

# BIOL668001-Evolutionary Medicine



Fall 2022

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## About the Course

### Overview

Evolutionary Medicine 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, as it 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 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 evolutionary *and* ecological factors driving or influencing infectious diseases (such as cholera, malaria, HIV or COVID-19).
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 'new 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. Be able to code simple mathematical models of infectious disease and examine their behavior.

## Logistics

### Schedule

Class meets Tuesday and Thursday, 11:30 to 12:50, in person in CKB 220 (**note: this is a room change from the original classroom**). You *must* attend class.

### Contact details

- Instructor: Gareth J. Russell
- E-mail: russell@njit.edu
- Phone: 973 596 6412 (but e-mail is better).
- Office Hours: Tuesday and Thursday, 1pm–2pm (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: CKB 377D, in the Biology office suite.

### Prerequisites

**An undergraduate background that includes study of evolution and ecology is assumed. Upper level coursework is strongly recommended.** I will also assume that you know the basics of cell biology and genetics, and have a basic ability in algebra so that model formulations can be followed. There will be a *graded* pre-requisite test at the beginning of the semester.

### Textbooks

There are two *required* textbooks. They should be 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 Foreward — 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, almost every live class in each week will have a whole class discussion, and many classes will also have a small-group discussions or other activities. 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 daily schedule, which is a separate document.**

## Grading breakdown

Graded components of the course are as follows:

Component	Grade percentage
Prerequisite quiz	5%

Participation (being in class)	15%
Participation (contributing to class)	15%
Term paper	35%
Viva 1	15%
Viva 2	15%
TOTAL	100%

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

## Notes on grade elements

### Prerequisite Quiz

On the first day of class you will be given a take-home pre-requisite quiz, covering basic topics in ecology, evolution and basic algebra you should have covered in earlier classes (Foundations of Ecology and Evolution, Concepts in Biology, General Biology) or, in the case of the algebra, high school. You have two weeks to score 90% in this quiz. You can make multiple attempts if you turn it in before the two weeks are up. Once you cross the 90% threshold, you will get 100% of the points. If you don't reach 90% by the deadline, you will score 0%.

Getting back up to speed on this material right away will let us explore more interesting topics.

### Participation

Please note that this is a flipped course, so participation in class activities is essential. This participation is worth 30% of your grade, and is assessed in two ways: 1) Coming to class, and 2) Contributing to class. Coming to class is assessed straightforwardly. Excused absences are fine, of course. Contributing means asking questions, volunteering answers, and generally participating actively in our discussions and other activities. If you do that, you will get all the points. If you don't, I will give you a warning early on that your participation points are at risk. After that it's up to you.

### Term Paper

Your term paper will be on a topic of your choosing. It should be one in which there have been recent developments in our understanding of how evolution or ecology helps understand, and perhaps even treat, a particular disease. You will write in the style of a short scientific review article, with citations.

### Viva Exams

That's right: we are going to have two viva (i.e., live, on-on-one) exams. They might sound scary, but they are actually not. (Or so I am told by students in previous classes where I used them.) One will be

a 'mid-term' and one will be the 'final exam.' I will explain how they will work in class, and you will get to pick a time that works for you within the space of about a week.

## 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_PioadoAWqfa2L0) ([https://www.youtube.com/playlist?list=PLh9mgdi4rNezvm7QkQ\\_PioadoAWqfa2L0](https://www.youtube.com/playlist?list=PLh9mgdi4rNezvm7QkQ_PioadoAWqfa2L0)). 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 is another [page with links to interesting articles](#). There will also be at least one non-public video in the Media Gallery.

## Current events

Keep an eye on the news and bring up any interesting stuff in class. There will be plenty, and not just about COVID!

## Detailed schedule

This is a [separate PDF document](#). Note that the schedule will likely be updated as the semester goes along.

## Important Rules and Policies

- If you miss an exam or other major assignment due to a valid excuse, medical or other, **you need to provide valid and verifiable documentation to the Dean of Students Office and ask them to inform me**. Make-up assignments will be determined on a case-by-case basis.
- 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](#).

<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. Any student found in 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.