



COURSE SCHEDULE

Tuesdays and Thursdays, 3:30 pm-5:00 pm, Room No. TBA

INSTRUCTOR

Prof. Ileana Pérez-Rodríguez, 264A Hayden Hall, ileperez@sas.upenn.edu
Office hours: by appointment only (please send e-mail proposing three time slots)

COURSE SUMMARY

The development of the biosphere is closely linked to earth's evolution, geochemical conditions and surface processes. This course gives an introduction into the basics of microbiological activities driving the global cycling of many elements on the planet. We will rely on techniques and ideas drawn from chemistry, geology, biology and ecology to study the many ways microbes make a living (diversity of metabolisms and habitats), how microorganisms drive key biogeochemical processes, and the role of microbial activities through time. Our discussions will also intersect with fields such as the origin of life, paleobiology, geochemistry, oceanography, planetary science, climate science, and bioengineering. Ultimately, we will explore how microorganisms are (i) central players in climate change while at the same time (ii) providing essential human services and vast opportunities for biotechnology. It is my goal that by the end of the course, you will have improved your analytical skills and your ability to evaluate/synthesize information; all while gaining a broad understanding of the role of microbes on our planet.

* The course is designed for upper-level undergraduates and graduate students.

TEXTS AND RESOURCES

The required text for this course is *Introduction to Geomicrobiology* (1st edition) by Kurt Konhauser (2007). Scheduled readings are from this text unless otherwise noted. Other readings, from *Earth System History* (4th Edition) by Steven Stanley and John Luczaj (2015), will be provided.

Students who have not taken any biology class recently may find it useful to have a textbook that can be used as a reference for general microbiology concepts. This is completely optional. Any general introductory microbiology text will do, but an option is *Brock Biology of Microorganisms* by Madigan et al. Although currently in its 15th edition, older versions are still very useful (ok, back to ~ 7th edition).

*All reading assignments should be completed before class on the day they are listed.

ATTENDANCE, ASSIGNMENTS AND PARTICIPATION

ATTENDANCE: Attendance is expected. If you cannot attend on a given day, please e-mail me in advance. Students are permitted 2 absences, after which their attendance and participation grade will be affected negatively. Consistent late arrival to class will also negatively affect your grade. For students who are observing any of the holidays listed on <https://catalog.upenn.edu/pennbook/secular-religious-holidays/> and/or requiring special accommodations, please contact me within the first two weeks of class to make schedule arrangements.

PARTICIPATION: Participation in class discussions is required. Your grade will reflect your participation in the form of (i) questions, (ii) comments, (iii) added content contribution and (iv) general engagement in class discussions.

SHORT ASSIGNMENTS: Part of the course is designed to serve as a “journal club” for the discussion of original research articles associated with the topics presented in class. A short assignment sheet, to be provided by the instructor via Canvas, must be thoroughly prepared before every “journal club” session (to be handed in to the instructor by the end of the class). No assignment will be accepted late. Unless justified, a grade of zero will be given for any assignment not delivered by the designated time and date. Computer equipment failures will not be accepted as valid reasons for late submissions.

PAPER PRESENTATION: Students will choose a scientific article within geomicrobiology for the development of an oral presentation highlighting the same main questions discussed during “journal club” sessions. Only in the event of a justified absence, students will be able to submit a written assignment instead.

REVIEW PAPER FOR GRADUATE STUDENTS: Graduate students in the course will choose and research a topic within geomicrobiology for the development of a review paper (i) highlighting current state of knowledge in the topic and (ii) identifying knowledge gaps in the field (due on the last day of class). Students who turn their review paper late will lose one grade “step” for every 24 hours the paper is late (e.g. a paper that would have merited an “A-” will receive a “B+” if submitted within 24 hours after the due date, a “B” if submitted within 48 hours after the due date, and so on).

ELECTRONIC DEVICE POLICY: The use of audio recordings and cell phones is prohibited. Laptop computers are highly discouraged. However, if quickly checking the web for some reference in class helps you follow or make sense of my or other students’ comments, please feel free to do so. If I find that you are abusing this policy, I will ask you to turn off the device. Repeated infractions will lower your attendance and participation grade.

CANVAS: We will use Canvas for access to required readings, scientific articles and assignment templates. Important class announcements will be made through Canvas, so check regularly. All class-related questions are to be posted publicly via Canvas (to ensure uniform distribution of course information). However, waiting for a Canvas response is not an excuse for incomplete or late assignments.

TIPS FOR SUCCESS: The ultimate success of this course depends on your participation. You will maximize both your enjoyment of this class and your grade by (i) attending all classes, (ii) reading and taking notes of class material and (iii) by participating in class discussions.

GRADE SCORES

Short Assignments	15 %
Attendance and Participation	15 %
1 st Exam	25 %
2 nd Exam	25 %
Paper Presentation (20 % for Undergraduates)	10 %
Term Review Paper (Graduate students only)	10 %

* There is no extra credit available in this course. This course is NOT graded on a curve, nor is any exam or assignment.

