

Syllabus for BIOL/EAS 6765: Geomicrobiology

I. General Information

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Classes: L1105 ES&T: Tu, Th 11:35 pm - 2:55 pm

II. Objectives

The objective of this course is to describe interactions between microorganisms and the geosphere and bridge the gap between geochemistry and environmental microbiology. Fundamental processes such as: microbial physiology and genetics; geochemical controls on microbial diversity and activity; microbiological controls on geochemical reaction networks; redox and acid-base geochemistry; biogeochemical cycles; and evolution will be studied.

III. Course Material

Course material is based on class notes, handouts, and assigned readings. The textbook associated with this course is:

J. F. Banfield, J. Cervini-Silva, and K. M. Nealson, 2005. Molecular Geomicrobiology. Reviews in Mineralogy Vol. 59. Mineralogical Society of America.

The following textbooks will also be used regularly:

- T. Fenchel; G. M. King; T. H. Blackburn. 2000. Bacterial Biogeochemistry: the ecophysiology of mineral cycling. Academic Press.
- E. A. Paul; F. E. Clark. 2000. Soil Microbiology and Biochemistry. Academic Press.
- F. J. Stevenson; M. A. Cole. 1999. Cycles of Soils: Carbon, Nitrogen, Phosphorus, Sulfur, Micronutrients, 2nd Edition. Wiley.
- M.T. Madigan; J.M. Martinko; J. Parker. 2006. Brock Biology of Microorganisms. 11th edition, Prentice Hall.
- J.W. Lengeler, G. Drews, H.G. Schlegel. 1999. Biology of Prokaryotes, Blackwell Science.
- W. Stumm; J. J. Morgan. 1996. Aquatic Chemistry. Chemical equilibria and rates in natural waters. Wiley.

IV. Grading

Paper presentations (2): 40%. Term paper: 50%. Participation: 10%.

V. Course Outline

1. Carbon

Methanogenesis; carbon uptake and fixation; mineralization of organic matter; greenhouse gases; gas hydrates; aerobic and anaerobic methane oxidation.

2. Oxygen

Cyanobacteria and photosynthesis; oxygenation events on Earth; bacterial mats and stromatolites, photosystem I and II.

3. Nitrogen

Nitrogen chemistry; mechanisms and regulation of bacterial N fixation; anaerobic and aerobic ammonium oxidation; ammonium formation; nitrification; denitrification; dissimilatory nitrate reduction to ammonium..

4. Sulfur

Sulfur chemistry; global sulfur cycle; sulfur oxidizers; sulfate reduction; microbial diversity in the sulfur cycle; formation and oxidation of sulfur minerals; anoxygenic photosynthesis.

5. Metals

Metal speciation; Mn and Fe oxidation; metal oxidizers and anoxygenic phototrophs; chemical and bacterial metal reduction; bacterial mechanisms for metal detoxification; uptake of essential elements..

6. Phosphorus

Phosphorus chemistry; global phosphorus cycle, P as a limiting nutrient in marine systems, phosphodiester and phosphonate compounds; bacterial mechanisms for uptake and P-regulated gene expression.

VI. Organization of the Course

The course will consist of a discussion on each topic using review papers as introductory material and recent journal articles. Each student will choose three topics of interest in the beginning of the course and will be assigned a review paper as well as recent journal articles on these topics (2012 and 2013 only). Each student will introduce the topic (based on the review paper) or discuss most recent findings from the literature by giving a presentation for an hour followed by a 30 minute discussion with the class. The course is designed to be a discussion between participants who will also read each paper assigned by the instructors. Every student is expected to read each paper carefully and have at least three questions to be addressed in class. Participation is graded.

A term paper will be required from each student in the class. This paper should be a critical review on a geomicrobiology topic. The term paper should be 10 pages in length (Font: Times 12; Lines: double-spaced) not including figures and references. Topics should be approved by the instructors by **November 14, 2013**.

FINAL CLASS SCHEDULE

August	20	Introduction – DiChristina & Taillefert
	22	Carbon – Chemistry review
	27	Carbon – Microbiology review
	29	Mary Beth / Kaitlin
September	3	Will / Eric
	5	Boryoung / Jennifer
	10	Xiaoxu / Carbon discussion
	12	Oxygen – Chemistry review
	17	Oxygen – Microbiology review
	19	Kaitlin / Raghav
	24	Nitrogen – Chemistry review
	26	Nitrogen – Microbiology review
October	1	Nicole / Cory
	3	Shannon / Melissa
	8	Mary Beth / Xiaoxu
	10	Eric / Sulfur – Chemistry review
	15	No Class - Fall Break
	17	Sulfur – Chemistry cont.
	22	Sulfur – Microbiology review
	24	Eryn / Raghav
	29	Piysuh / Ben
	31	Will / Boryoung
November	5	Metals – Chemistry review
	7	Metals – Microbiology review
	12	Metals – review cont. / Shannon
	14	Emily / Piyush
	19	Eryn / Ben
	21	Nicole / Jennifer
	26	Phosphorus – Chemistry / Microbiology review
	28	No Class – Thanksgiving
December	3	Emily / Taehwan
	5	Melissa / Cory
	13	Term Papers due at 5:00 pm