

Evolutionary Biology: Biol 420-02

Fall 2007

INSTRUCTOR

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TEACHING ASSISTANT

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Last updated: 04 August 2007

GENERAL DESCRIPTION

Class Meeting Times: Tuesday and Thursday 10:00 – 10:50 am – 1170 TMCB
TA Tutorials: Thursday 4:00 -4:50pm – Room TBA
Exam Review Sessions: TBA prior to exams

Evolutionary Biology is our senior-level 'capstone' course in the life science core curriculum. This 'capstone' status reflects the fact that evolution is conceptually *the single most important* biological discipline as measured by its ability to tie together all other fields of biology. Without the unifying framework of evolution, the biological sciences would exist as a set of isolated, specialized fields. Indeed, Theodosius Dobzhansky was right when he said that "nothing in biology makes sense except in the light of evolution." More recently, the National Academy of Sciences has stated that evolution is "the most important concept in modern biology, a concept essential to understanding key aspects of living things" (1998). Given this importance, it is not surprising to find that our class is filled by students with majors spanning the full realm of the biological sciences. What then is it that makes evolution the great unifying concept of biology? The purpose of this class is to help you answer that very question!

LEARNING OBJECTIVES

Upon successfully completing this course, you should be able to:

1. Provide an LDS perspective on evolution, and explain why scientific and religious views need not be mutually exclusive.
2. Describe the history and development of evolutionary thought.
3. Describe the nature of the current national debate on intelligent design.
4. Be able to distinguish between facts, hypotheses, and theories.
5. List and describe the evidence for evolution and its required corollaries.
6. Describe the mechanisms by which evolution occurs. Provide detailed explanations of the processes of evolution by mutation, migration, genetic drift, non-random mating, and natural selection.
7. Explain the interplay between genetic and ecological processes in shaping evolution.

8. Explain adaptation. Provide examples that relate to several different fields of biology (e.g., cell biology, physiology, virology, ecology, conservation biology, bioinformatics, medicine, etc.)
9. Describe ideas about why sexual reproduction evolved and explain the role of sexual selection in shaping evolution.
10. Explain behavior in an evolutionary framework.
11. Explain how new species form and how to use phylogenetic systematics to reconstruct evolutionary relationships among species.
12. Discuss the major concepts in developmental biology in an evolutionary framework.
13. Describe the history of life on earth. Identify the major evolutionary transitions over time, and explain the tools and evidence that support current hypotheses of the history of life.
14. Provide examples of transitional fossils.
15. Provide an overview of hominid and human evolution.

MY HOPES AND EXPECTATIONS FOR YOU

Evolutionary Biology is a vast discipline. It is impossible in a single semester to cover this field in its entirety. Hence, the selection of topics covered in class must be extremely limited. We'll do our best to cover some very interesting material. In addition, this course will not focus solely on content. I have no desire for you to obtain an encyclopedic knowledge of the field by spending all of your time on memorization. Instead, I am most concerned that you acquire and improve your skills in critical thinking and problem solving. In short, I want you to come away from this class better able to think like a scientist.

For some, this will be a new task. The undergraduate experience is filled with opportunities to sit passively in your seat without engaging your professor or your fellow students. Initially, some people feel uneasy and inadequate in voicing their ideas, especially when called upon to comment in front of other members of the class. I know of no magic remedy to remove this discomfort, except to practice. It is critical that when you leave BYU that you have mastered the skill of critical evaluation and that you have the tools to test competing ideas. This is what it means to "study it out in your mind."

COURSE MATERIALS

TEXT: Freeman, S. and J. C. Herron. 2004. *Evolutionary Analysis*. 3rd Edition. Prentice Hall.

PRIMARY LITERATURE: I have selected a set of published articles that do a nice job of complementing your text (see the course outline below). PDF's of these articles will be posted to *Blackboard*. Please read this material prior to class on the day when it will be discussed.

In addition to the course readings that I have chosen, you will have the opportunity to spend some time in the primary literature exploring a topic in evolution that interests you (you choose the topic). To do so, you will need to find, read, and critique at least 5-peer reviewed journal articles on your topic. I strongly encourage you to visit with the TA about your topic prior to selecting your articles; he can help steer you toward interesting ideas and good reading. This free-choice reading will be required for two kinds of writing assignments for the class (see assignments below).

