

PHIL749 (Philosophy of Science 1)

Modelling, Representation, and Inference in Science

Meeting Times: Wednesdays 11am–1pm in Building 201E (Social Sciences), Room 306

Course Coordinator: Dr Emily Parke

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Office hours: Wednesdays 2pm–4pm, or other times by appointment

Office: Room 427, Building 206 (Humanities)

Course Description:

What makes a series of mathematical equations a good stand-in for the global climate, or a laboratory mouse a good stand-in for a cancer patient? How do scientists get to make inferences about broad classes of systems or phenomena in the natural world, by studying representations or representatives of those classes in their laboratories or on their computer screens? What is representation anyway, and is scientific representation special? This course will examine these and other questions about scientific representation, modelling, and inference. We will discuss a range of topics such as how models represent the world, how scientific representation works in general, the relationship between different kinds of models (e.g., mathematical, computational and physical) and the debate about whether or not experiments are superior to models as sources of scientific knowledge. No particular background in science or modelling is required or expected.

In addition to engaging with these topics through reading about and discussing them, there are some particular objectives for this course. First, you will gain experience in presenting on and leading discussions about complex topics, including topics which are outside of your familiar areas of research or expertise. Second, you will gain experience in preparing a paper for submission to a peer-reviewed international conference.

This is a discussion based course. Everyone will be expected to come to class having done the assigned readings at least once, and prepared to discuss them. In addition, everyone will take turns leading the class discussion. There is no textbook; all assigned readings (as well as further suggested readings on each topic) will be available electronically through Canvas > Reading Lists.

Assessment is based on the following assignments:

- **85%—5000-word Essay:** You are expected to meet with me throughout the semester to develop an original essay topic based on the course material. Essays will be prepared for submission to the 2018 Biennial Meeting of the Philosophy of Science Association (submissions are due in early 2018, and while I cannot force you all to actually submit your essay to the conference, I will strongly encourage you to).
- **15%—Presentations:** Students will be responsible for leading the class discussion two or three times during the semester. This entails preparing a presentation outlining key points from the relevant reading(s) and guiding our group's discussion with questions and other points of interest. It does NOT mean that you must become an expert in the relevant week's topic, or have all the answers to questions about it. Further details of presentations will be discussed in the first weeks of class.

Tentative Schedule of Topics and Readings:

Week 1 (26 July): No Class

Week 2 (02 August): Introduction to Modelling

— Michael Weisberg, *Simulation and Similarity* (2013), Chapters 1–3: Introduction, Three Kinds of Models, and The Anatomy of Models

Week 3 (09 August): Models and Fictions

— Michael Weisberg, *Simulation and Similarity* (2013), Chapter 4: Fictions and Folk Ontology
— Arnon Levy, “Models, Fictions, and Realism: Two Packages” (2012)

Week 4 (16 August): Idealisation and Abstraction 1

— Angela Potochnik, *Idealization and the Aims of Science* (2017), Chapters 2 and 3: Complex Causality and Simplified Representation, and The Diversity of Scientific Projects

Week 5 (23 August): Idealisation and Abstraction 2

— Michael Weisberg, *Simulation and Similarity* (2013), Chapter 6: Idealization
— Martin R. Jones, “Idealization and Abstraction: A Framework” (2005)

Week 6 (30 August): Similarity

— Michael Weisberg, *Simulation and Similarity* (2013), Chapter 8: An Account of Similarity
— Wendy Parker, “Getting (Even More) Serious About Similarity” (2015)

***** Mid-Semester Break *****

Week 7 (20 September): Representation

— Mauricio Suarez, “An Inferential Account of Scientific Representation” (2004)
— Craig Callendar and Jonathan Cohen, “There is No Special Problem about Scientific Representation” (2006)

Week 8 (27 September): Extrapolation and External Validity

— Monika Piotrowska, “From Humanized Mice to Human Disease: Guiding Extrapolation from Model to Target” (2013)
— Daniel Steel, “A New Approach to Argument by Analogy: Extrapolation and Chain Graphs” (2010)

Week 9 (04 October): Computer Simulations

— Wendy Parker, “An Instrument for What? Digital Computers, Simulation, and Scientific Practice” (2010)
— Paul Humphreys, *Extending Ourselves: Computational Science, Empiricism, and Scientific Method* (2004), Chapter 4: Computer Simulations

Week 10 (11 October): Simulations/Models vs Experiments

- Mary Morgan, “Experiments Versus Models: New Phenomena, Inference, and Surprise” (2005)
- Emily Parke, “Experiments, Simulations, and Epistemic Privilege” (2014)

Week 11 (18 October): Model Organisms

- Sabina Leonelli and Rachel Ankeny, “What’s So Special About Model Organisms?” (2011)
- Maureen O’Malley, *Philosophy of Microbiology* (2014), Chapter 6: Microbes as Model Biological Systems

Week 12 (25 October): Course Wrap-Up, Essay Discussion and Peer Review