Ecology of Infectious Diseases, BIOM 460

Spring 2022

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
Jeanette Rankin Hall (JRH) 204

Office Hours: Wednesdays 1:00-1:50pm & by appt, Forestry 207A

Learning Assistant: Emily Towery (emily.towery@umconnect.umt.edu)

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:

SIR model

The epidemic curve and R_0

Density-dependent vs Frequency-dependent transmission

Threshold densities and community sizes theories

Spread of childhood diseases

Quizzes every other Friday: Jan 28 & Feb 11

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 Friday: Feb 25 & 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: Friday, May 13, 10:10-12:10

GRADE BREAKDOWN: (subject to minor changes)

	Undergrad students		Graduate students	
	points	percentage	points	percentage
Moodle Lessons & Assignments	220	(33%)	220	(29%)
Exams (6 quizzes at 50 pts each and comprehensive final at 140)	440	(67%)	440	(58%)
Grad students only: **Modeling project**			100	(13%)
Total	660		760	

Moodle Lessons and Assignments: Most weeks there will be a lesson and/or assignment due, 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. You can re-answer questions, and the grade will be the mean of your different attempts. 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. (Exams and longer assignments will be graded within one week of completion, barring unforeseen circumstances.)

Quizzes: In place of high stakes exams, approximately every other Friday, 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 140 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 week of class each graduate student will give a 20-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.)

COVID POLICIES: I expect everyone to follow UM safety protocols, as bulleted below. **If students decide not to follow all safety protocols, I will immediately transition all activities to fully remote for the entire class.** This is for the safety of everyone to minimize transmission. Transmission is likely to occur on campus, whether through contacts at school, work, or socializing. We need to do our best to try to minimize that transmission. If you are young and healthy, your risk of severe infection is low, but it is not zero, and we need to be mindful of starting a chain of transmission that may eventually infect someone who is high risk. We are in this together.

I will record all lectures and make them available if you need to miss class. Please let me know if you have concerns or need any other accommodations. This is a novel and ever-changing landscape so mutual respect, honest and early communication, and flexibility are needed for us to have a successful semester.

UM safety guidelines:

- Mask use is required within the classroom or laboratory.
- If you feel sick and/or are exhibiting COVID symptoms, please don't come to class and contact the Curry Health Center at (406) 243-4330.
- If you are required to isolate or quarantine, you will receive support in the class to ensure continued academic progress.
- UM recommends students get the COVID vaccine and booster. Please direct your questions or concerns about vaccines to the Curry Health Center.
- Drinking liquids and eating food is discouraged within the classroom.
- Up-to-Date COVID-19 Information from the University of Montana
    - UM Coronavirus Website: https://www.umt.edu/coronavirus
- Please remain vigilant outside the classroom in mitigating the spread of COVID-19

PLAGARISM: 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 Disability Services for Students (DSS). If you think you may have a disability adversely affecting your academic performance, and you have not already registered with DSS, please contact DSS in Lommason 154 or (406) 243-2243. I will work with you and DSS 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 (sarah.swager@umontana.edu or (406) 243-5225) for support. Furthermore, please notify the professor if you are comfortable in doing so. This will enable her to provide any resources that she 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.