

Blinded by Science: Scientists, their Experiments, and Societal Perception of their Ethics

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Introduction

History would suggest that the Scientist conducting an experiment is nothing more than a theatrical presentation. In viewing Joseph Wright's painting "An Experiment on a Bird in the Air Pump" (Refer to Appendix A), one can feel the stage presence of the all knowing scientist as he assumes a god-like power over the fragile life of an unsuspecting bird and, as reflected in the different attitudes of the spectators in the painting, the degrees of interest, awe, distaste, and/or ambivalence of "society" as to what will occur next. This particular painting exemplifies the notion of the scientist assuming the role of performer while society is given the task of wide-eyed, enthralled observer. Throughout the ages scientists have entertained and amazed their audience with the execution of their studies and experiments. Few scientists were or are capable of funding their own research and realize that in order to continue the works of "progress"-one must play upon the curiosity and generosity of their supporters.

Background

This is my tenth year as a high school science teacher. I received undergraduate degree in Biology and worked in food labs doing quality control and research and development for about 10 years before deciding to pursue a master's degree in education to become a science teacher. My previous experience of working in a laboratory as a scientist has been invaluable in being able to offer practical real-life examples as well as wanting to provide hands-on activities for my students. My past experiences have also allowed me to be able to better relate to science and to scientists. Just as life experiences can shape the views and productivity of artists, scientists can likewise be influenced by their environment and the societal climate of their time. This is the reasoning for me to not only expect my students to learn about the scientists' experiment, but also his or her life, background, and the social climate.

I have taught at my current assignment for 7 years now. My school has a population of about 1900 students, 54% on free and reduced lunch. 25% Caucasian, 49% African American, 5% Asian, 16% Hispanic, <1% American Indian, and 4% Multiracial students attend my high school. We have a large population of EC (exceptional child) students, an IB (International Baccalaureate) program, and offer Honor's and AP

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(Advanced Placement) programs. We are a very diverse school population which I think makes our school a good atmosphere for preparing them for real world experiences.

One of my most rewarding teaching experiences has been working with my ESL (English as a Second Language) students in the SIOP Program. SIOP stands for Sheltered Instructional Observation Protocol. This program is designed for those students that have limited English language proficiency and have recently come to the United States from their native country or are living in households where their primary language is not English. One of the main focuses of SIOP is to provide the ESL students with a “sheltered” environment as they transition into American culture from their native country. I try to achieve an atmosphere of safety and belonging by establishing early on that each member of the classroom has the right to learn and express his or her own opinions and we must be respectful of each others pacing and style of learning. SIOP stresses the effectiveness of differential instruction, cooperative learning, and the use of multiple intelligences. I have several different languages represented in my classroom. I have several students who are Spanish speakers, Vietnamese, and Russian students. I allow these groups to work together to help with translations and peer tutoring because I am aware of the importance and significance of mixing up the groupings, this forces them to strengthen their English speaking skills. We use picture dictionaries and I have found websites and web quests that can be converted into Spanish and other languages. I want these students to be a not only cultivate their use of the English language through writing and research, but also assist them in becoming more comfortable speaking in class with their peers. These students are very creative and have rich experiences to contribute to the class, but they tend to be shy when it comes to reading aloud or speaking in front of their classmates. I feel that the first part of my unit will be best suited for these students because they will be able to research and present their work while expressing their own unique creativity.

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My next group of students is in my Honor’s Biology Class. This class consists of 28 students ranging in grades from 9-12 and age’s 14-17. These students are ethnically diverse: Multi-racial, White, Black, Asian, and Hispanic. Most of the students are selected for this class based on previous math and other test scores as well as teacher recommendations based on their status as AG (academically gifted) and/or participation of the IB (International Baccalaureate) Program. This wide diversity of students, would contribute to quality and depth of the Socratic discussions. These students would be able to contribute their different viewpoints on the chosen topics for their discussions. This class is very vocal, social; they enjoy having discussions and sharing their opinions. These students benefit from any additional rigor and challenge incorporated into the standard curriculum which will provoke them to think, reason, and make connections with what they are learning. My goal for these students is to have them research the ethical issues related to viewed excerpts from selected movies (refer to appendix C) and discuss their findings in a Socratic Seminar format. This format will provide an avenue

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for my students to apply what is being taught in the classroom and how it impacts society's views and influences. Real-life application of these concepts will reinforce learning and enable my students to develop critical thinking and process skills needed later for college and life in general.

