

Scientific Revolutions I: Natural Philosophy in Context from Antiquity to Newtonianism

HPS 210 H1-S: Summer 2013 (July-August)

Instructor: Ari Gross

TA: Michael Cournoyea

Lectures: Tu/Th, 12-2pm, Sidney Smith Building, room 2102

Tutorials: All tutorials are held in Sidney Smith, room 1088

TUESDAY

101: 2-3 pm

201: 3-4 pm

THURSDAY

301: 11-12 pm

401: 2-3 pm

501: 3-4 pm

Contact Information

Office Hours: Wednesday, 12-2 pm, Victoria College (Old Vic) building, room 308

Course E-mail: hps210h1@utoronto.ca

Course Description

This course surveys the history of science from Antiquity to the Early Modern era. Through it, we shall gain an understanding of how knowledge of the natural world was obtained, applied, and transmitted from ancient Greece to the early eighteenth century. This course will focus on individual developments in specific scientific fields, such as astronomy/astrology, physics, biology/natural history, alchemy/chemistry, and medicine, as well as the social, cultural, and intellectual changes that will help us understand these developments.

HPS 210 strives to situate the events that constitute the history of science (or, more accurately, the history of natural philosophy) within their broader intellectual and historical contexts. In doing so, we shall gain insight into the reasons that underlie historical individuals' various conceptions of the world, as well as the methods that they believed were best applicable to its study. In viewing natural philosophy as a human activity we will see how the practice and content of science are intimately connected to philosophical and religious positions, social and economic structures, and available information and technology.

While this course is an interdisciplinary course, designed for both humanities and science students, its emphasis will be on the "history" side of history of science.

Objectives

By the end of the course, students should be able to identify critical features of the history of science from Antiquity to the late Early Modern era and explain their significance. Students should be able identify, describe, compare, and contrast the contributions, opinions, ideological commitments, and social and intellectual contexts of individuals and groups covered in this course. Students should be able to construct historical arguments, evaluate historical explanations, and properly situate historical actors and their scientific contributions in their respective contexts, and not from the perspective of modern science. In addition, students should be able to perform basic secondary-source research and orally argue for the significance of a specific development in the history of science.

Structure

Classes will last two hours with a brief break midway through. They will be divided into two “lectures”, in which distinct, yet related, historical developments will be discussed. For each lecture there are required readings, which serve to complement the lectures. Students are also required to attend one tutorial session per week, in which the readings will be discussed.

Evaluation

15% Tutorials

60% Tests: 20% – Mid-term test
40% – Final exam

25% Final Group Project: 10% – Progress report
15% – In-tutorial group debate

Tutorials (15% total)

There are five tutorial sessions for this course – see the first page of this syllabus for their times and locations. Students are obliged to sign up for (and subsequently attend) tutorials. Attendance will be taken. Grades will be awarded on the basis of student participation.

Final Group Project (25% total)

Students will be expected to participate in a group debate, in which teams of three students orally argue for the historical significance of a particular development in the history of science. Groups will be assigned during the second week tutorial sessions and the debates will be held during the final week’s tutorial sessions. In addition, a progress report will be required of each group. Due to the time requirements, students may have to debate in a tutorial session that they do not normally attend. Further information regarding this project will be uploaded to Blackboard.

Tests (60% total)

The mid-term test will be held in-class on Tuesday July 23 and the final exam will be held sometime between August 13-16 (exact date and time to be announced). The mid-term test will last one hour and the final exam will last two hours. The final test will be cumulative. No “study aids”, “cheat sheets”, or external sources of information are allowed for either test. To achieve a high grade on these tests students should be able to demonstrate a solid grasp of the information covered in the course, be able to situate developments in the history of science in their various contexts, and consider certain developments’ historical significance.

Course Texts

The required textbook for this class is Peter Dear's *Revolutionizing the Sciences: European Knowledge and Its Ambitions, 1500-1700*. Second edition textbooks are available in the bookstore, but first edition textbooks are also permitted. Students are encouraged to consider using a previously owned textbook.

Additional required readings will be uploaded to Blackboard.

