**Biology 347 – Disease Ecology**

Spring 2019 (Tue-Wed-Thur)

**Instructor**

Dr. David Civitello, Ph.D.

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**Teaching Assistant**

Olivia Zarella, MPH Candidate, May 2019

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Office hours: Wednesdays 11-1 PM

Office hours location: TBD

**Meeting Times and Locations**

Tuesday and Thursday, 10 – 11 AM, 1642 Clifton Rd, Room 308

 Wednesday, 1 – 2 PM, 1642 Clifton Rd, Room 113

**Prerequisites**

 QTM 100, BIO 142 + Lab

**Course description**

Parasitism is the most common trophic strategy on Earth, and many crucial issues in ecology involve outbreaks of harmful diseases. Research on the ecology of infectious diseases has increased tremendously in recent years, fueled by challenges to global human health and ecological conservation as well as advances in theory and molecular technologies. This course introduces major issues and advances in the ecology of infectious diseases. This course will specifically focus on the functional and taxonomic diversity of parasites, transmission routes of parasites, parasite virulence and strategies of host defense, mathematical models for the population dynamics of disease, the effects of parasitism on individual hosts and populations, disease in complex communities, co-evolution between hosts and parasites, emerging, and resurging diseases, and human impacts on disease emergence.

**Course objectives**

The goal of this course is for students to improve their understanding of the ecological factors that influence disease dynamics. Students will develop the skills necessary to read, interpret, and discuss primary scientific literature, formulate scientific hypotheses, organize, analyze, and present biological data, understand, build and analyze theoretical models of disease, and write and present research on the ecology of infectious disease.

**Course format**

This course will meet three times each week. Tuesdays will primarily be lecture based. On Wednesdays, 2-3 students will lead group discussion of pre-assigned scientific articles. Students will complete analytical lab assignments on Thursdays, which are due one week later. Students will complete a final project in which they use some of these analytical approaches to examine a question or problem in disease ecology, write a report, and present a 5 minute “Lightning talk” summarizing their findings.

**Course materials**

PDFs of all materials will be available on the Canvas website for the course.

**Course schedule**

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| --- | --- | --- | --- |
| **Date** | **Format** | **Topic** | **Due** |
| 1/15 | Lecture | Course overview/survey |  |
| 1/16 | Discussion | Survey/Open Discussion |  |
| 1/17 | Lab #1 | Introduction to R |  |
| 1/22 | Lecture | Introduction to disease ecology |  |
| 1/23 | Discussion | Bush et al. 1997, Journal of Parasitology, 83:575-583 |  |
| 1/24 | Lab #2 | Working with data: Virulence and castration | Lab #1 |
| 1/29 | Lecture | Host and parasite diversity |  |
| 1/30 | Discussion | Lafferty and Kuris. 2009, Trends in Parasitology, 25:564-572 |  |
| 1/31 | Lab #3 | Introduction to ecological models | Lab #2 |
| 2/5 | Lecture | Parasite transmission |  |
| 2/6 | Discussion | de Castro and Bolker 2005. Ecology Letters 8:117-126 |  |
| 2/7 | Lab #4 | Modeling parasite transmission I | Lab #3 |
| 2/12 | Lecture | Population ecology of disease I - Foundations |  |
| 2/13 | Discussion | Ryder et al. 2005, PNAS. 102:15140-15143 |  |
| 2/14 | Lab #5 | Modeling parasite transmission II | Lab #4 |
| 2/19 | Lecture | Population ecology of disease II – Control |  |
| 2/20 | Discussion | Hudson et al. 1998. Science. 282:2256-2258 |  |
| 2/21 | Lab #6 | Culling and vaccination | Lab #5 |
| 2/26 | Lecture | Population ecology of disease III – Environmental drivers |  |
| 2/27 | Discussion | Rohr et al. 2008. Nature. 455:1235-1239 |  |
| 2/28 | Lab #7 | Seasonal epidemics | Lab #6 |
| 3/5 | Lecture | Community ecology of disease – Competitors & Predators  |  |
| 3/6 | Discussion | Strauss et al. 2015 Ecology Letters 18:916-926 |  |
| 3/7 | Lab #8 | Host-parasite coevolution | Lab #7 |
| Spring Break |
| 3/19 | Lecture | Virulence and defense evolution |  |
| 3/20 | Discussion | Alizon et al. 2009. J. Evolutionary Biology 22: 245–259 |  |
| 3/21 | Exam | Midterm Exam |  |
| 3/26 | Lecture | Movement, aggregation, and contact networks |  |
| 3/27 | Discussion | Hamede et al. 2009. Ecology Letters. 12: 1147-1157 |  |
| 3/28 | Lab #9 | Transmission networks | Lab #8 |
| 4/2 | Lecture | Zoonoses, spillover, emergence, and One Health  |  |
| 4/3 | Discussion | Morens and Fauci. 2013. PLoS Pathogens e1003467 |  |
| 4/4 | Lab #10 | Final project – brainstorming | Lab #9 |
| 4/9 | Lecture | Ecosystem ecology of disease |  |
| 4/10 | Discussion | Suttle 2007. Nature Reviews Microbiology. 5: 801–812 |  |
| 4/11 | Lab #11 | Final project – peer feedback | Proposal |
| 4/16 | Lecture | Genetics and genomics for EEID |  |
| 4/17 | Discussion | Nkhoma et al. 2013. Molecular Ecology. 22:273-285 |  |
| 4/18 | Lab #13 | Final project | Final project |
| 4/23 | Talks | Final project presentations |  |
| 4/24 | Talks | Final project presentations |  |
| 4/25 | Talks | Final project presentations |  |

