# Philosophy of Science

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**Office:** 223A Miner Hall
**Office Hours:** Thursday 1:30-3:30pm

**Semester:** Fall 2023
**Time:** Tues/Thurs 4:30-5:45pm
**Room:** Miner Hall 225
**Course Website:** Canvas

*This syllabus was last updated January 24, 2024*

## Course Description

This course provides a survey of issues central to the philosophy of science, with the broad goal of giving students better insight in what science is, how it works, and what role it plays in our society. This will include classic topics such as demarcation problems (what is science vs. pseudoscience?) realism vs. antirealism (what can science tell us about what is out there?) explanation (what is a good scientific explanation?) and the role of values in science (what kinds of epistemic and social values guide science?). Alongside these topics, we will also explore newer directions, including discussions of data, measurement and experiment, models and simulations, and the social epistemology of science. We will also consider the relationship between general philosophy of science and the philosophy of particular sciences (biology, physics, etc.), especially in light of recent trends towards increased specialisation.

## Contents

# 1 Learning Outcomes

By the end of this course:

- You will be able to identify key positions in classic debates in the philosophy of science, and to analyse the arguments in favor of these positions.
- You will be able to defend your own views about recent topics in the philosophy of science by articulating arguments in favour of your view and defending it from objections.
- You will be able to identify key assumptions, arguments, and evidence being presented in favour of a scientific result (e.g., in a scientific article).
- You will be able to articulate aspects of the social context of science, and the ways in which science in a social practice.

# 2 Text(s)

There are **no required textbooks**. All required course readings will be uploaded to Canvas or will be freely available online. In some cases, you may need to use your Tufts credentials to access something through the Tufts library. Please feel free to ask me if you need help accessing any of the readings.

You may find it useful to have access to a copy of the following, which provides a survey of many topics we will discuss:

- Peter Godfrey-Smith. *Theory and Reality : an Introduction to the Philosophy of Science*. Science and its conceptual foundations. University of Chicago Press, Chicago, 2003

See also section 7 for further helpful resources.

# 3 Course Requirements

All written assignments should be submitted via Canvas (except one-minute papers).

## 3.1 Meaningful Participation (15%):

Philosophy is a group activity; together we are more than the sum of our parts. With this in mind, students are expected to carefully study all required readings for each week and come prepared to discuss them, raise questions about them, and draw attention to their strengths and weaknesses.

In addition, students will complete pre-class **reading journals** and end-of-class **one-minute papers**, which will contribute to their 'meaningful participation' grade. These are required, but will not themselves be graded. Rather, they provide an opportunity for you to demonstrate engagement with the course material beyond in-class discussion.

- **Reading Journals**: By 12pm (noon) on the day of every class, you will submit 1-2 paragraphs where you reflect on that day's reading. You should answer two questions:
    1. What (in your view) is the most important claim made by the author(s).
    2. What is the most important question you have about the topic after reading (or watching/listening to) this text. This might be about something you found confusing or unclear, or it might constitute an objection to the author's arguments.
- **One-minute papers**: At the end of each class, we will devote a few minutes to writing 'one-minute papers' in response to a prompt provided in class.

You should attend every class but extenuating circumstances arise that can make this difficult. If you cannot attend a class or will be more than 15 minutes late, please let me know.

Any more than two unexcused absences or missed journal entries will negatively impact your participation grade.

## 3.2 Response Papers (x2) (20% total)

For these assignments, you will be asked to annotate an article to identify key assumptions, arguments, and evidence being presented in favour of the conclusion. You will write a short paper (1000 words max.) responding to the article, following a prompt provided by the instructor. More detailed information will be provided in due course.

Due dates:

- 1st: Friday, 29 September by 5:00pm
- 2nd: Friday, 10 November by 5:00pm

## 3.3 Peer Reviewed Research Paper (65% total)

You will write a final paper on one of the topics covered in this class. In it, you will articulate a position on that topic, and provide your own argument for that position. You will then articulate objections to your argument, and respond to those objections.

The paper will be produced in stages, with each stage contributing to your overall grade for the assignment. Part of your grade will also be based on the quality of the feedback you provide during two peer review stages.

