HISTORY 104A

History of Ancient Science

Revised COVID19 Online Version – 1.20.2021

***PLEASE NOTE**: This is a **traditional lecture and discussion course** that is being implemented this semester as an online course, per Chancellor White's COVID-19 mitigation order. As a lecture and discussion course, **attendance is mandatory**. This is a **synchronous** online course, meaning **you must be 'virtually present' at the scheduled meeting times, just like a traditional class**. Careful attention to the readings and class participation will be crucial for a lively course.*

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Description

An examination of the theories, experiments, and calculations of Greek and Roman scientists as well as the work of major contributors to astronomy, natural philosophy, medicine, and technology in the ancient period. This course satisfies **GE Area B5**.

In more detail:

This course examines the historical foundations and evolution of ancient Greek physics, mathematics, and medicine, from the natural philosophy of the Presocratics to post-Aristotelian thought. Particular emphasis is given to the development of formal propositional logic and formalized inductive and deductive reasoning and their effect on the progression of Hellenic and Hellenistic physics, medicine, and mathematics. Along the way, we will explore the surprising ways in which key aspects of these ancient Greek conceptual frameworks have been reincorporated into current scientific theories, including quantum physics and cosmology.

Within the discipline of history, this course falls within the framework of the **history of ideas**--a field of research in history that deals with the expression, preservation, and evolution of ideas. The history of ideas is a central component of the discipline of **intellectual history**. Intellectual history refers to the historiography of ideas and thinkers, and, as practiced by historians, includes the history of philosophy and the history of science.

Intended audience: This course is open to all students. No prerequisites or specialized knowledge required. **For history majors, this course will count towards a European history elective**. Other majors, contact your department chair.

Course Outcomes:

- the ability to cite critical observations, underlying assumptions and limitations to explain and apply important ideas and models in the physical sciences, life sciences, and mathematics.

- the ability to recognize evidence-based conclusions and form reasoned opinions about science-related matters of personal, public and ethical concern.
- the ability to discuss historical and philosophical perspectives pertaining to the practice of science and mathematics.
- an understanding of the historical evolution of the conceptual foundations of modern science from its early roots in ancient Greek mathematics, logic, astronomy, physics, engineering, medicine, and natural philosophy more broadly.
- an understanding of formal deductive and inductive logic introduced by Aristotle (including the identification of formal and material fallacies) and their fundamental role in the historical development of mathematics, astronomy, physics, engineering, and medicine.
- an understanding of the evolution of the modern hypothetico-deductive scientific method from its earliest roots in the Aristotelian observational inductive-deductive method (i.e., the evolution of the modern concept of experiment from its ancient roots in logically analyzed natural observation).
- an understanding of the most important sources for the study of ancient science and technology.
- an understanding of foundational scientific questions that remain unsettled today, the historical roots of these questions, and the historical evolution of formal logic and scientific thought aimed at their answer.
- an understanding of the ways in which history has informed, and continues to inform, the evolution of scientific progress from the ancient period to the present day.
- the ability to apply historical knowledge of the origins and evolution of modern science, gained via the above 5 areas of understanding, to a critical rational evaluation of contemporary scientific claims.
- the ability to critically evaluate and employ literary and material evidence in studying the history of science and its evolution from Greek conceptions of nature and mathematics.

GE Area B (B5) Outcomes:

This course will • Develop an understanding of the principles underlying and interrelating natural phenomena including the foundations of our knowledge of living systems. • Introduce students to one or more of the disciplines whose primary purpose is to acquire knowledge of the physical universe rather than merely to apply existing knowledge. • Develop an appreciation of the methodologies of science, the requisite features of scientific endeavors, and the limitations of scientific inquiry. Students will be able to: • Demonstrate a knowledge and understanding of natural phenomena.• Apply the methodologies of science when approaching a scientific problem. • Explain the limitations of scientific inquiry.

Course Requirements

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For this special, synchronous online version of the course, you will need the following:

- Internet connection (DSL, LAN, or cable connection desirable)
- Access to Canvas

Canvas:

This course will be delivered entirely online through the course management system *Canvas*. To access this course on Canvas you will need access to the Internet and a supported Web browser (Chrome, Firefox, Safari). To ensure that you are using a supported browser and have required plug-ins, please visit the "Which browsers does Canvas support (Links to an external site.)" website.
You will use your Saclink account to login to the course from your My Sac State (Links to an external site.) account and click on the Canvas button or login directly through the Canvas Login Page.

