

HPS 154 · PHIL 163H
The History of Scientific Methods, Pythagoras to Popper

Fall 2010 · Room 200-032
Wednesdays 3:15pm-5:05pm

Dr. John P. McCaskey
mailbox@johnmccaskey.com

SYLLABUS
(as of August 13, 2010)

History of scientific methods and associated science from ancient Greece to the 20th century. Case studies include Pythagoras, Plato, and Euclid; Aristotle; medieval science; scientific Renaissance of the 1540s; methodological clashes involving the Church, Galileo, Bacon, and Descartes; Newton; Faraday; Darwin; rise of statistical methods; beginnings of modern physics; Popper. The mutual influences of method and practice. What does and does not qualify as science. Recommended: background in history, philosophy, or a technical field such as mathematics, science, or engineering.

How do scientists know what they know—or claim to know? It's an important question, not just for scientists themselves, but for any of us who drive on bridges, accept doctor's prescriptions, or are encouraged to change our lifestyles because of global warming. Science and its products pervade our personal, political, institutional, and cultural lives. We need to know where it comes from and whether it is reliable.

How do scientists know what they know? Well, we might say, they use the "scientific method." But, alas, there are now and have long been vigorous disagreements over exactly what a proper scientific method is. Scientific debates often come down to disagreements over method, and the results of the debates can be deadly. Millions of people have died from crackpot science, teachers have been condemned for teaching science developed with unauthorized methods, and scientists have been jailed and put to death for using particular methods.

The science that results from different methods can be vastly different, and great advances—and great declines—in science often result from a change in method. Reciprocally, reactions to particular scientific developments can greatly influence the methods other scientists use. To learn about how scientists know what they know, we will look at this interplay between science and scientific methods from Ancient Greece to modern times.

We will examine debates that began in ancient Greece about the nature of certainty. We will face an age-old question whether scientists must be content to accurately describe what they observe or can also be justified in claiming to know how things really are. We will examine conflicts between independent judgment and religious dogma. We will meet Pythagoras, Euclid, Plato, Aristotle, Ockham, Galileo, Descartes, Newton, Darwin, Heisenberg, and others. We will meet great scientists, great philosophers of method, and some who were both.

Primary sources will be the core of our study. Secondary courses will supplement. That is, for example, we will rely most heavily on our own reading of Aristotle or Galileo or Darwin than on what some modern commentator says about them. Though many of the works we'll read were written in another

language, we will use English translations. Nonetheless, we will occasionally face the problems that arise with translations. If you happen to know a little of another language (especially Latin or a Romance language) you may get the chance to use it.

When we finish, you will have an understanding of the different ways scientists have tried to explain nature and the implications of those attempts—both for them and for us.

Course grade

Your course grade will be based as follows on class participation, three papers, each 900–1100 words long, and one short quiz given during the final class.

35%	Class participation
15%	Paper #1
20%	Paper #2
25%	Paper #3
5%	A short quiz on the last day of class. Actually, it's against the rules for me give a quiz on the last day of class, but once you see what it is, I think you'll prefer I give it then than during exam week.

There is no final exam (unless you'd rather the quiz then).

The topics for the papers will be mutually agreed upon. Throughout our classroom discussions, I will note good paper topics as they come up.

Grades

I have no reservation about giving all As. I have no reservation about giving Bs, Cs, and Ds. In a small seminar class, as this one is, I am fully capable of finding enough time and energy to help any student excel who wants to. The concepts in this course are not difficult. Wide and deep prior knowledge is not required. The reading can be heavy, and I demand critical thinking and clear presentation, but any Stanford student interested in history, philosophy, or science, willing to budget the time, and committed to coming to every class prepared can do well in this course.

