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"Hands-on" History: A Comparison of History of Science Courses

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Worcester Polytechnic Institute

"Hands-on" History: A Comparison of History of Science Courses

Kellie Pawelski

4/30/2015

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TABLE OF CONTENTS

1 ABSTRACT

This paper compares ten different history of science syllabi from varying universities and colleges to evaluate the courses' inclusion of the relationship between science and society and its application of class features to encourage active learning.

2 ACKNOWLEDGEMENTS

I would like to express my gratitude to my advisors Professor Mike Buckholt, Professor Jill Rulfs, and Professor Constance Clark for their time and support with this paper. I would also like to thank the professors who sent me copies of their class syllabi and contributed to this paper.

3 INTRODUCTION

The combination of history and science courses is most evident within the universities and colleges that offer history and philosophy of science majors. However, “history of science” courses also exist at a variety of colleges. With all of these classes it is important to present the course in a way that allows students to learn about how the scientific discoveries were made and also the type of society and events that led up to those theories. Another important aspect is to structure the course with the ability to keep students engaged and actively learning. Thus, the following paper compares ten different history of science courses to evaluate whether or not the class includes the societal aspect involved with scientific discoveries, the acknowledgment that scientific discoveries are always undergoing change, and an interactive learning component to keep students interested in the subject material.

4 CURRENT HISTORY OF SCIENCE COURSES

4.1 History of Biology: Conflicts and Controversies (Chew 2015)

This course is an undergraduate course taught by Dr. Matthew Chew at Arizona State University. With topics ranging from anatomy and physiology to biochemistry, the class focuses on specific discoveries throughout the history of biology and how the political, social, religious influences of the discoveries' time affected the scientists involved (Chew 2015). Furthermore, with the class meeting three times a week for a total of fifty minutes each, specific weeks focus on one topic in what the professor calls "week-long seminars" (Chew 2015). During these seminars, the students learn about the discoveries made within the indicated topic and which scientists failed and succeeded in improving the knowledge about that topic. It is important to note that the professor acknowledges the fact that science is a process and the history of biology consists of failures that helped lead to the current theories and not just instantaneous breakthroughs. He does this by mentioning in his syllabus that "this course treats biology as a human pursuit, a cultural phenomenon, and an array of disciplines that arose, changed, and sometimes collapsed over time" (Chew 2015). This descriptions alludes to the fact that students in the course will not just learn the facts about the successful theories, but will also learn how the process of science stems from the repeated changing of ideas overtime and how ideas thought the ultimate truth at one point in history can be discarded later as being completely wrong. In addition to this, since the course is typically used as a "science and society" requirement, the professor includes facts about the society of the scientists who were part of the discovery learned about each week. In a personal communication, Dr. Chew acknowledges the subjects that he teaches aren't necessarily

relevant or interesting to his students. To relate the students more to the subject, Dr. Chew states that he helps "students find commonalities with men and women operating at the fringes of acceptance in their own cultures, and reveal the philosophical, religious and political commitments underlying their personal choices" (M. Chew, personal communication, April 17, 2015). He aids the students in learning about some aspects of the scientists' lives and how their time period affected their scientific ideas.

Overall, the course consists of mainly lectures and class discussion revolved around the reading done by the students about each topic. To grade the students, the professor takes an interesting approach by giving them take home exams and scheduled quizzes. The scheduled quizzes are unique in that they consist of what Dr. chew calls "open-mouthed quizzes" based on timed PowerPoints (M. Chew, personal communication, April 17, 2015). Each quiz contains twenty multiple-choice questions and the students are allowed to openly discuss the question while recording their own answer. In all, with the inclusion of societal issues and encouraged open communication between students, the course taught by Dr. Chew offers a noteworthy approach to teaching the history of biology.

4.2 A History of Cell and Molecular Biology (Matlin 2015)

A ten-week seminar offered to undergraduate and graduate students at the University of Chicago, "A History of Cell and Molecular Biology" is a course that focuses primarily on the topics of cell and molecular biology within the 20th century. It is taught by Karl Matlin and covers the definition and origin of molecular biology to modern systems biology. In all, the current seminar meets once a week for 3.5 hours and only consists of about 5-7 students (K. Matlin, personal communication, April 23, 2015).

Due to the small class size, the class is a discussion-based course that heavily relies on reading done outside of class. Every week before class, the students are required to read multiple journal articles and write a "reaction paper" about what they read (Matlin 2015). In addition to this, each student is required to give a five-minute talk about a topic of interest and write a final paper about that topic. The class itself places most of the emphasis on learning about the origins of molecular and cellular biology and how they developed over-time. This is done in a very analytical way by presenting the students with questions and the expected outcomes of the reading on the syllabus. Further, Matlin's approach to teaching this course comprises of questions that focus more on the science of the topic than the societal influences that affected the development of biology. Each week of the seminar is methodically mapped out with the topic, required readings, questions the students should be able to answer, and expected learning outcomes. For example, week three entails the students read six different journal articles about the origins of molecular biology and contemplate questions such as "was this standard narrative of molecular biology an outgrowth of nineteenth century biology and genetics, or was it distinct?," (Matlin 2015). Also, the one of the objectives for the week is that the students "define structural biology and describe its relationship to molecular biology" (Matlin 2015). Overall, this course takes a more scientific approach to the history of biology and doesn't stress learning the process of science as an inquiry.

4.3 History of Science/Medical History 133: Biology and Society, 1950-today (Nelson 2015)

This is a semester-long undergraduate course offered at the University of Wisconsin and taught by Nicole Nelson. Currently, the class contains about 160 students and meets three times a week for two, 50-minute based lectures, and one 50-minute based discussion section (N. Nelson, personal communication, April 18, 2015). The class is reading oriented and incorporates the traditional assessment of students through the use of exams and reading assignments. Additionally, the course centers on the history of biology and its relationship to society. It takes a unique approach to this subject by containing three different units throughout the entire semester. In fact, the three units taught include the investigation of the origin of institutions and practices that are used in biology today, areas of biology that have controversies about regulation and public participation, and how biological theories can be used to understand ourselves (Nelson 2015). One example of the various topics discussed falls under the "Biology and Self" unit and is called "seeing humanity through biology – Sociobiology," (Nelson 2015). This alludes to the idea that science plays a large part in the shaping of society and can also be affected by society itself, which is an important link that the professor mentions within the description of the class. Another unique part of this course is the stated course objectives comprise of ideas such as having the students acknowledge that the practices and ways of thinking in biology are particular to certain times and places and have changed multiple times throughout history. Instead of just presenting what happened discovery after discovery and making students memorizing the facts, the professor

approaches the history of biology in a way that allows the student to better understand all the aspects important to biological practices and theories.

4.4 HIST 240/340 The History of Evolution (Riskin 2015)

Offered at Stanford University, the seminar course for both graduate and undergraduate students is taught by Jessica Riskin and approaches the history of biology through the specific topic of evolution. The only requirements for the course are that the students complete the readings before each class and the final paper due at the end of the term. Thus, as can also be seen in the syllabus itself, the course is basically a reading and discussion based class. Moreover, the class only meets once a week for three hours so most of the student's learning is done through the form of reading (Riskin 2015). Since the course is exclusively about evolutionary biology, one of the major subjects throughout the entire term is Darwinism. Therefore, the students are required to read primary source documents written by Darwin himself. This gives the students the rare ability of seeing exactly how an important theory came about and progressed over time though the eyes of the scientist. The scientists methods and thoughts aren't being interpreted by another author and then presented to the student, but are being offered to the student in a way that allows them straightforward views of everything that is involved with discovering a theory. Furthermore, during the last week of the seminar, the students read about the current debates in evolutionary biology and are required to read parts of a book called *Darwin's Dangerous Idea*. The topic and the reading involved allow the students to see that the theory of evolution is not a designated, cannot be changed truth. Instead, students are presented with arguments that challenge current experts about evolution and have the potential to change views on how organisms have evolved.

Incorporating ideas about controversy within the course presents the students with the circumstance that once a discovery is made, it can change and also be challenged; once the scientific theory is postulated, it isn't necessarily correct from that point on.

4.5 History of Science Courses at WPI

4.5.1 HI 2353 – History of the Life Sciences (Spanagel 2013)

One of the many courses offered at Worcester Polytechnic Institute about the history of science is "History of the Life Sciences." Taught by David Spanagel, this course encompasses the history of biology, ecology, and medicine in a seven-week term. Furthermore, with a maximum of 50 students, the course consists of a "mixture of lectures, small group discussion, and other activities," (D. Spanagel, personal communication, April 17, 2015). One of these other activities includes films, which are then followed by class discussion. Overall, the course entails that the students read articles by historians of science, primary source documents, and selected chapters from other books in order to "understand how and why the life sciences have changed in themselves and affected the world over the past several centuries" (Spanagel 2013). This allows the students to better understand the process of science and get a better grasp of both the history of science and how it changes. Another requirement of the students includes completing a "QHQRT" essay, which stands for "Question, Hypothesis, Question, Research, Thesis" and is basically a history research paper (Spanagel 2013). In all, the topics presented in the class schedule range from "Healing as Art versus Science" to "Genetics and Eugenics" and open up interesting avenues to class discussion.

4.5.2 HI 2352 – History of the Exact Sciences (Spanagel 2014)

Another course taught by David Spanagel at WPI, this class follows the same principle set-up as his "History of Life Science" class. It requires reading and class discussion, as well as utilizes lectures and other activities such as watching films. The main purpose of this class, however, is to learn about the history of science in terms of mathematics, astronomy, and cosmology (Spanagel 2014). Within this class students examine different people's lives that are part of these sciences and read primary sources, an astronomy biography, and a mathematical reasoning from ancient Greece. Spanagel combines this with essays and exams in order to "equip students to become effective critical thinkers, speakers, and writers with an awareness of the nature of historical inquiry as a highly valuable qualitative analytical methodology," (D. Spanagel, personal communication, April 17, 2015). In addition to this, a unique aspect that is included within the class is the implementation of a hands-on laboratory activity about Galilean telescopes. This offers an alternative way to learning about an important discovery in science and allows the students to experience for themselves the process of figuring out how something works and how theories are developed.

4.6 History of Science Since the 17th Century: The Development of Modern Science (Heyck 2015)

This undergraduate course on the history of science is currently taught at the University of Oklahoma. Hunter Heyck teaches a class that touches upon multiple subjects within the history of science beginning after the Scientific Revolution of the 17th century (Heyck 2015). Although it is a more general course compared to others, the specifying factor is the focus on modern sciences and how they developed throughout the

last few centuries. Topics range from science and the Enlightenment to the Manhattan Project (Heyck 2015). One important element of this course that Heyck mentions in the syllabus is the central idea that "scientific ideas and practices are not isolated from the rest of society," (Heyck 2015). The societal culture and time in which scientific discoveries are made affect the discovery itself. Scientific breakthroughs and practices do not happen independently of the society in which those ideas are shaped. Further, the course itself utilizes a two lecture and one discussion per week schedule that requires the students to read numerous articles and books. As Heyck mentions in a personal communication, he attempts to incorporate Q&A into the lectures, as well as PowerPoint slides that only have a few "main point" slides, with the rest being pictures and videos (H. Heyck, personal communication, April 24, 2015). A noteworthy part of Heyck's course lies in the inclusion of race and gender as both specific topics and as an attempt to integrate these subjects within the rest of the course. As Heyck states he has had only "moderate success" at accomplishing this (H. Heyck, personal communication, April 24, 2015).

4.7 The Rise of Modern Science (Kingsland 2015)

Taught by Sharon Kingsland, this course offered at Johns Hopkins University encompasses the history of modern science from the mid-18th century to today. With topics ranging from the chemical revolution to the discovery of the double helix, the class focuses on the accomplishments of scientist in modern times and how these discoveries affected society (Kingsland 2015). Also, like many history of science courses, the class is reading-intensive and encourages class discussion. The class itself meets three times per week, with two lectures and one discussion section. Each week, a new topic is

introduced, with sub-topics being covered throughout the week. Similar to other general history of science classes, this class also narrows the time span looked at throughout the semester and keeps it within the last few centuries. Further, the requirements for grading the students rely heavily on essay assignments, while participation in class discussion makes up the final grade total. Overall, the most interesting part about the class is the span of topics that it incorporates.

4.8 History of Science: Plato to NATO (and beyond) (Doel 2015)

Offered at Florida State University, this course taught by Ronald Doel covers a large time span for the history of science. The current class has a class average between 180-188 students and consists of lectures combined with reading assignments (R. Doel, personal communication, April 17, 2015). As mentioned in the syllabus, the course examines how social, religious, and political factors have influenced science and why scientific interpretations change over time and affect how people see the world (Doel 2015). An important distinction between this course and other courses is the fact that the course covers such a large time period throughout the semester. The courses range from the discoveries made by renaissance scholars to quantum mechanics. Also, instead of using multiple journal articles and texts, this course mostly utilizes three textbooks in terms of reading assignments. Another noticeable difference is that this course does not offer a separate discussion section, even though the class numbers are large and it is a lecture-based course. An important aspect that is easily noticed is the inclusion of cultural features along with important scientific theories and areas of study.

4.9 HI 481H: History of the Life Sciences (Kimler 2015)

This course is taught at NC State University and is about the history and development of biology from the 17th century to today. Dr. William Kimler covers specific topics that include cell physiology to the nature of inheritance (Kimler 2015). Although this course is titled as a more general topic, the class itself narrows done to examine concepts from biology and includes connections to society and religious beliefs. It starts with exploring living structures and functions and progresses into each important discovery made about biology since the 1600s. This allows the students to gradually see how biological ideas unraveled throughout history and led to the ideas of today. Furthermore, the class is taught through lectures and requires the students to read before each class and write reading responses.

5 DISCUSSION AND CONCLUSION

One of the most obvious similarities between courses teaching history of science was the use of discussion sections. Since almost all the courses are lecture based, the professors need to supplement student interaction between the students and between student and teacher. The emphasis of discussion allows students to engage in cooperative learning and move towards active learning. In the journal article "Group Scribbles to Support Knowledge Building in Jigsaw Method", the authors mention the fact that students build their knowledge through interaction. They also note "classroom learning improves significantly when students participate socially, interacting in face-to-face collaborative learning activities with small groups of members" (Looi 2008). By allowing the students to participate in group discussion, the professors with discussion sections for their history of science courses are encouraging them to learn in a more effective manner.

This, in turn, provides a better learning experience and creates a more engaging class. Another journal article about jigsaw learning called "A 'Jigsaw Classroom' Technique for Undergraduate Statistics Courses," acknowledges the idea that "cooperative learning fosters positive attitudes toward the subject of study," (Perkins 2001). When using discussion sections for students to talk about the current week's scientific discovery topic, cooperative learning is employed and the students feel more knowledgeable about the subject matter. One of the courses in which cooperative learning creates a more positive attitude toward the topic is Dr. Chew's class "History of Biology – Conflicts and Controversies." As previously mentioned, a technique that the professor utilizes to improve learning in his class is timed "open-mouthed" quizzes. Since the students are given the opportunity to openly discuss the multiple-choice questions with their peers, they gain a more positive attitude toward the material and lessen their anxiety about the quiz. Dr. Chew states that "Students find themselves actively discussing and debating material they might otherwise approach only independently. Test anxiety all but disappears; even students normally accommodated with extra time have reported themselves comfortably able to cope," (M. Chew, personal communication, April 17, 2015). He even reported that, due to this open-discussion, quiz scores improved by 15%. Thus, the debate about which answer was correct gave the students a chance to think through their answers in a less stressful environment and actively learn with the aid of their peers. In fact, according to author Kristen Madden, "during discussion, students compare and debate the validity of different interpretations engaging skills of analysis, synthesis, and evaluation in the interactive setting," (Madden 2010). So the debate in the "open-mouthed" quizzes engaged the students' analysis skills and gave them a better

chance of getting the correct answer. Furthermore, the benefits of group discussion would also be seen in the history of science course implementing discussion sections just for the purpose of getting the students to communicate, even without a type of assessment tool. In conclusion, although each discussed history of science course had their own unique aspects, it was the utilization of group discussion that will enable them to be successful and engaging as a class.

6 REFERENCES

Chew, Matt. (2015). "History of Biology: Conflicts and Controversies."

Doel, Ronald E. (2015). "History of Science: Plato to NATO (and beyond)."

Heyck, Hunter. (2015). "History of Science Since the 17th Century: The Development of Modern Science."

Kimler, William. (2015). "HI 481H: History of the Life Sciences." Retrieved from http://www4.ncsu.edu/~kimler/hi481/481syllabus.pdf

Kingsland, Sharon. (2015). "The Rise of Modern Science, 140.32 Syllabus for Spring 2015."

Looi, C., Lin, C., & Liu, K. (2008). "Group Scribbles to Support Knowledge Building in Jigsaw Method." Learning Technologies IEEE Cs & ES. 1(3), 157-164.

Madden, Kirsten. (2010). "Engaged Learning with the Inquiry-Based Question Cluster Discussion Technique: Student Outcomes in a History of Economic Thought Course." *Southern Economic Journal* 77(1), 24-239.

Matlin, Karl. (2015). "Seminar: A History of Cell and Molecular Biology."

Nelson, Nicole. (2015). "History of Science/Medical History 133: Biology and Society, 1950 – today."

Perkins, D. V. & Saris, R. N. (2001). "A 'Jigsaw Classroom' Technique for Undergraduate Statistics Courses." Teaching of Psychology. 28(2), 111-113.

Riskin, Jessica. (2015). "HIST 240/340, The History of Evolution, Winter 2015."

Spanagel, David. (2013). "HI 2353 – History of the Life Sciences."

Spanagel, David. (2014). "HI 2352 – History of the Exact Sciences."

