

COURSE TITLE: CRITICAL THINKING FOR CRITICAL ISSUES IN SCIENCE

NO. OF CREDITS:	5 QUARTER CREDITS	WA CLOCK HRS:	50
	[Semester Cr Equivalent: 3.33]	OREGON PDUs:	50
		CEUs:	5.0**

INSTRUCTOR: DON DEAN, M.S.E.T.
dondean@hotmail.com

COMPLETION DATE:
6 months from your registration date.

LEARNING ENVIRONMENT:
This course requires assignment responses to be posted in a password-secured ONLINE website hosted by The Heritage Institute.

COURSE DESCRIPTION:
This course will help middle- and high-school students develop the critical thinking skills necessary to guide their future in making sound decisions on often-controversial topics such as stem cell research, genetically modified food, DNA testing, gene therapy, and other emergent issues in science. In addition, teachers will better understand the interrelationship of society and science both historically and in contemporary contexts and examine how religion, community, government, and other components inform the progress of science.

Although the science content is rich, it is not necessarily technical, and can benefit science teachers as well as teachers in all disciplines. This course is applicable to science teachers of grades 6-12. Texts costs total about \$10.

- LEARNING OUTCOMES:**
Upon completion of this course, participants will:
1. Embrace a critical thinking model for addressing sensitive issues in science from multiple viewpoints.
 2. Understand how science has been influenced by government and society in historical and modern times.
 3. Be able to better understand the bias of Internet information.
 4. Become more informed about critical contemporary issues in science.
 5. Be better able to guide students in determining their personal scientific truth.

COURSE REQUIREMENTS:
Participants will complete assignments and post responses online to specific questions outlined for each assignment. Completion of all specified assignments is required for issuance of hours or credit. The Heritage Institute does not award partial credit.

****HOURS EARNED:**
Completing the basic assignments (*Section A: Information Acquisition*) for this course automatically earns participants their choice of 50 Washington State Clock Hours, 50 Oregon PDUs or 5 CEUs (Continuing Education Units), which translates to 50 hours. The Heritage Institute is an approved provider of Washington State Clock Hours, Oregon PDUs, and CEUs by IACET (International Association of Continuing Education and Training, an official national and international certifier of CEUs).

UNIVERSITY QUARTER CREDIT INFORMATION

• UNIVERSITY QUARTER CREDIT OPTION 400 & 500 LEVEL

Teachers may opt to register for five (5) Antioch University, Seattle, 400 or 500 level quarter credits, instead of hours, and will be required to:

1. Complete all assignments for clock hours/CEUs (*Section A: Information Acquisition*)
2. Complete the extra reading/viewing, writing and classroom application assignments specified in the syllabus for the 400 or 500 level credit option (*Section B: Learning Application*)
3. Complete an Integration Paper by answering 5 questions (*Section C: Integration Paper*)

• REQUIREMENTS FOR UNIVERSITY QUARTER CREDIT

Antioch University Seattle requires 75% or better for credit at the 400 level (Upper Division) and 85% or better to issue credit at the 500 level (Post-Baccalaureate). These criteria refer both to the amount of work submitted as well as the quality of work as determined by each instructor

- | | |
|--|-----|
| 1. Completion of Information Acquisition assignments | 30% |
| 2. Completion of Learning Application assignments | 40% |
| 3. Completion of Integration assignment | 30% |

• CREDIT/NO CREDIT (No Letter Grades or Numeric Equivalents on Transcripts)

Antioch University Seattle Continuing Education Quarter credit is offered on a Credit/No Credit basis; neither letter grades nor numeric equivalents will show on a transcript. At the 400 level credit granted is equal to a "C" or better, and at the 500 level credit granted is equal to a "B" or better. This information is stated on the back of the transcript.

ADDITIONAL COURSE INFORMATION

COURSE MATERIAL and/or TECHNICAL REQUIREMENTS:

You will need high-speed (DSL) Internet access in order to easily view online resources. Some of the reading materials may be provided in the online course environment as PDF documents, a format readable by computers with Adobe Acrobat Reader. You may download a free copy of Acrobat Reader from our website if it is not already on your computer.

