Microbial Ecology: Cells to Ecosystems

BIOL - L492

Spring 2014

Instructor: Mario Muscarella

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Office Hours: Thursdays 2:30 – 5:00 PM
Other times by appointment

Class Info: Monday, Wednesday, Friday: 10:05 – 10:55 AM, Jordan Hall A105
Prerequisites: BIOL L111, BIOL L112, BIOL M250, or permission from instructor
Required Texts: *Processes in Microbial Ecology,* by David Kirchman,
Recommended Additional Texts (on reserve in library): Brock Biology of Microorganisms

Course Description/Goals: This course is designed to provide students with a general overview of classical and current work being done in the field of microbial ecology. Topics covered will range from microbial cells and physiology to communities and ecosystem processes. Students will be expected to play an active role including participation in discussions, reading scientific literature and blogs, and contributing to Microbe Wiki. The course is designed to challenge students to think beyond the material presented by interpreting ideas as if they were a scientist. The course structure will be a mixture of lecture days as well as discussion and case study days. There will be four case study session during the semester: two of which will be student selected and students will lead these discussion days.

General Course Outline:

Section 1 – Microbial Populations
Topics: General Physiology, Population Dynamics, Resources, and Growth
Readings: Schmidt 2006, Whitman *et al.* 1998; Thompson 1998; Lenski 2004, 2011; … others
Case Studies: The LTEE Experiment

Section 2 – Microbial Communities
Topics: Coexistence, Diversity (soils, freshwater, sediments, marine, extreme habitats), Biogeography (Niche and Neutral Theory), Dormancy
Readings: Fierer 2006; Fierer & Lennon 2011; Chow 2013; Martiney 2006; … others
Case Studies: Marine Virus Dynamics

Section 3 – Microbes and Ecosystem Processes
Topics: Elemental Cycling (Carbon, Nitrogen, Other), Plant-Microbe Interactions, Animal-Microbe Interactions, Applied Ecology (Bioremediation, Wastewater treatment)
Readings: Bardgett 2008; Peralta 2013; Kirchman 2009; Treseder 2011; Zac 2003; …others
Case Studies: TBD (Student Picked)

Tentative Course Schedule

Week 1	Topics	(M) Introduction – Course Objectives, Syllabus, Introductions (W) How to do a lit Search, Introduction To Biomolecules (F) Discussion 1 – What is Microbial Ecology?
	Readings	Schmidt 2006; Whitman et al. 1998; Kirchman Chap 1
	Assignments	
Week 2	Topics	(M) Bacterial Cell Physiology – The Basics (Cell Parts and Chemistry) (W) Physiology Cont. – Cell Growth, Resource Requirements (F) Physiology Cont. – DNA Replication, Protein Synthesis
	Readings	Kirchman Chap 2; Kirchman Chap 6; Brock Chapter 7 - sections I, II, & III
	Assignments	Article Summary I Handed Out
Week 3	Topics	(M) Case Study 1: The LTEE (Lenski Group's 25 yr *E. coli* Experiment) (W) Populations – Models, Growth in Batch Culture vs. Chemostats (F) Evolution – Basic Concepts, Microbial Evolution, Rapid Evolution
	Readings	Thompson 1998; Lenski 2004; Lenski 2011; Kirchman Chap 6
	Assignments	**Article Summary 1 Due**; Microbe Wiki Assignment Handed Out
Week 4	Topics	(M) Cell Physiology Stressors (osmotic pressures, temperature) (W) Archea, Fungi, and Protists (general info) (F) Section Discussion and Review for Exam 1
	Readings	Kirchman Chap 3; Brock Chap 17; Brock Chap 18
	Assignments	
Week 5	Topics	(M) **Exam 1 – Section 1 (Microbial Populations)** (W) Discussion 2 – Microbes in Communities (F) Coexistence Theory in stable and variable environments
	Readings	Fierer & Lennon 2011; Fierer 2006
	Assignments	Article Summary 2 Handed Out
Week 6	Topics	(M) Case Study 2: Marine Viruses (W) Predation and Predator Prey Interactions (F) Microbes and Foodweb Dynamics
	Readings	Kirchman Chap 7; Kirchman Chap 8; Weinbauer 2004; Chow 2013;
	Assignments	**Article Summary 2 Due**

