Microbiology 494FI

Integrated Experience: Soil Microbes and the Sustainability of Organic Agriculture

Meetings:	M, W & F, 10:10 – 11:00am in N448 Morrill I
Course Instructor:	Dr. Kristen M. DeAngelis
Office:	LSL N435
Office Hours:	Tuesdays and Thursdays 12:30 – 1:30pm, or by appointment
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Course Description

Soil sustains life in many ways, but soil is also a limiting and non-renewable natural resource. Current best practices, including "organic" and "sustainable" agriculture, have become both movements as well as marketing schemes. At best these practices aim to protect this valuable resource. At worst, these practices are expensive and may be harmful to the sustainability of soil and ecosystems. In this Integrative Experience GenEd class, we will take a critical look at the current state of organic farming at a local, national and international level, to critically evaluate the claims that organic is sustainable to soils, and that organic is more healthy for ecosystems and communities. As microbiologists, we aim to integrate our understanding of microbes with how they live in soil, and how they have become adapted to, and applied to, modern agriculture in organic and sustainable ways.

Students will **reflect and integrate their learning experiences** from the broad exposure in their general education courses and the in-depth knowledge garnered from their major by engaging in meaningful literature research and dialogue about whether organic standards are meeting the needs of both environmental and community sustainability. Students will have the opportunity to reflect on and integrate their Gen Ed learning experience from various courses as well as **practice Gen Ed learning objectives at a more advanced level** as they seek meaningful solutions to complex and ever evolving societal problems. Students will work in small groups to explore these solutions allowing them to participate in **shared learning experiences** as they apply **prior knowledge** from various Gen Ed courses and social experiences to solve challenging real-world problems.

Course Goals

By the end of the class, students should:

- define soil, and describe why it is a limiting natural resource;
- explain the green revolution, and describe how microbiology has contributed to contemporary efforts to make food production more sustainable
- describe what failures led to the dust bowl, and how this natural disaster resulted in new policies and attitudes of conservation and sustainability from the perspective of farmers, policy makers as well as consumers
- describe the advantages to organic fertilizers, pesticides, GMO bans, bans on ionizing radiation and organic land management practices have over more "traditional" farm practices? How do these new practices affect ecosystem and community health? Is organic farming sustainable?
- regarding soil microbes and the sustainability and organic agriculture, consider to what extent does this affect our environment's health? to what extent does this affect our community's health? to what extent does this affect our personal, physical health?

Activities

Students will give **group presentations** to the rest of the class on a designated topic, to be determined during the first week of class**.** Each group will decide on **one theme,** and then **each student in the group will present a 4 minute lightning talk on that theme**. Themes will concern issues or policies implemented at the local, national and international levels concerning the microbiology and sustainability of some aspect of organic farming practices. Each group will have 5 minutes devoted to answering questions from the class at the end. Though students work in groups, grades for presentations are individual.

Each student is responsible for producing a **personal expression piece, or final project**. This could be in the form of a final essay, a letter, with citations and first-hand accounts if appropriate, artwork, short film, website or whatever element they are most comfortable with to make connections between soils and sustainable agriculture and their own lives. This piece should explain the extent to which the support organic agriculture, what aspects of the current practices could be improved, and how, though this may be open to interpretation. Proper citations of primary literature are required. Group work is acceptable for this project, though must be approved by the instructor. A proposal for the personal expression piece will be part of the grade.

Attendance and Participation

Attendance at class meetings is expected except in cases of emergency, religious holidays, or when participating in official College functions. Instructors may require evidence to determine whether an absence is excused. Anyone requiring extra assistance must provide a letter from the University. Cheating, including plagiarism will not be tolerated.

Disability Statement

The University is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with Disability Services (DS), Learning Disabilities Support Services (LDSS), or Psychological Disabilities Services (PDS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements.

Academic Honesty Policy

Intellectual honesty requires that students demonstrate their own learning during examinations and other academic exercises, and that other sources of information or knowledge be appropriately credited. Scholarship depends upon the reliability of information and reference in the work of others. Student work at the University may be analyzed for originality of content. Such analysis may be done electronically or by other means. Student work may also be included in a database for the purpose of checking for possible plagiarized content in future student submissions. No form of cheating, plagiarism, fabrication, or facilitating dishonesty will be condoned in this class or the University community. For more information about what constitutes academic dishonesty, please see the Dean of Students' website: http://umass.edu/dean_students/codeofconduct/acadhonesty/

Schedule

Date	Topic	Assignment
4/2	Introduction to Soils, Sustainability, & Organic Agriculture	CATME Team-Maker
4/4	The Greening of the Green Revolution	
4/6	The Other Inconvenient Truth: How Agriculture is Changing the Face of Our Planet	
4/9	"Surviving the Dust Bowl," a 2007 documentary, part of the American Experience series on PBS	
4/11	"Surviving the Dust Bowl," part 2: Soil conservation	
4/13	Discussion on Soil Conservation and Group work on Presentations	Paper with project proposal suggested due
4/17		
4/18		
4/20		Paper with project proposal due
4/23	Presentations Group 1: Land management practices, and Presentations Group 4: Pesticides	
4/25	Presentations Group 2: GMOs, and Presentations Group 5: Fertilizers & eutrophication	
4/27	Presentations Group 3: Antibiotics, and Presentations Group 6: Livestock farming & grass-fed beef	CATME Peer evaluations due
4/30	Discussion: Organic agriculture is sustainable, Sustainable agriculture must include organic Fill out final evaluations	Submission of personal expression pieces