If you need technical assistance at any time during the course **or to report a problem with Canvas** you can:

- Submit a Ticket (Links to an external site.)to Report a Problem to the Information Resources and Technology Support Team
- Call the Canvas Support line at Sac State: M-F 8a.m. – 5p.m.
  (916) 278-2450.
- Schedule a Consultation (Links to an external site.)to get assistance with Canvas and other Academic technologies
- Visit the Canvas Instructor Video Guides (Links to an external site.)
- Visit the Canvas Student Video Guides (Links to an external site.)

Visit the Canvas Student Web Tutorials (Links to an external site.)

Examinations and Papers:

There will be two examinations--one take-home mid-term and one final. There will be one 6-8 page paper. All due dates are given in the reading and lecture schedule below. Late submissions are not accepted. If you are ill with symptomatic COVID19, or are experiencing some similar emergency, please contact me.

Attendance*:*

It is impossible to succeed in this course if you miss the lectures. To encourage attendance, students are permitted only 2 unexcused absences for the semester. Class participation is weighted at 10% of your final grade. 3 or more unexcused absences results in a 0%. The only exception to this rule is if you are severely ill (e.g., diagnosed with symptomatic COVID19) or are experiencing some similar long term emergency.

Note: With the exceptions above, anyone who misses 2 lectures in the first 2 weeks of class will be administratively dropped to make room for students who are attempting to add.

If you are sick, stay home. If you are experiencing any COVID- like symptoms (fever, cough, sore throat, muscle aches, loss of smell or taste, nausea, diarrhea, or headache) or have had exposure to someone who has tested positive for COVID contact Student Health & Counseling Services (SHCS) at 916-278-6461 to receive guidance and/or medical care. You are asked to report any possible COVID related illnesses/exposures to SHCS via this link COVID-19 Illness/Exposure Report Form. Expect a call from SHCS within 24 hours. The CDC provides a good source of information regarding COVID-19 and a way to self-check symptoms: https://www.cdc.gov/coronavirus/2019-ncov/index.html. (Links to an external site.)

Powerpoint Presentations and Pre-outlined Lectures:

I do not use these in my courses (other than for the occasional diagram, table, graph, or some other image of this kind.) The ability to listen attentively to a lecture or discussion, follow its structure, identify its key points, and take proper notes, is crucial. If this is done for you via Powerpoint slides, or lecture outlines (whether pre-distributed or written on the chalkboard), you are denied the opportunity to exercise and strengthen this ability, or develop it in the first place if you haven't already. It is not difficult, but requires effort. Whatever your intended profession, this is an ability that you will need, and one that many employers lament is deficient or even non-existent in recent college graduates.

For other arguments against Powerpoint-based lectures, including scientific studies demonstrating their hazards, see this article by Edward Tufte, Professor Emeretus of Political Science, Computer Science and Statistics, and Graphic Design at Yale University: https://www.wired.com/2003/09/ppt2/ (Links to an external site.). See also this article on the work of Dr. John Sweller, University of New South Wales: www.smh.com.au/news/technology/powerpoint-presentations-a-disaster/2007/04/03/1175366240499.html (Links to an external site.). Finally, see the following paper by R. Mayer, J. Heiser, and S. Lonn, "Cognitive Constraints on Multimedia Learning: When Presenting More Material Results in Less Understanding." *Journal of Educational Psychology*. Vol. 93:1 (2001): 187-198 (Links to an external site.)

Texts and Materials:

- E.R. Lloyd, *Early Greek Science: Thales to Aristotle*. W.W. Norton, 1974. (Text designated as [**EGS**] in the reading schedule.)
  Average cost new: $9, used $1.50

- E.R. Lloyd, *Greek Science After Aristotle*. W.W. Norton, 1975. (Text designated as [**GSA**] in the reading schedule.)
  Average cost new: $13, used $3

- Readings downloaded from course website / Canvas (Designated as [**D**] in reading schedule.)

Grading

Class Participation:	10%	3 or more absences results in 0%
Weekly Reading Quizzes:	10%	Due prior to Class Meeting 1 each week
Midterm Exam:	25%	Due 3/15 by 5 pm
Essay:	25%	Due 4/26 by 5 pm
Final Exam:	30%	Due 5/20 by 5 pm

A-level work: All students begin this course with an A. In order to maintain it, all written work (paper, mid-term, and final exams) must exhibit complete, well-argued responses to the questions asked. This requires reference to the readings and lectures. For this reason, on-time attendance of all lectures and completion of all scheduled readings are requirements for success in this course.

A	93-100%	Excellent work
A-	90-92%	Nearly excellent work
B+	87-89%	Very good work
B	83-86%	Good work
B-	80-82%	Mostly good work
C+	77-79%	Above average work
C	73-76%	Average work
C-	70-72%	Mostly average work
D+	67-69%	Below average work
D	60-66%	Poor work
F	0-59%	Failing Work

Academic Standards: All sources in papers must be cited and given appropriate credit. The author of any information from the Internet must be given credit; using such information without indicating the source constitutes plagiarism, as it would with print publications. Students are allowed to discuss lectures and even assignments with each other, but they must do their own work. Students are required to read the University policy on academic honesty, which can be found here: https://www.csus.edu/umanual/student/stu-100.htm

Students with Disabilities: If you have a documented disability and require accommodation or assistance with assignments, tests, attendance, note taking, etc., please see the instructor during the first week of the semester so that appropriate arrangements can be made to ensure your full participation in class. Also, you are encouraged to contact the Services for Students with Disabilities (Lassen Hall) for additional information regarding services that might be available to you.

Reading and Lecture Schedule

Week 1: 1/26, 28 ***Introduction***

- The essence of what we today call 'science' is to be found in its origins as natural philosophy. What were the first questions that inspired more than two millennia of historically evolving, systematic inquiry that we today call 'science'? How is science periodized?
- Science before the Greeks—Egyptian and Mesopotamian technology, mathematics, and astronomy.

Reading: [**EGS**] Chapter 1, 1-15

- A look at some of the methodological problems in studying the history of ancient science.

Reading: [**D**], G.E.R. Lloyd, "Methods and Problems in the History of Ancient Science: The Greek Case," *ISIS* 83,4 (1992): 564-577 (Links to an external site.)

Week 2: 2/2, 4 ***The Quest to Identify the Essence of the World***

- The context of the Greek world: A look at Homer and Hesiod.
- The origins of Greek philosophy: The Ionian Enlightenment—Thales, Anaximander, and Anaximenes—the history and philosophy of the first Western metaphysicians [c. 624 – 500 BCE]

Readings: [**EGS**] Chapter 2, 16-23

Week 3: 2/9, 11 ***The Origin of A Continuing, Contemporary Scientific Fashion: The Attempted Reduction and Deduction of Nature to Fundamental Dualisms* – PART I**

The problems of Presocratic natural philosophy: The dualism of conceptual vs. physical as the fundamental essence of nature. Pythagoreans and Xenophanes [c. 580 – 500 BCE]

Readings: [**EGS**] Chapter 3, 24-35

Week 4: 2/16, 18 ***The Origin of a Continuing, Contemporary Scientific Fashion: The Attempted Reduction and Deduction of Nature to Fundamental Dualisms* – PART II**

The problems of Presocratic natural philosophy (cont'd): The dualism of change vs. permanence as the fundamental essence of nature. Heraclitus and Parmenides [c. 540 – 430 BCE]

An Escape from Dualism and the Origin of a New Trend in Contemporary Science: Pluralism as Fundamental

Anaxagoras and Empedocles [c. 490 – 430 BCE]

A Synthesis of the Pluralist and Reductive Schools: Ancient Atomism

Leucippus (atomist lineage traces through Zeno to Parmenides) [fl. 400 – 500 BCE]
Democritus [c. 460 – 370 BCE]

Readings: [**EGS**] Chapter 4, 36-49

Week 5: 2/23, 25 ***Applied Ancient Greek Philosophy of Nature: A Synthesis of the Greek Natural Philosophy Surveyed So Far: The Example of the Medicine of Hippocrates of Kos* [c. 460 – 370 BCE].**

Readings: [**EGS**] Chapter 5, 50 – 65

Week 6: 3/2 , 4 ***The History and Philosophy of Plato* – PART I**

Introduction and overview. The relationship between conceptual / physical objects, and logical / causal orders; the relationship between logical deduction and physical reduction; a look at key modern scientific rehabilitations of these concepts from Platonic natural philosophy: Examples include the idea of 'real' conceptual-mathematical objects in quantum theory and quantum cosmology and information theory.