7 APPENDIX A: HISTORY OF SCIENCE COURSE SYLLABI

The History of Evolution (Stanford University)

Professor Jessica Riskin
Office hours: Tues 2:00-4:00
Bldg. 200, Rm. 116
telephone: 3-9379
e-mail: jriskin@stanford.edu

HIST 240/340
Thurs. 3:15 – 6:05
room: 50-51P

HIST 240/340:
The History of Evolution
Winter 2015

COURSE DESCRIPTION:
This course examines the history of evolutionary biology from its emergence around the middle of the eighteenth century. We will consider the continual engagement of evolutionary theories of life with a larger, transforming context: philosophical, political, social, economic, institutional, aesthetic, artistic, literary. Our goal will be to achieve a historically rich and nuanced understanding of how evolutionary thinking about life has developed to its current form.

ASSIGNMENTS & REQUIREMENTS:
In a seminar, it is crucial to do the reading and come to class prepared to participate in the discussion. **Undergraduates** will write a **7-10-pp. final paper due** on **March 20th** on a well-defined topic approved in advance. The **topic statement, outline and annotated bibliography** for this essay will be due on **February 12th**. Graduate students will write a **5-7-page essay review** treating at least 3 recent works on some aspect of our topic due on **February 12th** and a **15-20-page final paper** due on **March 20th**.

POLICIES: Laptops, mobile phones and all other portable electronic devices interfere with the class's navigational system and must be switched off and stowed for the duration of the course; extensions on assignments must be requested at least one week before the due-date and will be granted only in exceptional cases; late assignments are graded down 1/3 point per day of lateness.

READINGS: Readings are taken from the books listed below and/or are online. The books are widely available for purchase and are also on reserve at Green Library. **For all online readings, or readings that you choose to read online, please make printouts and bring them with you to class** (or, if you find it more convenient, purchase hard copies of these readings where possible).

Peter Bowler. *Evolution: The History of an Idea* (UC Press, 2009 [1st ed. 1983])
Denis Diderot, *Thoughts on the Interpretation of Nature* (Clinamen, 1999 (1754))
Denis Diderot, *D'Alembert's Dream* (1769)
William Paley, *Natural Theology* (Oxford 2008 (1802))
Jean-Baptiste Lamarck, *Zoological Philosophy* (1809)
Charles Darwin, *On the Origin of Species* (1859)

OTHER RESOURCES

Glass, Bentley, Owsei Temkin, and William L. Straus, Jr., eds.. *Forerunners of Darwin, 1745–1859*. Johns Hopkins, 1959.
Gould, Stephen Jay. *The Structure of Evolutionary Theory*. Harvard, 2002.
Kohn, David, ed.. *The Darwinian Heritage*. Princeton, 1985.
Lovejoy, Arthur. *The Great Chain of Being* (Harvard, 1990 [1st ed. 1936])
Mayr, Ernst. 1982. *The Growth of Biological Thought: Diversity, evolution and inheritance*. Harvard, 1982.
Richards, Robert. *The Meaning of Evolution*. Chicago, 1993.
Ghiselin, Michael. *The Triumph of the Darwinian Method*. Dover, 2003.

Pietro Corsi, Oxford Bibliogrpahy of the History of Evolutionary Thought Before Darwin.
http://www.oxfordbibliographies.com/view/document/obo-9780199941728/obo-9780199941728-0030.xml
Garland Allen, Oxford Bibliography of the History of Evolutionary Thought.
http://www.oxfordbibliographies.com/view/document/obo-9780199941728/obo-9780199941728-0021.xml
Lamarck CNRS website: http://www.lamarck.cnrs.fr/?lang=en
Buffon CNRS website: http://www.buffon.cnrs.fr/
Darwin papers at Cambridge University: http://www.darwinproject.ac.uk/
Darwin correspondence: http://www.darwinproject.ac.uk/

SCHEDULE:

Week 1 (January 8th) – **Introductions**

Week 2 (January 15th) – **Background to Evolution**

Reading:
Aristotle, History of Animals (4th c. BCE), Bk. 1, at
http://pm.nlx.com/xtf/view?docId=aristotle/aristotle.01.xml;chunk.id=div.aristotle.v1.64;toc.depth=1;toc.id=div.aristotle.v1.63;brand=default

Descartes, *Treatise on Man* (1630-33), at http://www2.dsu.nodak.edu/users/dmeier/31243550-Descartes-The-World-and-Other-Writings.pdf, skim, zeroing in on parts to read carefully.

Bowler, *Evolution*, Chs. 1 and 2

Week 3 (January 22nd) – **The First Transformists**

Reading:
Diderot, *Thoughts on the Interpretation of Nature* (1754), excerpts to be assigned
Diderot, *D'Alembert's Dream* and *Interview*, excerpts to be assigned

Bowler, *Evolution*, Ch. 3

Week 4 (January 29th) – **Lamarck's Theory of the Transformation of Living Forms**

Reading:
Jean-Baptiste Lamarck, *Zoological Philosophy* (1914 [1809]), Part I, preface; Part II, Chs. 2-3; Part III, Chs. 3-5
http://www.oeb.harvard.edu/faculty/friedman/Early_Evolution/Early_Evolution/Lamarck.html

Georges Cuvier, "Biographical Memoir of M. Lamarck" (1832), online at http://www.lamarck.cnrs.fr/ice/ice_book_detail.php?lang=fr&type=text&bdd=lamarck&table=bio_lamarck&bookId=15&typeofbookId=1&num=

Week 5 (February 5th) – **On the Origin of Darwinism**

Reading:
This week you will be doing research at Darwin's works online (http://darwin-online.org.uk/) and correspondance online (http://www.darwinproject.ac.uk/). Use the "advanced search" option to specify which sources you want to search.

Read the first two and final chapters of William Paley's *Natural Theology* (1809) and skim the rest.

Read the "Historical Sketch" that Darwin added in the third edition of the *Origin of Species* (1861), with particular attention to what he says about Lamarck. Compare this to what he says about Lamarck in unpublished manuscripts and correspondence, such as "Recollections of the Development of my Mind and Character." Do the same for William Paley.

Bowler, *Evolution*, Chs. 4 and 5

Week 6 (February 12th) – **The Descent of Darwinism with Modifications**

Reading:
Darwin, *On the Origin of Species*, excerpts to be assigned
Darwin, *The Descent of Man*, excerpts to be assigned
Darwin, *The Expression of Emotions in Man and Animals*, excerpts to be assigned

Bowler, *Evolution*, Ch. 6

Week 7 (February 19th) – **NO CLASS MEETING**

Week 8 (February 26th) – **Darwinism after Darwin**

Reading:
August Weismann, "The Supposed Transmission of Mutilations" (1888), in *Essays Upon Heredity and Kindred Biological Problems*, Edward B. Poulton, Selmar Schönland and Arthur Shipley, ed. and trans. (Oxford, 1889), online at http://www.esp.org/books/weismann/essays/facsimile/

Weismann, "The Significance of Sexual Reproduction in the Theory of Natural Selection," online at http://www.esp.org/books/weismann/essays/facsimile/

Julian Huxley, *Evolution: The Modern Synthesis* (1942), Ch. 1 [to be distributed]

Bowler, *Evolution*, Ch. 7, 8

Week 9 (March 5th) – **Neo-Darwinism and its Critics**

Reading:
Richard Dawkins, *The Selfish Gene*, 30th anniversary edition (Oxford, 2006), browse prefaces, Read Chs. 1, 4, online at
http://www.arvindguptatoys.com/arvindgupta/selfishgene-dowkins.pdf

Stephen Jay Gould and Richard C. Lewontin, "The Spandrels of San Marco and the
Panglossian Paradigm: A Critique of the Adaptationist Program," Proceedings of the Royal Society of London, Series B, Vol. 205, No. 1161 (1979), pp. 581-598, online at http://faculty.washington.edu/lynnhank/GouldLewontin.pdf

Bowler, Ch. 9

Week 10 (March 11th) – **Recent and Current Debates in Evolutionary Biology**

Reading:
Daniel Dennett, *Darwin's Dangerous Idea* (Penguin, 1995), browse Preface and Ch. 1, read Chs. 3 and 8, online at http://www.cui-zy.cn/Recommended/Nature&glabolization/Darwin's%20Dangerous%20Idea%20-%20Evolution%20and%20the%20Meaning%20of%20Life.pdf

Gould, Stephen Jay. "Darwinian Fundamentalism." *New York Review of Books* (June 12, 1997): 34-37, at http://www.nybooks.com/articles/archives/1997/jun/12/darwinian-fundamentalism/

Eva Jablonka and Marion Lamb, *Evolution in Four Dimensions* (MIT, 2005), Prologue and Chs. 1 and 4 [skim the rest to make sense of these chapters], online at http://www.explorelifeonearth.org/cursos/JablonkaLamb2005.pdf

Bowler, *Evolution*, Ch. 10

HI 2352 – History of the Exact Sciences (WPI)

HI 2352 – History of the Exact Sciences Term D 2014
revised syllabus (3/28/2014) David I. Spanagel

Introduction: Students should consider this a tool designed for continuous use. It answers many of the questions that will arise during the course of the term. Students should be familiar with all of its contents and should follow instructions in all particulars.

A. **Office and Office Hours**. **Office and Office Hours**. David Spanagel's office is located in Room 239 in Salisbury Labs, his WPI telephone extension is x6403, and his email address is spanagel@wpi.edu. Email is a MUCH BETTER way to communicate than the office phone, which will be virtually useless unless you call during a scheduled office hour. For Term D 2014, his "office hours" are Tuesdays and Fridays, 1:30 pm - 3 pm. Of course, other mutually convenient appointments may be arranged by appointment.

B. **Course Objectives**. As a 2000-level course, HI 2352 is conceived as an intermediate college-level history survey. As such, it will help students to practice and enhance skills that they may already have begun to develop during their academic careers at WPI, including:

1. reading
2. research
3. analytic (critical thinking)
4. expressive (writing, speaking, and collaborating)

Students enrolled in HI 2352 will be expected to master a fair amount of detail about the past, and to exercise analytical power over selected portions of this detail in order to recognize and discuss meaningful historical questions about the exact sciences. Students completing this course should be able to:

5. explain the nature of historical inquiry

6. to read, comprehend and interrogate primary source materials in the history of astronomy, mathematics, and cosmology
7. to read, comprehend, and evaluate a variety of scholarly secondary source materials that bear upon questions pertaining to these fields in the history of science
8. to write effective analytical historical prose

C. **The Main Course Topics for D14**. The overall purpose of gathering the exact sciences together in this history of science course is to survey major developments in the global history of mathematics, astronomy, and cosmology, as manifestations of the human endeavor to understand our place in the universe. During this term the course will examine the history of the exact sciences through a sampling of different people's lives in those sciences, and from a variety of methodological perspectives. A historical primary source (composed by Galileo Galilei), a historian of astronomy's joint biography of a brother and sister pair of amateur stargazers who made incredible celestial discoveries in the late 18th century, and a physics educator's episodic history of mathematical reasoning and abstraction from ancient Greece to today, will each be consulted as we try to understand how and why the exact sciences have changed in themselves and affected the world.

Requirements:

D. **Material to be Purchased**. Students should obtain the following four books. Each is available for purchase at the WPI Bookstore. Additional required reading materials will be provided either via online links or photocopies.

- Stuart Clark, *The Sun Kings: The Unexpected Tragedy of Richard Carrington and the Tale of How Modern Astronomy Began* (Princeton U. Press, 2007) paperback ISBN 978-0691141268
- Galileo Galilei, *Sidereus Nuncius, or The Sidereal Messenger* translated with introduction, conclusion, and notes by Albert Van Helden (U. Chicago Press, 1989) paperback ISBN 978-0226279039
- Michael Hoskin, *Discoverers of the Universe: William and Caroline Herschel* (Princeton U. Press, 2011) hardcover ISBN 978-0691148335
- Leonard Mlodinow, *Euclid's Window: The Story of Geometry from Parallel Lines to Hyperspace* (Free Press, 2002) paperback ISBN 978-0684865249

E. **Lectures**. Most class meetings will involve at least some lecturing by the instructor, punctuated by relevant questions from and/or brief discussions among the students.

F. **Films**. Portions of many class meetings will be spent engaged in viewing segments of course related documentary films, followed by instructor-led discussions. Students will be expected to participate fully in discussions.

G. **Class participation**. Each student's level of conscientious intellectual engagement while listening, speaking, class activities, presentations, asking questions – in lectures

and *especially* during review sessions, participating in film debriefings – and otherwise responding to course materials, will contribute 20% to the final course grade.

H. **Small group discussions.** In five class meetings, the class will break up into 5-person discussion groups to conduct a more intimate and creative discussion of the assigned readings. For every group discussion occasion, one student in each group will take responsibility for recording the entire substance of that group's work together. These notes will be used by the student to compose a Discussion Paper, which will be graded by the instructor. This paper will also be distributed to the rest of the group's members (and may be made accessible to the entire class via the myWPI discussion board), to provide everyone with materials for a comprehensive set of notes for the information covered. Discussion Paper responsibilities will rotate within the groups so that everyone will have at least one chance during the term to complete this assignment. The grade on the Discussion Paper will contribute 15% to each student's final course grade.

I. **Exams, laboratory activity, and optional research papers.** Two class meetings will be devoted to written assessments of your learning of the course materials. These will not be intentionally cumulative exams, but all relevant knowledge that you have acquired may be used to respond to the questions. The rules for the exams will permit access to any handwritten or printed out "notes" that students compose for themselves about the lectures, films and readings, plus printouts of group discussion write-ups. Students may not refer directly to course texts in the exams, nor to any other books, each other's papers, or any electronic resources whatsoever. The total exam grade will contribute 65% to each student's final course grade, but the weights of each exam score will be adjusted so that, for each individual, the better exam performance will count for more than the worse exam performance (e.g. 39%, 26%).

Any student may, however, choose to research and write about a specific historical question within the scope of the course, as an extra-credit or exam substitution assignment. All such optional research papers will be due and submitted in a hard copy to the instructor by 12 Noon, Tuesday, May 6. Students who wish to avail themselves of this option are required to submit paper proposals by 12 noon on Tuesday, April 15, and are strongly encouraged to submit a complete rough draft of their research papers before 12 noon on Tuesday, April 29 so that they may receive constructive critical feedback in time to do revisions on their final drafts, which will be collected at or before 12 noon on Tuesday, May 6. Any submitted paper, whose quality exceeds the lower of the two exam grades earned during the term, will be allowed to replace that exam grade in the final course grade calculations.

In addition, I am pleased to announce that in D 2014 HI 2352 will be cooperating with members of a WPI IQP project team that is exploring ways to enhance the teaching of the history of science at WPI. Course materials devoted to conducting a mini-research investigation, as well as a hands-on "laboratory" activity, have been designed and will be assessed by various means that involve direct observation, assessment of individual learning outcomes, and impressionistic student responses. To maintain confidentiality, every student will generate a unique "ID code" so that the IQP team may precisely conduct its analyses without being able to link outcomes data to anyone's name.

J. **Note on Plagiarism.** Not giving proper attribution – and thereby passing off someone else's material or idea as your own - will not be tolerated. All information in any discussion write-up that you work on must have proper attribution of its source, whether it is a quote, a paraphrase, an idea, a concept, a statistic or anything else you got from any source whatsoever, other than your own immediate knowledge. I will insist upon the use of proper historical footnotes or endnotes (as opposed to parenthetic references) for citations from the course readings. I will also urge you strongly to attribute individual ideas brought up in the discussions to their originators. Practice giving your classmates credit for their part in producing a collective body of understanding.

K. **Reading Assignments**. Students are expected to come to class each day having completed the reading assignment for that day, as outlined in the class schedule (O) below, so that they are optimally prepared to benefit from the lecture and/or participate in the discussions and activities. The heavy responsibility placed on students by WPI's intense seven-week terms makes this point especially important. Missing class and/or falling behind on the readings are the surest ways to earn an "NR" in the course, because there is virtually no opportunity to catch up on missed work.

L. **Students with Disabilities**
Students with disabilities who believe that they may need course adaptations or accommodations in this class because of a disability are encouraged to contact the Office of Disability Services (ODS) as soon as possible to ensure that such accommodations are implemented in a timely fashion. The ODS is located in the West Street House (157 West Street), (508) 831-49085. All students who require accommodations, or who have medical information that they feel they should share, should schedule a private meeting with the instructor (within the first week of classes if at all possible) to determine how they can work together most effectively.

Road Map:

M. **The Scope of the Field**. The history of science is a well-recognized branch of inquiry about the past that concerns itself with interesting and significant questions about humans and their knowledge and beliefs about nature over the past few thousand years. As such, the history of science is neither a branch of science nor a simplified form of "history for scientists." Instead, historians of science use the tools and methods of historical questioning and analysis to examine **details** about past scientific ideas and practices that their colleagues and predecessors have worked long and hard to uncover and document.

More importantly, historians of science develop **interpretations** which call attention to and define the significance of some details over others, culminating in the formulation of fruitful **thesis claims** that are intended not only to "explain" the past but also to inform further historical investigation. Throughout this process of questioning and analysis, historians of science draw upon and engage the work of scholars who are interested not only in science per se, but its patterns of past interactions with various belief systems, corporations, creativity, culture, economics, engineering principles,

aesthetics and the fine arts, the human intellect, influences upon or from literature, things like medical or military applications, political power, technology, and/or virtually any other aspect of human social activity and social structure.

N. **The Scope of the Course**. It is expected that many students enrolled in this course are pursuing their humanities depth area in history. This course will provide experience in a variety of areas of possible advanced work, showing both how to engage primary historical resources and scholarly secondary literature, skills useful in any field of the humanities and arts. Of the possible topics described in the catalog description, this iteration of HI 2352 will include: Ancient Greek, Ptolemaic, and Arabic knowledge systems; the Copernican Revolution; mathematical thinking and the Cartesian method; globalization of European power through the navigational sciences, applied mathematics, and Enlightenment geodesy; and theoretical debates over the origins of the solar system and of the universe.

