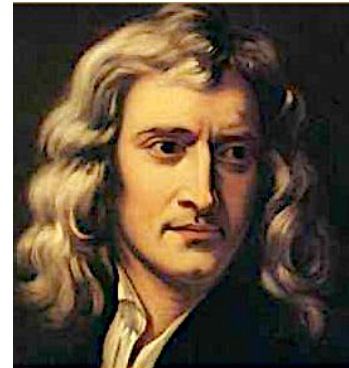


Newton (Phil 8019/5099)

Spring 2013

This course will focus on the transformation in philosophy of science wrought by Isaac Newton's *Principia*. We will examine the philosophy of science of Galileo Descartes, Boyle, Hooke, and Hobbes, and contrast their ideas about scientific investigation and progress with those of Newton. In particular, we'll discuss these thinkers's response to the threat of underdetermination regarding fundamental ontology, the nature of scientific idealization and its place in explanation and experimentation, and the very possibility of a mathematical science that can capture the structure of the world. We'll also investigate the foundations of Newtonian science: his accounts of space, time, matter, and force, and God's relation to the nature and existence of these four fundamental kinds.



Grading:

Graduate Students:

Grades will be based on two presentations (schedule worked out in class) and writing assignments. You have two options:

- Option A: Weekly writing.
1000 words of writing each week, on that week's writing. The writing must address (although not comprehensively, of course) each of the week's readings. This should not be a laundry list of reactions, but a single idea that you are beginning to flesh out that involves all of the readings. You can miss up to two weeks (i.e., 11 completed assignments).
- Option B: Long paper and weekly reactions.
A final paper for 6000 words, and 250-300 words of writing each week, on that week's writing. The weekly writing can be very sketchy, a reaction to the week's reading. It must, however, touch on all of the readings. A reaction paper merely expresses an idea that involves all of the reading, while the weekly writing of Option A takes that idea to a slightly more detailed level.

Undergrad Capstone and 4+1 Students:

See option B above. You **must** submit a draft of your final paper (at least 2000 words) by **March 27**.

Everyone:

The entire class will be involved in peer-reviewing each other's weekly writing. This will be the procedure:

The weekly writing will be due to me, by email, by 1:00PM on the day of class. In addition to emailing me, you will also email the student responsible for

peer-reviewing your writing for the week (see chart from class). You will review their writing. The primary concern will be on issues discussed in the Zinsser text (see below). You should also comment on content, but this is a secondary concern. Edits must be done using the reviewing mechanism of Word or Acrobat. **The revisions of weekly writing should be send to me and the original author by Friday, 5PM.**

Texts:

- Zinsser, William Knowlton (2006). *On Writing Well*. 30th anniversary ed., 7th ed., rev. and updated edition. New York: HarperCollins. [LINK](#).
- Cohen, I. Bernard (1985). *The Birth of a New Physics*. Rev. and updated edition. New York: W.W. Norton. [LINK](#).
- Newton, Isaac (2004). *Isaac Newton: Philosophical Writings*, ed. A. Janiak. New York, Cambridge, UK: Cambridge University Press. [LINK](#).
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All other texts will be available on blackboard, which you must consult regularly.

Schedule:

Jan 9: **Introduction: The Scientific Revolution, Broad Context.**

Jan 16: **The Standard Story**

Topics:

- What is Newton's place in the history of physics and philosophy?
- What was Newton's achievement in physics?
- What methods of physical investigation were prominent before Newton?
- What was the role of mathematics in natural philosophy before Newton?

Readings:

1. I.B. Cohen, *Birth of a New Physics* (excluding appendices, but *all the rest*).
2. Alexandre Koyre, "The Significance of the Newtonian Synthesis" (in Norton Critical Edition).
3. Maarten Van Dyck, "Mathematical Sciences in the Sixteenth Century" (Chap 2 of diss).
4. Zinsser, chaps 1-9, 11, 14, 15, 22.

Jan 23: **Copernicus & Kepler**

Topics:

- The Realism / Instrumentalism debate in the 15th century.
- What were Copernicus's and Kepler's methods of theory construction? What is the role of experiment?

- How is the use of mathematics in natural philosophy related to questions of ontology?

Readings:

1. Owen Gingerich, “The Astronomy and Cosmology of Copernicus”.
2. Owen Gingerich, “Kepler as a Copernican”.
3. Barker, Peter and Bernard R. Goldstein (1998). ‘Realism and Instrumentalism in Sixteenth Century Astronomy: A Reappraisal’, *Perspectives on Science* 6: 232–258.

Recommended Readings:

4. “Scientific Realism”, in Stanford Encyclopedia of Philosophy, Section, 1--3.

Jan 30: **Galileo I**

Topics:

- Galileo presents a variety of arguments for the Copernican hypothesis and for the foundational principles of a mathematical science of motion. What are they? What scientific methods to they embody?