Rationale

In the article, "Towards conceptual understanding: bringing research findings into the lecture theatre in tertiary teaching", Pauline Moss states, "The aim of science education is to help students develop a deep understanding of abstract concepts...Factors which have been shown to influence student learning are student motivation and understanding by the teacher of 'what the learner is doing', rather than 'what the teacher is doing'" (52). Moss goes on to express that students come into the classroom with a prior knowledge of what he or she perceives to be "right" or "wrong" and that as they continue, they begin to realize that there are "multiple possibilities of knowledge and personal interpretation". Most students benefit from hands-on activities and experiences. By incorporating a theatrical component into the science classroom, it is my goal to not only foster inquiry and a basic understanding of abstract concepts, but continue the already established legacy of the scientist "on stage" enthraling the onlooker with his or her craft. The ultimate coup would be to reveal to each individual student that he or she is capable of sharing that stage as we study and do science, we are scientists as well. Carl Djerassi in the essay *Contemporary 'Science-in-theatre': a rare genre* shares his reason for combining the disciplines of science and theatre, "I want to use fiction to smuggle scientific facts into the consciousness of a scientific illiterate public-because the majority of scientifically untrained persons are afraid of science...Instead of starting with the preamble 'let me tell you about my science', I prefer to start with the more seductive 'let me tell you a story' and the incorporate real science and true-to-life scientists into the tale." Today's students are much more motivated by what they observe and do than by merely listening to and repeating what they hear in a classroom lecture especially if they are able to relate what they are learning to their own lives and life experiences.

Another component that I would like to include in this unit on Scientists and their experiments is how society views the ethics and the knowledge gained from the Scientist's research-for the good or the bad of mankind. The issue of ethics is a complicated one. Scientific ethics is not about society's morals, but more about the responsible execution of the Scientist's ideas and experimentation. In *The Ethical Responsibilities of Scientists*, Gardner observes that the traditional restraints regarding the misapplication of science has been; the values of the community-particularly religious values, the law-right versus wrong from a legal standpoint, and the higher sense of calling or ethical standards of the scientific profession or community. Gardner gives examples of the consequences of rejecting these restraints such as the testing of individuals by the Nazis and the creation of the atomic bomb. Students need to realize

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that the pursuit of knowledge needs to be tempered by the responsibility of the Scientist. Gardner ends his article by proposing a covenant that should be honored by the Scientist and society, “a new covenant must be formed between the scientist and the society. Society makes it possible for scientists to proceed with their work—by the funding of science and also by cooperation in its execution. In return, scientists must relinquish the once-justifiable claim that they have no responsibility for applications and undertake a good faith effort to make sure that the fruits of science are applied wisely, and not foolishly.”

My original purpose of generating this unit is to support students’ knowledge and comprehension of scientists, their lives, their discoveries, and their impact on society through the vehicle of dramatic presentation. Initially, my focus for this lesson was my English as Second Language students as a way to reinforce their vocabulary skills, broaden their options for expression, and as a means of alternate assessment. Upon further consideration, I can now see the application of these areas in my inclusion, general, and Honor’s courses. I am excited to see what creative efforts will emerge from my students as they study these scientists and are able to resurrect these individuals with a better sense of understanding and relevancy of the content as it relates to the course curriculum for Biology. My primary goal is to align my instruction with the North Carolina Standards for Science. The first strand of science is that it needs to be taught as *Science as a Human Endeavor*-What is its relevancy? What impact does it have on our society- then and now? The next strand is *Science as a Vocation*- Who are these scientists? How do we relate to them as individuals, artists, and technicians. Another strand involves the *Historical Perspectives of Science* – What processes occurred that led to the scientific discovery? What else was going on in history during that time? Lastly, in the North Carolina Standards for Biology, the *Personal and Social Perspectives of Scientific Investigations, we will explore*- Is the science pure evil, genius, or both? What are the ethical implications of each discovery and their impact on society?