O. **Schedule**. The schedule of class meeting topics and assigned readings listed below is, of course, potentially subject to change during the course of the term. It provides, however, a framework that both students and the instructor will find useful as they try to absorb the wealth of material contained in these four distinct course texts and additional materials, within the limitations of a seven-week term.

Dates	**Topics and Assigned Readings**
Tues. Mar. 18	Introduction to the course; baseline survey of background knowledge; show excerpt from BBC/Open University *The Story of Math* DVD Episode One: "The Language of the Universe" (Karen McGann, director, 2008) What are the exact sciences? How could history be relevant to our understanding of them? Provisions for cooperation with the IQP project team this term
Fri. Mar. 21	Euclidean Geometry and the Ancient World; Group Discussion #1 Read before class: Mlodinow, Introduction and Part 1 Euclid (ix-xii, 3-49); Ptolemy, *Almagest* Book I (especially Chapters 3-5 and 7) – a translation of this primary source text from circa 137 CE is available online at http://bertie.ccsu.edu/naturesci/Cosmology/Ptolemy.html; Ptolemy's work included a catalog of over 1000 stars that were visible to the naked eye, examine a description and examples from a 1515 reprinting of this catalog, available online at http://www.ianridpath.com/startales/almagest.htm
Tues. Mar. 25	Group Laboratory activity on Galilean telescopes

Read before class: Galileo, editor's introduction and Galileo's original *Siderius Nuncius* in translation (1-86)
Note: **Pre-lab assignment DUE at the beginning of class**

Fri. Mar. 28 Mathematical Thinking and the Cartesian Method; Printing Press workshop/Group Discussion #2
Read before class: Galileo, Conclusion (87-113); Mlodinow, Part 2 Descartes (51-92)
Note: **Printing Press research presentation materials must be prepared in advance, to be shared in the workshop/group discussion**

Tues. Apr. 1 Globalization of European Power; Primary Source workshop on
Read before class: Hoskin, Prologue and Chapters 1-5 (1-81)
Note: **Post-lab assignment DUE at the beginning of class**

Fri. Apr. 4 Observational Astronomy During the Enlightenment; Group Discussion #3
Read before class: Hoskin, Chapters 6-10 (82-157)

Tues. Apr. 8 Launching Prodigies; Exam Review Session
Read before class: Hoskin, Chapters 11-13 (158-207); Mlodinow, beginning of Part 3 "Gauss" (93-120)

Fri. Apr. 11 **EXAM #1**

Tues. Apr. 15 View BBC/Open University *The Story of Math* DVD Episode 3 "The Frontiers of Space" (Karen McGann, director, 2008); Primary source workshop on the hunt for planet Vulcan
Read before class: Mlodinow, Chapters 17-20 (121-149); Clark, Prologue and Chapters 1-3 (1-57)
Note: **Optional Paper Proposals Due today**

Fri. Apr. 18 Solar Flares and Modern Vulnerabilities; Primary source workshop on the hunt for planet Vulcan
Read before class: Clark, Prologue and Chapters 4-9 (58-128)

Tues. Apr. 22 Thursday Schedule - NO CLASS (stay ahead by diving into the next reading assignment)

Fri. Apr. 25 View *Flatland* DVD (Ladd P. Ehlinger, Jr., director, 2007); Group Discussion #5
Read before class: Clark, Chapters 10-13 and Epilogue (129-191); Mlodinow, Beginning of Part 4 "Einstein" (151-192)

Tues. Apr. 29 Einstein's Relativity; view excerpt of History Channel *Einstein* DVD (Ted Marcoux, director, 2009)

Read before class: Mlodinow, Chapters 26-28 (193-214); Matthew Stanley, "An Expedition to Heal the Wounds of War," *ISIS* 94 (2003): 57-89; and/or listen to *Nature* podcast "March 1918: Testing Einstein" (featuring David Kaiser and Matthew Stanley)

Note: **Optional Paper Rough Drafts Due today** (if feedback for revision purposes is desired)

Fri. May 2 View Nova *The Elegant Universe* DVD Episode 2 "String's the Thing" (Joseph McMaster, director, 2003); Exam Review Session

Read before class: Mlodinow, Part 5 "Witten" and Epilogue (215-265)

Tues. May 6 **EXAM #2**

Note: **ALL OPTIONAL RESEARCH PAPERS DUE at 12:00 noon**

HI 2353 – History of the Life Sciences (WPI)

HI 2353 – History of the Life Sciences Term B 2013
REVISED syllabus (11/18/2013) Prof. David I. Spanagel

Introduction: Students should consider this a tool designed for continuous use. It answers many of the questions that will arise during the course of the term. Students should be familiar with all of its contents and should follow instructions in all particulars.

A. **Office and Office Hours**. David Spanagel's office is located in Room 239 in Salisbury Labs, his WPI telephone extension is x6403, and his email address is spanagel@wpi.edu. Email is a MUCH BETTER way to communicate than the office phone, which will be virtually useless unless you call during a scheduled office hour. For Term B 2013, his "office hours" are Mondays and Thursdays, 1:45 pm - 3:15 pm. Of course, other mutually convenient appointments may be arranged by appointment.

B. **Course Objectives**. As a 2000-level course, HI 2353 is conceived as an intermediate college-level history survey. As such, it will help students to practice and enhance skills that they may already have begun to develop during their academic careers at WPI, including:

9. reading
10. research
11. analytic (critical thinking)
12. expressive (writing, speaking, and collaborating)

Students enrolled in HI 2353 will be expected to master a fair amount of detail about the past, and to exercise analytical power over selected portions of this detail in order to recognize and discuss meaningful historical questions about the life sciences. Students completing this course should be able to:

13. explain the nature of historical inquiry

14. to read, comprehend and interrogate primary source materials in the history of biology, medicine, and ecology
15. to read, comprehend, and evaluate a variety of scholarly secondary source materials that bear upon questions pertaining to these fields in the history of science
16. to write effective analytical historical prose

C. **The Main Course Topics for B13**. The overall purpose of gathering the life sciences together in this course is to survey major developments in the global history of biology, ecology, and medicine, as manifestations of the human endeavor to understand living organisms. During this term the course will examine the history of the life sciences through a variety of methodological perspectives. Three big-picture historical surveys of the overlapping knowledge and instrumental practices of natural history, biology, and medicine (written by professional historians of science), selected chapters from a narrative history of the activities and ideas of Romantic (late 18th and early 19th century) science, a literary primary source reflecting infectious disease perceptions in the early 20th perspective (composed by American novelist Jack London), as well as two scholarly articles drawn from complementary methodological perspectives (media studies and literary studies), will each be consulted as we try to understand how and why the life sciences have changed in themselves and affected the world over the past several centuries.

Requirements:

D. **Material to be Purchased**. Students should obtain the following four books. Each is available for purchase at the WPI Bookstore. Additional required reading materials will be provided either via online links or photocopies.

- Jim Endersby, *A Guinea Pig's History of Biology* (Harvard U. Press, 2009) paperback ISBN 978-0674032279
- Paul Lawrence Farber, *Finding Order in Nature: The Naturalist Tradition from Linnaeus to E. O. Wilson* (The Johns Hopkins U. Press, 2000) paperback ISBN 978-0801863905
- Richard Holmes, *The Age of Wonder: The Romantic Generation and the Discovery of Beauty and Terror of Science* (Vintage Books, 2010) paperback ISBN 978-1400031870
- Roy Porter, *Blood and Guts: A Short History of Medicine* (W.W. Norton, 2004) paperback ISBN 978-0393325690

E. **Lectures**. Most class meetings will involve at least some lecturing by the instructor, punctuated by relevant questions from and/or brief discussions among the students.

F. **Films**. Portions of four class meetings will be spent engaged in viewing course related film materials, followed by instructor-led discussions. Students will be expected to participate fully in discussions.

G. **Class participation**. Each student's level of conscientious intellectual engagement while listening, speaking, asking questions – in lectures and *especially* during review sessions, participating in film debriefings – and otherwise responding to course materials, will contribute **20%** to the final course grade.

H. **Small group discussions.** In five class meetings, the class will break up into 5-person discussion groups to conduct a more intimate and creative discussion of the assigned readings. For every group discussion occasion, one student in each group will take responsibility for recording the entire substance of that group's work together. These notes will be used by the student to compose a Discussion Paper, which will be graded by the instructor. This paper will also be distributed to the rest of the group's members (and may be made accessible to the entire class via the myWPI discussion board), to provide everyone with materials for a comprehensive set of notes for the information covered. Discussion Paper responsibilities will rotate within the groups so that everyone will have at least one chance during the term to complete this assignment. The grade on the Discussion Paper will contribute **15%** to each student's final course grade.

I. **Exams, the QHQRT paper, and optional research papers.** Two class meetings will be primarily devoted to written assessments of what you are learning from the course materials. These 80-minute exams are designed to be noncumulative, but all relevant knowledge that you have acquired may be used to respond to the questions. The rules for the exams will permit access to any handwritten or printed out "notes" that students compose for themselves about the lectures, films and readings, plus printouts of group discussion write-ups. Students may not directly consult actual course texts or source readings during the exams, nor may they access any other books, each other's papers, or any electronic resources whatsoever. The total exam grade will contribute **50%** to each student's final course grade, but the weights of each exam score will be adjusted so that, for each individual, the better exam performance will count for more than the worse exam performance (e.g. **30%**, **20%**).

Each student will also undertake to write a history research paper proposal, in the form that I call the QHQRT (Question, Hypothesis, Question, Research, Thesis) essay. This paper will be due by 3 pm on Monday, December 2 (the first day of classes after the Thanksgiving holiday break). This essay will contribute another **15%** to each student's final course grade.

Any student may, in addition, choose to continue the research and write the actual research paper outlines in their QHQRT essay, as an extra-credit or exam substitution assignment. All such optional research papers will be due and submitted in a hard copy to the instructor by 3 pm, Thursday, December 19. Students are strongly encouraged to submit a complete rough draft of their research papers before 3 pm on Thursday, December 12 so that they may receive constructive critical feedback in time to do revisions on their final drafts, which will be collected at or before 3 pm on Thursday, December 19. Any submitted paper, whose quality exceeds the lower of the two exam grades earned during the term, will be allowed to replace that exam grade (i.e. **20%**) in the final course grade calculations.

J. **Note on Plagiarism.** Not giving proper attribution – and thereby passing off someone else's material or idea as your own - will not be tolerated. All information in any discussion write-up that you work on must have proper attribution of its source, whether it is a quote, a paraphrase, an idea, a concept, a statistic or anything else you got from any source whatsoever, other than your own immediate knowledge. I will insist upon the use of proper historical footnotes (as opposed to parenthetic references) for citations from the course readings. I will also urge you strongly to attribute individual ideas brought up in the discussions to their originators. Practice giving your classmates credit for their part in producing a collective body of understanding.

K. **Reading Assignments**. Students are expected to come to class each day having completed the reading assignment for that day, as outlined in the class schedule (O) below, so that they are optimally prepared to benefit from the lecture and/or participate in the discussions and activities. The heavy responsibility placed on students by WPI's intense seven-week terms makes this point especially important. Missing class and/or falling behind on the readings are the surest ways to earn an "NR" in the course, because there is virtually no opportunity to catch up on missed work.

L. **Students with Disabilities**
If you need course adaptations or accommodations because of a disability, or if you have medical information to share with me, please make an appointment with me as soon as possible. If you have not already done so, students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Services as soon as possible to ensure that such accommodations are implemented in a timely fashion. This office is located in the West St. House (157 West St), (508) 831.4908.

Road Map:

M. **The Scope of the Field**. The history of science is a well-recognized branch of inquiry about the past that concerns itself with interesting and significant questions about humans and their knowledge and beliefs about nature over the past few thousand years. As such, the history of science is neither a branch of science nor a simplified form of "history for scientists." Instead, historians of science use the tools and methods of historical questioning and analysis to examine **details** about past scientific ideas and practices that their colleagues and predecessors have worked long and hard to uncover and document.

More importantly, historians of science develop **interpretations** which call attention to and define the significance of some details over others, culminating in the formulation of fruitful **thesis claims** that are intended not only to "explain" the past but also to inform further historical investigation. Throughout this process of questioning and analysis, historians of science draw upon and engage the work of scholars who are interested not only in science per se, but its patterns of past interactions with various

belief systems, corporations, creativity, culture, economics, engineering principles, aesthetics and the fine arts, the human intellect, influences upon or from literature, things like medical or military applications, political power, technology, and/or virtually any other aspect of human social activity and social structure.

N. **The Scope of the Course**. Many students enrolled in this course are pursuing their humanities depth area in history. This lecture and discussion course will provide experience in a variety of areas of possible advanced work, showing both how to engage primary historical resources and scholarly secondary literature, skills useful in any field of the humanities and arts. Of the possible topics described in the catalog description, this iteration of HI 2353 will focus on: The Galenic medical tradition; Vesalius and the Renaissance; Linnaeus and Enlightenment natural history; Romantic biology and the Darwinian revolution; genetics from Mendel to the fruit fly; eugenics and racial theories as "applied" biology; modern medicine, disease, and public health; and microbiology from the double helix to the Genome project.

O. **Schedule**. This schedule of class meeting topics and assigned readings is, of course, potentially subject to change during the course of the term. It provides, however, a framework that both students and the instructor will find useful as they try to absorb the wealth of material contained in these four distinct course texts and additional materials, within the limitations of a seven-week term.

Dates **Topics and Assigned Readings**

Thurs., Oct. 31 Introduction to the Course
Distribute course syllabus
View most of Kenneth Branagh's feature film based on Mary Shelley's novel *Frankenstein* (1994)

Mon., Nov. 4 Educating Dr. Frankenstein (complete viewing the film and debrief)
Group Discussion #1
Read before today's class: Porter, Chapters 1-4 (1-98)

Thurs., Nov. 7 Healing as Art versus Science
Primary sources workshop on the real 18th century Dr. Edward Jenner
Read before today's class: Holmes, Chapter 5 (305-336); Porter, Chapters 5-6 (99-134); and John A. Dern, "Beyond Vaccination: Edward Jenner and the Problem of Contingency," *Interdisciplinary Literary Studies* 14 (2012): 164-179. [pdf of article will be posted on myWPI, or can be obtained directly through WPI library's electronic journals database]

Mon., Nov. 11 The Romantic Naturalist
Group Discussion #2
Read before today's class: Farber, Introduction and Chapter 1 (1-21); and Holmes, Chapter 1 (1-59)

Thurs., Nov. 14 Searching for Cures and Exotic Species
Primary sources workshop on quinine
Read before today's class: Farber, Chapters 2-4 (22-55); and Holmes, Chapter 5 (211-234)

Mon., Nov. 18 Philosophical Shift from Design to Randomness
Group Discussion #3
Read before today's class: Endersby, Chapters 1-2 (1-60); and Farber, Chapters 5 and 7 (56-71 and 87-99 – though we are skipping over it now, we will read Chapter 6 very soon)

Thurs., Nov. 21 Are there Universal Biological Laws?
First Exam Review Session
Read before today's class: Endersby, Chapters 3-4 (61-127); and Farber, Chapter 6 (72-86)

Mon., Nov. 25 **EXAM #1**

Thurs. Nov. 28 THANKSGIVING HOLIDAY – NO CLASS (note the lengthier than usual reading assignment for after break)

Mon., Dec. 2 Genetics and Eugenics
View portions of George Cukor's dramatic feature film, *A Bill of Divorcement* (1932)
Primary sources workshop on eugenic sterilization laws
Read before today's class: Endersby, Chapters 5-6 (128-208); and Melissa Ooten and Sarah Trembanis, "Filming Eugenics: Teaching the History of Eugenics Through Film," *The Public Historian* 29 (2007): 145-155. [pdf of article will be posted on myWPI, or can be obtained directly through WPI library's electronic journals database]
[**QHQRT essays due today at 3:00 pm**]

Thurs., Dec. 5 Modern Disease Anxieties
Group Discussion #4

Read before today's class: Porter, Chapters 7 and 8 (135-169); and Jack London, *The Scarlet Plague* (entire text of the novella is available online at http://www.gutenberg.org/files/21970/21970-h/21970-h.htm)

Mon., Dec. 9 Evolutionary Synthesis
Primary sources workshop on pesticide resistance
Read before today's class: Endersby, Chapters 7-8 (209-291); and Farber, Chapter 8 (100-108)

Thurs., Dec. 12 Applications from Agriculture to Biotechnology
View selected portions of The Kids in the Hall's comedy feature film *Brain Candy* (1996)
Group Discussion #5
Read before today's class: Endersby, Chapters 9-10 (292-372); and Farber, Chapter 9 (109-118)
[**Optional Paper Rough Drafts Due sometime today** – if feedback for revision purposes is desired]

Mon., Dec. 16 Ethical Limits to Science?
Second Exam Review Session
Read before today's class: Endersby, Chapters 11-12 (373-432); and Farber, Epilogue (119-121)

Thurs., Dec. 19 **EXAM #2**
ALL OPTIONAL RESEARCH PAPERS DUE at 3:00 pm

History of Biology: Conflicts and Controversies (Arizona State University)

HISTORY OF BIOLOGY—CONFLICTS AND CONTROVERSIES

BIO 316 / HPS 330, Spring 2015

M–W–F: 9:00 am – 9:50 am. **PSF 101**

PERSONNEL

Instructor:	Dr. Matt Chew	TA:	Don Irwin
E-mail:	mchew@asu.edu	E-mail:	Donald.Irwin@asu.edu
Office:	LSA 252	Office:	LSC 280
Ofc. Hours:	MWF by appointment	Ofc. Hours:	W-Th 2:00-4:00 pm. or by appt.