**Assessment and grade breakdown**

Students will be assessed as follows:

* Lab assignments (5% each, 45% total)
* Discussion leadership (10%)
* Discussion participation (5%)
* Midterm exam (10%)
* Final project proposal (5%)
* Final project report (20%)
* Final project presentation (5%)

Letter grades in this class are assigned as follows:

|  |  |
| --- | --- |
| Grade percentage | Letter grade |
| 93.3 < x ≤ 100 | A |
| 90.0 < x ≤ 93.3 | A- |
| 86.6 < x ≤ 90.0 | B+ |
| 83.3 < x ≤ 86.6 | B |
| 80.0 < x ≤ 83.3 | B- |
| 77.6 < x ≤ 80.0 | C+ |
| 73.3 < x ≤ 77.6 | C |
| 70.0 < x ≤ 70.3 | C- |
| 66.6 < x ≤ 70.0 | D+ |
| 63.3 < x ≤ 66.6 | D |
| 0 < x ≤ 63.3 | F |

**Course assignment details**

Lab assignments: Students will complete computational assignments focusing on the data analysis, conceptual thinking, and mathematical theory behind our understanding of parasite transmission and disease outbreaks. Portions of these assignments will be completed during the lab. Each assignment will contain sections to be completed by the student during or after the lab. Students can work collaboratively on these projects, but each student must submit their own work independently. These assignments will involve programming in the R Statistical Computing language, which is available freely at [www.r-project.org](http://www.r-project.org). Students may work on their own laptops or use desktop computers in the computer lab.

Group discussion and leadership: Scientists must learn to effectively read, communicate, and critique other research. Therefore, each Wednesday we will discuss a recent scientific article that focuses on an important facet of disease ecology. All students must read the assigned paper prior to the discussion session. Students will work in groups of 2-3 to act as discussion leaders once during the semester. Discussion leaders will give a short summary of the article (10-15 minutes, using PowerPoint or a similar program) and provide several questions and/or activities for the class to discuss. Discussion leader grades will be based on four components: your accurate summary of the assigned paper, additional insightful information that you present (such as background on the study system, pictures of organisms, or an activity that might demonstrate a key concept), the quality and conceptual depth of your discussion questions/activities, and your demonstrated effort to sustain discussion for the entire class period. Students are encouraged to arrange to meet with me at least 2 days before discussion, if needed. Students will be able to sign up for open leadership spots at the beginning of the semester. All students are expected to participate in all discussion sessions.

Final project: Each student will identify an interesting question or problem related to the ecology of infectious disease and apply or extend the approaches from the analytical lab to explore the problem. Students will write a two page, single-spaced (not including citations) report that includes the background, significance, and motivation for the study, a figure that graphically represents the concept under study (In most cases, this will include three panels (1) a community module diagram, (2) a verbal description of the model processes in each equation, and (3) the equations themselves), a mathematical and narrative explanation of the approach used, results, and conclusions. An example report and a checklist will be uploaded to the Canvas website for the course.

Final project presentation: Each student will present a 5 minute, 5 slide “Lightning Talk” on their final project. Each presentation should cover the following aspects of the project: a) the research question/hypothesis, b) relevant background, motivation or significance [basically why this is interesting], c) the research methods (possibly a module diagram or a diagram of your experimental design), d) the results of your simulation or experiment, and e) the significance and interpretation of these results with respect to your research question or hypothesis. Presentation grades will depend on appropriate use of time, the scientific quality of the research content, and the clear, accurate and complete description of the content in sections a-e.

**Late assignments**

There will be a 25% penalty for assignments submitted less than one week late. Assignments submitted more than one week after their due dates will not be accepted.

**Writing and ESL Support for Emory College of Arts and Sciences Students**

Tutors in the Emory Writing Center and the ESL Program are available to support Emory College students as they work on any type of writing assignment, at any stage of the composing process. Tutors can assist with a range of projects, from traditional papers and presentations to websites and other multimedia projects. Writing Center and ESL tutors take a similar approach as they work with students on concerns including idea development, structure, use of sources, grammar, and word choice. They do not proofread for students. Instead, they discuss strategies and resources students can use as they write, revise, and edit their own work. Students who are non-native speakers of English are welcome to visit either Writing Center tutors or ESL tutors. All other students in the college should see Writing Center tutors. Learn more, view hours, and make appointments by visiting the websites of the [ESL Program](http://college.emory.edu/oue/current-students/international-students/esl-program.html) and the [Writing Center](http://writingcenter.emory.edu/). Please review the Writing Center’s [tutoring policies](http://www.writingcenter.emory.edu/about_us/policies.html) before your visit.

**Office for Undergraduate Education – Additional Information for Syllabus**

The Office for Undergraduate Education provides additional information that is applicable to all syllabi and courses. This document contains information on important dates, academic advising, accessibility, and support services, attendance policies, the honor code, and the writing center and ESL program. This document is updated regularly and the most recent version can be downloaded from the following link:

Full text: <http://college.emory.edu/oue/documents/faculty-documents/OUE-Syllabus-Add.pdf>

**Honor Code**

*The Honor Code is in effect throughout the semester. By taking this course, you affirm that it is a violation of the code to cheat on exams, to plagiarize, to deviate from the teacher's instructions about collaboration on work that is submitted for grades, to give false information to a faculty member, and to undertake any other form of academic misconduct. You agree that the instructor is entitled to move you to another seat during examinations, without explanation. You also affirm that if you witness others violating the code you have a duty to report them to the honor council.*

Full text of honor code: <http://catalog.college.emory.edu/academic/policies-regulations/honor-code.html>