Class participation

When I say that 35% of your grade is for class participation, I'm serious. I do not mean class attendance, I mean class active participation. If you write all A papers but never engage in the class discussion, you could get a C for the course. Moreover, when I say class participation, I mean quality, not quantity. You do not need to be a pushy big-mouth. You can be reserved and naturally quiet. But you need to show me you have read and thought about the assignments, and you must be ready to engage in scholarly discussion with me and your classmates. I will make sure everyone has the opportunity to do so.

Workload and Pace

In our ten weeks, we won't really get through everything on the syllabus. I'll have to cut something out, but I don't want to decide what until I see what students are interested in. Nonetheless, there will be a lot of reading. Fortunately not all the material needs to be read with equal care, and I'll give you hints along the way on how best to manage it.

The three papers are not long and do not require extensive outside research. The final quiz is easy. The workload will ramp up quickly and stay moderate to heavy for several weeks. Weeks 3, 4 and 5 can be tough (though also some of the most fun). Plan accordingly.

We meet only once a week. That leaves you a lot time for reading. We meet on Wednesdays. Do *not* wait until Monday to start on a week's reading. If you do, you will not have enough time to finish all the material, reflect on it, and prepare for the class discussion.

Plagiarism

Until I had a student turn in a paper that was copied nearly verbatim from an old journal article, I never thought I'd see a case of plagiarism at Stanford University. But now that I have, let all be forewarned. Some professors prefer to handle cases of plagiarism themselves, exercising their own discretion, and working the matter out with the student one on one. I don't. I prefer to utilize the procedures administered by Stanford's Office of Judicial Affairs. It eliminates any arbitrariness by the professor, and it places decision-making authority in the hands of a panel composed primarily of fellow students.

And therein lies the warning: In cases of honest ignorance, there is nothing to fear, but in unambiguous and blatantly intentional cases of plagiarism, a panel of students judging other students can be flat-out merciless.

For info on plagiarism, see www.stanford.edu/dept/vpsa/judicialaffairs/students/plagiarism.sources.htm. For sample cases, see www.stanford.edu/dept/vpsa/judicialaffairs/judicialprocess/samplecases.htm. (Note the frequency of the phrase "one-quarter suspension.") For any questions, ask me.

Required Texts

We have a lot of material to read, but I've tried to keep costs down with on-line resources, public domain texts, and course reader excerpts.

You'll need to get these two at the bookstore:

- *HPS 154 / PHIL 163H Course Reader*.
- *Faraday's Experimental Researches in Electricity: The First Series*, edited and annotated by Howard J. Fisher (Green Cat Books/Green Lion Press, 2004.) This is the thin, 84-page 2004 book for about \$9, not the 619-page 2001 book with a similar title for \$35. You won't save money buying it online and you won't find used copies around, so you might as well buy it at the bookstore.

For the rest, the bookstore will have copies, but you may save money by shopping around for used copies or alternate editions. We need the first soon, so if you're shopping online, hurry. For the others, you'll have more time.

- Charles Freeman, *The Closing of the Western Mind*. We only need 23 pages of this, but it's not available in excerpts, so you'll have to borrow or buy the whole book. Fortunately, because it's been quite popular recently, you'll be able to find cheap copies. You can find used copies online for under \$8.
- Francis Bacon, *Novum Organum* (sometimes printed as *New Organon* or *Instauratio Magna*). There are several translations, many printings, and a few on-line editions of this. Any will do. A good on-line source is en.wikisource.org/wiki/Novum_Organum (edited by me!). A recent edition translated by Silverthorne and published by Cambridge is available online through Socrates. "Search everything" on "New Organon Silverthorne". A PDF is available at oll.libertyfund.org. Look under author Francis Bacon.
- Isaac Newton, *Principia*. The now standard scholarly translation is by Cohen and Whitman, but it costs over \$40 and has much we won't need. (Buy it if you plan to work more in history of science. Or if you'd get a kick out of working through some of Newton's math, get *Newton's Principia: The Central Arguments*, by Dana Densmore.) The only other full English translation was made by Andrew Motte in 1729 and revised by Florian Cajori in 1934. It has problems, but for us, it will do. You can get it in inexpensive new or used editions in the Great Minds Series published by Prometheus Books or the On the Shoulders of Giants Series by Running Press

Books. Pages not in the Motte/Cajori translation that we need are in the *HPS 154 / PHIL 163H Course Reader*.

