Advanced Soil Microbiology  
SOCR 755  
W-212 Plant Science, T TH, 1-2:15 pm  

Spring 2012  
**THEME: Managing Soil Microorganisms to Provide Ecosystem Services**

**Course Description**

This class is designed to encourage discussions on a broad range of topics related to Soil Organisms and Ecosystem Services, with a particular emphasis on understanding 1) the importance of microorganisms for soil functions that affect plant communities as well as air and water quality, 2) environmental constraints to microbial diversity and activity, 3) microbial spatial and temporal dynamics, and 4) how to manage microbial diversity and activity to promote specific services.

**Course Information**

**Instructor:** Dr. Mary Stromberger  
Office: Plant Science C103  Phone: 1-5283  
Lab: Plant Science W204  Phone: 1-6873  
Email: mary.stromberger@colostate.edu

**Readings:** Distributed in class

**Prerequisites:** SOCR 455 (Soil Microbiology) or MB 624 (Microbial Ecology)

**Grading policy:** Participation 100 points  
Writing assignments (2) 200 points  
Presentations (2) 200 points  

Total: 500 points

**Course Format**

This course combines traditional means of learning (lecture format) with alternate learning strategies based on problems and case studies. During the first part of the semester, I will introduce and discuss advanced topics in soil microbiology. The remainder of the class is devoted to discussions founded in current literature, which relate to our course theme. As graduate students, it is up to you to take responsibility for your life-long learning experience and development of scientific communication skills. Therefore, during this class, your progress will be evaluated partly by your active participation in student-led discussions and by presentation and writing activities.
Participation: It is my goal that this class provides you with meaningful insight to the ecological and functional roles of microorganisms in disturbed soil, as well as a realization of how much there is to learn about soil microbes and how to manage them. To fully accomplish this goal, students will be required to actively educate themselves by conducting literature searches, reading materials ahead of time, asking thoughtful questions and sharing information with the class. Therefore, I cannot stress enough the importance of student participation throughout this course!

Writing Skills: Each student is required to write two short writing assignments that will help hone your ability to define a problem and state objective(s) succinctly, develop sound hypotheses, and outline an experimental plan appropriate to the hypothesis and objective. References (3 minimum) will be listed at the end. This is not meant to be a full research proposal, but more like a two-page Research Approach statement.

Each writing assignment should be completed and handed to the instructor and students at least one class day prior to your scheduled presentation. Ideally, you presentation will be focused on one (or two) papers cited in your reference section.

Oral Presentation Skills: Each student will make two presentations to the class that relate to soil microorganisms and ecosystem services. Students are also encouraged to present an aspect of their thesis research project (an outline if a new project, or data presentation if underway) if it pertains to this theme and their above written assignment. Each presentation should be approximately 40 minutes long, allowing for class discussion. Students will be evaluated on the following: presentation of introductory and background information; methodologies and results; quality of presentation; quality of visual aids; demonstration of an understanding of the subject, and the ability to initiate a discussion among the other students.

Important Guideline #1

For presentations on journal articles, each student must distribute a copy of his/her article as well as their written assignment to each student prior to their presentation and no later than Thursday of the week before the presentation! Please mark each article with your name and the date of your presentation so that students can prioritize reading assignments. Please see me for assistance if you are not able to make student copies in your home department.

Important Guideline #2

As journal articles and written assignments are distributed to you (either from myself or another student), it is important that you take the time to read through the materials prior to coming to class. This will help you to participate more fully and intellectually in class discussions.
Some Sources of Journal Articles for Presentations

Applied and Environmental Microbiology
Applied Soil Ecology
Biology and Fertility of Soils
Canadian Journal of Soil Science
Ecological Applications
Ecology Letters
European Journal of Soil Science
FEMS Microbiology Ecology
FEMS Microbiology Letters
Geoderma
Journal of Environmental Quality
Journal of Soil and Water Conservation

