Syllabus NRM 485, Soil Biology

Fall 2022

Class time:
Monday 9:15 – 10:45am
Wed. 9:15 – 10:45am

Instructor: Mingchu Zhang
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Catalog course descriptions: Major groups of organisms in the soil and their interrelationships; the major biological processes which take place in the soil and their significance to soil productivity, plant growth and environmental quality; and methodologies for studying soil organisms and soil biological processes.

Course description: Subject matter in this course will include lectures on soil as a habitat for living organisms. They include types of organisms in soil, and their roles in the food chain, rhizosphere, carbon, nitrogen, sulphur cycling in soil, biogeochemistry of phosphorus, and arsenate, trace gas flux in soil, and biodegradation of contaminants in soil.

The course will consist mostly of lectures, but there will also be some class discussion, and each student is expected to participate.

Optional Textbook: Soil Microbiology, Ecology, and Biochemistry, 3rd ed., edited by E.A. Paul, Academic Press (ecopy is available)

Grading policy: The following grading policy will be used for this course:

Letter Grade	Score (%)
A	91-100
B	81-90
C	71-80
D	61-70
F	< 61

The instructor reserves the right to curve upward but not downward.

There will be two exams (middle term and final) in this course. There will be a synthesis paper of student choice. You will be required to turn in a draft, followed by the final paper. The draft will be critiqued and returned to you prior to writing

the final paper. In addition, a brief topic description will be required for the synthesis paper. You will be expected to give an oral presentation, near the end of the semester, on your synthesis paper. There is a list of topics in this syllabus.

Exams will consist of a combination of essays, short answer questions, and multiple choice questions, and will be a take home exam.

Middle term exam: 30 points,
Final exam: 30 points,
Synthesis paper: 30 points,
oral presentation on synthesis paper:10 points.
Total points: 100 points

Honor Code

The UAF Honor Code will be enforced in this class. The UAF Honor Code is as follows:

1. Students will not collaborate on any quizzes, in-class exams, or take home problems or exams that will contribute to their grade in the course unless permission is explicitly given by the instructor. Only those materials permitted by the instructor may be used to assist in quizzes and examinations.

2. Students will not represent the work of others as their own. A student will attribute the source of information not original with himself or herself in compositions, theses, and other reports.

3. No work submitted for one course may be submitted for credit in another course without the explicit approval of both instructors.

Violation of the Honor Code will result in a failing grade for the assignment, and ordinarily, for the course in which the violation occurred. Moreover, violations of the Honor Code may result in suspension or expulsion.

Student Outcome

After taking the class, students should,

1. Understand soil types, and functions of soil organisms.
2. Understand key soil factors affecting organism growth.
3. Understand interactions of soil organisms such as neutralism, commensalism, amensalism, parasitism, and predation.
4. Understand methods of studying soil microorganisms.

5. Understand role of microorganisms playing in organic matter, organic waste and contaminates. Understand role of metal status change facilitated by microorganisms.
6. Understand role of microorganism in nitrogen cycle.
7. Understand role of microorganisms in phosphorus cycle.
8. Understand roles of microorganism in sulphur cycle.
9. Understand management practice impact on carbon sequestration of soil.
10. Be able to use technical term to write a synthetic and research paper.

Learning Disabilities

If any student enrolled in this class has a learning disability which may interfere with his or her ability to perform any of the work in the course, it is the student's responsibility to inform the UAF Center for Health and Counseling and the course instructor within the first two weeks of class so that accommodations can be made.

Student protection and service

Every qualified student is welcome in my classroom. As needed, I am happy to work with you, disability services, veterans' services, rural student services, etc. to find reasonable accommodations. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. As required, if I notice or am informed of certain types of misconduct, then I am required to report it to the appropriate authorities. For more information on your rights as a student and the resources available to you to resolve problems, please go the following site: www.uaf.edu/handbook/ OR GRADUATE STUDENT VERSION.

UAF COVID-19 policies: social distance of 6 feet, and wear musk in classroom.

COVID-19 statement: Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website:
https://sites.google.com/alaska.edu/coronavirus/uaf/uafstudents?authuser=0
Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.

