

# SWS 4303/5305 Soil Microbial Ecology

## Fall, 2015

**Course Description** Lectures and laboratory exercises will cover the soil as a habitat for microorganisms, the taxonomy and biology of soil microorganisms, and the fundamentals of the microbial ecology of nutrient cycles, symbiotic associations, and bioremediation.

Students in the graduate course (SWS 5305) will be required to demonstrate a deeper understanding of fundamental concepts and details than is required of SWS 4303 students. SWS 5305 exams differ in content by at least 30% from SWS 4303 exams.

**Objective:** To provide students with the physiological bases for microbial activities in soil, and translate those to ecological interactions and processes.

**Instructor:**

Andrew Ogram  
Soil and Water Science Department  
2161 McCarty Hall  
Phone: (352)294-3138  
Email: [aogram@ufl.edu](mailto:aogram@ufl.edu)

**Laboratory Instructor:**

Abid Al-Agely  
2170 McCarty Hall  
Phone: (352)294-3144  
Email: [aaag@ufl.edu](mailto:aaag@ufl.edu)

**Office Hours:** By appointment.

**Format:** Two lectures per week; one laboratory session per week.

**Time and Location:**

Lectures: 3<sup>rd</sup> period (9:35 am-10:25 am) Tuesdays and Thursdays;  
G-001 McCarty Hall D.

Laboratory sessions: Mondays **or** Wednesdays (2 -3 pm), 3196 McCarty Hall B.

**Textbooks:**

Paul, Eldor. 2015. Soil Microbiology, Ecology, and Biochemistry, 4<sup>th</sup> Ed. Academic Press. ISBN: 978-0-12-415955-6. NOTE: This text will be available free of charge via the UF Libraries ARES Course Reserve System for registered students. ***There is no need to buy the text unless you want a hardcopy or unless you would like access after the course ends.***

Laboratory Manual (available as a PDF file from the course web site)

**Materials and Supplies Fees:** \$50 per student

**Class Attendance, Make-up Exams, and Missed Assignments:**

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

**Grading System:**

Lecture component:

○ Three exams @ 18.75% each	56.25%
○ Quizzes	11.25%
○ Participation:	7.5%
<i>Total:</i>	<i>75%</i>

Laboratory Component:

○ Weekly quizzes:	6.25%
○ Problem sets: 5 @2.5% each	12.5%
○ Final Presentation	6.25%
<i>Total:</i>	<i>25%</i>

**Grading Scale:** A=100-90; B+=89-87; B=86-80; C+=79-77; C=76-70; D+=69-67; D=66-60; E=<60

Current UF grading policies for assigning grade points:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx> .

**Basis for grades:**

*Exams*

- Based on lectures and assigned readings
- Combination of multiple choice, short answer, short essay.
- Closed book!
- Distance students: Exams will be administered with Proctor U (<http://www.dce.ufl.edu/Data/Sites/29/media/proctoru-student-handout1---december-2013.pdf>) .

*Optional Final Exam*

The regularly scheduled final exam is optional and may be taken by students who are not satisfied with their exam average for the three regular exams. Only students who have four or fewer unexcused absences will be allowed to take the optional final. The optional final may replace the low exam, or it may be used as a makeup exam. For students who wish to replace a low exam grade, there will be no penalty: the top three grades of the four will be counted. The optional final will be cumulative.

*Quizzes*

Approximately 10 quizzes will be administered on-line throughout the semester. These quizzes are based on assigned readings. They are open book and may be taken up to two times.

*Participation:*

- On campus students are encouraged to attend class. Attendance will be taken every class period. Students who have more than 4 unexcused absences will not be allowed to take the optional final exam.
- On-line students are required to respond to discussion points posted after each lecture on the course website.

*Laboratory Problem Sets:*

Five laboratory problem sets will be assigned throughout the semester. These problem sets require analysis of data and will ask questions related to general concepts.

*Laboratory Quizzes:*

Being prepared for lab before arriving in the lab is important for an efficient class. Please read the appropriate section in the lab manual before the lab session, and a brief quiz will be given at the beginning of each laboratory session. Quizzes for each lab session will also be posted for on-line students.

*Final Lab Presentation:*

At the end of the semester, each student (on-campus and on-line) will be present a summary of the findings on the microbial ecology of a particular biogeochemical cycle based on the results obtained throughout the semester. For more information on this presentation and the structure of the laboratory, see the information beginning on p. 6 of this document.

**Online Course Evaluation**

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu>.

Evaluations are typically open during the last two or three of the semester, but students will be given specific times with they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

**Accommodations for Students with Disabilities**

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

**Academic Honesty**

UF students are bound by The Honor Pledge, which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

**UF Counseling Services**

Contact information for the Counseling and Wellness Center:

<http://www.counseling.ufl.edu/cwc/Default.aspx> ; (352)392-1575.

University Police Department: (352)392-1111 or 9-1-1 for emergencies.

