

# Philosophy of Science

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## Focus

Philosophy of Science explores the possibilities, conditions, constraints, and limitations of scientific knowledge. As a skeptical endeavor it provides arguments to criticize all forms of dogmatism that are connected with the authoritative role of the sciences in modern societies, and as a philosophical discipline that studies the relation between knowledge and what this knowledge is about it provides theoretical means to discuss the role of observation, experiments, language, theories, models, and inferences in processes of knowledge generation.

In this class, we will focus on the following questions:

1. How do we gain knowledge about the world?
2. How can we justify such knowledge?
3. What is a scientific explanation?
4. How can we represent knowledge, and do our representations determine what we can know?
5. Are there facts and natural laws? Is it possible to know the truth?
6. How to define the boundary between science and non-science?

## New Ways of learning

Since “knowledge” is also a question of skills and practices (knowing *how* to justify, to argue, or to communicate clearly and reasonably), the main focus of this class will be on activities: *reading*, *writing*, *discussing*, *re-writing*, and *presenting*. Our class meetings on Tuesday will be reserved for discussions about the readings. To prepare these discussions, you will find in T-Square (under “Assignments”) a few questions each week that allow us to focus on the readings’ central points. Your job is to read the texts and to answer all these questions in about one page. The idea is that we are best prepared for our discussions when we have already grappled at home with the ideas we will focus on in class.

One interesting aspect of this will be to see how many different answers, interpretations, and arguments are possible. Our discussions will reveal these differences, and they will give you an opportunity to reflect critically on what you have done individually at home, and also an opportunity to improve your own thinking by learning from others. That is what is most important for learning. I am not interested in what you already know, but in how you improve your own thinking. To do this, your second task in each week will be to *revise* the answers you formulated for the preparation of the discussions. You will see that you are much better prepared for our discussions when you have already written something in advance. And I hope that our discussions will motivate you to improve these writings in a second round of reflections at home again.

On Thursday, we will have group presentations and discussions. In the first section, one group will present a short summary of the Tuesday discussion (5 to 10 minutes). In the second section, another group will introduce themes from additional readings (about 30 minutes). Everybody has to sign up for two groups, one summary and one presentation. For details regarding both the Tuesday and the Thursday sessions see the section “Grading” below.

## Readings

*Book to buy at the Engineers Bookstore:*

- Chalmers, Alan Francis (1999 <1976>). *What is this thing called science? An assessment of the nature and status of science and its methods*. Indianapolis: Hackett Pub Co.

*Additional readings*

(most of them can be downloaded from our course page at <https://t-square.gatech.edu>, folder “Resources.” The rest is from books that are on reserve in the library):

- Boersema, D. (2008). *Philosophy of Science. Text with Readings*. New York: Pearson Prentice Hall.
- Cartwright, N. (1997). Models: The Blueprints for Laws, *Philosophy of Science. Supplement* 64(4) S292-S303.
- Duhem, Pierre (1997 <1906>). Physical Theory and Experiment. In *Scientific Knowledge*. Ed. by J. Kourany. Belmont, CA: Wadsworth Publishing, 187-194.
- Economist (Oct 25, 2007). All Systems Go. A Powerful Way of Studying Biology Looks Set for Take-Off, *Economist*.
- Feyerabend, P. (2005 <1975>). How to defend society against science. In N. Warburton (Ed.), *Philosophy. Basic Readings* (2nd ed., pp. 365-375). New York: Routledge.
- Godfrey-Smith, Peter (2003). *Theory and reality. An introduction to the philosophy of science*. Chicago: University of Chicago Press.
- Haack, S. (1997). The First Rule of Reason. In J. Brunning & P. Forster (Eds.), *The Rule of Reason. The Philosophy of Charles S. Peirce* (pp. 241-261). Toronto, Buffalo, London: University of Toronto Press.
- Hacking, I. (1983). *Representing and Intervening. Introductory Topics in the Philosophy of Natural Science*. Cambridge Cambridge Univ. Press.
- Harré, R. (2002). Understanding scientific method. In *Cognitive science. A philosophical introduction* (pp. 8-9; 35-58). London; Thousand Oaks, Calif.: SAGE.
- Laudan, L. (1982). Commentary: Science at the Bar-Causes for Concern. *Science, Technology and Human Values*, 7(41), 16-19.
- Laudan, L. (1997 <1987>). Progress or rationality? The prospects for normative naturalism. In D. Paineau (Ed.), *The Philosophy of Science* (pp. 194-214). Oxford; New York: Oxford University Press.
- Law, S. (2005 <2003>). Why expect the sun to rise tomorrow? In N. Warburton (Ed.), *Philosophy. Basic Readings* (2nd ed., pp. 339-347). New York: Routledge.
- Longino, Helen E. (1996 <1993>). Subjects, Power, and Knowledge: Description and Prescription in Feminist Philosophies of Science. In *Feminism and science*. Ed. by E. F. Keller and H. E. Longino. Oxford; New York: Oxford University Press, 264-279.
- Mayo, D. G. (1996). *Error and the Growth of Experimental Knowledge*. Chicago and London: University of Chicago Press, 57-101.