REQUIRED TEXTBOOK OR RESOURCES:

- *The Aspiring Thinker's Guide to Critical Thinking* (Linda Elder and Richard Paul, ISBN 978-0-944583-41-9, available at www.criticalthinking.org, \$6. 52 pages <http://www.criticalthinking.org/store-page.cfm?P=products&ItemID=383&catalogID=224&catelD=132>)
- *Science and Creationism: A View from the National Academy of Sciences, Second Edition*, FREE download from National Academies' website http://www.nap.edu/openbook.php?record_id=6024&page=1
- *Science and Technology in World History, an Introduction, First Edition*, c 1999, (James E. McClellan III and Harold Dorn, ISBN-10: 0801858690. Available from Amazon.com for \$5 used plus shipping.
- Significant Web-based readings and research

MATERIALS FEE:

- Purchase *Aspiring Thinker's Guide* from online source for approximately \$6.
- Purchase *Science and Technology in World History* from Amazon.com for approximately \$5.

GETTING STARTED:

- Once you have registered for the course, you will be sent an email that contains the website address, password and course key that you need to access your online course, along with instructions on how to log into the online system.
- The assignments listed in this syllabus are also listed at the bottom of each online course document. Access each assignment and enter your responses online. We suggest that you write your responses in a WORD document and then do a copy/paste function into the Responses box.
- When you have completed all assignments for the course, CLICK the 'ALL ASSIGNMENTS COMPLETED' option. The instructor will be notified that you have completed all assignments.
- The instructor will review your work and enter his responses online. You will be notified by email when the instructor has marked the course completed, and you will be instructed to log in and view the instructor comments. At that time, you can also SAVE a complete copy of the course assignments and responses.

NOTES TO ALL PARTICIPANTS:

- You work at your own pace and are not required to be present / online at any specific time.
- You are encouraged to work collaboratively and submit similar responses on assignments except for the Integration Paper, which must be individually authored.
- Complete the readings, research and classroom activities on your own schedule.
- Alternate assignments are possible if you do not have access to a teaching environment or have difficulty locating the assigned readings, with the instructor's prior approval.
- Some of the assignments and materials may be substituted for ones that more specifically suit your interests or are more useful in your teaching as long as the materials and assignments meet the learning objectives.
- Please notify the instructor if you wish an alternate assignment or if you encounter difficulties getting the materials. The assignments can also be adapted to your level of science expertise. A list of optional assignments is available.
- Some of the assignments can be done out of sequence if you have not yet acquired the materials.

COURSE OVERVIEW:

Today's students will be making the decisions that affect not only their lives, but ours as well, as our young people will be determining the social and political processes that implement the policies that shape the journey of science.

This course is based on emerging issues in science and society and aims to assist teachers and their adolescent students to think critically and to make sound decisions on complex contemporary scientific issues, with an emphasis on understanding conflicting motives in a critical-thinking framework consistent with the diverse personal convictions of students and of their community.

Of critical importance is understanding the bias of information in presenting purported "science"; this course uses the World Wide Web as a model to view different viewpoints. The course uses a critical thinking model to explore the relationship of science, government and society as well as sensitive issues in modern science. This course considers some of the usual topics that have already been treated extensively, such as global warming, pollution, habitat loss and rainforest deforestation, then goes beyond to address often-overlooked modern issues.

ASSIGNMENTS for CLOCK HRS/PDUs, CEUs, 400 or 500 LEVEL UNIVERSITY QUARTER CREDIT

A. INFORMATION ACQUISITION

Assignment #1 – Introduction to Critical Thinking

- a) Begin collecting articles on science topics with societal implications from newspapers, journals, the Internet, or other sources. Put them away for future use. The more articles you have, the easier it will be to complete assignments later. Consider the journals *Scientific American*, *Nature*, *Science*, the *New York Times* (online – Tuesday Science section), other major publications as well as local newspapers.
- b) Read the booklet *The Aspiring Thinker's Guide to Critical Thinking*.
- c) Review an additional three or more sources on critical thinking on the Internet.
Suggested Resources
 - <http://faculty.ed.uiuc.edu/rhennis/SSConcCTApr3.html>
 - <http://www.accd.edu/sac/history/keller/ACCDitg/SSCT.htm>
 - <http://wsuctproject.wsu.edu/ctr.htm>
- d) Write a summary of the salient points and your thoughts on the most important things to consider when thinking critically (two page maximum). Include in your summary an analysis of where you believe your students as well as adults you know need the most work to be critical thinkers and why.

