

# Philosophy of Science: Physics, Reality, and Beyond

Instructor: Dr. Bixin Bell Guo

Tue. & Thur. 3:00-04:30 PM

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Old Main 003

Drop-in Hours: Tue. 4:30-5:30PM & Wed. 1:00-2:00PM

Old Main 113

Course website: <https://bixinguo.github.io/philsci.html>

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## Course Description

What is the world *ultimately, fundamentally* like, and how does science, especially physics, address this question? In what sense do quarks or quantum fields exist? Are they real? What about DNA molecules or distant galaxies? How are these scientific objects related to one another? What makes something a scientific law or a law of nature? While science (and the technologies that it has provided) are at the heart of modern society, and the “scientific method” is often held up as the gold standard in knowing about the world, what actually *is* science? What is its “method”, and just how seriously should we take its discoveries? Can the scientific method be understood as a genuinely objective way to gain knowledge? How does feminist philosophy of science challenge the idea that science is objective and value-free? How has the practice of science been influenced by its social and historical contexts? In this course, we will explore these topics in contemporary philosophy of science, philosophy of physics, and scientific metaphysics. No prerequisites in physics or other sciences.

## Learning Objectives

The immediate goal of this course is to (i) develop a basic understanding of the main themes in philosophy of science, (ii) develop and improve skills in analyzing, formulating, explaining, and critically evaluating arguments, (iii) learn how to read critically and write clearly.

## Classroom Policy

You are strongly encouraged to take notes in the old-fashioned way, on pen and paper. Electronic devices are not allowed in class for purposes other than taking notes. If, nonetheless, you want to use an electronic device—*It must be on flight mode*. It's too distracting for you and others. The same applies to any device (e.g. cellphone) that you bring to class but don't use.

To ensure the free and open discussion of ideas, students may not record classroom lectures, discussion and/or activities without the advance written permission of the instructor, and any such recording properly approved in advance can be used solely for the student's own private use.

## Office Hours and Email Guide

Please feel free to drop in any time during regular office hours. If you'd like to notify me earlier, you can also make an appointment (or see if other people have made an appointment during that time) here: <https://calendar.app.google/hXgeywJ8U31LuGDV6>. If the regular drop-in hours don't work for you, please do not hesitate to contact me to schedule an appointment. I'm happy to meet in person or over Zoom. It is very difficult to discuss philosophy by email, so it's recommended to ask them in office hours, during or after class. Some other reasons you might want to come to office hours include: you found something in the readings interesting and wanted to talk about it; you wanted to continue a conversation that started in class; you are confused about a reading; you are totally lost in class; you strongly disagree with a reading or with something someone said in class; you're interested in going to graduate school in philosophy; and so on.

If you have a logistical question about the course, the best way is to post it on Moodle (under 'Discussion' \_ 'Logistic Questions'). In the case of something urgent you'd like me to address, please include "urgent" in the email subject. If you don't hear from me in a week, please feel free to send a reminder.

## Requirements and Assessments

It is expected to have read the required readings for each class *before the class*. The readings are usually short (around 30 pages per session), but philosophy needs to be read slowly and carefully, so consider putting aside several hours for each week's reading. There are key questions and goals posted on the course website, which are meant to provide guidance for you to grasp the main ideas for each topic.

### ***1. Reading Responses***

A reading response consists of at least one question or objection that you have for the reading materials of each session. To receive full credit for this assignment, your reading response needs to directly engage with the reading materials and shows your understanding and critical thinking of the content. You may need to briefly explain the context of the question or objection for it to make sense. Each reading response is worth 1 point. You can receive up to 18 points. Reading responses are due every Tuesday and Thursday at 2pm.

### ***2. Participation***

One of the most important aspects of this course is your participation: asking and answering questions in class as well as engaging in group discussions. This is a way for you to actively engage with the class, instead of being merely recipients of information. It helps to develop your ability to think critically, to reflect and obtain a better understanding of the issues on hand, and to receive interactive guidance on your learning. To motivate and encourage your participation, you can earn 1 point for meaningful participation in each session, up to 20 points. Asking questions, engaging other students in conversation, and responding to questions that the professor asks all count.

If you have a good reason for missing class (such as a health issue), please contact me and conversations in office hours can also count as participation. If there is any other reason that participation is challenging for you, you can also ask me questions during the break or right after class, or possibly submit a written report after class—contact me as soon as possible to work out an alternative plan.

### ***3. Argument Quiz***

There will be a short logical-reasoning exercise at the beginning of the course. You'll have a week to take the quiz after it is posted, and you get two attempts to do the quiz. The point of this quiz is to make sure that you understand the fundamentals of arguments.

### ***4. Paper***

You will submit an essay of approx. 1200 words, in the style of an academic research paper. I'm not too strict about the word count, but definitely don't go above, say, 1500 words or below, say, 1000

words. I will post prompts for the essay in advance, but you are also free to propose a topic of your own choice. In preparation for your essay, we will have a writing workshop and a tutorial session in class, in which we will discuss more specific expectations and grading criteria.

To guide you through each stage of writing a paper, this assignment consists of multiple parts; for example, you can earn up to 2 points for submitting an outline and up to 3 points for submitting a draft (more details can be found below). You will receive extensive feedback on drafts from your peers and me (in terms of written comments and meetings). Only the final Paper Revision will be assigned a letter grade; other stages will be graded on the Complete/Incomplete basis.

*Alternative plan:* You can choose in the beginning of the semester to skip some stages: Paper Proposal, Paper Outline, and Paper Submission. In this case, your Paper Revision will weigh more to make up the missing points. It is also crucial that we communicate about expectations for this alternative plan. I invite you to discuss with me whether this alternative is a good fit for you.

