
2) To estimate the magnitude of the boreal ecosystem feedbacks.
3) To determine over ~~for~~ what time scale the boreal ecosystem feedback could affect global climate.

Project Objectives

There are numerous gaps in our understanding of climate-ecosystem feedbacks, including the rate at which ecosystems respond to climate change, the magnitude of ecosystem responses to climate, the accuracy of estimates of ecosystem influence on climate, the way in which these elements are represented in dynamic models of the climate system.

Before tackling this suite of issues for boreal ecosystem, I simulated the boreal forest feedback to climate change using Stella Model (Fig.1). The model results showed that the forest covers have significant impact on regional climate. However, the Stella model can not well study biogeochemical process.

With this study, I will estimate the relative importance of climate-ecosystem feedbacks to future predictions of climate change in boreal ecosystem, with a particular emphasis on native ecosystems and proposed afforestation scenario. I will

identify ecosystem types, such as boreal temperate forest, boreal deciduous forest, tundra, snow, and critical variables that have the largest leverage on climate-ecosystem interactions. To do this in a 1-year timeframe, I will make use of data products and models from previous projects and draw on the experience of researchers in this region.

The research objectives of the proposed work are:

1) To compile extant predictions of future ecosystem distributions based on (1) global future climate scenarios and a dynamic vegetation model, and (2) proposed options for terrestrial carbon sequestration;
2) synthesize existing data regarding boreal ecosystem properties that impact ecosystem climate forcing (e.g., albedo, rooting depth, canopy height, photosynthetic parameters);
3) To customize an existing regional climate model (1) to more closely reflect the character and distribution of boreal ecosystems and their influence on climate, and (2) to use near real time satellite observations of ecosystem properties (e.g., LAI).

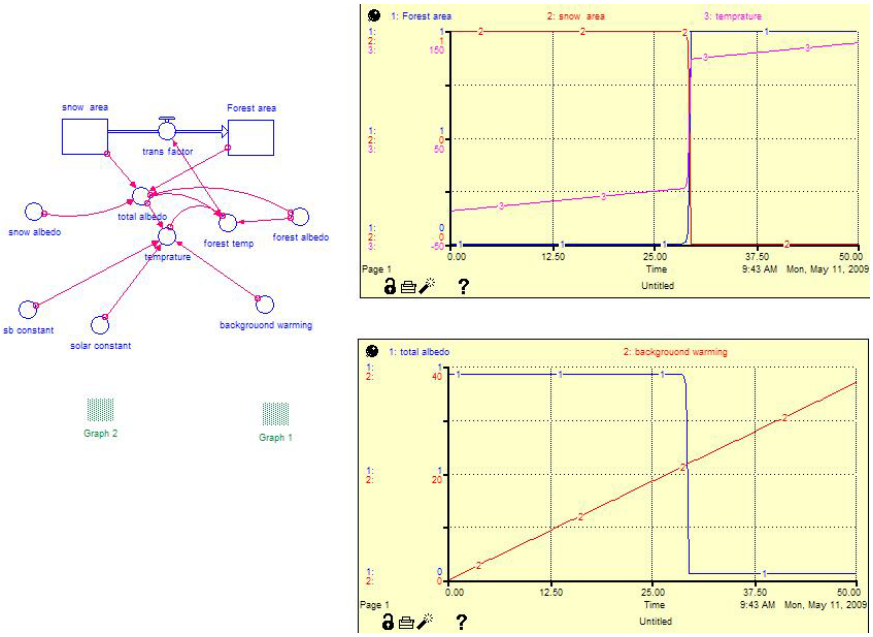

Figure 1. Stella Model of boreal forest feedback to climate change

Scientific and Technical Issue

Currently the most sophisticated global climate models (GCMs) have a very limited representation of ecosystem feedbacks (Torn and Harte 2006). One inherent

challenge to accurate representation of ecosystem feedbacks in GCMs is that dramatic variation in ecosystem properties and behavior exists at very small spatial scales relative to the horizontal resolution of the typical GCM. Regional climate models are better able to capture this fine scale variation. Another kind of model, called a dynamic vegetation model (DVM), has been used to predict potential shifts in vegetation distribution, ecosystem productivity, and fire frequency. In this study, a land surface model coupled with dynamic vegetation model (LPJ) was incorporated in WRF to represent both the biophysical and biogeochemical process.

Weather Research and Forecasting (WRF) modeling system is a multi-agency effort intended to provide a next-generation mesoscale forecast model and data assimilation system. The WRF model is designed to be a flexible, state-of-the-art, portable code that is efficient in a massively parallel computing environment (Skamarock et al, 2005). WRF mainly process the atmosphere movement, the precipitation formation and the energy and water transfer between the land surface and atmosphere. Lund-Potsdam- Jena dynamic global vegetation model (LPJ-DGVM) represent vegetation as spatially independent patches of plant functional types (PFTs). Each PFT is represented by an individual plant with the average biomass, crown area, height, and stem diameter (woody plants only) of the PFT population, by the number of individuals in the population, and by the fractional cover in the grid cell. The WRF-LPJ model has three timescales. Surface fluxes of energy, moisture, momentum, and CO2 occur at a 20-minute time-step, updating the hydrologic cycle and soil temperature every time-step. Carbon is accumulated annually and used to update PFT mass, density, and coverage once a year in response to establishment, resource competition, growth, mortality, and fire. Leaf area index is updated daily to a maximum value set by the annual vegetation dynamics. The model simulates global biogeography and biome-average net primary production that are consistent with observations (Bonan et al. 2003).

The planned climate model experiments are summarized in Table 1.I plan model simulations under current climate with prescribed CO2 (375ppm) and vegetation distribution, and with future climate with dynamic CO2 and vegetation distribution calculated by LPJ. The variables differences from the two runs will be computed, and then these differences will be compared to determine how future climate change is impacted by dynamic future vegetation change. A horizontal resolution of 15-20km, constant topography, sufficient time for ‘spin-up’ of soil moisture, and sea surface temperatures and atmospheric conditions from global climate model output (historical and one future scenario from Community Climate System Model (CCSM) separated by ~100 years). Each experimental run will be ~20 years in duration to statistically quantify the effects of the vegetation changes on climate.

Climate case	CO_2	Vegetation parameters
Current climate	375 ppm	Lawrence,2007
Future climate	dynamic	dynamic

Table 1. Proposed regional climate model experiment

Reference:

Bonan et al. Global Change Biology (2003) 9, 1543–1566, doi: 10.1046/j.1529-8817.2003.00681.x

Lawrence, P.J., and T.N. Chase (2007), Representing a new MODIS consistent land surface in the Community Land Model (CLM3.0), *J. Geophys. Res.*, *112*, G01023, doi:10.1029/2006JG000168

Levis S, Foley JA, Brovkin V, and Pollard D. 1999. On the stability of the high-latitude climate-vegetation system in a coupled atmosphere-biosphere model. Global Ecol Biogeogr 8: 489-500.

Levis S, Foley JA, and Pollard D. 2000. Large scale vegetation feed- backs on a doubled CO2 climate. J Climate 13: 1313-25.

Prentice IC, Cramer W, Harrison SP, et al. 1992. A global biome model based on plant physiology and dominance, soil proper- ties and climate. J Biogeogr 19: 117-34.

Torn, M., and J. Harte. 2006. Missing feedbacks, asymmetric uncertainties, and the underestimation of future warming. Geophysical Research Letters 33:doi:10.1029/2005GL025540, 022006.

Skamarock et al. A Description of the Advanced Research WRF Version 2, 2005

Woodward FI, Smith TM, and Emanuel WR. 1995. A global land primary productivity and phytogeography model. Global Biogeochem Cy 9: 471-90.

History

Paper #_____

Reader_____

	Primary Sources	Secondary Sources
Critically read		
Critically analyze		
Critically synthesize		

Key:
U=unacceptable
S=satisfactory
E=excellent

Results of these evaluations have been provided to all history program faculty. We have scheduled a series of meetings on the first Monday of each month at 12:00 p.m. throughout spring semester 2010 to discuss the results and determine how to revise the senior thesis project, according to the following schedule:

Monday February 1, 2010

Monday March 1, 2010

Monday April 5, 2010

Monday May 3, 2010

Appendix I: Student Work

Thesis #1

Causal Determinism in Historical Analysis

Thesis

Spring 09

The purpose of this thesis is to analyze both the historiographical and philosophical conceptions of determinism, and to examine the ways in which a more philosophically based characterization of the concept might be beneficial to the study of history. The concept of historical determinism has become bad word of sorts, and is often linked to the deep meaning interpretations of history championed by the likes of Hegel and Marx—interpretations of history that have to an extent fallen out of favor among mainstream historians. As a result, there is very little relevant debate pertaining to the topic of historical determinism today. Conversely, there is a great deal of philosophical discourse dealing with determinism. The vast amount of literature both for and against the notion of determinism has provided philosophers with a complex and sophisticated understanding of the subject. This thesis will ague that the application of a philosophical approach to the idea of determinism in history would be helpful in understanding the causal relationships that maintain a central role in historical analysis.

For the time being, we can think of causal determinism simply as the idea that if one possessed perfect knowledge of the state of the universe and the laws that govern it, one could predict with absolute certainty all future states of the universe. This is a highly simplified version of the determinist thesis, and we will see later on that such a characterization fails to tell the whole story. However, at this point in our discussion this simple conception of the thesis will provide a starting point which is more or less compatible with popular philosophical and historiographical conceptions of the term. Furthermore, a deterministic perspective can be understood as one in which an individual accepts the above thesis and therefore lives under the assumption that all events take place in a continuous causal network. This too will be elaborated upon further as we go on, but for the moment this description will be sufficient for our immediate concerns.

In *The Landscape of History*, John Lewis Gaddis briefly addresses the illusive topic of historical determinism. Gaddis defines the term as “the conviction that things could only have happened the way that they did” (140); he goes on to warn about the pitfalls of adopting such a perspective by stating that “Our responsibility as historians is as much to show that there were paths *not* taken as it is to explain the ones that were” (141). I take no issue with the latter point, indeed it fits quite nicely into a causal deterministic analysis of history, but Gaddis' characterization of determinism is oversimplified to the point of resembling fatalism, a superficially similar, but ultimately very different concept wherein ends are predetermined or otherwise fated regardless of the actions—be they causally situated actions or not—of any individual. It is this sort of misrepresentation of the concept that has led to a flawed and uncharitable understanding of a very complex subject. Ironically, it is also Gaddis who, in an earlier chapter of the very same text, gives a superb analysis of complex causal relationships in terms of historiographical analysis.

Understanding the complexities of causality is the first and most important step toward an understanding of determinism. In philosophy, the concept of causality and that of determinism are very much linked—hence the term causal determinism—but in historiographical analysis there seems to be a strange disconnect between the two ideas. It is necessary for historians to posses an intimate understanding of the nature of causal relationships in order to understand past events and to put them in context. If we are to analyze the paths not taken as Gaddis has suggested, should we not also attempt to situate such analysis within the causal network? In simpler terms, if the historian is to analyze what could have happened, it is also just as necessary for the historian to consider what need be different to allow for such a change. To assume that an event could have happened differently without considering the necessary changes in the causal

context would be a shortsighted move on the part of the historian.

The disconnect between causality and determinism in historical analysis may be due in part to an association between the concept of determinism and the more fatalistic interpretations of history. Causal determinism has very little in common with Hegelian or Marxist interpretations of history, but it is relatively easy to mistake one for the other. This is a result of the closely related nature of determinism and fatalism. Although these two terms are easily confused, they are fundamentally different concepts. The Hegelian and Marxist interpretations of history relate to fatalism in that they are wholly predictive, prescriptive, and attempt to find meaning in history; deterministic analysis does quite the opposite. Determinism is predictive only under the condition of perfect knowledge, non-prescriptive, and can be considered meaningful only in its attempts to find causal relationships in the context of history.

There is a particular danger in associating the idea of causal determinism with the philosophy of Hegel as his philosophy was in many ways a reaction against the idea that historical events were in any way determined (White 82). Although Marx incorporated Hegel's idea of change, his conception of history was also rooted in physical and social reality (Heilbroner 144). Regardless of the degree to which Marx attempted to incorporate cause into his theories, his conception of history, like Hegel's, had a definite, entirely prescribed, and ultimately fatalistic end in man's “struggle for his own humanity” (White 286). Both Hegel and Marx have in common theories which are wholly predictive in the absence of perfect knowledge. This complete knowledge of future outcomes based on imperfect knowledge of causal relationships goes against the idea of causal determinism wherein events are predictable only in the event that one possesses perfect knowledge of the universe and its laws.

As we have seen, the most immediate hazard of a deterministic perspective is the

unfortunate ease with which causal determinism can be confused with fatalism. Although the two concepts are superficially similar, they are fundamentally different. Causal determinism is determined in the context of the causal system, fatalism is predetermined in relation to fate, destiny, or some other inevitable force which leads all events to some ultimate end. Causal determinism only relates to the system of cause and effect, each event determining the next. Assuming perfect knowledge of all laws of the universe, one could predict the outcome of an event based on events prior. If there were any change in the prior chain of causes, or if there was a change in the laws governing the universe, there would be a change in the outcome of events. In a fatalistic system the outcome is inevitable regardless of changes in the preceding events.

The difference between the quasi-fatalistic interpretations of history found in Hegelian, Marxist, or the various other interpretationalist conceptions of history and the deterministic perspective is not in the identification and emphasis of causes, rather it is in the interpretation and end result. Firstly, the deterministic approach differs from the interpretationalist in that the laws being dealt with are physical and valueless whereas the laws of the Hegelian and Marxist interpretation are respectively rational and social in nature and deal are very much tied to value judgments, especially in the case of the latter. Secondly, the ends of determinism are forever obscured in the absence of perfect knowledge whereas the ends of interpretationalism are largely prescribed despite a lack of knowledge pertaining to the specifics of the small-scale causal relationships involved in bringing them about. Interpretationalist “theories hypothesize large-scale social forces, of which the individual people are but unwitting instruments in the pursuit of ends that they do not even recognize” (Rosenberg 117). Though this characterization may superficially resemble determinism in form, they are vastly different in many regards. Unlike interpretationalism, determinism deals with the causal network both on the small-scale as well as

the large-scale. There is no guiding force, no theme, and no end of history for the determinist, at least not in the interpretationalist sense. There nearest thing to a guiding force in determinism are physical laws, the nearest thing to an end of history is the end of conscious experience.

Like any other science, history is intricately linked to the causal sequence of events. If one is to understand history they must also understand causality. It would be much more beneficial for the historian to understand determinism in the context of causality rather than in fatalistic terms. The understanding of complex causal relationships necessary for a chartable interpretation of determinism is already present in the methodology of history, the problem relates more to nomenclature than anything else. As long as historians understand determinism in fatalistic terms, they run the risk of overlooking the importance of analyzing causal relationships. Causality is central to human understanding, and without understanding of the present adequate understanding of the future can hardly be expected, without contributing to the understanding of the present or the future, history becomes little more than the retelling of past events for the sake of the narrative. If history is to continue proving its merit as a social science, it must consist of more than a collection of interesting stories.

More than merely cleaning up the language of history, a determinist perspective would help to introduce a greater degree of objectivity into the discipline. By analyzing history in terms of cause and effect rather than in the context of a series of equally possible alternatives, historians would be better able to describe their subject matter in objective terms. It is important to note that a deterministic perspective does not outright eliminate the concept of agency from the analysis, rather it interprets choice in different terms. An agent can be seen as making a choice in terms of determinism, but cannot be seen as having a choice in the choice made. For example, in a deterministic system I may choose to eat a turkey sandwich rather than a ham

sandwich, but in the context of the causal system, ham was never really and option. Thus an agent may make a choice for various reasons which can be explained in causal terms, but any sense of having a choice is a phenomenon of conscious experience. Such an understanding of agency in limited terms can be considered a form of *soft determinism*. A deterministic interpretation of history that failed to account for agency in any respect would be an example of *hard determinism*. As agency is a central concept to historical analysis, a soft deterministic perspective would obviously be a more appropriate application to the discipline.

So if we are to assume that the concept of causal determinism is largely misrepresented in a historiographical context, what then is the proper conception? For the answer we need look no further than philosophy. In the simplest terms determinism is the theory that in the current state of the universe only one outcome is possible. The subtle difference between determinism and fatalism relates to where one puts the emphasis in this description. The determinist is concerned with the current state of the universe—if the state of things were different, the outcome would be different. The fatalist is concerned with the outcome which will remain constant regardless of any changes in the state of things. As the determinist is oblivious to the outcome in the absence of perfect knowledge, all one can do is observe past states and attempt to define causal relationships with which to predict future outcomes. For the determinist it is the causal process that is worthy of analysis much more than the predicted outcome.

Among the most well stated characterizations of causal determinism is that of Ernest Nagel who explains that:

> It is evident that if a deterministic system is in a definite state at a given time, the occurrence of that state at that time is determined—in the sense that the necessary and sufficient condition for the occurrence of that state at that time is that the

> system was in a certain state at a certain previous time. Moreover, if a variable of the system has a certain value at a given time, that value can be said to be determined by the state of the system at any prior time—that is to say, the necessary and sufficient condition for that variable of the system having that value at that time is that the system was in some definite state at some prior time (191).

Although Nagel gives a very technical account of determinism, it is immediately evident that he makes no mention of future states, instead opting to characterize the system in terms of present and past states. This is not a mistake on Nagel's part, rather his definition of determinism emphasizes the fact that, in the absence of perfect knowledge, one can only guess as to future states based on observation of present and past states. Thought Negel's account may not come across as immediately accessible, the concept is deceptively familiar. E. H. Carr quite clearly illustrates this familiarity in his analysis of the human personality, which he claims “is based on the assumption that events have causes, and that enough of these causes are ascertainable to build up in the human mind a pattern of past and present sufficiently coherent to serve as a guide to action” (122). It is indeed difficult to imagine a world in which one's actions had no predictable consequence or past experience held no significance in one's decision making process. If it is difficult to imagine a present wherein causation holds no bearing, can the past effectively be considered devoid of causal relationships? For the determinist, the answer is a resounding no.

I contend that the adoption of a deterministic perspective in line with a philosophical understanding of the concept would be advantageous to the analysis of history. Such a perspective would be beneficial to understanding the causal relationships between past events, and would demand a more rigorous analysis of what why events happened the way they did. Furthermore, any theories utilizing a counterfactual basis would be required to explain what

would have needed to be different in order to allow for such an unfolding of events to occur. It is not enough to examine what other choices could have been made by a historical agent, one must also examine why such choices were not made in the context of the causal system. Most importantly, it is only fitting that if the concept of determinism is going to be referenced in the context of any discipline, it should be done so with a fair degree of understanding.

Although there are many benefits to applying a philosophical understanding of causal determinism to historiographical analysis, there are also many pitfalls wherein there is room for further misunderstanding. We have already addressed the issue of fatalism in some detail, but there is also the danger of nihilism or in finding meaning where there is none. As we have seen, it is very easy for the theory of determinism to be identified with concepts with which it is not wholly linked. Just as there is a danger in oversimplifying determinism in history, there is also a danger in extending the implications of such a perspective beyond what is beneficial to the discipline. Ultimately, the potential hazards are far outweighed by the benefits of adopting the determinist approach to historiography, but it is critical that the pitfalls are addressed in detail; there is no benefit in substituting one oversimplification for another.

Nihilism, or the rejection of the idea that there is any meaning or value in human existence, is also an idea that should not be associated with determinism. The belief all events exist in a causal network that is ultimately determined does not entail a rejection of the value of the human experience. In the event that determinism is a correct assessment of the nature of the universe, what has changed? The answer is, of course, nothing. Determinism is not an explicit rejection of agency, ethics, or subjectivity; it is only a perspective. It is merely the notion that things happened the way the did for a reason—not some grand predetermined, fateful, or preordained reason—but because all events can be situated in a dynamic system of causes and

effects. Being aware of the causes of an event does not render said event valueless, but it does change how it is perceived. It is in this manner that cause and meaning are related, but the former is not a negation of the latter.

In discussing causation, historical understanding, and nihilism, it seems appropriate to briefly address the contributions of that most infamous of philosophers: Friedrich Nietzsche. Unlike Hegel or Marx, Nietzsche did not try to interpret history in fatalistic terms, nor did he attempt to characterize it in the context of causal determinism; his “purpose was to destroy belief in a historical past from which men might learn any single, substantial truth” (White 332). Of course, Nietzsche's views run counter to the idea that there is anything to be learned from history, be it entirely factual or merely interpretive. However, it is difficult to take seriously Nietzsche's nihilistic interpretation of history in that it suggests not only that nothing could be learned from the study of history, but also that nothing can be gained through the study of natural science nor from human experience in any respect. Not only does Nietzsche's philosophy go against the most basic tenets of causal determinism, it also attempts to undermine historical analysis, therefore we can safely conclude that neither Nietzsche nor nihilism in general is a particularly effective counter to the incorporation of causal determinism in historical analysis, unless one is simultaneously willing to deny the validity of historical analysis in any form.

Conversely, one must not overcompensate for nihilism by attempting to impose meaning were there is none. In a deterministic system there is not deep meaning in the Hegelian or Marxist sense; indeed, there is no intrinsic meaning in the causal chain at all. The only guiding powers in the causal system are the laws which regulate it. It is through an objective understanding of these laws that a subjective meaning can be derived. Of course, the more objectively grounded the subjective analysis, the more universally convincing the meaning is

likely to be. Ultimately, meaning is based on prediction, prediction on analysis, and analysis on observation. Just as one should not abandon all meaning as a result of causal analysis, one cannot impose meaning on the causal system as meaning is ultimately subjective. The determinist historian must simultaneously resist nihilism on one end, and the imposition of deep meanings on the other.

Gaddis, in response to Carr, contends that "History is either predetermined or it isn't; and if it isn't then surely some parts of it could have happened in some other way" (101). However, as Nagel has pointed out, "the assumption that a system is deterministic does *not* entail that the the states of the system are *predictable*" (191). In order to avoid the pitfall of fatalism, one must understand the subtle but significant distinction between a predetermined state and a causally determined one. The idea that events are predetermined assumes that a given event is ultimately inevitable as it has been preordained or otherwise fated. To claim that an event is causally determined is merely to say that it happened according to causal relationships which we are to some extent ignorant of. If, and only if, one possessed complete and perfect knowledge of the current state of the universe, all past states of the universe, and all of the laws that govern the universe would it even be conceivable that one could predict with certainty a future event. Even with such knowledge, there is still the inescapable distinction between fate, which deals with an inevitable future state, and cause, which deals with a past state as it relates to an effect.

As Gaddis has argued, the historian must examine what happened as well as what could have happened, but I have argued that in order to do this one must also consider what must have been different in the causal system in order for such an option to have been available. Our analysis of the path not taken can be broken down into three fundamental questions: What did happen? What could have happened? And what needed to have been different in order to allow

for a counterfactual sequence of events? It is the role of the historian to answer each of these three questions, and I contend that these three questions can be answered best through a deterministic analysis of the causal network. As we analyze the role of causal determinism in each of these three questions, the importance of such a perspective will become increasingly evident. However, in all three cases an understanding of causality is key.

The question of what could have happened otherwise is central to the historian. Without a sense of what could or should have happened, the historian would be severely limited in their ability to draw comparisons between past events and current ones. It is this ability to relate the past to the present that is a primary justification for the study of history. It is in this manner that historians look to the past in order to understand the present and perhaps even better the future. Although such counterfactual thought experiments about what could have been the case are irrelevant from a fatalist perspective, the very assumption that if historical agents had acted in a counterfactual manner, events would have unfolded differently serves to reinforce the idea of causality. Determinism, unlike fatalism, does not contradict such causal relationships, rather it is the direct link between cause and effect on which causal determinism is based. Counterfactual analysis such as this is not only compatible with determinism, it supports the interpretation of causality in which it is grounded.

Gaddis provides a particularly effective defense of the use of counterfactual analysis in historical inquiry: “Because not all sources survive, because not everything gets recorded in the sources in the first place, because even if they were reliable no participant would have witnessed all of an event from all possible angles, we can never get the full story of what actually happened” (103). Although Gaddis has oversimplified causal determinism, his analysis of the nature of counterfactual analysis is entirely valid. I have argued that an adoption of a

deterministic perspective would be beneficial to counterfactual analysis, as well as the analysis of history overall. Gaddis' work has to this point been presented in contrast to a deterministic approach to history, but on the subject on counterfactuals Gaddis himself seems to have unwittingly adopted a position fully in line with that of the proponents of determinism.

The value of counterfactuals in history is that “Counterfactual reasoning can help to establish chains of causation” (Gaddis 102), but is it possible to establish chains of causation without perfect knowledge? Of course, the answer is no, at least not in absolute terms. However, absolute knowledge of a deterministic system is never attained even in the small-scale controlled experimental environments of the natural sciences. Therefore, in history, as with our everyday experiences, we must fill in the blanks with our limited knowledge of causal relationships. Determinism is not, as is commonly believed, concerned with what will inevitably happen—this can never be known for sure—rather the determinist perspective focuses on why things are the way they are in the context of the way things were. This sort of analysis is meant to provide understanding in a manner similar to the way one can typically predict the manner in which a close friend will react to a situation more accurately than those of a complete stranger.

Few people can predict with much certainty precisely how they would act in a given situation, much less a complete stranger. The subjects which the historian deals with are strangers of time and space, culture and convention; furthermore, the subjects of historical inquiry are only partially revealed under the best of circumstances. Gaddis reminds us that “None of this means, though, that we lack a basis for determining causes in history: it only means that our basis is a provisional one” (103); here, Gaddis touches on an important aspect of the deterministic perspective. Determinism has a dual meaning of sorts: On the one hand consequences are determined by their antecedents; on the other, the agent of inquiry must

determine the relevance of the causes in a very imperfect manner using very imperfect knowledge. We can contrast this later point with the idea that the relevance of events is in their being predetermined by the system itself. The causal system only that: a system. It is not self-aware, it lacks an agenda, it is merely a series of causal relationships—the system has no plan, no ultimate goal, no overarching theme—it is only a pattern to be investigated by those that are self-aware. Gaddis repeatedly makes the mistake of confusing determinism and predeterminism. His theory supports the former and denies the latter, but he has confused the language of the terms to the point of using them interchangeably.

Although a deterministic perspective might not seem immediately necessary to understanding what has happened, causality is central to the understanding of a past event. In order to understand any event, one must have some understanding of the relationship between cause and effect. They must have some conception of how things became the way they were in order to understand why they are not what they are not. If I open my refrigerator to find every egg broken, I must at the very least have some idea that something has made them thus. If we look at an event in the past, something must allow us to conclude that things have changed, that an event has occurred, and that the state of things beforehand is different than after. It is in this context that we observe, or at least infer causality. If eggs were broken something had to have caused the change, determinism situates these changes in a complex system of causes and effects. However, the determinist does not claim certain knowledge without precise understanding of the causal relationships.

It is not enough to merely assume that an event could have happened differently and analyze the effects of such a counterfactual state of affairs. The historian must delve deeper and address what would have needed to happen differently in order for the counterfactual event to

occur. One should not start simply by assuming that a historical agent could have simply chosen to act in a different manner than they in fact did, but give a proper analysis of the events that prompted the agent to take such action, and provide a counterfactual explanation for why things might not have happened the way they ultimately did. Historians should not merely dream up counterfactual situations for the sake of having them, rather they should base such exercises in a strong understanding of the manner in which the event did play out. From the deterministic perspective, events in history happened the way they did because given their situation in the system of causes and effects, it is the only way they could.

In *The Landscape of History,* Gaddis claims that "three sets of distinctions that have to be made in connecting causes with consequences: one between the immediate, the intermediate, and the distant; a second between the exceptional and the general; and a third between the factual and the counterfactual" (95). We have already dealt with the relevance of counterfactual analysis in some detail, so our focus now is on the first two distinctions. These distinctions deal with the relevance of causes to the event being analyzed. The first of these deals with the relevance of the causes through time, while the second deals with the sufficiency of causes. Understanding the different types of causes is critical to a deterministic interpretation of historical analysis. Even the determinist will concede that some causes are less relevant to the analysis of a particular event than other more immediate causes. The importance of adopting a deterministic perspective is that, although one can overlook the less relevant causes in the context of their analysis, the fact that the relevant causes exist in a complex causal network cannot justifiably be overlooked.

While taking into account the relevance of causes is central to the role of the historian, understanding the conditions of the time and place in question is also crucial. Unfortunately, the historian must reconstruct such conditions using whatever limited information is available.

Considering the difficulty involved in understanding the historical scene in any detail, it is understandably difficult to provide in-depth analysis of the antecedents. This is where the attempt to establish general laws becomes key, but as Nagel points out "even if we knew all the relevant laws pertaining to the traits of an event under study, we are rarely if ever in the position in historical investigations to specify more than a fraction of the initial conditions for the application of those laws. Because of our ignorance of many if not of most of these initial data, we can therefore state only some of the *necessary* conditions for historical occurrences" (198). Of course, only identifying some of the necessary conditions leaves the historian with very little to work with in attempting to recreate the causal network; this is why it the consideration of less immediate causes becomes important in establishing patterns upon which to base general laws. A deterministic perspective does not rule out the importance of distant or intermediate causes solely on the grounds that they are not immediately relevant to the analysis as such causes in addition to the established necessary conditions can provide a greater degree of understanding than the established necessary conditions alone.

Although the determinist would contend that any historical event exists within a network of causal events which can be thought of as a continuous system consisting of chains of causal relationships, the historian must decide at what point the chain must be broken in order to have some starting point for analysis. I have argued the importance of not ignoring the causal system in historical analysis, but it would seem that the endless nature of causal relationships would force historians to trace the chain of causal relationships all the way back to the beginning of the universe. Nagel has shown this infinite regression of causal analysis to be unnecessary as "an explanation can be completely satisfactory, even though in offering it we are assuming something which has not in turn been explained" (196). So it is safe for the historian, even the

deterministically minded one, to determine for themselves at which point in the never ending chain of cause and effect that the causal relationships no longer have a direct and meaningful relevance to their area of interest. However, the determinist historian must not fail to realize that such distant and seemingly less relevant events may indeed have previously unforeseen significance to their investigation. This is the subtle distinction between the determinist historian and the non-determinist historian.

In Guns, Germs, and Steel: The Fates of Human Societies, Jared Diamond put an emphasis "on the search for ultimate explanations, and on pushing back the chain of historical causation as far as possible" (9). Despite the reference to *fate* in the books title, Diamond manages to construct a conception of world history that puts causal relationships at the forefront of inquiry. Although Diamond, like Gaddis, explains causal relationships in the context of a chain of events, what he ultimately provides the reader with is a complex causal network wherein explanations are provided in far reaching, general, and causally sound terms. In essence, he provides a deterministic analysis of world history. Diamond's success is a result of his unwillingness to oversimplify the causes. Perhaps Diamond is more willing than many historians are to dive deep into the the causal network—far beyond the traditional bounds of historical analysis—to ground his observations in a naturalistic foundation, but it is not how far back in human history he is willing to go that is of importance to our discussion, it is how effectively he stays on the track of deterministic causal analysis.

The perspective which a satisfactory understanding of determinism provides is not a radically different from the current system. Diamond's work represents only the most extreme case of such a perspective. The deterministic perspective is not meant to convert the methods of historians to those of physicists, rather it is meant to remind them of the nature of the system in

which the events they are studying take place. Whether historians concern themselves with a highly specific case or a broad general theory is a matter of preference, and both hold merit assuming that both areas of study are firmly grounded in causal analysis. Furthermore, the adoption of such a perspective is not meant to remove value judgments from the analysis, the deterministic perspective is merely intended to "develop a self-awareness and self criticism with respect to all kinds of *particular* value considerations" (Markovic 292). The deterministic perspective does not seek to remove the human aspect from the study of history, rather such a perspective attempts to balance the human element with the factual, interpretive value with causal objectivity.

Given the requisite knowledge, nothing is beyond deterministic analysis. Therefore, unless a controlled environment wherein a part of the causal system can be examined independently of influence of the unknown and potentially unknowable parts of the system, the interests of the determinist researcher are necessarily multidisciplinary in nature. Perhaps in the laboratory a deterministic approach can be applied to a controlled experiment, but historians, as well as most other social scientists, lack this luxury. Despite the lack of controlled observation "Historians are in the main habitually interested in accounting for the occurrence of only a somewhat limited class of traits; and they normally also seek to explain them in terms of a comparably restricted set of traits characterizing events" (Nagel 201). This does not go against the determinist perspective, in fact analysis of a select class of variable can be useful in determining causal relationships on a small scale. However, the determinist historian must, at the very least, be mindful of the notion that the small-scale analysis fits into a larger causal network with which the generalizations must also be compatible, but large-scale generalizations must not be forced on the small-scale system if they are incompatible. In this case the large-scale

generalization must be updated to take into account the small-scale analysis.

Historical causation is a complex subject, and numerous works have dealt with the concept in great depth and detail. In the context of our interests it would be advantageous to address causality in the simplest terms possible for the sake of both accessibility and brevity. A particularly simple account of historical causality is given by Frederick J. Teggart in *Theory and Process in History*:

> 'Cause' is conceived as an activity which operates to produce an 'effect'. To the Historian cause means the existence of will or activity on the part of some person or persons. Now historical investigation yields only isolated facts, and for the purposes of historiography these must be connected. The assumption is that the facts ascertained constitute a series of such an order that between any two of its members other series of inferred happenings may be interpolated (70).

Although this account of historical causality is sufficiently brief as well as accessible, there are a couple of points which require discussion. Firstly, we must address the manner in which the idea of the *will* is conceptualized from the deterministic perspective. In referring to the will, the determinist is not referring to a power of conscious beings to exercise influence over or otherwise manipulate the causal environment in which they exist, rather it refers to the self-aware manner in which conscious beings are an active part of the causal network. In essence, the will refers not to a power over the causal system, rather it is that conscious attribute that allows the being to be aware of the system in which they are a part. Secondly, as the determinist sees all factors as variables in a dynamic causal system, the determinist historian may very well be obliged to take into account those pieces of the causal puzzle that are not directly related to the activity of a historical agent. Although the focus of historical inquiry is on the human activity,

non-human aspects of the broader deterministic system should not be overlooked simply because they do not pertain directly to traditional limits of historical analysis. Diamond's work exemplifies this multidisciplinary underpinning of deterministic historical analysis.

The role of generalization in history is central to our discussion of determinism, and is worth exploring in some detail. Historical generalization suggests that one has the capacity to observe and define general laws which can be used to explain historical events and, presumably, to predict with some degree of certainty future events. Carl G. Hempel gives a particularly useful description of the relationship between explanation, prediction, and determinism: “While in the case of an explanation, the final event is known to have happened, and its determining conditions have to be sought, the situation is reversed in the case of a prediction: here the initial conditions are given, and their 'effect'—which, in the typical case, has not yet taken place—is to be determined” (234). In the case of both explanation and prediction, as with determinism, there is always some aspect of the relationship that is known, and some aspect that is unknown. Contrary to the popular misinterpretation of determinism, events cannot be predicted with absolute certainty unless one possesses perfect knowledge. Furthermore, as historians lack perfect knowledge of past events for various reasons which we have already discussed in detail, past events cannot even be explained with absolute certainty in the absence of perfect knowledge. Deterministic historical investigation, as it is firmly grounded in causal analysis, would provide a fuller understanding of causal relationships which in turn would provide better explanation. Better explanation of past events would provide better generalizations with which to make more accurate, though imperfect, predictions.

The confusion between the idea that events are determined and the idea that events can be predicted is common not only in historiographical conceptions of determinism but also in

popular philosophical characterizations of the term. Although the two terms are undoubtedly related, they are far from synonymous. Among the most detailed arguments against this common misconception of the two terms is Nagel who, in *Determinism in History*, not only gives a fantastic account of the relevance of determinism to historical analysis, but addresses many of the misconceptions about determinism as a theory in general. His analysis of unpredictability is as follows:

> In one sense, an event is unpredictable if, because of the state of our knowledge and our technology at a given time, the event cannot be foretold at all, or only with some degree of precision. In the second sense of the word, an event is *theoretically* unpredictable if the assumption that its occurrence can be calculated in advance, whether at all or with unlimited precision, is incompatible with some accepted theory of science. In neither of these senses, however, is 'unpredictable' synonymous with 'undetermined' (196).

Taking into account our discussion of the necessity of perfect knowledge to prediction in determinism, it should be immediately clear why it is that predictability and determinism are not synonymous in Negel's first sense. The distinction of Nagel's second sense of the term may be somewhat more difficult to understand. The concept of theoretical unpredictability as it relates to determinism is tied to one of the more convincing arguments against the idea of causal determinism: the idea that causal determinism is in many ways refuted by quantum mechanics.

Quantum mechanics is much too technical a subject to be described in great detail here, but it is nonetheless a vital consideration when discussing possible arguments against determinism, or more specific to our immediate aims, in discussing distinctions between prediction and determinism. The most obvious response to the problems raised by quantum

mechanics is that raised by Nagel himself, who argued that “even though quantum theory places an upper bound on the precision with which subatomic processes are predictable, it surely is not nonsense to hold, as Planck, Einstein, and De Broglie have in fact held whether correctly or mistakenly, that an alternative theory may eventually be constructed which will not impose such theoretical limits on precise predictions in that domain” (197). Doubtless that there are countless opponents of determinism who are entirely unconvinced by this appeal to an as of yet unproven overarching deterministic theory of quantum mechanics, I will present another response to the problem of reconciling quantum probability and determinism.

If one is willing to accept that the sense in which events can be predicted, even with perfect knowledge, is potentially probabilistic in nature, then events may be determined by their causes in probabilistic terms. Regardless of whether or not effects can be predicted in absolute or probabilistic terms, there are still causes. In this case the causal chain exists only in the context of past events, and future events could only be assigned an accurate probability of occurring even with perfect knowledge, but as human beings do not, and likely will never posses such knowledge, is this probabilistic determinism significantly different from absolute determinism from the perspective of human understanding? I believe the answer is no, but admittedly we have entered the realm of speculation, but the speculative nature of this position can be compensated for in some degree by grounding it pragmatically. In practice, the assumption that causal relationships cannot be determined with any degree of certainty would not be productive in the context of either a probabilistic or absolute deterministic system as such a perspective would fail to assign any value to the observation of causal relationships that may be useful in developing a better understanding of such a system. Even in a universe where such no such system existed, despite the fact that the perspective that there was no causal relationships probabilistic or

otherwise would be correct, it would do nothing to improve understanding as events would be neither probabilistic nor absolutely causally linked in nature and any sense of understanding would merely be an illusion of the mind in an essentially random universe. In the event that our universe is determined only in probabilistic terms as those who appeal to the current understanding of quantum theory would suggest, a strictly deterministic approach would be forced to adapt any general laws until all probabilistic occurrences which took place prior to the present were accounted for. Of course, these deterministic theories would ultimately be wrong, but they would likely become more reflective of the probabilistic nature of the universe as time went on and the theories were continually updated. In the event that there does exist some overarching laws which determine even what we currently perceive to be probabilistic quantum mechanics, holding a probabilistic view of the universe would lengthen and complicate the process of zeroing in on such laws. Simply put, adopting a entirely non-deterministic view is not beneficial in any of the three worlds which I have described, a probabilistic deterministic perspective is highly beneficial in one whilst being mildly beneficial in another, and a strictly deterministic perspective is beneficial in two of the three possible worlds. From this perspective it seems clear that a deterministic model of either form is preferable to none at all and, assuming my account is convincing, the strictly deterministic perspective is at least mildly preferable to the probabilistic one.

In discussing the closely related concepts of explanation, generalization, and law, it is important to distinguish as clearly as possible between the implications of each. As these ideas so nearly resemble each other in form, it is much to easy to confuse one for another, especially in the context of deterministic analysis wherein any explanation can be—assuming perfect knowledge—explained in terms of general laws. Furthermore, the explanations provided by

historians are typically not empirical in nature, therefore it becomes necessary to distinguish further between empirically based general laws and the non-empirical explanations provided by historical analysis, even assuming that such analysis is deterministic in nature. The subtle distinction between rational explanation and general law is perhaps mapped out best by William Dray:

> If *y* is a good reason for *A* to do *x*, then *y* would be a good reason for anyone sufficiently like *A* to do *x* under sufficiently similar circumstances. But this universality of reasons is unlike the generality of an empirically validated law in a way which makes it especially hazardous to say that by giving a rational explanation, an historian commits himself to the truth of a corresponding law. For if a negative instance is found for a general empirical law, the law itself must be modified or rejected, since it states that people *do* behave in a certain way under certain circumstances. But if a negative instance is found for the sort of general statement which might be extracted out of a rational explanation, the latter would not necessarily be falsified (132).

Although the determinist believes that all events can ultimately be described in terms of general laws of an empirical nature, the best they can hope to provide in the absence of perfect knowledge or controlled conditions is general statements of a rational nature. The benefit of a deterministic perspective over a non-deterministic perspective is that the former assumes that empirical laws are possible, therefore rational explanations should be constantly challenged and updated in order to move closer to the empirical ideal. In the absence of such general empirical laws, it is necessary to base historical explanation on imperfect rational generalizations in order to understand the causal system in any capacity. Of course, a distinction must be made between

the deterministic perspective wherein general explanations are a temporary stand-in for empirical laws, and that which assumes no such laws exist.

As we have already discussed at great length, at best determinism allows for accurate prediction only in the context of perfect knowledge. Furthermore, in the absence of perfect knowledge, a precise understanding of the past is equally impossible. However, in everyday life human beings make countless decisions—setting aside for the moment the question of to what degree these decisions are determined causally—pertaining to their futures, with presumably much less than perfect knowledge. It seems safe to assume that the average human being, lacking though they may be in perfect knowledge of all the laws of the universe, is effective enough at making predictions based on a limited knowledge of causal relationships. Nagel gives one of the most well stated descriptions of the role of folk-determinism in human understanding:

> It would be just silly to maintain that the whole of the human future is predictable by us, or that our present information suffices for retrodicting every element in the human past. But it would also be absurd to hold that we are completely incompetent to do any of these things with reasonable assurance of being correct. It is banal to note that our personal relations with other men, our political arrangements and social institutions, our transportation schedules, and our administration of justice, could not be what they are, unless fairly sate inferences were possible about the human past and future (197).

The study of History, with its focus often on specific, though far from causally isolated events, is no less deeply rooted in a causal framework that can often times be overlooked. This is not necessarily due to ignorance on the part of the historian, rather it is as much a result of being all too familiar with the specifics of their research. There is as much a danger both in becoming too

focused on too small a section of the causal system as there is in overlooking the specifics of the causal relationships, if not more of a danger. Although broad rational generalizations and general laws are far from being the same, generalizations often form a basis for new laws, but this can only be done if specific situations are taken into account. However, too much emphasis on a specific event, area, individual, or object fails to take the vast majority of the system as a whole into account. This also applies to counterfactual analysis which, as we have seen from earlier discussion, is critical to historical inquiry.

If events could not have played out differently as a result of their being determined by their causes, why conduct counterfactual analysis at all? The answer is relatively simple: Counterfactual analysis allows the historian to apply the events of a former time to those of today. Of course, the causal context for any two events are likely to be vastly different, but the historian cannot help but examine what might had happened if they knew then what we know now. The historian analyzes what could have happened differently then in order to know what should happen now. Our understanding of the world around us is grounded in our observations of causal relationships around us. When I see the ball bounce, I am prompted to believe that it will bounce again. If the ball does indeed bounce my expectations are fulfilled, if it does not my expectations are frustrated and I must update my understanding.

Historical observation, no matter how firmly grounded in causal analysis, would be nearly entirely without purpose unless it enhanced our understanding of other historical events or the current state of affairs. The benefit of a deterministic perspective is in its ability to isolate the causal interactions of events in order to piece together a better understanding of the analysis through observation of prior effects. In essence, we better understand the manner in which the ball bounces, because we have found the common threads through each observation. If similar

historical events emerge from similar causes and result in similar effects, a pattern can be developed to explain such an occurrence. Ultimately, the historian's expectations will either be fulfilled or frustrated through further analysis of the causal system that is history; assuming the former the prediction will be further validated, in the case of the latter it must be updated.

A major benefit of a deterministic perspective in history is that it puts the focus on causal relationships, and a major benefit of a causal focus is that—assuming the analysis of causes is correct—it potentially increases the objectivity of the historian. Of course, the role of objectivity in history, and in social science in general, is heavily debated. A satisfactory definition of objectivity is given by Peter Novick who states that “the value of an interpretation is judged by how well it accounts for the facts; if contradicted, it must be abandoned” (2). What is and is not to be considered a fact is understandably a point upon which there is much disagreement. In the absence of perfect knowledge there is no way to know precisely what is true and what is false, but if explanation is firmly rooted in causal analysis, and if one backs up said analysis with sound generalizations, such explanations would be more firmly rooted in fact than more interpretive and less deterministic methods. However, until general laws pertaining to historical analysis—if such laws can indeed be formalized—true objectivity will continue to be an illusive ideal in historiography. That being said, the determinist historian assumes that general laws are potentially identifiable, and therefore objectivity is an appropriate aim.

Through an objective understanding of causal relationships, a deterministic approach to history allows for a better understanding of events as they are situated in a causal system. Simply put, if one can understand the antecedent causes and the resulting effects surrounding an event, one can better understand the event itself. Presumably similar causes would result in similar events, therefore a deterministic perspective allows for a degree of predictive power. However, if

one does not observe similar results under similar conditions, what action should be taken? In the event that a deterministic model is proved inaccurate, it must be updated—but this does not warrant an abandonment of the entire deterministic perspective. Perceived causality is merely the application of observation, in the event that the causal model was incorrect, the observation should be readdressed. Without a sense causal relationships, it would be impossible for the mind to predict, understand, or function.

Without causality the aforementioned system of fulfillment and frustration could not exist, without expectations based on observations there would be no basis for learning, without the ability to learn from the past there would be little reason to study history. Thus causality is key to observation, and observation necessary for historical analysis. Historical observation would be useless without being causally grounded. A determinist perspective would put the observation of causal processes at the forefront of historical analysis, but still allow for the application of past lessons to current issues. A causal determinist perspective gives meaning to historical observation. The more grounded an observation is in the causal framework of the event, the more accurate predictions based on such an observation can be expected to be. Prediction, as with any science, is key to the practical application of historical analysis.

History, as with any other field of inquiry, would be ultimately useless if it did not provide understanding in some sense. A deterministic perspective is not necessary in this context as not every historian has adopted such a stance, yet such history is not utterly useless; we can therefore conclude that not all historical understanding is necessarily derived from a deterministic approach to history. However, there are some ways in which the deterministic approach can provide better understanding. Looking back at our discussion of Carr and Nagel we can recall that an understanding of the causal relationships around us is central to human

deliberation and action, a strikingly similar argument is presented by John Tosh in *Why History Matters*, but in this instance it is analogy, not causality which is the focus: "All human beings engage in almost continuous analogical reasoning as a means of finding their bearings in constantly changing circumstances. Most of the time we do not look for absolute repetition; we refer to our previous experience as much to establish what it is *not*, as to confirm what it *is*" (63). This account of analogy is so strikingly similar to the accounts of causality by Carr and Nagel because it is through analogy that causality is understood, and it is causality that defines determinism. Therefore, the concept of analogy is central to the deterministic position. It is through analogy that causal comparisons can be made, it is through these comparisons that generalizations can be made, and it is through the successes or failures of these generalizations that general laws can ultimately be hypothesized.

It was not the intention of this thesis to establish the truth of determinism, rather it was a twofold objective of clearing up historiographical misconceptions pertaining to determinism, and establishing the practicality of a deterministic perspective in the study of history. On both of these positions I feel the arguments I have provided are sufficient enough to open up the minds of historians to a position which they may have at one time misunderstood and prematurely dismissed. Those who are adamantly against deterministic principles will most assuredly not be phased by my argumentation, but those who have put little thought into the concept may be surprised to find that a deterministic stance might actually may be useful in historical analysis. Philosophers and historians alike potentially have something to gain through the analysis of the practical applications of a theory which is all too often dismissed.

Perhaps, this pragmatic characterization of determinism is more easily understood than the more esoteric theoretical conceptions. The perspective for which I have argued is one

intended to emphasize those qualities of the historian which are already characteristic of the discipline, but do so in a manner that in conducive to interdisciplinary considerations. The acceptance of the deterministic principles which I have introduced would not greatly alter the proven methodologies which are currently favored by historians, but it hopefully misconceptions about what fits into said methodologies have been appropriately dealt with. Although much of the preceding pages have taken the form of a critique, it is not because historians are wrong in their analysis, rather historians are quite effective in their analysis of history, but at least on this one issue I contend that at least in some cases they were mistaken in their philosophy.

This determinist perspective which I have described at length is intended to highlight the positive manner in which historians are already aware of and dealing with casual analysis. Rather than providing an argument against common historical conceptions of causation, the determinist perspective is meant to provide a philosophical basis for analysis that is consistent with both philosophical and historical conceptions of causation. Furthermore, this argumentation has hopefully provided a clearer understanding of the manner in which determinists in both fields perceive causal relationships—a manner that is not starkly different from commonly held perceptions of causation among philosophers, historians, and those individuals not actively involved in the academic community. The subtle change in perspective that has been argued is one of increased attention to the causal network of which history is a major part.

The concept of objectivity was only lightly touched on during this paper, and this was intentional. The nature of determinism automatically assumes that objectivity will be attained as rational generalizations are updated and modified into general laws. Objectivity, as it relates to history is a much more complex subject. Whether or not can or should be a desirable ideal for the purpose of historical analysis, and it is one that the deterministic perspective cannot quite answer.

Objectivity seems possible in the case of perfect knowledge, but even the determinist must consider whether such knowledge is even attainable. The perspective which I have argued for relates to how one views the causal connections in history, and it is not an unattainable one. However, complete objectivity in any field seems a much more difficult mentality to implement. It is because of this that the topic of objectivity was addressed only insofar as it related to the deterministic perspective.

Ultimately, what has been argued is a deterministic perspective which, if adopted, would call for a strict consideration of causation in order to produce rational generalizations—or in the best of cases general laws—which could increase the overall understanding of the past, present, and future links in the causal chain. Furthermore, such casually based generalizations may be used in order to establish analogies to past and present conditions to further promote understanding. Rather than characterizing human beings as unwitting objects caught in a flood of events outside their control, I have tried to characterize the human being as an active observer which, despite being a part of the causal system, is also the sole entity for which the otherwise unconscious interaction of physical bodies has any meaning. The deterministic approach changes nothing save the perspective one takes toward the nature of causation.

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Thesis #2

This paper will examine the intersection of the students of the Free Speech Movement and Civil Rights Movement. Although occurring nearly a decade apart in time, they have many similarities, but also many differences. People might naturally assume that the FSM is an extension or product of the CRM and it clearly is not.

The Civil Rights Movement (CRM) began in 1955 and the Free Speech Movement (FSM) began in 1962 and climaxed in the fall semester of 1964 at the University of California at Berkeley.

> It is October 1964 in Berkeley, California. On Sproul Plaza, outside the administration building of the University of California, a sprawling crowd of students surrounds and immobilizes a car full of police to prevent them from taking a student activist off to jail. Laughing gaily at their ability to immobilize the dreaded Berkeley police force, the students sing civil rights songs, a few pass out joints, and together they begin to form the collective identity that would eventuate in the Free Speech Movement. Without having the words to express it, they feel themselves to be in the presence of something new, at the center of a history they are making, and at the start of a new social movement. The sense of uncertainty and virtually unlimited possibility is pervasive. [1]

Had I been a student at this time, I think I would have found it hard not to have been involved in the Free Speech Movement. Although, it is hard to imagine which area of involvement I would have participated. I could easily have seen

[1] Meyer, S. David, Tarrow Sydney, A Movement Society: Contentious Politics For a New Century, page 1

myself being one of those students surrounding a cop car, passing out leaflets at Sather Gate, standing on top of a stage speaking on behalf of my fellow students or cramming myself inside Sproul Hall with hundreds of other students. I do know that the fight for the freedom of speech would have been enough to get me motivated, especially on a University of California campus and at a time when civil rights were being fought with such vigor.

THE IMPORTANCE OF THE MOVEMENT

The importance of this movement on an institution is small in scope compared to the United States as a whole. However, if it was not for the students of the University of California at Berkeley paving the way for other universities, I myself a student at a UC campus may have not been able to express myself the way we as students do today. I find the freedom of speech is an integral part of how students are not only able to express themselves, but also find the creativity in achieving their goals. Having the ability to express your self is a huge part of a persons' identity. At any time being involved with something such as constitutional or political rights there is an uncertainty of where it all will end and if it will be viewed as successful now and in the future. Students of the University of California at Berkeley much like protestors of other movements

were faced with these challenges as well. However, because the students were persistent in their fight for constitutional rights within an institution they were able to create history in due part because it had not ever before been done.

Former demonstrators and protestors of this era might conclude that it was the civil-rights movement that was responsible for getting the Free Speech Movement ignited. There is evidence to suggest that is just not the case.

> Since the Civil-rights movements was responsible for the pressures applied to the university which led to the suppression of free speech and free political expression and their interests were the one most seriously threatened, the civil-rights activities took the lead in protesting the suppression, and many concluded that the FSM is an extension of the civil-rights movement.[2]

STUDENT ACTIVISTS

Weinberg wrote that very few civil rights activists made up a small part of the ardent FSM supports[3]. My research also supports that the students were diversified in their agendas and political views, but banded together for the Free Speech Movement. The civil rights activists were more interested to in sitting at tables handing out leaflets, or publicly advocate any agenda. At the heart of the dispute for the FSM was the ability

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[2] Jack Weinberg. “The Free Speech Movement and Civil Rights”. 1965. 1
[3] Jack Weinberg. 2

for students to express themselves and their feelings of alienation with respect to university institutions.

> Two of the most basic themes that began to emerge in the very first speeches of the protest and that have remained central… and a demand that the voices of the students must be heard.[4]

POLITICAL DIFFERENCES

While some of the students wanted to have their voices heard, others were motivated by their own agendas. Some of the white middle class students who set up information tables on university property outside Sather Gate actually got their civil rights experience by working through non-violent civil disobedience programs the previous summer while working for the black civil rights organizations in South.

From the diary, "Present at the Birth: A Free Speech Movement Journal," Robert Hurwitt wrote on Sept 23, 1964: "Outside the kids were getting tired of the one lyric and some tried to vary (sic) it, substituting lyrics more traditionally associated with their own particular political group, but we monitors kept a lid on for the sake of unity. One CORE (Congress of Radical Equality) member began shouting freedom slogans and was surrounded by some of the monitors who argued with him, trying to calm him down, while I keep the line moving. We

[4] Jack Weinberg, *The Free Speech movement and Civil Rights*, 1965, 2

diverted the line and started back to Sproul Hall. The CORE guy was hot as hell and wanted to keep up his one man demonstration even after everybody else had left."[5] Hurwitt indicated in his journal that the "CORE guy" he encountered that night later said that he thought the movement was self-defeating and involved too many compromises and did not care if he was disruptive. Many of the students were not civil rights activist and were there to only further their own agendas. "Some of the professed monitors kept the students in line that may have wanted to go rogue at the demonstrations."[5] Hurwitt's diary suggests that the students were there for different reasons other than the Free Speech Movement.

Many of the Free Speech protestors did not have the same political or social agendas as other students prior to this encounter with those who banded with them.

Hurwitt wrote in a 1964 diary entry: "The Free Speech Movement was made up of representatives from each of the political groups that opposed the university rules, and a twelve-person steering committee elected by the executive

[5] Robert Hurwitt. "Present at the Birth: A Free Speech Movement Journal". 7

committee. … The vast majority of those who sat around the police car belonged to none of the organized political groups."[6]

Correlations of civil rights and free speech movement can be assumed by the fact that on November 20, 1964 the Board of Regents approved a new policy that identified certain campus areas in which student planning, implementation, fundraising and recruitment would be permitted "for lawful off-campus activities."[7] To the students, this qualification seemingly prohibited supporting black civil rights organizations involved in civil disobedience against Southern racial segregation laws.

According to Weinberg, "students wanted to have some input on this lonely existence, wanted to be heard and considered. Much of the FSM is a response to the movement followed directly on some action by the administration which neglected to take the students, as human beings into account and which openly reflected an attitude that the student body was a thing to be dealt with, to be manipulated."[8] While Weinberg was not a student at the time, he was arrested for his participation and was going to be taken to jail had it not been for Mario Savio standing atop the police car.

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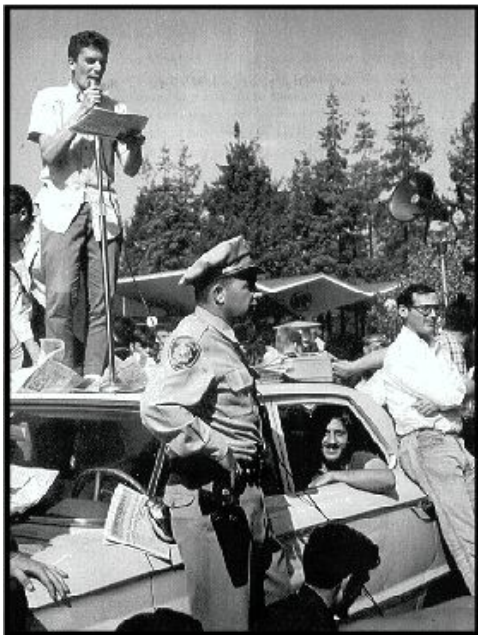
[6] IBID
[7] Constitutional Rights Foundation. The Berkeley Free Speech Movement: Civil Disobedience on Campus. Page 3
[8] Jo Freeman, *The Berkeley Free Speech Movement,* 2004, page 2

Ron Enfield, *Jack Weinberg the man in the car,* Berkeley Library, 1996



Steven Marcus, *Mario Savio speaking from police car,* Bancroft Library, October 1, 1964

Some of the Berkeley students capitalized on the Civil Rights Movement that had already been in full swing. It is apparent to me that the Civil Rights Movement although different in many respects was an inspiration for some the students at Berkeley. Students sang civil rights songs that became a mental cue for other people observing and participating in the free speech movement. Noted folk-singer Joan Baez visited the campus

during the height of the protest and performed for the students. These songs had a definite impact because of the political times and forces that were driving the civil rights movement. Even if the masses were unaware of the Free Speech Movement, they could relate to the Civil Rights Movement songs.

People could identify with the struggles of the movements and in this case the Free Speech Movement had a direct relation to the Civil Rights Movement. Although there were people who did not agree with the Free Speech Movement or the Civil Rights Movement, the impact within communities could be seen and heard. Berkeley was a fertile environment for the birthplace for the FSM. The atmosphere of Berkeley, the students and the political and social timing could not have been any better for the FSM to be born and gain attention on a national stage.

Students of the FSM protesting the establishment were familiar with picketing and demonstrations through the Civil Rights Movement. Some of the white middle class students of Berkeley had been trained only the summer before and gained valuable experience with non violent civil disobedience while working for black civil rights organizations in the South. Mario Savio happened to be one of those students who participated in the South. The Civil Rights Movement had already set a cast that would prove useful in moving forward some of the FSM

students. I think that while the students may have had different motivations they banded together for a common cause. Students wanted their voices to be heard.

MARIO SAVIO'S IMPACT WITHIN THE FSM

Identities of students during the Free Speech Movement and the Civil Rights Movement were formed during this time. Due to the fact they were students and protesting they may have appeared to be similar. They were fighting for the equality of human rights. Mario Savio, a young and charismatic speaker would become the face and voice of the FSM. He probably never imagined that he would be forever linked to the infamous Berkeley moment on top of the Police car at Sproul Hall.

In one of Mario Savio's speeches before the FSM sit-in he said:

> We have an autocracy which runs this university. It's managed….I ask you to consider: if this is a firm, and if the Board of Regents are the … then I'll tell you something; the faculty are a bunch of employees, and we're the raw material! But we're a bunch of raw material(s) that don't mean to have any process upon us, don't mean to be made into any product, don't mean to end up being bought by some clients of the University, be they the government, be they industry, be they organized labor, be they anyone! We're human beings![9]

Average students and people became public heroes during these times of struggle and growth at the University of

[9] Free Speech Movement Archives. Mario Savio's Speech Before the FSM sit-in. 1

California at Berkeley. They were not Hollywood actors. They were people who believed their voices could be heard and ultimately they thought they could make a difference. And I believe they did. During the Free Speech Movement, Mario Savio, Jack Weinberg, Bettina Aptheker and Jackie Goldberg emerged as some of the more notable heroes of the FSM who were fighting for the first amendment rights.

The young maverick’s words exemplify the student alienation that was being felt at the time of the FSM. Students wanted to have the administration understand their dissatisfaction and take charge of their own learning experience. The system in which the students belonged to, needed to change. They felt the University of California at Berkeley needed to recognize the needs of the student and change their policies on free speech.

The students of the Free Speech Movement took it upon themselves to insure their own form of success in winning the dispute versus the University of California at Berkeley. Not only were they students, but they were U.S. citizens too. There is nothing in the constitution that says if you are a student, you do not have the same rights of a U.S. citizen. It raised many questions about whether or not the university had the control to limit the freedom of speech of its students.

SIMILARITIES BETWEEN THE CIVIL RIGHTS MOVEMENT AND THE FREE SPEECH MOVEMENT

The Civil Rights Movement was a great example for activists who modeled their techniques of protest after it. Civil disobedience for later activists had been created through the Civil Rights Movement. Many Northern California white students became involved in social activism and radicalized their approach through examples based on the Civil Rights Movement. Student movements were founded "out of the collapsing 'old left' emerged new organizations on the left side of the political spectrum."[10] "They were largely compromised of young intellectuals, based in elite state colleges, united in their commitment to racial equality, and energized by a range of other local issues."[11] Many of the young radicals were in search of a new form of political involvement and rejected the current system they found themselves in.

In their search for an identity within the system they created a movement that got the attention of the media, the American public and the United States Government. As Michael Rossman wrote, "[t]he trademark of old radicalism was a political ideology with historical roots and structural goals.

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[10] Van Gosse, *Rethinking the New Left: An Interpretive History* (New York: Palgrave MacMillan, 2005), 5
[11] Van Gosse, *Rethinking the New Left,* 12

The trademark of the new radicals [was] a primitive, moral ideology."[12] The students of these movements weren't necessarily looking to re-invent the wheel. They were looking for change at a time when so much was changing. This change included the freedom of speech and political expression on a level that was beneficiary to student institutions such as the University of California at Berkeley.

PORT HURON STATEMENT

One of the most influential and political documents of this time was the Port Huron Statement. One of the first lines of the Port Huron Statement reads, "We are people of this generation, bred in at least modest comfort, housed now in universities, looking uncomfortably to the world we inherit."[13] Hayden's statement is calling for a change in American Democracy with the idea that participation among Americans could alleviate some of the adversity the American Government was dealing with. In return the political indifferences the "new left"[14] was challenging could be met with some sort of understanding. "It was "a new politics, somewhere between liberalism and radicalism, non-Marxist but open to social analysis, and focused on a total democratization of society- the economy, schools, and

[12] Michael Rossman, *Looking Back at the Free Speech Movement (1974)*
[13] Tom Hayden, *The Port Huron Statement*, 1962
[14] Van Gosse, *Rethinking the New Left*

government institutions."[15] The contemporaneous efforts in the South by civil rights activists were much more influential in respect to the Free Speech Movement.

In other words, the Free Speech Movement had a small amount of influence on the students compared to that of the Civil Rights Movement. It is important to remember that the Civil Rights Movement was being fought for the equality of all U.S. citizens, whereas the Free Speech Movement in Berkeley pertained strictly to the rights of the students.

> Student activists in Berkeley were further energized and mobilized by the events of 1964, which led to the birth of the Berkeley Free Speech Movement or FSM. These events were, as participant Michael Rossman notes, a turning point, rather than a beginning. By 1964, The movement itself had become a presence, forcing all the young to begin in some way to define themselves with respect to it[16]: "student political activism was the only major expression that clearly belonged to the young.

THE FIRST AMENDMENT

The first amendment of the Bill of Rights clearly states:

> Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and

[15] Van Gosse, *Rethinking the New Left,* page 69
[16] Michael Rossman, *The Turning Point*

> to petition the government for a redress of grievances.[17]

The students of Berkeley became exempt from the first amendment when the University of California Berkeley decided to not allow its students the freedoms of speech and political activities. The University further broke the laws of the first amendment when they prohibited the students from passing out political leaflets on campus. Leaflets were one of the most important ways of communication the demonstrators had used in advocating and delivering their message. Each cause specifically the Free Speech Movement made leaflets one of their staples in creating effective ways to inform and educate the public.

Students used quotes from our forefathers to drive home their freedoms being denied in the leaflets they were trying to distribute. The freedom of press was also denied to the students. The protests in which the students were involved were also denied by the university. The students argued that they

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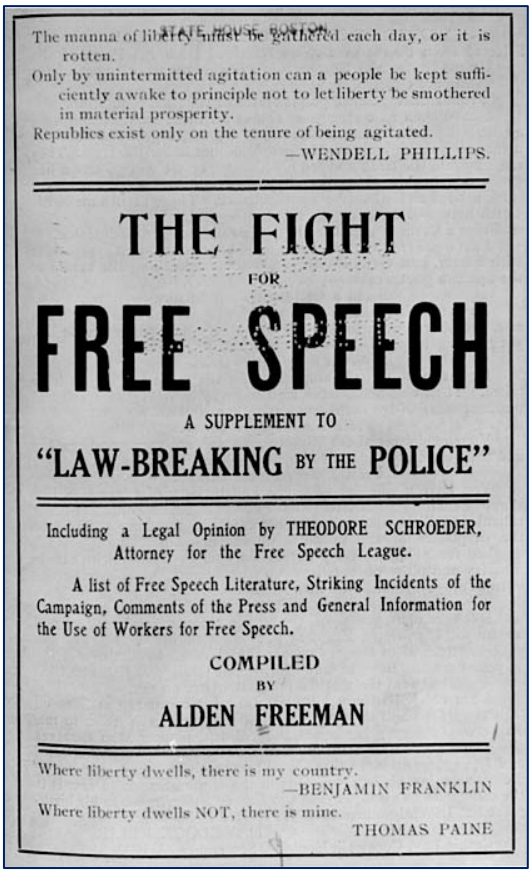
[17] Constitution of the United States, *Bill of Rights,* www.ratical.org/co-globalize/BillOfRights.html#1, 1791



The manna of liberty must be gathered each day, or it is rotten.

Only by unintermitted agitation can a people be kept sufficiently awake to principle not to let liberty be smothered in material prosperity.

Republics exist only on the tenure of being agitated.

—WENDELL PHILLIPS.

THE FIGHT

FOR

FREE SPEECH

A SUPPLEMENT TO

"LAW-BREAKING BY THE POLICE"

Including a Legal Opinion by THEODORE SCHROEDER, Attorney for the Free Speech League.

A list of Free Speech Literature, Striking Incidents of the Campaign, Comments of the Press and General Information for the Use of Workers for Free Speech.

COMPILED

BY

ALDEN FREEMAN

Where liberty dwells, there is my country.

—BENJAMIN FRANKLIN

Where liberty dwells NOT, there is mine.

THOMAS PAINE

Alden Freeman, *The Fight for Free Speech,* University of California Regents, 2002

"are going to be a democracy and everybody is protected by the first amendment."[18] The sit-ins were usually met with police either arresting students or attempting to break them up. Although the protests were peaceful and non violent, the right to assemble and fight for their cause was also denied. The Civil Rights Movement also was a victim of the first amendment. The protestors were able to protest but when they assembled in large groups they were met with police force and arrested. A good example of this with respect to the Civil Rights Movement is when Dr. Martin Luther King Jr. was arrested for his non violent protests calling for equality of all men. Record number of students were arrested and fined at UC Berkeley for participating in the non-violent protest at Sproul Hall. The protestors were petitioning the government for

[18] Michael Lamport Commons and Hadley Anne Solomon, *The Beginnings of the Free Speech Movement Within Slate,* 1990, page 10

the grievances in which their rights of freedom were being kept from them based on laws of old which needed to be updated.

EARLY ORIGINS AND SOCIAL TEMPERATURES

Many people would argue that the Free Speech Movement began as early as 1956.[19] One of those people who would agree with that is Michael Lamport Commons. Commons was a student at the University of California at Berkeley in 1956 but, he had become a graduate student at UCLA when the Free Speech Movement had climaxed in 1962.[20] In 1956, the students of Berkeley were not much different than the students who were involved in the Free Speech Movement of 1962.[21] They were just as unhappy with the policies of the United States government as the students of 1962.

In 1957, a group of students got together and formed a group called Slate. Slate was not based on religion or house affiliation directly related to the school, but rather on a basic set of principles. Slate had also leafleted and had demonstrations just as the students of 1962 had. “There were discussions concerning the role and policies of student

[19] Michael Lamport Commons and Hadley Anne Solomon, 1
[20] IBID
[21] IBID

government, compulsory ROTC, the curfew for females, as well as a lot of excitement about the Cuban revolution."[22]

The topics may have been slightly different but the one thing that seemed to continue were the discussions of student rights and the rights the Berkeley administration had in dealing with its students. The students of Slate "demanded that when the Sather Gate became part of the University that it remain a free-speech area. We said that state universities are public institutions. Therefore we are guaranteed the right to assemble and petition the government."[23] The students were met with opposition and arrested for talking to other students about political issues on campus.

[22] IBID, 3
[23] Michael Lamport Commons and Hadley Anne Solomon, 4

Chris Kjobech, *Free Speech Movement UC Berkeley,* UC Berkeley Library, 1965

To me it seems that because the United States Government was in such turmoil, police forces throughout the country were on edge and doing whatever was possible to either limit or rid these small groups from speaking out for their causes. Although the Free Speech Movement was an institutional based movement it did not abstain others, specifically government based positions from attempting to stop or disband their causes. Every student should be able to express themselves and have the right to free speech. However, I do not agree with Commons when he wrote, “Students should be able to invite whoever they want to speak on

campus."[24] This can cause many problems such as riots, further divide the students of a campus and could bring more police force which was already prevalent at this time.

Berkeley being as diverse as it is, would give any one person who wishes to take a political platform and fight for it, plenty of opposition. This is because the Berkeley campus itself is full of students who engage themselves in political activities. Commons seemed out of the loop when it comes to the Free Speech Movement's climax in 1962. "In fact, at the height of the Free Speech Movement, between 1962 and 1964, there was really very little disruption of classes. There was never any violence. I mean not even minor violence, as far as I can remember."[25] The reason Commons does not remember any violence or classes that were disrupted is because he was not there.

The police brutalized demonstrators and arrested hundreds of them. Classes were being canceled by the students' demonstrations and sit-ins. Professors began canceling classes to speak with their students and even joined them in fighting for the freedom of speech. The students of Berkeley were fighting for the freedom of speech alongside of the participants that did not necessarily attend classes. Many people joined the cause for the sake of protesting and wanting to be a part of

[24] Michael Lamport Commons and Hadley Anne Solomon, 6
[25] Michael Lamport Commons and Hadley Anne Solomon, 7

something bigger than themselves'. It was inherent in their nature to want to stand up and be heard.

ATTEMPTS TO PRESERVE SAFETY

The University of California at Berkeley had attempted to keep the institution as secure as possible. Due to the fact that there were many demonstrators on campus who were not students it had caused the University to be extremely cautious. Seemingly, it was a good idea in that it offered some sort of protection to its students. However, students really did not relish the idea of the police on the campus. Ironically, it seemed that the police were protecting demonstrators who were not even University of California at Berkeley students.

Student demonstrations and sit-ins were non violent. Violence and brutalities only came from the police officers who were attempting to break up the demonstrations. "We tried to point out that there were no security issues, but they felt that it was necessary to have a large contingent of police there, which there always were, watching the discussions and intimidating the bystanders."[26]

Despite the police being a constant on the Berkeley campus, and the media coverage they received throughout the

[26] Michael Lamport Commons and Hadley Anne Solomon, 7

movement, demonstrations across the country were increasing in size and more frequently. Increasing in the size of the movements and frequency in which they were springing up were not necessarily because of the Free Speech Movement but because of the American peoples dislike for how the United States Government was being run. The build-up of the Indochina War in 1960 is a good example of a demonstration that was in effect in Oakland, CA. The demonstrators who were protesting against the build-up of the Indochina war could have easily been part of the off-campus demonstrators who infiltrated the University of California at Berkeley's campus.

In 1960 the Civil Rights Movement was gaining such tremendous ground, it became more explosive and effective. The Free Speech Movement in 1962 was using the momentum created by the Civil Rights Movement. The number of students who were participating and demonstrating had been increasing. By the time the Free Speech Movement was in full swing in 1962, there were thousands of student demonstrators and the length in time the demonstrations lasted had also increased, some lasting for over three days straight.

Another reason the Free Speech Movement was able to gain momentum was due to the fact that the faculty had opposed the position of the University and "had decidedly moved towards free

speech."[27] The University of California at Berkeley had lost the support of those they had hired to uphold the prestige of its campus. Changes such as this one were small wars within the movement that made it successful. At this time, "The freedom rides were successful, leading to a Civil Rights Act in 1964, which has lead to a tremendous amount of integration. Our campus activism was extremely successful. Probably more successful than any national administration had ever been."[28] This is impressive in that the Free Speech Movement was able to implement its ideas and tactics successfully on a national level that received the recognition of the American news and peoples.

The national recognition may not have been seen as positive or reported as so, but it was effective in creating change and awareness of the disgruntled American student. "The Free Speech Movement was unique in movements in the United States, student movements especially. Not only did we demand the right to speech, but we protected the rights of others."[29] This type of attitude expressed the rights for free speech and the rights of all American people, including the fight for civil rights. Although many people would not agree, it was a statement that many others could agree with. Attitudes of the protestors and

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[27] Michael Lamport Commons and Hadley Anne Solomon, 8
[28] IBID
[29] Michael Lamport Commons and Hadley Anne Solomon, 9

demonstrators became infectious to the American public. It continued to put the pressure on the American Government in a way that put their problems to the front of the line.

"If universities do not support such inquiry then they are not really universities. They are trade schools, finishing schools, or something else, but they are surely not universities."[30] The Free Speech Movement and Civil Rights Movement had been successful at continuing the fight for the rights of not only people of color but also the student. "Things were accomplished because hundreds of students threw themselves into the work spontaneously and somehow did it in clots of organization, with a furious amount of talk but also with overweening energy and will."[31]

COMMUNICATION THROUGH ELECTRONIC AND WRITTEN WORD

Aside from the leaflets one of the other effective ways the students of the Free Speech Movement were to communicate with the people was by radio. KPFA was a radio station off campus that relayed the happenings in the Free Speech Movement but other movements such as the Civil Rights Movement as well. KPFA was not under the control of the federal government or the university. Listeners of KPFA essentially controlled what was

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[30] IBID, 10
[31]Hal Draper, *Berkeley: The New Student Revolt,* 1965, Chapter 17

on their station. This was able to happen because KPFA did not depend on grants or subsidiaries to keep it on the air. "KPFA is a listener-supported radio, one of the first, maybe the only, and is different from national public radio stations."[32]

Ron Enfield, *Students of the Free Speech Movement Protest at Sproul Hall,* Pat and Sandra's Library Display, 1964-1965

It is important to note that the news was being heard by people in the surrounding area. This means people in Texas would not be able to hear it when it was being broadcasted. It was controlled and confined to the people of the Bay Area. This was extremely important because it educated the people, specifically

[32] Michael Lamport Commons and Hadley Anne Solomon, 9

the students, who could or had been participating in the Free Speech Movement. If someone had not been involved with the Free Speech Movement this was a great way to recruit new members.

KPFA can be categorized as a radical radio station because of the fact that it was outright continuing the fight and support of the Free Speech Movement and its demonstrators. KPFA was also rebelling against the University of California at Berkeley and its policies on free speech.

Besides the radio the students of California Berkeley were able to use the university press to accurately express their views and ongoing struggles at the campus. Student writers were able to share their point of view through the school newspaper, the Daily Cal. Not always were the reports by the Daily Cal on the side of the student demonstrators and protestors. At times there were articles asking the students to stop the protests and directly took the side of the administration. Many newspapers at this time were not reporting events as they occurred.

However, the Daily Cal "had become very astute at reporting events as they actually occurred."[33] The Daily Cal had become an important tool for the Free Speech Movement in that anyone who was interested would be able to update themselves and keep others abreast of the accurate information given to them.

[33] Michael Lamport Commons and Hadley Anne Solomon, 9

Students were able to effectively utilize the sources around them and make them work to their benefit.

Despite having the sources to continue the fight for the freedom of speech, the students protested in the streets and surrounding communities. By taking their voices to the streets and local communities it helped to put pressure on the community and its peoples to directly challenge those who were making the decisions. The movement had become almost contagious as it spread across the campus and the City of Berkeley. Not only were the students fighting for their cause but the people of Berkeley who had joined them were helping their fight as well. At this time the Free Speech Movement had attracted those who had been or were still involved in other movements such as the Civil Rights Movement.

PRIMARY ACCOUNTS OF THE FREE SPEECH MOVEMENT

Due to the large number of protests and protestors, was the reason why so many non students were involved in the Free Speech Movement. In preparing for this paper I looked for primary sources of students who had actually been involved or at Berkeley at the time. I was able to find journal and diary entries from students who were involved in the Free Speech Movement.

Something that bothered me during my research was that I found people writing about the Free Speech Movement who were either not there or not students at the time giving what seemed to be first hand accounts. This made me feel that their body of work was less authentic than those who were actually there. Collectively, the stories that were retold by the students were quite similar despite some small differences. Some of these small differences could be attributed to the students' own bias.

Many accounts were told years later after the events of the Free Speech Movement had occurred are probably more shaded by nostalgia than hard facts. Indelible memories and moments were captured from the students who participated but more importantly were at the University of California at Berkeley during the Free Speech Movement.

STUDENTS MADE THE FREE SPEECH MOVEMENT

An integral part of the Free Speech Movement and its histories are the students. The events that occurred at the University of California at Berkeley will be remembered because of the students who were willing to defend their constitutional rights. Students of the University of California at Berkeley had widened the spectrum of what free speech really means and what the rights of student were. There is no difference between student and citizen.

It is a perfect argument that oral histories should be taken soon after the event to prevent time and memory from lapsing regarding the events that transpired during the Free Speech Movement. The University of California at Berkeley has an oral histories department that is dedicated to documenting the Free Speech Movements histories in an effort to accurately preserve this history.

The Free Speech Movement has found its place in history because of the students of the University of California at Berkeley. The students of the Free Speech Movement paralleled those of the Civil Rights Movements. However, both of these movements were on two different spectrums. The Free Speech Movement was an institutional based movement while the Civil Rights Movement was a movement that would not only effect students but all Americans. While these movements are similar in many ways, they are distinctively different.

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Thesis #3

An Examination of the Cold War Foreign Policies of Truman and Reagan

Senior Thesis

05/06/2009

Advisor:

Second Reader:

An Examination of the Cold War Foreign Policies of Truman and Reagan

When Democrat Harry S Truman succeeded Roosevelt at the conclusion of World War II he was committed to accommodating the Soviets and structuring a peaceful post-war global system. Before his Presidency ended the United States was involved in an armed conflict in Korea and the Cold War was firmly entrenched. Thirty years later Republican President Ronald Reagan was elected on a strong anti-Soviet stance and a decade later he would oversee the end of the Cold War. This thesis assesses the foreign policy of these tow Presidents and compares and contrasts the shifts during their time in office.

Introduction

At the end of World War II, as Harry S Truman succeeded Franklin Delano Roosevelt as President, the United States was Allied with the Soviet Union, supported the Nationalist forces of Chiang Kai-shek and looked toward organizing an international system that precluded another global conflagration. However, within five years the Cold War had developed and the United States and the Soviet Union had become implacable foes, locked in the Cold War.

Thirty years later as President Carter and Ronald Reagan campaigned for the Presidency the Cold War still raged. American diplomats were hostages in Iran and

the Soviet Union had recently invaded Afghanistan. Reagan campaigned on a strong anti-Soviet platform, even referring to the Soviet Union as the 'evil empire.' However, during the course of Reagan's Presidency, the Cold War ended with the devolution of the Soviet Union.

More importantly, in both instances a President elected with one foreign policy objective found himself becoming famous, in an historical sense, for achieving the exact opposite. Reagan was elected on a strong anti-Soviet platform and ended the Cold War. Truman assumed Roosevelt's mantle committed to reorganizing the post-War world and left office in the midst of the first major post-World War II conflict, the Korean War.

The following discussion will compare and contrast the foreign policy objectives and actions of these two Presidents. In particular, the foreign policy perceptions they entered office with will be compared with those that they left office with. Also, an attempt will be made to discern what led to these shifts in foreign policy emphasis.

President Truman, 1945-1952 and the Beginning of the Cold War

At the conclusion of the Second World War the United States found itself the most powerful nation in the world. It had the industrial capacity to produce the weapons of war at a greater rate than any other state. Also, possession of the atomic

bomb gave it a technological superiority that was unmatched. Financially, it had become the world's greatest creditor during the recently concluded conflict. With complete justification, George Donelson Moss asserts that, "a unified, proud, and powerful nation emerged victoriously, from war.... The United States strode the world as an international colossus; its armed forces, linked to its nuclear monopoly, made it the most powerful nation-state in the history of the planet."[1] However, neither overwhelming conventional military strength nor sole possession of nuclear weapons was sufficient to allow the United States to rise above diplomacy.

In international relations American skills were more limited. It was largely inexperienced globally and diplomatically naive. Despite the structure of the United Nations Security Council, the United States was not merely one of a 'concert' of powers: It had become the 'big man on campus.' The United States charged to the centre of the international stage like a brash adolescent in 1945.

With the unexpected death of President Roosevelt, Harry S Truman, the inexperienced Vice President from Missouri assumed power in the summer of 1945 and would be eventually re-elected in 1948. Upon taking the oath, Truman had been Vice President for a mere 82 days and he himself admitted after taking office that he might be over his head with his new role; "Boys, if you ever pray, pray for me now. I don't know if you fellas ever had a load of hay fall on you, but when they

[1] Moss, George Donelson. America in the Twentieth Century 2nd ed. Prentice Hall Engelwood Cliffs, NJ; 1993, p 249.

told me what happened yesterday, I felt like the moon, the stars, and all the planets had fallen on me."[2] As Vice President, Truman had had very little meaningful communication with Roosevelt about world affairs or domestic and was completely uninformed about major initiatives relating to the successful prosecution of the war. He had little, if any, experience in world politics and domestic affairs, and had absolute none of the charm and charisma of is predecessor, Roosevelt. Truman had been thrust into the seat of power of the most powerful nation following World War II, and thus, as the American head of state, was asked to lay the foundation for post war Europe and America alike.

With such an unknown and untested individual leading the most dominant and influential nation, the world now had their eyes on Truman to witness how he would set the stage. It would be the Potsdam Conference that would be one of Truman's first opportunities to showcase his ability at global politics. The Potsdam Conference was a meeting of the victorious leaders of the Allies in Europe, attempting to confront the delicate balance of power of the opposing governmental structures, democracy and communism. Those present at the conference included Winston Churchill, Joseph Stalin, and Harry Truman. Though Truman was no doubt the most inexperienced of the three in dealing with foreign, he brought one power that neither Churchill nor Stalin had; the atomic bomb, the most powerful

[2] Oshinsky, David M. "Harry Truman" in *The American Presidency*. Boston, MA: Houghton Mifflin. pp. 365–380

and destructive armament to date, the atomic bomb was solely in the hands of the United States government. It was with this power that Truman sought to exploit the other two leaders, specifically Stalin. He wanted to use the threat as leverage as evidenced in a letter to his wife concerning the conference: "He [Stalin] doesn't know it but I have an ace in the hole and another one showing - so unless he has threes or two pair (and I know he has not) we are sitting all right."[3] This exhibit of diplomacy employed by Truman marks the first attempt at a policy of "Atomic Diplomacy," the use of the threat of nuclear warfare to achieve diplomatic goals. The policy of atomic diplomacy would later influence other nuclear policies including nuclear proliferation, nuclear deterrence, and mutually assured destruction. In the subsequent years and events of the Cold War, numerous incidences involving this form of diplomacy would be evidenced, by the United States and later the Soviet Union, once the United States' nuclear monopoly ended in 1949 with the Soviet Union's development of the bomb.

Succeeding World War II, there was a growing concern of the entanglement of Eastern Europe falling to communism. Stalin, upset with the United States decision to exclude the U.S.S.R from the Japanese occupation and with Truman for being deceptive about the development of the atom bomb, began looking to advancing the interests of communist Russia in a post war ravaged Europe. Stalin saw this as their time for communist Russia to finally take the fore front of

[3] Letter, Harry S. Truman to Bess Wallace Truman, July 31, 1945

European politics and as well as global politics. "Everything must be done to advance relative strength of USSR as factor in international society. Conversely, no opportunity most be missed to reduce strength and influence, collectively as well as individually, of capitalist powers."[4] They sought to spread the Marxist-communist ideals throughout the world and it would be George Kennan in his two reports, "The Long Telegram" and "X Article" that would expose the U.S.S.R and would latter be the basis for a multitude of the foreign policies enacted by Truman and latter presidents during the Cold War.

George Kennan had been the U.S. deputy head minister-counselor of Moscow at the time that he wrote those articles depicting the Russian initiative following World War II. His "Long Telegram" and latter his "The Sources of Soviet Conduct" article, more commonly known as the "X Article," would become the basis of which many policies of Truman's administration and the Cold War in general, would be founded on. In the actual telegram, Kennan wrote of Josef Stalin and the circle of hardliners at the Kremlin; he warned they were planning to expand Soviet-style communism across the large sector of Eastern Europe where Red Army troops were still stationed. He held that the Soviet Union should be challenged only when it encroached on certain areas of specific American interest, but he did not accept the view that this could be accomplished only by military alliances or by turning Europe into an armed camp. As he states in his "X Article," "it will be

[4]Telegram, George Kennan to George Marshall "Long Telegram", February 22, 1946.

clearly seen that the Soviet pressure against the free institutions of the western world is something that can be contained by the adroit and vigilant application of counter-force at a series of constantly shifting geographical and political points, corresponding to the shifts and maneuvers of Soviet policy…"[5] This document, along with Kennan's original "Long Telegram" would later find many of the same concepts duplicated and affixed to the later policies enacted by Truman and his administration, policies that would include the Marshall Plan and the Truman Doctrine.

One of the most defining moments of Truman's geopolitical stance would come with the European Recovery Program, also known as the Marshall Plan, and later the Truman Doctrine. Had in hand, these two plans set the stage for American foreign policy for the next 20 years to come. At the time, European countries were falling into an increasing economic trouble following the war. Much of Europe was devastated with millions killed and wounded. Fighting had occurred throughout much of the continent. Sustained aerial bombardment meant that most major cities had been badly damaged, with industrial production especially hard-hit. Many of the continent's greatest cities lay in ruins and had been severely damaged. The region's economic structure was ruined, and millions had been made homeless. It was apparent that without the foreign aid of the United States, many of the

[5] George F. Kennan's "Sources of Soviet Conduct," 1947. Harry S. Truman Library, Book Collection (Foreign Affairs, p. 53-63)

economic systems, and the government themselves, would crumble, possibly to the communist ideals put forth of the U.S.S.R. As stated by State department officials:

> What will happen if we do not provide adequate funds and commodities for subsistence and reconstruction abroad? Human want, economic collapse, political crisis, collapse of democratic institutions, growth of extremism, and perhaps loss of independence would in many countries quickly follow. Our hopes for peace and prosperity would quickly vanish. We would live in unprecedented isolation. We would live in growing poverty. We would live in growing fear… It is entirely possible that this would lead to a widespread repudiation of the principles on which so many European civilizations has rested for so long – the principle of law, justice, of respect of individual dignity, and of restraint in the exercise of political power. [6]

Thus, to prevent the collapse of Europe economically and politically, we witnessed the introduction of two plans, the Marshall Plan and the Truman Doctrine. Together, the plans set the stage for the foreign policy for the U.S. for many of the subsequent events of the Cold War. The two documents together established that the United States would provide political, military and economic assistance to all democratic nations under threat from external or internal authoritarian forces. They effectively reoriented U.S. foreign policy, away from its usual stance of withdrawal from regional conflicts, to one of possible intervention in far away conflicts. As Truman states in his speech before congress, "I believe that it must be the policy of

[6] "European Recovery Program Basic Document No. 1", October 31, 1947

the United States to support free peoples who are resisting attempted subjugation by armed minorities or by outside pressures."[7] He stated that from that point forward he would actively seek to aid any foreign, capitalistic nation, from collapsing to the evils of any socialist government that would disadvantage the interests of the United States.

