

Fall 2023

BIOL 468-H01: Disease Ecology & Evolution

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Recommended Citation

Russell, Gareth, "BIOL 468-H01: Disease Ecology & Evolution" (2023). *Biology Syllabi*. 104.
<https://digitalcommons.njit.edu/bio-syllabi/104>

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BIOL 468/668 (Fall 2023) - Russell_MC



BIOL 468: Disease Ecology and Evolution (Honors)

BIOL 668: Evolutionary Medicine

Fall 2023 Combined Syllabus

About the Course

Overview

Disease Ecology and Evolution 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 FMH 305 (**note: this might change — I will let you know**). 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 (468)

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 strongly 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 in the first two weeks of the semester.

Prerequisites (668)

There are no formal prerequisites for the Master version of the course, but it is assumed that you have an undergraduate degree in biology or a related subject, and have the usual biology coursework, including basic cell and molecular biology, genetics, physiology and evolution. Helpful additions are immunology, and ecology.

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 any '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 (in class)	10%
Participation (posting questions)	15%
Discord article summaries	20%
Essay (468) or term paper (668)	20%
Viva 1	15%
Viva 2	15%
TOTAL	100%

The final letter grades will be based on the standard NJIT percentage intervals. There has never been any need for a curve in this course, so don't expect one.

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 25% of your grade, and is assessed in two ways: 1) Participating in class, and 2) Engaging with the material. Participating in class is assessed straightforwardly. First, you have to show up (excused absences are fine, of course). Second, you are expected to ask questions, volunteering answers, and generally participate 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.

Posted article summaries

During the semester you will be asked to make three posts on the NJIT Biology Discord server, in the #public-health channel. Each will end with a link to a news story or recently published scientific article, but the body of the post will be your summary of the material, written for your audience of other NJIT biology undergrads (most of whom will *not* have taken this course).

Essay (468)

The title of your essay will be: "How an evolutionary biologist thinks about xxx" where xxx is a disease or other medical issue of your choosing. The essay will be written in the style of a popular press magazine article, rather than a scientific paper. This does *not* mean it will be less rigorous than a scientific article: it refers only to the writing style and the expected audience.

Term paper (668)


Your term paper will address a similar topic to the essay, but be longer and in a more technical style, 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). 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](https://njit.instructure.com/courses/31669/pages/media-resources) (<https://njit.instructure.com/courses/31669/pages/media-resources>), which conveniently allows some kinds of videos to be embedded. There is another [page with links to interesting articles](https://njit.instructure.com/courses/31669/pages/ecology-and-evolution-of-disease-books-and-articles) (<https://njit.instructure.com/courses/31669/pages/ecology-and-evolution-of-disease-books-and-articles>). There may also be some non-public videos 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](https://njit.instructure.com/courses/31669/files/5313648?wrap=1) (<https://njit.instructure.com/courses/31669/files/5313648?wrap=1>). 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)  (<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.
- ChatGPT or other similar tools are **not allowed** in this class. Some have argued that technically

proficient writing is separate from creativity and 'thinking', and that ChatGPT etc. simply allows one to shift focus to the creative part. That might be true in the arts and humanities! But the writing in this course *is* technical writing, and until there is proof otherwise, it is writing that most of you will still need to be able to do, at least in the short term. So, you should learn to do it. In fact, I would argue that technical writing is a way of organizing and clarifying your (scientific) thoughts, and so in this context is not separate from 'thinking', but rather essential to it. Will I be able to tell if you are using ChatGPT? Hard to say, but in my experience it's pretty obvious (and there are also detection tools), so if you want to take the risk it's up to you. Just remember that any report of misconduct will be seen by medical and other professional schools.