Total scores will be converted to final letter grades using the following general scale:

A+ = 97-100%	B+ = 87-89%	C+ = 77-79%	D+ = 67-69%	F = <59%
A = 94-96%	B = 84-86%	C = 74-76%	D = 64-66%	
A- = 90-93%	B- = 80-83%	C- = 70-73%	D- = 60-63%	

GRADING POLICY

It is your responsibility to monitor your grades. Any omissions, errors or discrepancies should be reported to your instructor within two weeks of getting each of your exam/assignment scores (and a period of two weeks after obtaining your final grade). No petitions will be accepted after the two-week period. All regrade requests must be submitted in writing with a full explanation of why you think the work was incorrectly graded. Except in cases where I have added numbers incorrectly, I will only regrade entire exams or papers. Please understand that once you submit your work for regrading, the grade can go either up or down.

ACADEMIC CLIMATE

It is expected that everyone be respectful to their fellow classmates and professor. This includes interactions in class and online postings. Combative posturing or statements that work to silence others and stunt dialogue will negatively impact your participation grade.

ACADEMIC INTEGRITY

It is your responsibility to be familiar with the University of Pennsylvania's Code of Academic Integrity (<https://catalog.upenn.edu/pennbook/code-of-academic-integrity/>). A confirmed violation of that Code in this course will result in failure for the course.

SCHEDULE

Week 1	Topic	Reading	Total pp.
T Aug 30	Introduction to Geomicrobiology and The Geologic Time Scale	Stanley: pp. 1-21	21
R Sept 1	The Rock-Water Cycles/ Plate Tectonics	Stanley: pp. 186-202	17
Week 2			
T Sept 6	Red-Ox Chemistry, Thermodynamics and Bioenergetics	Konhauser: 2.0 and 2.1	11
R Sept 8	Basics of Catabolism	Konhauser: 2.3	7
Week 3			
T Sept 13	Chemoheterotrophy in the Oxidic/Suboxic Zones	Konhauser: 2.4	14
R Sept 15	Chemoheterotrophy in the Suboxic/Anoxic Zones	Konhauser: 2.4	14
Week 4			
T Sept 20	Chemolithotrophy	Konhauser: 2.5 and 2.6	14
R Sept 22	Anoxygenic Photosynthesis	Konhauser: 2.2	12
Week 5			
T Sept 27	Oxygenic Photosynthesis	Konhauser: 2.2	12
R Sept 29	Journal Club: Microbial Metabolism		
Week 6			
T Oct 4	Physico-Chemical Requirements for Growth	Konhauser: 1.3	11
R Oct 6	The Diversity of Microbial Lifestyles	Konhauser: 1.4, 1.5, 1.6	18
Week 7			
T Oct 11	Molecular Fundamentals and the 3 Domains of Life	Konhauser: 1.0-1.2	10
R Oct 13	FALL TERM BREAK		
Week 8			
T Oct 18	Early Earth and Habitability	Stanley: pp. 257-263 Konhauser: 7.0 and 7.1.1	11
R Oct 20	EXAM 1		

Week 9			
T Oct 25	Origin of Life + Central Dogma of Molecular Biology	Stanley: pp. 268-272, Konhauser: 7.0 and 7.1	12
R Nov 3	Progenotes and Early Life	Konhauser: 7.2	8
Week 10			
T Nov 1	Journal Club: Microbial Physiologies		
R Nov 3	EXAM 1- DISCUSSION (+ initial content from 11/08)		
Week 11			
T Nov 8	Bioenergetic Expansion and Early Phototrophy	Konhauser: 7.3.1	8
R Nov 10	Oxygenic Photosynthesis and The Great Oxidation Event	Stanley: pp. 287-289 Konhauser: 7.3.2, 7.3.3	12
Week 12			
T Nov 15	Metabolic Diversification driving Biogeochemical Cycles	Konhauser: 7.4 and 7.5.1	19
R Nov 17	PRESENTATIONS		
Week 13			
T Nov 22	Snowball Earth and Eukaryogenesis	Stanley: pp. 281-287 Konhauser: 7.5.2 and 7.6	12
R Nov 24	THANKSGIVING BREAK		
Week 14			
T Nov 29	Boring Billion, Snowball Earth and Multicellularity	Stanley: pp. 281-287 Konhauser: 7.5.2 and 7.6	12
R Dec 1	Journal Club: Microbial Evolution		
Week 15			
T Dec 6	Reservoirs, Fluxes, Feedback Loops and Climate Change	Stanley: pp. 226-231, 524-526 and 538-546	12
R Dec 8	EXAM 2		

* Course schedule may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.

The Earth and Environmental Science Department embraces human diversity and intends equity and inclusion in our community and our classrooms. We expect instructors, staff, and students to respect our diversity. We encourage you to contact our Climate, Diversity, Equity and Inclusion (CDEI) Committee EES-CDEIC@groups.sas.upenn.edu if you need support or have suggestions for how our CDEI efforts in EES can improve.