- Charles Darwin, *On the Origin of Species* (1859). There are many editions and printings of this, including some online (e.g., darwin-online.org.uk). Get the first, 1859, edition.
- Werner Heisenberg, *Physics and Philosophy*. Don't buy this yet. We might skip it. But if we don't, any edition will do. Used copies costing a few dollars are plentiful.
- Karl Popper, *The Logic of Scientific Discovery*, (Routledge, 2002). This edition, the second English edition, has been reprinted frequently since 1967. Any used copy after that is fine, but since used copies cost \$10-\$15 and you can get new ones for about the same price, you might as well buy a new one.
- Thomas Kuhn, *The Structure of Scientific Revolutions*. Don't buy this yet. In the past I've had students ask that we read it. We'll see what students want this time.

- And also: Strunk and White, *Elements of Style*. You must not leave Stanford without owning a copy of this book. Don't get the original 1918 one by Strunk alone; get one of the more recent Strunk and White editions.

Finally

I consider past student evaluations of my courses and the comments posted at courserank.stanford.edu, www.ratemyprofessors.com, www.johnmccaskey.com, etc. to be fair. If they are, you will find me supportive but demanding (especially in class engagement and in the quality of your writing), the readings thought-provoking, classroom meetings stimulating and fun, and the course overall rewarding and memorable. I'll do all I can to ensure you do.

Assignments.

This will change. There is more here than we can cover in ten weeks. I'll adjust as I learn students' interests.

Week 1 Mathematics: Pursuing Certainty by Deduction

Sept
22

Handout:

- Aristotle on Pythagoras, *Metaphysics* 1.5, 985b23–986a13.
- Plato on the ultimate constituents of creation, *Timaeus*, 52d–53d, 89c.
- Euclid's proof that the angles of a triangle add to 180° , *Elements*, bk. 1, prop. 32.

Week 2 Aristotelian Natural Philosophy: Pursuing Certainty by Induction

Sept
29

Read the following, in this order.

- Selections from Hippocratic writings
 - “On Ancient Medicine,” also known as “Tradition in Medicine,” in *HPS 154 / Phil 163H Course Reader*.
 - A sampling of your own choosing from “On Epidemics,” Book 1. Include some from the “Fourteen Cases” at the end of Book 1. You can find this all at <http://en.wikisource.org/wiki/Author:Hippocrates>.
- These selections from Aristotle, all in *HPS 154 / PHIL 163H Course Reader*. In the Irwin and Fine readings, an asterisk indicates a word included in the Irwin and Fine glossary. The necessary glossary pages are included in the course reader.
 - *Posterior Analytics* A 2 (on episteme).
 - *Posterior Analytics* A 13 (on fact vs. reasoned fact). Figure out what the two syllogisms are.
 - *Physics* II.3 (on four kinds of causes). Read <http://faculty.washington.edu/smcohen/320/4causes.htm>, especially the first half, if this topic of Aristotle's four causes is new to you.
 - Beginning of *History of Animals* II.15 (labeled chapter XI in Cresswell's edition) (on the esophagus).
 - *Parts of Animals* III.3 (on the esophagus and windpipe).
 - *Posterior Analytics* A 5 (on knowing triangles universally).

Physics and Astronomy: Realism vs. Instrumentalism

Read the following:

- David Lindberg, “The Mathematical Sciences in Antiquity,” *The Beginnings of Western Science*, pp. 89–105, 375–377, in *HPS 154 / PHIL 163H Course Reader*.
- Pierre Duhem, *To Save the Phenomena*, pp. 5–11, in *HPS 154 / PHIL 163H Course Reader*.

