

Biology 528 Microbial Ecology Fall 2015

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Prerequisites: Biology 203, 203L, 204, 204L. Recommended: Biology 350 and 354.

Grading criteria:

Lecture

Midterm exams (3 x 100)	300
Redox worksheet	5
Article list	10
Article summary	10
<u>Synthesis paper</u>	<u>25</u>
Lecture total	350

Laboratory:

Attendance	10
Quizzes	20
Participation/Performance	20
Laboratory notebook	50
<u>Group project presentation</u>	<u>50</u>
Laboratory total:	150

Course total 500 points

Laboratory Attendance and Participation Points Breakdown:

# Unexcused Absences	Points Earned	Participation / Performance 2 Pts deducted for each infraction
0	10	Working unsafely / Lack of cleanliness
1	7	Disruptive / inappropriate behavior
2	4	Not doing your share of group work
3	Fail the Lab	Arriving late / Leaving early (without consent)

Please note: cleanliness is required, and counts in your participation grade.

Examinations: The three midterm and final examinations will each be worth 100 points, and will include short answer, multiple choice, and essay questions. Students will be allowed to drop one exam grade. The final exam will be cumulative. No make-up exams will be given, but you may miss any one exam, including the final. Any disputes regarding grading must be made within one week of receiving your graded exam.

Laboratory: One three-hour lab section is scheduled each week. Students will use enrichment and dilution cultures to isolate microorganisms from various aquatic and terrestrial environments. Microscopic and biochemical methods will be used to characterize these isolates and the microbial communities, as a whole. Molecular techniques will be used to identify these microbes. Generally speaking, you will have fun. Attendance is required in the laboratory, together with participation in the group project (see below).

Lab Quizzes: There will be a three point pre-lab quiz at the start of most lab classes. The quiz will cover what students should know after preparing for that day's lab exercises. There will be no quiz on the first lab of the semester.

Laboratory Notebook: In science, keeping a detailed account of procedures in a lab notebook is essential. You will be expected to maintain a laboratory notebook which will be periodically checked for points. The laboratory notebook should be in a standard format and contain a table of contents with dates, page numbers, and titles of lab exercises. Each experiment should have dedicated page(s) for details, procedures, specific samples used by the student/group, observations, results, and conclusions. For each lab, a worksheet will be provided with questions associated with each lab exercise. These worksheets should be attached within the laboratory notebook and will be checked for completeness during notebook checks. Notebooks will be checked for proper use and completeness four times in the semester as noted in the schedule.

Group project: Students will work in groups of three or four to study a specific environmental microbe or group of microbes in more depth. The group will prepare a 15-20 minute oral presentation, in which each student will speak for about 5 minutes. Obvious slacking of any group member will be noted in the participation grade.

Literature synthesis paper: Each individual will also prepare a terse, pithy (3-4 pages, 12-point font, double-spaced) paper that reviews at least two studies from the primary literature (i.e. presenting original experimental data) in microbial ecology. These sources must be published in peer-reviewed scientific journals. The point of this assignment is to analyze scientific papers and to synthesize them into a greater understanding of the field. The sources should either disagree with each other on some key point, in which case your assignment is to reconcile the two contradictory studies, or alternatively the results of two non-contradictory studies may be creatively combined to support a broader conclusion than either reaches individually.

Texts:

Recommended: Atlas and Bartha, *Microbial Ecology: Fundamentals and Applications*, 4th ed. An old edition of this is on reserve in the library.

(Supplemental reading from other sources will also be assigned for lecture.)

Handouts will be provided for the lab as needed. Supporting materials will generally be available on the class Blackboard site.

Students with Disabilities:

If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact Student Disability Services at (619) 594-6473. To avoid any delay in the receipt of your accommodations, you should contact Student Disability Services as soon as possible. Please note that accommodations are not retroactive, and that accommodations based upon disability cannot be provided until you have presented your instructor with an accommodation letter from Student Disability Services. Your cooperation is appreciated.

