

PHIL 3380

University of Central Arkansas  
Fall Semester 2015

# Philosophy of Science

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## Basic Information

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Instructor: Bennett McNulty  
Office: Irby 118C  
Office Hours: TBA

Course Meetings: Tuesdays and Thursdays, 10:50–12:05  
Location: Irby 311

## Course Description

In this course, we consider philosophical questions that arise for science, generally, and some of the special sciences, in particular. We are especially interested in examining questions such as the following. What makes an intellectual inquiry genuinely scientific? What does history tell us about the nature of science? In a scientific context, what does it mean to explain a phenomenon or occurrence? Are the unobservable things postulated by our best scientific theories really *out there*? In addition, we consider specific philosophical issues that arise in particular sciences, including physics, chemistry, and biology.



Marie Curie in her laboratory

## Course Objectives

By the end of this course, each student will be able to

1. Describe prominent philosophical theories regarding the nature of scientific inquiry.
2. Explain fundamental philosophical issues that arise in physics, chemistry, and biology.
3. Support persuasively her own position on issues in the philosophy of science verbally and in writing.
4. Communicate clearly, precisely, and rationally about abstract topics.

Students achieve these outcomes through practice and feedback. During the semester, students produce written and verbal descriptions of theories in the philosophy of science, justify positions using historical and contemporary examples in assignments and discussions, and receive feedback on these activities from the instructor and peers.

## Texts

### Textbook

*Philosophy of Science: The Central Issues*, edited by Curd, Cover, and Pincock. 2<sup>nd</sup> edition. ISBN: 978-0393919035. (The first edition, edited by Curd and Cover, is also acceptable.) Readings not otherwise noted are in this book. All other readings will be posted to the course webpage.

### Supplementary Resources

There are a wide variety of useful introductory texts on the general philosophy of science. I encourage all students to look at alternative texts. I recommend the following.

*Theory and Reality: An Introduction to the Philosophy of Science*, by Godfrey-Smith. ISBN: 978-0226300634.

*What is This Thing Called Science?*, by Chalmers. ISBN: 978-1624660382.

*Representing and Intervening: Introductory Topics in the Philosophy of Natural Science*, by Hacking. ISBN: 978-0521282468.

## Assignments

### Attendance and Participation

Attendance and participation are required. In order to achieve the course learning outcomes, students need to take part actively in the numerous in-class activities. Completing the readings is only the first step in understanding the course topics; one must subsequently work with the ideas and discuss them.

## Presentation

At the beginning of each class a group of 2-3 students introduce the topic or reading which we are considering during that session. These presentations are somewhat short (approximately 15 minutes), but they ought to be precise, succinct, and motivate further discussion and investigation of the topic. Use of multimedia or non-standard presentation methods (posters, videos, etc.) are encouraged. Students also write examination questions on the presented topic.

## Summaries

Throughout the semester, each student will write two, approximately 2-paged summaries of course readings in order to improve her abilities to discuss clearly and precisely abstract philosophical topics and to concretize them.

## Argumentative Essays

Each student will write two, approximately 2-paged argumentative essays during the semester. In each of these essays, the student defends a position on one of the core topics of the class—such as demarcation between science and pseudo-science, underdetermination of theories, social influences on science—with rational argumentation as well as historical and contemporary evidence.

## Rewrite

Rewriting is the key to quality writing. Hence, near the end of the semester, each student will rewrite one summary or argumentative essay, taking into account peer and instructor feedback.

## Final Examination

During the final examination period, students answer short-essay questions asking them to describe concepts or issues from the class and to justify positions on course topics. The examination will include questions written by the instructor as well as those posed by presentation groups. The examination evaluates students' achievement of course outcomes over the semester.

## Grading

### Scale

		A	≥ 90
90	>	B	≥ 80
80	>	C	≥ 70
70	>	D	≥ 60
60	>	F	

There will be **no curve**, and all grade boundaries are **strictly** enforced. (E.g., 89.5 is a B, not an A.)

### Breakdown

Final grades will be computed as follows.

Attendance and Participation	10%
Presentation	15%
Summaries	20%
Argumentative Essays	20%
Rewrite	15%
Final Examination	20%

Additionally, exceptional participation can have a positive influence on student's final grade in the case that she is on the cusp between two grades.

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## Policies

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### **Attendance**

Attendance is mandatory and will be taken during each course meeting.

### **Late Work**

Students may hand in assignments late, however, one loses 10% of the original possible points for every 24-hour period after the deadline.

### **Missing Assignments**

Immediately following the end of the final examination, all missing assignments will receive a score of 0.