COURSE DESCRIPTION

Biology is a diverse and technically complex topic. Its history is even more diverse and complex. As the life sciences were invented, competing hypotheses were proposed and tested. Most of those have been superseded or greatly modified since their initial conception. As a result, the history of biology is as much about discarded ideas as accepted ones. This course treats biology as a human pursuit, a cultural phenomenon, and an array of disciplines that arose, changed, and sometimes collapsed over time.

The course is taught as a series of week-long seminars. Each week we will look at ideas and discoveries and some of the principal scientists and institutions who proposed and opposed them, and who 'won' or 'lost' their bids to invent or improve human knowledge. Overall, we will move forward from the most ancient ideas to more recent ones, but we will return to first principles as each topic requires. Since this is a history course, all of the specific breakthroughs we will cover are now at least partially obsolete; they have since been superseded or refined. We will not cover current theories or methods discussed in regular biology courses.

There are no prerequisites, but we will discuss biological topics in technical terms and relate science and scientists to their social, political, religious, and technological influences. Students lacking knowledge of basic biology and the history and geography of western civilization (particularly post-Renaissance Europe) will find the material more challenging than students with knowledge of these topics. Learning historical facts about the political, philosophical, and religious views held by various figures is necessary to understanding their lives, times, and ideas. Arguing for or against personal beliefs is not an objective of the course and will neither be required nor tolerated during classroom discussions or in answering quiz and examination questions.

It has been said, "the past is a foreign country." You will soon agree with that sentiment. We work hard to make the course content accessible and interesting, but we cannot make it "easy." If you have difficulty remembering facts like names, places and dates, perhaps it will help to approach this as a social process of moving to a new place and getting to know a whole new set of people.

HONORS: We will accept up to 4 separately graded Honors contract projects by Barrett Honors College students. Honors projects require a 2000 to 4000 word research paper, additional meetings and a brief presentation to the class on May 1. Research papers will be evaluated by typical BHC/THE writing criteria and must represent "B" work or better to fulfill the Honors Contract. At least two drafts will be required. The first draft will be due Friday, April 3. Alternative projects are possible, but it will be up to you to propose something plausible. **Contact Dr. Chew by Friday, January 30 for details.**

GRADING: Grading is based on your best 14 scores from 15 multiple choice quizzes (worth 50 points each) and 3 take-home essay exams (worth 100 points each) for a total of 1000 possible points. Quizzes cover material from lectures and readings assigned for that week. Exams require synthesizing material from lecture and readings over a period of several weeks. Grading will follow the default *My*ASU Blackboard percentage scale and include +/– grades, as follows:

Grade	***Percentage (%)***	***Total Points***
A+	≥97	≥ 970
A	≥94 but <97	940 to 969.5
A-	≥90 but <94	900 to 939.5
B+	≥87 but <90	870 to 899.5
B	≥84 but <87	840 to 869.5
B-	≥80 but <84	800 to 839.5
C+	≥76 but <80	760 to 799.5
C	≥70 but <76	700 to 759.5
D	≥60 but <70	600 to 699.5
E	<60	≤599.5

There is no extra credit available. Don't ask.

COURSE REQUIREMENTS AND EXPECTATIONS

Expected Effort: ASU students are expected to expend at least 45 'contact' hours on each credit hour earned. That means this three credit course will require 135 hours of your time during the semester. Lectures will account for 44 hours. Take home exams may account for six hours. That leaves 85 hours for reading and study.

Attending Lectures: Some topics covered in quizzes or exams will be encountered **only** during lecture, and concepts from the readings may be expanded on or modified during lectures. Only selected slides introducing historical individuals will be posted on *My*ASU Blackboard. ***Lectures and related notes will NOT be posted.***

Reading assigned materials (books, handouts, and online materials):

History courses require extensive reading, and this one is no exception. Some topics covered in quizzes and exams will be encountered **only** in readings. Successful completion of exams will require completing the readings. It will all make more sense to students who prepare by keeping up with the readings. I have already pared the readings down to the absolute minimum. Use your 85 hours wisely.

*Links on the My*ASU *Blackboard course site* will allow you to access uploaded or online reading assignments and other materials.

*Two **required** books* are available at the ASU bookstore in inexpensive paperback editions: *The Annotated Origin* [Darwin's *On the Origin of Species*, facsimile of 1st edition, 1859] plus notes by James T. Costa, ISBN-13 978-0674060173 Harvard, 2011; and *The Half-Life of Facts* by Samuel Arbesman, Penguin, 2013. ISBN-13 9781591846512.

Scheduled quizzes (15): Quizzes will be administered during normally scheduled lecture periods every Friday. By registering for the course you are committing yourself to being present for them. Each 25-minute quiz will include 20 multiple-choice questions on material covered during that calendar week (M-W-F). Each quiz question will be projected on the screen for between 35 and 75 seconds (depending on its complexity) during which time students will mark their answers on a Scantron sheet. **Notes and other materials may not be consulted during quizzes; however, students may openly discuss any question while it is projected**.

Each take home exam (3) will consist of **one** essay question requiring students to think synthetically about the relationship between several topics covered in the course up to that point. Questions will be posted at *My*ASU Blackboard one week before the exam submission deadline. Answers must be 750-1250 words long, and submitted via "Safe Assignment" by the deadline specified. Group study and preparation are encouraged, but **you must write your submitted answers in your own words**. ASU's Academic Integrity policies and procedures will be strictly followed.

Late/Makeup Quizzes and Exams: Requests for makeup quizzes or exams will be considered only if made in a timely manner through the ASU Office of Student Affairs and your predicament meets University-wide criteria for an excused absence during the scheduled exam or quiz period. Because one score will be dropped, a makeup quiz will only be considered if you have missed at least 2 quizzes.

Assignments: Read the assigned texts. Readings other than the required books will be posted on *My*ASU Blackboard. Except for Honors projects, there will be no term papers. Your first assignment is to read the syllabus. To demonstrate that you have done so, and to earn 10 bonus points, send an email message to TA Don Irwin at the address listed above by 11:59:59 pm on Sunday, January 18. Use the subject line "assignment one". In the body of the text, submit one question about the history of biology you would like us to answer during the course.

THIS SCHEDULE MAY BE REVISED AS NEEDED AT THE INSTRUCTOR'S DISCRETION

Topical Schedule for BIO316/HPS330 S2015 Version 1.2

Day→ ↓Week	*Monday*	*Wednesday*	*Friday*	Segment Title
1	Jan 12 Intro/abstract	Jan 14	Jan 16 Quiz 1	Preliminaries; Ancient & Medieval
2	Jan 19 MLK Holiday	Jan 21	Jan 23 Quiz 2	Anatomy & Physiology
3	Jan 26	Jan 28	Jan 30 Quiz 3	Natural History
4	Feb 2	Feb 4	Feb 6 Quiz 4	Taxonomy
5 Exam 1	Feb 9	Feb 11	Feb 13 Quiz 5	Biogeography
6	Feb 16	Feb 18	Feb 20 Quiz 6	Microbiology
7	Feb 23 Jane Maienschein	Feb 25	Feb 27 Quiz 7	Embryology
8	Mar 2	Mar 4	Mar 6 Quiz 8	Evolution I: Pre-Darwinian
Spring Break Mar 8-15				
9	Mar 16	Mar 18	Mar 20 Quiz 9	Evolution II: Darwin
10 Exam 2	Mar 23	Mar 25	Mar 27 Quiz 10	Genetics and Eugenics
11	Mar 30	Apr 1	Apr 3 Quiz 11	Evolution III: Modern Synthesis
12	Apr 6	Apr 8	Apr 10 Quiz 12	Biochemistry
13	Apr 13	Apr 15	Apr 17 Quiz 13	Public Health
14	Apr 20	Apr 22	Apr 24 Quiz 14	Ecology
15 Exam 3	Apr 27	Apr 29	May 1 Quiz 15	Big Science

Readings will be released week by week via Blackboard, except for required books:

We will read *The Half Life of Facts* during weeks 1-5. Week 1: Chapters 1-3
Week 2: Chapters 4-5
Week 3: Chapters 6-7
Week 4: Chapters 8-9
Week 5: Chapter 10, Afterword.

Quizzes 1-5 will include questions about chapters read during respective weeks.

We will cover *The Annotated Origin* during weeks 8-9. You should read, at minimum, chapters 1-6 and 14. Quiz 9 and Exam 2 will include references to this book.

Readings to be made available via Blackboard (subject to change):

Week	Titles
1	Excerpts from William Beebe's *The Book of Naturalists* (1944) ~20 pages: Altamira Cave (~15,000 BCE); Aristotle: Fishing frogs, cuckoos and other things (~344 BCE); Pliny the Elder: Disagreements between elephants and dragons; The birth of pearls (77 CE); Theobaldus of Cassino: The Whale (~1030 CE); Emperor Frederick II: The Migration of Birds (1245 CE); Gesner: The rhinoceros and the mouse (1551 CE)
2	• Goethe: Basic Morphological Types (1817) ~ 5½ pages • Lavoisier & Laplace: Memoir on Heat (1783) ~ 8 pages
3	• White: Excerpts, *The Natural History and Antiquities of Selbourne* (1789) ~6 letter-sized pages • Bates: "The Natural History of Naturalists" (1950) ~15 pages.
4	• Ray – *Methodus Plantarum Nova* (1682) Excerpt 1: Preface to the Reader ~5 pages • Ray – *Methodus Plantarum Nova* (1682) Excerpt 2: Section V. A general division of plants… ~4 pages • Mayr: Excerpts, *Systematics and the Origin of Species* (1942), Forward by T. Dobzhansky ~2 pages; Chapter 1: Methods and Principles of Systematics ~15 pages
5	• Schiebinger: Excerpt from *Plants and Empire – Colonial Bioprospecting in the Atlantic World* (2004) Chapter 1: Voyaging Out **~50 pages** • Krulwitch: *The Story of Jeanne Baret* (2012) ~3 pages
6	• Fara: *A Microscopic Reality Tale* (2009) ~3 pages • Cromatic Aberration (Nikon Microscopy online) • Astigmatism (Nikon Microscopy online) • Pasteur: *Studies in Fermentation* Chapter 1. ~18 pages
7	• Maheshwari, Excerpt from *An Introduction to the Embryology of Angiosperms* (1950): Chapter 1, 'Historical Sketch' ~ 16 pages • Lawrence: "Ovism" (2008) from ASU's *Embryo Project Encyclopedia* ~2 pages • Lawrence: "Spermism" (2008) from ASU's *Embryo Project Encyclopedia* ~3 pages
8	• Buffon: Excerpt, *The Natural History of Animals, Vegetables…* (1761; Transl. 1781) ~3 pages • Lamarck: Excerpt, *Zoological Philosophy* (1809; Transl. 2000) ~9 pages • Anonymous [Chambers]: Excerpt, *Vestiges of the Natural History of Creation* (1844) Chapter 12. ~7 pages.
9	[Darwin: required book only. No online readings this week]
10	• Mendel: Experiments in Plant Hybridization (1866; Transl. und.) ~20 pages • Painter: When Poverty was White (2012) ~3 pages • Allchin: Morgan & the White-eyed Mutant ~10 pages • Ball: Celebrate the Unknowns (2013 - DNA 60th Anniversary) ~2 pages
11	Two Entries by Peter Bowler from *Encyclopedia of Life Sciences* (2001) • "Evolutionary Ideas: The Eclipse of Darwinism" ~5 pages. • "History of Modern Ideas: The Modern Synthesis" ~5 pages.
12	Five short online accounts of the discovery of the chemical structure of DNA: • The Secret of Life -- Discovery of DNA Structure (Video) ~9½ minutes • PBS: Watson and Crick describe structure of DNA in 1953 ~1½ pages • Allensby: The people responsible for the discovery of DNA ~5 pages • Rosalind Elsie Franklin…Pioneer Molecular Biologist ~2 pages • Beaton: *Hark! A Vagrant* (undated comic strip) ~¼ page
13	• Amsterdamska: "Demarcating Epidemiology" (2005) 29 pages
14	• Tansley: "The Use and Abuse of Vegetational Concepts and Terms" (1935). ~ 22 pages. • Odum: Excerpt from *Ecology* (1963): Chapter 1. ~ 5 pages • Chew & Laubichler: Natural Enemies–Metaphor or Misconception (2003) ~2 pages.
15	• Smith: "The International Biological Program and the Science of Ecology," (1968). 6 pages. • Boffey: "International Biological Program: Was it Worth the Cost and Effort?" (1976). 2 pages.

A History of Cell and Molecular Biology (University of Chicago)

SYLLABUS

Seminar: A History of Cell and Molecular Biology

(HiPS 25902, BIOS 29270, CHSS 34300, HIST 25511, HIST 35511)

Instructor: Karl Matlin (kmatlin@uchicago.edu; 773-834-2242 or 773-612-8426)

Meeting Time: Wednesdays 1:30-4:20PM

Meeting Location: Cobb 403

This course will trace the parallel histories of cell and molecular biology, focusing particularly on the 20th century. The seminar is not designed to be comprehensive but rather to provide a framework for thinking about the historical development of and conceptual tensions between cell and molecular biology.

The overall goals and objectives of the course are to:

1. Explore continuities and discontinuities between cell biology and molecular biology and their precursors, cytology and genetics.
2. Define cell biology and molecular biology based upon their practices and explanatory strategies, and determine to what extent these strategies overlap.
3. Examine the relevance of these definitions to current developments in biology.

Required Books

The following books are required and are available for purchase in the Seminary Cooperative Bookstore (5751 S Woodlawn Ave.). Copies have also been placed on reserve in the Crerar Library:

William Bechtel (2006) *Discovering Cell Mechanisms* (Cambridge)

Robert Olby (1994) *The Path to the Double Helix* (Dover)

Readings

Readings will include selected articles from the primary scientific literature, historical essays by scientists, and works by historians and philosophers of biology. All required and supplemental readings other than those from Bechtel's and Olby's books will be available on Chalk, either under Library Course Reserves or Course Documents. Printed copies of the required readings will also be distributed.

Course Requirements

a) Read required materials prior to class and participate in class discussions (30%).
b) No later than 12 noon on Tuesday prior to the relevant class, submit a weekly one-page "reaction paper" to one or more of the required readings and two discussion questions based upon the readings (20%). The reaction papers and questions will not be graded, but late or absent reaction papers may affect your final grade. **Note: no reaction paper or discussion questions are required for the first session of the course on April 1st.**
c) Submit (via e-mail) a one-page paper topic outline by Monday May 11th and present a 5 min talk on your topic to class on Wednesday May 13th. Undergraduates are **required** and graduate students **strongly encouraged** to meet with me prior to May 11th to discuss paper ideas (10%).
d) Submit a final paper on a course topic of interest. Undergraduate papers should be 8 pages long (double-spaced) exclusive of references; graduate student papers should be 12-15 pages long (double-spaced) exclusive of references (40%). Appropriate formatted citations are required.

Paper Submission Deadlines

Graduating Seniors: NO LATER THAN THE START OF THE LAST CLASS - WEDNESDAY JUNE 3RD!!

All Other Students: NO LATER THAN MIDNIGHT JUNE 13TH!!

Please submit papers electronically to kmatlin@uchicago.edu - preferably as a Word document.

Office Hours

By appointment. My office is located in the Surgery-Brain Building., 58th St. and Ellis Ave., Room J557. Appointments can be arranged by contacting Ms. Ruth Crawford (rcrawford@surgery.bsd.uchicago.edu).

Sessions, Topics, and Readings

Session #1 April 1st

Introduction: What is cell biology? What is molecular biology?

What do biologists mean when they define themselves as cell or molecular biologists? Are there differences? Are these really separate disciplines? What is the perception of the general public? Of historians and philosophers of biology? If they are separate disciplines, what are their defining characteristics? A "classic" history of the life sciences in the 20th century (up to the 1970s) does not mention cell biology. Why is that?

Objectives:

a) Based upon your pre-existing notions and our discussions, define cell and molecular biology.
b) Compare and contrast molecular and biological phenomena.
c) Describe what characteristic practices are employed by cell and molecular biologists to explain biological phenomena.

Reading:

a) Bechtel, W. (2006). *Discovering Cell Mechanisms*. Cambridge: Cambridge University Press, pp. 1-18.
b) Judson, H.F. (1979) *The Eighth Day of Creation.* New York: Touchstone-Simon and Schuster. pp. 201-222.

Session #2 April 8th

Historical Foundations: From the 19th to the 20th century

To what extent do cell and molecular biology share a common origin? Did cell and molecular biology develop from cytology and genetics? What were fundamental unsolved questions in biology at the turn of the century?

Objectives:

a) Define cytology and trace its origins from the development of the cell theory.
b) Describe what was meant by "inheritance" at the end of the 19th century.
c) Outline the relationship between Mendel's discoveries and the chromosomal theory of inheritance.
d) Describe how the relative roles of the nucleus and cytoplasm were understood at the turn of the 20th century.

Reading:

Required:

a) Bechtel, W. (2006). *Discovering Cell Mechanisms*. Cambridge: Cambridge University Press, pp. 64-117.
b) Wilson, E.B. (1924) Introduction. In: *General Cytology*, E.V. Cowdry ed., Chicago: University of Chicago Press, pp. 1-11.
c) Laubichler, M.D. and Davidson, E.H. (2008) Boveri's long experiment: Sea urchin merogones and the establishment of the role of nuclear chromosomes in development. *Developmental Biology* **314**: 1-11.
d) Sturtevant, A.H. (1965) *A History of Genetics*. New York: Harper and Row, pp. 1-50.
e) Müller-Wille, S. and Rheinberger, H.-J. (2012) *A Cultural History of Heredity*. Chicago: University of Chicago Press, pp. 81-94.
f) Pauly, P. (1984). The appearance of academic biology in late nineteenth-century America. *Journal of the History of Biology* **17**: 369-397.
g) Sapp, J. (2009). "Just" in time: Gene theory and the biology of the cell surface. *Molecular reproduction and development* **76**: 903-911.

