COURSE SYLLABUS
BIOL/EAS 6765 GEOMICROBIOLOGY
FALL SEMESTER 2021
PROFESSORS DICHRISTINA AND TAILLEFERT

Scheduled Time and Room: TR 12:30 - 1:45 PM, Ford EST Building, room L1118
Required Class Material: *Science* and *Nature* papers will be uploaded to class Canvas site.
Office hours: By appointment [ES&T Building, rooms 1240 (DiChristina) and 1254 (Taillefert)]. To meet students' requirements, needs, and comfort levels, meetings and office hours will be offered in-person, virtually, or outdoors.
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General Information

Course Description: Geomicrobiology describes the 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 examined.

Recommended (But Not Required) Textbooks:

- M.T. Madigan; J.M. Martinko; J. Parker. 2017. Brock Biology of Microorganisms. 15th edition, Prentice Hall, *On reserve in library*.
- 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.
- W. Stumm; J. J. Morgan. 1996. Aquatic Chemistry. Chemical equilibria and rates in natural waters. Wiley.
- J. F. Banfield, J. Cervini-Silva, and K. M. Nealson, 2005. Molecular Geomicrobiology. Reviews in Mineralogy Vol. 59. Mineralogical Society of America.

Prerequisite (requires a minimum grade of "D"):
BIOL/BIOS 4410, BIOL/BIOS 4418, or EAS 3620

Grading:
Two paper presentations: 20% each (40% total grade)
Term Paper: 50%
Class Participation: 10%

Grading scale:
A: 90-100%
B: 80-90%
C: 70-80%
D: 60-70%
F: <60%

Geomicrobiology Topic Areas

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; aerobic and anaerobic 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.

Course Organization: The Geomicrobiology course will consist of a discussion on each topic using recent journal articles from *Science* and *Nature* articles in 2019. Each student will dissect the article by giving a PowerPoint presentation of 45 minutes 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 ask questions during the discussion period in class. Participation is graded.

A term paper is required from each student in the class. This paper should be a critical review of a geomicrobiology topic. The term paper should be 10 pages in length (Font: Times New Roman 12; Lines: double-spaced), not including figures and references. Term paper topics should be approved by the instructors by **Thursday, November 16, 2021**. PDF files of term papers should be submitted via email to the instructors by **Monday, December 13, 2021.**

Expectations: Students are responsible for knowing the material covered in lectures. Students are required to read the assigned papers prior to class to aid in their understanding and participation during presentations. It is the responsibility of the student to obtain any missed information, instructions or materials that results from a missed presentation. Students are also expected to be proactive, meeting with either Dr. DiChristina or Dr. Taillefert if they encounter difficulties in the class, require assistance or have any unanswered questions.

Learning Outcomes: In this course, students will be exposed to the most recent understanding of fundamental geomicrobial processes across a wide range of disciplines and their impact on the biogeochemical cycling of elements in natural and engineered systems. Students will learn how to prepare before class by investigating the scientific background behind each topic

covered. At the same time, students will learn how to communicate with a broad scientific and engineering audience that is not always well versed in their own discipline. Finally, this course will include a number of career development activities that will be beneficial to students.

CLASSROOM POLICIES:

Class structure during the Pandemic
As we are in the middle of a pandemic, please be aware that the course's structure and delivery may be affected by the most current events. The course is scheduled to include in-person delivery. However, we will accommodate anyone who is not comfortable attending the course in-person by providing online lectures synchronously. Please let Dr. DiChristina and Taillefert know as soon as possible, should you decide to participate remotely.

Covid-19 Guidelines and Expectations
Students are expected to be familiar with and abide by the Institute guidelines, information, and updates related to Covid-19. Find campus operational updates, Frequently Asked Questions, and details on campus surveillance testing and vaccine appointments on the **Tech Moving Forward site**.
Each of us has a responsibility to ourselves and our fellow classmates to be mindful of our shared commitment. We encourage everyone participating in the course to vaccinate and wear a face mask while inside any campus facilities/buildings, including during in-person classes, and to adhere to social distancing practices. A clearly marked supply of masks will be available in each building if needed.