Several particularly useful books have been put on course reserve at Gerstein library:

- Dear, Peter. *Revolutionizing the Sciences: European Knowledge and Its Ambitions, 1500-1700*. 2nd Edition. Princeton: Princeton University Press. 2009.
- Harrison, Numbers, and Shank (Eds). *Wrestling with Nature: From Omens to Science*. Chicago: University of Chicago Press. 2011.
- Hellyer, Marcus (Ed.) *The Scientific Revolution*. Malden, MA: Blackwell. 2003.
- Henry, John. Henry, John. *The Scientific Revolution and the Origins of Modern Science*. 3rd Ed. Basingstoke: Palgrave Macmillan. 2008.
- Lindberg, David C. *The Beginnings of Western Science: The European Scientific Tradition in Philosophical, Religious, and Institutional Context, prehistory to A.D. 1450*. 2nd ed. Chicago: University of Chicago Press. 2007.
- Shapin, Stephen. *The Scientific Revolution*. Chicago: University of Chicago Press. 1996.
- *The Cambridge History of Science*. Lindberg, David C. and Numbers, Ronald L (series Eds). Volume 3: Early Modern Science. Park and Daston (Eds.) 2006.

Extra-Curricular Resources

Students are encouraged to consult the following extra-curricular resources:

- University of Toronto Writing Centres – <http://www.writing.utoronto.ca/writing-centres/learning>
 - All assignments and tests are to be written in proper English. If you have any questions as to what constitutes proper English, or if English is not your native language, consider seeing one of the Writing Centres on campus.
 - You can book an appointment with one of our writing centres online here: <https://awc2.wdw.utoronto.ca/awc-login/>
- Accessibility Services – <http://www.accessibility.utoronto.ca>
 - If you have (or think you have) a disability (learning or otherwise), or an accessibility issue for this course, please see Accessibility Services (the sooner the better). Also, please let your course instructor and TA know early on in the course so they can accommodate your needs.
- Sustainability Office – <http://sustainability.utoronto.ca>
 - HPS 210 is a Certified Green Course. On the Sustainability Office's website you can find helpful hints on how we can help produce a sustainable culture within higher education.
- Health and Wellness – <http://healthandwellness.utoronto.ca/>
 - This link contains information about Student Health Services, as well as Counseling and Psychological Services.

COURSE POLICIES

- **Email:** Please send all emails to the course email, hps210h1@utoronto.ca.

Student inquiries via email will usually be responded to within 48 hours. All students *must* have a valid and working UTOR email. **This is university policy.** E-mails sent through other providers will not be opened.

Emails asking for course material that is already posted on blackboard, additional information concerning the structure or content of exams, or assistance with assignments may go unanswered.

E-mails should be succinct, well-written, and of a proper tone. Please keep all emails short and to the point – emails that are long and rambling, are incomprehensible, or contain inappropriate or offensive language may not be responded to.

- **Blackboard:** Access to blackboard is required for this course, as lecture slides and other material will be posted there. You can access Blackboard here: <https://portal.utoronto.ca>.

Lecture slides will only be posted online in PDF format *after* the lecture.

- **Submitting Assignments, Late Penalties, and Illness:** All assignments must be submitted electronically to the course email (hps210h1@utoronto.ca) – no exceptions! Assignments are due at the end of the day. Late assignments will be docked at the rate of 10% per day (including weekends).

The only permissible excuse for missed tutorials, exams, or other evaluated components are situations that are entirely beyond your control. **All reported illnesses must be accompanied by an official University of Toronto student medical certificate.**

- **Academic Honesty: DO NOT PLAGIARIZE.** Plagiarism is a serious academic offense and often results in a failing grade, severe academic sanctions, and permanent expulsion from the University. If you are unclear as to what constitutes plagiarism, ask your instructor or TA.

Ignorance of what constitutes plagiarism is no excuse. Don't expect to win any arguments by claiming that "you didn't know" that what you were doing wasn't allowed. **Students are responsible for familiarizing themselves with the University of Toronto's plagiarism policy**, which can be found here: www.governingcouncil.utoronto.ca/policies/behaveac.htm.

