



BETHANY
LUTHERAN COLLEGE

Fall 2011
SCIENCE 320:
History and Philosophy
of Science

Instructor: Dr. Ryan MacPherson
Honsey Hall 308
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Schedule:

Section A:
Tue/Thu, 10:30–11:45 a.m.
Honsey Hall 342

“Young gentlemen, we are about to ask God a question.”
Joseph Henry, professor of natural philosophy, introducing a physics experiment
at the College of New Jersey (now called Princeton University), ca. 1845

Catalogue Description:

This course examines the social and intellectual foundations of Western science from antiquity to the present. Students will evaluate scientific achievements in their respective historical, philosophical, cultural, and theological contexts, and compare previous scientific understandings to present ones.

Relation to Students' Curricular Needs:

- *required* for a B.A. in Elementary Education (science certification only) or Physical Sciences (3/2 Engineering Program)
- *elective* for a B.A. in Broad Field Social Sciences, Chemistry, History, Human Biology, or Liberal Arts (Philosophy Concentration)
- *elective* for Biotechnology Program (Science Track)
- *elective* for a Minor in Chemistry or Mathematics

Required Texts:

- Ryan, Jay. *Signs and Seasons: Understanding the Elements of Classical Astronomy*. Cleveland: Fourth Day Press, 2007. ISBN 978-0-9792211-0-1.
- Kuhn, Thomas S. *The Structure of Scientific Revolutions*, 3d ed. Chicago: University of Chicago Press, 1996. ISBN 0-226-45808-3.
- Lindberg, David C. *The Beginnings of Western Science: The European Scientific Tradition in Philosophical, Religious, and Institutional Context, 600 B.C. to A.D. 1450*. 2d ed. Chicago: University of Chicago Press, 2008. ISBN 0-226-48205-7.
- MacPherson, Ryan C., ed. *After Creation: Readings in the History of Science*. Fall 2011. Course packet available in the bookstore.
- Turabian, Kate L. *A Manual for Writers of Research Papers, Theses, and Dissertations*. 7th ed. Chicago: University of Chicago Press, 2007. ISBN 0-226-82337-7. —OR— Hacker, Diana. *A Pocket Style Manual*. 4th ed. Boston: Bedford/St. Martin's, 2004. ISBN 0-312-40684-3.

Objectives of the College (OCs) Pertinent to This Course (*Catalog*, Aug. 2010, p. 6):

2. To demonstrate critical thinking and moral reasoning, oriented by objective standards consistent with Holy Scripture.
3. To become responsible citizens, aware of social realities, through the study of American and world cultural heritage as well as contemporary social, economic, and political issues.
6. To increase their ability to use written and oral English effectively.
7. To secure a foundation in mathematics and the sciences for a better understanding of the world.
9. To acquire the necessary skills for achieving a satisfactory vocational adjustment.

Interpretation of “Vocation Adjustment” (OC 9)

Your “vocation” is *how your station in life serves as a channel of God's blessings to the people around you*. Each person has multiple, overlapping stations in life (child, sibling, spouse, parent, student,

neighbor, employee, registered voter, etc.). As indicated in OC 9, Bethany Lutheran College seeks to expand your vocational opportunities so that you might better serve others to the glory of God.

Course Learning Objectives (CLOs):