Consideration to classmates: Silence all cell phones. Remove headphones and headsets. No talking unless asking or answering questions relevant to the course.

Lateness: Please be on time.

Excuses and Make-up Classes: Documentation of excused absences must be obtained through the Office of the Dean of Students (http://deanofstudents.gatech.edu) and provided by the class period immediately following the class missed. Valid excuses include personal emergencies such as being hospitalized, or being in a car accident, excused absences due to official school events, family events over which you do not have control, such as a funeral. If you have a valid excuse, you can make up the missed class during the instructor's office hours (or at another pre-arranged time) within 3 days of the missed class period.

Regrade requests: Any request for a reconsideration of the grading of a presentation or term paper must be submitted in writing to either Dr. DiChristina or Dr. Taillefert. This request must include a clear explanation of why you think your presentation or term paper should be re-graded.

Academic Integrity: Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/.
Any student suspected of cheating or plagiarizing on an assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities: If you are a student with learning needs that require special accommodation, including a student at higher risk for severe illness with Covid-19, contact the Office of Disability Services at 404-894-2563 or

http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail either Dr. DiChristina or Dr. Taillefert as soon as possible in order to set up a time to discuss your learning needs.

Campus Resources for Students: In your time at Georgia Tech, you may find yourself in need of support. Below you will find some resources to support you both as a student and as a person.

Academic support

- Center for Academic Success http://success.gatech.edu
  - 1-to-1 tutoring http://tutoring.gatech.edu/tutoring
  - Peer-Led Undergraduate Study (PLUS) http://tutoring.gatech.edu/plus-sessions
  - Academic coaching http://advising.gatech.edu/academic-coaching
- OMED: Educational Services (http://omed.gatech.edu/academic-support)
  - Group study sessions and tutoring programs
- Communication Center (http://communicationcenter.gatech.edu)
  - Individualized help with writing and multimedia projects

Personal Support:

Georgia Tech Resources

- The Office of the Dean of Students: http://studentlife.gatech.edu; **404-894-2565**; Smithgall Student Services Building 2nd floor, 353 Ferst Drive
  - You also may request assistance at https://gatech-advocate.symplicity.com/care_report/index.php/pid383662?
- Counseling Center: http://counseling.gatech.edu; **404-894-2575**; Smithgall Student Services Building 2nd floor (suite #238)
  - Services include short-term individual counseling, group counseling, couples counseling, testing and assessment, referral services, and crisis intervention. Their website also includes links to state and national resources.
  - Students in crisis may walk in during business hours (8am-5pm, Monday through Friday) or contact the counselor on call after hours at **404-894-3498**.
- Students' Temporary Assistance and Resources (STAR): http://studentlife.gatech.edu/content/star-services
  - Can assist with interview clothing, food, and housing needs.
- Stamps Health Services: http://health.gatech.edu; **404-894-1420**
  - Primary care, pharmacy, women's health, psychiatry, immunization and allergy, health promotion, and nutrition
- OMED: Educational Services: http://www.omed.gatech.edu
- Women's Resource Center: http://www.womenscenter.gatech.edu; **404-385-0230**
- LGBTQIA Resource Center: http://lgbtqia.gatech.edu; **404-385-4780**
- Veteran's Resource Center: http://veterans.gatech.edu; **404-385-2067**
- Georgia Tech Police: **404-894-2500**

Statement of Intent for Inclusivity: As a member of the Georgia Tech community, we are committed to creating a learning environment in which all of our students feel safe and included. Because we are individuals with varying needs, we are reliant on your feedback to achieve this goal. To that end, we invite you to enter into dialogue with us about the things we can stop, start, and continue doing to make our classroom an environment in which every student feels valued and can engage actively in our learning community.

Syllabus change policy: Syllabus changes substantially affecting the grading of the course will not be made. Other syllabus changes may be made and will be announced.