Spring 2012
Dr. Patrick Dennis
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Office: JO 3.926
Office Hours: Tues. 4:30-5:30pm
Fri. by appointment

HIST 3328.501
History and Philosophy of Science: Perspectives
Thursdays, 5:30-8:15pm
FN 2.106

Prerequisites

HIST 1301, HIST 1302, HIST 2301, HIST 2330, HIST 2331, or equivalent, as well as enrollment in the UTeach program. This course is designed specifically for those students training to be elementary and secondary science and mathematics teachers through the UTeach program, and (space permitting) other students interested in the interdisciplinary relations between the sciences and the humanities, such as pre-health majors and those pursuing the minor in Medical and Scientific Humanities (MaSH). **This course counts toward the Minor in Medical and Scientific Humanities (MaSH).**

Course Description

Where did science come from? How did human beings begin to make sense of the natural world and their part in it? How has science evolved? How are the same processes of imagination, invention, and discovery still at work today in shaping our understanding of natural phenomena? What roles have those from diverse epistemological backgrounds played in the evolution of science?

In this interdisciplinary history course, we will ask such questions (and more) as we read and discuss works in the history and philosophy of science and mathematics, primary texts in natural philosophy, as well as scientific biography and literature. We will trace the origins and development of Western science and its construction of natural knowledge from the ancient world through to the near present. From philosophical, scientific, and literary points of view, we will explore whether there was any such thing as the "Scientific Revolution," and if so, how the "revolutionary" changes in world views influenced human life on social and political levels. How do scientific ideas and technological developments continue to exercise influence in the world today?

The central inquiries of this class will focus on the following questions: What is "nature"? What does it mean to say something is "natural"? What is "supernatural"? How have our definitions of such concepts changed over time? Do we "discover" order in the universe or do we "invent" it? How have the relationships between (and relative values and roles of) imagination, faith and reason shifted from the ancient world through the early modern period into the present day, and with what consequences?

Class meetings will include lecture, discussion, films, and student presentations as we examine developments in magic and alchemy, astronomy and cosmology, natural history, the history of medicine, the history of mathematics, and experimental science. NO technical or specific scientific background is required.

Course Objectives

Students will read and discuss a wide variety of literary, philosophical, and historical texts, demonstrating the ability to interpret and analyze themes and issues using various critical methods, including formal, historical, biographical, and cultural approaches. Students will write a film critique, an analytical/interpretative paper, a lesson plan, as well as make in-class presentations.

NOTE: All student papers and presentations will be expected ***to connect*** *the historical and literary "perspectives" presented in class* ***to*** *modern (18th century to contemporary) developments in science.* ***All students*** *will write a* ***two-page film critique*** *and a*

three-page interpretative/analytical essay *over a relevant scientific auto/biography, work of "literary science," or work in the history of science, medicine, or mathematics. The three-page analytical essay will be graded as the take-home essay portion of the final exam. In addition,* ***UTeach students*** *will create lesson plans and in-class presentations ("mini-lessons") that draw upon the historical and cultural information found in their selected text and paper.*

Required Texts (Literature and Science)

Christopher Marlowe, *Doctor Faustus*
Brian Baigrie, *Scientific Revolutions: Primary Texts in the History of Science* (selections)
Philip Appleman, ed., *Darwin* (selections)
Richard Feynman, *Surely You're Joking Mr. Feynman*

Required Texts (History and Philosophy of Science)

Ian Hacking, *Representing and Intervening*
David C. Lindberg, *The Beginnings of Western Science* (second or third edition)
Michael Crowe, *Theories of the World: From Antiquity to the Copernican Revolution* (selections)
Thomas Kuhn, *The Structure of Scientific Revolutions*
Ivor Guinness, *The Rainbow of Mathematics* (selections)

Electronic Reserve (and 2 hr. Reserve)

Thomas Hankins, *Science and the Enlightenment* (selections)
The Day the World Changed (DVD)
Galileo's Battle for the Heavens (DVD)

Additional Required Text

This text will be the subject of the three-page take-home essay (and, for UTeach students, the lesson plan and in-class presentation). All students **must** select from one of the three categories below. You may also substitute another choice, with the professor's prior approval.

