Philosophy of Science

Instructor

Nora Mills Boyd

"Dr. Nora"

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Office Location

Siena Hall 423

Office Hours

Tuesday 3-4pm & 5:45-6:45pm

Wednesday 11am-noon

Thursday 3-4pm & 5:45-6:45pm

and by appointment

Class Meeting

Tuesday & Thursday

9:50-11:15am

Kiernan Hall 121

Course Description

Are our best scientific theories true or merely provisionally adopted? What is the proper aim of scientific inquiry? Is there such thing as *the* scientific method? What makes science different that other human activities? In this course we will trace some of the historical trajectories that have led to the development of science as we know it today. We will get a taste for some of the most interesting problems that contemporary philosophers of science work on. Most importantly, this course will provide students with the opportunity and tools to deepen their appreciation of the importance of nuanced and active public engagement with science.

Course Material

- There are no required books for this course; all readings are posted on Canvas
- Instructions and rubrics for assignments are also posted on Canvas

Learning Goals

By the end of this course, if you work hard, you will have 1) a sense of the historical trajectories in the development of scientific methods, 2) a taste for live problems in philosophy of science, and 3) an appreciation of the importance of nuanced and active public engagement with science in practice, and 4) made a contribution to the public understanding of science yourself.

Background and Motivation

The aim of this course is to give you the background, tools, and the opportunity to evaluate the epistemic significance of a scientific result in a philosophically savvy way, and to communicate your interpretation to a public audience. (We'll talk about what "epistemic significance" means.) Scientific understanding and appreciation are particularly important today. Despite our political and intellectual culture awash in uninformed skepticism and "alternative facts" we face some incredibly important decisions, addressing climate change being one of the most disturbing, that would be best informed by thoroughly understood scientific results. But understanding and evaluating scientific results can be difficult. When the International Panel on Climate Change publishes "Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a *likely* range of 0.8°C to 1.2°C. Global warming is *likely* to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. (*high*

confidence)", what does this really mean?[1] What does this statement tell us about what we really know? What could we reasonably use such knowledge for? You may have heard skeptics say things like "evolution is just a theory." This retort is frustratingly ambiguous. On one hand, of course it's true. On the other hand, to say that evolution "just" a theory, belies the very real sense in which the products of scientific inquiry are different than the products of other human activities like art or politics. In this course we'll work to understand what exactly is importantly different about science and the products of scientific research by analyzing actual science from a philosophical perspective.

Preparing for Class

This is 300 level class and it will involve a lot of student-lead discussion. It is therefore essential that you carefully and thoroughly prepare for class. Please do the assigned readings. Philosophically rich material is often best digested in multiple iterations. A good strategy would be to read the material at least twice, marking it up and taking notes as you go. Please bring topics, questions, reflections that arise for you as you are reading to class so that we can discuss them as a group. If you run into trouble that prevents you from attending class, please contact me.

Important Note on the Final Project

This course builds up to a final project that will require you to do research outside of the course readings on a topic of your own choosing. Moreover, I am asking you not only to write up your final project, but also to find a way to communicate the fruits of your research to others outside of our class in a format of your own choosing. I provide detailed instructions and rubrics, we will talk about this in class, and I am readily available to help you throughout this process. Start early, ask questions, and get invested. I will be out of the country for a conference and a workshop in February. During that time, in lieu of regular classes, I have designed assignments for you to do on your own (2/5 and 2/7) and as a class without me (2/12). These assignments are crucial preparation for the successful execution of the final project.

[1] https://www.ipcc.ch/sr15/chapter/summary-for-policy-makers/

Course Schedule

Date	Readings	In Class
T 1/15	War between science and religion is far from inevitable Yes, there is a war between science and religion The Ill-logic of Alternative Facts (*sic*)	
	HISTORY OF EMPIRICAL METHODS	
H 1/17	Lorraine Daston's "The Empire of Observation, 1600-1800" (pages 81-113)	
T 1/22	Sir Francis Bacon's Aphorisms Concerning the Interpretation of Nature: Book 2: 1-24 from The New Organon (pages 48-74)	
	HUME'S PROBLEM OF INDUCTION	
H 1/24	David Hume's Sceptical doubts about the operations of the understanding and Sceptical solution of these doubts (part 1) in *Enquiry Concerning Human Understanding* (pages 11-20)	Introduction to your project group
	HOLISM, UNDERDETERMINATION, AND GOOD SENSE	
T 1/29	Pierre Duhem's Physical Theory and Experiment in *The Aim and Structure of Physical Theory* (pages 180-218)	
	VERIFIABILITY, INFERENCE, AND PARADOX	
H 1/31	Carl Gustav Hempel's "Studies in the Logic of Confirmation" in Aspects of Scientific Explanation (pages 3-46)	
	PROJECT RESEARCH AND GROUP BRAINSTORMING	
T 2/5	--your choosing--	No class meeting; see instructions for Homework 1
H 2/7	--your choosing--	No class meeting; see instructions for Homework 2
T 2/12	----	Autonomous project brainstorming meetings; see instructions for meeting report and debrief paragraph