- Oppenheimer, M., O'Neill, B. C., Webster, M., & Agrawala, S. (2007). Climate change - The limits of consensus. *Science*, 317(5844), 1505-1506. (Doi: 10.1126/science.1144831).
- Oppenheimer, M., O'Neill, B. C., & Webster, M. (2008). Negative learning. *Climatic Change*, 89(1-2), 155-172. (Doi: 10.1007/s10584-008-9405-1).
- Popper, K. (2005). The problem of demarcation. In N. Warburton (Ed.), *Philosophy. Basic Readings* (2nd ed., pp. 351-361). New York: Routledge.
- Quine, W. V. O. (1964 <1951>). Two Dogmas of Empiricism. In *From a Logical Point of View: 9 Logico-Philosophical Essays*, W. V. O. Quine. Cambridge, Mass., Harvard Univ. Press: 20-46, **only** pp. 42-46.
- Ruse, M. (1982). Response to the Commentary: Pro Judice. *Science, Technology and Human Values*, 7(41), 19-23.
- Sokal, A., & Bricmont, J. (2005 <1998>). Feyerabend: Anything goes. In N. Warburton (Ed.), *Philosophy. Basic Readings* (2nd ed., pp. 376-381). New York: Routledge.
- Tiles, Mary (1997). Science and the Politics of Hunger, *Philosophy of Science. Supplement 64* (4), S161-S174.
- Zimbardo, P. G. (2006). Stanford Prison Experiment web site. Retrieved June 30, 2008, from <http://www.prisonexp.org/>
- Zimbardo, P. G. (2007). Revisiting the Stanford Prison Experiment: a Lesson in the Power of Situation. *The Chronicle Review*, 53.

### **Tools (available in “Resources” in T-Square):**

- “Tools for Philosophy.” A document that lists encyclopaedias (books and online) that can help if you have problems with philosophical terminology.
- Tips for presentations (including some special advice for some of the presentations)

### **E-mails**

Make sure that you receive e-mails sent to your GT e-mail address because this is the only one that I can use to contact you. This is also important for your group work. Check your e-mail regularly.

### **Academic Honor Code**

Based on GT’s Honor Advisory Council recommendation I would like to clarify the following points: You are allowed (and encouraged) to work together with other students on homework, as long as you write up and turn in your own solutions. Submitting any work other than your own is a violation of the Academic Honor Code. Quoting other authors, of course, is common scientific practice. However, you have to make absolutely clear what are your own formulations, and what those of others. You can quote the texts of our seminar in short form (e.g. “Esposito, p. 52”). Other sources have to be listed under “References.” Plagiarism will be dealt with according to the GT Academic Honor Code. Note that plagiarizing is defined by Webster’s as “to steal and pass off (the ideas or words of another) as one’s own : use (another’s production) without crediting the source.”

For any questions involving these or any other Academic Honor Code issues, please consult me or [www.honor.gatech.edu](http://www.honor.gatech.edu).

## Schedule

<i>Week</i>	<i>Date</i>	<i>Theme</i>	<i>Readings</i>
1	Aug 19	Introduction	
	Aug 21	Workgroups: Who is right regarding the boundaries between science and non-science in a debate about “creationism”?	Laudan 1982; Ruse
2	Aug 26	Deriving knowledge from observations	Chalmers xix-18
	Aug 28	<i>Presentation: Observation and Measurement</i>	<i>Boersema chap. 2</i>
3	Sept 2	Deriving theories from facts: induction	Chalmers 41-58; Law
	Sept 4	<i>Presentation: Theories and Models</i>	<i>Boersema chap. 4</i>
4	Sept 9	Falsificationism	Chalmers 59-86
	Sept 11		
5	Sept 16	Limitations of falsificationism	Chalmers 87-103
	Sept 18	<i>Presentation: Duhem-Quine-Holism</i>	<i>Duhem, Quine</i>
6	Sept 23	Kuhn's paradigm shift	Chalmers 104-129
	Sept 25	<i>Presentation: A rational or irrational shift?</i>	<i>Godfrey-Smith 102-121</i>
7	Sept 30	Lakatos' research programs	Chalmers 130-148
	Oct 2	<i>Presentation: Rationality of methodology choice?</i>	<i>Laudan 1997</i>
8	Oct 7	Feyerabend. Changes in method	Chalmers 149-173
	Oct 9	<i>Presentation: Defending society against science, and vice versa</i>	<i>Feyerabend; Sokal &amp; Bricmont</i>
9	Oct 14	<b>GT Fall break</b>	
	Oct 16	<i>Presentation: Feminist philosophy of science</i>	<i>Longino; Godfrey-Smith 136-144</i>
10	Oct 21	The new experimentalism	Chalmers 193-212
	Oct 23	<i>Presentation: What is scientific realism?</i>	<i>Hacking 21-40</i>
11	Oct 28	Why should the world obey laws?	Chalmers 213-225
	Oct 30	<i>Presentation: Models as blueprints for laws</i>	<i>Cartwright</i>
12	Nov 4	Modeling in science	Harré, Economist
	Nov 6	<i>Presentation: Microscopes—seeing by doing and the realism problem</i>	<i>Hacking 186-209</i>
13	Nov 11	Scientific Explanation	Boersema chap. 5
	Nov 13	<i>Presentation: Bayesian and error statistics</i>	<i>Mayo</i>

<i>Week</i>	<i>Date</i>	<i>Theme</i>	<i>Readings</i>
14	Nov 18	Values in science	Tiles
	Nov 20	<i>Presentation: The first rule of reason</i>	<i>Haack</i>
15	Nov 25	Research ethics	Zimbardo 2006+2007
	Nov 27	<b>GT holiday</b>	
16	Dec 2	Scientific uncertainty and policy making	Oppenheimer 2007+2008
	Dec 4	<i>Final discussion</i>	

## Grading

The basis for your grade is your *continuous* reading, writing, and participating in our class discussions, and the participation in a group that presents a summary, and another one that presents one of the texts listed above. You have to work hard to get the grades you wish to have, but this work is equally distributed over the whole semester. There will neither be an extra essay, nor a final exam.

### *Attendance*

Since you will learn mainly by our class discussions, **attendance** is mandatory. There will be 30 class meetings over the whole semester. Independently of the other points you can get in the other areas, you will get an “**F**” if you attend less than 20 meetings, and nothing better than a “**C**” if less than 23. Please sign the attendance list that will be available during the first 5 to 10 minutes of each class.

### *Participation*

8% of your final grade will depend on the amount and quality of your **contributions** to our class discussions over the whole semester. Your contributions are essential for this seminar-style class.

Maximum for your contributions to class discussions: **8 points**.

### *Homework, first version*

33% can be reached by sending each week your first version of the assignment **before class starts on Tuesday**. You will find the questions and tasks for each week in the folder “Assignments” in T-Square, and you have to submit your answers through the text field that you will find at the same location. Only T-Square submissions are accepted, but you should save copies on your own computer. You can “save” your work in T-Square (do that when you leave your computer for a while, because after a while you have to log-in again and everything will be lost otherwise), but you have to click “submit” before the deadline.

There are first version assignments for 14 weeks, but I will count only 11 weeks (that gives you some flexibility). I will not evaluate the quality of these first version answers, but you have to submit them before class on Tuesday, and they must be complete (3 points for each, unless they are incomplete).

Maximum for first version homework: **33 points**.

### *Homework, second version*

What I will evaluate, however, is the quality of your revisions of your first version, especially the *progress* between first and second version (max. 5 points each). I expect these revisions **before class starts**

**on Thursday of the same week.** However, you can submit these second versions within three weeks (there is a second deadline set in T-Square which is not visible for you. Those submissions will be marked as “late” but that does not matter for the evaluation. The second deadline is exactly 3 weeks after the class discussion on Tuesday). For the last weeks of the semester, however, you will have less than 3 weeks for your second versions because there is a final deadline at the end of the semester: December 11.

On these revisions depends another 40% of your final grade. Evaluation criteria: 0 points if your second version is the same as the first one; 1 point if there are only marginal changes in your second version, or if you do not answer the questions. One further point, up to a maximum sum of 5 points, is possible for each of the following cases: (1.) there are improvements, but no substantial ones; (2.) there are substantial improvements (for example: a new argument, clarification of terminology, a new structure of your answer, better examples); (3.) you reflect explicitly on the reading, and (4.) on the main point(s) of our class discussion. A 5-points submission must not only be good, but excellent with regard to clarity and adequacy for the topic. Please note that an improvement is not necessarily longer than the original version, rather the opposite. Clarifying the structure of your argument and focusing on the essential points is mostly better than making things more complex. To improve your work over the semester, you should check regularly my comments on your assignments in T-Square.

I expect second versions for 8 weeks out of 14 possible. If you submit answers for more weeks, I will count only the 8 best weeks (second versions will only be evaluated if you submitted a first version. If not, the second version counts as a first one).

The main point is that I really expect that you revise your first version answers based on what you have learnt in our discussions. Even if your first answers are nearly perfect, there are always new perspectives that can enrich your prior point of view, and it is always possible to structure and formulate an argument in a better way. Learning means the development of your own thinking. There are no absolute standards what you should “know” at the end of this semester. More important is the process of learning and the improvement of your thinking.

Maximum for second version homework: **40 points**.

### *Presentation*

Further 14% are based on your group presentation on the reading that is listed in the syllabus. Go to “Section Info” in T-Square to sign up for a presentation. The presentation should be about 30 minutes for the whole group; additional discussion time about 30 minutes. In order to distinguish these groups from the summary groups, they are listed in T-Square as “Discussions.” If you do a Powerpoint presentation, please upload it into the “Resources” folder in T-Square.

Evaluation criteria: The presentation should be interesting and challenging for the audience; clearly structured with regard to theses, arguments, and problems; all group members must be involved; the audience should be motivated to discuss the issues presented. There is a certain danger that people in class get overwhelmed by too many details. Therefore, you should focus on only one essential message, one central idea (or a clearly defined set of ideas). Use the material of the reading only so far as it supports your point. It is important to repeat this point time and again, and to relate all the details of your talk clearly to your overall message. To identify the central point of your presentation, ask yourself: What is the function of the reading for this seminar?

Maximum for the presentation: **14 points**.

### *Summary*

6% are based on a short presentation that summarizes only your revised answers to the homework questions and some central points of the previous class discussion (5-10 minutes for the whole group). Talk especially about questions you might have and problems that are still open. You have to sign up for one summary in T-Square via "Section Info." The summary groups are listed here as "Labs" to distinguish them from the presentations mentioned above.

Maximum for the summary: **5 points**.

### *Check your points regularly to see whether the system works*

During the whole semester, you can see all your points in the "Gradebook" of "T-Square." But give me a few days to put them into the system.

### *Grading system*

At the end, all your points will be transformed into letter grades according to the following list:

A	90-100
B	80-89
C	70-79
D	60-69
F	0-59

### **Contact**

Feel free to contact me if there are any problems you would like to discuss. My office hours are Tuesday at 3 p.m. or by appointment. The office is located in the basement of the DM Smith Building, room 004. My phone number is 404-385-6083. The easiest way to contact me is by e-mail: [m.hoffmann@gatech.edu](mailto:m.hoffmann@gatech.edu).