VIDEOS: (these make great date nights!) – see assignment below:

1. Darwin's Dangerous Idea. 2001. *Evolution Series* for PBS, WGBH, Boston.
2. Inherit the Wind. 1960. MGM Studios.
3. What about God? 2001. *Evolution Series* for PBS, WGBH, Boston.
4. Dogs and More Dogs. 2004. Nova, WGBH, Boston.
5. Secrets of the Dead III: Mystery of the Black Death. 2004. PBS Home Video.
6. The Evolutionary Arms Race. 2001. *Evolution Series* for PBS, WGBH, Boston.
7. Great Transformations. 2001. *Evolution Series* for PBS, WGBH, Boston.
8. Why Sex? 2001. *Evolution Series* for PBS, WGBH, Boston.
9. Extinction! 2001. *Evolution Series* for PBS, WGBH, Boston.

READING

Reading assignments should be completed **before** each lecture. The responsibility for gaining a good first exposure to each topic rests with you. As a general rule, lecture time will be spent in helping you process and apply information you have previously acquired on your own.

ASSIGNMENTS

Video Critiques (2)	40
Literature Summaries (5)	50
Review Paper	100
Exam I	100
Exam II	100
Final Exam	200
ETS Biology Exam	<u>10</u>

Total **600**

Turning in assignments: Deadlines, unless otherwise stated, are at the **beginning of class** on the due date.

Late Policy: Extra-curricular activities, travel, or work in other courses, are not justifications for late work here. Participants in the course must submit **all** required assignments to receive a grade better than C for the course.

A brief description of assignments:

1) Video Critiques – Science thrives on healthy debate! I will put on reserve several videos dealing with topics and issues in evolutionary biology. These are available at the HBL in the Learning Resource Center (south end of 4th Floor: 7am – midnight). You will be required to view two of these (out of nine available – see course timetable below) and to write a short one-page single-spaced report. Each report is worth 20 points. You will receive 5 points for watching the video if you hand in the critique on time. The remaining 15 points will be awarded based on your ability to carefully evaluate ideas presented in the video.

The purpose of the video critiques is to help you hone your skills in dialectical thinking. In most of these videos, the narrator, filmmaker, or the storyline tries to convince you of something (or perhaps several things). I expect you to come up with at least one **scientifically defensible** alternative hypothesis to an argument made in the video. The narrator's argument may be correct or it may not, but I expect you to put it to the test by exploring alternatives. Your report should be well organized and coherent. The first paragraph should introduce your thesis and each subsequent paragraph should support your argument. A typical paper might have a single introductory paragraph, three supporting paragraphs, and a final summary (or concluding) paragraph. Feel free to bring in data from outside sources if this helps you develop your point. Some students find it helpful to do this assignment with a partner, watching the video together and then discussing competing ideas. If you do this assignment with a partner, you must each generate an independent critique. Remember, the goal here is to practice coming up with alternative explanations—an important part of science. Don't wait until the last day to check out the videos as you might find it difficult to get a copy.

2) Literature Summary –The purpose of this exercise is to allow you to explore at least one topic in evolution in detail. Reading these articles will also help you appreciate the fact that science is a dynamic endeavor that relies upon creative discussion, critical debate, and empirical tests of ideas based on material data. You will be expected to write a short summary (no longer than one page) for five of the articles you read. Your reviews should include the following elements: a brief synopsis describing the major problem being addressed by the authors (i.e., what is the question and how important is it?); your evaluation of the author's experimental approach to address the problem; strengths and weaknesses of the study, especially with respect to providing evidence to test the hypotheses; your evaluation of what should be done next to further answer the problem being addressed. These reviews will help prepare you for writing the Review Paper (described below).