With the Truman Doctrine, the fundamental conception behind it was that once one European country fell to communism, there would be an exponential possibility that all other countries in the region would follow fall as well. The greatest fear of the American people and government was that of a red Europe, one that would hold no mutual economic interests, and markets inexplicably closed to American consumer goods. It would only take one nation to fall to the throngs of communism for the rest to come crashing down after; hence a "domino effect" of communist would arise. It is specifically, this scenario wishes to avoid. He depicts the consequences of a failure to act within Europe during this time as stated in his Truman Doctrine: "Collapse of free institutions and loss of independence would be disastrous not only for them but for the world… Should we fail to aid Greece and Turkey in this fateful hour, the effect will be far reaching to the West as well as to the East."[8] The doctrine was the first presentation by Truman of what would latter be known as the Domino Theory, that speculated that if one land in a region came

[7] Truman, Harry S, "Truman Doctrine Address" (March 12, 1947) pg 1

under the influence of communism, then the surrounding countries would follow in a domino effect. The idea of a domino effect of communism, would find its place with the subsequent administrations of the Cold War to justify American intervention around the globe in Europe, Asia, and Latin America for years to come.

The Truman Doctrine was also the first significant implication toward the containment policy that the United States would latter except towards the U.S.S.R. and communism around the globe. Truman and United States sought to keep communism in check, keeping it contained in the current borders that in resided in and to counter any intrusion of it into the foreign soil of any free nation and country. "As long as the Soviet Government adheres to its present policy, the United States should maintain military forces powerful enough to restrain the Soviet Union and to confine Soviet influence to its present area"[9] Though the notion of containment was first introduced by Kennan in his "Long Telegram", he envisioned the United States containing the Soviet threat through political and economic means, not through the use of military. In his speech before congress, as well as the later National Security Council Report 68, Truman and his administration built upon Kennan's policy of containment with the addition of using force to stop communism and the Soviet Union from ever advancing beyond

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[8] *Ibid,* pg 4
[9] "American Relations With The Soviet Union" by Clark Clifford, September 24, 1946.

its existing borders. As Truman outlined in his memoirs, "he saw the Russian pressures on Iran and Turkey as an immediate threat to the global balance of power." Truman was under the impression that nothing but brute force would stop the Soviets. Because of this, he began to pursue a military policy, along with his economic or political policies, to contain the Soviets.

Ultimately what would define the foreign policy of the Truman Presidency as well as other subsequent administrations would be the implementation of National Security Council Report 68 or NSC 68. It was a then top-secret report completed and is among the most influential documents composed by Truman's administration during the Cold War. The report argued that one of the most pressing threats confronting the United States was the hostile design of the Soviet Union. It concluded that the Soviet threat would be exponentially increased by the addition of more weapons, including nuclear weapons, to the Soviet arsenal. The report argued that the best course of action was to respond in kind with a massive build-up of the U.S. military and its weaponry. "Forces of this size and character are necessary not only for protection against disaster but also to support our foreign policy. In fact, it can be argued that larger forces in being and readily available are necessary to inhibit a would-be aggressor than to provide the nucleus of strength and the mobilization base on which the tremendous forces required for victory can be built… a substantial and rapid building up of strength in the free world is

necessary to support a firm policy intended to check and to roll back the Kremlin's drive for world domination."[10] This type of build up would soon characterize every U.S. presidential term until the end of the Cold War.

NSC-68 rejected a renewal of U.S. isolationism, fearing that this would lead to the Soviet domination of Europe, and leave the United States marooned on the Western Hemisphere, cut off from the allies and resources it needed to fend off further Soviet encroachments. The report also ruled out a preventive strike against the Soviet Union, because it reckoned that such an action would not destroy the Soviet military's offensive capacities, and would instead invite retaliatory strikes that would devastate Western Europe. Ultimately it concluded that the only plausible way to deter the Soviet Union was for President Harry Truman to support a massive build-up of both conventional and nuclear arms. More specifically, such a program should seek to protect the United States and its allies from Soviet land and air attacks, maintain lines of communications, and enhance the technical superiority of the United States through "an accelerated exploitation of scientific potential." In order to fund the substantial increase in military spending this conclusion demanded, the report suggested that the Government increase taxes and reduce other expenditures.

Truman's first inaugural address in 1949 would set the stage for the United

[10] "A Report to the National Security Council - NSC 68", April 12, 1950. President's Secretary's File,

States foreign policy perceptions that Truman held then. Truman began by stating plainly, "the supreme need of our time is for men to learn to live together in peace and harmony." Moreover, he asserted that his objective could only be achieved under American leadership, "in this time of doubt, they look to the United States as never before for good will, strength and wise leadership." [11] Essentially, Truman was stating that the world was going to become a better place and it was to become such under the tutelage of the Untied States

Indeed, Truman then went on to outline the principles that the United States would ensure that the world lived by in the future. His address would include four main courses of actions during his term for the United States. He sought to aid and give unfaltering support of the United Nations and agencies similar to it as well as increase the effectiveness and power of it. Secondly, he wanted to continue the programs of economic stability. He felt it was of the upmost importance that Europe became self-supporting and that its markets and world increase should increase and open to the United States. Thirdly, Truman wanted to strengthen freedom-loving nations against the dangers of aggression. He sought to increase the defense of the democratic and capitalist countries around the globe and stated "that any armed attack affecting our national security would be met with overwhelming

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Truman Papers.

[11] Harry S Truman "Inaugural Address" (Jan 20, 1949)

force, the armed attack might never occur."[12] And lastly, Truman wanted to implement a new program for the benefit of scientific advances and industrial improvement. Essentially, through the "four points" of his address, Truman wanted to see the growth of democracy and capitalism worldwide and see that the free nations of the world are prepared to aid and protect one another in times of crisis. His policy was the democratic development under American guidance but his program was one of consent and cooperation. Implicit in teaming these ideals is the belief that the nations of the globe all want what the United Sates wants and will willingly do as they are told. According to Truman coercion would never be necessary because all the peoples of the world shared his goals and perceptions and would willingly act in concert under the guidance of the Untied States

Truman also spends a good deal of this speech addressing the issue of communism and its spread. He stated that communism was a philosophy of violence, while democracy, America's objective, "proved that social justice could be achieved through peaceful change." [13]Though in his speech, Truman specifically avoided referencing the Soviet Union, he did refer vehemently to communism, the communist program and the ideals that the Soviet Union was attempting to spread globally. He depicted communism as the basis of evil and unjust stating that "Communism subjects the individual to arrest without lawful cause, punishment

[12] *Ibid*
[13] *Ibid*

without trial, and forced labor as the chattel of the state. It decrees what information he shall receive, what art he shall produce, what leaders he shall follow, and what thoughts he shall think."[14] Though the policy of containment is never specifically mentioned in the address, it was implied and months later would be officially introduced in NSC – 68.Truman sough to have the United States spreading the ideals of freedom, equality, world trade and not the enslavement, suppression, and destruction of the Soviet Union; and it would be this policy that entwine the United States in the military engagements of the Korean War.

In 1951 the Korean War became one of the first significant post-World War II conflicts, one of the first direct military confrontations in the emerging bi-polar global configuration.[15] It provided an excellent illustration of the links between local conflicts and global considerations of the balance of power as was the first true test at the policy of containment that Truman had implemented. As such, the conflict provides insight into the bi-polar arrangement that came to characterize superpower dealings and the foreign policy as outlined in his inaugural address and in NSC-68.

As the Cold War began to dominate U.S. foreign policy, America extended security commitments to two nations in Northeast Asia, the Republic of Korea and Japan. Truman and his administration created a series of agreements to build a

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[14] *Ibid.*

[15] Knox, Donald. *The Korean War: Uncertain Victory* Harcourt, Brace Jovanovich: 1988. pg 28

permanent American presence in the region and support these two nations. In Asia, as in Europe, Truman tried to contain the spread of communism. The U.S. denied the U.S.S.R any hand in the postwar reconstruction of Japan and occupied Japan until 1952, at which point the U.S. officially exited but left troops behind on American military bases. In China, the U.S. spent almost $3 billion in a failed effort to support Chinese nationalists against Mao Zedong's communists.[16] In 1949, the communists achieved victory and established the People's Republic of China (PRC). The nationalists fled to Taiwan, where they established their own government to rival the PRC. Asia, much like Germany, became the site of division between contending camps, communist and noncommunist.

The Cold War conflict in Asia erupted into outright war in June 1950, when troops from Soviet-supported North Korea invaded South Korea. Without asking for a declaration of war, Truman committed U.S. troops as part of a United Nations "police action," when in actuality, the Korean War was carried out by predominantly American forces by late September, American troops had forced the North Koreans back past the thirty-eighth parallel, the dividing line between North and South Korea. Truman authorized an offensive drive across this divide and toward China, but the U.S was repelled by Chinese forces in November. Fighting stabilized around the previous border, and in the spring of 1951 Truman sought to scale back the war effort and negotiate peace, despite MacArthur's proposals for

[16] Knox, Donald. *The Korean War: Uncertain Victory* Harcourt, Brace Jovanovich: 1988. Pg. 93

bombing attacks north of the Yalu River in China. After a month of publicly denouncing the administration's policy of restraint, MacArthur was relieved from duty in April 1951. Limited fighting would continue until June 1953, when a peace restored the prewar border between North and South.

Over U.S. forces had lost almost 55,000 lives in the American intervention of Korea, the most dramatic test to that date for containment. At that time, Truman and his advisers had concluded that North Korea had attacked South Korea, that Stalin had approved and planned the attack, and that the North Korean invasion was a Soviet test of American credibility and a possible preliminary to Soviet probes elsewhere—in Europe, perhaps in Germany. "Korea is the Greece of the Far East. If we are tough enough now, if we stand up to them like we did in Greece three years ago, they won't take any next steps. But if we just stand by, they'll move into Iran and they'll take over the whole Middle East. There's no telling what they'll do, if we don't put up a fight now,"[17] Truman declared days aftyer the invasion of Korea by Untied States forces. Korea had been the first test for Truman and his administration to contain the soviet and communist threat and they had met it head on. It would be this policy, first enacted and introduced by Truman and his administration, which would set the precedent for all prior engagements against communism and its expansion.

[17] Bevin, Alexander. *Korea: The First War We Lost* Hippocrene Books New York: 1986. Pg. 81 - 82

When Truman entered the world stage, a farmer from Missouri who had largely been kept in the dark about foreign policy by Roosevelt, he was unprepared and potentially even unqualified for geopolitical events that would take place in the subsequent years. Despite his lack of experience, Truman and his administration would later be labelled as the "Father" of the Cold War and rightly so. Many of his foreign policy initiatives, specifically in regards to the notion of "containing" the Soviet threat, atomic diplomacy, and his quest to spread democracy, freedom, and world trade around the globe would be continued to be implemented into the policies of the subsequent.

President Reagan (1980-1988) and the end of the Cold War

In contrast to Truman, Reagan may have campaigned on one of the most hard-nosed platforms ever proposed by an American President. Ronald Reagan was elected president in 1980 and advocated a return to a hard-line policy in dealing with the U.S.S.R. after a decade of détente, or reduced tension, between the two superpowers. He hoped to cause the U.S.S.R.'s collapse from within by stepping up anti-Soviet rhetoric, forcing the U.S.S.R. to overextend itself by building up a nuclear arsenal to compete with the United States.

The first and most prominent aspect of Reagan's Cold War policy was a heightening of anti-Soviet rhetoric after a decade of more friendly relations.

Interestingly, he avoided commenting on the "evil empire" specifically in his first inaugural address. However, he acknowledged that America had "potential adversaries" who were "opponents of freedom." He repeated Truman's admonition that violence would be avoided. However, the manner in which he voiced it was extremely confrontational: "Our reluctance for conflict should not be misjudged as a failure of will…. We will maintain sufficient strength to prevail if need be, knowing that if we do so we have the best chance of never having to use it."[18] In 1948 Truman had stated that force would not be necessary to realize America's foreign policy: In 1981 Reagan merely stated that its use would be avoided, and if it were resorted to it would be as a result of a *casus belli*, the justification for acts of war, provided by America's opponents. He sought a deterrence of aggression through the promise of retaliation much in line with the doctrine of Mutual Assured Destruction, in that the deployment of strong weapons is essential to threaten the enemy in order to prevent the use of the very same weapons. In this case, Reagan was affirming that any aggressive stance against the Untied States, would garner a military stance and possible action by the United States.

Although Reagan did not refer to the Soviet Union, he repeatedly recalled past American glories. His speech ended with one of his trademark anecdotes about a soldier killed in 1918 and throughout he mentioned the Argonne, Omaha Beach, Pork Chop Hill and other American memories of marital glory. Reagan's speech did

[18] Ronald Reagan "First Inaugural Address (Jan 20, 1981)

not directly target the Soviet Union but it was extremely martial in tone, and it was obvious that the Soviet Union was the implied enemy. "As for the enemies of freedom, those who are potential adversaries, they will be reminded that peace is the highest aspiration of the American people. We will negotiate for it, sacrifice for it; we will not surrender for it—now or ever."[19]

Much like Truman, Reagan sought to strengthen the ties of neighbors and allies alike who shared the common freedom of democracy. He offers them support and a commitment to uphold their values as well as our own against any foreign nation that seeks to impose their sovereignty on them. In light of his opposition to the Soviet Union, it is not surprising that Reagan quickly acted to revitalize the American military.

One of the first initiatives of the Reagan administration was the dramatic increase of the defense budget. Under Reagan the United States defense budget increased at a phenomenal rate, increasing by 10 percent from 1982 to 1983 alone.[20] Reagan began a massive re-armament based on high-technology that obsoleted a generation of Soviet weaponry. Before Reagan took office, U.S. defense technology had fallen badly behind the Soviets during the Jimmy Carter administration. The defense upgrade include a 600 ship Navy, new Army divisions, tanks, planes, and missiles. Under the orders of Reagan, Caspar Weinberger cleared

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[19] *Ibid*
[20] Kramer, 1999.

out the Carter Defense Department, instilled morale within the ranks, and rebuilt the military as an instrument for the Soviets to fear. In Reagan's address to the nation in his National Security speech in 1983, he states that

> "We haven't built a new long-range bomber for 21 years. Now we're building the B-1. We hadn't launched one new strategic submarine for 17 years. Now we're building one Trident submarine a year. We have also begun the long-needed modernization of our conventional forces. The Army is getting its first new tank in 20 years. The Air Force is modernizing. We're rebuilding our Navy, which shrank from about a thousand ships in the late 1960's to 453 during the 1970's."[21]

The method was unpredictable. Incursions into Russian airspace, sending B-52s in attack formation over the North Pole, disrupting naval exercises. The weapons build-up forced the Soviets to increase military spending and it sought to cripple the Soviet economy by forcing the U.S.S.R. to overextend itself by building a nuclear arsenal to compete with the United States. Negotiations on the SALT II treaty for limiting nuclear arms, begun in 1972, were abandoned, and Reagan spent over $1 trillion on the military in his first three years in office.[22] This stockpiling proceeded despite the fact that both powers had, by the mid-1980s, approximately 25,000 nuclear warheads, enough to accomplish any foreseeable military goals

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[21] "Address to the Nation on National Security" By President Ronald Reagan, March 23, 1983

[22] Thornton, Richard. The Reagan Revolution, I: The Politics of U.S. Foreign Policy. New York:

several times over.

One of Reagan's most controversial proposals included in his defense budget was the Strategic Defense Initiative (SDI), a system intended to make the U.S. invulnerable to nuclear missile attacks by the Soviet Union. By stationing those defenses in outer space, the U.S. was able to circumvent the United Nation's Anti-Ballistic (ABM) Treaty. In a speech in 1983, President Reagan announced his plans to create a shield against nuclear missile attacks. The news media quickly dubbed his new proposal for the SDI as "Star Wars," as well as characterizing it as a carelessly drawn-up science fiction idea. SDI was designed to vaporize missiles from space by way of a laser guidance system, before they reached U.S. soil. The system grew into a series of systems that also formed a layered ballistic missile defense. The SDI was capable of zeroing in on only 30 percent of the earth's surface, and wasn't able to get a fix on the Soviet's nuclear launch sites. The policy was expressly identified as "deterrence of aggression through the promise of retaliation." Fundamentally, it was a revision of the Nixon policy of Mutually Assured Destruction (MAD). Any power that attacked the United States would find itself subject to massive retaliation from the protected American ballistic missiles that would survive the initial attack.[23] But, by 1985, after billions of dollars but minimal results, Reagan's SDI was shut down but research would later continue

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Trafford Publishing, 2006. pg 48

[23] Peter Kramer "Star Wars" History Today March 1998.

into the 21st century.

As the defense budgets began ever increasing, Truman began publicly shifting the cross hairs directly on the Soviet Union. National Security became an ever increasing area of concern to Reagan. As stated in his Presidential Inaugural address, Reagan continued to preach that America will not bring the war to the Soviets unless otherwise threatened. "The United States does not start fights. We will never be an aggressor."[24] Until the Soviets and communism physically intervened in the American philosophy of preserving freedom and peace, the United States would remain in a strategic policy of deterrence with the Soviet Union. Reagan's states that the old form of deterrence, out numbering the enemies nuclear weapons and capabilities, had become obsolete. The Russians had more than enough nuclear weapons to delimitate the entire world. In the form of atomic weapons, neither side had a distinct advantage over the other. Both sides, through the years, had amassed such an arsenal of nuclear weapons that they could physically destroy the world twice over. Reagan would look to break from the previous Cold War policies, many of which were still based on the policies of the Truman administration, to adapt ever changing geo-political scene between the U.S.S.R and the Untied States.

As is evidenced in Reagan's address to the National Association of Evangelicals, which later would become known as the "Evil Empire Speech,"

Reagan is a strong proponent to the nonproliferation of nuclear weapons. Unlike the start of the Cold War where we saw the race to nuclear weapons, and the need to accumulate more than the opposing threat, Reagan sought to put a halt to the continuance of nuclear programs for warfare and asked for the disarmament of those weapons. Reagan asked to "resist the attempts of those who would have you withhold your support for our efforts, this administration's efforts, to keep America strong and free, while we negotiate real and verifiable reductions in the world's nuclear arsenals and one day, with God's help, their total elimination."[25] The U.S.S.R vehemently declined the request but sought instead a condition of a "nuclear freeze." Reagan saw this as an attempt by the Russians to disadvantage the Untied States and their nuclear weapons programs and thus lobbied that a freeze would solve nothing of the current problem but would "be a very dangerous fraud, for that is merely the illusion of peace."[26] It is at this point that Reagan exhibits the iniquity of communist Russia in their refusal to seek a mutual peace and adherence to the advance of nuclear weapons. Reagan had deemed them as the "evil empire" and that it was the duty of United States to not only contain the evil of their rhetoric and ideologies but them push it back and eventually eliminate it.

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[24] "Address to the Nation on National Security" By President Ronald Reagan, March 23, 1983
25 Reagan, Ronald. Address to the National Association of Evangelicals (Soviets as "Evil Empire"), Sheraton Twin Towers Hotel, Orlando, FL, Reagan Library. March 8, 1983
[26] *Ibid.*

Much like the Truman Doctrine would define the foreign policy of the Untied States at the beginning of the Cold War, it would be the Reagan Doctrine that dominated foreign relations at the conclusion. In his 1985 State of the Union address, President Ronald Reagan called upon Congress and the American people to stand up to the Soviet Union, what he had previously called the "Evil Empire":

> "We must stand by all our democratic allies. And we must not break faith with those who are risking their lives on every continent, from Afghanistan to Nicaragua to defy Soviet-supported aggression and secure rights which have been ours from birth."[27]

Breaking with the doctrine of "Containment," established during the Truman administration President Reagan's foreign policy was based on the design of a "Roll-Back" strategy from the 1950s in which the United States would actively push back the influence of the Soviet Union. Reagan's policy differed, however, in the sense that he relied primarily on the support of those fighting Soviet dominance.[28] This strategy was perhaps best summarized in NSC National Security Decision Directive 75. This 1983 directive stated that a central priority of the U.S. in its policy toward the Soviet Union would be "to contain and over time reverse Soviet expansionism," particularly in the developing world. As the directive noted:

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[27] Reagan, Ronald. "Address Before a Joint Session of the Congress on the State of the Union." Reagan Library. February 6, 1985

28 Thornton, Richard. The Reagan Revolution, I: The Politics of U.S. Foreign Policy. New York:

> The U.S. must rebuild the credibility of its commitment to resist Soviet encroachment on U.S. interests and those of its Allies and friends, and to support effectively those Third World states that are willing to resist Soviet pressures or oppose Soviet initiatives hostile to the United States, or are special targets of Soviet policy.[29]

To that end, the Reagan administration focused much of its energy on supporting nations to curtail Soviet influence. Among the more prominent examples of the Reagan Doctrine's relevance was in Nicaragua; the United States had sponsored the contra movement in an effort to force the leftist Sandinista government from power. And in Afghanistan, the United States provided material support to Afghan rebels helping them end Soviet occupation of their country.

Into the late 1980s, it became readily apparent that the Soviet state began deteriorating economically and industrially. Numerous reforms were implemented by Gorbachev and appeared that there was a mutual respect for the tow leaders. As result, throughout Reagan's term there were numerous discussions between the two concerning the disarmament of the Untied States as well as the Russian nuclear weapons.

It would be in the fall of 1986, that Reagan and Gorbachev would hold a summit meeting in Reykjavik, Iceland that signaled a breakthrough. At the meeting,

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Trafford Publishing, 2006. Pg 154

29 "U.S. Relations with the U.S.S.R" (NSC-NSDD-75) Ronald Reagan Library (NLS). Jan 17, 1987

Gorbachev suggested that he would reconsider the idea of concluding an INF-only treaty and proposed that it be expanded to include shorter-range missiles as well. This meeting revived the idea that neither side would maintain either intermediate or short range missiles in Europe. At this point, the agreement suffered a familiar setback, as the Soviet Union returned to the theme that the United States should give up SDI before signing any arms control agreements but by December, 1987, Reagan and Gorbachev would eventually sign the INF Treaty in Washington, D.C. In regards to the treaty, Gorbachev would later state;

> The modern world has become much too small and fragile for wars and policy of force. It cannot be saved and preserved if the thinking and actions built up over the centuries on the acceptability and permissibility of wars and armed conflicts are not shed after all...[If the arms race continues] The situation in the world may assume such a character that it will no longer depend on the intelligence or will of political leaders. It may become captive to technology, to technocratic logic.[30]

The final treaty eliminated an entire class of nuclear weapons, restricting the deployment of both intermediate and short-range land-based missiles worldwide. The treaty also called, for the first time, inspections of nuclear facilities and weapons. It was the first arms control agreement the two nations had completed since the SALT II agreement failed at ratification, and the first treaty that required

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[30] Sakwa, Richard. *The Rise and Fall of the Soviet Union: 1917-1991*. New York: Routledge, 1999. Pg 417

the destruction of existing weapons, instead of simply setting future limits on deployments. Unlike the beginning of the Cold War, Gorbachev and Reagan were capable of seeing eye to eye, contain a mutual respect for another, and solve the issues at hand.

Unlike in the previous presidencies, Reagan witnessed a fundamental change to leadership and reform of the Soviet Union with the coming of Soviet leader Mikhail Gorbachev to power. Gorbachev implemented a series of changes in his country's social, economic and foreign policies designed to bolster the domestic standard of living and usher in a new era of detente with the United States. Ultimately it would be these enactments, as well as the policies of the Reagan administration that would hasten not only the end of the Cold War, but also the breakdown of the Soviet Empire and, in time, the Soviet Union itself.

Mikhail Gorbachev became head of the Communist Party of the Soviet Union in 1985, after the death of Leonid Brezhnev. From the start, Gorbachev was different from previous Soviet leaders. He had been educated at Moscow State University, grew up in a Christian family, and perhaps most importantly, reached adulthood after Stalin died, so he was not troubled by the haunting memory of purges or indoctrinated in strict Marxist-Leninist thought. Gorbachev's generation was far more familiar with the West than its predecessors, and the growing professional class, that was also well-educated, demanded reforms to improve the

standard of living and address the troubled economic situation in the Soviet Union.[31]

The Soviet economy in the mid-1980s faced serious challenges. Years of centralized controls had led to stagnation, and the Soviet economy was already straining to compete with the military buildup in the United States led by President Ronald Reagan. In response, at the Twenty-Seventh Party Congress in 1986, Gorbachev made two proposals: the first for "perestroika," a complete restructuring of the economy, and the second for "glasnost," or openness.[32] The former proposal would pave the way for privatization of farming and industry, the creation of profit incentives, and a market system for setting prices and governing internal trade. Glasnost would ease censorship controls and create new personal freedoms. Although the proposals were warmly received by Soviet citizens, the Party leadership remained suspicious of change.

Ultimately, it would be the reforms enacted by Gorbachev, a declining economic and industrial base, the suppression of populace, and the denial of freedoms that would lead to demise of Soviet Union and bring an end to the Cold War. As the decade came to an end, much of the Eastern Bloc began to crumble. The

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[31] *Ibid* Pg 451 - 452

[32] "Program of the Communist Party of the Soviet Union." Twenty-Seventh Party Congress, Moscow. Feb, 1986

Hungarian government took down the barbed wire on its border with Austria and the West. The Soviet Union did nothing in response and the Iron Curtain was starting to unravel. On November 10, 1989, one year after the term of Reagan ended, one of the most famous symbols of the Cold War came down: the Berlin Wall. By the end of the year, leaders of every Eastern European nation except Bulgaria had been ousted by popular uprisings.

By mid-1990, many of the Soviet republics had declared their independence. Turmoil in the Soviet Union continued, as there were several attempts at overthrowing Gorbachev. On December 8, 1991, the Soviet Union ceased to exist. Boris Yeltsin, president of the Russian Republic, formed the Commonwealth of Independent States (C.I.S.). After 45 years, the Cold War was over.

The United States, in the years during the Reagan presidency, underwent a revolution in high technology that the Soviets could not match. The Soviet system was under pressure from Reagan's defense buildup and deployment of medium-range missiles in Europe, the CIA-backed mujaheddin fighting Soviet forces in Afghanistan and Reagan's proposed missile defense system, the Strategic Defense Initiative. Reagan had challenged the fundamental beliefs of communism and had enacted a policy to not just contain but “roll back” the communist spread. He challenged Soviet regional power in several conflicts from Nicaragua to Angola and

lent support to the Polish dissident movement. It would be these final battles of the Cold War shaped Reagan's foreign policy.

Conclusion

By the end of the Cold War, with the fall of the Berlin Wall and the end of a communist Soviet Union in sight, the United States foreign policy had taken a radical transformation from the days of the Truman Presidency to Reagan's. The onset of the Cold War had the United States pitted against a power who sought to see the destruction of the Western ideals of freedoms, democracy, and capitalism. Its fundamental philosophy was to see that communism was spread abroad to ensure its own safety by securing its natural boarders, as well as create to create a society that rivaled the greatest in history. This philosophy was in direct opposition of the Untied States own policy to ensure that the god given freedoms and liberties of democracy was spread to all free peoples. It was in this storm that Truman would be directly placed in.

Despite Truman lack of experience in the form of geopolitics, he and his

administration nonetheless created a platform of foreign policy that would continue for 20 years and would ultimately influence Reagan's own policies to conclude the Cold War. Policies such as containment, the domino theory, democratic expansion globally, the economic recovery plan, NSC 68, atomic diplomacy, among many others would have an immense influence on the events to occur during the Cold War years. Kennan's and Truman's philosophy of containment would be later adapted into the "Flexible Response" of Kennedy in regards to Asia and Latin America. Massive retaliation, mutually assured destruction, and nuclear deterrence would be founded on the principles that began with the only President to ever use a nuclear weapon. NSC 68 would begin a continual build of military and nuclear arms, increase economic spending, and dramatic increase to defense spending that would be apparent throughout the entire War. Each and every one of these would principles had some basis in their creation tied to the original administration of Truman's, it would be Reagan who eventually take the policies of the past administration to facilitate is own policies to the end of the Cold War.

Though Truman is classified as the President that started the Cold War, Reagan is certainly viewed as the President who would end the Cold War. Less than a year after Reagan left office, the Berlin Wall fell, and 2 years after that the U.S.S.R and the Cold War came to an abrupt end in 1991. Though Reagan certainly does not warrant all the credit and attention for the fall of the U.S.S.R, much of it was due in large part to the Soviet's own destruction, there is no doubt that his

policies added to their demise. The Soviet Union had already been dying but Reagan ensured that they were nailed to the coffin. Reagan departed from the strategy of détente and brought a hard line policy against the Soviets. His defense initiative and his resurrection of the arms race certainly were factors that can be attributed to their economic downfall. The Soviets had already been deteriorating economically and industrially and by forcing them to increase their own spending militarily, away from domestic issues to match that of the United States, certainly contributed to the revolutions of the many of the Soviet states in 1989. His role as the "Great Communicator" with Gorbachev and the Russians in the INF treaty and other summits facilitated a means to the end for them. He built upon the policy of containment of the Truman administration and took it a step further and incorporated it into his own "roll back" policy. The Soviet threat would not only be contained but confronted.

As Reagan stated, "Each generation goes further than the generation preceding it because it stands on the shoulders of that generation" and it would be that same philosophy, a continuing development of the policies of Truman and other presidents, that would lift in the Untied States in triumph over the Soviet Union after 45 years of a Cold War.

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Thesis #4

The lasting effects by the Black Hills mining town of Deadwood, upon the Black Hills environment, Great Plains history, and the American Wild West mythos.

By

Deadwood River, so named for the vast quantities of dead trees that occupied the Hillside at the time of the valley's discovery, was the site of the wealthiest mining town during the "last gold rush" in the lower continental United States. But the town of Deadwood, named for the river it sat upon, would become more than a Black Hills, placer gold miner's boom town. For starters, the town was established during the time that the Black Hills were located not on US soil but on Sioux Indian reservation land. Moreover, under treaty law, no whites were permitted within the Hills under penalty of, if they were found by the US military, jailing, and if found by the Sioux, death.

In the books of history, this dilemma sparked Sioux aggression which reciprocated US aggression. Soon after, the Sioux would be defeated by the mighty military might of the United States and confined to reservations while gold prospectors moved into the Hills and history marched on. However, the mining towns of the Black Hills contributed more to the US than simple conduits for gold in the metal's transition between its earlier home in quartz deposits and later home in the banks across the nation. Deadwood, and other Black Hills mining towns, would contribute to the nation's later mythos of that period, reinforcing the romanticized ideas of a "wild" frontier where a single homesteader, armed only with a revolver faced down blood thirsty bands of Indians, warded off criminals and murders, and pulled from the earth a way of life through the sweat of his own brow. But the town of Deadwood also did more.

Deadwood, as the largest town in the Black Hills at the time, the wealthiest, and considered to be the capital of the Hills by most, exerted immense pressure upon Washington and other politically powerful bodies. This influence was used to obtain military protection from the Sioux during their illegal existence and rally support for a war against the legal owners of the land the protectors of the mountains were currently occupying. Deadwood also possessed the

largest population of the entire Hills and as a result contributed disproportional to environmental degradation inflicted upon the Black Hills. Finally, Deadwood was indeed a mining camp with banks full of money; this money was put not into the pocket lining of the elites but used for the benefit of the people allowing the inhabitants of the northern Black Hills to enjoy a high standard of living during their time.

Paragon of a Mythos

One of the many legacies of Deadwood was that it influenced the Wild West mythos by embodying the ideals of individualism, resilience, and independence along with the ideas of what nature meant and the progress of civilization. Obvious illustrations of this can be seen in the shared opinions by the prospectors and settlers on the Indians the daily life of a Black Hills miner. To quote from Estelline Bennett, a native of Deadwood during the gold rush years, “They had no concern at all about the terror that stalked behind trees and rocks and little hills. It was all a part of the scenery — even when it moved and pulled a gun."[1] The Indians were not a hated group of people worthy of extinction on all levels of life, but instead a people which were sometimes a hindrance to one’s longevity in life and simply in the way of progress during the rest.

To the people of Deadwood the Indians were seen as a part of nature that needed to be tamed rather than a “breed” of humans who were lower on the eugenic scale necessitating their extermination; though their idea of “taming” may be confusing and very similar to extinction. By “taming”, the prospectors meant that the troubling ones, which preyed upon the prospectors and settlers, must be dealt with similarly, to how wolves must be dealt with by ranchers. No permanent ill will was extended upon the Sioux by the white inhabitants of the Hills in general

[1] Estelline Bennett, *Old Deadwood Days:* pp 15

before, during or after the Great Sioux war. Indians who were "civilized" were respected for their knowledge of the land and wisdom. Of those Native Americans who adopted the life of the "civilized" white man, and who lived in or near the Hills, no occurrence of bigotry was recorded[2]. That is to say that there were no land ordnances preventing the Indians from owning land or laying stake to claims as there were in California during the 1849 gold rush. During the later years of Deadwoods life, after the "rush" had ended, Sitting Bull would regularly visit the town with a procession of other Sioux and perform a show consisting of Native Sioux dances.[3] This is not to be confused with a picturesque setting for Native American and White relations.

Racism was abundant during this time and Deadwood was no exception. It does do is serve to illustrate how the people in the Hills, and thus Deadwood, differed from the people still living in the plains; i.e., that those in the Hills, who were only a arms reach away from a Sioux war party's grasp and certain death, extended a special degree of respect upon the Indian people that the plains folk did not. Contrary to the belief of current times, the settlers and prospectors of 1876 knew well what drove the Sioux on the warpath[4] but made no attempts to rectify the situation. That is, those in the Hills were fully aware that the Sioux valued the Black Hills as sacred land and the presence of whites in the Hills was greatly insulting to them. The prospectors did not abandon the land, or use their political leverage to dissuade the US government away from war.

Instead, the people of Deadwood wrote letters home to relatives pleading for support against the Indian threats. Even before Deadwood, the people of the Hills leveraged neighboring towns and through them Washington, to declare war on the Sioux and after the town of

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[2] Watson Parker, *Deadwood: the golden years:* pp 48
[3] Watson Parker, *Deadwood: the golden years:* pp 53
[4] Watson Parker, *Deadwood: the golden years; Robert F. Karolevitz, Challenge: the story of South Dakota;* George W, Stokes, *Deadwood gold;* Helen Rezatto, *Tales of the Black Hills*; Edwin A. Curley, *Edwin A. Curley, Edwin A. Curley ' s Guide to the Black Hills*

Deadwood existed, it became the launch point to a campaign of verbal dehumanization against those Sioux who would wish the prospectors off the land. Not to steel themselves against the war with the Sioux but to reaffirm their belief that they, as whites, were just in their raping of the land.[5] In a travel guide published in 1877, Edwin A. Curly, transcribes the sentiments of those in the Hills, and some in the lower plains,

> "There is no race on the earth that deserves extermination
> and certainly not any in America, where there is room
> enough and to spare for all classes and conditions of men
> to work out a destiny of progressive usefulness."[6]

While the man kept his travel guide clear of the colorful language that so many others in the Hills wrote proudly in their journals and letters, he none the less personifies the love hate relationship that was common in the Hills. As not even two pages before he expressed his contempt for those who whish the extermination of the Indian he writes about the Hills,

> "The sovereignty of the Untied States resides ultimately with the
> people and not in the Government; to that sovereignty pertains the
> right of "eminent domain," which the government has no right to
> dispose of in any way except in so far as it shall pertain to a portion
> of land absolutely ceded to an independent sovereignty, such as was
> not contemplated in the making of [the Fort Laramie] treaty."[7]

He later goes on to describe for his reader that the government can do whatever it wants, and make deals with whomever it pleases, but the people have the right to do what they want as well and that since the Sioux lands are still part of the US, whites have a legal right to use the

[5] Interview with David Milch, HBO's Deadwood, Season 1. In this interview David Milch speaks at length about the type of language used by the everyday inhabitant of deadwood and his beliefs pertaining to the higher than average amount of racial slurs directed towards Indians for the time period.
[6] Edwin A. Curley, *Edwin A. Curley's Guide to the Black Hills: pp 136*
[7] Edwin A. Curley, *Edwin A. Curley's Guide to the Black Hills: pp 134*

land as they see fit[8]. His comment about eminent domain is explained later as being evoked by the white people of the untied states over the Indians because the Indians were not civilized enough to use the land given to them in the Fort Laramie treaty.

The Fort Laramie treaty, which Curly does not think he needs to follow being a white man and a citizen of the United States, stipulated that the US government was responsible for keeping whites out of the 'Hills[9] and could they not, the Sioux were allowed to defend their land. While the Sioux war parties never entered the Hills or towns, they did so for good reason. The canyon walls prevented a full-scale assault by war parties as only a hand full of armed prospectors could defend an entire pass. However, the individual braves used the canyons as protection, lurking and waiting for individual whites or wagons. Prospectors who were alone on their claims or in passing from one town to another were known to be victims of Sioux attacks. Horses were stolen on a regular enough basis that it became possible to differentiate between horse thefts by whites and by the neighboring Sioux[10]. Of course, not all the supposed attacks were caused by the Sioux.

Road agents, who wanted to divert attention from them, would make their crimes look like the acts of Sioux. Sometimes the ruse would work other times it would not. One notable case was the murder of Preacher Smith, who was killed while passing between Deadwood and another Black Hills mining town.[11] Either way, the presence of these acts has clouded the reliability of the claims against the Indians. Regardless of how many actual Indian murders or thefts occurred, there were enough problems with the neighboring Sioux that in the town of

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[8] Edwin A. Curley, *Edwin A. Curley's Guide to the Black Hills: pp 135*
[9] Edwin A. Curley, *Edwin A. Curley ' s Guide to the Black Hills: pp 135*
[10] Watson Parker, *Deadwood: the golden years:* pp 52
[11] Helen Rezatto, *Tales of the Black Hills*: pp 208

Deadwood issued a bounty of up to $150[12] for the head of a Sioux Indian. However, there were also enough good will, or lack of blood thirsty animosity between the two, that only one person claimed the bounty.

With the attacks of the Sioux and road agents, and a high population with only one sheriff, people soon came to realize that their safety was left to them and no one else. Deadwood was one of the few towns were there were no laws preventing the wearing of weapons with its premises, there were no laws period. Ammunition was as important as food for a claim worker while on their remote claim. The possession of firearms was considered a necessity, especially during winter when mining became impossible, gold dust had to be stretched as far as possible, and food supplies increased in price. Hunting was not a pastime then but a way of life. A miner working a claim was also, by custom, required to maintain their presence at their claim or have it be forfeit to anyone passing by[13]. This resulted in miners be relatively solitary creatures, even more so than the act of mining required. The owner of claim was also responsible for protecting their land against the advances of both Native Americans and other prospectors.

With no laws in the Hills, a strict rule was unspokenly agreed upon by the prospectors. The Golden Rule, or most often called the "Six Barrel Law" was in effect across this Hills until population densities warranted substantial law enforcement. These rules effectively were: do not impede or hinder the right of another prospector to obtain his gold or you will be shot. Do not steal horses from a white man or you will be shot. Do not steal another white man's gold from his claim or you will be shot. It was not uncommon for a miner to be seen squatting in the water with a pistol at this side, or warding off a passerby with a Winchester rifle.

[12] Watson Parker, *Deadwood: the golden years:* pp 52
[13] Watson Parker, *Deadwood: the golden years*: pp 19

Last of the Frontier Towns

Continuing with Deadwood's effect on the mythos of the American Wild West, the town of Deadwood came into existence at the end of that American era and with it, the "frontier towns" vanished along with the overall frontier. Because of the physical location that Deadwood was built upon, lawless Indian land, and the temporal location that Deadwood occupied, the town became a cowboy Mecca of sorts attracting highly publicized celebrities which became synonymous with the Wild West in modern eyes. At the time that Deadwood was founded the "open range" had begun to close. The cattle drives that are now famous for creating the rugged, individual, cowboy of current western films became less frequent with the introduction of trains that could span the continent.

About this time, the romanticized "free cowboy" came into popular culture through the medium of dime novels[14]. These cowboys were expert gunmen who swore constantly and drank twice as often where as the actual cattle drives forbid swearing and liquor. These dime novels became so popular that they would later serve as some of the foundations for the 20th century's spaghetti westerns. But by 1876, the year Deadwood came into existence; the wild frontier was becoming less wild and more known. Deadwood, however, was situated in Indian Territory and truly lawless to whites. Moreover, the Sioux nation was relatively unchanged from 1868, when the Sioux nation was founded, and 1868 was the height of the frontier era.

During this time, everything between pacific and the Mississippi was relatively un-touched by whites, or Mexicans, and widely considered "free". Gaining the reputation as a town with easy money, and no laws, the few "cowboys" who reminisced upon the old days, before the range became fenced off, the many more people who read about the "free cowboys", and the

[14] Helen Rezatto, *Tales of the Black Hills: pp 192-199*

many, many more criminals and degenerates who could not make it in "civilized society" were naturally drawn to Deadwood.

Of the most notable of the icons of the Wild West who ventured into Deadwood was the notorious Wild Bill Hickok. Many have found it amusing that the man spent no more than a week in the town but has become synonymous with it. Wild Bill had been popularized by the novels using his likeness, his performances in Buffalo Bill's circus, and his own personal reputation as a lawman. He was possibly one of the most popular gun fighters during his life, so much so that he wrote a manual to the general public on how to shoot pistols with better speed and accuracy.[15] Like most folk heroism, his popularity only grew after his death.

Wild Bill arrived in the town of Deadwood in the summer of '76 in the same precession of wild west notability to enter Deadwood as Calamity Jane, "the queen of the wild west"[16], Seth Bullock and Sol Star, the first of the town's many whores brought in by Charley Utter, and an ox cart full of cats[17]. Wyatt Earp, the famous lawman of the Wild West and one of the few "real life cowboys"[18] was already present in camp at the time, though he was not to spend much more time in the camp nor was he as famous as he would become after his legendary shootout in Arizona.

Wild Bill's reputation started while he was employed by the US Army as a sharp shooter during the civil war, a profession in which he excelled. He was quickly promoted and after the war continued his service in the army seeing action in the Indian wars of the late 1860s. After the army, he gained notoriety as a take no attitude US Marshal with a rumored body count of 100; though it was most likely 20. US Marshals at the time were generally discharged union soldiers who were tasked with keeping the peace in towns after the cattle drives ended. Cattle drives

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[15] Helen Rezatto, *Tales of the Black Hills: pp 192-199*
[16] Helen Rezatto, *Tales of the Black Hills: pp 200*
[17] Watson Parker, *Deadwood: the golden years:* pp 95; Helen Rezatto, *Tales of the Black Hills: pp 192-199;* More will be told on the subject of the cats later
[18] Helen Rezatto, *Tales of the Black Hills: pp 200*

brought with them not only the cattle but also the cowboys, who were mostly ex-confederate solders with money to burn on whiskey witch brought with it impaired judgment and an ease to violence.[19] It was expected of marshals at that time to simply murder the most vocal ex-confederate cowboys they found as an example to the rest, and Wild Bill was no different.

While in Deadwood he did little more than drink and play poker, horribly, it would appear, since he is rumored to have lost most of his games. Wild Bill had lost a great deal of money in poker before and originally came to Deadwood in an attempt to recuperate his losses via prospecting. During a game of poker in the Number 10 Saloon, which Bill was a frequent patron of, he was shot in the back of the head by the "cowardly nobody" [20] Jack McCall. In his hand at his death he held a poker hand of black aces and eights the now known as the "dead man's hand". Jack McCall was later arrested in Cheyenne where he was tired, found guilty of the murder of Wild Bill, and hanged till he was dead.

In the procession that entered the town on that summer afternoon in 1876, Calamity Jane was right at the side of Wild Bill. While she could be considered to be mildly famous during her life, her popularity exploded just before her death as her literary doppelganger started along side Wild Bill in dime novel westerns. The author of these novels chose her, as he had done Wild Bill because she matched the personality and history that the other felt best personified the Wild West. Her likeness was rather spot on; just as in life, she dressed in men's clothes and possessed a mouth that could make a sailor cringe.[21] She led a full life of open range jobs before entering the town of Deadwood in '76. She was a scout for Custer during the civil war, she was an ox driver, she was first entered the Black Hills in 1875 with the surveying party sent to verify Custer's finds. She, along with Wild Bill, and Red Cloud, worked for Buffalo Bill in his western

[19] Interview with David Milch HBO's Deadwood; *Helen Rezatto, Tales of the Black Hills: pp 192-199*
[20] George W, Stokes, *Deadwood gold*: pp 81
[21] Interview with David Milch HBO's Deadwood; *Helen Rezatto, Tales of the Black Hills: pp 200*

circus which contributed more then anything else to the modern notion of the Wild West. She spent many years in the town of Deadwood; many of those years were spent drunk and as a whore under the employ of Al Swearengen in the infamous Gem Theater.

The few times she did sober up and left her mark on the town as more than a cross dressing boozer. She worked the sick tent just outside Deadwood during the town's small pox epidemic and was always kind to the children of the camp. During her time in the Hills, she made enough of an impression that the people of the Hills named one of the peaks in the mountains after her.[22] As it stands today, she is buried in the town's cemetery in a plot next to Wild Bill's, being closer to him in death than she was in life.

Now a brief mention of the notorious law man, Wyatt Earp: as mentioned earlier, Wyatt Earp was in the camp during its founding year of 1876. He came in during that winter and not much is known about him before he was unceremoniously kicked out of camp by Seth bullock, the town's first sheriff. He was employed by the Wells Fargo company to "ride shotgun" on their heavily armored, gold carrying, stage coaches in and out of the Hills.[23] That is to say, he was hired to hold a shotgun and shoot anyone who looked suspicious the moment they stepped into view.

In the year 1879, a fire swept through the town of Deadwood destroying everything and it is generally marked as when the town began to grow up and settle down. The fire had little to do with slowing down the Black Hills' rush as much as the introduction of hard rock ore mines into the region did. However, as a result of the population decline caused by the fire and hard rock ore mines, the town possessed a low population density and was still highly isolated from the rest of America preserving a frontier feel. Those who grew up during the ages of the Wild West and

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[22] George W, Stokes, *Deadwood gold:* pp 83
[23] Helen Rezatto, *Tales of the Black Hills: pp 200*

were fortunate to find permanent employ as a homesteader in the Hills, enjoyed a semi frontier life until a decade later when the trains came. While the town was obviously more law abiding than during its founding years, with such a low population density following the collapse of the rush, the Hills were as much a part of the frontier as Alaska was. Even after becoming a legal part of the US in 1877, Deadwood remained restless and dangerous due to the isolation brought by the Black Hills.

Ox drawn wagons and carriages were still the primary transportation into the Hills and into the town of Deadwood. While some trails had been transformed, many carts and coaches still had to be painstakingly lowered into the narrower parts of the Hills. Moreover, the Sioux were only pacified in so much as the large war parties were concerned. Young Sioux warriors still left the reservation often to hunt the white population of the Hills. Not until 1889, when a narrow gauge rail line was completed into the town did Deadwood, and its citizens begin to view themselves as truly part of the rest of America and the Sioux were not pacified until after the battle of Wounded Knee a year later.

Imitators are Dime a Dozen

Deadwood's "birth" as a town, was unique amongst all mining towns in the US. This added to its popularity at the time and the attraction it had to the general public. While the events that surrounded the creation of deadwood are worthy of note on a historical side, they also contributed greatly to the general public's desire to risk the journey and go to deadwood. Where previously the nature of Deadwood being a lawless town attracted those who were joined at the hip with the Wild West, the average citizen cared more about land to make an honest living from than panning for gold and making city wages. Many people read about Deadwood and the black hills and embarked on the journey of following their dream, some without the addition of gold.

It should be mentioned that at this point the industrial gold mining machine was already existent in the US. Moreover, it was at that time highly efficient at not only extracting the gold ore from the ground, but also in buying up and controlling, the gold producing claims. The gold rushes in the Montana Territories and New Mexico Territories were short lived because of this and only the great distance that prospectors had to travel during the beginning of the California gold prevented this during the ’49 rush. The existence of hard rock ore mines meant that instead of living free in the river making their own fortune, gold prospectors worked in a company mine and lived in a company town under company rules and were paid in controlled wages with nothing left up to luck.

Because the Black Hills were in Sioux territory, and thus removed from the protection of US mining laws, large mining firms did not immediately move in. This gave time for placer miners to not only dodge the roaming bands of Sioux, who were attacking all whites in the area, and US Cavalry, who were tasked with keeping prospectors out,[24] but to set up claims and towns free of outside interference. While most of these claims would be sold to the professional mining operations, and the nearby towns would become company towns, the only town in all of the Black Hills to remain “free” was that of Deadwood. But first, a bit of back-story on the state of the Black Hills.

In 1874, the climate of the US was much different from in 1868 when Red Cloud began a war with the US in the Powder Ridge country in Montana. To start with, President Grant was in power and his administration had a distinctively harsher tone with the Indian tribes than Johnson did, but more on that later. In the medium, the Grant administration felt it necessary to respond to the rumors of gold in the Black Hills quickly to help alleviate the 1870s banking crisis. The US

[24] Robert F. Karolevitz, *Challenge: the story of South Dakota*: pp 115-124, Helen Rezatto, *Tales of the Black Hills*: pp 88-94

Army dispatched Colonel Custer to the Black Hills in the summer of 1874 with the explicit purpose of surveying the Black Hills. On the record it was to determine a location for a military fort[25], off the record it was to find gold.

In 1868, Red Cloud and his organized Sioux warriors defeated the US army and Washington sued for peace. This peace treaty was known as the Fort Laramie treaty. The single most important part of the Fort Laramie treaty was the creation of the great Sioux reservation and through it the Sioux Nation. A single reservation which then encompassed large portions of Montana, Wyoming, and Half of what is now South Dakota; it also included the Powder River country as an unseeded territory for Sioux hunting. Within the land granted to the Sioux, their most scared land, the Black Hills, were given to the Sioux and placed under their direct control with strict rules pertaining to them, such as the provision that whites were not to enter it.

While whites were allowed in parts of the Sioux reservations, and in the general Sioux nation, no whites were allowed in the Black Hills without expressed permission from the Sioux.[26] This single line of the treaty would be "the groundwork for endless trouble between the Indians and the United States Government"[27] That line also created the unique experience that was to become the Black Hills Gold rush. Custer's expedition was illegal, since the Sioux had not given permission to Custer nor did the US government seek permission in the first place; perhaps because they knew permission would not be given. There exists a clause in the treaty which allows for whites to enter the Black Hills unannounced, when those in question are in pursuit of boarder violators or whenever necessary to keep the border safe from violent Sioux.

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[25] Watson Parker, *Deadwood: the golden years:* pp 3
[26]Robert F. Karolevitz, *Challenge: the story of South Dakota*: pp 115-124; Helen Rezatto, *Tales of the Black Hills*: pp 88-94; Robert M. Utley, *Custer Battle Field*: pp 15
[27] Robert M. Utley, *Custer Battle Field*: pp 15

An expedition consisting of mounted soldiers, wagons, geologists, experienced gold miners, engineers, a mounted brass band, and newspaper reporters does not fall under either definition.

One might question why Custer had brought reporters along with his expedition, or the president's son and a military brass band which continuously at the head of their expedition, but Custer was no fool and he knew how important reporters could be if gold was discovered. The expedition was not founded upon a wild goose chase, and after a few short days, the expedition found gold in the Deadwood River in the summer of 1874. While Custer himself wrote sparingly at the end of a letter addressed to his wife that gold had been discovered in moderate quantities[28], he wrote in great detail in his military report as the reporters in their rough drafts of future articles which would depict the Deadwood river valley as an El Dorado.

The discovery of gold was printed in all the major newspapers across the country soon after the metal's discovery. They all spoke of rivers so covered in gold that all you needed was a knife to disturb the river bed before you found it[29], they all spoke of the Deadwood River; so named for the trees in the valley which appeared dead when it was discovered. Soon people from all across the country, whether rich or poor, employed or, more commonalty at that time, unemployed, dropped what they were doing and left for the Deadwood River Valley in the Black Hills. However, in the military report that Custer also leaked to the press, he spoke grandly of virgin meadows and forests. He spoke in such grand terms about the natural beauty of the hills that, without the desire for gold, people began leaving in droves in order to claim some part of it for themselves.

As many mining tows before had been considered "lawless" due to the lack of lawmen in boomtowns and the mistrust between thousands of people, the mining camps of the Black Hills

[28] Helen Rezatto, *Tales of the Black Hills*: pp 85-86
[29] Helen Rezatto, *Tales of the Black Hills*: pp 85-86

were actually without laws. More the point, in the eyes of the US government, even the humble, law abiding prospector became an immediate criminal once that person entered the Black Hills, subject to arrest and detainment.

By the Fingers on One Foot

The settling of the Black Hills was troublesome enough for all parties involved. The US government would have rather purchased the land rather than going to war for it, but the influx of prospectors into the Hills inflamed the Sioux adding to the list of grievances against them. The US attempted to remove the prospectors, in fear of retribution from the Sioux and entering into another, possibly un-winnable war, however the narrow Limestone canyons of the Black Hills served to protect the prospectors and hinder the advance of the Cavalry. It also helped maintain the remoteness of the town of Deadwood during the post gold rush days. This, along with the lack of mining company control over the affairs of the town, allowed the town to remain "young" and wild when all other towns were "old" and civilized contributing to the idea that Deadwood was the last frontier town.

Now, if the prospectors were able to get past the roaming US Cavalry and Sioux war parties, they suddenly found themselves inside weathered limestone canyons in part of a limestone and granite outcropping in the middle of South Dakota's elevated sandstone plains. Canyons so narrow that only one oxcart could pass at a time and which rose hundreds of feet into the air; pristine ambush points if the prospectors chose to defend themselves a large military force. The Sioux understood this and hesitated launching large scale assaults onto the mining towns of the Black Hills for just such reasons. Unfortunately, the canyons also made communication and re-supplying difficult, so not every mining town was privy to their own post

office, bank, general store, and excreta. The only town which had the combination of both accessibility and notoriety, and therefore a steady influx of new people bringing with them capital to sustain their banks, stores, clothing shops, hotels, and post offices, was Deadwood.

The result was that other towns began to do business on a regular basis with Deadwood. Just as miners came from other boom towns during the rush to Deadwood to buy food, ammunition, equipment, and spend their gold on whiskey and whores, in the years after the gold rush ended, miners still came into Deadwood to spend their money on whisky and restock their home supplies. The Homestake mine would use Deadwood banks rather than the town of Lead's or their own stages coaches in favor of Deadwoods.[30] While Deadwood could not employ nearly the same number of people that any of the mines could, it still possessed a lucrative non-mining employment sector.[31] These factors would aid Deadwood in becoming the only non company town in the Hills during the 19th and 20th centuries.

Deadwood became famous as a rich location for placer mining, not hard rock load mining. As one old timer from Deadwood quaintly put it, "you can count the number of hard rock mines that are actually in Deadwood on the fingers of one foot."[32] Thus Deadwood, unlike it's sister towns, stopped being a large gold producing area. It still remained a profitable commerce town and was the home for the major banks of the Hills, all independent of the mining companies and taxable by the town.

It would seem that US was correct in their hopes that the Black Hills would produce enough gold to bring the US out of it's recession and stave off further recessions down the road. The huge quantities of gold brought out by the Homestead mine in general undoubtedly helped

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[30] George W, Stokes, *Deadwood gold:* pp 122

[31] Watson Parker, *Deadwood: the golden years*: Large amounts of lumber mills were established in the region for both the construction of mining equipment and also of buildings which survived late into the 19th century. *George W, Stokes, Deadwood gold:* pp 26

[32] Watson Parker, *Deadwood: the golden years*. Pp 58.

improve the economy over the years[33]. While the rest of the country was held under the sway of the market hand, Deadwood and the Hills were under the protection of a steady supply of gold. Large mining firms, mostly the Homestake mine, placed their newly smelted gold ingots in Deadwood banks allowing for lending to continue. The mines of course, made hefty sums off their "investments" but the effect it had in the Hills was a continued sense of independence and a stable standard of living brining with it many people from outside the Hills well after the glory days the 'rush were over.

Something should be said now about what a company town is. A company town is a town in which the primary employment of a majority of its residents resides with a single company. The company then holds sway over the elections and laws in the town and in some form or another owns and operates the commerce. Deadwood was unlike the company towns in that it maintained its older elected government which stemmed from the illegal days, remained intact. While the other camps in the Hills operated under the golden rule or the "blue six barrel law" Deadwood employed a Mayor, Sheriff, fire marshal, and health commissioner. In only one instance it could be said that anyone was bought off or an election stolen making Deadwood a "free" town increasing its already heavy gravity amongst the citizenry of the United States.

The steady increase of new people on a regular basis, the mild danger associated with traveling between towns, the remoteness of those who lived on the outskirts of town maintained the feel of independence the town had during its founding years. Adding to this was the daily image of a stage coach arriving into down in the same muddied and worn fashion that they had arrived in during the gold rush years. Before the automobile, transportation was on horse carts, horses, or trains. Rarely did people arrive in a new town by stage coach or freight did arrive

[33] A full detail of the effect that the gold brought out of the Black Hills did for the nation can be found in the second chapter of *Deadwood: the golden years.*

pulled by 8 oxen, or if they did, the coaches would be far nicer than the ones that still arrived in Deadwood.

This was the result of the same canyons and trails that prevented the military from evicting the prospectors during the summer of ’75. The exact same armored Wells Fargo coaches that transported gold out of the Hills during 1876 were still being used, on the same schedule in 1889 before the railroad opened[34]. The road, as a result of stage coaches and horse traffic was still a muddy mess that caked horses in layers of mud so think that their color could not be distinguished.[35] Not until the 20th century did, the conditions of the black hills roads become in any way capable of providing speedy and safe travel for people and freight leaving deadwood, still the hub of rail traffic, as the “Hub of the Hills” for a few more years.

Hub of the Hills

Deadwood was the center of the Black Hills gold rush, and as such, commanded substantial power in the region. Deadwood was the center of the Black Hills for many reasons; primary among them was because the town sat at the termination of all direct routs into the Hills. Because of this, the town received a steady income of both money and people. It became the hub that all the gold out of the Homestake mine passed through; both shipments and pocket money from the miners. Anyone entering the Hills would have to pass through Deadwood first. But then again, why would they, the richest placer gold claims were along the Deadwood river[36] not until the1880s did mining in deadwood die off. Later, with the trains, Deadwood would command the

[34] Watson Parker, *Deadwood: the golden years*: 101
[35] Edward A. Curley, *Edward A. Curley’s Guide to the Black Hills*: pp 129
[36] G. M. Smith & C. M. Young, *History and Government of South Dakota*: pp 61; Robert F. Karolevitz, *Challenge: the South Dakota story*; pp 114

economy of the hills keeping its title until truck traffic replaced train traffic and Deadwood began to fade.

It was in the winter of 1875 that the US's negotiations to buy the Hills, or the mining rights to the Hills, were both declined by the Sioux. The result was decision by the US to stop caring about removing the prospectors who lived illegally in the hills. And in the spring of 1876, after the influx of new, unabated, miners into the region the town of Deadwood was born.[37] In the summer of that same year, the population of Deadwood was at 10,000,[38] half the population of the hills and placer mining along on the Deadwood river had produced more than one million dollars of gold at 20$ and ounce.[39] While later hard rock load mines would produce far more money for much longer (read: the Homestake mine was the richest gold mine in the world), at the time, Deadwood was the destination for most people heading into the Hills.

Furthermore, as a sign to the influence of Deadwood on the gold rush itself, and subsequently on the Black Hills, the Deadwood fire of 1879 is considered to be the end of the gold rush. It was not simply that Deadwood ended, or that the population was destroyed by the fire, but that placer mining had died off in favor of hard rock ore mining and the large sums of easily obtained money which founded the initial grown of the town were gone. Deadwood had nothing to do with this development but the fire that destroyed the city is the marker for the rush's end and not the date when all of its neighboring towns became hard rock ore mines.

Deadwood's commerce dependency sprang up from the roll it played as a trail noxious. At the time, three paths lead into the Hills before the railroad came in 1889, and the Dakota Territory was allowed, by treaty, to maintain them even on Indian reservations. Two of the three were chosen, and they happened to be the only two of the three that terminated in the town of

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[37] Robert F. Karolevitz, *Challenge: the South Dakota story*; pp 111
[38] Robert F. Karolevitz, *Challenge: the South Dakota story*; pp 114
[39] Robert F. Karolevitz, *Challenge: the South Dakota story*; pp 114

Deadwood. They were not simple mule trials either, both departed from heavy traffic areas in the region, one from the town of Yankton and other from fort mission.[40] This location presented Deadwood with a grand opportunity, and Deadwood would later be known as the most profitable town in the Black Hills[41] both during the early gold rush and afterwards. Deadwood was the home to more than [three hotels], the best cook in the Hills, who happened to be black and a woman, a mail/freight depot, and more brothels, whiskey, and whores than a Hindu god could shake a fist at. With this new position came power, and as Spider-man is fond of saying, it also came with responsibility.

Deadwood had become the leader of technology not only in the Hills but also in the mid-western region of the US. Citizens of Deadwood enjoyed electricity in the early 1880s when electricity was not common in the west until after the great depression. Two power plants were created in the hills, one to power the Homestake mine, the other to provide power to the town of Deadwood.[42] Deadwood was to have the best of what money could buy, and Deadwood had a lot of money. The spring of 1877, the telegraph was established in Deadwood and with the addition of the only mail service in the Hills, Deadwood added to its title the information hub of the Hills to its list of many titles. During that time, mail was uncertain and irregular, being carried in and out by good natured wagon operators and travelers. Not until Charley utter opened a freight business did mail begin coming on a semi regular basis into the Hills. The method for this was individual pick up by the recipient of the letter in person. Utter Freight operated out of Deadwood, not out of Lead or Whitewood, making Deadwood the hub of money, people and information.

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[40] Robert F. Karolevitz, *Challenge: the South Dakota story*; pp 115-124
[41] Watson Parker, *Deadwood: the golden years*: pp 34
[42] Watson Parker, *Deadwood: the golden years:* pp 92

Not only did Deadwood have the telegraph installed in the spring of ’77 by a major telegraph company, but also Deadwood possessed one of the first civilian telegraphs outside of the east coast. On top of that, Deadwood became the second location in the United States to call itself home to the new invention by Alexander Graham Bell[43]. Deadwood owned and operated 150 separate telephone lines in the Black Hills a year after the Whitehouse had its first telephone installed. This development connected those lucky enough in the hills to use one, with the rest of the world, well somewhat, since at the time, telephone lines went to Washington, San Francisco, and Deadwood. The telephone did however prove to be one of the few things that the Sioux decided they enjoyed about white civilization.[44]

Even the Hill’s once short time enemy, later long time friend, the US military, played a special visit to Deadwood in its time of need. The end of the Horse Meat March General Crook lead his hungry and trail-worn soldiers to the Black Hills, were supplies were waiting for them in the town of Deadwood.[45] The horsemeat march, as it came to be known, was a military excursion in pursuit of Sioux War Chief, Crazy Horse.

The expedition ran out of supplies while hunting down renegade groups of Indians. Only after their rations were depleted did the military engaged in skirmishes with the Sioux and one pitched large scale Cavalry battle. Neither the Sioux nor the US was prepared for long battles at that time, and both sides were starving.[46] The Sioux war parties which had been watching the army from just out of their reach set fire to the brush depriving General Crook horses of food and choking the men with smoke. The march then turned south, into the Black Hills. Along the way,

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[43] Robert F. Karolevitz, *Challenge: the South Dakota story*; pp 115-124

[44] A brief account is made in *Watson Parker, Deadwood: the golden years:* pp 92, about an elderly Sitting Bull expressing shock, joy and general excitement after hearing his friend’s voice through the phone and having a conversation with him.

[45] Robert F. Karolevitz, *Challenge: the South Dakota story*; pp 121

[46] Robert F. Karolevitz, *Challenge: the South Dakota story*; pp 115-124

the soldiers were forced to kill and eat their starving horses to prevent starving themselves.[47] The march stopped off in only one town, Deadwood, before riding on to the final destination.

The march ended in Deadwood because it was the only place that could supply all the troops. The military had known that the town of Deadwood was prospers and there is some inclination that General Crook knew full well that his men would be re-supplied in the town of Deadwood rather than having to continue on to the nearest fort before being relieved. While there the military men became drawn to the "luxuries" of life they were deprived of as solders; luxuries such as women, alcohol, in their case food.

All this gave the people a Deadwood a bit of an ego which they expressed in secession demands. Comical yes, especial when considering how many hoops the people jumped through to make sure Washington did not think of the miners as secessionists while they were illegally occupying the Black Hills. However, the people of Deadwood, later echoed by the Hills in general, did not want to succeed from the United States but instead from all their neighboring territories; Montana, Wyoming, and Dakota. They wanted to be their own territory, known as the Territory of El Dorado, which of course did not succeed. The amount of Influence witch Deadwood was able to exert in Washington and other locations, during this bid and before the Great Sioux war, has been attested to the high, unemployed, lawyer population of the town. The same population that extended their influence to help rid themselves of the Sioux both during and after the Sioux war of 1876.

Leading Causes

Deadwood, as the center of the Black Hills, and its gold rush, played a large role in the Great Sioux war that ended the Sioux nation and confined the Sioux people to reservations. That

[47] Robert F. Karolevitz, *Challenge: the South Dakota story*; pp 115-124

is not to say that the entire town of Deadwood was fully to blame for the Great Sioux war, but instead that elements within it, played a major role in the war. Using its influence with the outside towns and forts, along with controlling the communications in and out of the Hills, Deadwood was capable of influencing Washington and the American public. While the people of the Hills had a live and let hate relationship with the Sioux, they were the exception not the rule. The US Government had spent the better part of 1875 trying to buy the Hills from the Sioux with nothing to show for it. Pressure was mounting from both the people of America and from members of congress to do something about the Black Hills and the Sioux.

The military at the time was President Grant's old Civil War lieutenants, Sherman and Sheridan. Generals, Sherman and Sheridan were in control of the western portion of the army, and through the war department also Indian affairs, and "were poised to rule with their fists."[48] The three decided that the Black Hills must fall under the control of the US and in lieu of a sale, war must be brought swiftly. Coincidently, Sherman had expected the problem to solve itself if given time. He reasoned that as the buffalo disappeared, the Indians would be left with no choice but go to the reservations. But time was not an option, and pressure intensified faster than the buffalo diminished.[49]

The first thing that Sherman and Sheridan looked at was the act of stopping the prospectors and giving themselves the before mentioned time. Yet, they concluded that the amount of people who were trying to enter the Black Hills greatly outnumber the army Cavalry tasked with stopping them and decided upon axing the entire plan. As mentioned before, this resulted in a flood of people into the Hills and the creation of the town of Deadwood. The Sioux, who before demanded that those who were in violation of the treaty should be imprisoned or

[48] Robert M. Utley, *Custer Battle Field*: pp 19
[49] Robert M. Utley, *Custer Battle Field*: pp 19

executed, obviously did not respond well to the news and began attacking any whites in the Hills; even soldiers who were legally allowed to patrol the boarders[50].

The military took pro-action and began sending the exact same regiments who were sent out on patrol to stop the miners, into the Hills to root out Indians, protect the towns and camps, and stop other less-desirable actions and people. The gold was also guarded by the military, when needed, as were some of the paths leading into the Hills from the plains end only. Of course, the military could not be every ware and many caravans were raided by the Sioux, or road agents masquerading as the Sioux, but no reporter in the Hills or in the rest of America bothered to notice that when writing their editorials. Deadwood took advantage of such closer relations with the US government to obtain protection on a town wide scale[51] and to remind the army that neither the town of Deadwood, nor any other considered themselves an independent nation and deserved US protection and annexation. Reasons for this abound but the most convincing of them relates to the claims[52]. If the US government viewed Deadwood and all towns in the Black Hills as secessionists, their claims would become invalidated once the inevitable occupation began.

To prevent this outcome, gestures of good faith were made. Small gestures similar of this had been made before, but never so popularized, or worse misrepresented. While the citizens of Deadwood had delegated positions of civic authority upon certain citizens, it had been done as a sign that the Hills were more than simple squatters in the hopes that the government would side in favor of them if tensions with the Sioux got heated[53]. The end result was achieved and the US

[50] Robert F. Karolevitz, *Challenge: the South Dakota story*: pp115-124
[51] Watson Parker, *Deadwood: the golden years:* pp 53
[52] Interview with David Milch HBO's Deadwood: Season 1
[53] Interview with David Milch HBO's Deadwood: Season 1; *Watson Parker, Deadwood: the golden years*: pp 53

began a war in effort to protect the valuable gold shipments out of the Hills and gain access to the resources of the Hills.

Deadwood also reached out beyond the federal government into the hearts of the American people. As all three of the Black Hills newspapers were located in Deadwood, the amount of editorials proclaiming that the Hills were theirs by right soon stacked to the sky during this time. Evermore, the letters written home, and then published according to their will, asked for assistance from the American people to end the attacks on the prospectors by military force. Washington soon succumbed to mounting pressure both within the camp and from outside it.

While in the eyes of the prospectors in the Hills Washington had looked favorably upon them and began to act in their interests, it was not entirely the case. Washington had been looking at the Hills since before the gold rush. The Hills were not only rich in gold; they possessed huge forests of untapped lumber. Black Hills forests could provide lumber for the Missourian forts and settlements that begun to run short of their much needed lumber.[54] While the need for lumber would not have made the US break their treaty, gold would have, and gold along with the additional lumber from the forests and untapped farmland would be enough.

Washington began to look for a justifiable reason to break the treaty with the Sioux because, unfortunately for the US government, the settlers and prospectors in the Black Hills were there illegally and the attacks the Sioux made upon them were legal and justified. With a year of negotiations and nothing to show for it, Washington began to "bribe" some of the Sioux chiefs into signing an abridged treaty. This failed for many reasons, chief among them was glaring fact that whites had already been in the Hills defiling their sacred ground for over a year. No chief was going to sign any document that allowed the defiling to continue.

[54] Watson Parker, *Deadwood: the golden years*: pp 34

Even if Washington sweetened the deal with additional food rations, or if the Chief in question felt that the Hills were not important (which never happened), and a chief did sign it, "risked his life at the hands of"[55] the younger braves who lived free of the agencies in the open plains with chiefs such as Sitting Bull and Crazy Horse. These traditional war chiefs lived the unseeded territory and hunting grounds provided by the 1868 treaty; hunting grounds such as the Powder Ridge Valley, the cause of the war in 1868 which resulted in the treaty of Fort Laramie. These chiefs resented the whites who lived in the Hills and defiled their sanctity. They resented more, if it was possible, their fellow Sioux that had abounded the older ways and settled down on reservations and agencies to receive food rations.

Most who settled down did not stay permanently. "In fact, many Sioux and Cheyenne shuttled back and forth between the powder ridge country and the reservation, enjoying the best of both worlds"[56] but such famous leaders, such as Red Cloud, had moved their tribes to agencies for the security and rations of the agency in the winter".[57] These Indians who lived on the fringe were the most adamant about war with the US and soon became just what Washington needed to start the war. Washington thus declared that too many Indians were trespassing outside of reservation lands and into sovereign US territory and subsequently ordered all Indians to report to agency centers, during the winter, when there was no food, and when they knew full well almost none of the Indians would be able to make the trip without starving.[58] The date came and went and so few Indians showed up at the centers the treaty was declared broken and the Great Sioux war resulted. The war ended in the fall of 1876, not even a half a year after the war had started, and "the Sioux were forced to sign away the Black Hills…giving legal validation to what

[55] Robert M. Utley, *Custer Battle Field*: pp 22
[56] Robert M. Utley, *Custer Battle Field*: pp 19
[57] Robert M. Utley, *Custer Battle Field*: pp 19
[58] Robert F. Karolevitz, *Challenge: the South Dakota story*: pp115-124; Helen Rezatto, *Tales of the Black Hills*: pp 78-94

the miners had already made an uncompromised fact."[59] Deadwood, the other mining camps, and prospectors then entered the new year of 1877 as legal residence of the United States on the backs of crushed Sioux.

The Neglected Third Path

While the town of Deadwood did not send troops to the battles nor did any of the battles take place in the Hills, they all took place on the same lands that Red Clouds war was fought on ten years before. The only time the war ever directly entered, in any form; into the Hills was when General Crook and his third Cavalry entered the Hills at the conclusion of the disastrous Horse Meat March. But something should be said here as to the war that Deadwood and the gold pulled from its rivers had caused. Deadwood's existence and the actions of those who lived within Deadwood, was a contributing factor in the breaking of Indian resistance to the US in the North West region of the country.

The infamous battle of Little Big Horn, the greatest defeat in army history before the Second World War, occurred during the Great Sioux War of 1876-1877 which resulted squarely from the prospector's existence in the Black Hills. Before the battle of Little Big Horn, the most crushing defeat the US army had sustained was from the Sioux only a decade before in Red Cloud's war. In fact, most of the battles at the start of the Sioux war were similar to those fought in Red Cloud's war. The army did not miss this connection either. Rather than make the same mistakes they had before resulting in terrible loss of life, money and time due to the inability of the US military to bring the Sioux to battle and destroying their war making capabilities, Washington was eager to try new tactics.

The tactic that initially showed the most promise was to confiscate weapons and firearms from peaceful Indians when they entered reservations or agencies to get food. This not only

[59] Robert M. Utley, *Custer Battle Field*: pp 79

disarmed potential Sioux warriors but it prevented the Sioux from hunting easily, forcing them to live off government rations. The other tactic was to arrest the marauding Sioux as they would come in to abuse the Indian agencies regardless of their innocence.[60] Many Sioux and Cheyenne warriors switched back and forth between the hunting grounds of powder ridge country and the reservation, "enjoying the best of both worlds- the old free life of the chase in the summer and the security and rations of the agency in the winter."[61] The Army was unable to prove that those who were arrested had anything wrong but were arrested just the same. At the same time, the military began a campaign of diplomacy to end the war and acquire the Black Hills from the Sioux, initially with cash payments. However, eventually the negotiations focused on food rations.

During the past ten years the lands of the Sioux Nation had been degraded and the Indians were either starving or near starvation.[62] The Sioux needed food and the US knew it. In the fall of 1876, just before winter, Congress passed an Indian appropriations bill that included a provision dying the rations previously guaranteed to the Sioux under the treaty of Fort Laramie and subsequent additions to it by Congress, until the Sioux chiefs signed away the Black Hills to the US.[63] There were previous signs of weakening but, the young braves who "spent part of the year with Sitting Bull would have none of it. Any chief that signed risked his life at the hands of those men."[64] While the action was drastic, it worked and Sioux chiefs signed away the Black Hills in return for food rations during the winter. With the loss of support from their native tribes Most of the Sioux, Cheyenne, and Lakota peoples did not fight in the war, the surrenders from

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[60] Robert F. Karolevitz, *Challenge: the South Dakota Story*: pp 115-124
[61] Robert M. Utley, *Custer Battle Field*: pp 15
[62] Robert M. Utley, *Custer Battle Field*: pp 15; "Most of the Tetons, some 15,000, succumbed to the lure of free rations and when to the reservations"
[63] Robert M. Utley, *Custer Battle Field*: pp 79;
[64] Robert M. Utley, *Custer Battle Field*: pp 22;

many of the smaller Indian tribes involved in the war came by the end of 1877 with the larger tribes of some war chiefs taking longer to surrender, but they eventually did.

The war was officially declared over when a new peace treaty was signed by the select Sioux chiefs. The treaty would later be deemed illegal, but at the time the Sioux were defeated and dependent upon US rations and Washington was in control of the Black Hills. The lands granted to them under the 1868 treaty were taken away, the hunting lands were taken given to settlers and the Sioux were confined to reservations. This effectively made the Sioux entirely dependent upon the US government for rations as Edwin A. Curley put its,

> "The Indians… cannot get food by the chase, for the pressure of the white race has destroyed the game; he cannot get food by agriculture… for the area fit for cultivation is far too small, and he cannot get it by stock raising, the industry for witch the country is best adapted, because he has no flocks or heard to start with."[65]

While the United States celebrated the victory of finally putting the Sioux under a watchful eye and moved on with the labors of mining and foresting the Black Hills, the Great Sioux War left large political divides in the tribes who did and did not fight in the war. These divides persisted for years to come and affected reservation politics into the next century.

In the aftermath of the Great Sioux War, a great number of disenfranchised former Sioux braves lived restlessly on reservations. More than a decade after their defeat, the Sioux who were raised on the stories of the hunt and the warpath eventually found an outlet for their discontent and desire to reclaim their lost land. The original Ghost Dance movement, inspired by Wovoka, sought a greater connection with the earth and harmony between both whites and Indians. For the

[65] Edwin A. Curley, *Edwin A. Curley' s Guide to the Black Hills:* pp 135

most part the teachings of this "Indian messiah" were the ideals of the Christian faith[66] but during a meeting with Wovoka, Strong Bull became obsessed with the movement and manipulated the teachings. The new form of the Ghost Dance that Strong Bull endorsed preached that if the Sioux were to be "good" and practice the Ghost Dance, the Sioux ancestors would return, the white man would disappear and the Buffalo would return.[67]

The more militant chiefs found the teachings of the ghost dance to be, surprisingly, in defense of future violence against the US, which may have possibly been Strong Bull's intent. These groups viewed the movement as a call to the traditional ways of life away from reservations and agencies and Washington of course, caught wind of this. The agency leaders and people of the Hills did not view the Ghost Dance as a peaceful assembly of religious Native Americans, but instead former war Chiefs that had fought two wars against the US, manipulating a religious movement to foster an upraise against the US. Washington was not entirely without fault on this assessment since the Ghost Dance was similar in the eyes of the laymen to the Sioux war dance.

This stigma that became associated with the Ghost Dance eventually lead to the Wounded Knee massacre and with it the destruction of the Sioux's most influential chiefs who knew what it was like to be "free." The ramifications of the Wounded Knee Massacre were wide spread in the continental North West. Since most of the former leaders, or influenced braves, of the Great Sioux war, were present for the Ghost Dance at Wounded Knee[68] and were subsequently killed in the massacre, the possibility of a Sioux resurgence, or rebellion against the US died with them. Since Crazy horse had died in captivity following his surrender in 1877, the deaths of Sitting Bull and Dull Knife marked the end of the war Chiefs who commanded enough

[66] Robert F. Karolevitz, *Challenge the South Dakota Story:* pp 196-200
[67] Robert F. Karolevitz, *Challenge: the South Dakota Story:* pp 196-200
[68] Robert F. Karolevitz, *Challenge: the South Dakota Story:* pp 196-200

support from the people to possibly instigate an uprising or unify the tribes in any form of cohesion.

With the end of the Sioux, the major Native American obstacle against US expansion westward was removed. Following the victories of both the Great Sioux war, and the unfortunate massacre at Wounded Knee, rebellious Native American tribes soon began to lay down arms and take to the reservations. Their deaths meant that chiefs which remained were the ones who "sold out" the Sioux and newer chiefs would be unable to gain the prestige the legendary Chiefs had gotten through war. Coupled with the inability of the Sioux to remove themselves from their dependency on government rations;[69] the Sioux would never again accomplish an uprising against the US. Their reservation lands would be further contracted as time passed to what are now the present day boundaries. The Sioux nation, which once comprised more than half of South Dakota, the North Eastern corner of Wyoming, and the South Eastern corner of Montana, was ended by a desire for Deadwood gold on behalf of the Untied States citizenry and their government.

Where the Buffalo Roamed

Deadwood's influence on the American plains went beyond additions to the mythos and included large scale, permanent environmental changes upon the region. The obvious environmental effects of mining forever changed the landscape of the Hills but the individual miner and the settlers introduced new species into the Hills, deforested on a massive scale, and polluted the waters. The town of Deadwood is a perfect example of the urban-core/periphery relationship in regards to the size of its ecological shadow compared to its population density. On the positive side, Deadwood propelled Seth Bullock on to the national stage.

[69] Edwin A. Curley, *Edwin A. Curley's Guide to the Black Hills:* pp 136

In the same wagon caravan that brought to the town of Deadwood famous figures such as Wild Bill Hickok and Calamity Jane, it also brought an ox cart full of cats and an important national figure, Seth Bullock. Seth was the town of Deadwood's first Sheriff yet he originally came to the town as a hardware store owner with his long time friend, Sol Star. The two moved from the Montana territory, where Seth had been a Sheriff and a member of the territorial council, to Deadwood with the intent to make it rich in the timeless scheme of supplying miners at inflated prices.[70] Both he and Sol Star rose to importance in the camp as they became Sheriff and Mayor respectively. Later in the camps history they would both become major investors in the town building banks and hotels

As sheriff, Seth Bullock gained the reputation as a fair lawman and most remarkably never killed anyone in during his tenure of enforcing the laws in a lawless town. However, Seth Bullock was more than just a Sheriff. During his time in Montana, he was the youngest person to be elected to the Montana Council when he was elected at the age of 21. During his time on the council, he proposed the first bill ever to preserve Yellowstone as a national park[71]. Theodore Roosevelt, who would later champion such ideas during his presidency, met Seth Bullock while they were both lawmen in the Black Hills.

They had been unknowingly pursuing the same suspect when the encounter occurred. Roosevelt later wrote that he had taken a strong liking to Seth that day; they would become close friends. So close that Bullock was hired as a bodyguard for Theodore Roosevelt during his campaign for president. After the national parks were created, Seth Bullock became the first Forest supervisor[72] for the Black Hills ensuring that they retained their natural beauty.

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[70] Helen Rezatto, *Tales of the Black Hills*: pp 211-215
[71] Helen Rezatto, *Tales of the Black Hills*: pp 211-215
[72] Helen Rezatto, *Tales of the Black Hills*: pp 211-215

As for the cats, they were brought into the Hills by a crafty entrepreneur with the intent sell them as either pets, or pest control to the miners and saloon operators. He only had the opportunity to sell three cats before someone, intentionally or accidentally neither is known for sure, knocked over the cages letting the cats loose to ravage the Hills. To this day, there is still a large population of common feral cats all of which are descendants of those ordinal cats brought into the camp in 1876. While the common house cat has been known to be just as adaptive to the environment as American wolves and even considered a pest in some countries, in the black hills the feral cats took the place of over predator species that were diminished though human actions.

The late 1870's has been marked as the end of the Great Buffalo era, for never again would the buffalo reach such numbers or span such distances. The reasons for the demise of the buffalo abound, and if recorded, may well match in length the number of bison that once roamed the plains. However, the human effects upon them cannot be ignored, nor can the effects that humans had upon the wildlife of the Black Hills. The first aspect that must be considered is the effect that the sheer number of people entering the Hills on such a regular basis had on the environment.

In the winter of 1875, there were so few people in the Black Hills that the military had no idea were to even look for them yet alone find them end remove them. Not even six months later, by the summer of 1876, the population of the Deadwood alone was at 10,000 and the Black Hills, at a conservative assessment of the historical census, was at 20,000 people.[73] In six months time the population of the Hills grew at more than 111 people a day, traveling not on well paved roads or on foot but by ox driven wagons though two narrow passes only. The wheels of the ox carts and stage coaches cut deep into the earth destroying any plant matter that was previously there and further erosion and soil degradation caused during the next Midwest rain storm removed any

[73] Robert F. Karolevitz, *Challenge: the South Dakota story*: pp 114

near possibility that those trails would function as anything other than mud. If the roads of Deadwood are anything to compare the much more trafficked Black Hills passes to, then ankle deep mud was something to look forward too.

The decimation of the native wildlife was not accomplished by the prospectors entering the Hills alone. Both the game and predator declines of the Black Hills were the result of land clearance for homestead farms and ranches, general deforestation, water pollution caused by placer mining, and miners hunting game during the winter.[74] The effect that ranchers had upon the predator population is well documented to be common knowledge. In efforts to protect their flocks/herds, ranches hunted wolves which would prey upon their livestock. The same effect that Ranchers had upon the predators the homesteaders had upon the game populations. As habitat was turned into farming land, the local wildlife had to find new places of food and nourishment or die. The likelihood that the huntable game would find alternative meadows and dense growth forests became smaller as more people entered the hills with intentions other than prospecting.

In 1876 when Edward A. Curly visited Deadwood for his guide of the Black Hills and the northern Great Plains, he commented upon the status of farmland. He described, in one solitary line, that all the good locations for farming and ranching had been taken and these locations consisted of natural meadows and clearings.[75] Meadows and clearings that proved so naturally nutritious to cattle and horses once fed large deer, bison, and other grazing Black Hills game. By the year 1889, just before the Deadwood fire, the total amount of cattle in the hills numbered close to 150,000 heads. This excludes sheep and horses which were also raised in the meadows and clearings of the black hills. These ranches and farms were not in existence to support the people of Chicago or Cheyenne, but Deadwood with its 10,000 person population.

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[74] Robert F. Karolevitz, *Challenge: the South Dakota story*: pp 128
[75] Edwin A. Curley, *Edwin A. Curley ' s Guide to the Black Hills:* pp 136

If auxiliary grazing grounds could be found in the forests, the game soon saw those disappearing at 300 trees a day and had to move again. The lumber mills of Deadwood produced wood slower than the demand. So slower in fact, that it was profitable to, with great effort and cost, move steam engines up into the hills during the summer of 1876[76] to power lumber mills. These steam driven lumber mills, were capable of producing 30 thousand plank feet of wooden planks a day.[77] This figure does not include the rate of plank production before the arrival of steam powered lumber mills, which had been going on since January of ’76, nor does it factor in the number of trees deforested by the still present hand operated lumber mills or the general deforestation by the inhabitants of Deadwood. Where did all this wood go? Everything in the town of deadwood, and surrounding mining camps, was made from wood; this would later contribute greatly to the speed that the Deadwood fire moved.

Each cabin on a claim or house in the city was made from wood, same as saloons, hotels, and every building in town. While sides of cabins could be made from simple cut trees cut into logs, the roof would traditionally be made from planks of wood, as would the floor. Initially, it was not the buildings that needed the wood but the miners who required planks for the construction of their sluice boxes.[78] Additionally, these sluice boxes would not survive more than a few months at most[79]. The boxes would become waterlogged, warped, or the miner would simply think that there was enough residual gold dust caught in the cracks and groves of the wood to warrant the tool’s destruction. The sluice box would be dried and burned, its ashes panned, and usually enough gold dust would be produced to cover the construction costs of a new box, preserving the demand for cut lumber.

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[76] Watson Parker, *Deadwood: the golden years:* pp 26
[77] Watson Parker, *Deadwood: the golden years:* pp 26
[78] Watson Parker, *Deadwood: the golden years:* pp 26
[79] George W, Stokes, *Deadwood gold:* pp 138

Excluding the demand for building materials the demand for wood was always constant, though not at 300 trees a day. Everything before the “modern age” was dependant upon wood. The steam engines that cut the planks ran on wood not electricity or water power, and while it is possible that the fuel consumption of the engines was supplemented by using the unusable parts of the lumber, the fuel could not be made up entirely of lumber scraps. Assuming the lumber mills could provide their own fuel based on scraps, the individual miner could not. Stoves and heaters were not powered by electricity or natural gas, but by burning wood.

20,000 people demanding wood each day for the heat required for cooking undoubtedly made its mark upon the Hills forests, since unlike the Sioux, whites did not use only dead wood for their fires. Thankfully, for the hills, most people left before the start of the winter months as they did not wish to endure a Black Hills winter. The effect that Deadwood alone would have had with its 10,000 burning unknown amounts of wood constantly to stave off the sub zero temperatures is frightening.

It may appear that Deadwood is getting much of the blame or something that occurred across the entire Black Hills region. However, since the start of Deadwood’s existence, the town possessed certain commercial enterprises that other towns and camps simply did not bother to create duplicates of. Services such as banks, commerce areas, large hotels, court houses, and this remained true with lumber mills until the introduction of the hard rock ore mines of the later period and their company controlled mills and stamps. Yet even then, deadwood was without a majority of the blame for Deadwood banks were still being used predominantly. Deadwood banks demanded wood all year round to produce coal for the smelting processes required to produce their large, “theft proof” gold bars. While gold does have a relatively low melting point, it still required large amounts of fuel to melt such quantities of gold. While the Black Hills did

have a few coal veins, they were never mined in enough effectively to meet the demands by the population. Returning to the Black Hills game, while winter did spare the forest, however slightly, it did not help the game in the slightest.

