Biology 15: Genetic Variation and Evolution  
Winter 2018  
*Mon, Wed, Fri 11:30-12:35; X-hour, Tue 12:15-13:05*  
Life Sciences Center (LSC) 105  

*Laboratory: Wednesday 17:30-21:30*  
Life Sciences Center (LSC) 102

**Instructor:**  
Olga Zhaxybayeva (aka Professor Z.)  
**Office:** LSC 333  
**Phone:** 603-646-8616  
**Email:** OlgaZh@dartmouth.edu  
(expected response time is up to 24-48 hours)  
**Office Hours:** To be announced weekly via Canvas

**Laboratory Coordinator**  
Craig Layne (Craig.D.Layne@Dartmouth.edu)

**Teaching Assistants**  
Anne Farrell (Anne.A.Farrell.GR@dartmouth.edu)  
Keith Fritschie (Keith.J.Fritschie.GR@Dartmouth.edu)

**Course Description**  
The overall goal of the course is to understand relevance of evolution to all of biology and to real-world problems. To achieve this goal we will study fundamental processes and mechanisms of evolution on a population level that give rise to variation and diversity of living organisms. We will examine the source and distribution of phenotypic and genotypic variation in nature; the forces that act on genetic variation (mutation, migration, selection, drift); and the genetic basis of adaptation, speciation, phenotypic plasticity and social interactions. Throughout the course we will exemplify the topics with data on natural populations, emphasizing humans and their microbial commensals and pathogens. For in-depth understanding of the material, lectures will be combined with problem-solving sessions, discussions of scientific papers, and a weekly laboratory. Laboratory sessions will be a mix of experimental evolution, observational data analyses and computer-based evolutionary inferences.

**Learning Objectives**  
At the end of the class you will be able to:  
- Reconstruct evolutionary relationships among organisms using phenotypic and molecular data.  
- Recognize evolutionary forces acting on natural populations, and evaluate their impact.  
- Interpret biological phenomena in an evolutionary context.
Additionally, via activities in this course, you will...

- Become a creative problem solver (in-class and take-home problem solving)
- Learn to efficiently read primary literature (in-class and lab activities)
- Learn to communicate to scientific and layperson audience (lab report and popular press article)
- Learn how to design and carry out an experiment (lab activities)
- Learn how to model a process (lecture, lab and in-class activities)
- Learn how to make an effective research poster and how to present it (lab activity)

Reading Materials:

Textbook:

  (a hard copy is available on Library Reserves, Dana Library)
  (available as a PDF file via Canvas, courtesy of the publisher)

Additional Texts on Library Reserves (Dana Library, 2 hr. loan):

- Jonathan Losos (ed.), *In the Light of Evolution: Essays from the Laboratory and Field*.
- Roberto Kolter and Stanley Maloy (eds.), *Microbes and evolution: The world that Darwin never saw*.

Occasional extra materials for specific class periods will be made available via Canvas.

Other Course Materials:

As term progresses, the following types of materials will be shared with you via Canvas (http://canvas.dartmouth.edu):

- Pre-lecture videos and associated PowerPoint slides
- Pre-lecture quizzes
- PowerPoint slides and notes for material covered during class periods
- Problem sets and answer keys
- Echo360 class recordings
- Laboratory materials and assignments
- Suggestions for further reading
Expectations

Here is what we expect from you:

(1) to critically read and watch the assigned material before class,
(2) to reflect on the assigned material via ungraded pre-lecture quizzes,
(3) to enthusiastically participate in class discussions and problem-solving sessions,
(4) to diligently prepare for all exams,
(5) to engage in laboratory activities and thoughtfully compose laboratory reports.

Cell Phones: Cell phone use during the class could be extremely distracting to many students. Please be sure your cell phone is turned off before class starts.

Laptops: We will occasionally use computer simulations as in-class exercises. I will prompt you to bring the laptops to those class periods. You are welcome to use laptops for taking notes. However, note that multi-tasking with the laptop (such as checking e-mail or Facebook, making online purchases, reading blogs, watching a ball game, etc.) will distracts you (and, more importantly, students who sit next to you) from participating fully during class and therefore will interfere with learning.

You can expect your professor, laboratory coordinator, and TAs to:

(1) Bring expertise into the classroom.
(2) Stimulate interest in the course material.
(3) Provide consultations during the hands-on activities and be available to answer questions.
(4) Return graded assignments promptly.

Evaluation

No memorization is required for this class. You will be allowed to compose and bring an "information sheet" to the exams (a 8.5 x 11" sheet of paper with formulas etc.)

Midterm exams will take place on Tuesday, January 23 and Tuesday, February 13 at 6:00PM. The midterm exams are not timed, and most students complete them in ~ 2 hours. Final exam will take place on March 9 from 8:00 to 11:00AM.