For more information, see: www.writing.utoronto.ca/advice/using-sources/how-not-to-plagiarize.

- **Class Etiquette:** Please be on time! If you're going to arrive late, please sit in the ends of rows as to not disturb the class in progress. Everyone who is on time, please leave the ends of rows open as to accommodate latecomers.
- **Environmental:** HPS 210 is a certified Green Course, so please try to reduce paper consumption by reducing and reusing paper.



COURSE SCHEDULE

Tuesday, July 2 – INTRODUCTION TO THE HISTORY OF SCIENCE

Lecture 1 – Introduction: Course overview and “science in context”

Readings: Lindberg. *Beginnings of Western Science*. “What is Science?”. pp. 1-3.
Dear. *Revolutionizing the Sciences*. “Introduction”. pp. 1-9.

Lecture 2 – Aristotle and his Natural Philosophy

Reading: Lindberg. *Beginnings*. Ch. 3: “Aristotle’s Philosophy of Nature”. pp. 45-66.

Thursday, July 4 – THE EARLY FOUNDATIONS OF NATURAL PHILOSOPHY

Lecture 3 – Natural knowledge in the Classical World and Late Antiquity

Readings: Lindberg. *Beginnings*. Ch. 4: “Hellenistic Natural Philosophy”. pp. 67-81.
Lindberg. *Beginnings*. Ch. 6: “Greek and Roman Medicine”. pp. 111-131.

Lecture 4 – Christianity and Natural Philosophy from the End of Antiquity to the Early Middle Ages

Reading: Lindberg. “Science and the Early Christian Church”. *Isis*. Vol. 74. 1983. pp. 509-530.

Tuesday, July 9 – ISLAMIC OPTICS AND ALCHEMY

Lecture 5 – Science in the Medieval Islamic World

Readings: Gutas. *Greek Thought, Arabic Culture*. Ch. 5: “Translation in the Service of Applied and Theoretical Knowledge”. 1998. pp. 107-120.
Lindberg. “Alkindi's Critique of Euclid’s Theory of Vision”. *Isis*. Vo. 62. 1971. Pp. 469-489.

Lecture 6 – Alchemy from Antiquity to the High Middle Ages

Reading: Principe. *The Secrets of Alchemy*. Ch. 2: “Development: Arabic *al-Kīmyā*”. 2012. pp. 27-50.

Thursday, July 11 – Natural Philosophy from High Middle Ages to the Renaissance

Lecture 7 – Scholasticism and Philosophy in the High Middle Ages

Reading: Shank. “Natural Knowledge in the Latin Middle Ages”. In *Wrestling with Nature*. pp. 83-115.

Lecture 8 – Renaissance Humanism: Revival and Revision

Readings: Dear. *Revolutionizing*. Ch. 1: “‘What was Worth Knowing’ in 1500”. pp. 10-28.
Dear. *Revolutionizing*. Ch. 2: “Humanism and Ancient Wisdom: How to Learn Things in the 16th C”. pp. 29-56.

Tuesday, July 16 – ASTRONOMY AND ASTROLOGY FROM ANTIQUITY TO KEPLER

Lecture 9 – Astronomy and Astrology from Antiquity to Copernicus

Readings: Cohen and Drabkin. *A Source Book in Greek Science*. "Hypotheses of Ptolemaic Astronomy". 1948. pp. 122-130.
Thorndike. "The True Place of Astrology in the History of Science". *Isis*. 1955. Vol. 46. pp. 239-244.

Lecture 10 – The New Astronomy: Tycho Brahe and Johannes Kepler

Reading: Thoren. "Tycho Brahe". In *Planetary Astronomy from the Renaissance to the Rise of Astrophysics: Part A: Tycho Brahe to Newton*. 2003. pp. 3-21.

Thursday, July 18 – GALILEO AND INSTRUMENTATION

Lecture 11 – The New Physics: Galileo, his Profession and his Contributions

Reading: Dear. *Revolutionizing*. Ch. 4: "Mathematics Challenges Philosophy". pp. 64-78.

