

SYLLABUS

Instructor:	Eric DeChaine	Class time:	MWF 11:30-12:50
Office Hours:	M 1:00-2:00 and by appointment	Location:	CF 225
		Prerequisite:	BIOL 321 - Genetics

Required textbook: Futuyma, D.J. 2005. Evolution. Sinauer Associates, Sunderland, MA
*Note: You are expected to read the assigned text prior to lecture.

Course objectives: As distinguished biologist T. Dobzhansky said, "Nothing in biology makes sense except in the light of evolution." Through this course, you will appreciate the significance of this statement as you become familiar with the evolutionary process and its consequences. Lectures will provide a conceptual foundation of fundamental principles in evolution. Student-led discussions will augment your understanding by focusing on classic papers of historic significance and important recent papers from the primary literature. These articles will provide intriguing material for dialogue on topics ranging from evolution within populations to processes on acting on macro-evolutionary scales. Upon completion of the course you should be able to...

1. apply the principles of evolutionary biology and the phylogenetic relationships of the major groups of organisms;
2. explain and apply your understanding of the importance of evolutionary theory as a unifying principle of biology.
3. develop enhanced critical thinking skills
4. identify questions that can be addressed scientifically and demonstrate the ability to read, understand and critically review scientific papers
5. develop effective quantitative reasoning skills, such as using mathematical equations and models to represent and explain biological phenomena
6. communicate precisely and analytically in written and oral forms

Evaluation:

Standard Section		Writing Proficiency	
<u>Requirement</u>	<u>% Grade</u>	<u>Requirement</u>	<u>% Grade</u>
Quizzes	5%	Quizzes	3%
Midterm Exam	35%	Midterm Exam	17%
Discussion Leading	15%	Discussion Leading	8%
Discussion	5%	Discussion Participation	2%
Final Exam	40%	First Draft of Term Paper	10%
		Peer Reviews of Term Papers	10%
		Final Version of Term Paper	30%
		Final Exam	20%

Grading policy: Grades will be based upon your performance in the class as follows:
A (93-100%) A- (90-93%), B+ (87-89%), B (83-87%), B- (80-83%), C+ (77-79%), C (73-77%), C- (70-73%), D (60-69%), F (<60%).

Quizzes: Bi-weekly quizzes based on the prior two weeks' lecture material will be given at the *beginning* of class every other Monday and last for 15 minutes. The purpose of the quizzes is to test your knowledge and to encourage you to keep up with the material in the course. There are no make-ups, but your lowest score will be dropped.

Exams: A large portion of your grade will be based on mid-term and final exams. The mid-term exam will test your knowledge of the material covered in the lecture and the assigned readings from the Futuyma text. Make-up exams will only be given in rare cases for extenuating circumstances and only if you are excused from the exam prior to the scheduled date and time. Because the second half of the course will build on concepts presented in the first half, the final exam will necessarily be comprehensive, covering material from the entire course but focusing on concepts covered in the latter half. We will have a review session in class prior to the final exam.

Discussions: Participation in the discussion section is paramount to your success in the class. For the discussion, the class will be divided into groups (5-7 students each). Each group will lead a discussion on selected papers from the primary literature (see schedule below). Each group will *meet with the instructor one week prior* to their presentation to review the subject and the format of their discussion. The students will be responsible for researching and providing background information on the topic subject (e.g., the importance of the questions, a historical perspective from the 'classic' paper, the techniques used to address the problem, the results, and where this research is going in the future), providing the class with at least *5 questions for thought one week before* the presentation (that the instructor will post on Blackboard), summarizing the readings and presenting questions for discussion in class, and leading the discourse. After presenting an introduction to the topic and papers (~15-20 min), students in the lead-group will join the other groups to guide and facilitate the conversation (~20 min per paper or 40 min overall), and then summarize the discussion with conclusions from each group as well as the presenter's groups overall conclusions (~5 min). Everyone is expected to contribute substantially to discussions and to ensure that all students do so, I would like each of you to bring 1 question with you to class the day of the discussion. The question should be based on the readings and can be about any aspect of the papers, from something deep in evolutionary thought to something regarding whether the author's conclusions are supported by the data. Please email me your question prior to the beginning of class and bring a copy (this could be mental) for yourself so that you can ask it to your group (not just the discussion leader) at an appropriate time during the discussion. My hope is that this will, in conjunction with the Questions for Thought, promote discussions and participation by everyone in the group. These questions will count towards your participation points.

LECTURE SCHEDULE

<u>Date</u>	<u>Topic</u>	<u>Reading (Futuyma 2005)</u>
W9/23	Introduction to evolution	Chapter 1
F9/25	Evolution in the fossil record	Chapter 4, 5
M9/28	Phylogenetics and the tree of life <i>WP Paper Topics Due before class via email</i>	Chapter 2
W9/30	General patterns of evolution	Chapter 3
F10/2	Biogeography	Chapter 6
M10/5	Variation <i>WP Outlines Due via email</i>	Chapter 8, 9 (not 205-212)
W10/7	<i>Discussion 1 - Evolution in the fossil record</i>	
F10/9	Genetic Drift	Chapter 10 (225-235)
M10/12	<i>Discussion 2 - Evolution of populations</i>	
W10/14	DeChaine in Spokane	
F10/16	DeChaine in Spokane	
M10/19	Natural selection and adaptation <i>WP Paper Drafts Due</i>	Chapter 11 (not 258-260)
W10/21	Natural selection on single locus traits	Chapter 12 (not 288-293)
F10/23	<i>Discussion 3 - Natural selection and adaptation</i>	
M10/26	Natural selection on polygenic traits	Chapter 9 (205-212), Ch. 13
W10/28	Mid-term review <i>WP Peer Reviews Due</i>	
F110/30	Boo! Midterm Exam	
M11/2	Sexual selection and Reproduction	Chapter 14 (329-339, 343-346), Chapter 17
W11/4	Spatial patterns and gene flow	Chapter 10 (241-244)
F11/6	Co-evolution	Chapter 18
M11/9	<i>Discussion 4 - Coevolution</i>	
W11/11	No Class – Veteran’s Day	
F11/13	Species	Chapter 15
M11/16	<i>Discussion 5 - Speciation</i>	
W11/18	Speciation	Chapter 16
F11/20	Genes, genomes, and development	Chapter 10 (335-340), Ch. 19, 20
M11/23	Macroevolution <i>WP Final Paper Due</i>	Chapter 21
W11/25	No Class - Thanksgiving	
F11/27	No Class - Thanksgiving	
M11/30	Patterns of biodiversity	Chapter 7
W12/2	Human evolution	Chapter 4 (79-83), Ch. 9 (219-222), Ch. 10 (243-244)
F12/4	Review	
T12/11	Final Exam 10:30-12:30	

DISCUSSION SCHEDULE

1 ***Evolution in the fossil record***

- Conway Morris, S. 1989. Burgess shale faunas and the Cambrian explosion. *Science* 246: 339-346.
- Lahr, M.M. and R. Foley. 2004. Human evolution writ small. *Nature* 431: 1043-1044.

2 ***Evolution of populations***

- Darwin, C. and A. Wallace. 1859. On the tendency of species to form varieties and on the perpetuation of varieties and species by means of natural selection. *Proceedings of the Linnean Society of London* 3: 45-62.
- Glenn, T.C., W. Stephan, and M. J. Braun. 1999. Effects of a population bottleneck on Whooping Crane mitochondrial DNA variation. *Conservation Biology* 13: 1097-1107.

3 ***Natural selection and adaptation***

- Dobzhansky, T. 1947. Adaptive changes induced by natural selection in wild populations of *Drosophila*. *Evolution* 1: 1-16.
- Grant, P.R. and B.R. Grant. 2002. Unpredictable evolution in a 30-year study of Darwin's Finches. *Science* 296: 707-711.

4 ***Co-evolution***

- Ehrlich, P. R. and P. H. Raven. 1964. Butterflies and plants: a study in coevolution. *Evolution* 18: 586-608.
- Benkman, C. W. 1999. The selection mosaic and diversifying coevolution between crossbills and lodgepole pine. *American Naturalist* 153 (suppl.): S75-S91.

5 ***Speciation***

- Mayr, E. 1940. Speciation phenomena in birds. *American Naturalist* 74: 249-278.
- Schluter, D. 1996. Ecological speciation in postglacial fishes. *Philosophical Transactions of the Royal Society of London B* 351: 8071-814.

Discussion Rubric: The Discussion will be scored on a 50 point scale as follows:

	Thorough	Sufficient	Limited	Attempted
Presentation Content: Provides background information for placing the topic in the broader context of evolution, summarizes the papers being discussed (presents hypotheses and predictions, results), gives overall conclusions that relate to both papers.	20	17	14	10
Presentation Clarity: Clear and understandable presentation, provides images that help to convey the concepts, explain results, and identify organisms	10	8	6	4
Questions for Thought: On-time and insightful questions that direct readers to specific, important points and delve into deeper issues in evolution.	5	4	3	2
Leading Discussion: Leaders are prepared with many questions to lead an engaging discussion in several directions, are able to answer questions about the papers and in a broader context.	15	12	9	6