A winter in the Black Hills results in a deep snow cover over most of the hills and valleys. This snow cover and sub freezing temperatures prevented all but the most hardened miners from working their claims[80], and even the hardened could only work for short periods of time at that. Food an warmth were the two primary concerns for a miner out on his solitary claim for he owned the land by working it and had no debts. If, during the warmer months, the miner had not procured enough gold dust to purchase supplies or "live like a white man"[81] during the winter months, the miner was forced to rely upon hunting skills or starve. While the winter months did mark a decrease in the black hills population[82], as most people decided to leave the winter months in search of less harsh winter locations, the exodus of such a magnitude of people worsened the already present migration problems upon the game. However, the miners and settlers, with the exception of hunting, never intended to kill the wildlife off. That was reserved for the telegraph and railroad companies.

The American Bison have a nasty habit about charging solitary trees and knocking them down. There is even mounting evidence that the older Native Americans of the plains, who were exterminated by the Sioux as they moved westward, burned down trees in an effort to improve the buffalo pastures. This is not an anecdotal tidbit since telegraph poles, which were only installed in the western part of the plains and the Black Hills following the defeat of the Sioux and in an effort to connect Deadwood with the rest of the Plains, looks rather a lot like a tree to a buffalo.

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[80] George W, Stokes, *Deadwood gold:* pp 94
[81] George W, Stokes, *Deadwood gold:* pp 94
[82] Watson Parker, *Deadwood: the golden years:* pp 12

After enough buffalo began knocking down telegraph posts, the telegraph companies finally decided to do something about it. The companies hired an "army of guards"[83] and hunters to patrol the telegraph lines and "protect" the poles from the buffalo.[84] The hunters were told, in effect, to kill any and all buffalo they found near the lines on sight, after all there was no point in killing the bison after it knocked the pole down and disrupted communication. The exact number of buffalo slain because of the telegraph "guards" is unknown but the numbers are easy to imagine after looking at the success that the railroad had.

The railroads did come later into the Hills and the western portions of the now annexed Sioux Nation but when they did, they hurt what was left of the buffalo much worse. The railroads of the time saw no reason to move into the Black Hills or much of western South Dakota, but with the influx of people brought by the gold rush soon proved to be profitable enough to warrant rail lines. The railroad companies too hired hunters to protect the rail lines from the buffalo[85] and supply food to the workers. Buffalo Bill was one such hunter hired as to remove enough buffalo from the region that the owners of the rail lines no longer had reason to worry about their trains derailing on a bull Bison. But whites were not the only ones hired to kill the buffalo indiscriminately, Sioux who wanted the luxuries of the white's world got in on the action.

Buffalo hides were a valuable commodity in the east and the meat was lean, making it good for drying and preserving. The lure of wealth proved too much for some Sioux as they took to the plains and hunted their buffalo beyond their need.[86] Taking the hide of the buffalo, and as much meat as they could carry away from a dead beast and leaving the rest. Perhaps the Sioux

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[83] Robert F. Karolevitz, *Challenge: the South Dakota story*: pp 128
[84] Robert F. Karolevitz, *Challenge: the South Dakota story*: pp 128
[85] Robert F. Karolevitz, *Challenge: the South Dakota story*: pp 128
[86] Robert F. Karolevitz, *Challenge: the South Dakota story*: pp 128

who were unable to resist the lure of wealth did not realize they were assisting their own cultural demise, or if they did, they did not care. Regardless, the end result was the depletion of the buffalo and wild game that the Native Americans, mainly the Sioux, depended upon. As a traveler of the time, Edwin A. Curley wrote, "The Indians… cannot get food by the chase, for the pressure of the white race has destroyed the game."[87] This played a pivotal role in their defeat in 1876 by the US government and why the Sioux were unable to ever again rise against the US.

Finally, deadwood exemplified more than just a classical Wild West town; it was also a pristine example of an urban-core/periphery relationship. While most urban center cores produce something of value to the population, Deadwood, being a mining camp, produced nothing but gold. Most cities, which are urban cores, engage in the production of transforming a raw material provided by the hinterland/ periphery into a finished product. The periphery supplies the corn; the city turns it into flower, chips, bread and distributes it back to the periphery. Deadwood supplied the gold and nothing else.

The lumber that was produced at 300 trees a day did not go into manufacturing tables, chairs, chandeliers, wheels or anything other than planks for buildings or sluice boxes. Everything had to be shipped in through the same muddy trails that carried the other 111 people a day. Some items that were shipped in as part of the daily shipment of tonnage[88] included, chairs, tables, candles, glasses, windows, bottles of various alcohols, ammunition, explosives, mining equipment, non wooden building materials, all forms of clothing, ink for the printing presses, and food. This meant that Deadwood, with a population of 10,000 in 1876 when most towns in the Black Hills had a population of about 201, had an incredibly large and disproportionate to its population ecological shadow.

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[87] Edwin A. Curley, *Edwin A. Curley's Guide to the Black Hills:* pp 136
[88] Watson Parker, *Deadwood: the golden years:* pp 36

Fin

History marches on, and at the head of North Western portion of that march, for a good 15 years at least, sat the Black Hill's down of Deadwood. Flamboyant and excessive, like the mounted brass band at the head of Custer's expeditionary column into the Hills a year before its birth, Deadwood attracted all the attention afforded to a Midwestern mining town. The attention was not unwarranted, and Deadwood deserved to lead as the resting place for two of the nations Wild West era "heroes", the first Forest Supervisor of the newly created Black Hills national forest, and one time bodyguard to President Theodore Roosevelt. The town also embodied, in both heart and in sole, the violent yet noble ideals of a romanticized era of US history.

Deadwood had, by simply existing, helped contribute to the US war against the Sioux which brought an end to their nation. The war's effects did more than that, the Sioux were forever beaten from that point forward and major opposition to the American idea of Manifest Destiny was beaten with them. The Battle of wounded knee, considered by most to be the end of the "frontier" as it was the last major Indian battle, was a result of a volatile combination between the desire of the Sioux to reclaim their lost land and way of life, and the lingering terror that the Sioux inspired in the people of the Black Hills during their violent raids 14 years earlier.

Deadwood gave, through its educated population and wealth, electricity to the Northern Black Hills at a time when the average town a three hundred mile radios did not receive power until the new deal in 1938. Deadwood provided the telephone to the Hills a shocking one year after the first telephone was installed in the Whitehouse, and provided telephone service to more than 150 locations. The desire by railroad companies to gain access to the rich gold shipments

out of Deadwood would lead to the expansion of the Nebraskan railroad, providing access to hundreds of acres of land to the masses.

Deadwood would unfortunately, also contribute to the ecological degradation of the area and further destruction of the majestic American Bison. In efforts to connect Deadwood with the rest of the world, telegraph companies hired hunters to kill buffalo on sight in order to protect their lines. The vast number of people coming and going each year into Deadwood through narrow paths disrupted the wildlife patters of the Hills and the polluted waters caused by mining did what human migration could not. The initial demand for lumber by the citizens in Deadwood demanded the destruction of tree after tree endlessly for four years. And not to be excluded is the yet unknown total damage that the mining did to the surrounding environment during its time.

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Thesis #5

On the Transfer of German Aerospace Technology to, and Influences on, the United States and the Soviet Union Post-WWII

History 191 Senior Thesis

May 30, 2009

The Second World War was the only war in history where technological development during the war was instrumental to the combat efforts of the combatants. Prior to the Second World War, technological advances had generally been gradual refinements of existing weaponry, and had never had significant effects on the outcome of a war. The weaponry used in earlier wars had been invented, refined, and put into serial production before the wars started, and did not change over the course of the war. Even the First World War, which saw the advent of the tank to cross no-man's land, and the airplane to fly above it, was fought and won with weapons that were in their second or third decade of services. The Second World War then was the first time that countries could not spend lengths of time developing, testing, and refining weapons for their armed forces, but rather were forced to develop and put new weapon systems into production quickly.

While almost every weapon system in the military benefitted from this increased pace of development and production, the areas were these benefits were most obvious were in combat aircraft and in rocketry. Aircraft at the start of the Second World War were still reminiscent of those of the First World War, to the point that all of the major combatants during the war had frontline biplanes, with most of them still used in ground attack or air combat roles. By the end of the war, however, these airplanes were all several generations behind the curve, with then modern aircraft reaching the limits performance. This would have been the end of it, except that the war also saw the rapid development and refinement of a technology that hadn't existed at all until a few years before the war: the jet engine. The integration of the jet engine with the new field of high

speed aerodynamics that emerged to help design aircraft during the Second World War would set the stage for the dogfights over Korea, and for the entire Cold War air race.

The Second World War also spurred the development of the rocket, transforming it from a fringe science, more likely to be seen in a fantasy novel or movie than in real life, into a weapon of war that would, with nuclear weapons, define the Second World War. Not only would it serve as one of the most powerful weapons of the Second World War, but it was also set the stage for one of the most insane and terrifying military strategies of all time: Mutually Assured Destruction, the idea that peace can be achieved if both sides have the power to wipe out life on earth.

Both of these systems, the jet combat aircraft and the ballistic missile, where developed and brought to fruition in Germany. While other nations had similar or related programs ongoing in some instances, no other nation came close to being able to equal German technological advances in either high speed jet aircraft or in rocketry. To change this deficiency and to prepare for the Cold War that was looming on the horizon, the United States and the Soviet Union took everything they could that might conceivably help them equal and even surpass what the Germans had been able to do in high speed aviation and rocketry.

This set the stage for a unique definition of spoils of war. In addition to the economic reparations that Germany was forced to pay, their technical and industrial centers were raided as well for anything that could help either the Soviet Union or the United States in the coming Cold War. The machinery, information, and people that were removed from Germany were miniscule in the absolute sense, but would have a profound

impact on the future of aviation and rocketry in the early cold war years, and continue to have influences well into the modern world.

Aviation and Rocket Technology during World War II in the United States and the Soviet Union

Aviation and Rocket Technology in the United States

The end of the Second World War left the United States and the Soviet Union with highly skilled, but narrowly focused air force capabilities. In the United States, this focus was on maximizing the ability of its long range bomber fleets to do as much damage to the industrial ability of a country as possible[1]. To this end, the aircraft that were designed and built in the United States were masterpieces of efficiency. P-51 Mustang, P-47 Thunderbolt, and P-38 Lighting fighter planes could escort American strategic bombers over the course of an entire eight hour mission, with the single goal of protecting the bombers long enough for them to deliver their deadly payload.

This imperative for range, coupled with the massive numbers of bombers that needed protecting, produced a simple equation that dictated all American aircraft development for the majority of the war: Build as many planes as possible, with as much range as possible[2]. Thus, while early in the war the United States acquired a Whittle jet engine[3], this then new and untested jet technology was ignored in favor of refining the reciprocating engines that were already in production[45].

However, by the end of the war this technology was reaching the point of diminishing returns. While technology and development had allowed the United States to

field planes capable of flying higher and faster than anything before them, this was unsustainable. The increasing power of aircraft engines had made it difficult to fit propellers large enough to be useful, to the point were aircraft design began to be dictated by the engine power, and thus the size of the propeller used, as in the case of the F4U Corsairs. There no longer were the quantum leaps that had characterized the early war period. Given the airframe sizes and roles for aircraft, aircraft development among the western allies was no longer characterized by such innovations as multiple stage super-chargers for high altitude performance or fuel injected engines for reliability during air combat maneuver. At the end of the war, the American air force had reached the point that can be referred to as “polishing rivets”, that is, they were trying to maximize the technology that they already had. There were still refinements to be done to the propeller driven airplanes that fit into US air doctrine, but the propeller had reached the final stage in its useful life as a propulsion device for the United States. However, all this work had been done to maximize high altitude performance and range. When American planes inevitably got dragged down to lower altitudes during tog fights, their performance advantage began to disappear relative to their opponents, and the negative effects of this highly focused approach to aircraft design became apparent.

Rocketry in the United States was in a very different situation. Rather than being a mainstream part of the military effort against Germany and Japan, the rocket had been exploited where it was easy, and then simply left in stasis. The rocket artillery used by the US Army did not change significantly during the war, when it was used at all, and while there was some development in aerial rockets, it was limited primarily to building larger payloads. The only new rockets that the United States military was interested in

developing and fielding that were new to the war effort were designed to assist in the liftoff of heavily laden bomber aircraft[6].

This seems odd considering that one of the founding fathers of modern rocketry did all of his work in the United States. The problem was that while Goddard was making great strides in the field of liquid fueled rockets[7], he was also an extremely paranoid man, and so refused to work with others who were developing rockets, such as von Karman and his team[8].

This alone, however, normally would not have been enough to stifle innovation into the field of rocketry. However, there is little to no evidence that the armed forces were interested in rocketry beyond what they already had other than the assisted takeoff units that von Karman built[9]. A great deal of this lack of interest stems from the air doctrine that dictated aircraft development. Because the United States is geographically isolated, unlike Soviet Union and Germany, there was no perceived need to develop any kind of interceptor aircraft that could quickly climb to meet a bomber group, which is what drove much of the rocket development in Europe. The lack of any doctrinal need for a rocket interceptor coupled with Goddard's psychosis preventing him from working with any other innovators[10], thus conspired to prevent the United States from progressing very far at all beyond simply unguided artillery or air-to-ground rockets.

Aviation and Rocket Technology in the Soviet Union

The Soviet air force had taken a vastly different approach to aircraft doctrine and design than the United States. Rather than focus on getting the most range that they could out of their planes, they instead focused on smaller, short range tactical fighter aircraft.

There were three major reasons for this. The first of these was simply geographic: The Soviet air force was always going to be able to have runways near wherever they were fighting, because of the proximity of the Soviet Union to other nations. This negated the need for any extreme range fighters like the United States was forced to develop.

The second reason that the Soviet military focused on smaller, more agile fighters during the war is that their primary mission was not to destroy the German industrial capacity, as the United States was, but rather to protect ground formations from German tactical bombers and ground attack aircraft. They also were charged with escorting their own ground attack aircraft and protecting them from German fighter patrols.

These two forces that drove aircraft design and development in the Soviet Union resulted in a peculiarity in the Soviet air force. While most militaries were flying aircraft made almost entirely out of metal, Soviet aircraft were still primarily made out of wood[11], to the point that it was only towards the very end of the war, when the Soviet army clearly had the upper hand against German ground forces, that the Soviet air force began to include large amounts of steel and aluminum into their airplanes.

All these factors combined by the end of World War II in Soviet airplanes that were at the same rivet polishing phase as their American counter-parts, but focused on low level maneuverability above all else rather than maximum range. The Soviets were, in this regard, just as successfully single minded as the United States, to the point that German pilots were instructed not to engage Soviet fighters below five thousand meters. However, like the United States, the Soviets painted themselves into a corner. They had the best low level dogfighters in Europe, but at higher altitudes, or against faster opponents, they began to struggle.

Rocketry in the Soviet Union, however, was far more ‘mainstream’ than in was in the United States. Unlike the United States, were only a limited number of people were involved in rockets, before the war there were regional rocketry clubs and organizations in the Soviet Union[12]. This laid the foundation for the most widespread rocket use during the Second World War.

There were two major focuses of rocket research and development in the Soviet Union during the Second World War. The first, and most well known of these uses was in rocket artillery. Unlike the United States, the Soviet military focused heavily on the development and deployment of rockets in front line artillery units. There are a variety of reasons for this, but some of the major reasons include the portability of rocket launchers compared to tube artillery (especially over dirt and gravel roads in poor conditions), and the ability to fire massive salvos in advance of attacks. Soviet artillery rockets were so effective that the basic design remained unchanged during the entire war, and by the end of the war made up the bulk of the Soviet artillery batteries.

The second focus of rocket development in the Soviet Union was in their applicability to aircraft use. However, the Soviets were not intending simply on using rockets in the ground attack role like the United States did, but rather they were developing rocket planes such as the BI-1 interceptor to attack German bomber formations. However, the larger use of rocket propelled aircraft in the Soviet Union was in hybrid propulsion setups, were a rocket would be integrated into the rear fuselage of a standard fighter plane, to provide a vastly superior climb rate and short bursts of speed, while still retaining most of the maneuverability that the fighter aircraft already had. Unlike the rocket assisted takeoff devices designed and built in the United States,

however, the Soviets used primarily liquid fuel for aircraft rockets, and they were integrated directly into the frame of the aircraft, rather than being jettisoned after use[13].

The proliferate use and development of rockets in the Soviet Union stands in stark contrast to the activities of the United States for a single reason. The rocketry organizations and clubs in the Soviet Union allowed scientists and engineers to gather together and improve on each others ideas, rather than working alone, as in the United States. The later greats of Soviet rocketry such as Korolev were able to become great because of the connections that they forged in these rocketry clubs.

Technology Removed From Germany

Removal of Technology to the United States

The American effort to capture as much German technology as possible had it's genesis during 1944, when V-2 rockets and Me-262 jet fighters began to be encountered, either during attacks on London or at high altitude by bomber flights. All of a sudden, the allied leadership realized that they were dealing with technology that they might understand the basics of, had reached a level of refinement and advancement that they were completely unable to equal. In response, groups of scientists, engineers, and technicians were formed with the sole job of finding out as much as they could about German technology during the allied army advances[14]. These groups were the immediate predecessors to later, larger, and more important efforts such as Operation LUSTY and Operation Paperclip.

Operation LUSTY stood for **Lu**ftwaffe **S**ecret **T**echnolog**y**; which in a rarity in the armed forces perfectly describes the goal of the operation. The teams sent out by Operation LUSTY had a simple mission: find all the information possible about secret Luftwaffe projects, and get that information back to the United States[15]. As a result, the teams took control not just of documents, blue prints and spare aircraft parts, but also many complete, flying condition aircraft. The most important aircraft of the 41 that Operation LUSTY acquired and shipped to the United States were ten Messerschmitt Me-262 jet fighters, four Arado Ar-234 jet powered bombers[16]. These fourteen planes represented the future of airpower, and along with the literally tons of documents and data collected by the teams of Operation LUSTY, were an invaluable head start in the development of high speed aircraft for the United States. The first American pilots of these aircraft, when they first took a solo flight in the new jets, upon landing had their air force insignia removed and modified by the simple expedient of ripping the propellers while being told that they "No longer needed the propellers"[17]. Indeed, these planes would help make it so that no combat pilot in the United States needed propellers in a few years.

Unfortunately, the above information is essentially all there is that has been formally published about Operation LUSTY. The rocket programs that led to the Saturn V, the moon landings, and ballistic missiles overshadowed what happened in relation to Operation LUSTY. While a great many academic works mention LUSTY in passing, it is generally as a post-script to the air war in Europe, with no context as to what the effects of the Operation were. Equally unfortunate, unlike the Soviet Union where the absence of any jet program prior to the end of the second world war makes tracing the influence of

German technology clear, the United States had a pre-existing jet production and research program, which had already built the P-59 and P-80 jet fighters by the end of the second world war (though none of them would see combat). This camouflaged much of the influence of the German technology, making it difficult to tell what in the years to come would be entirely domestic produced, and what would be influenced by German technology.

Figuring out what exactly the United States took out of the German aircraft industry is extremely hard to determine, and likely is better suited to a full length book than it is to this paper. However, the question of why the United States took all of this technology is much easier to answer. The overarching reason that the United States took as much jet and high speed flight technology as they could out of Germany was that General Arnold had become convinced during the course of the war that technology was the only way for the air force to remain effective in the future[18]. To this end he created the first teams that went into Germany to learn whatever they could from captured documents and people[19].

However, while that was the overall reason for the exploitation of German technology, the more immediate reason, and what influenced the creation of Operation LUSTY the most was that the end of the Second World War had seen a sea change in air power. The advent of the jet and of high speed aerodynamics meant that every plane then flying was to some extent obsolete. The American aircraft that stood at the pinnacle of high speed, high altitude flight, and were the product of years of evolution and refinement, were unable to even catch jet aircraft that were still in their crude, problematic infancy as weapons of war. Jet aircraft, even though not available in very

large numbers, became such a problem that entire squadrons would be tasked to attack them as they took off or landed, the only time when they were vulnerable to propeller driven aircraft.

Jet propulsion then had become the next quantum leap forward in military aviation. Like the supercharger before it, jet engines would allow aircraft to fly faster, higher, and eventually further and any propeller driven aircraft could ever be able to. The United States leaders correctly perceived that after the Germans had successfully flown a jet fighter, and shown just how inadequate propeller drive aircraft were in comparison, that any combat aircraft that was NOT a jet would be next to useless, as there was no way for it to fight successfully.

This is where General Arnold comes back into the picture for why the US took German technology after the war. He was one of the first people to recognize the essential truth about jet aircraft and high speed flight before the end of the war[20], and so he was able to set in motion Operation LUSTY, and much of what was to come later with developments in aeronautics, going so far as to have a road map created for the future of high speed flight in the United States military. Using this plan, the German technology was integrated into the jet programs already existing in the United States, and would help to produce the most advanced air combat force in the world.

What Operation LUSTY was to the aircraft technology of Germany, Operation Paperclip ended up being to rocket technology and technicians. Operation Paperclip from the outset was designed to be non-specific. The operation was designed to get German scientists, technicians and other people with technical information about any advanced science, to work in the United States. The people that came to the United States along

information about projects ranged from wind tunnel designers to people who were working on synthetic rubber production.

However, the largest component of Paperclip, and the aspect of it that it became famous for, was the massive collection of rocketry specialists that it brought to the United States[21]. Towards the end of the war, when the Germans began to bombard London and Antwerp with V-2 rockets, Allied command and civilian authorities, it became clear that one way or another, the United States had to get its hands on the skills and technology to build their own missiles. Because of this overwhelming drive to get missile technology into the United States, the majority of scientists and engineers brought over by Paperclip ended up being related in one way or another to the German rocket programs. The most important person that Paperclip got however was Wernher von Braun, the man responsible for the design and construction of the V-2 rocket, and one of the future prime movers in the future American space program. Along with him though, were various engine specialists, fuel specialists, and aerodynamicists who had all left Peenemunde with von Braun in the hopes that they would fall into American instead of Soviet hands. In short, Operation Paperclip managed to round up all of the specialists in Germany needed to completely restart the V-2 rocket program in the United States under the direction of the US Army.

While this alone would have been a coup in itself, the organizers of Operation Paperclip also managed to get several complete V-2 rockets, and parts for many more, for importation into the United States. Additionally, they managed to secure much of the tooling and technical drawings of sub assemblies as well. This windfall for the United States allowed them to bypass whatever minimal start up time there might have been in

converting German knowledge and experience into actual rockets, and start launching rockets and training rocket teams immediately.

Understanding why the United States focused so much on getting rocket engineers and scientists out of Germany is not unfortunately as straight forward as it is with their acquisition of jet technology. While the overall desire to have the best technology in a given field that drove the pursuit of jets also drove the search for rocket technology[22], that fails to fully explain the reasons for Paperclip.

The larger reason for the pursuit of V-2 technology is likely that is was quite simply a revolutionary weapon. For the first time, a city could be attacked from beyond the visible horizon without a massive manpower requirement. While the V-2 was admittedly following in the footsteps of the Paris Gun (in both concept and overall affect on the war), it was also a clear departure in its lack of necessary logistical support. The Paris Gun needed such a large support structure, and so many people to operate it and its support, that it was completely impractical as a weapon (as evidenced by the fact that it could only be used to bombard Paris). However, the V-2 was a radical departure from this. While it is true that the fuel of the V-2 (Liquid oxygen and alcohol) were difficult to create and store for long periods of time, the actual manpower and industrial needs of the V-2 were much smaller than any other weapon that had a similar range (including aircraft). This was amply demonstrated to the leaders of the United States not only during the near-continuous bombardment of Antwerp and London, but also when they discovered the slave labor factories that had been producing the rockets.

In addition to being a new, long range, low man power weapon, there was also the implicit understanding that while both the rocket and the nuclear bomb were powerful

and terrifying in their own rights, by combining them a completely new and unprecedented weapon of war could be created. Since the dawn of the gunpowder era in Europe, cities generally were not completely wiped out in wars. They were sacked, plundered, blown up, or burned, but this was almost always easily reversible. The nuclear bomb changed that completely. After that, it was assumed that any war would involve nukes, and that more cities would share the fates of Hiroshima and Nagasaki, getting essentially wiped off the map. However, this was only possible with the rocket. Bombers could be shot down, and the only reason that the *Enola Gay* and *Bock's Car* had so little trouble with fighters in their own attacks was that at that point in the war the United States had already swept the skies clear of enemy fighters. However, it was recognized that an enlarged V-2 was the answer to this quandary. At the time, no weapon could intercept the new rockets, not even jet fighters, and so they were the closest thing to invulnerable that there was. Thus, the V-2 and other rockets would provide the ideal way to bypass the defenses of a nation and attack it without the possibility of quick retaliation, though this ability would ironically be countered by the Soviet's own rocket programs that came out of the V-2.

Removal of Technology to the Soviet Union

The Soviet Union was not very far behind the United States when it came to exploiting the technology of the Germans. In both aircraft and rocket technology, the Soviet armaments industry benefitted greatly from the influx of German technology and experience.

While the influx of rocket technology into the Soviet Union is well documented, the influx of aircraft technology and the changes that it spawned are far less well known. A great deal of this has to do with secrecy, though a major contributing factor is that unlike the space race with the United States, there was never any glamorous competition with the Soviet Union over aircraft design, and so western academics, scholars, and historians tend to ignore the aircraft technological shifts in the Soviet Union during the beginning of the Cold War.

However, even in the absence of serious academic research, there are still some significant advances in the Soviet Union that can be attributed to the German technology that they acquired. The first, and most obvious of these, is the turbo-jet engine. While the British, Americans, and Germans all had domestic turbojet projects, there is no evidence that the Soviets had any equivalent, instead focusing (as mentioned previously) on rocket propulsion to achieve high speed flight in aircraft[23]. However, there is no doubt that it was German technology that allowed the creation of the first Soviet jet fighters, the Yak-15 and Mig-9 series. While they bear little to no external indications of German influence, the engine selection is where the German origin is obvious. The Soviet RD-10 and RD-20 engines that powered these two early soviet fighters were direct copies of the German Jumo 004B and BMW 003A jet engines respectively, to the point that on some of the early prototype aircraft, when RD-10 or RD-20s were not available, captured BMW and Jumo jet engines were used without difficulty[24].

An additional inference of German influence can be made from the speed at which Soviet jet fighter technology progressed. From the first flight of the very first Soviet jet fighters in April of 1946, to a modern, second generation jet fighter in the Mig-

15 took less than two years. As context, the jump from the P-59 Airacomet to the F-86 Saber (technologically equivalent to going from the Mig-9 to the Mig-15) took exactly five years, from 1942 to 1947. While the debate over the origin of the swept wing will likely never be solved, its rapid appearance in Soviet fighters indicates that it was initially taken from German sources. Additionally, the necessity for the swept wing (improved high speed flight characteristics) was never existent in the Soviet Union until the advent of the first jet fighters, due to the low level dogfight doctrine that Soviet aircraft were designed for.

The reasons for the Soviet importation of aircraft technology from Germany are shrouded in just as much mystery as what they actually took. However, the relations between the United States and the Soviet Union, and the design of the aircraft that resulted from this technology transfer provide some guide posts.

The tensions that were developing between the United States and the Soviet Union at the end of the Second World War, over the governance of liberated countries, over financial assistance, and generally between the two economic systems, ensured that the Soviet leadership would look for any advantage that they could get in a potential conflict with the United States. While it is doubtful that they were interested in initiating a Third World War in the near future (especially without nuclear weapons, and little information about the American nuclear program), they still would have wanted to prepare for a possible war, if for no other reason than to avoid the same catastrophic defeats that marked the beginning of the Second World War for them.

However, this was easier said than done. The Soviet ground forces and navy could not be changed in short order. In the army this was because of the sheer size of the

force, and the success that it enjoyed pushing to Berlin was still influential. In the case of the Navy, it was because of the lack of experience, and the massive inferiority in almost every sector when compared to nations such as Britain or the United States. This means that the Soviet air force was the only part of the armed forces that could not only be changed in short order, but also could benefit the most from the change.

The simple reason for this is that the Soviet air force was not designed to be able to fight the aircraft that the United States was producing. While from a purely numbers standpoint, the Lavochkin and Yakolev fighters could engage American B-29 bombers and P-51 fighters at relative parity, this doesn't show the whole story. The P-51 and B-29 were designed for high speed, high altitude flight, while the Soviet fighters were, as discussed earlier, designed for low level intercept of German fighters and bombers. As such, even with similar top speeds and maximum service ceilings, performance differences within those envelopes relegated Soviet and American aircraft to different roles and altitudes.

Several B-29 bombers that had landed in the Soviet Union due to mechanical problems or battle damage also gave the Soviet leadership a chance to examine their potential targets in the next war. The highly advanced design, engines, and systems of the B-29 made it clear that a major change would have to take place in the Soviet air force if they wanted to be able to effectively engage high flying strategic bombers.

To this end, German technology and experience in aircraft production provided not only the quickest, but also the easiest way to re-equip the air force. The changes in all areas of the air force: from propeller to jet driven, low altitude dogfights to high altitude

bomber interception, and doctrinal changes for primary targets; coming together at the same time ensured a clean slate for the future.

One of the clearest examples of this sea change in the Soviet air force can be seen in the weapons selection changes between the late propeller driven planes and the early jet planes. The Yakolev and Lavochkin fighters used at the end of the war, primarily designed for low level dogfights with German fighters and for engaging German tactical bombers, have a mixture of small cannons and machine guns. This mixture, while ideal for shooting at fast moving, small targets that have very little tolerance for damage, is inadequate for engaging the heavy bombers that America was producing. The early Soviet jets, therefore, departed greatly from this established anti-fighter armament scheme.

The Mig-9, the first wholly original jet design in the Soviet Union, was equipped with a pair of medium sized 23mm cannon, along with either a massive 57mm cannon, or an only slightly less massive 37mm cannon[25] that the fuselage was built around. These cannons, with low muzzle velocities and slow rates of fire, were ideal for engaging bombers, being powerful enough to destroy most in only a few hits, but correspondingly suffered greatly against fighters, which would have been moving too rapidly to be easily engaged with the slow moving explosive shells. The limits on ammo capacity imposed by the huge shells the cannon fired also made it less than ideal for engaging fighters. Later MiG fighters, such as the Mig-15 and its derivatives were equipped with the exact same anti-bomber armament.

The history of German influence on the Soviet rocket programs is far better known and studied than that of the aircraft programs. The primary reason for this is that

during the cold war, this was simply the most obvious (and easiest) way to tell who was "winning" the war. Whichever side had the most advanced ballistic missiles, or was the first to put a probe or man into space or onto another planet was perceived as being 'ahead' in the race. As such, it is almost impossible to read about the Soviet space rocket or missile programs without some reference to the German V-2 program.

However, the story of German rocket technology in the Soviet Union is highly convoluted. The initiation of Soviet interest in the V-2 did not exist really until the British asked them for any information they got out of the missiles sites in Poland as the red army overran them on the road to Berlin[26]. It was only after this request that Stalin and the Soviet command structure began to look seriously at the V-2s.

At this point, still several months from the end of the war, the Soviets sent out several teams, similar to the later Operation LUSTY teams, to various missile launch and assembly centers in Poland. While some information was passed onto the British, the Soviets began to horde more and more of the technical data and materiel that they found at these sights. It was not until the detonation of the atomic bomb, and the concerted efforts by the United States to acquire German rocket technology that the Soviets began to make their own efforts to acquire this technology.

However, the United States by this point already had a head start. They had managed to snatch the majority of the scientists and engineers that were responsible for the design of the V-2 rocket[27], and had cleaned out the launch and assembly centers that had been taken by American troops, but were in the future Soviet Zone of occupation[28][29]. The Soviet response to this was to begin offering anyone that was connected with the rocket programs employment, living quarters, and the chance to continue their research

under the Soviets if they would come over to the Soviet side. Since this offer was extended to even the lowliest technician, the Soviets managed to get many of the 'hands-on' people that were in charge of the missile projects, providing them with an almost idea group of people to combine with the already existing theoretical knowledge that existed on rockets in the Soviet Union.

While the Soviets did not get the same kind of jumpstart in rocketry as they did in airplane technology, the technicians, machinery, and rockets that they acquired allowed their designers and engineers to begin to put their ideas into actual production, and provided a starting point for many of their future designs.

However, they got more than enough technical expertise and machinery to jump start their large scale rocketry program[30], which likely was their goal from the beginning. While the Soviet rocket sector was more than capable of making smaller liquid fuel rockets for use in aircraft, or solid rockets for use in artillery roles, they, like the rest of the world, were several generations of rockets behind the Germans when it came to developing a rocket the size of the V-2[31]. Their need for an equalizing force after the detonation of the atomic bomb meant that rocketry was of paramount importance. At the time, the Soviets had no bomber aircraft capable of reaching the mainland United States, even on a one way mission, with an atomic bomb. The V-2 and its potential derivatives presented the opportunity to not need a bomber that far, if they could only refine the V-2 beyond what Germany had been able to do.

In a way, the drive behind the soviet rocket program is identical to the drive behind their absorption of aircraft design technology. They saw the threat that the B-29 bomber and nuclear weapons posed, and saw (correctly) that in the short term at the very

least, the easiest way for them to have an equivalent would be to develop long range rockets. While they also built copies of the B-29 (as the Tu-4), these never managed to equal the performance of their American templates, and could never have reached the mainland of the United States, even on a one way mission.

Short Term Influences of German Technology

Short Term Influences on American Programs

The influence of the German technology influx in American aerospace programs was felt immediately. Aircraft designs were reconsidered in light of both the empirical and theoretical data that was brought to the United States, as well as practical knowledge gained by studying the aircraft the Operation LUSTY brought to the United States.

The most immediately obvious of these influences was the rapid adoption of the swept wing as a feature on jet fighters. The F-86, the first post-war jet design, set the standard for swept wings in American aviation for the decades to come. While there was some research in the United States on the advantages of a swept wing before Operation LUSTY and the transfer of technology from Germany, the ability to study the swept wing Me-262 greatly advanced the speed of implementation for new wing designs[32]. Even though the wings on the Me-262 were originally swept to shift the center of gravity, Messerschmitt had unknowingly stumbled upon a method for dramatically increasing the top speed of an aircraft. Development teams in the United States were quick to capitalize on the experience and data from Germany, since the Me-262 had proved that accidental or not, a swept wing was instrumental for increasing the top speed of an airplane.

A far less obvious influence from Germany was the modification and perfection of the axial flow turbojet engine. All of the prior jet projects in the United States had been primarily with centrifugal flow jet engines, which in a manner similar to the supercharges and turbo chargers that the air force was familiar with, compressed the intake air charge outwards before piping it to the combustion chambers and from there out to the tail pipe. While this engine design was technically simpler, having far less moving parts and compressor blades, in addition to using technology that was already well understood, the major problem with it for high speed flight in fighters was that it was very wide, and the only real way to make a centrifugal jet engine more powerful was to make it wider to allow for more air compression. Eventually, this would reach a point where the engine could no longer be mounted on fighter aircraft. Unlike the axial flows, the performance figures on the centrifugal flow engines did not even offer any real advantage over propeller driven planes, and being significantly shorter ranged as well[33].

The axial flow turbo jets that the Germans had refined and used on all of their prototype jets and jet fighters were of a far different design, which offered a simple solution around this problem. Instead of a single compressor at the very front of the engine, the Germans used a series of fan blades in a line to incrementally compress the air. This meant that not only were the initial axial flow engines only about half as wide as a centrifugal engine, but to increase the power of the engine, it simply got longer, which would not significantly add to the drag.

The F-86 and other early jet fighters, in addition to using the swept wings and axial flow engines that were developed from German data, also benefitted greatly from the experience of the high speed aerodynamicists that came over to the United States[34].

At the end of the war, the best aerodynamicists and wind tunnels were in operation in Germany, and these two were major targets of Paperclip[35]. This aeronautical design experience allowed not only for minor tweaks to airframes, but also significant redesigns (as in the case of converting the F-84 from straight wings to swept wings).

All of these innovations in aircraft design allowed the United States to enter the cold war with a highly advanced air force, with only a few remnants (such as the B-29 bomber) of the Second World War still in active service. This all jet air force would set the stage for the last major gun dogfights, and only major jet powered gun dogfights over the skies of Korea, against the Soviet MiG-15 fighters.

Additionally, as a direct result of Operation Paperclip and LUSTY, the United States acquired a primitive long range rocket force, and the experience to start building their own V-2s in the guise of the Hermes A-1 and A-3 missiles. However, far more important than that was the immediate work that began on the future ballistic missiles for the United States by the scientists brought over by Paperclip. While some of them were assisting with the development of the A-1 and A-3 missiles, the majority of them working under von Braun were working on the first post war American missile: the PGM-11 Redstone[36][37]. It has been estimated that Paperclip and the scientists that were brought to the United States under its auspices accelerated the acquisition of ballistic missiles by as much as a decade[38].

Further, in the short term, Paperclip essentially saved rocketry in the United States during the immediate post war period. The death of Goddard in the ending days of the Second World War[39] left the United States without any experienced theoretical rocket designers. While there were several groups of technicians who could make and maintain

simple rockets (Such as von Karman's group in the air force, and the team that worked for Goddard during his navy work in the war), they were not necessarily up to the task of designing and building anything approaching the size of the V-2.

Finally, though the United States never made any concerted effort to acquire V-1 cruise missiles (An American version, the JB-2 Doodle Bug, was built shortly after the first V-1 attacks), the V-1 served as the genesis for a series of cruise missiles during the early cold war, including the first submarine launched missiles, the 'Loon' and 'Regulus' missiles.

Short Term Influence on Russian Programs

While in the United States, the short term effects of Operation Paperclip and LUSTY are difficult to follow in aircraft development, in the Soviet Union the effects were far more obvious. The first of these, as mentioned earlier, was the mere presence of jets in the Soviet Union[40]. Prior to acquiring BMW and Jumo jet engines, the closest that the Soviet Union had to a jet was the motorjet powered MiG I-250 aircraft. This design used essentially the compression section of a jet turbine, and connected it to the aircraft's standard piston engine to power it. However, this plane could only fly for about 10 minutes with both engines on, and so, with the arrival of the turbojet in the Soviet hands, was abandoned[41].

The major short term affects that the influx of German technology had in the Soviet Union were on the air force. As discussed earlier, the Soviets were able, using captured German technology, to change their air force over from low level, propeller

driven, wooden construction dog fighters into a high speed, high altitude bomber killing force.

Additionally, the Soviets benefitted in all of the same ways that the United States did, though they were starting at a lower technology level. Unlike in the United States, where it took three successive jet fighter models to finally get to a swept wing, in the Soviet Union, the jump was completed by the second model of fighters, going from the MiG-9 to the MiG-15. This quick change development also ensured, unintentionally, that the Soviet jet forces were as advanced as possible, due to the lack of earlier, yet still effective generations of fighters to replace.

All this ensured that when Soviet supplied fighters went into combat over the skies above Korea, it was a nearly even match between the F-86 fighters on the American side, and the Soviet designed, produced, and often flown Mig-15s. The difference in Korea that accounted for the kill ratios being skewed in favor of the American pilots had nothing to do with the technology transfer out of Germany. Rather, it was simply superior training and a primitive form of aerial radar that allowed American pilots to emerge victorious. Indeed, had the Soviet Union not had the chance to fully integrate German technology into their air force with swept wings and the jet engine, it is entirely possible that the air war in Korea would be remembered in a similar light to the air war in Operation Desert Storm; that is to say, non-existent.

Not only did the Soviet development of their air force parallel the United States' largely, but their progress after acquiring V-2 rockets was also similar. In the Soviet Union, all of the rocket engineers had been focusing on aircraft and artillery rockets[42], with little care given to actual ballistic missile design or development, however, when the

Soviets acquired the V-2, they instantly (like the United States), received a leg up in their rocket program. However, unlike the United States, the Soviet Union had a very large and very active body of scientists and engineers who could capitalize on the technology that they received, where the United States had to make due with using almost entirely foreign scientists brought over by Paperclip.

The byproduct of this ability to use domestic scientists is quite unique. After the R-1 rocket was built (an exact copy of the V-2)[43], the developmental efforts in the Soviet Union were split. The primary group for all future rocket and missile work, including ballistic missile, was a team of soviet scientists, including Korolev, who had gained practical knowledge on the construction of large rockets from the Germans, both in occupied territories and in the Soviet Union. The second, far less important, group was composed almost entirely of German engineers and technicians who had been deported from Germany to work in the Soviet Union on rocket designs[44]. This group would have very little overall effect on Soviet rocketry, with only the occasional development incorporated into the designs of the Soviet team, and would within a few years be returned to Germany. However, their immediate presence, and their assistance to the Soviet rocket programs cut almost a decade off the time line for the Soviets to be able to design and build their own ballistic missiles[45]

Long Term Influences of German Technology

Long Term Influence on the United States

The long term influences of German technology on American research and development programs in aviation and rocketry are immense, and are what made American achievements and technology what they have become famous for.

The first major long term influence that German technology had on the United States' aircraft programs was in variable geometry wings. These are wings designed to be adjustable for various sweep angles, optimizing either low speed maneuverability and lifting capacity, or high speed aerodynamics and efficiency. The first American plane to utilize this technology was the Bell X-5 experimental plane. However, this X-plane was based on a German project designated P.1101, undertaken by the Messerschmitt company late in the Second World War. The technical data drawn from the P.1101 led directly to the construction of the X-5, down to even looking almost exactly the same[46]. The only significant difference between the two planes was that the X-5 could adjust the wing sweep angle in flight, while the P.1101 could only do this while on the ground.

The information gathered from the X-5 and the P.1101 were later used in the design and construction of the B-1 and F-111 bombers, as well as the famous F-14 naval fighter. It is generally not a good idea to play the "what if" game in history, but if the P.1101 and it's information had never come to the United States, it is likely that the X-5, F-14, B-1, and F-111 would never have existed, or if they had, would have been far less refined and capable than they are.

An even longer term influence that illustrates the confluence of German and American technical experience and vision is the design known as the flying wing. This is simultaneously one of the oldest, and yet most advanced designs in the world[47]. During the Second World War, there were three major design groups involved in flying wing

research. Two of these, the Horten brothers and Alexander Lippisch, were working in Germany on projects for the Luftwaffe. The third and only non-German working on the flying wing was Northrop, in the United States. All three groups managed to get flying wings (or similar tailless aircraft) flying, but it was only in Germany, with Horten and Lippisch that there was real support for the idea. Even then though, Lippisch's design, the Me-163 rocket interceptor, was not quite a true flying wing, and saw only limited service[48]. The Horten flying wing prototype crashed after a jet engine failed in flight, and in the United States, Northrop's flying wings were too little, too late.

However, this was not the end of the flying wing. The one remaining prototype of the Horten flying wing came into the United States under LUSTY or a successor program. This prototype, along with the continuing work of Lippisch in the United States and the legacy of Northrop's flying wing bombers eventually came back together at the very end of the Cold War to produce the B-2 bomber, the first true flying wing bomber in operational service.

Beyond the flying wing though, the greatest effect that German engineers had on the development of aircraft in the United States was in the area of high speed aerodynamics. Unlike Germany, the United States had little in the way of either facilities or people trained in studying this field, and so they were prime candidates for Paperclip[49]. Their contributions would affect all aircraft production for the cold war, and likely has continued to influence the design of aircraft in the United States today.

However great the long term contributions to American aircraft design might be, however, the prime beneficiary in the United States were the rocket programs. The German scientists that came to the United States because of Paperclip generally stayed in

the United States, and many of them stayed with von Braun and his continuing efforts to further the American space and missile programs[50]. This eventually culminated in the massive Saturn V rocket to send astronauts to the moon and back. Not only did the V-2 rocket provide an initial starting point for development of larger and larger rockets, but the German scientists were really the only people in the United States that fully understood rocketry, and were willing to work with others to expand that knowledge. It was later estimated that Paperclip and the scientists that were brought into the United States saved almost two billion dollars in development and research costs, and up to five years in development time[51] (excluding the decade saved in ballistic missile research that is covered elsewhere).

Long Term Influence on the Soviet Union

German influences on Soviet advances later in the Cold War were very different from the United States. Unlike those German technicians and scientists who went to America, those who had gone to the Soviet Union, either voluntarily or by force, generally returned to Germany only a few years after the end of the war[52]. While there is obviously no single reason for all of them to have done this, the primary reason was no doubt that, as mentioned earlier, they were doing relatively little to progress the sciences that they were trained in due to their isolation. Additionally, the separation of the German scientists from their Soviet counterparts meant that the soviets in a sense had two entirely separate development programs going on. When they felt that they had extracted all that

they could from the German scientists, they were finally released and allowed to return to Germany.

While the direct German influence on the long term development of the Soviet rocket and aircraft forces was thus minimized, the indirect influence was far greater. In the realm of aircraft development, those companies (including, primarily, MiG) who had gotten access to German technical materials and engines early after the war later became the premier combat aircraft designers and manufactures of the Soviet Union. Mikoyan has become one of the most well known Soviet (now Russian) aircraft design groups, in a very large part because of the MiG-9 and MiG-15, neither of which could have happened without the influx of German technology and the jump start that they gave the Soviet aircraft industry.

The long term German influence on the rocket industry in the Soviet Union was very similar to that of the aircraft industry. While there was very little in the way of direct influence, the indirect influence was enormous, possibly even greater than that of the influence on the aircraft industry. The Soviet rocket industry built their first ballistic missile as a barely improved version of the V-2 rockets that they had taken out of Germany, and later missiles were simply additional refinements upon the basic missile chassis, engines, and guidance systems. This is not very surprising though since the primary soviet missile designer of the Cold War, Sergey Korolev, was also one of the few people that had serious contact with the German scientists and technicians, as well as the rockets themselves after they came into the Soviet Union.

However, beyond looking at the design bureaus that got their start because of appropriated German technology, an analysis of long term German influence on Soviet

development suffers from the same problems that looking at the short term influences encounters: there is very little in the way of information on the subject, and what little information there is, is primarily concerned with the people who were involved on the Russian side and their personal lives in relation to the Cold War, rather than on German influences on their later designs.

Concluding Remarks

That German technology influenced the technological status of both superpowers at the start of the Cold War is indisputable. It set up the future ballistic missile arms races by providing both blocs with the same jump start in technology. It also provided the Soviet Union and the United States with jump started jet development programs. The technological development in Germany, and the subsequent transfer of that technology to the Soviet Union and the United States essentially created a blank slate in aviation and rocketry for the cold war, with subsequent developments having more to do with doctrinal differences (as discussed earlier) than with available technology or traditions.

However, this raises a question of its own: Why did Germany have such advanced technology? How was it that Germany, the losing power of the Second World War and one that spent the majority of its resources on its ground units manage to produce such technologically unrivaled items as the Me-262 and the V-2? Germany did not have any one who was intrinsically smarter than either the United States or the Soviet Union. They did not have huge amounts of resources that they could spend in the middle of a war to advance these programs. Nor did they (as evidenced by the multitude of projects) even have a single, overriding dedication to perfecting a single technology. So why did they

have the most advanced jet aircraft and long range rockets in the world at the end of the war?

There are two primary reasons for this superiority.

The first of these is simply that the Germans had a head start on all of these technologies. When America was still developing the P-51, and the Soviet Union was still fielding biplanes, Heinkel was already looking ahead and working on jet engines and high speed aerodynamics[53][54]. They had the foresight (or pure luck) to diverge in purpose from the majority of the aircraft industry, which was still working on refining the propeller driven aircraft. The He-178, the first turbojet powered aircraft in the world, flew three years before any other jet plane. This massive lead in aircraft development, combined with increasing interest by other, larger aircraft companies ensured that work was continuing in Germany at a time when Stalin was busy throwing his top aircraft designers in jail[55], and the United States was too busy trying to feed itself to worry about anything else.

In rocketry the Germans were in a similarly fortuitous situation, though in a large part it was actually a situation imposed upon them. The terms of Germany's disarmament at the end of the First World War specified maximum power for tube artillery that Germany was allowed to possess. However, it said nothing at all about rocket artillery, and so there was huge support from within the army to develop rockets. In addition to this, there was no public or widespread reason for people to not work on rockets, unlike in the Soviet Union, where it could lead to imprisonment, or in the United States, were it simply didn't pay.

The second major reason for this superiority in both jet propulsion and rocketry was that these projects were, in terms of the strain they put on the German economy, the equivalent of the American Manhattan Project. Obviously, not as much money went into rocketry and jets as did the atomic bomb, but that is an issue of total size, rather than dedication to a cause. When the rocket and jet projects are put on the same level as the atomic bomb was in the United States, then their advances start to make a great deal of sense[56]. Just as in the United States, the complete devotion of a huge portion of the economy into producing just a few new weapons of war results in weapons that are not necessarily fully refined, yet are still so far in advance of their competitors that they become the new benchmark. Just as the Soviet bomb project can be considered the result of the successful American project, so the Soviet and American aircraft and rocket projects could be viewed as the result of successful implementation of these technologies by the Germans. Indeed, "German achievements are not the result of any superiority in their technical and scientific personnel, however, but rather due to the very substantial support enjoyed by their research institutions"[57]. This support never disappeared after the war. It simply moved to different countries.

The problem though, is tracing the movement of technology and personnel once it moved to either the United States or Russia. While with the rocket programs there tends to be a fair amount of literature on the various designs and the causes for the evolution of designs from the German V-2 rockets onwards, either to the current generation of missiles or to the point at which a country decided to start with a clean slate, there is no real equivalent when dealing with aircraft technology.

While this is unfortunate, it is also entirely understandable. Unlike aircraft, during the Cold War the progression of rocket technology not only was easy to track, but also one of the central fixtures of the Cold War, with the space race, the missile gap, and all of the associated treaties that focused on strategic missiles. Aircraft, by comparison, were hiding in the shadows. Other than in open conflicts such as the Korean or Vietnam Wars were Soviet aircraft really measured up to their American counterparts. Even then, there was nothing flashy and easy to write about as with the ballistic missiles. Performance figures were shrouded in mystery, and so little information ever came out of the Soviet Union that could be studied. Because of the lack of information on Soviet aircraft, and the flashiness of ballistic missiles and space rockets in comparison, it is natural that the majority of authors writing about the technology of the Cold War focus on the rocketry. Unfortunately, this has left one of the great stories of the Cold War: the birth of the Soviet jet programs out of the ashes of the German programs; almost unknown in the west.

This, unfortunately, leaves the story of the German jet planes of the Second World War partially untold. As it stands now, generally the story of the German jets ends on May 8th, 1945, when Germany surrendered. While this paper attempts to extend the story of the German jets and jet technology later, into the Korean War, the reality is that the story of the German jets in the United States and the Soviet Union deserves for more space than this single paper can provide for it.

[1] Daso, “Hap Arnold”, 155
[2] Daso, “Hap Arnold”, 160
[3] Daso, “Hap Arnold”, 193
[4] Daso, “Hap Arnold”, 156
[5] Heppenheimer, 246
[6] Von Karman, 250
[7] Heppenheimer, 305
[8] Heppenheimer, 305
[9] Harford, 43
[10] Harford, 43
[11] Green, 152, 166
[12] Siddiqi, 5-10
[13] Gordon, 86, 210
[14] Von Karman, 271
[15] Daso, “Hap Arnold”, 205
[16] Drury, H.M.S REAPER
[17] Petrie, Stormbirds
[18] Von Karman, 271
[19] Daso, “Hap Arnold”, 151
[20] Daso, “Hap Arnold”, 151
[21] Junker, 199
[22] Neufeld, “Von Braun”, 206
[23] Junker, 200
[24] Gunston, 47, 49
[25] Gunston, 47
[26] Harford, 64-65
[27] Lasby, “German Scientists in America”, 123
[28] Junker, 198
[29] Neufeld, “Von Braun”, 206
[30] Harford, 64
[31] Junker, 203
[32] Junker, 200
[33] Heppenheimer, 246
[34] Lasby, “German Scientists in America”, 123
[35] Junker, 199
[36] Cornwell, 422
[37] Neufeld, “Von Braun”, 274, 278
[38] Junker, 203
[39] Neufeld, “Von Braun”, 261
[40] Junker, 200
[41] Gunston, 42
[42] Harford, 44
[43] Zaloga, 125
[44] Zaloga, 121
[45] Junker, 203
[46] Hueber, Me P.1101 and Bell X-5
[47] Lippisch, 1
[48] Lippisch, 45
[49] Lasby, “German Scientists in America”, 123
[50] Neufeld, “Von Braun”, 278
[51] Lasby, “German Scientists in America”, 136
[52] Zaloga, 121
[53] Heppenheimer, 241

[54] Heppenheimer, 246
[55] Siddiqi, 10-14
[56] Daso, “Hap Arnold”, 210
[57] Daso, “Hap Arnold”, 210

Rubric for learning outcome #1: "Interpret texts with due sensitivity to both textual and contextual cues." Interpretation is not a mechanical act, of simply applying an interpretive algorithm—it's an act of co-creation, with the critic marshalling appropriate strategies to interpret salient details, or rather, of balancing different details and strategies for interpreting, and assembling from this dynamic interplay a compelling argument. Context, too, is dynamic, in that there are two simultaneous contexts: those of the author, and those of the practice of literary and cultural criticism that the critic inhabits. Powerful interpretation responds to both, with balance between the two appropriate to the critic's particular purpose.					
Level/stage	Knowledge/ indicators	Standard of work/ indicators	Autonomy/ indicators	Coping with complexity/ indicators	Perception of context/ indicators
1/novice	Minimal or "textbook" without connecting it to practice/ work shows very literal understanding of the assignment, offering nothing beyond the task, or shows misunderstanding of some or all of the assignment. In particular, grasps hold of textual or contextual details in a mechanical fashion, or applies interpretive strategies without regard to appropriateness.	Unlikely to be satisfactory unless closely supervised./ Replete with errors showing misunderstanding of interpretive strategies or misreading of textual cues, especially in misreading or weak reading of literary language.	Needs close supervision or instruction./ Examples of revision respond only to instructor's literal advice, without any extension to larger issues. Revisions may not show an understanding of instructor's advice	Little or no conception of dealing with complexity./ work shows a straightforward statement of ideas with little argument, and with no intimation of counter-arguments. Argument may lack cogency; certainly lacks subtlety and creativity. .	Tends to see actions in isolation./ work stays completely in the parameters of the assignment, showing no relevance to anything but the assignment itself. "Presentist" in interpreting generic and cultural norms. No sense of either the class as the basis for entering the conversation or of the larger cultural context of the literary and cultural conversation.

2/advanced beginner	Working knowledge of key aspects of practice./ Work shows very literal understanding of the assignment, offering little or nothing beyond the task, but shows excellent understanding of the task itself.	Straightforward tasks likely to be complete to an acceptable standard./ handles well the interpretive strategies clearly called for in the assignment, but does not connect these with other possible approaches. Shows a certain bluntness in handling literary language and other textual cues.	Able to achieve some steps using own judgment, but only in narrow context of given "rules" or interpretive strategies. / Interpretations likely to repeat instructor's, or class discussion, or of outside "expert." Examples of revision respond just to instructor's advice, but may extend that advice to multiple points in the work. Revisions show an understanding of the instructor's advice	Appreciates complex situations but only able to achieve partial resolution. / Argument is cogent, but neither subtle nor creative. Thesis may be derivative, but there may be contradictory statements that show complexity without being able to manage it. Alternative arguments may be presented poorly, perhaps as a "straw man," perhaps without balance or proportion in regard to the thesis, even to the point of undercutting the thesis.	Sees actions as a series of steps. / "Presentist" in interpreting generic and cultural norms. A sense of the class as the basis for entering the conversation, but not of the larger cultural context of the literary and cultural conversation. Work may seem mechanical in moving from point to point. Transitions may be absent or forced. Sub-parts all support thesis, but without flow, without much, if any connection to the context of the class as a whole, without drawing fluidly on knowledge or skills developed in other

					classes or earlier in the semester. Work seems isolated within the demands of the assignment.
3/Competent	Good working knowledge of areas of practice / demonstrates a understanding of the standards of the discourse community, in part by using strategies beyond those immediately called for in the assignment but clearly pertinent and useful	Fit for purpose, though may lack refinement. / Insightful, cogent, identification of pertinent details; yet presentation and support tend toward the formulaic in structure and approach	Able to achieve most tasks using own judgment. / Interpretations will show some originality, even if only in contradiction or extension of ideas already presented by the instructor, in class, or by an outside "expert." Revision shows resistance to re-thinking an idea; instead shows strong ability to bolster an idea.	Copes with complex situations through deliberate analysis and planning. / Argument is cogent and subtle, and may verge on creative. Does more than simply answer the assignment's question; may even begin to question the assignment, but certainly shows an understanding of counterargument, nuanced positions, ambiguity in evidence, etc. Feels argumentative in handling nuance and complexity—tends to debate, to resolve ambiguity tendentiously. Assertiveness feels	Sees actions at least partly in terms of longer-term goals. /Truly responsive to the conversation of the class, and beyond. May respond not just to the assignment, but to the larger goals of the course or the major, and may even explicitly engage the larger cultural conversation.

				defensive.	
4/Proficient	Depth of understanding of discipline and area of practice. / Shows easy conversation with the norms of the discourse community. Interpretive strategies are apt, flexibly and skillfully applied.	Fully acceptable standard achieved routinely. / Interpretation is insightful, cogent, and well-supported. Presentation is fluid, even elegant. Rhetorical forms are tools rather than constraints. .	Able to take full responsibility for own work. /Revisions show full integration of advice as part of conversation in a community of inquiry; they show re-vision as a substantial re-thinking, rather than as a collection of local improvements	Deals with complex situations holistically, decision-making more confident/ Cogent, subtle, and creative. Assignment is a jumping off point for a conversation in the field. Counter arguments are nuanced, rich, and real, not tendentiously dismissed but rather honored as part of the conversation.	Sees overall "picture" and how this individual action fits within it/ Comfortably responds at multiple levels to the literary and cultural conversation.
5/Expert	Authoritative knowledge of discipline and deep tacit understanding across area of practice. / Not only shows easy conversation with the norms of the discourse community, but pushes on those	Excellence achieved with relative ease. / Shows such mastery of interpretive practices and of the rhetorical forms used to present them that the writing seems "transparent," that is, so perfectly attuned to the	Able to take responsibility for going beyond existing standards and creating own interpretations./ While the work fulfills the assignment, it is clear that the assignment served merely as a	Holistic grasp of complex situations, moves between intuitive and analytical approaches with ease. / Transcends the argumentative traditions of the field, integrating the esthetic experience with the cognitive	Sees overall "picture" and alternative approaches; vision of what may be possible; full integration of experience with norms of practice./ Not only responsive to, but creatively extends the

	norms, extending the boundaries or deepening the discussion within the boundaries. Interpretive strategies are apt, flexibly and skillfully inhabited, indeed transformed, from tools to extensions of the writer's persona.	work's purpose, audience and argument as to seem at one with the work rather than as a medium of expression.	springboard into exploration. Thesis takes intellectual and aesthetic risks, pushing an interpretation beyond the obvious.	seamlessly and without needed to indulge in grandstanding or proclamation.	conversation.

Appendix ii: samples of student work

Essay A

Writing 190

Gregg Camfield

5/13/10

Out of the Jungle and Into the Dilemma: The Legacy of Upton Sinclair and Michael Pollan's New Trajectory in Muck Raking Food Journalism

> "Now, as to this article," said Cincinnati, slashing into the ostensible butter and holding forward a slab of it on his knife blade . . . . "You can't tell it from butter; by George, an *expert* can't! We supply most of the boats in the West; there's hardly a pound of butter on one of them . . . . You are going to see the day pretty soon, when you can't find an ounce of butter to bless yourself with . . . . And we can sell it so dirt-cheap that the whole country has got to take it . . . . Butter's had its *day*—and from this out, butter goes to the wall.
>
> Mark Twain, *Life on the Mississippi, pp. 267-268*

Separating food fact from food fiction, it seems, has been a difficult task since Mark Twain's day at least. Contemporary readers of *Life on the Mississippi* may be as impressed to realize that butter substitutes were available in the middle of the 19th century as they are by Twain's prescience about their future prevalence. Not much has changed regarding the sale of ingenious new food products to the public since then, except perhaps the increased story-telling abilities of marketers. As Michael Pollan shows in *The*

Omnivore's Dilemma: A Natural History of Four Meals, a trip to the modern supermarket can be a "literary experience," where the line between fact and fiction is often deliberately blurred. (134) He also reveals the startling number of items in that same supermarket that are derived from a single plant source: corn. The fact that many readers will not have been familiar with this justifies Pollan's endeavor to discover the breadth of the facts when it comes to food and its production, a subject, he observes, in which much is taken for granted and much less is what it seems. Corn begins Pollan's extensive investigation into contemporary American food, a long and ranging narrative about the production and consumption of exactly what it is we eat when we sit down to a meal, or, just as often, when we eat it on the run. The question "What should I eat?" notes Pollan, has come to depend on the questions "What am I eating?" and "Where in the world did it come from?" He also notes the irony of his attempt to answer those questions. "Not very long ago an eater didn't need a journalist to answer these questions." But, Pollan implies, "eaters" weren't always, first and foremost, consumers. (17)

"Not very long ago" is a fairly vague reference to history. We can't be sure exactly when it refers to but it must be some time before 1906 when Upton Sinclair wrote *The Jungle*, a time when eaters found they needed to know what they were eating when they thought what they were eating was "Durham's Pure Leaf Lard!" and instead were informed they might be consuming Eastern European immigrants. (105) A book like *The Omnivore's Dilemma* cannot escape comparison to *The Jungle*, that seminal text in the tradition of muckraking journalism. The questions Pollan attempts to answer place him squarely in the tradition of muckraking journalists like Sinclair who seek to discredit certain sectors of industry under capitalism and, by association, the capitalist system that

empowers them. As James L. Aucoin points out in his essay **"**Journalistic moral engagement: Narrative strategies in American muckraking," "Muckraking as a journalistic genre… reports abuses of the capitalist system to stimulate 'righteous indignation' in the American middle class and urge an organized response that will demand reforms (Tichi, 2004: 14)." (560)

But whereas Sinclair's is a narrative of one Lithuanian family's journey to America and then through its perilous meat packing industry, and by metonymy through the harrowing landscape of capitalism, Pollan's is a narrative of food's journey through various food chains – industrial, organic and hunter-gatherer. The different focus of either narrative reflects the different reform goals of their authors. Sinclair sought reform in the wages and conditions of workers, ultimately through the adoption of socialism, using a certain industry of food production as a compelling backdrop. (Bloodworth, 44) Pollan seeks reform of the industrial food system for the wellbeing of consumers and seeks to effect this by influencing readers' choice of food. The two authors, writing a century apart from one another, represent points in history and points of view that are similar in some way but different in others. Their strategies in accomplishing their goals are also similar yet different in important ways. My aim is to discover Pollan's place in the tradition of muckraking journalism using *The Jungle* as a point of reference and by foregrounding the assumptions and agendas present in *The Omnivore's Dilemma*.

Michael Pollan's book *The Omnivore's Dilemma* is, like Upton Sinclair's *The Jungle*, a critique of a capitalist system, but the two accounts differ in important ways. For one thing, where Sinclair puts forth a critique of the capitalist system in general (Bloodworth, 61), it cannot be said whether Pollan advocates the same or is merely

critical of its application in the production of food. For another, where Sinclair is primarily concerned with the plight of workers Pollan is concerned with the plight of consumers. Furthermore, whereas Sinclair's proposed solution to the problems of capitalism, as presented through the character Jurgis' conversion narrative, is socialism, Pollan advocates, through his presentation and quotation of the sustainable farmer Joel Salatin, and through his own experiences hunting and gathering food, a more libertarian, consumer driven reform.

Critiquing Capitalism.

As in so many other realms, nature's logic has proven no match for the logic of capitalism.

- *The Omnivore's Dilemma* (184)

Aucoin points out that "The muckraking tradition can best be understood as carefully constructed narratives designed to focus Americans' attention on the negative social effects of industrialization, monopolization, and the capitalist economic system and to generate fundamental social and political change." (560) One of the primary negative effects of the industrialization of food that Pollan seeks to draw attention to is the demand it places on efficiency and quantity at the expense of quality. "Before the commodity system farmers prided themselves on a panoply of qualities in their crop: big ears, plump kernels, straight rows, various colors; even the height of their corn plants became a point of pride. Now none of these distinctions mattered; "bushels per acre" became the only boast you heard." (60) One of the primary effects of the capitalist economic system that

Pollan critiques is the incentive it gives companies to foster confusion about food in the mind of the public. “The lack of a steadying culture of food leaves us especially vulnerable to the blandishments of the food scientist and the marketer, for whom the omnivore’s dilemma is not so much a dilemma as an opportunity.” (5) This confusion that arises from the odd marriage between advertising and something as seemingly straight forward and fundamental as food is the reason d’ etre for the book’s title. It is the same confusion that Pollan points toward when referring to “our present predicaments surrounding food.” (3) Our present predicaments being a tidy way of summing up the current epidemic rates of obesity, diabetes, heart disease and, what Pollan contends is the source of these ailments, Americans’ confusion about what to eat.

Maura Spiegel, in her introduction to the Barnes & Noble Classics edition of The Jungle observes that:

> Although Sinclair portrays the crushing, machine-like force of a man-made hell, he turned for his title to an image of the natural world…to a place that, particularly in this period, evoked a sense of primal fear, a “heart of darkness.” The jungle represented a setting inhospitable to human life, where “civilized” man does not thrive, where life is an unrelenting and ultimately a dehumanizing battle.

Both Sinclair and Pollan then, wish to illustrate with their chosen titles how far backwards the capitalist system is capable of dragging “civilized” man. The phrase “omnivore’s dilemma” was coined by a research psychologist named Paul Rozin at the University of Pennsylvania to describe the peculiar situation of omnivores, beings who can eat much of what nature has to offer, but who probably shouldn’t eat

indiscriminately, if they want to survive and be healthy. Humanity's primitive forbearers had this problem all the time, according to Rozin; deciding what was and wasn't poisonous for instance. Over the millennia, humans learned to obviate this difficulty by passing on knowledge and building cultural traditions around food. It is the loss of a "stable culture of food," (2) insists Pollan, that leads to the prevalence of this dilemma in contemporary American society, where grandmother's recipes have been replaced by food scientists' expertise. "Such has been the genius of capitalism, to re-create something akin to a state of nature in the modern supermarket or fast-food outlet, throwing us back on a perplexing, nutritionally perilous landscape deeply shadowed again by the omnivore's dilemma." (303)

But Pollan's critique of capitalism extends beyond charging the system with willfully confounding the public's appetite, extends beyond the subject of food even. He cites the Sociologist Daniel Bell, who's book The Cultural Contradictions of Capitalism "called attention to the tendency of capitalism, in its single-minded pursuit of profit, to erode the various cultural underpinnings that steady a society but often impede the march of commercialization." In order to steer this serious indictment of capitalism back to the subject at hand Pollan adds, "The family dinner, and more generally a cultural consensus on the subject of eating, appears to be the latest such casualty of capitalism." (302) Yet another such casualty is, according to Pollan: "mercy toward the animals in our care." (318) And another: The environment. (46-47) And lastly, the casualty with perhaps the farthest reaching implications: energy independence, since we rely on the Middle East for most of our oil. (47)

In addressing these issues, Pollan acts as an advocate in the muckraking sense. Aucoin Describes the muckrakers' function thus:

> Consequently, these investigative reports are primarily located within the first of Aristotle's three traditional forms of rhetoric, the forensic or judicial form, which presents a legalistic argument of advocacy. This differentiates them from mainstream modern American investigative journalism, which is primarily epideictic – pointing out problems without seriously weighing solutions – and settles them within the muckraking tradition of American journalism (Ettema and Glasser, 1989: 271). Rather than being 'custodians of conscience', as described by Ettema and Glasser (1998: 4–11), these mid-20th century muckrakers went beyond their fellow modern investigative reporters to become moral judges of society and the people and institutions within it. (11)

Sinclair also addresses the issues of animal welfare and the environment. He describes a water way near the packing plants that is so polluted that it sometimes catches on fire (100) and devotes a number of passages to the treatment of animals in the packing plants. (40) However, the animals primary place for Sinclair proves to be as metaphor for the plight of workers. "In *The Jungle*, Sinclair made the cri de coeur of the Chicago packinghouse worker the metaphoric "hog squeal of the universe"" (Tichi, 824) Sinclair is first and foremost an advocate for workers. Similarly, Pollan is first and foremost a consumer advocate.

In the twenty-first century, Eric Schlosser, author of *Fast Food Nation*, has preceded Pollan as Sinclair's muckraking descendant. A failure to mention this text, an

exposé of fast food and its production, would leave any analysis of current muckraking food journalism lacking. All three books inarguably contain intertextual consistencies, even while they maintain important differences. Of the three, *The Jungle* and *Fast Food Nation* bear the most resemblance to each other due to their focus on workers and working conditions in the food industry. While all three books critique capitalism's handling of food production, Sinclair's and Schlosser's criticisms comprise more direct attacks on the system and insist on reform – Sinclair in the final pages of *The Jungle* through Jurgis' socialist conversion narrative, Schlosser through his own analysis:

> Over the past twenty-five years the United States has swung too far in one direction, weakening the regulations that safeguard workers, consumers, and the environment. An economic system promising freedom has too often become a means of denying it, as the narrow dictates of the market gain precedence over more important democratic values. (261)

Like Sinclair, Schlosser also spends much of his efforts attempting to garner public sympathy for the workers involved in food production, addressing many of his grievances to capitalism's cool disregard for its labor force. As Tichi observes in an essay comparing Schlosser's book to The Jungle, "A major issue in Schlosser… concerns contemporary workplace conditions in the meat-packing industry." (825) In Tichi's analysis Fast Food Nation seeks to appeal to reader's sympathies with workers:

> The individual workers in *Fast Food Nation,* Schlosser argues, typify groups "linked by common elements" that prove to be common not only to blue-collar workers but also to those in high-rise towers and office parks and even college

> and university campuses—"the same struggle to receive proper medical care, the same fear of speaking out, the same underlying corporate indifference" (186). Those at the desk may come to see kindred spirits, or at least distant relations, across the fast-food counter and over the computer keyboard to the boning knife. (828)

Sinclair sought to achieve a similar effect among middle-class readers as one of his biographers, William Bloodworth points out.

> Although he spoke *for* the lowest working classes, he spoke *to* a much wider audience in *The Jungle*…He wanted to show that not only did the Beef Trust exploit the lives of the workers, it also exploited the ignorance of the middle-class public. Food and it's processing could therefore be used politically and rhetorically as a means of bridging class difference. (60)

Sinclair himself mourns the fate of this attempt with his famous remark about The Jungle's reception. "I aimed at the public's heart, and by accident I hit it in the stomach." ("What Life Means to Me," 594) And as for Schlosser, Tichi show's that authorial intent continues to be disregarded in the modern era:

> Only 3 of the 39 reviewers, however, name working conditions as significant in Schlosser's project. "This is a book about America's stomach," according to the *Baltimore Sun,* and thus does reader response make *Fast Food Nation* another *The Jungle* in recalling Upton Sinclair's wry remark that he had aimed for the public's heart and hit the stomach instead. (Tichi, 825)

Jason Pickavance, in his essay *Gastronomic Realism*, examines scholarly takes on

this failure of audiences to connect to Sinclair's broader message due to what critics call a "culture of consumption":

> "The overriding theme of this scholarship is that our consumer culture prevents us from being properly critical of dominant political and social structures. As Fox and Lears argue, "consumption became a cultural ideal, a hegemonic 'way of seeing' in twentieth-century America." Critics of Sinclair's middle class readers follow in this tradition. A concern with safe food prevented readers from interpreting the novel correctly and, consequently, obtaining a critical perspective on America. Instead, consumers settled for legislation that addressed their narrow set of concerns. Upton Sinclair's *The Jungle* thus becomes a primary exhibit in the case against the culture of consumption. The novel's failure to achieve real reform, critics suggest, is an index of the power of America's emerging consumer culture to prevent a critique of American capitalism. Consumption was somehow an obstacle to the realism consumers demanded. Sinclair fashioned his dissent, however, not as an alternative to consumption but rather a perfection of it. (90)

By Pickavance's account Sinclair's problem did not arise from addressing consumers' interests by exposing the impurities in food - that was his only success. His problem then, was in failing to connect readers as consumers to the plight of workers. Pollan expands on Sinclair's success when he forgoes the effort of asking readers to be empathetic and identify with workers, instead asking middle class consumers to identify only with themselves. He rarely mentions workers. When he does mention workers he spends no more than a sentence on the subject and steers clear of proselytizing. Perhaps

his most damning statement in this regard comes parenthetically in the middle of his discussion of capitalism's morally corrosive effect on the treatment of animals. "(It is no accident that the nonunion workers in these factories receive little more consideration than the animals in their care.)" (318) This does not necessarily indicate a lack of concern on Pollan's part for the welfare of the workers. It is possible that he took note of the fate that befell his predecessors' attempts at publicizing working conditions and decided not to address the subject at length, or perhaps he trusted that they had said what needed to be said. More likely, in my opinion, is that he trusted consumers would be won over by the vision he lays forth of a food utopia in the final chapters of the book and that this food utopia will encompass the livelihood of workers.

Consumers, not workers or their sympathizers, are the intended audience of Pollan's efforts at reform. In a chapter six, entitled "Consumers," Pollan makes his focus on consumers plain by delivering data pertinent to them. "Three of every five Americans are overweight; one of every five is obese." Statistics like these lead into more startling ones like this: "The United Nations reported that in 2000 the number if people suffering from overnutrition – a billion – had officially surpassed the number suffering from malnutrition - 800 million." (102) Pollan attributes the glaring contrast between the stuffed and the starved to an overabundance of food, specifically corn, and the cleverness of food scientists: "Since the human desire for sweetness surpasses even our desire for intoxication, the cleverest thing to do with a bushel of corn is to refine it into thirty-three pounds of high-fructose corn syrup." (103) And, bringing the conversation back to the original dilemma: "It is the amped-up energy density of processed foods that gets

omnivore's like us into trouble." (107) When addressing the question "Is organic food better?" Pollan also answers it primarily in terms of consumer health. (176)

More explicit evidence is found in an interview with the magazine *Writing on the Edge* where Pollan sums up who he intends to be his audience:

> I guess I have some idea in my head of a New York Times reader, someone who's well-educated and generally well-informed but hasn't thought really hard about the particular issue I'm working on. I'm very careful not to assume a lot of knowledge about the issue. I know I have a reader who's curious but hasn't probably focused on this in any kind of serious way. Often in the beginning of a piece, like when I wrote that piece on industrial organic, I evoke a consumer at the beginning, someone who has this basic sense that organic has got to be better and it's worth spending the money, and they like the whole imagery that comes with it, but, gee, is it really better? And where does it come from? In a way, that's my reader and I depict myself as that reader when I start out, to connect with that reader.

If Pollan seems acutely aware of who his audience is, it might be because much of the material that ended up in the book had already been read by some of that demographic as it was published in the New York Times. Sinclair also knew his audience and was equally influenced by that knowledge in writing The Jungle since it was first published serially in the socialist publication *Appeal to Reason*. According to Bloodworth, "[The Jungle]…had a specific audience – the Socialists – who's political attitudes were largely shared with the author." (44) In addressing this audience, Sinclair chose to write fiction because, as Bloodworth observes, "*The Jungle* is a muckraking

novel directed at documenting conditions and striving for an emotional response on the part of its readers. " (61) By delivering documented conditions through fiction, Sinclair was able to manipulate the pathos to dramatic effect, such as in this passage, where he makes light of the anguish of a poet, noting in characteristically hyperbolic fashion that:

> It is not likely that he had reference to the kind of anguish that comes with destitution, that is so endlessly bitter and cruel, and yet so sordid and petty, so ugly, so humiliating…How, for instance, could anyone expect to excite sympathy among lovers of good literature by telling how a family found their home alive with vermin, and of all the suffering and inconvenience and humiliation they were put to, and the hard earned money they spent, in efforts to get rid of them? (81)

Pollan, however, wrote fact-studded and statistic-laden narrative non-fiction to deliver to consumers (educated middle-class ones) something akin to a consumer report, only more interesting and thus more compelling. This commitment to consumerism, and thus to an essential aspect of capitalism does not necessarily jettison Pollan from the ranks of traditional muckraking journalists. As Pickavance observes:

> One need only be reminded of Edward Bellamy's novel *Looking Backward* to understand that popular, literary dissent from capitalism did not necessarily involve principled opposition to consumption. Bellamy's utopia is the consumer's utopia. It is a world where the consumer receives "whatever he desires whenever he desires it."12 As Vachel Lindsay later quipped, "[i]t was a combination of glorified department-store and Coney Island, on a cooperative basis." (89)

The reason that Pollan addresses readers as consumers, as opposed to, say, readers as citizens is that he seeks to encourage consumer driven reform; reform from the bottom

(or at least the middle) up. In a chapter covering "artisanal economics" Pollan muses about the idea of such reform, quoting an essay by the agriculturalist Wendell Berry: "I'd read an essay…in which he argued that reversing the damage done to local economies and the land by the juggernaut of world trade would take nothing less than "a revolt of local small producers and local consumers against the global industrialism of the corporation." (254) This goal is distinct as opposed to seeking reform from the government. Pollan makes his appraisal of government regulation clear throughout the book. He doesn't seem to put much stock in the prospect of government regulation for curtailing the excesses of capitalism. Earlier in the same chapter he notes the irony present in the fact that a Virginian man named Bev couldn't operate his small, local meat processing facility because "his artisanal enterprise was being forced to conform to a USDA regulatory system that is based on the industrial model – indeed, that was created in response to the industrial abuses Upton Sinclair chronicled in The Jungle." Those regulations, according to Pollan, accommodate a system that is intrinsically immoral and fundamentally flawed when it comes to food. This failure of regulation, according to Aucoin, comes as no surprise to the muckraking journalist. "In muckraking investigations, the capitalistic and democratic systems operated the way capitalistic-democratic systems operate – and that, in their view, was the broader social problem in America." (562) For Pollan, such regulations also accommodate the flawed system at the expense of the solution to public problems ranging from health to animal and worker rights to the environment. That is, at the expense of artisanal food. (250)

Thus Pollan contends that the problem with industrial food is not that it is under-regulated but that it is industrial. Sinclair's proposed solution was socialism, a system of

total governance that would presumably regulate the sins out of industry, at least in terms of worker's rights. (quote from Sinclair) Pollan, however, having witnessed history's judgment of the practice of socialism in its extreme form, communism, has this to say about it:

> Perhaps it is no accident that sentimental communism foundered precisely on the issue of food. The Soviets sacrificed millions of small farms and farmers to the dream of a collectivized agriculture that never managed to do what a food system has to do: feed the nation. By the time of its collapse, more than half the food consumed in the Soviet Union was being produced by small farmers and home gardeners operating without official sanction. (256)

Thus, Pollan advocates a different path to gastronomic salvation. The revolution that Pollan and Berry envision centers on food but extends beyond to constitute "a gathering world wide rebellion against what [Berry] calls "the total economy."" "Why should food, of all things, be the linchpin of that rebellion?" asks Pollan rhetorically. "Perhaps because food is a powerful metaphor for a great many of the values to which people feel globalization poses a threat, including the distinctiveness of local cultures and identities, the survival of local landscapes, and biodiversity." (255) The revolution is about integrity, in other words, and, as the sustainable, "beyond organic" farmer Joel Salatin sees it, "you can't regulate integrity." (235) The solution presented by Pollan appears to be for consumers to opt out of the industrial food chain as much as possible. As he quotes Salatin, "We don't need a law against McDonalds or a law against slaughterhouse abuse – we ask for too much salvation by legislation. All we need to do is

empower individuals with the right philosophy and the right information to opt out en masse." (260)

Much of the philosophy presented as the solution to the ills of the industrial food system comes from Salatin. If *The Omnivore's Dilemma* were a novel like *The Jungle*, he would be the hero. Readers won't be blamed for confusing Salatin's words and philosophy for Pollan's own. Indeed, they cannot be expected to do otherwise since Pollan presents no alternatives to the ideal of Salatin's pastoral utopia. Quite the contrary, he gives Salatin the Jeffersonian seal of approval:

> The agrarian self-sufficiency that Thomas Jefferson celebrated used to be a matter of course and a product of necessity; nowadays that sort of independence constitutes a politics and economics and way of life both deliberate and hard-won - an achievement. Were Jefferson to return today he would no doubt be gratified to learn that there were still farmers down the road from Monticello as Jeffersonian as Joel Salatin. Until, that is, Jefferson got around a bit more and discovered there weren't many others like him. (204)

By invoking Thomas Jefferson Pollan is both praising Salatin and, more importantly, portraying his efforts as quintessentially American. In American political and cultural discourse it is necessary to consult the founding fathers on any subject of great importance when advocating to establish the legitimacy of any contested claims or new ideas. But Pollan does maintain some rhetorical distance from Salatin, designating him early on as a "self described "Christian-conservative-libertarian-environmentalist-lunatic farmer."" (125) And he does retain some of his journalistic objectivity stopping short of a whole-hearted endorsement of Joel Salatin when the latter questions the need

for a place like New York City. (245) But it is through Salatin that Pollan learns to distrust industrial organic agriculture (139) and eventually to partially discount it as "A much greener machine, but a machine nevertheless." (159) And it is through Salatin that much of the anti-regulatory libertarian rhetoric that grows more prevalent throughout the book is delivered. Whether Salatin is Pollan's mouthpiece, or Pollan is Salatin's or whether they both just happen to agree is unclear but is probably not important. The point here is that they do agree, and that through Pollan's presentation of Salatin he segues into something, in spirit at least, not unlike the last section of *The Jungle* in which Sinclair delivers through several characters a series of sermons advocating socialism. Only, in Pollan's case, his character preaches the gospel of self-reliance.

Sinclair, for his part, relies on "salvation by legislation," despite his critical observations of the political process and its ties to big business. Bloodworth summarizes Sinclair's account of Chicago politics, "The immigrants are also exposed to the corrupt nature of politics in a community where elections are never less than a fraud, and to the economic stranglehold exerted by the Beef Trust and its lackeys." (52) But in the end, Sinclair seeks a political solution to the excesses of capitalism. Bloodworth again: "[Sinclair's] vision of socialist triumph was something to be achieved by majority vote, not an end result of class struggle and revolution. The statement that "Chicago will be ours!" at the end of the novel refers only to voting gains in the 1904 elections." (60)

Pollan is also critical of government involvement with the economy and vice versa. He criticizes the favor that the USDA bestows upon large scale food processing facilities and points out the government run organization is staffed by those invested in the very industries it is supposed to regulate. In general, Pollan seeks to deflate the

capitalist myth of entirely free markets full of “”self made” American successes.” (41) In terms of corn, the plant that Pollan devotes many of the early pages of his book to tracking through the food system, he adds that “the closer you look the more you find the federal government lending a hand – a patent, a monopoly, a tax break – to [corn] at a critical juncture.” Pollan lays the vast surplus of corn that he attributes much of the food system’s and the public’s health problems to (101) at the feet of the federal government and its attendant military industrial complex. (41) But Pollan’s proposed solution lies at the opposite end of the political and philosophical spectrum from Sinclair’s. If he’s asking his readers to vote, he is asking them to do so with their dollars – a very modern philosophy. If Sinclair was addressing middle class audiences by aiming at their stomachs to reach their hearts with *The Jungle*, as Bloodworth suggests, then he was doing so in hopes of getting them to clamor for reform in the meat packing industry, not to seek alternatives as consumers. (59)

But Pollan is doing just that. Here he describes the market-movement that he says is starting to take place and which he seeks to encourage:

> To talk to chefs, customers and farmers working together in this one corner of the country to rebuild a local food chain is to appreciate that it is a movement, and not merely a market. Or rather it is a novel hybrid, a market as movement, for at its heart is a new conception of what it means to be a consumer – an attempt to redeem that ugly word, with its dismal colorings of selfishness and subtraction. (254)

To attempt to redeem the word “consumer” is to suggest that it was once free of its current connotations, which is unsubstantiated, but more importantly it is to try to raise

the value of that word to, in the context of what Pollan is saying, the level of value placed on the word civilian. This treatment of consumption as civic engagement is representative of a sea change in American politics and culture that has happened between the time when *The Jungle* was written and when *The Omnivore's Dilemma* was. The phrase "voting with your dollar" is after all, a very recent phenomenon. To quote Pickavance again, "In the rhetoric of consumer rights consumers found a vocabulary for helping them understand how they, in their capacity as consumers, could effect change in society by demanding that products truly represent themselves." (91) Yet this is how the free market is supposed to work according to proponents of it. It is surprising however to think of Pollan as a free-market idealist since that is often a conservative stance and many of Pollan's attitudes are decidedly liberal (Remember that his audience is largely comprised of New York Times readers). More likely he is merely conforming to the principle inherent in the statement made by Gene Kahn, the once hippy idealist-turned industrial organic farmer, that "everything eventually morphs into the way the world is." (152) The market place is encroaching more and more upon the democratic arena, or at least the distinction is becoming increasingly blurred, as evidenced, again, by the phrase "voting with your dollar," and the market-movement reflects that.

The movement is predicated on consumers' desire to have more control of their food supply. With more control, however, comes more responsibility and less convenience. Convenience, it should be noted, was probably the masthead under which many consumers once began to slowly concede control of the food supply in the first place. As Pollan describes our relationship to the industrial food chain, it is one in which we have shifted most of the responsibility for feeding ourselves to a steadily decreasing

number of industrial scale farmers as well as food scientists, food processors and marketers. This shift in responsibility has resulted in consumer convenience – the organic TV dinner that Pollan describes (96, 138) – but also in an ignorance on the consumer's part. Pollan writes in the introduction to the book:

> To go from the chicken (Gallus gallus) to the Chicken McNugget is to leave this world in a journey of forgetting that could hardly be more costly, not only in terms of the animal's pain but in our pleasure, too. But forgetting, or not knowing in the first place, is what the industrial food chain is all about, the principal reason it is so opaque, for if we could see what lies on the far side of the increasingly high walls of our industrial agriculture, we would surely change the way we eat. (10-11)

In Pollan's view modern day consumers are as far out in the woods and at the whim of marketers as the Lithuanian immigrants in Packingtown, who didn't know at first about the contaminants in the food they bought trusting that it was wholesome and natural. (140) But according to Pollan some Americans are beginning to take stock of what they have lost in the transaction and are starting to ask for a refund. This change that you can not only believe in but buy at the grocery store will, predicts Pollan, proceed as the incipient organic movement once did, with "exactly no help from the government." (257) It will proceed at the behest of consumers who will be, albeit with their dollars, voting libertarian.

The Oxford English Dictionary defines the political ideology of Libertarianism thus: "A person who believes the role of the government should be limited to upholding

individual rights, and who therefore opposes government regulation of economic or social affairs; an anti-statist. Also (with capital initial): a member of any of various political parties promoting these views." It is unsurprising that OED traces this use of the word to origins in the United States, a country with a long history of valuing radical independence and self-reliance. (See Pollan's appeal to Jeffersonian-vintage values above) This value stems from a uniquely American past when a surfeit of land made possible somewhat egalitarian property ownership practices and many were able to farm their own land. This quintessentially American agrarian ideal of owning your own land and living off of it has been present in America and its literature at least since St. John de Crèvecoeur wrote *Letters from an American Farmer*. Within the frame of this bucolic past, the less hassle there is from the government, the better.