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Objectives

I would like to be able to construct a unit which will address Scientists, their experiments, and their ethical responsibility to society while allowing my students to take ownership of their learning and creative expression. The classes that I teach include a variety of levels and learning styles, I want to differentiate this unit in order to accommodate these differences. My first Biology class is SIOP (Sheltered Instructional Operational Protocol) Biology- these students are Limited English Proficiency and/or have English as a Second Language. The SIOP model stresses the use and incorporation of the English language through reading, writing, and speaking. The first activity that I have suggested will be an excellent venue for these students to better develop their English language skills and create more confidence in the classroom... I want to focus more for this class on assigning a list of prominent Scientists in Biology such as Mendel, Darwin, Pasteur, or Linnaeus, and have the students research their lives and their experiments. Next I want to encourage

these students to “act out” what each scientist did as it relates to what we are studying in Biology. The “dramatic presentations” do not have to be long or extensive (refer to appendix B); I want the students to be able to express their own interpretation and understanding as well as receive feedback from their peers. I feel that this will foster a more inquiry based approach to learn about what these Scientists did rather than rote memorization. Another benefit for this class is that the assignment will focus on their thought and ideas rather than their literacy abilities.

Another Biology course that I teach is Inclusion Greenhouse Biology- in this class I have a high percentage of EC (Exceptional Children) who have any combination of learning or behavioral disabilities. In Greenhouse Biology, I have the students for two semesters the first semester covers the curriculum while focusing more and plants and the second semester focuses on the rest of the Kingdoms while reinforcing the curriculum as a whole. These students would definitely benefit from the research aspect of this unit, but I feel that they would be much more interested in the theatre component. Many of my inclusion students have some form of attention deficit and have a need for more kinesthetic activities. Being able to dramatize and perform an experiment would not only captivate, but would also sustain their attention while learning the basic concepts needed to complete this course. I also want to have a general class discussion on the ethical consequences of the Scientist and their discovery. This discussion will be more beneficial after the Scientist because the students will have newly acquired background knowledge as well as the “expertise” of knowing about their particular Scientist that they had already researched.

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The next level of Biology that I teach is Honor’s Biology. This particular class contains a high level of students who are classified as AG (Academically Gifted) and require coursework which will be more of a challenge. This class will benefit from a more in depth discussion of scientific ethics versus societal views of science. For this class, I would like to chose excerpts from several of the plays that we have covered in this seminar and have the students research and discuss their views on the ethics of scientists and what they do. The Honors students will benefit from this discourse because many of the even though they are very opinionated, have not been afforded the opportunity to think about these issues and be able to share their insights with their peers in a guided format. As dictated by the North Carolina Department of Instruction, honors courses must provide rigor and a high level of inquiry based instruction in addition to covering the general curriculum for the course. Exploring the ethical aspects of science as well as societal views would be a wonderful vehicle stimulate conversation and encourage these students to constructively think for themselves as they are provided various view and insights.

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Objectives

Unit Part One

I have found some sites that I have found helpful in providing the students with basic information concerning each of the assigned scientists and well as some interesting anecdotes that will hopefully enable them to construct a dramatic piece which they will be able to enact before their classmates (refer to appendix B, parts 1,2). In the research and production of their project, the students will be expected to answer the following questions:

1. Who is this scientist? What is she/he really like?
2. What accomplishment(s) to science did he or she make?
3. What impact did this scientist and the discovery have on society- then and now?
4. What ethical issues or concerns did this scientist and his or her experiment raise?
5. How does this discovery relate to the topics that we are studying in our Biology class?

Students will be given a list of the prominent scientists that will study in Biology which will be taken from the North Carolina Standard Course of Study for Biology. They will choose one of the scientists and research him or her and their particular research. The students will then be expected to present this information in the form of a PowerPoint presentation or brief paper. The students will present the findings of their research to the class. The final step to this part of the unit is that the students will design a play or more accurately a skit demonstrating a scene which demonstrates the experiment of his or her chosen Scientist. For example, Gregor Mendel is the Father of Genetics; a student would actually germinate some peas and simulate Mendel making his "crosses". After the presentation, classmates would be offered the opportunity to provide feedback or ask for clarification on what was presented. I feel that this should be a very student-focused, teacher-directed activity.

The following scientists will be chosen for this particular activity: Louis Pasteur, Gregor Mendel, Jane Goodall, Charles Darwin, and Carolus Linnaeus. These scientists were chosen because their contributions to science relate well to the major concepts which my students will be learning about in Biology. Pasteur's experiments led to the development of pasteurization and supports the concept of biogenesis—the idea that living things arise from other living things. This was a significant discovery during a time when common society did not know about bacteria and viruses as a cause of disease. They could not see these microscopic organisms in order to believe that existed. Gregor Mendel was chosen because he is known as the father of genetics. He was a monk who came up with several theories concerning patterns of inheritance. Through researching Mendel, my students will have a reinforcement of the genetics vocabulary and will be able to demonstrate their understanding of the basic concepts of Mendel's work. These concepts are Mendel's Law of Segregation, Law of Dominance, and Law of Independent Assortment. I chose Jane Goodall because of her work with chimpanzees in the field of animal behavior as well as to incorporate a female scientist. I feel that my students will especially enjoy dramatizing

Goodall interacting with chimps almost as much as choosing some of the students to act out being chimps themselves. Charles Darwin was chosen because of his theories of Evolution through Natural Selection. Evolution is a very controversial topic even today. I hope to encourage my students to view the basic principals of Natural Selection and be able to conduct a well rounded dialog on how Darwin developed his theory of Natural Selection and how his discoveries still impact society today. Carolus Linnaeus developed the classification system known as binomial nomenclature. Linnaeus sorted living organisms based on similarities and common ancestors. My students will have the opportunity to relate Linnaeus' method of categorizing organisms to their own methods of sorting things. My ESL students especially will appreciate that Linnaeus named organisms in Greek and Latin as a means of having a universal language for all scientist in order to better communicate with each other. There are other scientists that could be included, but for the sake of efficiency, I narrowed down my choices. I regret that I didn't have the opportunity to add women or scientists from different ethnic backgrounds. My decision was based on the fact that we are time restricted due to the constraints of our End of Course pacing guide and I felt that list of scientists chosen would more efficiently align with what must be covered within the curriculum. If time were to permit, I would love to include more women and individuals from various ethnic and cultural backgrounds which would be more of a reflection of the students in my class.

The students will each receive a handouts for the assignments (refer to appendix B) and will be taken to the media center to begin research. Students will be allowed 3-5 days to research the scientist and write a brief biography to turn in for a grade. After the papers have been returned, the students will be instructed to begin work on their dramatic presentations in which they will be given 3-5 days to complete and present. This lesson will span approximately two weeks, taking 3 actual class periods for research and actual class presentation.

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Unit Part Two

The second half on this unit relates the scientist and the experiments to society's ethical issues. After discussing the role science and of the scientist, I would like to discuss the impact that specific scientific research plays in society and whether these have positive or negative implications. I chose to utilize media as a means of relating to my students the significance of the issues that we are studying in this curriculum as well as provide "real-life", concrete examples that they may be able to identify with. It is my goal in this part of my unit to stimulate classroom discussion and hopefully, interest to research these topics further.

The film "Lorenzo's Oil" was chosen because it is a movie based on a story about a young boy, Lorenzo and his parents who struggled against the medical system in search of a treatment for their son's debilitating illness. Lorenzo's parents took matters into their own hands and eventually developed a treatment they called Lorenzo's Oil. The medical

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felt intruded upon and many in society were amazed that the Odone's would not accept the prognosis of the "experts"-the medical community. This movie is an appropriate choice for my students because it not only introduces them to the unique challenges of caring for a child with a genetically inherited, debilitating disease, but it supports that anyone is capable of becoming a scientist as demonstrated by the father, Augusto as he studied Lorenzo's illness and eventually developed a viable treatment.