NRM 485, Soil Biology

General Course Outline

	Topic
Week 1 Lecture 1, 2 8/29-9/2	Introduction of the class The soil as a habitat for organisms - Review soil properties - Architecture of organisms using soil as their houses
Week 2 Lecture 3, 4 9/5-9/9	The organisms of the soil - Vascular (higher) plants - Non vascular plants - Fauna - Microorganisms
Week 3 Lecture 5, 6 9/12-9/16	Methodologies for studying the soil populations and their activities, and experiment and data analysis - Traditional methods - Molecular technologies
Week 4 Lecture 7, 8 9/19-9/23	Relationships among organisms in soil - Neutralism - Commensalism - Symbiosis - Amensalism - Parasitism - Competition Relationship between soil organisms and plants - Lichens
Week 5 Lecture 9, 10 9/26-9/30	Relationships between soil organisms and plants - Rhizobia - Frankia - Mycorrhizae Synthesis paper topic description/ Discuss topics and area of studies
Week 6 Lecture 11, 12 10/3-10/7	The carbon cycle and decomposition of organic residues - Components of carbon cycle, and their pool sizes - Residue composition and their properties - Residue decomposition - Variables affecting residue decomposition
Week 7 Lecture 13, 14	Soil organic matter and its management - Methods of soil organic matter separation

10/10-10/14	- Concept of mean resident time - Rate and rate constants of soil organic matter decomposition. - Introduction of simulation models
Week 8 10/17-10/21	Take home middle term exam Draft synthesis paper due
Week 9 Lecture 15, 16 10/24-10/28	Nitrogen cycle - Forms of N in soil - Sources of N addition in soil - Processes of N conversion Ammonization Nitrification/denitrification Immobilization/mineralization
Week 10 Lecture 17, 18 10/31-11/4	Sulfur cycle - Forms of sulphur - Organisms for sulphur conversion - Factors affecting sulphur conversion
Week 11 Lecture 19, 20 11/7-11/11	Biogeochemistry of phosphorus and other elements - Forms of P in soil and its conversion - Forms of Fe in soil and its relation to redox - Forms of Mn in soil and its relation to redox - Forms of As in soil and its conversion
Week 12 Lecture 21, 22 11/14-11/18	Gas fluxes out of soil and their measurement - Nitrous oxide emission - Organisms involved in nitrous oxide emission - Conditions controlling the emission - Methane emission - Organisms involved in methane emission - Environmental conditions for methane emission
Week 13 Lecture 23, 24 11/21, 11/28	Fate of organic and inorganic contaminants in soil - Organic contaminants Adsorptions in soil Degradation in soil - Inorganic contaminants Chelating and adsorption in soil Status of contaminants affected by redox potential
Week 14 11/29	Student oral presentations
Week 15 12/5-12/9	Take home final exam
Week 16 12/16	Synthesis paper due

Synthesis and technical report for NRM 485

The purpose of the NRM 485 written synthesis paper is to give you a chance to research a topic in more detail than will done in class and to gain practice in synthesizing information from the class and the literature. The paper should be on a topic of interest to you and related to soil biology. I have included a list of example topics at the end of this file; you are **NOT** required to use a topic from the list. Papers will be graded on coverage of topic (i.e. adequate coverage without excess detail), accuracy of information presented, appropriateness of references, organization, ability to discuss the pertinent information from the literature and synthesize it into a coherent body of information, and quality of presentation (how well it is written, including spelling and grammar). A brief (1/2 page) topic description will be due on Week 5. I will use this to determine if your topic seems reasonable for a synthesis paper and if it is appropriate for this class. You should turn in a draft by Week 8. I will critique the draft, and then return it to you with comments and suggestions for improvement. The final paper will be due on Week 16.

The main purposes of the topic description are to help you focus on your topic early in the semester and to help me decide if your topic is appropriate for the class and if it doable. It should simply be a short description of what you plan to write you paper on. Some time should have been spent searching the literature prior to writing the topic description. At least three references should be included with the topic description.

The paper should **not exceed five pages** (line spacing: 1.5, font size: 12) in length. **At least eight pertinent references** should be cited in the paper; **at least five of them must be from the peer reviewed literature**. Internet sources are acceptable, but must be credible. The internet can be a good source of information, but there is also a lot of bad information on the internet and much of it is unverifiable. I urge you to use care if you use it. **Wikipedia or You-tube are not a acceptable references for this class.** If you have trouble finding information, please feel free to contact me. My phone number is 474 7620, fax number is 474 7004, and e-mail address is mzhang3@alaska.edu

You should list all references cited in a section called Reference List or Literature Cited. This section should be placed at the end of the report. Proper formats for references are given below. Please follow these formats for citing and listing references for you paper.

