

**BIOLOGY 368-H01: ECOLOGY & EVOLUTION OF DISEASE HONORS**

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<b>OFFICE HOURS:</b>	M, W: 11:30am - 12:30pm or By Appointment	<b>COURSE SCHEDULE:</b>	M, W: 10:00 - 11:25am, CKB 313

**INTRODUCTION:** **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. While designated Honors, this course is open to all with the necessary background (see the pre-requisites below). However, it 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.

**PREREQUISITES:** Foundations of Ecology and Evolution is **required**. (General Biology or Concepts in Biology is not sufficient). An upper level ecology or evolution course is **recommended**. It will also be assumed 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.

**CREDITS:** 3 ■ **SCHEDULE:** Class meets Monday and Wednesday, 10:00am to 11:25am, in CKB 313 on the [NJIT campus](#). I expect you to attend class *and arrive on time*.

**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, which is one of the foundations of the field, you might also find helpful. You can get it for about \$10 on [amazon.com](http://amazon.com)

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**TEXTBOOKS CONT'D:**

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

**LINKS:** Links to external media are [now on their own page](#). You will also use [Canvas](#) to submit assignments and for other things.

**GRADING & EXAMS:** There will be two exams, a mid-term and a final, and ten short writing assignments. The grading will be as follows:

Component	Percentage
Short writing assignments (total)	20%
Participation in class activities	5%
Prerequisite quiz	5%
Current event postings	5%
'Explainer' writing assignment	25%
Mid-term Exam	20%
Final Exam	20%
<b>Total</b>	<b>100%</b>

**WRITING ASSIGNMENTS**

The idea behind the writing assignments is that you will get better at doing them, and your scores will increase. If you manage to do at least four excellent ones by the end of the semester, you will get the full 'quality' score.

Component	Total
2 points for simply doing each assignment 'adequately.'	12
A quality score for each assignment out of 5, <i>top three scores only count</i>	18
<b>Total</b>	<b>30</b>

\*SCALED TO 20% OF YOUR FINAL GRADE

**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.

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### PARTICIPATION

Please note that this is a flipped course, so participation in class activities is **essential**. You start with all five participation percentage points. If you start being regularly late to class, or missing classes without an acceptable reason, you will start losing points. I will give you a warning if that is about to happen. This is not an arbitrary rule: it is the nature of a flipped class that only the students who come to class will succeed. I want you to succeed, and I hope you want to as well!

### ONLINE POSTINGS

Sometimes you will be asked to put something online, usually some kind of interesting case study you have found in the news or other media.

### CURRENT EVENT POSTINGS

You will be asked to keep an eye on the news and post any interesting articles related to the course. There will be plenty to find.

'Explainer' writing assignment

The class is going to write a 'Conservation Reader' — a single document with chapters on certain 'of the moment' topics in public health. They will be written in the style of a quality magazine article (think *Time*).

### SYLLABUS

- **Important Note: The syllabus is different every time the course is taught!** Some the details may change even as the semester progresses. The reason is that there is usually some emergent infectious disease in the news that we can use as an overall case study. Last year it was zika virus. Before that it was ebola. What is it this year? The syllabus below provides a general outline of topics, but the specifics and timings may still change. Check back [here](#) regularly for updates.
- Textbook readings are identified as "EM" (Evolutionary Medicine) and "PT" (Plague Time). Other readings are provided as PDF files — click on the name to download each one.
- **A week is defined (here and on [Canvas](#)) as being from the Thursday prior to the classes, to the Wednesday when the second class meets.** That is because you should read the Chapter pertaining to that week's topic *before the first class on Monday*.

### Learning goals

#### 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.).

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### Content learning goals cont'd

- 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.
- Understand the multi-disciplinary teamwork required in the field public health.

### Skill learning goals

After taking this course, students will

- Be proficient at reading and extracting the important data and conclusions from scientific publications.
- Be able to summarize the message of a scientific publication in a few sentences.
- Be able to recognize and 'read' simple mathematical models of infectious disease.

### COURSE OUTLINE:

#### WEEK 1 (WED ONLY): INTRODUCTION TO THE COURSE.

**CONTENT:** Class introduction and logistics — Prerequisites (importance and quiz) — Discussion of need for the course — Discussion of writing, and writing assignments — The Reader — Discussion of notes, and note-taking.