Lecture 12 – Telescopes and Microscopes, Observing and Communicating

Readings: Van Helden. "Galileo, telescopic astronomy, and the Copernican system". In *Planetary Astronomy*. pp. 81-105.
Neri. "Between Observation and Image: Representations of Insects in Robert Hooke's *Micrographia*." In *The Art of Natural History*. pp. 82-107.

***** Group project progress report due by midnight, Monday July 22*****

Tuesday, July 23 – MID-TERM TEST AND NATURAL HISTORY

Lecture 13 – In-class MID-TERM TEST (1 hour)

Lecture 14 – Guest Lecture (Chris Belanger) – Natural History

Reading: Harrison. "Natural History". In *Wrestling with Nature*". pp. 117-148.

Thursday, July 25 – CHYMISTRY AND MEDICINE

Lecture 15 – Guest Lecture (Paul Greenham) – Chymistry in Early Modern Europe

Readings: Newman. "Boyle's Debt to Corpuscular Alchemy". In *Robert Boyle Reconsidered*. 2003. pp. 107-118.
Newman. "What have we learned from the recent historiography of alchemy?". *Isis*. 2011. Vol. 102. pp. 313-321.

Lecture 16 – Guest Lecture (Adam Richter) – Medicine in Early Modern Europe

Readings: Gentilcore. "Medical Pluralism in the Kingdom of Naples". In *Healers and Healing in Early Modern Italy*. 1998. pp. 1-25.
Waddington. "Anatomy and Medicine". In *Introduction to the Social History of Medicine*. 2011. pp. 98-108.

***** Monday July 29 is the final day to drop this course without incurring an academic penalty *****

Tuesday, July 30 – THE AIMS OF KNOWLEDGE IN THE EARLY MODERN WORLD

Lecture 17 – Useful Knowledge: Natural Magic and Francis Bacon

Reading: Dear. *Revolutionizing*. Ch. 3: “The Alchemist, the Craftsman, and the Scholar”. pp. 47-63.
Henry. *Scientific Revolution*. Ch. 4: “Magic and the Origins of Modern Science”. pp. 56-68.

Lecture 18 – Jesuits, the Church, and the Religious Importance of Mathematics

Reading: Caruana. The Jesuits and the Quiet Side of the Scientific Revolution. In *The Cambridge Companion to The Jesuits*. 2008. pp. 243-260.

Thursday, August 1 – NEW DIRECTIONS IN NATURAL PHILOSOPHY

Lecture 19 – Mechanism and Cartesian Mechanical Philosophy

Readings: Dear. *Revolutionizing*. Ch. 5: “Mechanism and Corpuscles”. pp. 79-98.
Osler. *Reconfiguring the World*. Ch. 4. pp. 77-93.

Lecture 20 – Learned Societies and the Politics of Experience

Readings: Dear. *Revolutionizing*. Ch. 6: “Extra-Curricular Activities”. pp. 99-126.
Dear. *Revolutionizing*. Ch. 7: “Experiment”. pp. 127-144.

Tuesday, August 6 – NEWTON AND NEWTONIANISM

Lecture 21 – Isaac Newton: The Man and his Work

Reading: Dear. *Revolutionizing*. Ch. 8: “Cartesians and Newtonians”. pp. 145-163.

Lecture 22 – Newtonianism and the Enlightenment

Readings: Feingold. “The Voltaire Effect” and “Newtonian Women”. In *The Newtonian Moment: Isaac Newton and the Making of Modern Culture*. 2004. pp. 94-141.

Thursday, August 8 – HOW TO THINK ABOUT THE HISTORY OF SCIENCE

Lecture 23 – Science in Context: Re-Thinking the History of Science

Reading: Dear. *Revolutionizing*. Ch. 8: “Conclusion”. pp. 164-166.

Lecture 24 – Wrap-up and in-class mega-tutorial

No readings

FINAL EXAM: to be determined (sometime between August 13-16)

- Exact exam date will be announced as soon as it’s known
- 2 hours, cumulative
- No cheat sheets, study aids, etc. allowed