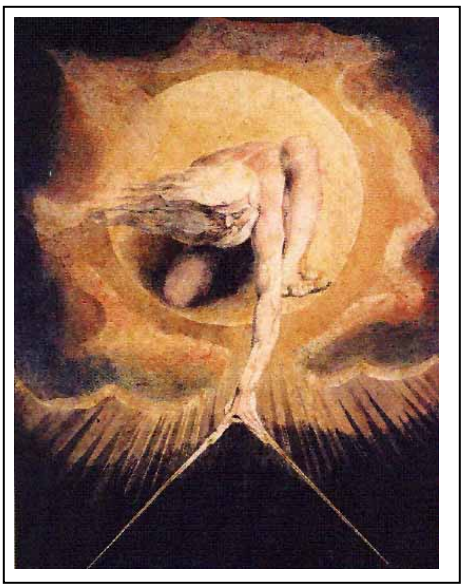
# Biology 313. Evolution.



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classes:

MWF 1:00-1:50 K413
Tue 2:00-5:00, Kirk. 313, 4 cu.

course web site: http://www.science.widener.edu/~grant/courses/bio313.html

Course Objectives.

Evolution is the most powerful and elegant theory in biology. Without evolution, biology becomes a disparate set of technical sub-disciplines. Evolutionary explanations pervade all fields in biology and bring them together under one theoretical umbrella. For this reason, evolution is the unifying concept of the biological sciences.

There are three major objectives of this course:

**(1) Increase Your Understanding of the Causes, Processes, and Consequences of Evolution.** This is the domain related to disciplinary content – the "knowing things" domain. This objective includes three sub categories:

(a) Understand the Principal Mechanisms of Evolution. You will understand how the mechanisms of microevolutionary change (genetic drift, gene flow, mutation, and natural selection) create, maintain, and destroy genetic variation and have resulted in the remarkable diversity of life forms present today. Also, you will learn that these microevolutionary mechanisms affect ongoing ecological processes and can explain many current interactions among organisms.

(b) Understand the Major Evolutionary Trends in Biotic Diversity. Several major evolutionary trends occurred during the history of life on Earth (e.g. often increasing complexity – but not always, evolution of predation, colonization of land, etc.). You will understand (i) what constitutes a major evolutionary trend, (ii) the concept of macroevolution, (iii) the role of natural selection in molding key traits, and (iv) the pathways along which life forms "progressed" within the major phyletic lineages.

(c) Understand the Evolutionary Origin of Life. A common evolutionary ancestry interconnects all life forms on Earth. You will understand the theory of how life evolved on Earth and diversified into the variety of forms we see today.

**(2) Improve Your Scientific Literacy About How Evolutionary Knowledge is Constructed Using the Scientific Method.** It is through the process of scientific inquiry using the scientific method that natural phenomena are observed, interpreted, and reported. Science is a "way of knowing" about the world around us with which one gains an understanding of our environment and the effects of human activities upon it. This is the domain related to knowing how to construct the disciplinary content knowledge from (1) – thus, this objective spans both the "knowing how to do things" and "knowing how to know things" domains. This objective includes three sub categories:

(a) Understand How to Investigate and Model the Dynamics of Evolutionary Change in Ecological Systems (Populations and Communities). You will improve your skills at applying the scientific method to investigating, modeling, and understanding evolution in simulated populations and communities.

(b) Understand the Principles of Phylogenetic Systematics and the Methods of Bioinformatics. Bioinformatics is one of the fastest growing fields of biology. Huge advances are being made as entire genes and genomes are being sequenced and shared. Although the principal goal of many of these efforts is in applied biomedical, agricultural, or environmental research, exciting and new insights are emerging about evolutionary relationships among organisms at all taxonomic levels. Previous phylogenies, based mostly on morphological or developmental data and ill-defined guesswork, are crumbling almost daily beneath this onslaught of hi-resolution rigorous molecular genetic analyses. In this course, you will understand these techniques, and draw from the vast internet database of published genetic research and pose and text hypotheses about evolutionary relationships among organisms of interest to you.

(c) To Improve Your Scientific Thinking Skills Including Systems Thinking and Reflective Judgment. Systems thinking approaches complex problems from an holistic rather than a reductionist perspective. Reflective judgment extends evidence-based thinking to the analysis of problems such as the complex challenges facing the sustainability of our global society today. These skills will be developed throughout all activities in this course.