Supplemental:

h) Just, E.E. (1939). *The Biology of the Cell Surface*. Philadelphia: P. Blakiston's Son and Co., pp. 1-30.
i) Moore, J.A. (1993) Science As a Way of Knowing. Cambridge, Massachusetts: Harvard University Press, pp. 302-327.
j) Sutton, W.S. (1903) The chromosomes in heredity. *Biological Bulletin* **4**:231-251.

<u>Session #3 April 15th</u>

The Origins of Molecular Biology

The history of molecular biology is well known: physics and genetics came together, the structure of DNA was discovered, and biology was revolutionized. Is this accurate? Was this standard narrative of molecular biology an outgrowth of nineteenth century biology and genetics, or was it distinct?

Objectives:

a) Define structural biology and describe its relationship to molecular biology.
b) Outline the roles of chemistry and physics in the development of molecular biology.

c) Outline the relationship between genetics and molecular biology.
d) Explain what was meant by the "informational" school of molecular biology.

Readings:

Required:

a) Olby, R. (1990). The molecular revolution in biology. In: *Companion to the History of Modern Science*, eds. R.C. Olby, G.N. Cantor, J.R.R. Christie, and M.J.S. Hodge, 503-520, London: Routledge.
b) Olby, R. (1994) *The Path to the Discovery of the Double Helix*. New York: Dover, pp. 167-320.
c) Kay, L.E. (1993) *The Molecular Vision of Life*. Oxford: Oxford University Press, pp. 77-103, pp. 121-142.
d) Carlson, E.A. (1971). An unacknowledged founding of molecular biology: H. J. Muller's contributions to gene theory. *Journal of the History of Biology* **4**:149-170.
e) Kendrew, J.C. (2007). How molecular biology started. In: *Phage and the Origins of Molecular Biology*, eds. J. Cairns, G. Stent, and J. Watson, 343-347, Cold Spring Harbor: Cold Spring Harbor Laboratory Press.
f) Delbrück, M. (2007). A physicist looks at biology. In: *Phage and the Origins of Molecular Biology*, eds. J. Cairns, G. Stent, and J. Watson, Cold Spring Harbor: Cold Spring Harbor Laboratory Press, pp. 9-22.

Supplemental:

g) Muller, H.J. (1922) Variation due to change in the individual gene. *The American Naturalist* **56**: 32-50.
h) Keller, E. (1990). Physics and the Emergence of Molecular Biology: A History of Cognitive and Political Synergy. *Journal of the History of Biology* **23**: 389-409.

Session #4 April 22nd

DNA and the Central Dogma

Was the discovery of DNA the beginning or the end of an era, or both? How did the discovery affect explanatory strategies in biology? To what extent is contemporary biology indebted to Watson and Crick's finding?

Objectives:

a) Trace the history of the DNA concept of the gene.
b) Describe the relationship between studies on the mechanism of protein synthesis and the "central dogma."
c) Based upon the readings, define biological information.

Readings:

Required:

a) Olby, R. (1994) *The Path to the Discovery of the Double Helix*. New York: Dover, pp. 323-443.
b) Russell, N. (1988). Oswald Avery and the Origin of Molecular Biology. *The British Journal for the History of Science* **21**: 393-400.
c) Watson, J.D. and Crick, F.H. (1953). Molecular structure of nucleic acids; a structure for deoxyribose nucleic acid. Nature **171**: 737-738.
d) Watson, J.D. and Crick, F.H. (1953). Genetical implications of the structure of deoxyribonucleic acid. Nature **171**: 964-967.
e) Crick, F. (1958) On protein synthesis. *Symposium of the Society for Experimental Biology and Medicine* **12**:138-163.
f) Rheinberger, H.-J. (1996). Comparing Experimental Systems: Protein Synthesis in Microbes and in Animal Tissue at Cambridge (Ernest F. Gale) and at the Massachusetts General Hospital (Paul C. Zamecnik), 1945-1960. *Journal of the History of Biology* **29**: 387-416.

Supplemental:

g) Crick, F. (1970). Central dogma of molecular biology. Nature **227**: 561-563.
h) Strasser, B. (2006). A world in one dimension: Linus Pauling, Francis Crick and the central dogma of molecular biology. Hist. Phil. Life Sci. **25**: 491-512.

Session #5 April 29th

The Origins of Modern Cell Biology

What distinguishes cell biology from cytology? What technological developments contributed to the origins of modern cell biology? Which of these were most important? How were these techniques employed?

Objectives:

a) Describe the limitations of cytology prior to the mid-1930s.
b) Explain the importance of technical developments in the origin of cell biology.
c) Define what is meant by a scientific discipline.

Readings:

Required:

a) Bechtel, W. (2006). *Discovering Cell Mechanisms*. Cambridge: Cambridge University Press, pp. 118-189.
b) Rasmussen, N. (1997). *Picture Control*. Stanford, California: Stanford University Press, pp. 102-152.
c) Claude, A. (1948). Studies on cells: morphology, chemical constitution, and distribution of biochemical functions. *Harvey Lect* **43**: 121-164.
d) Porter, K.R. *et al.* (1945). A study of tissue culture cells by electron microscopy: Methods and preliminary observations. *J Exp Med* **81**: 233-246.
e) Porter, K.R. and Bennett, H.S. (1981) *Introduction: Recollections on the Beginnings of the Journal of Cell* Biology In: Discovery in Cell Biology, J.Cell Biol. 91(Pt. 2 - Suppl.): vii-ix.

Supplemental:

f) Porter, K.R. and Blum, J. (1953). A study in microtomy for electron microscopy. *Anat Rec* **117**: 685-709.

Session #6 May 6th

Case Study in the History of Cell Biology: The Secretory Pathway

One of the most important early accomplishments in modern cell biology was the elucidation of the secretory pathway in eukaryotic cells. How were the new techniques of cell biology employed to make these discoveries? Was a particular explanatory strategy employed?

Objectives:

a) Describe the fundamental "epistemic strategy" (explanatory strategy) used by Palade and his colleagues. How did it different from explanatory strategies of cytologists.

b) Explain the significance of the use of autoradiography in the studies of Jamieson and Palade.

Readings:

Required:

a) Bechtel, W. (2006). *Discovering Cell Mechanisms*. Cambridge: Cambridge University Press, pp. 222-249.
b) Palade, G. (1975). Intracellular aspects of the process of protein synthesis. *Science* **189**: 347-358.
c) Palade, G.E., and Siekevitz, P. (1956). Liver microsomes an integrated morphological and biochemical study. *J Cell Biol* **2**: 171-200.
d) Jamieson, J.D., and Palade, G.E. (1967). Intracellular transport of secretory proteins in the pancreatic exocrine cell. I. Role of the peripheral elements of the Golgi complex. *J Cell Biol* **34**: 577-596.
e) Jamieson, J.D., and Palade, G.E. (1967). Intracellular transport of secretory proteins in the pancreatic exocrine cell. II. Transport to condensing vacuoles and zymogen granules. *J Cell Biol* **34**: 597-615.

Supplemental:

f) Palade, G.E. (1955). A small particulate component of the cytoplasm. *The Journal of biophysical and biochemical cytology* **1**: 59.

Session #7 May 13th

Cell Biology Without Cells

In the 1970s cell biologists began to investigate processes in cell-free or "in vitro" systems. Why did they do this? What distinguishes this approach from approaches used by biochemists and molecular biologists? Was the epistemic strategy of such experiments different from the strategies utilized earlier by Claude and Palade?

Objectives:

a) Discuss possible differences between molecular and biological explanations.
b) Describe the key aspects of Blobel and Dobberstein's experiments that enabled them to explain a cellular process without cells.

Readings:

Required:

a) Redman, C.M. *et al.* (1966). Synthesis and transfer of amylase in pigeon pancreatic microsomes. *The Journal of biological chemistry* **241**: 1150-1158.
b) Blobel, G., and Dobberstein, B. (1975). Transfer of proteins across membranes. I. Presence of proteolytically processed and unprocessed nascent immunoglobulin light chains on membrane-bound ribosomes of murine myeloma. *J Cell Biol* **67**: 835-851.
c) Blobel, G., and Dobberstein, B. (1975). Transfer of proteins across membranes. II. Reconstitution of functional rough microsomes from heterologous components. *J Cell Biol* **67**: 852-862.
d) Blobel, G. (1980). Intracellular protein topogenesis. *Proceedings of the National Academy of Sciences of the United States of America* **77**: 1496-1500.
e) Matlin, K.S. (2011). Spatial expression of the genome: the signal hypothesis at forty. *Nature Reviews Molecular Cell Biology* **12**: 333-340.
f) Wagner, G.P. and Laubichler, M.D. (2000). Character identification in evolutionary biology: the role of the organism. *Theory in Bioscience* **119**: 20-40. Note: only the short highlighted section (pp. 23-24) is required.

Session #8 May 20th (no class -work on papers)

Session #9 May 27th

Reductionism and Reductive Explanation in Biology

Reductionism is frequently associated with modern biology. What is it - an ontological conviction or an approach to scientific discovery? If you are an anti-reductionist, are you also a vitalist?

Objectives:

a) Compare reductionism as defined by cell or molecular biologists with reductionism defined by philosophers of biology.

b) Distinguish (if possible) reductionism in cell biology and reductionism in molecular biology.
c) Compare and contrast explanatory strategies of cell biologists and molecular biologists.

Readings:

Required:

a) Brigandt, I., and Love, A. (2012). Reductionism in biology. Stanford Encyclopedia of Philosophy.
b) Kitcher, P. (1984). 1953 and all that. A tale of two sciences *Phil. Rev.* **93**: 335-373.
c) Fuerst, J. (1982). The Role of Reductionism in the Development of Molecular Biology: Peripheral or Central? Social Studies of Science **12**: 241-278.
d) McKaughan, D.J. (2011) Was Delbrück a reductionist? In: Creating a Physical Biology. Chicago: University of Chicago Press, pp. 179-210. ***OR*** Roll-Hansen, N. (2011) Neils Bohr and Max Delbrück: Balancing autonomy and reductionism in biology. In: Creating a Physical Biology. Chicago: University of Chicago Press, pp. 145-178.
e) Beckwith, J. (1996). The hegemony of the gene: reductionism in molecular biology. In: *The Philosophy and History of Molecular Biology: New Perspectives*, ed. S. Sarkar, 171-183, Dordrecht: Kluwer Academic Publishers.

Supplemental:

f) Darden, L., and Craver, C.F. (2001). *Reductionism in Biology*. In: Encyclopedia of Life Sciences (eLS). Chichester, UK: John Wiley and Sons, Ltd., pp. 1-6.
g) Sarkar, S. (1998). *Genetics and Reductionism*. Cambridge: Cambridge University Press, pp. 101-174.

Session #10 June 3rd **(French pastry day!!) Papers due for graduating seniors!!**

Genomics and Systems Biology

Biology in the 21st Century is dominated by "high throughput techniques" and "BigData" approaches. How are these related to molecular biology and cell biology? Systems biology is viewed by some as a reaction to reductionism as an approach to explaining complex biological systems. If so, then what as changed in system biology's epistemic strategy?

Objectives:

a) Define systems biology and describe how it is different (if at all) from cell and molecular biology.
b) Explain the effects of big data and genomics on the explanatory strategies of cell and molecular biology.

Readings:

Required:

a) Wright, S. (1986). Recombinant DNA Technology and Its Social Transformation, 1972-1982. *Osiris* **2**: 303-360.
b) Noble, D. (2008). Genes and causation. *Phil. Trans. R. Soc. A* **366**: 3001-3015.
c) Noble, D. (2011). The aims of systems biology: between molecules and organisms. *Pharmacopsychiatry* **44 Suppl 1**: S9-S14.
d) Callebaut, W. (2012). Scientific perspectivism: A philosopher of science's response to the challenge of big data biology. *Studies in history and philosophy of biological and biomedical sciences* **43**: 69-80.
e) Moss, L. (2003) *What Gene's Can't Do*. Cambridge: MIT Press, pp. 75-116.

Supplemental:

f) [**a classic]** Stent, G.S. That was the molecular biology that was. In: *Phage and the Origins of Molecular Biology*, eds. J. Cairns, G. Stent, and J. Watson, Cold Spring Harbor: Cold Spring Harbor Laboratory Press, pp. 348-362.
g) Woese, C.R. (2004). A new biology for a new century. *Microbiol. Mol. Biol. Rev.* **68**: 173-186.

June 6th-7th Reading Period

History of Science/Medical History 133: Biology and Society, 1950-today (University of Wisconsin)

History of Science / Medical History 133: *Biology and Society, 1950–today*

Professor Nicole Nelson
Bradley Memorial Building, Room 207
ncnelson@wisc.edu
Office hours: W 12:00–2:00 pm, or by appointment

Spring 2015
Social Science 5208
MW 11:00–11:50, plus discussion section

From medical advancements to environmental crises and global food shortages, biology and the life sciences are implicated in some of the most pressing social issues of our time. This course explores events in the history of biology from the mid-twentieth century to today, and examines how developments in this scientific field have shaped and are shaped by society. The course is divided into three thematic units. In the first unit, we investigate the origins of the institutions, technologies, and styles of practice that characterize contemporary biology; such as the use of mice as "model organisms" for understanding human diseases. In the second unit, we delve into areas of biology that have raised controversies about regulation, governance, and public participation; such as the introduction of genetically modified plants into the food supply. The final unit asks how biological facts and theories have been and continue to be used as a source for understanding ourselves. Within the units, each week begins with an examination of an historical event or controversy that provides an entry into a discussion about how biology and society interact. The creation of a cloned sheep named Dolly and the ensuing media coverage and controversy, for example, demonstrates how new reproductive technologies are challenging fundamental categories that we use to describe the life course such as "parent" and "offspring."

The course content is delivered through two lectures and one discussion section per week. Students will also read a selection of historical, sociological, and popular articles each week in preparation for class, which will be contextualized and discussed in lecture and section. Evaluation will be based on the quality of students' participation in section, two short writing assignments, and midterm and final exams. This course will help students in the sciences, social sciences, or humanities to develop the analytical and writing skills needed to confront complex social issues involving the life sciences. No prior knowledge of biology, history, or social theory is required.

Course Objectives

By the end of the course, students will:

- develop an appreciation for the ways in which the institutions, practices, and ways of thinking associated with contemporary biology are specific to a particular place and time, and have changed over time;
- be able to identify and state the significance of key people and events in the recent history of biology;
- understand key theoretical frameworks for describing interactions between biology and society, and be able to apply these frameworks to new empirical cases
- be able to identify and evaluate the strength of the arguments and evidence used in an academic paper;
- be able to extrapolate complex arguments to new contexts and assess how new information would change the argument.

Course materials

There are no textbooks assigned for this course. A course pack containing all of the required readings is available for purchase at the Social Science Copy Center (Social Science 6120), and a copy of the course pack will also be at the reserve desk at College Library in Helen C. White Hall. Lecture slides will be available for download from the Learn@UW website the day before lecture.

Assignments and grading

Assignment	*% of final grade*	*Due date*
Discussion section participation	15%	formative assessment at mid-semester
Reading summary assignment	15%	February 11–26, as assigned
Midterm exam	25%	March 18
Critical thinking assignment	20%	April 24, 5:00 pm
Final exam	25%	May 14

Discussion section participation You are expected to arrive at section having read the assigned readings for the week, and to participate actively in discussion or other in-class exercises—mere attendance is not enough for a good section grade. A rubric outlining expectations for section participation will be distributed and discussed in the first week of sections, and you will receive written feedback and an interim grade on your participation at mid semester.

Reading summary assignment This assignment focuses on your ability to understand a complex academic argument and how it is constructed. You can choose the reading you would like to work with for this assignment (a list of eligible course readings and a schedule will be distributed in section), and the assignment will be due on the day that the reading you selected is due in section. A detailed description of the assignment and a grading rubric will be distributed and discussed in section.

Critical thinking assignment This assignment focuses on your ability extend an academic argument to a new context, and assess how new factors or information would impact that argument. Starting with one of the course readings on biology and the public, you will demonstrate your understanding of the author's argument and do research to find new evidence that would challenge or change the argument. A detailed description of the assignment and a grading rubric will be distributed and discussed in section.

Midterm and final exams Exams will contain a combination of multiple choice questions, identification questions (where students must identify and state the significance of a person, event, or concept from the course), short answer questions, and essay questions. A study aid with a list of example identifcation questions will be distributed in class prior to the midterm and final exams.

Course policies

Email Due to the size of the course, I am unable to answer questions via email. For short questions (e.g. assignment due dates), please post on the course questions forum on the Learn@UW website, and one of the TAs or I will reply there. For longer questions (e.g. feedback on a draft assignment), or if you have personal concerns you would like to discuss, please come see me during office hours. If you are not able to meet during office hours, you can email me to arrange an alternative meeting time.

Discussion section absences Attendance will be taken weekly at discussion sections, and counts towards your discussion section grade. For absences due to illness, family emergencies, scheduled conflicts, or other legitimate reasons, you can make up the missed participation grades by handing in a 250 word informal reading response instead of attending class. You must contact your TA in advance of the missed class (except in exceptional circumstances) to clear your absence with him/her and agree on a due date for your reading response.

Grading and late assignments All assignments will receive a numeric score (e.g. 29/30), which will also be displayed as a percentage score on the Learn@UW website. Your final percentage grade will be converted into a final letter grade using the conversion table below. Late assignments will be penalized by 3% of the total assignment points per day, unless you have made prior arrangements with your TA or me.

