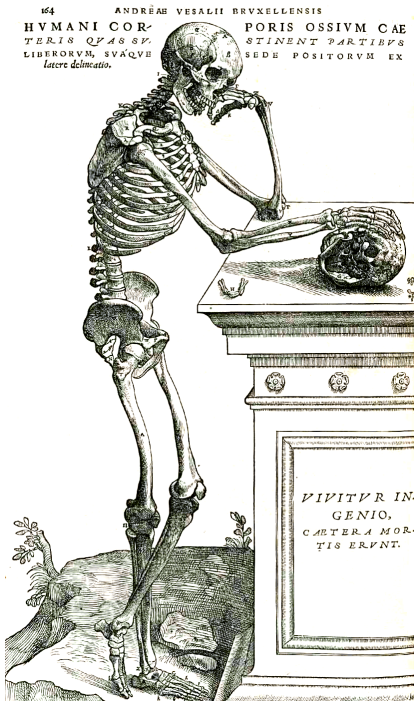

THE EMERGENCE OF MODERN SCIENCE
STSC 001 920 / HSOC 001 920

MWF 9am-11.30am

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Office Hours: Immediately after class and by appointment.

COURSE DESCRIPTION:

Modern Science, perhaps more than anything else, makes our contemporary society unique in history. But where and when did modern science come from? What makes something scientific? Is science simply a stockpile of technique and knowledge that has accumulated slowly and steadily over the centuries? Has it been more reliable than other means of gaining knowledge? This course presents a complex and dynamic picture in which the history of science takes twists, turns and conceptual leaps in response to changing social, political, cultural, and religious interests, as well as shifting intellectual or scientific assumptions, methods, and forms of organization and presentation. The course introduces some of the major formative steps in the scientific tradition, each of which extended or overturned earlier ways of investigating and understanding nature. These include: Aristotelian natural philosophy and Galenic medicine; the Scientific Revolution of the 15th through the 18th centuries that ushered in Copernican astronomy, Newtonian physics, and new ideas about physiology and medicine; the Chemical and Darwinian Revolutions; and the rise of modern physics and biology. This course shows that our modern and familiar image of reality is not self-evident, and in fact did not come into existence until very recent times. Past conceptions of nature, and approaches to its study, often differed radically from our own.

The course has no prerequisites, and is designed to be accessible to all students. It can serve students in the sciences by providing a historical context for scientific knowledge, and students in other fields by providing some knowledge of how science works and has worked in the past. The course fulfills sector requirements in humanities and social science (sector IV) and natural sciences and mathematics (sector VII).

*****IMPORTANT PREFACE***:***

The history of science is a challenging and exciting discipline that necessitates considerable time spent reading texts. Material presented in the lectures will often highlight or give a context to the reading, thus you will be quickly lost if you do not do

the reading. Likewise, you will probably find some of the readings difficult, so it is important that you study these prior to class and use discussions as an opportunity to understand them better. Also, because this is a summer-session course, you can expect our pace to be furious. We will be covering sixteen weeks of material in the space of five weeks, so be prepared to put in a large amount of work both inside and outside the classroom.

OBJECTIVES:

1. To develop a familiarity with major ideas, persons, and concepts that constituted and shaped the development of Western science.

2. To develop a familiarity with the major historiographical questions and problems central to the discipline of the history of science.

3. To foster an appreciation for the approach of the historian to questions past and present, and the manifold methods used in historical analysis. Thinking as a historian involves studying evidence from the past and developing descriptive and interpretive arguments based on the evidence available. Critical reading, logical thinking, and clarity of expression are target skills for this course.

4. To better understand our world and our place in it by investigating the history and influence of science on society and culture.

TEXTS

Most of the readings for this course will be provided to you in pdf form on the course website (Canvas). We will also be reading *Revolutionizing the Sciences: European Knowledge and Its Ambitions, 1500–1700* by Peter Dear (second edition: Princeton University Press, 2009). These texts are available at the Penn Book Center at 130 South 34th Street.

TECHNOLOGY

Many parts of this course will be carried out online. For instance, you will submit discussion questions either via email or through the course website. Similarly, some class activities will require you to have an internet-enabled device, such as a laptop, tablet, or smartphone. If this is a problem for you, please let me know and a solution will be found.

