**Biology 528 Microbial Ecology**
**Fall 2007**

Instructor: David Lipson
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Office hours: after lectures, or by appointment.

Prerequisites: upper division standing in the Biology or Microbiology Major, or graduate standing in a biological science. Required courses: Biology 352, 354. Recommended courses: Biology 350, 366

Grading criteria:

Lecture

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| Midterm exams (3 x 100) | 300 |
| article list | 10 |
| article summary | 15 |
| Synthesis paper | 25 |
| Lecture total | 350 |

Laboratory:

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| Attendance/participation | 40 |
| Peer evaluations | 10 |
| Lab notebook/handouts | 50 |
| Group project | |
| written report | 25 |
| oral presentation | 25 |
| Laboratory total: | 150 |

Course total 500 points

Examinations:

The three midterm and final examinations will each be worth 100 points, and will include short answer, multiple choice, and essay questions. Students will be allowed to drop one exam grade. The final exam will be cumulative. No make-up exams will be given, but you may miss any one exam, including the final. Any disputes regarding grading must be made within one week of receiving your graded exam.

Laboratory

One three-hour lab section is scheduled each week. Students will use enrichment and dilution cultures to isolate microorganisms from various aquatic and terrestrial environments. Microscopic and biochemical methods will be used to characterize these isolates and the microbial communities, as a whole. Molecular techniques will be used to identify and/or enumerate these microbes. Generally speaking, you will have fun.

**Attendance is required. Not only does attendance and class participation account for 8% of the grade, but EACH UNEXCUSED ABSENCE BEYOND THE SECOND ABSENCE WILL RESULT IN THE LOWERING OF THE FINAL GRADE BY HALF A LETTER GRADE.**

**Please note: cleanliness is required, and counts in your participation grade**.

*Laboratory notebooks*: Each student will keep a lab notebook, in which all methods and results are recorded during each lab session. The goal is to produce a complete and accurate record of your activities, not necessarily an orderly, easy-to-read document. So, do not re-copy your daily scribbles, just turn in the original, stains, mistakes, and all. There will also be approximately three graded worksheets that cover aspects of the laboratory activities.

*Group projects:*

Students will work in groups of three or four on a simple microbial ecology study. The group will prepare a 15-20 minute oral presentation, in which student will speak for about 5 minutes. The group will also collaborate in preparing a short written report, to which each student will contribute some material. To promote a fair distribution of labor, each group member will receive a peer evaluation grade from the others in the group.

*Literature synthesis paper*

Each individual will also prepare a terse, pithy (3-4 pages, 12-point font, double-spaced) paper that reviews at least two studies from the primary literature (i.e. presenting original experimental data) in microbial ecology. These sources must be published in peer-reviewed scientific journals. The point of this assignment is to analyze scientific papers and to synthesize them into a greater understanding of the field. The sources should either disagree with each other on some key point, in which case your assignment is to reconcile the two contradictory studies, or alternatively the results of two non-contradictory studies may be creatively combined to support a broader conclusion than either reaches individually.

A note about plagiarism: DON"T DO IT! Your written work must be original, and all sources must be cited properly. See www.sa.sdsu.edu/htc/Plagiarism.pdf, and http://its.sdsu.edu/turnitin/pdf/Plagiarism_AcadSen.pdf for more information on definitions of plagiarism, how to avoid it, and what terrible things can happen to you if you do it.

Text for lecture:

Required: Atlas and Bartha, Microbial Ecology: Fundamentals and Applications, 4th Ed.

(Supplemental reading from other sources will also be assigned.)

Text for Lab:

Handouts will be provided as needed.

Supporting materials will generally be available on the class Blackboard site.

**Learning Objectives for Microbial Ecology**

After taking this course, students should be able to:

Describe the diversity of all microbial life in terms of the three domains, knowing major characteristics of each.

Understand the importance of microbes in the early evolution of the earth and the atmosphere

Relate metabolic reactions carried out by microbes to global biogeochemical cycling of elements: understand these reactions in terms of chemistry, microbial physiology, and the importance in the environment.

Appreciate the vast genetic and physiological diversity of microbes, and classify microbes into basic categories based on their metabolic fueling reactions (e.g. chemoheterotrophy, photoautotrophy, etc.)