Biography/Autobiography	"Literary" Science	History of Science/Medicine/Mathematics
Dava Sobel, *Galileo's Daughter*	Jonathan Swift, *Gulliver's Travels*	Lisa Jardine, *Ingenious Pursuits*
Dennis Overbye, *Einstein in Love*	Neal Stephenson, *Quicksilver*	Dava Sobel, *Longitude*
James Gleick, *Isaac Newton*	Galileo, *Sidereus Nuncius*	Robyn Arianrhod, *Einstein's Heroes*
James Gleick, *Genius: The Life and Science of Richard Feynman*	Mary Shelley, *Frankenstein*	James Gleick, *Faster*
Walter Isaacson, *Einstein*	H.G. Wells, *The Time Machine*	Richard Holmes, *The Age of Wonder*
Pietro Redondi, *Galileo: Heretic*	H.G. Wells, *The Island of Dr. Moreau*	Simon Singh, *Big Bang*
Alan W. Hirshfeld, *The Electric Life of Michael Faraday*	Fontenelle, *Conversations on the Plurality of Worlds*	Owen Gingrich, *The Book Nobody Read*
Dava Sobel, *A More Perfect Heaven*	Poems: Crowe & Butler, Crowe & Thomson	Richard Feynman, *QED*
James A. Connor, *Kepler's Witch*	Edwin Abbott, *Flatland*	Edward Dolnick, *The Clockwork Universe*
Keith Devlin, *The Man of Numbers*	Margaret Cavendish, *The Blazing World*	Stuart Clark, *The Sun Kings*

<u>Grading/Course Requirements</u>: UTeach students will complete 1-4 (with each counting 25%); all other students will complete items 1-3 (each of which count as 1/3 of overall course grade).

1. Attendance/Participation [in-class participation, two-page film critique, quizzes, peer review comments]
2. Midterm Exam (Unit 1): in-class essay (25 points) + objective section (75 points)
3. Final Exam (Unit 2): three-page analytical essay (30 points) + objective section (70 points)

UTeach Students Only

4. Presentation (10 min.) and Lesson Plan (due on the day of the presentation) → average of two grades = 25% of overall course grade.

<u>COURSE CALENDAR</u>

The overall course has been divided into two units, with one exam for each unit (midterm – Unit 1; final – Unit 2):

UNIT 1: Ancient and Medieval Worldviews: Laying the Foundations of Modern Science.

UNIT 2: The "Mechanical" Worldview: The Development of Science in the post-Copernican world.

Most classes will be divided into two 75-minute sections, "a" and "b" (with a 10-15 minutes break).

"Background Reading" is intended to provide you with supplementary perspectives and contexts that will enrich your understanding of information mentioned in lecture and other required texts. While we will not often have time to discuss the background reading directly, you are always welcome to ask questions about the background reading as part of the lecture discussions. As the background is "testable" information, you should take notes and study/review the information in preparation for your papers, presentations, quizzes, and exams.

UNIT 1: Ancient and Medieval Worldviews: Laying the Foundations of Modern Science

<u>Week 1 (19 January)</u>:

a. Introduction to the Course (Structure, Expectations, Definitions); Go over the syllabus and take roll. Preliminary Questions (What is science? What is the History of Science? What is meant by the Philosophy of Science?) (approx. 1 hour, 15 minutes)

b. Lecture: "Pre-Greek Mathematical and Scientific Thought" (approx. 1 hour, 15 minutes)

Background Reading: Lindberg, *Beginnings of Western Science* (pp.1-20) – "Science before the Greeks"
Crowe, *Theories of the World* (pp.197-219) – Archaeoastronomy, Stonehenge

<u>Week 2 (26 January)</u>:

a. Discuss expectations and tips for Essays/Lesson Plans/Presentations (approx. 20 minutes)
Lecture (begin): "Natural Philosophy and Cosmology in the Ancient Greek World" (approx. 55 minutes)

b. Lecture (finish); "Mathematics in the Ancient Greek World" (approx. 1 hour, 15 minutes)

Background Reading: Lindberg, "The Greeks and the Cosmos" (pp.21-44)
"Aristotle's Philosophy of Nature" (pp.45-66)
"Hellenistic Natural Philosophy" (pp.67-81)
Crowe, Chapter 2: "Greek Astronomy before Ptolemy"
Chapter 4: "The Ptolemaic System"

Week 3 (2 February):

a. Quiz – Greek Science (approx. 15 minutes)
   Lecture: "Science, Mathematics, and the Revival of Learning in the Latin West" (60 minutes)

b. Video: "In Light of the Above: Medieval Conflict: Faith and Reason" and discussion (1 hour, 15 minutes)

Background Reading: Lindberg, "Revival of Learning in the West" (pp.193-224)
"Recovery and Assimilation of Greek and Islamic Science" (pp.225-253)
Grattan- Guinness, "A quiet millennium: from the early Middle Ages into the European Renaissance" (pp.104-138)