Assignment #2 - WWW – World-Wide Wonderland or World-Wide Wasteland?

Here, we look at various motives of web pages to gain a better understanding of information bias as an essential part of the critical thinking model. A generation ago, writing a school term paper required trips to the library, writing notes on file cards, organizing ideas and putting a carbon copy sandwich in a manual typewriter. A search for more esoteric information, say, which species of fish lived in the Caspian Sea, was frustrating and extremely time-consuming. Today, in less than three seconds, Google links claim that there are at least 120 species of fish in the Caspian Sea, divided into two groups of sturgeons and bony fishes. Perhaps.

Despite the inconvenience of having to lift them and flip through the pages, the previous generation of tangible encyclopedias had an unlikely benefit: they were expensive to produce. They had to submit to editorial scrutiny and convince a publisher that their content was accurate and verifiable. If the information in a reference work was not durable, it would not be worth the publishing cost.

Web “publishing” is not burdened by accountability or cost. Anyone, and it seems everyone, is an instant author. Then, how do we assess the quality of what we read on the Internet? Is the writer qualified to produce the information? How do the sponsor’s objectives influence the writing? Why does any particular web page exist?

- a) Visit ten (10) or more diverse Web sites (for example, product sales, governmental, education, culture, non-profit) and think about the reason why each page exists. Make a list of four (4) or more motives for creating a web page. Visit <http://ptonline.org/CriticalScience/www.htm> to review a teacher’s approach to this topic.
- b) Then in a two page paper:
Comment on your list of Web page motives and give examples
OR
Select several Web sites that present the same topic with different biases. Comment on the validity of the information based on the motive of the web site.

Assignment #3 - Defining Science

The National Academy of Sciences writes that “*truth in science is never final, and what is accepted as a fact today may be modified or even discarded tomorrow.*” Global warming, evolution, life on Mars – these concepts may be accepted as “truth” when the evidence reaches a critical mass, but that tipping point is personal rather than universal. Indeed, the definition of science is the most critical component of critical thinking about critical science issues.

- a) Read *Science and Creationism, a View from the National Academy of Sciences*.
http://www.nap.edu/openbook.php?record_id=6024&page=1
- b) Respond to the following in no more than two pages: What is your view of the essence of science, and how is it similar to or different from the view of the National Academy of Sciences?

Assignment #4 – A Window into Science in Western Historical Context

This assignment takes a look at how culture affected the “tipping point” of evidence and how culture expedited or impeded scientific milestones.

- a) Skim Chapter 10 in *Science and Technology in World History, an Introduction, Second Edition*, then read Chapters 11-14, concentrating on the events changing the view of the solar system. Supplement your readings online or other sources, focusing on Galileo’s interactions with the Church.
- b) Read Chapter 16, “Life Itself” in *Science and Technology in World History, an Introduction, Second Edition*. You may supplement the history of the Darwinian Revolution with sources from the Internet.
- c) Research the Manhattan Project using Internet or printed materials.
- d) Write one paragraph summarizing each of the above advances in science. Then choose one of the topics and identify the key events in a timeline, chart or outline, and comment on how societal/political climate may have shaped the course of science.

Assignment #5 – “For the Common Good”

In this assignment we look at some complex issues and how science has been applied in a balance between the rights and desires of the individual and the benefit of the community at large.