Readings:

- [**EGS**] Chapter 6, 66 – 79
- [**D**] Selections from *Theaetetus* (Links to an external site.)
- [**D**] Selections from Book VI of *The Republic* (Links to an external site.)

Midterm exam: Take-home exam prompt distributed in class on **3/2**. It is due by 5 pm on **3/15**. It will cover all material through Week 5.

Week 7: 3/9, 11 ***The History and Philosophy of Plato* – PART II**

Platonic cosmology and its underlying deductive conceptual framework.

Readings: Selections from *Timaeus* 27e – 58c (Links to an external site.) [**D**]

Week 8: 3/16, 18 ***More Applied Ancient Greek Philosophy of Nature: The Example of Fourth Century Greek Astronomy***

Eudoxus, Calippus, Heraclides of Ponticus

Readings: [**EGS**] Chapter 7, 80 – 98

Midterm exam: Due by 5 pm on **3/15**.

3/22 - 3/28 ***SPRING BREAK***

Week 9: 3/30, 4/1 ***The Evolution of Platonic to Aristotelian Natural Philosophy: A Crucial Historical Waypoint Toward the Modern Scientific Method***

Introduction to Aristotelian natural philosophy--its underlying inductive and deductive conceptual framework, and the formalization of logical relations.

Readings:

- [**EGS**] 99 – 104
- Selections from *Prior Analytics* (Links to an external site.) [**D**]
- Selections from *Posterior Analytics* (Links to an external site.) [**D**]

Week 10: 4/6, 8 ***Aristotle's Philosophy of Nature and Cosmology***

Readings for Day 1: The Nature of Reason

- [**EGS**] 104 – 105
- Selections from *Nicomachean Ethics* - Book VI: The Intellectual Virtues and Practical Wisdom (Links to an external site.) - [**D**]

Readings for Day 2: The Reason in Nature

- [**EGS**] 105-115
- Selections from *Physics* (Links to an external site.) [**D**]

Essay: The topic of the 5 page essay will be assigned in class on **4/6**. It is due by 5 pm on **4/26.**

Week 11: 4/13, 15 ***Aristotelian Philosophy of Nature and Cosmology (cont'd)***

A look at key scientific rehabilitations of Aristotelian concepts in modern physics: The reality of *actual* and *potential* physical states.

Readings:

- *Selections from Metaphysics Book XII, 6 (Links to an external site.)* [**D**]
- Selections from *Generation and Corruption* (Links to an external site.) [**D**]
- Aristotle, Heisenberg, and Quantum Mechanics – *Science News* article [**D**]

Week 12: 4/20, 22

Aristotelian Philosophy of Nature and Biology

Readings:

[**EGS**] 115-124

Week 13: 4/27, 29

After Aristotle: Hellenistic and Roman Science and Technology

The Lyceum after Aristotle; the Epicureans and Stoics

Readings: [**GSA**] Chapters 1-3

Essay: The essay assigned on 4/6 is due by 5 pm on **4/26.**

Week 14: 5/4, 6

From Hellenic to Hellenistic Mathematics and Astronomy

Cosmological developments and Hellenistic planetary astronomy. The science of optics and weights. Euclid, Archimedes, Apollonius, Eratosthenes, Aristarchus, Seleucus, Ptolemy

Readings: [**GSA**] Chapters 4-5

Week 15: 5/11, 13

Applied Mechanics and Technology

The application of science to practical ends. Philo of Byzantium, Hero of Alexandria, Archimedes.

Review, summary, and outlook.

Readings: [**GSA**] Chapter 7.

Final Exam Prompt - Distributed in class on **5/11**.

Final Exam:

Due 5/20 by 5:00 pm.