A	AB	B	BC	C	D	F
93.0–100%	88.0–92.9%	83.0–87.9%	78.0–82.9%	70.0–77.9%	60.0–69.9%	0–59.9%

Students with disabilities I am available to discuss academic accommodations for students with disabilities. Please present your McBurney visa to your TA and/or me within the first three weeks of the semester (except in unusual circumstances) so that there is enough time for appropriate arrangements to be made.

Academic integrity All students are expected to adhere to the University of Wisconsin—Madison's core values regarding academic integrity. Plagiarism or other academic misconduct may result in a zero on the assignment or exam, a lower grade in the course, or failure in the course. See the Dean of Students Office website for more information about the academic misconduct process (`http://students.wisc.edu/doso/acadintegrity.html`).

Course schedule

January 21: Course Introduction

No assigned readings or sections for this week

January 26 and 28: Historical narratives and origin stories about contemporary biology

- Kary Mullis. 2000. *Dancing naked in the mind field.* Vintage Books, January, pp. 3–14

Unit One: The institutions and social practices of biology

February 2 and 4: From big physics to big biology (World War II)

- Nicolas Rasmussen. 2002. "Of "small men," big science, and bigger business: The Second World War and biomedical research in the United States." *Minerva* 40:115–146

February 9 and 11: University–Industry relations – Bayh Dole Act (1980)

- Steven Shapin. 2003. "Ivory Trade." *London Review of Books* 25, no. 17 (September): 15–19
- Daniel S. Greenberg. 2007. *Science for Sale: The Perils, Rewards, and Delusions of Campus Capitalism.* University of Chicago Press, pp. 233–42

February 16 and 18: Model organisms – *C elegans* (1963)

- Daniel Engber. 2011. "The Trouble with Black-6." *Slate* (November 17)
- Susan E. Lederer. 1992. "Political Animals: The Shaping of Biomedical Research Literature in Twentieth-Century America." *Isis* 83 (1): 61–79

February 23 and 25: **Reshaping the clinic – BRCA genes (1994, 1995)**

Guest lecture by Dr. Don Waller, Department of Botany

- Robert C. Green and Nita A. Farahany. 2014. "Regulation: The FDA is overcautious on consumer genomics." *Nature* 505 (January 16): 286–287
- Andrew J. Hogan. 2013. "Locating genetic disease: the impact of clinical nosology on biomedical conceptions of the human genome (1966–1990)." *New Genetics and Society* 32 (1): 78–96

Unit Two: Governance and participation in biology

March 2 and 4: **The popularization of genetics – The Human Genome Project (1990)**

- Dorothy Nelkin and Susan Lindee. 2000. "The DNA mystique: the gene as a cultural icon." In *Perspectives in medical sociology,* 3rd ed., edited by Phil Brown, 406–424. Prospect Heights, IL: Waveland
- Martin Richards. 2006. "Heredity: Lay Understanding." In *Living with the genome: ethical and social aspects of human genetics,* edited by Angus Clarke and Flo Ticehurst, 177–182. Houndmills, Basingstoke: Palgrave Macmillan

March 7 and 9: **Toxic landscapes and environmental politics – Silent Spring (1962)**

Guest lecture by Dr. Mrill Ingram, Department of Geography

- Gregg Mitman. 2007. *Breathing space: how allergies shape our lives and landscapes.* New Haven: Yale University Press, pp. 130–166

March 16: **Regulation of biotechnology – Asilomar (1975)**

- Sheila Jasanoff. 2005. *Designs on nature: science and democracy in Europe and the United States.* Princeton, NJ: Princeton University Press, pp. 42–67

March 18: **In-class midterm exam** !!!

No sections this week.

March 23 and 25: **Who gets to participate in biology? – Colony collapse disorder (2006)**

Guest lecture by Dr. Sai Suryanarayanan, Department of Community and Environmental Sociology

- Harry M. Collins and Trevor J. Pinch. 1998. "The science of the lambs: Chernobyl and the Cumbrian sheepfarmers." In *The golem at large: what you should know about technology,* 113–125. Cambridge: Cambridge University Press

- Daniel Lee Kleinman and Sainath Suryanarayanan. 2013. "Honey bees under threat: a political pollinator crisis." *The Guardian* (May 8). `http://www.theguardian.com/science/political-science/2013/may/08/honey-bees-threat-political-pollinator-crisis`

March 28–April 3: **March break**

Unit 3: Biology and the Self

April 6 and 8: **Seeing humanity through biology – Sociobiology (1975)**

- Robert M. Sapolsky. 1998. "The trouble with testosterone." In *The Trouble with Testosterone: And Other Essays on the Biology of the Human Predicament,* 147–159
- Jonathan M. Metzl. 2010. "Why Against Health?" In *Against Health: How Health Became the New Morality,* edited by Jonathan M. Metzl and Anna Kirkland, 1–11. NYU Press

April 13 and 15: **Neuroscience and the Decade of the Brain (1990)**

- Ilina Singh. 2005. "Will the "real boy" please behave: dosing dilemmas for parents of boys with ADHD." *The American Journal of Bioethics: AJOB* 5 (3): 34–47

April 20 and 22: **Race and Reproduction – Dolly the cloned sheep (1997)**

- Charis Thompson. 2001. "Strategic naturalizing: kinship in an infertility clinic." In *Relative values: reconfiguring kinship studies,* edited by Sarah Franklin and Susan McKinnon, 175–202. Durham, NC: Duke University Press

April 24: **Critical thinking assignment due** !!!

May 5 and 7: **Globalizing biology**

- Margaret Lock. 1996. "Death in Technological Time: Locating the End of Meaningful Life." *Medical Anthropology Quarterly* 10 (4): 575–600

May 4 and 6: **Conclusion**

No readings or sections this week

May 14, 7:25–9:25 pm: **Final exam** !!!

Room to be announced

History of Science Since the 17th Century: The Development of Modern Science (University of Oklahoma)

HSCI 3023

History of Science Since the 17th Century: The Development of Modern Science

Associate Professor Hunter Heyck

Office: PHSC 601 Office Hours: MW 10:00-11:30 and by appointment

Email: hheyck@ou.edu

In the years since the Scientific Revolution of the 17th century, science has come to occupy a position of enormous importance in Western culture. This course explores how science rose to such a high position in modern society, looking at new ways of understanding the natural world and at the ways that these new ideas have become parts of our lives. The course has at its heart one central idea: scientific ideas and practices are not isolated from the rest of society. Rather, they are created in certain historical contexts and inevitably reflect the conditions of their origin, even as they change the world. Scientific ideas and practices do not always reinforce the existing order—in fact, they often undercut it—but they are never independent of it. Thus, in order to understand the development of modern science and modern society, one must understand how they shaped each other.

Course Mechanics

As a rule, each week there will be three class meetings. Generally speaking, Monday and Wednesday will be lecture days and Friday will be a discussion day. Both the lectures and the discussions are important to this course, and attendance is expected for every class meeting. Each week (except for midterm weeks), there will be a short quiz on the course D2L site. You are to take this quiz ***before*** class meets on Friday. The quiz will be timed (you'll have 20-30 minutes, usually), so you will need to have completed the week's readings and to have reviewed your lecture notes *before* you start the quiz.

When we meet for discussions on Fridays, we will divide into small groups. You will remain in the same group all semester unless I decide that it is best to move people around. During each discussion meeting, your group will have a set of questions to answer. Some will be straightforward, and some will require a bit of imagination. You will answer the questions as a group, with one person recording your group's answers. The job of recording group answers should rotate. Your group's grade will depend on the quality of your written answers *and* on the quality of the discussion. The more people that participate actively, the better the group grade. You also will be graded on your individual contributions to discussion; twice during the semester you will do a peer evaluation of your group-mates. These peer evaluations will be used to help inform our judgments about your individual participation grade.

In addition to the quizzes and discussion work, there are three other important components of your grade: the midterms, the final, and the research paper. The midterms and final exam will include a mix of short-answer/multiple choice and mini-essay questions (IDs). A full description of the research paper requirements and grading rubric will be posted on the D2L site.

The overall grade breakdown for the course is as follows:

Group Discussions: 13% **Individual Participation: 13%**

Midterms: 20% **Final Exam: 20%**

Quizzes: 14% (total) **Essay: 20%**

Books to Buy

1) Michael Adas, *Machines as the Measure of Men*, (Cornell University Press, 1989)
2) Philip Appleman, ed., *Darwin*, 3rd edition (W.W. Norton, 2000)
3) Edward Larson, *Summer for the Gods*, (Harvard University Press, 1998)
4) Sinclair Lewis, *Arrowsmith* (Penguin USA, 1998)
5) Jeff Hughes, *The Manhattan Project* (Columbia University Press, 2003).

All of these books are available in inexpensive editions from a number of online retailers and also can be ordered from local bookstores. In addition to these books, there are a number of readings available on D2L, as well as some videos and podcasts, also available via D2L.

Course Schedule

Week 1.

Jan. 12. Opening Day. What is science? What is technology? Why study their history?

Jan. 14. Lecture: The Old World and the New: Background to the Scientific Revolution

Jan. 16. Discussion: The Heavens and the Earth

Readings:

1) Nicholas Copernicus, *On the Revolutions of the Heavenly Spheres*, pp. xv-22. **On D2L.**

2) Selections from *The Essential Galileo.* **On D2L.**

Week 2.

Jan. 19. **No Class. MLK Day.**

Jan. 21. Lecture: The Scientific Revolution and the Mechanical Worldview

Jan. 23. Discussion: The New Philosophy. (Take quiz 1 online *before* class.)

Readings:

1) Isaac Newton, selections from *The Principia Mathematica*, pp. 3-20, 319-21, 439-43. **On D2L.**

2) *In Our Time,* podcast on Robert Boyle. **On D2L.**

Week 3.

Jan. 26. Lecture: Knowledge is Power—Experimentation and the Control of Nature

Jan. 28. Lecture: Newton's Legacy—The Cultural Meaning of the Scientific Revolution

Jan. 30. Discussion: Science and Enlightenment. (Take quiz 2 online *before* class.)

Readings:

1) Dorinda Outram, "Science and the Enlightenment," pp. 47-62. **On D2L.**

2) Marquis de Condorcet, excerpts from "The Future Progress of the Human Mind." **On D2L.**

3) David Hume, excerpts from "On Miracles." **On D2L.**

4) Benjamin Franklin, excerpts from "Experiments with Balloons." **On D2L.**

5) Adam Smith, excerpts from *The Wealth of Nations*. **On D2L.**

6) [Optional. Podcast on the Ottoman Enlightenment. **On D2L.**]

Week 4.

Feb. 2. Lecture: New Lands, New Men.

Feb. 4. Lecture: A Science of Man?

Feb. 6. Discussion: Science and the Making of "The West". (Take quiz 3 online *before* class.)

Reading:

1) Michael Adas, *Machines as the Measure of Men*, pp. 1-20, 69-132.

2) Hunter Heyck, "The Social Sciences." **On D2L.**

Week 5.

Feb. 9. Lecture: Genesis and Geology—the discovery of time.

Feb. 11. Lecture: Industry and Ideology—the invention of progress.

Feb. 13. Discussion: Science, Technology, and Empire. (Take quiz 4 online *before* class.)

Readings:

1) Michael Adas, *Machines as the Measure of Men*, pp. 199-266.

2) Hunter Heyck, "Time is Money." **On D2L.**

Week 6.

Feb. 16. **Midterm 1.**

Feb. 18. Lecture: The Origins of Darwin.

Feb. 20. Discussion: Design, Chance, and Change. (Take quiz 5 online *before* class.)

Readings:

1) William Paley, selections from *Natural Theology*, pp. 1-23. **On D2L.**

2) Charles Darwin, selections from *The Origin of Species*, in *Darwin*, pp. 95-174.

3) John Dewey, "The Influence of Darwinism on Philosophy," in *Darwin*, pp. 483-89.

4) Darwin Correspondence Project, "Darwin's Women," video available **On D2L.**

Week 7.

Feb. 23. Lecture: Social Darwinism and Social Science.

Feb. 25. Lecture: Race, Eugenics, and Science.

Feb. 27. Discussion: Science and Religion in 20th-21st Century America. (Take quiz 6 online *before* class.)

Readings:

1) Edward Larson, *Summer for the Gods*. (Read parts 1 and 2 thoroughly, skim part 3.)

2) Michael Ruse, "Darwin's New Critics on Trial," in *Darwin*, pp. 605-12.

3) National Academy of Sciences, "Frequently Asked Questions About Evolution and the Nature of Science," in *Darwin*, pp. 617-23.

Week 8.

Mar. 2. Lecture: The Laboratory Revolution.

Mar. 4: Lecture: The Laboratory and the World.

Mar. 6: Discussion: The Profession of Science. (Take quiz 7 online *before* class.)

Readings:

1) Sinclair Lewis, *Arrowsmith,* chapters 1-18. (The first half of the book, roughly.)

2) [Optional.] Video—*Tesla: Master of Lightning.* Available **On D2L.**

Week 9.

Mar. 9. Lecture: Science and the Technologies of Daily Life.

Mar. 11. Lecture: Science in the Popular Imagination.

Mar. 13. Discussion: Science as a Calling. (Take quiz 8 online *before* class.)

Readings:

1) Sinclair Lewis, *Arrowsmith*, rest of book.

2) [Optional.] Video—*The Poisoner's Handbook*. Available **On D2L.**

Week 10.

Mar. 16. Spring Break.

Mar. 18. Go Home.

Mar. 20. Rest, Relax.

Week 11.

Mar. 23. **Midterm 2.**

Mar. 25. Lecture: Energy and Efficiency.

Mar. 27. Discussion: Energy and Society. (Take quiz 9 online *before* class.)

Readings:

1) Peter Bowler and Iwan Morus, "The Conservation of Energy," pp. 79-103. **On D2L.**

2) Hans Christian von Baeyer, selections from *Time Passes, Heat Disperses*, introduction and pp. 1-12. **On D2L.**

Week 12.

Mar. 30. Lecture: The Structure of All Things.

Apr. 1. Lecture: Fission.

Apr. 3. Discussion: The New Alchemy? (Take quiz 10 online *before* class.)

Readings:

1) Spencer Weart, *Nuclear Fear*, pp. 3-74. **On D2L.**

2) *In Our Time* podcast on "Relativity." **On D2L.**

Week 13.

Apr. 6. Lecture: The Manhattan Project.

Apr. 8. Lecture: Creation Stories--Science, Secrecy, and Sin?

Apr. 10. Discussion: The Bomb. (Take quiz 11 online *before* class.)

Readings:

1) Jeff Hughes, *The Manhattan Project*.

2) President Truman, "The Report of President Truman on the Atomic Bomb," pp. 163-65. **On D2L.**

3) R. Gordon Arneson, "Notes of the Interim Committee Meeting," pp. 105-20. **On D2L.**

4) "The Franck Report," pp. 140-47. **On D2L.**

5) *Top Secret Rosies*, video available **On D2L.**

Week 14.

Apr. 13. Lecture: Big Science, Big Technology, and Big Government.

Apr. 15. Lecture: Social Science and the Postwar State.

Apr. 17. Discussion: Science and Politics in the Cold War. (Take quiz 12 online *before* class.)

Readings:

1) Stuart W. Leslie, "Science and Politics in Cold War America," pp. 199-233. **On D2L.**

2) Jamie Cohen-Cole, "The Creative American." **On D2L.**

3) Slava Gerovitch, "'New Soviet Man' Inside Machine." **On D2L.**

Week 15.

Apr. 20. Lecture: DNA and the Human Machine.

Apr. 22. Lecture: The Natural and the Artificial.

April 24. Discussion: The Human Machine. **FINAL ESSAYS ARE DUE !!!**

Readings:

1) Richard Dawkins, selection from *River Out of Eden*, pp. 1-29. **On D2L.**

2) *The Beauty of Diagrams—Vitruvian Man and DNA*, video available **On D2L.**

Week 16.

Apr. 27. Lecture: The Gender of Science.

Apr. 29. Lecture: Full Circle.

May 1. Discussion: Women, Men, and Nature. (Take quiz 13 online *before* class.)

Readings:

1) Carolyn Merchant, selections from *The Death of Nature*, pp. Xv-xxiv, 1-41. **On D2L.**

2) Londa Schiebinger, "Women in the Origins of Modern Science," pp. 8-33. **On D2L.**

3) Gender and science statistics from the NSF. **On D2L.**

Final Exam: Wednesday, May 6, 1:30-3:30 pm

OU Policies Regarding Instruction

Religious Holidays
It is the policy of the University to excuse the absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required classwork that may fall on religious holidays.

Adjustments for Pregnancy/Childbirth Related Issues
Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me as soon as possible to discuss. Generally, modifications will be made where medically necessary and similar in scope to accommodations based on temporary disability. Please see www.ou.edu/content/eoo/pregnancyfaqs.htmlfor commonly asked questions.

Title IX Resources
For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24.7, counseling services, mutual no contact orders, scheduling adjustments and disciplinary sanctions against the perpetrator. Please contact the Sexual Misconduct Office 405-325-2215 (8-5) or the Sexual Assault Response Team 405-615-0013 (24.7) to learn more or to report an incident.

Disabilities
The University of Oklahoma is committed to providing reasonable accommodation for all students with disabilities. Any student in this course who has a disability that may prevent him or her from fully demonstrating his or her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate your educational opportunities. Students with disabilities must be registered with the Office of Disability Services prior to receiving accommodations in this course. The Office of Disability Services is located in Goddard Health Center, Suite 166, phone 405/325–3852 or TDD only 405/325–4173.

