

Fall 2020

BIOL 368-H01: Ecology & Evolution of Disease

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BIOL368H01-ECOLOGY & EVOLUTION OF DISEASE - HONORS



BIOL 368 (NJIT) and 28:120:368 (Rutgers) — Fall 2020

3 Credits

About the Course

Overview

Ecology and Evolution of Disease addresses those aspects of ecology and evolutionary biology most relevant to understanding the origin, dynamics and treatment of disease (both infectious and hereditary/genetic). It is particularly recommended for pre-health students, including those in the Accelerated Programs, and serves as an introduction to the science behind public health. As well as basic biology, material covered will include aspects of human behavior, as well as some mathematical models.

The course follows a 'flipped' model, with class time devoted to discussion as well as group and individual activities intended to reinforce the basic material. This is no different when the course is offered online.

This course is taught at an advanced level, and assumes you have learned *and retained* knowledge about fundamental evolutionary and ecological processes. Without this background, you will struggle to do well.

Content learning goals

After taking this course, students will

1. Understand the evolutionary factors driving or influencing a variety of non-infectious ailments (such as obesity, heart disease).
2. Understand the ecological *and* evolutionary factors driving or influencing infectious diseases (such

- as cholera, malaria, or HIV).
3. Understand how failing to take into account evolutionary and ecological principles when addressing disease can have unfortunate consequences (e.g., antibiotic resistance, virulent 'super-bugs' etc.).
 4. Understand the basis and evidence for 'germ theory', which posits that a number of diseases traditionally thought of as non-infectious may, in fact, be caused by cryptic infectious agents.
 5. Understand the multi-disciplinary teamwork required in the field public health.

Skill learning goals

After taking this course, students will

1. Be proficient at reading and extracting the important data and conclusions from scientific publications.
2. Be able to summarize the message of a scientific publication in a few sentences.
3. Be able to recognize and 'read' simple mathematical models of infectious disease.
4. **New for 2020 — Be able to code simple mathematical models of infectious disease and examine their behavior.**

Logistics

Schedule

Class meets Tuesday and Thursday, 11:00 to 12:20, online. You must attend class *and log on at the right time.*

Contact details

- Instructor: Gareth J. Russell
- E-mail: russell@njit.edu
- Phone: N/A
- Office Hours: Tuesday and Thursday, 12:30pm – 2:00pm (after class), or by appointment. *Let me know by the end of class if you are going to the following office hour.*
- Office Hours Location: <https://njit.webex.com/meet/russell> [_ \(https://njit.webex.com/meet/russell\)](https://njit.webex.com/meet/russell)

Prerequisites

Foundations of Ecology and Evolution is **required**. (General Biology, or Concepts in Biology, are not sufficient on their own.) An upper level ecology or evolution course is **recommended**. I will also

assume that you know the basics of cell biology and genetics, so Foundations of Cell and Molecular Biology (or equivalent) is also recommended, as is a basic ability in algebra so that model formulations can be followed. There will be a *graded* pre-requisite test about 2 weeks into the semester.

Textbooks

There are two *required* textbooks. They are in the NJIT bookstore.

- *Evolutionary Medicine* by Stephen C. Stearns and Ruslan Medzhitov. ISBN 978-1-60535-260-2
- *Plague Time* by Paul Ewald. ISBN 0385721846. (Note that there are two editions of this book, with different subtitles. The only other difference is in the Foreword — the one subtitled “The New Germ Theory of Disease” has an updated forward that mentions a few case studies that occurred after the original version. If you have the other version, don’t worry.)

The following book is not required, but it is one of the foundations of the field, and you might also find it helpful. It's not expensive: you can get it for about \$10 on Amazon.

- *Why We Get Sick* by Randolph M. Nesse and George C. Williams. ISBN 0679746749.

How the class works

This is a flipped class, which means that basic information gathering happens outside of live class time. Live class time is a mixture of discussion and other activities intended to reinforce the material. You should think of class time like you would a review session before an exam, or perhaps as office hours. It is when *you* guide the discussion to get your questions answered.

The basic structure of a week

The main topics of the class are organized around weeks, but because this is a flipped course, the definition of a 'week' is this:

A week starts immediately after a Thursday class and runs to the end of the class the following Thursday.

