

## **GS 125/225 Atmospheric Evolution of Rocky Planets (Winter 2022)**

**Instructor:** Laura Schaefer, lkschaef@stanford.edu

**Meeting Times:** TuTh 1:30 – 3:00pm, Geocorner 227

**Office hours:** TBD, Green 255

**Overview** This course will cover formation and evolution of the atmospheres of rocky planets, with a focus on atmospheric chemistry. Topics to be discussed include atmospheric structure, energy balance, chemical equilibrium and kinetics, surface reactions, atmospheric escape, volatile delivery, impacts and volcanic outgassing. Topics will be discussed in the context of both the Solar system (Venus, Earth, Mars, Titan) and extrasolar planet observations. To be offered every other year, Winter or Spring quarter. Topics can be adjusted to suit the needs of the students.

**Class Format** There will be lectures covering textbook reading assignments every Tuesday. On Thursdays, we will discuss one (or more) articles from the literature related to the lecture topics. Students will be responsible for leading the paper discussions in Thursday classes.

**Who should take this course:** This course is aimed at graduate students and upper level undergraduates. The homework for this course will require knowledge of calculus and some basic knowledge of derivatives. Numerical calculations will be necessary for the homeworks, which can be done with whatever programming or spreadsheet methods the student is most comfortable with.

**Textbooks:** Reading assignments for lectures will come primarily from Atmospheric Evolution on Inhabited and Lifeless Worlds (Kasting & Catling), which is available through Stanford Libraries in electronic format (<https://searchworks.stanford.edu/view/12099388>).

**Grading:** Grades will be based on 4 homework assignments (60%), leading article discussions (20%) and participation (20%). There will be no exams. Grades will be maintained in Canvas throughout the quarter and good-faith attempts will be made to return homework in a timely fashion.

**Homework:** Biweekly homework sets will be assigned on Thursdays and due in two weeks. Homework sets will be graded out of 20 points. Graded homework may be corrected and resubmitted for additional partial credit within 1 week of return. Some homework assignments may require the use of computational tools or the development of a simple program. Any programming language (or spreadsheet program) may be used as long as proof of original work is supplied. Students are encouraged to contact me early with questions on the homework assignments. Homework assignments for students taking the 200-level course will be more computationally intensive than for 100-level students.

**Participation:** Class participation will be gauged by attendance, and contribution to discussions. Missing a few classes for e.g. conference attendance is fine (expected, even), and will not negatively affect the student's grade as long as the student remains actively engaged in the coursework.

**Honor Code:** All students must read and abide by Stanford's Honor Code (<https://communitystandards.stanford.edu/student-conduct-process/honorcode-and-fundamental-standard>). Students are encouraged to collaborate with others on their homework. Copying is not permitted. Please state your answers in your own words. Students who collaborate must list their

collaborators on the bottom of the homework. Students may use outside sources, such as books, peer-reviewed journals, or credible Internet sites, but these sources must be cited.

**Students with Documented Disabilities:** Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty. Unless the student has a temporary disability, Accommodation letters are issued for the entire academic year. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, URL: <https://oae.stanford.edu/>).

Week	Date	Topic	Reading & Assignments
1	Tuesday 1/4	Structure of Planetary Atmospheres	CK Ch. 1
	Thursday 1/6		
2	Tuesday 1/11	Energy & Radiation	CK Ch. 2
	Thursday 1/13		
3	Tuesday 1/18	Atmospheric chemistry principles	CK Ch. 3
	Thursday 1/20		
4	Tuesday 1/25	Atmospheric escape	CK Ch. 5
	Thursday 1/27		<b>HW#1 due</b>
5	Tuesday 2/1	Atmosphere formation	CK Ch. 6
	Thursday 2/3		
6	Tuesday 2/8	Volcanic Outgassing & Redox balance	CK Ch. 7 & 8
	Thursday 2/10		<b>HW#2 due</b>
7	Tuesday 2/15	Prebiotic/Postbiotic atmospheres and rise of O <sub>2</sub>	CK Ch. 9 & 10
	Thursday 2/17		
8	Tuesday 2/22	Long-term climate evolution	CK Ch. 11
	Thursday 2/24		<b>HW#3 due</b>
9	Tuesday 3/1	Mars	CK. Ch. 12
	Thursday 3/3		
10	Tuesday 3/8	Venus	CK Ch. 13
	Thursday 3/10		<b>HW#4 due</b>