Week 3
Oct
6

FIRST PAPER DUE at the beginning of class.

- Before writing your paper, read or reread Chapter 2, “Elementary Principles of Composition,” in Strunk and White.

Canonical Science: Finding Certainty in Authority

Read the following:

- Charles Freeman, ““But what I wish, that must be the canon,”” *The Closing of the Western Mind*, ch. 12, pp. 178–201.
- Edward Grant, “The reception and impact of Aristotelian learning and the reaction of the Church and its theologians,” *The Foundations of Modern Science in the Middle Ages*, ch 5, pp. 70–85, in *HPS 154 / PHIL 163H Course Reader*.
- William of Ockham, “Do the elements remain in a mixed thing?” *Quodlibetal Questions*, Third Quodlibetal, Question 5, pp. 185–89, in *HPS 154 / PHIL 163H Course Reader*.

The 16th-Century Renaissance: The Role of Personally Verifiable Observation

- Read Bernardino Telesio, Prooemium to book 1 of *De Rerum Natura*, in *HPS 154 / PHIL 163H Course Reader*.
- The 1540s were a remarkable time in the history of science. Books of tremendous importance were published in about a half-dozen separate fields. Each student will pick a book, track it down in Stanford’s rare book collection, read selections from a modern translation if necessary, and then be prepared to discuss what was found. Authors include Copernicus, Fuchs, Vesalius and Agricola. (Maybe Leonardo, too, though he was a little earlier.)

Week 4
Oct
13

The 17th-Century Methodological Debate: Authority, Experimentation, Induction, and Deduction

The early seventeenth century witnessed several contentious debates over what was and was not the proper way to study nature. An author could have his books banned over this or even get himself burned at the stake. Galileo was forced to recant some of his scientific beliefs. Philosophers, scientists, politicians, and the pope all weighed in. We'll explore four views of science, those of Cardinal Bellarmine, Galileo, Francis Bacon, and Rene Descartes, and scientific works based on each. Read the following.

- Bellarmine's scientific method: "Cardinal Bellarmine to Foscarini, April 12, 1615," in *HPS 154 / PHIL 163H Course Reader*.
- Bellarmine's science: *Louvian Lectures of Bellarmine*, ed. Ugi Baldini and George V. Coyne, 8–22 (even) ; in *HPS 154 / PHIL 163H Course Reader*.
- Galileo's scientific method: "Galileo to Castelli (21 December 1613)," in *HPS 154 / PHIL 163H Course Reader*.
- Galileo's science: Selections from Galileo, *Dialogues Concerning Two New Sciences*, on equal speed of descent regardless of weight and on the inclined-plane experiment, pp. 65–75, 153–71 in Wall & Emerson, 2000 edition, in *HPS 154 / PHIL 163H Course Reader*.
- Bacon's scientific method: Francis Bacon, *Novum Organum*. "Proemium"; the "Plan of the Work" through the description of the second part of the work (about six pages); Book 1, Aphorisms 1–38.
- Bacon's science: *Novum Organum*, Book 2, Aphorisms 10–20 (you can skim most of this, but slow down to see what the three tables are, and pay attention to the beginning and end of Aphorism 20); *Sylva Sylvarum*, p. 1 in *HPS 154 / PHIL 163H Course Reader*.
- Outline of Rene Descartes, *Principia philosophiae* in *HPS 154 / PHIL 163H Course Reader*. There is no reason to read all of this book, but it is important to know its high-level outline and to get a sense of its scope. This chart will help. As you read through, as instructed below, see if you can figure out what the three shaded parts indicate.
- Descartes' scientific method: *Principia philosophiae*, Part 1. I'll email you a copy. Read the first few paragraphs slowly; then go quickly, reading the headings and just enough of the paragraphs to get a sense of Descartes' style of arguing; slow down at and carefully read paragraph 24; flip through the rest, slowing down to read paragraphs 30, 45, 75, 76.
- Descartes' science: Selections from *Principia philosophiae*, Parts 2, 3, and 4. Most is in the PDF I'll mail around; the rest is at <http://www.princeton.edu/~hos/mike/texts/descartes/desc-mot.html>. Read part 2, paragraph 1; then go quickly, reading the headings and just enough of the paragraphs to get a sense of Descartes' style of arguing; notice paragraph 11 (does it say something is the same as nothing?); skim forward into the laws of motion. Switch over to the Princeton web site. Again, keep skimming, but slow down and read paragraphs 46 through 52 (i.e., rules 1 through 7). Are these rules true? Just flip quickly through the rest of the book (in the pdf file), slowing down only to read part 4, paragraphs 199 and 207.