1. By surveying the chronological development of scientific ideas from ancient times to the present day, students will be able *describe* the chief accomplishments in Western science, including Aristotelian physics, Ptolemaic astronomy, Galenic medicine, Copernican astronomy, Newtonian physics, Enlightenment chemistry, evolutionary biology, relativity theory, quantum mechanics, the “Big Bang” theory, and molecular genetics (cf. OCs 3 and 7).
2. By exploring specific historical contexts (social, political, philosophical, theological, etc.) in which scientific discoveries were made and scientific theories were proposed and debated, students will be able to *analyze* science as a fundamentally human activity, inextricably intertwined with historical contexts (cf. OC 3).
3. By studying philosophies of science, students will be able to *identify* the epistemological challenges faced by people who engage in scientific activities. Informed by the philosophy of science, students will *evaluate* longstanding debates concerning what the proper scientific method is and how much certainty should be attached to scientifically established claims (cf. OC 2).
4. By combining insights from the history of science with those from the philosophy of science, students will *synthesize* an interpretation of how scientific theories change, focusing particularly on the issue of “scientific revolutions” (cf. OCs 2, 3, and 7).
5. By drawing upon their own theological heritage, students will *evaluate* the history and philosophy of science from a standpoint that is situated both in historical time and also in eternity. Students will be encouraged to recognize science as a finite human attempt to understand the work of the infinite Creator, who accomplishes His eternal plan in historical time (cf. OCs 2, 9).

Assessment:

Class Participation	<u>10</u>		
	10	10	
Document Report I	10		
Document Report II	<u>10</u>		
	20	20	
Exam I	16		
Exam II	16		
Exam III	<u>18</u>		
	50	50	
Literature Review Essay	<u>20</u>		
	20	20	
Total	<u>100</u>		

93.34 – 100.00	A
90.00 – 93.33	A–
86.67 – 89.99	B+
83.34 – 86.66	B
80.00 – 83.33	B–
76.68 – 79.99	C+
73.34 – 76.66	C
70.00 – 73.33	C–
66.67 – 69.99	D+
63.34 – 66.66	D
60.00 – 63.33	D–
00.00 – 59.99	F

Attendance and Class Participation (formative assessment of CLOs 1–5):

Students are required to earn a “class participation grade” by maintaining punctual attendance with assigned texts at hand, completing assigned study questions and worksheets prior to class, actively participating in class discussions, and being absent no more than twice during the semester. Absences may be excused if a valid reason is supplied (such as a sports event for student athletes, or a prolonged illness). **However, student athletes, speech team members, or others who miss a substantial number of classes should realize that their grade likely will suffer as a consequence of not being present to learn alongside their classmates. Thus, even “excused” absences can result indirectly in lower grades.** The professor reserves the right to drop students from the class for excessive absences or habitually tardy attendance.

Importance of Turning in Assignments on Time:

Assignments are due at the beginning of class on the dates indicated below. *If a student anticipates difficulty completing an assignment on time, he or she should request a deadline extension well in advance of the due date.* This policy is intended to encourage planning and communication skills that will be helpful later in life. Generally, the less often and the longer in advance that a student requests a deadline extension, the more willing the professor will be to grant the request.

Unless a student has received a deadline extension, then the following late penalties will apply:

- a 5% grade deduction for submitting an assignment after the start of class, but prior to 4:30 p.m. on the due date; and,
- an additional 10% grade deduction for *each* additional school day that the assignment is late. ("School day" means Monday through Friday, excluding school holidays.)

Written assignments must be submitted in hard copy and stapled if longer than one page.

Document Reports (formative assessment of CLOs 1–3):

Each student will read one specialized article, not assigned to the rest of the class, and present an analysis to fellow students so that the class as a whole may be exposed to a broader selection of documents than any single student will have time to read. A list of eligible articles and criteria concerning the oral presentation and one-page handout will be provided in a class handout.

Literature Review Essay (formative and summative assessment of CLOs 1–5):

Each student will write a literature review essay concerning a topic chosen in consultation with the professor. Further instructions and a sample essay are included in the course packet. **Students enrolled in the 3/2 Engineering Program must write their essay on a theological topic** pertaining to the history or philosophy of science in consultation with a Religious Studies faculty member, a requirement that compensates for the fact that their senior year will be spent off campus, and therefore the senior-year Religious Studies requirement will be waived.

Specifications: 4 to 6 pages numbered and stapled; 1-inch margins; double-spaced text; 12-point Times Roman or equivalent (such as 11-point Book Antiqua); footnote citations (9-point, single-spaced), with full citations in a bibliography (*Chicago Manual of Style* standards).

