



## PHL 380: Nature of Science

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**Office hours:** 10:15-11:15 T/TH, or  
by appointment  
**Class time:** 8:30-9:50 T/TH  
**Location:** Berkey Hall 107

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### **COURSE DESCRIPTION**

PHL 380 Nature of Science analyses those questions which emerge from a deliberate consideration of the methods and practices of science. Within this close examination of science and scientific practice, it encounters questions such as:

How is the acquisition of scientific knowledge possible?

Is there a clear distinction between science and non-science?

Can scientific knowledge be verified, or falsified?

How does scientific knowledge progress?

At first glance, these questions seem to have obvious answers within scientific theory, however, many of these answers fail to provide clear or even logical accounts of the underlying problems which arise. A critical and reflective approach to these scientific questions is the aim of the philosophy of science and of this course.

### **ASSESSMENT**

Assessment is by one written in class final examination (40%), one midterm essay (30%), one seminar presentation (20%), and class participation (10%). Class participation requires students to contribute to seminar discussions (every week) having read the assigned texts and engage in the in-class problem-solving activities. Your seminar presentation will be either on your own or with other students (depending on how many students are enrolled in the class) and will be based the seminar readings. The purpose of your presentation will be to introduce and guide the seminar discussion for that week. Students will sign up for these presentations at the beginning of the semester. In order to earn full marks for participation students must actively engage in classroom discussions.

The midterm essay should be 1500 words in length. The essay must be submitted through D2L. More details about the essay will be given in separate handouts. The final exam for this course will be comprehensive—covering material from Units 1-12. Please note that you must complete all assessed elements in order to complete this course, and that anyone who does not complete any one of the assessed elements will receive an overall mark of zero. For each assessment, you will need to master the content of the lectures, the required readings, and any other specified readings.

## MAIN TEXTS

There are two required textbooks for this course, in which you can find all of the required readings and some of the recommended further readings, these are

- Martin Curd and J. A. Cover, ed., *Philosophy of Science: The Central Issues* (New York and London: W. W. Norton & Company). This is an anthology of classic readings, with some helpful introductions, notes and commentary by the editors. NB: you may use either the 2<sup>nd</sup> edition (2013) or the 1<sup>st</sup> edition (1998).
- A. F. Chalmers, *What Is This Thing Called Science?* (Indianapolis: Hackett Publishing Co). NB: you may use either the 4<sup>th</sup> edition (2013) or the 3<sup>rd</sup> edition (1999).

Books are available for purchase at the MSU Bookstore as well as online. (In the schedule of readings below, these sources will be indicated simply as “Curd and Cover” and “Chalmers”.)

## SESSION STRUCTURE

Students must attend every class—both Mondays and Wednesdays each week. Each week there will be a lecture and discussion seminar for PHL 380. The lecture will introduce the philosophical theory that will be discussed in that week and scientific questions that will be addressed. For the seminar, students will be required to discuss the topic for that week. Seminars will begin with a short presentation by a student (or pair of students). All students are required to attend both lectures and seminars. It is a requirement of the course that students attend seminars having read and reflected on relevant sections of the required readings and are prepared to actively participate in the seminar discussions. Remember that class participation makes up a substantial portion of your grade.

## SCHEDULE OF LECTURES AND READINGS

### PART I. WHAT IS SCIENCE?

#### **UNIT 1. INTRODUCTION AND INDUCTIVISM**

##### Lecture (7 January)

Welcome and Introduction to PHL380 Nature of Science

Required reading:

- Chalmers, "Introduction" and Ch. 1, pp. 1-17 "Science as knowledge derived from the facts of experience"

##### Seminar discussion (9 January)

- Chalmers, pp 1-17 "Introduction", Ch. 1, "Science as knowledge derived from the facts of experience"
  - Chalmers, pp. 40-45 of Ch. 4 "Deriving theories from the facts: induction"
  - Karl Popper, "The Problem of Induction", in Curd and Cover, pp. 406-411.
- Also recommended:
- Anthony O'Hear, *An Introduction to the Philosophy of Science* (Oxford: Clarendon Press, 1989), pp. 12-34 (Ch. 2).