If you require special/alternative arrangements for the exams, please let me know ASAP (and not later than two weeks prior to each exam.)

Exam #1 25%
Exam #2 25%
Final 25%
Lab 20%
Participation 5%
- Ungraded pre-lecture quizzes and surveys
- Active participation in the in-class discussions and problem solving
Academic Honor

The Dartmouth Honor Principle applies to all work you submit for a grade in this course. That is, the reports you turn in must be your own unless the assignment has been explicitly identified as a group activity by the professor. All computer output that you turn in should be created, typed, documented, and generated by you. During the in-class activities, you may consult freely with others while designing analyses, running analyses, and drawing conclusions, but you should generate your own output, including the write-up, and answer activities’ questions on your own. Any copying of another person’s report, in whole or in part, is a violation of the Honor Principle. For more information, go to http://www.dartmouth.edu/~reg/regulations/undergrad/acad-honor.html.

Additional Support for your Learning

Academic Skills Center (http://www.dartmouth.edu/~acskills/)
The Academic Skills Center is open to the entire Dartmouth Community. Here are some common reasons why you might visit the ASC:

• You don't feel comfortable talking in class
• You're attending class regularly but you feel like you're missing important points
• You feel like you're a slow reader
• You're having trouble completing tests in the allotted time
• You're spending hours studying for foreign language but still not “getting it”
• You feel like you don't have enough time to get everything done
• You're not sure how to take notes
• You want to sign up for a tutor or study group
• You're not sure if you should get tested for a learning disability

The Research Center for Writing, and Information Technology (RWiT) (http://www.dartmouth.edu/~rwit/)
The Student Center for Research, Writing, and Information Technology (RWiT) is a place where you can meet with an undergraduate tutor to discuss a paper, research project, or multi-media assignment. The RWiT tutors are trained to help you at any phase of your process. Whether you are brainstorming or planning, drafting or structuring, tweaking or polishing, the RWiT tutors can provide feedback that will help you to create final products of which you can be proud.

Student Needs and Wellness

Students who may need disability-related classroom accommodations are encouraged to make an appointment to see me before the end of the second week of the term. All discussions will remain confidential, although the Student Accessibility Services office may be consulted to discuss appropriate implementation of any accommodation requested. Student Accessibility Services (http://www.dartmouth.edu/~accessibility/facstaff/).

I recognize that the academic environment at Dartmouth is challenging, that our terms are intensive, and that classes are not the only demanding part of your life. A number of
on-campus resources is available to you to support your wellness, including your undergraduate dean (http://www.dartmouth.edu/~upperde/), Counseling and Human Development (http://www.dartmouth.edu/~chd/), and the Student Wellness Center (http://www.dartmouth.edu/~healthed/). I encourage you to use these resources to take care of yourself throughout the term.

**Course Topics Broad Overview**

*Class-by-class details are posted to Canvas.*

- What is evolution. How evolution works
- Inference of evolutionary histories of genes and organisms. Human Evolution
- Mutation as a source of genetic variation. Human genetic variation
- Mendelian inheritance of traits. Modeling dynamics of allele frequencies in a population
- Evolutionary forces that shape genetic composition of populations
- Evolution of complex traits that are determined by multiple genes and are influenced by environment
- Adaptation and adaptationism
- Evolution of cooperation
- Implications of evolution for human health. Human-pathogen co-evolution
- Use of human genomic data for tracking human migration, inferring selection, and associating genes with traits and diseases
## Laboratory Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
<th>Assessment Item</th>
<th>% of Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 January</td>
<td><strong>Phylogenetics of Tetrapods</strong></td>
<td>Data Analysis &amp; Report</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Trees, Branches, Nodes, and Clades</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 January</td>
<td><strong>Adaptation in Bean Beetles</strong></td>
<td>Research &amp; Poster Presentation</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Background and Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Experimental Implementation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 January</td>
<td>More Phylogenetics of Tetrapods</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inferences from Nucleotide Sequences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 January</td>
<td><strong>Selection in Goldenrod Galls</strong></td>
<td>Written Scientific Report</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Gall and Inhabitants Measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Processing, Analyses, and Results</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communicating Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 January</td>
<td>More Bean Beetles</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Collection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 February</td>
<td>Even More Bean Beetles</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Processing, Analyses, and Results</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communicating Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 February</td>
<td><strong>Evolution of Wrinkly Spreaders</strong></td>
<td>Popular Press Article</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Background and Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Experimental Implementation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 February</td>
<td>More Wrinkly Spreaders</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Collection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 February</td>
<td>Even More Wrinkly Spreaders</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Processing, Analyses, and Results</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communicating Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 March</td>
<td>No Lab</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Details about lab activities, assessment items, due dates, etc. will be discussed in lab.