After synthesizing information in the literature in the area of your choice, you should be able to develop a hypothesis and lay out what approach(es) might be used to solve one of the problems from the area of your choices. In brief, for synthesis, you need find a subject area and collect information in that area, and then identify one area that needs further research (synthesis), and develop research ideas and methods from that (technical report).

At least eight pertinent references should be cited in the paper. Internet sources are acceptable, but must be credible. The internet can be a good source of information, but there is also a lot of bad information on the internet and much of it is unverifiable. I urge you to use care if you use it. Again, **Wikipedia is not an acceptable reference for this class** If you have trouble finding information, please feel free to contact me. You should list all references cited in a section called Reference List or Literature Cited. This section should be placed at the end of the report. Proper formats for references are given below. Please follow these formats for citing and listing references for you paper.

Examples of Publications in Reference List or Literature cited (should be alphabetical)

The publication types listed below are the most commonly cited in papers in soil science and related fields. Many other types of publications exist. If you have questions about citation style, please see me.

Single author in journal:

Clay, D.E. 1997. Comparison of the difference and delta ^{15}nitrogen approaches for evaluating liquid ammonium nitrate utilization by maize. Communications in Soil Science and Plant Analysis 28:1151-1161

Multiple authors in journal:

Häkan, W., Arnebrant, K., Östrand, F., and Kårén, O. 1997. Uptake of ^{15}N-labeled alanine, ammonium, and nitrate in *Pinus sylvestris* L. ectomycorrhiza growing in forest soil treated with nitrogen, sulphur or lime. Plant and Soil 195:329-338**. Note: list all authors, do not use et al.**

Circulars, bulletins, numbered reports:

Pellett, H. 1923. Bacteria and root rot diseases of potatoes. University of Alaska. Agricultural and Forestry Experiment Station Circular # 115. 30 pp. Fairbanks, Alaska.

Books:

Schwarts, R.J. 1955. The Complete Dictionary of Abbreviations. T.Y. Corwell Co., New York.

Chapter in Book:

Link, G.K.K. 1928. Bacteria in relation to plant diseases. pp 590-606. *In* E.O. Jordon and I.S. Falk (ed.) The Newer Knowledge of Bacteriology and Immunology. University of Chicago Press, Chicago.

Author is agency, business, etc.:

Alaska Cooperative Extension. 1996. Food for Thought. University of Alaska. Alaska Cooperative Extension Bulletin # 39. Fairbanks, Alaska

Internet:

Holmes, J.K. and Carpenter, P.J. 1995. Guidelines for better writing [Online]. http://www.usa.net/-vinced/home/better-writing.html.

Suggested topics for term paper (NRM 485 Soil Biology)

1) Pesticide decomposition in soil (if you pick this topic, you should choose a specific pesticide or class of pesticides; otherwise the topic will be too broad).

2) Effect of heavy metals on soil microbial activity.

3) Effect of management practices (pick one, such as tillage, crop rotation, application of pesticides, many others) on soil microbial biomass and activity.

4) Effect of management practices (pick one, such as tillage, crop rotation, afforestation, others) on carbon sequestration in soil.

5) Microbial transformation of metals (you should pick a particular metal or class of related metals).

6) Biodegradation of organic contaminants in soil (if you choose a topic similar to this one, you will want to narrow it, maybe by picking a particular compound or class of compounds).

7) Probable effects of climate change on decomposition of forest litter in subarctic environments.

8) Microbial activity under snow or in frozen soil.

9) Mineralization and nitrification of nitrogen in sewage sludge.

10) Role of nematodes in controlling bacteria populations in soil.

11) Role of nematode trapping fungi on soil ecosystem function.

12) Soil enzyme activities and environmental impact (choose one of nitrogenase, phosphatase).

13) Transgenetic genes in soil and their impact on soil ecosystems.

14) Soil impact on prion proteins (mad cow disease causing protein).

15) Advances in using genomic technologies in study soil microorganisms.