PLPA 5444: ECOLOGY, EPIDEMIOLOGY, AND EVOLUTIONARY BIOLOGY OF PLANT MICROBE INTERACTIONS

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Spring Semester, 2024 | Tues 1-2:15 and Thurs 1-3:30, Borlaug 491

3 credits

COURSE DESCRIPTION

Microbes exist in close association with plants as pathogens, saprophytes, epiphytes, endophytes, and mutualists. This course will explore the intimate connections between the ecology, life history, evolutionary biology, and fitness of plants and their microbes.

We will begin by considering what it means to live small, and the consequences of body size for life history, ecology, and evolution. Subsequently we will explore the distinct types of interactions that microbes engage in with plants, the relative fitness costs and benefits of these to the microbial and plant partners, and coevolutionary models and patterns in coevolution of plants and microbes. In the second section of the course we will focus on epidemiology, including a consideration of traditional epidemiological models for studying plant-microbe interactions in time and space, the significance of the physical and biological environments in mediating plant-microbe interactions and disease development and, the development and use of forecasting models for plant disease management. Finally, we will explore applications of ecology and evolutionary concepts to enhance our understanding of the roles of symbiotic fungi and bacteria in plant community ecology and plant productivity, the potential impacts of introduced or invasive plants and microbes on native and agricultural species, the influences of climate change on plant-microbe interactions, and strategies for managing microorganisms to optimize crop and/or ecosystem productivity.

Plants' bacterial zoos, Dan Bright/LostStudio

SCHEDULE:

Week	Date	Topic	Assignment Deadlines
Course Part 1: Ecology and Evolution of Plant-Microbe Associations			
1	T 16 Jan	Course overview and attributes of microbes	
	Th 18 Jan	Phyllosphere and rhizosphere communities* **Asynchronous lecture, no discussion this week*	
2	T 23 Jan	Evolution of virulence	Quiz due from asynchronous lecture on 1/18
	Th 25 Jan	Dispersal and symbiosis *Dis: Fitness trade-offs and microbiome assembly*	
3	T 30 Jan	Diverse roles of plant-associated microorganisms Introduce Homework 1	
	Th 1 Feb	Mutualism, guest Lecture by Dr. Zoe Hansen *Dis: Exploring the Continuum of Symbiotic Interactions*	
4	T 6 Feb	Coevolution	
	Th 8 Feb	Microbial diversity *Dis: Applications in microbial diversity data*	
5	T 13 Feb	Disease in natural systems	
	Th 15 Feb	Invasive species, guest lecture by Dr. Brett Lane *Dis. Pathogen-weeds interactions*	Homework 1 due
6	T 20 Feb	Diversity and disease in agriculture	
	Th 22 Feb	Ecological management of plant diseases *Dis: Microbiome data, think-a-thon*	
7	T 27 Feb	Review and integration	
	Th 29 Feb	No lecture	Midterm 1
Spring Break, March 4-8			
Course Part 2: Measuring and Modeling Epidemics			
8	T 12 March	Characterization of agricultural vs native systems	

		and disease assessment Introduce symposium	
	Th 14 March	Disease cycles and monocyclic vs polycyclic epidemics *Dis: Modeling monocyclic and polycyclic diseases*	
9	T 19 March	Spatial gradients Introduce Homework 2	
	Th 21 March	Spatio-temporal disease spread *Dis: Simulating spread, Dr. Mathew Michalska-Smith*	
10	T 26 March	Physical environment	Symposium paper topics due
	Th 28 March	Physical environment-microbe interactions *Dis: Epidemics in the context of climate change*	
11	T 2 April	Inoculum	
	Th 4 April	Developing and testing a forecasting model, guest lecture, *Dr. Damon Smith, UW Madison* *Dis. Deploying and validating forecasting tools*	Homework 2 due
12	T 9 April	Managing plant-microbe interactions	
	Th 11 April	Yield loss and economic considerations *Dis: Forecasting yield losses*	
13	T 16 April	Summary and review	
	Th 18 April	No lecture	Midterm 2
Course Conclusion and Wrap Up			
14	T 23	Applications, big challenges, and course wrap up	
	Th 25	No lecture	Symposium presentations

COURSE MECHANICS: The course will consist of two, 75-minute standard class sessions and one, ~1hr literature-focused discussion session each week. The 75-minute sessions will be a mixture of lecture, discussion, and small-group breakouts.

