EPS 120/220: Introduction to Planetary Sciences
Spring 2024

An overview of the key physical and chemical processes that occur on planetary bodies of the solar system and a survey of current topics of research.

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Teaching Fellow:	Sarah Steele Office: Geological Museum 209 Email: sarah_steele@fas.harvard.edu Office hours: Thursdays 10:30-11:30 AM
Meetings:	Time: Monday and Wednesday. 3:00 – 4:15 PM. Room: Geological Museum 103A Labs: Wednesday 7:00 – 10:00 PM. Feb 14th and Mar 20th One-day required field trip to Western Massachusetts
Prerequisites:	Single variable calculus and introductory physics or permission of instructor. Introductory EPS class such as EPS 10 recommended, but not required.
Grading:	40% Problem sets and reading summaries 25% Term project report and presentation 20% Labs and fieldtrip report 15% Mid-term
Late policy:	All students will have 5 “late days” (24-hour delays) to use automatically without penalty. Up to two late days can be used on any one assignment. Late days can't be used on the mid-term or final project. Beyond these late days, students must request an extension ahead of the due date, or as soon as feasible. Unexcused late work will receive a 10% penalty per day.
Text:	Recommended, not required: Planetary Sciences. 2nd Edition Imke de Pater and Jack J. Lissauer **Available under the “Library Reserves” tab of the Canvas website**

Assignments: Three problem sets
Seven posts on Canvas for discussed papers
Two lab reports
Attend one-day fieldtrip and report
One mid-term
One team final project to design NASA mission

Extra assignments for PhD students:
Present extra background paper during paper discussions
Double posts on Canvas for paper discussions

Class description:

Planetary science is perhaps the oldest science- observations of the complex motions of the Sun, Moon, and five naked-eye planets led directly to the development of mathematics and the scientific method in the ancient world. Since then, the advent of space probes and advanced laboratory techniques has afforded us amazingly detailed views of our Solar System neighbors.

In this course we will first cover how systems of planets are believed to form from primordial clouds of gas and dust. We will then turn to the most important physical processes that occur on planetary bodies such as internal differentiation, orbital evolution, and hypervelocity impacts. Special emphasis will be placed on understanding common techniques employed to explore the Solar System.

The format of this course will change after the mid-term exam. During the first 2/3, our meetings will consist of lectures covering the basic principles that govern how planetary bodies form and change. Readings for this part of the course are optional and will be from the textbook. Homework will consist of problem sets.

For the last 1/3 of the course, our class meetings will include both a short lecture from the instructor on relevant background and a student-led discussion of one or more research papers. Homework for this portion will consist of discussion posts on Canvas. See calendar for details.

Fieldtrip:

The class will include a mandatory fieldtrip to study 201 million-year-old flood basalts and associated rock units in Western Mass. This style of volcanism is observed pervasively on other rocky planets in the Solar System. We anticipate this field to take place in late February or early March during one weekend day.

Project:

At the end of the semester, you will work in groups of two to three to **propose a Discovery Class NASA mission.** Answer the "simple" question: How exactly would you spend 500 million dollars to move planetary sciences forward? A successful proposal for a NASA mission requires (1) a compelling scientific goal that generates excitement among a wide audience and (2) a thorough study of technological feasibility. Think of an area of planetary science where you find interesting unanswered questions. You will write a report detailing the design of a spacecraft (orbiter and/or lander) and the scientific objectives. All groups will present on their proposal and we will vote on a mission to fund. The winning group will receive perks.

Lecture schedule:

Mon	22-Jan	Organizational meeting. Introduction to planetary sciences history.
Mon	29-Jan	Development of planetary sciences.
Wed	31-Jan	Survey of current developments. Start solar system formation.
Wed	31-Jan	MEET AT SECTION TIME 7-8:15 in Rm 103A; Disk formation, structure, substructure
Mon	5-Feb	Condensation sequence; Chronology activity U-Pb
Wed	7-Feb	Chronology activity Al-Mg; lecture on Pb-Pb
Mon	12-Feb	Finish telescopic observations of disks; Paper on current topics: Kruijer et al. discussion.
Wed	14-Feb	MEET IN SCIENCE CENTER 314, 7-10 pm. Meteorites lecture + lab. PSET 1 DUE.
Wed	21-Feb	Lecture on dust and accretion, streaming instability. Meteorite lab write up DUE.
Mon	26-Feb	Core accretion and pebble accretion; Migration activity.
Wed	28-Feb	MEET AT SECTION TIME 7-8:15 in Rm 103A; Nice model, P-R, Yarkovsky, orbital elements, tides
Mon	4-Mar	Small body populations, impact velocities and pressures.
Wed	6-Mar	Impacts, hydrostatic equilibrium derivation.
Mon	18-Mar	Spherical harmonics, moments of inertia. PSET 2 DUE.
Wed	20-Mar	MEET IN SCIENCE CENTER 804, 7-10 pm. Moon Lab
Mon	25-Mar	Gravity activity, free-air, bouguer anomalies
Wed	27-Mar	Planetary magnetism. Moon lab write up DUE.
Mon	1-Apr	Planetary atmospheres.
Wed	3-Apr	Paper on current topics: Early Earth. Was there a Late Heavy Bombardment?
Wed	10-Apr	Mid-term (regular class time)
Wed	10-Apr	MEET AT SECTION TIME 7-8:15 in Rm 103A; Paper on current topics: The Moon. How sure are we the Moon formed in an impact?
Mon	15-Apr	Paper on current topics: Venus. Catastrophic resurfacing? PSET 3 DUE.
Wed	17-Apr	Paper on current topics: The icy satellites. How likely is life in Europa's ocean?
Mon	22-Apr	Paper on current topics: Student-voted topic
Wed	24-Apr	Paper on current topics: Mars. The early martian dynamo.
TBD	TBD	Reading period, presentation for project

Not on here: Fieldtrip final date and Fieldtrip Write due date.