### **Make-Up Work**

If you must miss a day of class, please notify me as soon as possible. In the case that there are documented extraordinary circumstances which force you to miss a class, your missing attendance score will be dropped. If you are going to miss the exam, please notify me no less than two weeks before the examination. I will schedule a make-up exam only in the case of documented extraordinary circumstances.

### **Regrading Policy**

There will be no regrading of assignments. All grades are final. However, it is important for each student to understand the grade she received and how to improve. Hence I am more than happy to explain my grading and comments.

### **Extra Credit**

There may be opportunities for extra credit throughout the quarter. If there is such an opportunity, I will announce so in class as well as via email.

### **Evaluations**

Student evaluations of my teaching are crucial, so that I teach in an effective, responsive manner. For this reason, I offer each student extra credit for each evaluation that she completes. A student can gain 0.5% extra credit to her final grade for filling out the midterm or final evaluations (for a total possible 1% of extra credit).

## Extensions

There will be no extensions on homework assignments, except in the case of documented extraordinary circumstances.

## Reporting Illness

To report an illness that makes it impossible for you to attend class, please send me an email immediately. In order to schedule a make-up examination or drop the associated attendance score, I will require a doctor's note as soon as possible thereafter.

## Email Policy

I am more than happy to respond to your emails throughout the quarter. If you send an email during the week, you can expect a response within 24 hours. If you send an email during the weekend, you can expect a response within 48 hours.

## Academic Integrity

The penalty for any violation of academic integrity—including but not limited to plagiarism and cheating—may involve *failure on the assignment*, *failure in the course*, and *a letter recording the violation sent to the Dean*. Please acquaint yourself with [UCA's academic honesty policy](#).

## Disabilities and Special Needs

I will make every attempt to accommodate special needs of students. If you require special accommodations, please contact myself and the Disability Resource Center at 501-450-3613 as soon as possible.

## Syllabus Revisions

The syllabus may be revised throughout the semester. Please check it whenever a question comes up during the course of the semester.

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## Schedule

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### Science and Pseudo-Science

#### Sessions and Readings

August 25<sup>th</sup>

- Popper, “Science: Conjectures and Refutations”
- Kuhn, “Logic of Discovery or Psychology of Research?”

August 27<sup>th</sup>

- Ruse, “Creation-Science Is Not Science”
- Laudan, “Commentary: Science at the Bar—Causes for Concern”
- Michael Ruse, “Response to the Commentary: *Pro Judice*”

September 1<sup>st</sup>

- **Watch:** [Intelligent Design on Trial](#), NOVA episode

#### Outcomes

By the end of this unit, students will be able to

- Explain and defend theories regarding the distinction between science and non-science.
- Describe the controversies regarding the teaching of creationism and of intelligent design in science classrooms.

## Rationality, Objectivity, and Values

### Sessions and Readings

September 3<sup>rd</sup>

- Kuhn, “The Nature and Necessity of Scientific Revolutions”
- Kuhn, “Objectivity, Value Judgment, Theory Choice”
- **Recommended:** Kuhn, *The Structure of Scientific Revolutions*

September 8<sup>th</sup>

- Laudan, “Dissecting the Holist Picture of Scientific Change”

September 10<sup>th</sup>

- Longino, “Values and Objectivity”
- Okruhlik, “Gender and the Biological Sciences”
- **Recommended:** Martin, “The Egg and the Sperm: How Science Has Constructed a Romance Based on Stereotypical Male-Female Roles,” *Signs*
- **Recommended:** Lloyd, *The Case of the Female Orgasm: Bias in the Science of Evolution*.

### Outcomes

By the end of this unit, students will be able to

- Describe the role of social influences in science, generally, and theory changes, in particular.
- Support a view on the implications of social influences for the rationality and objectivity of science.

# Underdetermination

## Sessions and Readings

September 15<sup>th</sup>

- Duhem, “Physical Theory and Experiment”

September 17<sup>th</sup>

- Quine, “Two Dogmas of Empiricism”

September 22<sup>nd</sup>

- Laudan, “Demystifying Underdetermination”

## Outcomes

By the end of this unit, students will be able to

- Explain why theory change is underdetermined by falsifying evidence.
- Differentiate precisely the different conceptions of underdetermination.



# Induction

## Sessions and Readings

September 24<sup>th</sup>

- Russell, “On Induction,” *Problems of Philosophy*
- Popper, “The Problem of Induction”
- **Recommended:** Hume, “Skeptical Doubts Concerning the Operations of the Understanding” and “Skeptical Solution of these Doubts” (Chapters 4 and 5 of his *Enquiry Concerning Human Understanding*).

