Philosophy of Space and Time
Philosophy 1810-001
Fall 2023
MW 12-1:29p
GLAB 100

Description	What is space? It seems to be all around us, but we can't see it (and not because it is too small, for it may be infinite). It is part of the physical realm, for it is studied in physics (in classical physics physical objects are located in space, and in relativistic physics one studies the physical curvature of space), but it is not a material object like other physical objects. Space is at once familiar and unfamiliar. This course looks at the history of scientific and philosophical attempts to come to grips with these questions, from antiquity to modern times. Our central idea is that space is described by geometry, for instance, as a three dimensional version of the Euclidean plane. We will study the alleged difficulties of this view: Zeno's paradoxes seem to show that it is incompatible with the possibility of motion, and we must untangle this challenge. We will also consider an important debate between Newton and Leibniz concerning the relation between space and material objects: does space exist at all independently of matter? Does space influence matter? (Does matter influence space?) We will consider what it is to be handed: left and right hands are at once very similar -- twins -- but wholly different -- just try to put a left hand glove on your right hand. Can we find an explanation of this phenomenon in space? Finally we will also look at two key features of modern views of space: that space and time are not truly distinct but are really combined in one four dimensional entity, 'spacetime', and that space is not, as Euclid would have us believe, flat, but can be 'warped'. Both of these ideas jar with our intuitions, and we have to think through physical examples carefully to illustrate them. Aside from learning about the history of thought on space and understanding some important concepts of contemporary spacetime physics, students will discover how philosophy and physics interact.
Instructor:	Dr George Borg e-mail: gborg@sas.penn.edu phone : 215-898-7535
Instructor Office Hours:	Claudia Cohen Hall 426 Tu 11-12, F 11-12 and by appointment
Course website:	canvas.upenn.edu
Course Objectives	Knowledge • Learn the history of thought on space • Understand important concepts of contemporary spacetime physics • Discover how philosophy and physics interact Skills • To learn how to read philosophically • To learn how to evaluate and make philosophical arguments • Practice solving logical and conceptual problems

Required Texts

From the Penn Bookstore

We will be working our way through Nick Huggett's *Space from Zeno to Einstein: Classic Readings with a Contemporary Commentary.* 1999, The MIT Press.

All other required readings will be available on Canvas (**C).**

Recommended Texts: Library reserve. Announced in class.

How to read: The text is comprised of primary readings and commentaries. I suggest that you first read the primary text – which are not always easy – taking notes on what you do and (just as importantly) do not understand. Then read the commentary to help you understand better. And then, reread the primary text, looking at your notes to see how your understanding has changed and improved. This way you don't just parrot the book, but develop your own understanding; remaining issues you can write up for class questions.

ALL READINGS ARE TO BE DONE BEFORE THE CLASS ON WHICH THEY ARE DUE.

Requirements	• 4 Mini-Exams, each 18% of grade • Short (approx. 100 word) questions on readings turned in every lecture in hard copy, starting September 6. 18% of grade. See example p. 4. • Attendance and participation in class, and reading before class, 10% of grade. Class participation will be self-evaluated in class.
Procedures	• I will use the university's grading schema (see below) to grade exams. • Reading questions will be graded pass/fail • Final grades are computed as averages of all work • Exams will consist of problems from the book as well as new short answer questions.

Date	**Topic**	**Reading Due**
1. W, Aug 30	1. Introduction 2. "How to read philosophy" exercise	Ch 1: *Timaeus*; §1.1
M, Sep 4	**LABOR DAY - NO CLASS**	
2. W, Sep 6	Deductive, Inductive and Abductive Reasoning	1. "How to Read Philosophy" hand-out 2. Ch. 1: §1.2-3
3. M, Sep 11	Euclid	Ch. 2: Euclid

