INSTRUCTOR: Prof. Gareth Russell  

PHONE: 973-353-1429

Office Hours: W: 1–3:00pm (after class), Boyden Hall 409  

EMAIL: russell@njit.edu

COURSE SCHEDULE: Class meets M, W: 11:30am-12:55pm in [KUPF 202] on the NJIT CAMPUS

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). The class will be a mixture of lecture and discussion of case studies, including topics of current interest. Material covered will include biology, mathematical models, and some aspects of human behavior.

This course is open to all with the necessary biology background, and is particularly recommended for pre-med students, including those in the Accelerated Programs. It serves as an introduction to the science behind public health.

CREDITS: 3

PREREQUISITES:

Foundations of Cell & Molecular Biology (R120: 201, 202), Foundations of Ecology and Evolution (BIOL 205/206), and Math 111, with grade of C or better. NOTE: Foundations of Ecology and Evolution is required. (General Biology or Concepts in Biology are not sufficient). 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 strongly recommended, as is a basic ability in mathematics so that model formulations can be followed. Calculus I is strongly recommended.

REQUIRED TEXTBOOKS:


GRADING AND EXAMINATIONS:

- There will be two examinations, a mid-term and a final. There will be at least one in-class quiz. The final grade in this course is determined as follows:

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<tr>
<th>COMPONENT</th>
<th>GRADE PERCENTAGE</th>
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<tbody>
<tr>
<td>Quiz</td>
<td>10%</td>
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<tr>
<td>Participation in Class</td>
<td>30%</td>
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<td>Midterm Examination</td>
<td>30%</td>
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<tr>
<td>Final Examination</td>
<td>30%</td>
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- Please note that in-class participation is very important! It means doing the readings, coming to class prepared with notes, questions, and ideas, and engaging in discussion. If you sit in the corner and don’t say anything until asked, or if it transpires that you haven’t done the reading, then you will not do well in this class.

- You will get three scores out of 10, after 5 weeks, 10 weeks, and at the end of the semester. The sum of these will be your participation score. Individual scores greater than 10 are possible if your participation is exceptional, but your final score cannot be greater than 30.

- Attendance is MANDATORY.

EXAMPLE EXAM QUESTION

The mid-term and final exams will be medium- and long-answer form. Here is an example of how a question might be worded. I would expect you to take approximately 15 minutes to answer a question like this:

We have studied two examples of interacting disease pairs: Sickle-cell Anemia/Malaria and Measles/Whooping cough. Compare and contrast the ways in which the diseases within each pair interact. (For example, what aspect of each disease’s life history does the other one influence?)

ACADEMIC INTEGRITY:

This course will strictly adhere to the NJIT Honor Code. There is zero tolerance for violations against NJIT’s University Code on Academic Integrity.
**BIOLOGY 368-H01: ECOLOGY AND EVOLUTION OF DISEASE HONORS**

**Course Outline:** This syllabus is a general outline. Exact timings may change if we go slower or faster than anticipated on some topics. Check back with this page for updates. Textbook readings are identified as "Ewald" or "OKE" (Ostfeld, Keesing and Eviner — see above). Other readings are PDF files—click on the name to download.