#### **UNIT 2. FALSIFICATIONISM**

##### Lecture (14 January)

Required reading:

- Chalmers, pp. 55-68 (Ch. 5) "Introducing falsificationism"

##### Seminar discussion (16 January)

Required reading:

- Karl Popper, "Conjectures and Refutations", in Curd and Cover, pp. 3-10.
  - Karl Popper, "The Problem of Induction", in Curd and Cover, pp. 406-411.
- Also recommended:
- Karl Popper, *Conjectures and Refutations*, 3rd ed. (London: Routledge, 1969), pp. 39-59 (Sec. 1.IV-1.X). This is the continuation of the first selection above.
  - Anthony O'Hear, *An Introduction to the Philosophy of Science* (Oxford: Clarendon Press, 1989), pp. 54-81 (Ch. 4).

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**CLASS CANCELLED—TUESDAY, 21 JANUARY**  
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#### **UNIT 3. NORMAL SCIENCE**

##### Lecture (23 January)

Required reading:

- Chalmers, pp. 97-104 (first part of Ch. 8) "Theories as structures I: Kuhn's paradigms"

##### Seminar discussion (28 January)

Required reading:

- Thomas S. Kuhn, "Logic of Discovery or Psychology of Research?", in Curd and Cover, pp. 11-19.
- Also recommended:
- Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 2nd ed. (Chicago: University of Chicago Press, 1970), pp. 10-51 (Sec. 2-5).
  - Karl Popper, "Normal Science and Its Dangers", in Imre Lakatos and Alan Musgrave, eds., *Criticism and the Growth of Knowledge* (Cambridge: Cambridge University Press, 1970), pp. 51-58.

## UNIT 4. PROGRESS, RATIONALITY AND SCIENCE

### Lecture (30 January)

Required reading:

- Chalmers, pp. 121-137 (Ch. 9) “Theories as structures II: Research programs”
- \*Topics for Midterm Essay assignment will be distributed.

### Seminar discussion (4 February)

- Imre Lakatos, "Science and Pseudoscience", in Curd and Cover, pp. 20-26.
- Paul R. Thagard, "Why Astrology is a Pseudoscience", in Curd and Cover, pp. 27-37.

Also recommended:

- Brendan Larvor, *Lakatos: An Introduction* (London and New York: Routledge, 1998), pp. 47-72 (Ch. 4).
- Imre Lakatos, "Criticism and the Methodology of Scientific Research Programmes", *Proceedings of the Aristotelian Society*, Vol. 69 (1968), pp. 167-186 (Sec. 3,4).

## UNIT 5. THE CASE OF CREATION-SCIENCE

### Lecture (6 February)

Required reading:

- Michael Ruse, "Creation-Science Is Not Science", in Curd and Cover, pp. 37-46.
- Larry Laudan, "Commentary: Science at the Bar -- Causes for Concern", in Curd and Cover, pp. 47-52.

### Seminar discussion (11 February)

Formal debate

## PART II. SCIENTIFIC CHANGE AND THEORY-CHOICE

## UNIT 6. FALSIFICATION AND THEORY-CHOICE

### Lecture (13 February)

Required reading:

- Chalmers, pp. 69-96 (Ch. 6) “Sophisticated falsificationism,” (Ch. 7) “The limitations of falsificationism”

### Seminar discussion (18 February)

Required reading:

- Wesley C. Salmon, "Rational Prediction", in Curd and Cover, pp. 412-423.