Microbial Ecology
Molecular Plant-Microbe Interactions
Nature
Oecologia
Plant and Soil
Renewable Agriculture and Food Systems
Plant and Soil Science
Soil Biology and Biochemistry
Soil Science
Soil Science Society of America Journal
<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Activity</th>
<th>Notes</th>
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<tbody>
<tr>
<td>2: 8/28-30</td>
<td>Soil organic matter dynamics</td>
<td>Hands-on-measurements of SOM fractionation</td>
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<td>3: 9/3-6</td>
<td>Land use change and soil organic matter dynamics</td>
<td>Visit to ARDEC</td>
<td>Essay 2</td>
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<td>4: 9/11-13</td>
<td>Past-present and future increase in atmospheric CO₂</td>
<td>Visit to the Wyoming PHACE (Data)</td>
<td>Essay 3</td>
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<td>5: 9/18-20</td>
<td>Elevated CO₂: effects on soils and methods of study</td>
<td>Hands-on demonstration of soil respiration</td>
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<td>6: 9/25-27</td>
<td>Current and projected climate changes. Field manipulation experiments</td>
<td>Midterm exam (I): group discussion and evaluation of the draft models</td>
<td>Midterm assignment (I) - Built first draft of conceptual model</td>
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<td>7: 10/2-4</td>
<td>Effects of warming - and feedbacks - on soil processes and biota</td>
<td>Temperature sensitivity of SOM decomposition Hands-on demonstration of temperature incubation experiments/labs</td>
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<td>8: 10/9-11</td>
<td>Effects of precipitation changes on soil processes and biota. Field climate manipulation experiments</td>
<td>Data elaboration</td>
<td>Essay 4</td>
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<td>9: 10/15-18</td>
<td>Soils and biodiversity: Does loss of biodiversity affect soil processes?</td>
<td>Hands-on-demonstration on the extraction and counting of soil fauna for measurements of biodiversity Visit to the Wall’s lab</td>
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<td>10: 10/23-25</td>
<td>Human alteration of the N cycle: Soils and reactive N</td>
<td>Midterm exam (II): group discussion and evaluation of the revised models</td>
<td>Midterm assignment (II) - Build a revised conceptual model</td>
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<td>11: 10/30-11/1</td>
<td>Soil-microbial linkages and ecosystem N retention (recitation)</td>
<td>Hands-on demonstration on measurement GHG efflux from soil (Paul)</td>
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<td>Soil in the CH₄, N₂O biosphere-atmosphere exchange (Joe von Fisher)</td>
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<td>12: 11/6-8</td>
<td>Increased UV-B radiation and soil processes</td>
<td>Hands-on demonstration on UV experiments (Barbara)</td>
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<td>14: 11/27-29</td>
<td>Soil Erosion and Desertification/</td>
<td>Interactions among global changes and the chemical-physical environment Norby and Luo (recitation)</td>
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<td>15: 12/3-6</td>
<td>Land use change: effects on soil &amp; GHG accounting</td>
<td>Free Lab to work on final assignment</td>
<td>Final assignment: Contextualization of conceptual model with knowledge derived from visit to field experiments - paper</td>
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<td>16</td>
<td>Finals</td>
<td>Open discussion of final project paper</td>
<td>Essay 6 (post-test)</td>
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Instructional Methodology: The class will meet as a single group two days a week for lectures (Tuesday-Thursday, 11-11.50am, Plant Science W01) and laboratory activities (Thursday 1.50-3.50 pm W212 pm). An inquiry-based lecturing method will be used, and student input will be solicited throughout lectures.

Mode of Delivery: Lectures will be delivered as interactive presentations, and will include plenty of activities complying with the inquiry-based learning approach. Laboratory classes will consist of hands-on experiences and visits to several field sites, which will enable students to explore state-of-the art research approaches and interact with expert scientists.

Methods of Evaluation: Students will be evaluated based on their critical thinking, knowledge of the subject, ability to synthesize knowledge in conceptual models and to evaluate these models. Students will be evaluated through the following assessments:

1) Lab visit papers – After field site visits two short problems related to the visit will be posted on Ram CT. Students will be required to submit a short paper to address the problems.

2) Midterm exam (I and II) - students will have to synthesize their knowledge to construct a conceptual model on how a global change of interest (e.g. N deposition, warming, etc.) would affect soil processes. We will dedicate two lab classes to the group discussion and evaluation of the conceptual models.

3) Final Exam will consist in a paper (max 5 pages) in which the conceptual model is discussed in the context of the knowledge acquired during field sites visits and lectures.

Grading: Course participation 10%, Lab visit papers 30%, Mid-term model 20%; Final paper 40%.

Grading Scheme: ≥ 90 A; 80-89% B; 70-79% C; 60-69% D; < 60% F

Academic Integrity Policy: This course adheres to the Academic Integrity Policy of the Colorado State University General Catalog and the Student Conduct Code. This in particular applies to plagiarism in the preparation of the final paper. Please consult the resources for students at: http://tilt.colostate.edu/integrity/resources/forstudents.cfm to document yourself about Academic Integrity.