Week 5 Isaac Newton

Oct
20

The name, method, and science of Isaac Newton dominated the following two centuries and still permeate modern thought.

- Read the following, in this order:
 - Preface to Book 3 (p. 319 in Great Minds edition).
 - The unpublished preface, pp. 49–54 in Cohen and Whitman, in *HPS 154 / PHIL 163H Course Reader*.
 - Editor’s preface to 2nd edition, pp. 385-399 in Cohen and Whitman, in *HPS 154 / PHIL 163H Course Reader*.
 - Author’s preface to 1st edition (pp. 3–5 in Great Minds edition).
 - “Rules of philosophizing,” or “Rules of Reasoning in Philosophy” at the beginning of Book 3 (pp. 320–21 in Great Minds edition).
- Skim the following, guided by my comments in the prior class. As throughout the course, we need not focus on all the details of the author’s science. Read and skim so as to understand the kind of argument Newton is making and the kind of science he presents.
 - Definitions, axioms, sections 1, 2 and 3 of Book 1.
 - Book 3, through Proposition 7.

Week 6 The 19th-Century Debate over Induction

Oct
27

Vigorous debates over scientific method arose in the 1830s and ran through mid-century. A particularly prominent and important one was over the nature of the philosophy of induction.

Read the following.

- *Faraday's Experimental Researches in Electricity: The First Series*. The introduction pp. 1–28 is valuable, but if pressed for time, you can skip it at first and refer back to it as needed when reading Faraday's text. The editor's notes at the bottom of the pages can be helpful.
- John McCaskey, "William Whewell (1794–1866)," in *HPS 154 / PHIL 163H Course Reader*. This is a highly condensed summary of Whewell's epistemology. It will save us a lot of reading.
- William Whewell, "On the Logic of Induction," in *The Mechanical Euclid* (Cambridge, 1837), 172–82. You can find this reprinted in William Whewell, *Theory of Scientific Method*, ed. Robert E. Butts (Hackett Publishing Company, 1989) or online at books.google.com. (Google has two editions scanned. The 1838 edition is mis-scanned. Get the 1837.)
- William Whewell, "Establishment and Development of the Idea of Chemical Affinity," in *The History of Scientific Ideas*, vol II. (London: 1858), 15–28. You can find this at books.google.com.
- Richard Whately, "Of Induction," *Elements of Logic*, bk. IV, ch. 1, pp. 255–66 in the London 1848 edition, in *HPS 154 / PHIL 163H Course Reader*. I have marked the crucial few paragraphs for you.
- John Stuart Mill, *A System of Logic, Ratiocinative and Inductive* in ***HPS 154 / PHIL 163H Course Reader***.
 - "On the Ground of Induction," bk. III, ch. III ;
 - "Of the Evidence of the Law of Universal Causation," bk. III, ch. XXI;
 - "Of the Four Methods of Experimental Inquiry," bk. III, ch. VIII.
 - Of these three chapters, you need to read the first two. You might not need to read the third. It explains what are now called "Mill's Methods." You need to know what Mill's Methods are, but you don't really need to read Mill to learn them. They are now explained in shorter and often clearer form in many textbooks and web sites. If you know the methods, you don't need to read Mill's chapter on them.
 - Regardless which you read, be sure to work through the summary and examples of Mill's methods included **in the course Reader**.
- William Whewell, *Of Induction with Especial Reference to Mr. J. Stuart Mill's System of Logic* (London 1849), in *HPS 154 / PHIL 163H Course Reader*.