Also recommended:

- Karl Popper, *The Logic of Scientific Discovery*, rev. ed. (London: Hutchinson, 1959), pp. 251-281 (Ch. 10).
- Hilary Putnam, "The 'Corroboration' of Theories", in Paul Arthur Schilpp, ed., *The Philosophy of Karl Popper* (La Salle: Open Court, 1974), Vol. 1, pp. 221-240; see also Popper's reply to Putnam in the same collection, Vol. 2, pp. 993-999.

**\*\*\*MIDTERM ESSAY DUE: 18 FEBRUARY, 5:00PM\*\*\***

## UNIT 7. SCIENTIFIC REVOLUTIONS

### Lecture (20 February)

Required reading:

- Chalmers, pp. 104-120 (latter parts of Ch. 8) “Theories as structures I: Kuhn’s paradigms”

Seminar discussion (25 February)

Required reading:

- Thomas S. Kuhn, "The Nature and Necessity of Scientific Revolutions", in Curd and Cover, pp. 79-93.
- Thomas S. Kuhn, "Objectivity, Value Judgment, and Theory Choice", in Curd and Cover, pp. 94-110.

Also recommended:

- Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 2nd ed. (Chicago: University of Chicago Press, 1970), pp. 52-91, 111-135 (Sec. 6-8, 10).

**UNIT 8. OBJECTIVITY AND EVIDENCE**

Lecture (27 February)

Required reading:

- Chalmers, pp. 38-54 (Ch. 4), "Deriving theories from the facts: induction"

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**SPRING BREAK: CLASSES CANCELLED TUESDAY, 3 MARCH**

**AND THURSDAY, 5 MARCH**  
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Seminar (10 March)

Required reading:

- Helen Longino, "Science and Objectivity" in Curd and Cover, pp. 144-164

**UNIT 9. RATIONALITY IN PARADIGM CHANGE**

Lecture (12 March)

Required reading:

- Larry Laudan, "Dissecting the Holist Picture of Scientific Change", in Curd and Cover, pp. 139-169 (focus on pp. 156-169) (1998 edition).

or

- Larry Laudan "Kuhn's Critique of Methodology" in Curd and Cover, pp. 131 (2013 edition).

Seminar discussion (17 March)

Required reading:

- Ernan McMullin, "Rationality and Paradigm Change in Science", in Curd and Cover, pp. 111-130.

Also recommended:

- Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 2nd ed. (Chicago: University of Chicago Press, 1970), pp. 160-173 (Sec. 13), 198-201 (latter part of the Postscript).

- Karl R. Popper, "The Rationality of Scientific Revolutions", in Ian Hacking, ed., *Scientific Revolutions* (Oxford: Oxford University Press, 1981), pp. 80-106; also in Rom Harré, ed., *Problems of Scientific Revolution* (Oxford: Clarendon Press, 1975), pp. 72-101.

**UNIT 10. UNDERDETERMINATION**

Lecture (19 March)

Required reading:

- Donald Gillies, "The Duhem Thesis and the Quine Thesis", in Curd and Cover, pp. 271-287.

Also recommended:

Anthony O’Hear, *An introduction to the philosophy of science*. Oxford: Clarendon Press, 1989) pp. 82-105 (Ch. 5)

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**CLASS CANCELLED—TUESDAY, 24 MARCH**

**CLASS CANCELLED—THURSDAY, 26 MARCH**  
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Seminar discussion (31 March)

Required reading:

- Pierre Duhem, "Physical Theory and Experiment", in Curd and Cover, pp. 227-249.

#### **UNIT 11. FEYERABEND’S ANARCHISM**

Lecture (2 April)

Required reading:

Chalmers, pp. 138-147 (Chp. 10) “Feyerabend’s anarchistic theory of science”

Seminar discussion (7 April)

Required reading:

- Paul Feyerabend, “How to be a good empiricist—a plea for tolerance in matters epistemological” in Curd and Cover, pp. 927-953.