### ***5. Final Project***

This is an opportunity for you to integrate our work in this class and to apply what you learn to analyze a topic of your own choosing in greater depth. You can choose any topic covered in class (but different from the Paper topic). You can present your work in standard formats, such as a presentation. You can also choose a creative project (including but not limited to, a debate, an interview, podcast episodes, zines, paintings, sculpture, maps, crochet art, music, etc.) supplemented with a short essay explaining the goal and rationale of your project. You may team up with other students in class for the final project. When you present your work in the last two sessions of class, make sure every member of your team gets equal time on stage. A proposal for Final Project is due on April 18. It includes: the format of the project, an outline or summary of your project, and, if you have any team members, their names and how you distribute work among team members. If you prefer the traditional method, you can also choose to take a written or oral exam as an alternative.

Note that, given the flexibility for this part of the course, it will be crucial that we communicate about expectations for the project. I invite you to discuss ideas for your project with me and with your peers before you develop a proposal.

### ***\*Extra Credit***

To encourage you take notes and share notes with other classmates, you can earn extra credits by submitting your notes. Please let me know in advance if you plan to submit your notes so we can make arrangements for different sessions.

***Grading breakdown***

Assignments	Deadlines	Credits
Participation in class		1*20=20
Reading Responses	Due before class	1*18=18
Argument Quiz	February 7	3
Paper		(39)
- Paper Proposal	February 21	1
- Paper Outline	February 28	2
- Paper Draft	March 7	3
- Paper Comments	March 14	2 * 3 = 6
Midterm Reflection	March 25	1
- Paper Submission	March 28	3
- Individual Writing Meeting		3
- Paper Revision		20
Final Project		(20)
- Proposal for Final Project	April 18	2
- Presentation/Submission	Last week of class	18
Total		100
*Extra Credit		3

***Grading Scale***

	A: 93	A-: 90
B+: 87	B: 83	B-: 80
C+: 77	C: 73	C-: 70
D+: 67	D: 63	D-: 60

\*Numeric grades like 92.5 will be rounded up to A if and only if students show either excellent participation or significant improvements through the term.

***Late Policy***

In general: if something is up, let me know, and I'll see what I can do to help.

If you experience any health problems or emergency and cannot finish the assignments on time, the class plan is designed in a way that you would be able to make it up later. If there are any further problems, please contact me so that we can work out a solution. Usually late work is worth 10% fewer points for every day it is late from the time it was due, unless you have a compelling reason for turning it in late (for instance, you were sick, had to work late, or had to take care of someone else). In order to give you full credit for your late work, please contact me as soon as possible.

**Topics (*subject to revision*)**

- Introduction
- Deductive and inductive reasoning
- The problem of induction
- Logical Positivism
- Popper and falsification
- Kuhn, theory change, and scientific revolution
- Scientific Realism
- Constructive Empiricism
- Structural Realism
- Laws of nature
- Scientific explanation
- Reduction and emergence
- Science and value
- Feminist Philosophy of Science
- The direction of time
- Philosophy of quantum mechanics

## Other Resources and Policy Statements

### Disability Resources and Services

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and [Center for Disability Resources](#), (651)-696-6748, [disabilityresources@macalester.edu](mailto:disabilityresources@macalester.edu), as early as possible in the term. The center will verify and determine reasonable accommodations for this course.

NOTE: If you have read this far in the syllabus, send me an email saying that the secret password to the universe is “42” and you’ll get credit for one reading response. Feel free to let me know also what you think of the answer.

### Diversity and Inclusion

Macalester College is committed to creating an accessible and inclusive environment that supports and serves our community members, and does not discriminate based on factors as stated in the Title IX policy. For more information about policies, procedures, and practices, see: <https://www.macalester.edu/title-ix/sexualmisconductpolicy/>.

The assignments and exams will be graded anonymously to ensure fairness and to avoid biases. The reason to grade anonymously is to eliminate the possible effects of implicit biases. For an introduction to implicit bias, take Project Implicit’s “Implicit Association Test” (<https://implicit.harvard.edu/implicit>) or read the Stanford Encyclopedia of Philosophy’s article on Implicit Bias (<https://plato.stanford.edu/entries/implicit-bias/>).

### Health Resources and Policy

Your health is a priority. Please take care of yourself by staying hydrated, eating well, exercising, getting enough sleep, and taking time to relax. There are many other wonderful people at Macalester and in our broader community who can also help with specific aspects of your mental and physical health. Some of them are listed here: <https://docs.google.com/document/d/1IhoiGs6iUgX-htD64jf60CqbfVE1lp9JhVNlnm6iNsA/preview?pli=1>.

An important part of the college experience is learning how to ask for help. Take the time to learn about all that’s available and take advantage of it. Ask for support sooner rather than later—this always helps. If you or anyone you know experiences any academic stress, difficult life events, or difficult feelings like anxiety or depression, we strongly encourage you to seek support. Consider

reaching out to a friend, faculty or family member you trust for assistance connecting to the support that can help.

### Academic Integrity

Students in this course will be expected to comply with the [Macalester's Policy on Academic Integrity](#). Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, and Students found guilty are subject to disciplinary action, as outlined in the guidelines on Academic Integrity. Furthermore, no student may bring any unauthorized materials to an exam. To learn more about Academic Integrity, visit the [Academic Integrity Guide](#) for an overview of the topic.

If you have any questions about the academic integrity policy, please bring them up to me in class or in office hours. I will never, ever judge you for having a question about the academic integrity policy. I would much prefer that you ask me any questions you have than that you end up suffering serious disciplinary consequences because you were confused or misinformed.