3) Review Paper – You will have the opportunity to write a short (~5 page double spaced) review paper on any topic of evolutionary biology that you choose. These papers should follow the guidelines given by the journal *Trends in Ecology and Evolution (TREE)* for their *Review* articles (see PDF on *BlackBoard*), but will be much shorter. In brief, you will need to identify a field of interest in evolutionary biology and then provide a cutting edge review of that field. Your paper should both review the topic and project where future work would be most fruitful. I suggest that you read several *Review* articles in *TREE* to get a good feel for how this is done. The format of your paper should follow that of *TREE* in every respect. Tables and figures are allowed (but not required) consistent with the guidelines of *TREE*. Find something that you feel passionate about and have fun! The total assignment is worth 100 points. You will receive 25 points for meeting with the TA to review your outline by the established deadline (see course outline and watch for the TA to provide a sign-up schedule). The remaining 75 points will be awarded based upon the quality of your paper (A = 75; A- = 70, B+ = 67; B = 63, B- = 60, etc.). Papers must be submitted on time or you will not receive points.

4) Exams – To evaluate how well you have achieved the course learning objectives, there will be three exams. The first two exams are not comprehensive. The final exam is comprehensive. These tests will include several ways of assessing subject mastery and critical thinking skills including: definitions, multiple choice, matching, short answer,

problems, and short essay. Your TA will offer review sessions prior to each exam and can help you get a feel for how the exams are structured. Keys to success on exams include completing all of your reading assignments *prior* to class discussions, thinking carefully and critically about what you have read, engaging your peers in discussion about different concepts, attending tutorials, and practicing problems and questions found in your text. Also, don't be shy about coming to see me during office hours just to chat.

The first and second exams will be administered in the Testing Center and at least partially machine graded. Bring a calculator. **It is your responsibility to know the Testing Center hours and to allot sufficient time to complete the exam.** If you show up at the Testing Center on the last day that the exam is offered, and find the center closed, tough darts. You should allot **at least 2 hours** for the exam. Exam scores will not be adjusted for improper erasures on the scantron sheets. **Any one caught cheating on an exam will automatically fail the course and a permanent note will be placed in your university student record.** Late exams will not be given except under very serious circumstances, and normally only with prior notification. The final exam will be given in class on Wednesday, December 19th from 11 am to 2 pm. Anyone who does not take the final exam will fail the course.

5) ETS Biology Exam – The College of Life Science has paid for you to take a national standardized exam to evaluate your competency in biology. This is a great opportunity for you to assess your mastery of the skills taught in the college core curriculum. The exam is scheduled for the final week of November (more details to come from the College). Taking this exam is required. I will award up to 10 points for this exam. Points will be awarded on a merit system: 10 points for top 20% of class scores; for those not in the upper 20% of class scores, 8 points will be awarded for anyone who scores in the upper 50th percentile of the national average, and 6 points for those who score below the 50th percentile.

TUTORIALS

Regular class lectures are held on Tuesday and Thursday from 10 am to 10:50 am. In addition, the TA will hold at least one weekly tutorial on Thursday at 4pm (if additional tutorials are offered, times and locations will be posted on *Blackboard*). These tutorials provide an opportunity for you to discuss concepts in smaller groups and to toss around new ideas relating to the course material. **I strongly encourage you to get to know the TA.** He is your friend and will help you succeed in this class.

COURSE GRADING

The top two student's total scores will be averaged and that averaged total set as 100%. Percentage scores for everyone else will then be calculated using that baseline, and letter grades will be assigned as follows:

		A	95%	A-	90%
B+	87%	B	83%	B-	80%
C+	77%	C	73%	C-	70%
D+	67%	D	63%	D-	60%

GRADING WRITING ASSIGNMENTS

A typical "A" paper presents a compelling argument, is well written and well organized. It provides an excellent synthesis of different aspects of the course as it relates to your topic in evolutionary biology. It also demonstrates that you have grappled with the issues raised in class, that you have synthesized the readings, discussions, and lectures, and that you have formulated a perceptive, original, central argument well supported by well-chosen examples. "A" papers are rare.

A typical "B" paper is a solid work containing flashes of insight that demonstrate the student has wrestled with most of the issues in the literature and the course. The synthesis is good but some aspect is missing. The argument is still clearly presented, well written and organized. Other "B" papers give evidence of independent thought, but the presentation is not clear or convincing.

