

Laws of Nature: Philosophical Analysis and Historical Context
Philosophy 190S/290S
Fall 2008

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Laws of Nature: Philosophical Analysis and Historical Context

We often hear that scientists discover the "Laws of Nature". What are these laws? How strict, universal, and necessary are they? Can they serve to unify and reduce a variety of sciences to fundamental physics? How are they empirically confirmed? Do they actually exist? As we shall see in the first part of this course, philosophers in the 20th century analytical tradition have addressed these important questions in an insightful manner. Unfortunately, they have failed to explore the emergence and development of the concept in the history of science. Since the power and interest of the concept derives precisely from the sciences, this lacuna is problematic. We will try to remedy it by investigating the history of science in the second part of this course. When, and under what conditions, did the very concept of laws of nature emerge? Does the historical evolution of science point to a plurality of ways of imagining laws of nature – e.g., fundamental, historical and statistical laws? And how do trends in contemporary science—systems thinking, experimentation, and computational power—reframe our conceptualization of laws of nature? Ultimately, the goal of this course is to evaluate and concretize abstract philosophical analyses of laws of nature in the context of real history of science. Both Analytic Philosophy and History of Science have much to gain from such an endeavor.

COURSE REQUIREMENTS

1. A weekly one-paragraph summary of the reading (roughly 10% of your grade)
2. Two one-page assignments for undergraduates; three one-page assignments for graduates (20% of your grade)
3. A short (10-15 minute, 2-page) presentation. (15%)
4. Paper (undergraduates 5-7 pages; graduates 10-14 pages, 1.5 spaced), with rough draft. (40%)
5. Class participation. Attendance is mandatory. (15%)
6. In addition to the regular course meetings, there will be a special graduate student section of 1.5 hours, which will meet every other week (5 times per quarter).

GRADING POLICY

1. In order to pass the course, you must satisfy every requirement.

2. One third of a letter grade will be deducted per day for any late assignments (e.g., a B+ becomes a B, etc.).

3. No assignments will be accepted more than seven (7) days after the due date.

WARNING

Academic misconduct will not be tolerated. Please consult:

http://www.ucsc.edu/academics/academic_integrity/index.html

READINGS

PART 1. Philosophical Analysis

Week 1. *Laws of Nature. Basic Definitions.*

-- van Fraassen B. "What are Laws of Nature?", Chapter 2 of *Laws and Symmetry* (1989), Oxford University Press.

-- Peirce, CS. "Laws of Nature", pp. 67-74 in *The Essential Peirce*. Vol 2 (ed. Houser et al.).

Recommended:

"Laws of Nature", Stanford Encyclopedia of Philosophy:

<http://plato.stanford.edu/entries/laws-of-nature/>

Week 2. *Analytic Philosophy of Laws of Nature.*

(i) *Deductive Systems?*

-- Lewis, D., 1973, *Counterfactuals*, pp. 72-77, Harvard University Press

(ii) *Universals?*

Armstrong, D., 1978, *What is a Law of Nature?*, pp. 3-10, 77-110, Cambridge University Press.

Week 3. *Analytic Philosophy Skepticism Regarding Laws?*

-- Goodman, N. 1983, *Fact, Fiction, and Forecast*, pp. 59-83, Harvard University Press.

-- Fodor, JA. 1974. Special Sciences (Or the Disunity of Science as a Working Hypothesis) *Synthese* 28: 97-115.

Week 4. *Philosophy of Science and Laws of Nature*

-- Cartwright N. 1983. *How the Laws of Physics Lie*, "The Truth Doesn't Explain Much" pp. 44-53 and "Do the Laws of Physics State the Facts", pp. 54-73. Oxford University Press. [Parts]

-- Scriven, M. 1961. The Key Property of Physical Laws -- Inaccuracy. In *Current Issues in the Philosophy of Science*, ed. H Feigl and G Maxwell, pp. 91-101. New York: Holt, Rinehart & Winston.

-- Hull DH. (1992). The Particular-Circumstance Model of Scientific Explanation. (In M.H. Nitecki & D.V. Nitecki, *History and Evolution* (pp. 69-80). Albany, New York: SUNY Press.)

PART 2. Historical Context

(General Resource: Weinert F (ed.). 1995. *Laws of Nature: Essays on the Philosophical, Scientific and Historical Dimensions*. New York: Walter de Gruyter)

Week 5. Newton and the 17th Century Scientific Revolution: Fundamental Laws

-- Milton JR. 1981. The Origin and Development of the Concept of the "Laws of Nature" *Archives Européennes de Sociologie* 22: 173-95.

-- Giere, R. 1995. Science Without Laws of Nature. In *Laws of Nature: Essays on the Philosophical, Scientific and Historical Dimensions*. Ed. F. Weinert, 120-138. New York: Walter de Gruyter, 1995.

Primary Sources:

Selections: Isaac Newton

Week 6. The Emergence of Historical Laws: Geology (primarily 19th Century)

-- Frodeman, R. (1995). Geological reasoning: Geology as an interpretive and historical science. *GSA Bulletin*, 107, 960-968

-- Crombie, A. 1994. *Styles of Scientific Thinking in the European Tradition*. 3 vols. London: Duckworth. [Parts]

Primary Sources:

Selections: Charles Lyell (*Principles of Geology*), Darwin (*On the Origin of Species*).

Week 7. The Emergence of Statistical Laws (17th to 19th Centuries)

-- Hacking I. 1983. Nineteenth Century Cracks in the Concept of Determinism. *Journal of the History of Ideas* 44: 455-475.

-- Crombie, A. 1994. *Styles of Scientific Thinking in the European Tradition*. 3 vols. London: Duckworth. [Parts]

Week 8. Bohr, Einstein and Rethinking the Fundamental Laws of Nature

-- MacKinnon E. 1983 *Scientific Explanation and Atomic Physics*, University of Chicago Press. [Chapter 10, "Two Theories of Scientific Knowledge: Bohr and Einstein"]

Week 9. Laws in science today? Systems, the Experimental Life, and Computers

-- Galison P. 1997. *Image and Logic. A Material Culture of Microphysics*. University of Chicago Press. [Parts]

-- Fox Keller, Evelyn 2003, "Models, Simulation, and 'Computer Experiments'", in Hans Radder (ed.) *The Philosophy of Scientific Experimentation*, Pittsburgh: University of Pittsburgh Press: 198-216.

-- Winther RG. 2008. Systemic Darwinism. *Proceedings of the National Academy of Sciences*. (USA) 105 (33): 11833-11838.

Week 10. Tying Together the Philosophical Analysis and the Historical Context of Laws of Nature

Discussion of emergent themes from the course.