**CLASS ACTIVITIES:** Watch beginning of Dawkins lecture while making notes — In small groups, compare note-taking strategies and discuss — In a group, write 250 word 'abstract' summarizing lecture — Discussion of levels of explanation.

**ASSIGNMENTS:** Get the textbooks!

- Read EM Chapter 1 *before Monday's class*. Write notes and questions to bring to class.
- Find your notes and other materials from Foundations of Ecology and Evolution. Make a study plan for the prerequisite topics.

#### WEEK 2: (RE-)INTRODUCTION TO EVOLUTIONARY THINKING

**CONTENT:** Natural selection, neutral evolution, random change, mismatch and adaptation — Styles of thought.

**CLASS ACTIVITY:** Review of EM Chapter 1 — Countering examples of bad evolutionary thinking.

**ASSIGNMENTS:** Study for pre-requisite quiz. Read EM Chapter 2. Write notes and questions

#### WEEK 3: PRE-REQUISITE QUIZ (MONDAY) — WHAT IS A PATIENT?

**CONTENT:** Pre-requisite quiz — Ancient and recent evolutionary history — The types and origins of human variation — The patient as an ecosystem

**CLASS ACTIVITIES:** Review of EM Chapter 1 — Countering examples of bad evolutionary thinking.

**SUPPLEMENTAL READING:** [Jernberg et al. 2010](#)

#### Week 4: What is a disease?

**Preparation (do in advance):** Read EM Chapter 3

**Supplemental reading:** [Medzhitov et al. 2012](#)

#### Week 5: Defenses

**Preparation (do in advance):** Read EM Chapter 4

**Writing assignment 1 (due Wednesday):** [Chahroudi and Silvestri 2016](#)

### Week 6: Pathogen Evolution

**Preparation:** Read EM Chapter 5

**Writing assignment 2 (due Wednesday):** [Ewald et al. 1998](#)

### Week 7: Pathogen evolution (continued) and review

**PREPARATION:** Study for mid-term. Wednesday is a review session, with topics determined by *you*, so study *before* Wednesday! Use the review to get clarification on topics you don't understand — come with questions.

**Writing assignment:** None

### Week 8: Mid-term exam (Monday) — Cancer

**PREPARATION (DO IN ADVANCE):** Read EM Chapter 6

**Writing assignment 3 (for Wednesday):** [Merlo et al. 2006](#) Cancer as an evolutionary and ecological process. *Nature Reviews Cancer* 6: 924-935.

**Important note:** There is an unsurprising tendency to take the class after a mid-term exam 'off.' Please don't!

### Week 9: Cancer (continued) — Reproductive medicine

**PREPARATION (DO IN ADVANCE):** Read EM Chapter 7

**Writing assignment:** None

### Week 10: Infectious diseases

**PREPARATION (DO IN ADVANCE):** None

**Writing assignment 4 (for Wednesday):** [Jones et al. 2008](#)

### Week 11: Infectious diseases (continued) — Germ theory

**PREPARATION (DO IN ADVANCE):** Read *Plague Time* Chapters 8 through 10 (for Monday), and *Plague Time* Chapter 3 and 7 (for Wednesday)

### Week 12: Germ theory (continued) — Antibiotic resistance and microbial ecology

**Writing assignment 6 (for Wednesday even though there is no class):** [Kodaman et al. 2014](#)

**READING PREPARATION (DO IN ADVANCE):** *Plague Time* Chapters 8 through 10

### Week 13: (Mon only): Antibiotic resistance and microbial ecology (continued)

**READING PREPARATION (DO IN ADVANCE):** *Plague Time* Chapters 11 through 14

### Week 14: Mismatch

**SUPPLEMENTAL READING:** [Koopman et al. 2016](#)

**READING PREPARATION (DO IN ADVANCE):** EM Chapter 8

### Week 15: Open questions and review

**READING PREPARATION (DO IN ADVANCE):** EM Chapter 11

**FINAL EXAM:** TBD

**Russell Lab**

Spatial Ecology and  
Conservation Biology

<https://structuralecology.net/biol-368-syllabus/>