BI 413 / 613: Microbial Ecology

Spring 2023

Schedule, Contact, & Location Information

Tuesdays: 9:30 AM – 10:45 AM (lecture)
Wednesdays: 9:05 AM – 9:55 AM (discussion section)
Thursdays: 9:30 AM – 10:45 AM (lecture)

Professor: Jeffrey Marlow // jjmarlow@bu.edu // Office: BRB 431
Office hours are Tuesdays and Thursdays, 8:00 AM – 9:30 AM, or by appointment if needed. Please send me an email if you will be stopping by, briefly describing what you'd like to discuss. All lectures and discussion sections will take place in CAS 227.

Course Description

Microorganisms are the most ancient and abundant form of life on Earth, comprising the vast majority of biodiversity and metabolic functionality. This course views microbes in coordination with their environments, revealing the ways in which they evolve, move, metabolize, and interact in relation to their abiotic and biotic surroundings. Through a progression of lectures, we will contextualize microbial diversity in the context of Earth history and the broader tree of life before focusing on microbial metabolism. We will consider photosynthesis and primary production, as well as organic carbon degradation through a series of different electron acceptors. We will then explore the link between microbial activities and the geosphere, through the production and degradation of minerals; both processes can regulate microbial activity and leave critical clues when interpreting evidence of microbial activity. Finally, we will apply principles of biotic and abiotic interactions to applied systems, such as engineered microbial communities to assist with pressing challenges including bioremediation and greenhouse gas sequestration. In addition to the series of lectures, discussion section will incorporate journal clubs to present and workshop important concepts around phylogenetic trees, bioenergetics, turnover rates, and interactive models of predation and syntrophy.

Course Objectives

At the end of this course, you will gain the following domain-specific knowledge, technical abilities, and analytical & communication skills:

- An intuitive sense of the microbial world, including the ways in which microbial communities control the fluxes of key nutrient and elemental cycles.
- An appreciation of the importance of interspecies interactions in a range of microbiomes.
- An understanding of phylogenetics and the diversity revealed by the tree of life.
- A quantitative sense of metabolic activity, from both thermodynamic and kinetic perspectives.
- Skills for interacting with primary research studies, including how to read scientific papers and how to conduct literature-based research.

Instructional Format, Course Pedagogy, and Approach to Learning

In recognition that we all learn and communicate in different ways, there will be several ways in which you will demonstrate your knowledge. You will read primary literature, attend audio-visual lectures, and

discuss questions and ideas with the instructor. You will complete a written problem set, take written quizzes, and engage in classroom discussions.

Assignments and Grading Criteria

Your grade will be determined based on the following components:

- Participation (class discussions, lecture questions, etc.) and paper summaries: 10%
    - This component will include voluntary participation in class discussions and presentations, responses to in-lecture questions, and submission of your paper summaries.
- Paper presentation: 10%
    - Once during the semester, you will co-present a paper with one of your classmates. This will involve presenting the context, findings, and interpretation of a study, and drawing connections to other research papers.
- Problem set: 10%
    - There will be one problem set with several problems related to the lecture material and/or research papers we've read.
    - Distributed 2.16.23, due 3.14.23 at 9 AM.
- Quizzes: 70%
    - On most Tuesdays, class will start with a 20-minute quiz, which may include multiple choice or short answer questions. Questions will relate to any of the material (lecture and paper discussions) covered to date. You will need a simple calculator for these quizzes, so please bring one to class. You will be able to drop the lowest of your 11 quiz scores.
- Extra credit assignment TBD: 5%

The grade scale is as follows: A+: 97-100; A: 93-97; A-: 90-93; B+: 87-90; B: 83-87; B-: 80-83; C+: 77-80; C: 73-77; C-: 70-73; D+: 67-70; D: 63-67; D-: 60-63; F: <60. Grades will not be rounded up or down for equity reasons (as rounding is essentially a curve based only on your proximity to a round number). Grading curves will only be used to benefit everyone's scores, if necessary (e.g., if the average grade is below 80%).

Community of Learning: Class and University Policies

Attendance throughout the course is required for lectures and discussion sections. Late Work will be considered for a maximum of 75% if submitted within 24 hours, a maximum of 50% if submitted between 24-96 hours late, and 0% thereafter. If you envision any issues with attending a class session or submitting work on time, let me know at least 24 hours in advance.

All course participants are bound by BU's Code of Conduct. In written and oral presentations, all information and data not directly collected by the student must be cited appropriately. Any case of suspected misconduct (e.g., cheating or plagiarism) will be referred to the Dean of the College; if misconduct is found to have occurred, a grade of zero will be applied to the assignment in question, and further disciplinary actions may be considered.

This course is committed to supporting diversity and inclusion among all participants. We proactively strive to construct a safe and inclusive environment by respecting each other's dignity and privacy. We treat one another fairly and honor each member's experiences, beliefs, perspectives, abilities, and backgrounds. Bullying, discrimination, and other disrespectful or threatening language or behavior will not be tolerated in the classroom or online. If you ever have any concerns about the classroom climate, do not hesitate to contact me.

Course Schedule (subject to adjustments)

1.19.23: Lecture 1
1.24.23: Lecture 2
1.25.23: Paper discussion (practice)
1.26.23: Lecture 3; Practice quiz
1.31.23: Quiz 1; Lecture 4
2.1.23: Paper discussion 1
2.2.23: Lecture 5
2.7.23: Quiz 2; Lecture 6
2.8.23: Paper discussion 2
2.9.23: Lecture 7
2.14.23: Quiz 3; Lecture 8
2.15.23: Paper discussion 3
2.16.23: Lecture 9
2.22.23: TBD
2.23.23: Lecture 10
2.28.23: Lecture 11
3.1.23: TBD
3.2.23: Lecture 12
3.14.23: Quiz 4; Lecture 13
3.15.23: Paper discussion 4
3.16.23: Lecture 14
3.21.23: Quiz 5; Lecture 15
3.22.23: Paper discussion 5
3.23.23: Lecture 16
3.28.23: Quiz 6; Lecture 17
3.29.23: Paper discussion 6
3.30.23: Lecture 18
4.4.23: Quiz 7; Lecture 19
4.5.23: Paper discussion 7
4.6.23: Lecture 20
4.11.23: Quiz 8; Lecture 21
4.12.23: Paper discussion 8
4.13.23: Lecture 22
4.18.23: Quiz 9; Lecture 23
4.20.23: Lecture 24
4.25.23: Quiz 10; Lecture 25
4.26.23: Paper discussion 9
4.27.23: Lecture 26
5.2.23: Quiz 11; Lecture 27
5.3.23: Wrap-up discussion