Please, familiarize yourself with the course website on Canvas (canvas.upenn.edu) and with Socrative (b.socrative.com), a site we may be using for in-class feedback.

ASSIGNMENTS AND RESPONSIBILITIES

- Take-Home Midterm..... (20%)
- In-Class Final..... (20%)
- Group Project.....(20%)
- Discussion and Participation .....(20%)
- Short Writing Assignments..... (20%)

*** This course uses a standard grading scale: A+ (100-97%), A (96.9-93%), A- (92.9-90%), B+ (89.9-87%) ... F (60-0%). A curve will not be used. If all students earn an A, all students will receive an A.

- EXAMS: The take-home midterm and in-class final will consist of a variety short answer, multiple choice, identification/definition, and essay questions. The final exam will not be cumulative, but you will be expected to apply major ideas from the first half of the course to the latter half.

- GROUP PROJECT: Students will work in groups of four and will choose an experiment/ demonstration **from a primary source in the history of science, technology, or medicine** and recreate it as it was originally carried out (insofar as that is possible). Students will document the experiment by producing a video presentation that will be shown in class, and if groups are amenable, to Youtube (for posterity). Groups will work closely with the instructor to choose an appropriate experiment that can be safely carried out with easily obtainable materials, and to ensure that each individual in the group has a role to play in the production and presentation of the project. Videos should be approximately 3-5 minutes (after editing) and should 1) introduce your experiment, 2) contextualize its significance in the history of science, 3) clearly and cogently explain and show what you did and why did did it, and 4) analyze your results. You will be graded on 1) the general quality of your presentation and 2) completing the experiment with all limbs, digits, and eyes. Naturally, experiments/ demonstrations must not use animal subjects and must not pose any threat to the humans carrying them out. Also, nothing involving bodily fluids, please.

    - Some examples:
        - Galileo's inclined plane experiments
        - Louis Pasteur's swan-necked flask experiment
        - Volta's "pile"
        - See https://www.aip.org/history/syllabi/experiments.htm for a large list of experiments.
        - Emily du Chatelet's physics experiments
        - Michael Faraday's candle experiments

- DISCUSSION & PARTICIPATION: To earn these points, a student must attend class, actively participate in discussion and exercises, and complete assignments on time.

  *** **Students will submit one question for discussion from a reading of his or her choice for the upcoming class session prior the beginning of each class.**

  We will try submitting discussion questions using the course website, but if this does not work, questions can be submitted to the instructor via email with the date and "discussion question" written in the subject (e.g., "July 11 Discussion Question").

  An effective discussion question will be open-ended and will arise from a close reading of the material. It should be a question that requires significant analysis and critical thinking in order to address. Ask questions about evidence, cause and effect, and comparisons between authors. How do we know something is true? Is the author's argument convincing? What are the implications of the author's argument? Naturally, your questions will address a diverse array of topics and will arise from your own creativity and critical thinking skills.

  Please, as we are all adults, refrain from texting and surfing the web for material unrelated to class during lectures and discussions.

- WRITING: There will be two short writing assignments during the course.

  - *Argument Analysis:* You will be given several articles and chapters from which you will choose one to read. You will carefully analyze and critique the argument of the paper or chapter (2-3 pages).
  - *Contextual Analysis:* You will pick a historic book (perhaps one that we view during our field trip to the U. Penn rare book library) or a scientific object and describe its significance within the context in which it arose (2-3 pages).

  *** Both papers should be in 12 pt. Times New Roman, 1-inch margins, double-spaced.
  *** You will receive further instructions at the time of the assignment.

STATEMENT FOR STUDENTS WITH DISABILITIES

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you

believe you have a disability requiring an accommodation, please contact the Office of Student Disabilities Services (http://www.vpul.upenn.edu/lrc/sds/).

STATEMENT ABOUT ACADEMIC MISCONDUCT AND PLAGIARISM
University rules concerning academic misconduct and plagiarism will be enforced in this class.