Week 7 Science of the Unobservable: EvolutionNov
3

The mid-19th century was also the time of remarkable and provocative scientific advances, many involving things that could not be directly observed, such as electricity, atoms, the distant past, and the core of the earth. In class, we will examine one of these, Darwin's proposal for evolution by natural selection. Read the following, in order.

- Phillip R. Sloan, "The Making of a Philosophical Naturalist," *The Cambridge Companion to Darwin*, pp. 17–39. You can read this lightly, but give attention to section IV, "The Transformation of 1831," in *HPS 154 / PHIL 163H Course Reader*.
- Charles Darwin, *Origin of Species*, "Introduction" and first four chapters (to page 130 in first edition). You will find you can read through some parts of this quickly, but take care to follow Darwin's overall argument. For class, sketch out his argument in an outline or block diagram—not a lot of detail, just the central three to ten points.
- M. J. S. Hodge, "Darwin's Argument in the Origin," *Philosophy of Science*, Vol. 59, No. 3. (Sep., 1992), pp. 461–464. You can get this at www.jstor.org.

Week 8
Nov
10

SECOND PAPER DUE at the beginning of class.
--

Social Sciences and the Rise of Statistical Thinking

- Read a short introduction to Adolphe Quetelet, in, say, *Encyclopedia Britannica* or Wikipedia.
- Read Adolphe Quetelet, "Preface" and "Introductory," *A Treatise on Man*, in *HPS 154 / PHIL 163H Course Reader*.
- Read James Clerk Maxwell, "Essay for the Eranus Club on Science and Free Will," in *HPS 154 / PHIL 163H Course Reader*.
- Read James Clerk Maxwell, "Molecules," in *HPS 154 / PHIL 163H Course Reader*.
- Read Theodore M. Porter, *The Rise of Statistical Thinking 1820–1900*, pp. 110–28, in *HPS 154 / PHIL 163H Course Reader*.

Week 9 20th Century: Futility of the Search for Scientific CertaintyNov
17

- Read Werner Heisenberg, *Physics and Philosophy*. Pages to be determined.
- Read Karl Popper, *The Logic of Scientific Discovery*, pp. 1–73.

Week off to celebrate Thanksgiving.**Week 10 Scientific Methods at the Beginning of the Twenty-First Century**Dec
1

- Read Michael Crichton, "Aliens Cause Global Warming," <http://www.michaelcrichton.net/speech-alienscauseglobalwarming.html>.
- Do some independent research on global warming. The IPCC reports and drafts, their history, and the process by which they come about may be fruitful sources. Be ready to discuss, with reference to scientific methods we've examined in this course, Crichton's position.

THIRD PAPER DUE at the end of the time scheduled for our final exam.

HPS 154 / PHIL 163H Course Reader Table of Contents

These are not the assignments. This is just a list of what is in *HPS 154 / PHIL 163H Course Reader*. For assignments, see the assignments section of the syllabus.

(Items marked with ♦ are public domain or for some other reason do not require copyright clearance.)

