BIOL 464/694
Environmental Microbiology
Fall 2007

Instructor: Dr. Mary Beth Leigh
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Class meeting time
Tues. and Thurs. 1.5 hours per class period

Course overview
This course provides a comprehensive overview of the role of microorganisms in environmentally-relevant processes including bioremediation of pollutants, wastewater treatment and biogeochemical cycling. Upper level undergraduate and graduate students in Biology, Environmental Chemistry or other related disciplines will gain expertise in microbial processes with an emphasis on their application to environmental quality issues.

Prerequisites
Students must have taken BIOL 342 Microbiology and CHEM 321 Organic Chemistry. Exceptions may be made on an individual basis with permission of instructor.

Required reading materials
Text: “Environmental Microbiology” by R. M. Maier, I. L. Pepper and C. P. Gerba
Journal articles: Electronically available through UAF library or provided on Blackboard.

Course objectives
Understand application of microbial processes to environmental remediation
• Appreciate contribution of microorganisms to geochemical cycling
• Develop skills in reading and criticism of primary scientific literature
• Graduate students: Develop literature research, writing and oral presentation skills

Instructional methods and class activities
A variety of teaching strategies will be integrated to both provide a foundation in Environmental Microbiology and develop critical thinking skills. Regular lectures and assigned readings from textbook and current scientific literature will form the knowledge base of the course. Each week a journal article relevant to the current topic will be assigned for critical group discussion. Beyond understanding the content, group discussions will be aimed at critically evaluating the quality of the scientific work, the conclusions drawn and the presentation style. Students will also be assigned to independently read and write short critiques of 3 journal articles of their choice during the semester. Two take-home midterms and one final exam will be assigned to all students in the form of several thought questions requiring independent reading of text and primary literature and preparation of essay responses. Students may work together to collect and
discuss literature but writing must be an individual effort resulting in distinct essays. Graduate students will additionally prepare research papers in the style of a review article on a subject of their choice (subject to instructor approval) and will deliver oral presentations to the class. The class will take a field trip to the Fairbanks municipal wastewater treatment plant.

Grading

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of assignments</th>
<th>Points per assignment</th>
<th>Total</th>
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<tbody>
<tr>
<td>ALL STUDENTS</td>
<td></td>
<td></td>
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<tr>
<td>Journal article critiques</td>
<td>4</td>
<td>10</td>
<td>40</td>
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<tr>
<td>Midterms + Final</td>
<td>3</td>
<td>100</td>
<td>300</td>
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<tr>
<td>Discussion participation</td>
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<td>60</td>
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<tr>
<td><strong>Total (Undergraduates)</strong></td>
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<td><strong>400</strong></td>
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<tr>
<td>GRADUATE STUDENTS</td>
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<tr>
<td>Research paper</td>
<td>1</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Oral presentation</td>
<td>1</td>
<td>25</td>
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<tr>
<td><strong>Total (Graduates)</strong></td>
<td></td>
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<td><strong>525</strong></td>
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Topic outline

Review of prokaryotes
- Structure
- Phylogenetic diversity
- Metabolic diversity
- Microbial growth

Methods in environmental microbiology
- Cultivation approaches
- Physiological methods
- Nucleic acid-based techniques
  - Community analyses
  - Functional gene analyses

Biodegradation of organics
- Aromatic compounds
- Crude oil and petroleum
- Chlorinated compounds
  - Aerobic pathways
  - Dehalogenation
Geochemical cycling
- Carbon
- Nitrogen
- Sulfur
- Geochemical cycles gone wild
  - Corrosion
  - Acid mine drainage
  - Nitrous oxides

Microbial Metal resistance and detoxification
- Mercury
- Radionuclides
- Other metals

Wastewater treatment processing
- Wastewater treatment plants
- Septic systems
- Landfills
- Field trip to local treatment plant

Graduate student presentations
- Various topics in environmental microbiology