

Evolution and Population Genetics, BISC 313L, Spring 2016

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Overview:

Evolution is one of the pillars of modern biology. As evolutionary biologist, Theodosius Dobzhansky, put it so elegantly, in the title of his 1973 essay, “Nothing in biology makes sense except in light of evolution.” The same can be said of human biology and medicine. Pathogens, parasites, symbionts, and their victims or hosts evolve. Training in evolutionary thinking enables biologists to understand biological diversity and how organisms adapt and can help biomedical researchers and clinicians to ask useful questions about modern human health and disease that they might not otherwise pose. BISC 313 reviews the diversity of life on Earth, Darwin’s revolutionary explanation of this diversity, as the result of common descent with modification by natural selection, the population genetic mechanisms underlying our current theory of evolution, and how evolutionary thinking in the era of genomic science is advancing our understanding of biology and medicine.

The laboratory section of the course exposes students to the design and analysis of experiments in evolutionary biology and to co-curricular activities outside of the classroom, including trips to local museums, which are rich storehouses of evolutionary lessons, and to the USC Wrigley Marine Science Center on Santa Catalina Island.

Meeting times:

Lec 13034R	11:00 AM – 11:50 AM	MWF	ZHS 163
Lab 13326R	3:30 PM – 5:20 PM	W	ZHS 460
Lab 13328R	2:00 PM – 3:50 PM	Th	ZHS 460
Lab 13327R	9:00 AM – 10:50 AM	F	ZHS 460

Prerequisites:

- BISC 120/121 and BISC 220/221, the first year biology sequence

Recommended preparation includes:

- Familiarity with basic chemistry and physics
- Facility with algebra is recommended.
- BISC 320, Molecular Biology
- BISC 325 Genetics

Content:

- Why study Evolution?
- Evolution at the Molecular level (DNA & Proteins)
- Evolution within Populations (Population Genetics)
- Evolution at the level of species and higher (Macroevolution)
- The processes (how) and patterns (results) of evolution above and below the species level

Text:

Evolution, 3rd Edition. Douglas J. Futuyma. Sinauer Associates, Inc., Publishers. 2013. Additional readings from the primary literature will be assigned on occasion (see Calendar).

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Course Credit (your final grade adds up to 1000 points):

Weekly Quizzes	100 pts. (10%)
Participation	50 pts. (5%)
Midterm Exam	275 pts. (27.5%)
Final Exam	275 pts. (27.5%)
Lab	300 pts. (30%) (2 lab write-ups @ 100 pts. each + worksheets adding to 100 pts.)

Calendar:

Day	Date	Topics	Instructor	Readings (Ch: pp)
Mon	11-Jan	"Nothing makes sense... except in light of evolution"	Rizk	23:631-636, 646-656
Wed	13-Jan	The Triumph of the Darwinian Method	Rizk	1:1-10
Fri	15-Jan	Evolution vs. Genetics and Other Controversies	Rizk	1:10-17
Mon	18-Jan	<i>M.L. King Day - University Holiday</i>		
Wed	20-Jan	Evidence for evolution	Rizk	3:53-63, Box 3A; 23:636-646
Fri	22-Jan	Origins of Life	Rizk	5:103-110
Mon	25-Jan	The Tree of Life: Introduction to Phylogenetics	Rizk	2:19-49; 3:52
Wed	27-Jan	LUCA and the Tree of Life	Rizk	Iwabe et al 1989; Woese 1998
Fri	29-Jan	Diversification of Bacteria and Archaea	Rizk	Woese et al 1990; Pace et al 2012
Mon	1-Feb	Origin and Diversification of Eukaryotes	Rizk	5:108-110; 20:537-564
Wed	3-Feb	Multicellularity and Development	Rizk	5:109; 22:617
Fri	5-Feb	Snowball Earth, Plate Tectonics, & Animal Diversity	Rizk	4:77-83; 5:111-112
Mon	8-Feb	The Invasion of Land by Higher Plants & Animals	Rizk	4:83-90; 5:115-128
Wed	10-Feb	Macroevolution & Extinctions	Rizk	4:95-101; 5:118; 7:161-187; 22:605-614
Fri	12-Feb	The Evolution of Developmental Programs	Rizk	21:565-572, 585-603
Mon	15-Feb	<i>President's Day - University Holiday</i>		
Wed	17-Feb	Gene Regulation & Evolution	Rizk	3:63-76; 21:572-585
Fri	19-Feb	Geography & Evolution	Rizk	6:135-160
Mon	22-Feb	Human Evolution	Rizk	4:90-94; 6:149-152
Wed	24-Feb	Conservation	Rizk	Box 7A; 652
Fri	26-Feb	Discussion & Review	Rizk	
Mon	29-Feb	MID-TERM EXAM		
Wed	2-Mar	Variation: The foundation of evolution	Dean	9
Fri	4-Mar	Variation: The foundation of evolution	Dean	9
Mon	7-Mar	Genetic drift: Evolution at random	Dean	10
Wed	9-Mar	Natural selection and adaptation	Dean	11
Fri	11-Mar	Natural selection and adaptation	Dean	11

Mar 14 - 20: Spring Break

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Day	Date	Topics	Instructor	Readings (Ch: pp)
Mon	21-Mar	The genetic theory of natural selection	Dean	12
Wed	23-Mar	The genetic theory of natural selection	Dean	12
Fri	25-Mar	Phenotypic evolution	Dean	13
Mon	28-Mar	Phenotypic evolution	Dean	13
Wed	30-Mar	The evolution of life histories	Dean	14
Fri	1-Apr	The evolution of life histories	Dean	14
Mon	4-Apr	Sex and reproductive success	Dean	15
Wed	6-Apr	Sex and reproductive success	Dean	15
Fri	8-Apr	Conflict and cooperation	Dean	16
Mon	11-Apr	Conflict and cooperation	Dean	16
Wed	13-Apr	Species	Dean	17
Fri	15-Apr	Species	Dean	17
Mon	18-Apr	Speciation	Dean	18
Wed	20-Apr	The evolution of interactions among species	Dean	19
Fri	22-Apr	The evolution of interactions among species	Dean	19
Mon	25-Apr	Evolution of the domestic dog	Rizk	Handout
Wed	27-Apr	Sexual selection in mice	Dean	Handout
Fri	29-Apr	Synthesis & Review	Instructors	
Wed	4-May	Final Exam: 11 AM – 1:00 PM		

Out of the classroom

Several labs will take place outside the classroom, including trips to the Natural History Museum, the Page Museum, and Catalina Island.

Catalina Island Field Trip

An optional Saturday field trip to USC's Wrigley Marine Science Center on Santa Catalina Island will be arranged. Although optional, this trip will involve hands-on science (i.e., it's fun) and all attendees will have their final grade bumped up one percentage point (i.e., it's extra credit).

Weekly Quizzes

Most weeks, a quiz of 1-3 questions will be given out on Friday. Students must be present to receive credit for quizzes (or contact the professor prior to the beginning of class with an explanation about why the student is unable to attend). Due the following Monday, these take-home quizzes serve two functions: 1) to review material covered in that week's lectures, and 2) to give students an idea of the type of questions that will be on exams.

Participation

This class is meant to be more interactive than lower-level biology courses. Interaction includes asking and responding to questions posed during lecture, field trips, and labs.

Midterm Exam

The midterm exam will cover all material up to and including the lecture on Feb. 26.

Final Exam

Approximately 90% of the final exam will come from lectures given after the midterm. The other 10% will be taken from the material covered by the Midterm.

Lab

Labs will consist of experiments that test fundamental evolutionary and population genetic concepts. There will be two lab write-ups, in the format of a short scientific paper, based on data collected in multi-session experiments on the evolution of multicellularity and mate-choice. Three labs are reserved for guided visits to local museums, which are treasure troves of evidence for evolution. Two labs are devoted to detailed, critical discussions of papers from the primary literature in evolutionary biology. Worksheets that ask questions relating to lab material will be given throughout the semester.

Lab #	Dates	Laboratory Topic	Readings
	Jan 13, 14	No labs this week.	
1	Jan 20, 21	Page Museum	
2	Jan 27, 28	Evolution of Multicellularity I (set-up)	Ratcliff et al. 2012
3	Feb 3, 4	Evolution of Multicellularity II (sample 1)	Ratcliff et al. 2012
4	Feb 10, 11	Evolution of Multicellularity III (sample 2)	Ratcliff et al. 2012
5	Feb 17, 18	Sequence alignments & phylogenetic trees	
6	Feb 24, 25	Journal club	Primary literature TBA
7	Mar 2, 3	Field trip: Natural History Museum (Birds)	Kimball Garrett, Curator
8	Mar 9, 10	"Field work": Mammal prep.	Instructor handout
Mar 14 - 20: Spring Break			
9	Mar 23, 24	Collecting molecular data: DNA sequencing	Instructor handout
10	Mar 30, 31	Analyzing molecular data: Testing for selection	Instructor handout
11	Apr 6, 7	Mate choice experiments I	Instructor handout
12	Apr 13, 14	Mate choice experiments II	Instructor handout
13	Apr 20, 21	Field trip: Natural History Museum (Mammals)	TBD
14	Apr 27, 28	Journal club	Primary literature TBA

Course Policies

Marked improvement through the course of the semester may be taken into account during the determination of final grades. A student who is within a small number of percentage points from a grade break may be bumped from one grade to the next. This policy is solely at the discretion of the Instructors.

The midterm exam will be returned to students. The final examination will not be returned but will be retained for one year by the Instructors.

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Missed Exams. Missed exams will receive a grade of zero unless the student can document a medical or family emergency. An excused missed exam will be given a prorated score based on performance in the rest of the course. A missed final will result in an incomplete.

Regrades. To contest a grade, a student must submit the exam or assignment, along with a written explanation of why the grade was incorrect. Please note that the ENTIRE exam or assignment will be subject to reevaluation and your score may therefore go up, go down or remain the same. Regrade requests must be submitted to the instructor within two weeks of the return of an exam or assignment.

Late assignments. Due dates are written in the schedule. Late assignments will not be accepted.

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *Scampus*, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: <http://www.usc.edu/dept/publications/SCAMPUS/gov/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.