During this particular Socratic Seminar, I would like for my students to discuss whether or not we should blindly, without question, trust science or the scientist- are they infallible? If the Odone's had listened to the doctors and specialists, Lorenzo would not have lived to reach adulthood as many children who benefited since the treatment. The next issue is to discuss whether or not science the sole solution for all of our problems- what about love, determination, and the will to live. I would like for my students to come away from this activity with a more balance and realistic view of science which includes the common person such as Lorenzo and his family. I would like them to realize that anyone who has the curiosity and desire can be a scientist as long as they are determined to do so. Many times we view the men in the "white coats" as the only individuals to possess all of life's answers. This movie allows my students to not only appreciate the hard work and dedication of the scientist, but they can and should think and reason for themselves.

I have added option of showing scene selections for the other two videos due to time restrictions. In the case of this particular video, Lorenzo's oil is not currently available in DVD format. I have a vhs copy and it is difficult to edit out the scenes. I try to show the video sections over several class periods while continuing my lessons on genetically inherited disorders.

The next movie that I have chosen for Socratic Seminar is "Miss Evers' Boys". This HBO movie is based on the true story about the syphilis experiment conducted at Tuskegee in the 1930's. This portrays the ethical dilemma concerning the blind testing of humans and the accountability of the scientific community to society. My students will be able to debate what is or is not ethical and who has the right to decide. The question of should we blindly trust those conventionally considered to be the experts. The main character, Miss Evers is portrayed as a nurse who has lived with the turmoil of having to care for men that she helps recruit and are participating in a highly controversial blind medical study. She is conflicted between fulfilling her duty as a nurse-following the instructions of the doctors and her own conscience as one who eventually understands the sacrifice her patients are being asked to make "for the good of science". I would like for my students to complete this activity with a better understanding of the concept of ethics, its consequences, and accountability. In addition to the ethical dynamics of the movie, I would like to incorporate the progression of the disease as it relates to our unit on Kingdom Monera- bacteria and viruses.

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Considering the amount of time allotted for each unit as indicated in our End of Course Guide for Biology, I have selected the following scenes in the event that the movie cannot be seen in its entirety:

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Scene 1- Main Title /Prologue

Scene 2- Syphilis-A Negro Disease?

Scene 4- And so they came

Scene 8- Budget Cuts

Scene 9- No treatment

Scene 12- Being taken up over the hill

Scene 15- Paying the consequences

Scene 17 Coda/End Credits

My final movie chosen is GATTACA. This movie deals with eugenics-the ability to manipulate the genetic sequence in a manner that could create the "perfect" organism. The main character, Vincent longs to have a higher station in life, but is hampered by the confines of his genetics. In this movie he tries to manipulate "the system" just as the system also tries to manipulate him. Vincent introduces the fact that the human spirit, fate and self-determination can triumph over the pre-determination of our heredity. My students will enjoy discussing the ethical implications and accountability of science and scientists of this topic. Even the title 'GATTACA' represent the nitrogen bases in the DNA structure (G-guanine, A-adenine, T-thiamine, and C-Cytosine). This seminar will be a good reinforcement after our unit on the DNA and while we discuss DNA technology. The recurrent theme about trusting science and the scientist still prevail in this movie as with the previous movies chosen. The following are two opening quotes from the movie:

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"Consider God's handiwork; who can straighten what He hath made crooked?"- Ecclesiastes 7:13 (opening quote)

"I not only think that we will tamper with Mother Nature, I think Mother wants us to."-Willard Gaylin (second opening quote)

As stated in the previous sections, one of my major concerns is the time constraints of following a pacing guide. If time does not permit the viewing of this movie in its entirety, I have chosen the following scene selections:

Selection 1- "Opening Titles"- includes the two above opening quotes as well as highlights the nitrogen bases of DNA (A-adenine, T-thiamine, G-guanine, and C-cytosine) in the names of the cast members.

Selection 2- "The Not-too-distant-future"-introduces the world of the main character, Vincent/Jerome

Selection 3 ‘Ten fingers, ten toes’- Describes Vincent’s conception, birth, and how his genetics determines his place in society as an “In-valid”

Selection 4 “The Natural “way- describes the new way of selecting offspring and the conception of Vincent’s brother-Anton who is considered a “Valid”

Selection 6 “Discrimination down to a science”- Illustrates Vincent’s life as an ‘In-valid’ and his desire to overcome his limitations based on his genetics.

These particular scenes will adequately provide my students with the major concepts in order to discuss the issues of eugenics and the ethical implications of genetic engineering.