When someone from the city thinks of libertarianism they may be forgiven for thinking of it as a reactionary, antisocial and sometimes militant strain of political ideology from the heartland. After all, Timothy McVeigh was an adherent of a particular brand of libertarianism, so it is no surprise that for many the word has developed negative connotations. But Pollan advocates for a less vitriolic libertarianism, one he hopes will be practiced by New York Times readers. Pollan doesn't explicitly express a desire, as Sinclair and Schlosser do, to bridge a gap between social classes. Instead, through preaching a doctrine of self-reliance, or the next best thing, reliance on neighbors, he hopes to bridge the gap between city and country. He uses Salatin's surprising statement about the lack of a need for New York City as an opportunity to address the gap that currently exists between the two places and the bridge that might potentially span it. "For my own part, this taut little exchange made me appreciate what a deep gulf of culture and

experience separates me from Joel – and yet at the same time, what a sturdy bridge caring about food can sometimes provide." (245) In the words of Carlo Petrini, the founder of the Slow Food movement, a movement that Pollan endorses, "the consumer becomes…a "coproducer."" (259)

Pollan isn't unilaterally opposed to Government involvement in food production. Instead he seems to be in favor of the type of governance that, as the definition of Libertarianism states, is interested in "upholding individual rights." In an open letter to the president-to-be, published in the New York Times just before the election in October 2008, he details a laundry list of suggestions for the next head of the federal government regarding correction of the food system. The central issue that he raises in the letter is switching American agriculture over from fossil fuel driven model to a solar driven one, arguing that for instance, this would go a long way toward achieving energy independence. Still, many of his suggestions are for less regulation, where small producers and processors are concerned, not more. His suggestions for government intervention are mostly for stimulating certain areas of the economy, not regulating them, and this is posited as an option of getting on board with an inevitability, or alternately facilitating failure. Among his personal suggestions for the president-to-be are installing a garden on the south lawn of the white house and providing an example for the country by supporting locally and sustainably produced food. Another is for the coming president to lend rhetorical support to the sustainable and largely fossil fuel-free practice of hunting.

Pollan would not call himself a libertarian, politically, I don't think, although he did write a book about building his own house. His allegiances to the politics are perhaps more circumstantial than anything. Partly it's that the old Thoreauvian pull has come

around again. The back to the landers of the 1960's, influenced in large part by authors like Thoreau, have became the Gene Kahns of today, working for big corporations, having "sold out," and so the author of Walden has become relevant once again, for a new generation looking for alternatives to industrial systems of commerce. Libertarianism, in this tradition is about personal responsibility and self-reliance. The libertarian strain in politics reflects people's desire to not be told what to do and to be allowed to do what they please – such as slaughtering their own meat and selling it themselves to their neighbors. I met a self-described libertarian on the plane once who described with pride how during the Christmas season in a black out of his local electrical grid, his was the only house on the street with power and Christmas lights due to his ownership of a generator. The same man kept gold around for similar reasons of maintaining independence, either not trusting the stability of state controlled currency or resenting its existence in the first place.

Pollan, like any good libertarian leader, does not want to tell his readers what to do. He merely wants to teach them how to fish. In his interview with *Writing on the Edge* he asks, "Do you really want some journalist to tell you what you should have for dinner? I'm trying to give you the tools so you can think about it and come to your own conclusion." After all, a belief in libertarianism in its political form is meaningless if not supported by a practice of self-reliance on the part of its adherents.

Or is he trying to teach readers how to hunt? Pollan, like Sinclair, describes his ideal economy in the last section of his book with a similarly reverential, almost religious zeal. In *The Jungle*, the protagonist Jurgis sees the light when introduced to Socialism by the speaker Nicholas Schliemann. (319) In *The Omnivore's Dilemma* Pollan casts himself

as the naïve protagonist and is shown a different sort of light by a paragon of self sufficiency, Angelo Garro. With Garro's help, Pollan embarks on an adventure of hunting and gathering in order to provide, if only for one meal, his own food independent of commercial mediation. If for Sinclair the ideal economy consists in everyone opting in to a collective form of governance, for Pollan it consists of opting all the way out of both economic systems and systems of governance. To participate in an alternative, artisanal economy like the one Joel Salatin is part of is one thing, but to opt out of economies altogether is quite another.

But why would Pollan want to do that? Is it solely in pursuit of a libertarian ethic? Of course not. Pollan is concerned with a deeper set of ethics. The libertarian rhetoric itself is a vehicle for arriving at a destination, - not unlike an appeal to the founding fathers- a destination that would be described by Jason Pickavance as gastronomic realism. Pickavance points out that in *The Jungle*, the character that leads the protagonist Jurgis to socialist conversion, Nicholas Schliemann, studies his food scientifically and also chews it scientifically. In other words, he is a "Fletcherizer," after the 19th century diet-reformer Horace Fletcher. In Pickavance's analysis, which has as its aim associating realism in literature and realism in consumer knowledge and expectation when it comes to food, Schliemann's act of scientific chewing is an assertion by Sinclair of consumer empowerment:

> Schliemann's chewing can also be read another instance of what the novel has been about all along: finding the right kind of experience in which to ground reality. Chewing can thus be read as the novel's closing and most intense

> invocation of gastronomic realism. In conscious chewing we recover the referent through physical contact with the thing itself, food. (105)

Pollan is also interested in gastronomic realism. He also believes that consumer empowerment can be achieved if "we recover the referent through physical contact with the thing itself, food." That is, if we see and experience how our food is produced. The best way to do this, by the lines of Pollan's logic, is to kill the food ourselves:

> "What is." I suppose that this as much as anything else, as much as a pig or a meal, is what I was really hunting for, and what I returned from my hunt with a slightly clearer sense of. "What is" is not an answer to anything, exactly; it doesn't tell you what to do or even what to think. Yet respect for what is does point us in a direction. That direction just happens to be the direction from which we came – to that place and time, I mean, where humans *looked* at the animals they killed, regarded them with reverence, and never ate them except with gratitude. (362)

One does not need to go hunting necessarily to achieve the kind of gastronomic realism that Pollan is talking about. A more practical or accessible version might be:

> Were the walls of our meat industry to become transparent, literally or even figuratively, we would not long continue to raise, kill, and eat animals the way we do. Tail docking and sow crates and beak clipping would disappear over night, and the days of slaughtering four hundred head of cattle an hour would promptly come to an end – for who could stand the sight? (333)

Animal welfare, treatment of workers, environment and climate change, health, energy independence – Pollan addresses these problems within the food system through a

single elegant prism: the consumer. Although he returns towards the end of his book to reflecting on the consumer-centric idea that "storied food" – or, food attended by realism – "can feed us both body and soul," (408) ultimately Pollan's appeals to consumerism and libertarian ethic are in service to something greater. He ends the book with a sort of grace: what we're eating is never anything more or less than the body of the world." (411) If all Pollan cared about was consumers' freedom of choice he would not address all of these other issues. But by capitalizing on reader's self interest and tying it to a larger set of issues he was able to blur the distinction between consumer and citizen. Thus he may succeed where Sinclair did not: in hitting the public's heart through its stomach.

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Essay G

Lit 190 / Senior Thesis

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Down With Love: Ovid's *The Art of Love 1.1-269* as a Disguised Cautionary Tale

On its surface, The Art of Love is a joyful text. Its narrator is an expert at picking up women, and will teach this knowledge to any reader of the poem.

But on a number of other levels, the exuberant narrator gives way to a more pessimistic subtext. Alone, the narrator seems to suggest that loving women is more than enough to be happy forever. This other reading - which we can call not the narrator's, but Ovid's perspective - persistently warns the reader about many dangers of love - as they come about through hitting on people, being hit on, or even when taking advice about love.

First, it is important to define love, as it is used by Ovid (and according to this paper). In my opinion, the types of love treated by this text can be summed up in the expression "making love", in the antiquated sense. That is, this text concerns itself with picking up and flirting with people - or trying to be picked up, and being flirted with. It also deals with keeping amorous feelings going - that is, "making love" once a relationship is already underway. As the text puts it, it will treat "find[ing] the object of your pursuit", "wooing and winning", and "ensuring that the love you're won is enduring" (5). As might be expected, the text will sometimes deal with sexual innuendo; and sometimes, what it discusses can be applied to a very general meaning of "love", as in simple interpersonal relationships.

The opening lines of The Art of Love text read: "If any Roman knows nothing about love-making, please / Read this poem and graduate in expertise" (3). Here, the narrator tries to reassure the reader that this poem will be a masterwork in love-instruction; but the passage can go much further in arousing the reader's suspicion. To begin, these lines come across as comically bold: can a beginner really become a love "expert", just by reading a poem? In their over-confidence, these lines actually make the reader more suspicious of the narrator's efficacy. As a result, these lines suggest to the reader that successfully making love takes more than reading about it, if not being given advice about it; learning about this matter may take actual experience, in order to really gain insight and know-how. Consequently, these lines can come across as self-deprecating: even if there is a wiser Ovid trying to give instruction beneath the facade of an overconfident "narrator", this is still merely a poem, and probably has some instructive limitations.

The narrator's credibility is further diminished when we see that they would like to preach to the ignorant: they specifically encourage the audience of those who know nothing about their subject. Soon after, the narrator gives a similar message:

> But you with headbands and ankle-length robes, staid matrons,
> Stay well clear - *you* are not my patrons.
> My theme is safe and licit love, stolen joys which women'll
> Condone; I'll mention nothing criminal. (5)

In both cases, the narrator seems to be shielding themselves from

criticism: from someone also familiar with their subject, who may disagree with their points; or from a "staid matron" who might see the narrator as having disreputable, troublemaking intentions. By contrast, a "good" narrator might suggest that anyone listen to their message, as they have nothing to hide (and then do a very good job of fooling everyone). Because the narrator is avoiding these potentially troublesome audiences, the reader is encouraged to see the narrator as being insecure about their talents (at best), or actually possessing disrepute, troublemaking intentions (at worst). By extension, the reader could apply this situation to someone who is hitting on them. If the hitter seems to be avoiding people who might be critical of them, it's possible they see themselves as having something to hide - something that if you were aware of, you might disapprove of - and thereby disapprove of them.

Finally, this passage suggests cultural relativity. The targeted audience isn't anyone, but specifically Romans. This can be seen as a caution that both Ovid and the narrator are only discussing the world they are familiar with: not just Rome, but Rome in their time, as they themselves saw it; with any of these variables changed, the circumstances might be different than as they are described in The Art of Love. In fact, since all of the possible readers of this text are not Ovid (save one), it seems like a guarantee that the reader's world is not the same one seen by the author - and that therefore, the text may be inaccurate in the reader's world.

The next passage of the text reads: "Ships and chariots with sails, oars, wheels, reins, / Speed through technique and control, and the same obtains / For

love" (3). Overtly, the narrator is making an analogy: oars, wheels, technique and control are what a ship or chariot needs to function properly, and the reader's love life needs this poem to function properly as well. But this analogy seems troublesome, when we see that the reward being promised is 'speed': speed is not necessarily a good thing, when it comes to love.

The overtones of this analogy are that in reading this text the reader will have faster sex, which some might say is a bad thing. Moving on from this particular example, the reader may wonder: do I really want to achieve love expertise, if it means that everything I do related to love, I'll do faster? By encouraging the reader to question if 'speed' is a desirable quality when it comes to love, the passage suggests a number of things. Even if you're no expert, you can still be happy during the process of learning to love, if you enjoy the experience. What's more, a "master" may know how to go through all of the motions to achieve "success", but they might not enjoy themselves. A master might even "speed through" an imperfect process of achieving what they desire, instead of watching and learning, and figuring out a process that works for them. In this respect, this passage interacts with the previous one, with regards to whether reading a poem can give someone "mastery" over love. The answer this passage offers, is that by learning how to love by reading about it, you can achieve only a certain kind of mastery: one that knows all the right moves, but not necessarily to pleasurable effect.

Continuing their introduction, the narrator claims divine influence: "I am appointed by Venus as the technician / Of her art". Again, the narrator is makes a

very, perhaps overly zealous claim which may arouse the readers' mistrust. What's more, this assertion has no backing: the narrator offers no story explaining or proving that they are Venus' chosen one.

If anything, the narrator makes this statement seem untrue in the very next line: "Love often fights against me". Later, the narrator explains how the poem was not inspired by Apollo:

> The hoot of an owl, the flight of a swallow,
>
> Have taught me nothing; awake or asleep,
>
> I never had a vision of the Muses tending sheep
>
> In pastoral valleys. (5)

The reason for the narrator's denying divine inspiration are explained in the next words: "This poem springs / From experience. Listen, your poet sings / Of what he knows, he tells no lies." (These lines also remind the reader that even if their love-advising narrator has sincere intentions, they might simply be wrong.) The narrator denies divine inspiration, to stress that their material comes from an implicitly more reliable source, their own experience. But in so doing, they contradict their previous claim that they are the directly-appointed prophet of Venus.

As with all of the narrator's flawed self-presentations, a parallel can be drawn to someone who is trying to present themselves favorably in a romantic situation: if they make a really impressive claim, it's possible they are lying: if their claim can't be verified, if evidence points to the contrary, or if they contradict themselves in other parts of their self-flattery.

The statement "Love often fights against me, for he's wild" is answered with "Yet he's also controllable, for he's still a child." The narrator attempts to recover from their admission that they have some sort of trouble with love, by assuring that since Eros / Cupid / Love is a child, romantic situations can be brought under one's control. Here, it seems that Ovid is tentatively questioning a kind of thinking which reasons that if one of the gods has a certain attribute, then the thing which they preside over is like that as well. Ovid could have written a more ridiculous scenario here: for example, the narrator could have chosen a certain attribute about Eros (he flies), reasoned this to be true in an inapplicable situation (jumping off a cliff with a lover, expecting to fly), and reaped the disastrous consequences.

The extrapolation the narrator makes - love is a child and therefore controllable - is comparatively tame; saying that love is (like) a child is a general-enough statement, that it could apply to most situations. Perhaps it is simply not Ovid's style, to give quite so obvious a message. (Had the above example been used here, it would have made for a much shorter text.) Perhaps Ovid does not criticize this kind of reasoning as harshly as he could have, because of his position as a creative author. As a writer of texts whose meanings are multifaceted, it is conceivable that Ovid could value the kind of creative, open-minded thinking which asks: how might this certain attribute of this divinity, relate to my current situation - showing me a different perspective, and new insight? At the same time, Ovid might hesitate to apply this thinking more assertively: to reason that because a certain god has wings, therefore all love can be accurately

thought of as having wings somehow. Ovid's advice here seems to be targeted as much to a person's thinking in general, as to how one may think about love: comparing your romantic situation to the qualities and myths of Eros may bring about a refreshing way of seeing the situation - but those parallels should perhaps not be believed too insistently.

At this point in the poem, we have our first mythological interlude. We are told of Achilles' early life:

> Chiron made Achilles expert with the lyre,
>
> His cool tuition quenched youth's primitive fire,
>
> So that the boy who later became
>
> A terror to friends and foes alike stood tame
>
> ……
>
> And the hand that Hector would feel one day
>
> Was held out meekly to be rapped
>
> At his schoolmaster's bidding. (3-5)

This story fleshes out a parallel the narrator makes immediately: "Achilles was the apt / Pupil of Chiron, Love is mine". It is followed by two brief images: "the heavy plough will make / Even the bull's neck docile, and the friskiest colt will take / The bit in his teeth."

The story of Achilles, and the bull and colt images, are the narrator's attempt to lend credibility to their earlier assertion that they can control love, who is "still a child". But comically, these words again shows us an inept narrator who, despite their intentions, encourages a suspicious rather than favorable self-

presentation. Despite all of the parallels made, the narrator has not actually given any evidence showing *why* what they are asserting is true. In effect, the narrator keeps on rephrasing that they can "tame" love, but they don't explain why. Thus, the reader is shown how a self-presenter might disguise a baseless assertion of themselves.

Still, the comparison between Achilles and love can be unpacked. In making that comparison, the narrator is trying to show that in much the same way that fearsome Achilles was domesticated by Chiron, so too can fearsome love be reined in. But this comparison becomes more complex when we consider Achilles' later actions. As the text says, Achilles "later became / A terror to friends and foes alike", and was "the hand that Hector would feel one day". These refer to certain actions of Achilles during the Trojan War (as recounted in The Iliad): Because he was slighted by Agamemnon (one of the Kings of Greece) over losing one of his slave girls, Achilles arranges with the gods to have the Greek forces - whom he had been fighting alongside - to get beaten by the Trojans to the brink of defeat (Homer 1.1-6, 452-459). Achilles goes on to slay a number of people despite their pleas for mercy (20.545-563), and famously desecrates Hector's corpse after killing him (22.494-505).

<u>The Art of Love</u>'s narrator draws a parallel between Chiron taming Achilles, and the narrator taming Love. But when we are reminded of these things Achilles did later in his life, it seems that Chiron's soothing of Achilles' spirit was only temporary at best, and backfired at worst. If we allow the narrator's love life to be compared to Chiron and Achilles, we arrive at the

worrisome image that the narrator - who forebodingly, finds themselves in romantic situations that are wild and dangerous to begin with - can only "control" love temporarily, before the romantic situation gets bad again and worse.

Furthermore, a number of parallels can be drawn to romantic situations gone sour. Achilles' revenge on the Greeks reminds the reader that a person who feels considerably offended by an emotional situation - which romances can be - may lash out angrily, perhaps even violently. Achilles has influence with the gods; this fact suggests that slighting people who have power is particularly dangerous; as such, seducing the rich may be very nice if it works out, but could be disastrous if it really does not.

The simple fact that Achilles' tutoring by Chiron contradicts his later behavior suggests that if a person whose behavior changes, might very well change back someday; if a person once hot-tempered seems to become nicer once they've been won over, it's entirely possible they may become hot-tempered again. This example supports Ovid's later assurance that when it comes to love, one must not only be concerned with "wooing and winning", but also "ensuring that the love you've won is enduring."

Achilles also serves as an example of someone with a particularly incitable temperament. Even if one person in a relationship thinks that something they've done isn't particularly offensive, another may strongly disagree - and arguing this point (as Agamemnon and Achilles do) will probably make them even angrier.

This last point resonates with the narrator's statement that even the

friskiest colts can be tamed, and with the passage following:

> Love shall be tamed under my hand,
>
> Though his arrows riddle me, though his flaming brand
>
> Is waved in my face. The worse the wounds, the fiercer the burn,
>
> The prompter I'll be to punish him in return. (5)

A problem with the narrator's various metaphors for taming Love, is that it's clear both he and the love he's warring with are very determined. In the end, the narrator may be the mare and not the harness: instead of the might not be the one who triumphs despite strong opposition, but the one who is defeated despite their own strong fighting to the contrary. This seems more likely when it's noted that love is the immortal deity, and not the narrator. From this exchange, the reader can reason that if they try to alter their own (or someone else's) romantic feelings, they may utterly fail despite their best efforts. Likewise, this passage suggests that any kind of a fight concerning love will figuratively riddle one with arrows, get burned, and be generally unpleasant.

It is only after all of the ominous forebodings about love suggested above - condensed into just under 35 lines of poetry - that Ovid finally introduces the means by which he'll overtly explain love, in the text to come:

> Your first job, then, love's volunteer recruit,
>
> Is to find the object of your pursuit;
>
> Next comes the work of wooing and winning; and, last, ensuring
>
> That the love you've won is enduring.
>
> These are the limits of the ground my wheeled

Chariot will rapidly cover, my chosen field. (5)

Because they have followed so much negative content, these lines have an almost portentous feel to them. They remind us: we have encountered a narrator, who is (in many different ways) the model of a lover who lies about themselves. The romantic advice in this text may not apply to your situation, if it is not simply inaccurate. Love can lead to battles which are long, unpleasant, and ultimately lost. *And we're just getting started*. Are you sure you want to continue in this text, and with your career in love?

In our case, at least - after a moment's pause - we cannot help but proceed.

The following section of The Art of Love treats "finding the object of your pursuit." Towards the beginning of this section, the reader is advised that they need not go to the lengths Perseus went for Andromeda, or Paris for Helen:

You can achieve your ambition / More easily.

……

Look nearer home

And you'll say, "The prettiest girls in the world are in Rome" -

They're thicker than … birds in the trees,

Stars in the sky, fish in the seas,

For Venus is a strong presence / In the city her son founded. (7)

Though still cautionary, the advice suggested here is more upbeat than it has been so far. The text suggests that the reader need not obsess over one person. There are countless women in Rome alone: if things don't work out with

them, try another. But on a bittersweet note, this passage also reminds the reader just what kind of love is being discussed in this poem. Other texts may deal with the kind of love Perseus has for Andromeda, or Paris for Helen: mythic love that travels the known world and goes to great lengths for the target of affection. Grimly, the lines preceding this passage compare the art of finding a girl to a hunter's work: someone who finds and feeds off of a target, and then finds a new one. The Art of Love's romances are not eternal, but last only for as long as is convenient - at which point a new person is sought out.
Also, in making sure to establish its setting is Rome, this passage reminds the reader that such a lifestyle may only be possible in a metropolis, with a seemingly infinite population.

After a list number of places in Rome where women gather, we're told that law-courts are another place to find love: "Venus' nets / Trap even lawyers … [Venus laughs] at the sight / Of the advocate turned client overnight" (9). A number of cautions are suggested in this passage. It is warned that someone may be seduced for their wealth or status (as lawyers may have had). The passage also warns that "even" lawyers, or educated people, may be seduced: a fine (legal) mind does not prevent falling for someone, perhaps to be taken advantage of. More generally, the passage suggests that a person wields status and power, might find those things circumvented when it comes to love; in the same way that a skillful lover may be at a loss to a lawyer in the forum, so too might a lawyer feel strangely inept when looking for love. Even for a (perhaps) skillful love-maker as the narrator, they could still suffer an unexpected inversion:

they (or anyone), in trying to pick people up, may might get picked up - played - themselves.

From the lawyers in Rome's forums, we move directly to the theater. Our narrator calls it "the place / Richest in spoils of the sexual chase", and praises of it, "Our smart women swarm to the games in such numbers my vision / And judgment blur - often I lose my powers of decision." Here, the implicit warning seems fairly obvious: at the theater, the narrator is surrounded by actors. The "smart women" all know how to give a believable performance, to the point that the narrator doesn't know who to begin with - everyone seems so desirable. To begin with, readers could simply gather from this passage that there are those - maybe even themselves - who could act a desirable part in order to attract people, and who are in fact just giving a believable performance, to win over people's sympathies. More generally, it could be gathered that if a potential lover's demeanor seems to good to be true, it's possible they're just putting on a good act - to take advantage of you at worst, or whom may simply act like different people once their "performance" is over, at best.

However, the narrator follows a different line of reasoning: the theater must be one of the best places to find desirable women, because it was the scene of Rome's mythical Rape of the Sabine Women, dating back to its early days (in Roman popular history) with Romulus. A brief retelling of the myth follows, and ends with the following passage:

> A girl who struggled and wouldn't co-operate
>
> Was hoisted up and hauled off by her new mate

> [Who tells her,] "I'll be as kind to you as your father was kind
> To your mother." Romulus, you found the right reward
> For soldiers - for *that* I'll enlist myself, with a sword!
> Since then time-honored custom has made our Roman
> Theatres danger spots for pretty women." (11)

This passage shows how on many different levels, Roman society seemed to condone sexually taking advantage of women. The "new mate's" comment suggests that this is a family practice - that people's parents (or at least, their fathers) acted this same way, making it seem more acceptable to their children. Most obviously here, a situation plainly referred to as a "Rape" was culturally celebrated, considered to be part of its mythic history, and "time-honored custom" - which at least would go a small way towards condoning the behavior in people's minds; and lastly, rape was expected, perhaps even looked forward to, by army recruits.

Thus, on three different levels, Ovid seems to be stressing that women need to be very careful if they are to play in the same game of "making love" as the narrator, as the women at the theater do: the reason being that the society in which they lived seemed to condone sexual exploitation - particularly of women - and in more than one way.

We then move from the venue of the theater, to the chariot races of the Circus. While previously the reader could only draw parallels between a disreputable narrator and a suspicious smooth-talking character, here they are given the first direct example of someone who is enjoying themselves with

women they don't know. The narrator says that at the chariot races, a person can sit next to a girl, share allegiance with her, touch her several different ways, and even see her ankles, all without seeming to be doing anything out of the ordinary. Here, it is also fairly clear (if it was not made obvious before) that the narrator has no problem with lying, or otherwise partaking in morally questionable behavior. After asking which racer the girl is backing, the narrator advises us to "Given a reply, / Add instantly, 'So am I!'" And one of several nice things the narrator suggests be done for a girl, is justified thus: "Any gallant excuse in the service of lust" (13). Relating to the narrator's faulty self-presentation earlier in the text, this passage again shows the reader that someone may have different true intentions than how they are trying to come across as.

The scene at the races concludes with the passage,

> A frivolous mind / Is won by small attentions. Many a man
> Has scored by arranging a cushion or plying a fan
> Or slipping a little stool / Under the dainty feet of a sweet fool. (13)

On the surface, the narrator here is simply encouraging who they see as their audience, men trying to pick up women. If any readers of the poem happen to have been Roman women of Ovid's time, then this passage could be seen as Ovid's attempt to incite, and encourage them to heed what they have read about in this section, and in the text thus far. Ovid suggests that someone who is won by these small attentions has "a frivolous mind" and is "a sweet fool"; in short, that they should know better - and if they don't, that they should become more aware (of people's disguised intentions) right there and then.

From the races, we are briefly taken to the arena - and given a scene very much like the one we just saw. Like the advised person at the races, the man here touches "her" every now and then, and talking about whom she hopes will win. But this scene has a different outcome than winning the "sweet fool":

> the man who came to see blood himself gets a wound - / In the heart.
>
> ……..……
>
> ...the steel's / Struck home, he groans - and the spectator
>
> Joins in the show, a dying gladiator.

Here, Ovid seems to suggest that the art of love is better compared to an arena fight than a chariot race. A prospective lover can suffer just the same fate they wished to inflict on someone else, inadvertently losing the game - and falling in love. Reminiscent of the court of law visited earlier, someone - not necessarily "a frivolous mind" - might suddenly realize they are on the wrong end of a romantic bargain - perhaps only when it is too late.

After a number of lines of what seem to be undisguised political commentary, we are given some very pointed advice about wine. Fairly direct, it is uncertain whether it is the narrator or Ovid's voice speaking here: "Wine rouses the heart, wine makes all men / Lovers, wine undiluted dilutes worry." Wine is said to make people speak the truth, and prompt girls to "bewitch men with desire". On this last point, it is advised: "On these occasions don't trust the lamps - they can lie: / Darkness and drink blur the judging eye" (19).

This passage could easily be taken for at face value; some comparisons

can also be made between this scene, and love in general. This scene may encourage the reader to see being in love - or having a lover - to be a lot like being drunk: while it feels great, one's otherwise good judgment may become distorted. On a literary level, it is interesting that Ovid sees wine as a virtuous thing, which not only makes people laugh but brings "truth (rare bird these days)" into their hearts, and presumably their mouths. However, as truth-bringing wine is said to also make people easier to seduce, a parallel seems to be being drawn between being honest, and being tempted. Ovid - or perhaps the narrator - seems to be suggest that honest people are the ones most easily tricked, and that the best way to avoid this is to be of the same kind, and be dishonest oneself.

This section ends with two images. First, the narrator seems to throw their hands up in the air: "But why count grains of sand? How can I list all the places / Where girls go and you can hunt pretty faces?" (19) This passage seems to undo the instances earlier in the text where the scene is located specifically in Rome. Rather than saying the situation might be relative, Ovid here suggests the contrary: the reader should perhaps not take what goes on in the text too specifically; what happens in the text, albeit in a slightly different form, could happen in countless places, as many as there are grains of sand.

Next, we are given a brief image of Diana, a goddess famous for their virginity who "Out of hatred of love's darts / Wounds and will go on wounding, human hearts" (21). Like the bitter war with flames and arrows at the end of the introduction, it is again suggested that there are some people who are simply

unresponsive to romantic appeals, no matter how attractive they may look.

After these two last images, we are given a transition much like the one ending the introduction:

> Having carried you this far / In my Muse's bumpy, elegiac car
> And taught you hunters in which coverts to find
> And how to spread nets for the bird you have in mind,
> Now for the trickiest, subtlest part: how to get
> Your darling well entangled in the net. (21)

As with the introduction, we are reminded just how far we have been carried thus far; after reading specifically for the pitfalls of love, the reader may again feel well-advised: love thus far seems like a dangerous thing. "Having carried you this far / In my Muse's bumpy, elegiac car" can be seen as lighthearted sarcasm on the narrator's part: for them, love is anything but an unpleasant, somber experience. But after a cautionary reading, it only further reminds the reader of the warnings they've encountered.

As before, after the reader has been encouraged to recall all they have encountered and learned, Ovid invites the reader to read on - promising that things will only get worse, that the forthcoming section will be "the trickiest, subtlest part." They are directly implored: "you, the common people, kindly lend / My enterprise your favor till the end."

Again, the reader is encouraged to really consider whether they want to proceed - in the text, and in pursuing love. Thousands of articles have been written on this text, and it has persisted to this day, despite being banished from

libraries by the Emperor (Augustus) of its country and time. It would seem that not only did many people choose to proceed: they saw value in the experience, and somehow made sure it found its way to someone else.

Despite all of its oft-hidden warnings about love - both for seducing, and being seduced - it seems that most readers would find The Art of Love to be an amusing text. Reading it as a caution against love is not necessarily the proper way to read the text: it could be argued that this text could be read for its lighthearted, overzealous narrative on its surface, as it could be examined for the wise, foreboding Ovid whose advice only seems to appear after textual analysis. These readings need not be exclusive of each other. A reader might combine the two, and see an incessant conversation in the text between Ovid, chastising the narrator for being too careless, and the narrator, chastising Ovid for worrying too much. The reader could shift between either of these readings, as it seemed to suit them or the text at a given moment. When all else failed, the reader could consider the text - or their love life - however they wished, come what may.

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Professor Camfield

Literature 190

Noir and its Role in American History, Society, and Culture

It is widely believed that when the War Production Board capped Hollywood's set construction budget at $5,000 per film during World War II, the federal government inadvertently helped to expand the film noir genre and give the genre one of its most defining aesthetic characteristics: the shadowed, dim lighting from which the genre got its name (Lipsitz 282). This style of lighting and the heavy reliance on indoor sets that gave films the claustrophobic, enclosed feel became associated almost exclusively with the genre. However, over the past 60 years or so the term "noir", the French word for black, which was used by Nino Frank to describe the genre in 1946, has come to refer to more than just the aesthetic characteristics of the genre; it has come to encapsulate specific content and themes that pervade and seem to characterize the mode in a less obvious and concrete way than film production aesthetics do. Because the term noir was given to the film medium, it is important to point out that the novels can be considered noir regardless of whether noir is considered to be based on cinematography or content. It has already been explained that noir films and novels are composed of the same content, but they are also composed of the same setting in terms of light and dark imagery. Film noir is known for being shadowy, but it is evident that the cinematography style was influenced by the written descriptions in the novels on which the films were based. Chandler was able to depict the darkness of the city with words as well as any

director of photography can with lighting. In the Big Sleep, Chandler describes the room in which Geiger, a smut peddler, is lying dead: "The black candles guttered in the draft from the open door. Drops of black wax crawled down their sides. The air in the room was poisonous and unreal (Chandler 103)." Because of these universal elements that are found in noir, the mode transcends film and is found in many different creative mediums, from the novels of James M. Cain and Raymond Chandler to the songs of Elvis Costello. This paper will attempt to explain what makes a product of any medium "noir," and how the noir mode is a direct product of the cultural, political, and economic climate and infrastructure of America.

In 1946, shortly after the end of World War II, France saw the opening of a number of wartime films from America. Among these films were *The Maltese Falcon*, *Double Indemnity*, *Laura*, and *Murder My Sweet*, which have all come to be considered canonical works of the film noir genre. After seeing these four films, Nino Frank took note of the change that had taken place in American Cinema during the war in his foundational essay on film noir titled *A New Kind of Police Drama: The Critical Adventure*. In this essay, Frank dubs the genre "film noir" not on any visual aesthetic similarities among the films; rather he designates the genre by noting its "verisimilitude" and "true to life" quality, internal development, and "the intervention of a narrator or commentator [that] permits a fragmentation of the narrative, to quickly gloss over the traditional plot elements and to accentuate the 'true to life side (Frank 139).'"

Most of the noir films that were produced and released during the 1940s and 1950s were based on novels that were written during the Great Depression and the literary influence on the genre is one of the most important defining aspects of "film

noir." The innovators of this fiction included Dashiell Hammett, Raymond Chandler, and James M. Cain, who all had novels adapted into films and also worked on screenplays in Hollywood. These writers developed plots and examined aspects of society that became mainstays in noir content. This content included criminal behavior, disillusionment, hopelessness, corruption, and greed of society's citizens at a time when all of these characteristics were coming together in the modern American city. James M. Cain skillfully depicted the unrelenting greed in society and the archetype of the femme fatale; Chandler, one of the most literary and complex noir writers, examined the debauchery and corruption of high society, and relied heavily on the seediness and the pervasiveness of criminality throughout the city of Los Angeles. The era in which they were writing their novels greatly influenced this content. In an essay titled Cultural Intersections: The American Hardboiled Fiction Novel and Early French *Roman Noir*, Claire Gorrara writes:

> Hammett represented a new generation of writers who had more than a passing acquaintance with the darker side of American society. The specific historical context in which Hammett wrote presented him with a vision of society on the verge of breakdown: Prohibition, the Depression, the Wall Street crash, the rise of a gangster culture, racial tension and violence, rural poverty, and corruption at all levels of policing and government. For those American novelists like Hammett returning from the battlefields of the First World War, the American Dream had failed to materialize, leaving a bitter aftertaste of what could have been (Gorrara 591).

This idea of the failed American dream that is deeply rooted in Jeffersonian philosophy and the concept of manifest destiny is the driving force behind every noir story but unlike Cain and Chandler's contemporaries that made up the *Lost Generation*, there does not seem to be any emphasis on impotence or the inability to do anything about it; instead the failure of the American dream seems to be something natural that is rooted in human nature and directly linked to the failures of capitalism during the Great Depression. This idea seems to be what drives protagonists and supporting characters to turn to a life of crime in order compensate for their poverty, greed, and desire to get ahead in society.

The literary genre of noir consists of two subgenres: the hardboiled detective novel, such as Raymond Chandler's *The Big Sleep* and Hammett's *The Maltese Falcon*, and the more general hardboiled novel, such as James M. Cain's *Double Indemnity* and *The Postman Always Rings Twice*. Each of these two subgenres share plot characteristics that include corruption, murder, greed, sex, and setting, which is usually an urban dystopia where crime runs the city. When the hardboiled detective novel came into popularity during the 1930s, it was clear that it was unlike the traditional detective novel that had been formulaically perfected by Edgar Allen Poe and Arthur Conan Doyle in his Sherlock Holmes series. Nino Frank observed that there is a stock formula for the classic detective story that consists of "an unsolved crime, some suspects, an in the end the discovery of the guilty party through the diligence of an experienced observer (Frank 137)." The hardboiled detective story changed all of that; it added an element of reality and grittiness that Conan Doyle's work lacked. The hardboiled detective story also deviated from the traditional detective story's narrative structure. Instead of a single crime, there is a web of crime that is too extensive and pervasive for any man to solve.

Hardboiled detectives such as Marlowe may solve whatever it is they are hired to solve, often times by the seediest of people, but their findings rarely ever bring any justice; they merely scratch the surface of that ingrained, pervasive web of crime that plagues the modern city.

Kevin Starr credits Hammett with inventing the hardboiled detective story (Starr 302) and Chandler credited Hammett with "taking murder out of the Venetian vase and dropping it into the alley (Gorrara 591)". In her essay Gorrara also writes:

> It was Hammett who wrote what Chandler called 'realistic mystery fiction', set in an urban metropolis which had nothing to do with the intellectual puzzle and refined location of the English country-house mystery, so much in vogue during the interwar period. Instead, Hammett's narratives presented an urban jungle where social, political, and economic interests conspired to defeat the small man, where organized crime was routinely found pulling the strings of elected city officials, and where each murder was the tip of the iceberg, destroying the fragile illusion that the rule of law sustained the social order.

With this in mind, it is easy to see that the hardboiled genre has defining characteristics, but not every hardboiled novel had a detective type character in it, and this presence, or lack thereof, of a moralist similar to Chandler's Philip Marlowe drastically alters the story and the possibility of a fixed hardboiled genre. There are two types of hardboiled novels and the major difference between the two is found in the protagonist. The hardboiled detective novel is always told through the lens of a tough-talking detective who is on the fringes of society, aware of all of the corruption and greed, but manages to

be the only person who remains uncorrupted by the capitalist drives of everyone around him. A prime example of this genre character is Chandler's classic protagonist, Philip Marlowe. Marlowe is a friendless, alcoholic private detective who works for little money and maintains a strict devotion to his clients. Although hardened and made cynical by his dystopic Los Angeles environment, Marlowe has been described by Matthew Bruccoli as being an urban knight errant, or "an English gentleman transplanted to one of the bizarre colonies, setting an example for the natives (Starr 306)." He doesn't fight back when he is manhandled; he refuses women even when he arrives home to find them naked in his bed, and rarely carries a gun.

Characters like Marlowe do not exist in what I have chosen to refer to as the crime novel. This subgenre includes the novels of James M. Cain and focus on characters that are at the center of the crimes that are being committed. They usually have no moral conscience and exhibit sociopathic behavior; there are no moral protagonists in these novels. *Double Indemnity* revolves around a greedy housewife, Phyllis Nirdlinger, who craves a life of lavishly wealthy independence and an insurance salesman without a backbone, Walter Huff, who conspires with Phyllis to take out a fraudulent life insurance plan on Phyllis' husband and murder him in a manner that would allow them to cash in on a double indemnity clause and live together free of financial burden. These are characters that represent the scum of society; they will sink to the lowest depths to get what they want and who hardboiled detectives such as Marlowe detest. Characters that embody the moral decay of society drive the plots and themes of these crime novels. If a character of the Marlowe sort were to be inserted into a novel such as *Double Indemnity*, it would be a completely different story; a sense of

morality, regardless of how little, would be added to story thus eliminating the moral void that makes the story what it is.

It could be argued that this particular subgenre referred to here as the "hardboiled crime" story is the opposite of the traditional and even hardboiled detective stories in terms of character tropes, narrative structure and perspective, and conclusion. Instead of focusing on how the crime is solved, this subgenre serves as an exploration of the motives and psychology of the criminals and focuses on how these people intend to get away with the crime. There is no mystery about who committed the crime; many of these novels tell the reader right off the bat. The first chapter of *Double Indemnity* is loaded with allusions to what is to come in the novel. The narrator, Walter Huff, refers to the Nirdlinger's Spanish house as the "House of Death that you've been reading about in all of the papers (Cain 149)," as if the reader is already well aware of the story. This narrative structure is similar to that used in Dickens' *Great Expectations* and W. Somerset Maugham's *Of Human Bondage*; it is somewhat of a subverted form of the bildungsroman. The narrators of these crime stories present the events from a hindsight perspective in an effort to share a life changing experience or late, second coming-of-age narrative.

These novels often also differ in conclusion from traditional crime and detective novels: it is not uncommon for the criminals to get away with the crimes that they commit. This is the case with Walter Huff and Phyllis Nirdlinger in *Double Indemnity*. After murdering Mr. Nirdlinger, Phyllis turns on Walter and attempts to murder him; however, he survives the shooting, the insurance fraud and murder is solved, but instead of being turned over to the police, Phyllis and Walter are given tickets to get away on a

ship that is headed toward Mexico. They are back together and are able to live out their illicit romance despite all their wrongdoings. There is no real justice, which highlights the lack of moral fiber and flawed law enforcement system in the urban city. It is stories like these that make Chandler's Marlowe so cynical. Then there are endings such as the one of Cain's *The Postman Always Rings Twice* in which people end up being punished for a crime different from the one they committed. *The Postman Always Rings Twice* tells the story of Frank Chambers, a drifter who finds work at a roadside diner/gas station, falls in love with Cora Papadakis, the proprietor's wife, and together they murder her husband and collect his life insurance policy. They face a heavy investigation, get charged with murder, but are found innocent. However, the story ends with an actual car crash in which Cora dies and Frank ends up being charged with and convicted of her murder. This is not true justice either, and it serves as a notion that people are able to get away with crimes that they do commit, but can be found guilty for crimes they did not commit which greatly contrasts with the plots of Earl Stanley Gardner's best selling Perry Mason series in which justice always pervails. This points out another flaw in the justice system here in America.

In addition to examining the idea of flawed justice and corruption in America, noir seems to be a natural American genre because of its heavy reliance on capitalism in its plots. Without capitalism noir wouldn't work as a genre. The driving force behind nearly every motive for the noir criminal is economic monetary greed, and capitalism is an economic system in which greed is fostered and overwhelmingly prevalent. Richard Hofstadter wrote of American capitalism:

> We demand leisure; we demand that we be spared economic suffering; we build up an important business, advertising, whose function it is to encourage people to spend rather than save; we devise institutional arrangements like installment buying that permit people to spend what they have not yet earned; and we take up an economic theory like that of Keynes which stresses the importance of spending. We think of the economic order in terms of welfare and abundance rather than scarcity; we concern ourselves more with organization and efficiency than with character and punishments and rewards (Hofstadter 11).

These values of American capitalism are what drive characters such as Phyllis Nirdlinger, Frank Chambers, and Cora Papadakis. It is a subversion of William Graham Sumner's idea that "economic activity was considered to be above all a field for the development and encouragement of personal character (Hofstadter 10)." Sumner also believed that "economic life was construed as a set of arrangements that offers inducements to men of good character, while it punished those who were… 'negligent, shiftless, inefficient, silly, and impudent' (Hofstadter 11)." Noir presents the opposite scenario of this theory of social Darwinism: many of the characters who would fall into the categories of being negligent, shiftless, inefficient and, impudent are offered inducements and often times go unpunished; they are people who have zero work ethic and seek to obtain immediate wealth. However, it is almost as if noir subverts the "survival of the fittest theory" that was developed and presented by Herbert Spencer and his predecessors by depicting characters who, in the traditional sense of the theory, would have failed to rise to the top as those who succeed due to their lack of work ethic and are able to obtain what they

want through underhanded and often times violent ways or as those who go unpunished if they are unsuccessful. This exposes a major flaw in the idealistic element of Spencer's theory that is rooted in the ideals of hard work and smart economic maneuvering.

The noir genre serves as a critique of capitalism, and this is evident in the aforementioned novels and their plots. Every character is looking out for his or her individual self fulfillment; there is no sense of collectivity or community in the noir world. When there is, such as in *Double Indemnity* when Walter Huff goes along with the plan to murder Phyllis' husband because he thinks that it is a joint effort to secure their future together as a loving couple, the weaker character gets the shaft from the vicious one who embodies the spirit of the individual and capitalism. After the crime is committed, Phyllis shoots Walter in an attempt to murder him so that she will not have to split the insurance settlement with him. This genre and its plots and characters serve as a microcosm for what occurs in America as a whole in terms of the importance that is placed on personal wealth. It also reflects the notion of the deteriorated American dream that has given way to urban crime and moral decay.

In regard to this idea of societal decay, it is necessary to examine the economic and social climate of the United States during which Cain and Chandler produced their novels. The Great Depression was in full effect and the national economy had suffered a blow that was brought on by the accumulation of exorbitant debt and spending. For many Americans at that time, the capitalist system had failed. Unemployment was at an all time high, people in parts of the country had literally lost everything and were starving as depicted in John Steinbeck's *The Grapes of Wrath* which came out the same year as *The Big Sleep*. There is an overwhelming contrast between these two novels and this has

to do with the setting. John Steinbeck's depiction of the Depression is from the perspective of rural Midwestern farmers while Chandler and Cain depicted the Depression from the perspective of city dwellers. It seems as though the Great Depression is usually imagined from the Steinbeck perspective and also seems to be the way that it is depicted in historical study. Dorthea Lange's "Migrant Mother" photograph has been considered the quintessential image of the Depression; however this image fails to encapsulate the urban aspect of the Depression. In fact, there is no image that encapsulates the urban aspect of the Depression like Lange's image encapsulates the rural aspect. This is where the noir authors of the 1930s come into the picture. Instead of depicting failing farmers and rural poverty, Chandler and Cain depicted the Depression in the urban streets. The prominence of bootleggers and bank robbers such as Bonnie and Clyde and John Dillinger are a testament to the idea that capitalism had failed the people by justifying the practice of obtaining wealth through illegal means. Los Angeles, the epicenter for noir, was one city in particular in which urban decay was magnified and because of the significance of Los Angeles as a setting in many of the noir novels written during the depression, the urban theorist Mike Davis labels the literary genre of noir as a viable history of 1930s Los Angeles (Davis 36). In his book *City of Quartz*, Davis writes:

> As jobless accountants and ruined stockbrokers stood in the same breadlines as truckdrivers and steelworkers, much of the babbitry of the 1920s was left with little to eat except for obsolete class pride. [Lewis] Corey warned that the downwardly mobile middle stratum, 'at war with itself', was approaching a radical crossroads, and would turn either toward socialism or fascism. This invocation of the dual immiseration and

> radicalization of the middle classes applied more literally, and appositely, to Los Angeles during the early 1930s than anywhere else in the country. The very structure of the long Southern California boom – fueled by middle class savings and channeled into real-estate and oil speculations – ensured a vicious circle of crisis and bankruptcy for the mass of retried farmers, small business men and petty developers. Indeed, the absence of heavy industry (together with the deportation of tens of thousands of unemployed manual workers back to Mexico) meant that the Depression in Los Angeles was foregrounded and amplified in the middle classes, producing a political fermentation that was at times bizarre (Davis 36-37).

The so-called depression crazed middle classes were manifested in the noir writing of the time. The ruined middle classes transformed Los Angeles into in urban nightmare and out of this we get characters such as Phyllis Nirdlinger, Walter Huff, and Cora Papadakis who will stop at nothing to retain a sense of financial security, regardless of the means through which they achieve it. Mike Davis adds further significance to noir protagonists when he reads Chandler's Marlowe as "the small business man locked in a struggle with gangsters, corrupt police, and the parasitic rich (Davis 38)."

Although it is not set in Los Angeles, there is no better example of this in the noir mode than John Huston's 1950 film *The Asphalt Jungle* based on W.R. Burnett's novel of the same title. Whereas many works of noir don't seem to have an overt message, *The Asphalt Jungle* possesses a certain didacticism that other films of the genre lack. The film follows a team of five men who plan an elaborate jewel heist: One is a prominent lawyer who is broke but continues carry on a façade of wealth, another is a criminal

mastermind, and the remaining three are men who are poor and living in urban squalor. Gus Minissi, a diner owner, Louie Ciavelli who commits the crime to earn money to support his sick child and pregnant wife, and Dix Handley, whose only dream is to score enough money to buy back his family's Kentucky farm that was lost during the Great Depression. Dix sees the heist as his opportunity to get out of the Midwestern urban nightmare in which he is living and buy back his family's country farm and the American dream. Gus ends up in jail; Louie is shot by a stray bullet and leaves behind a dying child and a pregnant wife in squalor. Dix gets tagged by a police bullet and sets off for the farm while he is slowly dying. The film ends in dramatic fashion as Dix finally arrives at the farm and runs into the field, collapses, and dies, thus falling victim to the binds of capitalism and becomes the embodiment of the death of the American dream that is so prevalent in the noir genre.

These themes seem to constitute the genre well, but there are still some gray areas in regard to what makes something noir. One particular example of this is Nathanael West's 1936 novel *The Day of the Locust*. During the 1930s, when Nathanael West wrote and published his Hollywood novel *The Day of the Locust*, the Hollywood film industry underwent a significant transformation: silent films were replaced by "talkies," new genres were developed, production studios flourished, glitz and glamour pervaded the public consciousness and the period became known as the Golden Age of Hollywood. This is the era in which West's novel is set; however, the novel examines the seedy underbelly of the city and industry that were perceived by many to be the key to achieving fame, fortune, and happiness in a time when the United States was facing its worst economic depression in history. During the Great Depression, many of the films

that were released were loaded with optimistic and uplifting themes that catered to an audience that was facing both financial and social hardships brought on by the devastated economic state of the country: Jefferson Smith went to Washington to fight corruption and uphold the foundation of true democracy, gangsters got back at the system that kept them down by bootlegging and robbing banks, and as Lawrence Levine wrote, Scarlet O'Hara "survives the war, the siege of Atlanta, the destruction of her society,…grows and matures, rebuilds her plantation, and…remains unbowed (Levine 218)."

An unmistakable contrast exists between Hollywood movies of the era and the actual society and industry from which they are coming. *The Day of the Locust* was published the same year that the *Wizard of Oz* was released, but there is nothing even remotely as optimistic as a girl trapped in depression and tornado-addled Kansas who is transported to a magical world only to return home again to find everything's OK. In West's novel, on the contrary, we're given the likes of Tod, Homer, and Faye who are trapped in an urban dystopia where there are two types of people: those who masquerade and those who have come to Los Angeles to die. There are several characters in *The Day of the Locust* who went to Hollywood with the hope of indulging in the glitz and glamour of the film industry or escape from personal problems. All of the characters in West's novel lead lives that never get better. Todd, who is an easterner and intellectual, has come to Los Angeles to work as a set designer and to paint his magnum opus *The Burning of Los Angeles*. For much of the novel he maintains the status of an outsider who is able to observe intellectually from a distance. However, he eventually gets caught up in the seediness of the city and stoops to the level of so many others in his lust for and desire to rape Faye. Faye is also a victim of the capitalist culture: she embodies the

looks, attitudes, and dreams of an aspiring Hollywood starlet. Her naivety and shallowness is manifested in her casual and unserious relationships with men and her movie-plot dreams that she shares with Homer. Her father Harry represents the ultimate American casualty. He moved the Los Angeles expecting to become famous, never got a break, and died a poor silver-polish salesman. All of the characters in West's novel embody the destruction of the dreams that have been perpetuated by the illusion of a mythical American Dream.

Perhaps the most vivid image of the illusion of Hollywood is found in Tod's Discovery of the Dream Dump while he is searching the studio for Faye's movie set. The dream dump consists of the throwaway set pieces from movies, the physical artifacts from plots such as those that Faye comes up with. This scene also enforces the notion of the inevitability of the abandonment and destruction of dreams because "the dump grew continually, for there wasn't a dream afloat somewhere which wouldn't sooner or later turn up on it, having first been made photographic by canvas, lath, and paint (West 132)." The dream dump represents the fleetingness of dreams and the ultimate death of them, even if they do come true only for a short while. This reinforces the theme of the urban city being the place where dreams go to die, just like the people that Tod wants to paint. The last scene in the novel sums up and presents the full extent of the novel's bleak depiction of the American Dream when a riot breaks out for no apparent reason and Los Angeles is burned to the ground, bringing Tod's painting to life. The fact that there appears to be no real reason or motive behind the riot makes it seem as though it is something natural, something that had been waiting to happen for quite some time; however there is a greater underlying cause that West writes about that is rooted in the

frustration over the menial and unhappy existences of those with failed dreams who plague the city.

It is clear that this novel has the characters and themes that coincide with the noir genre. But is it noir? There is no real crime that drives the story, but aside from that, there seems to be the strong environmental element that characterizes noir. This environmental element that characterizes the noir mode is an offshoot of the naturalism literary movement that gained momentum during the late 19th century. Naturalism was defined by Rend Wellek as "the objective representation of contemporary society (Pizer 3)." Many of the novels that were written during the naturalism and realism literary movements were rooted in the philosophy and theory of Herbert Spencer who was a leading scholar and proponent of Social Darwinism. The theory of Social Darwinism is based on the idea the fittest will survive and directly feeds into American capitalist ideology. Spencer's opposing stance against a welfare state to allow a natural order to form among people who would excel and those who would not factors into much of the overriding themes of greed and determinism in the noir mode. There is really no better example of an economic system than capitalism under which this "survival of the fittest" could be carried out. As a result of this theory's popularity, novelists such as Jack London, Theodore Dreiser, and Frank Norris incorporated this theory into their work, thus developing the naturalism/realism literary movements. There are many similarities between naturalist and noir works and the influence of naturalism on noir is evident. Take for instance Frank Norris' novel *McTeague*, in which a poor dentist undergoes a series of misfortunes and is forced further and further into poverty until he makes the decision to steal his wife's savings and run away; or Theodore Dreiser's *Maggie: A Girl*

of the Streets, in which a pretty girl with potential is driven into a life of prostitution and eventual death leaving her life unfulfilled. These naturalist novels examine the inner workings of the modern, industrialized city. They possess the same verisimilitude that Nino Frank wrote about and thus parallel and closely relate to the literary works of noir that were coming out of major cities in America during the Depression.

This instance of *The Day of the Locust* further calls into question the essence that makes a work of art "noir." The discrepancy between the lack of crime and the noir-like feel and themes of the novel poses the idea that noir is not made by content, but instead by characterization and tone. Faye as a femme fatale, the overriding theme of failed dreams, urban decay, and the negative side of American capitalism fulfill the criteria for making the novel noir in content, but these aspects of the novel are not the aspects that make it a work of noir; West's tone and dark, bleak prose are what make the novel noir. There are many examples of this tone and characterization in works of both film and literature that content-wise do not seem to fit the mold of what has been traditionally considered to be noir. The mode has become so pervasive and malleable that it is found in all sorts of contemporary works of cinema, television, and art. For example, much of the work that David Lynch has produced over the past 25 years can be considered noir, even though much of it bucks, transcends, and subverts the traditional idea of noir that Nino Frank described over 60 years ago.

In 1990, Lynch's television show *Twin Peaks* aired with a pilot episode that revolved around the murder of Laura Palmer, a seemingly perfect American female archetype in a seemingly perfect American town. Soon after her discovery, FBI Special Agent Dale Cooper is called in to investigate the murder after a second victim crosses

state lines. There are many aspects of this series that on the surface would not make noir in terms of content: comedic elements, teleological themes, and its heavy reliance on surreal elements such as Dale Cooper's reliance on dreams, teleology, and intuition to solve the case of Laura Palmer's death. There is an overwhelming sense of collectivity among people in the town to solve the murder that is the opposite of character relationships in works such as *The Big Sleep* and *Double Indemnity* and Dale Cooper embodies every good quality that is lacking from the characters in the work of Cain and Chandler. Cooper is like Marlowe in many respects, however: He is single, waits for a woman for whom he has genuine affection for, and is dedicated to his job as an FBI agent much like Marlowe is to his profession as a private investigator. There is even a scene in an episode of *Twin Peaks* that directly references and parallels a scene from the *Big Sleep*. When Marlowe returns to his apartment one evening he finds Carmen Sternwood, the troublesome nymphet daughter of the man who has hired him, lying naked in wait for him in his bed. The same happens to Cooper when he retires to his hotel room for the night only to find Audrey Horne, the troublesome nymphet daughter of Benjamin Horne, a prominent local business man and owner of the hotel, lying naked in bed waiting for Cooper. The difference comes in the manner in which each detective handles the situation: Marlowe, the misanthrope, harshly scolds Carmen and throws her out of his apartment while Cooper comforts Audrey, explains to her that she is too young for him, and proceeds to get to the root of her problems by getting her a warm glass of milk and offering to listen to what's on her mind. This is a significant comparison and contrast between one of the preeminent works of noir and a short-lived yet important television

series. This particular scene subverts the traditional idea of the noir detective as a hardened cynic.

Also within the past 25 years or so, the noir mode has developed greatly to include aspects and realms that were not explored in traditional works of noir. Along with *Twin Peaks*, David Lynch pioneered a second generation of noir that moved settings out of cities and into the American suburban haven. In 1986, *Blue Velvet* was released and became one of the first works of noir to examine the seedy underside of the traditional American neighborhood. Lynch set up an incongruous combination of extreme brutality, violence, and self indulgence and the archetypical quaint Middle American town to create a work of noir and mystery that was subversive due to its move away from the urban nightmare and into the suburban dream. The storyline unravels when a college student is walking through a field and finds a severed human ear. This gross discovery leads him into a secret underworld in which crime and corruption run rampant. Other recent noir films that have bucked tradition include *Brick*, which is centered around a suburban high school that includes dialogue that meshes the tough-talking detective style of dialogue from films such as Howard Hawks' adaptation of *The Big Sleep* and John Huston's *The Maltese Falcon* with underground high school kingpins and drug dealers whose unwitting suburban parents are never aware of what's going on. Another development and transition that has taken place within noir literature is situated within the realm of postmodernity. Writers such as Thomas Pynchon have recently used the genre to examine underlying social issues in a hyper-intellectual manner. James Ellroy created an entirely fictional story around Los Angeles' greatest unsolved murder: The Black Dahlia. He has also included storylines that venture out into the occult and

supernatural, similar to Lynch, that are held together by his encyclopedic knowledge of the genre's traditional form, content, style, and dialogue. Mike Davis says of Ellroy: "His *Los Angeles Quartet*, depending on one's viewpoint is either the culmination of the genre, or its *reductio ad absurdum* (Davis 45)." Nevertheless, Ellroy has established himself as a pioneer of the genre and his work serves as a testimony to the flexibility and complexity of the genre. The noir mode also has pervaded music over the last two-and-a-half decades. One song in particular, Elvis Costello's *Watching the Detectives*, stands out for its dark, prominent bass line, slow eerie rhythm, and mysterious lyrics about girls, guns, and investigation, such as *You snatch a tune and you match your cigarette/She pulls your eyes with a face like a magnet/I don't know how much more of this I can take/She's filing her nails as they're dragging the lake*. The song simply exudes *noir*, so much so that it was used in a Turner Classic Movies television spot to promote a film noir marathon. Once again, this demonstrates how pervasive noir has become in American culture.

It is fascinating to trace the roots of a specific mode in an attempt to understand its significance and role in history and society. The noir mode is the product of so many economic, political, and social influences and thus it is highly representative of America in terms of both history and culture. Like most modes and genres, noir is very difficult to establish parameters for that allow a comprehensive definition of the genre or mode to be extracted, but this demonstrates its complexity and uniqueness. From the argument of it being exclusive to film due to aesthetic qualities to the argument of it being universal due to content, style, tone, and characterization, the mode demonstrates a malleability that differentiates itself from the rigidity of other modes and genres of film, literature, and

even music. It cannot be argued, however, that the origins and implications of the mode are not rooted in the social, economic, and political conditions of the Great Depression during which the foundational texts and films were produced. The novels and films are direct products of the flaws of American consumerism, capitalism, and ever-changing class issues that have characterized America for centuries. It is still evident today that the mode continues to be reshaped to correspond to the changes that are taking place in society and art. This is reflected in the contemporary work of filmmakers such as David Lynch and novelists such as James Ellroy and Thomas Pynchon who are expanding the genre while still keeping in touch with the traditional aspects of the mode. The themes of capitalism, greed, corruption, societal decay, and the pervasiveness of seediness and crime, characterize the genre in a manner that makes it historically important and culturally and artistically pervasive in the United States; for this reason it is not inappropriate to characterize the noir mode as uniquely American.

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Appendix iii

Notes on Senior Thesis Review. (Jan's comments in Black, Gregg's in blue)

Essays A-C read together for norming. Agreed to the following:
Essay A, 3 / 4
Essay B, 2
Essay C, 2
Essay D : 2, even a high 1. Very literal in terms of summarizing, repeatedly, without analysis. The good points introduced early don't function as guideposts or points of development, so the only coherence comes via repeated phrasings of ideas.
Essay G : high 4. clear explication, very detailed and wonderfully focused, coherent, energetic and engaged. Don't know enough about classical lit to know if he is paraphrasing another's argument, so while the potential conflicting readings are taken into account, I don't know if his counters are his. Assuming they are, wonderful work.
Essay F : started 3, due to very writer based, non reader attentive or aware, thinking and writing. By the end, close to 5, pushing relentlessly against thought constructs that would confine it. I'm not sure what to do. A 4, perhaps, although that doesn't encompass the essay. For me, the essay's pulling together of the seemingly separate sections into one fell and resounding swoop was pretty amazing. [Yes, but performance indicators would suggest a need to have the brilliance polished. In some ways, because he's pushing the envelope, the structure falls back into the "2" range—as would be expected for someone pushing the envelope. But before such a piece could be published (i.e. reach either the level of 4 or 5, it would need to be revised yet again, and maybe even further. This is where a chance to include the drafts would help us do this evaluation. I think the "writer-based" point you make is true of the entire essay, and so a "3" seems right to me.]
Essay K : 4. The essay knows what it is doing, and thinks about how to demonstrate its thesis in the most effective ways possible. There is a lot of summary, although it's generally drawn back to an argument. [Your discussion says "3," that is competent, but not really moving beyond that in a consistent way.]
Essay H : high 3, low 4. Very fluent in the "speak." Unfortunately, that threatens to overcome any potentially original thoughts. Most of the essay recapitulates what other writers have said. Certainly, there could be more counter consideration, if only through more examples from Rechy's novel. [Agreed. That's why I'd say "high 3,"]
Essay E : 3. very clear understanding of 'how things go' in research papers. In essence, this is a well augmented lecture from LIT 30 so it falls perfectly into ""extension of ideas already presented by the instructor" although it misses a number of questions within its subject matter. he has done the research, documented it, and added to what he was introduced to. There are no original thoughts and little attention to counter arguments. [I completely agree]
Essay I : low 4? Certainly, much of the 4 rubric applies. The essay shows understanding of "the norms of the discourse community" not simply in its presentations of ideas but its topic overall—literature has narrative as its substance, and the essay seeks to explore the narrative forms outside of the acceptable definitions of "literary." The issue is in its inability to fully explore, develop, question theories of reader response, relying solely on Iser, and the essay's seeming choice not to fully confront the counter arguments to interactive literature as literature. In other words, the entire topic is, by

default, a "jumping off point for a conversation in the field." It simply doesn't fully outline or address that reality, instead simply moving to its presentation of materials in an instructional format—here is how this one works; here is how that one works. [I agree, though I'm scoring it as a high 3 because the sloppiness suggests a kind of nonchalance toward his audience. Still, it's fascinating material.]]
Essay J : 3/4. really falls off the cliff on page 16 or so, whenever it ambles into naturalism and then begins summarizing recent noir, all without any of the remarkable analysis and confidence that have characterized the first 15 pages. Up to that point, I would call the essay a clear 4. Beyond that, the "textbook knowledge" that is not fully applied to develop the argument invades things. [So, then, the final performance is 3, right?]

Final thoughts about the rubric:
Two things came up for me, mostly as the result of Jake's (E) and Everett's (F). One is that there is no indicator of communication. I know we want to stay with expertise, but in Everett's essay, the inability to communicate his level of expertise was fascinating. By his own admission, the essay was all over the place. But the originality, his interweaving of his experiences with full scale theory, and his inability to present that in ways the average reader could grasp—all was problematic, even with this rubric, which is so expansive in its approach. The second was Jake's essay which was, by this rubric's standard, competent. The frustration arises when it's clear that for Jake, these were NEW discoveries. Ie; he didn't know this before, and he does not know enough about the field to know what he has written is a fairly mundane summary of everything that has already been written. I don't know how to address that, in all honesty, but it did occur to me.

I agree. After all, Jake did not take LIT 30, and so this stuff was all new to him. And his efforts to present his understanding are perfectly competent, but not publishable. In other words, he has hit the undergraduate standard pretty well, but is a long way from hitting a professional standard. I think "3" is great---for him in particular, it's a marker of extraordinary growth in two years from a standard of "1"!
As for Everett's, again I think the rubric works. It's not just that his thinking is pushing the limits, it's that the essay needs to cohere in that leap beyond the norms. In other words, it has to show that connection to audience. So in some ways, he's at the "2" level; in others at "4" pushing "5," but an "expert" makes the new coherent in a seemingly effortless way. Everett's essay does not. I think "3" is right here, too.
After all, this rubric is supposed to judge the students' skill levels by performance, and we talked about it, appropriately, I think, in terms of whether or not a piece could be published. I don't think any of these reaches that standard (i.e., either 4 or 5), yet many have the potential because they are pushing boundaries, sometimes in spots, sometimes in a big way.

Appendix iv: LIT 190, Reflective essay assignment, Spring 2010

Write an essay of five to seven pages in which you reflect broadly on your undergraduate education.

Before you write this essay I'd like you to think first about your sense of what you think your major means to you. Undoubtedly, you've been asked about a million times, "What are you going to do with a major in literature?" Presuming that what you learned here will bear on your answer, what is the value of your education? What have you learned? What have you learned how to do? How do you imagine using both the knowledge and skills you have learned in your life, including both your professional (whether or not you contemplate further education) and your private life?

Then, I'd like you to think about a few of the objectives that the LIT faculty have been developing for the major. While these were not officially public when you began your studies, they articulate what we think we've been doing all along:

Literature and Culture learning outcomes:

Literature and literary criticism are significant parts of an ages old, continuing conversation about what it means to be human and what value humanity has. Unlike scientific or social scientific approaches to this conversation, literary discourse emphasizes the particular in the dialogue between particular and universal. It always arises out of specific times, places, and cultural traditions, and it often gives powerful voice to cultural differences and individual differences against the backdrop of larger, homogenizing forces. Moreover, literature has traditionally fore-grounded questions of value over questions of definition, or rather, sees questions of value as central to the definition of humanity itself.

The study of literature enables one to engage this conversation richly, both for personal development and for the ability it gives one to be a responsible agent in the many societies each person inhabits. Moreover, literary study gives one insight into how cultures operate in such a way as to facilitate ethical cross-cultural interactions. Literary study facilitates such agency by teaching readers how to inhabit and then critique literary artifacts, and then to apply the complex understanding—an understanding that engages intellectual, ethical and aesthetic faculties—that arises from the shift between inhabiting and critiquing.

The successful student majoring in Literature and Cultures will be able to participate in this larger conversation. More specifically, the successful student will be able to:

- Interpret texts with due sensitivity to both textual and contextual cues;
- Appreciate the aesthetic qualities of texts and the cultures from which they're drawn;

- Judge the ethical value(s) of texts and contexts;
- Apply interpretive strategies developed in literary study to other contexts;
- Articulate, cogently and with sensitivity to context, in both speech and writing, her/his interpretations and evaluations.

(If you're curious about how we plan to "assess" majors in the future, please see the assessment plan in the resources section of this web-site. I'd love any feedback you'd like to give.)

Now, in five to seven pages, write an essay that describes the impact your major has had on you. Please cite any resources you use (in MLA or Chicago style) and append any papers you've written, any assignments that you want to comment on, etc. In other words, you'll need to support your argument by drawing on your own performance in particular classes, and you'll need to document the particular items to which you refer. Appended items do not count in the page total.

I hope you find the page limit daunting, that you think you need books to answer such a question, but I'm giving you just five pages for several reasons: One, to focus you on the most important points. Two, to help you prepare to answer such questions when you apply for jobs, for placement in graduate programs, etc. Three, to give you a sort of outline or compendium that will stick in your mind, helping you to structure your memories and thus make them more useable in many different contexts over time. Four, to make it possible for you to write, and me to grade, the essay in the short time we have available.

This essay is due on April 21.

Appendix 1 – Rubric for evaluating ME course assignment relevant to assessing ME PLO l

Criterion → PLO 2 component	Irrelevant 1	Some relevance 2	Relevant 3	Highly relevant 4
Critical thinking	Assignment is straightforward problem solving (e.g., self-contained problems)	Assignment is reasonably straightforward but requires some purposeful thinking or judgment to complete	Assignment requires purposeful thinking (e.g., reasoned assumptions) and interpretation of given information to complete	Assignment requires independent research and interpretation to gather information as well as purposeful thinking to complete
Problem solving engineering principles & reasoning	Problems are self-contained, require only one or two basic steps or operations, and solution is independent of prior knowledge	Problems are self-contained but require multiple steps or operations, and some prior knowledge from the current course	Problems are self-contained, require multiple steps or operations, and in-depth knowledge from the current course	Problems are open-ended, require critical selection of solution technique, and build upon prior knowledge from both current and previous courses
Complex methods	Assignment is self-contained and based on well-understood basic principles	Assignment is self-contained and based primarily on physical principles learned in introductory classes	Assignment requires mastery of several conservations principles applied to specific fields of engineering	Assignment requires use of modern computational or experimental tools in order to design or analyze complex systems
Appropriate Depth	Assignment is a little different than textbook problems	Assignments involves some level of research or study to be completed	Assignment cannot be completed without researching several sources and carefully evaluating different options	Assignment requires mastery of material that is considered pre-requisite to the class and exercises engineering judgment to be completed

APPENDIX E

Program Learning Outcome[4]
Portfolio Rubric Draft
9 December 2009

Synopsis: During October 2009, Merritt Writing Program faculty reviewed samples of online portfolios, designated by the instructor of record as high-middle-low. Evaluation of sample portfolios was guided by a set of five criteria-based questions, including a likert scale to determine levels of quality followed by an open-ended question. The open-ended question provided narrative to explain the rating of a criteria-based element, providing the basis for the following portfolio rubric draft. The goal of this process is to further refine this portfolio rubric during spring 2010 by faculty review of another set of samples. Once this rubric is refined, students will be provided with these program rubric guidelines for spring 2010 portfolio submission.

	Low	**Middle**	**High**
Organization	Appears rushed; artifacts appear random or repetitive; cover letters have significant problems with coherence and logic; difficult to navigate	Relevant supporting evidence; cover letters are logical and focused; some minor confusion with navigating materials	Well-organized and specific supporting evidence; cover letters are coherent, logical, and organized; easy to navigate
Professional Style	Unprofessional style; conversational or casual approach;	Reflective tone though not consistently academic or professional;	Reflective in focus and academic in tone; engaging; clear and confident voice
Overall engagement with supporting evidence	Learning outcomes are not mentioned; little reference to evidence or what the evidence reveals;	Clearly identifies and addresses artifacts though relevance at times may be confusing or general	Analytical comments supported by specific examples; insightful evidence based on multiple drafts or reflective journal entries;
Self-Assessment	Focus is general; does not address accurately or include reference to ongoing progress and challenges; lacks awareness of notable writing issues	Addresses greater purpose of the course; includes an open and honest reflection on progress and challenges; may be course reflective but lacking in self-reflection	Displays strong critical awareness and understanding of outcomes; thorough and precise engagement with describing progress and challenges; demonstrates strong awareness of how coursework affected change
Grammar & Mechanics	Many surface errors or major errors in grammar and usage; needs extensive editing;	Occasional major errors in grammar or usage, enough to be distracting to a reader	Virtually free of sentence-level errors; polished mechanics

[4] Demonstrate thorough engagement with the iterative processes of reading, writing, and speaking

APPENDIX F

WRI 116: Portfolio Rubric Results
Written by: Paul Gibbons, Mary Smith, Mike Truong and Anne Zanzucchi

Synopsis: During November 2009, WRI 116: Writing in the Natural Sciences faculty evaluated sample portfolios (selected by the instructors of records as high-middle-low samples). The following rubric draft is based on the narrative descriptions provided by faculty, rating anticipated portfolio criteria. During spring 2010, WRI 116 instructors will continue to develop this rubric based on a new set of sample portfolios. The aim is to implement this rubric for spring 2010 WRI 116 portfolios, by sharing the rubric with students during April to guide their projects.

Ratings: Most participating faculty agreed with the instructor of record about the quality of the project. One reviewer rated the High and the Middle sample inversely, so our level of agreement was 75%.

	LOW	**MIDDLE**	**HIGH**
Overall Presentation	Evidence missing, inaccessible, and/or confusingly labeled. Personal identifying information (i.e. headshot, personal info, etc.) missing and/or inappropriate.	Evidence somewhat complete and clearly labeled. Personal identifying information somewhat appropriate and/or complete.	Evidence complete and labeled clearly. Personal identifying information appropriate, complete, and interesting.
Professional Style	Distracting language issues that detract from accepted professional norms. No awareness of audience.	Language somewhat sophisticated and insightful with some awareness of audience.	Thoughtful and professional prose with keen awareness of audience.
Engagement with Evidence	Cover notes don't mention attached evidence in any meaningful way.	Cover notes somewhat address attached evidence, but generally and/or indirectly.	Cover notes address attached evidence in specific, insightful, and purposeful ways.
Self-Assessment	Reflections about personal achievement of learning outcomes are missing, poorly explained or supported, and/or too general.	Reflections about personal achievement of learning outcomes are somewhat accurate and supported with specific contexts and evidence.	Sophisticated reflection about personal achievement of learning outcomes, supported by specific contexts and evidence.
Mechanics & Grammar	Frequent syntax errors that impede meaning. Spelling with frequent errors that indicate a lack of care or significant struggle with language use.	Simple and some complex phrasing, some inaccurate word choice, and notable punctuation errors. Spelling has several errors, mainly contextual.	Usage of sophisticated sentence structures, appropriate word choice, and accurate punctuation. Spelling is highly accurate, little to no errors.

APPENDIX G

Example Student Work from Writing 100

Hello FIG E,

This year the Merritt Writing Program is reviewing its first program learning outcome, a students' ability to "demonstrate thorough engagement with the iterative processes of reading, writing, and speaking." Normally FIGs review portfolio samples at mid-semester, determining which among a set of portfolios are the high-middle-low samples. The main purpose of this activity is to demonstrate agreement about how we rate student work, with opportunities for further discussion.

This year, we are engaging in a similar process, with the added layer of a brief survey to collect further information. The aim of this survey is to collect faculty responses to basic portfolio criteria, with attention to the iterative aspects of writing. The survey functions basically like a coversheet to describe how you reached your conclusion about the high-middle-low rating. These questions also begin to outline what a shared portfolio rubric might attend to as far as standards and criteria. Faculty feedback to the "please comment" category will provide a richer vocabulary for these aspects of a portfolio, from which we hope to draft a representative rubric for future portfolio review processes. Program-wide results of this process will be shared with your FIG in November.

Appended below are three links to portfolios. Please review these portfolios and complete a survey for each one to summarize your conclusions. Each faculty member has an individual folder on the MWP site, under the Project Tool -- Dropbox. When you complete a survey for each portfolio, please upload these to your individual DropBox folder. The deadline for survey submissions is Monday, October 26 (please be in touch if you need a little more time, of course).

Following this reading process, these ratings would ideally be shared and discussed in your FIG. Please do try to meet either online or in-person at the end of October or during November to discuss your responses to this student work. As a general reminder, part-time faculty are more than welcome to participate in program-wide assessment projects like these, but are not expected to do so.

If you have any questions about this project, please feel free to be in touch. Mike Truong is available to respond to any technical questions. Michael Winder coordinates the FIGs, should you have a question related to groups. Thank you,

Anne.

FIG E, Sample Portfolios -- WRI 100, Sec 3 Spring 09

[Pineda] https://ucmcrops.ucmerced.edu/osp-presentation-tool/viewPresentation.osp?id=A31DCA3D4C5EE32093970FE416105226&sakai.tool.placement.id=d3aa009e-cd1e-4438-9432-c72b7aed11d3

[Holt] https://ucmcrops.ucmerced.edu/osp-presentation-tool/viewPresentation.osp?id=3C45AB8A8730FF2A855187346EEA55A8&sakai.tool.placement.id=d3aa009e-cd1e-4438-9432-c72b7aed11d3

[Garibay] https://ucmcrops.ucmerced.edu/osp-presentation-tool/viewPresentation.osp?id=146FE8F69C1993E822E6C5992B6CB34A&sakai.tool.placement.id=d3aa009e-cd1e-4438-9432-c72b7aed11d3

APPENDIX H

Example Student Work from Writing 10

Sample Portfolios: WRI 10 (Sec. 15) Spring 2009

[Taha] https://ucmcrops.ucmerced.edu/osp-presentation-tool/viewPresentation.osp?id=45CDC921D2EA41DDF50A9F7DAE9F5E63&sakai.tool.placement.id=d3aa009e-cd1e-4438-9432-c72b7aed11d3

[White] https://ucmcrops.ucmerced.edu/osp-presentation-tool/viewPresentation.osp?id=1A892AB398FECF00E80646802F107435&sakai.tool.placement.id=d3aa009e-cd1e-4438-9432-c72b7aed11d3

[Shapiro] https://ucmcrops.ucmerced.edu/osp-presentation-tool/viewPresentation.osp?id=59F12F3BB6795DB75C12ED9E748DCEF2&sakai.tool.placement.id=d3aa009e-cd1e-4438-9432-c72b7aed11d3

- (CB) Based on the report's analysis begin development of upper-division capstone courses.

2013-2014 Academic Year:

- (CB-OP) Develop exams and surveys to incorporate into the new upper division capstone courses.

- (CB-OP) Identify strong and weak points of the program and develop a plan to adjust the curriculum and program elements to improve the degree to which program learning outcomes are achieved. *Participants:* Dean of School of Natural Sciences, faculty director, program coordinator, courses instructors.

Assessment Methodologies – Direct and Indirect Assessments

Since the coursework constitutes the base of the NSED program we have chosen to focus on course based (CB) evaluation in this inaugural portion of the five-year-assessment plan. Analysis of the collected information will then guide our next evaluation as well as help improve the courses which are the major component of the program. Our study was designed to evaluate whether the PLOs are met using both *direct* and *indirect* methods.

The *indirect* method included (i) development and administration of surveys which asked students to evaluate the impact the courses and the program have on their learning and skills acquisition, and (ii) informal interviews of NSED instructors and students. The survey was administered in all NSED courses offered in the Fall 2009; these include the seminar/fieldwork lower division combo classes NSED 23/33-24/34 (Introduction to Teaching Science and Math in Elementary School), NSED 63/73-64/74 (Introduction to Teaching Science and Math in High School). The survey consisted of the six statements that the students were asked to evaluate by choosing one of the following six responses: "Strongly Disagree", "Moderately Disagree", "Undecided", "Moderately Agree", "Strongly Agree". The prompts that students were asked to respond to are presented along with the number of a PLO they address:

1. *This NSED course helped me improve on my own learning in my other classes* ***(PLO 2).***

2. *After completing this NSED course, I have a better understanding of what constitutes duties and responsibilities of a teacher* ***(PLO 1a).***

3. *After completing this NSED course, I have a better understanding of what skills and knowledge are necessary to become a good teacher* ***(PLO 1b).***

4. *This NSED course helped me learn how to develop a lesson plan and deliver an effective lesson* ***(PLO 2a).***

5. *This NSED course helped me learn how to design different types of assessments to evaluate students learning* ***(PLO 2b).***

6. *This NSED course helped me learn how to distinguish between students with different learning abilities and needs and adapts my teaching methodology to address this diversity* ***(PLO 2c).***

Additionally the upper division course NSED 120 used the following questions:

1. ***(PLO 1d, 2c)*** *Through the class meetings and assignments, this course provided me with an understanding of the various kinds of diversity among K-12 students in schools in California and the U.S.*

2. ***(PLO 1e, 2c)*** *This course provided me with useful information in meeting the needs of all students in K-12 settings in the U.S.*

3. ***(PLO 1d, 2c)*** *This provided me with a deep understanding of teaching for social justice.*

The *direct* assessment included question embedded into each of the courses that tested whether the PLOs have been achieved. The questions along with the corresponding PLO numbers are given below for each of the courses assessed.

<u>NSED 23/33 – 24/34</u>

The following question is a True/False question.

1. ***(PLO 1e, 2c)*** *Teaching strategies used for English Language Learners may not be used for any other students.*

The following three questions are multiple choice questions.

2. ***(PLO 2b)*** *The purpose of formative assessments is*
    a. *To determine what students learned in the course*
    b. *To determine students' prior knowledge*
    c. *To check for understanding periodically throughout a lesson or unit*
    d. *To help the teacher make adjustments in future lessons*
    e. *b, c, and d*

3. ***(PLO 2a)*** *The first step in planning a lesson is*
    a. *Decide what you what the students to understand*
    b. *Decide how the students will demonstrate their understanding*

c. *Decide what activities you want to do*
d. *Assess the students' prior knowledge*
e. *None of the above*

4. ***(PLO 2b)*** *The difference between "Wait Time" and "Wait Time 2" is*
   a. *"Wait Time" is for elementary students, "Wait Time 2" is for middle school and high school students*
   b. *"Wait Time" is the time a teacher waits after asking the first question of the lesson. "Wait Time 2" is the time a teacher waits after asking any subsequent questions.*
   c. *"Wait Time" is the time a teacher waits after asking a question before allowing students to answer. "Wait Time 2" is the time a teacher waits after a student answers a question before asking the student a follow-up question or asking for clarification.*
   d. *"Wait Time" is the time a teacher waits for students to begin listening before giving instructions. "Wait Time 2" is the additional time a teacher waits for students to begin listening before giving instructions.*
   e. *There is no difference.*

The following question is a short response question.

(PLO 2) *A teacher wants to increase "student talk time" in his/her classroom. What is "student talk time"? Why is it important in helping students gain understanding? What are two strategies that could be used to accomplish the teacher's goal? Explain how to use the strategies and how they can be used to increase "student talk time."*

<u>NSED 63/73-64/74</u>

The following three questions are multiple choice questions.

1. ***(PLO 2c)*** *In California's diverse classroom environment, what teaching strategies listed below would be most effective when working with students with limited English proficiency?*
   a. *Cooperative Learning*
   b. *Identifying similarities and differences*
   c. *Reinforcing effort and providing recognition*
   d. *All of the above*

2. ***(PLO 1a, 2)*** *As a teacher, it is important that you*
   a. *Maintain classroom discipline*
   b. *Provide feedback on assignments in a timely manner*
   c. *Create new and exciting ways to learn information*
   d. *All of the above*

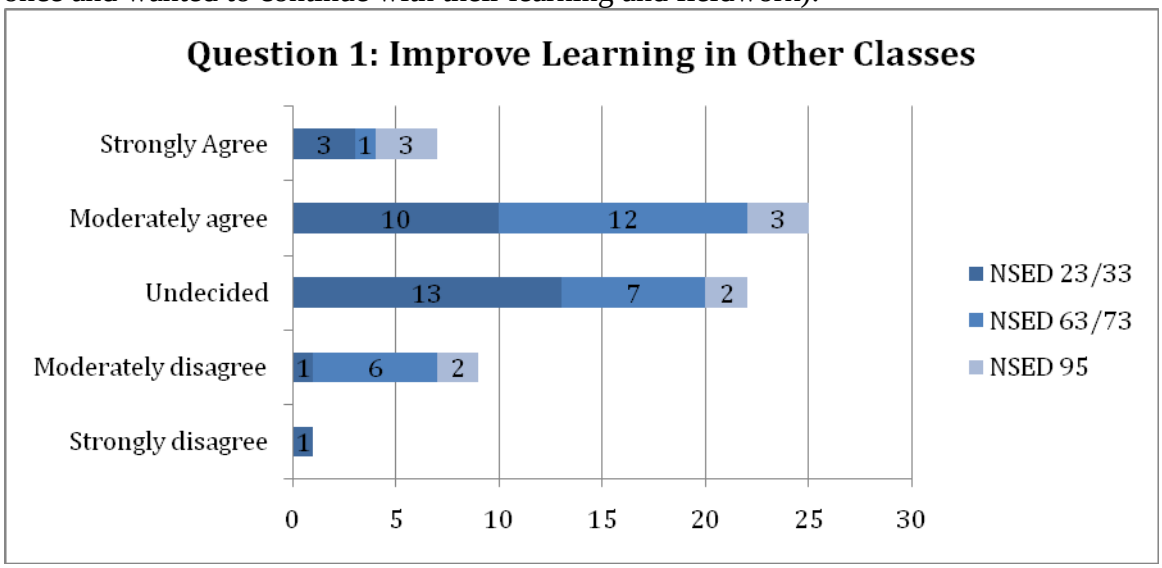
3. ***(PLO 1,2)*** *When planning a lesson for a particular math or science class, what do you use as a guide to what students should know at the end of your lesson?*
    a. *Textbook chapter*
    b. *Internet lesson plan*
    c. *California State standards*
    d. *Nothing, you teach what you want to teach*

The following question is a short response question.

(PLO 2) *You are hired to teach Algebra I at a local high school. After the first few homework assignments, you notice that one of your students is really struggling to understand the material. How would you handle the situation? List two teaching strategies we talked about this semester for differentiating your instruction to help your struggling student and tell why you would use them.*

5. Surveys Assessment Results

The following charts display results of the administered surveys (note that NSED 95 is an advanced version of the NSED 63/73 – 64/74 course for students have completed this course once and wanted to continue with their learning and fieldwork):



Philosophy Minor

Philosophy 5: Logic & Critical Reasoning (Spring 09)
Final Exam

25

NAME [redacted] _____

Student ID# [redacted] _____

Instructions: Answer all questions from all seven sections.

Section I: **(3 points)** Which of the following symbolic sentences is a tautology (i.e., theorem)? You may use a truth table (or any other means) to help determine your answer. In the blank provided write "YES" if it's a tautology, "NO" if it isn't.

1. $(P \rightarrow Q) \vee (Q \rightarrow R)$ No
2. $(P \wedge Q \rightarrow R) \rightarrow (P \rightarrow R)$ Yes
3. $(P \rightarrow Q) \wedge (Q \rightarrow P) \rightarrow (P \leftrightarrow Q)$ Yes

Section II: **(4 points)** Which of the following are well-formed, *official* symbolic formulas? Reminder: *official* symbolic formulas are formed according to the rules for constructing symbolic formulas, and *do not* omit any parentheses that accompany binary connectives. In the blank provided write "YES" if it is, "NO" if it isn't.

4. $\sim(\sim \Lambda x \sim Fx \vee Gy)$ No
5. $\Lambda y\,(Hy \rightarrow Vx\,Hx)$ Yes
6. $(Vx) \sim Fx$ No
7. $\Lambda y\,(Hx \rightarrow Gx)$ Yes

4

Section III: (5 points) Using the following scheme of abbreviation:

F: *a* is a dog
G: *a* is a cat

translate the following English sentences into *official* symbolic sentences, and write the answers in the blanks provided:

8. All dogs are cats. $\bigwedge x (Fx \rightarrow Gx)$
9. Some dogs are not cats. $\bigvee x (Fx \wedge \sim Gx)$
10. Only dogs are cats. $\bigwedge x (Gx \rightarrow Fx)$
11. Some dogs are cats. $\bigvee x (Fx \wedge Gx)$
12. No dogs are cats. $\bigwedge x (Fx \rightarrow \sim Gx)$

Section IV: (4 points) From the formula:

$$FA \leftrightarrow Gx$$

which of the following formulas follow by existential generalization (EG)? In the space provided write "YES" if the formula follows by EG, "NO" if it doesn't.

~~13.~~ $\bigvee x (Fx \leftrightarrow Gx)$ YES
14. $\bigvee y (Fy \leftrightarrow Gx)$ YES
15. $\bigvee x (FA \leftrightarrow Gx)$ YES
16. $Fx \leftrightarrow \bigvee x\, Gx$ NO

8

Section III: **(5 points)** Using the following scheme of abbreviation:

F: *a* is a dog
G: *a* is a cat

translate the following English sentences into *official* symbolic sentences, and write the answers in the blanks provided:

8. All dogs are cats. $\bigwedge x(Fx \rightarrow Gx)$

9. Some dogs are not cats. $\bigvee x(Fx \wedge \sim Gx)$

10. Only dogs are cats. $\bigwedge x(Gx \rightarrow Fx)$

11. Some dogs are cats. $\bigvee x(Fx \wedge Gx)$

12. No dogs are cats. $\bigwedge x(Fx \rightarrow \sim Gx)$

Section IV: (4 points) From the formula:

$$FA \leftrightarrow Gx$$

which of the following formulas follow by existential generalization (EG)? In the space provided write "YES" if the formula follows by EG, "NO" if it doesn't.

13. $\bigvee x\,(Fx \leftrightarrow Gx)$ NO

14. $\bigvee y\,(Fy \leftrightarrow Gx)$ YES

15. $\bigvee x\,(FA \leftrightarrow Gx)$ YES

16. $Fx \leftrightarrow \bigvee x\,Gx$ NO

9

Section V: (2 points) Which of the following, if any, is a correct application of quantifier negation (QN)? (Write "YES" if it is, "NO" if it isn't)

17. $\sim \bigvee x\,(Fx \rightarrow Gx)$

$\therefore\ \bigvee x \sim (Fx \rightarrow Gx)$ No

18. $\bigwedge x \sim (Fx \rightarrow Gx)$

$\therefore\ \sim \bigvee x\,(Fx \rightarrow Gx)$ Yes

Section VI: (4 points) Theorem 18 can be written as follows: $\sim P \rightarrow (P \rightarrow Q)$

Which of the following is an instance of Theorem 18? (Write "YES" if it is, "NO" if not)

19. $\sim\sim \bigwedge x\, Fx \rightarrow (\sim \bigwedge x\, Fx \rightarrow Gx)$ Yes

20. $\sim (P \rightarrow Q) \rightarrow ((P \rightarrow Q) \rightarrow Q)$ Yes

21. $\sim Fx \vee Gy \rightarrow (Fx \vee Gy \rightarrow Hx)$ No

22. $\sim P \rightarrow (P \rightarrow \bigvee x\,(\sim Fx \wedge Q))$ Yes

6

Section VII: Give a complete proof (derivation) of each of the following three theorems in the space provided. Number every line, and give complete annotations for all lines *except* assertion and assumption lines.