- a) Visit <http://www.pbs.org/wgbh/nova/sciencenow/3318/02.html> to learn how the genome of the 1918 lethal influenza virus was decoded and published, making it available to anyone with altruistic or even criminal aspirations.
- b) In “*The Questionable Contribution of Medical Measures to the Decline of Mortality in the United States in the Twentieth Century*”, the authors argue that public health measures caused a precipitous decline in mortality that far exceeded the value of medicine. Read the articles below and briefly research other Web-based articles.
<http://www.whale.to/vaccine/mckinlay.pdf>
http://www.pbs.org/wgbh/amex/fever/peopleevents/e_1878.html
- c) Eugenics, “*the idea that one can improve the human race by careful selection of those who mate and produce offspring,*”¹ has been used nefariously in Hitler’s drive for the perfect race and the involuntary sterilization of institutionalized patients in the USA. Science has also embraced the idea for seemingly positive outcomes – for example, in identifying genes that could lead to serious health problems or birth defects. Is there a line to be drawn? Where should it be drawn?
Starting points: <http://personal.uncc.edu/jmarks/eugenics/eugenics.html>
Fine student summary: <http://www.accd.edu/sac/honors/main/papers02/Judge.htm>
- d) In one (1) paragraph each, summarize your thoughts on each of the above topics, (a,b,c).
- e) Then choose **one (1)** of the following:

1) For **a)** Go through the voting procedure. Note how your position may have changed as the dialog progressed as well as the important arguments on both sides. Write a one-page summary of each position (for or against)

OR

2) For **b)** answer the following (1 page):

i) According to McKinlay and McKinlay, of the nine common infectious diseases studied, which ones responded better to public policy than to medical intervention? Why?

ii) How is America's monetary expenditure related to the decline of total mortality from 1900 to 1970? Does this surprise you?

iii) Describe two steps that the federal government has taken toward public health.

OR

3) For **c)** answer the following in a maximum of two-pages: Which aspects of the American Eugenic Movement were most surprising to you? Why?

¹ *American Heritage Dictionary of Cultural Literacy*

Assignment #6 – Science and the US Government

This assignment takes a look at the influence of US government in regulatory processes and in applying advances in science.

- a) Download or open the Food and Drug Administration's handbook (Center for Drug Evaluation and Research). <http://ptonline.org/CriticalScience/FDACDERhandbook.pdf>
View the diagram on the FDA's steps to develop a new drug on page 4 and the summaries of each step on the following pages. For each step of the process, consider the resources and costs that might be required, for example: renting laboratory space, recruiting volunteers, hiring statisticians, acquiring lab animals, etc. In your mind, make a wild estimate of the cost of bringing a drug to market.
- b) Use the Internet or other sources to research the FDA's role in regulating the substances thalidomide, laetrile and medical marijuana.
- c) Use Internet or other sources to research the US Government's role in The Human Genome Project or in the development of biological weapons.
- d) Summarize a), b), and c) above in a single paragraph each. Choose one of the topics to expand in your findings in a maximum of two pages. Include your interpretation of the appropriateness of the government's role.

Assignment #7: Selected Emerging Science Issues

- a) With recent advances in science and technology, it is relatively easy to transplant genes across species. Use the Internet or other sources to research genetic modifications in tomatoes, soybeans, corn, rice and two additional foods or organisms.
- b) DNA can be used to convict criminals or to exonerate the wrongly accused, or can become a player in the misuse of information that crosses privacy lines. Browse the following sites and supplement with other sites:
 - <http://www.dna.gov/info/>
 - <http://www.innocenceproject.org/>
- c) Research the science and debate on embryonic stem cell research.

- d) Choose a discretionary topic from your collection of articles or research any issue that interests you or that may be helpful in a classroom setting.
- e) Using your critical thinking model, read “*Land Developers Find New Angle in Environmental Law*”: <http://ptonline.org/Ethics/>
- f) Summarize a), b), c), d) and e) above in a single paragraph each.
- g) Then choose **one (1)** of the topics to expand using the following guidelines:
1. For **a)**, make a table of the foods and organisms, their genetic modifications, their potential positive and negative consequences, sources of information and any comments you have.
OR
 2. For **b)**, summarize the main arguments and answer the following: Do you think a person has a right to keep their genetic makeup private? Why or why not?
OR
 3. For **c)**, make a table of the pros and cons and comment on the forces that support and oppose the research.
OR
 4. For **d)**, summarize the issue from two different viewpoints in a maximum of two pages.
OR
 5. For **e)**, comment on the article in a maximum of two pages. Make sure to use the lessons learned during this course in your review.