- **Annotated bibliography with draft abstract** (5%)
  - due Friday 13 October by 5:00pm
- **In-class peer feedback on abstracts** (5%)
  - Thursday, 19 October (in class)
- **First draft (introduction + main argument)** (10%)
  - due Friday 3 November by 5:00pm
- **Peer feedback on drafts (written report)** (15%)
  - written report due Friday 17 November by 5:00pm
- **Final paper (including responses to objections)** (30%)
  - due Thursday, 14 December by 5:00pm

### 3.4 Letter Grade Conversion

| | | | |
|---|---|---|---|
| >= 93.00 | A | 73.00 - 76.99 | C |
| 90.00 - 92.99 | A- | 70.00 - 72.99 | C- |
| 87.00 - 89.99 | B+ | 67.00 - 69.99 | D+ |
| 83.00 - 86.99 | B | 63.00 - 66.99 | D |
| 80.00 - 82.99 | B- | 60.00 - 62.99 | D- |
| 77.00 - 79.99 | C+ | <= 59.99 | F |

## 4 Course Outline

All readings listed here are subject to change. The current version of this document will always be available on `Canvas`.

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### 4.1 Week 1: What is (Philosophy of) Science?

Tuesday, 5 September: Introduction and Syllabus

- No required reading

Thursday, 7 September: What is Science? What is Philosophy of Science?

- Angela Potochnik, Matteo Colombo, and Cory Wright. Chapter 1: What is Science? In *Recipes for Science*, pages 7–45. Routledge, 1 edition, 2019

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### 4.2 Week 2: Logic + Empiricism

Tuesday, 12 September: Logical Empiricism I

- Peter Godfrey-Smith. *Theory and Reality : an Introduction to the Philosophy of Science*. Science and its conceptual foundations. University of Chicago Press, Chicago, 2003, Chapter 2
- OPTIONAL: Peter Godfrey-Smith. *Theory and Reality : an Introduction to the Philosophy of Science*. Science and its conceptual foundations. University of Chicago Press, Chicago, 2003, Chapter 3 (The Problem of Induction)

Thursday, 14 September: Logical Empiricism II

- Rudolf Carnap. Empiricism, Semantics, and Ontology. *Revue Internationale de Philosophie*, 4(11):20–40, 1950

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### 4.3 Week 3: Theory Change

Tuesday, 19 September: Popper and Falsification

- Karl Popper. *The Logic of Scientific Discovery*. ISSR Library. Hutchinson, London, Chapters 1-2
- OPTIONAL: Peter Godfrey-Smith. *Theory and Reality : an Introduction to the Philosophy of Science*. Science and its conceptual foundations. University of Chicago Press, Chicago, 2003, Chapter 4

Thursday, 21 September: Kuhn and Scientific Revolutions

- Thomas S. Kuhn. *The Structure of Scientific Revolutions*. University of Chicago Press, Chicago, IL, 3rd ed. edition, 1996 (excerpts)
- OPTIONAL: Peter Godfrey-Smith. *Theory and Reality : an Introduction to the Philosophy of Science*. Science and its conceptual foundations. University of Chicago Press, Chicago, 2003, Chapters 5 & 6

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### 4.4 Week 4: Explanation

Tuesday, 26 September: The Covering-law Account

- Carl G. Hempel and Paul Oppenheim. Studies in the Logic of Explanation. *Philosophy of Science*, 15(2):135–175, 1948
- OPTIONAL: Peter Godfrey-Smith. *Theory and Reality : an Introduction to the Philosophy of Science*. Science and its conceptual foundations. University of Chicago Press, Chicago, 2003, Chapter 13
- OPTIONAL: Wesley C Salmon. *Four Decades of Scientific Explanation*. University of Pittsburgh Press, Namur, 2006 Chapter 2: The Second Decade

Thursday, 28 September: Causal Explanation

- James F. Woodward. *Making Things Happen: a Theory of Causal Explanation*. Oxford studies in philosophy of science. Oxford University Press, New York, 2003, Chapter 5: A Counterfactual Theory of Causal Explanation

- OPTIONAL: Philip Kitcher. Explanatory Unification and the Causal Structure of the World. In Philip Kitcher and Wesley Salmon, editors, *Scientific Explanation*, pages 410–505. Minneapolis: University of Minnesota Press, 1989