4. W, Sep 13	Zeno's Dichotomy Paradox	Parmenides extract, Fr 1-7 (pp.29-32); §3.1-2 (pp.37-44)
5. M, Sep 18	Zeno's Paradox of Plurality	Fr 13 (p.36); §3.3
6. W, Sep 20	Zeno's other paradoxes	Fr 8-12; §3.4
7. M, Sep 25	Aristotle's theory of place and motion	*Physics* Bk IV (pp. 53-60); §4.1-3 (pp.72-80)
8. W, Sep 27	**MINI-EXAM ON LECTURES 1-6**	
9. M, Oct 2	Aristotle's theory of the universe	*On the Heavens* I.1,2,8 & II.4,13,14 (pp. 61-71); §4.4. (pp. 80-82)
10. W, Oct 4	The Aristotelian Tradition	Ch. 5: The Aristotelian Tradition
11. M, Oct 9	Galileo	Galileo, *Dialogue Concerning the Two Chief World Systems,* pp. 5-7, 138-148 (**C**) Huggett, "Motion and Relativity Before Newton," pp. 1-9, 34-5 (**C)**
12. W, Oct 11	Descartes on Space, Matter, and Motion	Ch. 6: Descartes
13. M, Oct 16	Newton on Descartes on Space	Ch. 7: *De Gravitatione* pp. 107-115; §7.1-2
14. W, Oct 18	Newton on Absolute and Relative Spaces	Ch. 7: *Principia* Preface and Scholium I-IV (pp. 116-119); §7.3
15. M, Oct 23	**MINI-EXAM ON LECTURES 8-13**	
16. W, Oct 25	Newton on Absolute Motion	Ch. 7: *Principia* Scholium pp.119-124, Laws pp.124-125; §7.4-5
17. M, Oct 30	Leibniz & Clarke: The Principle of Sufficient Reason	Ch. 8: Leibniz Papers 1-3 and Clarke's Replies (pp.143-9); §8.1-2, 8.3 (thru p. 163)
18. W, Nov 1	Leibniz & Clarke: The Identity of Indiscernibles	Ch. 8: Leibniz Papers 4-5 and Clarke's Replies (pp.149-158); §8.3 (to end)
19. M, Nov 6	Berkeley & Mach	Ch. 9: *De Motu* and *Science of Mechanics* (pp.169-177); §9.1-9.2
20. W, Nov 8	Mach cont.	Ch. 9: *Science of Mechanics* pp.177-180; §9.3
21. M, Nov 13	**MINI-EXAM 3 ON LECTURES 14-20**	
22. W, Nov15	Spacetime	Ch. 10: §10.1-4

23. M, Nov 20	Kant on Handedness	Ch. 11: *Concerning the Ultimate Foundation …* (pp.197-202); §11.1-2
W, Nov 22	**THURSDAY/FRIDAY CLASS SCHEDULE – NO CLASS**	
24. M, Nov 27	Kant on Absolute Space	Ch. 11: §11.3
25. W, Nov29	Kant on the Geometry of Space	Ch. 12: *Critique* (pp. 213-220); §12.1-3
26. M, Dec 4	Poincaré	Ch. 13: *Space and Geometry* (pp.235-40); §13.1-2
27. W, Dec 6	Poincaré	Ch. 13: *Experiment and Geometry* (pp.241-2); §13.3
28. M, Dec 11	Einstein	Ch. 14
TBD	**FINAL MINI-EXAM**	

Here's an example of the kind of question (and thoughts about an answer) that you might turn in:

What if there are a number of scientific theories that all agree with experiments? How then do we know which one is true? For example, Euclid assumes that points are infinitely small but what if points were instead so tiny that Euclidean geometry were true only to a very good approximation? (Or what if space wasn't perfectly flat, only very nearly so?) Then, since experiments are only ever accurate to a certain degree of error, the predictions of Euclidean geometry and those of finite point geometry (or non-Euclidean geometry) might both agree with our experimental results. How then could we discover which theory was true? We might try better experiments if possible. Or we might consider other criteria - such as simplicity - to decide. (But why should the simpler theory be more likely to be true?)

Note!! This is an <u>example</u>!! Don't answer this question, ask your own question about the readings -- a question like this one.

The kinds of things you might ask about include: what don't you understand in the reading? why is it important? what might the meaning be? what questions are raised by the reading? what questions are suggested to you by the reading? This exercise gives you plenty of freedom to think about the texts and talk about what interests you.

I will use the University's grading schema to calculate your grade:

GRADES

The grade point average (GPA) is calculated at the end of every term based on the following grading scale:

A+	4.0
A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
C-	1.7
D+	1.3
D	1.0
F	0.0

*There is no D-.

Student Support Services:

The Weingarten Center offers a variety of resources to support all Penn students in reaching their academic goals. All services are free and confidential. To contact the Weingarten Center, call 215-573-9235. The office is located in Stouffer Commons, 3702 Spruce Street, Suite 300.

Academic Support

Learning consultations and learning strategies workshops support students in developing more efficient and effective study skills and learning strategies. Learning specialists work with undergraduate, graduate, and professional students to address time and project management, academic reading and writing, note-taking, problem-solving, exam preparation, test-taking, self-regulation, and flexibility.

Undergraduates can also take advantage of free on-campus tutoring for many Penn courses in both drop-in and weekly contract formats. Tutoring may be individual or in small groups. Tutors will assist with applying course information, understanding key concepts, and developing course-specific strategies. Tutoring support is available throughout the term but is best accessed early in the semester.

Disability Services

The University of Pennsylvania is committed to the accessibility of its programs and services. Students with a disability or medical condition can request reasonable accommodations through the Weingarten Center website. Disability Services determines accommodations on an individualized basis through an interactive process, including a meeting with the student and a review of their disability documentation. Students who have approved accommodations are encouraged to notify their faculty members and share their accommodation letters at the start of each semester. Students can contact Disability Services by calling 215-573-9235.