Example Questions for Thought: Refugia

1. What factors make the Quaternary Refugium discussed in the article relatively stable throughout the glacial cycles and what comparisons can you make with proposed refugia in the Pacific Northwest (e.g, the Olympics, the Queen Charlotte Islands, the Columbia Gorge)?
2. How did the authors test the hypothesis that this area was a Quaternary Refugium? What are other ways to examine whether a habitat area “remained immune from the extreme effects of Quaternary climate variability?” What assumptions are made in testing the hypotheses by these different approaches?
3. The paleobotanical data on temperate trees presented in this paper does not correspond with data for mammals in Europe. Fossil and genetic data on mammals inhabiting temperate forests show that they occurred much further north during the glacial periods. What could lead to the discrepancy between the location of refugia delimited by pollen data in this article and ‘cryptic northern refugia’ shown for other taxa?
4. The following question leads in to what we will be discussing next week (The impacts of Ice Ages on Speciation). If the refugium served as a source of individuals for intermittent population expansion, how could it also have been isolated enough to promote speciation?

More Example Questions for Thought: Comparative Studies

1. What are the benefits of comparing co-distributed species patterns? What can be learned from these comparisons? How can they be used to generate hypotheses?
2. Can comparisons be made given that species responded independently to environmental changes? How related must organisms be in order to make descriptive comparisons and why? How can you accommodate or account for the variation among species due to random processes or differences in life histories?
3. Compare and contrast the two hypotheses that Soltis et al. 1997 presented for the history of flora in the Pacific Northwest. Which hypothesis has greater support (from this and other studies with which we have become familiar)? Do you expect all species to fit one ecosystem model? How can the model(s) be tested?
4. Concordance among distantly related species patterns suggests a common historic cause. Is it possible to estimate the history of a region, given all the ‘noise’ associated with interspecific differences? Is there one single best approach for estimating the history of a region or ecosystem? How can ecosystem-level hypotheses be generated and tested? How do estimates of time play into comparisons?
5. The goals of Carsten’s et al 2005 were 1) to infer the process responsible for the formation of the disjunction distribution in each lineage and 2) to assess the degree of congruence among members of the ecosystem. Do these (and if so how) aims differ from Soltis et al. 1997? How did Carsten’s approach differ from that of Soltis et al 1997? Compare and contrast the benefits of each approach.
6. Compare the hypotheses that Carsten’s et al. 2005 addressed. In general, how did they go about testing the hypotheses? What did they conclude? How did the robustness or reliability of their conclusions differ from those of Soltis et al. 1997? How do both studies contribute to our understanding of the processes that have given rise the distribution of genetic diversity in taxa of the Pacific Northwest?

Writing proficiency requirements: In addition, writing proficiency students will have the opportunity to write a paper on a topic of your choosing that explores the evolution of some phenotypic trait within a taxon (either a single species, a family, a phylum, etc.). Your text and the primary literature should provide many ideas for interesting topics. Under the heading of your chosen topic (“The evolution of _____ (some trait) in _____ (some taxon)”), you should provide an introduction that places your question about the evolution of your chosen trait in the broader context of evolutionary biology, a thorough discussion of the evidence relating to your question (including how those questions have been studied), and what conclusions you can draw from the review of the literature and what questions still remain. Your paper should be comprehensive, including a historical perspective, as provided by fossil, phylogenetic, and biogeographic evidence as well as the evolutionary forces that have influenced the trait and organism. Your paper should include citations (15-20) from the primary literature, such as *Evolution*, *Biological Journal of the Linnean Society*, *Heredity*, *Molecular Ecology*, *Trends in Ecology and Evolution*, and etc. The paper should be 8-10 pages, double-spaced, in 12 point Arial font, and should include helpful figures (in addition to the 8-10 pages).

The final draft of your paper will be a result of a peer review process, just as if you had submitted it for publication in a journal. After approval of your topic, you will write an outline and your initial draft, which should be of the highest quality for evaluation by your peers (see rubric below). When you submit this draft, please provide *three copies*, which will be reviewed by two other writing proficiency students and myself, who will provide constructive criticism on how to improve your paper. From the peer comments and any additional remarks from myself, you will re-write your paper and submit the *final version and a letter* describing how you addressed each of the reviewers' comments (or why not changes were made).

Writing Rubric: Each draft will be scored on a 100 point scale. Note that the first draft is worth 10%, which includes the topic submission and outline are worth 10% of your first draft score, and the final draft is worth 30% of your total grade.

	Thorough	Sufficient	Limited	Attempted
Addresses the evolutionary question posed, presents hypotheses and predictions, gives background info and reasoning to explain and support argument, and provides the author’s own conclusions	55	45	40	35
Gives details and examples from the primary literature to explain and support ideas	15	12	10	9
Strong, clear, easy to understand writing that flows logically, provides insight, and relates examples elegantly	15	12	10	9
Errorless grammar and spelling	10	8	7	6
Bibliography: At least 15 citations from the primary literature (not the web), appropriate format in text and bibliography	5	4	3	2

* 10 points (10%) will be lost for every day the assignment is late.