<table>
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<tr>
<th>WEEK</th>
<th>TOPICS, CASE STUDIES AND READINGS</th>
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| **Week 1** (W: 9/7 only) | **Introduction:** Overview of examples. Need for understanding. Assessment of student knowledge.  
**Case Study:** Machupo Virus and Acute Hemorrhagic Fever.  
**Readings:** Ewald: Ch 1; OKE: Ch 22, Ch 19 |
| **Week 2** | **Genetic Diseases:** Hardy Weinberg equilibrium. Selection. Persistence of recessive traits.  
**Case Studies:** Sickle-Cell Anemia and Malaria. Tay-Sachs Disease.  
**Readings:** Allison 1954; Koeslag et al. 1984; Class 3 homework |
| **Week 3** | **Simple Disease Models:** SIS, SIR, SEIR, etc. Vaccination strategies.  
**Readings:** Extract from Keeling; Rohani 2008 |
| **Week 4** | **Finish Disease Models:** Review Class 3 homework & material so far. |
| **Week 5** | **QUIZ [Mon. 10/3] on knowledge & math basics.**  
**Symptoms as Defense: Manipulation of the Evolutionary Process:**  
**Case Study:** Cholera.  
**Readings:** Ewald: Ch2; Ewald: Ch5; Ewald et al. 1998 |
| **Week 6** | **Vector-Borne Diseases:** Biodiversity and the dilution effect.  
**Case Study:** Lyme Disease.  
**Readings:** OKE: Ch1; Ewald: Ch3; Keesing et al. 2006  
**Multi-Pathogen Systems:**  
**Case Study:** Measles and Whooping Cough.  
**Readings:** OKE: Ch3 |
| **Week 7** | **Antibiotic Resistance:**  
**Readings:** Ewald: Ch7; Neu 1992; Levy 2001; Enright et al. 2002; Kennedy et al. 2008 (quite technical, read just introduction and conclusions); NYT article on emerging resistance among gram-negative bacteria. |
| **Week 8** | Mon. 10/24: Review of material [Mid-Term notes].  
Wed. 10/26: Midterm Exam |
| **Week 9** | **Emerging Infectious Diseases:** (EIDs). Zoonotic Origins.  
**Readings:** OKE: Ch16, Ch20; Daszak et al. 2000 |
| **Week 10** | **HIV/AIDS:**  
**Readings:** Ewald: Ch8; Article from CNN; Worobey et al. 2008 (paper that the CNN article mentions, about origin of HIV-1 strain — it's short, so try to read what you can); Wertheim and Worobey 2009 (about overall phylogeny of HIV and SIV strains); Pybus and Rambaut 2009 (discussion about within- and between-host evolutionary rates — focus on the box devoted to HIV). NEW — GapMinder HIV Chart and Animation |
## Course Outline Continued:

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<th>WEEK</th>
<th>TOPICS, CASE STUDIES AND READINGS</th>
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<tr>
<td>Week 11</td>
<td><strong>HIV/AIDS:</strong>&lt;br&gt;Readings: Ewald: Ch9; Ariën et al 2005 (just the introduction and conclusions); Quiñones-Mateu 2005 (this is a commentary on Ariën et al); Herbeck et al 2008 (the latest on the evolution of virulence); Optional readings: Lipsitch and Nowak 1995 (a quite simple model of an HIV-like disease); Nathan Wolfe video from ted.com (see above).</td>
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<td>Week 12</td>
<td><strong>HIV/AIDS:</strong> Cancer as an ecological and evolutionary process within the body. Transmissible cancer.&lt;br&gt;<strong>Case Studies:</strong> Chronic myeloid leukemia (CML) and cervical cancer/human papilloma virus (HPV)&lt;br&gt;Readings: Merlo et al. 2006; Abbot and Michor 2006 (optional).</td>
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<td>Week 13</td>
<td><strong>Viral-caused cancer and virus therapies: The consequences of climate change for disease:</strong>&lt;br&gt;Readings: Baseman &amp; Koutsky 2005; Parato et al. 2005; Woodman et al. 2007; Patz et al. 2005; Frumin et al. 2008; Optional reading: Duelli et al. 2007</td>
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<td>Week 14</td>
<td><strong>Recent advances in HIV study.</strong>&lt;br&gt;Readings: New York Times on new policy in South Africa; Esquire on HIV in Africa (work of Emily Oster); Oster 2005 (original paper). Video: Emily Oster on TED.&lt;br&gt;<strong>Recent advances in cancer study.</strong>&lt;br&gt;Readings: Foo and Michor 2009 (original paper on chemotherapy dosing schedules); Attolini and Michor 2009 (overview of the evolutionary theory of cancer). Slideshow: RNAi basics. Esquire on RNAi (much hype); Robinson 2004 (problems with developing RNAi therapies). Website about RNAi, including difficulties. Berkhout and ter Brake 2010 (book chapter available on Google books. Video: David Agus on TED.</td>
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<td>Week 15 (M: 12/12)</td>
<td><strong>Wrap-up and review.</strong>&lt;br&gt;Readings: <strong>OKE:</strong> Ch21, all of Part IV; <strong>Ewald:</strong> Ch11.</td>
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<td>Epilogue</td>
<td>If you feel like it, watch the TED Video featuring Susan Blackmore talking about memes, and ask yourself whether what we have learned in this course might apply to cultural transmission. Are there pathological ideas?</td>
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<td><strong>FINALS</strong></td>
<td><strong>FINAL EXAM WEEK: DECEMBER 14-20, 2011</strong></td>
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