23. (5 points) $\Lambda x\,(Fx \rightarrow Gx) \rightarrow (Vx\,Fx \rightarrow Vx\,Gx)$

1.	~~Show~~ $\Lambda x\,(Fx \rightarrow Gx) \rightarrow (Vx\,Fx \rightarrow Vx\,Gx)$	
2.	$\Lambda x\,(Fx \rightarrow Gx)$	
3.	~~Show~~ $Vx\,Fx \rightarrow Vx\,Gx$	
4.	$Vx\,Fx$	
5	Fy	4, EI
6.	$Fy \rightarrow Gy$	2, UI
7.	Gy	5, 6, MP
8	$Vx\,Gx$	7, EG

5

24. (7 points) $\Lambda x\,(P \vee Fx) \rightarrow P \vee \Lambda x\,Fx$

1. ~~Show~~ $\Lambda x\,(P \vee F_x) \rightarrow P \vee \Lambda x F_x$
2. $\Lambda x\,(P \vee F_x)$
3. ~~Show~~ $P \vee \Lambda x F_x$
4. ~~Show~~ $\sim P \rightarrow \Lambda x F_x$
5. $\sim P$
6. ~~Show~~ $\Lambda x F_x$
7. $P \vee F_x$ — 2, UI
8. F_x — 5, 7; MTP
9. $P \vee \Lambda x F_x$ — 3, CD

7

25. (6 points) $\bigwedge x\, Fx \wedge \bigvee x\, Gx \rightarrow \bigvee x\, (Fx \wedge Gx)$

1.	Show $\bigwedge x\, Fx \wedge \bigvee x\, Gx \rightarrow \bigvee x\, (Fx \wedge Gx)$	
2.	$\bigwedge x\, Fx \wedge \bigvee x\, Gx$	
3.	~~Show~~ $\bigvee x\, (Fx \wedge Gx)$	
4.	$\bigwedge x\, Fx$	2, S
5.	$\bigvee x\, Gx$	2, S
6.	Gy	5, EI
7.	Fy	4, UI
8	$Fy \wedge Gy$	6, 7, Adj.
9	$\bigvee x\, (Fx \wedge Gx)$	8, EG

6

VI. Appendices

1. PLO #1 Rubric

2. PLO #2 Rubric (draft)

3. Student focus group protocol (2 pages)

4. Focus group summary report (4 pages)

5. Copies of the four final exams used for assessment, with solutions. One of these includes an example of student work [redacted]. (34 pages)

Final Exam Rubric:
Assessing Outcomes of the Physics Programmatic Learning Objectives (PLOs)

Description: Using this rubric, we will categorize the final exams from upper division physics courses. The results will provide information on the success of and potential for improvement for the first PLO: physical principles.

Utilizing this rubric: Take the conditions of the exam—timed-versus-take home, open-versus-closed book, formula sheet allowed or provided—into account when applying this rubric. Each group analyzing a final exam should choose a problem or small subset of problems from the final exam to evaluate using this rubric. Since it's currently a small program, names will be obscured and codes will be given to reduce any potential bias.

PLO	Unacceptable	Acceptable	Excellent
1. Physical Principles. Students will be able to apply basic physical principles—including classical mechanics, electricity & magnetism, quantum mechanics, and statistical mechanics—to explain, analyze, and predict a variety of natural phenomena.	• Knowledge of basic physical principles is missing. • Knowledge of basic physical principles evident, but o Application is missing. o Significant errors exist in their application. o *Example: student can write down Maxwell's equations, but cannot calculate the magnetic field around a wire.* • Knowledge and/or application of two or more physical principles are confused.	• Knowledge of basic physical principles is evident. • Those principles are applied correctly, o although some errors exist. • Misconception in knowledge or application of more subtle feature of principle may exist.	• Knowledge of basic physical principles is evident. • Those principles are applied correctly. o although minimal errors may be present. • Evidence that more subtle aspects of physical principles known and correctly applied.

Final Exam Rubric:
Assessing Outcomes of the Physics Programmatic Learning Objectives (PLOs)

Description: Using this rubric, we will categorize the final exams from upper division physics courses. The results will provide information on the success of and potential for improvement for the first two PLOs: physical principles and mathematical expertise.

Utilizing this rubric: Take the conditions of the exam—timed-versus-take home, open-versus-closed book, formula sheet allowed or provided—into account when applying this rubric. Each group analyzing a final exam should choose a problem or small subset of problems from the final exam to evaluate using this rubric. Since it's currently a small program, names will be obscured and codes will be given to reduce any potential bias. [[Just a suggestion, what do you think?]]

PLO	Significant Improvement Needed	Acceptable	Excellent
2. Mathematical Expertise. Students will be able to apply advanced mathematical techniques (e.g. calculus, linear algebra, probability, and statistics) in their explanations, analyses, and predictions of physical phenomena.	• Did not apply advanced mathematics required to correctly solve problem. • Tries to apply the wrong advanced mathematical technique. • Tries to apply the correct mathematical technique(s), but significant errors exist.	• Utilizes advanced mathematics correctly, although some errors exist. • May not have used the most efficient mathematical method, but solved the problem correctly.	• Utilizes advanced mathematics correctly, minimal errors may be present. • Utilizes an efficient mathematical approach to solve the physics problem.

DRAFT

Physics 105 – 2008
Final Exam

Problem 1 (25 points)
Beginning with the equation of motion for a damped harmonic oscillator, show that $x = h(t)e^{-\beta t}$ is a solution for the case of critical damping, what is $h(t)$. There is no driving force.

Problem 2 (25 points)
The Lagrangian for a mechanical system is $L = a\dot{q}^2 + bq^4$ where q is a generalized coordinate and a and b are constants. The equation of motion for the system is:

a) $\dot{q} = \sqrt{\frac{b}{a}}q^2$

b) $\dot{q} = \frac{2b}{a}q^3$

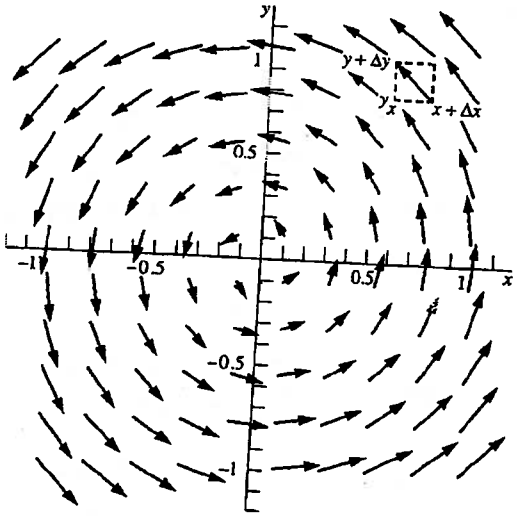
c) $\ddot{q} = -\frac{2b}{a}q^3$

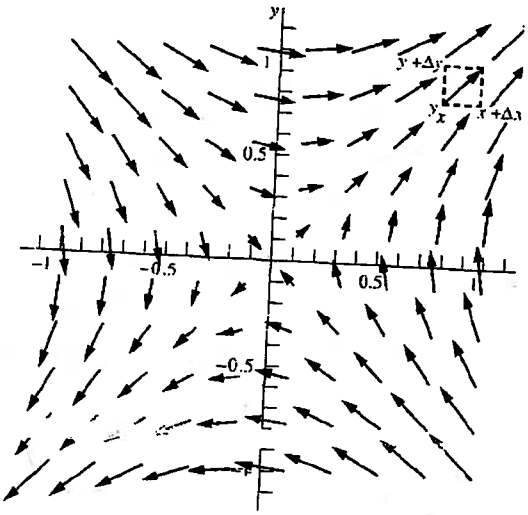
d) $\ddot{q} = +\frac{2b}{a}q^3$

e) $\ddot{q} = \frac{b}{a}q^3$

Note: in order to get full credit you have to show work.

Problem 3 (25 points)





$$\vec{F} = -by\hat{x} + bx\hat{y} \qquad \vec{F} = by\hat{x} + bx\hat{y}$$

Above are representations of two "force fields" and their corresponding mathematical representations. Arrow points on the graphs represent the magnitude and directions of the force evaluated at the center of each arrow.

a) **Test each of the above forces (either graphically or mathematically) to see if they are conservative.**
b) **Write the potential energy function for the case(s) where the force is conservative.**
c) **Consider the case of a force given by $\vec{F} = ay\hat{x} + bx\hat{y}$ where $a \neq b$ are both positive numbers. Is this a conservative force?**
d) **Can you always tell by looking at a force field whether or not the force is conservative?**

Problem 4 (25 points)

Skim the attached manuscript paying particular attention to the boxed portions of the material. Discuss the following questions (less than 3 sentences {or bullet points} each should suffice):

a) **What is the basic point of this paper?**
b) **What role is radiation pressure serving in their scheme?**
c) **Equations (3) and (6) are similar to those we have seen in class. What kind of system do they represent?**
d) **What are the dimensions (units) of Γ and g?**
e) **What does Figure 2 say about the behavior of the mechanical resonance as a function of temperature?**

Cooling of a Mirror by Radiation Pressure

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We describe an experiment in which a mirror is cooled by the radiation pressure of light. A high-finesse optical cavity with a mirror coated on a mechanical resonator is used as an optomechanical sensor of the Brownian motion of the mirror. A feedback mechanism controls this motion via the radiation pressure of a laser beam reflected on the mirror. We have observed either a cooling or a heating of the mirror, depending on the gain of the feedback loop.

PACS numbers: 42.50.Lc, 04.80.Nn, 05.40.Jc

Thermal noise is a basic limit for many very sensitive optical measurements such as interferometric gravitational-wave detection [1–3]. Brownian motion of suspended mirrors can be decomposed into suspension and internal thermal noises. The latter is due to thermally induced deformations of the mirror surface and constitutes the major limitation of gravitational-wave detectors in the intermediate frequency domain [4,5]. Observation and control of this noise have thus become an important issue in precision measurements [6–8]. In order to reduce thermal noise effects, it is not always possible to lower the temperature and other techniques have been proposed, such as feedback control [9].

In this Letter we report the first experimental observation of the cooling of a mirror by feedback control. The principle of the experiment is to detect the Brownian motion of the mirror with an optomechanical sensor and then to freeze the motion by applying an electronically controlled radiation pressure on the mirror. Mechanical effects of light on macroscopic objects have already been observed, such as the dissipative effects of electromagnetic radiation [10], the optical bistability and mirror confinement in a cavity induced by radiation pressure [11], or the regulation of the mechanical response of a microcantilever by feedback via the photothermal force [12]. In our experiment the radiation pressure is driven by the feedback loop in such a way that a viscous force is applied to the mirror. It thus plays a role somewhat similar to the one in optical molasses for atoms.

The cooling mechanism can be understood from the experimental setup shown in Fig. 1. The mirror is used as the rear mirror of a single-ended Fabry-Pérot cavity. The phase of the field reflected by the cavity is very sensitive to changes in the cavity length [13–15]. For a resonant cavity, a displacement δx of the rear mirror induces a phase shift $\delta\varphi_x$ of the reflected field on the order of

$$\delta\varphi_x \approx \frac{8\mathcal{F}}{\lambda}\,\delta x\,, \tag{1}$$

where $\mathcal{F}$ is the cavity finesse and λ is the optical wavelength. This signal is superimposed to the quantum phase noise of the reflected beam. Provided that the cavity finesse is high enough, this quantum noise is negligible and the Brownian motion of the mirror can be detected by measuring the phase of the reflected field [15].

To cool the mirror we use an auxiliary laser beam reflected from the back on the mirror. This beam is intensity modulated by an acousto-optic modulator driven by the feedback loop so that a modulated radiation pressure is applied to the mirror. The resulting motion can be described by its Fourier transform $\delta x[\Omega]$ at frequency Ω which is proportional to the applied forces

$$\delta x[\Omega] = \chi[\Omega](F_T[\Omega] + F_{\rm rad}[\Omega])\,, \tag{2}$$

where $\chi[\Omega]$ is the mechanical susceptibility of the mirror. If we assume that the mechanical response is harmonic, this susceptibility has a Lorentzian shape

$$\chi[\Omega] = \frac{1}{M(\Omega_M^2 - \Omega^2 - i\Gamma\Omega)}\,, \tag{3}$$

characterized by a mass M, a resonance frequency Ω_M, and a damping Γ related to the quality factor Q of the mechanical resonance by $\Gamma = \Omega_M/Q$.

The force F_T in Eq. (2) is a Langevin force responsible for the Brownian motion of the mirror. At thermal equilibrium its spectrum $S_{F_T}[\Omega]$ is related to the mechanical

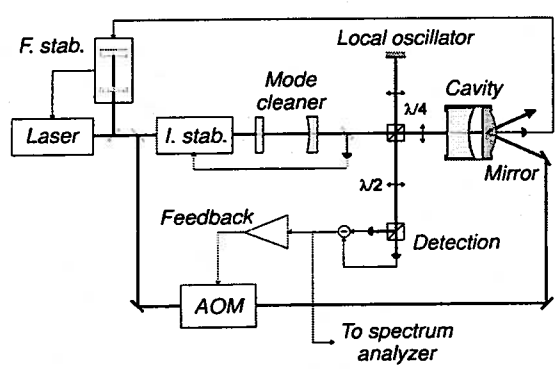

FIG. 1. Experimental setup. The Brownian motion of the mirror is detected with a high-finesse cavity. A frequency (F. stab.) and intensity (I. stab.) stabilized light beam is sent into the cavity, and the phase of the reflected field is measured by homodyne detection. This signal is fed back to the mirror via the radiation pressure exerted by a beam with modulated intensity (AOM).

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susceptibility by the fluctuation-dissipation theorem

$$S_{F_T}[\Omega] = -\frac{2k_BT}{\Omega}\,\mathrm{Im}\left(\frac{1}{\chi[\Omega]}\right) = 2M\Gamma k_BT\,, \quad (4)$$

where T is the temperature. The resulting thermal noise spectrum $S_x^T[\Omega]$ of the mirror motion has a Lorentzian shape centered at frequency Ω_M and of width Γ.

The second force F_{rad} in Eq. (2) is the radiation pressure exerted by the auxiliary laser beam and modulated by the feedback loop. Neglecting the quantum phase noise in the control signal, this force is proportional to the displacement δx of the mirror [Eq. (1)]. We choose the feedback gain in such a way that the radiation pressure is proportional to the speed $v = i\Omega\delta x$ of the mirror

$$F_{\mathrm{rad}}[\Omega] = iM\Omega g\delta x[\Omega], \quad (5)$$

where g is related to the electronic gain. The radiation pressure exerted by the auxiliary laser beam thus corresponds to an additional viscous force for the mirror. The resulting motion is given by

$$\delta x[\Omega] = \frac{1}{M[\Omega_M^2 - \Omega^2 - i(\Gamma + g)\Omega]}F_T[\Omega]. \quad (6)$$

This equation is similar to the one obtained without feedback [Eq. (2) with $F_{\mathrm{rad}} = 0$] except that the radiation pressure changes the damping without adding any fluctuations. The noise spectrum $S_x^{fb}[\Omega]$ of the mirror motion still has a Lorentzian shape but with a different width $\Gamma_{fb} = \Gamma + g$ and a different height. The variation of height can be characterized by the amplitude noise reduction $\mathcal{R}$ at resonance frequency

$$\mathcal{R} = \sqrt{\frac{S_x^T[\Omega_M]}{S_x^{fb}[\Omega_M]}} = \frac{\Gamma_{fb}}{\Gamma} = \frac{\Gamma + g}{\Gamma}. \quad (7)$$

The resulting motion is then equivalent to a thermal equilibrium at a different temperature T_{fb} which can be either reduced or increased depending on the sign of the gain g

$$\frac{T_{fb}}{T} = \frac{\Gamma}{\Gamma_{fb}} = \frac{\Gamma}{\Gamma + g}. \quad (8)$$

We now describe our experiment. The mirror is coated on the plane side of a small plano-convex mechanical resonator made of silica (Fig. 1). The coating has been made at the *Institut de Physique Nucléaire de Lyon* on a 1.5 mm thick substrate with a diameter of 14 mm and a curvature radius of the convex side of 100 mm. Internal acoustic modes correspond to Gaussian modes confined around the central axis of the resonator [16,17]. The fundamental mode studied in this paper is a compression mode with a waist equal to 3.4 mm and a resonance frequency close to 2 MHz [15,17]. The front mirror of the cavity is a *Newport high-finesse SuperMirror* (curvature radius = 1 m, transmission = 50 ppm) held at 1 mm from the rear mirror. We have measured the following parameters of the cavity: free spectral range = 141 GHz, cavity bandwidth = 1.9 MHz, beam waist = 90 μm. These values correspond to a finesse $\mathcal{F}$ of 37 000.

The light entering the cavity is provided by a titane-sapphire laser working at 810 nm and frequency locked to a stable external cavity which is locked to a resonance of the high-finesse cavity by monitoring the residual light transmitted by the rear mirror. The beam is intensity stabilized and spatially filtered by a mode cleaner. One gets a 100 μW incident beam on the high-finesse cavity with a mode matching of 98%. The phase of the field reflected by the cavity is measured by homodyne detection. The reflected field is mixed with a 10 mW local oscillator and a servoloop monitors the length of the local oscillator arm so that we measure the phase fluctuations of the reflected field. This signal is sent both to the feedback loop and to a spectrum analyzer.

The feedback loop consists of an amplifier with variable gain and phase which drives the acousto-optic modulator. The 500 mW auxiliary beam is uncoupled from the high-finesse cavity by a frequency shift of the acousto-optic modulator (200 MHz) and by a tilt angle of 10° with respect to the cavity axis. We have checked that this beam has no spurious effect on the homodyne detection. A bandpass filter centered at the fundamental resonance frequency of the mirror is also inserted in the feedback loop to reduce its saturation. For large gains, the radiation pressure F_{rad} can become of the same order as the Langevin force F_T, and it must be restricted in frequency in order to get a finite variance. The electronic filter has a quality factor of 200 and limits the efficiency of the feedback loop to a bandwidth of 9 kHz around the fundamental resonance frequency.

Figure 2 shows the phase noise spectrum of the reflected field obtained by an average of 1000 scans of the spectrum analyzer with a resolution bandwidth of 10 Hz. Curve *a* is obtained at room temperature without feedback. It reproduces the thermal noise spectrum $S_x^T[\Omega]$ of the mirror which is peaked around the fundamental

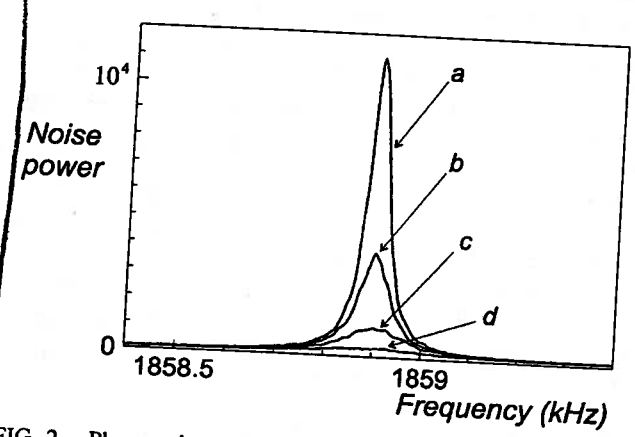

FIG. 2. Phase noise spectrum of the reflected field normalized to the shot-noise level for a frequency span of 1 kHz around the fundamental resonance frequency of the mirror. The peak reflects the Brownian motion of the mirror without feedback (*a*) and with feedback for increasing gains (*b*) to (*d*).

resonance frequency (1858.9 kHz) with a width $\Gamma/2\pi$ of 45 Hz (mechanical quality factor $Q \simeq 40\,000$). The spectrum is normalized to the shot-noise level, and it clearly appears that the thermal noise is much larger than the quantum phase noise [15].

Curves b to d are obtained with feedback for increasing electronic gains. The phase of the amplifier is adjusted to maximize the correction at resonance. From Eqs. (5) and (6) this corresponds to a global imaginary gain for the loop and to a purely viscous radiation pressure force. The control of the mirror motion is clearly visible on those curves. The thermal peak is strongly reduced while its width is increased. The amplitude noise reduction $\mathcal{R}$ at resonance is larger than 20 for large gains.

The effective temperature T_{fb} can be deduced from the variance Δx^2 of the mirror motion which is equal to the integral of the spectrum $S_x^{fb}[\Omega]$. From Eqs. (4), (6), and (8) one gets the usual relation for a harmonic oscillator at thermal equilibrium

$$\frac{1}{2} M\Omega_M^2 \Delta x^2 = \frac{1}{2} k_B T_{fb} . \tag{9}$$

The decrease of the area of the thermal peak observed in Fig. 2 thus corresponds to a cooling of the mirror.

Figure 3 shows the effect of feedback for a reverse gain ($g < 0$). Noise spectra are obtained by an average of 500 scans with a resolution bandwidth of 1 Hz. Curve b exhibits a strong increase of the thermal peak which now corresponds to a heating of the mirror. The feedback also reduces the damping from Γ to $\Gamma - |g|$, thus increasing the quality factor of the resonance. We have obtained a maximum effective quality factor of 2.2×10^6 ($\Gamma_{fb} \simeq \Gamma/50$), limited by the saturation of the feedback loop.

It is instructive to study the efficiency of the cooling or heating mechanism with respect to the gain of the feedback loop. Figure 4 shows the variation of the damping Γ_{fb}/Γ, of the amplitude noise reduction $\mathcal{R}$ at resonance, and of the cooling factor T/T_{fb}, as a function of the feedback gain. These parameters are derived from the experimental spectra by Lorentzian fits which give the width and the area of the thermal peak, the latter being related to the effective temperature by Eq. (9). To measure the feedback gain, we detect the intensity of the auxiliary beam after reflection on the mirror. The ratio between the modulation spectrum of this intensity at frequency Ω_M and the noise spectrum $S_x^{fb}[\Omega_M]$ is proportional to the gain g. This measurement takes into account any nonlinearity of the gain due to a possible saturation of the acousto-optic modulator.

As expected from Eqs. (6) and (7), the damping and the amplitude noise reduction $\mathcal{R}$ have a linear dependence with the gain, as well for cooling ($g > 0$) as for heating ($g < 0$). The straight line in Fig. 4 is in excellent agreement with experimental data and allows one to normalize the gain g to the damping Γ, as this has been done in the figure.

This figure also shows that large cooling factors T/T_{fb} can be obtained. This cooling factor does not, however, evolve linearly with the gain as it would be expected from Eq. (8). This is due to the presence of a background thermal noise visible in Fig. 2. This noise is related to all other acoustic modes of the mirror and to the thermal noise of the coupling mirror of the cavity. The feedback loop does not have the same effect on this noise and on the fundamental thermal peak. The solid curve in Fig. 4 corresponds to a theoretical model in which the background noise is assumed to be unchanged by the feedback. As a consequence, only the fundamental mode is cooled at a temperature T_{fb}, whereas all other modes stay in thermal equilibrium at the initial temperature T. The resulting cooling factor T/T_{fb} is in excellent agreement with experimental data.

The cooling mechanism is not limited to the mechanical resonance frequencies. Figure 5 shows the cooling obtained at frequencies well below the fundamental

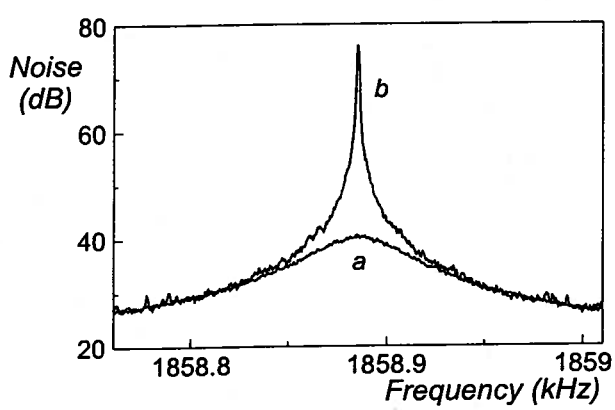

FIG. 3. Phase noise spectrum of the reflected field in dB scale normalized to the shot-noise level for a frequency span of 250 Hz, without feedback (a) and with feedback for a negative gain (b).

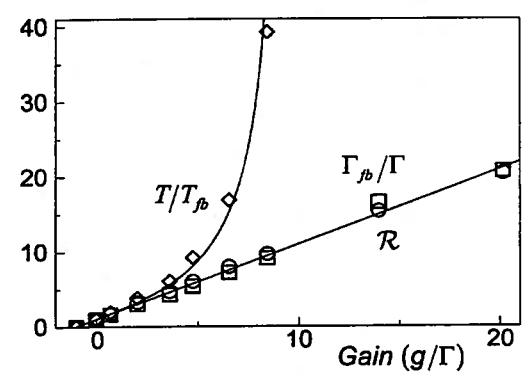

FIG. 4. Variation of the damping Γ_{fb}/Γ (squares), of the amplitude noise reduction $\mathcal{R}$ at resonance (circles), and of the cooling factor T/T_{fb} (diamonds), as a function of the feedback gain g normalized to Γ. Solid curves are theoretical results.

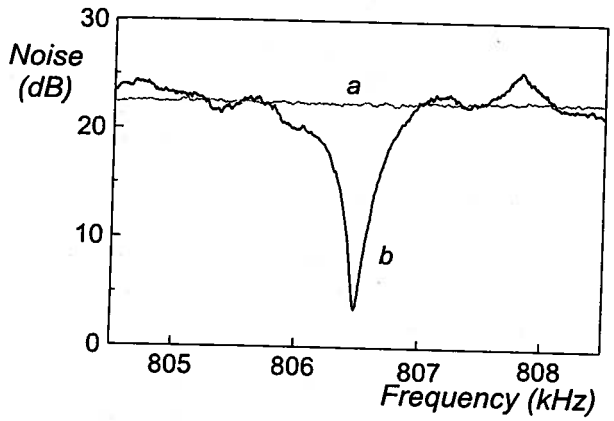

FIG. 5. Cooling far from resonance (800 kHz). The background thermal noise (a) is reduced in the presence of feedback (b). Curves represent the phase noise spectra of the reflected field in dB scale normalized to the shot-noise level.

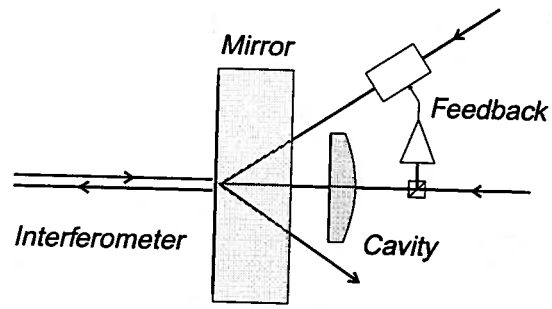

FIG. 6. Application of the cooling mechanism to reduce the thermal noise in a gravitational-wave interferometer.

resonance frequency. The electronic filter is now centered around 800 kHz and the feedback loop reduces the background thermal noise (curve a). The width of the noise reduction (curve b) is related to the filter bandwidth. The phase and the gain of the feedback loop have been adjusted since the electronic gain g has now to be compared to the real part $M\Omega_M^2$ of the inverse of the mechanical susceptibility at low frequency [Eq. (6)]. Note that the amplitude of the radiation pressure exerted by the auxiliary laser beam is, however, approximately the same as in the resonant case. Large noise reduction is actually obtained when the radiation pressure $F_{\rm rad}$ is on the order of the Langevin force F_T whose amplitude is independent of frequency [Eq. (2)].

In conclusion, we have observed a thermal noise reduction by a factor of 20 near the fundamental resonance frequency. The radiation pressure exerted by the feedback loop corresponds to a viscous force which increases the damping of the mirror without adding thermal fluctuations. For large gains, the thermal peak of the fundamental mode becomes of the same order as the background thermal noise and no global thermal equilibrium is reached. As far as an effective temperature can be defined for the fundamental mode, we have obtained a reduction of this temperature by a factor of 40. We have also observed a heating of the mirror for reverse feedback gains, and a cooling of the background thermal noise at low frequencies.

The cooling mechanism demonstrated in this paper may be useful to increase the sensitivity of gravitational-wave interferometers. The main difficulty is to freeze the thermal noise without changing the effect of the signal. We propose in Fig. 6 a possible scheme to control the thermal noise of one mirror of the interferometer. A cavity performs a local measurement of the mirror motion which is fed back to the mirror via the radiation pressure of a laser beam. The coupling mirror of the cavity is a small plano-convex mirror with a high mechanical resonance frequency and a low background thermal noise at low frequency. As a consequence the cavity measures the thermal noise of the mirror of the interferometer. For a short cavity, this measurement is not sensitive to a gravitational wave and the cooling can reduce the background thermal noise at the gravitational-wave frequencies without changing the response of the interferometer.

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Problem 1

$$\ddot{x} + 2\beta\dot{x} + \omega_0^2 x = 0$$

critical damping $\Rightarrow \beta = \omega_0$

$$\dot{x} = \frac{dh(t)}{dt} e^{-\beta t} + h(t)(-\beta)e^{-\beta t}$$

$$\ddot{x} = \ddot{h} e^{-\beta t} + 2\dot{h} e^{-\beta t}(-\beta) + h\beta^2 e^{-\beta t}$$

$$(\ddot{h} + 2\dot{h}(-\beta) + h\beta^2)\cancel{e^{-\beta t}} + 2\beta(\dot{h} - h\beta)\cancel{e^{-\beta t}} + \omega_0^2 h \cancel{e^{-\beta t}} =$$

$$\ddot{h} + h\beta^2 - 2h\beta^2 + \omega_0^2 h = 0$$

$$\ddot{h} + h(\omega_0^2 - \beta^2) = 0$$

$\ddot{h} = 0$ as long as

$\dot{h} = C_1$

$$\boxed{h = C_1 t + C_2}$$

Problem 2

$$L = a\dot{q}^2 + bq^4$$

$$\frac{\partial L}{\partial q} = \frac{d}{dt}\frac{\partial L}{\partial \dot{q}}$$

$$4bq^3 = \frac{d}{dt} 2a\dot{q}$$

$$= 2a\ddot{q}$$

$$\boxed{\ddot{q} = \frac{2b}{a} q^3}$$

(d)

TOPS 35500

Problem 3

a) Both depend only on position

$\vec{F} = -by\hat{x} + bx\hat{y}$ $\nabla \times F = (0 + 0)\hat{x} + (0 + 0)\hat{y}$

$+ (b + b) \neq 0$ NOT CONSERVATIVE

* can be seen from graph easily as work done in going from A → B ccw or cw.

$\vec{F} = by\hat{x} + bx\hat{y}$ similar

$\vec{\nabla} \times \vec{F} = (0+0)\hat{x} + (0+0)\hat{y} + (b - b) = 0$

Conservative!

b) $U = -\int_0^r \vec{F} \cdot dr'$

$\parallel$

$U = -bxy$

Check

$\vec{F} = -\nabla F$

$\vec{F} = \hat{x}\, by + \hat{y}\, bx + 0$

or

c) No the force is conservative only if $a = b$

d) ~~Sometimes it is easy to tell~~ that a force is not conservative, but sometimes it is quite difficult.

Problem 4

a) The basic point is to reduce the motions of a mirror using radiation pressure and a feedback circuit. ~~Cott~~ Cool a mirror.

b) The radiation pressure creates a controllable viscous force. It is a damping term.

c) Mechanical resonance ... a damped / driven harmonic oscillator.

d) They both have units of "frequency"

e) As the temperature is reduced, the resonance gets damped ie it gets smaller and wider.

TOPS 35500

Physics 105, Spring 2009
Final Exam

Print Name: Key

By signing this test, I agree to abide by the University of California, Merced's Academic Honesty Policy. I agree to neither seek assistance from any classmate during the exam, nor provide it. Any questions I have will be addressed to the instructor. I understand that collaborative behavior during the exam will result in a score of zero, and may lead to failure of the course and University disciplinary action.

Signature: _____

If you need to use additional paper, please write the problem number.

1. (10 points) Compare and contrast a particle's motion in a medium with linear drag and another medium with quadratic drag. Give a real-life example for a mass moving in each type of medium. You may use equations and graphs to *supplement* your written response.

Linear Medium

$x = x_\infty (1 - e^{-t/\tau})$

$\tau = m/b$

$v_y = v_{y_0} e^{-t/\tau} + v_{ter}(1 - e^{-t/\tau})$

$y = v_{ter} t + (v_{y_0} - v_{ter})\tau(1 - e^{-t/\tau})$

- exponential decay
- oil drop or mist falling through air
- small objects in a very viscous fluid

- drag is due to viscous drag of medium + proportional to viscosity + linear dimension of object

Quadratic Medium

$x = v_0 t \ln(1 + t/\tau)$

$\tau = m/cv$

$y = \frac{(v_{ter})^2}{g} \ln\left(\cosh\left(\frac{gt}{v_{ter}}\right)\right)$

- baseball flying through air
- drag due to accelerating the medium that is colliding w/ it

$f_{drag} \propto \rho_{medium} + \text{Area}_{\text{x-sect}}$

2. (10 points) A projectile that is subject to quadratic air resistance is thrown vertically *up* with initial speed v_o. Derive the equation of motion for the upward motion and solve it to give v as a function of t. (2.38)

$$m\dot{v} = -mg - cv^2 \Rightarrow \dot{v} = -g\left(1 + v^2/v_{ter}^2\right)$$

$$\dot{v} = -\left(g + \frac{cv^2}{m}\right)$$

$$\dot{v} = -g\left(1 + v^2/v_{ter}^2\right)$$

let $u = v/v_{ter}$

$$\dot{v} = -g(1+u^2) = \frac{dv}{dt}$$

$$\frac{du}{dv}\cdot\frac{dv}{dt} = \frac{du}{dt}$$

$$\frac{du}{dv} = \frac{dv}{v_{ter}}$$

$$\frac{du}{dt} = \frac{dv}{v_{ter}}(-g)(1+u^2) = \frac{dv}{v_{ter}\,dt}$$

$$\Rightarrow \int\frac{du}{(1+u^2)} = \int\frac{-g}{v_{ter}}\,dt$$

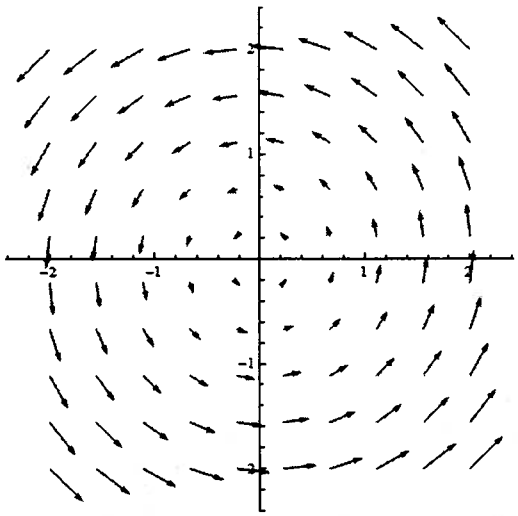
$$\arctan u \Big|_{u_0}^{u_f} = \frac{-gt}{v_{ter}}\Big|_{t_0}^{t_f}$$

$$= -\arctan u_f + \arctan u_0 = +\frac{gt}{v_{ter}}$$

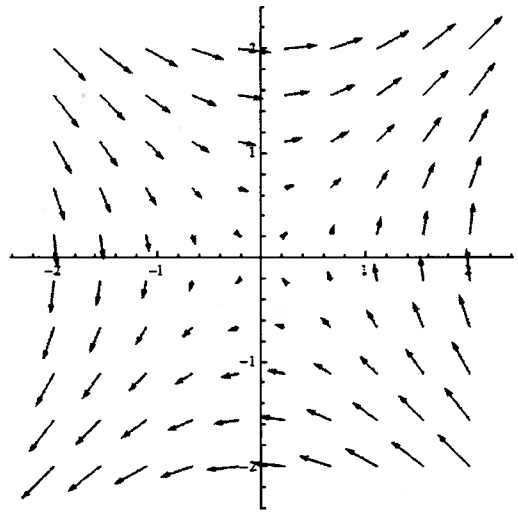
$$\arctan\left(\frac{v_0}{v_{ter}}\right) - \arctan\left(\frac{v}{v_{ter}}\right) = \frac{gt}{v_{ter}}$$

$$\arctan\left(\frac{v}{v_{ter}}\right) = \arctan\left(\frac{v_0}{v_{ter}}\right) - \frac{gt}{v_{ter}}$$

$$v = v_{ter}\tan\left[\arctan\left(\frac{v_0}{v_{ter}}\right) - \frac{gt}{v_{ter}}\right]$$



$\vec{F} = -by\,\hat{x} + bx\,\hat{y}$



$\vec{F} = by\,\hat{x} + bx\,\hat{y}$

3. Above are graphical and mathematical representations of two force fields. Arrows on the graphs represent the magnitude and directions of the force evaluated at the center of each arrow.
   a. (5 points) Which, if any, of the above forces are conservative? Back up your answer with an explanation or calculation.
   b. (5 points) Derive the potential energy function for the case(s) where the force is conservative.
   c. (5 points) In terms of the energy of a system, what is the significance of a spherically symmetric force?

a) $F = -by\,\hat{x} + bx\,\hat{y}$ is <u>not</u> conservative b/c it has a non-zero curl as seen graphically.

$$\nabla \times F_1 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{d}{dx} & \frac{d}{dy} & \frac{d}{dz} \\ -by & bx & 0 \end{vmatrix} = \hat{i}\left(0 - \frac{d}{dz} by\right) - \hat{j}\left(0 - \frac{d}{dz}(-bx)\right) + \hat{k}\left(-\frac{d}{dx} bx - \frac{d}{dy} by\right)$$

$$= 0\hat{i} + 0\hat{j} + \hat{k}(-b-b) = \hat{k}(-2b) \neq 0$$

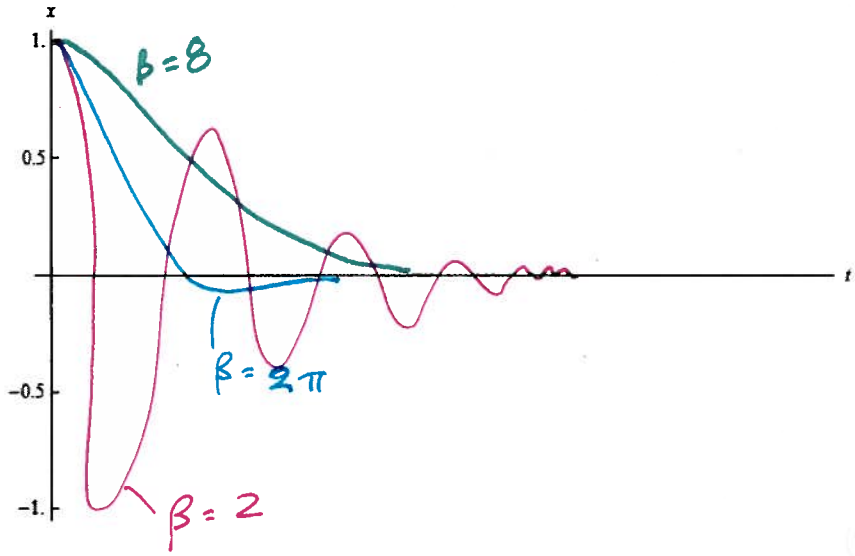
$$\nabla \times F_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{d}{dx} & \frac{d}{dy} & \frac{d}{dz} \\ +by & bx & 0 \end{vmatrix} = 0$$

c) spherically symmetric forces are automatically conservative.

b) $F = -\nabla U \Rightarrow U = \int F \cdot dl = \int (by, bx) \cdot (dx, dy) = \int by\,dx + \int bx\,dy$

$= 2bxy$

4. Consider a cart on a spring with natural frequency $\omega_o = 2\pi$.
   a. (10 points) When the cart is released from rest at $x_o = 1$ the period is $\tau = 1.001s$. What is the cart's position as a function of time?
   b. (5 points) In each of the following cases, the cart is released from rest at $x_o = 1$. On the plot below, sketch the position of the cart as a function of time when (i) $\beta = 2$, (ii) $\beta = 8$, and (iii) $\beta = 2\pi$. Be sure to label each function.



$\omega_1 = \frac{2\pi}{\tau_1} < \omega_0$, so $\beta < \omega_0$ and the damping is weak.

$$x(t) = [\cos(\omega_1 t)]\, e^{-\beta t}$$

$$\omega_1 = \sqrt{\omega_0^2 - \beta^2} \qquad \beta = \frac{b}{2m}$$

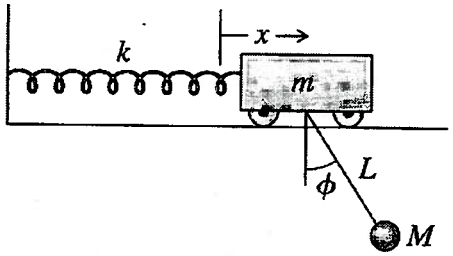
$$\omega_1^2 = \left(\frac{2\pi}{\tau_1}\right)^2 = \omega_0^2 - \beta^2$$

$$\beta^2 = \omega_0^2 - \left(\frac{2\pi}{\tau_1}\right)^2$$

$$\beta = \sqrt{\omega_0^2 - \omega_1^2}$$

$$x = e^{-\beta t} \cos(\omega_1 t) \qquad \omega_1 = \frac{2\pi}{\tau_1}$$

$$\beta = \sqrt{\omega_0^2 - \omega_1^2}$$



5. A simple pendulum (mass M and length L) is suspended from a cart (mass m) that can oscillate on the end of a spring of force constant k, as shown in the figure.
   a. (10 points) Assuming that the angle ϕ remains small, show that the system's potential and kinetic energies can be written as follows

$$U \approx \frac{1}{2}kx^2 + \frac{1}{2}MgL\phi^2$$

$$T \approx \frac{1}{2}(m+M)\dot{x}^2 + ML\dot{x}\dot{\phi} + \frac{1}{2}ML^2\dot{\phi}^2$$

   b. (10 points) Using the Lagrangian, find the equations of motion for x and ϕ.
   c. (10 points) Assuming that $m = M = L = g = 1$ and $k = 2$ (all in appropriate units) show that the normal frequencies are $\omega_1 = \sqrt{2-\sqrt{2}}$ and $\omega_2 = \sqrt{2+\sqrt{2}}$.
   d. (10 points) And for each normal frequency find (mathematically) and describe (in words) the motion of the corresponding normal mode.

$1 - \cos\phi = \cancel{\sin\phi \approx \phi}$

a) $U = \frac{1}{2}kx^2 + MgL(1 - \cos\phi)$ $\cancel{\approx \frac{1}{2}kx^2 + M}$

$\cos\phi = 1 - \frac{1}{2}\phi^2 + \cancel{\frac{1}{4!}\phi^4} + \dots \approx 1 - \frac{1}{2}\phi^2$

$1 - \cos\phi = 1 - (1 - \frac{1}{2}\phi^2) = +\frac{1}{2}\phi^2$

$U \approx \frac{1}{2}kx^2 + \frac{1}{2}MgL\phi^2$

for small $L\phi$ is in the same direction as $\dot{x}$

~~The~~ position of bob

$x \Rightarrow x + L\sin\phi$

$y \Rightarrow L(1-\cos\phi)$

this approach gives you a mess...

$\dot{x} + \dot{\phi}L\cos\phi$

$y = L(\dot{\phi})\sin\phi$

$$\mathcal{L} = T - U = \tfrac{1}{2}(m+M)\dot{x}^2 + ML\dot{x}\dot{\phi} + \tfrac{1}{2}ML^2\dot{\phi}^2 - \tfrac{1}{2}kx^2 - \tfrac{1}{2}MgL^2\phi^2$$

$$\frac{\partial \mathcal{L}}{\partial x} = -kx \qquad \frac{\partial \mathcal{L}}{\partial \dot{x}} = (m+M)\dot{x} + ML\dot{\phi} \qquad \frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{x}} = (m+M)\ddot{x} + ML\ddot{\phi} = -kx$$

$$\frac{\partial \mathcal{L}}{\partial \phi} = -MgL^2\phi \qquad \frac{\partial \mathcal{L}}{\partial \dot{\phi}} = ML\dot{x} + ML^2\dot{\phi} \qquad \frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{\phi}} = ML\ddot{x} + ML^2\ddot{\phi} = -MgL\phi$$

b)

2 eqns:
$$\boxed{\begin{aligned}(m+M)\ddot{x} + ML\ddot{\phi} &= -kx \\ ML\ddot{x} + ML^2\ddot{\phi} &= -MgL\phi\end{aligned}}$$

$$\underbrace{\begin{bmatrix} m+M & ML \\ ML & ML^2 \end{bmatrix}}_{M\text{ - matrix}} \begin{bmatrix} \ddot{x} \\ \ddot{\phi} \end{bmatrix} = -\underbrace{\begin{bmatrix} +k & 0 \\ 0 & MgL \end{bmatrix}}_{K\text{ - matrix}} \begin{bmatrix} x \\ \phi \end{bmatrix}$$

$$K - \omega^2 M = \begin{bmatrix} k - \omega^2(m+M) & -\omega^2 ML \\ -\omega^2 ML & MgL - \omega^2 ML^2 \end{bmatrix} \qquad \begin{aligned} m = M = L = g = 1 \\ k = 2 \end{aligned}$$

$$K - \omega^2 M = \begin{bmatrix} 2 - 2\omega^2 & -\omega^2 \\ -\omega^2 & 1 - \omega^2 \end{bmatrix} = \begin{bmatrix} 2(1-\omega^2) & -\omega^2 \\ -\omega^2 & (1-\omega^2) \end{bmatrix}$$

(c)

$$\det(K - \omega^2 M) = 2(1-\omega^2)^2 - (-\omega^2)^2 = 0$$

$$2(1 - 2\omega^2 + (\omega^2)^2) - (\omega^2)^2 = 0$$

$$2 - 4\omega^2 + 2(\omega^2)^2 - (\omega^2)^2 = 0$$

$$(\omega^2)^2 - 4\omega^2 + 2 = 0$$

let $\omega^2 = u^2 \Rightarrow u^2 - 4u + 2 = 0$

$$u = \frac{4 \pm \sqrt{4^2 - 4(2)}}{2}$$

$$= \frac{4 \pm \sqrt{4(4-2)}}{2}$$

$$u = 2 \pm \sqrt{2} = \omega^2$$

$$\omega_1 = \sqrt{2 - \sqrt{2}} \qquad \omega_2 = \sqrt{2 + \sqrt{2}}$$

d) $$[K - \omega_1^2 M]\begin{bmatrix} a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} 2(1-(2-\sqrt{2})) & -(2-\sqrt{2}) \\ -(2-\sqrt{2}) & 1-(2-\sqrt{2}) \end{bmatrix}\begin{bmatrix} a_1 \\ a_2 \end{bmatrix}$$

$$= \begin{bmatrix} 2(1+\sqrt{2}) & -(2-\sqrt{2}) \\ -(2-\sqrt{2}) & -(1+\sqrt{2}) \end{bmatrix}\begin{bmatrix} a_1 \\ a_2 \end{bmatrix}$$

$$= 2(1+\sqrt{2})a_1 - (2-\sqrt{2})a_2 = 0$$

$$a_1 = \underline{2-\sqrt{2}}$$

5.

8.b

d) $$\begin{bmatrix} 2(1-\omega^2) & -\omega^2 \\ -\omega^2 & (1-\omega^2) \end{bmatrix} = \begin{bmatrix} 2(1-(2-\sqrt{2})) & -(2-\sqrt{2}) \\ -(2-\sqrt{2}) & (1-(2-\sqrt{2})) \end{bmatrix}$$

$$= \begin{bmatrix} 2(-1+\sqrt{2}) & (-2+\sqrt{2}) \\ (-2+\sqrt{2}) & (-1+\sqrt{2}) \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix}$$

$$2(-1+\sqrt{2})a_1 + (-2+\sqrt{2})a_2 = 0$$

$$a_1 = -\frac{(-2+\sqrt{2})}{2(-1+\sqrt{2})} a_2 \quad \frac{(-1-\sqrt{2})}{(-1-\sqrt{2})}$$

$$= -\frac{(-1-\sqrt{2})(-2+\sqrt{2})}{(1-2)} \frac{a_2}{2}$$

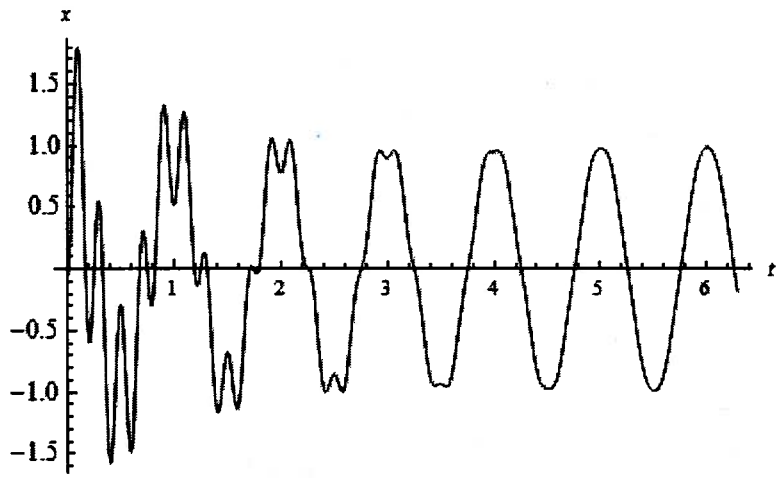
$$= -\frac{(\overset{+}{\cancel{+2}} \cancel{-2} - \sqrt{2} + 2\sqrt{2})}{-1} \frac{a_2}{2}$$

$$= \frac{+\sqrt{2}\, a_2}{+2} \Rightarrow a_1 = \frac{+a_2}{\sqrt{2}}$$

bob + cart are in phase w/ each other

$$\begin{bmatrix} 2(1-\omega^2) & -\omega^2 \\ -\omega^2 & (1-\omega^2) \end{bmatrix} = \begin{bmatrix} 2(1-(2+\sqrt{2})) & -(2+\sqrt{2}) \\ -(2+\sqrt{2}) & (1-(2+\sqrt{2})) \end{bmatrix}$$

$$\Rightarrow a_1 = \frac{-a_2}{\sqrt{2}}$$



6. (10 points) Write everything you can determine about this one-dimensional system.

1-D weakly damped driven HO

transients

$\omega_f = 2\pi$

Start from rest

$v_x = +v_0$

7. (10 points) Consider a rocket (initial mass m_o) accelerating from rest in free space. At first, as it speeds up, its momentum p increases, but as its mass m decreases p eventually begins to decrease. For what value of m is p maximum?

$$m\dot{v} = -\dot{m}\, v_{ex}$$

$$m\frac{dv}{dt} = -v_{ex}\frac{dm}{dt} \Rightarrow dv = -v_{ex}\frac{dm}{m}$$

$$v - \cancel{v_0}^{\,0} = v_{ex}\ln(m_o/m)$$

$$v = v_{ex}\ln(m_o/m)$$

$$p = mv = m\, v_{ex}\ln(m_o/m)$$

$$\dot{p} = \dot{m}v + m\dot{v} = v_{ex}\left[\dot{m}\ln\left(\frac{m_o}{m}\right) + m\left(\frac{m_o}{m}\right)\left(\frac{\dot{m}}{m_o}\right) \Rightarrow \dot{m}\right]$$

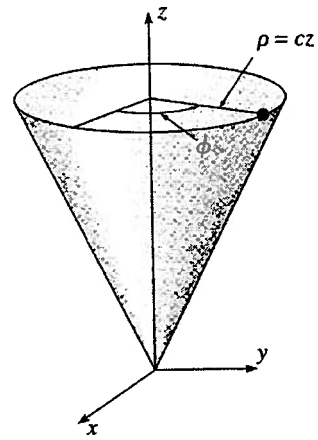
$$\dot{p} = v_{ex}\left[\dot{m}\ln\left(\frac{m_o}{m}\right) - \dot{m}\right] = 0$$

$$\Rightarrow \dot{m}\, v_{ex}\left[\ln(m_o/m) - 1\right] = 0$$

$$\ln\left(\frac{m_o}{m}\right) = 1$$

$$\frac{m_o}{m} = e \Rightarrow \text{when } m = \frac{m_o}{e}$$

5690



8. (10 points) Consider a mass which is constrained to move on the frictionless surface of a vertical cone where $\rho = cz$ (in cylindrical coordinates ρ, ϕ, z with $z > 0$) in a uniform gravitational field g vertically down. What is the Hamiltonian H and calculate Hamilton's equations of motion.

$T = \frac{1}{2} m v^2 \qquad U = mgh = mgz$

$\vec{v} = (\dot{\rho}, \rho\dot{\phi}, \dot{z}) \qquad v^2 = \dot{\rho}^2 + \rho^2\dot{\phi}^2 + \dot{z}^2$

$\rho = cz \qquad \dot{\rho} = c\dot{z}$

$v^2 = c^2\dot{z}^2 + c^2 z^2 \dot{\phi}^2 + \dot{z}^2$

$= \dot{z}^2(1+c^2) + c^2 z^2 \dot{\phi}^2$

$T = \frac{1}{2} m \left((1+c^2)\dot{z}^2 + c^2 z^2 \dot{\phi}^2 \right)$

$E = \frac{1}{2} m \left((1+c^2)\dot{z}^2 + c^2 z^2 \dot{\phi}^2 \right) + mgz$

$P_z = \frac{\partial T}{\partial \dot{z}} = m(1+c^2)\dot{z} \Rightarrow \boxed{\dot{z} = \frac{P_z}{m(1+c^2)}}$

$P_\phi = \frac{\partial T}{\partial \dot{\phi}} = mc^2 z^2 \dot{\phi}$

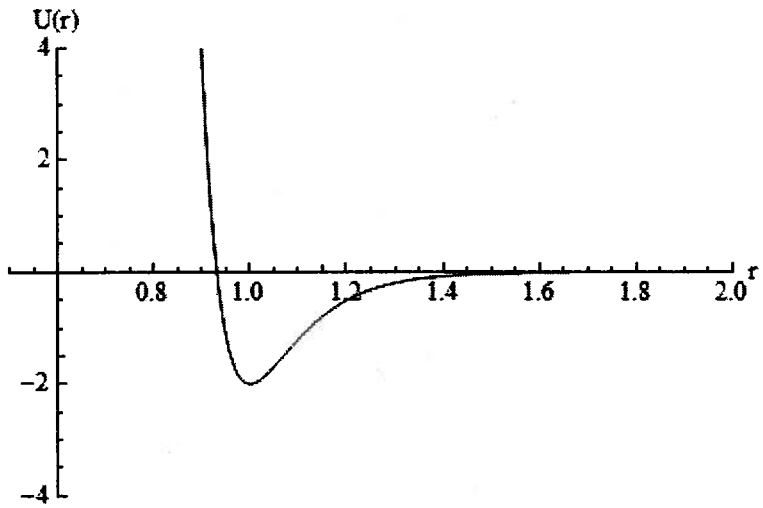
$\boxed{\frac{P_\phi}{mc^2 z^2} = \dot{\phi}}$

$H = \frac{1}{2m} \frac{P_z^2}{1+c^2} + \frac{P_\phi^2}{2mc^2 z^2} + mgz \qquad \dot{z} = \frac{\partial H}{\partial P_z}$

$\dot{z} = \frac{\partial H}{\partial P_z} = \frac{P_z}{m(1+c^2)}$

$\boxed{\dot{P}_z = \frac{-\partial H}{\partial z} = + \frac{P_\phi^2}{mc^2 z^3} - mg}$

$\boxed{\dot{P}_\phi = 0}$



$$U(r) = A\left[\left(e^{(R-r)/S} - 1\right)^2 - 1\right]$$

r is the distance between the two particles. A, R, and S are positive constants with $S << R$.

9. (15 points) This problem is a test of your conceptual *and* mathematical understanding of how to answer the following question. Two particles interact via the potential energy shown above. The particles' equilibrium separation is $r = 1.0$. Using sentences and equations detail the steps you would take to find the equation of motion and the particles' separation distance as a function of time if the separation is increased slightly and released. Make note of any assumptions you're taking.

For small deviations from r_0, $U \approx \frac{1}{2} k r_x^2$, where r_x is the change from the equilibrium position.

$U \approx \frac{1}{2} k r_x^2$ from a Taylor expansion of U about $r_0 = 1$

Then you can use Lagrangian Mechanics

$$\mathcal{L} = T - U = \frac{1}{2} m v^2 - \frac{1}{2} k r_x^2 = \frac{1}{2} m \dot{r}_x^2 - \frac{1}{2} k r_x^2$$

$$\frac{\partial \mathcal{L}}{\partial r_x} = -k r_x = \frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{r}_x} = \frac{d}{dt} m \ddot{r}_x$$

$$m \ddot{r}_x = -k r_x \Rightarrow r_x = A \cos(\omega t - \delta)$$

Chris Ferri

Physics 110 Fall 2008

Final Exam - Part 1

For this part of the final, you may not use any notes, at all! Please sit every other seat, and *please don't cheat*! If something isn't clear, please ask. **PLEASE BOX YOUR FINAL ANSWERS!** Once you have finished this part, hand it in and pick up the second part of the final. If you attach any additional scratch work, then make sure that your name is on every sheet of your work. **Good luck!**

- Write down all four of Maxwell's equations.
- Write down the Lorentz force law.
- Write down the electric and magnetic fields in terms of the scalar and vector potentials, i.e., write $\vec{E} = \vec{E}\left(V, \vec{A}\right)$, etc.

$\nabla \times E = -\frac{\partial B}{\partial t}$

$\nabla \cdot E = \frac{\rho}{\varepsilon_0}$

$\nabla \cdot B = 0$

$\nabla \times B = \mu_0 J + \mu_0 \varepsilon_0 \frac{\partial E}{\partial t}$

$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$

$E = -\nabla \phi - \frac{\partial A}{\partial t}$ ~~+24~~

$B = \vec{\nabla} \times \vec{A}$

$+\frac{29}{30}$

$+\frac{149}{150}$

Good!

Chris Ferrl
Phys 110

Physics 110 Fall 2008
Final Exam - Part 2

For this part of the final, *you only need to do 4/5 of these problems!* Which four you do is left up to you. You can attempt the remaining problem for extra credit! You may use three sheets of notes with whatever you want to put on it, front and back. Please sit every other seat, and *please don't cheat*! If something isn't clear, please ask. You may use calculators. All problems are weighted equally. **PLEASE BOX YOUR FINAL ANSWERS!** You have the full length of the final. If you attach any additional scratch work, then make sure that your name is on every sheet of your work. **Good luck**!

1. In 1959 Lyttleton and Bondi suggested that the expansion of the Universe could be explained on the basis of Newtonian mechanics if matter carried a net electric charge. Imagine a spherical volume of astronomical size containing unionized atomic hydrogen of uniform number density n and assume that the proton charge is $q_p = -(1+\eta)\, q_e$, where q_e is the electron charge.

   (a) Recalling that Newton's law of gravity says that $F_G = -\frac{GmM}{r^2}$, show that for $\eta > 10^{-18}$, the electrostatic repulsion becomes larger than the gravitational attraction, and the gas expands.

   (b) Show that the force of repulsion on an atom is then proportional to its distance R from the center and that, as a consequence, the radial velocity of an atom at R is proportional to R. Assume that the density is maintained constant by the continuous creation of matter in the Universe.

   (c) Show that the velocity is $v = R/T$, where T is the time required for the radial distance R of an atom to increase by an $e-$fold, a factor of e. This time can be taken to be the age of the Universe in this model.

X5

I refuse to answer this question due to the clear violation of physics assumed here.

Ha! -500 points please. =P

not necessarily look up "steady state universe"

a) $F_G = -\frac{GmM}{r^2}$ $\quad F_e = \frac{-1\, q_1 q_2}{4\pi\varepsilon_0\, r^2}$

$GmM = k q_1 q_2$

$GmM < k(1+\eta)^2 q_e^2$

$\frac{G(m_p)^2}{k q_e^2} < (1+\eta)^2$

$\sqrt{8.09\times10^{-37}} < \sqrt{(1+\eta)^2}$

$(8.996\times10^{-19}) - 1 < (1+\eta) - 1$

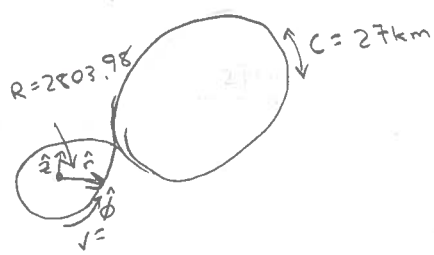
$\boxed{\eta > \sim 10^{-18}}$ ✓

b) $F = \frac{k\, n \left(\frac{4}{3}\pi r^3\right) q_p}{r^2}$

$\boxed{F = \frac{n q_p}{3\varepsilon_0} R}$ ✓

c)

2. The Large Hadron Collider (LHC) has been completed, and will *restart* very soon. The LHC is a circular particle accelerator with a circumference of 27 km, and accelerates protons up to a kinetic energy of $7\,TeV$, or $7\times10^{12}\,eV$. Since they are moving at roughly 99.9999991% of the speed of light, one needs Einstein's theory of Special Relativity to properly calculate the momentum of the protons. However, if this is done, it is found that for particles moving this fast, the momentum, $p = E/c$, where E is the kinetic energy of the particle, and c is the speed of light. When they are injected, the protons are moving through a circular ring of radius $R = 2803.98$ meters (*this is* ***not*** *the radius of the large ring, described above*). Calculate the magnetic field, perpendicular to the motion of the proton, needed to keep the protons moving at this radius, with the momentum given above.



accel protons

$K = 7\times10^{12}\,eV$

$p = \frac{E}{c}$

+25

$F = q(E + \vec{v}\times\vec{B})$

$F = \frac{mv^2}{r}$

$\frac{mv^2}{r} = (\vec{v}\times\vec{B})\,q$

$\frac{mv^2}{rq} = \vec{v}\vec{B}\,\cancel{\sin\theta}^{\,0}$

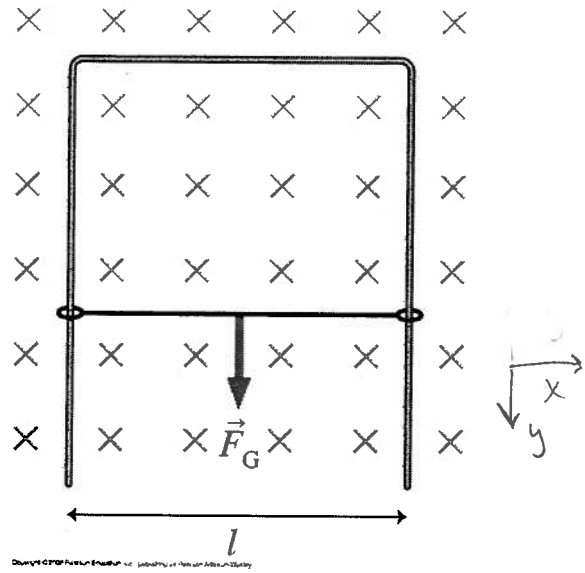
$B = \frac{mv}{rq_p} = \frac{p}{rq_p} = \frac{E}{rq_pc} = \frac{7\times10^{12}}{(2803.98)(q_p)(c)}(-\hat{z})$

wrong units!

$\vec{B} = \boxed{5.194\times10^{19}\,(-\hat{z})\,\frac{eV\cdot s}{m^2\,C}}$

where $\hat{z}$ is out of the page

3. The figure to the right shows a U-shaped conducting rail that is oriented vertically (along the y−direction) in a horizontal magnetic field, B. The rail has no electrical resistance and does not move. A slide wire with mass m and resistance R can slide up and down without friction while maintaining electrical contact with the rail. The slide wire is released from rest at time $t = 0$, and reaches a velocity v at time t.



(a) Show that, if the wire has fallen a distance y from the top of the rail, then there is a current $I = \frac{lvB}{R}$ induced in the wire, where $v = \dot{y}$ is the speed of the wire as it falls, and R is the resistance of the wire. This leads to an upward-pointing resistive force $F_{\text{res}} = IlB$.

+30

(b) Since the sum of the forces is mass times acceleration, we have that $-ma = -m\dot{v} = F_{\text{res}} - mg$, where the minus sign comes from the fact that the acceleration is downward since the wire is falling. Plug in the expression you find for F_{res} and integrate to find the following expression for the velocity as a function of time

$$v(t) = \alpha\left[1 - e^{-\beta t}\right],$$

and determine the expressions for α and β. (Another alternative way of determining α and β is by assuming this solution for v, and plugging in to the force expression. Whichever way you choose to solve it is fine.)

(c) Show that the wire reaches a terminal velocity v_{term}, and give an expression for this terminal velocity.

a) $\cancel{F_{net} = ma = -F_g + F_{res}}$

$\cancel{m\ddot{y} = -mg + F_{res}}$

$\frac{\partial \Phi_{mag}}{\partial t} = \frac{\partial}{\partial t} BA$

$\frac{\partial \Phi}{\partial t} = B \frac{\partial (yl)}{\partial t}$

$\mathcal{E}_{emf} = \frac{\partial \Phi}{\partial t} = Bl\dot{y} \leftarrow v = \dot{y}$

$\mathcal{E} = IR$

$Blv = IR$

$\boxed{I = \frac{Blv}{R}}$

4. Show that the electric and magnetic fields are unchanged under a gauge transformation:

$$\begin{aligned} V &\rightarrow V' \equiv V - \tfrac{\partial}{\partial t}\lambda(\vec{r},t) \\ \vec{A} &\rightarrow \vec{A}' \equiv \vec{A} + \nabla\lambda(\vec{r},t), \end{aligned}$$

where V is the scalar potential, and $\vec{A}$ is the vector potential. λ is an arbitrary scalar function of $\vec{r}$, and t. Show further that one can always choose V' and $\vec{A}'$ to satisfy the Lorenz (*not* Lorentz!) gauge

$$\nabla \cdot \vec{A} = -\mu_0\epsilon_0 \frac{\partial V}{\partial t},$$

for a particular choice of conditions on λ - what is this condition?

a) $E(V,\vec{A}) = -\nabla V - \frac{\partial A}{\partial t}$ $\quad B(V,\vec{A}) = \nabla \times A$

$E(V',\vec{A}') = -\vec{\nabla}(V') - \frac{\partial(A')}{\partial t}$ $\quad B(V',A') = \nabla \times A'$

$E' = -\vec{\nabla}(V - \frac{\partial}{\partial t}\lambda) - \frac{\partial(\vec{A} + \vec{\nabla}\lambda)}{\partial t}$ $\quad B' = \nabla \times (\vec{A} + \nabla\lambda)$

$E' = -\vec{\nabla}V + \frac{\partial}{\partial t}(\vec{\nabla}\lambda) - \frac{\partial \vec{A}}{\partial t} - \frac{\partial}{\partial t}(\vec{\nabla}\lambda)$ $\quad B' = \nabla \times \vec{A} + \nabla \times (\nabla\lambda)$

$\boxed{E' = -\vec{\nabla}V - \frac{\partial \vec{A}}{\partial t} = E}$ $\quad \boxed{B' = \nabla \times \vec{A} = B}$

b) $\nabla \cdot \vec{A} = -\mu_0\varepsilon_0 \frac{\partial V}{\partial t}$

$\nabla \cdot (A') = -\mu_0\varepsilon_0 \frac{\partial V'}{\partial t}$

$\nabla \cdot (A + \nabla\lambda) = -\mu_0\varepsilon_0 \frac{\partial}{\partial t}(V - \frac{\partial}{\partial t}\lambda)$

$(\nabla \cdot A) + (\nabla \cdot \nabla\lambda) = -\mu_0\varepsilon_0 \frac{\partial V}{\partial t} - \frac{\partial^2}{\partial t^2}\lambda$

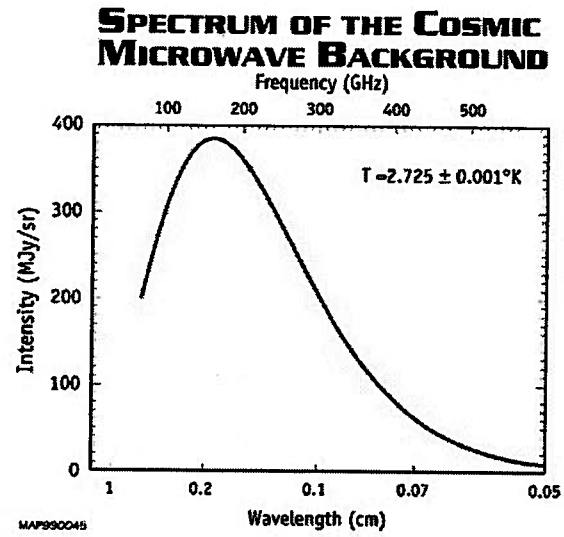
$(\nabla \cdot A) + (\nabla \cdot \nabla\lambda) = (\nabla \cdot A) + \mu_0\varepsilon_0 \frac{\partial^2 \lambda}{\partial t^2}$

$\lambda(\nabla \cdot \nabla) + \nabla \cdot (\nabla\lambda) = \mu_0\varepsilon_0 \frac{\partial^2 \lambda}{\partial t^2}$

$\nabla^2\lambda + \underbrace{\nabla \cdot (\nabla\lambda)}_{n} = \mu_0\varepsilon_0 \frac{\partial^2 \lambda}{\partial t^2}$ $\Rightarrow \nabla^2\lambda = \mu_0\varepsilon_0 \frac{\partial^2 \lambda}{\partial t^2}$ Lorentz wave eqn.

condition on λ: $\begin{cases} \text{goes to } 0 \text{ if } \lambda \text{ is not conservative} \end{cases}$

5. In 1965, Penzias and Wilson discovered the cosmic microwave background (CMB) radiation left over from the Big Bang expansion of the Universe, which subsequently earned them the Nobel Prize in physics in 1978. This radiation background behaves like a blackbody with a temperature of $2.725\,K$, as seen in the figure. The temperature is extremely uniform, with fluctuations less than one part in 100,000! Precise measurements of the CMB are critical to cosmology, since any proposed model of the Universe must explain this radiation. These fluctuations in the temperature are thought to have formed the seeds of galaxy formation in the early Universe, as the CMB dates to roughly 379,000 years after the Big Bang.



(a) For an electromagnetic wave, the maximum value of the magnetic field is related to that of the electric field by $B_0 = cE_0$, where c is the speed of light. Show that the energy densities of the electric and magnetic fields are equal in this case, and hence that an electromagnetic wave splits its energy evenly between the electric and magnetic fields.

x25

(b) The energy density of a blackbody (such as the CMB) is given by the expression

$$u = \frac{\pi^2 k_B^4 T^4}{15\,(\hbar c)^3},$$

where k_B is Boltzmann's constant, and T is the temperature. Plug in the values and show that the energy density is $4.235 \times 10^{-14}\,J/m^3$.

(c) The energy density of the CMB comes from the electromagnetic waves in the microwave region of the electromagnetic spectrum. Determine the maximum values of the electric and magnetic fields of the CMB radiation.

a) show $u_{em} = \frac{1}{2}\int\left(\varepsilon_0 E^2 + \frac{1}{\mu_0}B^2\right)d\tau$ plug in $E_0 = cB_0$

$\frac{1}{2}\int \varepsilon_0 c^2 B_0 + \frac{1}{\mu_0}B^2\, d\tau = \frac{1}{2}\int \varepsilon_0 E^2 + \frac{1}{\mu_0 c^2}E_0\, d\tau$

$\int\left(\frac{1}{\mu_0}B_0^2 + \frac{1}{\mu_0}B_0^2\right)d\tau = \int(\varepsilon_0 E_0^2 + \varepsilon_0 E_0^2)\,d\tau$

$\frac{2}{\mu_0}\int B_0^2\, d\tau = 2\varepsilon_0\int E_0^2\, d\tau$

$\frac{2}{\mu_0}\int \frac{1}{c^2}E_0^2\, d\tau = 2\varepsilon_0\int E_0^2\, d\tau$

$\boxed{2\varepsilon_0\int E_0^2\, d\tau = 2\varepsilon_0\int E_0^2\, d\tau}$ True ⇒ that is correct

Exam

Final Exam: 3 pm - 5 pm, Dec. 18th, 2008, Rm 279. Please answer the following 7 questions. Total score for this test is 70, with 10 scores for each question.

1. Pauli matrices are usually used to study spin 1/2 particles. Here, we consider the matrices:

$$\sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, \ \sigma_y = \begin{pmatrix} 0 & -i \\ -i & 0 \end{pmatrix}, \ \sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}.$$

   (1) Please derive the commutation relation: $[\sigma_x, \sigma_y]$; (2) Please solve the eigenstates and eigenvalues of σ_y.

2. Adiabatic quantum computing uses the basic principles of adiabatic evolution of a quantum system to implement quantm operation on an initial state. We consider one qubit (two-level system) in an initial Hamiltonian: $H_0 = E_0\sigma_z$ and the qubit is in the ground state of H_0. Now we adiabatically adjust the Hamiltonian to the final Hamiltonian: $H_f = E_f\sigma_x$. (1) Please write down the initial state of the qubit. (2) Please write down the final state of the qubit.

3. In a quantum system with eigenstates $|\psi_n\rangle$ and eigenenergies E_n for $n \geq 1$, we have $H|\psi_n\rangle = E_n|\psi_n\rangle$, where the ground state is $|\psi_1\rangle$ with an energy E_1. Please prove that for an arbitray state $|\psi\rangle$, the expectation value of the Hamiltonian satisfies: $\langle\psi|H|\psi\rangle \geq E_1$.

4. Non-degenerate perturbation theory. Given the Hamiltonian

$$H_0 = \begin{pmatrix} e_0 & 0 & 0 \\ 0 & 2e_0 & 0 \\ 0 & 0 & 3e_0 \end{pmatrix}$$

   and a perturbation of the form

$$H_1 = \begin{pmatrix} \lambda_1 & 0 & \theta_1 \\ 0 & \lambda_2 & \theta_2 \\ \theta_1 & \theta_2 & 0 \end{pmatrix}$$

   where $\lambda_{1,2}$ and $\theta_{1,2}$ are small perturbations compared with e_0. (1) What are zeroth order energy of the eigenstates? what are the first order corrections to the eigenenergy by the perturbation H_1? (2) what are the first order corrections to the 1st eigenstate of H_0 by the perturbation H_1?

5. Hanbury Brown-Twiss Experiment. Consider a particle with two states: state $|L\rangle$ and state $|R\rangle$. In an optics setup, when a particle injects onto a mirror, the particle experiences the following unitary transformation:

$$\begin{aligned} U|L\rangle &= \frac{1}{\sqrt{2}}(|L\rangle + |R\rangle) \\ U|R\rangle &= \frac{1}{\sqrt{2}}(|L\rangle - |R\rangle) \end{aligned}$$

which is also called the Hadamard transformation in the language of quantum information. Now, we have two bosonic particles 1 and 2. In the initial state, one particle is in state $|L\rangle$ and another particle is in state $|R\rangle$. (1) Please write down the initial states of the two particles. (2) Please write down the final states of the two particles after they inject on the mirror.

6. Consider an infinite square well with the length L and the potential barrier:

$$V_i(x) = \{ \begin{array}{ll} 0, & 0 < x < L \\ \infty, & otherwise \end{array}$$

The eigenstates of this potential are $\psi_n(x) = \sqrt{\frac{2}{L}}\sin(\frac{n\pi}{L}x)$ with the eigen energy $E_n = \frac{n^2\pi^2\hbar^2}{2mL^2}$. Initially, the particle is in the ground state of $V_i(x)$. Now, the barrier is SUDDENLY switched to $2L$ and the potential becomes:

$$V_f(x) = \{ \begin{array}{ll} 0, & 0 < x < 2L \\ \infty, & otherwise \end{array}$$

(1) What are the new eigenstates $\psi'_n(x)$ in the potential $V_f(x)$? (2) Only consider the lowest two states $\psi'_1(x)$ and $\psi'_2(x)$, how to express the initial state of the particle in these two states? And please write down the time evolution of state in the new potential $V_f(x)$.

7. Hydrogen atoms. Given the state $\psi_{210}(r,\theta,\phi) = R_{21}(r)Y_1^0(\theta,\phi)$ for the atom with

$$R_{21}(r) = \frac{1}{\sqrt{24}}a^{-3/2}\frac{r}{a}e^{-r/2a}$$

and

$$Y_1^0(\theta,\phi) = (\frac{3}{4\pi})^{1/2}\cos\theta$$

(1) What's the expection value of an arbitrary function of the coordinates $f(r,\theta,\phi)$ when the atom is in state $\psi_{210}(r,\theta,\phi)$? (2) For $z = r\cos\theta$, please derive $\langle z\rangle$. No complicated integral is required to solve this problem.

5.17 – 5.39

Solution

1. $[\sigma_x, \sigma_y] = 2i\sigma_z$

$\begin{bmatrix} & -i \\ i & \end{bmatrix} \psi_n = \varepsilon_n \psi_n \qquad \lambda = \begin{cases} 1 & \to (-i, -i)\begin{pmatrix} -i \\ 1 \end{pmatrix} = 0 \quad \begin{pmatrix} -i \\ 1 \end{pmatrix}\frac{1}{\sqrt{2}} \\ -1 & \to (i \ \ -i)\begin{pmatrix} i \\ 1 \end{pmatrix} = 0 \quad \begin{pmatrix} +i \\ +1 \end{pmatrix}\frac{1}{\sqrt{2}} \end{cases}$

2. $H_0 = E_0 \sigma_z \qquad \psi_{in} = \begin{pmatrix} 0 \\ 1 \end{pmatrix}, \quad E_{in} = -E_0$

$H_f = E_f \sigma_x \qquad \psi_f = \begin{pmatrix} 1 \\ -1 \end{pmatrix}\frac{1}{\sqrt{2}}, \quad E_f = -E_f$

3. $|\psi\rangle = \sum C_n |\varphi_n\rangle$

$\langle\psi|H|\psi\rangle = \sum C_n^* \langle\varphi_n|H|\varphi_m\rangle C_m = \sum |C_n|^2 E_n \geq E_1$

4. $E_1^0 = e_0 \qquad E_1^1 = \lambda_1 \qquad \psi_1^1 = \frac{|\langle 1|H_1|2\rangle|^2}{-e_0}\varphi_2^0 + \frac{|\langle 1|H_1|3\rangle|^2}{-2e_0}\varphi_3^0$

$E_2^0 = 2e_0 \qquad E_2^1 = \lambda_2 \qquad = -\frac{|Q_1|^2}{2e_0}\varphi_3^0$

$E_3^0 = 3e_0 \qquad E_3^1 = 0$

5. $\frac{1}{\sqrt{2}}\left(|L\rangle_1 |R\rangle_2 + |R\rangle_1 |L\rangle_2\right)$

$\frac{1}{2\sqrt{2}}\left((|L\rangle + |R\rangle)(|L\rangle - |R\rangle) + (|L\rangle - |R\rangle)(|L\rangle + |R\rangle)\right)$

$= \frac{1}{\sqrt{2}}\left(|LL\rangle_{12} - |RR\rangle_{12}\right) = \frac{1}{\sqrt{2}}\left(|L\rangle_1 |L\rangle_2 - |R\rangle_1 |R\rangle_2\right)$

6. $\psi_n' = \sqrt{\frac{1}{L}} \sin\frac{n\pi}{2L}x \qquad E_n' = \frac{n^2\pi^2\hbar^2}{8mL^2}$ Solution

$$\psi_{in} = \sqrt{\frac{2}{L}}\sin\frac{\pi}{L}x = c_1\psi_1' + a\psi_2'$$

$$c_1 = \int_0^L dx\, \frac{\sqrt{2}}{L}\sin\frac{\pi}{L}x \sin\frac{\pi}{2L}x = \frac{\sqrt{2}}{2L}\int_0^{2L} dx\left(\cos\frac{\pi}{2L}x - \cos\frac{3\pi}{2L}x\right)$$

$$= \frac{\sqrt{2}}{2L}\left(\frac{\frac{2L}{\pi}\sin\frac{\pi}{2L}x}{} - \frac{\frac{2L}{3\pi}\sin\frac{3\pi}{2L}x}{}\right) = \frac{\sqrt{2}}{2L}\left(\frac{2L}{\pi} + \frac{2L}{3\pi}\right) = \frac{\sqrt{2}}{\pi}\left(\frac{4}{3}\right)$$

$$c_2 = \int_0^L dx\, \frac{\sqrt{2}}{L}\sin\frac{\pi}{L}x \sin\frac{\pi}{L}x = \frac{\sqrt{2}}{L}\int_0^{2L} dx\, \frac{1-\cos\frac{2\pi}{L}x}{2} \cancel{= \frac{\sqrt{2}}{L}\frac{2L}{2} = \sqrt{2}}$$

$$\cancel{\psi_{in} = \sqrt{2}\psi} \qquad = \frac{\sqrt{2}}{L}\frac{L}{2} = \frac{\sqrt{2}}{2}$$

$$\psi_{in} = \frac{4\sqrt{2}}{3\pi}\psi_1' + \frac{\sqrt{2}}{2}\psi_2'$$

$$\overline{P_1} = 0.36 \qquad P_2 = 0.5$$

$$\psi(t) = \frac{4\sqrt{2}}{3\pi}\psi_1' e^{-\frac{iE_1't}{\hbar}} + \frac{\sqrt{2}}{2}\psi_2' e^{-\frac{iE_2't}{\hbar}}$$

7. $$\int 2\pi r^2 \sin\theta\, d\theta\, d\varphi\, dr\, f(r,\theta,\varphi)\, \frac{1}{24}a^{-3}e^{-\frac{r}{a}}\left(\frac{r}{a}\right)^2 \frac{3}{4\pi}\cos^2\theta$$

$$\cancel{\langle z\rangle = \int 2\pi r^4 \sin\theta \cos^3\theta\, \frac{a^{-3}}{24} e^{-\frac{r}{a}}\left(\frac{r}{a}\right)^2 \frac{3}{4\pi}}$$

$$\langle z\rangle = \int \frac{2\pi r^2}{24} \sin\theta\cos^2\theta\, a^{-3}e^{-\frac{r}{a}}\left(\frac{r}{a}\right)^2 \frac{3}{4\pi} r\cos\theta\, d\theta\, d\varphi\, dr$$

$$= \int \frac{2\pi}{16}\sin\theta\cos^3\theta\, d\theta\, a^{-3}\frac{r^5}{a^2}e^{-\frac{r}{a}}\, dr \qquad \int_0^\pi \cos^3\theta\, d\cos\theta$$

$$= -\frac{\pi}{8}\int^{\pi} \cos^3\theta\, d\cos\theta \xrightarrow{\frac{d\cos^4\theta}{4}} \frac{1}{a^5}\int dr\, r^5 e^{-r/a} = 0 \qquad = \frac{1}{4}\int_0^\pi d\cos^4\theta = 0$$

II. Introduction

The Political Science Program Assessment Committee (the Committee) chose to assess the first Political Science Program Learning Outcome (PLO) listed in the Program Assessment Plan. This PLO is for political science students to "understand the processes, theories, and empirical regularities of political institutions and political behavior in the student's chosen emphasis area: American politics, comparative politics, or international relations."

III. Assessment Methods

Following the Program Assessment Plan, the Committee sought both indirect and direct forms of evidence regarding student attainment of PLO #1.

A. Indirect Evidence (Focus Group)

Per the Program Assessment Plan, the Committee organized a focus group of graduating political science majors to indirectly assess attainment of PLO #1. The focus group was held on May 6, 2009 and all 12 graduating students were invited to attend. Unfortunately, only two students ultimately participated. Both of these students had selected American politics as their area of emphasis, so the Committee's questions focused on their perceptions of what they had learned about the processes, theories, and empirical regularities of political institutions and behavior in the U.S.

Following the focus group format, the Committee asked both specific questions (e.g., "Please tell us about theories of political institutions you have learned") and much more open-ended questions (e.g., "what have been the strengths and weaknesses of your training in political institutions and behavior?"). As it became clear that the more open-ended questions were yielding more interesting and informative responses from the students, the Committee relied more heavily on this type of question.

We found the participating students very candid about their experiences, education, and perceived attainment of PLO 1. The major limitation with the execution of the focus group was the limited participation. The Committee had anticipated that students might not volunteer to participate in this exercise and food was provided as a small incentive. Nonetheless, only two students participated.

B. Direct Evidence (Embedded Questions)

Per the Program Assessment Plan, the Committee coordinated with Professor Nathan Monroe to embed questions that assess students' understanding of processes, theories, and empirical regularities of political institutions - namely the U.S. Congress - on his Congressional Politics (POLI 100) final exam in Spring 2009. Because students in the course had participated in a several week long "legislative simulation" of the U.S. Senate, the questions were framed in the context of that exercise. Students were given the choice to answer one of the following essay questions:

1) Imagine the following scenario. A reporter walks into our classroom just as S .12 comes up for debate on the floor. She observes the following: Senator Thune begins “debating” the bill by reading a celebrity blog aloud from a laptop on the floor of the simulated Senate. After five minutes, Senator Byrd stands up and makes a motion for something that sounds like “closure.” After calling the roll, the “clerk” announces that the vote passes 24-16. The clerk immediately calls the roll again, and then announces that S. 12 passes 21 to 18 with one abstention. The reporter wants to know what just happened. Put on your political scientist hat and explain the following: Identifying the correct procedural jargon, what just happened? In what way does this simulate what might actually happen in the real Senate under similar circumstances? Why did the first vote pass 24 to 16, and the second passed only 21 to 18 (and why is this significant)?

2) One of the weaknesses of the simulation was that it did not reflect the pressures that members of Congress face from external actors. In general, how would the strategies and decisions of members – individually and collectively – have changed if the simulation had included the president? The federal courts? The bureaucracy? The media? Interest groups?

Notice that the three specific questions at the end of question 1 mirror the three types of knowledge we wished to asses: "identifying the correct procedural jargon" assesses their understanding of legislative "processes", asking "what might actually happen in the real Senate" assesses their understanding of the "empirical regularities" of Congress, and the vote comparison and "why is this significant" question assesses their understanding of a core theory of Senate behavior (i.e. that Senate parties manipulate procedure to bias legislative outcomes).

Question 2 is also intended to elicit responses directed at each type of knowledge, though it is framed differently. Here, students are expected to demonstrate an understanding of the ways in which these external actors interface with Congress ("processes"), use examples from real world politics ("empirical regularities"), and speculate about changes in "strategies and decisions of members," which calls for demonstration of "theories" about how political actors behave.

IV. Results

A. Indirect Evidence (Focus Group)

The committee’s open-ended discussion with the two participating graduates was highly illuminating. Both students clearly felt that they learned a great deal about the various institutional and behavioral theories of American politics. They were readily able to identify and describe several theories they had learned in their classes. The students also felt that they had a good feel for the empirical regularities of American politics, but perhaps to a lesser extent than the theoretical components. Both students agreed that they would like to have a better understanding of some of the basic processes and factual information regarding American politics. To this end, they suggested that the Political Science Faculty considering offering additional lower division courses on American politics.

In sum, these students reported mixed success in the achievement of PLO 1. They perceive that they succeeded in learning the theories and, to a slightly lesser degree, the empirical regularities of American politics. They felt they did not learn as much about the basic “facts” of American politics as they would have liked.

B. Direct Evidence (Embedded Questions)

The committee's overall assessment of student responses to the two essay questions is generally positive, though mixed.

In general, the students exhibited a strong grasp of institutional processes, both basic and complex. The following are representative responses, with respect to legislative process:

> *Question 1*: "As the reporter walks into the classroom, what she is observing is a filibuster in progress. Senator Thune is reading the celebrity blog as a way to delay further progress on S. 12. Five minutes later, Senator Byrd has had enough of the celebrity blog. The reporter observes a motion which she believes to be "closure." In actuality, Senator Byrd invoked the cloture motion which will end Senator Thune's filibuster with a 60% aye vote."
>
> *Question 2*: "[Senators] have the power to shape the influence of the federal courts, because [they] help decide who gets to be appointed. This is important because the bills the become law are interpreted by the federal courts."

Responses to question 1, along the lines demonstrated above, showed a level of procedural understanding that is deep and complex, and implies an understanding of the broader, more basic context of core American political institutions. Though less nuanced, the responses to question 2 also showed a level of procedural knowledge that is adequate (or better) for a graduating senior in political science.

With respect to understanding empirical regularities, competence varied more across questions. The following are representative responses:

> *Question 1*: "The previous scenario illustrates a scene that will probably occur multiple times from now through 2010: cloture being invoked to break a Republican filibuster."
>
> *Question 2*: "Interest groups, representing conglomerated factions of the public, will lobby legislators to persuade them to vote favorably for their cause."