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**⋆⋆⋆ Friday, 29 September: Submit First Response Paper by 5:00pm (via Canvas)**

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### 4.5 Week 5: Realism I: 'No Miracles' vs. the 'Pessimistic Induction'

Tuesday, 3 October: In favor of Scientific Realism

- Stathis Psillos. *Scientific Realism: How Science Tracks Truth*. Philosophical issues in science. Routledge, London, 1999, Chapter 4: In Defense of Scientific Realism

Thursday, 5 October: Against Scientific Realism

- Larry Laudan. A Confutation of Convergent Realism. *Philosophy of science*, 48(1): 19–49, 1981
- OPTIONAL: Peter Godfrey-Smith. *Theory and Reality : an Introduction to the Philosophy of Science*. Science and its conceptual foundations. University of Chicago Press, Chicago, 2003, Chapter 12

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### 4.6 Week 6: Realism II: IBE and Epistemic Values

Tuesday, 10 October: Constructive Empiricism

- Bas C. Van Fraassen. *The Scientific Image*. Clarendon library of logic and philosophy. Clarendon Press, Oxford, 1980, Chapter 2: Arguments Concerning Scientific Realism
- OPTIONAL: Anjan Chakravartty. Scientific Realism. In Edward N. Zalta, editor, *The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, Stanford University, Summer 2017 edition, 2017 [LINK]

Thursday, 12 October: Epistemic Values

- Thomas S. Kuhn. Objectivity, Value Judgment, and Theory Choice. In *The Essential Tension: Selected Studies in Scientific Tradition and Change*, pages 320–39. University of Chicago Press, 1977

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**⋆ ⋆ ⋆ Friday, 13 October: Submit Annotated Bibliography and Draft Abstract by 5:00pm (via Canvas)**

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### 4.7 Week 7: Social Construction of Science

Tuesday, 17 October:

- Allan Franklin and Harry Collins. Two Kinds of Case Study and a New Agreement. In Tilman Sauer and Raphael Scholl, editors, *The Philosophy of Historical Case Studies*, volume 319 of *Boston Studies in the Philosophy and History of Science*, chapter 6, pages 95–121. Springer, 2016

Thursday, 19 October:

- Donna Haraway. *Simians, Cyborgs, and Women: the Reinvention of Nature*. Routledge, New York, 1991 (excerpts)

  ⋆⋆⋆ **In-class peer review assignment: discussion and feedback on research paper bibliographies and abstracts.** Please bring a two printed copies of your assignment to share with your peers.

### 4.8 Week 8: Science and Social Values I

Tuesday, 24 October: Inductive Risk

- Heather Douglas. Inductive risk and values in science. *Philosophy of Science*, 67(4): 559–579, 2000

Thursday, 26 October: Science as Social Knowledge

- Helen E. Longino. *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton University Press, 1990, Chapter 4: Values and Objectivity

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### 4.9 Week 9: Science and Social Values II

Tuesday, 31 October: Social reform, scientific reform

- Janet A. Kourany. A philosophy of science for the twenty-first century. *Philosophy of Science*, 70(1):1–14, 2003
- Maintenance Phase Podcast: The Body Mass Index. Listen at: https://www.maintenancephase.com/ or wherever you get your podcasts [transcript also available]

Thursday, 2 November: Systemic injustice in physics and astronomy

- Chanda Prescod-Weinstein. *The Disordered Cosmos : a Journey into Dark Matter, Spacetime, and Dreams Deferred*. Bold Type Books, New York, first edition. edition, 2021 (excerpts)
- Alexandru Marcoci, Ann C. Thresher, Niels C. M. Martens, Peter Galison, Sheperd S. Doeleman, and Michael D. Johnson. Big STEM Collaborations Should Include Humanities and Social Science. *Nature human behaviour*, 7(8):1229–1230, 2023

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⋆⋆⋆ **Friday, 3 November: Submit Research Paper Draft by 5:00pm (via Canvas).**

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### 4.10 Week 10: Experiments and Simulations

Tuesday, 7 November: Tufts Friday (no class)

Thursday, 9 November: Is a computer simulation an experiment?