## CLASS SCHEDULE

*Reading from textbook (TB) and laboratory manual (LM) are indicated in italics*

WK	TOPIC	
1	Class Starts - No Lab	
	<b>General Course Overview</b>	
	Soil Habitat	<i>TB Chapter 2</i>
	<b>Field Trip and Sampling</b>	
	Soil Habitat	<i>TB Chapter 2</i>
2	Bacteria and Archaea	<i>TB Chapter 5</i>
	<b>Mycorrhizal Quantification</b>	<i>LM pp. 8-11</i>
	Bacteria and Archaea	<i>TB Chapter 5; pp 224-230</i>
3	Fungi	<i>TB Chapter 6</i>
	<b>Soil Decomposition and Microbial Community Structure Experiment</b>	<i>LM pp. 12 - 14</i>
	Fauna and Viruses	<i>TB Chapters 8 and 9</i>
4	Microbial Genetics	<i>TB Chapter 4</i>
	<b>Dilution plating</b>	<i>LM pp. 15 -22</i>
	Microbial Metabolism	<i>TB Chapter 3</i>
5	Microbial Metabolism part 2	<i>TB Chapter 3</i>
	<b>Microscopy, Observe Bacteria, Riddell Mounts Collect 2nd Dilution Plating Data</b>	<i>LM pp. 23 - 36</i>
	<b>EXAM I Collect 1st Dilution Plating Data</b>	
6	Traditional methods in microbial ecology	
	<b>Direct Counts, Observe Fungi</b>	<i>LM pp. 37 - 38</i>
	Molecular methods in microbial ecology	
7	Microbial Interactions	<i>TB Chapter 10</i>
	<b>Nitrifier MPN and Phosphatase Tests</b>	<i>LM pp. 43 - 48</i>
	Rhizosphere	<i>TB Chapter 11</i>
8	Mycorrhizae	
	<b>Rhizobium Experiment</b>	<i>LM pp. 39 - 42</i>
	Carbon Cycle	<i>TB Chapter 13</i>
9	Anaerobic carbon cycle	
	<b>Soil Respiration Experiment</b>	<i>LM pp. 49 - 53</i>
	<b>EXAM II</b>	
10	Nitrogen cycle	Chapter 14
	<b>Collect 1<sup>st</sup> Week Respiration / Biomass Data</b>	<i>LM 49-55</i>
	Biological Nitrogen Fixation	<i>TB Chapters 15-16</i>
11	Sulfur Transformations	<i>TB Chapter 17</i>
	<b>Collect 2<sup>nd</sup> Week Respiration / Biomass Data</b>	<i>LM 49-55</i>
	Other cycles	<i>TB Chapter 18</i>
12	Global Gasses	<i>TB Chapter 19</i>
	<b>Collect Mycorrhizal and Rhizobium Data</b>	<i>LM 8-11</i>
	Biodegradation	<i>TB Chapter 20</i>
13	Bioremediation	<i>TB Chapters 21</i>
	<b>Collect Nitrifer Data</b>	<i>LM pp. 43 - 48</i>
14	Biological Control	
	<b>THANKSGIVING DAY</b>	
	<b>THANKSGIVING DAY</b>	
15	<b>EXAM III</b>	
	<b>CLASS ENDS</b>	

## **SWS4303/5305 Soil Microbial Ecology Laboratory Project: Cross system comparisons of the C, N, and P cycles**

Various aspects of the microbial ecologies of three different environments will be analyzed and compared throughout the semester. This will allow cross-system comparisons to be made with respect to the major microbially-mediated biogeochemical cycles: carbon, nitrogen, and phosphorus. Each of these different environments is very likely to exhibit significant differences with respect to the microbial ecology of those cycles.

The three environments are:

1. Forest soil collected from the upland pine ecosystem of the Natural Area Teaching Lab on campus: <http://natl.ifas.ufl.edu>.
2. Wetland soil will be collected from an area dominated by sawgrass in the Stormwater Ecological Enhancement Project (SEEP) of the NATL: <http://natl.ifas.ufl.edu/seep.php>.
3. Agricultural soil will be collected from a plot in the Student Agricultural Garden (<http://sustainable.ufl.edu/faqs/where-is-the-student-garden-and-how-do-i-get-a-plot/>).

Students will be divided into three groups of three to four students each. Each group will focus on a specific soil throughout the semester, and will share data with other groups. Each group will conduct the same analyses as the other groups; however, each group will analyze only one soil type.

On the last laboratory session of the semester, each group will make a powerpoint presentation to the class that will compare one biogeochemical cycle (C, N, or P) across the soils. For example, Group 1 will focus on the wetland soil throughout the course and share their data with the other groups. At the end of the course, all groups will have access to all data collected by the other two groups. Group 1 will analyze the carbon cycle across systems, explaining differences and similarities between the different soils. Much of this analysis should be related to the individual physical and chemical characteristics of the soils that will impact the microbial communities in different ways. Each student in the group will have a defined responsibility for data analysis, and a group leader will make the presentation. The presentation is expected to take at least 15 minutes. Each student will receive a grade for the presentation based on his/her contributions to the presentation.

Online students will be divided between the groups, and will interact with their assigned groups on-line. This will require communication between the on-campus and on-line students!

Examples of cross system analysis would include:

- For C cycle, relate concentrations of bacteria and fungi to pH, organic carbon concentrations, and respiration rates.
- For N cycle: relate concentrations of NO<sub>3</sub> concentrations (provided in class) to ammonia oxidizers (determined in class), bacterial numbers, pH. Relate these parameters to N-fixation potential.
- For P cycle, relate concentrations of mycorrhizal spores, infection potential, and phosphatase activities to P concentrations.

*And finally, how do these three cycles interact in different ways across systems?*