Readings:

1. Selection from Dialogue on the Two Chief World Systems (1632).
2. Selection from Discourse on Two New Sciences (1638)

Galilei, Galileo (2008). *The Essential Galileo*, ed. M. A. Finocchiaro. Indianapolis, Ind.: Hackett Pub. Co.

Feb 6: **Galileo II**

Topics:

- What is the *regressus*? Is this scientific methodology revealing? Trivial?
- How does Galileo idealize?
- What is a ‘mixed-mathematical’ science? How does it incorporate idealization and abstraction?
- How is scientific ‘modeling’ related to the above scientific methods?
- What substantive assumptions do the above scientific techniques/methods make about the world?

Readings:

1. Koertge, Noretta (1977). 'Galileo and the Problem of Accidents', *Journal of the History of Ideas* 38: 277–318.
2. Wallace, William A. (1983). 'The Problem of Causality in Galileo's Science', *Review of Metaphysics* 36.
3. Lennox, James G. (1986). 'Aristotle, Galileo and "Mixed Sciences"', in William A. Wallace (ed.), *Reinterpreting Galileo*. Washington, D.C.: Catholic University of America Press. 29–52.
4. Palmieri, P. (2006). 'A New Look at Galileo's Search for Mathematical Proofs', *Archive for history of exact sciences* 60: 285–317.

Feb 13: **Galileo III**

Topics:

- Let's be real, we didn't finish last time.

Readings:

1. Finish the readings.

Recommended Readings:

1. Seriously, finish the readings.

Feb 20: **Cartesian Science**

Topics:

- Why does Descartes's 'science' appear less sophisticated than that of his predecessors? [Hint: time to think of historical categories. What is 'natural philosophy'? What is a mathematical or 'mixed-mathematical' science? What reasons did one have to pursue one over the other?]
- How does Descartes establish the principle of inertia, his first law of nature? What is the role of "force" in this reasoning?
- Descartes makes the "Laws of Nature" a standard concept for use in physical theory. On what presuppositions does the use of this concept rely? How is it related to idealization and abstraction?

Readings:

1. Rene Decartes, selections from *Le Monde* and *Principia Philosophiae*.
2. Garber, Daniel (1992). 'Descartes' Physics', in John Cottingham (ed.), *The Cambridge Companion to Descartes*. Cambridge; New York: Cambridge University Press. 286–320.
3. Gabbey, Alan (1993). 'Descartes's Physics and Descartes's Mechanics: Chicken and Egg? ', in Stephen Voss (ed.), *Essays on the Philosophy and Science of René Descartes*. New York: Oxford University Press. 311–323.

Feb 27: **Descartes and the Mechanical Philosophy**

Topics:

- What is the mechanical philosophy? How does its supposed methodology and substantive assumptions about the world compare to those of ‘mixed-mathematical’ sciences?

Readings:

1. Garber, Daniel (2002). ‘Descartes, Mechanics, and the Mechanical Philosophy’, *Midwest Studies in Philosophy* 26: 185–204.
2. Anstey, Peter R. (2002). ‘Robert Boyle and the Huerisitic Value of Mechanism’, *Studies in History and Philosophy of Science* 33: 161–174.
3. Gabbey, Alan (2001). ‘Mechanical Philosophies and their Explanations’, in *Late Medieval and Early Modern Corpuscular Matter Theories*. Leiden; Boston: Brill. 441–465.

Recommended Readings:

1. Boas, Marie (1952). ‘The Establishment of the Mechanical Philosophy’, *Osiris* 10: 412–541.
2. Westfall, Richard S. (1971). *The Construction of Modern Science: Mechanisms and Mechanics*. New York: John Wiley.

Mar 6: Newton: The Laws of Motion, Force and Matter

Topics:

- If motion is a state and not a species of change, why does inertial motion require a force?
- Fluxions for Babies
- How does Newton solve the direct problem? What’s the direct problem?
- How are the laws of motion justified? (This question will remain w/ us for the rest of the course).

Readings:

1. *Principia*, Definition, Laws - in Newton *Philosophical Writing*, pp. 40-42, 59-64, 70-86.
2. Brackenridge, J. Bruce (1995). *The Key to Newton’s Dynamics: The Kepler Problem and the Principia*. Berkeley: University of California Press, Chap 1, 2.
3. Brading, Katherine (2012). ‘Newton’s Law-Constitutive Approach to Bodies: A Response to Descartes’, in *Interpreting Newton: Critical Essays*. Cambridge University Press. 13–32.
4. McGuire, J. E. (1994). ‘Natural Motion and its causes: Newton on the *Vis insita* of bodies’, in Mary L. Gill and James G. Lennox (eds.), *Self-motion: from Aristotle to Newton*. Princeton: Princeton University Press. 305–329.

Recommended Readings:

1. Meli, Domenico Bertoloni (2006, 05). ‘Inherent and Centrifugal Forces in Newton’, *Archive for the History of Exact Sciences* 60: 319–335.
2. Blay, Michel (2001). ‘Force, Continuity, and the Mathematization of Motion at the End of the Seventeenth Century’, in Jed Z. Buchwald and I. Bernard Cohen (eds.), *Isaac Newton’s Natural Philosophy*. Cambridge, Mass.: MIT Press. 225–248.