Week 2

- Hippocratic Writings. "Tradition in Medicine." Translated by J. Chadwick and W. N. Mann. Penguin, 1984. 70–86.
- Aristotle. *Selections*. Translated by Terence Irwin and Gail Fine. Hackett, 1995.
On the Parts of Animals I-IV. Translated by James G. Lennox. Oxford University Press, 2001.
History of Animals. Translated by Richard Creswell. Henry G. Bohn, 1862. ♦
Posterior Analytics. Translated by G. R. G. Mure. 1928. ♦
 - *Posterior Analytics* Bk. I, ch. 2; Irwin and Fine, 39–42.
 - *Posterior Analytics* Bk. I, ch. 13; Mure. ♦
 - *Physics* Bk. II ch. 3; Irwin and Fine, 102–105.
 - *History of Animals* II.XI; Cresswell, 39. ♦
 - *Parts of Animals* III.3; Lennox, 52–54.
 - *Posterior Analytics* Bk. I, ch. 5; Irwin and Fine, 48–50.
 - Pages from Glossary, Irwin and Fine, 569, 570, 574, 575, 585, 597, 600, 602, 603, 607, 608, 610, 611, 618.
- David Lindberg. "The Mathematical Sciences in Antiquity." *The Beginnings of Western Science*. The University of Chicago Press, 1992. 89–105, 375–377.
- Pierre Duhem. *To Save the Phenomena*. 1908. Translated by Edmond Doland and Chaninah Maschler. University of Chicago Press, 1969. 5–11.

Week 3

- Edward Grant. "The reception and impact of Aristotelian learning and the reaction of the Church and its theologians." *The Foundations of Modern Science in the Middle Ages*. University of Chicago Press, 1996. 70–85.
- William of Ockham. "Do the elements remain in a mixed thing?" *Quodlibetal Questions*. Third Quodlibetal, Question 5, 185–89.
- Bernardino Telesio. Proemium to book 1 of *De Rerum Natura*. Translated by John P. McCaskey and Elena Lemeneva. ♦

Week 4

- Bellarmine. "Cardinal Bellarmine to Foscarini, April 12, 1615." *The Galileo Affair*. Edited by Maurice A. Finocchiaro. University of California Press, 1989. 67–69, 333.
- Galileo. "Galileo to Castelli (21 December 1613)." *The Galileo Affair*. Edited by Maurice A. Finocchiaro. University of California Press, 1989. 49–54, 330.
- *Louvian Lectures of Bellarmine*, ed. Ugi Baldini and George V. Coyne, 8–22 (even).
- Galileo. *Dialogues Concerning Two New Sciences*. On equal speed of descent regardless of weight and on the inclined-plane experiment; pp. 65–75, 153–71 in the Wall & Emerson, 2000 edition.
- Francis Bacon. *Sylva Sylvarum*. 1. ♦
- John P. McCaskey. "Outline of Rene Descartes, *Principia philosophiae*." ♦

Week 5

- Isaac Newton. "The Unpublished Preface." *The Principia*. Edited by I. Bernard Cohen and Anne Whitman. University of Chicago Press, 1999. 49–54.

- Roger Cotes. “Editor’s Preface to Second edition.” *The Principia*. Edited by Cohen and Whitman. University of Chicago Press, 1999. 385-399.

Week 6

- John McCaskey. “William Whewell (1794–1866).” ♦
- Richard Whately. “Of Induction.” *Elements of Logic*. Bk. IV, ch. 1. 255–66 in the London 1848 edition. ♦
- John McCaskey. “Mill’s Methods.” ♦
- William Whewell. *Of Induction with Especial Reference to Mr. J. Stuart Mill’s System of Logic*. London: 1849. ♦

Week 7

- Phillip R. Sloan. “The Making of a Philosophical Naturalist.” *The Cambridge Companion to Darwin*. Cambridge University Press, 2003. 17–39.

Week 8

- Adolphe Quetelet. “Preface” and “Introductory,” *A Treatise on Man*, 1842. ♦
- James Clerk Maxwell. “Essay for the Eranus Club on Science and Free Will.” *The Scientific Letters and Papers of James Clerk Maxwell*. Edited by P. M. Harmon. Cambridge University Press, 1995. Vol. II, 814–23. ♦
- James Clerk Maxwell. “Molecules.” *The Scientific Papers of James Clerk Maxwell*. Cambridge University Press, 1890. Vol. II, 361–78. ♦
- Theodore M. Porter. *The Rise of Statistical Thinking 1820–1900*. Princeton University Press, 1986. 110–28.