Question 1 commonly elicited responses similar in nature to the example above, showing a solid grasp of the past and (impressively) future legislative reality of the U.S. Senate. Students tended to understand the relative frequency and proper real world context of dilatory activity in Congress. On Question 2, students demonstrated more superficial knowledge (like the example above) of empirical regularities. In part, this may be because of how the question was worded. It may also have been a selection effect (i.e. weaker students chose may have disproportionately chosen to answer question 2).

Students showed basic understanding of institutional theories of American politics, but by in large party their responses lacked the desirable depth and awareness that what they were explaining was a theoretical approach. Here are examples of responses for each question:

> *Question 1*: "There will also be considerable pressure from the party itself to follow the party line. Once cloture passes, however, only a simple majority is needed, so several senators are freed to vote with their constituents, while the party goal is still bet by the bill itself."
>
> Question 2: "Senators would have to be aware that their votes may be monitored by interest groups rating their decisions, which can be used for or against them in upcoming elections."

While the example response to question 1 above (like many other similar responses to that question) actually *implies* a very sophisticated theoretical understanding of legislative politics, it does not suggest that the student understands that this is a theoretical take, as opposed to a concrete fact about the way political institutions work. Similarly, the response to question 2 suggests that the student sees interest group pressure as a political *reality*, rather than a theoretical explanation of the possible source or legislators' behavior.

V. Conclusions and Recommendations

A. Student Learning

It is clear that the evidence indicates that the students have grasped much of the process, theories, and empirical regularities of American politics (the relevant area of emphasis given the composition of the focus group and the nature of the exam in which the questions were embedded). What is less clear is whether the students understand the distinction between facts, theories, and systematic data. To address this issue, the committee will propose to the political science faculty that they should whether 1) Theoretical Models of Politics should be offered relatively regularly (it has yet to be offered) or 2) Theoretical Models of Politics should become a required course for all political science majors. This class should help students gain a better understanding of the nature and role of theory in political science.

B. Assessment Methods

The PLO being evaluated is general and quite difficult to measure in any objective sense. The committee will suggest to the political science faculty that they consider revising this PLO in order to make it more assessable.

The focus group was very useful, but in the future more effort and/or incentives will be needed to increase student involvement.

The responses to the embedded questions were illuminating, but the use of questions in only one upper division class limits the committee’s ability to generalize about student attainment of the

VIII. APPENDICES:

APPENDIX A: RUBRIC FOR ASSESSING SOCIOLOGY MINOR CAPSTONE PROJECTS (2009)

CRITERIA	**Level of performance expected in order to achieve each ranking and points associated with each rank.**			
	EXCELLENT (4)	**GOOD (3)**	**SATISFACTORY (2)**	**POOR (1)**
A. Use of evidence	Strong, peer-reviewed research based support for argument. Demonstrates clear understanding of prior research.	Primarily use peer-reviewed research to support argument. May demonstrate minor misunderstandings of prior research OR use some evidence that does not fit argument.	Uses some peer-reviewed research, but primarily uses sources that are not peer-reviewed. Demonstrates minor misunderstandings of prior research AND uses some evidence that does not fit.	Few sources support thesis. Lack of peer-reviewed research for evidence. Sources insignificant or unsubstantiated. Demonstrates serious misunderstandings of prior research.
B. Use of research methods	Use of research method is fully appropriate in terms of applicability, scope, data collection or analysis. If paper is a literature review, discussion of methods in prior research is fully appropriate.	Use (or discussion) of research method is mostly (but not fully) appropriate in terms of applicability, scope, data collection, or analysis.	Use (or discussion) of research method is marginally appropriate in terms of applicability, scope, data collection, or analysis.	Student does not adequately discuss use of method, or use of method is inappropriate in terms of applicability, scope, data collection or analysis.
C. Use of sociological concepts/theories	Student displays intellectual creativity and independent thought in use of sociological concepts and theories. Sufficient, accurate and appropriate use of reference to sociological concepts and theories.	Sufficient, accurate and appropriate use of reference to sociological concepts and theories.	Paper refers to sociological concepts and theories, but there are some gaps in the application such that they are not sufficiently, accurately, or appropriately discussed.	Paper does not refer to relevant sociological concepts and theories or does not use them accurately or appropriately.
D. Writing style	No problems with spelling, grammar, syntax, or usage. References are correctly and completely cited.	Minor problems with spelling, grammar, syntax or usage. OR References are missing or have incomplete citations.	Minor problems with spelling, grammar, syntax or usage. AND References are missing or have incomplete citations.	Significant problems with spelling, grammar, syntax or usage. AND/OR No explicit references or use of inappropriate references.

APPENDIX B: STUDENT WORK

Three examples of student work are attached in .pdf format. Below, we provide the average rating on the rubric (across three raters) for the key dimensions of assessment for each of the samples of student work.

Student (topic)	Use of Evidence	Research Methods
A (Comic book superheroes)	4	3.333
B (Drug policy)	2.667	2
C (Mental health)	2	1

REALLY SUPER?

Really Super?: Racism and Sexism Among Comic Book Superheroes

STUDENT NAME REMOVED

Dr. Simon Weffer

SOC 190

The pattern and role of the superhero in comic books closely mimics that of heroes in the myths and legends of every culture on the continent. The hero, usually male, acquires, either through birth or trials, some sort of non-natural abilities that make him superior to everyone else (Campbell, 1949). He uses his powers to stop monsters and villains to win the admiration of the people thus inspiring them to become better people themselves. That is why so many stories in so many different parts of the world have similar plot line because the human mind needs to believe in something more (Campbell, 1949). Such myths are also used to teach basic lessons about morality or to give hope such as that good will always triumph over evil. At the same time such stories always give some kind of character flaw or weakness to the main hero that makes them human as well. For all of his strength Hercules has a temper and Odysseus' pride gets him in trouble with the sea god Poseidon. Finally the heroic efforts of the hero always allows him to find love in the form of a beautiful woman being what renowned mythologist Joseph Campbell says is the greatest reward of all (Campbell, 1949).

Comic books are set up the same way. A hero ends up acquiring abilities that make him stand out from the rest of world. He chooses to use these abilities to fight evil thus earning the admiration of everyone else. And like the heroes of legend they all have their fatal flaws. Superman has kryptonite. Both Tony Stark and Oliver Queen are alcoholics and womanizers. Finally the hero is always having problems with finding love, though this never stops him from looking for it. So comic books are modern day ways of telling stories that have existed throughout human history. As a result they fulfill the same needs that the heroes of ancient myths do. They fill the need to believe that the average human is capable of becoming something more. But of course that raises the question of what happens when a group of people do not have the necessary heroes to believe that they are capable of becoming something more? If there is no

example to inspire a group of people to become more then they will just stay the same allowing for another group to rise and seize control. This is what has happened in America. The country's social values are set up so that white, heterosexual men are the ones who have dominance over the rest of the country. This is reflected in the heroes of comic books, especially in the two main houses of Marvel and DC, where the most powerful and strongest heroes are white, heterosexual men. The success of these men allow for other white, heterosexual males to see and believe that they are capable of doing great things while everyone else is let down by a lack of strong heroes to adhere to. But sometimes comic books will resist the mainstream values of society and present new heroes that challenge the norm. Comic books both reflect and challenge the white, heterosexual patriarchy that dominates society through the roles and actions of its characters.

Stereotypes about race have always existed within every form of media so it is no surprise that comic books should be any different. Characters of racial minority were first added to both Marvel and DC comics in the 1970s in response to Civil Rights movement of the 1960s (Kaveney, 2008; Wood, 1976). One of the first heroes to be added to the Marvel universe was that of Falcon who worked as a sidekick to Captain America (*Marvel Encyclopedia*, 2006). In the DC universe Lucius Fox and Gravedigger were among some of the first African American characters to be added (Teitelbaum, 2008). While these men were good, strong, talented characters they were all easily accepted mainly because despite all of their skills they still worked under a white man. This idea of needing a white man to watch over the black superhero appears in later comics too. After all Blade has Whistler to watch him and Cyborg, as one of the leaders of the Teen Titans, has the Justice League watching over him headed up by Superman and Batman (*Marvel Encyclopedia*, 2006; Teitelbaum, 2008). It implies not only the idea that African American heroes are not truly capable to work on their own, but, on a more sinister level,

that you cannot completely trust one either. Another common theme among African-American heroes is that of their origin. In both the Marvel and DC universe African American or African heroes tend to come from Harlem or some other DC equivalent urban setting or they come from Africa itself (*Marvel Encyclopedia*, 2006; Teitelbaum, 2008). By having African American primarily come from those two setting comic books are encouraging the idea that African Americans have either at one point been in trouble with the law, such as Falcon and Luke Cage, or that they are from supposedly more primitive, tribal areas, such as Storm, Black Panther, and Freedom Beast (*Marvel Encyclopedia*, 2006; Teitelbaum, 2008). This makes it hard for African American children to find someone to connect with because they are stuck with heroes who come from a very select background and might not be a good idea to trust.

Asian characters are also trapped in general, common stereotypes though theirs tend to be slightly more positive. The first common tend among Asian superheroes is that they all tend to either come from Japan or China thus encouraging the idea there is really only two main types of Asian cultures on the entire continent (*Marvel Encyclopedia*, 2006; Teitelbaum, 2008). Even though there are a few other characters from both Marvel and DC who are other ethnicities, such as Karma who is Vietnamese and Aruna who is Indian, overwhelming majority are Chinese and Japanese (*Marvel Encyclopedia*, 2006; Teitelbaum, 2008). It makes it hard for children who are not either Japanese or Chinese to find a hero to admire because virtually none exist. It is especially hard for Filipino children because there are no superheroes who are Filipino. It also encourages the idea of Asia being a panethnic continent causing outsiders to view the people from or descended from that area as are all being the same. Also, almost all Asian superheroes are martial art masters or master gymnastics (*Marvel Encyclopedia*, 2006; Teitelbaum, 2008). Of course in the world of fighting superheroes there are plenty of people who know martial arts that

are not Asian, such as Batman. But for many of the Asian superheroes their super power is that they are martial art masters such as Shang-Chi and Lady Shiva (*Marvel Encyclopedia*, 2006; Teitelbaum, 2008). It encourages the false belief that every Asian person grows up knowing martial arts and can fight like Jackie Chan or Jet Li. Even if they cannot fight they can still do various flips that should allow them to move around like a ninja. So Asian superheroes have their own stereotypes to deal with as well because they are not only all grouped together, but often assumed to have certain abilities as well.

American Indians are also highly stereotyped, in not only their culture and powers but in the assumption that there is no such thing as an non-perfect American Indian. Like Asian and African superheroes comic books lump every single American Indian Culture together as well. This is usually symbolized by the racist, “traditional” clothing that American Indian heroes wear (Teitelbaum, 2008). For example Thunderbird, Shaman, and Strongbow all wear headbands with feathers attached (Sanderson, 2006). This implies that all American Indian tribes have the same culture because they almost always wear the same type of clothes. Also many American Indian superheroes’ ability is that of either of shaman like quality or some other ability to affect dreams such as Shaman and Moonstar (Sanderson, 2006). When people think of the word shaman they associate it with religion. So by giving so many American Indian superheroes shaman like powers writers are imply that they all believe in the same thing. The only one who seems exempt from this stereotype is the X-Man Forge because does not appear like the “traditional” American Indian, but even he has shaman like abilities implying that he has the same religious beliefs as Shaman and Moonstar (Sanderson, 2006). Also throughout the entire Marvel and DC universe there does not seem to be any supervillians who are American Indian. At first this seems like a good thing except it just continues to label America Indians as the “noble savage”. This idolizes

American Indians as people who are eternally wise and incapable of doing wrong. This may not be seen as a bad thing except American Indians are people too and therefore able to make mistakes. So by idolizing them so much it makes it that much easier for them to fall and be seen as fake even though they were being held by ridiculously high standards in the first place. American Indians have their own racism to face in the comic book world. Not only is it assumed that despite coming from different tribes they all wear and believe in the same thing, but that they are incapable of doing wrong continuing the belief of the noble savage.

Latino and Latino Americans are discriminated against more in the make up of their demographic then any other group. Despite the fact that the majority of Latinos in the United States are Mexican or Mexican American a majority of Latino superheroes are not Mexican. In the Marvel universe they are almost all from Brazil with a few from Puerto Rico and one Mexican. While in the DC world it is spilt more between Mexican, Dominican, and Puerto Rican (Teitelbaum, 2008). This is bizarre because since Mexican Americans are the largest racial and ethnic minority in the country one would think that Marvel and DC would put out more Mexican superheroes to convince kids to buy their comics. Instead they portray other Latino ethnicities more as if to imply that Mexican and Mexican Americans are not good enough to be superheroes.

The one minority group that is ostracized and villainized in comic books more then any other is that of Arab and Arab Americans. There are only two positive Middle Eastern characters in both DC and Marvel worlds. The first is that of Sabra who is Israeli and the second is of the one time X-Man, Dust (cite). Besides these two women Arab and Arab Americans are not shown as heroes. Instead they are virtually always associated with evil. The Arab villain appear in one of three roles; that of the repulsive terrorist, the sinister sheikh, or the rapacious bandit (Shaheen, 2004). All three are deadly and often shown as ugly, greedy men who are anti-American, anti-

Christian and anti-Israel thus making it easy for the majority of American readers to develop negative feeling towards them (Shaheen, 2004). These feelings are only further amplified when the Joker, one of the most hated and recognizable villains in all of comic book history, becomes the Iranian Ambassador to the United Nations (Shaheen, 2004). Once there he delivers a speech about how much he and Iran are alike and that neither of them are going to take any abuse anymore. The Joker then proceeds to try and gas the entire United Nations (Shaheen, 2004). The Joker's association with Iran in the minds of readers means associating Iran with the evil that Joker represents. Add in a bunch of filthy looking, backstabbing men who are covered in "traditional" Arab clothes and reader will almost always associate anything that is related to the Middle East as evil. Plus the only way that the evil Arab men are ever dealt with in comic is through shear force usually resulting in the death of the Arab. This influences the belief that the only way to deal with the evil Arab is with violence. Arab women are not shown better either. They typically fall into two categories; that of either the faceless and shapeless housewife or that of the beautiful belly dancer who is needs to be rescued from an evil sheikh's harem (Shaheen, 2004). While the faceless housewife is ignored and forgotten, the beautiful belly dancer is often shown as a helpless woman who ends up being the love interest of the hero thus endearing her to the reader. So in the end the only good Arab character is that of the belly dancer, but even then she is a helpless character who needs to be saved by the strong Western hero. Arabs are unfairly portrayed the worst out of all ethnic and racial groups. Not only are there virtually no Arab superheroes, but all of the characters, minus the belly dancer, are automatically aligned with evil and thus encourage the belief that anyone of Arab or Muslim decent should be feared and destroyed.

Every racial and ethnic minority is discriminated against in superhero comic books in someway. African Americans always have some white man with seniority looking over their shoulder. Asian Americans all appear to be martial artists. Both groups only seem to come from certain areas. American Indians are also all grouped together by the misleading belief that they wear the same thing and believe in the same religion. Plus they are never seen as anything but good making it harder from them to seem human. Latino superheroes are from all over the place, but only a minority of them are Mexican mimicking the public's attitudes about people from Mexico. Arab and Arab Americans have it the worst out of everyone. They are virtually portrayed only as evil men who wish to destroy America and everything relating to it. The only good character is that of the helpless belly dancer who exists solely as a romantic love interest for the hero. These stereotypes affect the readers in two different ways. The first is that it makes it hard for young audiences to connect and be inspired by a hero if they are unable to relate to any of them. It is especially bad for Arab Americans because not only are there almost no superheroes, but they are shown as virtually nothing but the bad guys. This also affects how other people see different groups in the world. As sociologist Bonilla-Silva showed it is much easier for people who come from homogeneous neighborhoods to believe the stereotypes that the media portrays (Bonilla-Silva, 2006). This is do to the fact since everyone in their area looks and acts the same they have no real world experience to disprove to them that the stereotypes they see are false. As a result they engrain those beliefs into their head as true and whenever they do come up against someone who does not fit in with their beliefs they disregard that person as an anomaly rather then the norm. This applies to comic books because, despite being fantasy, they are a source of information about the world and thus affect people's views and decisions.

It is interesting to that while romance plays a very heavy part in superhero stories that the sexuality of various characters is rarely ever discussed. For while there are a few characters that are out of the closet there seems to be just as many who are in it. Out of four official DC and Marvel character encyclopedias only four characters are openly homosexual (*Marvel Encyclopedia*, 2006; Teitelbaum, 2008). Northstar of the X-Men is the only gay man, while Batwoman/Kate Kane and her lover Question II/Renee Montoya, as well as the mutant Sunfire are the only three lesbians in the books. There only being a total of four openly homosexual characters out of thousands in the combined Marvel and DC universes show just how dominant the heterosexual norm is in America. It is especially interesting to note that two of them are X-Men since their creator, Stan Lee, has specifically mentioned multiple times that one of the purposes of creating such a group was to show how fear over people who are different is irrational. Because of this one would think that he would create a few more openly homosexual characters instead of sticking with just two. The DC universe is interesting in its decision to create lesbians, but not gay men as superheroes. It tends to reflect patriarchy more than even Marvel's lonely Northstar does. This is because while Northstar is alone he is still male and thus challenges societies ideas of what it mean to be male. Kate Kane, Renee Montoya, and Sunfire have a harder time because even though they are actually lesbians, and not bisexuals or women pretending to be lesbians, they can still theoretically pass under the idea with the heterosexual male fantasy of girl-on-girl action. Thus it is easier for them to be seen as just more masculine women rather then a complete challenge to the heterosexual norm. It does not help that all of women were introduced in the 2000s when society, at least appeared to, became more acceptable of lesbians (Teitelbaum, 2008). As a result they do not really have the same impact on society as Northstar did when he was introduced in the 1970s when it was not as posh to be gay (*Marvel*

Encyclopedia, 2006). Despite that homosexual characters are the smallest minority in the comic book world making it hard for homosexual readers to relate to them.

Even though there are not many openly homosexual superheroes in comic books both Marvel and DC have characters with homosexual undertones. One such pairing was that of Professor Charles Xavier and Magento. Before they become enemies it is remarked that they spent more time with each other then their families causing some to imply that they were more then just friends (Kaveney, 2008). This relationship however is often just explained by being an extremely close relationship between two male friends. Though, in all honesty, once the thought of them as something more is implanted it can be hard to get out. The best and most popular example though is that of the Sapphic tendencies of Wonder Woman, especially when she was first created. Throughout the adventures of the Wonder Woman of the early 1940's she is often seen either binding or being bound by women (Robbins, 2006). And whether she is at her homeland of the all women's community of Paradise Island or out in the rest of the world she always has female admires (Robbins, 2006). Admittingly, minus the binding, these women never did anything more then hug., but it was strong enough to cause codes to be incorporated at the time to forbid nonheterosexuality (Robbins, 2006). Of course Wonder Woman had her token boyfriend in the form Steve Taylor, but she consistently refused to marry him at every turn potentially because she does not like him as much as she does other, female companions (Robbins, 2006). Assuming that Wonder Women and her female companions, along with Prof Xavier and Magneto, are all more then just friends then comic books are secretly sending the message that it is okay to be homosexual, as long as you stay in the closet. It is oppressive because no one should have to deny who they really are especially in a genre where in accepting those who are different is taught so often.

Comic books support the idea of heterosexual dominance by providing very few superheroes that are openly gay, instead preferring to keep them all hushed up in the closet. But the fact that they have any homosexual characters at all is evidence of Marvel's and DC's rebellion of the heterosexual norms that dominate society because they are willing to bring a suppressed minority into the mainstream.

Unlike ethnic minority characters there has been even less changes for women. Women are not only stereotyped, but also have to subscribe to impossible standards of beauty and femininity leading them to almost always being portrayed as sex objects. Those that are not are almost always villains. These representations and limits are just as dangerous, if not more so then the racial stereotypes because the issues they present are often ignored.

Women can fall into one of two types of categories in the comic book world. That is of either the Poison Maiden or the Great Bitch. These terms were used by Susan Wood in the 1970s to describe how Marvel comics was changing its characters to follow the Civil Rights movement, but kept women in one of the two categories. The Poison Maiden is usually one of three people in the comic book world. She is either the male hero's mortal girlfriend, the less aggressive superhero girlfriend or sister, or the random heroine that exists solely to be saved in every storyline (Wood, 1976). These women include Spiderman's first girlfriend, Gwen Stacy, The Scarlet Witch, Lois Lane and countless other women in comic book history. These women always play the second rate hero or maiden in distress that sets up the story for the men to come in and save the day. This teaches both young female and male readers that women are not as strong or smart as men because if they are always needing a man to save them then they must not be able to survive without one. However the Poison Maiden also makes the hero's life more complicated because she actively servers as his love interest thus becoming a liability to the hero

(Wood, 1976). Because the hero loves the maiden he will always rescue her whenever the villain kidnappers her to draw the hero into a trap. This method works especially well when the villain figures out the hero's secret identity. Any good villain would have figured out from previous encounters that brute strength is not enough to destroy the hero. The villain has to attack the ones that the hero loves the most if he wants to kill him. Thus the maiden becomes a liability because the villain can use her to force the hero into a trap where, if he cannot destroy the hero, the villain can at least hurt the maiden and damage the hero symbolically. The best example is when the Green Goblin kidnapped Spiderman's girlfriend Gwen Stacy and used her to lure the hero into a trap. While the villain did not succeed in destroying Spiderman he was able to kill Gwen thus causing great harm to the hero (Wood, 1976). Even female characters with powers are liabilities to superheroes because while they are powerful they are not strong enough to defeat the villain alone. The Scarlet Witch is actually a very strong magic user, but is still defeated in every battle and then used later on to lure out her husband and the rest of the Avengers into a trap (Wood, 1976). Of course not all women in the comic book world need saving. The Great Bitch is portrayed as the opposite of the Poison Maiden. The maiden is usually kind and loving, and weaker then the hero. The Great Bitch on the other hand is strong, clever, dishonest, greedy and about half the time wants the hero dead (Wood, 1976). Because of this it is hard for little girls and boys to admire her. The whole reason why they read certain comics is to see their favorite hero triumph. So if their hero is always fighting a certain type of woman then they are always going to associate that woman and her characteristics as being the opposite of what the hero stands for. As a result, even if certain Great Bitches, such as the Black Widow and Elektra, are helping out the hero the reader is not going to take their help too seriously because the reader knows they'll just become enemies again in the next issue. Early on the Great Bitch had a more

devious purpose of being used to belittle the Women's Movement. Wood points out that certain, more male hating characters, such as the more butch Valkyrie, are often implied to be a part of the Women's Movement (Wood, 1976). This belittles the idea behind the Women's Movement because it twists it from being about equality to being about destruction of men instead. Valkyrie in particular is used to this end when she is seen attacking the beloved Hulk shouting, "Up against the wall, male chauvinist pig," (Wood, 1976, pg 15). The fact that she was under an evil spell by the evil Enchantress at the time makes the situation reflect even worst on feminism. It implies that Valkyrie would never attack the Hulk, and thus call him a chauvinist pig, without being under the influence of evil. This causes the readers to associate the Women's Movement with evil and therefore discourage them from taking the issues that the movement was raising seriously. Finally whenever a woman gains a significant amount of power she is often shown as either becoming more ruthless or just becomes plain evil. Emma Frost rose to become one of the most power female CEOs in the X-Men universe, but is often portrayed as a ruthless bitch figure for doing so, mainly because she used her beauty and ability as a telepath to her advantage (*Marvel Encyclopedia*, 2006). Yet if she was a man one cannot help, but wonder if she would not be seen as so cruel. Lady Shiva is regarded to be the best martial artist out of everyone in the DC universe, yet she is often portrayed as switching sides (Teitelbaum, 2008). The best example of a woman is power being bad is that of Jean Grey. When Jean Grey first becomes the Phoenix she is seen as a powerful and majestic figure, but it is not long before the presence of such power corrupts her and she becomes the destructive Dark Phoenix (*Marvel Encyclopedia*, 2006). Jean Grey is the ideal example of the Great Bitch because as soon as she becomes a powerful figure that surpasses everyman she is sentenced to become evil as if women are not capable of being responsible of such power. Her example teaches both male and female readers that women are

not able to handle power and thus great power should solely remain the possession of men. Between these two categories, of the Poison Maiden or the Great Bitch, it is hard for young girls to find a strong positive role model. They are stuck between the two choices of either the good, but weak Maiden character or the strong, but morally ambiguous Bitch who is very likely to try to kill the male lead on the next page. Since the female reader will probably want to be on the side of good she'll emulate the Poison Maiden and wait for the hero to come and save her and thus learn to always depend on men to save her rather then save herself.

Even when it is possible to find a strong female character who is not a Great Bitch there is always the problem of the personified image of feminine beauty that the women of the comic book world present because it just continues the male belief that all women have to be beautiful. Since the comics are drawn it means that those in charge can create their characters to look however they want to. This freedom allows the primarily male drawers to create all the women as they fantasize and believe they should look like. This is why in the comic book world almost all of the female characters look the same because they have long hair, big eyes, large breasts and small waist that the male drawers fantasize they should have (Wood, 1976). These similar images continue the idea that there is only one type of beauty. This idea is not so different from those portrayed in other types of media, except in the comic book world they can be exaggerated to extremes even more. For example various heroines, such as Wonder Woman, Super Girl, Black Cat, and Black Widow, have very lean and muscular bodies that they need in order to do their job (*Marvel Encyclopedia*, 2006; Teitelbaum, 2008). But they do not only just have lean bodies, but breasts that have to be C-cups at the very least, if not larger. This then reflects society's desire for thin women with large breasts, a standard that is obtainable only by a select few. However the women not only have unlikely figures, but figures that are impossible to obtain

with their weight. A study was done where the Body Mass Index of twenty-five randomly selected Marvel female heroes was calculated. Out of those twenty-five women the average BMI was of 19.33, the lower half of “normal” BMI range, with 1/5 of the women have an underweight BMI of 17 (Healey & Johnson). This lower BMI only further perpetuates the idea that women have to be thin to be beautiful. It also makes it even more impossible for female readers to imitate such an ideal. Many of the women on the list, such as Black Cat who has a BMI of 17.25, Ms. Marvel who has a BMI of 17.33, and Elektra who has a “heavier” BMI of 19.24, are suppose to have advance strength and be martial art masters (Healey & Johnson). In order for them to obtain and maintain these abilities they would have to work out constantly to keep the necessary muscle mass. Instead they are either underweight or barely heavy enough to be in the normal range. Either way they certainly would not have enough muscle in order to properly carry out their jobs, especially if one adds in the weight of their giant sized breasts. The disproportionate figures of the comic book world tend to just reinforce the idea that there is only one type of beauty for young male readers to desire and young female readers to follow.

Besides body type there is also the problem of clothes in comic books. Virtually all female comic book characters have on skintight revealing clothing. From Marvel’s Jean Grey and Elektra to DC’s Wonder Woman and Supergirl all female character, especially heroes, have outfits that show a little more skin then most people do in reality. The fact that female superheroes wear such ridiculous outfits is often joked about. Problem is that such jokes have a double effect on readers. Not only do they continue the idea that women have to dress and look a certain way, but they also make it hard to take such female heroes seriously. Very few women would go out and fight in Elektra’s bright red corset and thong or wear Emma Frost’s reverse bra with matching underwear and thigh-high boots (cite). But the most revealing costume of a

female superhero would defiantly go to the Teen Titan Starfire whose, barely there metal bathing suit does not leave much to the imagination (Teitelbaum, 2008). Only in a world where everything is completely drawn could a woman wear such little clothing and yet never reveal anything. Even Wonder Woman's outfit is a little silly as one cannot help but wonder how her breasts do not fall out as she is battling evil and oppression. Despite the lack of tack and practicality of many female heroes costumes they are continuously drawn that way because the men who draw fulfill some sort of fantasy by doing so.

Of course not every woman is stuck in this narrow physical ideal of beauty, but the problem is that the majority who do not are villains. It goes back to the idea of the Poison Maiden that all of the heroes be attractive. So in order to tell the good from the bad generally only villainesses are shown as being ugly such as Granny Goodness or the Queen of Fables (Teitelbaum, 2008). This continues the idea of the Great Bitch because if goodness is associated with beauty then making only the villains ugly helps the reader identify who to root for. However this also has the affect of reinforcing the idea that good girls should fit within the narrow standards of beauty that society deems acceptable. The only female heroes that do not fit within this image are that of Callisto, Question II and Jessica Jones (*Marvel Encyclopedia*, 2006; Teitelbaum, 2008). However there are reasons to why to each of these women are not shown the same as the rest of their female companions. Callisto is the leader of the Morlocks and therefore is suppose to look damaged in order to not fit in with the rest of their society. Question II is a lesbian and therefore under the rules of heterosexual patriarchy excused to be more butch looking then other female characters. The only true exception is Jessica Jones, but even then one woman does not cancel out all of the other hundreds of other females in the comic book community. So while there may be a few exceptions to the rule of the underweight, yet large

bosomed female hero usually only the villainesses are ugly reinforcing the idea that one can only be good if they are beautiful.

It is not just the standard of beauty that separates female characters from that of male, but also the treatment of characters themselves. Female characters are more likely to suffer from what is known in the comic book world as women-in-refrigerator syndrome which is used to describe female characters who have been killed, mutilated or depowered (cite). Generally such women are Poison Maidens who die because they are incapable of fighting off the villain. However, what makes them different from men is that they do not die or lose their abilities in the same way that men do. As comic book writer Gail Simone pointed out female heroes do not die heroically like their male counterparts (cite). They are instead killed in a very gruesome manner or just found after the fact. While she did not die Barbara Gordon was shot by the Joker while answering the door of her home and thus has to live out the rest of her comic book career in a wheelchair (cite). The most sadistic death that raised an uproar among female fans was that of Stephanie Brown as a female Robin, who was bond, tortured and then killed by a power drill (cite). But it did not end there for unlike a previous Robin who had died, Jason Todd, Stephanie did not have a statue erected in her honor in the Batcave allowing her to be forgotten in the mind of the reader (cite). By experiencing such a gruesome and graphic end writers and drawers are passing on the lesson that girls should not attempt to become superheroes otherwise they will meet a violent fate. This would not necessarily be a bad thing in that realistically most superheroes' lives would end violently. However only female characters tend to meet such a fate thus making it seem as if only men are meant for the world of superheroes.

The only woman who seems to be able to be both a beautiful and a truly strong character is that of Wonder Woman, but even she has had a turbulent history where she changed from feminist icon to boring housewife to icon again.

In order to understand what made Wonder Woman so unique one needs to understand her creator. Wonder Woman was created by self-proclaiming feminist William Marston in the 1940's in response to bloody, male dominated violence that existed in comic books (Pereira, 2006). Marston believed that women were morally superior to men and thus wanted to create a character that expressed his belief and Wonder Woman was born (Pereira, 2006). Even from her birth Wonder Woman did not need a man in her life since she was molded from clay by her mother and then granted life from the Olympic goddesses (Robbins, 2006). From there she was raised on Paradise Island that was only inhabited by women. The reason why Marston gave the character her lasso was because he felt that bondage was an appropriate way for Wonder Woman to defeat her enemies without shedding blood (Pereira, 2006). With this Wonder Women went out to America to teach other women to stand up for themselves without the help of men (Pereira, 2006). Finally Marston made Wonder Woman unique in that even though she fought male oppression she still faced her strongest oppostition in women. These women were not truly evil, but instead were so taken with the male focused mentality that ruled them they committed crime, but in the end were saved by Wonder Woman and her bondage lasso of truth (Pereira, 2006). The Wonder Woman that Marston created truly was a symbol of feminism, especially in the 1940s and 1950s. Not only did she not bow down to any man, but she encouraged other women to do the same, thus helping little girls to become all that they believe they can be. The fact that she was both feminine and strong helped out because it allowed female readers to see her as the best

aspects of both the Poison Maiden and the Great Bitch. That of a strong, beautiful young woman who is able to stand on her own.

Of course not everyone liked Wonder Woman and what she stood for as many found her ways too deviant for society. Because of her short shorts and brazier many people criticized her for being to scantily clad (Pereira, 2006). There was also protest to all of the bondage that kept on reappearing (Pereira, 2006). However the most protest came from Dr. Fredric Wetham who believed that Wonder Woman was dangerous especially to young women who might actually believe that it was socially acceptable to be both independent and strong (Pereira, 2006). Dr. Wetham's comment shows how powerful not just Wonder Woman has on people, but that of comic books as well because if they had no power then Wonder Woman would not be seen as such a threat to the American patriarchy. As a result of such fear, codes were put into place that forbade ideas of female independence and strength (Pereira, 2006). Wonder Woman was eventually then turned into a shopping, beauty obsessed housewife after Marston died as a result allowing the male dominated genre to overtake the only challenge they had to their rule. This was further shown by Wonder Woman having to prove herself multiple times to convince the male dominated Justice League to let her join because if she was really as strong and independent as she was created to be then she would not feel the need to win their approval in the first place (Pereira, 2006). It was not until the 1970s that the character got a reboot through feminists like Gloria Steinem and with the success of the TV show. Even then there was no undertone of bondage so the revamped Wonder Woman was not fully restored to her former glory (Pereira, 2006). The affects of her becoming a fashion, obsessed frail thing still has it's impact. When ever a picture of the Justice League it shown the character at the front is virtually never Wonder Woman, but Superman instead. And even if Superman is absent then Batman

takes his place followed by Wonder Woman. Wonder Woman is third tier to two other male heroes which continues the ideal that men are in charge before women. This does not mean that Wonder Woman is not a good role model for young women. She has still done the best of escaping the Poison Maiden/Great Bitch categories that dominate the comic book scene so much. But even Wonder Woman cannot escape the patriarchal grasp that dominates comic books because she is still portrayed as being behind men.

Sexism against women is the only major obstacle left in the comic book world that affects so many characters. Women are generally either portrayed as being helpless yet dangerous to have around or ruthless bitches who can never be completely trusted. They are almost always shown as sex symbols through their unrealistic body type and clothing. Female superheroes are also doomed to a more violent end then their male counterparts whereupon after their death they will be forgotten. Even the famous Wonder Woman is incapable of completely escaping the hold of the patriarchy undertones that dominate the business. These all have affects on both the male and female readers because it influences them into believing that women are incapable of becoming strong, independent heroes thus allowing men to stay in power.

One of the great things about the comic book word is that it is always getting revamped with new storylines and characters all the time. So it is possible for old favorites to be changed to put in more diversity as well adding new faces. One of the ways that DC answers the desire for more diversity is to have old favorites pass down their abilities to new heroes. For example one of the first Green Lanterns was a white man named Hal Jordan, but eventually he gave some of his powers to an African American man named John Stewart who become one of the most powerful and popular Green Lanterns in DC history (Teitelbaum, 2008). The spirit like power of the Spectre needs a host so it also is often passed down. Its most recent host is that of African-

American cop Crispin Allen (Teitelbaum, 2008). Titles and abilities can also be passed from man to women. For example, when the first Question discovered he was dying of cancer he trained Renee Montoya to take his place (Teitelbaum, 2008). All of these characters were able were able to be added to the superhero world and thus better demonstrating that anyone can become a hero. Marvel tends to mix it up differently though. Instead of just having certain characters hand down their powers they will reboot a series and thus change certain characters personality or even race. Originally a white man when introduced to the world Nick Fury became African American in the revamped *Ultimate Nick Fury* series (*Marvel Encyclopedia*, 2006). Traditional Poison Maidens, such as Jean Grey and Scarlet Witch, were given an attitude change as both were introduced as being strong, self-confident women from the start of the *Ultimate X-Men* series allowing them to be less dependent on their male counterparts (Kubert, 2001). The most noted female superhero that received a reboot is that Jessica Jones in the *Alias* storyline. Jessica, formally known as the minor superhero Jewel, is considered by many to be the most current, perfect example of feminism in comic books due to not only the complexity and realism of her character, but how she defeats her nemesis, the mind controlling Purple Man (Healey, 2006). Jessica Jones is a former superhero who threw down her cape to become a private detective and went into a self destructive streak of alcohol and sex (Kaveney, 2008). The reasons for her self-destructive streak become clear as the story progresses and ends up accumulating in her confrontation with the evil, mind controlling Power Man who played a major role in her fall from superhero status (Healey, 2006). Jessica is in many ways the perfect example of a strong female hero because she manages to break all bounds. By being an alcohol and have sex with random men in bars she cannot be defined as a Poison Maiden, but because she always fights on the side of good she is able to not be called a Great Bitch either. She is also incredible brave and strong. This was best shown in the

story arc where she refuses to give up the secret identity of Captain America after accidentally discovering proof of it on a role of film. In the end of the story the Captain admits that very few people would have been able resist all of the pressure from the media, government and villains hounding her for the information (Kaveney, 2008). Being able to resist pressure from all sides is something that only a very strong person can do proving even more that Jessica is neither a Poison Maiden nor Great Bitch or she would have cracked. Even the outfit she wears breaks norms. Instead of wear the skin tight outfit that all the other female superheroes don she goes around in baggy jeans and an over sized jacket making her shapeless (Kaveney, 2008). In the end Jessica is able to defeat her opponent the Purple Man with help. But the help comes not from the traditional male source, but in the form of Jean Grey symbolizing the power of sisterhood among the Marvel characters (Healey, 2006). Jessica Jones is truly a symbol of a strong female in the comic books word because not only does she manage to stay out of the two categories that dominate female character, but she is also able to defeat her enemy without the assistance of men. Both DC and Marvel are trying to meet the demands for change by changing aspects of certain character. While DC prefers to just hand down the power Marvel believes in starting entirely anew by changing people's race and behaviors to create more variety.

Another way that Marvel tries to bring variety to the comic book world is by adding on completely new series aimed at younger readers. These new series tend to focus on very diverse and strong characters that are of different races, genders and sexualities. The first series is that of the *Young Avengers*. The basic storyline is one where a group of teens gather together to fight evil, but are watched, because of their age, by the watchful eye of the Avenges. They are lead by Eli Bradly/Patriot who is the grandson of one of the African American, World War II soldiers that they tested the super solider serum on before giving it to Captain America (Heinberg, 2008).

The characters are notable not only in that this is one of the first teams lead by a African American, but also in that two of its male characters, Hulking and Wiccan, are in a relationship with each other (Heinberg, 2008). *The Runaways* are a group of teens who discover that their parents are supervillians and thus decide to escape (Vaugh, 2006). In the beginning they are also similar to the Young Avengers in that they are lead by an African American boy named Alex Wilder and also have a lesbian couple in characters Karolina Dean and Xavin (Vaugh, 2006). As the story line progresses Alex dies and the team is lead by Nico Minoru who is Chinese-American (Vaugh, 2006). These two series are unique in their characters. Traditionally teams in the comic book world are lead by white men, but here they are both lead by African American boys and in the case of Runaways later on a Chinese American girl (Heinberg, 2008; Vaugh, 2006). These differences in leader roles allow for a wider variety readers to better believe in the idea that they are capable of becoming strong leaders. This is especially important since the series is aimed at younger audiences because they tend to be more impressionable then older ones. The fact that both groups have homosexual couples also encourages acceptance for people who are homosexual as well as providing ideal for children who are. The new series are positive ones they provide a greater variety of heroes to admire and influence a wider audience of the younger generation.

Sometimes in order to truly find original superheroes that are not touched by all the bias that exists dominates the business one has to look outside the Marvel and DC houses. Milestone Media Inc. is a black owned and controlled comic house that sells comics that feature black heroes that are not only strong, but do not always resort to force to defeat their opponent (Brown, 1999). As assistant professor Jeffrey Brown pointed out African American superheroes generally have to by hypermasculinized in order to escape being grouped in with the weak Other (Brown,

1999). African Americans were always displayed in the media as being part of the weak Other so the white men in power had an excuse to subject them. As a result many African American superheroes are shown as being overly big and buff in order to prove that they are tough. Such heroes include Luke Cage, Cyborg, and Bishop (Brown, 1999). It would be hard not to call any of these heroes tough because they are all so strong and burley. Interestingly enough though the heroes of Milestone Media Inc. are not physically imposing and burley. What makes the superheroes of Milestone Media Inc special is that they usually use their brains to defeat their opponents instead of brute strength (Brown, 1999). This has awarded them a wide fan base among a variety of people, but especially young boys who feel that it is easier to identify with the slightly geeky Virgil Hawkins/Static or the super-genius Hardware rather then with some over muscular hulk figure (Brown, 1999). These character prove an exceptionally strong role model for kids because not only do they not fit into the idea of the over muscular black superhero, but they change young readers to use their head to solve problems rather then their fists. The only problem with Milestone Media Inc. is that it has trouble staying financially afloat in a businesses dominated by Marvel and DC (Brown, 1999). Outside publishing houses like Milestone Media Inc are important because they often have the freedom to come up with original characters that are not trapped within the bounds of stereotypes, thus allowing them to come up with uniquely original story lines that can truly inspire readers to be different.

It may seem silly that a bunch of pictures with a few words would have such a great affect on society. But many, various people love comic book superheroes and what they represent. If people were not invested in it then superhero movies would not make millions of dollars at the box office. People would not dress up and then go to comic book conventions or spend of thousands of dollars on a first addition issue of Spiderman. Comic books mean a lot to

people because they allow them to connect to their primal desire for a hero to believe in. Joseph Campbell argues that the point of myths and their heroes is to allow us the hope to transform into something greater then we currently are (Alsford, 2006). Because of this people need heroes that they can relate to so they can believe that they are capable of becoming something more. Without heroes of different race, ethnicities, genders, and sexualities the majority of society is stuck believing that they are able to do and become great things, thus allowing the white, heterosexual patriarchy to continue to dominate their lives. Comic books reflect this through the stereotypes and sexualization of their characters. At the same time though they also try to challenge and surpass it by reinventing characters and introducing new ones that might inspire change.

The research on superheroes and comic books is not complete. More needs to be do to show that women and minorities not only read, but are affected by what they see so that readers are able to influence more equality in comic books so that future fanboys and fangirls will be inspired to believe that they can become something super.

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Running head: DRUG LAWS AND SOCIALIZATION

Drug/Controlled Substance Policy and Ruling Class Interest

A Conflictive Approach

University of California, Merced

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Abstract

The recreational use of drugs and substance exist well throughout the world as well as throughout time. However, their acceptance depends greatly on the society in which they are utilized. In our current society, the use of substances such as cannabis, amphetamines, and hallucinogens have most commonly been placed on the list of schedule one category drugs. Not only are most outlawed, but the pretenses on which they have been outlawed are based on faulty logic, racism and the threat of communist subversion as shown throughout history. This manuscript serves as an analysis of what our society considers legal and illegal, socially acceptable and morally wrong, but more importantly strives to understand why some minorities are over represented in various crime statistic data.

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Introduction

The definition of an illegal drug in our country stands on a thin line between what we consider socially acceptable and morally wrong. For example, it is perfectly legal for a person to consume a mood elevator such as Xanex ©, drink several cups of coffee, smoke a cigarette and proceed to operate a motor vehicle. However if that cigarette happened to contain tetrahydrocannibinol (THC) instead of nicotine, the person in question would be committing a drug offense. The dynamic formed in the previous statement is purely social and is a product of the laws created by the ruling class concerning drug litigation. This conflictive analysis of drug and substance laws questions the deliberation of drug laws in terms of what is classified as legal versus illegal and why said laws are a representation of the ideas of the ruling class.

In the past, laws have existed that exemplified racial disparities among arrestees in the criminal justice system. An example of such a law is the infamous one hundred to one rule, regarding rock versus powder cocaine, the latter yielding the same jailing sentence for one hundred grams compared to one gram of rock cocaine(Tonry, 1994). It was well known that the users of rock cocaine were primarily minorities in low SES areas. This is concordant with the fact that rock cocaine was easier to produce and required less attention to compared to the shipping and processing of powder cocaine. With the knowledge that rock cocaine was more prevalent in use and trafficking in urban areas, a social scare broke out, media focused on the craze known as crack and stigmatized those who used it.

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A number of theories have been applied to the subject of drug offenses both looking at empirical evidence of racial disparities in arrests, and methods as to deter the use and trafficking of illegal substances. Social Disorganization theory exemplified the breakdown and decay of social cohesion on various criteria within impoverished areas resulting in crime. According to a study done by Parker and Maggard in 2005, one of three criteria for social disorganization theory was found to significantly influence drug arrests for disadvantaged black and whites. This consistently fits with the idea that urban areas have less informal control, and less social cohesion, as well as further disruption within the family unit from divorce and a lack of suitable male marriage partners. Parker and Maggard did however find statistically significant results in terms of social control indicators of threat, a rise in police activity in urban areas showed a positive correlation to the number of black arrests made. Influence was seen in the media, reinforcing concepts of social control by the ruling class, resulting in an image of blacks becoming a threat to society at large (Parker & Maggard 2005). Assumptions of Racial Threat and Social Control theories can explain the differences of types of drugs used by certain individuals based on their area of residence and the creation of the drug laws that followed. Many of the laws created to control the use and trafficking of various narcotic substances have shown to have a more detrimental effect on minorities living in lower socioeconomic status (SES) areas, as well as showing no significant reduction in recidivism for drug crimes (Tonry, 1994). In summary, if the deterrent supply side reduction methods (i.e. Mandatory Minimums,

Three Strikes, harsher sanctions) were to have caused a drastic decrease in drug use/trafficking, they would have done so already.

History of Drug Laws

Faulty and Discriminatory Logic

Schlosser (2003) states that "For too long the laws regarding marijuana have been based on racial prejudice, irrational fears, metaphors, symbolism and political expediency"(p.74). Throughout history, the progression of drug laws (in this case, cannabis) has undergone drastic transformations to describe the social ills created by its use. Integration of Mexican immigrants during the early 1900's was the first of many social upheavals influencing laws regarding cannabis. With their arrival came the notion and image of their preferred method of inebriation, and an oncoming threat to The Unites States social well being. An icon most prevalent in the fight against (and now currently "War on...") drugs is Harry J. Anslinger, a former commissioner of the Federal Bureau of Narcotics (FBN). Adapting a conspiracy method of application, Anslinger utilized the threat of the Japanese during World War Two, and later the threat of communist China and Russia to back his reasoning for intense drug violation sentencing and the enactment of the Bogg's act (Schlosser, 2003). A product of communist subversion and The Red Scare, The Bogg's act was the landmark for what we know today as

mandatory minimum sentencing. The establishment of a two to five year sentence for mere possession of marijuana or heroin presided, yet the effectiveness of the Bogg's act was later put to rest with the social movement we all know as the 60's. Intensity of drug law sanctions have been examined and according to an article concerning prohibitionist policy of marijuana by Stuart Hills (1970) a lack of empirical evidence is shown of the reduction of usage and trafficking due to supply side reduction strategies. Namely, the severe penal sanctions and exorbitant legal intervention by the government has proven ineffective.

Beginnings of Public Policy Concerning Drugs

Laws such as the Bogg's act or the Narcotics Control act did not prevent the social movement of "Tune in, turn on, drop out" of the 60's nor did it change the attitudes of frequent users of substances at that time. An exploration of the "social consequences of pursuing a prohibitionist policy backed by the threat of severe mandatory penal sanctions" was analyzed by Hills (1970) in regards to the efficacy of such methods. Hills commented on the impact of the media through negative imaging of marijuana, more specifically a case of a young boy in Florida who allegedly murdered his immediate family while under the influence of marijuana, it was never mentioned in the media that the boy was a schizophrenia patient. Hills states that the political campaign pressure built up from such drastic but rare cases as the "homicidal boy, pot

smoker" resulted in the creation of such legislation such as the Bogg's act. The appearance of being soft on drug users, to most politicians was viewed as cavalier and high risk, any who spoke out against the harsh laws against drugs was consistently followed and tracked by agents of the Federal Bureau of Narcotics. A concrete example of some of the hysteria formed in association with political campaigns, was the case of James V. Bennet, a former director of the U.S. Bureau of Prisons, who was subsequently followed by FBN agents after negatively commenting on the intense sanctions placed on drug offenders (Schlosser 2005)

Despite a consensus during the 1960's of the failure of the Bogg's act in terms of its ability to reduce drug flow and use in the country, several laws appeared in conjunction to further combat the growing threat of narcotics. The sentencing reform of 1984 brought back mandatory minimum sentencing to drug related crimes, with no consideration of the failure of previous laws and their ineffectiveness in controlling trafficking and use. Political pressure during this period was prevalent due to the death of a basketball star from the University of Maryland who had apparently suffered from cardiac arrest due to a rock cocaine overdose. Once again, lawmakers made it a point to reinstate harsher drug sentencing laws. Mandatory minimums now took even greater consideration of type of drug possessed as well as amount, depending on the mentioned criteria, a jailing sentence of anywhere from five to twenty years followed. Shortly following the Sentencing Reform act came another provision meant to deter the act of drug offenses. The "Three Strikes" provision targeted those labeled as repeat drug

offenders, and shoved a life sentence into the mix following a third drug offense. The failures in reducing drug prevalence shown from enacting such provisions as the "Three Strikes" and various mandatory minimum laws focused heavily on supply side reduction of crime. Seventy percent of all federal anti-drug funds were devoted primarily to law enforcement, while less than thirty percent of funding went towards education and rehabilitation (Office of National Drug Control 1990). Much concern has been placed over what mandatory minimums do in terms of removing sentencing decision from court judges and placing that same power in the hands of attorneys. As commented by Richard D. Hartley on the harsh sanctions placed on drug offenders, such an instance robs individuals of their due process of rights and places them in circumstances in which they are stigmatized and criminalized rather than rehabilitated (2008). It is clear that mistakes from history have not been taken fully into account when litigation of new laws concerning drugs were being produced, flowing into the saying "Those who cannot learn from history are doomed to repeat it".

Application of Theory

Deterrence Theories Reconceptualized

It is more than evident that the criminal justice system favors a supply side strategy (increasing of police force, creation harsher sentences) in regards to attempting to reduce drug prevalence in our country. The applied methods thus far seem to rely on a deterrent rather than rehabilitative form of treatment, thus an application of a reconceptualization of deterrence theory by Stafford and Warr will be applied to analyze the efficacy of harsh sanctions on drug laws. A reconceptualization of traditional deterrence takes into the accordance if ones personal experience with punishment and punishment avoidance. As stated in their analysis of their reconceptualization, this theory can work in reverse, as in direct experience of punishment avoidance reinforcing ones perception of certainty of punishment (Stafford & Warr, 1993). This coupled with the fact that many hear of others who get away with committing drug offenses further reinforces their certainty and severity of punishment. In latent terms, getting away with using drugs and hearing and knowing about others who have gotten away with it as well will further increase someone's likelihood of doing it again. Deterrence theory takes another blow when applied to the social movement of the 1960's drug craze. Thousands of people utilized and enjoyed the "Acid Test" tour knowing that D-Lysergic Acid Diethylamide (LSD) was in consideration of becoming illegal. The greatest example being the end of 1967's "Summer of Love", prior to which LSD had become illegal in California. A large

number of people in protest of the new laws had in defiance gathered and simultaneously took several doses of the newly appointed schedule 1 psychedelic (Herrer 1985).

As for explaining the introduction to the use of drugs deterrence theory has some substantial grounds for explaining this complicated dynamic. Those with little to no direct experience with punishment or punishment avoidance (e.g. someone who has not committed an offense yet) are more likely to be a product of their indirect experiences with punishment and punishment avoidance (e.g. hearing about others who have been arrested, or have gotten away with an offense). In application to the development of drug laws, there are several concerns on the general efficacy of deterrent methods of controlling drug use and trafficking. For one, it is nearly impossible to track down every single person who has ever utilized an illicit substance in their lifetime. It is even more difficult to keep track of social networks in which one becomes accustomed to drugs, not to mention specific individuals within said networks.

There is also the concern of those who do have immense experience with both punishment and punishment avoidance and who continue to take part in drug usage regardless. A possible medical explanation can be the addiction factor that a number of drugs (both legal and illegal) possess. If that is the case, then why do we continue to adapt policies and sanctions that have been empirically proven to be ineffective? (Tonry 1994) Deterrence theory has little to add to this assessment and therefore laws that focus on a supply side reduction to control drug use and trafficking should be heavily re-assessed. Most drug laws that exist today are a

face image of the laws put into place in the past, mandatory minimums from the Bogg's act being the greatest example. If such a policy could not halt the drug craze of the 60's, what is the general efficacy of their presence today? The benefits of focusing more on a demand side reduction strategy in addressing drugs, as Schlosser notes "benefits would be felt immediately, law enforcement resources would be diverted from the apprehension and imprisonment of marijuana offenders to the prevention of more serious crimes" (p. 73).

Another item to consider in the general efficacy of harsh drug laws is the attitudes of the offenders themselves. Our society has given much faith, as shown within our current drug laws, within deterrent methods of control. But it has yet to consider and analyze if such methods work, as some empirical evidence has shown, these methods have done little to reduce the amount of drug offenses that occur. Wright and colleagues offer three possible answers to the concepts of punishment and motivation. Individuals may all act in very similar ways in response to harsher sanction threats, there is also the notion that criminals are impulsive and live from moment to moment resulting in criminals being less responsive to sanction threats. Finally there is the notion that criminals are not inhibited by extralegal factors such as moral concerns (Parker & Maggard 2005). However it is currently being assessed that criminals, like many other people, are highly rational individuals, and think things out clearly before engaging in an act. In the case of a drug user, the assessment of whether or not his/her current location is suitable or concealable from possible detection. If an area is concealable and

possibility of detection is not likely, said individual will act accordingly. This example lays to waste the second point mentioned by Wright and colleagues, the assessment of area and detection shows the rationality exhibited by someone thinking about committing a drug, or any offense in general.

Drugs and the Disadvantaged

A number of studies done on the effects of drug law impacts on pockets of minorities have shown some amount of varying results depicting racial disparity. It is quite evident that policies in effect today have had substantial increases in our current prison population, a majority of which are incarcerated for drug related matters. According to the Bureau of Justice, drug offenders accounted for approximately twenty one percent of state and over sixty percent of federal prisoners in 1997 (Mumola 1999). Also noted in the Bureau report was the prevalence of those arrested for crack cocaine use, possession and sale (72.1% state, 65.5% federal). During the crack cocaine rise during the 80's, the image of a crack user was that of an unemployed African American male with a jail record living in an impoverished area. Furthermore, the data from the 1999 Bureau report shows that African Americans reported the highest amount of drug use among state and federal prisoners (Zhang 2003).

A study on sentencing reform effectiveness done by Richard Hartley (2008) showed that racial and ethnic minorities are still sentenced differently than whites for drug offenses. More importantly, the study noted that the attempts to make the federal sentencing system more uniform by utilization of mandatory minimum statues have not produced the desired results of equality in sentencing. Variation of results, varying from state to state as well as district may have shown individual effects at the judge's discretion. Coupled with the notion that sentencing for drug offenses have become more mechanical, allow for less individual sentencing, e.g. committing someone to a certain amount of jail time (Sphon 2002, as cited in Hartley 2008).

Parker and Maggard (2005) conducted a study regarding three separate theories in an attempt to measure disparity in sentencing procedure. Social disorganization, urban disadvantage, and racial threat theories were applied to explain the differences in sentencing and the seemingly disproportionate effects that such laws placed on African American offenders. Their results showed only significant results on criteria regarding social disorganization, and deprivation as a tangent from racial threat theories. Findings from the study showed that an increase in police beats in urban areas produced a positive impact on the amount of drug sales among African Americans. Overall their findings added much to an understanding on how disadvantaged areas are more prone to drug arrests, but simultaneously fail to explain white drug arrests. Perhaps the most important finding was that of social control efforts and their disproportionate affects on African Americans (increase of police presence).

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Environmental Explanations of the Disadvantaged

Data from studies done by The Bureau of Justice has revealed that African Americans have been incarcerated more often for drug offenses in federal and state measurements (Mumola 1999). It is highly possible that an environmental factor plays a significant role in this discrepancy of arrests. Impoverished areas are prevalently occupied by African Americans, and as mentioned previously by Parker & Maggard, an increase in police force has positively affected the number of African American arrestees. An environmental explanation would describe the areas of residence as the main factors for who gets arrested and for what offense. For example, Tonry notes that it is not just the urban disadvantaged that partake in the use and sale of drugs, but those more privileged do as well; the difference here is purely environmental. Drug sales in middle class neighborhoods are more likely t occur indoors where visibility is fairly low and limited, middle class dealers are also more likely to sell to only people they know out of fear of selling to an undercover agent, where those in impoverished areas need to sell to whomever they find looking for product out in the street, becoming more prone to undercover sting operations. Take for instance, the sale of narcotics in urban disadvantaged areas where sales most often occur out on the streets versus the sale of narcotics behind closed doors in private residencies. It is much easier to catch a dealer out on the streets or public property such as a bar or in a poorly lit alleyway as opposed to garnering the rights to search a private

residence via a warrant. This example gives light to the discrepancies formed in the types of arrests made warranting to drug offenses. There is also the fact that rock cocaine, which was more prevalently used by African Americans is much easier as well as less monetarily constricting than importing powder cocaine from another country. The hassle of smuggling narcotics is more costly, requires much more thought and planning, and has a greater risk for detection as compared to the simple method of buying the products needed to cook freebase cocaine and producing it. Coupled with the fact that street operation dealers are more easily replaced due to an abundance of minority males with little or no other way to make a living, crime statistics have shown an over representation of African Americans. Minorities arrested are also more likely to serve a longer sentence for narcotics sales due to a monetary inability to make bail. Yet, those more privileged who are convicted and jailed for a similar offense has the financial backing to make it out of the jailing system unscathed. Schlosser notes that having friends in high places plays an important impact in the criminal justice system:

> " The offspring of important government officials , however tend to avoid severe punishments for their marijuana crimes. In 1982, the year that President Regan launched the war on drugs, his chief of staff's son was arrested for selling pot. John C. Baker, the son of future secretary of state, James Baker, sold a small amount of marijuana-around a quarter of an ounce-to an undercover agent near the family's ranch in Texas" (pg. 52).

Due to the nature of mandatory minimums at the time, as well as his being convicted in the state of Texas, under state law, Baker was faced with a possible prison sentence between two and

twenty years of jail time. Rather, he was instead charged with a misdemeanor after pleading guilty. In another separate instance of power and a reduction of sentence, a congressman by the name of Dan Burton, a long time advocate in the war against drugs, brought up legislation for the death penalty for drug dealers, stating that children must be educated and the imposition of this harsh penalty of death would help in that cause. His son was later convicted of transporting a large quantity of marijuana across states. During his trial he was convicted again for growing marijuana in his apartment, as well as with the possession of a fire arm in the premises. Instead of facing a prison sentence of eight years (five years for the gun alone, 3 years for possession and intent to distribute) under federal law, he got off with a community sentence contract and was placed under house arrest (Schlosser 2003). These environmental factors accompanied by the sheer amount sentencing and jailing discrepancies between races is an indicator that certain individuals are more privileged and are more prone to avoiding jail time when knowing the proper people.

Discussion & Conclusion

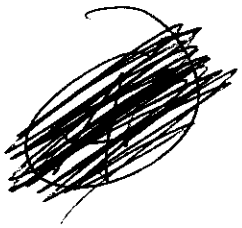
It is more than evident that the concept of what we consider a legal versus an illegal substance is a very complex dichotomy that exists on a very fine line of separation. Throughout history, laws against the use of substances such as cannabis have stressed a heavy focus on strategies employing a supply side reduction of crime. Methods of such application have resulted in the Bogg's act as well the sentencing reform act of 1984, instilling the idea that those who use drugs are inherently evil people and can only be controlled when laws scare them to the point of losing the will to use and sell. If it was as simple as creating laws that give hard jail time to one time and repeat drug offenders, the Bogg's act would have completely halted the drug craze of the 60's. This analysis and critique of past and recent

drug laws does not go without saying, that most of the aforementioned substances are addictive and have detrimental effects on health. Be that as it may, one must consider those who have become addicted both physically and psychologically to any illegal substance. Does the existence of a harsher punishment cross their mind when they choose to use again? Does it affect them in terms of how they cognitively process and weigh the benefits and outcomes? Such questions need to be assessed before the creation of laws that impose drastic measures on someone with a drug problem. It is in this sense that, as a country, a more rehabilitative and educational stance needs to be taken if we are to educate future generations about drugs and their use.

Being a complex issue, policy on drug litigation have often been one sided, making it hard for a rational critique and assessment of current laws. No politician wants to appear soft on drugs due to a loss of credibility and bad public image. Candidates campaigning with pictures of prisons and grief stricken relatives that have lost a loved one to a murder victim or drug related violence, who promise that laws that emphasize longer and harsher prison sentences will reduce crime, are more likely to yield a positive response from the public. Furthermore, this rationale can explain why conservative republicans can (and have) successfully impose more severe penalties for crime and drug control (Tonry 1994). Frankly put, campaigning out of fear is much easier than campaigning out of reason and rationality.

Discrepancies formed in arrest rates are yet another consequence of hastily creating laws focused on supply side reduction of crime. With environmental standpoints in place, blacks living in urban disadvantaged areas, where crime is more easily detected, where police frequently patrol, where finding

drugs is a matter of walking down the street to a local crack house, it is no wonder that most laws negatively affect African Americans. To say that race is not a factor of consideration in drug litigation is to ignore the foundations in which most drug laws were centered on in the past. They were based on the concepts of faulty logic, racism and stigma of Mexican Americans, and conspiracy of communist subversion. Without a re-assessment of current drug laws, countless more will enter the criminal justice system based on pretenses that are flawed and destructive to society as a whole.



Running head: DRUG LAWS AND SOCIALIZATION

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Running Head: Minority Children's Mental Health

Mental Health in Minority Children: Prevalence, Resource Utilization and Satisfaction

Sociology 190
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Abstract

There are many psychological and sociological issues that plague our community. A large concern in today's society is the prevalence of mental health issues in children, specifically minority children. The purpose of this study is to look at minority children's mental health diagnoses, resource utilization as well as mental health resource satisfaction. This study was conducted with children with mental health issues and their families. The subject's parents were given questionnaires and then given an interview based on the answers to the questionnaire. The results indicated that race and income play a major role in mental health resource utilization and satisfaction, however based on the data obtained there were no conclusive results on diagnoses based on race/ethnicity. The results support the notion that environment plays a large role in mental health, and that the government needs to take measures to improve mental health resources and create preventative plans to help groups that may be more susceptible to mental health issues.

Mental Health in Minority Children: Diagnosis, Resource Utilization and Satisfaction

Introduction

Mental health related issues are a large concern in society today. There are many people that struggle with mental health issues on a daily basis and do not receive adequate help. This usually happens because the mental health sector is an underfunded department of human services. There is a large area of concern for children with mental health issues and their access to effective treatments. Research shows that children in general do not receive adequate care; however minority children are far less likely than non minority children. There are several reasons for the lack of access and utilization of mental health resources. It can be caused by cost of health insurance as well a lack of coverage for mental health issues. But what factors are limiting minority groups and their utilization?

In the United States one in ten children suffer from an illness that can cause server mental health issues. These mental health issues are common in urban communities and in particular they are common in low income children of color. The prevalence of mental health issues in low income minority youths is not the only problem with mental health resources for children. Along with these factors is the fact that out of all the children receiving mental health assistance only about 10% receives effective help (Weist, Mark D., and Steven W. Evans). Effective help is defined as a measurable difference in the child's initial behaviors. This means that although some do receive help, the help is generally not effective enough to make measurable changes.

There are many factors that contribute to the lack of available and assessable resources; however the main factors being evaluated are the socioeconomic status of the children and the quality of the resources available to them. Several factors contribute to the lack of utilization of mental health resources including socioeconomic status, location in relation to resources, age,

gender and cultural beliefs.

There are many psychological and sociological issues that plague our community. A large concern in many impoverished areas is the mental health state of children. There are three major areas being evaluated in this paper. The first issue is over-diagnosis of minority children with environmental related mental health issues. Lack of utilization of mental health resources based on diagnosis is also being looked at. The last factor being considered is the satisfaction of the mental health resources and treatments that are being used. All of these factors combine to create a troubling outlook for minority children with mental health issues.

There are other factors that need further consideration as well, one of which being that tends to be a higher prevalence of mental health issues among lower income children. This is a major concern because low income may be a correlate to the prevalence of mental health issues in general. Some studies have shown that people with a lower socioeconomic status tend to have more mental health issues. This could be a result of lack of health care and living in harsh living conditions and in negative environments, all of which may lead to mental health issues. This proves to be one of the main downfalls of the mental health sector because although this group is most likely to receive help, they are more likely to receive substandard help as well.

The research is meant to evaluate the overall status of minority children with special needs. This is a major issue because the growing prevalence of minority children with mental health issues needs to be addressed. One of the main areas of interest in the study is the relationship between poor and minority and how these two factors may be connected in the status of mental health in minority children. One aspect is that families with children with special needs often need several forms of support and access to help other than that offered in special education classes. This aspect of the research is vital for understanding underlying issues within

resource utilization for minority children.

The framework being used to evaluate the research is Conflict theory. This theory is applicable to the mental health field and minorities based on several factors. The most predominant feature of conflict theory is the relationship between those in power and that not in power, and how the powerful control society. This is directly related to the mental health field and how minority groups are often over diagnosed and over represented in the mental health diagnosis and treatments. The core of conflict theory is related to inequalities that can be based on income or race. In the case of the mental health field both race and income play vital roles in the prevalence, utilization and satisfaction of the mental health sector.

In order to understand the complexity of the issues being discussed in this paper, many factors have to be considered and analyzed. The main factors being evaluated are mental health mental illness prevalence, resource utilization, and the results of utilization (satisfaction). The first factor being analyzed is diagnoses of minority children. This topic will look at several elements including prevalence of specific diagnosis, diagnosis referrals as well as some diagnostic biases that may lead to the over diagnosis of minority children.

Prevalence

Mental health issues are a commonly studied occurrence; however one group is often overlooked. The prevalence of mental health issues among minority children is not a widely studied field. Some studies suggest that mental health issues among minority children do not differ from those of white children. Other studies however suggest differences in environment related mental health issues. Most research done on mental health issues are in relation to adult populations, and not children. Some important findings are in mental health issues such as mental retardation and learning disabilities as well as conduct disorders.

The prevalence of mental retardation in minority children is generally higher than it is in white populations. The prevalence of mild retardation is higher in both Hispanics and African Americans than in Whites. The diagnostic criteria for mild retardation include an IQ score between 50-70 (Yeargin-Allsopp, M., Drews, C., Decouflé, P. & Murphy, C 1995). This difference could mean several things for minorities diagnosed with moderate mental retardation. The environmental factors may play a larger role in the prevalence of mental retardation Race and socioeconomic status are correlated to the prevalence of mental retardation in minority children, however there can be other factors included as well(Yeargin-Allsopp, M., Drews, C., Decouflé, P. & Murphy, C 1995). There is no empirical evidence that can explain the major difference in degree of mental retardation and race, however more severe forms of mental retardation are generally caused by organic factors, suggesting environment may play a large role in the prevalence in mental retardation diagnosis.

Learning disorders seem to have similar results as those of mental retardation. Learning disabilities is a category of mental illness that includes several different types of illnesses. The group includes difficulties in listening, speaking, reading, writing, reasoning, mathematics, foreign languages, coordination, spatial adaptation, memorization, and social studies. Minority groups, specifically African Americans and Hispanics/mixed race have a higher percentage of learning disabilities (Altarac, M. & Saroha E. 2006). African American youths are over represented in special education classes as a result of their common diagnosis of MR (mental retardation), learning disabilities, and emotional problems. In 1991 African Americans made up 35 % of special education classrooms (Harry, B & Anderson, M., 1994)

Conduct disorders, elimination disorders, substance abuse and phobias also tend to have a high prevalence in minority groups. According to DSMIV criteria Conduct disorders were more

common in general among whites than blacks. However, later onset of conduct disorder(adolescent onset) is higher in blacks than whites(Angold, A., Erkanli, A., Farmer, E., Fairbank, J., Burns, B., Keelser, G., Costello, J., 2002). This can be associated with environmental factors that can cause African American youths to act out and display symptoms of conduct disorders. Elimination disorders which include functional enuresis and functional encorpresis have a higher prevalence in African American youths than Whites (Angold, A et al. 2005). The Angold study also reported that African Americans score higher in the diagnostic categories of behavioral and anxiety disorders as well as behavioral disorders. These statistics can support the notion that environmental influences can contribute to the diagnosis of African American youth with specific mental health issues.

Utilization

The main contributors to lack of mental health resource utilization can be broken down into four main categories. The categories are: types of resources available, limited access to resources based on cultural and social factors, cost of mental health care, quality and effectiveness of resources.

Types Mental Health Resources

There are several types of mental health resources that are available to children and families with mental health needs. These resources fall into five different types: the first category is the health sector, which is any form of medical practice including hospitals and medical centers. The second category is the mental health sector which includes psychiatric hospital, residential treatment centers, group homes, outpatient drug and alcohol centers. There are also educational resources which includes school psychiatry, school based therapy, and special education classes. Lastly there is the child welfare sector which includes juvenile facilities and

social work or counseling (Burns, B., Costello, J., Adrian Angold, Tweed,D., Stangl, D., Farmer,E., Erkanli, A., 1995). These different types of mental health resources can be governmentally funded and therefore for children that receive government funded medical coverage should have access to these forms of medical care.

With all of these different types of resources one would think that there is sufficient help available to children with mental health issues. One of the main issues that limit utilization of mental health resources for children is the lack of consensus among all of the mental health sectors. The previously mentioned categories have different views on providing mental health assistance to children; therefore it is difficult for parents and health care providers to come to agreements for treating mental health issues. With several different forms of mental health resources there is difficulty with overlapping sectors of mental health and which sector should provide which form of assistance. The different sectors provide different types of assistance depending on the child's diagnosis and family income among other factors. However it is common for children to receive assistance from more than one sector at a given time (Burns, B., Costello, J., Adrian Angold, Tweed,D., Stangl, D., Farmer,E., Erkanli, A., 1995). The issue with providing assistance with more than one sector at the same time is the lack of integration between the sectors. There are many different types mental health aid, and certain sectors may employ one type of therapy while another employs another. This overlap often leads to frustration for both the child and their family and the service providers.

The presence of numerous mental health resources and options has led to the disbursement of responsibility among mental health care providers. The current focus has been put on schools and their involvement with children, and their responsibility in recognizing the onset or symptoms of mental health issues (Pelham, W., Wheeler, T.,Chronis, A.,1998). Most

research supports that school based therapy is beneficial in many ways, the main advantage being that it is easily accessible for all children, because all children attend school (Owens, J., Richerson, L., Beilstein, E., Crane, A., Murphy, C., Vancouver, J., 2005). & (Vernberg, E., Michael, R., Randall,C.,. Biggs, B., Nyre, J., Jacobs, K., 2006). This type of therapy is also beneficial because it is not income dependent. This is also important because under the Federal special education law and the Individuals with Disabilities Education Act school systems are mandated to provide special education services to children with mental health issues or disabilities that affect their school behavior or performance.

Other studies have indicated the limitations of these school based treatments. Teachers have many other priorities within the classroom, and devoting their time and attention to these in class therapies may hinder other students (Owens, J., Richerson, L., Beilstein, E., Crane, A., Murphy, C., Vancouver, J.,2005). And although there are significant benefits the downfalls can outweigh the positives. Other factors that were also discussed were that there can be other effective treatments that are less time consuming and less expensive to administer. (Hoagwood, K., Erwin, H., (1997). Another negative aspect of school based therapies is that it is difficult to apply to universal situations, meaning that effectiveness should be able to be generalized among parents, teacher, and mental health professionals. Along with this When children participate in school based therapies parent participation declines, and this can be a major hindrance in the therapies because the outcomes have to be transferred from the school environment to the home environment, and with out parent participation, that is nearly impossible (Watts, B., Dadds, M., 2007, & Pelham, W., Wheeler, T., Chronis, A.,1998). All of the different perspectives of the negative aspects of school based therapies may be adding to lack of utilization and effectiveness of mental health resources.

The school believes that it is the responsibility of the family and the family's general practitioner to pick up on these issues. The issue with this notion is that most families do not know the symptoms of mental health issues and may have cultural beliefs that limit the idea of having a child with mental health needs. Along with this notion is that early in development children see their primary care doctor often and thus the doctor should see the onset of mental health issues. There are two problems with this notion; firstly most general practitioners are not trained in psychiatric illnesses and secondly they are often not equipped to deal with the diagnosis of many mental illnesses (Gardner, W., Kelleher, K., Pajer, K.,2002 & Bruce D. Watt and Mark R. Dadds, 2007).

There is no doubt there are endless types of resources available, however the issues involved with deciding the most effective and assessable type is often a major part of the decision making process. This means that just because there are an abundance of options available, it does not mean that choosing the best option is easy for families in this situation. One of the main issues discussed in the article by William G. Hollister, is that despite positive advancements in school based resources is the fact that in some cases it is the only assistance that the child receives. This is an issue because schools are not fully equipped to deal with these mental health issues on a large scale. It is also an issue because school based assistance and general mental health providers. There is a lack of communication between these two groups, which leads to a stained division of labor between the two groups. The extent that this is harmful to mental health consumers has yet to be measure but it is an obvious problem in that children may not be receiving consistent or enough assistance.

Limited Utilization due to: Socioeconomic status, race/ethnicity, rural/urban setting/ Cultural beliefs

There is extensive research that suggests that income and mental health are directly related. There are several factors that contribute to the mental health state of a children, it is a widely accepted notion that socioeconomic status can contribute to the prevalence of mental health issues in children. Lisa Strohschein explores some of the factors of social economic status and how it affects children's mental health. The research's main focus is household income and poverty, and how that can lead to certain mental health issues (2005). The correlates of mental health issues and income have many factors, the main factors being environment, nutrition, and high stress (Gonzalez, J., 2005). It is unknown whether these risk factors cause mental health issues, but they do affect the utilization of mental health utilization.

The socioeconomic factors that contribute to mental health issues of children play a large role; however it is not the main determinant, nor is it the reason why people do not seek help. There are many reasons why economic status plays a keep role in mental health issues; socioeconomic status and race are often dependent upon one another. The racial make-up of mental health consumers is often in favor of White (Caucasian) consumers. As much research has indicated there are several reasons for this racial disparity in use of mental health resources. Race has been found to be related to how individuals perceive and present their symptoms as well as how they seek assistance. (Wells, K., Manning, W., Duan, N., Newhouse, P., Ware, J., 1986)

One of the major factors that contribute to lack of utilization of mental health resources is due to socioeconomic status. The reasons behind this can be because higher income groups are more likely to have better health insurance or more access to better forms of health care (Wells, K. ,Manning, W., Duan, N., Newhouse, P., Ware, J., 1986). The utilization of better healthcare, results in higher quality care, and therefore retention rates for assistance is higher in those with

better health care. Along with the access to better healthcare is the utilization of private mental health resources, such as therapy (Cooper-Patrick, L., Gallo, J., Powe, N., Steinwachs, D., Eaton, W., Ford, D.,1999). The factor of income in relation to healthcare plays a major role in that those that can not afford health care or those that receive government provided healthcare may not be receiving the best care possible, and therefore not utilizing the resources.

A factor that has been research, but has little support is lack of utilization due to cultural beliefs. Different cultures have different perspectives on abnormal behavior as well as need for mental health assistance. In the case of African Americans, mental health issues are corrected through spirituality as apposed to other forms of mental health assistance (Vega, W, Rumbaut, R. (1991)). These different views of mental health, lead to a lack of utilization due to a lack of need for mental health assistance. Other research related to this issue is that those from different race or ethnicity tend to have shorter duration of therapy and are more likely to end services early (Stanley, S. Zane, N.,1987). This plays a major role in utilization because those that do not utilize or continue services due to racial or cultural difference are not receiving adequate assistance.

Another main factor of culture and mental health services is that African Americans are less likely to seek mental health assistance from a mental health provider from another race (Takeuchi, D., Kim, K., 2000). This is a major issue for mental health care utilization because the majority of mental health care providers are not African American. This is also a hindrance because it suggests that African Americans are less likely to receive help, but not for the reasons mentioned in this paper but for personal cultural expectations. The racial disparities do not end at cultural difference between provider and patient. Some research indicates that African Americans receive higher diagnosis rates in disorders such as schizophrenia when compared to

similar white patients. They also receive higher doses of medication as well as being more commonly prescribed anti-depressant medication as well (US Department of Health Services). These elements combined may contribute to the lack utilization of mental health resources for Adult African Americans, and thus may limit the use by African American children as a result as well.

Cost of Mental Health Care:

One of the major issues in proving mental health care resources is cost. Health care in general is very expensive, and the mental health sector tends to have even higher costs. Mental health costs for treatment and rehabilitation are a large part of health care in general. The elements of lack of use of mental health care are based on several factors associated with costs. For those that do not have insurance, mental health services are incredibly expensive. For those that have insurance that covers mental health issues generally does not cover as much as for general health issues (US Department of Health Services).

The main factor the limits use of mental health services is due to cost (Stroul, B., Pires, S., Armstrong,. M., Meyers, J., 1998). There are several reasons for the high cost of mental health services, and depending on the type of insurance company one has, mental health costs vary. Research shows that people with HMOs and fee for service insurance are equally likely to seek mental health assistance; however the fee for service patients had three times more outpatient expense (Wells, K., Manning, W., Benjamin, B.,1987 and Diehr, P., Williams, S., Martin, D., Price, K., 1984). These costs may be a factor that limits usage after the first year of treatment.

Another main concern with the cost of mental health coverage is that many people that may have a mental health issue are more concerned with if their insurance will cover the service

as apposed to the risks of their mental health issue (Mechanic, D., 1994). The problem with this is that mental health issues are responsive to insurance as opposed to being responsive to risk. This relates to cost in that people that can not afford mental health assistance do not seek it unless it is covered by their insurance. This is a major issue because mental health issues do not seem to be prioritized as those of general health issues, and thus are often not considered important enough to treat unless paid for.

Quality/ Efficiency of available resources:

Another aspect of the research is that along with lack of resources is lack of qualified providers. In many cases families receive their mental health services from their primary care physicians. The efficiency of the mental health sector is continuously up for debate. The reasons why mental health care lacks efficiency is because there are so many different sectors involved in the diagnosis and treatment of mental health disorders. These facts are incredibly crucial in particular for children because there are many things that can occur. One is that children can "slip through the cracks" and their condition goes undetected. Two; children may go the doctor regularly, but the screening and testing necessary to diagnose mental illness is not always utilized in general practitioners offices (Gardner, W., Kelleher, K., Pajer, K. 2002).

Along with the fact that many children do not receive the help that they need, there is also the possibility of receiving help, but often the help is in general hospitalization, and not in specific treatment based assistance. In the study, "mental illness of the Elementary-school aged children" specific diagnosis of children was analyzed. The statistics indicated that a large number of these hospitalizations were depressive disorders, anxiety disorders, post concussion syndrome, substance abuse, pervasive disorders, anxiety disorders, control disorders, and other organic disorders. This article gives background statistics of childhood mental health diagnosis including

race, and socioeconomic information, as well as the prevalence of these disorders.

The other main issues in the effectiveness of mental health care are that many of the individual sectors do not have a consensus of what is effective or successful. This is an issue because if all of the involved parties are not defining their goals similarly the client may not be receiving the best care possible (Tash, W ,Stahler, G, 1985). This article also discusses that efficiency is often defined in terms of cost, and not purely by what may be most effective. This is an issue because the best options may not always be the most cost effective ones. However, with higher quality, may come better results as indicated in "Sociodemographic Factors and the Use of Outpatient Mental Health Services" (1986) which presents evidence that if families with children with mental health issues are all given the same high level insurance and high level treatment, the outcomes are extremely similar.

Satisfaction

There has not been much research on resource satisfaction, especially in minority children. However some research has been done for minority adults and groups from lower SES backgrounds. Satisfaction is highly correlated with utilization, and because there is often a lack of utilization, there is in turn a lack of satisfaction. In general minorities have low satisfaction with services they receive and it can be related to several factors. According to Constantine, 2002 one main contribution to lack of satisfaction is socioeconomic status. Satisfaction is related to income and quality of treatment. This relates to other research regarding quality of services and type of services received as well as access. Some research has indicated that access to resources along with utilization can contribute to the patient's satisfaction (Thomas, W. & Penchansky, R. 1984).

There is also a racial and cultural difference in satisfaction. In adult African Americans there were factors that contributed to their lack of satisfaction with treatments. Some of these factors were related to cultural beliefs. In some cases the patient's preconceived notions about whites will determine their satisfaction with a white therapist (Diala, C,. Muntaner, C., Walrath, C., Ph.D., Nickerson, K., LaVeist, T., Leaf, P., 2000). This suggests that although they may be receiving adequate and effective care, they will not be satisfied based on racial preconceived notions. Some other cultural factors may be related to cultural beliefs regarding medication. African Americans and Hispanics are less likely to approve of taking antidepressant medication and more likely to be less satisfied with a therapist if certain medications are prescribed. (Cooper,R., L., Gonzales, J., Gallo, J., Rost, K., Meridith, S., Rubenstien, L., Wang N., Ford, D 2003). These factors play a large role in the perceptions of therapy and the subsequent satisfaction with treatment. Although these factors would be difficult to limit because they are rooted in cultural beliefs they can be addressed by adapting cultural differences in different therapeutic practices.

Methods

Participants

The sample of this study consisted of 22 families with a child with a mental health issue living in Merced County. The sample included five girls and seventeen boys with the ages ranging from three years old to fourteen with the average age being six. The racial backgrounds of the children were four African Americans, eight Latinos (Mexican American, Argentinean), one Indian, two Hmong, and seven Caucasians. The families were found using two methods, one was through Pacific Family and Child Associates, a company that works with children with Autism, and though visiting a special education class as Ada Givens Elementary school in

Merced. The mental health diagnoses were Autism, ADHD, Mental Retardation and Conduct disorder.

Instruments

There were two methods used to collect data. The first method was a questionnaire, and based on the answers to the questionnaire the participants were interviewed to answer further questions. The parents were asked several questions about their child's diagnosis, the treatment that they receive, the family's income, as well as any government funded assistance that the family may be receiving. Based on the answers to the questionnaire the parents were interviewed about their experiences with mental health resources in general. The questions included how satisfied they were with their experience with the mental health sector, if they felt that the school provided efficient and sufficient assistance, how difficult was it to obtain information about receiving supplemental assistance, and utilization of supplemental assistance. The questions pertaining to satisfaction or difficulty were answered using a were able to be rated on a scale was given a scale ranging from one to seven, one being the low option and seven being the high option.

Procedure

The process of collecting data was initiated by giving the parents of the subjects consent forms that explains the research being done. The consent form had to be given to the parents due to the age and status of the subjects. The participants were also debriefed on an individual basis on the purpose of the research and where the results would be used. Both the questionnaire and interview was done at the home of the participants. The questionnaire was given and based on the evaluation of the answers given an interview as administered either on the same day, or scheduled a future appointment.

Results

The results of this study were similar to those done by many other studies pertaining to mental health. The results can be broken down into several categories. The main results based on income and mental health diagnosis, and race and mental health diagnosis. The second sets of results are separated into income and mental health utilization, and race and mental health utilization. The third set of results are based on income and type of mental health care, race and type of mental health care, and income and satisfaction with mental health care, and race and satisfaction with mental health care. Finally the last sets of results are satisfaction with mental health care (treatment) for the whole sample, and utilization of mental health care for the whole sample.

The findings based on income and mental health diagnosis suggested that higher incomes tended to have less severe diagnosis. Based on the data there were seven children with a family income below $20,000 a year. This group made up all of the participants with mental retardation which was a group of eight children (2 African Americans, 3 Caucasians, 1 Hmong, and 2 Latinos). They also had the only prevalence of conduct disorders which was two Latinos, and no prevalence of ADHD or Autism. The next income group was $21,000-$40,000 which made up the largest group of the sample with 13 participants. There were two African Americans with ADHD, two Latinos with ADHD, two Caucasians with ADHD, and one Hmong with ADHD. The next group was made up of four Latinos with Autism, and two Caucasians with Autism. The final group was made up of one Indian with a family income of above 80,000 with a diagnosis of Autism.

The results for income/race and utilization also suggested similar results as other research. The results were as follows based on income; all of the participants with a family

income of $20,000 or less utilized mental health resources. All of their assistance however was funded through the government, or provided by the school. Also 75% of this group admitted to not using the resources consistently or for the entire duration of the treatment programs. The group with an income of $21,000-$40,000 also utilized mental health resources. However about 61% of this group utilized only mental health resources provided by the state or the schools. The other 39 % subsidized their health care with outside sources including private behavior therapy, speech therapy, and personal tutors. Also 30% of this group did not utilized mental health resources consistently and ended services early. The final group with an income above $80,000 did utilize state funded mental health resources, and also provided speech therapy, and private therapy at their own expense. This group also utilized services consistently.

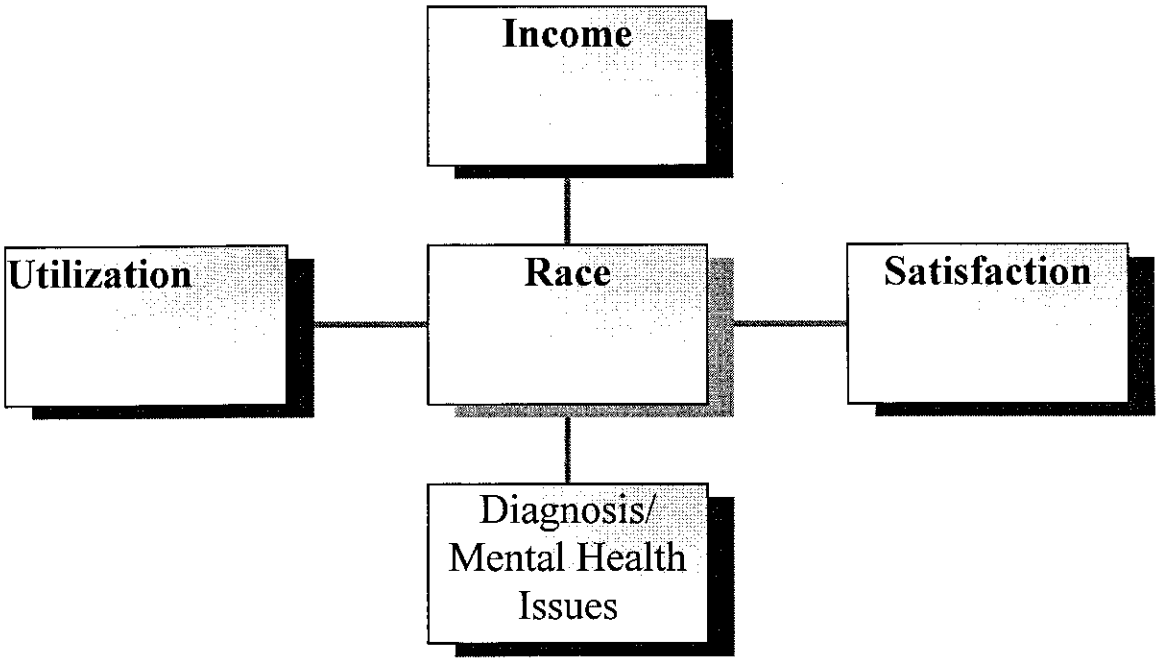
The results based on race and mental health resources are very similar to income and utilization, however there are some specific differences. The data suggested that Latinos (5), African Americans (3) and Hmong (2) were all among the group that ended services early or did not utilized services consistently. Of this group of eleven children only one of them was Caucasian. This group was also exactly 50% of the sample. The second group made up of one African American, three Latinos, six Caucasians, and one Indian all utilized resources on a consistent basis.

The next set of results is based on income/race and type of health care. As stated previously all of the participants have government funded health care (Medi-Cal) which is provided because of their child having a mental health issue. Out of the total number of participants 27% of the whole sample provided outside mental health assistance for their child other than government funded Medi-Cal. The racial break down of the results was four Caucasians, one Latino, one Indian and one African American that utilized outside mental health

care assistance not covered through Medi-Cal.