This completes the assignments required for Washington Clock Hours, Oregon PDUs, or CEUs.

Continue to the next section for additional assignments required for University Quarter Credit

ADDITIONAL ASSIGNMENTS for 400 or 500 LEVEL UNIVERSITY QUARTER CREDIT

B. LEARNING APPLICATION

ASSIGNMENT #8:

For 400 Level – Complete Part A only

For 500 Level – Complete Part A and Part B

Part A: (400 & 500 Level)

Choose ONE (1) of the following:

- a) Choose four science issues from the course materials, the articles you have been collecting, or other sources, based on connections to your curriculum or elements that require critical thinking based on your model. Make a table of the salient points and how they could be used in the classroom.

OR

- b) Describe a change in science teaching that has occurred due to influences outside science. Feel free to solicit ideas from your colleagues. Summarize your thoughts in 2-3 pages.

OR

- c) Design a 2-3 lesson unit on one science issue that integrates critical thinking. You may use the attached model lesson plan format from The Heritage Institute or the format required by your district.

OR

- d) Class writing option: Research gene-linked disorders, discuss them with your class, then pose the following question to your class(es) in a writing assignment, class discussion or form that suits your curriculum and teaching situation:

“If you could have a DNA test that would predict your lifespan (excluding smoking, and accidents), would you have it done, and if so, at what age? Explain your thinking”.

Summarize the responses in a 1-2 page paper.

Part B: (500 Level only)

Choose **ONE (1)** of the following:

- a) Review the ideas about critical thinking that you considered at the beginning of the course. Does your critical thinking model include the repercussions of decisions? Does it include the ability to approach issues from multiple perspectives? Does it consider ethics (or is that important?) Is it consistent with the type of thinking required by today’s complex science issues? Submit a critical thinking model using a graphic design, text, short essay, or other form.

OR

- b) View the film *King Corn* or *Super Size Me*. Comment in a 2-3 page paper on how science is applied or not applied in terms of treating issues of health, culture and food production. [Note: At the time of writing (July 2009), *King Corn* was available for free download at PBS.ORG; otherwise both films are available for rental or purchase]

OR

- c) Another assignment of your choice with the instructor’s prior approval.

ADDITIONAL ASSIGNMENT REQUIRED for 400 or 500 LEVEL UNIVERSITY QUARTER CREDIT

C. INTEGRATION PAPER

**Assignment #9: Integration Paper
(Required for 400 and 500 Level Credit)**

Complete the requirements for university quarter credit by submitting a final Integration paper (2-3 pages).

A heading is required; please use the following format.

Your Name:	Date:
Course Name:	Course Number:
# of Credits:	Level: (400 or 500)
Advisor Name:	

Respond to each of the 5 questions below. (First list the question and then write your answer)

1. What did you learn vs. what you expected to learn from this course?
2. What aspects of the course were most helpful and why?
3. What further knowledge and skills in this general area do you feel you need?
4. How, when and where will you use what you have learned?
5. How and with what other school or community members might you share what you learned?

INSTRUCTOR COMMENTS ON YOUR WORK:

Be sure to mark the “All Assignments Completed” section in the online course environment as this will notify the instructor that you have completed the course.

Upon receiving notification of your completion of all course assignments, your instructor will provide written comments online.

QUALIFICATIONS FOR TEACHING THIS COURSE:

Don Dean, M.S.E.T., is a middle-school science teacher and the District Coordinator of Science in the Oakland, New Jersey School System. He holds a B.A. in Natural Science and Mathematics, a B.S. in music, and an M.S. in Educational Technology. Don is also an avid traveler and student of foreign languages and cultures and is currently active in projects in South America studying microclimates, medicinal plants, sustainable farming and rainforest preservation.

CRITICAL THINKING FOR CRITICAL ISSUES IN SCIENCE BIBLIOGRAPHY

Brockman, John, editor. 2003. *The New Humanists: Science at the Edge*. Sterling Publishing. 416 pages.