Also recommended:

- Paul Feyerabend, "How to Defend Society Against Science", *Radical Philosophy*, No. 11 (1975), pp. 3-8; reprinted in E. D. Klemke, Robert Hollinger, and A. David Kline, eds., *Introductory Readings in the Philosophy of Science*, revised ed. (Buffalo: Prometheus Books, 1988), pp. 34-44.

#### **UNIT 12. REALISM, ANTI-REALISM AND HACKING’S EXPERIMENTAL REALISM**

Lecture (14 April)

Required reading:

- Chalmers, pp.209-226 (Chp. 15) “Realism and anti-realism”

Seminar discussion (21 April)

- David B. Resnik, “Hacking’s Experimental Realism” in Curd and Cover, pp. 1156-1171.

Also recommended:

- Ian Hacking “Experimentation and Scientific Realism” in Curd and Cover, pp. 1140-1155.

(23 April)

**\*\*\*FINAL EXAMINATION: THURSDAY 23 APRIL  
8:30-9:50am\*\*\***

#### **Sources for General Reference**

Introductory textbooks

- Nicholas Everitt and Alec Fisher, *Modern Epistemology: A New Introduction* (New York: McGraw-Hill, 1995).
- Rom Harré, *The Philosophies of Science* (Oxford: Oxford University Press, 1972).
- Carl G. Hempel, *Philosophy of Natural Science* (Englewood Cliffs: Prentice-Hall, 1966).
- Peter Kosso, *Reading the Book of Nature* (Cambridge: Cambridge University Press, 1992).
- Anthony O’Hear, *An Introduction to the Philosophy of Science* (Oxford: Clarendon Press, 1989).

#### Intermediate-level textbooks

- George Couvalis, *The Philosophy of Science: Science and Objectivity* (London: Sage Publications, 1977).
- Donald Gillies, *Philosophy of Science in the Twentieth Century* (Oxford: Blackwell, 1993).
- Ian Hacking, *Representing and Intervening* (Cambridge: Cambridge University Press, 1983).
- Alan Musgrave, *Common Sense, Science and Scepticism: A Historical Introduction to the Theory of Knowledge* (Cambridge: Cambridge University Press, 1993).
- W. H. Newton-Smith, *The Rationality of Science* (London and New York: Routledge, 1981).

#### Anthologies

- Richard Boyd, Philip Gasper, and J. D. Trout, eds., *The Philosophy of Science* (Cambridge, Mass.: The MIT Press, 1991).
- Ian Hacking, ed., *Scientific Revolutions* (Oxford: Oxford University Press, 1981).
- E. D. Klemke, Robert Hollinger, and A. David Kline, eds., *Introductory Readings in the Philosophy of Science*, revised ed. (Buffalo: Prometheus Books, 1988).
- Philip P. Wiener, ed., *Readings in Philosophy of Science* (New York: Charles Scribner's Sons, 1953).

#### Books by and about particular philosophers

- Paul Feyerabend, *Against Method* (London: Verso, 1978); other editions are fine.
- Paul Hoyningen-Huene, *Reconstructing Scientific Revolutions: Thomas S. Kuhn’s Philosophy of Science* (Chicago: University of Chicago Press, 1993).
- Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 2nd ed. (Chicago: University of Chicago Press, 1970); the 3rd edition is essentially the same; do not use the 1st edition of 1962.
- Imre Lakatos and Alan Musgrave, eds., *Criticism and the Growth of Knowledge* (Cambridge: Cambridge University Press, 1970); this contains critiques of Kuhn and replies by Kuhn.
- Brendan Larvor, *Lakatos: An Introduction* (London and New York: Routledge, 1998).
- Anthony O’Hear, *Karl Popper* (London: Routledge and Kegan Paul, 1980).
- Karl Popper, *Conjectures and Refutations*, 3rd ed. (London: Routledge, 1969); other editions are fine.
- Karl Popper, *The Logic of Scientific Discovery*, revised ed. (London: Hutchinson, 1959); other editions are fine.
- Paul Arthur Schilpp, ed., *The Philosophy of Karl Popper* (La Salle: Open Court, 1974), 2 vols.

