

SYLLABUS

Biology 628: Microbial Ecology

Instructor: Michael Shiaris
SPRING 2015

Class Meetings: CLASS MEETS ON Mondays & Wednesdays FROM 9:00 TO 10:15 AM IN THE BIOLOGY PRESENTATION ROOM (M/1/318)

Instructor Information

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Office Hours

Very flexible, usually M-F, just email or call to set up a specific time to make sure that I am in my office to meet. Open hours Monday and Wednesdays 10:30 AM to 12:30 PM.

COURSE PROSPECTUS

There has been a major *revolution* in microbial ecology in the last 20 years! Even since I last taught this course two years ago, 2013, the pace of new discoveries has accelerated. New discoveries have expanded the field, and have made microbial ecology ever more dynamic and innovative, and enriched it intellectually. Some of the major changes in our perception of microbial ecology over the last decade include:

- The realization that most microorganisms in environmental samples cannot be easily cultured nor studied by traditional methods
- The recognition that microbial activities studied in the laboratory do not accurately reflect activities in nature
- The appreciation that microorganisms live largely in biofilms in nature
- The recognition that only a small fraction of the microorganisms in the biosphere are presently known
- The accelerating rate of discovery of new and exotic microorganisms

- The development of novel experimental approaches and methods to study microbial ecology (for example, advances in genomics, microscopy, and computational methods)
- The recognition that viruses are present in high abundances in nature and play major roles in the biogeochemistry of the biosphere and shape the evolution of species
- The impact of microbial genomics (whole genome sequences)
- The advent of metagenomics (microbial sequences from the entire target ecosystem) and the technology of sequencing is becoming cheaper and faster

The course is designed as an overview of basic microbial ecology principles and methods. Key topics will include the role of microorganisms in the biogeochemical cycling of elements; microbial diversity, microbial molecular phylogeny; interactions among microorganisms, between microorganism and other organisms, and with the environment; biofilms; and the microbiology of extreme environments. ***This semester, I plan to use examples and readings as closely related to students' research interests as possible. Thus the focus could range from marine and coastal microbial ecology to terrestrial ecology to microbial symbioses.*** The course focuses on bacteria and viruses; less so on fungi, and protists; and briefly touches upon phytoplankton. One of the emerging new paradigms of microbial ecology, bacterial and viral ecology to be specific, is the unexpectedly high numbers of species and genetic diversity that is encountered in the environment. We will examine this area more closely. Topics will include Role of bacteria in nature; 3-Domain system of phylogeny, Microbial phylogeny; Microbial species concept; Microbial diversity and evolution; Energetics and microbial ecology; Habitats and niches; Macroenvironment and microenvironment; Microbes and surfaces - adhesion and biofilms; Methodology (numbers, biomass and activities); Molecular microbial ecology and metagenomics; Distributions of microorganisms in the environment; Microbial interactions with viruses, microbes, plants, and animals; Gene transfer in the environment and microbial genome evolution.

NO REQUIRED TEXTBOOK. I have assigned textbooks in the past, but none of them has been satisfactory. Therefore, I will be assigning chapters from various textbooks to provide broad concepts and summaries, and specific papers (mainly review papers but also primary research papers) will be assigned for class discussion. The in-class time therefore, is primarily for group discussion of the material as well as individual assignments for presenting the rest of the class material. However, I do recommend several textbooks as background references for the course. I have them in my office:

- Slonczewski and Foster, 2011, *Microbiology: An Evolving Science*, 2nd Edition
- Madigan, and Martinko, 2006, *Brock's Biology of Microorganisms*, 11th Edition
- Pepper, I. L., C. P. Gerba, et al. (2015). *Environmental microbiology*, 3rd Edition

GRADING. Preparedness and participation in class blogging and oral discussion (50%), microbial ecology news presentations (10%), midterm exam (20%), and paper (written as a research proposal based on your blogging, 20%). There will be a take-home midterm examination and a final paper in the form of a grant proposal to conduct a microbial ecology research project. There will also be several written assignments (homework) in the form of blogs, but the significant part of the grade will be based on ***presentation of reading material*** and ***participation*** in discussions.

Blackboard Learn. All course materials, syllabus, week-by-week topics, supplemental papers, blogs, and discussions will be posted on Blackboard Learn 9.1 (note: this is not the old Blackboard Vista). Login from <http://umb.umassonline.net>

For problems resetting your password: Call the IT Service Desk at 617.287.5220.