Define the various forms of interactions (competition, predation, mutualism, etc.) among and between microbial populations

Understand the factors that regulate interactions between microbes

Understand the importance of these interactions in structuring microbial communities

Define horizontal gene transfer, and explain its implications for microbial ecology and evolution

Relate general principles of microbial ecology to role of microbes in human disease

Understand how the specific environmental properties of soils, oceans and biofilms affect microbial communities therein.

Appreciate the extraordinary resistance of microbes to environmental stress, know examples of stress-resistant microbial species, and explain the strategies employed by microbes to cope with various environmental stresses.

Describe how microbes are useful in biotechnological and environmental applications such as sewage treatment, bioremediation, etc. Relate the physiology of microbes to their role in these processes.

| Date | Lecture | Reading† | Lab Activity (or assignment) |
|---|---|---|---|
| Aug 28 | Intro, Microbial evolution | Online Articles (Purcell, Pace) A&B ch 1 | Check in/lab safety, Winogradsky columns |
| Aug 30 | Microbial diversity I | A&B ch 2 | |
| Sep 4 | Microbial diversity II | A&B ch 2 | Microscopes; Enrichment cultures; aseptic technique, dilution cultures, MPN |
| Sep 6 | Physiological diversity I | A&B ch 2 | |
| Sep 11 | Physiological diversity II | A&B ch 2 | More enrichment and dilution cultures; Observe and purify cultures; Calculate MPN; spot test for denitrifiers |
| Sep 13 | Biogeochemical cycles I | A&B ch 10 | |
| Sep 18 | Biogeochemical cycles II | A&B ch 11 | Microbe-microbe interactions (competition, antibiotics) |
| Sep 20 | Microbial communities I: competition, predation | A&B ch 3, 6 | |
| Sep 25 | Microbial communities II: consortia, quorum sensing | A&B ch 3, 6 Online article | ARTICLE LIST DUE Microbe-microbe interactions (Predation by phage, protozoa) |
| Sep 27 | Microbial communities III: lateral gene transfer | A&B ch 3, 6 Online article | |
| Oct 2 | EXAM #1 | (lectures 1-10) | Soil microbial processes: respiration and N mineralization (field trip to Mission Trails) |
| Oct 4 | Plant-microbe interactions (Rhizobia, agrobacterium) | A&B ch 4 | |
| Oct 9 | Plant-microbe interactions, II (mycorrhizae) | A&B ch 4 | Soil microbial processes: extracellular enzymes, N mineralization (continued), plant-microbe interactions |
| Oct 11 | The soil environment | A&B ch 9 | |
| Oct 16 | Microbial ecology of the human body I (Elio Schaecter) | A&B ch 5, 16 | ARTICLE SUMMARIES DUE Observe and culture marine phytoplankton; Bioluminescence; |
| Oct 18 | Microbial ecology of the human body II (Elio Schaecter) | A&B ch 5, 16 | |
| Oct 23 | Microbes in marine environments | A&B ch 9 | Soil microbial processes, cont. |
| Oct 25 | Biofilms | Online article | |
| Oct 30 | MOs and marine invertebrates | A&B ch 5 | Group projects; PCR amplification of isolates |
| Nov 1 | EXAM #2 | (all lectures since Exam#1) | |
| Nov 6 | Microbial adaptations to stress/radiation/UV | A&B ch 8 | ARTICLE SYNTHESIS ASSIGNMENT DUE Work on group projects; run gel, purify PCR product, |
| Nov 8 | Life at low temperatures | A&B ch 8 | |

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| | | | submit for sequencing |
| Nov 13 | Piezophiles (life under pressure) | A&B ch 8 | Work on group projects; Analyze sequencing results |
| Nov 15 | Thermophiles | A&B ch 8 | |
| Nov 20 | Water and osmotic stress | A&B ch 8 | |
| Nov 22 | **THANKSGIVING – NO CLASS** | | **THANKSGIVING - NO LAB** |
| Nov 27 | Applied Microbiology & Biotechnology | A&B ch 12 | GROUP PRESENTATIONS; WRITTEN REPORTS DUE |
| Nov 29 | Bioremediation: hydrocarbons and metals | A&B ch 13-15; online article | |
| Dec 4 | Bioremediation: xenobiotics | A&B ch 13-15 | GROUP PRESENTATIONS clean up/ check out |
| Dec 6 | EXAM #3 | (all lectures since Exam#2) | |
| Dec 13 | FINAL EXAM (10:30 am-12:30 pm) | Cumulative | |