Grade basis

Students will be evaluated on a 100 percent scale based on

(1) **group presentations** on subtopics exploring the questions surrounding the sustainability of organic agriculture, and the role of microbes in soil health (35%), will be based on quality of presentation content and delivery (25%), ability to answer questions (5%) and questions asked to other groups during their presentations (5%);
(2) **personal expression pieces** composed as an essay, artwork, short film, public service announcement, website or whatever element students are most comfortable with to make connections between soils and sustainable agriculture and their own lives (35%).
(3) **participation** in cooperative learning exercises in class and on moodle forums (10%).

Grades will be calculated to the nearest whole percent. The grade cut-offs may be lowered on the basis of the point distribution. Please contact the instructor with any problems regarding course materials immediately. All materials will be discarded 30 days after the end of the semester. **Regrades** will be considered. Students who choose to may submit a revised version of their written work no later than 10 days after the corrected work has been handed back. Additional points will be administered at the discretion of the instructor. Students should prioritize incorporation of comments on the corrected first version, though instructor comments

should be considered a minimum for revising. No regrading will be done after 10 days. **Late assignments** will not be accepted, unless prior permission has been granted from the instructor. A late penalty of 10 percentage points per assignment per day will be assessed, unless otherwise agreed upon. Regrading does not remove a late submission penalty.

Glossary

diversity - Biological diversity can refer to the number of species in an area, the number of types of species (e.g. microbial functional groups, or plant structural types), the degree of genetic variability within a species, or the distribution of species within an area.
emergent properties - Properties of a whole system that are not apparent from examining properties of the components of the system.
food web, soil - The interconnected community of organisms living all or part of their lives in the soil.
functional redundancy - The presence of several species that serve similar functions (e.g. nitrification).
organic matter - Any material that is part of or originated from living organisms. Includes soil organic matter, plant residue, mulch, compost, and other materials.
organic matter, stabilized organic matter - The pool of soil organic matter that is resistant to biological degradation because it is either physically or chemically inaccessible to microbial activity.
rhizosphere - The narrow region around roots where most soil biological activity occurs. Soil organisms take advantage of the sloughed and dead root cells and the root exudates found in this region.
soil ecology - The study of interrelations among soil organisms and between organisms and the soil environment.
soil function - Any service, role, or task that soil performs, especially: 1) sustaining biological activity, diversity, and productivity; 2) regulating and partitioning water and solute flow; 3) filtering, buffering, degrading, and detoxifying potential pollutants; 4) storing and cycling nutrients; and 5) providing support for buildings and other structures and to protect archaeological treasures. (Compare to function, functional capacity.)
soil health or soil quality - The capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. In short, the capacity of the soil to function. There are two aspects of the definition: inherent soil quality and dynamic soil quality. (Compare to functional capacity.)
soil resilience - The capacity of a soil to recover its functional capacity after a disturbance.
soil resistance - The capacity of the soil to maintain its functional capacity through a disturbance.
soil respiration - The amount of carbon dioxide given off by living organisms and roots in the soil.
soil structure - The arrangement of soil particles into aggregates which form structural units. Size, shape, and distinctness are used to describe soil structure. Farmers often describe soil structure with words such as crumbly or cloddy.
use-dependent or management-dependent properties - Soil properties that show change and respond to use and management of the soil, such as soil organic matter levels and aggregate stability.
use-invariant properties - Soil properties that show little change over time and are not affected by use and management of the soil, such as mineralogy and particle size distribution.
water holding capacity - The amount of water that can be held in soil against the pull of gravity.

From http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/health/?cid=nrcs142p2_053848

future:
more guidelines for **presentations** eg., no reading from slides; don't show figures directly from the papers; make sure people can read all the text on your slides so minimum 18 point font; Avoid saying

- "et cetera" say what you mean
- "as you can see here," "clearly," or any variation
- include references on your slide & make it legible

PEER REVIEW
have students rate or evaluate each other during the presentations: qualitative and quantitative
offer students to test their slides at the end of classes so they can make sure all text is legible
group presentation has to include microbiology but not every subtopic

do the essay at the beginning as a way for them to set goals for themselves
last CLE could be to evaluate whether they'd met those goals

make it more explicit that the project is one for Science Communication – should stand on its own though cover letters explaining are required

file naming conventions for submitted documents

Have the students grade each other somehow. Idea from one student from a class "Golden Age of Greece," where "In the Greek course, the professor not only gave each person their own grade, but also weighted their final grade against the grade their teammates granted them. If he were to present really well and get a 100, but had only a 42% grade from his teammates, his grade would then be averaged with a 42, giving him a mere 71. It was great to work in that setting because it really fostered a great team environment, where everyone was interested in working together, something that didn't really happen during our group project in this course."