Mar 13: Newtonian Metaphysics of Space and Time.

Topics:

- How does Newton establish the existence of an insensible, immobile, absolute space? Did he, as Leibniz (and Mach) asserted, overreach?
- Overview of absolute vs. Relational spacetime debate.
- What evidence did Newton marshal for the existence of absolute space? What evidence did he marshal for the nature of absolute space? Are Newton's theological concerns independent of his physical ones?

Readings:

1. Principia, scholium on space and time. In Newton *Philosophical Writing*, pp. 64--70.
2. Rynasiewicz, Robert (1995). 'By Their Properties, Causes and Effects: Newton's Scholium on "Time, Space, Place and Motion-I. The Text"', *Studies in History and Philosophy of Science* 26: 133--153.
3. Rynasiewicz, Robert (1995). 'By Their Properties, Causes and Effects: Newton's Scholium on "Time, Space, Place and Motion-II. The Context"', *Studies in History and Philosophy of Science* 26: 295--321.
4. Hugget, Nick (2012). 'What did Newton mean by "Absolute Motion"?' , in Andrew Janiak and Eric Schliesser (eds.), *Interpreting Newton: Critical Essays*. Cambridge University Press.

Mar 27: Newtonian Metaphysics of Space and Time.

Readings:

1. *De Gravitatione*. In In Newton *Philosophical Writing*, pp. 12--39.
2. McGuire, J. E. (1990). 'Predicates of Pure Existence: Newton on God's Space and Time', in Phillip Bricker and R. I. G. Hughes (eds.), *Philosophical Perspectives on Newtonian Science*. Cambridge, Mass.: MIT Press. 91--108.
3. Carriero, John (1990). 'Newton on Space and Time: Comments on J. E. McGuire', in Phillip Bricker and R. I. G. Hughes (eds.), *Philosophical Perspectives on Newtonian Science*. Cambridge, Mass.: MIT Press. 109--133. *This is the weightier article*.
4. DiSalle, Robert (2002). 'Newton's Philosophical Analysis of Space and Time', in I. Bernard Cohen and George E. Smith (eds.), *The Cambridge Companion to Newton*. Cambridge University Press. 33--56. *This should be read before Hugget, and perhaps skip hugget. This explains reference frames well*.

Apr 3: Newtonian Method.

Topics:

- How is Newtonian methodology different from the one implicit in mechanical philosophies?
- How does Newtonian methodology deal w/ the problem of underdetermination?
- Was Newton's methodology novel, or a simple refinement of previous methods?

Readings:

1. Smith, George E. (2002). 'The Methodology of the *Principia*', in I. Bernard Cohen and George E. Smith (eds.), *The Cambridge Companion to Newton*. Cambridge University Press. 138–173.
2. Machamer, Peter, J. E McGuire, and Hylarie Kochiras (2012). 'Newton and the Mechanical Philosophy: Gravitation as the Balance of the Heavens', *The Southern Journal of Philosophy* 50: 370–388.
3. Harper, William L (2011). *Isaac Newton's Scientific Method: Turning Data into Evidence about Gravity and Cosmology*. Oxford: Oxford University Press. Huygens Chapter.

Recommended Readings:

1. Bertoloni Meli, Domenico (2010). 'The Axiomatic Tradition in Seventeenth-Century Mechanics', in Mary Domski, Michael Dickson, and Michael Friedman (eds.), *Discourse on a New Method: Reinvigorating the Marriage of History and Philosophy of Science*. Chicago: Open Court. 23–42.

Apr 10: Rules, Hypotheses, and Phenomena

Topics:

- What purpose do the Rules serve in the *Principia*? Why are they introduced in the Second Edition?
- Do the rules embody the implicit method of the *Principia* previous discussed? What is the relation between the Rules and the implicit methodology?

Readings:

1. Koyre, Alexandre (1965). 'Newton's Regulae Philosophandi', in 261–272. Cambridge: Harvard University Press.
2. Mamiani, Maurizio (2001). 'To Twist the Meaning: Newton's Regulae Philosophandi Revisited', in Jed Z. Buchwald and I. Bernard Cohen (eds.), *Isaac Newton's Natural Philosophy*. Cambridge, Mass.: MIT Press. 3–14.
3. McGuire, J. E. (1970). 'Atoms and the 'Analogy of Nature': Newton's Third Rule of Philosophizing', Reprinted in ZMcGu95, Ch. 2. *Studies in History and Philosophy of Science* 1: 3–58.
4. Harper, William L (2011). *Isaac Newton's Scientific Method: Turning Data into Evidence about Gravity and Cosmology*. Oxford: Oxford University Press. Selections.

Recommended Readings:

Apr 17: Catch-Up, or Presentations.

Topics:

Readings:

Recommended Readings: