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ENST 422/622: Soil Biochemistry and Microbial Ecology & Advanced Soil Biochemistry and Microbial Ecology

ENST 422/622 is designed for upper level undergraduate and beginning graduate students who have been previously introduced to basic concepts in biology, chemistry, and/or soil science. The course introduces microorganisms that live in various terrestrial environments and examines how the microbes interact and in large part mediate soil ecosystem functions.

The course will be modified this upcoming semester to more fully incorporate concepts of sustainability. Sustainability will be addressed in two distinct ways, as described below. The lectures that have been added or modified to specifically address sustainability are highlighted in red on the syllabus. These modifications are designed to make students more aware of environmental issues, to increase critical thinking concerning sustainability, and to consider the scale of these issues from local to global impacts.

- 1) During a unit on the elemental cycles of carbon, nitrogen, phosphorus, and sulfur; students will complete a series of short activities to critically evaluate how human interactions have impacted the global cycles and in some cases directly changed microbial activity. Two examples are provided:
  - a. The nitrogen cycle is examined over three class periods. During each of these lectures the specific reactions are described and the microbes that mediate each step. Part of the assigned reading for this section is an article entitled, "Transformation of the Nitrogen Cycle: Recent Trends, Questions, and Potential Solutions." During the last nitrogen cycling lectures, students will be divided into five groups. Each group will be given one nitrogen transformation: N-fixation, ammonification, nitrification, denitrification, or anammox. Groups will be asked to brainstorm ways that human activities have effected this particular transformation on local, region, and global scales. Groups will then share the results of their group discussion with the class.
  - b. The sulfur cycle class will begin with a brief lecture discussing the major microbial transformations of sulfur and the organisms involved. Prior to class, students will read a review article entitled, "Acid Mine Drainage (AMD): causes, treatment, and case studies." After the brief lecture, a student lead discussion will cover important points of the article: What is the source of "acidity" in mine operations? How does the presence of bacteria affect the rates of AMD production? How is AMD currently remediated? What are the advantages/disadvantages of these remediation processes? Following discussion of the article, we will expand our discussion of AMD to the Mid-Atlantic region where coal mining, including mountain top removal, contributes to

AMD creation. Each student will have a brief take home assignment, where they will search online for a current example of AMD remediation taking place in our region.

- 2) The course includes discussion of soil microbes in relationship to agriculture, including biocontrol, biotechnology, and this fall sustainable agriculture. In addition to modifying the lecture on biocontrol and biotechnology to specifically address current sustainability issues, a new lecture has been added on sustainable agriculture. This lecture will be given by a guest scientist, Jude Maul from the USDA-ARS Sustainable Systems Farming Lab. His lecture will include background information concerning the challenges and benefits of conversion to organic agriculture and current research on soil microorganisms on land being transitioned to organic agriculture.