

**Metaphysics of Science:
Reductionism and Emergentism**

Reductionism has been a central concern for metaphysicians and philosophers of science at least since the heyday of logical empiricism. For some philosophers, the “unity of science” requires that all theories or phenomena be reducible in principle to some more fundamental set of more basic or lower-level theories or phenomena. Others contend that higher-level scientific domains can be autonomous from, or indeed emergent with respect to lower-level ones. But there is still no settled account of what reduction consists in, or indeed, how to understand its opposite, emergence. Some accounts of reduction conceive of it as a relation between theories, while others think of it as a relation between entities or properties. Similarly, emergence is sometimes understood epistemically and at other times metaphysically. In this course we will examine various different accounts of reduction and emergence, from the classic work by Oppenheim & Putnam, Nagel, and Hempel, to more recent approaches. Along the way, we will look at various case studies drawn from the physical and chemical sciences, as well as the biological, cognitive, and social sciences, in an attempt to adjudicate the dispute between reductionists and emergentists, as well as to discern various intermediate positions.

Course Requirements

Weekly Comments and Class Participation (20%): As of Week 2 (Sept 20), comments on each week’s readings will be due by 10:00 am each Tuesday morning before the seminar, on the Moodle discussion board. Comments should be approximately 300 words and take up some issue related to the readings; they are meant to raise questions and elicit discussion, not necessarily convey a polished argument or objection. Late comments will not be accepted and a comment cannot be fully credited unless a student is present at the relevant class session. You have the option of skipping one week’s comments, in addition to the week that you will be presenting (i.e. two passes in total).

Expository Presentation (10%): After the first couple of weeks, presentation of the material will be shared between myself and other seminar members. The presentation schedule will be settled by the second meeting, based on the preferences submitted at the first meeting.

First draft of a term paper (25%): This will be a paper of 3000 words, due on 13 November, on a topic chosen from a list of topics that will be distributed around the middle of the semester. Based on comments on this first draft, students will be expected to revise and expand their papers.

Presentation in mini-conference (10%): During the final session of the course, we will have a series of brief conference-style presentations on topics related to the course content (these will be based on your term papers). Each of you will give a presentation based on the term paper and each of you will also be assigned the task of commenting on another student’s paper. Papers should be distributed in advance to allow time for comments to be formulated.

Term paper (35%): This will be a paper of 6000 words, a revised version of the first draft, due on 13 December.

Reading Schedule

The reading schedule covers the first nine weeks of the semester, to allow for some flexibility regarding what to cover in the remaining weeks. I've also included the titles of a number of additional papers that we could take up in the remaining weeks, depending on student interests. We could go in various directions, such as focusing on one or more of the special sciences (including the social sciences), or scrutinizing some particular variant of reductionism or emergentism, or concentrating on particular lines of argument. The list of additional papers is not meant to be a definitive list, so other suggestions are welcome.

Week 1 (Sept 13): Introduction

Background reading: Alyssa Ney, "Reduction," *Internet Encyclopedia of Philosophy*

Week 2 (Sept 20): Good Old-Fashioned Reduction

Oppenheim, Paul & Putnam, Hilary, "The Unity of Science as a Working Hypothesis," in H. Feigl et al. (eds.), *Minnesota Studies in the Philosophy of Science*, vol. 2 (Minneapolis: Minnesota University Press, 1958).

Nagel, Ernest, "The Reduction of Theories," in *The Structure of Science* (New York: Harcourt, 1961), selections (chap 11, sections I-III, pp.336-366).

Week 3 (Sept 27): Twists on Reduction

Kemeny, John G. & Oppenheim, Paul, "On Reduction," *Philosophical Studies* 7:1-2 (1956), 6-19.

Hempel, Carl G., "Reduction: Ontological and Linguistic Facets," in *Philosophy, Science, and Method*, eds. S. Morgenbesser, P. Suppes & M. White (New York: St Martin's Press, 1969).

Nickles, Thomas, "Two Concepts of Inter-Theoretic Reduction," *Journal of Philosophy* 70 (1973), 181-201.

Week 4 (Oct 4): Non-Reductive Physicalism

Lewis, David, "Psychophysical and Theoretical Identifications," *Australasian Journal of Philosophy* 50 (1972), 249-58.

Davidson, Donald, "Laws and Cause," *Dialectica* 49:2-4 (1995), 263-79.

Week 5 (Oct 11): Reduction and Multiple Realization

Fodor, Jerry, "Special Sciences (Or: The Disunity of Science as a Working Hypothesis)," *Synthese* 28:2 (1974), 97-115.

Kim, Jaegwon, "Multiple Realization and the Metaphysics of Reduction," *Philosophy and Phenomenological Research* 52 (1992), 1-26.

Week 6 (Oct 18): Multiple Realization and Its Critics

Fodor, Jerry, "Special sciences: Still autonomous after all these years," *Noûs* 31:s11 (1997), 149-163.