Schedule

July

4: NO CLASS: Holiday

7: NO CLASS: I am out of town until the 8th, so our first meeting in person will be on the 9th of July. Nevertheless, please complete the following readings by the 7th in order to participate in an online discussion.

- Various, "What is the History of Science?"
- Mendelsohn, "Why Study the History of Science, Medicine and Technology?"
- Dear, 1-9.
- Watch NOVA documentary on Antikythera Machine

9: General Introduction to the History of Science; Ancient Background

- Baum, "Popper, Kuhn, Lakatos"
- Plato, *Timaeus*
- Lindberg, ch. 3 – "Aristotle's Philosophy of Nature"
- Aristotle, Selections (on the History of Animals; Physics)

11: Medieval Natural Philosophy, Medicine, and the Scholastic University

- Grant, Foundations of Modern Science in the Middle Ages, "What the Middle Ages Inherited from Aristotle."
- Siraisi, Medieval Medicine
- Peregrinus, "The Properties of the Lodestone"
- Roger Bacon, "Letter on Secret Works of Art and of Nature"

14: NO CLASS: Please, complete the following readings by the 14th in order to participate in an online discussion.

- Dear, "What was Worth Knowing in 1500," 10-48.
- *Making Modern Science*, 1-19, 23-33, 50-52.

16: Renaissance & Revolution!

- SEP – Scientific Revolutions
- Burke, 89-107
- Vesalius, Dedicatory Letter to Charles V
- Dear, 30-48.

18: Galileo and Descartes – Science and Religion; Mechanism

[Argument Analysis DUE]
- Dear, ch. 5: "Mechanism: Descartes builds a universe"
- Dear, ch. 6, 101-114.
- Descartes Excerpt
- *Making Modern Science* ch. 15, "Science and Religion"
- Galileo, Letter to the Grand Duchess Christina of Tuscany

21: Scientific Societies, Experiments, and Methods – Bacon, Harvey, and the Royal Society

- Bacon, New Atlantis
- Harvey, Selections from *De Motu Cordis*
- Dear, 114-144
- Boyle Selections re: the Air Pump
- Harvey Video [Please note that this video contains material which may be disturbing to some viewers. In particular, it contains footage of the vivisection of anesthatized animals. If you have a strong ethical objection to viewing this material, please see me during office hours and we will discuss the content in lieu of viewing the video.]

23: Newton and Newtonianism; The Enlightenment and the Chemical Revolution

- Dear, 145-166
- Newton, Oster, 163-172
- Chymistry of Isaac Newton Selections [Skim the whole manuscript, look at several "page images," and read carefully from 'It may seem an admirable...' on p. 5r]
- *Making Modern Science*, 55-77
- Chemical Revolution Selections

25: Introduction to the History of the Book. Field Trip to U. Penn Rare Book Room

[Take-Home Mid-Term **Due**]

28: Natural History, Darwin, and Darwinism

- Making Modern Science, "The Darwinian Revolution" (129–162) and "Biology and Ideology" (415–436)
- Darwin, The Origin of Species, "Recapitulation and Conclusion" (158–174)
- Moore, Charles Darwin
- ~~Hutton~~
- ~~Ray~~

30: Modern Medicine and the Industrial Revolution

- *Making Modern Science,* "The Conservation of Energy" (79–101)
- Burke, 163-197

Aug.

1: Genetics and Heredity; The New Atomism

[Contextual Analysis **DUE**]

- *Making Modern Science*, "The New Biology" (165–186) and "Science and Medicine" (439–460)
- *Making Modern Science*, "Genetics" (189–211)
- Morgan, excerpt from "The Scientific Basis of Evolution" (356–362)

4: Twentieth-Century Physics

- *Making Modern Science*, "Twentieth-Century Physics" (253–275)
- Einstein, "What Is the Theory of Relativity?" (342–344)
- *Making Modern Scienc*e, "Science and War" (463–484)
- Excerpt from the Franck Report (371–375)

6: Global Science and the Information Age

[Group Presentations]

- Watson and Crick, "Molecular Structure of Nucleic Acids" (737–738)
- *Making Modern Science*, "Ecology and Environmentalism" (213–234)
- DNA – Secret of Life Documentary (PBS)

8: Final Exam