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I would like to start this part of the lesson by presenting the opening quotes to the class prior to showing the above scene selections to begin dialog and prompt them to be aware of any other issues for later discussion as well as opinions for the Socratic Seminar. Before viewing the scene selections, the students will be presented with a brief video guide to further focus them on key observations and implications from each scene. Refer to appendix for GATTACA Video Guide.

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Upon discussion of the video guide, students will receive their essential questions and directions for their GATTACA Socratic Seminar discussion. Their homework assignment will to prepare to share their views, questions, and comments relating to the essential questions for the next day’s seminar. On the next day, students will conduct the GATTACA Socratic Seminar which will address the ethics of eugenics and the implications of being subjected to such technology. I feel that the students will have strong opinions on both of these concepts as they begin to apply and relate these ideas to their own circumstances.

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I feel that this activity is an excellent link between our unit of DNA and DNA structure and the Units of Genetics and Biotechnology. We can relate terms used in the movie such as “de-gene-rate,” ladder borrower”, and the movie’s title-GATTACA all to what we have already covered prior to the movie. I feel that this will not offer unique opportunities to review material, but will allow my students to make meaningful connections throughout the various units.

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Summary

In Christopher Frayling’s book “Mad, Bad, and Dangerous? The Scientist and The Cinema”, he summarizes beautifully,

“All scientists say they’d love to see scientists portrayed realistically. It is a little difficulty to make a two hour movie that will attract large audiences, which simply shows somebody working away in his or his laboratory. I would be nice, though, to see at least some places in which scientists are shown solving problems in a normal way by thinking

in a logical fashion. It would be nice if scientists were shown as people with outside interests...” (225)

As an individual who came from a laboratory background before teaching, I couldn't agree with this statement more. I want my students to have a well-round view of what science is and what it is to be a scientist. I would also like my students to appreciate the ethical dilemmas which occur within the scientific community and its impact on society and our individual lives. It is my hope that this curriculum unit will open dialog for my students as well as provide a greater appreciation and identification with science and the scientist.

Appendix A-Introduction to Science as a theatrical presentation

Joseph Wright's painting “An Experiment on a Bird in the Air Pump”



Appendix B-Part I: The Scientist and the Experiment

1. Scientist Biography Guideline

Scientists and their Experiments

Part I – Getting to know your Scientist

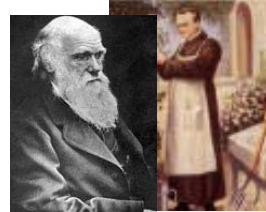
Below are a list of scientists and a corresponding websites where you can find information. Select one of the following scientists then go to the site and find out more about him or her. Use what you learn to write a one-page description of your scientist that would answer the following questions:

6. Who is this scientist? What is she/he really like?

7. What accomplishment(s) to science did he or she make?
8. What impact did this scientist and the discovery have on society- then and now?
9. What ethical issues or concerns did this scientist and his or her experiment raise?
10. How does this discovery relate to the topics that we are studying in our Biology class?

a. Gregor Mendel

- ◆ http://www.accessexcellence.org/RC/AB/BC/Gregor_Mendel.html
- ◆



http://www.mnsu.edu/emuseum/information/biography/klmno/mendel_gregor.html

b. Charles Darwin

- ◆ http://www.bbc.co.uk/history/historic_figures/darwin_charles.shtml
- ◆ <http://darwin.baruch.cuny.edu/biography/>

c. Carolus Linnaeus

- ◆ <http://www.ucmp.berkeley.edu/history/linnaeus.html>
- ◆ <http://info.uu.se/fakta.nsf/sidor/carolus.linn%E6us.id63.html>



d. Jane Goodall

- ◆ <http://www.janegoodall.org/study-corner-biography>
- ◆ <http://www.biography.com/articles/Jane-Goodall-9542363>



e. Louis Pasteur

- ◆ http://www.bbc.co.uk/history/historic_figures/pasteur_louis.shtml
- ◆ http://www.biographyshef.com/louis_pasteur_biography.html



2. Experiment Performance Guidelines:

The Scientist's Experiment

After you have chosen and written the biography of your chosen scientist, you must design a one act dramatization of one of his or her famous experiments which will be presented to the class. Include the following information:

1. Describe and demonstrate the scientist's experiment using appropriate props. For example, if you were describing if you were researching Isaac Newton discovering gravity-include the apple and the apple tree.
2. Next, describe how this experiment relates to what we are studying in Biology and how this information has impacted society.
3. Perform presentation to classmates for discussion and turn in written assignment.