Use of Sources: Students are expected to summarize, compare, and evaluate a minimum of ten (10) reputable sources, including scholarly books and peer-reviewed journal articles.

Suggested Research Topics for Literature Review Essays (historical, philosophical, or both):

- African Americans and Science
 - Archaeoastronomy (Stone Henge, the Mayans, etc.)
 - Artificial Intelligence
 - Atomic Bomb Casualty Commission
 - Biography: Robert Boyle, Michael Faraday, Marie Curie, etc.
 - Cartesian Physics
 - Causality
 - Chaos Theory
 - Copernicanism and Religion: Catholic, Lutheran, Calvinist, or Muslim
 - Creation Science
 - Cybernetics
 - Egyptian Mathematics
 - The Ether
 - Eugenics
 - Extraterrestrial Life
 - Fertility Management
 - Genes: Where, Exactly, Are They?
 - German Idealism
 - Global Warming
 - Greek Atomism
 - Hellenistic Medicine
 - The Hippocratic Oath
 - Human Cloning
 - Instrument: Abacus, Astrolabe, Telescope, etc.
 - A Law: Inertia, First or Second Law of Thermodynamics, Ideal Gas Law, etc.
 - The Nebular Hypothesis
 - The Population "Crisis"
 - Quantum Theory
 - Realism vs. Instrumentalism in the Philosophy of Science
 - Science in Lutheran Education
 - Science and Technology in China
 - Scientific Literacy
 - Scottish Common Sense Realism
 - Stellar Navigation
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- Stem Cell Research
- String Theory
- *Tennessee v. Scopes* (1925), a.k.a., “the Monkey Trial”
- Vaccination

Exams (summative assessment of CLOs 1–5):

The course is divided into three parts. At the conclusion of each part, students will be assessed by an exam that may consist of multiple-choice, true/false, matching, short-answer questions, and essay questions. Each exam will focus primarily on the part of the course that was just completed, but some questions may require students to recall historical developments discussed during previous parts of the course. The third and final exam will in this respect be more comprehensive than the preceding exams, though it will focus primarily on the material from Part III of the course.

Patriotic Use of Cell Phones:

The following policy was developed particularly with an eye toward the instructor’s courses in American history. However, it pertains well also to this course, insofar as *political* science belongs in to the history and philosophy of science.

America’s founding fathers recognized that the republican form of government embodied in the U.S. Constitution would secure the blessings of liberty and security only so long as the people of America acted responsibly. The founders thus spoke often of “civic virtue”—moral character that empowers a people to act with the best interests of their neighbors in mind. In the spirit of civic virtue, it is expected that students enrolled in this class will turn off their cell phones before class begins. If a cell phone rings during class, then the student possessing that phone will be expected to serve his or her fellow classmates by reciting, from memory, one of the first ten amendments to the U.S. Constitution at the beginning of the next class period. The professor will begin by assigning the First Amendment when the first cell phone rings. If, due to unfortunate negligence on the part of the students, the class is interrupted by a cell phone as many as ten times during the semester, at least everyone will receive the consolation of hearing all ten amendments recited from memory. Students who feel nervous about the prospect of reciting an amendment from memory in front of their peers should be especially cautious not to become responsible for the fifth cell phone disturbance of the semester, since the Fifth Amendment—the longest in the Bill of Rights—contains 104 words. Those who believe that this consequence is too severe should be careful not to leave their cell phone turned on until after the seventh infraction, since the Eighth Amendment, the shortest of them all, consists of a mere 16 words. It is, after all, the Eighth Amendment that protects citizens from “cruel and unusual punishments.”

Plagiarism Policy:

Plagiarism may be defined briefly as the presentation of another’s original work as if it is one’s own, whether by copying exact wording, using similar phrasing, or pursuing a similar course of argument. Avoiding plagiarism in essays generally requires nothing more than giving credit where credit is due, by referring the reader to the original source and placing quotation marks around any copied language. (See Turabian’s or Hacker’s book for *Chicago Manual* citation formats.) Students who commit an act of plagiarism risk a failing grade for the assignment or exam and for the entire course, and even expulsion from the college. The instructor will follow whatever due process policies are established by the college, both for the sake of the student and for the integrity of the college as an academic institution that respects the intellectual property rights of others.