Thus most of the time in a 'week' is *before* the live classes. In this time you will read the material and make notes, and in particular develop and post questions (due before Tuesday's class). You will also think about 'prompter' questions posted by me beforehand. Tuesday's live discussion will be based around my prompter questions, and Thursday's live discussion around *your* questions (I will copy a selection of your questions to the discussion boards: that way they will be anonymous).

So, each live class in each week will have a whole class discussion, and most classes will also have a small-group discussions or other activities using breakout rooms. The remainder of the live class

a small group discussions or other activities using breakout rooms. The remainder of the live class time will be spent in some combination of looking at case studies that illustrate the topic at hand, live coding demonstrations and reviewing any relevant news articles that have appeared in the last week. The details will be in the detailed schedule, which is a separate document.

Grading breakdown

Graded components of the course are as follows:

Component	Grade percentage
Prerequisite quiz	5%
Participation	30%
Coding	10%
Personal essay	5%
Assessment 1	20%
Assessment 2	20%
Assessment 3	10%
TOTAL	100%

The final letter grades will be based on the standard NJIT percentage intervals.

Notes on grade elements

Prerequisite quiz

At the end of the second week or beginning of the third week, there will be a short quiz on various prerequisite topics. You will be given a listing of topics on the first day of class. These are all things which you should recall from Foundations of Ecology and Evolution, and to some extent also Concepts in Biology (or a General Biology course if you are a transfer student) and high school biology. Getting back up to speed on this material right away will let us explore more interesting topics later.

Participation

Please note that this is a flipped course, so participation in class activities is essential. This participation is worth 36% of your grade, and is assessed in three roughly equal ways: 1) Submitting discussion questions based on the reading you must do before each class; 2) Posting responses to these questions on the Canvas discussion boards, and 3) Participating live in small group discussions using Zoom breakout rooms.

Coding

This is somewhat experimental — being online rather than face-to-face actually makes this a bit easier. Normally we would have a class section devoted to simple epidemiological models, in which I would present them and then demonstrate dynamics using small computer programs. However, given that COVID-19 is looming large in our lives, and that a familiarity with programming concepts is useful in many walks of life, I have decided to see if *you* can do some of this yourselves. We will take it step by step and see how it goes. You might even like it!

Personal essay

As most of you are hoping to enter a health-related profession, I usually ask students to write about how the things they have learned in the course have impacted their thinking about their future. This year, in the midst of a global COVID-19 pandemic, I want you to write about how *that* has impacted you and your vision of your future. (Of course, you should still bring to bear the insights you have hopefully obtained from the course.)

The assessments

There will be three major assessments, playing the traditional role of exams. I have not yet decided exactly what these will look like, but they will likely be open-book assignments that you can complete over an extended period. The deadlines are in the schedule document. The third assessment will be shorter (and worth fewer points) than the other two, and there will be no assessment during the final exam period.

Online lectures

The Evolutionary Medicine textbook is your primary resource for most of the course content, and I expect you to read it. Please don't complain to me that it is a lot of reading — if you are going into any kind of health career, you will soon be reading *way* more than this. I will not be doing 'traditional' lecturing, either live or pre-recorded. But, if you want to listen to someone slowly give a bullet-point summary of the textbook, you are in luck: one of the authors, Stephen Stearns, **[has posted such lectures online](https://www.youtube.com/playlist?list=PLh9mgdi4rNezvm7QkQ_PiadoAWqfa2L0)** (https://www.youtube.com/playlist?list=PLh9mgdi4rNezvm7QkQ_PiadoAWqfa2L0). Feel free to use these to supplement — not replace — your reading. I give you fair warning though: he is a great scientist, but he is *not* a dynamic lecturer.

Other links and media

Links to external media are **[now on their own page](#)**, which conveniently allows some kinds of videos to be embedded. There will also be at least one non-public video in the Media Gallery.

Current events

Keep an eye on the news and post any interesting articles related to the course. There will be plenty to find!

Detailed schedule

This is a [separate PDF document](#) ↓

(https://njit.instructure.com/courses/13023/files/1434856/download?download_frd=1) . Note that it will be updated as the semester goes along.

Academic integrity

Academic integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at:

<http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf>

(<http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf>).

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. **Violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action.** This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at [dos@njit.edu \(mailto:dos@njit.edu\)](mailto:dos@njit.edu).