The editor uses the ideas of some of the leading scientific minds of the 21st Century, including Jared Diamond, Steven Pinker, Daniel Dennett and others, to synthesize their contributions and define “who and where we are.” Each provocative short essay reads separately and any of them can change even the best-informed scientist’s perspective.

Grant, John. *Corrupted Science: Fraud, Ideology, and Politics in Science*. 2007. Artists’ and Photographers’ Press, Ltd. 336 pages.

Fascinating, sometimes seemingly unbelievable examples of how science has been abused. A blistering comparison in terms of the repression of science emerges in the regimes of Hitler, Stalin and the US government.

McClellan James E. III and Harold Dorn. 1999. *Science and Technology in World History, an Introduction, First Edition*. Baltimore: Johns Hopkins University Press. 464 pages.

As the name implies, the authors trace the history of academic and applied science from the earliest civilizations including seminal work in Greece, India, the Americas and Near-Eastern cultures providing the foundation to the modern scientific and technological powers. Very accessible reading for the layman yet deep enough for the scientist.

Miller, Judith, Stephen Engelberg and William J. Broad. 2001. *Germs: Biological Weapons and America’s Secret War*. New York: Simon and Schuster.

The depth of the Superpowers’ development of biological weapons programs is a chilling story that has mostly gone unnoticed by the public. At its height, it rivaled the world’s nuclear destructive potential and today much of the stockpile of weapons is unaccounted for. Nicely written by three New York Times reporters.

National Academy of Science. 2008. *Science, Evolution and Creationism*. National Academy of Science Institute of Medicine. 88 pages.

This nicely revised edition is the successor to *Science and Creationism*, one of the required resources and can be used in its place. A great resource for teachers who want to address the meaning of science and its proper place in addressing evolution without promoting a religious debate.

Porter, Roy. 1999. *The Greatest Benefit to Mankind, a Medical History of Humanity*. New York: Norton. 831 pages.

Do not be fooled by the heft of this book; it is easily accessible to the non-expert and is not necessarily meant to be read cover to cover. Students of both history and science will enjoy the connections not found in standard texts. The author seamlessly ties together a rich history with the cultures and events that drove the growth and application of medical knowledge and practice through history.

Sobel, Dava. 1999. *Galileo’s Daughter*. New York: Walker and Co. 384 pages.

A view of Galileo’s life from a personal viewpoint, in part reconstructed from letters to his daughter. The long history of Galileo’s struggle with the Church in advocating the model of the solar system is documented from a unique perspective, often exposing Galileo’s own weaknesses, a refreshing change from the “winners’ history” presented in most accounts.

**THE HERITAGE INSTITUTE
ONLINE COURSE
LESSON PLAN TEMPLATE**

Grade Level: _____

Subject: _____

Theme/Topic: _____

Student Outcomes: *(with connection to State standards)*

Required Materials and Equipment:

Agenda: *(The major events of the day posted for public viewing. Schedule warm-up, bathroom breaks, surprises (pop quiz), guest speakers, specials, assemblies, movie clips, outside assignments etc. so students can manage their time with you.)*

Warm Up: *(A one to two sentence task, written or drawn on the board, to be completed alone or in groups prior to the beginning of the lesson. At the elementary level it would be used for classroom transitions, and in grades 7-12 to define one content area from another. The warm-up is designed to access learning from the previous lesson and settle students into the flow for the present lesson on hand.)*

Anticipatory Set: *(Attention Getter to kindle student interest)*

Direct Instruction (10-20 mins): *(Input, Modeling/demo, giving directions, check for understanding)*

Guided Practice (x mins): *(Under teacher's direct supervision, students individually apply or practice what they have just learned and receive immediate feedback)*

Closure (x mins): *(Actions designed to cue in students that they have arrived at an important point in the lesson or at the end of the lesson; often closure consists of review and clarifying key points)*

Independent Practice: *(Student directed, may be incorporated before closure or as outside assignment. The aim is repetition in enough different contexts so that the learning may be applied to any relevant situation, not only the context in which it was originally learned.)*

Assessment and Follow-Up: *(Self-reflection, collaborative rubric, other rubric, anecdotal evidence, teacher created quiz/test etc., peer review, standardized test, exhibition, portfolio piece(s))*