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 the major groups of microbes associated with plants and what it means to live small. 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 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 the significance of developing an enhanced understanding of plant-microbe ecology, epidemiology, and evolutionary biology to the development of sustainable land management systems.

**SCHEDULE:**

**W 3 Sept**  
Course overview.  
The Phytobiome: a new way of looking at plant-microbe interactions?

**M 8 Sept**  
Living small: microbes are not just little big things!  
Microbial life history, processes that generate variation.  
The challenge of being a LITTLE organism in a BIG world.  
Doing Science.

**W 10 Sept**  
Dispersal.  
Plant-microbe associations, limits to microbial fitness.  
Definitions: epi, endo, mut, path, sym, decomp, rhizo, phyllo  
Microbial life history in relation to plants  
**DISCUSSION1**

**M 15 Sept**  
‘Causal organisms’ and Koch’s Postulates.  
What is disease? What traits confer pathogenicity?  
Mechanisms of infection, mechanisms for resisting or facilitating infection.  
Do only pathogens infect?  
Terms: obl, non-obl, spec, gen, tolerance, R, partial R

**W 17 Sept**  
Mutualists I  
Mycorrhizal fungi, N-fixing microbes, Endophytes.  
**DISCUSSION2**

**M 22 Sept**  
Mutualists II: Diffuse associations, multi-organismal interactions  
Characterizing the phytobiome....so what?
**EXTENDED DISCUSSION**

**Coevolution I**

**Coevolution II**

**Review**

**Midterm 1**

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**Epidemiology Overview and introduction**

Characteristics of agricultural vs. native systems

Assessing disease: what, how, and why

**Time, Disease progress curves**

**Space, disease through space**

**Space and time together**

**Physical environment**

**The physical environment and plant-microbe interactions**

**Inoculum, Dose-response relationships**

**Dispersal gradients**

**Managing plant-microbe interactions**

**Forecasting, crop losses, management strategies**

**Review and Summary**

**MIDTERM II**

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**MEET AT T.R. ANDERSON GALLERY ON THE MINNEAPOLIS CAMPUS**

Disease in natural systems

Plant-microbe feedbacks

**Suppressive soils and biological control**

**Diversity: agricultural vs. natural systems**

**Feedbacks**

**Value of plant and microbial diversity**
Introduced and invasive species
Escape from enemies, biotic resistance, and hybridization

Introduced and invasive species, ctd.
Implications/consequences of lack of recent coevolutionary history

Emerging pathogens/symbioses
Origins of agricultural pathogens
Spillover

Climate change and plant-microbe symbioses

Wrap-up and summary
Symbioses and sustainability
Ethics of research

Saturday 13 Dec  Final Exam (tentative) 10:30-12:30 p.m. OUCH!!!

General course mechanics: The course will consist of 2, 75-minute standard class sessions and one, 50-minute discussion session each week.

Grading:
- Class participation, discussion: 15%
- Homework assignments: 30%
  - 2 moderate writing assignments (Section 1)
  - 1 epidemiology assignment (Section 2)
- Midterms (2 @ 15% each): 30%
- Final project: 25%

Office hours: I am available every day after class, or at most any other time by prior arrangement. If this isn’t convenient for you, call or email me to set-up a time to meet.

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 Absences: 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: http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html.
**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, please refer to:
http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html.

**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. (Student Conduct Code: http://www1.umn.edu/regents/policies/academic/Student_Conduct_Code.html) 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:
http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: http://www1.umn.edu/oscai/integrity/student/index.html. 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 nine hours a week on coursework outside the classroom.

**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: http://www1.umn.edu/regents/policies/academic/Student_Conduct_Code.html.

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: http://policy.umn.edu/Policies/Education/Education/CLASSROOMPED.html.

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: http://policy.umn.edu/Policies/Education/Education/CLASSNOTESSTUDENTS.html.

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: http://www1.umn.edu/regents/policies/humanresources/SexHarassment.html

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: http://www1.umn.edu/regents/policies/administrative/Equity_Diversity_EO_AA.html.

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: http://ds.umn.edu/students/Enrolled/responsibilities.html.

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: