

**Biology 15: Genetic Variation and Evolution**  
Winter 2017  
*Mon, Wed, Fri 11:30-12:35; X-hour, Tue 12:15-13:05*  
Life Sciences Center (LSC) 105

**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

**Teaching Assistants**

Anne Farrell (*Anne.A.Farrell.GR@dartmouth.edu*)

Flora Krivak-Tetley (*Flora.E.Krivak-Tetley.GR@Dartmouth.edu*)

**Laboratories**

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

We will be offering laboratory sections on Monday (3:30-7:30PM) and Tuesday (2:30-6:30PM) in LSC 102. You will sign up for the lab section on the first day of class, January 4<sup>th</sup>.

**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 and discussions of seminal scientific papers. Laboratories 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 read primary literature efficiently (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:

- Carl Zimmer and Douglas Emlen, *Evolution: Making Sense of Life*, Second edition, Roberts and Co., 2016
- Allison Perkins, Study Guide to accompany *Evolution: Making Sense of Life*. (also available as a PDF file via Canvas, courtesy of the publisher)

### Library Reserves:

- Jon Herron and Scott Freeman, *Evolutionary Analysis*, 5th Edition, Pearson, 2014.
- Jonathan Losos (ed.), *In the Light of Evolution: Essays from the Laboratory and Field*.
- Daniel Hartl and Andrew Clark, *Principles of Population Genetics*, 4th edition.
- Roberto Kolter and Stanley Maloy (eds.), *Microbes and evolution: The world that Darwin never saw*.

Additional materials for specific class periods will be made available via *Canvas*.

## Other Course Materials:

- PowerPoint slides, problem sets, links to relevant popular articles, lecture videos and Echo360 class recordings will be posted onto **Canvas** (<http://canvas.dartmouth.edu>). Use your NetID to access the web site.

- We will use **Piazza (linked from Canvas)** as a place to discuss and clarify concepts, muddiest points and problem sets. The system is highly catered to getting you help fast and efficiently from classmates and teaching staff. I encourage you to post your questions on Piazza instead of emailing them. Note that you can post anonymously!

## **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 distract 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 Wednesday, January 25 and Wednesday, February 15 from 6:00 to 9:00PM. Final Exam will take place on March 11 from 8:00 to 11:00AM.

Exam #1	25%
Exam #2	25%
Final	25%
Lab	20%
Participation	5%
- Pre-lecture Quizzes	
- 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 **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>.

## **Student Needs**

Students with disabilities enrolled in this course and 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/>).

## **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.

## **Course Topics Outline**

**The list is subject to change. Details will be posted to Canvas.**

- What is evolution. How evolution works
- Phylogenetic inference
- Raw material: mutation as a source of variation
- Dynamics of genetic variation in a population
- Null model: Hardy-Weinberg equilibrium
- Natural selection. Mutation-selection balance
- Effects of small populations on genetic variation
- Migration
- Multiple loci. Recombination. Quantitative traits
- Adaptation: From genes to traits
- Speciation
- Co-evolution. Parasitism. Cooperation. Mutualism
- Human evolution and its implications to human health

## Laboratory Schedule

<b>Week of</b>	<b>Activity</b>	<b>Assessment Item (see Canvas for due dates)</b>	<b>% of Score</b>
<b>2 January</b>	No Lab		
<b>9 January</b>	Bean Beetles Adaptation <i>Background and Design</i>	Research & Poster Presentation	8
<b>16 January</b>	Tetrapod Evolution <i>Phylogenetic Inference</i>	Data Analysis & Report	3
<b>23 January</b>	Selection in Goldenrod Galls <i>Gall and Inhabitants Measures</i>	Written Scientific Report	6
<b>30 January</b>	More Bean Beetles <i>Data Collection</i>		
<b>6 February</b>	More Goldenrod galls <i>Analyses and Results</i>		
<b>13 February</b>	Even More Bean Beetles <i>Data Processing, Analyses and Results</i>		
<b>20 February</b>	Wrinkly Spreaders <i>Evolutionary Forces</i>	Popular Press Article	3
<b>27 February</b>	More Wrinkly Spreaders <i>Data Processing, Analyses and Results</i>		
<b>6 March</b>	No Lab		

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