Scientist	Experiment	Props	Relate to Lesson in Class	Impact on Society
Louis Pasteur	S-shaped flask/ pasteurization	Flasks/"broth"	Biogenesis/ Spontaneous Generations	Safety of packaged foods Better Sanitation
Gregor Mendel	Pea plant Crosses	Plants Paint brush Chart crosses	Heredity/ Genetics	"Father of Genetics" Laws for Heredity
Jane Goodall	Animal Behavior/ Chimps	"Chimps" Behavior "tests"	Animal Behavior	Knowledge of behavior- Animal /Human Society
Charles Darwin	Galapagos Island Observation	Examples of different types of animals- turtles	Natural Selection/ Evolution	Controversy/ Principals for Theory of Evolution
Carolus Linnaeus	Classification	Items to categorize/ classify & name	Taxonomy/ Binomial Nomenclature	Modern system for classifying/naming organisms

Written Assignment Guideline to be turned in:

Part I In 1-2 paragraphs describe experiment and write out directions that will be acted out.
Part II In 1 paragraph describe how this experiment relates to what we have studied in class on this topic.
Part III In 1-2 paragraphs describe how the discoveries of this scientist have impacted our society.

Appendix C- Part II: Socratic Seminar

1. Video Guide for Lorenzo's Oil:

Lorenzo's Oil Video Guide

Name _____ Period _____

1. What was Lorenzo's condition? When did the Odone's begin to discover that something was different?
2. How did Lorenzo inherit the trait for this disorder? Which parent was responsible for passing on this trait? Why?
3. What was the conflict between the medical community and the Odone's? Why do you think this conflict exists?
4. One critic states, "The movie portrayed nurses as heartless, physicians pompous fools, and parent support groups as mindless as a herd of sheep." Do you agree or disagree with this statement? Why or Why not?
5. What does this movie say about the determination of Augusto and Michalea in searching for a "cure" for their son?

6. **Should the Odone's or any researcher use humans as "guinea pigs"? Would this be considered ethical?**
7. **If you were a carrier for this type of trait, would you consider the possibility of passing it on to future offspring? Why or why not?**
8. **What do you think were Lorenzo's moral and legal rights as an individual? Do you think that they were respected? Why or why not?**
9. **What do you think it would have been like to have been "trapped" in Lorenzo's body?**
10. **What does this movie say about the power of the human spirit and determination?**

2. **Video Guide for Miss Evers' Boys:**

Miss Evers' Boys Video Guide

Name _____ Period _____

1. The men in the movie appear to be wary of participating in a government study. Why? In this particular case, were they justified?
2. What was Miss Evers' initial reason for participating in the study? Do you believe that she fulfilled her oath as a nurse in this movie?
3. What was the full name of the study and what was it intended to examine? How was this a total contradiction to what actually happened throughout the study?
4. What argument does Dr. Douglas use with Dr. Brodus to allow the study to continue after the money and "treatment" had run out?

5. What is syphilis and why was it not considered "worthy" of government research funds?
6. Why didn't the affected men receive penicillin when it became available? Do you feel that these men were treated fairly? Why or why not?
7. Why isn't the study terminated even when the results are absolutely clear? How long did it actually continue?
8. The study participants were offered "free doctoring." In your judgment, what were some of the ways that this promise was met, and what were some ways it was not met. Were they part of the treatment or subjects of research? Explain.
9. The study asks a basic research question: "Is the rate and progression of syphilis in the Black male the same as that for the White male?" Is that, in your opinion, a legitimate scientific question? Is it ethical? Explain your answer.
10. How would you feel if you or one of your family members had participated in this study today? Explain your answer.