Academic Misconduct Policy
Integrity in all aspects of scholarship is essential to the University's mission. The Academic Misconduct Code sets forth the rights and responsibilities of all students on the Norman Campus regarding academic integrity, and provides the procedures to be followed in cases of suspected misconduct. Academic misconduct is defined as any act which improperly affects the evaluation of a student's academic performance or achievement. It specifically includes cheating, plagiarism, fabrication, fraud, destruction of property, and bribery or intimidation, as well as assisting others or attempting to engage in such acts. It is the responsibility of each student to be familiar with the definitions, policies and procedures concerning academic misconduct; unfamiliarity with the code alters none of a student's rights or responsibilities thereunder. The Academic Misconduct Code is printed with the Student Code and is also available on the Internet at http://integrity.ou.edu/students_guide.html.

Writing Center: The Writing Center at OU is a place for students, faculty, and staff to meet and talk about writing as well as to find assistance with and get feedback on your writing assignments. I encourage you to use this resource. The writing consultants at the Center are able to talk with you about your writing —at any stage in the process and for any course you are taking. You can make an appointment online or by phone at 405-325-2936, and you can drop in whenever they are open. Their web site URL is: **http://www.ou.edu/writingcenter.html**

History of Science: Plato to NATO (and beyond) (Florida State University)

HIS 3464, section 01 | *Department of History, Florida State University*

History of Science: Plato to NATO (and beyond)

SPRING 2015
VERSION 2.1 | 1 JANUARY 2015

Bellamy 102
Mon. Wed. Fri. 2:30 PM– 3:20 PM

Instructor: PROF. RONALD E. DOEL
Email: rdoel@fsu.edu
Office Hours: Tuesdays 2-3 PM;
Fridays 10-11 AM, *or by appointment*

Office: 438 Bellamy Bldg.
Departmental phone [msgs]: 644-5888

Course Description
Science and technology have become integral features of modern life and society. This course examines how science has influenced the advancement of the modern world, and illuminates how social, political, religious factors, as well as the rise of the nation-state, have influenced the growth of natural philosophy and distinct fields of science. It explores human attempts to explain the natural world over time, how and why these explanations changed, and how these interpretations changed the way people experienced everyday life. More than explaining why an apple falls from a tree, science has shaped human understanding of the world, and fundamentally altered how people live. It has, for example, helped create and reinforce categories of difference such as race, gender, class, and nationality. This course reveals that science, much like history, is an important but imperfect attempt to explain the world, carrying broad consequences.

Liberal Studies Statement
The Liberal Studies Program at Florida State University has been designed to provide a perspective on the qualities, accomplishments, and aspirations of human beings, the past and present civilizations we have created, and the natural and technological world we inhabit. This course has been approved as meeting the requirements for Liberal Studies Area III, History and Social Science, and in combination with other Liberal Studies courses you will take, provides an important foundation for your lifelong quest for knowledge.

Course Goals
By the end of the course, students will be able to:
1) explain and narrate the development of science over time
2) use key people, ideas, events, and places to illustrate that history
3) identify the broader social, political, and cultural context of scientific developments
4) interpret the significance of primary and secondary sources
5) employ primary and secondary sources to develop, support, and revise written and oral arguments

Student Responsibilities
Students are expected to:
1) arrive to every class on time, having read the assigned texts, and being prepared to discuss them;
2) participate in class, which includes taking notes on the material presented, engaging in discussion, and not using any electronic media without the instructor's permission
3) complete all assignments on time and honestly, acknowledging the work of others in line with the FSU honor code
4) discuss all absences with the instructor

Assignments and Grades

Writing assignments:

1) One essay of close to 1500 words on a topic to be distributed during the second or third week of class, due (on the course's Blackboard site) by the start of class on Monday, 2 February.
2) One essay of at least 1500 words on a topic to be distributed during the eighth week of class and due to the course's Blackboard site by the start of class on Monday, 30 March;
-Papers must be submitted via Turnitin on Blackboard [see the 'Assignments' tab];
-After graded assignments have been returned, students are encouraged to resubmit revised papers; and
-Papers will lose two points (out of 100) for every day they are late, including weekends.

Gordon Rule

Writing assignments fulfill the Gordon Rule requirement and are necessary in order to pass the class. In order to fulfill FSU's Gordon Rule ("W" credit), the student must earn a "C-" or better in the course, and in order to receive a "C-" or better in the course, the student must earn at least a "C-" on the required writing assignments for the course. If the student does not earn a "C-" or better on the required writing assignments for the course, the student will not earn an overall grade of "C-" or better in the course, no matter how well the student performs in the remaining portion of the course. Students must still complete the writing assignments even if the Gordon Rule Requirement has been fulfilled in another class.

Diversity in Western Experience

The second paper will fulfill the Diversity in Western Experience ("Y" credit) requirement. Diversity in Western Experience courses will introduce students to the diversity within Western culture by examining the nature of the relations among the many groups that have contributed to Western experience. Courses will focus primarily on one or more groups whose contributions traditionally have been undervalued. Topics such as race, class, gender, or ethnicity will be explored.

Exams

1) one in-class midterm on Monday, 16 February
2) a final exam on Friday, 1 May at 12:30 PM, per university schedule

-Both exams will include short-answer and essay questions taken from course readings and in-class materials; study guides for the exams will be distributed if possible
-Students must be in-class to take the exams; rescheduling can only be done for emergencies

Quizzes

Unannounced in-class quizzes and writing prompts will cover material from previous class meetings and assigned readings

Grades

Class participation and quizzes: 20% (10% *each category*)
First writing assignment: 15%
Second writing assignment: 25%
Midterm exam: 15%
Final exam: 25%

93–100: A	83–86: B	73–76: C 6	3–66: D
90–92: A-	80–82: B-	70–72: C-	60–62: D-
87–89: B+	77–79: C+	67–69: D+	59 or below: F

***University Attendance Policy*:**
Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.

Academic Honor Policy:
The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to ". . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University." (Florida State University Academic Honor Policy, found at http://fda.fsu.edu/Academics/Academic-Honor-Policy.)

Americans With Disabilities Act:
Students with disabilities needing academic accommodation should:
(1) register with and provide documentation to the Student Disability Resource Center; and
(2) bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.

This syllabus and other class materials are available in alternative format upon request.

For more information about services available to FSU students with disabilities, contact the:

Student Disability Resource Center
874 Traditions Way
108 Student Services Building
Florida State University
Tallahassee, FL 32306-4167
(850) 644-9566 (voice)
(850) 644-8504 (TDD)
sdrc@admin.fsu.edu
http://www.disabilitycenter.fsu.edu/

Free Tutoring from FSU:
On-campus tutoring and writing assistance is available for many courses at Florida State University. For more information, visit the Academic Center for Excellence (ACE) Tutoring Services' comprehensive list of on-campus tutoring options - see http://ace.fsu.edu/tutoring or contact tutor@fsu.edu. High-quality tutoring is available by appointment and on a walk-in basis. These services are offered by tutors trained to encourage the highest level of individual academic success while upholding personal academic integrity.

Syllabus Change Policy
Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.

***Course Readings*:**

Required texts:

David C. Lindberg, *Beginnings of Western Science: The European Scientific Tradition in Philosophical, Religious, and Institutional Context, Prehistory to A.D. 1450* [*second edition*] (Chicago: University of Chicago Press, 2007).

Andrew Ede and Lesley B. Cormack, *A History of Science in Society: From Philosophy to Utility*, second edition (Toronto: University of Toronto Press, 2012)
Carl Djerassi, *Cantor's Dilemma*: *A Novel* (New York: Penguin, 1991) [*any edition is fine*]

Additional readings [on Blackboard]:

Peter J. Bowler and Iwan Rhys Morus, *Making Modern Science: A Historical Survey* (Chicago: University of Chicago Press, 2005).
Peter Dear, *Revolutionizing the Sciences: European Knowledge and Its Ambitions, 1500-1700* (Princeton: Princeton University Press, 2001).
Paul Farber, *Finding Order in Nature: from Linnaeus to E.O. Wilson* (Baltimore: The Johns Hopkins University Press, 2000)
.

Schedule of Meetings

Week 1: Introduction: Looking Back from 1543
7 – 9 January
Reading:
EDE & CORMACK, pp. ix-xii [Introduction]
LINDBERG, pp. 1-20 [Chapter 1]
Peter Dear, *Revolutionizing the Sciences*, pp. 1-9 [Introduction] and pp. 10-29 [Ch. 1] [Blackboard]

Week 2: What Renaissance Scholars Sought to Recover from the Ancients
12 - 16 January
Reading:
LINDBERG, pp. 21-81[Chapters 2 to 4]; *skim* pp. 111-131 [Chapter 6]
EDE & CORMACK, pp. 1-27 [Chapter 1]

Week 3: Transmission of Knowledge: Pathways Between Civilizations
21 - 23 January [*no class Monday, 19 January—Martin Luther King Day*]
Reading:
LINDBERG, pp. 132-224 [Chapters 7 to 9]; please *skim* pp. 132-162 [Chapter 7]
EDE & CORMACK, pp. 29-63 [Chapter 2]

Week 4: The Copernican Revolution: How To Learn Things in the Sixteenth Century
26-30 January
Reading:
EDE & CORMACK, pp. 91-127 [Chapter 4]
LINDBERG, pp. 225-285 [Chapters 10 and 11] *skim for comprehension*
Dear, *Revolutionizing the Sciences*, pp. 30-48 [Chapter 2]

Week 5: The Scientific Revolution: How to Explain Nature
2 – 6 February
Reading:
LINDBERG, pp. 225-285 [Chapters 10 and 11] *skim for comprehension*

Dear, *Revolutionizing the Sciences*, pp. 65-79 [Chapter 4] [Blackboard]
Galileo, *Dialogue Concerning the Two Chief World Systems* [excerpts: *please read* 'To the Discerning Reader' and the first third of the First Day] [Blackboard]
First writing assignment due on 2 February, start of class

Week 6: Building Scientific Institutions: Natural Philosophy in the Enlightenment
9 – 13 February
Reading:
EDE & CORMACK, pp. 129-135
Dear, pp. 101-130 [Chapter 6]

Week 7: Newton and Newtonian Physics: ("God said, 'Let Newton be!' and all was light")[1]
16 – 20 February
Reading:
EDE & CORMACK, pp. 135-141
Dear, pp. 149-167 [Chapter 8]
MID-TERM EXAM THIS WEEK [CURRENTLY SCHEDULED FOR MONDAY, 16 FEBRUARY]

Week 8: Emerging Modern Science: Exploring the World to the Chemical Revolution
23 - 27 February
Reading:
EDE & CORMACK, pp. 141-201
Dear, pp. 168-170 [Conclusion]
Farber, pp. 1-21 [Introduction and Chapter 1]

Week 9: Natural History: From the Geology of Genesis to Darwin
2 to 6 March
Reading:
EDE & CORMACK, pp. 203-239
Bowler and Morus, pp. 129-164 [Chapter 6] and pp. 341-366 [Chapter 15]

Break week follows… then

Week 10: Astronomy: Revelations about the Stellar Neighborhood, and the Galaxy
16-20 March
Reading:
Bowler and Morus, pp. 277-297

Week 11: Revolutions in Physics: Classical Physics through Relativity and Quantum Mechanics
23 – 27 March
Reading:
EDE & CORMACK, pp. 241-278
Bowler and Morus, pp. 253-276 [*skim*]

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[1] Alexander Pope (1688-1744), "Epitaph… Intended for Sir Isaac Newton, in Westminster Abbey." (1730)

Week 12: The Modern Earth Sciences: Learning about the World
30 March – 3 April
Reading:
EDE & CORMACK, pp. 323-348
Bowler and Morus, pp. 237-252
Second writing assignment due on 30 March, start of class

Week 13: From Microbiology to Cosmology: Contemporary Upheavals
6 – 10 April
Reading:
EDE & CORMACK, pp. 278-321

Week 14: The Challenges of Professional Science
13-17 April
DJERASSI, *Cantor's Dilemma* [all—*a short, fast read*]

Week 15: Contemporary Science: What Does History Tell Us?
20 – 24 April
Reading:
EDE & CORMACK, pp. 379-396

Final exam scheduled [university calendar] for Friday, May 1st, 12:30-2:30 PM.

Reminder of important dates:

Monday, 2 February, at 3:20 PM (start of class): first writing assignment due
Monday, 16 February: mid-term
Monday, 30 March, at 3:20 PM (start of class): second writing assignment due
Friday, May 1, at 12:30 PM: final exam.

Any revisions to the syllabus will be made on Blackboard: see 'Syllabus' tab.

The Rise of Modern Science (Johns Hopkins University)

The Rise of Modern Science, 140.302
Syllabus for Spring 2015

Prof. Sharon Kingsland, (410-516-7505; Sharon@jhu.edu)
Department of History of Science and Technology
Office: Gilman 382

Class format: Lectures MW 10:00 (Hodson 311); Discussion sections: Fridays 10:00, Section 01 (Krieger 309); Section 02 (Ames 218).

TA's: Richard Nash (rnash2@jhu.edu), Emily Margolis (emily.margolis@jhu.edu)

How have science and technology shaped the modern world? Our course begins in the mid-18th century and considers some of the most important scientific developments that have shaped our worldview. From Lavoisier's Chemical Revolution, through the age of industry and empire, to the current era of Big Science, we'll explore what scientists accomplished and what the social consequences of their discoveries were. What does it mean to make a "discovery" in science? What does it mean to speak of a "scientific revolution"? What happens when new ideas or discoveries arise that have the potential to transform our world? How does the political context affect science, and what roles have scientists played as activists and intellectual leaders? These are the themes we will examine through different case studies.

There is no central text for this course. Each week there will be assigned readings from both secondary and primary sources. These will either be available on electronic reserve, from the electronic journal archive JSTOR, or they will be handed out in class. In addition the course is supported by a Blackboard site which includes announcements, syllabus and essay assignments, lecture summaries, supplementary information on certain topics, and a link to e-reserves.
Go to: http://blackboard.jhu.edu and log in with your Hopkins ID and password.

Requirements and distribution of grades for the class:

1. Class attendance and participation in section discussions: 30 percent. Note that the weekly discussion sections constitute nearly one-third of the course. These sessions will also be important in helping you prepare the essay assignments.

2. Essay assignments (3 during the semester = 70 percent of final grade): Essays will be on assigned topics relating to course readings. The first is worth 20 percent of the total grade and the second and third are 25 percent each. The first two will be about 4 pages (about 1000 words) in length, and the third about 5 pages (1250 words).

3. Bonus quiz. In the last lecture class (Wednesday) we'll have a quiz on the semester's lecture material. The quiz is not an exam, is purely for bonus points, and there is no

penalty for not taking it. It will consist of about 20 multiple choice questions, with topics selected from the semester's lectures (not from readings). If you have no more than two incorrect answers, we will increase your final grade by one "step" (e.g. A- becomes A). Key to scoring high is attending lectures regularly.

Due dates for assignments are indicated in the syllabus. Students may take a short late extension for any reason, *but there will be a small penalty (grade reduced by one "step", i.e. A becomes A- etc.)* no matter what the reason. Note the late dates on the syllabus. Late papers must be submitted by class time on the date indicated, and *no papers will be accepted past this deadline* except in unusual circumstances. Some lecture time will be devoted to discussing the essay assignments, which means that if you habitually miss lectures, you will also be missing valuable advice. Due dates are:

Essay 1: Friday, February 20; late date Monday, Feb. 23 by class time.
Essay 2: Monday, March 9; late date Friday, March 13 by class time.
Essay 3: Monday, April 20; late date Friday, April 24 by class time.

Class etiquette: Laptops should be used just for taking notes.

Grading philosophy: A is excellent; B is good; C is satisfactory; D is passing (unless the course is being taken pass/fail); F is failure. We are available to assist you, but you must come to us for help well in advance of the due dates. Although the course is not writing intensive, we expect essays that are grammatically correct, clear and logical.

Lecture and discussion schedule:

January 26: Where does the history of modern science start?
January 28: Introduction: Newtonian science after Newton. The dual legacies of the *Principia* and *Opticks*.
January 30: Introduction from your TA: How to approach this class; how to approach the assignments. Forster, "Voltaire's laboratory: How they weighed fire." ***First assignment posted. The assignment will be based on the readings from Lavoisier's Elements of Chemistry.***

February 2: Enlightenment Science: Natural history and biology.
February 4: Enlightenment Science: Electrical and chemical sciences.
February 6: Discussion: Science in the Enlightenment. Hankins, "The character of the Enlightenment" (e-reserve).

February 9: The Chemical Revolution I.
Levere, *Transforming Matter*, chapters 3, 5, 6 (e-reserve).
February 11: The Chemical Revolution II. What did Lavoisier achieve?

February 13: Discussion: How should we think about the Chemical Revolution? How is caloric theory an improvement on phlogiston theory – or is it an improvement? Lavoisier, Preface and chapter 1 from *Elements of Chemistry*. If you have questions about how to handle the assignment, bring them to class today!

February 16: Michael Faraday: Experimentalist Extraordinaire. Bruce Hunt, *Pursuing Power and Light*, chapter 4 (e-reserve).
February 18: Extending electrical science: Thomson and Maxwell.
February 20: Thomas A. Edison: The age of electricity. For discussion: Hunt, *Pursuing Power and Light*, chapter 6 on Edison (e-reserve). Other readings on Blackboard site. ***First assignment due. Late date is February 23 by class time (small deduction). Second assignment posted (on Darwin's theory of evolution).***

February 23: Charles Darwin: A naturalist's education. Readings handed out.
February 25: The *Origin of Species*. Table of contents, chapter 3, and concluding summary of *Origin of Species* handed out.
February 27: How is *Origin* structured and how does it address the key problems that Darwin thought needed to be answered? Analyze the logical argument that he presented in chapter 3 on the "struggle for existence."