#### Attendance

Your participation in class discussions contributes significantly to your overall grade. Obviously, you can only participate in class discussions if you regularly attend class. Therefore, if you have more than 6 absences this semester you will drop one letter grade as you will fail to adequately complete one element of the class due to non-attendance and inadequate participation in class discussions.

### Submission of Coursework

Essay papers must be submitted on time. There will be no extensions given. In order to pass this course all coursework must be completed. Failure to complete all assignments will result in a “0.0”.

### General Evaluation Criteria\*

Essay exams and papers will be evaluated on the basis of the following criteria.

a) *Clarity and precision* The central claims of the paper should be stated precisely and presented in a manner that another student who was interested in the topic, but not enrolled in the course, could understand. Frequent spelling and grammatical errors are distracting, and will lower your grade. Clear and concise prose is of the utmost importance. The more people that read your work and think that it makes sense, the more likely it does make sense. Remember: I am reading what you write very closely and with a critical eye. Say what you mean and mean what you say. Be careful!

b) *Depth and Persuasiveness* I ask: How deep (i.e., how insightful) are the central claims of the paper, and how persuasive are the arguments given in support of them? Your arguments should at the very least provide plausible support for their conclusions. Also, the arguments should be consistent with one another. Important concepts and terms should be clarified. Generally, the deeper the paper’s central claims, and the stronger their support, the better the paper.

c) *Breadth of knowledge* Have you made good use of the relevant concepts, distinctions, and arguments **that have been included in the assigned readings or that were brought out in classroom discussion**? For example, where one of your central claims clearly contradicts a thesis in one of the reading assignments you should explain what is wrong with the opposing position. (\*adopted from M. McKeon, Spring 2009)

### 4 Point Scale to Percentage Conversion Key.

Your final grade will be converted to 4-point scale as follows:

4.0	=	92–100%
3.5	=	87–91%
3.0	=	80–86%
2.5	=	75–79%
2.0	=	70–74%
1.5	=	65–69%
1.0	=	50–64%
0.0	=	0–49%

### The Meaning of Grades\*\*

4.0 =excellent work

“4.0” assignments are of exceptionally high quality. They are innovative, adding something to the topic. They are accurate, clear, organized, use compelling



reasoning, and possess a spark of innovation/creativity. They show depth of thought and the writing is polished.

3.0= good work

“3.0” assignments meet the expectations of the assignment and are accurate, clear and organized. They contain good reasoning and although they do not have any significant problems, they do not add anything to the topic.

2.0= acceptable work that has significant problems

“2.0” assignments contain inaccuracies or significant problems with reasoning, organization, or quality of writing.

1.0 work has serious problems and is unacceptable as college-level work.

0.0 is normally reserved for work that is not turned in, is borderline unintelligible, or has little or no relevance to the assignment. (\*\*adopted from Hedrick 2010)

### **Classroom Courtesy**

Be nice. Respect yourself and each other. I want you to be bold, argumentative, and challenging—but in an open-minded and thoughtful way. You will disagree with each other. Being respectful doesn’t mean you have to agree with each other, it just means you are willing to listen to each other.

Please arrive to class on time. All mobile phones must be turned off during class time (this includes discussion sessions unless explicitly allowed by me). Do not text, use your phones, iPods or MP3 players in class. If you do so you will be asked to leave.

### **MSU Email Communication**

All communication will be through your MSU email. Please refer to Student Rights and Responsibility (<https://www.msu.edu/~ombud/index.html>) .