GRADING:

Class participation, discussion (25): 10%
Homework assignments: 30%
1 ecology and evolution thought experiment (Section 1)
1 epidemiology assignment (Section 2)
Midterms (2 @ 15% each): 30%
Final project: 30%

OFFICE HOURS: I am available Mondays and Wednesday 10:30-12:30 in my office located at 214 Stakman Hall. Please email in advance to arrange a meeting or drop by with questions. I am also happy to meet at alternate times that work best for you.

COURSE EXPECTATIONS: Regular student attendance in class is required. **Late assignments will be penalized 25% of their final score per day unless you have spoken with the instructors PRIOR to the due date. EXAMS MUST BE TAKEN AT THEIR SCHEDULED TIME UNLESS PRIOR ARRANGEMENTS ARE MADE WITH THE INSTRUCTOR.** There are no options for extra credit in this course.

MAKEUP WORK FOR LEGITIMATE ABSENCE: Note that students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement, and religious observances. Such circumstances do not include voting in local, state, or national elections. For complete information, please see:https://policy.umn.edu/education/makeupwork

COURSE GRADING STANDARDS:
A: achievement that is outstanding relative to the level necessary to meet course requirements.
B: achievement that is significantly above the level necessary to meet course requirements.
C: achievement that meets the course requirements in every respect.
D: achievement that is worthy of credit even though it fails to meet fully the course requirements.
F: represents failure and signifies that the work was either 1) completed but at a level of achievement that is not worthy of credit; or 2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I.
I (incomplete): assigned **at the discretion of the instructor** when, due to extraordinary circumstances, e.g. hospitalization, a student is prevented from completing the work of the course on time. Requires a written agreement between instructor and student.
For additional information and grading scales, please refer to:
https://policy.umn.edu/education/gradingtranscripts

ACADEMIC DISHONESTY: Academic dishonesty in any portion of the academic work for a course shall be grounds for awarding a grade of F or N for the entire course. You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see:
https://policy.umn.edu/education/studentconductcode-proc01

If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular

class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

CREDITS AND WORKLOAD EXPECTATIONS: For undergraduate courses, one credit is defined as equivalent to an average of three hours of learning effort per week (over a full semester) necessary for an average student to achieve an average grade in the course. For example, a student taking a three credit course that meets for three hours a week should expect to spend an additional six hours a week on coursework outside the classroom (note: according to University policy, "one hour" equates to 50 minutes of time). More information can be found here:
https://provost.umn.edu/about-evpp/policies/academic-policy-public-review/expected-time-course-credit

STUDENT CONDUCT CODE: The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.
As a student at the University you are expected adhere to Board of Regents Policy: Student Conduct Code. To review the Student Conduct Code, please see:
chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://regents.umn.edu/sites/regents.umn.edu/files/2022-07/policy_student_conduct_code.pdf
Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities."

USE OF PERSONAL ELECTRONIC DEVICES IN THE CLASSROOM: Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each faculty member to determine if and how personal electronic devices are allowed to be used in the classroom. For complete information, please reference:https://policy.umn.edu/education/studentresp

APPROPRIATE STUDENT USE OF CLASS NOTES AND COURSE MATERIALS: Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see:
https://policy.umn.edu/education/studentresp

SEXUAL HARASSMENT: "Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy:
https://policy.umn.edu/hr/sexharassassault

EQUITY, DIVERSITY, EQUAL OPPORTUNITY, AND AFFIRMATIVE ACTION: *The University will provide equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender*

identity, or gender expression. For more information, please consult Board of Regents Policy: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://regents.umn.edu/sites/regents.umn.edu/files/2024-01/policy_diversity_equity_inclusion_and_equal_opportunity.pdf

DISABILITY ACCOMMODATIONS*:* The University is committed to providing quality education to all students regardless of ability. Determining appropriate disability accommodations is a collaborative process. You as a student must register with Disability Services and provide documentation of your disability. The course instructor must provide information regarding a course's content, methods, and essential components. The combination of this information will be used by Disability Services to determine appropriate accommodations for a particular student in a particular course. For more information, please reference Disability Services: https://disability.umn.edu/

MENTAL HEALTH SERVICES: As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: http://www.mentalhealth.umn.edu.