Course Objectives

1. To understand the breadth of the fields of microbial ecology and evolution, as well as their practical and social relevance
2. To continue to learn to write and think critically as a scientist
3. To become a more skillful reader and critic of contemporary science literature, and to participate in its discourse, using modern social network methods (blogs and threaded discussions)
4. To become more informed of the modern genome technology that drives much of this field
5. To collaborate and interact critically with your peers over this subject matter and inspire others by your creativity.

TENTATIVE COURSE SYLLABUS – I plan to fine-tune the exact topics and readings based on student interests and areas of research (ocean, coastal, terrestrial, microbe-plant symbiosis, microbe-microbe interactions, nitrogen cycle, etc are all possibilities)

Week of (Monday)	Topic
JAN 26	Role of Bacteria in Nature - Introduction Historical Notes, 3 Domain system of phylogeny
FEB 2	Microbial Phylogeny

Microbial Species Concept

- FEB 9 Microbial Diversity
Microbial Evolution
- FEB 16 **Presidents Day Holiday (Monday)**
Energetics and Microbial Ecology
- FEB 23 Ocean/Coastal Habitats and Niches
Macroenvironment and Microenvironment
- MAR 2 Microbes and surfaces, adhesion and biofilms
- MAR 9 Methodology and Measurements in Microbial Ecology (numbers,
 biomass and activities)
Molecular Microbial Ecology and Metagenomics
- MAR 15 **SPRING BREAK**
SPRING BREAK
- MAR 23 Distributions of Microorganisms in the Environment
- MAR 30 Interactions: Basis of Microbial Ecology
- APR 6 Viral interactions with prokaryotes and protists
Midterm Examination?
- APR 13 Prokaryote interactions with Protists
- APR 20 **Patriots Day Holiday (Monday)**
Microbe interactions plants and animals — common strategies
Microbe interactions with microbes (quorum sensing, biofilms,
..)

APR 27	Microbial Genomes Gene transfer in the environment and genome evolution
MAY 4	Grazing, viruses, DOM and microbial loop
MAY 11	Nitrogen cycle

Blackboard Learn WEB SITE: All handouts, sample exams, daily assignments, course PowerPoint slides, and supplementary material will be posted on this site and continually updated. Link your Internet Browser to <http://umb.umassonline.net>

Communicating With Me

Instead of sending me e-mail with general questions regarding this course, please post them in the Q & A folder (link through site map here) found in the Discussions section instead. I will respond to any questions posted in the within 48 hours (except on weekends). This is the best place to post all non-private questions that pertain to the course since other members of the class will benefit from the answers as well.

Method of Instruction:

This class will start each Monday and Wednesday at 9:00 with the “microbial ecology news” item presented by students. This will also be posted by you as an ongoing blog on the BlackBoard site. Ultimately, the blogging will be used to develop a “final paper” in the form of a research proposal.

I will do occasional short lectures, but this is primarily a discussion of the literature course. Please visit the weekly folder at the beginning of each week to review the plan for the week so you can budget your time accordingly. I will also send you a weekly e-mail to remind you that a new week has started and describe the activities planned for the week.

You should plan on logging onto the course web site 3 -4 times each week to check the Course Questions and Answers folder as well as any course discussions that may be underway.

Library: Accessing the UMB Library Virtually

Students enrolled in a UMB online course are eligible to receive a barcode for access to Healey Library resources located at <http://www.umb.edu/library/>. UMB library is a rich and valuable academic online resource which will allow you to do most of your research work off-campus. To access most of the resources there campus, you will need your

barcode number found on the reverse of your student id card. If you don't have a student ID card or are unable to read the bar code number you can send an e-mail request to: Library.circulation@umb.edu. Your request should include your first and last name, Social Security number (or student ID number), course name and number and semester. You will receive address of the library website. Barcode access terminates at the end of the semester. (**Note:** This service is available Monday - Friday 9 - 5 PM)

How to get the Grade for Your Course

Currently students taking courses at UMass Boston use the campus WISER system (Web Information for Everyone Remix) to access secure information and their grades. To enter the WISER system go to http://www.umb.edu/it/getting_services/wiser/ and enter your Self Service ID. If you are just starting out with WISER, and do not know your Self Service ID, you can use the https://www.umassadmin.net/isis/id_lookup_email/ link to find that information or get help with getting one.

Students with Disabilities

Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 offers guidelines for curriculum modifications and adaptations for students with documented disabilities. If applicable, students may obtain adaptation recommendations from UMass Boston's Ross Center for Disability Services <http://www.umb.edu/academics/vpass/disability> (617-287-7430). The student must present and discuss these recommendations with each professor within a reasonable period, preferably by the end of the Drop/Add period.