### **Course Management System: *Desire to Learn***

Syllabus, reading materials, PowerPoints, and announcements are available on *Desire to Learn*. All papers completed for the course will be uploaded to *Desire to Learn* site for this class. It is your responsibility to understand how to use *Desire to Learn*. Help is available at: [http://learndat.tech.msu.edu/communicate\\_guide/](http://learndat.tech.msu.edu/communicate_guide/) and instructions for technical assistance for *Desire to Learn* at: <https://d2l.msu.edu> or 355.2345 or 1-800-500-1554

### **Academic Honesty**

Do not cheat. Do not plagiarize.

Submitting another’s work as your own—either in part or in whole.

Penalty for plagiarism is a zero on the assignment and the student will receive an F for the course.

### **Turnitin Statement from MSU**

*“Consistent with MSU’s efforts to enhance student learning, foster honesty, and maintain integrity in our academic processes, instructors may use a tool called Turnitin to compare a student’s work with multiple sources. The tool compares each student’s work with an extensive database of prior publications and papers, providing links to possible matches and a “similarity score.” The tool does not determine whether plagiarism has occurred or not. Instead, the instructor must*

make a complete assessment and judge the originality of the student's work. All submissions to this course may be checked using this tool. Students should submit papers to Turnitin Dropboxes without identifying information included in the paper (e.g., name or student number), the system will automatically show this information to faculty in your course when viewing the submission, but the information will not be retained by Turnitin."

**Reminders of Relevant University Policies**

Please be aware that MSU prohibits the commercialization of course notes and materials. MSU prohibits students from commercializing their notes of lectures and University-provided class materials without the written consent of the instructor.

**Disability Accommodation Requests**

Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at rcpd.msu.edu. Once your eligibility for an accommodation has been determined, you will be issued a verified individual services accommodation ("VISA") form. Please present this form to me at the start of the term and/or two weeks prior to the accommodation date (test, project, etc). Requests received after this date will be honored whenever possible.

**Notification of Changes, Inclement Weather Policy, and Emergency Procedures**

The schedule of reading is the plan for the course. However, changes may need to be made and so it is tentative and subject to change. Any changes or modifications to the course schedule/syllabus will be announce ahead of time in class. Emergency Procedures: If there is an emergency or there is inclement weather, or other related cancellations, we will follow University policy. Any additional necessary changes to will be posted to D2L.

Related Student Organizations or Clubs, if Applicable	<a href="http://studentlife.msu.edu/about-student-life">http://studentlife.msu.edu/about-student-life</a>
<b>Learning Resources Center:</b>	355.2363 or <a href="http://lrc.msu.edu/">http://lrc.msu.edu/</a>
<b>Office of Supportive Services:</b>	353.5210 or <a href="http://www.oss.msu.edu">http://www.oss.msu.edu</a>
<b>The Writing Center:</b>	<a href="http://writing.msu.edu">http://writing.msu.edu</a>
<b>Libraries:</b>	432.6123 or <a href="http://www.lib.msu.edu/">www.lib.msu.edu/</a>
<b>MSU IT Service Desk:</b>	Help Desk: 432.6200 or <a href="http://www.tech.msu.edu/support/">www.tech.msu.edu/support/</a>
<b>Office of the Ombudsperson:</b>	353.8830 or <a href="http://www.msu.edu/unit/ombud">www.msu.edu/unit/ombud</a>
<b>Olin Student Health Center:</b>	<a href="http://olin.msu.edu/">http://olin.msu.edu/</a>
<b>MSU Counseling Center:</b>	<a href="http://www.counseling.msu.edu">www.counseling.msu.edu</a>
<b>MSU Psychological Clinic:</b>	355.9564
<b>English Language Center:</b>	<a href="http://www.elc.msu.edu">www.elc.msu.edu</a>
Community Groups (Adult Students, International Students, Persons with Disabilities, LBG, Family Resource Center, Veterans, The Women's Resource Center) see <i>Student Handbook and Resource Guide</i> : <a href="http://splife.studentlife.msu.edu/information-and-services/services-for-community-groups">http://splife.studentlife.msu.edu/information-and-services/services-for-community-groups</a>	