3. Video Guide for GATTACA:

GATTACA Video Guide

Date:

Period:

1. What do you think the movie director is trying to say by using the quote from Ecclesiastes 7:13 and the quote by Willard Gaylin at the beginning of the film?
2. What is the significance of the word "GATTACA"? What are the positive and negative aspects of the GATTACA world?
3. What are "valids" and "in-valids" in the story? Explain in definition.

4. Think about the staircase in the movie. How is the staircase a SYMBOL of genetics?
5. Explain the new "natural way" to have children.
6. "This child is you, simply the best of you. You could conceive a hundred times and never achieve the same result." Explain this statement using the terms: HOMOLOGOUS CHROMOSOMES and ALLELES.
7. Why do you think Vincent's father decided to name him "Vincent Anton" rather than "Anton"? How was Vincent's childhood/family life affected by his genetic profile?
8. In the movie, what is a "borrowed ladder" or "de-generate"?
9. What is the term given to discriminating against people because of their genetic profile?
10. What would you say to a friend who believes themselves to be solely a product of their DNA and with no true freedom or control over their destiny?

4. Socratic Seminar Guidelines

Guidelines for Participants in a Socratic Seminar

1. **Refer to the text** during the discussion. A seminar is not a test of memory. The goal is to understand the ideas, issues, and values reflected in the text.
2. Cite reasons and evidence for your statements.
3. Do not participate if you are not prepared. A seminar should not be a bull session.
4. Do not stay confused; ask for clarification.
5. Stick to the point currently under discussion; make notes about ideas you want to come back to.
6. Take turns speaking; you should not have to raise your hands, but if the need arises you may do so.

7. Listen carefully to all that is being said, and write down the ideas that are expressed.
8. Follow proper speaking techniques (make eye contact, sit up in your chair, speak to the group not the teacher, do not pile your desk with irrelevant materials...).
9. Avoid hostile exchanges. Question each other in a civil manner. Discuss ideas rather than each other's opinions.
10. You are responsible for the seminar, even if you don't know it or admit it.

Adapted from:

<http://www.wcs.edu/fhs/StaffDevelopment/socraticseminars.htm>

5. Suggested Seminar Prompts

Socratic Seminar Response Suggested Prompts/Responses

Inner Circle Prompts:

1. I agree with what (___name___) said because.....
2. I want to add another reason why I think (___example___) is true-
[___give reason___]
3. I disagree with what was said by (___name___). They said_____ and I disagree because _____.
4. I understand your point, but I want to [add/disagree/give another point].
5. I think that what you are saying is _____. Is that correct?
6. I'm interested in what (___name___) said. What other thoughts does everyone have about _____?
7. What you said made me think about my own opinion about _____, and now I think that _____.

Outer Circle Response:

1. What was the most interesting question asked?
2. Give an example of an interesting response that added to the discussion.
3. What would you like to have heard more about?
4. Where did you see room for improvement within this particular topic? What do you think needs further exploration?

6. Essential Questions for Curriculum Seminars:

Media Selection	Scientific Issues Discussed	Essential Questions For Seminar
GATTACA	<ol style="list-style-type: none"> 1. DNA/DNA Structure 2. Eugenics and Ethics 3. Science and Government Involvement in human lives 	<ol style="list-style-type: none"> 1. Should humans be “controlled by the use of genetic engineering? 2. Who should decide how genomic information should be used? 3. How much of who we are genetics and how much is a factor of our environment and self determination?
Miss Evers’ Boys	<ol style="list-style-type: none"> 1. Bacteria /transmission and Disease 2. Medical research and procedures 3. Ethics of Human testing 	<ol style="list-style-type: none"> 1. Should we blindly trust the logic of scientific experimentation and the scientists who conduct them? 2. Should humans be used as test subjects with or without their consent? 3. To whom is the

		government and/or the scientist held accountable?
Lorenzo's Oil	<ol style="list-style-type: none"> 1. Genetic Diseases and patterns of inheritance 2. Science/Medicine vs. society on Ethics 3. Who has the right to decide an individuals course of medical treatment 	<ol style="list-style-type: none"> 1. Are scientists infallible/ 2. Who can be a scientist? 3. Should members of society blindly trust the reasoning of science and/or the scientist? 4. Is it all about the science or is there "something else"- human will and determination?

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