Date	Readings	In Class
	FALSIFIABILITY	
H 2/14	Sir Karl Popper's *Conjectures and Refutations* (18 pages)	Discussion leaders 1& 2
	NON-EMPIRICAL VIRTUES AND THEORY CHOICE	
T 2/19	Thomas Kuhn's "Objectivity, Value Judgement, and Theory Choice" (17 pages)	Discussion leaders 3 & 4
H 2/21	Helge Kragh's "Testability and Epistemic Shifts in Modern Cosmology" (pages 48-56)	Discussion leaders 5 & 6
	ANTI-REALISM AND THE PESSIMISTIC META-INDUCTION	
T 3/5	Larry Laudan's "A Confutation of Convergent Realism" (pages 19-49)	Discussion leaders 7 & 8
H 3/7	----	Paper discussion
	OBJECTIVITY	
T 3/12	Lorraine Daston & Peter Galison's Prologue: Objectivity Shock and Chapter 1: Epistemologies of the Eye in *Objectivity* (pages 11-54)	Discussion leaders 9 & 10
	OBSERVATION AND INSTRUMENTS	
H 3/14	Ian Hacking's "Do We See through a Microscope?" (pages 132-152)	Discussion leaders 11 & 12
T 3/19	Dudley Shapere's "The Concept of Observation in Science and Philosophy" (pages 485-525)	Lab demo: Cosmic ray detection
H 3/21	----	Project workshop
	DATA	
T 3/28	James Bogen & James Wooward's "Saving the Phenomena" (pages 303-352)	Discussion leaders 13 & 14
H 3/28	Allan Franklin's Forging, cooking, trimming, and riding on the bandwagon: fraud in science in *The Neglect of Experiment* (pages 226-243)	Lab demo: Millikan oil drop experiment

Date	Readings	In Class
	MEASUREMENT	
T 4/2	Hasok Chang's Keeping the Fixed Points Fixed in *Inventing Temperature* (pages 8-56)	Discussion leaders 15 & 16
	SIMULATION	
H 4/4	Margaret Morrison's "Models, Measurement and Computer Simulation: The Changing Face of Experimentation" (pages 33-57)	Discussion leaders 17 & 18
T 4/9	Sherrilyn Roush's "The Epistemic Superiority of Experiment to Simulation" (24 pages)	Discussion leaders 19 & 20
H 4/11	Wendy Parker's "Simulation and Understanding in the Study of Weather and Climate" (pages 336-356)	
T 4/16	----	Paper discussion
	FURTHER	
H 4/23	Naomi Oreskes' "The Scientific Consensus on Climate Change: How Do We Know We're Not Wrong?" (37 pages)	

Assignment Schedule

Date*	Assignment	Percentage of Course Grade
W 1/16	Science Topics	2
W 1/23	Sign-up for Leading Class Discussion	----
T 2/5	Homework 1: Science Research	3
H 2/7	Homework 2: Philosophy of Science	3
T 2/12	Project Brainstorming Debrief Paragraph	2
T 2/12	Project Brainstorming Meeting Report	3
W 2/20	Final Project Written Proposal	5
W 3/6	First Essay	10
W 3/20	Homework 3: Science Communication	3
H 3/21	Final Project Workshop Worksheet	2
TBD 3/5-3/21	Group Project Meeting with Me	2
TBD 2/14-4/9	Leading Class Discussion	10
M 4/15	Second Essay	15
M 4/22	Final Project Write-up	25
W 4/24	Final Project: Science to the People	15
Sun 4/28	Extra Credit	Up to 2 possible

*****Unless otherwise noted, all assignments are due through Canvas on the assigned date before 11:59pm, although I encourage you to submit them earlier in the evening and to get enough sleep.

Communication

Please feel free to drop by my office hours to talk. I am committed to doing what I can to help you succeed in this course and I would love to work with you as you draft your course papers and develop your final projects. I strongly encourage you to come to my office hours or to set up an appointment at a different time if need be. Of course, you are also welcome to email me with questions about the course. I will do my best to respond within 48 hours.

Accommodation and Special Needs

I am committed to working with students with disabilities and special needs to make sure everyone gets the most out of the course and is assessed fairly. Students with disabilities or special needs should contact the Office of Accessibility at the beginning of the semester so proper accommodations can be made. More information about the Office of Accessibility can be found at: https://community.siena.edu/student-life/departments/office-of-accessibility/

Diversity and Inclusivity

In this course, I will do my best to ensure that students from all backgrounds and perspectives will be served equitably. The diversity that students bring to this class will be viewed as a resource, strength and benefit. Cultivating an inclusive class climate is partly your responsibility too. We will have plenty of opportunity to practice respectfully listening and responding to one another. In class discussion please:

- Do not interrupt others
- Avoid Ad Hominem responses
- Charitably interpret others
- Think before you speak
- Apologize if you make a mistake

Your suggestions about how to improve the value of diversity, inclusivity, and respect in this course are encouraged and appreciated—please reach out.

Academic Integrity

I have a zero-tolerance policy on plagiarism. As Saints, I expect much better of you. In this course, students and the instructor will respect Siena College's policies on academic integrity, which can be found at: https://community.siena.edu/academic-affairs/resources/academic-integrity/ It is your responsibility to understand and refrain from cheating, plagiarism and other forms of academic dishonesty. If you have *any questions* about what constitutes a failure of academic integrity, please ask me.

Grading Scale

Letter	Score Between	Letter	Score Between
A	94% and 100%	C	73% and less than 77%
A-	90% and less than 94%	C-	70% and less than 73%
B+	87% and less than 90%	D+	64% and less than 70%
B	83% and less than 87%	D	57% and less than 64%
B-	80% and less than 83%	D-	50% and less than 57%
C+	77% and less than 80%	F	0% and less than 50%