Learning Objectives for Microbial Ecology

After taking this course, students should be able to:

- Describe the diversity of all microbial life in terms of the three domains, knowing major characteristics of each.
- Understand the importance of microbes in the early evolution of the earth and the atmosphere
- Relate metabolic reactions carried out by microbes to global biogeochemical cycling of elements: understand these reactions in terms of chemistry, microbial physiology, and the importance in the environment.
- Appreciate the vast genetic and physiological diversity of microbes, and classify microbes into basic categories based on their metabolic fueling reactions (e.g. chemoheterotrophy, photoautotrophy, etc.)
- Define the various forms of interactions (competition, predation, mutualism, etc.) among and between microbial populations
- Understand the factors that regulate interactions between microbes
- Understand the importance of these interactions in structuring microbial communities
- Define horizontal gene transfer, and explain its implications for microbial ecology and evolution
- Relate general principles of microbial ecology to role of microbes in human disease
- Understand how the specific environmental properties of soils, oceans and biofilms affect microbial communities therein.
- Appreciate the extraordinary resistance of microbes to environmental stress, know examples of stress-resistant microbial species, and explain the strategies employed by microbes to cope with various environmental stresses.
- Describe how microbes are useful in biotechnological and environmental applications such as sewage treatment, bioremediation, etc. Relate the physiology of microbes to their role in these processes.

Date	Lecture	Reading	Lab Activity (or assignment)
25-Aug	Course Intro, Life at microscopic scales	Online Articles; A&B ch 1	Check in/lab safety, Lab Intro, Enrichment cultures, Winogradsky Columns, Microbial Fuel Cell
27-Aug	Microbial diversity I	A&B ch 2	
01-Sep	Microbial diversity II	A&B ch 2	QUIZ 1 Microscopy, Enrichments, Aseptic technique, Dilution cultures, Swarmers, MPN
03-Sep	Physiological diversity I	A&B ch 2	
08-Sep	Physiological diversity II	A&B ch 2	QUIZ 2 Microscopes, purify cultures, streak plating, calculate MPN
10-Sep	Physiological diversity III	A&B ch 2	
15-Sep	Biogeochemical cycles I	A&B ch 10	QUIZ 3 NB check (lab 1, 2, 3) Microbe-microbe interactions I
17-Sep	Biogeochemical cycles II	A&B ch 10	
22-Sep	Biogeochemical cycles III	A&B ch 11	QUIZ 4 REDOX WORKSHEET DUE (Th) Microbe-microbe interactions II, Microscopy: Gram Stain
24-Sep	Review session		
29-Sept	EXAM #1		Soil microbiology: field trip to Mission Trails! ☺
01-Oct	Microbial communities I: negative interactions	A&B ch 3, 6; article	
06-Oct	Microbial communities II: cooperation & cheating	A&B ch 3, 6; article	QUIZ 5 NB check (lab 4, 5, 6) ARTICLE LIST DUE (T) ; N cycle, extracellular enzymes, phototrophs, halophiles
08-Oct	Microbial communities III: positive interactions	A&B ch 3, 6; article	
13-Oct	Microbial ecology of the human body I	A&B ch 5, 16; article	Extracellular enzymes, continued; In Lab Group Project Workday
15-Oct	Microbial ecology of the human body II	A&B ch 5, 16; article	
20-Oct	Microbe-invertebrate interactions	A&B ch 5	QUIZ 6 ARTICLE SUMMARIES DUE (Th) ; Net mineralization & Nitrification
22-Oct	Plant-microbe interactions I	A&B ch 4	
27-Oct	Plant-microbe interactions II	A&B ch 4	In class Group Project Workday
29-Oct	EXAM #2		

03- Nov	Microbial adaptations to stress/radiation/UV	A&B ch 8	QUIZ 7 Plant-microbe interactions; Group projects
05- Nov	Water and osmotic stress	A&B ch 8	
10- Nov	Life at low temperatures	A&B ch 8	QUIZ 8 NB check (lab 7, 9, 11); Marine phytoplankton; Group Projects; ARTICLE SYNTHESIS ASSIGNMENT DUE (Th)
12- Nov	Piezophiles (life under pressure)	A&B ch 8	
17- Nov	Thermophiles	A&B ch 8	In Lab Group Project Workday
19- Nov	Soil Microbiology	A&B ch 9	
24- Nov	Marine Microbiology	A&B ch 9	
26- Nov	<u>THANKSGIVING</u>	article	<u>NO LAB!</u>
01- Dec	Biofilms	article	
03- Dec	Bioremediation	A&B ch 13-15; article	NB check (lab 12, Group Project) Last Lab: clean up / check out; ☺ GROUP PRESENTATIONS ☺
08- Dec	Review/catch-up		
10- Dec	EXAM #3		
17- Dec	FINAL EXAM (10:30-12:30)	Cumulative	