Week 4 (9 February):

a. Introduction to Alchemy and Magical Thought (approx. 40 minutes)
   Discuss reading: Christopher Marlowe, *Doctor Faustus* (whole play) (approx. 50 minutes)

b. STUDENT PRESENTATIONS (approx. 1 hour)

   1. _____

   2. _____

   3. _____

Week 5 (16 February):

a. Lecture: Ancient and Medieval Medical Thought (approx. 45 minutes)
   Discuss Vesalius and Paracelsus (Baigrie, pp.40-55) and Harvey (Baigrie, pp.71-87) (approx. 45 minutes)

b. STUDENT PRESENTATIONS (approx. 1 hour)

   4. _____

   5. _____

   6. _____

REMINDER: Be sure to view the film, "Galileo's Battle for the Heavens" (NOVA, 120 minutes) either this week or next week. The film is downloadable and on Reserve at the Library. Two-page film critique is due on 1 March.

Week 6 (23 February):

a. Lecture: "Questioning the Scientific Revolution" (approx. 50 minutes)
   Discuss Kuhn, *The Structure of Scientific Revolutions* (Chapter 3, Chapter 9, Chapter 10) (approx. 40 minutes)

b. STUDENT PRESENTATIONS (approx. 1 hour)

   7. _____

   8. _____

   9. _____

Background Reading: Lindberg, "The Legacy of Ancient and Medieval Science" (pp.357-367)
Copernicus (Baigrie, pp.16-39)

Week 7 (1 March): Two-page film critique due at the beginning of class!

a. Quiz – Medieval Science (approx. 30 minutes)
Lecture: "The 'New' Astronomy and Physics of Brahe, Galileo, Kepler, and Gilbert (approx. 45 minutes)

b. STUDENT PRESENTATIONS (approx. 1 hour)

10. _____

11. _____

12. _____

Go over the structure and content of the Midterm Examination (approx. 15 minutes)

Background Reading: Tycho Brahe (Baigrie, pp.56-61)
Galileo (Baigrie, pp.88-98)
Crowe, Chapter 7: "The Tychonic System" (pp.136-145)
Chapter 8: "Kepler" (pp.146-155)
Chapter 9: "Galileo" (pp.156-172)

Week 8 (8 March):

MIDTERM EXAMINATION (2 hours, 30 minutes)
In-Class Essay (25 points)
Objective Section (75 points)

Week 9 (15 March):

SPRING BREAK – NO CLASS

UNIT 2: The "Mechanical" Worldview: The Development of Science in the post-Copernican world

Week 10 (22 March):

a. Lecture: "The Newtonian Achievement: From Descartes to Newton"
Discuss Gleick, *Isaac Newton* (all)

b. STUDENT PRESENTATIONS (approx. 1 hour)

13. _____

14. _____

15. _____

Background Reading: Descartes (Baigrie, pp.99-107)
Newton (Baigrie, pp.133-150)

Week 11 (29 March):

a. Lecture: "Post-Newtonian Astronomy and Cosmology" (approx. 45 minutes)
Discuss Herschel and Mitchell (Baigrie, pp.175-188)
Hankins, Chapter 1 (pp.1-16) (approx. 45 minutes)

b. STUDENT PRESENTATIONS (approx. 1 hour)

16. _____

17. _____

18. _____

Week 12 (5 April):

a. Lecture: "Natural History and Darwin" (approx. 40 minutes)
Discuss Darwin, *Origin of Species* and *Descent of Man* (pp.3-20; 87-94; 95-135; 175-213; 243-254) (approx. 40 minutes)

b. STUDENT PRESENTATIONS (approx. 1 hour, 10 minutes)

19. _____

20. _____

21. _____

22. _____

Background Reading: Linnaeus (Baigrie, 151-156)
Cuvier (Baigrie, 239-246)

Week 13 (12 April):

a. Video: "Fit to Rule: Darwin's Revolution" (approx. 1 hour)

b. Student-Group led discussion of the film (approx. 30 minutes)

GROUP LEADERS:

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Lecture: "The Social Impact of Darwinism: Its Representations in the Literature of the Nineteenth Century" (approx. 1 hour)

REMINDER: Three-page analytical essay due next week (at the beginning of class)!