A typical "C" paper has a good grasp of the literature, but does not provide an independent synthesis and analysis of the topic. It is a mere rehashing of work done by others and doesn't make a concerted attempt to come to "intellectual ownership" of the ideas discussed in the paper. It does not incorporate all of the readings, discussions, and lectures. A 'C' paper may present a B level analysis, but is poorly written, or may be well written but presents a flawed analysis.

A "D" paper is poorly written and presents a flawed analysis, does not respond adequately to the assignment, is marred by frequent errors, unclear writing, poor organization, or some combination of these problems.

For feedback on writing, feel free to use the BYU Writing Center (1010 JKB), the Biology Tutoring Lab (436 WIDB), your TA, or come and see me during office hours. I am looking for well developed ideas, critical thought, and clearly written papers. Make it easy for your reader to read! I will deduct one letter grade from any paper with 10 or more spelling and grammatical errors.

REGRADE POLICY

1. Exams will be available to review no later than the Thursday after the exam. If you have a concern about a graded exam, check the key first. The TA will go over the entire exam in the tutorial on Thursday.
2. If you then request a re-grade, the *entire* exam, not just the disputed question will be graded.
 - i. On a separate sheet of paper, write a note identifying the problem and **why your answer is correct**, providing documentation (such as specific page numbers in your text). It is not enough to explain why you made the mistake. You must demonstrate that your answer is correct. If you cannot demonstrate your answer is correct, please do not request a regrade.
 - ii. Suggest how the grade should be changed. For example, "Increase my score by 2 points" or "+2 points." If you do not suggest what should happen, no change will be made.
3. Return your exam to me no later than 5:00 pm on the Monday after the exam is available to review. Even if you are not around to pick up the exam, the deadline remains.

BOOKS and JOURNALS THAT YOU MIGHT FIND INTERESTING

- Alcock, John. 2001. *The triumph of sociobiology*. Oxford University Press, Oxford, UK.
The American Naturalist. Published by the American Society of Naturalists.
- Carroll, Sean B. 2005. *Endless Forms Most Beautiful: The New Science of EvoDevo*. W. W. Norton and Company, New York, NY.
- Coyne, Jerry & Alan Orr. *Speciation*. 2004. Sinauer Associates, Inc. Sunderland, MA.
- Darwin, C. 1839. *The Voyage of the Beagle: Charles Darwin's Journal of Researches*.
- Darwin, C. 1859. *The Origin of Species by Means of Natural Selection or the Preservation of Favored Races in the Struggle for Life*.
- Evolution*. International Journal of Organic Evolution. Published by the Society for the Study of Evolution.
- Endler, John A. 1986. *Natural selection in the wild*. Princeton Univ. Monographs, Princeton, NJ.
- Felsenstein, Joseph. 2004. *Inferring phylogenies*. Sinauer Associates, Inc. Sunderland, MA.
- Fox, Charles W., Derek A. Roff, and Daphne J. Fairbairn. 2001. *Evolutionary Ecology: concepts and case studies*. Oxford University Press, Oxford, UK.
- Futuyma, Douglas J. 1998. *Evolutionary Biology*. Sinauer Associates, Inc. Sunderland, MA.
- Gould, Stephen Jay. 1991. *Wonderful Life*. Penguin Books.
- Lewin, Roger. 1999. *Human evolution: an illustrated introduction*. Blackwell Science, Malden, MA.
- Mayhew, Peter. 2006. *Discovering evolutionary ecology*. Oxford University Press, Oxford, UK.
- Mitton, Jeffry B. 1997. *Selection in natural populations*. Oxford University Press, Oxford, UK.
- Morris, Simon Conway. 2003. *Life's solutions: inevitable humans in a lonely universe*. Cambridge University Press, Cambridge, UK.
- Nesse, Randolph M. and George C. Williams. 1994. *Evolution and healing: the new science of Darwinian medicine*. Phoenix Press, London.
- Pianka, Eric R. 1988. *Evolutionary ecology*. Harper and Row, Publisher, Inc., New York.
- Pigliucci, Massimo. 2002. *Denying evolution: creationism, scientism, and the nature of science*. Sinauer, Sunderland, MA.
- Quammen, David. 1996. *The song of the dodo: island biogeography in an age of extinctions*. Scribner Publishers, New York.
- Quammen, David. 2006. *The reluctant Mr. Darwin: an intimate portrait of Charles Darwin and the making of his theory of evolution*. Atlas Books, New York, NY.
- Real, Leslie A. (editor). 1994. *Behavioral mechanisms in evolutionary ecology*. University of Chicago Press, Chicago.
- Roff, Derek A. *The evolution of life histories: theory and analysis*. Chapman and Hall, New York.
- Scott, Eugenie. 2004. *Evolution versus creationism: an introduction*. Greenwood Press, Westport, CT.
- Tattersall, Ian. 1995. *The fossil trail: how we know what we think we know about human evolution*. Oxford University Press, Cambridge.
- Trends in Ecology and Evolution*. Published by Elsevier Publishers.

