HPS 0611: Principles of Scientific Reasoning Fall 2016

August 31, 2016

1 Important Information

Class Meeting Time: Wednesday 6:00-8:30PM
Location: Cathedral of Learning 335
Required Text: Gimbel, Steven. 2011. *Exploring the Scientific Method: Cases and Questions.* Chicago: University of Chicago Press.
Website: Courseweb

Instructor: George Borg
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Office: Cathedral of Learning 901N
Office Hours: (*encouraged!*) Friday 11:45 am - 1:45 pm & by appointment

2 About This Course

University Course Description

The course will provide students with elementary logic skills and an understanding of scientific arguments. Ours is an increasingly scientific and technical society. In both our personal life decisions and in our work we are daily confronted by scientific results which influence what we do and how we do it. Basic skills in analyzing the structure of arguments in terms of truth and evidence are required to make this type of information accessible and useful. We hear, for example, that drinking alcoholic beverages reduces the chances of heart disease. We might well ask what sorts of tests were done to reach this conclusion and do the tests really justify the claim? We read that certain geographical configurations in South America "prove" that this planet was visited by aliens from outer space. Does this argument differ from other, accepted scientific arguments? This course is designed to aid the student in making sense of a variety of elementary logic skills in conjunction with the application of those skills to actual cases.

Quantitative & Formal Reasoning Requirement

This course fulfills the Quantitative & Formal Reasoning Requirement of the School of Arts and Sciences, as described here:

> Mathematics is well described as the queen of sciences, providing the universal language of measurement, quantitative analysis and quantitative reasoning, and providing that predictive power that is the base of our science and our technology. All students are required to take and pass with a grade of C or better at least one course in university mathematics (other than trigonometry) for which algebra is a prerequisite, or an approved course in statistics or mathematical or formal logic in a department of the Dietrich School.

A student who has demonstrated proficiency in mathematics adequate for placement in an upper-level course in mathematics is exempt from this requirement.

A Note on Our Textbook and Choosing Your Own Adventure

This course is intended as an introduction to scientific reasoning and to the practice of analyzing and interpreting evidential claims and the arguments made in their support. You will engage with real scientific episodes via primary sources using your understanding of a wide variety of frameworks developed by philosophers of science. Throughout, we will be concerned with the question: what is "the scientific method?" Are there just one, several or no scientific methods? The rationale for this approach is that the skills you develop by seeking to understand science itself will serve as the foundation for evaluating science-related claims and arguments made in both scientific and non-scientific venues. We will also have the opportunity to investigate general argument types and scientific claims in daily life.

I chose our textbook on the basis of three major factors. One is its use of historical episodes, as mentioned above. In addition, the book is cleverly designed to gradually build up your research skills as the course progresses, by having you apply philosophical theories of scientific method to the historical cases. While our textbook includes the first two sets of readings that you will need to complete your initial case studies, the remaining six will require you to locate and navigate the source material yourself, in an increasingly sophisticated manner. This is a good way for you to practice something that will be useful to you not only in this course, but in your education more broadly.

Finally (and best of all) this is a *choose your own adventure* course. At the beginning of the term you will select from a list of nine areas of science according to your interest (astronomy, atomic physics, chemistry, genetics, evolutionary biology, geology, psychology, sociology, or economics). The readings that you do for the rest of the course will be relevant to the area that you have chosen. This means you and your peers will contribute expertise in different case studies (in addition to our shared philosophical tools) to our classroom. My hope is that this diversity will make the course richer and more interesting than it would otherwise be. This format will also allow us to use small-group discussions to investigate the commonalities and differences that we encounter in different kinds of science.

HPS 0611 Schedule

Please note that the Fall Term add/drop deadline is 9/9. We will not meet on Wednesday, November 23rd due to the Thanksgiving Recess.

Note that the readings should be done *before* the date on which they are listed in the schedule below. The page numbers listed refer to our required text (ESM) unless noted otherwise. Be prepared to discuss the assigned readings in class. Assignments are due in class on the date listed. Note that this schedule may change over the course of the term, but that you will be informed of changes with adequate adjustments made for assignment due dates and other course expectations.

Week	Date	Topic	Readings	What's Due
1	8/31	Intro/Arguments I	handout	
2	9/7	Arguments II	handout	
3	9/14	Deductivism	1-29 ESM case study Aristotle, from *Posterior Analytics* and *Physics* Descartes, *Discourse on Method*	WS 1 & CS 1

4	9/21	Inductivism	43-74[1] & ESM case study Francis Bacon, from *Novum Organum* Newton, from *Principia* J. S. Mill, from *A System of Logic*	
5	9/28	Hypothetico-Deductivism	91-111, 155-169 [read case study of interest] W. Whewell, from *Novum Organum Renovatum* R. Carnap, "Theoretical Procedures in Science" R. B. Braithwaite, from *Scientific Explanation*	CS 2
6	10/5	Paradoxes of Evidence	112-140 Hume, from *An Enquiry Concerning Human Understanding* Nelson Goodman, from *Fact, Fiction, and Forecast* C. G. Hempel, from "Studies in the Logic of Confirmation"	
7	10/12	Falsificationism	141-154 Karl Popper, from *The Logic of Scientific Discovery*	
8	10/19	Interlude on social epistemology. Guest lecture by Haixin Dang	Hardwig (1985), "Epistemic Dependence" (Courseweb); "Social Dimensions of Scientific Knowledge" http://plato.stanford.edu/entries/scientific-knowledge-social/	CS 3
9	10/26	Holistic View of Theories [& final essay info]	171-213 & case study P. Duhem, from *Aim and Structure of Physical Theory* T. Kuhn, from *The Structure of Scientific Revolutions* I. Lakatos, *The Methodology of Research Programmes*	
10	11/2	Semantic View of Theories	231-269 & case study Marshall Spector, "Models and Theories" Max Black, "Models and Archetypes" Ronald Giere, from *Explaining Science*	CS 4
11	11/9	Critical Views of Scientific Theories	281-314 & case study Paul Feyerabend, from *Against Method* Ruth Hubbard, "Science, Facts, and Feminism" Bruno Latour, "The Science Wars: A Dialogue"	
12	11/16	Probability I	handout	CS 5, Final Essay Proposal
13	11/23	**No Class**		

[1] The Bacon reading is difficult, so I have uploaded an easier-to-understand, albeit somewhat anachronistically worded, version by Bennett to Courseweb (under "Course Documents").

14	11/30	Probability II	handout	CS 6
15	12/7	Wrap-up		WS 2
Finals Week	12/14	**No Class**		**Final Essay (Courseweb)**

4 Evaluation

Class Participation

A component of your grade in this course depends on your participation in class. This includes attendance as well as your contribution to group discussions and exercises.

Assignments

Throughout the term you will be asked to complete a number of assignments to help you engage deeply with the course material and to practice your philosophical skills. The due dates for these assignments are listed on the course schedule above. The majority of the assignments will be case studies relevant to the scientific area that you choose at the beginning of the course. To do these case studies you will need to read the relevant part of our textbook, read the additional material on which your case study will be based, answer the questions appropriate to your case specified in our textbook, and submit your work in class. These case studies will serve as preparation for your final essay. You will also be asked to complete two worksheets designed to assess your comprehension of some of the more quantitative and formal aspects of our course.

Final Essay

This course is intended to prepare you to engage in a philosophically savvy manner with evidential claims and arguments having to do with science. Completing several case studies on historical scientific episodes will equip you with tools for, and practice in, conducting such analysis. For the final essay, I invite you to apply the skills you develop in the course to analyze a scientific episode of your choosing in somewhat greater depth than the brief case study assignments. My hope is that you will explore some topic that you find personally intriguing. More detailed instructions for the final essay will be presented in class and posted on Courseweb.

Your grade for the final essay in this course will be based on your on-time submission of an essay proposal (due 11/16) and the essay itself. Both of these elements contributes to the overall 32% of your grade allocated under “Final Essay”. It is advisable to discuss ideas for your project with me and with your peers before you craft the project proposal, although I will also give you feedback on the proposal you submit.

Note that you have the opportunity to submit your final essay at any time between when your proposal has been approved and the final deadline, which is 12/14. It may be convenient for you to submit your project early, especially if you know that your final exam schedule will be brutal.

Grading

20% Participation

12% Worksheets (2 x 6% each)

36% Case studies (6 x 6% each). 1-2 pages double-spaced.

32% Final essay. 4 pages double-spaced + 1 paragraph proposal.

100% Total

Class participation will be self-evaluated in class.

You will be allowed one absence throughout the semester. Unless you can excuse *all* your absences with legitimate excuses, no additional absences will be allowed. Please plan accordingly.

5 Course Policies

Deadlines

If you are having trouble finishing the work on time, please contact me before the due date and we can discuss arrangements and penalties for late work. Unless serious misfortune befell you, I will not accept late work if you don't approach me beforehand.

Plagiarism

Plagiarism will not be tolerated in this course. The University's Policy on Academic Integrity can be found at <http://www.as.pitt.edu/fac/ policies/academic-integrity>. If you have questions about this issue, or about how to cite your work, make sure to utilize university resources and to approach me with any remaining concerns. *It is better to ask.*

Classroom Climate

Philosophy happens in dialog. It is therefore essential to the success of this course to cultivate a respectful and collaborative atmosphere in the classroom. Please do your best to contribute to a productive, supportive, and inclusive learning environment for yourself and your peers. If at any time during the course you have concerns related to classroom climate, you are strongly encouraged to raise them with me or with another trusted member of the university community.