<u>Week 14 (19 April)</u>: THREE-PAGE ANALYTICAL ESSAY due at the beginning of class!

a. Lecture: The Experience of Experiment in the Biological and Physical Sciences (approx. 35 minutes)
Discuss Hacking, *Representing and Intervening* (all) (approx. 40 minutes)

b. STUDENT PRESENTATIONS (approx. 1 hour, 15 minutes)

23. _____

24. _____

25. _____

26. _____

<u>Week 15 (26 April)</u>:

a. Lecture: "Nineteenth- and Twentieth-Century Physics: Re-envisioning the World" (approx. 1 hour)

b. Video: "Making Waves: The New Physics, Newton Revised" (approx. 1 hour)
Student-group led discussion of film (approx. 30 minutes)

GROUP LEADERS:

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<u>Week 16 (3 May)</u>:

a. Student-group led discussion of *Surely You're Joking Mr. Feynman* (approx. 30 minutes)

GROUP LEADERS:

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Video: *Greatest Mind Since Einstein* (approx. 1 hour)

b. Discuss video (approx. 30 minutes)
Discuss structure and content of Final Examination; fill out evaluations (approx. 30 minutes)

Week 17 (10 May):

FINAL EXAMINATION (2 hours)

Three-page Analytical Essay (30 points) – handed in on 19 April.

Objective Section (70 points)

*** This schedule is tentative and is subject to change at the professor's discretion. Any changes made to the schedule will be announced in class as earlier as possible. ***

Course & Instructor Policies

Students are responsible for turning in assignments on the dates indicated on the syllabus; in addition, students are expected to take exams on the specified dates. Please inform the professor *in advance* (via UTD email) of any possible absences or situations that may keep you from submitting assignments on time. I will only grant a make-up exam in the case of a medical emergency documented by the original copy of a doctor's note. No copies will be accepted.

Before turning in assignments, a student's paper must be stapled, in 12-pt. font (not courier), and with page numbers. If any of these requirements are not met, I will not accept the assignment.

For information on the policies of the university regarding Academic Integrity, Scholastic Discipline, et al., please visit the following website:

http://go.utdallas.edu/syllabus-policies

Additional Recommended Texts for Essays and Presentations
HIST 3328

History of Ancient and Medieval Science, Medicine, and Mathematics

1. David C. Lindberg, *The Beginnings of Western Science*
2. Edward Grant, *A History of Natural Philosophy*
3. Edward Grant, *The Foundations of Modern Science in the Middle Ages*
4. Edward Grant, *Physical Science in the Middle Ages*
5. A.C. Crombie, *Medieval and Early Modern Science,* 2 vols.
6. A.C. Crombie, *The History of Science from Augustine to Galileo*
7. A.C. Crombie, *Robert Grosseteste and the Origins of Experimental Science*
8. Ivor Grattan-Guinness, *The History of the Mathematical Sciences*

Scientific Revolution/Copernicus/Tycho Brahe/Kepler

1. John Banville, *Doctor Copernicus* (biographical novel)
2. Peter Dear, *Revolutionizing the Sciences*: *European Knowledge and Its Ambitions, 1500-1700*
3. John Henry, *The Scientific Revolution and the Origins of Modern Science*
4. I. Bernard Cohen, *The Birth of a New Physics*
5. James Voelkel, *Johannes Kepler and the New Astronomy*
6. Richard Westfall, *The Construction of Modern Science*
7. Timothy Ferris, *Coming of Age in the Milky Way*
8. Thomas Kuhn, *The Copernican Revolution*

Science and Religion

1. David C. Lindberg and Ronald Numbers, eds., *God and Nature*
2. Richard Westfall, *Science and Religion in the 17th Century*
3. John Brooke, *Science and Religion*

Isaac Newton

1. Richard Westfall, *Never at Rest: A Biography of Isaac Newton*
2. Richard Westfall, *Newton: The Life of Isaac Newton: Abridged.*
3. Betty Jo Teeter Dobbs, *Newton and the Culture of Newtonianism*

Experimental Science/Philosophy of Science

1. Shapin and Shaffer, *Leviathan and the Air Pump*
2. J.L. Heilbron, *Electricity in the 17th and 18th Century: A Study of Early Modern Physics*
3. Bruno Latour, *Laboratory Life*
4. Paul Feyerabend, *Against Method*
5. J.A. Cover and Martin Curd, *Philosophy of Science*: *The Central Issues*

Literature of Science

1. Ben Jonson, *The Alchemist*
2. Umberto Eco, *The Island of the Day Before*
3. Marjorie Nicolson, *Science and Imagination*
4. Aphra Behn, *Emperor of the Moon*