COURSE TIMETABLE

Date	Class Topic	Reading Assignment (read before class)	Assignment due	Thursday Tutorial Topic
Sep 04	Course Goals, Objectives, and Expectations	BB – Course syllabus BB – Plummer: <i>"Ophelia Syndrome"</i>		
<i>Historical Perspective on Evolution</i>				
06	Mormonism and Evolution	BB – BYU Evolution Packet		Q&A about learning in this class
11	What is Evolution? Evidence for Evolution and its Corollaries	Chapter 2 BB - Dobzhansky: <i>"Nothing in Biology Makes Sense Except in the Light of Evolution"</i>		
13	History & Development of Evolutionary Biology	BB – Futuyma Chapter 2. <i>"A Brief History of Evolutionary Biology"</i>		Choosing and "owning" a review paper topic
18	What is 'Intelligent Design'? What's wrong with ID as science?	BB – Read web pages: National Center for Science Education & Discovery Institute BB – <i>Natural History</i> 2002: <i>"Intelligent Design?"</i>	Video Report #1	
<i>Mechanisms of Evolutionary Change</i>				
20	Origin of Variation	Chapter 4 & 5	Lit. Summary #1	Discussion on evolution and society. How do <i>you</i> deal with uncertainty?
25	Evolution by Mutation & Migration	Chapter 6		
27	Evolution by Genetic Drift & Non-random Mating	Chapter 3 & 5	Video Report #2	Mechanisms of Evolution
Oct 02	Evolution by Natural Selection			
04	Evolution by Natural Selection			Review for Exam 1

Date	Class Topic	Reading Assignment (read before class)	Assignment due	Thursday Tutorial Topic
Exam 1 (Testing Center: Friday October 5 th , Saturday October 6 th , and Monday October 8 th)				
<i>Adaptation & Speciation</i>				
09	Studying Adaptation	Chapter 9 <i>BB – Gould and Lewontin 1979: "The Spandrels of San Marco and the Panglossian Paradigm"</i>		
11	Adaptation		Lit. Summary #2	Questions and Answers on Exam 1 Evolution is not teleological Adaptation and natural selection
16	Evolution of Reproductive Strategies: Why Sex?	Chapter 7 (parts on sex) http://www.sciencemag.org/content/vol281/issue5385/index.shtml (several articles to choose from)		
18	Sexual Selection and the Evolution of Sexual Ornaments	Chapter 10	Lit. Summary #3	Why sex?
23	Models of Mate Choice			
25	Evolution of Behavior: kin selection	Chapter 11	Lit. Summary #4	Sexual Selection
30	Evolution of Behavior: altruism			
Nov 01	Life History Evolution	Chapter 12	Lit. Summary #5	Behavioral ecology Is there such a thing as true altruism in humans?
06	Life History Evolution			
08	Evolutionary Medicine & Human Health	Chapters 1 & 13		Life history evolution Evolution and Human Health

