

Biology 15: Genetic Variation and Evolution

Winter 2020

Mon, Wed, Fri 11:30-12:35; X-hour, Tue 12:15-13:05

Life Sciences Center (LSC) 105

Instructor

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Office Hours: To be announced weekly via Canvas

Experiential Learning Facilitator

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Office Hours: To be announced weekly via Canvas

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, chance); the evolution of complex traits determined by multiple genes and environmental conditions; and the genetic basis of adaptation. 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, the course is structured to consist of pre-class videos and quizzes, in class mini-lectures and discussions, in-class problem-solving sessions, and several hands-on activities that include 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
- Learn how to model a process
- Learn how to design and carry out an experiment, and analyze results
- Learn to summarize and communicate your scientific findings

Reading Materials

Textbook:

- Carl Zimmer and Douglas Emlen, *Evolution: Making Sense of Life*, Second edition, Roberts and Co., 2016
(two hard copies are available on Library Reserves, Baker-Berry Library)
- Allison Perkins, Study Guide to accompany *Evolution: Making Sense of Life*.
(available as a PDF file via Canvas, courtesy of the publisher)

Additional Texts on Library Reserves (Baker-Berry Library, 2 hr. loan):

- 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*.
- Carl Bergstrom and Lee Dugatkin, *Evolution*.

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
- Graded assignments and grading rubrics
- Suggestions for further reading

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.
- Mutation as a source of genetic variation. Human genetic variation.
- Inheritance of traits.
- Evolutionary forces that shape genetic composition of populations: Modeling dynamics of allele frequencies in a population.
- Evolution of complex traits that are determined by multiple genes and are influenced by environment.
- Adaptation. Detection of adaptation.
- 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.

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 complete graded assignment thoughtfully and timely.

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 computers for 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, texting, 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, experiential learning facilitator, 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

Exam #1	25% (January 22, 6:00-8:00PM)
Exam #2	25% (February 12, 6:00-8:00PM)
Final Exam	27% (March 10 from 8:00 to 11:00AM)
Graded Assignments	18%

- Tetrapod Evolution and Phylogeny – 4% (due January 28)
- Spirit Bear Evolution (4 quizzes) – 4% (due January 31, February 3, 7, 11)
- Experimental Microbial Evolution – 5% (due February 18)
- Selection in Goldenrod Galls – 5% (due March 3)

Participation **5%**

- Ungraded pre-lecture quizzes and surveys (posted regularly to Canvas)
- Active participation in the in-class discussions and problem solving
- Attendance of classes when data for graded assignments is collected and analyzed

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

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.)

Academic Honor

The Dartmouth Honor Principle applies to all work you submit for a grade in this course. That is, the exams and graded assignments you turn in must be your own unless the assignment has been explicitly identified as a group activity. During the in-class activities, you are encouraged to consult freely with others while designing analyses, running analyses, and drawing conclusions, but you should **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>.

Your Needs and Wellness

If you have questions about whether you need to receive academic adjustments and services, please contact the Student Accessibility Services (SAS) office (Carson Hall, Suite 125, 646-9900; all inquiries and discussions are confidential) as early in the term as possible. Once SAS has authorized services, please come to see me privately and bring with you the originally signed SAS paperwork.

If you have a religious observance that conflicts with your participation in the course, please meet with me before the end of the second week of the term to discuss appropriate accommodations. If you encounter financial challenges related to this class, please let me know.

The academic environment at Dartmouth is challenging, our terms are intensive, and classes are not the only demanding part of your life. There are a number of resources available to you on campus 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.

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.