- Eric Winsberg. A tale of two methods. *Synthese*, 169(3):575–592, 2009

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⋆ ⋆ ⋆ **Friday, 10 November: Submit Second Response Paper by 5:00pm (via Canvas)**

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### 4.11 Week 11: Peer Feedback Session & Guest Lecture

Tuesday, 14 November:

⋆ ⋆ ⋆ **Peer feedback session (JE travelling, will join remotely)**

- Peer drafts (we will go over the plan for this session and how you should prepare for it closer to the time)

Thursday, 16 November: Guest lecture: Dr. Nacho Sanguinetti Scheck, postdoctoral fellow in neuroscience at Harvard University

- TBA

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⋆⋆⋆ **Friday, 17 November: Submit Written Peer Review by 5:00pm (via Canvas).**

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### 4.12 Week 12: Model-laden Data

Tuesday, 21 November: Alisa Bokulich. Towards a Taxonomy of the Model-Ladenness of Data. *Philosophy of science*, 87(5):793–806, 2020

Thursday, 23 November: Thanksgiving (no class)

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### 4.13 Week 13: Observational and Historical Science

Tuesday, 28 November: Anti-realism about Astronomy

- Ian Hacking. Extragalactic Reality: The Case of Gravitational Lensing. *Philosophy of Science*, 56(4):555–581, 1989
- OPTIONAL: Dudley Shapere. Astronomy and Antirealism. *Philosophy of science*, 60 (1):134–150, 1993

Thursday, 30 November: In Defence of Historical Science

- Adrian Currie. *Rock, Bone, and Ruin: An Optimist's Guide to the Historical Sciences.* Life and Mind: Philosophical Issues in Biology and Psychology. MIT Press, Cambridge MA, 2018, Chapter 4: Over and Under

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### 4.14 Week 14: Wrapping Up

Tuesday, 5 December: The Event Horizon Telescope

- Watch: Peter Galison. Black Holes: The Edge of All We Know, 2020 Available through the library (or click `HERE`) using your Tufts credentials to log in. Also on Netflix.

Thursday, 7 December: Wrapping up

- No required reading

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⋆⋆⋆ **Thursday, 14 December: Submit Research Paper by 5:00pm (via Canvas).**

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# 5 Course Policies

## 5.1 Classroom Learning Agreement

In this class, we will:

- Come prepared to discuss the readings
- Let everyone contribute
- Be respectful, even when we disagree and try to approach disagreement with curiosity.
- Reflect on our own biases and how they may enter into our ways of thinking, interacting, etc.
- Remember that we are all human beings with emotions, so be kind!
- If you do mess up, apologize and take responsibility
- Cultivate a friendly learning community by:
  - Sharing our names with each other early and often
  - Waving or saying hi if you see each other outside of class.

## 5.2 Late or Incomplete Work

We all live busy lives outside of the classroom and we each face our own unique challenges. I understand that these challenges will sometimes make it difficult to complete class assignments or to show up for class ready to make our best contributions.

Please let me know as soon as possible (and ideally before the deadline) if you know that you will struggle to meet a deadline. When you do, we can determine a reasonable timeline for you to complete the assignment or, under some circumstances, an alternative way for you to demonstrate your learning

All students are entitled to two no-questions-asked 24-hour extensions on assignments, with the exception of in-class assignments (in particular, in-class peer review). You still need to let me know if you want to use one of these extensions! Further extensions are at the instructor's discretion, but I promise to be as flexible as possible in offering reasonable extensions.

Late work without such an extension will be penalised by 1/3 of a letter grade per day (so, e.g., an A- handed in one day late would become a B+).

# 6 Other Policies and Resources

## 6.1 Tufts Academic Resources

The `StAAR Center` offers a variety of FREE resources, available to *all students*. Students may make an appointment to work on any writing-related project or assignment, attend subject tutoring in a variety of disciplines, or meet with an academic coach to hone fundamental academic skills like time management or overcoming procrastination. Students can make an appointment for any of these services by visiting go.tufts.edu/TutorFinder, or by visiting their website: https://students.tufts.edu/staar-center

## 6.2 Accommodations

Tufts is committed to providing equal access and support to all qualified students through the provision of reasonable accommodations. If you have a disability that requires reasonable accommodations, you are encouraged to contact the StAAR Center at:

- `StaarCenter@tufts.edu` or
- 617-627-4539.

Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect for their provision.

In addition, students with or without a formally documented disability are warmly encouraged to contact me about accommodations. I am committed to collaborating with students to ensure that my course does not present unreasonable or inequitable barriers to their success.

## 6.3 Religious Accommodations

Tufts University faculty, staff, and administration highly value and acknowledge the religious diversity of its student body. Students seeking religious accommodations related to their holy days are encouraged to collaborate with faculty to make arrangements during the first week of each semester. The religious holy days calendar, including the holy days policy from the Faculty Handbook, is available `here` for your reference. Students seeking additional support may refer to the University Religious Accommodations Policy, available `here`. The University Chaplaincy is also available to respond to questions on religious observances; their contact information is available `here`.

## 6.4 Academic Integrity

All members of the Tufts community are responsible for integrity in their own behavior and for contributing to an overall environment of integrity at the university. You can find resources relating to academic integrity in the Tufts Academic Integrity handbook (`click here`). It is your responsibility to familiarize yourself with the requirements of ethical behavior and academic work as described in Tufts' Academic Integrity handbook.

If you ever have a question about the expectations concerning a particular assignment or project in this course, please ask me for clarification.

The Faculty of the School of Arts and Sciences and the School of Engineering are required to report suspected cases of academic integrity violations to the Dean of Student Affairs Office. If I suspect that you have cheated or plagiarized in this class, I must report the situation to the dean.

### 6.5 Guidelines for the use of AI

In this course, you may use AI tools for your learning, just as you can collaborate with your peers for things such as brainstorming, getting feedback, revising, or editing of your own work. However, you may not submit any work generated by an AI program as your own. This is a violation of Tufts Academic Integrity policies.

To help guide you in the use of AI in this course – consider the following guidelines:

- Familiarize yourself with AI tools, including that: Bias is embedded in the creation of these systems and in their output and you may encounter harmful language and ideas. AI platforms can produce inaccurate or false information with confidence (so called hallucinations, e.g, it frequently invent false references). Text from AI may closely mimic human knowledge, understanding and even human emotions. Many of these tools retain the rights to use your information and the content shared with them in a variety of ways.
- Cite all AI tools when used or referred to in assigned work. See `How to Cite ChatGPT` from the APA & `How to Cite Generative AI` from the MLA. Identify the way it contributed to your work. For example, you can include a statement that you asked an AI to "identify any grammatical or spelling errors" in your writing, or you used it to get started in thinking about topics for your paper. Any statement directly generated by an AI system should be in quotes.
- If you have questions please ask via email, in office hours or during class.

### 6.6 Student Support, Including Mental Health

As a student, there may be times when personal stressors or difficulties interfere with your academic performance or well-being. `The Dean of Student Affairs Office` offers support and care to undergraduates and graduate students who are experiencing difficulties, and can also aid faculty in their work with students. In addition, through Tufts' `Counseling and Mental Health Service` (CMHS) students can access mental health support 24/7, and they can provide information on additional resources. CMHS also provides confidential consultation, brief counseling, and urgent care at no cost for all Tufts undergraduates as well as for graduate students who have paid the student health fee. To make an appointment, call 617-627-3360. Please visit the CMHS website: `http://go.tufts.edu/Counseling` to learn more about their services and resources.

## 7 Other Resources

### 7.1 The Stanford Encyclopedia of Philosophy

Find it online here: https://plato.stanford.edu/

The SEP is a good place to start when learning about a new philosophical topic. The SEP entries are written by experts in that area and generally provide a good overview of the issues.

A good next step is often to follow up by reading the sources that the SEP entry sites on a particular issue.

### 7.2 Writing Philosophy Papers

- Jim Pryor's guide to philosophical writing:
  http://www.jimpryor.net/teaching/guidelines/writing.html
- Harvard guide to writing philosophy papers:
  https://philosophy.fas.harvard.edu/files/phildept/files/brief_guide_to_writing_philosophy_paper.pdf