September 29<sup>th</sup>

- Salmon, “Rational Prediction”
- Hempel, “Criteria of Confirmation and Acceptability”

## Outcomes

By the end of this unit, students will be able to

- Explain why inductive arguments are (apparently) unjustifiable.
- Describe and support solutions to this so-called “problem of induction”.

# Explanation

## Sessions and Readings

October 1<sup>st</sup>

- Carnap, “The Value of Laws: Explanation and Prediction”
- Hempel, “Two Basic Types of Scientific Explanation
- Hempel, “The Thesis of Structural Identity”

October 6<sup>th</sup>

- Hempel, “Inductive-Statistical Explanation”
- Ruben, “Arguments, Laws, and Explanation”

## Outcomes

By the end of this unit, students will be able to

- Describe and evaluate Hempel’s Deductive-Nomological and Inductive-Statistical models of scientific explanation.
- Present and clarify the classic (counter-)examples regarding scientific explanation.

## Laws of Nature

### Sessions and Readings

October 8<sup>th</sup>

- Ayer, “What Is a Law of Nature?”
- Recommended: *Philosophy Bites*, [“Helen Beebee on Laws of Nature”](#)

October 13<sup>th</sup>

- Dretske, “Laws of Nature”

October 15<sup>th</sup>

- Cartwright, “Do the Laws of Physics State the Facts?”

### Outcomes

By the end of this unit, students will be able to

- Explain and evaluate the regularity and necessitarian accounts of causal laws.
- Summarize Cartwright’s skepticism regarding classically conceived laws.

# Realism

## Sessions and Readings

October 20<sup>th</sup>

- Maxwell, “The Ontological Status of Theoretical Entities”

October 27<sup>th</sup>

- Van Fraassen, “Arguments Concerning Scientific Realism”

October 29<sup>th</sup>

- Musgrave, “Realism versus Constructive Empiricism”

November 3<sup>rd</sup>

- Laudan, “A Confutation of Convergent Realism”

November 5<sup>th</sup>

- Hacking, “Experimentation and Scientific Realism”
- Resnik, “Hacking’s Experimental Realism”

## Outcomes

By the end of this unit, students will be able to

- Support and argue against the thesis that the things posited by our scientific theories actually exist ‘out there’ in the world.

# Philosophy of Physics: Space and Quantum Weirdness

## Sessions and Readings

November 10<sup>th</sup>

- Selections from *Leibniz-Clarke Correspondence*, in Huggett, *Space from Zeno to Einstein: Classic Readings with a Contemporary Commentary*

November 12<sup>th</sup>

- Albert, *Quantum Mechanics and Experience*, ch. 1
- Barrett, *The Quantum Mechanics of Minds and Worlds*, ch. 1

November 17<sup>th</sup>

- Norton, *Einstein for Everyone*, chs. 36-7
- **Recommended:** Albert, *Quantum Mechanics and Experience*, ch. 4

## Outcomes

By the end of this unit, students will be able to

- Rehearse and evaluate arguments for and against the idea that absolute space.
- Describe counterintuitive quantum phenomena.
- Explain the quantum measurement problem and solutions proposed thereto.

## Philosophy of Chemistry and Reduction

### Sessions and Readings

November 19<sup>th</sup>

- Nagel, "Issues in the Logic of Reductive Explanations"
- Nickles, "Two Concepts of Intertheoretic Reduction"

November 24<sup>th</sup>

- Van Brakel, "Philosophy of Science and Philosophy of Chemistry," *Hyle*
- Scerri, "The Ambiguity of Reduction," *Hyle*
- **Recommended:** Van Brakel, *Philosophy of Chemistry*, Ch. 5
- **Recommended:** Scerri, "Has Chemistry Been at Least Approximately Reduced to Quantum Mechanics?" *PSA*

### Outcomes

By the end of this unit, students will be able to

- Explain philosophical theories of intertheoretic reduction.
- Justify a view on whether or not chemistry is reducible to physics.

## Biology: Fitness and Genes

### Sessions and Readings

December 1<sup>st</sup>

- Sober, “Fitness,” Chapter 3 of *Philosophy of Biology*

December 3<sup>rd</sup>

- Griffiths and Stotz, “Gene,” *Cambridge Companion to Philosophy of Biology*

### Outcomes

By the end of this unit, students will be able to

- Explain the notion of fitness as well as ambiguities surrounding the term.
- Describe the diversity of conceptions and uses of genes in the biological sciences.