The last sets of results are based on income/race and satisfaction with mental health care, and satisfaction with mental health care for the whole sample The results for satisfaction of mental health assistance was based on a seven point scale, seven (greatly satisfied) being the highest possible score and 1 being the lowest (completely unsatisfied). In the income group with family income of $20,000 or less about 62% of the participants rated their satisfaction with mental health services with a score of 4. Two (25%) participants rated their satisfaction with a score of 6. One person (12%) rated their services with a score of 2, and one person (12%) rated their services with a score of 1. In the second group with income of $21,000-40,000 the most common score was a 5 (38%). Three (23%) participants rated their satisfaction with a score of 4. Two participants (15%) rated their satisfaction with a score of 6, and two (15%) participants rated their satisfaction with a score of 1. One (7%) participant rated their satisfaction with a score of 3. The last income group of $80,000 and above, which only consisted of one person, rated their satisfaction with a score of 6. The scores based on race were similar to the scores based on income. The average scores for African Americans were 3.5, Latinos was 3, Caucasians was 4.5, Hmong was 3.5, and Indian was 6.The average score for the whole sample was 4, with no participants rating their satisfaction at a seven.

The last set of data is in relation location. The sample is representative of Merced County, which includes several small cities. Of the 22 participants 18 live in the city of Merced, and four live in the city of Los Banos. Six of the children that reside in Merced live in Northern Merced, 10 live in south Merced, and 2 live in Atwater.



Relationship Chart 1

Chart A

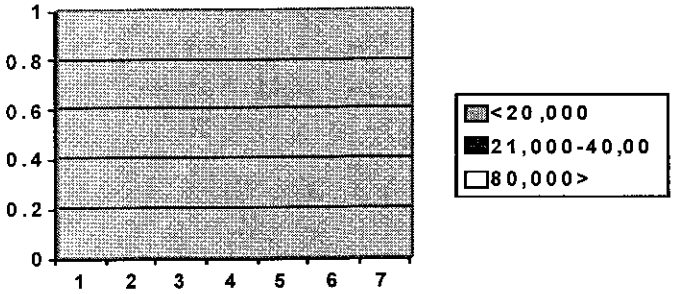


Chart B

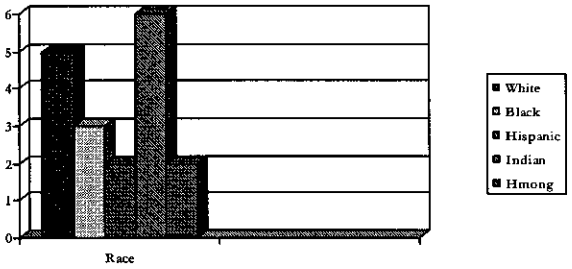
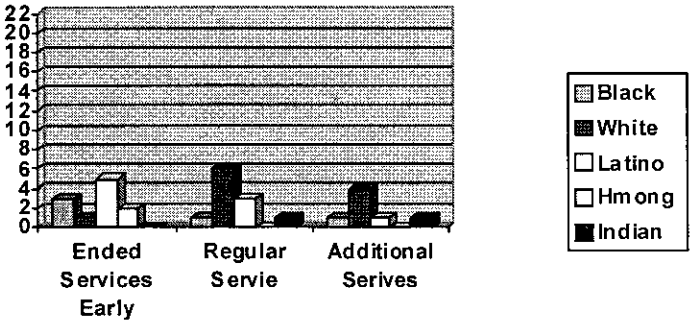


Chart C



Relationship Chart 1 shows the relationship between races, income, Utilization, and mental health diagnosis.

Chart A illustrates treatment satisfaction (scale of 1-7) in relation to income.
Chart B illustrates treatment satisfaction in relation to race.
Chart C illustrates utilization in relation to race.

Discussion

The results of the data suggest several things about the sample. The results are also similar to those of other research studies done on this topic as well. The major focus of the study was to consider race and income in relation to mental health service utilization and satisfaction. Some of the background information suggested that income and race may play a larger role in mental health diagnosis as well as utilization. The research showed that the more severe diagnosis were in low income families. This is a key piece of data because it can be related to other research in that mental health issues can derive from income or race, or income and race can cause mental health issues.

The data will be analyzed in terms of race and income in relation to mental health diagnosis, type of mental health assistance implemented, mental health utilization, and mental health service satisfaction. The first group being looked at will be Hispanics. There was a higher prevalence of mental health issues in Hispanics; however the sample location was a predominantly Hispanic location. Due to the fact that there were more Hispanics in the sample than in any other race, they accounted for each type of diagnosis including mental retardation, ADHD, and Autism. Their utilization in general was similar to other races based on income. However, the results indicated that the lower the income the more likely they were to end services early or not utilize services consistently. The other factor being considered is type of mental health care being provided as well as type of health care utilized. The types of mental health assistance being utilized varied based on the child's diagnosis, however most children had school based therapies, and those from higher income backgrounds enlisted other types of assistance such as behavior therapy. The scores that Hispanics rated their satisfaction was an average of three. This could be due to cultural difference in the type of therapy that their child

was receiving, or a language barrier that limits the parents understanding of the type of results that they expect their child to be having.

There can be many other factors considered as to why resources are not properly utilized, such as stressful living environment, education or knowledge of treatments, and transportation. Another factor that goes along with the research is that higher income tended to be more involved with the treatment of their child. The higher income also tended to seek out alternatives other than school based therapies. This was universal across race for the middle/upper income group.

The next group being considered is Caucasians (whites). This group in relation to income was very similar to that of Hispanics. For lower income families, utilization was not consistent and was more likely to be ended early. Caucasians had the second highest rating of mental health services at a 4.5. Within the middle income bracket Caucasians were just as likely as Hispanics and African Americans to provide supplemental therapies or assistance. And as with the other groups, the rate of utilization depended on the income of the family, not just the race.

The last three groups being considered had the smallest amounts of subjects in the sample. African American and Hmong had similar results as those of Hispanic origin across the board. The only differences were is that Hmong and African American's rated their satisfaction with mental health services slightly higher with both African Americans and Hmong rating their satisfaction at a 3.5. The smallest group was that of one Indian. This subject had the highest income, and had the highest mental health resources satisfaction as well with a score of 6. This can be for many reasons, the main one being that this particular subject paid for most of their therapies aside from government funded services. This may mean that the subject was receiving higher quality services, and therefore more satisfied with them.

The racial and income differences within all of the groups were the defining factor between satisfaction and utilization. These findings align with other research studies that look at similar aspects of the mental health sector. Although race and income play a major role, the general usage and satisfaction amongst children is considerably lower than the usage of adults. The racial differences may be related to the racial difference in the sense that minorities tend to be from lower incomes.

Significance of the Study

The results of this study are very similar to those of other studies that are researching these topics. There are several significant aspects of this research. One of the main aspects of importance is general mental health utilization for children. Despite racial differences in the results, satisfaction and utilization rates were not significantly high, no matter the severity of the diagnosis. This is an important factor because the use of mental health resources for children should be utilized to the fullest capacity in order to limit mental health issue prevalence in adults.

Another important factor in the research is the cultural and racial issues of the study. The racial element of the study can answer sociological questions pertaining to minorities and their mental health issues. The racial element also connects to the income elements of the study. The main focus of the study was to determine the utilization of mental health resources in relation to income and race, and the findings suggest that satisfaction of mental health resources relies on a person's race or income.

There findings of the research indicate that race and income play a major role in mental health resources utilization and satisfaction. These findings are beneficial in that they give a contribution to psychological and sociological research based in small town location. This is important because results based in small town settings can provide for different results due to

environmental differences. The location of the study can also play a major role in mental health resources because location can affect the prevalence and occurrence of certain mental health issues, especially in children. This contribution of this research can also help the Merced County and Central Valley of California provide better mental health services.

Implications

This particular study has a great amount of potential in that it can help the Central Valley provide better mental health services. The study however, was done on a small scale, and therefore the results can not be considered significant. If the research could be done with a larger population with equal racial and income distribution, the results will be more representative of the general population. Along with the size of the study are the independent variables that can not be controlled such as parent accuracy in answering the questionnaire as well as other factors that might limit utilization or satisfaction of mental health services. The last issue with this study is that utilization and satisfaction is a subjective judgment ideas. People with children are likely to not be satisfied with mental health resources if they do not see major results, however when working with children with mental health issues such as ADHD and Autism results are generally slow coming. With this being said, most parents are not satisfied with the results of their child's types of therapies, and thus tend to not utilize the resources consistently because they do not believe it is affective.

The future of this research can be done on a wide scale basis and can help both the government and private providers provide more efficient and cost affective assistance. Merced County's mental health services department can utilize the results to implement better service both for in school and in home based treatments. The research can also be done through the

University of California, Merced, which is a research University. The study can be beneficial for both the County of Merced and The University in that important research would be being done to help the area.

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VIII. Appendices

-*Appendix 1*

Minor in Spanish Program Learning Outcome: Writing

COMPOSITION RUBRIC			
CONTENT	20–17	Excellent—Very Good	has fully anticipated reader questions in selecting information; topic well-thought-out and carefully developed with effective supporting detail; interesting to read
	16–12	Good—Adequate	has anticipated most reader questions in selecting information; topic may not be fully explored; development is adequate although some ideas may be incompletely supported or irrelevant; interesting ideas in places
	11–7	Fair—Poor	has anticipated few reader needs in selecting information; topic explored only superficially and inadequately developed with many ideas unsupported or irrelevant
	6-0	Needs a lot of work	shows no awareness of reader needs; ideas superficial and/or uninteresting with little development; OR not enough to evaluate
ORGANIZATION	20–17	Excellent—Very Good	has fully anticipated reader needs in organizing and presenting information; clear thesis; flow of ideas fluid and logical; a pleasure to read
	16–13	Good—Adequate	has anticipated most reader needs in organizing and presenting information; main ideas stand out, but sequencing of ideas sometimes choppy or disconnected; reader may sometimes have difficulty following flow of ideas
	12–9	Fair—Poor	has anticipated few reader needs in organizing and presenting information; ideas frequently confused and/or disconnected, with logical breakdowns apparent; reader frequently has difficulty “getting the point” of message as communicated
	8–0	Needs a lot of work	shows no awareness of reader needs; logical organization absent; OR not enough to evaluate
GRAMMAR	20–17	Excellent—Very Good	wide range of structures with few or no significant errors (e.g., sentence structure)
	16-13	Good—Adequate	adequate range of structures, but little variety; tends to overuse simple constructions; both significant and minor errors (e.g., agreement) present, but meaning seldom obscured
	12-9	Fair—Poor	limited range of structures with control of grammar uncertain; errors frequent, especially when more complex constructions attempted; meaning often confused or obscured
	8–0	Needs a lot of work	frequent and persistent errors of basic grammar and sentence construction; meaning blocked as text dominated by errors; OR, not enough to evaluate
VOCABULARY	20–17	Excellent—Very Good	language choices appropriate for topic, purpose and reader; excellent use of idioms and precise, colorful vocabulary; little or no evidence of English interference
	16–13	Good—Adequate	language choices usually appropriate for topic, purpose and reader; vocabulary accurate but may be somewhat limited; some errors or interference may be present but meaning rarely obscured

	12–9	Fair—Poor	language choices sometimes inappropriate for topic, purpose and reader; vocabulary very limited, with overuse of imprecise or vague terms; English interference evident, particularly with respect to idioms; meaning often confused or obscured
	8–0	Needs a lot of work	language choices often inappropriate for topic, purpose and reader; range of vocabulary extremely limited; English interference frequent; OR not enough to evaluate
CONVENTIONS	20-17	Excellent—Very Good	very few or no faults with respect to spelling / accentuation, punctuation, or presentation (handwriting or typing)
	16-13	Good—Adequate	occasional faults in spelling / accentuation, punctuation, or presentation (handwriting or typing)
	12-9	Fair—Poor	frequent errors in spelling / accentuation or punctuation; messy presentation that is sometimes illegible
	8-0	Needs a lot of work	persistent errors in spelling / accentuation and punctuation; handwriting often illegible; OR not enough to evaluate
TOTAL	/100	Comments:	

-Appendix 2

Program Learning outcome 2008-2009: Writing

Direct Evidence: Portfolio (DE)
Indirect Evidence: Reflective Essay (IE)

SPAN 110

1. Student 1: SPAN 110 Spring 2009

- Portfolio: Student included all the material requested by the instructor.

- *DE- Portfolio Compositions:*

Content: Student has improved in each of the research assignments. It is evident that she has been working in this aspect of her writing throughout the semester. She did an excellent job in incorporating the instructor's comments in her corrected essays. By the last essay, she displayed an outstanding piece of work in regard to the content of her essay.

Organization, Grammar, Vocabulary and Spelling: It seems that student did not have serious problems organizing her essays and kept the quality of her work in this aspect throughout the semester. Likewise, she did not show any serious grammar or vocabulary problems in her writing and demonstrated a high level of Spanish. Her spelling problems are limited to accent marks. While they are still present by the end of the semester, they are limited to a fewer number of cases.

- *IE- Portfolio self reflection on the Spanish Minor:*

Student 3
Excellent.

Porfolio

Español 110

Introducción a la lingüística española

6 de mayo de 2009

COMPOSITION RUBRIC			
CONTENT	20–17	Excellent—Very Good	has fully anticipated reader questions in selecting information; topic well-thought-out and carefully developed with effective supporting detail; interesting to read
	16–12	Good—Adequate	has anticipated most reader questions in selecting information; topic may not be fully explored; development is adequate although some ideas may be incompletely supported or irrelevant; interesting ideas in places
	11–7	Fair—Poor	has anticipated few reader needs in selecting information; topic explored only superficially and inadequately developed with many ideas unsupported or irrelevant
	6-0	Needs a lot of work	shows no awareness of reader needs; ideas superficial and/or uninteresting with little development; OR not enough to evaluate
ORGANIZATION	20–17	Excellent—Very Good	has fully anticipated reader needs in organizing and presenting information; clear thesis; flow of ideas fluid and logical; a pleasure to read
	16–13	Good—Adequate	has anticipated most reader needs in organizing and presenting information; main ideas stand out, but sequencing of ideas sometimes choppy or disconnected; reader may sometimes have difficulty following flow of ideas
	12–9	Fair—Poor	has anticipated few reader needs in organizing and presenting information; ideas frequently confused and/or disconnected, with logical breakdowns apparent; reader frequently has difficulty "getting the point" of message as communicated
	8–0	Needs a lot of work	shows no awareness of reader needs; logical organization absent; OR not enough to evaluate
GRAMMAR	20–17	Excellent—Very Good	wide range of structures with few or no significant errors (e.g., sentence structure)
	16-13	Good—Adequate	adequate range of structures, but little variety; tends to overuse simple constructions; both significant and minor errors (e.g., agreement) present, but meaning seldom obscured
	12-9	Fair—Poor	limited range of structures with control of grammar uncertain; errors frequent, especially when more complex constructions attempted; meaning often confused or obscured
	8–0	Needs a lot of work	frequent and persistent errors of basic grammar and sentence construction; meaning blocked as text dominated by errors; OR, not enough to evaluate
VOCABULARY	20–17	Excellent—Very Good	language choices appropriate for topic, purpose and reader; excellent use of idioms and precise, colorful vocabulary; little or no evidence of English interference
	16–13	Good—Adequate	language choices usually appropriate for topic, purpose and reader; vocabulary accurate but may be somewhat limited; some errors or interference may be present but meaning rarely obscured
	12–9	Fair—Poor	language choices sometimes inappropriate for topic, purpose and reader; vocabulary very limited, with overuse of imprecise or vague terms; English interference evident, particularly with respect to idioms; meaning often confused or obscured
	8–0	Needs a lot of work	language choices often inappropriate for topic, purpose and reader; range of vocabulary extremely limited; English interference frequent; OR not enough to evaluate
CONVENTIONS	20-17	Excellent—Very Good	very few or no faults with respect to spelling / accentuation, punctuation, or presentation (handwriting or typing)

	16-13	Good—Adequate	occasional faults in spelling / accentuation, punctuation, or presentation (handwriting or typing)
	12-9	Fair—Poor	frequent errors in spelling / accentuation or punctuation; messy presentation that is sometimes illegible
	8-0	Needs a lot of work	persistent errors in spelling / accentuation and punctuation; handwriting often illegible; OR not enough to evaluate
TOTAL	/100	Comments:	

Tareas

Lenguaje, lengua y lingüística

Actividad 2.1 (página 25)

Durante todo un día, haga un registro de los usos del lenguaje que encuentre o en que participe. ¿Cuales fueron las primeras manifestaciones del lenguaje oral con las que tuvo contacto desde que despertó? ¿Y las manifestaciones escritas? ¿En qué idiomas se dieron?

El domingo, 1 de febrero de 2009

Los enunciados

1. Al despertarme a las 10:00 de la mañana – Revisé mi teléfono móvil porque recibí un mensaje de texto que decía: "¡Hola Caro!" -Josh [Alegría]

2. 10:05 – Le respondí: ¡Hola, buenos días! – [Alegría]

3. 12:00 de la tarde—Fui a la cocina me encontré con mi compañero de casa:
Yo: "¡Buenos días!, ¿Cuáles son tus planes de hoy? [Alegría]
Daniel: "Tarea, tarea y más tarea, ¿tú crees?" [Indignación]
Yo: "Lo siento, yo también tengo que hacer la mía, ya somos dos" [Solidaridad]

4. 1:00 de la tarde—Mi compañera y yo tuvimos una conversación:
Yo: ¿A dónde vas?
Maricela: "Voy a la universidad, tengo que asistir a una junta"
Yo: "¡No me digas!, ¿en domingo? [Sorpresa] a el domingo
Maricela: Sí, ¿tú crees?, no es justo, pero qué le voy hacer" [Indignación]
Yo: "Oye ¿es tu perro el que está chillando? ¿Lo vas a dejar solo?" [Duda]
Maricela: "Pues sí, no creo que tarde" [Acuerdo]
Yo: "Si quieres lo saco a pasear, aprovecho y hago ejercicio"
Maricela: "Estupendo, muchas gracias, así no lo tengo que dejar solo" [Gratitud]

5. 3:00 de la tarde—Maricela me invito a salir:
Maricela: "¿Caro, quieres ir a tomar algo al centro?"
Yo: "¿Crees que sea buena idea después de lo que paso con tu novio?" [Duda]
Maricela: "Bueno, a lo que me refería era que si querías acompañarnos, a mi novio y a mí, a tomar algo. [Clarificación]
Yo: "Ah, ándale pues, vamos" [Acuerdo]

6. 7:00 de la noche—Me llamo Ricardo por teléfono:
Ricardo: ¡Hola Caro!, ¿cómo estás? [Alegría]
Yo: ¡Muy bien Ricardo!, y ¿tú qué tal?, ¡No puedo creer que me hayas llamado! [Alegría, sorpresa]

Ricardo: ¡Yo me encuentro genial!, pero te llamo para agradecerte que me hayas mandado una carta, la recibí hace unos días, ¡muchas gracias! [Alegría, gratitud]
Yo: Ni hablar, no tienes que agradecerme nada, por eso somos amigos. [Desacuerdo]
Ricardo: ¡Por eso te quiero mucho, eres bien a todo dar! [Admiración]

Manifestaciones escritas

1. Terminé la tarea para mi clase de español (en español)
2. Le mandé un mensaje de texto a mi amiga para pedirle un favor (en inglés)
3. Escribí notas sobre mi lectura para mi clase de literatura (en español)
4. Le mandé un mensaje electrónico a mi novio (en español)
5. Escribí un número telefónico de un compañero de la universidad (en español)

Conclusión

Evidentemente, durante el domingo, 1 de febrero de 2009 hablé más que escribir, el lenguaje oral tomó gran parte de mi día, en cambio el lenguaje escrito sólo tomó una porción pequeña de mi día entero. Por la mayor parte del tiempo utilicé más el español. Cuando me comuniqué con mis compañeros con los que vivo, suelo usar el español más que el inglés, pero en ocasiones, [tengo que admitir] usamos ambos. Maricela, fue con la que hablé casi todo el día, dado a que vivo con ella y pasamos mucho tiempo juntas. Sin embargo, cuando se trata del lenguaje escrito, utilizo mucho el español porque la mayoría de mis clases son en español y mi tarea consiste en el uso del lenguaje castellano.

Actividad 2.14 (página 41)

Elija situaciones que contrasten en grado de formalidad (una conversión con sus amigos en una pizzería, una entrevista para conseguir un trabajo, una conversación en la oficina de un profesor) y analice la manera de hablar de los participantes. ¿Qué clases de palabras se usan o no se usan? ¿Hay diferencias en la pronunciación? ¿En el tono de la voz? ¿En la manera como cada interlocutor espera su turno? ¿O es que se interrumpen mutuamente?

La conversación que se me viene a la mente ocurrió hace dos días en la cafetería de la universidad. Fue entre Amelia, mi compañera de la universidad, y yo. La conversación fue algo breve pero hubo mucha interacción. Amelia comenzó a nombrar varios títulos de películas, cuales ella desea ver para la próxima semana, de hecho no utilizo pausas ni mucho menos comas. Cuando nombro los títulos no los dijo completos, de modo que no pude captar cada una de ellas,

pero supuse que cada una era una de esas películas que a ella le gustaban. Yo, para no interrumpir, sólo movía mi cabeza de arriba hacia abajo indicando que sabía lo que ella me estaba diciendo. Cuando Amelia y yo charlamos, solemos mezclar el inglés con el español, así que nuestra forma de pronunciar en cada lenguaje es diferente. Por ejemplo, cuando ella nombraba los títulos de las películas, cuales eran casi todas en inglés, su pronunciación era muy clara y eficaz, en cambio yo traté de repetir los títulos pero no fue igual. ¿Quizás fue porque yo tengo un acento al hablar el inglés?, o ¿quizás ella tiene un acento? De hecho ella tiene la costumbre de usar palabras más cortas, me refiero a que corta las palabras para no decirlas completamente, pero comunicando todo lo que ella quiere decir. Incluso, entre nosotras hemos creado palabras que no existen pero que entre nosotras entendemos. Como por ejemplo: "shibanga", "shetos", "tololol", entre otras. Durante nuestra charla ambas tomamos turnos, si ella empieza yo escucho, cuando ella termina, entonces yo respondo, y así es por el resto de la plática. Eso si, nuestro tono era un poco humorístico y de vez en cuando solíamos llegar a ser más serias.

¡Interesa

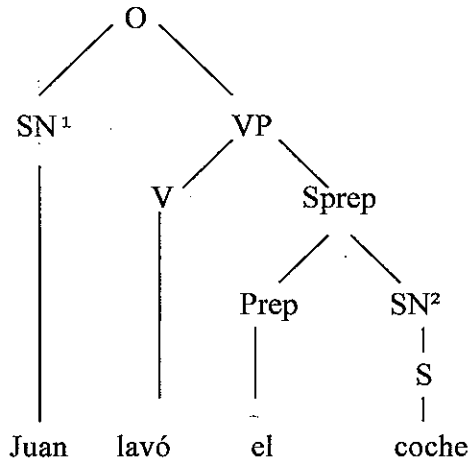
100% Excelente

Lunes, 16 de marzo de 2009

Tarea 7

Act. 7.1 – página 179

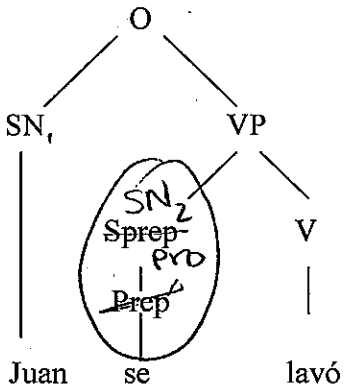
(a)

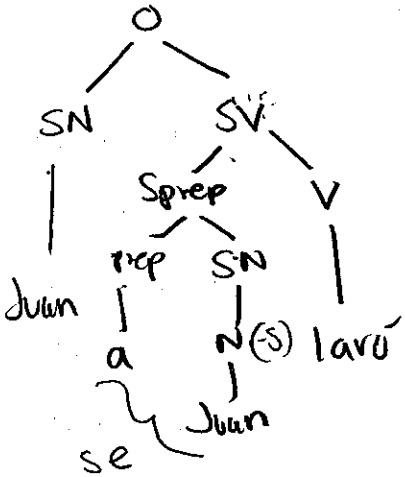


100% Bien

(no hay reflexividad: SN¹ ≠ SN²)

(b)

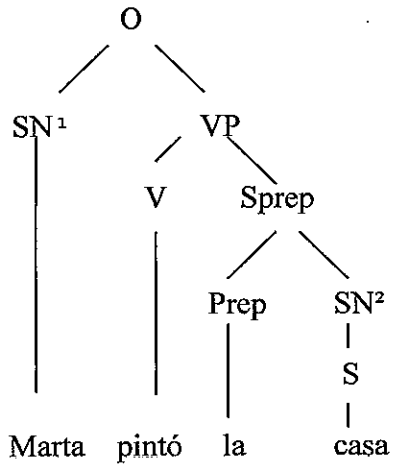




(Hay reflexividad: SN¹ = SN²)

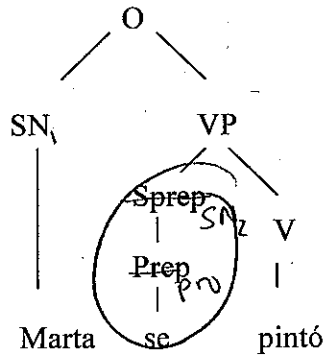
Para b y d, ve el diagrama 7.2

(c)



(No hay reflexividad: SN¹ ≠ SN²)

(d)



(Hay reflexividad: SN¹ = SN²)

Act. 7.3 – página 181

(a) ¿El diccionario? Se lo he prestado a Juan ~~[reflexivo intrínseco]~~. OI

(b) Se comieron las setas y se envenenaron ~~[OD reciproco]~~? OI reflexivo

(c) Juan se quejaba del ruido del piso de arriba [OD ~~reflexivo~~]. no reflexivo

(d) Paco y Marta se quieren mucho [OD reciproco].

(e) Jaimito se comió tres bocadillos y dos tortillas en cinco minutos [reflexivo intrínseco]. OD

(f) Si usted quiere, puedo traérselo por la tarde [OI no reflexivo].

(g) Panchito se cortó al afeitarse.[OI Reflexivo]

Act. 7.9 (p. 193) –Analice la función sintáctica del pronombre relativo que o quien.

(a) El policía que te telefoneó es amigo de mi padre.
que te = ~~objeto indirecto~~ de "telefoneó"
sujeto

(b) El chico con quien salía Martita era catalán.
quien = objeto ~~directo de~~ "el chico"
de prep.

(c) Dame el postre que está en la nevera.
que = ~~sujeto de~~ "el postre"
OD

(d) Ha vuelto a visitarnos el pordiosero a quien mi madre regaló la chamarra.
quien = objeto indirecto de "el pordiosero"

(e) Quiero hablar con la secretaria que me presentaste ayer.
que = objeto de preposición ~~de~~ "hablar con la secretaria" OD
Prep

Act. 7.11 (p. 196) —Analice y clasifique las oraciones subordinadas adverbiales.

(a) Corregiremos las pruebas [SubAdv **mientras** vemos la televisión.] tiempo tipo?

(b) Hago mi trabajo [SubAdv **como** puedo.] ?

(c) Vive en la calle y duerme [SubAdv **donde** le dejan.] ?

(d) Leeremos esos libros [SubAdv **si** tenemos tiempo.] ?

(e) Pensamos visitarte el domingo [SubAdv **aunque** llueva.] ?

100% Bien

Contesten las preguntas G, H y hagan la letra J (Práctica – páginas 280-281)

G. ¿Qué procesos fonológicos afectan el contraste /r/: /l/ en el español caribeño?

La neutralización del contraste entre los fonemas /r/ y /l/ en posición implosiva provoca los procesos fonológicos de lambdacismo y rotacismo, resultando en pronunciaciones como puerto [pu̯el̩-to] por [pu̯e-rto] o calma [kar-ma] por [kal-ma].

H. ¿Cuales son algunas de las realizaciones fonéticas del fonema /r/ en el español hispanoamericano?

En latín existía el fonema vibrante simple /r/, representado R. Como otras consonantes, esta /r/ podía prolongarse, articulándose fonéticamente como una vibrante larga [r:] o [rr]. La vibrante larga, representada en la escritura como RR, fue el donde comenzó, en castellano medieval, del fonema /r/. En este caso el fonema original /r/ se dividió en dos, a saber, /r/ y /r/.

J. Parece ser que las palabras que lo confunden son léxicas, ya que en cada parte de México el pan lo llaman distinto. Es difícil para él saber la distinción entre uno y el otro. Los *cojinillos* parecen ser los que causan mas confusión y si alguien quien es de fuera no seria fácil distinguir. **Luego luego** se podría decir **rápido** o **ahorita** para indicar que lo que esta exigiendo lo desea tener al instante.

96%

Contesten las preguntas 1 y 3 (Práctica – página 312)

1.) ¿Qué es una comunidad de habla y qué influencia tiene sobre sus miembros?

Una comunidad de habla es donde por lo natural se usan expresiones en varios dialectos sociales, o sociolectos, por parte de la participación en una red de subcomunidades. La influencia que tiene sobre sus miembros se debe al menos variación y así estar en una red social densa. Por lo cual fuerza a tener el mismo comportamiento lingüístico del grupo. Por consecuencia los miembros de esa región no tienen las variedades lingüísticas que los que viven en una ciudad grande lo tienen.

Letra E

3.) ¿Qué es el lunfardo? ¿Cómo se caracteriza?

El lunfardo es un tipo de habla que origino en la cuidad de Buenos Aires y sus alrededores. Usualmente se usaba por la de clase baja. Este habla fue usado mucho antes de que el español fuera introducido y así mismo se fue difundiendo al paso de que el español empezó a ser la lengua popular en Argentina y el Uruguay. Se caracteriza como un habla utilizada por delincuentes urbanos.

100% Bien

Proyectos de Investigación

~~Lunes,~~ 27 de abril de 2009

Aspectos lingüísticos:
Periódicos en español en los Estados Unidos

Las comunidades inmigrantes de nuevas generaciones usualmente adoptan el inglés para poder comunicarse con los angloparlantes y también con otros miembros de la comunidad. De hecho esto ha causado la desaparición de los idiomas que los inmigrantes han llegado a incorporar dentro de la lingüística de los Estados Unidos (Milton, 359). Sin embargo, la población de inmigrantes ha crecido cada año y su influencia dentro de los Estados Unidos es inevitable. La prensa de habla hispana en los Estados Unidos ha logrado llegar a ser un gran componente para las comunidades inmigrantes. Periódicos como La Opinión (Los Ángeles, California), El Diario La Prensa (Nueva York), La Frontera (Texas), El Observador (San José, California), entre otros, han logrado mantenerse como base informativa ya que sus noticias son completamente en español o bilingües (inglés y español).

El periódico La Opinión, por ejemplo, es uno de los periódicos más reconocidos en el estado de California, especialmente en el área sur de California. Su versión electrónica ~~consiste~~ de artículos sobre noticias, negocios, deportes, entretenimiento, inmigración, el medio ambiente, vida y estilo, viajes y otros temas que ~~enteran~~ al público sobre el mundo entero. No obstante, su enfoque es siempre el de los hispanohablantes que viven en California y Latinoamérica. El aspecto lingüístico se puede encontrar en el periódico La Opinión es ~~aquella~~ de formalidad, ~~y~~ brevedad y claridad. Varios de los artículos que se publican en La Opinión contienen un español

bastante clarificativo, un español que la comunidad hispanohablante en California utiliza y que puede ser entendido por un amplio público. Es raro encontrar palabras relacionadas con el inglés en los artículos, lo que contribuye a la claridad y efectividad que el periódico intenta administrar a través de su información.

El Observador al igual que La Opinión se encuentra en el estado de California. Sin embargo, la audiencia para El Observador es mucho más amplia, ya que su periódico es bilingüe. La estructura de su periódico consiste de tener en primera plana información sobre la comunidad de habla hispana. Su enfoque es poder llevar la noticia en una forma creativa, ya que su manera en informar es bilingüe y en una combinación de ambas. Es decir, por ejemplo, en su versión electrónica el leyente puede encontrar frases como "Quinceañera Contest", es evidente que dentro de una comunidad donde se habla el inglés y el español, se sabe lo que la palabra "quinceañera" significa, logrando tener ambos idiomas y un mensaje claro. Además, fue interesante leer los artículos que aparecen completamente en español, pero sus encabezados son bilingües.

En La Frontera, periódico de Texas, se puede encontrar la variedad escritores con nombres que nunca hubieras pensado que fuese habla hispano. No obstante, este aspecto no es tan importante como el hecho de la gramática y contexto de los artículos. Es importante no asumir que porque uno tiene un nombre que aparenta una cultura tiene que ser necesariamente una conexión con el idioma. De nuevo, dentro del periódico fue raro encontrar alguna palabra en inglés sin ser traducida o equivocadamente utilizada. El español utilizado es bastante claro y me pareció adecuado para el tipo de audiencia que tienen.

En conclusión, es evidente que la prensa es muy importante dentro de las comunidades de habla hispana. Además, no sólo brindan el hecho del idioma pero la oportunidad de llevar la

noticia a todos aquellos que no cuentan con ~~lo~~ ser bilingües y sólo hablan español. Sin duda, hay que tener en cuenta que hacen su trabajo muy bien y que retienen un español correspondiente.

C 19/20 → casi no llegaste al mínimo de 40 líneas
falta un conector

Org 20/20

G 20/20

V 19/20 (vocabulario incorrecto, repetición)

Ort 19.5/20 (faltan acentos

97.5%

muy bien, Carolina

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el sello

Variaciones morfológicas

Menos espacio entre el título y el inicio del ensayo.

Después de haber hecho una encuesta entre algunos hispanohablantes originarios de distintos países en la Universidad de California, Merced fui capaz de notar semejanzas y diferencias entre cada individuo. Al principio fue difícil encontrar personas que fueran de distintos países donde hablar (ambos) ~~al~~ español, ok ya que en California es muy común el origen mexicano. No obstante, con la ayuda de algunos profesores, compañeros y trabajadores de la universidad pude realizar la encuesta con buenos resultados.

Falta un conector

Mi encuesta fue muy sencilla ya que con el sólo hablar con cada entrevistado/a en español me di cuenta si usaban el *vos*/tú o usted. En la primera encuesta entreviste a un estudiante originario de El Salvador, Al comenzar me di cuenta de que al hablarme usó el tú; cual me resultó confuso, porque yo creía que en El Salvador se usaban el *vos* en vez del tú. Sin embargo, durante la charla el estudiante me dejó saber que después de haber llegado a California se dio cuenta de que otros hispanohablantes se burlaban de la manera en que usaba el *vos* y es por eso que lo dejó de usar. Además, agregó que cuando está con su familia y amigos de El Salvador sigue utilizando el *vos*. Durante la segunda entrevista, con un profesor originario de Argentina me pude dar cuenta que al igual había dejado de usar el *vos*, ya que su permanencia dentro de los Estados Unidos ha sido la de un largo tiempo. Pero, insinuó que los argentinos

Interesante

la 1ª persona singular y la 3ª persona singular del pretérito (pasado simple) → verbos regulares rigen el uso del acento en la última sílaba

entrevisté usó resultó insinuó dejó agregó

suelen usar el *vos* cuando se encuentran en una charla informal, y que el usted lo usan en circunstancias con formalidad, pero que no siempre es el caso. En cambio, las personas que entreviste de origen mexicano usaban el tú frecuentemente y sólo utilizaban el usted para referirse a una persona adulta. De hecho, sus respuestas me llevaron a la conclusión de que en México el *vos* no se utiliza y que el tú y el usted se usan dependiendo en distintas circunstancias. Como por ejemplo, el hecho de que yo soy de la misma edad que mis compañeros entonces al conversar lo común es usar el tú, pero al hablar con los profesores se suele usar el usted. Todo depende de con quien se esté hablando y si es una conversación formal o informal. También tuve la oportunidad de entrevistar a profesores originarios de España. De efecto, su manera de hablar es distinta a la de otras personas originarias de países en Latinoamérica al igual que el Caribe. Su forma de hablar constituye en usar el vosotros y aunque el vosotros no es lo mismo que el *vos*, uno puede darse cuenta que no usan el tú o el usted para referirse a una persona. Asimismo, suelen usar el vosotros cuando se encuentran en una circunstancia informal y formal. Después de haber adquirido todas las respuestas de la encuesta, me di cuenta de que no todos los hispanohablantes usan la misma forma de tú/usted/*vos*. De hecho, me permitió aprender sobre la diversidad que existe en el idioma español. Sin embargo, me hubiera gustado poder haber entrevistado a más personas con origen de otros países del Cono Sur o de Centro América, para así poder comparar un poco el uso del *vos*. Definitivamente después de haber hecho este trabajo puedo apreciar las distintas formas en que los hispanohablantes dentro y fuera de la Universidad de California, Merced usan para comunicarse y así poder aún retener sus raíces.

Carolina, Trata de escribir oraciones más cortas y más breves para que se lea con más facilidad

¿Sólo se usa en España (o informal)?

Comenzaste tu introducción así (repetitivo)

Falta un conector

aún = todavía

aun → aunque

36 líneas enteras

C 13/20 (falta una bibliografía y faltan conectores)

Org 20/20

G 20/20 (algunos problemas de gramática)

V 20/20 (repetitivo)

Ort 18.5/20 (faltan acentos)

90.5 %

Bien

Carolina,
El mínimo consta de 40 líneas. Tengo que quitarte 1 punto por cada línea que falta. La próxima vez quitar 2. ¡Anímate! Sé que sabes escribir muy bien y tu ensayo

Variaciones morfológicas

Después de haber hecho una encuesta entre algunos hispanohablantes originarios de distintos países en la Universidad de California, Merced fui capaz de notar semejanzas y diferencias entre cada individuo. Al principio fue difícil encontrar personas que fueran de distintos países donde hablan el español, ya que en California es muy común el origen mexicano. No obstante, con la ayuda de algunos profesores, compañeros y trabajadores de la universidad pude realizar la encuesta con buenos resultados.

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"Uso del tú, vos o usted." Entrevista personal. 12 Abril. 2009.

"Las siglas: formación y uso"

? (Tamaño) Fort 12 Times N Roman

De acuerdo a las Real Academia Española la "sigla" es una palabra "formada por las iniciales de los términos que integran una denominación compleja", es decir, el conjunto de letras iniciales de un nombre largo (RAE, siglas). También se denomina sigla a cada una de las letras que forman la mencionada palabra. Las siglas pueden ser utilizadas cuando uno quiere referirse de forma abreviada a organismos, instituciones, empresas, objetos, sistemas, asociaciones, entre otros.

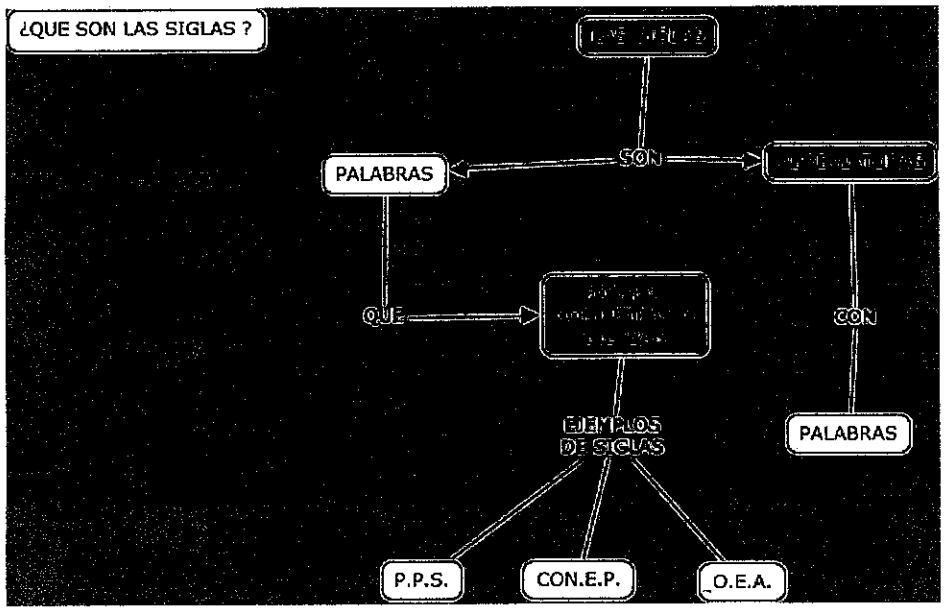
Después de haber entrado a un sitio de Internet donde pude identificar un texto en español que contaba con el uso de siglas, pude darme cuenta (de) que varias eran extrañas y nuevas para mi conocimiento. Hay siglas en las que se pueden escribir puntos entre cada letra, sin embargo, lo más común es omitirlos a menos que se quiera enfatizar su carácter de sigla. Por ejemplo: M.E.Ch.A. (Movimiento Estudiantil Chicano de Aztlán), sigla que si utiliza los puntos entre cada letra y así puede resaltar su representación en cada una de las letras. No obstante, hay que tener cuidado con el uso de las siglas que tienen puntos entre cada letra y las abreviaturas. Las abreviaturas "constan de más de un elemento y debe colocarse un punto después de cada uno de ellos", y un espacio en blanco entre ellos. En cambio "las siglas suelen escribirse sin punto entre ellas, y solo en el caso de ir integradas en textos escritos enteramente en mayúsculas, por ejemplo, MEMORIA ANUAL DEL C.S.I.C., se utiliza sin dejar espacio entre cada punto" (Marín Candón, siglas y acrónimos).

Otra manera en que las siglas pueden ser vistas y utilizas es conforme a su pronunciación habitual. Es decir, cuando la sigla se articula habitualmente como suena, se le denomina acrónimo y se suele escribir en minúsculas. Por eso, las siglas FM (Frecuencia modulada), SIDA (Síndrome de inmuno-deficiencia adquirida), NIC (Normas Internacionales de Contabilidad), RENFE (Red Nacional de Ferrocarriles Españoles), ONU (Organización de las Naciones Unidas) son pronunciadas constantemente simplemente como suenan. De hecho, cuando las palabras son pronunciadas y denominas como un acrónimo se suele escribir en minúsculas. Por ejemplo: las siglas, AVE—ave (Alta Velocidad Española), UCI—uci (Unidad de Cuidados Intensivos), VIP—vip (Persona muy importante (Very Important Person), cuyas se usan frecuentemente en minúscula pero tienen el mismo significado, y así se denomina en un acrónimo.

Dentro del significado de la sigla también se suele ver el doblar de las letras, eso significa que cuando las palabras son las iniciales de varias palabras en plural se doblan las letras para manifestarse de forma plural. Por ejemplo: Estados Unidos (EE.UU.), Comisiones Obreras (CC.OO.), Sus Majestades (SS.MM.) Ferrocarriles del Estado (FF.CC. del E.). En este caso se pueden usar los espacios en vez de puntos: EE UU. Este tipo de siglas no se deletrean sino que se leen igual que el nombre completo. Otra incorrección común es escribir puntos entre cada letra: Recursos humanos (R.R.H.H., RR.HH.)

Como he dicho antes, las siglas pueden tener distintas funciones; sin embargo su definición sigue siendo la misma. Las siglas suelen ser aquellas iniciales que se unen para formar una denominación compleja. Es así como hoy en día seguimos usando las siglas, facilitando el significado y la pronunciación de varias instituciones, organizaciones, sistemas, entre otras para nuestra vida cotidiana.

*Un diagrama que encontré y me ayudó bastante al comprender la definición y la formación de las siglas.



Fuentes:

1. Juan Antonio Marín Candón. "Siglas y acrónimos." Morón de la Frontera. 2006. Sevilla. http://www.reglasdeortografia.com/siglasyacronimos.html

2. Real Academia Española. "Las siglas". http://buscon.rae.es/dpdI/SrvltConsulta?lema=sigla

3. IHMC-A University Affiliated Research institute. "diagrama de formación: siglas" http://elcoco.conectate.gob.pa/servlet/SBReadResourceServlet?rid=1216740867140_722027965_73&partName=htmltext

4. Spot Image. "Glosario, Las siglas". 2008. http://www.spotimage.fr/web/es/314-glosario-las-siglas.php

C 20/20
Org 20/20
G 20/20
V 20/20
Ort 19.5/20 (falta un acento)
99.5 Excelente

Carolina,
¡Muy interesante y bien escrito! Prof. Torres

"Las siglas: formación y uso"

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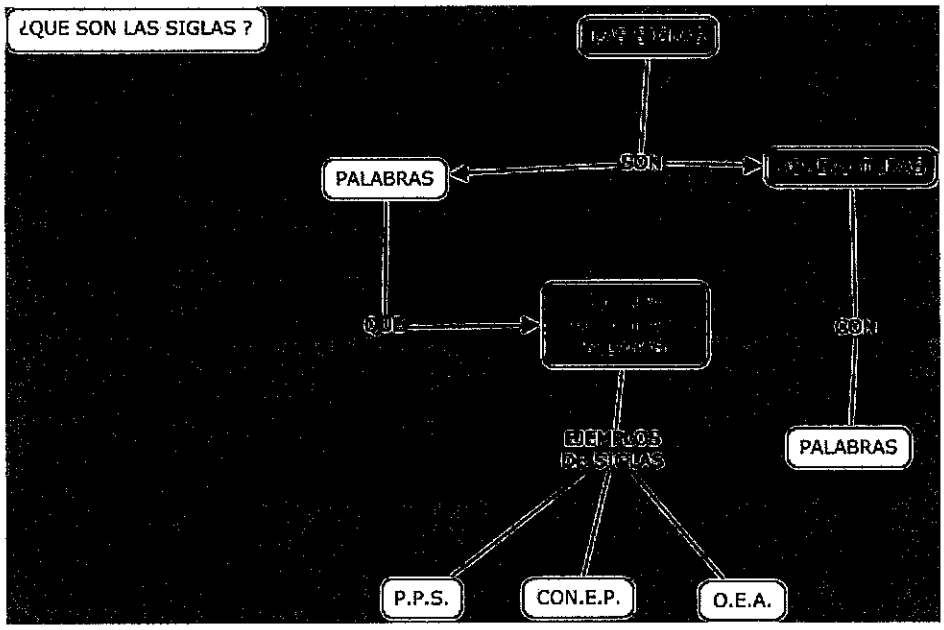

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Juan Antonio Marín Candón Morón de la Frontera (Sevilla). Copyright © 2006 http://www.reglasdeortografia.com/siglasyacronimos.html

Real Academia Española. "Siglas". http://buscon.rae.es/dpdI/SrvltConsulta?lema=sigla

Spot Image. "Glosario, Las siglas". 2008. http://www.spotimage.fr/web/es/314-glosario-las-siglas.php

¿*Hispanic* o *Latino*?

A pesar de que vivimos dentro de una sociedad donde el español no es reconocido como un idioma oficial, los Estados Unidos cuenta con una gran población de personas que hablan español. Esta población cuenta con una gran diversidad que proviene de distintas partes de Latinoamérica, España, y otras partes del mundo.

Tomando en cuenta que los Estados Unidos es uno de los países más diversos del mundo, es difícil poder definir y referirse a cada persona por lo que él o ella se define propiamente. En otras palabras, el gobierno y otros dominios se han encargado de etiquetar a personas por su color de piel, el idioma que hablan, sus prácticas, su cultura, la manera de vestir, etc. Sin embargo esto no sólo causa que se crean estereotipos dentro y fuera del país sino que llega a generalizar la identidad de cada individuo que llega a pisar tierra estadounidense. Este es el caso de las comunidades que hablan español, cuales han sido comúnmente representadas como *Hispanics, Latino, Latin American,* o *Spanish.*

La prensa usualmente utiliza dichas representaciones, puesto a que ya es algo que se ha usado a través del tiempo. Por ejemplo, en la página Web de MSN, encontré más de un artículo que hablaba de *Hispanics* y su salud. El artículo se titula "*Hispanic women get breast cancer treatment late*" cual habla sobre una mujer "hispana" en particular, quien no fue atendida por doctores estadounidenses cuando sintió una bola en su seno. Al parecer, dentro de este contexto la mujer "hispana" se encuentra dentro la definición de una minoría que vive los Estados Unidos. Aún después de leer el artículo no pude sacar conclusión de si la mujer "hispana" fuese aquella que proviene de una clase media o clase baja, pero lo que si pude analizar fue que usaron la

palabra "*hispanic*" versus decir "latina" o quizás sólo referirse a una mujer. Sin embargo, al decir que la mujer es "hispanic," la audiencia que ha leído el artículo llega a crear sus propias interpretaciones sobre porque se le da importancia que sea hispana y no anglosajona. Es algo confuso y sobre todo contradictorio en algunos casos. Por ejemplo, cuando se habla de los estudios que se han hecho sobre casos como éstos, lo titulan totalmente distinto para sólo condensar a mexicanas-americanas que caben dentro de la investigación "*Like Rubeo, about half of women in a study of 230 Mexican-American breast cancer patients in Arizona and Texas noticed changes in their breasts...*" (Madison Park). Evidentemente no sólo se está hablando de mujeres que son vistas como (conjunción) cómo → adverbio "*hispanic*", pero que caben dentro de la representación de una mujer que también es "Mexican-American".

En otro artículo que leí hace muy poco, me di cuenta que la palabra "*Latino*" fue mencionada. "*Latinos in the Entertainment*" hablaba sobre aquellos escritores y productores de películas que ganaron premios recientemente. Reseñas que contaban con ambas representaciones fueron utilizadas para distinguir ambos "*Latinos*" y "*Hispanics*". "*And while some are using those opportunities to address issues dear to Hispanic moviegoers, others are more concerned with impressing audiences of all kinds*"(Cesar). Este artículo contaba con una descripción de cómo estos productores no solamente tratan de hacer películas latinas pero si no que sean para la identificación de todo aquel que la vea. Sin duda alguna, puedo darme cuenta de que al decir "*latinos*", se refieren a todo aquel que vive y es nativo de Latinoamérica y todo aquel que nace pero habla español en los Estados Unidos es un "hispanic" según dominios estadounidenses.

Carolina, de repente esta explicación está cita, pero no hay nada que la introduce

No cabe duda que ambas connotaciones pueden ser relacionadas, pero ~~en~~ desde mi punto de vista no creo que dentro de esta sociedad sean correctamente utilizadas para describir a un individuo por cualquiera que su nacionalidad o su color de piel. Las palabras podrán definir a uno, pero la última palabra es la de aquel que se define como uno quiere.

No en negrilla

Fuentes

http://mylatinonews.com/2008/08/latinos-in-entertainment/

http://mylatinonews.com/category/immigration/

la cita (página 2) → es confusa

C 18 / 20 → falta un verbo, buena conclusión

Org 20/20

G 20/20 → faltan un pronombre, una preposición (una incorrecta)

V 20/20

Ort 19/20 → cuidado con los acentos y la ortografía

97%

Bien

¿Hispanic o latino?

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Escritos de Reflexión

Introducción a la lingüística española

El curso de español "Introducción a la lingüística española" me ha ayudado a conocer y entender un poco más sobre la estructura y función social de la lengua española. El hecho de que este curso me proporciono con la oportunidad de mejorar mi habilidad de leer, escribir, escuchar y hablar el español me ha dado la motivación de seguir aprendiendo más sobre la lingüística española. A pesar de que sólo fue una introducción a la lingüística, fue de gran ventaja el poder entender la historia y origen del vocablo castellano. Además, hay que tener en cuenta que en los Estados Unidos habita una gran población de hispanohablantes lo cual indica que es indispensable saber el español en términos de comunicación, empleos, política, salud y en otros medios.

De hecho, al final de este curso pude obtener un poco más de seguridad al hablar, escribir y leer el español, ya que a través del material visto en clase pude practicar y mejorar el uso del español en general. Una de las formas en que pude practicar fue a través del cuaderno de ejercicios y los proyectos de investigación. El cuaderno de ejercicios fue de gran ayuda durante todo el curso puesto que me facilito el proceso de practicar y comprender mejor el material visto en clase. Igualmente, los proyectos de investigación me permitieron entender la formación de la lingüística y de la lengua española. Por ejemplo, los proyectos me ayudaron bastante al poder realizar una investigación sobre un tema relacionado a la lingüística, escribir sobre mis descubrimientos y al mismo entender el tema en un mejor contexto. No obstante, tengo que admitir que no fue fácil realizar cada uno de ellos, ya que el proceso de investigación es largo y no se toma tiempo organizar un buen reporte sobre los descubrimientos. Lo que si me fue

bastante útil fueron las correcciones por parte de nuestra profesora ya que después de ver mis errores los tome en cuenta para aprender y evitar hacerlos de nuevo en el próximo proyecto. Indudablemente, cada capítulo del curso fue algo nuevo para mi conocimiento, lo que me ha inspirado en seguir estudiando la lingüística en mi futuro mundo académico.

Estoy satisfecha con el haber estado en este curso aprendiendo más sobre las distintas peculiaridades del lenguaje español de acuerdo a la región, sociedad, y variaciones contextuales. Me hizo entender que el español no es el mismo en todos lados, pero que cada región o sociedad utiliza un español de acuerdo a su influencia por parte de la localidad y su historia. Además, comprendí que hay una gran diferencia entre la manera de hablar de cada país hispanohablante y la importancia en entender las razones y motivos del porque se usa de esa manera.

En conclusión, quisiera añadir que después de este curso he podido conectar todos los cursos de español que anteriormente realice en el proceso de mis estudios universitarios. Ahora soy capaz de comprender la estructura interna de las palabras y los cambios que ocurren en la variación gramatical en el español. Es por eso, que después de este curso me siento capaz y preparada para comenzar en un curso que cubra la lingüística más allá de una sola introducción. En un fututo espero poder llegar al punto de comprender los distintos subcampos de la lingüística teorética.

Programa de español en la Universidad de California, Merced

Los distintos cursos que tome en la Universidad de California, Merced por parte del programa de español me ayudaron a conseguir un nivel avanzando en las técnicas del español escrito, leído, escuchado y hablado. En mi proceso de adquirir un énfasis en español durante mis estudios universitarios, tuve la oportunidad de participar en más de 5 cursos en español con distintos enfoques y temas. Algunas más interesantes que las otras, pero definitivamente llenas de conceptos necesarios para conseguir un conocimiento avanzado de la lengua española.

Aún recuerdo el haber estado en el curso de introducción a la literatura hispana, la cual es instruida en español, y poder identificarme con varios elementos culturales que se encuentran en el idioma. Después de haber estado en ese curso me di cuenta de que para poder entender un poco sobre el origen de mi propia cultura es importante saber la formación de nuestra propia lengua. Uno de los cursos que más recuerdo fue "Composición y conversación en español" (español 103), donde no sólo fue introducida a la variedad gramatical y a las distintas formas de composición, sino también tuve la oportunidad de trabajar con un periódico oficial ubicado en la ciudad de Merced. Esta experiencia fue una de las más memorables, puesto a que pude trabajar con un editor, escritor y productor de un periódico en español, quien me ayudo a mejorar mi escritura y a entender el proceso de como una historia periodística es escrita. Además, por medio de este proyecto de servicio y aprendizaje conseguí publicar tres historias que me ayudaron a perfeccionar mi español escrito.

Otro curso que me ayudo a mejorar mi español escrito fue "Temas sobre el lenguaje y cultura hispana" (español 180), el cual me ayudo a usar conectores para utilizar en nuestros

escritos y composiciones. Anteriormente, el uso de los conectores no era parte de mi técnica al escribir en español, pero después de español 180 obtuve la práctica necesaria para saber que al realizar una composición uno debe de una manera u otra usar conectores para así conseguir claridad y entendimiento. Por cierto, el tema de este curso fue bastante interesante ya que trato de varios filmes con temas relacionados a Latinoamérica o países hispanohablantes. Me intereso bastante el poder escuchar otras formas de hablar el español y como varia el pronunciamiento.

De hecho el curso de "Español para los negocios y administración" (español 142) proporciono el vocabulario que se utiliza en el área de los negocios y la oficina. Aunque mi enfoque en mis estudios universitarios no toca con el tema de los negocios o de la administración el curso de español 142 me proporcionó con el conocimiento de las distintas formas de cómo utilizar el español. Por ejemplo, cuando uno se encuentra en un ámbito profesional dentro de la oficina la manera de conversar se diferencia del español informal o casual. Incluso, hay un vocabulario donde solo se toca con referencias a los negocios o a la oficina, los cuales son necesarios para poder dialogar con personas que están dentro del mismo interés.

Concluyendo, me gustaría agregar que cada curso me brindo una variedad de conceptos y técnicas que las tendré siempre en cuenta al escribir, hablar o leer en español. Para mi ha sido una gran experiencia el haber completado mis estudios en el énfasis de español y el haber tenido varios puntos de vista acerca la lengua española por parte del programa de español. Me tomo la oportunidad de agradecerles a las profesoras y profesores que nos hicieron posible aprender más sobre el aprendizaje de una lengua, pero mucho más sobre su intelectualidad y sabiduría como hispanohablantes. ¡Gracias!

individuo por cualquiera que su nacionalidad o su color de piel. Las palabras podrán definir a uno, pero la última palabra es la de aquel que se define como uno quiere.

Fuentes:

http://mylatinonews.com/2008/08/latinos-in-entertainment/

http://mylatinonews.com/category/immigration/

Student 4
Good.

[redacted]

[redacted]a

Espanol [redacted]

Primavera 2009

COMPOSITION RUBRIC			
CONTENT	20–17	Excellent—Very Good	has fully anticipated reader questions in selecting information; topic well-thought-out and carefully developed with effective supporting detail; interesting to read
	16–12	Good—Adequate	has anticipated most reader questions in selecting information; topic may not be fully explored; development is adequate although some ideas may be incompletely supported or irrelevant; interesting ideas in places
	11–7	Fair—Poor	has anticipated few reader needs in selecting information; topic explored only superficially and inadequately developed with many ideas unsupported or irrelevant
	6-0	Needs a lot of work	shows no awareness of reader needs; ideas superficial and/or uninteresting with little development; OR not enough to evaluate
ORGANIZATION	20–17	Excellent—Very Good	has fully anticipated reader needs in organizing and presenting information; clear thesis; flow of ideas fluid and logical; a pleasure to read
	16–13	Good—Adequate	has anticipated most reader needs in organizing and presenting information; main ideas stand out, but sequencing of ideas sometimes choppy or disconnected; reader may sometimes have difficulty following flow of ideas
	12–9	Fair—Poor	has anticipated few reader needs in organizing and presenting information; ideas frequently confused and/or disconnected, with logical breakdowns apparent; reader frequently has difficulty "getting the point" of message as communicated
	8–0	Needs a lot of work	shows no awareness of reader needs; logical organization absent; OR not enough to evaluate
GRAMMAR	20–17	Excellent—Very Good	wide range of structures with few or no significant errors (e.g., sentence structure)
	16-13	Good—Adequate	adequate range of structures, but little variety; tends to overuse simple constructions; both significant and minor errors (e.g., agreement) present, but meaning seldom obscured
	12-9	Fair—Poor	limited range of structures with control of grammar uncertain; errors frequent, especially when more complex constructions attempted; meaning often confused or obscured
	8–0	Needs a lot of work	frequent and persistent errors of basic grammar and sentence construction; meaning blocked as text dominated by errors; OR, not enough to evaluate
VOCABULARY	20–17	Excellent—Very Good	language choices appropriate for topic, purpose and reader; excellent use of idioms and precise, colorful vocabulary; little or no evidence of English interference
	16–13	Good—Adequate	language choices usually appropriate for topic, purpose and reader; vocabulary accurate but may be somewhat limited; some errors or interference may be present but meaning rarely obscured
	12–9	Fair—Poor	language choices sometimes inappropriate for topic, purpose and reader; vocabulary very limited, with overuse of imprecise or vague terms; English interference evident, particularly with respect to idioms; meaning often confused or obscured
	8–0	Needs a lot of work	language choices often inappropriate for topic, purpose and reader; range of vocabulary extremely limited; English interference frequent; OR not enough to evaluate
CONVENTIONS	20-17	Excellent—Very Good	very few or no faults with respect to spelling / accentuation, punctuation, or presentation (handwriting or typing)

	16-13	Good—Adequate	occasional faults in spelling / accentuation, punctuation, or presentation (handwriting or typing)
	12-9	Fair—Poor	frequent errors in spelling / accentuation or punctuation; messy presentation that is sometimes illegible
	8-0	Needs a lot of work	persistent errors in spelling / accentuation and punctuation; handwriting often illegible; OR not enough to evaluate
TOTAL	/100	Comments:	

Índice

- Ensayo de Reflexión

- Ejemplos de Tareas

- Proyectos de Investigación
  Proyecto Original seguido por proyecto con cambios

Ensayo de Reflexión

Reflexión de Spanish 110

La clase de español 110 fue una experiencia muy diferente comparada a otras clases de español. Los trabajos que nos dio la Profesora Torda fueron buenas herramientas para aprender sobre la lingüística.

En primer lugar, las actividades del cuaderno de ejercicios y la tarea adicional, me forzaban a leer determinadamente el libro y comprender lo que estaba leyendo. Sin leer el libro era demasiado difícil completar los ejercicios. La tarea adicional me daba la oportunidad de practicar lo que acababa de leer y de saber si en realidad entendí el material.

Los proyectos de investigación eran muy adecuados para darme cuenta que todo lo que aprendimos sobre la lingüística (léxica, modismos, dialectos, las variaciones del español) está presente cuando hablamos con alguna persona al igual que cuando leemos algo. La lingüística no está presente solamente en el español, sino también existe en todas las lenguas. Con los proyectos de investigación también pude ver cómo se emplean todas las reglas de la lingüística en la vida real. Cuando hablamos, no nos damos cuenta de las reglas que estamos utilizando. Tampoco nos preguntamos porque es que nos entendemos aunque haya algunas diferencias en la forma y las palabras que utilizamos al hablar. Después de haber tomado el curso de lingüística, a veces puedo reconocer algunos componentes de la lingüística cuando escucho a personas hablar español.

Creo que un área en donde hubo mejoramiento a través del semestre fue en la forma de explicar los conceptos. Es difícil comprender un concepto cuando no hemos visto ningún ejemplo. Creo que una forma de lograr que los estudiantes tengan un mejor entendimiento de los conceptos sería dar un ejemplo, y después explicar porqué el ejemplo está relacionado con el

concepto. Los ejemplos son muy importantes, especialmente para una clase como lingüística que puede ser muy confusa.

Otra sugerencia seria el de conocer qué tipo de estudiantes están en la clase desde el principio del semestre. Por ejemplo, saber el año en el que va cada estudiante. También, sería bueno preguntar cuales estudiantes hablan el español como primer idioma, quienes aprendieron el español como segundo idioma y cuantos años llevan hablando español. Estos datos servirían para entender algunos problemas de escritura o de habla de los estudiantes y para poder ayudarlos mejor.

Algo que me ayudó mucho fue corregir las tareas en grupo. No es necesario corregir todas las tareas sino que se deberían escoger las tareas que reflejen más el material del examen. Antes de corregir las tareas en grupo o como una clase, debería haber una explicación del concepto del capítulo y después proceder a corregir el cuaderno de ejercicios o tarea adicional.

Reflexión del Programa de Español

Todo el programa de español es bueno aunque se puede mejorar. Algunos cursos no los ofrecen frecuentemente, pero entiendo que no haya suficientes estudiantes que se inscriban a la clase. De modo vaya creciendo la Universidad también aumentará la cantidad de cursos. Las clases de español son muy divertidas. A la vez se aprende mucho sobre la cultura de los países hispanohablantes y las diferencias entre ellos. Por lo menos para mí, saber las diferencias que existen entre los países hispanohablantes, ya sea en sus costumbres o en la forma de hablar, me será muy útil. Tal vez sea porque obtendré mi bachillerato en administración y puedo utilizar lo que he aprendido si algún día trabajaré en una empresa internacional.

Por lo regular, cuando me registraba para una clase de español, uno de los factores que me ayudaba a decidir qué clase tomar fue el horario. Algunas veces no tomé clases que me interesaban porque se ofrecían en un horario inadecuado para mí. A veces eran otras clases del currículo de administración que me impedían tomar alguna clases de español o mi horario de trabajo. Espero que en el futuro las opciones de horario sean más, aunque yo no pueda beneficiar de estos cambios.

Creo que sería beneficiario que sigan ofreciendo clases relacionadas con los "majors," por ejemplo, español de negocios para los estudiantes que estudien administración, español de términos médicos para aquéllos que estudian biología o psicología. A mí se me hizo muy interesante la clase de negocios y me ayudó a aprender cómo hacer lo que hago en inglés en español. Es difícil pensar en español cuando se está acostumbrado a pensar en ingles.

El programa de español de la Universidad de California, Merced tiene mucho por delante. Los profesores, con los que he tenido la oportunidad de trabajar, son muy dedicados y realmente se preocupan por los estudiantes. Preparan actividades como la mesa de español y "service

learning." Estas actividades que son muy útiles para refinar el español de aquellos que ya lo hablan y para los que están aprendiendo, les da la oportunidad de conversar en un español que no podrían aprender en la clase.

Disfruté mucho el tiempo en las clases de español aunque algunas veces si me estresé un poco, pero no me puedo quejar. Quiero agradecer a todos los profesores de español por su trabajo y tiempo que dedican para mejorar el programa. ¡Sigan adelante! Están haciendo un trabajo excelente.

Ejemplos de Tarea

Figura 5.8 p123 Paradigma general de los verbos regulares

VERBO: BAILAR

	P1 sg YO	P2 sg TÚ	P3 sg él/ella/Ud	P1 pl nosotros	P2 pl vosotros	P3 pl ellos/ellas Uds.
presente indicativo	Bailo	Bailas	Baila	Bailamos	Bailáis	Bailan
presente subjuntivo	Baile	Bailes	Baile	Bailemos	Bailéis	Bailen
imperativo afirmativo		Baila	Baile	Bailemos	Bailad	Bailen
imperfecto	Bailaba	Bailabas	Bailaba	Bailábamos	Bailabais	Bailaban
pretérito	Bailé	Bailaste	Bailó	Bailamos	Bailasteis	Bailaron
futuro	Bailaré	Bailarás	Bailará	Bailaremos	Bailaréis	Bailarán
condicional	Bailaría	Bailarías	Bailaría	Bailaríamos	Bailaríais	Bailarían
imperfecto subjuntivo -ra	Bailara	Bailaras	Bailara	Bailáramos	Bailarais	Bailaran
imperfecto subjuntivo -se	Bailase	Bailases	Bailase	Bailásemos	Bailaseis	Bailasen
futuro subjuntivo	Bailaré	Bailares	Bailare	Bailáremos	Bailareis	Bailaren

	GERUNDIO	PARTICIPIO	INFINITIVO
Tiempos Impersonales	Bailando	Bailado	Bailar

100% excelente

Actividad 6.5 y 6.6

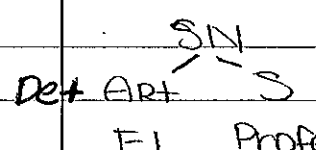
Act 6.5 Dibuje un diagrama arbórero para cada sintagma nominal:

O = Oracion
SN = Sintagma Nominal
SV = Sintagma Verbal
SPrep = Sintagma Preposicional
S.Adv = Sintagma Adverbial
SAdj = Sintagma Adjetival

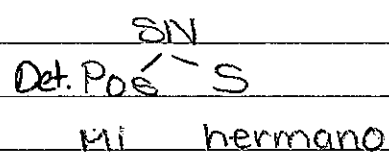
S = Sustantivo
Pro = Pronombre
Det = Determinante
Art = Artículo
Dem = Demostrativo
Pos = Posesivo
Cuant = Cuantificador

100%

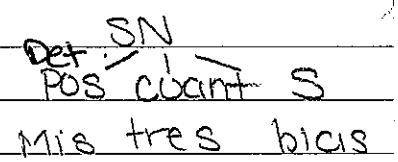
A) El Profesor



B) Mi hermano

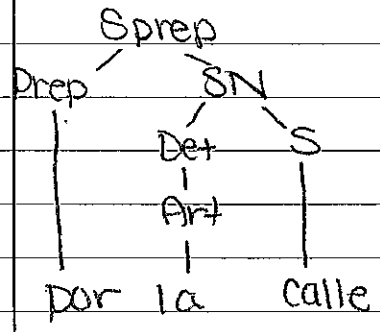


C) Mis tres bicis

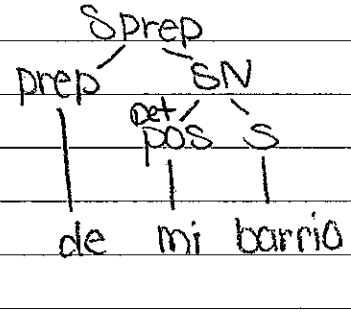


Act. 6.6

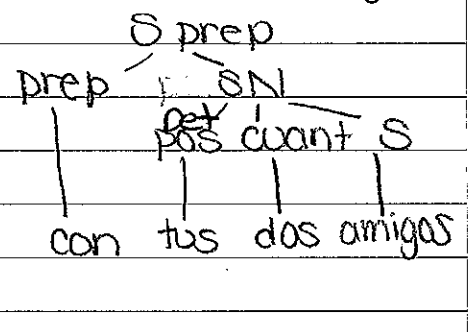
a) Por la calle



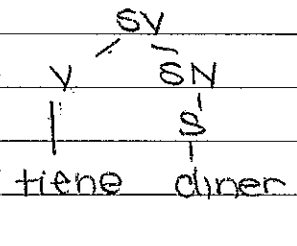
B) De mi Barrio



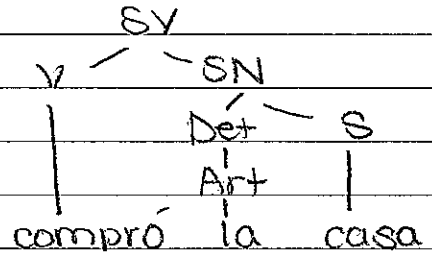
c) con tus dos amigos



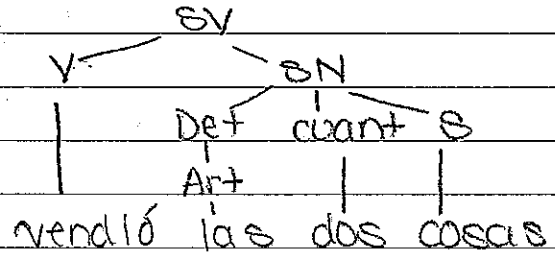
6.7 a) tiene Dinero



B) Compró la cas



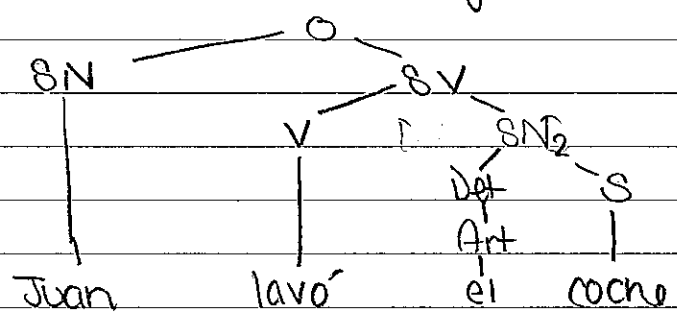
c) vendió las dos cosas



Tarea #7 act 7.1 p 179; act 7.3 p 181

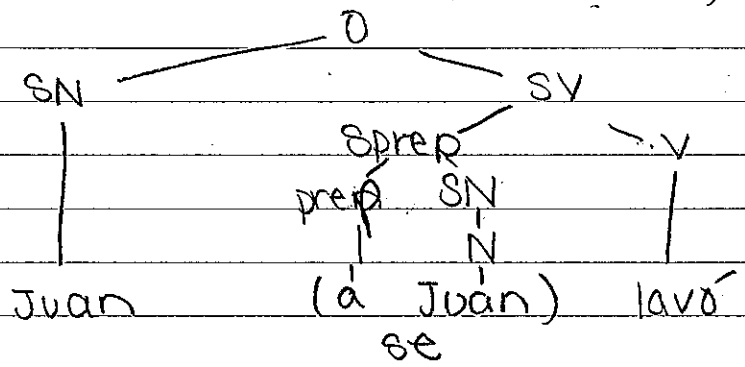
7.1 Determine si hay o no reflexividad en las oraciones siguientes y dibuje diagramas arbóreos

a) Juan lavó el coche (No hay reflexividad)

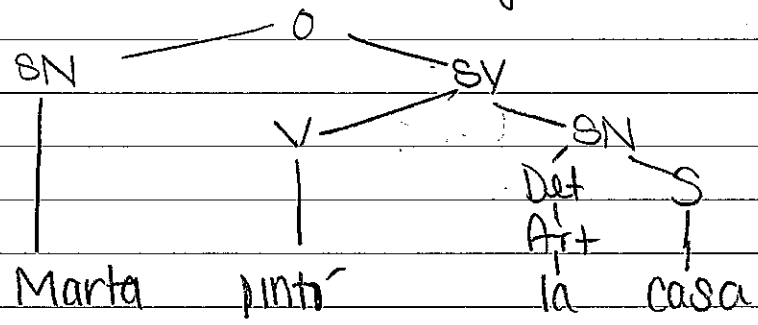


100% Excelente

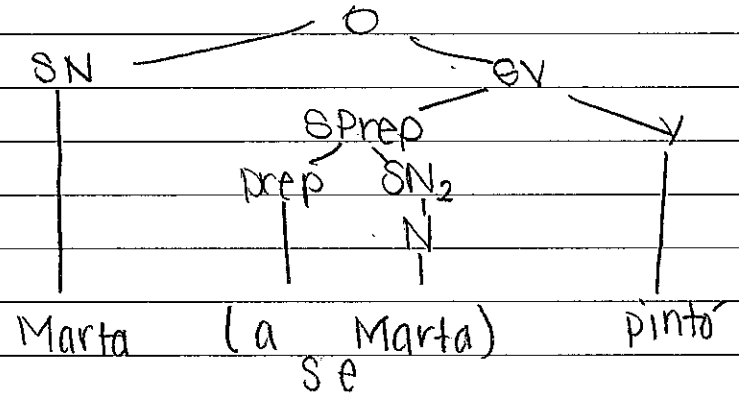
b) Juan se lavó (Reflexividad)



c) Marta pintó la casa (No hay reflexividad)



d) Marta se pintó (Reflexividad)



7.3. Analice la función del pronombre clítico se en las oraciones siguientes (posibilidades: objeto directo reflexivo, objeto indirecto reflexivo, objeto indirecto no reflexivo, reflexivo intrínseco, objeto directo recíproco.)

a) ¿El Diccionario? Se lo he prestado a Juan – OD no reflexivo
OI,

b) Se comieron las setas y se envenenaron; ~~reflexivo intrínseco~~,
OI reflexivo ~~OD reflex~~

c) Juan se quejaba del ruido del piso de arriba: OI
Reflexivo intrínseco

d) Paco y Marta se quieren mucho: OD recíproco
Paco quiere a Marta y Marta quiere a Paco.

e) Jaimito se comió tres bocadillos y dos tortillas en cinco minutos.
OI Reflexivo

f) Si usted quiere, puedo traérselo por la tarde
OI ~~OD~~, no reflexivo

g) Panchito se cortó al afeitarse OD reflexivo

Los tiempos verbales en español: Verbos regulares

IND: pres/fut/imprf/pret./pres-prf/fut-prf/plusc-prf. COND cond-prf. SUB: pres/imprf/pres-perf /plus

I. Los tiempos del indicativo

100% Bien

Presente de indicativo

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	Hablo	Hablas	Habla	Hablamos	Habláis	Hablan
comer:	Como	Comes	Come	Comemos	Coméis	Comen
vivir:	Vivo	Vives	Vive	Vivemos	~~Vivais~~ vivís	Viven

Futuro de indicativo voy a

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	Hablaré	Hablarás	Hablará	Hablaremos	Hablaréis	Hablarán
comer:	Comeré	Comerás	Comerá	Comeremos	Comeréis	Comerán
vivir:	Viviré	Vivirás	Vivirá	Viviremos	Viviréis	Vivirán

Imperfecto de indicativo

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	hablaba	hablabas	hablaba	hablábamos	hablabais	hablaban
comer:	comía	comías	comía	comíamos	comíais	comían
vivir:	vivía	vivías	vivía	vivíamos	vivíais	vivían

Pretérito de indicativo de algun verbo que explican voluntad. queria que

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	Hablara	Hablaras	Hablara	Hablaramos	Hablarais	Hablaran
comer:	Comiera	Comieras	Comiera	Comieramos	Comierais	Comieran
vivir:	Viviera	Vivieras	Viviera	Vivieramos	Vivais	Vivieran

?

Presente perfecto de indicativo Con "haber" haya hablado, etc.

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	He hablo	Has hablas	Ha habla	He hablamos	~~Habeis~~ hableis	Han hablan
comer:	como	comes	come	comemos	comeis	comen
vivir:	vivo	vives	vive	vivemos	viveis	viven

Futuro perfecto de indicativo habré hablado, etc.

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	hablaré	hablaras	hablará	hablaremos	hableis	hablarán
comer:	comeré	comeras	comerá	comeremos	comereis	comerán
vivir:	viviré	vivirás	vivirá	viviremos	vivireis	vivirán

Pluscuamperfecto de indicativo Había ___ (imperfecto de HABER con pasado)

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	Había hablado	Habías hablado	Había hablado	Habíamos hablado	~~Habeis~~ habíais hablado	Habían hablado
comer:	Había comido	Habías comido	Había comido	Habíamos comido	~~Habeis~~ comido	Habían comido
vivir:	Había vivido	Habías vivido	Había vivido	Habíamos vivido	~~Habeis~~ vivido	Habían vivido

9 9 9

II. El condicional (o potencial)

Nota: Algunos consideran éste como si fuera un modo aparte; otros lo consideran parte del indicativo

Condicional hablaríais

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	Hablaría	Hablarías	Hablaría	Hablaríamos	~~Hablareis~~	Hablarían
comer:	Comería	Comerías	Comería	Comeríamos	Comeríais ~~Hablareis~~	~~Hablarían~~ Comerían
vivir:	Viviría	Vivirías	Viviría	Viviríamos	~~Vivireis~~	Vivirían

Condicional perfecto *Habrian hecho en el pasado* : verbo HABER viviríais

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	habría hablado	habrías hablado	habría hablado	Habríamos Hablado	~~Habreis~~ habríais Hablado	Habrían. Hablado
comer:	Habría Comido	Habrías Comido	Habría Comido	Habríamos Comido	~~Habreis~~ Comido	Habrían Comido
vivir:	Habría vivido	Habrías vivido	Habría vivido	Habríamos vivido	~~Habreis~~ vivido	Habrían vivido.

III. Tiempos del subjuntivo

Presente de subjuntivo (que) verbos de emociones, duda, impersonales.

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	Hable	Hables	Hable	Hablemos	Hableis	Hablen
comer:	Coma	Comas	Coma	Comamos	Comais	~~Comeman~~ Coman
vivir:	Vive	Vivas	Viva	Vivamos	~~Viveis~~	Vivan

Imperfecto de subjuntivo(Forma alternativa (-se)) viváis

	yo	tú	Ud./él/ella	nosotros, -as	vosotros, -as	Uds./ellos/ellas
hablar:	Hablara	Hablaras	Hablara	Hablaramos	~~Hablareis~~	~~Hablaran~~ ok
comer: comiera	Comiera	Comieras	Comera	Comiéramos	~~Comereis~~	~~Comieran~~ comieran
vivir:	Vivire	Vivieras	Vivira	Viviramos	Vivireis	Viviran

Viviera . . . . Viviéramos

Presente perfecto de subjuntivo				con haber → haya hablado, etc.			
	yo	tú	Ud./él/ella	nosotros, -as		vosotros, -as	Uds./ellos/ellas
hablar:	hablé	hablaste	habló	hablamos		hableis	hablaron
comer:	comí	comiste	comió	comimos		comais	comimos
vivir:	viví	viviste	vivió	vivimos		vivais	vivimos.

Pluscuamperfecto de subjuntivo(Forma alternativa (-se))				Hubiera			
	yo	tú	Ud./él/ella	nosotros, -as		vosotros, -as	Uds./ellos/ellas
hablar:	Hubiese hablado	Hubieses hablado	Hubiese hablado	Hubiesemos hablado		Hubieseis hablado	Hubiesen Hablado
comer:	Hubiese Comido	Hubieses Comido	Hubiese Comido	Hubiésemos Comido		Hubieseis Comido	Hubiesen Comido
vivir:	Hubiese vivido	Hubieses vivido	Hubiese vivido	Hubiésemos vivido		Hubieseis vivido	Hubiesen vivido.

IV. Mandatos (el Imperativo)

Mandatos				
	tú	vosotros, -as	usted	ustedes
hablar:	Habla	Hablais	Hable	Hablen
comer:	Come	comeis	coma	coman
vivir:	Vive	vivais	viva	vivan

hablad
comed
vivid

Presente perfecto de subjuntivo				con haber → haya hablado, etc.			
	yo	tú	Ud./él/ella	nosotros, -as		vosotros, -as	Uds./ellos/ellas
hablar:	hablé	hablaste	habló	hablamos		hableis	hablaron
comer:	comí	comiste	comió	comimos		comais	comimos
vivir:	viví	viviste	vivió	vivimos		vivais	vivimos.

Pluscuamperfecto de subjuntivo (Forma alternativa (-se))				Hubiera			
	yo	tú	Ud./él/ella	nosotros, -as		vosotros, -as	Uds./ellos/ellas
hablar:	Hubiese hablado	Hubieses hablado	Hubiese hablado	Hubiesemos hablado		Hubieseis hablado	Hubiesen Hablado
comer:	Hubiese Comido	Hubieses Comido	Hubiese Comido	Hubiésemos Comido		Hubieseis Comido	Hubiesen Comido
vivir:	Hubiese vivido	Hubieses vivido	Hubiese vivido	Hubiésemos vivido		Hubieseis vivido	Hubiesen vivido.

IV. Mandatos (el Imperativo)

Mandatos				
	tú	vosotros, -as	usted	ustedes
hablar:	Habla	~~Hablais~~	Hable	Hablen
comer:	Come	~~comeis~~	coma	coman
vivir:	Vive	~~vivais~~	vivá	vivan

hablad
comed
vivid

Morfología: Forma y función de las palabras

100% Bien

5

5.1. Localizar morfemas

Divida las palabras siguientes en morfemas e indique si son morfemas léxicos o gramaticales.

EJEMPLO: perrito

perr: M. léxico **it:** M. léxico **o:** M. gramatical -o : gram. - r gram

1. dudar dud: M. léxico -ar : M. gramatical
2. niñera niñ: M. léxico , era: M. léxico er - léxico a-gram.
3. gentuza gent. M. léxico , ~~tu~~ : ~~M. léxico~~ ; uza : M. léxico
4. aspiración aspira: M. léxico ; ción : M. léxico aspir : léxico a: gram. ción: léxico
5. decapitar de: M. ~~gramatical~~; capit. M. léxico ; ~~ar~~ar : M. ~~léxico~~ gram
6. veintidós vein. M. léxico ; ~~ti~~ : M. ~~léxico~~ ; dós: M. léxico
7. viajaba viaj: M. léxico ; ~~ba~~ : ~~M. léxico~~ ; ~~ba~~ba: gramatical a-léxico gram.
8. atea te a-gram ~~atea~~ te : M. léxico ; a: M. gramatical a - léxico tea: te
9. tristemente triste: M. léxico, ~~e~~ men: M. léxico ; mente (sufijo) léxico te: M. gramatical
10. estuve est : M. léxico ; uve: M. gramatical
uv : gram e gram.

5.2. Palabras flexionadas

Partiendo de los términos que aparecen a continuación (es decir, tomándolos como radical), busque dos palabras relacionadas con ellos por flexión. — no cambia significado.

EJEMPLO: tonto → tontos/tonta

1. salvar salvarnos / salvarlo : salvo, salvaba
2. perro perros / perra : perritas sustantivo
3. peluquero peluqueros/ peluquera / ~~peluquería~~ porque cambia el sentido
4. cortar cortaron / cortan / cortaria
5. vine vinieron , vienen
6. sabido sabian, saber participio ya sacó
7. él ella , ellos

pronombre demostrativo

8. computar ~~computen, compuesto~~ ~~computador~~ OK
9. sabia (adj.) ~~sabiamos, sabiar~~ sabio sabias
10. éste éstos, ésta

5.3. Alomorfos

Identifique los verbos de la lista y dé los alomorfos del radical de cada uno de ellos.

EJEMPLO: estoy estaba estuve estar
Infinitivo: estar
Alomorfos de el radical del infinitivo: est-, estuv-

Este libro = Este 3

estoy	salía	durmiendo	pondré	decir
puedo	salgo	fue	pude	salir
dormía	dije	pongo	vas	poder
dormir	vine	hacer	vengo	era
soy	estaba	hizo	quise	tener
hacía	tengo	ser	viene	hago
dirá	querré	haré	estuve	decía
tiene	venir	tendré	puse	podía
hice	tuve	saldré	querer	vendré
seré	quería	venía	tenía	diciendo
poner	digo		quiero	estar

Pongan solamente alomorfos (variaciones)

1. decir dir- digo dec- dic- dij-
2. poner pon- pong- pondr- pus
3. salir sal- salg saldr
4. dormi dorm- duerm-, duerm
5. venir ven- veng- vendr- vin- vien-
6. poder pod- pued- pud- podr-
7. hacer hag- hac- hic- har- hiz-
8. tener ten- teng- tien- tuv- tendr-
9. querer quier- quer- quis- querr-
10. Ser s- e-

5.4. Palabras derivadas

Partiendo de los términos que aparecen a continuación (es decir, tomándolos como radical), busque dos palabras relacionadas con ellos por derivación.

EJEMPLO: papel → papelera/papelería

1. agua aguacero / aguatero / aguar
2. chocolate chocolatería / chocomilk / chocolatoso / chocolatendo
3. nadar nadando / nadará / natación / nadador
4. cielo Rascacielos / celeste cielito
5. hablar hablará / hablo habladuría, hablador
6. zapato zapatería / zapatero
7. té tetera / tetería / cafetera
8. teléfono teléfonear / telefónica / telefonista.
9. presentar presentación / presentando (presentador/a)
10. casa casona, casero, casita

5.5. ¿Afijos flexionales o derivativos?

Identifique si cada una de las palabras está formada por derivación o por flexión.

EJEMPLO: psicología psicólogas parapsicología parapsicológico Derivado: proceso
radical
Palabras flexionadas: psicólogas
Palabras derivadas: psicología, parapsicología, parapsicológico

1. flechó, flechas flechar flechazo flecharemos
   Flexionadas: flechas; Derivadas: flechó, flechar, flechazo, flecharemos.
2. dictadura dictaduras dictatorial dictatorialmente dictadores
   Flexionadas: dictadura, dictadura; Derivadas: dictatorial, dictatorialmente, dictadores.
3. aguada aguamos aguas aguacero
   F: aguas D: aguada, aguamos, aguacero
4. linda lindísimo lindeza lindura
   E: linda D: lindísimo, lindeza, lindura
5. nevó nevar nevada neviscar
   E: ∅ D: nevó nevar nevada neviscar
6. casucha casona casero casilla casas
   E: casas D: casucha, casona, casero, casilla
7. fonos alófono fonética eufonía teléfono
   E: fonos D: alófono, fonética, eufonía, teléfono
8. aceituna aceitar aceitoso aceites
   F: aceites D: aceituna, aceitar, aceitoso.

9. deshacer hechos hago contrahecho rehacer R: hacer.

F: hago D: deshacer, hechos, contrahecho, Rehacer

10. llover lloviznas llueve lluvioso

F: ~~llover~~ D: llovisnas, llueve, lluvioso, llover

5.6. Palabras compuestas

Partiendo de los términos que aparecen a continuación, busque dos palabras relacionadas con ellos por composición.

Ejemplo: sacar → sacacorchos/sacamuelas

1. cara ~~carabana~~ / ~~cargar~~ / ~~caracol~~ carilarga
2. lavar lavando / lavadora / lavaplatos / lavandería — derivados
3. pelo peluquero / pelon / pelirroja — derivados
4. casa ~~casando~~ / ~~caseria~~ / casa de campo / casa cuna
5. café cafetera / cafetería / café con leche — derivados
6. lápiz porta lápiz
7. parar ~~parando~~ / paracaidas / paraguas / parabrisas
8. dulce agridulce agridulce
9. portar porta vasos
10. papel pisapapel

5.7. Familia de palabras

Usando como radical las palabras siguientes, encuentre un término formado por flexión, derivación y composición a partir de cada una de ellas (utilice el diccionario si lo cree necesario).

numero, genero, gramatical.