Sober, Elliott, "The multiple realizability argument against reductionism," *Philosophy of Science* 66 (1999), 542-564.

Week 7 (Oct 25): Patterns of Complexity

Dennett, Daniel, "Real Patterns," *Journal of Philosophy* 88:1 (1991), 27-51.

Wimsatt, William, "Ontology of Complex Systems: Levels of organization, perspectives, and causal thickets," *Canadian Journal of Philosophy* 20: sup1 (1994), 207-274.

Week 8 (Nov 1): Reduction and Laws

Cartwright, Nancy, "Fundamentalism and the Patchwork of Laws," *Proceedings of the Aristotelian Society* 94 (1994), 279-292.

Mitchell, Sandra D., "Dimensions of scientific law," *Philosophy of Science* 67 (2000), 242-265.

Week 9 (Nov 8): What Is Emergence?

Kim, Jaegwon, "Making Sense of Emergence," *Philosophical Studies* 95 (1999), 3-36.

Mitchell, Sandra D. (2012), "Emergence: logical, functional and dynamical," *Synthese* 185:2 (2012), 171-186.

Week 10 (Nov 15): TBD

Week 11 (Nov 22): TBD

Week 12 (Nov 29): Conference-style presentations

Some suggestions for readings for Weeks 10-11

- Morrison, Margaret (2006), "Emergence, Reduction, and Theoretical Principles: Rethinking Fundamentalism," *Philosophy of Science* 73:5, 876-887.
- Anderson, Philip W. (1972), "More is different." *Science* 177.4047: 393-396.
- Needham, Paul (2009). Reduction and emergence: a critique of Kim. *Philosophical Studies*, 146(1), 93-116.
- Delehanty, Megan (2005). Emergent properties and the context objection to reduction. *Biology and Philosophy* 20 (4):715-734.
- Poidevin, Robin Le (2005). Missing Elements and Missing Premises: A Combinatorial Argument for the Ontological Reduction of Chemistry. *British Journal for the Philosophy of Science* 56 (1):117-134.
- Hendry, Robin Findlay & Needham, Paul (2007). Le Poidevin on the reduction of chemistry. *British Journal for the Philosophy of Science* 58 (2):339 - 353.
- Batterman, RW (2000). Multiple realizability and universality. *British Journal for the Philosophy of Science* 51 (1):115-145.
- Bickle, John (2003). *Philosophy and Neuroscience a Ruthlessly Reductive Account*, chaps 1-2.
- Schaffner, Kenneth F. (2006). Reduction: The Cheshire cat problem and a return to roots. *Synthese* 151 (3):377 - 402.
- Sklar, Lawrence (1999). The reduction(?) of thermodynamics to statistical mechanics. *Philosophical Studies* 95 (1-2):187 - 202.
- Sklar, Lawrence (1967). Types of inter-theoretic reduction. *British Journal for the Philosophy of Science* 18 (2):109-124.
- Waters, C. Kenneth (1994). Genes made molecular. *Philosophy of Science* 61 (2):163-185.
- Waters, C. Kenneth (1990). Why the antireductionist consensus won't survive the case of classical Mendelian genetics. *Philosophy of Science Association* 1:125-39.
- Humphreys, Paul W. (1997). Emergence, not supervenience. *Philosophy of Science Supplement* 64 (4):337-45.
- Humphreys, Paul (2008). Computational and conceptual emergence. *Philosophy of Science* 75 (5):584-594.
- Humphreys, Paul W. (1997). How properties emerge. *Philosophy of Science* 64 (1):1-17.
- Taylor, Elanor (2015). An explication of emergence. *Philosophical Studies* 172 (3):653-669.
- Thalos, Mariam (2006). Nonreductive physics. *Synthese* 149 (1):133 - 178.
- Horst, Steven W. (2007). *Beyond Reduction: Philosophy of Mind and Post-Reductionist Philosophy of Science*. Oxford University Press.
- Epstein, Brian (2009). Ontological individualism reconsidered. *Synthese* 166 (1):187-213.
- Loewer, Barry (2009). Why is there anything except physics? *Synthese* 170 (2):217 - 233.
- Nathan, Marco J. & Del Pinal, Guillermo (2016), Mapping the mind: bridge laws and the psycho-neural interface, *Synthese* 193:2, 637-657.
- Steel, Daniel (2004). Can a Reductionist Be a Pluralist? *Biology and Philosophy* 19 (1):55-73.
- Schröder, Jürgen, "Emergence: Non-Deducibility or Downwards Causation?" *Philosophical Quarterly* (1998) 48 (193): 433-452.
- Schaffner, Kenneth F. (1967). Approaches to reduction. *Philosophy of Science* 34 (2):137-147.
- Corradini, Antonella & O'Connor, Timothy (eds.) (2010). *Emergence in Science and Philosophy*. Routledge.