Week 7	Topics	(M) Discussion 3 – Diversity of Bacteria (in Central Park) (W) Diversity: Alpha Diversity (F) Diversity: Beta Diversity
	Readings	Kirchman Chap 9; Kirchman Chap 10
	Assignments	**Lit Review for Microbe Wiki Due**
Week 8	Topics	(M) Case Study 3: TBD (Student Choice) (W) Biogeogrphy Theory (F) Disease Ecology
	Readings	Green 2006; Martiney 2006; Schrag 1995
	Assignments	Article Summary 3 Handed Out
Week 9	Topics	(M) Temporal Variability, Stability, and Dormancy (W) Co-Evolution (F) Section Discussion and Review for Exam 2
	Readings	Lennon & Jones 2011; Fierer & Ladau 2012;
	Assignments	**Article Summary 3 Due**
Week 10	Topics	(M) **Exam 2 – Section 2 (Microbial Communities)** (W) Case Study: TBD (Student Choice) (F) Ecosystem Processes – General Review
	Readings	Kirchman Chap 4; Treseder 2011;
	Assignments	
Week 11	Topics	(M) Carbon Cycling and Microbes I (W) Carbon Cycling and Microbes II (F) Nitrogen Cycling and Microbes
	Readings	Kirchman Chap 5; Kirchman Chap 11; Kirchman Chap 12
	Assignments	
Week 12	Topics	(M) Other Elemental Cycles and Microbes (S, P, metals) (W) Discussion: Microbial Interactions (F) Plant Microbe Interactions
	Readings	Kirchman Chap 13; Zac 2003;
	Assignments	**Microbe Wiki Submission Due**
Week 13	Topics	(M) Animal Microbe Interactions (W) Case Study: Wastewater Treatment (F) Applied Microbial Ecology (Bioremediation and Wastewater)
	Readings	Kirchman Chap 14; Nyholm 2004; Daims 2006
	Assignments	Article Summary 4 Handed Out

Week 14	Topics	(M) Managing Microbial Services: Human and Environmental (W) Section Discussion and Review for Exam 3 (F) **Exam 3 – Section 3 (Microbes and Ecosystem Processes)**
	Readings	Peralta *et al.* (In Press); Fierer 2012
	Assignments	**Article Summary 4 Due**
Week 15	Topics	(M) Microbes and Climate Change (W) Open Questions And In Class Practice Problems (All Sections) (F) Review for Final
	Readings	Bardgett 2008; Kirchman 2009
	Assignments	**Dead Week – No Assignments**

(*Full Reading Bibliographies and Papers Available On OnCourse)

Grading Policy

This course will be graded on a point system as outlined below:

A+	98-100 points	A	93-97.9 points
A-	90-92.9 points	B+	87-89.9 points
B	83-86.9 points	B-	80-82.9 points
C+	77-79.9 points	C	73-76.9 points
C-	70-72.9 points	D+	67-69.9 points
D	63-66.9 points	D-	60-62.9 points
F	< 60 points		

Point Distribution

Exam 1	12 pts
Exam 2	12 pts
Exam 3	12 pts
Final	20 pts
Quizzes	5 pts
Article Summaries	12 pts
Microbe Wiki Project	12 pts
Participation	15 pts
Total	**100 pts**

Assignment Submission & My Policy on Due Dates: All assignments (Article Summaries and Wiki Assignments) will be submitted electronically through OnCourse and Turnitin.com. Turnitin.com is a resource (now directly linked with OnCourse) that checks student work for originality and proper citation. All written assignments will be checked via Turnitin.com and student work will remain in a private, Indiana University database. Assignments will be due by the start of class on the date in which they are due. Grades for late assignments will be ***deducted 10% per day*** after the due date.

Participation Grade

My goal is to create an interactive and thought provoking learning environment; however, I cannot do this on my own. Students provide an important component to the classroom through questions, discussion, and open debate. As a result, your participation grade will be based upon your contribution to the microbial ecology course. As attendance is a requirement for contribution, unexcused absences will be penalized. In addition, the success of a classroom discussion is dependent upon individual behavior and respect for your fellow classmates; as such, in appropriate behavior and disruptions will be penalized. Finally, part of your participation grade will depend on your involvement in the student lead case study discussions (both selecting articles and presenting material to the class).

Plagiarism and Cheating

You are responsible for knowing the IU Code of Students Rights, Responsibilities, and Conduct. The student code is available online at http://www.iu.edu/~code/. The IU plagiarism policy is available online at http://college.indiana.edu/plagiarism/. You will be required to review both the IU Code of Students Rights, Responsibilities, and Conduct; the IU Plagiarism Policy; and take an online plagiarism oath (https://www.indiana.edu/~istd/test.html) prior to submitting your first assignment.

Students with Disabilities

If you have specific physical, psychological, or learning disabilities and require accommodations, please let me know early in the semester so than any learning needs may be appropriately met. You will need to provide documentation of your disability to the Office of Disability Services for Students (DSS), located in the Herman B. Wells Library, Rm W302, (812) 855-7578. Additional information about DSS may be obtained at: http://studentaffairs.iub.edu/dss/.