March 2: Extending Darwinism: problems of adaptation, inheritance, and human evolution.
March 4: Linking animals and humans; Wallace's heresy.
March 6: Darwin's argument for human morality in *Descent of Man*. Darwin, chapter 5 from *Descent*, on e-reserve. Think about how his arguments for human evolution, especially the evolution of higher morality, draw on analogies with animals as well as on observations of contemporary society.

March 9: Mendelism: A Delayed "Revolution"? Why did Mendel's obscure findings attract attention? ***Second assignment due; late date is Friday March 13 by class time.***
March 11: Creating the Science of Genetics
March 13: Applied genetics: The gospel of Eugenics – Should human evolution be controlled? Popenoe and Johnson, *Applied Eugenics*, chapters 7 and 19 (e-reserve).

MARCH BREAK March 16-22.

March 23: 1905: Einstein's Miraculous Year. ***Third assignment will be posted. (Choice of topics; selections will be related to readings for the next 3 weeks).***
March 25: General Relativity and the Cult of Einstein.
March 27: How Einstein got the Nobel Prize. R. M. Friedman, "Einstein must never get a Nobel Prize," from *The Politics of Excellence* (e-reserve).

March 30: Nuclear Physics: Models of the Atom.
April 1: The Discovery of Fission and the Atomic Bomb. McKay, *Making of the Atomic Age*, chapters on e-reserve.
April 3: Ruth Sime, "An inconvenient history: the nuclear-fission display in the Deutsches Museum," *Physics in Perspective* 12(2010):190-218. (Available electronically through our library, also uploaded on Blackboard site).

April 6: The Path to the Double Helix. M. Morange, *A History of Molecular Biology*, chapters on e-reserve.
April 8: After the Double Helix: Genetic Engineering and Gene Mapping.
April 10: Soviet Science: Lysenkoism and the Cold War. (Readings for this week will be on JSTOR, electronic database accessed through the library website).

April 13: The Subversive Science: Ecology and Environmentalism
April 15: Film on the environmental movement, first half.
April 17: Film on the environmental movement (classes combined).

April 20: Earth Sciences: Alfred Wegener and Continental Drift.
Third assignment due; late date April 24 by class time.
April 22: Discovery of Plate Tectonics: A Scientific Revolution? J. Tuzo Wilson, "Static or Mobile Earth: The Current Scientific Revolution," *Proceedings of the American Philosophical Society* 112 (1968): 309-320 (available electronically on JSTOR).
April 24: Geology East and West: Comparing US, Soviet, and Chinese approaches. "Geopolitics of Plate Tectonics," *Science News* 98 (July 11, 1970):29 (JSTOR); Frank Press, "Plate Tectonics and Earthquakes Prediction: Contrasting Approaches in China and the United States," Bulletin of the American Academy of Arts and Sciences 28(1975):14-27 (on JSTOR).

April 27: The Era of Big Science: The Space Telescope and High Energy Particle Physics.
April 29: Quiz: optional multiple choice quiz for bonus points.
May 1: No class.

HI 481H: History of the Life Sciences (NC State University)

HI 481H : HISTORY OF THE LIFE SCIENCES Dr. William Kimler

OFFICE: # 474 Withers Hall PHONE: 919-513-2238 E-MAIL: kimler@ncsu.edu

Course Prerequisite:

Jefferson Scholar [or by permission from Dr. Kimler, with Junior standing and Honors GPA].

General Education Program fulfillment:

This course is on the list for "Interdisciplinary Perspectives" courses. The course will help you to distinguish between the distinct approaches of history and science, identify and apply the connections between them, and explore and synthesize the views of the two disciplines as we examine modern ideas about living processes.

The course treats the growth of biology as a story about developing a set of core ideas or organizing concepts about the nature of life. Starting in the 1600s, investigators learned how to experiment on living functions. Over the next two centuries they developed a view that life is explained by structure (organs, tissues, cells) and function (chemistry). As new tools and methods provided control and precision, a biology of physiology, development, and heredity went from promise to the flourishing of molecular biology. On an overlapping track, naturalists developed the sciences of the ecological interactions, deep history, and evolution of life. Ideas never exist in a social vacuum, and so the course will draw attention to the connections between the life sciences and other aspects of culture, including religious beliefs, professional behavior and practices, and social goals.

In trying to explain the development of biological science, the historian asks some basic questions: 1. What do we know about the biological phenomenon? This includes what we think we're seeing, how we describe it, how it connects to other things we know, and some explanation of its causes or operations.

2. How do we know all that? This means understanding the scientist's method of working and explaining, and also how other scientists have been persuaded of this answer.
3. Who figured it out? The story of scientific ideas is an account of creativity and insight, which also means it's an explanation of the cultural and intellectual conditions that allowed or fostered the work. It is also by turns peculiar, obvious, ironic, tragic, funny, unexpected, twisted, or noble. Seldom is it boring.

Biology today is one of most rapidly developing sciences, and its implications for modern life promise to be profound. As educated citizens, you ought to become aware of the history of the ideas that form the modern, biological view of life. This course is intended to provide you with the chance to develop an understanding of biological and biomedical

ideas and practices as they developed, and provide material for your own reflections on this view of life.

Lectures organize the major themes and provide a narrative about the scientists as background and guidance. You'll read extracts from the original works of biologists. Together, lectures and discussions of the readings will provide the foundation for a historical view of biology.

and by appointment by email Syllabus & Readings & Updates at go.ncsu.edu/hi481

SPRING 2015

OFFICE HOURS: Tuesday 3:00 - 5:00 Wednesday 1:30 - 4:00

Readings will be available online at <http://www4.ncsu.edu/~kimler/hi481/481readings.html> and also come from the required texts:

William Harvey, On the Motion of the Heart and Blood in Animals (R. Willis translation, Prometheus Books, 1993; also available from the Internet Archive http://www.archive.org/stream/onmotionheartan00harvgoog#page/n6/mode/2up)

Charles Darwin, On the Origin of Species (J. Carroll, ed., Broadview Press, 2003; the original 1859 text is also available from The Complete Work of Charles Darwin Online http://darwin-online.org.uk/content/frameset?viewtype=side&itemID=F373&pageseq=1)

Claude Bernard, An Introduction to the Study of Experimental Medicine (Dover, 1957)
James Watson, The Double Helix (Norton Critical Edition, 1981)

Attendance at class sessions is essential and required. Your responsibility to the class is to attend and to be familiar with the readings, able to discuss their content, and ready to explore ideas in class. In addition, you are responsible for material covered in class, independent of the readings. Much class material will be my synthesis of the scholarship, and you'll be expected to be able to draw on class discussions in your own written work.

You are responsible for keeping up with changes made in class for our topics or readings, and posted online at <http://www4.ncsu.edu/~kimler/hi481/481syllabus.pdf>.

You should contact me as soon as possible about absence because of illness or emergency. Consult the University's Attendance Regulation for the definition of excused absence at <http://policies.ncsu.edu/regulation/reg-02-20-03>

Grades will be based on

30% :

Reading Response comments, due at the class session indicated in the schedule of reading assignments. Responses should be less than 300 words. As these comments coordinate with the class sessions, no late papers are accepted. You will write 15 of these, out of 19 choices. Pick a major feature of the author's argument to summarize in your own words. Point out something that strikes you as interesting, perplexing, disgusting, amusing, or curious about the text, as a prompt for class discussion.

30% : Take-home Review Essays. You will write on two of these questions:
#1. Analyze William Harvey's argument in On the Motion of the Heart and Blood — you might consider such matters as his logic, the strategic way that he builds his case, the types of evidence he uses, its novel or traditional aspects, or how the rhetoric of argumentation serves to advance his promotion of new knowledge. Due January 29.
#2. Discuss Claude Bernard's argument for both the status and logic of "experimental medicine" [modern biological methods] as the most legitimate view of life and way to study living processes. Due February 17.
#3. Discuss the presentation of the "one long argument" that Charles Darwin makes for evolution in his Origin of Species – you may focus more on his reasoning and how he presents it, or more on the rhetoric of a persuasive case. Due March 24 26.
#4. Analyze James Watson's presentation in The Double Helix of Watson and Crick's accomplishment, addressing a clear thematic question of your choice – such as the nature of their discovery, their style of collaboration and competition, questions of scientific integrity, or the role of Franklin or others in the discovery. Overall, I expect a historian's critique of Watson's "memoir." I will expect you to be aware of the various criticisms of the text or disagreements with or alternatives to Watson's version (Stent's chapter on the reviews will give you the quick overview). You will need to explicitly address the perspective of at least one of these views. Due April 23.

30% :

10% :

Research Paper of at least 2500 words [10 standard pages] in length, plus literature cited. In general, the paper will be an investigation of the development or impact of a particular idea, individual, technique, or institution in the history of biology, with preference given to a topic connected to your CALS major. But you may also investigate a different area of biology. I will discuss with you possibilities for papers, and must approve your choice of a topic. I will expect you to have picked a topic and discussed sources with me by March 5.

Submission of Research Paper Draft and Comments on classmate's draft. I will be happy to discuss literature searching and materials you find as you research and write your Draft. A Draft version of the Research Paper is due by April 3. By draft, I expect a well-formed research question, a close-to-complete search for sources, detailed coverage of your sources, and an attempt at your final analysis and conclusion. On any topic, I expect you to incorporate the course's insights about the developments of biological science. If there are parts of the paper not finished because you are waiting on a source or are still

trying to figure something out, just indicate so in the draft with an outline of what you might fill in for that section. The purpose of a draft, after all, is to find the holes to be filled by more sources or analysis. It also allows a reader to see what's missing.

Each of you will write a review of one classmate's draft. After reading the paper, you ought to be able to summarize the main thesis – the historical question being posed and a succinct version of the explanation provided. A history paper is essentially a narrative with explanation that points out some issue or conditions or event of interest. It then uses particular sources as evidence for an explanation of why it occurred in the way it did, or explains the particular context of the issue.

Thus you can help your classmate by writing, in your own words, a brief account of what the paper raises as a question, what it covers as narrative and evidence, and what the overall explanation is. If you have trouble seeing those things in the paper, your critique should point out where and why you had trouble with the question or argument. Even just seeing the topic and explanation described in someone else's words can help the writer to clarify what they're trying to say, or notice relative emphasis throughout the paper.

Make suggestions for improvement – clarifying the question or point of the paper, and strengthening the explanation or conclusions. You might not be convinced of a claim in the paper – point out why not, even perhaps what it would take to be more convincing. You may wish to point out where you'd like more evidence for particular claims, or even suggest subjects or sources that you think would help with the writer's particular interest. It is not your job to correct grammar or style, although you might indicate where the organization or text is not clear.

I expect you to consider comments from your classmates and from me in your revisions.

Keep in mind that the paper is the author's intellectual property and you may not use it, share it with others, post it to the web, tweet about it, turn it into a video on YouTube (with or without kittens), or anything else that violates their inherent copyright. It should go without saying that you will treat your classmate's work with respect and discretion, making helpful suggestions. I will consider any disrespect to be a violation of the standards of integrity of an academic community, and treat accordingly.

The Comments are due in class on Tuesday, April 7.
The finished version of the Research Paper is due on Thursday, May 7.

Grading scale:

A+ 97-100 B+ 87-89 C+ 77-79 D+ 67-69 F <60 A 93-96 B 83-86 C 73-76 D 63-66
A- 90-92 B- 80-82 C- 70-72 D- 60-62

Academic Integrity:

I have come to expect the highest integrity from NC State students. I assume that you are familiar with NC State policy on Academic Integrity, found in the Code of Student Conduct, at <http://policies.ncsu.edu/policy/pol-11-35-01>. You are required to uphold the Honor Pledge ("I have neither given nor received unauthorized aid on this test or assignment."), and your adherence to academic honesty is certified by your name on the test or assignment.

Scholarly forms of citation in historical writing are not trivial, and every publisher has its own requirements. Mine are for citation in footnotes, with a Literature Cited section at the end. I do not accept in-text citations (parenthetical MLA or "scientific" format). Citation format must follow The Chicago Manual of Style, available on-line <http://www.chicagomanualofstyle.org/home.html>.

It is your responsibility to know what constitutes plagiarism and avoid it. If you have any questions about what is appropriate scholarly use of sources and citation, see the History Department's site "What is Plagiarism" at <http://history.ncsu.edu/pages/what_plagiarism> and "How to Identify and Avoid Plagiarism" at <http://history.ncsu.edu/pages/avoid_plagiarism>. Or talk to me.

Disability Accommodations:

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, you must register with Disability Services for Students (DSS) at 1900 Student Health Center, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please consult the Academic Accommodations for Students with Disabilities Regulation at <http://policies.ncsu.edu/regulation/reg-02-20-01>

HI 481H: Schedule of Topics and Readings SPRING 2015

http://www4.ncsu.edu/~kimler/hi481/481readings.html

STRUCTURE & FUNCTION

JAN 8 The Modern Biological View of Life
Scientific ideas about living processes, and the nature of modern science.

Envisioning Living Structures and Function
The early medical tradition. The role of illustration in medical texts.

JAN 13, 15 Envisioning Living Structures and Function Vesalius and the Padua anatomists.

JAN 20, 22

READ: Illustration set of links and articles
Vesalius, extracts from De humani corporis fabrica [Response due 1/13]

Experimental Investigation
Harvey's methods of research. Harvey's arguments for the circulation of the blood. Demonstration and experimentation.
READ: Harvey, On the Motion of the Heart and Blood – thru Ch. 14 [Response due 1/20]

Kimler, Reception of Harvey's Theory
Redi, Experiments on the Generation of Insects [Response due 1/22]

THE MATERIAL OF LIFE

JAN 27, 29 Ideas of Mechanism
Mechanistic theories of vital activity. Descartes and reductionist methodology. READ: Descartes, extract from Discourse on Method [Response due 1/27]

Foster, Lectures on early physiology Vaucanson, Letter on the mechanical duck

The Reductionist View of Life: Function
Anatomical concept of disease. Bichat's tissue doctrine. The nature of digestion. Magendie's chemical view. The question of determinism and replication. Analytical organic chemistry and drug synthesis.
READ: Gasking, extract from The Rise of Experimental Biology

Review Essay 1 due 1/29

FEB 3, 5 The Reductionist View of Life: Chemistry & Cell Physiology
Liebig's agricultural chemistry. Animal models and the chemical machine. The "medical materialists." Methods for experimental study of physiology.
READ: Bernard, An Introduction to the Study of Experimental Medicine [PART 1 Response due

2/3]
Bernard, An Introduction to the Study of Experimental Medicine [PART 2 or 3 Response due 2/5]

FEB 10, 12

Germ Theory, Disease, and Public Health
The cell doctrine. Pasteur and the physiological unity of living processes. Pathology and germ theory. Contagion, sanitation, and epidemiology.
READ: Pasteur, "Memoir on the Organized Corpuscles" [Response due 2/10]

Snow, On the Mode of Communication of Cholera Virchow, extract from Cellular Pathology Sedgwick on typhoid epidemic

Review Essay 2 due 2/17

[Response due 2/12]

THE ECOLOGICAL WEB & THE EVOLUTIONARY TREE FEB 17, 19 NO CLASS
FEB 24, 26 NO CLASS

MAR 3, 5 "Nature's Economy"
Great Chain of Being. Man's place in nature. Exploration and biogeography. Economy of Nature and natural theology.
READ: Linnaeus, extract from The Œconomy of Nature [Response due 3/3]

The Question of Species and Progress in the History of Life
Geological strata, fossils, and deep time. Lyell's uniformitarian geology. Expectations for natural explanations.
READ: Lyell, extract from Principles of Geology]

Buckland, extract from Geology and Mineralogy, Considered with Reference to Natural Theology [Responses on both due 3/5]

MAR 17, 19 Creation of a Theory of Evolution
Darwin's field and theoretical investigations. The theory of Natural Selection. Natural order and material explanations.
READ: Darwin, Origin of Species extracts, Introduction thru Ch. 6 [Response due 3/17]

MAR 24

Unifying biology.
READ: Darwin, Origin of Species extracts, Ch. 8 thru 14 [Response due 3/19]

Reactions to Evolution
READ: Contemporary reviews of Origin [Response due 3/24]

Review Essay 3 due 3/26

HEREDITY

MAR 26 The Nature of Inheritance
Plant and animal breeders. Gametes and sexual reproduction. Darwinian theory and genetic mechanisms. Mendel's methods and reception. Factorial and blending theories of

heredity in 19th century.
READ: Goodale, extract from The Principles of Breeding

and Mendel, “Experiments in Plant Hybridization” [Response due 3/26]

MAR 31 The Invention of “Genetics”
The experimentalist revolt against morphology. The creation of Mendelism. Intellectual

and institutional contexts of the new biological disciplines. The Morgan school of classical Mendelian genetics. Lingering vitalism.
READ: Morgan,"What Are 'Factors' in Mendelian Explanations?"

and Morgan, extract from The Physical Basis of Heredity [Response due 3/31] DRAFT Research Paper due by Friday, 4/3

COMMENTS on classmate’s Draft due 4/7

APR 7, 9 The Nature of the “Gene”
Biochemistry and theories of vital function. Enzymes, vitamins, and genetic metabolic disease. Protein structure and function. Nuclein and heredity. Structural methods and the molecule of heredity. Functional models (one gene-one enzyme). Delbrück, Schrödinger, and the movement of “romantic” physicists.
READ: Allen, Ch. 7, Life Science in the Twentieth Century

Schrödinger, extract from What Is Life? [Response due 4/9]

APR 14, 16 The Structure of DNA The narrative and character of James Watson.

READ: Watson, The Double Helix [Response due 4/16]

APR 21, 23 The Structure of DNA
Pauling, Watson, Crick and model-building. The role of Franklin. The nature of scientific practice and discovery.
READ: individually assigned selections of alternative accounts [Response due 4/21]

MAY 7

Review Essay 4 due 4/23
Final Version of Research Paper due 10:00 a.m.