

Ecology of Infectious Diseases, BIOM 460

Spring 2024

Instructor: Dr. Angie Luis (angela.luis@umontana.edu)

Readings

There is no course book, but there will be assigned readings and videos on Moodle most weeks with corresponding quizzes.

Class meeting times:

MWF 11:00-11:50am
Forestry (FOR) 106

Office Hours: Mondays 12:00-12:50pm & by appt, Forestry 207A

Learning Outcomes

In this course we will take an ecological approach to understand infectious disease. We will examine how diseases spread through time and space, and examine mathematical models of disease spread and their usefulness in control strategies. We will discuss case studies of both human and animal diseases (and a few plants)—the ecological concepts apply to a wide range of systems. Upon course completion, students will

- understand the mechanisms, patterns and dynamics of disease spread and persistence
- understand the concept of the basic reproduction number and critical community size
- understand the concept of herd immunity in relation to invasion and vaccination
- understand the conditions required for spillover (cross-species transmission)
- understand the concept of evolution of virulence
- understand how biodiversity affects infectious disease dynamics
- have knowledge of a range of infections and features of emerging infectious diseases
- understand the processes that generate heterogeneities in parasite load
- be able to formulate a basic epidemiological model for a given parasite
- be able to formulate the basic reproduction number for the parasite/model
- be able to recommend multiple management strategies for a given parasite

Topics Covered

Microparasite (pathogen) fundamentals:

The epidemic curve and R_0

SIR model

Density-dependent vs Frequency-dependent transmission

Threshold densities and community sizes theories

Spread of childhood diseases

Quizzes every other Monday: Jan 29 & Feb 12

Microparasite complexities:

SEIR

Microparasite strategies for persistence

COVID Model

Vaccination and disease eradication

Evolution of virulence

Importance of Heterogeneities / Case study: HIV

Quizzes every other Monday: Feb 26 & Mar 11

Wildlife & Vector-borne diseases:

Case study: Foot and Mouth Disease

Wildlife disease – detection and impacts

Case Study: CWD

Emerging diseases & Zoonoses

Case study: Sin Nombre virus

Vector-borne disease (VBD) patterns and processes

VBD models and control

Quizzes: Apr 1 and Apr 15

Macroparasites, & Parasites in communities:

Macroparasite patterns and process of distribution

R_0 in macros and control through anthelmintic application

The effect of biodiversity on parasites

The role of parasites in ecosystem functioning

Quiz: Apr 29

Final Exam: Thursday, May 9, 10:10-12:10

GRADE BREAKDOWN: (subject to minor changes)

	Undergrad students		Graduate students	
	<u>points</u>	<u>percentage</u>	<u>points</u>	<u>percentage</u>
Moodle Lessons & Assignments	220	(35%)	220	(32%)
Exams (6 quizzes at 50 pts each and comprehensive final at 100)	400	(65%)	400	(57%)
Grad students only: Modeling project			80	(11%)
Total	620		700	

Moodle Lessons and Assignments: Most weeks there will be a lesson and/or assignment due on Wednesdays, submitted through Moodle. Moodle lessons cover basic concepts and terms to free up class time for more active learning, application of knowledge, and examples. Moodle lessons may consist of multiple content pages with associated quiz questions. Check the progress bar to make sure you have completed the whole lesson. Moodle lessons will be worth between 6 and 15 points each. Additionally, there will be approximately 4 larger assignments that demonstrate understanding and synthesis of covered material. These will be worth between 15 and 50 points. You will have approximately one week to complete most lessons and assignments. There will be one group assignment that you will have 2 weeks to complete. See Moodle for details. (This is all subject to minor changes). All grades (including exams) will be kept on Moodle, so your grade in Moodle should reflect your current grade. (Quizzes and longer assignments will be graded within one week of completion, barring unforeseen circumstances.)

Quizzes: In place of high stakes exams, approximately every other Monday, we will have a quiz worth 50 points. You will have 20 minutes to complete the quiz, and then we will have class for the last 30 minutes of the period. There will be 7 quizzes total and you can drop your lowest score. There will be a comprehensive final worth 100 points.

GRADUATE INCREMENT: Students taking this course for graduate credit will be expected to perform at an advanced level compared to undergraduates. Grading on assignments and quizzes will be evaluated accordingly. Additionally, grad students will be required to do a project. Throughout this course, we will discuss various mathematical model structures describing spread of infectious diseases. For this project, the student will adapt one of the models discussed to an infectious disease of

their choice, and explore drivers of dynamics and potential ways to control the spread of infection. The student will formulate equations which describe transmission and spread of the parasite, code them up in R, explore how different parameters affect the spread (for example how decreasing the infectious period would affect final outbreak size, etc), and potential management strategies (such as vaccination or movement bans). In addition to the learning outcomes above, after the project, graduate students should have a working knowledge of modeling methods discussed in class, be able to formulate their own models and explore potential management strategies. In the last few weeks of class each graduate student will give a 15-minute presentation on their project to the rest of the class. The projects will be evaluated on the appropriate background, model structure, analysis, conclusions, and thorough statement of assumptions. (See above for contribution to total grade.)

PLAGIARISM: Plagiarism will not be tolerated and will result in failing the course.

STUDENT CONDUCT CODE: All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the [Student Conduct Code](#).

STUDENTS WITH DISABILITIES: The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Office for Disability Equity (ODE). If you think you may have a disability adversely affecting your academic performance, and you have not already registered with ODE, please contact ODE in Aber Hall 116 or (406) 243-4216. I will work with you and ODE to provide an appropriate modification.

BASIC NEEDS: Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Office for Student Success (officeforstudentsuccess@mso.umt.edu or (406) 243-2800) for support. Furthermore, please notify me if you are comfortable in doing so. This will enable me to provide any resources that I may possess.

GRADING OPTION: Please note, this class is offered for traditional letter grade only, it is not offered under the credit/no credit option.