This policy is not an idle statement. The professor has previously enforced it, with the result of one student failing an entire course and other students receiving zero credit for major writing assignments, which resulted in their final course grades dropping from the B and C range into the D range.

Writing Center:

Talented juniors and seniors are available at the Ada Stokes Writing Center (HH 217) to provide free consultations for students seeking to produce the best possible essays for any class assignment. The faculty has nominated these students based on their previously demonstrated skills in writing, revising, and polishing essays. Contact the Registrar’s Office for further information.

SCHEDULE OF ASSIGNMENTS

The instructor reserves the right to modify this schedule during the course of the semester should unusual circumstances arise. Generally, students can be confident that this schedule will be followed closely.

INTRODUCTION

1. Discussion: Doc. 1D (Umbrellaology); Tue. 23 Aug.
Syllabus and Doc. 1C (Chronology);
Assignment of Student Reports for Part I (Doc. 1B)
Handout: Syllabus

PART I: IN SEARCH OF SCIENCE'S ROOTS

2. Babylonian and Egyptian Natural Thought Thu. 25 Aug.
Readings: Ryan, Introduction, Prologue, and Epilogue;
Lindberg, chap. 1; Docs. 2A (Gen. 1–2) and 2B (Job 38)
Reminder: Study Questions (Doc. 1A) are due each day.
3. Greek Natural Philosophy, Part I: Thales to Plato Tue. 30 Aug.
Readings: Ryan, chap. 2; Lindberg, chap. 2; Docs. 3A (Plato)
In Class: Docs. 3B (Platonic Music), 3C (Pythagorean Solids)
4. Greek Natural Philosophy, Part II: Aristotle Thu. 1 Sept.
Readings: Ryan, chaps. 1 and 3; Lindberg, chap. 3; Doc. 4A (Aristotle)
5. Hellenistic Natural Philosophy, Part I: Epicureans and Stoics Tue. 6 Sept.
Readings: Ryan, chaps. 4 and 5; Lindberg, chap. 4 and pp. 98–105;
Docs. 5A (Luke), 5B (St. Paul and Epimenides)
6. Hellenistic Natural Philosophy, Part II: Mathematics and Astronomy Thu. 8 Sept.
Readings: Ryan, chaps. 6 and 7; Lindberg, chap. 5;
Doc. 6A (Ptolemy)
7. Hellenistic Natural Philosophy, Part III: Medicine Tue. 13 Sept.
Readings: Lindberg, chap. 6; Docs. 7A (Hippocrates),
7B (Galen)
8. Roman and Islamic Science Thu. 15 Sept.
Readings: Ryan, p. 131; Lindberg, chaps. 7–8
Discussion: Assignment of Student Reports for Part II
Preview: Literature Review Assignment (Docs. 12A-C)
9. Islamic Science and the Western Revival Tue. 20 Sept.
Readings: Lindberg, chaps. 9–10; Doc. 9A (Plato, *Timaeus*)
In Class: Doc. 9B (Eucharistic Physics)
10. **Assessment:** Exam on Part I Thu. 22 Sept.
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PART II: THE SCIENTIFIC REVOLUTION

11.	The Late Medieval Cosmos Readings: Ryan, pp. 77–79, 89; Lindberg, chap. 11 consult Turabian, chaps. 2-3 —OR-- Hacker, pp. 101–111 In Class: Doc. 11A (Astrolabe Lab)	Tue. 27 Sept.
12.	Early Modern Astronomy, Part I: Copernicus Readings: Kuhn, chap. 1; Docs. 12B (Literature Review), 12C (Sample Bibliography), 12D (Copernicus) Due: Doc. 12A (Thesis Question worksheet)	Thu. 29 Sep.
13.	Early Modern Astronomy, Part II: Brahe, Kepler, and Galileo Readings: Kuhn, chap. 2; Docs. 13A (Galileo), 13B (diagrams)	Tue. 4 Oct.
14.	Late Medieval Physics Readings: Lindberg, chap. 12; Doc. 14A (Bacon) In Class: Docs. 14B (Merton) and 14C (Inertia)	Thu. 6 Oct.
15.	Newtonian Physics Readings: Docs. 15A (Newton), 15B (<i>Principia</i>); Kuhn, chap. 3	Tue. 11 Oct.
16.	Late Medieval Medicine and Natural History Readings: Lindberg, chap. 13; Kuhn, chaps. 4–5;	Thu. 13 Oct.
17.	Early Modern Medicine: Vesalius and Harvey Readings: Docs. 17A (Huxley, “Harvey”) and 17B (Harvey); Kuhn, chap. 6 consult Turabian, chaps. 15-17 — OR — Hacker, 184–204, 208	Tue. 18 Oct.
Fall Break		No Class
		Thu. 20 Oct.
18.	The Chemical Revolution Readings: Docs. 18A (Sponholz), 18B (Stahl), 18C (Priestley), and 18D (Lavoisier) Due: Annotated Bibliography (cf. Doc. 12C), with at least 8 of 10 sources (<i>Late penalty: 10% decline in Literature Review Essay grade</i>)	Tue. 25 Oct.
19.	Natural History and Natural Theology Readings: Doc. 19A (Paley); Kuhn, chaps. 7–8 Discussion: Assignment of Student Reports for Part III	Thu. 27 Oct.
20.	Interpretations and Conclusions Special Reading: Doc. 20A (Dark Sucker Theory) <i>Students are encouraged to read this document aloud together in a small study group. For full understanding of the text, they should have a flashlight and closet available.</i>	Tue. 1 Nov.
21.	Assessment: Exam on Part II	Thu. 3 Nov.

PART III: MODERN AND POSTMODERN SCIENCE

22.	The Nature of Scientific Revolutions Readings: Lindberg, chap. 14; Kuhn, chap. 9	Tue. 8 Nov.
23.	The Nebular Hypothesis and Historical Geology Readings: Docs. 23A (Chronology), 23B (MacPherson), 23C (Chambers)	Thu. 10 Nov.
24.	Evolutionary Biology Readings: Docs. 24A (Chambers) and 24B (Darwin); Kuhn, chap. 10	Tue. 15 Nov.
25.	Thermodynamics and Electromagnetism Readings: Docs. 25A (Sponholz), 25B (Kelvin), and 25C (Helmholz); Kuhn, chap. 11	Thu. 17 Nov.
26.	Special and General Relativity Theories Readings: Docs. 26A (Relativity), 26B (Sponholz), 26C (Raiter), 26D (Einstein); Kuhn, chap. 12 Due: Literature Review Essay	Tue. 22 Nov.
No Class: Thanksgiving Day		Thu. 24 Nov.
27.	Quantum Mechanics Readings: Docs. 27A (Quantum Theory), 27B (Sponholz), 27C (Oribtals); Kuhn, chap. 13 In Class: Doc. 27D (Modern/Postmodern Science)	Tue. 29 Nov.
28.	The Big Bang Theory and Intelligent Design Theory Readings: Doc. 28A (MacPherson), 28B (Overview); Kuhn, Postscript; In Class: Doc. 28C (Epistemic Virtues)	Thu. 1 Dec.
29.	Molecular Biology and Genetics Readings: Docs. 29A (Sponholz), 29B (Mendel), 29C (Watson/Crick)	Tue. 6 Dec.
30.	Global Warming / Concluding Reflections Readings: Docs. 30A (Global Warming), 30B (Global Warming), 30C (Sponholz), 30D (Buelow/MacPherson), 30E (Using and Misusing Science)	Thu. 8 Dec.
31.	Interpretations and Conclusions Assessment: Exam on Part III	Final Exam Period Tue. 13 Dec. 3:30-5:30 p.m.