Date	Class Topic	Reading Assignment (read before class)	Assignment due	Thursday Tutorial Topic
13	Species Concepts	BB – Sites and Marshall 2003: " <i>Delimiting Species...</i> "		
15	Speciation Mechanisms	BB – Rundle and Nosil 2005 " <i>Ecological Speciation</i> " Chapter 15	Review Paper Rough Draft (Optional)	Review for Exam 2
Exam 2 (Testing Center: Friday November 16 th , Saturday November 17 th , and Monday November 19 th)				
No class this week (Friday instruction on Tuesday, November 20 th and Thanksgiving holiday on Thursday November 22 nd)				
<i>History of Life on Earth</i>				
<i>ETS Biology Exam scheduled for this week (November 26-30) – See BB for specific times</i>				
27	Systematics and Phylogenetics	Chapter 14		
29	Evolutionary Developmental Biology		Review Paper Due to TA	Questions and Answers on Exam 2 Systematics EvoDevo
Dec 04	Origins of Life and Precambrian Evolution Cambrian Explosion and Beyond	Chapter 16 & 17 BB – Bada and Lazcano 2003: " <i>Prebiotic Soup...</i> " BB – Miller 1953: " <i>Production of Amino Acids ... Primitive Earth</i> "		
06	Fossil Formation and Dating Techniques	BB – Lewin (Chapter 7): " <i>Dating Methods</i> "		Fossil Dating Vertebrate Transitional Fossils
11	Vertebrate Transitional Fossils: behold the missing links	Chapter 14		

Date	Class Topic	Reading Assignment (read before class)	Assignment due	Thursday Tutorial Topic
13	Hominid Evolution / Human Evolution	Chapter 19 <i>BB – Krings et al. " Neandertal DNA sequences and the origin of modern humans"</i>		
Final Exam (In Class, Wednesday, December 19 th , 11am – 2pm)				

MISCELLANEOUS

Sexual Harassment Statement. Title IX of the Education Amendments of 1972 prohibits sex discrimination against any participant in an educational program or activity. Title IX covers faculty-student, student-faculty and student-to-student sexual harassment. BYU's policy against sexual harassment extends not only to employees of the university but to students as well. If you encounter unlawful sexual harassment or gender-based discrimination, please talk to your professor; contact the Equal Employment office (378-5895); or contact the Honor Code Office at 378-2847.

Honor Code Standards. In keeping with the principles of the BYU Honor Code, students are expected to be honest in all of their academic work. Academic honesty means, most fundamentally, that any work you present as your own must in fact **be** your own work and not that of another. Violations of this principle may result in a failing grade in the course and additional disciplinary action by the university. Students are also expected to adhere to the Dress and Grooming Standards. Adherence demonstrates respect for yourself and others and ensures an effective learning and working environment. It is the university's expectation, and my own expectation in class, that each student will abide by all Honor Code standards. Please call the Honor Code Office at 422-2847 if you have questions about those standards.

Students with Disabilities. If you have a disability that may affect your performance in this course, you should get in touch with the office of Services for Students with Disabilities (1520 WSC). This office can evaluate your disability and assist the professor in arranging for reasonable accommodations.

Privacy. Your assignment and test scores will be posted on *BlackBoard*. Please keep track of your scores so that you can confirm that our record of your work is correct. With your permission, assignments will be returned to you in alphabetically labeled folders at the back of the classroom. To give your consent, please sign and return the permission sheet included at the back of this syllabus. If you choose not to grant permission, you may obtain your graded assignments from a teaching assistant.

Tutoring. I am convinced that you can learn and accomplish more in this class collectively than individually. Thoughtful examination of my grading policy leads to the conclusion that analogues of kin selection, social responsibility and intrinsic reciprocal altruism should be *modus operandi* for this course.

The College of Biology and Agriculture supports the University Tutoring Program, and so do I. Consider tutoring.

"Rather than a few professors or teaching assistants helping as many as possible, why not all students willingly help others to learn? It's lifting each other so all rise together. Many are now participating. We invite you to share your knowledge." Contact: Tutoring Services at 422-4793 or tutoring@byu.edu.

Assignment / Exam Returns

This form allows you to give permission for your various assignments and exams in Biology 420 to be returned to you publicly by placing them in the alphabetical folders at the back of the classroom. This allows the possibility that your scores on assignments could be visible to other students while they are searching the box for their own assignments. If you do not want your assignments to be returned to you by this mechanism, do not return this form. In that case, you may request your assignments directly from the teaching assistant. To grant permission for your assignments to be returned in the boxes, sign and date the form as indicated below. You have the right to rescind this permission at any time by contacting the professor.

I grant permission for assignments to be returned via the bins at the rear of the classroom or in the tutorial session:

Name (printed) _____

Signature _____

Date _____