	Flexión	Derivación	Composición
Ejemplo: corcho	corchos	acorchado	sacacorchos
1. flor	flores	florecando	sacaflores Flor de Pascua
2. limpiar	limpiaron	limpiesa	limpiaventanas
3. droga	drogas	drogarse	drogadicto, anti droga
4. cuento	cuentos	descuento	cuentacuentos, corta
5. abrir	abrimos	abierto	abrelatas
6. diente	dientes	dentadura	sacadientes
7. mano	manos	antemano	balonmano.
8. cortar	cortés	corte	cortaunas
9. pie	pies	pedal	a pie, besapié
10. matar	mató	matador	matasellos.

limpiaba Flexion de verbo

5.8. Creación de neologismos

5.8.a. Invente un sustantivo, adjetivo o verbo para cada una de las definiciones siguientes.

EJEMPLO: Un pronombre sujeto de tercera persona de plural que no sea ni masculino ni femenino: "Elles"

1. El nombre de un objeto para escribir que combine un lápiz y un bolígrafo.

   pluma, bolígrafo

2. El nombre de un *software* para corregir errores antes de que se hayan cometido.

   software ortografico

3. Un adjetivo que signifique frío lo suficiente como para ponerse un jersey de lana.

   congelando

4. Un verbo que signifique leer rápidamente, saltando cada tercera línea.

   echarle un vistazo

5. Un verbo que signifique hace un tiempo ideal como para salir en camiseta.

   refrescar

6. Un adjetivo que combine las nociones de "urbano" y "rural".

   periférico

5.8.b. Invente palabras formadas con el nombre del producto comercial y escriba un anuncio como el que se da en el modelo.

EJEMPLO: Un producto llamado Garrón para limpiar coches.
Anuncio: Limpiar el auto con Garrón es limpiarlo dos veces. ¡En vez de lavar su auto, garronéelo!

1. Una pintura para paredes, llamada Paredex.

   Paredex; solo una pasada, y los niños nunca escribieron en la pared.

2. Una copiadora llamada Bemox.

   Comparta sus memorias a todo color y desde casa. "Bemox", reviviendo las experiencias

3. Un detergente para la ropa llamado Blancax.

   Blancax, para que su ropa blanca siga blanca

4. Un cereal para el desayuno, llamado Maizfloc.

   La comida mas importante es el desayuno, Empieze su mañana con energia, nutritivamente, y con Maizfloc.

5. Zapatillas para correr de la marca Velocex.

Velocex, comodidad rapida y ~~asequible~~ accesible

5.9. ¿Verdadero o falso?

Señale con un círculo la respuesta correcta (verdadero: V/falso: F).

EJEMPLO: Madrid no es la capital de España.	V	F
1. El morfema es la unidad máxima de significado.	V	F
2. Un alomorfo es un concepto abstracto realizado por los morfemas.	V	F
3. Todos los morfemas léxicos son, a su vez, morfemas libres.	V	F
4. Un prefijo puede ser un morfema léxico. anti- (contra)	V	F
5. La flexión crea neologismos. → la derivación	V	F
6. Los sufijos peyorativos no modifican la clase gramatical de la palabra.	V	F
7. Los artículos no son morfemas léxicos.	V	F
8. La variación de género en la palabra siempre marca una diferencia sexual en la realidad.	V	F
9. El leísmo es el uso de "le" para objeto directo de persona.	V	F
10. Sólo existen tres procesos de formación de palabras en español.	V	F
11. Los pronombre son una clase léxica.	V	F
12. No todos los afijos son morfemas ligados.	V	F
13. Los artículos determinados son morfemas ligados.	V	F
14. Una expresión idiomática es un modismo.	V	F
15. La formación sintética es un tipo de composición.	V	F
16. Un morfema libre es siempre una palabra independiente.	V	F
17. La reducción consiste en eliminar sílabas sólo al final de la palabra.	V	F
18. "Pelirrojo"es un compuesto subordinado.	V	F
19. La flexión es el proceso más productivo en la creación de léxico.	V	F
20. Un morfema léxico no tiene significado extralingüístico.	V	F
21. El radical de un verbo puede tener distintos alomorfos.	V	F
22. Los pronombres átonos son morfemas ligados.	V	F
23. Las terminaciones verbales son morfemas gramaticales.	V	F
24. El género de los sustantivos es masculino, femenino y/o neutro. determinantes y pronombres	V	F
25. Los afijos y los prefijos pertenecen al grupo de los sufijos.	V	F

5.10. Prueba de autoevaluación

Para realizar esta actividad de revisión y autoevaluación de forma adecuada,

- relea el capítulo y sus apuntes, pero no los utilice durante la prueba.
- limite a quince minutos la prueba.
- siga la escala de notas a continuación.

Escala de notas:
(A) 50–45 puntos (B) 44–40 puntos (C) 39–35 puntos (D) 34–30 puntos (E) 29–0 puntos

1. ¿Cómo se denominan las palabras como "chatear"? Realice asímismo la división en morfemas de "chatear". (10 puntos)

   Se dividen en artículo y morfemas chat - e - ar
   Neologismo: Chat - e - a - r

2. ¿Cuáles son los tres procesos principales en la producción de palabras en español? (5 puntos)

   Flexion, Derivación, composición

3. Proporcione un ejemplo de un modismo. (5 puntos)

   Echar de menos

4. ¿Qué afijo significa "contrario/a"? Proporcione dos ejemplos usando este afijo (10 puntos)

   cualquier palabra que comienze con anti-
   anticonceptivo, anticonstitucional.

5. Identifique los morfemas de las palabras siguientes como en el modelo: (20 puntos)

   EJEMPLO: niñas → niñ- [Radical], a [género femenino], -s [número plural]

   a. bailo: bail (radical); o (persona/número)

   b. americano: americ (radical), an, o (masc.)
   america (radical); n (gentilicio); o (género masculino)

   c. comprando: compra
   compr (radical); a (~~re~~ vocal temática); ndo (gerundio)

   d. cerdita: cerd (radical), i (interfijo), ta (
   cerd (radical); it (diminutivo); a (género femenino)

Proyectos de Investigación

en doble espac

o de Investigacion 1

Real Académica Española → no en negrilla ni subrayada

Podría usar adjetivos de mayores de 1 por favor?

Juan Manuel Fernández Pacheco tomó la iniciativa de fundar la Real Academia Española. El propósito de esta Academia fue «fijar las voces y vocablos de la lengua castellana en su mayor propiedad, elegancia y pureza». La misión de la Real Academia Española es el de velar por los cambios que suceden en la lengua Española a través del tiempo y adaptar las necesidades de sus hablantes para no quebrar la unidad que mantiene en todo el ámbito hispánico. La Real Academia Española es un gran recurso para aquellos que estudian español.

→ Si es una cita, tiene que ponerla e. corchetes.

La Real Academia Española busca que los cambios que experimente la lengua española en su constante adaptación a las necesidades de sus hablantes quiebren la unidad que mantiene en todo el ámbito hispánico. La academia debe establecer los criterios de propiedad y corrección de la lengua. Esto ayuda a los que estudian el español a reconocer las formas correctas del español a pesar de todos los variantes que tiene el idioma en distintos lugares regionales. Para estudiantes de español, puede ser que un uso principal ~~es~~ sea el diccionario. Además, la Real Académica ofrece recursos muy útiles para estudiar la lengua.

También

Se pueden consultar grandes conjuntos materiales por los que se pueden obtener información que no estaba disponible hace varios años. Tiene disponibles distintos textos que ayudan en la lengua española. Unos recursos disponibles son: el Diccionario de la lengua española, el Diccionario Esencial, el Diccionario del Estudiante, el Diccionario

práctico del estudiante, el Diccionario académico de americanismos, el Diccionario ~~pan~~ panhispánico de dudas, el Nuevo diccionario histórico de la lengua española, la Nueva gramática de la lengua, y la Ortografía de la lengua española (que es el primer texto formalmente orientado en la línea de una política lingüística común adoptada por todas las ~~la~~ Academias).

falta la concordancia

Este sitio ofrece el servicio de español al día con el objetivo de resolver dudas de carácter lingüístico ~~ligústico~~ como de ortografía, léxicas, y gramaticales. La información es en perspectiva de la norma que regula el uso culto del español. Así que esta información es confiable y segura. La Real Academia también cuenta con un banco de datos en el que se encuentran varios corpus textuales como lo son el Corpus de Referencia del Español Actual, y el Corpus Diacrónico del Español. Estos dos textos son muy útiles. El primero tiene textos desde 1975 a 2004 y el segundo contiene información de periodos anteriores. Estos textos permiten el estudio de la lengua porque se puede observar, estudiar, y analizar las diferencias que han ocurrido a través del tiempo y en diversos lugares como en España y en América.

Otro beneficio de la Real Academia Española, es que junto con las veintiún Academias de América y Filipinas, forman la ~~La~~ Asociación de Academias de la ~~La~~ Lengua Española. Estas Academias colaboran para sostener la unidad ~~la recesa~~ del idioma español a través del diccionario, la gramática, y la ortografía internacionalmente. Permite que la lengua español alcance (el presente del subjuntivo) ~~alcancé~~ muchos rincones internacionalmente y así unifica a los hispanohablantes de modo que falta un verbo como va cambiando la lengua española. Las Academias están unidas para compartir la responsabilidad de fijar la norma que regula el uso correcto del idioma, a la misma vez permitiendo los usos diferentes de las regiones lingüísticas en diferentes áreas.

Yo alcancé (el pretérito)

Buena conclusión

Este sitio, ayuda en el aprendizaje del idioma. La Real Academia no se enfoca en una sola área del idioma español, ~~si no~~ sino que como ya ~~e~~ he (del verbo haber) mencionado, cubre desde un diccionario para entender el significado de palabras hasta la gramática, al igual que la enseñanza de la estructura y el funcionamiento de la lengua. Personas que estén estudiando el idioma les es necesario aprender más que el significado de la palabra. También es importante que aprendan la formación y el uso de cada palabra. Es útil aun considerando que el idioma ~~varea~~ varía en dialecto en diferentes comunidades o regiones.

Fuentes: → no en negrilla ni subrayada

Real Academia Española, http://www.rae.es

C	20/20	
Org	20/20	
G	19/20	→ falta la concordancia y una preposición; pretérito subjun.
V	20/20	
Ort	18/20	→ Cuidado con los acentos y la ortografía
	97%	

Muy bien

Real Académica Española

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También se pueden consultar grandes conjuntos materiales por los que se pueden obtener información que no estaba disponible hace varios años. Tiene disponibles distintos textos que ayudan en la lengua española. Unos recursos disponibles son; el Diccionario de la lengua española, el Diccionario esencial, el Diccionario del estudiante, el Diccionario práctico del estudiante, el Diccionario académico de americanismos, el

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Este sitio, ayuda en el aprendizaje del idioma. La Real Academia no se enfoca en una sola área del idioma español, sino que como ya he mencionado, cubre desde un diccionario para entender el significado de palabras hasta la gramática, al igual que la enseñanza de la estructura y el funcionamiento de la lengua. Personas que estén estudiando el idioma les es necesario aprender más que el significado de la palabra. También es importante que aprendan la formación y el uso de cada palabra. Es útil aun considerando que el idioma varía en dialecto en diferentes comunidades o regiones.

Fuentes:

Real Academia Española, http://www.rae.es

número de tu apellido, por favor

Proy. de ... Proyecto de Investigacion 2

~~Temas para profundizar p 174 C~~

Es más fácil aprender a usar palabras léxicas que palabras gramaticales

Cuando se lee y escucha una palabra, se percibe su significante a través de la vista y del oído. Al escuchar una palabra o conjunto de palabras, se crea una imagen en la mente y se puede interpretar lo escuchado y lo leído. Las palabras también tienen un significado que son los conceptos que se reproducen en la mente y son evocados por las palabras cuando se leen o se oyen. Aunque todas las palabras tienen significado, existen diferencias entre distintos tipos de palabras como palabras léxicas y palabras gramaticales. Cuando se estudia un idioma extranjero, resulta relativamente más fácil aprender a usar las palabras léxicas que las palabras gramaticales. Las palabras léxicas contienen el significado básico para poder transmitir información.

De tal modo, aquellas palabras que poseen y que evocan conceptos como seres, objetos, cualidades, acciones, procesos, y estados son las palabras léxicas. El léxico es el conjunto de palabras de una lengua que puede venir del diccionario materno. Estas palabras forman la mayor parte de un comunicado porque contiene el significado básico. Las palabras léxicas también son conocidas como palabras autónomas o independientes y pueden ser definidas con otras palabras del léxico común. Estas palabras no siempre deben ser acompañadas, y ~~se~~ pueden ser utilizadas independientemente.

Vestir solo/sola → adjetivo sólo = solamente → adverbio

En cambio las palabras gramaticales son dependientes y sólo pueden ser explicadas utilizando conceptos gramaticales. Estas palabras deben seguir un sistema de reglas de una lengua o de un libro que contiene dichas reglas. Los hablantes de una lengua han internalizado estas reglas y las aplican intuitivamente aunque no sepan los términos técnicos. Las palabras gramaticales incluyen artículos, preposiciones, pronombres tónicos, demostrativos, y conjunciones. Como ya he dicho, las palabras de estas categorías, no se pueden utilizar solas. Siempre se les agregan morfemas y palabras con significado y que indican relaciones. Por ejemplo, la palabra conejas, tiene el sufijo –a, y el sufijo –s. Estos sufijos son gramaticales porque le agrega más información a la palabra *conejo (léxico),* que contiene el significado básico. El sufijo –a, le informa al lector que la palabra es femenina, y el sufijo –s, informa que es plural. De esta manera las palabras gramaticales complementan a las palabras léxicas.

De modo semejante, la competencia lingüística es la capacidad de manipular las reglas que rigen la estructura del idioma. Es un conjunto de las reglas que desarrollamos mientras adquirimos nuestro primer idioma. Una persona que no sea hispanohablante debe adquirir competencia lingüística. En cambio, una persona hispanohablante, elige los términos correctos y apropiados sin tener que pensar en la formación de las oraciones. Por otro lado, la competencia comunicativa nos permite elegir las palabras o expresiones apropiadas a la situación. Al elegir palabras apropiadas para una situación, uno se basa en la idea principal. Esto puede ser ~~ne~~ menos confuso para una persona no hispanohablante porque las palabras léxicas son las que tienen mayor contribución para formar la idea principal. Una persona que no es hispanohablante no tiene las reglas gramaticales internalizadas.

No se comienza un párrafo con a

~~Por ejemplo~~, una persona que está estudiando una lengua extranjera no le es fácil aplicar las reglas gramaticales ~~porque no las tiene internalizadas.~~ Por esa razón En inglés, algunas oraciones tienen una organización diferente ~~al~~ a la del español. Una frase simple como "tengo frío," en inglés sería "I am

Hace falta una oración con un conector

cold". Si se tradujera "tengo frío" literalmente, un angloparlante se podría confundir y decir "I have cold." Al igual, "I am cold" se convertiría a "Yo soy frío." Los términos apropiados son distintos en estas dos lenguas y por eso es difícil modificar una acción intuitiva.

Bueno conclusión

Por lo tanto, cuando se estudia un idioma extranjero, es más fácil aprender a usar las palabras léxicas que las palabras gramaticales. Se debe pensar en las reglas y procesar todo antes de hablar porque no es la intuición. Las palabras léxicas contienen la mayor información y significado de las oraciones y transmiten el tema o/e información sobre el mensaje. El estudio de las palabras gramaticales es más difícil porque se debe desarrollar el conocimiento de las reglas y memorizar las conjugaciones, las excepciones, los diversos tensos y las reglas de ortografía.

Fuentes de Información:

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Clases de Palabras. Alfonso Sancho Rodríguez.
http://personal.telefonica.terra.es/web/apuntesasr/ClasesDePalabras.htm

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C 20/20
Org 20/20
G 20/20.
V 19.5/20 (pequeños problemas de gramática
Ort 17/20 (falta acentos

96.5

muy bien

Es más fácil aprender a usar palabras léxicas que palabras gramaticales

Cuando se lee y escucha una palabra, se percibe su significante a través de la vista y del oído. Al escuchar una palabra o conjunto de palabras, se crea una imagen en la mente y se puede interpretar lo escuchado y lo leído. Las palabras también tienen un significado que son los conceptos que se reproducen en la mente y son evocados por las palabras cuando se leen o se oyen. Aunque todas las palabras tienen significado, existen diferencias entre distintos tipos de palabras como palabras léxicas y palabras gramaticales. Cuando se estudia un idioma extranjero, resulta relativamente más fácil aprender a usar las palabras léxicas que las palabras gramaticales. Las palabras léxicas contienen el significado básico para poder transmitir información.

De tal modo, aquellas palabras que poseen y que evocan conceptos como seres, objetos, cualidades, acciones, procesos y estados son las palabras léxicas. El léxico es el conjunto de palabras de una lengua que puede venir del diccionario materno. Estas palabras forman la mayor parte de un comunicado porque contiene el significado básico. Las palabras léxicas también son conocidas como palabras autónomas o independientes y pueden ser definidas con otras palabras del léxico común. Estas palabras no siempre deben ser acompañadas, y pueden ser utilizadas independientemente.

En cambio las palabras gramaticales son dependientes y solo pueden ser explicadas utilizando conceptos gramaticales. Estas palabras deben seguir un sistema de reglas de una lengua o de un libro que contiene dichas reglas. Los hablantes de una lengua han internalizado estas reglas y las aplican intuitivamente aunque no sepan los términos técnicos. Las palabras

gramaticales incluyen artículos, preposiciones, pronombres tónicos, demostrativos y conjunciones. Como ya he dicho, las palabras de estas categorías, no se pueden utilizar solas. Siempre se les agregan morfemas y palabras con significado y que indican relaciones. Por ejemplo, la palabra conejas, tiene el sufijo –a, y el sufijo –s. Estos sufijos son gramaticales porque le agrega más información a la palabra *conejo (léxico),* que contiene el significado básico. El sufijo –a, le informa al lector que la palabra es femenina, y el sufijo –s, informa que es plural. De esta manera las palabras gramaticales complementan a las palabras léxicas.

De modo semejante, la competencia lingüística es la capacidad de manipular las reglas que rigen la estructura del idioma. Es un conjunto de las reglas que desarrollamos mientras adquirimos nuestro primer idioma. Una persona que no sea hispanohablante debe adquirir competencia lingüística. En cambio, una persona hispanohablante, elige los términos correctos y apropiados sin tener que pensar en la formación de las oraciones. Por otro lado, la competencia comunicativa nos permite elegir las palabras o expresiones apropiadas a la situación. Al elegir palabras apropiadas para una situación, uno se basa en la idea principal. Esto puede ser menos confuso para una persona no hispanohablante porque las palabras léxicas son las que tienen mayor contribución para formar la idea principal.

Una persona que no es hispanohablante no tiene las reglas gramaticales internalizadas, por esa razon, una persona que está estudiando una lengua extranjera no le es fácil aplicar las reglas gramaticales. En inglés, algunas oraciones tienen una organización diferente a la del español. Una frase simple como "tengo frió," en inglés sería "I am cold". Si se tradujera "tengo frió" literalmente, un angloparlante se podría confundir y decir "I have cold." Al igual, "I am cold" se convertiría a "Yo soy frío." Los términos apropiados son distintos en estas dos lenguas y por eso es difícil modificar una acción intuitiva.

En conclusión, cuando se estudia un idioma extranjero, es más fácil aprender a usar las palabras léxicas que las palabras gramaticales. Se debe pensar en las reglas y procesar todo antes de hablar porque no es la intuición. Las palabras léxicas contienen la mayor información y significado de las oraciones y transmiten el tema o/e información sobre el mensaje. El estudio de las palabras gramaticales es más difícil porque se debe desarrollar el conocimiento de las reglas y memorizar las conjugaciones, las excepciones, los diversos tensos y las reglas de ortografía.

Fuentes de Información:

Introducción a la Lingüística Española. Third Edition. Milton M. Azevedo. University of California, Berkeley. 2009 Pearson Education Inc.

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(Ve el modelo en (rup))

espacio triple

Proyecto de ...

15 de abril de 2009

El Subjuntivo

El subjuntivo suele ocurrir en oraciones subordinada nominales cuando hay un verbo o expresión de voluntas, deseo, mandato o duda en la frase principal. Al contrario del indicativo, el subjuntivo es algo que no existe y no es un hecho. Cuando se encuentra el subjuntivo en una oración subordinada hay una correlación entre el uso del subjuntivo y las características de la información. Se correlaciona con verbos o expresiones de mandatos como: querer, esperar y decir y dudas como es posible, dudo y no es cierto. El subjuntivo nos es útil para expresar deseos o comentarios y sentimientos. A veces el subjuntivo es considerado un recurso para señalar presuposiciones

Falta un conector

repetitivo

El subjuntivo puede ocurrir en diferentes tipos de oraciones subordinadas. Existe el subjuntivo en oración subordinada adjetiva. Este tipo de oración es cuando hay un referente hipotético, irreal o negado. Un ejemplo es "una medicina, la medicina" porque aún no existe.

aún = todavía

aun = aunque

También existe el subjuntivo en oración subordinada adverbial condicional. Estas oraciones son introducidas por la conjunción "si" y expresa una condición para que se realice lo que dice la oración principal. Un ejemplo de una ~~Horacio~~ oración subordinada adverbial condicional es "Saldremos contigo si tenemos tiempo." El tener tiempo es la condición para salir, pero aun no es un hecho que salgan.

saldríamos

tuviéramos

pero no es el subjuntivo

A continuación se encontrará unos ejemplos del subjuntivo:

impersonal

En la Ciudad de México la mayoría de las oficinas abren de 9:00am a 5:00pm, pero también pueden estar abiertas hasta las 7:00pm de lunes a viernes.

Es una oración subjuntiva porque las oficinas "pueden" estar abiertas pero no lo están. No es un hecho. La palabra "pueden" es la palabra clave que indica una. El subjuntivo se encuentra en ~~al~~ la oración subordinada "pueden estar abiertas." No es un hecho que esté abierto hasta las 7:00pm pero es una posibilidad.

No es el subjuntivo

Es importante que aprendas a distinguir entre los casos en los que tu socio de negocios necesite un poco más de presión y los casos en los que no hay oportunidad de que se haga el negocio, para que no malgastes tus recursos.

En esta oración la frase que señala el subjuntivo es "es importante que" se refiere al proceso de distinguir. La importancia de distinguir es irreal o hipotética. La frase se pude considerar como un cometario, una sugerencia u opinión.

Es una oración impersonal que rige el uso del subjuntivo (emoción).

A la gente le gusta prometer las perlas de la Virgen mientras te dan por tu lado. → No es el subjuntivo

¿Dónde?

Esta oración también contiene el subjuntivo porque expresa el sentimiento de "gustar." No es algo que existe o que es un hecho, solamente expresa la manera de sentir de la gente con referencia a "las peras de la Virgen." No es un hecho que a la gente le "guste prometer."

Es importante recordar que las compañías mexicanas muchas veces no tienen los fondos suficientes, de ahí que puedan encontrarse con serios problemas.

Como una de las oraciones anteriores, en esta oración el subjuntivo ~~esta~~ presente en la frase "Es importante recordar que.". Es un comentario sobre "las ~~campanas~~ compañías mexicanas." Esta oración contiene dos frases con el subjuntivo. La segunda parte "que puedan encontrarse con serios problemas" también es el subjuntivo. La primera parte de la oración afecta la segunda

del verbo estar

esta frase

adjetivo demostrativo

¿Dónde?

parte de la oración pero no es una frase condicional. La segunda parte es una posibilidad pero no es algo definitivo.

No es de buena educación dividir la cuenta, se espera que la persona que hace la venta pague la cuenta, o también se entiende que la persona que sugirió o "invitó" a las otras personas a la comida es la que pagará la cuenta.

En esta oración el subjuntivo se encuentra en la frase "se espera que." Es un deseo referente a la persona que hace la venta. Es algo que tal vez ocurra en el futuro, aunque aún no es algo seguro. Puede ser una forma de mandato porque "se espera" es una sugerencia muy fuerte de cómo se debe actuar. Al igual que la oración anterior, esta oración también tiene una segunda subjuntiva. La frase "se entiende que la persona" tampoco es un hecho. Esta frase expresa un comentario sobre la manera de hacer negocios en México. No es el subjuntivo

Otra posibilidad para una empresa extranjera es la de operar a través de una filial en México.

En esta oración, El subjuntivo es un poso más obvio por la frase "otra posibilidad." Pero no es el subjuntivo Inmediatamente sabemos que es algo que no existe pero que es algo que podría pasar en el futuro. La posibilidad se refiere a "la operación a través de un filial." "Es posible" también se puede considerar como una duda porque no es algo definitivo.

La compañía extranjera debe procurar evitar la posibilidad de que el ingreso sea generado por la empresa fuera de México y que se le atribuya a las operaciones en México. Esta posibilidad se debe a las reglas de la "fuerza de atracción" que se incluyen en la legislación fiscal mexicana.

En Esta oración el subjuntivo "debe procurar evitar la posibilidad" Aunque la frase habla sobre evitar la posibilidad, de todos modos se considera el subjuntivo. No es algo definitivo, o

h → del verbo "haber"

real que se aya evitado la posibilidad. Esa duda de posibilidad aún existe. "La posibilidad" se refiere al ingreso generado por la empresa.

Un acuerdo de este tipo puede adoptar cualquier forma en la que todas las partes estén de acuerdo en desarrollar su negocio y en ofrecer sus respectivos servicios y contribuciones de capital o recursos, según los estatutos de una nueva compañía independiente, o ambos.

En esta frase vuelve aplacer la posibilidad en la frase "puede adoptar cualquier forma." Existe la posibilidad que la adopción ocurra en el futuro. Aún no es un hecho, pero puede ocurrir si es que ocurre el acuerdo. Esta oración se puede considerar como subjuntivo condicional. Si no existe el acuerdo entonces tampoco existe la posibilidad de "adoptar cualquier forma."

En conclusión Nosotros utilizamos el subjuntivo frecuentemente al hablar. Muchas veces no nos damos cuenta que estamos usando oraciones subordinadas con frases en el subjuntivo. Algunas palabras o frases comunes que indican la presencia del subjuntivo son: quiero, ruego, dudo, es posible, puede, es lógico, me gusta que, para que, a fin de que, con tal que, a menos que, ojalá y quizás. Ahora que conocemos un poco más sobre el subjuntivo, tal vez reconozcamos un poco más cuando utilicemos el subjuntivo.

Dalila, ver a mi oficina para hablar del subjuntivo, por favor. Profesor Tomás

C 18/20 (faltan conectores)
Org 20/20
G 19/20 (algunos problemas de gramática)
V 19/20 (repetición)
Ort 18/20 (faltan acentos, errores de ortografía)
94%

Dalila, Escribes bien. Trata de emplear más conectores para que tus ensayos se lean mejor y que sean fluidos.

Fuentes de información: → ¿Tradujiste todo? Es mejor buscar y utilizar fuentes (en español)

1. Business Practices in México
http://solutionsabroad.com/sp/business-in-mexico/business-category/business-practices-in-mexico-the-basics.html

2. Setting up a Business in Mexico
http://www.solutionsabroad.com/sp/business-in-mexico/business-category/setting-up-a-business-permanent-establishment.html

Lo del subjuntivo no me quitado puntos, pero necesitamos hablar de [illegible]

El subjuntivo

El subjuntivo suele ocurrir en oraciones subordinadas nominales cuando hay un verbo o expresión de voluntad, deseo, mandato o duda en la frase principal. Al contrario del indicativo, el subjuntivo es algo que no existe y no es un hecho. Cuando se encuentra el subjuntivo en una oración subordinada hay una correlación entre el uso del subjuntivo y las características de la información. Se correlaciona con verbos o expresiones de mandatos como: querer, esperar y decir y dudas (es posible, dudo y no es cierto). El subjuntivo nos es útil para expresar deseos o comentarios y sentimientos. A veces el subjuntivo es considerado un recurso para señalar presuposiciones

Al igual que en oraciones nominales, el subjuntivo existe en oraciones subordinadas adjetivales. Este tipo de oración es cuando hay un referente hipotético, irreal o negado. Un ejemplo es "una medicina, la medicina" porque aún no existe.

Además, existe el subjuntivo en oración subordinada adverbial condicional. Estas oraciones son introducidas por la conjunción "si" y expresa una condición para que se realice lo que dice la oración principal. Un ejemplo de una oración subordinada adverbial condicional es, "Saldríamos contigo si tuviéramos tiempo." El tener tiempo es la condición para salir, pero aun no es un hecho que salgan.

A continuación se encontrará unos ejemplos del subjuntivo:

Seria bueno que en la Ciudad de México la mayoría de las oficinas estuvieran abiertas hasta las 7:00pm de lunes a viernes.

Es una oración subjuntiva porque "seria bueno" estuvieran abiertas hasta las 7:00pm pero no lo están. No es un hecho. La frase "seria bueno que" es la clave. No es un hecho que esté abierto hasta las 7:00pm pero la persona que dice la oración cree que es una bueno opción.

Es importante que aprendas a distinguir entre los casos en los que tu socio de negocios necesite un poco más de presión y los casos en los que no hay oportunidad de que se haga el negocio, para que no malgastes tus recursos.

En esta oración la frase que señala el subjuntivo es "es importante que" se refiere al proceso de distinguir. La importancia de distinguir es irreal o hipotética. La frase se puede considerar como un comentario, una sugerencia u opinión. Es una oración impersonal que requiere el uso de; subjuntivo porque tiene emoción.

Es importante recordar que las compañías mexicanas muchas veces no tienen los fondos suficientes, de ahí que puedan encontrarse con serios problemas.

Como una de las oraciones anteriores, en esta oración el subjuntivo esta presente en la frase "Es importante recordar que…." es un comentario sobre "las campanias mexicanas. La primera parte de la oración afecta la segunda parte de la oración. La frase "puedan encontrarse con serios problemas" no puede quedar como una oración sola. Esta es una posibilidad de algo que puede ocurrir en el futuro si no hay fondos pero no es algo definitivo.

No es de buena educación dividir la cuenta, se espera que la persona que hace la venta pague la cuenta, o también se entiende que la persona que sugirió o "invitó" a las otras personas a la comida es la que pagará la cuenta.

En esta oración el subjuntivo se encuentra en la frase "se espera que." Es un deseo referente a la persona que hace la venta. Es algo que tal vez ocurra en el futuro, aunque aun no es algo seguro. Puede ser una forma de mandato porque "se esperar" es una sugerencia muy fuerte

de cómo se debe actuar. Aunque normalmente la persona que hace la venta pague, todavía existe la posibilidad de que no ocurra de esa manera por la razón de que hay diferencias entre culturas.

La compañía extranjera debe procurar evitar la posibilidad de que el ingreso sea generado por la empresa fuera de México y que se le atribuya a las operaciones en México. Esta posibilidad se debe a las reglas de la "fuerza de atracción" que se incluyen en la legislación fiscal mexicana.

En la oración el subjuntivo es "debe procurar evitar la posibilidad" Aunque la frase habla sobre evitar la posibilidad, de todos modos se considera el subjuntivo. No es algo definitivo, o real que se haya evitado la posibilidad. Esa duda de posibilidad aun existe. "La posibilidad" se refiere al ingreso generado por la empresa.

Un acuerdo de este tipo puede adoptar cualquier forma en la que todas las partes estén de acuerdo en desarrollar su negocio y en ofrecer sus respectivos servicios y contribuciones de capital o recursos, según los estatutos de una nueva compañía independiente, o ambos.

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Fuentes de información:

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2. Setting up a Business in Mexico
http://www.solutionsabroad.com/sp/business-in-mexico/business-category/setting-up-a-business-permanent-establishment.html

"Los Hispanos en California; Hoy y en el Futuro"

Poco a Poco los hispanos van teniendo una mayor presencia en el estado de California. De acuerdo al Centro Virtual Cervantes, California es uno de los estados en donde vive la mayoría de los hispanos. Esto podría ser porque California comparte la frontera con México de donde inmigran muchos hispanos. La presencia y el impacto de los hispanos en California representa la presencia y el impacto de los hispanos en el futro de los estado unidos.

Según los datos del census, el 1ro de abril de 2000 habían 10, 966,556 hispanos en California. De ese número 5, 615,031 eran hombres y 5, 351,525 mujeres. Se estima que en julio de 2007 habían un total de 13, 220,891; 6, 789,462 hombres y 6, 431,429 mujeres. En sólo siete anos, el número de hispanohablantes ha aumentado un poco más de 2 millones de personas. Aunque hay más hombres hispanos que mujeres, el número de personas de los dos géneros aumenta proporcionalmente. La información del census también indica que de una población de California estimada en 36, 553,215 en el 2007, el 36.2% eran hispanos o latinos. Se espera que en 2042 haya 51% de hispanos en California (Contacto Magazine.com). En estos momentos, los estados unidos se está preparando para el census 2010. Considerando que el numero de hispanos después del census 2000 son sólo estimaciones, el census de 2010 será muy importante porque revelará la realidad en cuanto al amuleto de personas hispanas no sólo en California si no también en los estado unidos.

En estos momentos la presencia de los hispanos se está notando en el ambiento académico. Los estudiantes latinos representan el 48.7% de todo el alumnado en el estado.

Basada en la información de HITN, los hispanos aun no pueden ser considerados la mayoría porque no exceden el 50%, pero la mitad de niños de la edad escolar serán hispanos en 2014. El español está siendo más visto en un ámbito escolar, no sólo al nivel de primaria sino también a un nivel universitario. El ser bilingüe se está convirtiendo en algo casi necesario porque son tantas las personas que hablan la lengua. Algunos empresarios están requiriendo que sus empleados sean bilingües para tener mejor comunicación con sus clientes y con sus socios. Tal vez por eso se está expandido la presencia de cursos de español y cultura hispana en universidades.

Según el monitor hispano, "California es el punto de referencia, porque lo que está pasando hoy en ese estado pasará a nivel nacional dentro de 50 años" (López). Los cambios que estamos viviendo en California con la gradual incrementación de hispanos se reflejarán en toda la nación. Los hispanos tendrán una influencia aun más grande y tendrán un gran impacto en el ámbito académico norteamericano, al igual que en el ámbito económico.

Aun así, hoy en día, el español tiene un lugar privilegiado porque es "la segunda lengua de comunicación internacional y la segunda lengua más estudiada del mundo" (Carmen Caffarel Serra). Actualmente, el español es la segunda lengua o lengua co-oficial en estado unidos.

Se proyecta que para el año 2050 aya una población hispanohablante estadounidense arriba de los 132 millones convirtiendo a estados unidos en el país con un mayor número de hablantes de español. Estas proyecciones son importantes para medios de comunicación y actividades promocionales de cultura hispana como las revistas. El español tiene una gran importancia y peso en la transmisión y difusión de contenidos y mercado publicitario al igual que su presencia en el Internet. La población de hispanos en estados unidos tiene una gran potencia económica. Existen muchas posibilidades profesionales para aquellas personas que son bilingües

porque

por que todas las transacciones se están convirtiendo en algo global. A través se la lengua, no

solo se logra una comunicación efectiva, si no que también resalta la incorporación del español al

ámbito profesional.

El español es una lengua que "transmite la riqueza cultural… y como un idioma imprescindible en el ámbito profesional estadounidense e internacional en la actualidad" Carmen Caffarel Serra).

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Presencia Latina crece en escuelas, Monitor Hispano.
http://www.monitorhispano.com/news.php?nid=879&pag=3

C 18/20 (faltan conectores)

Org 19.5/20

G 19/20 (falta de concordancia y mal empleo de tiempo verbal)

V 18/20 (uso incorrecto de vocabulario

Ort 16/20 (faltan muchos acentos, problemas de ortografía)

90.5%

Bien, Dalila

"Los hispanos en California; hoy y en el futuro"

Poco a poco los hispanos van teniendo una mayor presencia en el estado de California. De acuerdo al Centro Virtual Cervantes, California es uno de los estados en donde vive la mayoría de los hispanos. Esto podría ser porque California comparte la frontera con México de donde emigran muchos hispanos. La presencia y el impacto de los hispanos en California representan la presencia y el impacto de los hispanos en el futuro de los Estado Unidos.

La presencia de los hispanos queda registrada en el los datos del censo. Según los datos del censo, el 1 de abril de 2000 había 10, 966,556 hispanos en California. De ese número 5, 615,031 eran hombres y 5, 351,525 mujeres. Se estima que en julio de 2007 había un total de 13, 220,891; 6, 789,462 hombres y 6, 431,429 mujeres. En sólo siete anos, el número de hispanohablantes ha aumentado un poco más de 2 millones de personas. Aunque hay más hombres hispanos que mujeres, el número de personas de los dos géneros aumenta proporcionalmente. La información del censo también indica que de una población de California estimada en 36, 553,215 en el 2007, el 36.2% eran hispanos o latinos. Se espera que en 2042 haya 51% de hispanos en California (Contacto Magazine.com). Actualmente, los Estados Unidos se está preparando para el censo 2010. Considerando que el número de hispanos después del censo 2000 son sólo estimaciones, el censo de 2010 será muy importante porque revelará la realidad en cuanto al aumento de personas hispanas no sólo en California sino también en los Estado Unidos.

Hoy en día la presencia de los hispanos se nota en el ambiente académico. Los estudiantes latinos representan el 48.7% de todo el alumnado en el estado. Basada en la información de HITN, los hispanos aun no pueden ser considerados la mayoría porque no exceden el 50%, pero la mitad de niños de la edad escolar serán hispanos en 2014. El español está siendo más visto en un ámbito escolar, no sólo al nivel de primaria sino también al nivel universitario. El ser bilingüe se está convirtiendo en algo casi necesario porque son tantas las personas que hablan la lengua. Algunos empresarios están requiriendo que sus empleados sean bilingües para tener mejor comunicación con sus clientes y con sus socios. Tal vez por eso se está expandiendo la presencia de cursos de español y cultura hispana en universidades.

Su presencia no solo aumenta en las universidades, sino que también en el estado de California. Según el monitor hispano, "California es el punto de referencia, porque lo que está pasando hoy en ese estado pasará a nivel nacional dentro de 50 años" (López). Los cambios que estamos viviendo en California con la gradual incrementación de hispanos se reflejarán en toda la nación. Los hispanos tendrán una influencia aun más grande y tendrán un gran impacto en el ámbito académico norteamericano, al igual que en el ámbito económico. Aun así, hoy en día, el español tiene un lugar privilegiado porque es "la segunda lengua de comunicación internacional y la segunda lengua más estudiada del mundo" (Carmen Caffarel Serra). De hecho, el español es la segunda lengua o lengua co-oficial en estado unidos.

Se proyecta que para el año 2050 haya una población hispanohablante estadounidense arriba de los 132 millones convirtiendo a Estados Unidos en el país con un mayor número de hablantes de español. Estas proyecciones son importantes para medios de comunicación y actividades promocionales de cultura hispana como las revistas. El español tiene una gran importancia y peso en la transmisión y difusión de contenidos y mercado publicitario al igual que

su presencia en el Internet. La población de hispanos en Estados Unidos tiene una gran potencia económica. Existen muchas posibilidades profesionales para aquellas personas que son bilingües porque todas las transacciones se están convirtiendo en algo global. A través de la lengua, no sólo se logra una comunicación efectiva, sino que también resalta la incorporación del español al ámbito profesional. El español es una lengua que "transmite la riqueza cultural… y como un idioma imprescindible en el ámbito profesional estadounidense e internacional en la actualidad" Carmen Caffarel Serra).

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Student 7
very good

Portfolio SPan 106

Cursos de Español

Durante mi educación en la Universidad de California Merced he tomado varias clases de español para mi "minor" en español. Todas estas clases me han ayudado a mejorar como escritor. Desde la clase de Español 103 hasta esta última, la de Español 106, me han ayudado a practicar y a mejorar mi escritura. Unas clases me han ayudado a analizar documentos y otras a escribir sobre temas de mi interés, lo que me ha ayudado a ser un escritor más dinámico.

Una clase que me ayudó mucho fue la clase de Traducción, donde aprendí a ser un mejor traductor. Esas tareas y ensayos me ayudaron mucho como escritor analítico y como lector. El concepto de traducción no solamente es de leer y traducir palabra por palabra, sino de conllevar el mensaje y ser leal al texto. Al escribir esos ensayos uno aprende a identificar los anglicismos y a corregirlos. Ya estando en la clase de Español 106 aprendí que uno se mantiene como buen escritor en el idioma que sea, pero para esto uno debe practicarlo constantemente.

Cada clase de español me ha ayudado a practicar y a mejorar en mi escritura. Cada una fue una nueva experiencia donde se aprende mucho. En la clase de lingüística se aprende la base de que es el español. Al estudiar en esta clase aprendí que el español es un lenguaje muy elaborado, confuso y bello por la variedad de palabras que se pueden usar para describir algo. Al mismo tiempo aprendí que como cualquier otro idioma, el español está cambiando constantemente por la influencia de otros idiomas.

Otra clase que fue singular fue la clase de Cine donde aprendimos sobre la historia y situación de países latinoamericanos y de España. Al escribir sobre películas, uno analiza y escribe, pero es otro tipo de escritura, una más crítica. Esta clase me ayudó bastante para estar

preparado para la clase de Español 106, ya que muchas de las películas que vimos son relevantes a esta clase. Al igual que las películas uno también aprende mucho leyendo artículos e investigando sobre la historia y economía de los países latinoamericanos como en la clase de Español 140. Ahí se aprende de cómo se maneja un negocio en estos países y sobre las cosas que tiene que saber uno si quiere empezar un negocio en el extranjero.

Cada una de estas clases está conecta con las demás de cierta manera, lo que ayuda a uno a estar más preparado para todas ellas. | Muy interesante para demostrar la articulación del programa.

Español 106

En la clase de español 106 he aprendido mucho, especialmente con los ensayos e investigaciones. Como escritor me di cuenta de varios errores que cometía sin darme cuenta y del porque estaban mal. Aprendí que usaba varios anglicismos sin darme cuenta. Ahora ya estoy más consiente al escribir para ver los tipos de anglicismos que uso. Fue una clase donde practique la escritura, especialmente la puntuación y ortografía. Además practique como analizar documentos y dar opinión propia sobre el documento. Fue un proceso de aprendizaje y de prender de nuevo.

Un buen ejemplo donde use más anglicismos fue en la tarea especial sobre el presidente Alfonsín. En la siguiente oración el anglicismo era una palabra que me parecía estar bien en la oración hasta que la profesora lo señaló. "Alfonsín no solo tuvo influencia en su país, pero [sino] también en los países vecinos…" El "no solo" en la oración principal hace que la oración subordinada empiece con "sino" en vez de "pero." Al igual me sucedió con el mexicanismo, que fue lo que hizo que mi ensayo estuviera limitado a un solo grupo de lectores. Un ejemplo se encuentra en el ensayo de "Dos ciudades ejemplares" donde escribí, "mal vivientes" que quiere decir criminales. Al ser corregido por estas faltas, eh aprendido a ser más consciente de mi escritura y de mis lectores.

También, usé artículos y preposiciones que simplemente no eran necesarios ni relevantes al texto. Me di cuenta que últimamente al escribir agrego artículos que se usan en ingles y que en el español no se usan. Un ejemplo lo podemos encontrar en el ensayo "Raúl Alfonsín" donde escribo, "…para reintegrar la democracia y [de] hacer justicia en el país." La preposición [de] no entra en esta oración. De un modo u otro sabía que esa preposición no iba ahí pero estaba

confundido y es por eso que lo deje ahí. Y por últimos muchas de las faltas fueron de acentuación que después de revisarlas aprendí donde se agregan.

Sin duda alguna la clase de Español 106 me enseñó muchas cosas acerca de mi escritura. Al mismo tiempo me hizo consiente de como he cambiado como escritor en los últimos años.

El rey que devolvió la democracia a España

Juan Carlos Alfonso Víctor María de Borbón y Borbón-Dos Sicilias nació en Roma, Italia, el 5 de enero de 1938. Don Alfonso es nieto de Alfonso XIII quien se exilio con su familia a Italia en 1931 por la proclamación de la Segunda República. Su padre el príncipe Juan de Borbón y Battenberg decidió que su hijo estudiaría en España y para esto lo acordó con el general Francisco Franco. En 1947 Franco aprobó la Ley de sucesión en la Jefatura de estado donde define que "España es como un Reino provisionalmente sin rey" y que se nombraría a un rey como su sucesor. Franco fijo sus ojos como posible candidato para el trono de España a Don Juan Carlos (Juan Carlos I 2). Franco no se imagino que después de su muerte, Don Juan Carlos sería el que traería un gran cambio a la historia de España.

En 1948 Don Juan Carlos llega a España por primera vez y retoma sus estudios en Madrid y San Sebastián finalizando el bachillerato en el Instituto San Isidro. Después, de 1955 a 1959 estudió en las fuerzas armadas, la naval, y la fuerza aérea respectivamente, así terminando su educación militar. Más tarde, estudió Derecho Público e Internacional, Economía y Hacienda Pública en la Universidad Complutense de Madrid (Juan Carlos I 2). Sin duda alguna el Rey se estaba educando para ser un líder y hasta entonces parecía que sería uno bueno tomando en cuenta que vivía donde el problema, que algún día él arreglaría, se veía a diario. Franco lo tenía en la mira a todo momento pero también lo apreciaba y estaba convencido que sería su sucesor. Por otra parte, Don Juan Carlos también tenía una buena amistad con el general Franco y parecían ser buenos amigos. A Don Juan, sin embargo, no le parecía que su hijo tuviera tanto afecto hacia el dictador.

Finalmente el 22 de Julio de 1969 las cortes Españolas decidieron que Don Juan Carlos sería el sucesor de Franco (Juan Carlos I 3). Don Carlos fue nombrado "Príncipe de España" lo cual no seguía la tradición monárquica, ya que su titulo hubiera sido príncipe de Asturias. Al ser nombrado como príncipe de España también fue ascendido a grado de general de brigada de los ejércitos de Tierra y Aire y a contralmirante de la Armada. Poco a poco se acercaba al poder máximo, algo parecido a muchos otros gobernantes, la mayoría dictadores. Luego más tarde a mediados de1971 fue designado por ley para sustituir interinamente al jefe del Estado en caso de ausencia o incapacidad (Juan Carlos I 3). Parecía como algo ya escrito y destinado para Don Juan Carlos. Hasta ese momento Don Juan Carlos sólo sería jefe del Estado sin verdaderos atributos de poder de acuerdo a Franco y esto porque él pondría a Luis Carrero Blanco, uno de sus más fieles lugartenientes, como presidente del Gobierno. Desgraciadamente y afortunadamente para el bien común, seis meses después de su nombramiento, Carrero fue asesinado por ETA (Juan Carlos I 3).

Durante los últimos meses de vida de Franco, la gobernación del Rey era muy discreta, ya que tenía que mantenerse más o menos neutral. En 1975 Franco muere y no queda nadie más que él en el poder y es cuando empieza a tomar las riendas del Gobierno. Él asignó como jefe del gobierno a Alfonso Suárez, quien lanzó la Ley para la Reforma Política. Fue un periodo muy difícil para el rey ya que por una parte los de la oposición democrática lo despreciaban y lo veían como el títere del dictador y por el otro los franquistas sospechaban que tenía ideas muy liberales (Juan Carlos I 3). Indiscutiblemente, era una etapa de miedo y de incertidumbre ya que no sabían si el rey seguiría los pasos de Franco o si sería una nueva esperanza para España.

En 1977 el Rey toma el compromiso de restaurar la democracia en España. En 1978 el Rey firma La Constitución luego que las Cortes franquistas (muchos de ellos se habían cambiado

de bando dando de esta forma esperanza a la democracia) aprueban la Ley para la Reforma Democrática. En esta reforma el Titulo II establece que el rey pierde todo su poder ejecutivo heredado por Franco y se convierte en un monarca parlamentario y democrático al uso en Europa Occidental. También establece en el artículo 56 que el rey quedaría como jefe del Estado (Juan Carlos I 4). Fueron tres años de tensión que amenazaban con un comienzo de otra guerra civil si el débil balance que había se distorsionaba. Después de las primeras elecciones democráticas las tensiones bajaron considerablemente.

Posteriormente, el rey volvió a marcar su ideología democrática durante el golpe de Estado del 23 de febrero de1981. Al aparecer en la televisión vestido con el uniforme de capitán de los tres Ejércitos y defendiendo la corona aclaró cuáles eran sus ideologías y le tranquilizo a su pueblo con el siguiente discurso "no puede tolerar [la corona], en forma alguna, acciones o actitudes de personas que pretenden por la fuerza interrumpir el proceso democrático que la Constitución votada por el pueblo español determinó en su día a través de referéndum (Juan Carlos I 4)." Esta acción fue muy importante para que el pueblo español aceptara y apoyara su mandato. También, fue felicitado varias veces por esta acción durante su visita a otros países.

De esta manera el rey restauró a una España destrozada y dividida, así mismo dándole un mejor futuro. También, restauró la monarquía en España y el respeto y la simpatía hacia ella que había la perdido mucho tiempo. Hasta el presente, el rey es un embajador de la nueva España.

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Segunda composición : 85

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De esta manera el rey restauró a una España destrozada y dividida, mismamente dándole un mejor futuro. También, restauró la monarquía en España y el respeto y la simpatía hacia ella que había perdido hace mucho tiempo. Hasta el presente el rey es un embajador de la nueva España.

C: Bien -2
Gy: Bien
G: -2
V: -3
Gr: B

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1. Hijo del príncipe Juan y sucesor designado por Franco

Juan Carlos Alfonso Víctor María de Borbón y Borbón-Dos Sicilias nació el 5 de enero de 1938 en el Hospital Anglo-Americano de Roma como el segundo de los cuatro hijos tenidos por Juan de Borbón y Battenberg (1913-1993) y María de las Mercedes de Borbón-Dos Sicilias y Orleans (1910-2000), futuros condes de Barcelona. Recibió el bautismo católico de manos del cardenal Eugenio Pacelli, futuro Papa Pío XII. En 1941, cuando su retoño tenía tres años, don Juan se convirtió en el cabeza de la Casa Real española con motivo de la renuncia a sus derechos dinásticos, poco antes de morir, de su padre, el destronado rey Alfonso XIII.

El futuro príncipe y monarca nació y creció en la capital italiana, lugar de exilio de la familia real luego de verse obligada a abandonar España por la proclamación de la Segunda República en 1931, y posteriormente en Lausana (Suiza) y Estoril (Portugal), donde los borbones recalaron en 1946 tras finalizar la Segunda Guerra Mundial. En Friburgo estuvo varios meses internado en un estricto colegio regido por los Padres Marianistas y en Estoril asistió a clases en una escuela local bajo la tutoría del secretario político de su padre, Eugenio Vegas Latapié.

El príncipe Juan deseó que su heredero dinástico se educara en España, para lo que llegó a un acuerdo con el general Francisco Franco, pese a las profundas diferencias que les separaban. En 1945 el conde de Barcelona había publicado el llamado Manifiesto de Lausana, en el que criticaba duramente la dictadura instaurada al cabo de la Guerra Civil en 1939 y ofrecía al pueblo español la posibilidad de regirse por una monarquía cuya naturaleza precisa no indicó. Dos años después, en 1947, Franco hizo aprobar la Ley de Sucesión en la Jefatura del Estado, que definía a España como un Reino provisionalmente sin rey; en tanto que jefe del Estado, Franco se reservó la función de regente de hecho, la cual ejercería hasta que propusiera a las Cortes (Parlamento) un sucesor a título de rey. La actitud desafecta de don Juan le autodescalificó como posible sucesor de Franco, quien fijó su atención en don Juan Carlos.

Llegado a su patria de origen por primera vez en 1948, el infante retomó los estudios en Madrid y San Sebastián, y acabó el bachillerato en el Instituto San Isidro, el más antiguo centro educativo de la capital española, en 1954. Recibió su instrucción castrense en la Academia Militar de Zaragoza (1955-1957), la Escuela Naval de Marín (Pontevedra, 1957-1958) y la Academia General del Aire de San Javier (Murcia, 1958-1959), de donde salió con los galones, respectivamente, de alférez de infantería, alférez de fragata y teniente de aviación. En esta época estuvo bajo la tutela del general Carlos Martínez de Campos y Serrano, duque de la Torre, encargado por Franco de supervisar la formación militar del infante. Como guardiamarina, el joven realizó un viaje en el buque-escuela Juan Sebastián Elcano.

En marzo de 1956 falleció prematuramente su hermano tres años menor, el infante don Alfonso, en un accidente de tiro sucedido en la residencia familiar en Estoril, la Villa Giralda. Según informaciones periodísticas de la época, que se limitaron a reproducir el comunicado oficial facilitado por la Embajada española en Lisboa, el muchacho, de 14 años, resultó muerto al recibir en la frente un disparo escapado de un revólver que, aparentemente, estaba limpiando don Juan Carlos, quien disfrutaba de un permiso militar con motivo de la Semana Santa. El manto de silencio echado sobre el trágico accidente por la Casa Real y el Gobierno franquista, y ciertas insinuaciones realizadas posteriormente por personas muy allegadas a la familia real alimentaron las especulaciones sobre que don Juan Carlos, en realidad, había matado fortuitamente a su hermano mientras jugaban con el arma ignorando que ésta estaba cargada.

En 1961 finalizó sus estudios de Derecho Político e Internacional, Economía y Hacienda Pública en la Universidad Complutense de Madrid, que complementó con cursos monográficos en Toledo. A partir de entonces realizó prácticas profesionales en diversos ministerios así como numerosos viajes por España y el extranjero. El 14 de mayo de 1962, para satisfacción de Franco, que ya tenía decidida la sucesión en su persona -en tanto el conde de Barcelona observaba con grandes suspicacias el afecto que el dictador y su hijo se profesaban mutuamente-, don Juan Carlos contrajo matrimonio en Atenas con la princesa Sofía Oldenburg y Guelph, nacida en noviembre de 1938, primogénita de los reyes Pablo I y Federica de Grecia, hermana por

tanto del futuro rey Constantino II, que aportó el nombre de Grecia al linaje borbónico y que recibió la condición de alteza real. Los príncipes consortes fijaron su residencia en el Palacio de la Zarzuela, en las cercanías de Madrid, y entre 1963 y 1968 tuvieron tres hijos, las infanta Elena y Cristina, y el infante Felipe, futuro príncipe de Asturias. Ella hubo de renunciar a su fe cristiana ortodoxa y abrazar el catolicismo, que era la religión oficial de España.

El 22 de julio de 1969 don Juan Carlos fue designado por las Cortes sucesor de Franco en la jefatura del Estado en calidad de rey y con el título provisional de príncipe de España. Al día siguiente, el nieto de Alfonso XIII prestó en las Cortes, sobre los Evangelios y bajo la mirada del anciano dictador, juramento de "lealtad al jefe del Estado y fidelidad a los Principios del Movimiento Nacional y demás Leyes Fundamentales del Reino". El príncipe ascendió seguidamente a los grados de general de brigada de los ejércitos de Tierra y Aire, y a contralmirante de la Armada. El 15 de junio de 1971 fue designado por ley para sustituir interinamente al jefe del Estado en caso de ausencia o incapacidad. Franco aclaró que la designación de don Juan Carlos era una "instauración", no una "restauración" de la monarquía borbónica, convencido como estaba de que el por ahora príncipe, una vez fallecido él, se supeditaría al esquema político-jurídico del régimen surgido del alzamiento militar del 18 de julio de 1936. La designación de don Juan Carlos como príncipe de España en lugar de príncipe de Asturias, título tradicional de los herederos de la Corona, sirvió para marcar la diferencia del proyecto monárquico franquista.

La mudanza de 1969 introdujo una fuerte tensión en las relaciones del conde de Barcelona con su hijo, al que reprochó haberse sometido a los planes políticos de Franco, aceptando un título dinástico que desde un enfoque legitimista no le correspondía. Sin duda, el dictador, que se aproximaba rápidamente a una senilidad mortal, veía a don Juan Carlos como un futuro jefe del Estado sin verdaderos atributos de poder, el cual detentaría uno de sus más fieles lugartenientes, el almirante Luis Carrero Blanco, desde el nuevo puesto de presidente del Gobierno. Carrero, considerado el cancerbero del edificio franquista, fue nombrado en junio de 1973 presidente del Gobierno en virtud de la Ley Orgánica del Estado de 1967, pero seis meses después fue asesinado por la organización terrorista vasca ETA, dejando al régimen sin un *delfín* político claro.

Se abrió entonces para don Juan Carlos el periodo más difícil en su larga marcha hacia el trono, ya que por una parte se ganó el desprecio de la mayoría de la oposición democrática española, incluidos los partidarios de su padre, que le consideraba un títere del dictador dispuesto a contribuir a la perpetuación del régimen autoritario y violador de libertades, y por la otra la hostilidad del sector franquista más duro, el popularmente llamado *búnker,* integrado por falangistas de la vieja guardia, que sospechaban -con razón- de unas ideas principescas secretas de corte liberal. Para socavar la posición del príncipe, la derecha más extrema del franquismo se dedicó a favorecer la causa de su primo el duque de Cádiz, don Alfonso de Borbón y Dampierre, primogénito del príncipe Jaime de Borbón (hermano mayor del príncipe Juan, quien había sido obligado a renunciar a sus derechos dinásticos por Alfonso XIII debido a su sordomudez, antes de nombrarse a sí mismo jefe de la Casa Real de los borbones en sus ramas española y francesa así como duque de Anjou y de Madrid) y de paso marido de la nieta mayor de Franco, María del Carmen Martínez-Bordiú.

2. Monarca de la restauración democrática en España

Postrado Franco por enfermedad, don Juan Carlos le sustituyó en la jefatura del Estado con carácter interino entre el 19 de julio y el 2 de septiembre de 1974, y nuevamente desde el 30 de octubre de 1975. El 20 de noviembre el dictador murió y el día 22, tras dos días de interinidad desempeñada por un Consejo de Regencia de tres miembros presidido por el presidente de las Cortes, Alejandro Rodríguez de Valcárcel y Nebreda, el príncipe fue proclamado rey de España por la cámara legislativa, lo que supuso la reposición de la monarquía borbónica tras el largo paréntesis que habían supuesto los ocho años de república parlamentaria y los 36 de dictadura unipersonal. La princesa Sofía de Grecia adquirió asimismo la condición de reina de España.

Cinco días más tarde, don Juan Carlos inauguró su reinado con una misa del Espíritu Santo en la iglesia madrileña de San Jerónimo el Real, que fue oficiada por el cardenal Vicente Enrique y Tarancón, arzobispo de la diócesis de Madrid-Alcalá, y a la que asistieron los presidentes de Francia, Valéry Giscard d'Estaing, y la

República Federal de Alemania, Walter Scheel. El acto litúrgico, con su ceremonia de la unción, equivalía a una coronación o exaltación al trono. El 14 de mayo de 1977 el conde de Barcelona, que había demostrado ser un hombre de convicciones democráticas, transfirió a su hijo sus derechos dinásticos y la jefatura de la Casa Real, una vez constatado el compromiso adquirido por don Juan Carlos en la restauración de la democracia en España.

La Constitución, sancionada en referéndum nacional y firmada por don Juan Carlos en diciembre de 1978, luego de aprobar las Cortes franquistas la Ley para la Reforma Política (en noviembre de 1976, una especie de *harakiri* político de los procuradores elegidos bajo la dictadura que abrió las puertas a la creación de instituciones democráticas) y de celebrarse las primeras elecciones generales pluripartidistas desde 1936 (en junio de 1977, que dieron la victoria al partido Unión de Centro Democrático, UCD), definía en su Título II las funciones apolíticas, representativas y protocolarias del rey, el cual perdió todo el poder ejecutivo heredado del sistema franquista y se convirtió en un monarca parlamentario y democrático al uso en Europa Occidental. El artículo 56 de la Constitución establece que "el Rey es el jefe del Estado, símbolo de su unidad y permanencia, arbitra y modera el funcionamiento regular de las instituciones, asume la más alta representación del Estado español en las relaciones internacionales, especialmente con las naciones de su comunidad histórica, y ejerce las funciones que le atribuyen expresamente la Constitución y las leyes".

Los artículos 62 y 63 enumeran las atribuciones concretas del monarca, la mayoría de tipo meramente procedimental: sancionar, promulgar y expedir las leyes y decretos aprobados por las Cortes y el Gobierno; convocar y disolver las Cortes, y convocar elecciones y referendos; proponer y nombrar el candidato a la Presidencia del Gobierno, siempre conforme a lo decidido por los poderes políticos del Estado; nombrar y separar a los miembros del Gobierno a propuesta de su presidente; ser informado de los asuntos de Estado y presidir, a estos efectos, las sesiones del Consejo de Ministros; ser el comandante supremo de las Fuerzas Armadas; previa autorización de las Cortes, declarar la guerra y hacer la paz; y, acreditar a los embajadores y otros representantes diplomáticos.

Don Juan Carlos dio reiteradas muestras de mesura e inteligencia a la hora de ejercer su autoridad sobre los acontecimientos políticos, sobre todo en el período preconstitucional de su reinado, tres años en los que pautó de una manera sutil pero firme la en extremo complicada transición a la democracia, que muchos temían pudiera desembocar en otro enfrentamiento fratricida como el de 1936-1939 si terminaba estallando la caldera donde se juntaban el terrorismo vasco, las reclamaciones autonomistas de los nacionalismos periféricos, las provocaciones de la extrema derecha política, el malestar conspirativo de los generales *azules*, las movilizaciones obreras y la aguda crisis económica.

Una de sus decisiones más elogiadas -aunque esta actitud se expresó más que nada a posteriori, ya que en el momento disgustó a la oposición democrática-, fue la de nombrar presidente del Gobierno en julio de 1976 a Adolfo Suárez González, hasta entonces ministro secretario general del Movimiento, en sustitución del ultraconservador Carlos Arias Navarro, quien obstaculizaba los planes reformistas del monarca. Suárez se reveló como un reformista liberal que, con la confianza que le inspiraba saberse respaldado por el monarca, se lanzó al desmontaje del aparato legal del franquismo desde dentro, valiéndose de sus propios instrumentos normativos, y con el consenso de las principales fuerzas políticas por encima de las diferencias ideológicas. El Gobierno de Suárez lanzó la Ley para la Reforma Política, devolvió a la legalidad a los partidos de la izquierda y convocó las primeras elecciones democráticas.

Entre 1977 y 1982 don Juan Carlos ejerció su reinado sobre dos legislaturas, la primera constituyente, en las que el Gobierno estuvo en manos de la UCD de Suárez y de su breve sucesor, Leopoldo Calvo-Sotelo Bustelo. El monarca volvió a sobresalir con motivo del intento de golpe de Estado militar del 23 de febrero de 1981, perpetrado semanas después de presentar Suárez la dimisión como presidente del Gobierno, cuando intervino en la defensa del orden legal establecido. Su aparición en la televisión en la madrugada del 24 de febrero, vestido con el uniforme de capitán general de los tres Ejércitos y advirtiendo que la Corona "no puede tolerar, en forma alguna, acciones o actitudes de personas que pretenden por la fuerza interrumpir el proceso democrático que la Constitución votada por el pueblo español determinó en su día a través de referéndum",

tranquilizó a una población presa del miedo y resultó decisiva para la rendición a las pocas horas de los generales sediciosos que confiaban en obtener el plácet del monarca, uno de los cuales, Alfonso Armada Comyn, había sido su profesor y, durante doce años, su secretario.

El fracaso del *23-F* supuso un punto de inflexión que consolidó definitivamente la democracia española y la imagen del monarca dentro y fuera del país. Significativos fueron los elogios dirigidos a don Juan Carlos por el secretario general del Partido Comunista (PCE), Santiago Carrillo Solares, quien en 1975 le había colgado el apodo de *El Breve*. En los años siguientes, don Juan Carlos, sin desempeñar ya ningún papel aparente en la política nacional, recibió varios premios y distinciones, y su ejecutoria fue citada a menudo como ejemplo a seguir en hipotéticos escenarios de restauración monárquica en repúblicas que afrontaban una transición desde la dictadura a la democracia. La referencia española estuvo muy presente en los movimientos legitimistas, en su mayor parte muy poco consistentes, emprendidos por varias casas reales sin trono de la Europa del Este a raíz de los sucesos revolucionarios de 1989, en particular la búlgara, que encabezaba el rey exiliado en España Simeón II, a la sazón un buen amigo del borbón.

Por otro lado, con sus numerosos viajes al exterior, en los que ejerció como un verdadero embajador de la nueva realidad política española, el rey prestó una ayuda inestimable para la recuperación o el fortalecimiento de las relaciones con áreas geográficas de especial importancia para la política exterior de un país que quería modernizarse y romper con su aislamiento internacional. Aquellas eran América Latina, Oriente Próximo y el bloque norteño occidental, con la Comunidad Económica Europea y Estados Unidos a la cabeza.

Muchas fueron las giras y visitas regias que revistieron una dimensión histórica o que entrañaron una especial significación para la diplomacia española. Bajo los gobiernos de Suárez don Juan Carlos y doña Sofía viajaron a la República Dominicana, la sede de las Naciones Unidas en Nueva York, Colombia, Venezuela y Francia en 1976; al Vaticano, Egipto, Jordania, Arabia Saudí, Alemania Occidental, Bélgica y los países centroamericanos en 1977; a Austria, Portugal, Irán, Irak, la República Popular de China, México, Perú y Argentina en 1978; a África Occidental, Marruecos, Suiza y Suecia en 1979; a Dinamarca, Países Bajos, Luxemburgo, Ecuador, Japón, Indonesia y Kuwait en 1980; a Italia y Estados Unidos en 1981; y a India, Noruega y nuevamente Arabia Saudí y Estados Unidos en 1982.

Durante los gobiernos socialistas de Felipe González Márquez, entre 1982 y 1996, los monarcas se desplazaron a Argelia, Túnez, Zaire, Brasil y Uruguay en 1983; a Canadá y la URSS en 1984; a Rumanía y Yugoslavia en 1985; al Reino Unido, Irlanda, Nigeria y Zimbabwe en 1986; a Bolivia, Puerto Rico, Hungría, Checoslovaquia y Tailandia en 1987; a Australia y Nueva Zelanda en 1988; a Polonia y Finlandia en 1989; a Chile y Paraguay en 1990; a Bulgaria, Turquía e Israel en 1993; y a Filipinas y Malasia en 1995. En la primera legislatura del Gobierno del Partido Popular (PP), encabezado por José María Aznar, los reyes estuvieron, por citar sólo los desplazamientos más destacados, en Rusia (mayo de 1997) y Cuba (noviembre de 1999), último país latinoamericano que les quedaba por visitar, con motivo de la IX Cumbre Iberoamericana que tuvo lugar en La Habana.

Monarca campechano y popular, aficionado a los deportes acuáticos (en 1972 compitió como tripulante de un velero de la clase Dragón en los Juegos Olímpicos de Munich), al esquí y a los vehículos potentes, Juan Carlos I disfrutó en todos estos años de una alta consideración en su país, donde todo lo referente a la familia real solía ser difundido con acentos elogiosos. Pese al encomio generalizado, algunas voces representativas de los pequeños sectores republicanos, ligados a partidos de izquierda, criticaron el carácter "intocable" de los Borbones, ya que si la prensa española no dejaba de hacerse eco de los escándalos y chismes que rondaban a las demás familias reales europeas, esta actitud, destilando mordacidad y un cierto regodeo comparativo, se cortaba en seco cuando tocaba hablar de las actividades de la realeza local, habitualmente retratada disfrutando de períodos vacacionales en el palacio veraniego de Marivent, en Palma de Mallorca, o en las estaciones invernales de Baqueira-Beret y Candanchú, en el Pirineo.

Ahora bien, podía observarse que incluso entre aquellos que consideraban a la Monarquía una institución

anacrónica existían un respeto y una simpatía por la persona del inquilino del Palacio de la Zarzuela, debido a su papel histórico en la transición y a su talante afable próximo al del pueblo, ajeno a las complacencias palaciegas o aristocráticas, un fenómeno que algunas veces se ha denominado *juancarlismo*.

La prensa española, asimilando el secretismo que a veces emanaba de la Casa Real, pasó de puntillas -o directamente, corrió un tupido velo- sobre aspectos de la actividad del monarca, algunos no meramente anecdóticos, susceptibles de crítica y controversia, que fueron aventados por canales del exterior. En octubre de 1996 medios internacionales se hicieron eco de un telegrama enviado desde el avión que transportaba al rey a Corea del Sur, mientras sobrevolaba esta antigua república soviética, al "presidente Stanislau Shushkevich" de Bielarús; en realidad, Shushkevich no era presidente del país desde hacía dos años, siendo ahora un mero diputado, y en la oposición a su autoritario sucesor, Alyaksandr Lukashenko; divertido por la equivocación, Shushkevich aseguró que pensaba conservar el mensaje como un "*souvenir*".

Justo una década después, en octubre de 2006, periódicos rusos difundieron una carta enviada por un funcionario de protección cinegética de la región de Vologda en la que se denunciaba que el monarca español había abatido "de un solo disparo" un oso "emborrachado con vodka y miel" en un cacería organizada por autoridades locales en el mes de agosto, en el curso de una visita privada del rey a Rusia en la que tuvo un encuentro en su residencia vacacional con el presidente Vladímir Putin. El denunciante añadía que don Juan Carlos ignoraba que la cacería estaba amañada con la suelta de este oso amaestrado y embriagado, y culpaba de lo sucedido al vicegobernador regional y a su jefe del Servicio de Protección de los Recursos Naturales de Vologda.

El servicio de prensa de la Casa Real negó tajantemente a la agencia Associated Press que el rey hubiese cazado osos o cualquier otro animal durante su estancia en Rusia (que no fue consignada en el historial público de viajes al exterior del monarca), y tachó de "ridícula" la información. Sin embargo, el gobernador de la región ordenó una investigación para esclarecer el hecho. La afición cinegética del rey ya había levantado una considerable polémica en octubre 2004 en Rumanía, donde participó en una batida costeada por cuatro cazadores estadounidenses en la que se mataron nueve osos jóvenes, una osa gestante y un lobo. La cacería de estas dos especies protegidas, realizada en el condado carpático de Covasna, concitó airadas críticas de políticos y ecologistas rumanos.

3. Sucesión de controversias regias en 2007

El 10 de noviembre de 2007 el rey de España adquirió un protagonismo nacional e internacional desconocido desde el 23-F, sucedido hacía ya 26 años, con motivo de una polémica actuación suya en el cierre de la XVII Cumbre Iberoamericana, en Santiago de Chile. Fue en el momento en que el presidente del Gobierno español -desde 2004-, el socialista José Luis Rodríguez Zapatero, salía al paso de unas duras palabras pronunciadas minutos antes por el mandatario de Venezuela, Hugo Chávez, en las que acusó al ex presidente Aznar de haber apoyado el fracasado golpe de Estado antichavista de 2002 y le tildó reiteradamente de "fascista"; Chávez, fuera de su turno de intervención y sin micrófono, interrumpía constantemente la réplica de Zapatero para defender a Aznar y exigir respeto a las diferencias ideológicas, lo que hizo enderezarse en su sillón al monarca, quien, visiblemente irritado, se dirigió al venezolano para espetarle con un sonoro "¿por qué no te callas?".

Poco después, el rey, decidiéndolo sobre la marcha con Zapatero y el ministro de Exteriores, Miguel Ángel Moratinos Cuyaubé, se levantó y abandonó la sala como gesto de protesta por la alocución del presidente de Nicaragua, Daniel Ortega, quien arremetía contra la eléctrica privada española Unión Fenosa por operar en su país "con tácticas gansteriles" y acusaba a "embajadores españoles" de haber intentado interferir en las elecciones nicaragüenses del año anterior contra las posibilidades de victoria del Frente Sandinista de Liberación Nacional (FSLN). El monarca regresó a la sala antes de la clausura de la cumbre.

Estos dos gestos sin precedentes, el primero espontáneo y el segundo reflexionado, de don Juan Carlos, que nunca antes había sido visto enojado en público y menos, lógicamente, encararse con un dignatario

La crisis en España deja a inmigrantes por los suelos

La crisis económica en España ha devastado a la comunidad inmigrante enormemente en cuestiones económicas, especialmente a los inmigrantes rumanos, marroquíes y ecuatorianos. Como es una crisis económica mundial, también ha afectado a varios países de la Unión Europea. Tomando esto en cuenta, los inmigrantes proveniente de Romania, Marruecos, Ecuador y entre otros han emigrado a España ya no tiene muchas opciones hacia donde partir.

El gobierno Rumano se ha asociado con oficinas de desempleo Españolas para apoyar a su gente y para incentivarlas a regresar a su país (De vuelta a… 2). Sin embargo, esto no ha motivado a la mayoría ya que unos aseguran que la corrupción del gobierno Rumano es increíble y no confían en él. También toman en cuenta la situación global y dudan que les vaya mejor en su país de origen (Me quiero marchar…1). Pero algunas personas se sienten optimistas y dicen que regresaran porque les irá mejor ya que ahí tienen propiedades y familiares que les puedan ayudar (De vuelta a… 2).

Sin duda alguna esta crisis ha hecho que la mayoría de los emigrantes toquen fondo. Tal como los rumanos, los ecuatorianos también han sido devastados. Tristemente la situación ha obligado a muchos a tomar como solución el volver a Ecuador y a renunciar a sus documentos de residencia. Se les perdonaría también los impuestos sobre las cosas que se lleven a su país de origen. También en el programa que los gobiernos de Ecuador y España crearon, "bienvenido a casa," les libra de impuestos por cinco años a los que se acojan a él y además recibirán siete mil dólares para adquirir una casa (La crisis económica española…). Sin embargo, renunciar a sus documentos de residencia es lo que les impide a muchos ecuatorianos volver a su patria (Me

quiero marchar… 1). Adquirir dichos documentos se demora mucho tiempo y esfuerzo, lo cual no se olvida rápidamente y de hecho no lo dejaría ir uno tal fácilmente (La crisis económica española… 0:25min).

Esta crisis les ha afectados a los inmigrantes no solo económicamente sino también moralmente y emocionalmente. Muchos se sienten solos y deprimidos porque se han de sentir derrotados. No hay que olvidar que muchos no tienen a quien acudir, lo cual los hace vulnerables a chantajes y abusos.

Por favor use doble espacio.

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¿recuerdas de nuestra clase de traducción como este "toma" es un anglicismo?

2.

2.5

+ Buen análisis
- fuentes en el texto de apoyo
- mencionar los planes de vuelta a casa.

Fuentes de informacion

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Llorente, Rebeca. ""Me quiero marchar porque aquí, sin trabajo, no soy nadie." EL PAIS edición empresa. 19 Jan. 2009. 19 Jan. 2009. <http://www.elpais.com/articulo/Comunidad/Valenciana/quiero/marchar/trabajo/soy/nadie/elpepiespval/20090119elpval_1/Tes>.

Dos ciudades ejemplares

Las siguientes ciudades de Latinoamérica son primero que nada singulares, en aspectos que no todas las bellas ciudades tienen en común. También, nos enseñan que cuando hay dedicación y esfuerzo se puede conseguir muchas cosas. Además, se necesitan líderes que ejemplares, literalmente. Estas dos ciudades, Guayaquil de Ecuador y Curitiba de Brasil, son ciudades que con diferentes métodos de implementación han conseguido la admiración mundial por ser ciudades ~~en primer lugar~~ de primer orden en todos los aspectos.

desorden

La ciudad de Guayaquil localizada en la orilla este de Ecuador fue por mucho tiempo una ciudad ~~abundada por mal~~ vivientes. El artículo, La nueva cara de las Américas, menciona que típicamente los que visitaban las islas Galápagos procuraban no que quedarse más de lo necesario en la ciudad por miedo a ser asaltados (La nueva cara... 6). Sin embargo, esto cambió por el bien de la ciudad, especialmente por la seguridad de todo aquel que pisara sus suelos. Al igual que Guayaquil, la ciudad de Curitiba al Sur de Brasil sufría de varios problemas de crecimiento desorganizado, contaminación y problemas de transporte público, sólo para mencionar algunos.

Las dos ciudades tenían problemas que resolver, pero cada una tomó un rumbo distinto de cómo resolver los problemas. En Guayaquil, los funcionarios municipales fueron los que iniciaron el ambicioso proyecto de la revitalización urbana que incluyó limpiar los barrios decaídos, agregar atracciones turísticas, modernizar el aeropuerto, reforzar la seguridad y transformar a la ciudad en una metrópolis con un arenoso puerto marítimo (La nueva cara.. 6). En Curitiba el cambio empezó antes y de otra forma. Todo empezó con la creación de la entidad,

IPPUC, que se encargaría de llevar a cabo el Plan Maestro. El plan consistía de renovar parte de la ciudad para que luego los residentes decidieran si les gustaba o no. Luego se necesitó del entusiasmo de profesionales que tomarían decisiones técnicas y políticas, entre ellos Jaime Lerner que después de tomar la alcaldía jugó un papel crucial en la renovación de la ciudad (Lecciones de Curitiba 1-2).

La primera ciudad, Guayaquil, estaba lista para empezar la renovación de un solo golpe porque los gobernadores de la ciudad no eran corruptos como lo son muchos de las ciudades de Latinoamérica. Esto fue un factor significativo ya que el dinero asignado para cada aspecto del plan se respetó y fue utilizado eficazmente. Aquí el dinero del pueblo fue usado solo para el pueblo. La gente estuvo de acuerdo con el plan e hizo el esfuerzo en colaborar con el gobierno para llevarlo a cabo. Fue significativo enlistar las cosas que se hicieron para actualizar a la ciudad porque esto fue lo que le trajo la admiración pública y la buena economía a esta.

Ya que la ciudad cambió de vista y de seguridad, la gente que visitaba las Islas Galápagos ahora podía quedarse en la ciudad sin ninguna preocupación y al mismo tiempo visitar los nuevos centros de atracción. Esto acarreó más turismo, no solo para las islas, sino también exclusivamente para la ciudad. Es más, la ciudad fue nombrada una de las mejores ciudades del mundo por su magnífica transformación y por ser consciente del medioambiente. Otra cosa muy importante que no se puede pasar por alto es que los gobernantes de la ciudad motivaron a los residentes a contribuir a dicha restauración. Es de relevancia mencionar esto, ya que cuando alguien hace algo, lo valora aun más y lo procura mantener intacto.

En la ciudad de Curitiba, los gobernadores tomaron un poco más de tiempo para completar el Plan Maestro, pero el modo que se enfoco el plan fue magnífico. La estrategia del alcalde de poner un ejemplo para la gente de cómo se vería la ciudad fue riesgosa. Pudo haber

pasado dos cosas; uno, que los ciudadanos después de llegar del feriado no lo hayan visto la nueva avenida como algo estupendo y que de tal forma se haya perdido una gran cantidad de dinero, o dos, como ocurrió que la gente quedó pasmada y quiso seguir el ejemplo en sus colonias.

A petición de la gente, IPPC seguido con el plan de restauración. Fue un plan sumamente ambicioso pero con resultados nunca antes vistos. Fueron en parte pioneros de "la ciudad ecológica" ya que empezaron con el pie derecho en este sector. Es elemental recalcar que mucho de sus méritos son por ser una de las pocas ciudades con sistemas avanzados de reciclaje, y no solo eso sino que esto empezó hace casi cuarenta años y hasta hoy en día muchas de las ciudades modernas no le llegan a los talones a Curitiba en este sector.

Las dos ciudades cuentan con muchas zonas verdes, que son atractivo para los turistas y lugares recreacionales para los habitantes de estas. Estas zonas aportan a la ciudad en términos de mantener a una población más saludable física y mental. Casi todo esto fue posible con la ayuda económica de las respectivas ciudades y con la dedicación de sus residentes. Otra característica que une a estas dos ciudades es que se ha enriquecido con bibliotecas y al mismo tiempo con ciudadanos cultos. Es posible decir que las dos ciudades se saltaron la etapa de ser una ciudad semi-moderna, empezando de ser terrible a ser una "utopía".

Sin duda alguna, muchos de los críticos que dicen que estas ciudades son ejemplares no se equivocan en lo absoluto. Las dos ciudades han acortado la distancia entre las clases sociales drásticamente, y por decirlo así se han deshecho de casi todo lo despreciable que desnutría a la ciudad. Ahora gozan de una estable economía y de una fama mundial.

Dos ciudades ejemplares

Las siguientes ciudades de Latinoamérica son primero que nada singulares, en aspectos que no todas las bellas ciudades tienen en común. También, nos enseñan que cuando hay dedicación y esfuerzo se puede conseguir muchas cosas. Además, se necesitan líderes que ejemplares, literalmente. Estas dos ciudades, Guayaquil de Ecuador y Curitiba de Brasil, son ciudades que con diferentes métodos de implementación han conseguido la admiración mundial por ser ciudades ~~en primer lugar~~ de primer orden en todos los aspectos.

desorden

La ciudad de Guayaquil localizada en la orilla este de Ecuador fue por mucho tiempo una ciudad ~~abundada por mal~~ vivientes. El artículo, La nueva cara de las Américas, menciona que típicamente los que visitaban las islas Galápagos procuraban no que quedarse más de lo necesario en la ciudad por miedo a ser asaltados (La nueva cara... 6). Sin embargo, esto cambió por el bien de la ciudad, especialmente por la seguridad de todo aquel que pisara sus suelos. Al igual que Guayaquil, la ciudad de Curitiba al Sur de Brasil sufría de varios problemas de crecimiento desorganizado, contaminación y problemas de transporte público, sólo para mencionar algunos.

Las dos ciudades tenían problemas que resolver, pero cada una tomó un rumbo distinto de cómo resolver los problemas. En Guayaquil, los funcionarios municipales fueron los que iniciaron el ambicioso proyecto de la revitalización urbana que incluyó limpiar los barrios decaídos, agregar atracciones turísticas, modernizar el aeropuerto, reforzar la seguridad y transformar a la ciudad en una metrópolis con un arenoso puerto marítimo (La nueva cara.. 6). En Curitiba el cambio empezó antes y de otra forma. Todo empezó con la creación de la entidad,

IPPUC, que se encargaría de llevar acabo dicho Plan Maestro. Luego se necesitó del entusiasmo de profesionales que tomarían decisiones técnicas y políticas, entre ellos Jaime Lerner que después de tomar la alcaldía jugó un papel crucial en la renovación de la ciudad (Lecciones de Curitiba 1-2).

¿cual?

Pero en los dos casos hubo personas interesadas con la capacidad de trabajar para el cambio.

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¿y donde está la lista?

Ya que la ciudad cambió de vista y de seguridad, la gente que visitaba las Islas Galápagos ahora podía quedarse en la ciudad sin ninguna preocupación y al mismo tiempo visitar los nuevos centros de atracción. Esto acarreó más turismo, no solo para las islas, sino también exclusivamente para la ciudad. Es más, la ciudad fue nombrada una de las mejores ciudades del mundo por su magnífica transformación y por ser consciente del medioambiente. Otra cosa muy importante que no se puede pasar por alto es que los gobernantes de la ciudad motivaron a los residentes a contribuir a dicha restauración. Es de relevancia mencionar esto, ya que cuando alguien hace algo, lo valora aun más y lo procura mantener intacto.

Sí, muy bien

En la ciudad de Curitiba, los gobernadores tomaron un poco más de tiempo para completar el Plan Maestro, pero el modo que se enfoco el plan fue magnífico. La estrategia del alcalde de poner un ejemplo para la gente de cómo se vería la ciudad fue riesgosa. Pudo haber pasado dos cosas; uno, que los ciudadanos después de llegar del feriado no lo hayan visto la nueva avenida como algo estupendo y que de tal forma se haya perdido una gran cantidad de

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Sin duda alguna, muchos de los críticos que dicen que estas ciudades son ejemplares no se equivocan en lo absoluto. Las dos ciudades han acortado la distancia entre las clases sociales drásticamente, y por decirlo así se han deshecho de casi todo lo despreciable que desnutría a la ciudad. Ahora gozan de una estable economía y de una fama mundial.

2.5

Está bien Jorge, pero un poco desorganizado, de la revolución que va de donde sale hes de un lugar a otro.

Fuentes de Information

"La nueva cara de Guayaquil." Americas (Octubre 2008): 6-13.

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Raúl Alfonsín

Raúl Alfonsín es considerado el mejor presidente que haya tenido Argentina por sus logros después de la dictadura militar que sufrió el país. Muchos colegas del ex mandatario están de acuerdo que Alfonsín hizo lo que pudo para re establecer la democracia en Argentina y así lográndolo en un periodo muy difícil. Tuvo muchos problemas que tuvo que superar para lograr su meta. Por sus logros, muchos incluyendo opositores consideran a Alfonsín como uno de los líderes políticos más importantes para democracia Argentina y otros países.

Alfonsín no sólo tuvo influencia es su país, pero también en los países vecinos que aun no gozaban de la democracia. En Argentina luchó para reintegrar la democracia y de hacer justicia en el país. Tuvo el valor de enjuiciar a los líderes militares que tuvieron la mayor culpa de aterrorizar al país y de cometer atrocidades a los derechos humanos. Alfonsín mandó a la prisión con cadena perpetua a 15 militares acusados de 30.000 asesinatos y desapariciones (Visión Política 1). No pudo condenar a todos los que participaron en estas atrocidades por presiones y rebeliones lo que lo obligó a dictar la Ley de Obediencia Debida (Visión Política 2). Esta ley salvó a aquellos que tenían un rango inferior y que actuaron por obligación y no por decisión propia.

Aun con estas honorables acciones a la democracia, el pueblo no estaba muy contento ya que la economía estaba por los suelos, que fue lo que afecto la presidencia de Alfonsín. La inflación había subido demasiado, del 10% hasta el 80% lo cual causó que el mandatario renunciara a su cargo cinco meses antes de su término (Murió Raúl… 3). Su sucesor fue Carlos Menen quien fue elegido democráticamente por el pueblo desde 1916 (Murió Raúl 3).

Aunque tuvo muy poca influencia en la economía Argentina, Alfonsín si trato de reunificar al Cono Sur por medio de un mercado que fue Mercosur (Mercado Común del Sur). En este mercado se unieron Argentina, Paraguay, Uruguay y Brasil. Y para hacer paz con Chile con el cual casi entra en guerra en 1978, arregla el trazo del Canal del Beagle (Murió Raúl… 3). Ahora Argentina estaba en paz con sus vecinos lo que le quitaba un peso menos a los problemas del país. Ahora el problema era recuperar la economía, una lucha que Alfonsín ya perdía.

¿qué? (recuerda que están escribiendo, no hablando)

No obstante, hoy en día muchos todavía lo consideran como un líder transparente y muy honesto que luchó hasta el final. Durante su término, Alfonsín tuvo que lidiar con la presión del pueblo, quien no sabía que también el ejército lo presionaba. Él tuvo que satisfacer de una manera u otra a los dos bandos para mantener un tipo de equilibrio. Para hacer esto, el líder tuvo que separar a los que estaban con sus ideales de los que simplemente están corrompidos para así tener un mejor control de la situación. La meta era de adquirir y mantener el "bien mayor" (El testimonio de un aliado 3).

mandato / gobierno

?

Hasta sus opositores estaban de acuerdo que Alfonsín hizo un buen trabajo tomando en cuenta cual fue la situación durante su mandato. Uno, en la defensa del ex mandatario dijo que "a veces acertar con algunas decisiones y otras veces equivocarse. Pero no fueron desaciertos: fueron errores propios del que actúa en la política (El testimonio de un opositor 2)." Aquí el opositor reconoce que estar en la política es algo difícil y que todo aquel que esté en un puesto comete errores. Esto no quiere decir que por cometer unos cuantos errores ya no es ser un buen líder. Muchas veces unas decisiones que parecen ser buenas terminan siendo fracasos, ya que el pueblo no reacciona como se había previsto. En situaciones difíciles muchas veces parece ser como un juego de ajedrez donde el balance es muy frágil y donde cada movimiento es sumamente importante.

¿quién?

Igual que muchos el opositor también está de acuerdo que Alfonsín junto a Perón, fue uno de las dos grandes figuras del siglo XX. Alfonsín se ganó el respeto de muchos por su honestidad y ansia de luchar por el bien mayor. Su meta fue re establecer el orden en Argentina y así lo hizo.

2.5

Tu composición está más o menos organizada y tiene unos pocos aspectos. Hay algunos aspectos como la repetición de palabras innecesarias que me gustaría que cuidaras más en tu composición final.

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