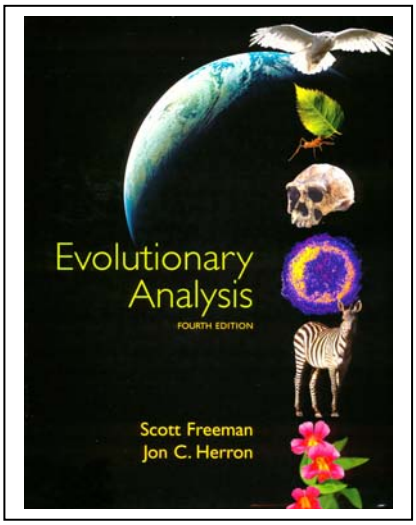
**(3) Understand the Uses and Effects of the Theory of Evolution in Society.** Evolutionary knowledge is at the fore-front of the biological revolution that has characterized the past several decades, and will likely dominate biology, medicine, and policy for the rest of this century. For example, biotechnology is now being used to manipulate the genome to improve our domesticated plants and animals (genetic engineering), our environment (bioremediation), and ourselves (numerous desirable examples such as gene therapy, but some much less so such as eugenics). In addition, evolutionary theories have been and continue to be brought into social debates to sometimes explain social behavior (sociobiology) but often to justify racism, social injustice, or even cultural genocide. Finally, recently the theory of evolution has come under vigorous attack by extremists who proclaim themselves to be "creation scientists" or proponents of "intelligent design" and demand access to the minds of our youth through public school science curricula. No course in evolution would be complete without an exploration of the non-scientific belief system that these critics advocate.

Course Structure.

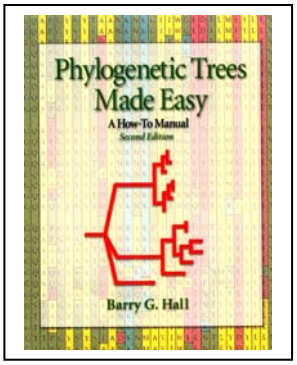
Requirements.

Attendance is required and will benefit your grade. There will be weekly journal clubs (Fridays), several presentations, two in-class exams and a final exam based on these two exams, an individualized project-based "midterm exam" (dates on the next page, based on your choice of course project), and numerous other in-class writing assignments and quizzes. All of the journal club assignments and your course project will involve cycles of revision; consequently, this course is designated "Writing Enriched."

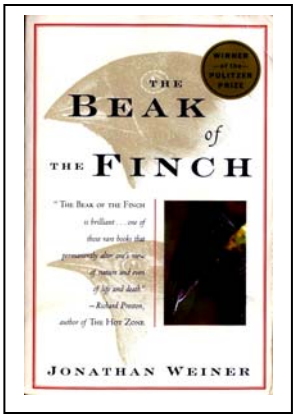
There is NO one required text. I will draw from several published texts, copies available in the Evolutionary Ecology Reading Room (K414); however, a great deal will come from Freeman and Herron (2007). Evolutionary Analysis. 4th edition. Prentice Hall. This is an excellent text by two of the leaders in the field of evolutionary biology. This text blends an unique combination of natural history, rigorous theory, and critical experimentation using current literature. It excellently summarizes what is known in many important areas of evolutionary biology using crisp and simple prose and great examples. Required readings will be announced in class.




In addition, for the unit on phylogenetic systematics, there is a workbook: Hall, B. G. 2004. Phylogenetic Trees Made Easy: A How-To Manual for Molecular Biologists. 2nd edition, Sinauer. Copies will also be available in K414.




Lastly, I will be assigning chapters in Jonathan Weiner's Pulitzer Prize winning book – "The Beak of the Finch" to improve your understanding of Darwinian natural selection and the effort required in field work to detect it.




Assessment.

Your grades will be based upon weekly journal club writing assignments using the primary literature in evolution, several projects with presentations and writing assignments, in-class exams, an individualized "Project Exam," and a Final Exam during final exam week. Details are posted on Campus Cruiser. Lastly, to encourage and reward participation, there will be frequent in-class assessment and evaluation activities. Your final grade is based on your total accumulated points, and if everyone earns >90%, then everyone gets an "A."

# Syllabus (Spring 2007).

| class # | date | topic |
|---|---|---|
| **Evidence for Evolution** | | |
| lab | Tue Lab, Jan 16 | Introduction to Evolution |
| #1 | Wed, Jan 17 | Misconceptions About Evolution |
| #2 | Fri, Jan 19 | Journal Club 1 - Why Teach Evolution? |
| **Microevolution** | | |
| #3 | Mon, Jan 22 | Introduction to Microevolution |
| lab | Tue Lab, Jan 23 | Modeling Mutation |
| #4 | Wed, Jan 24 | Modeling Selection |
| #5 | Fri, Jan 26 | Journal Club 2 - Detecting Natural Selection |
| #6 | Mon, Jan 29 | Modeling Genetic Drift 1 |
| lab | Tue Lab, Jan 30 | Microevolution Mini-projects Begin |
| #7 | Wed, Jan 31 | Microevolution Mini-project Work Day |
| #8 | Fri, Feb 2 | Journal Club 3 - Microevolution |
| #9 | Mon, Feb 5 | Microevolution Mini-project Work Day |
| lab | Tue Lab, Feb 6 | Microevolution Mini-project Presentation Day |
| #10 | Wed, Feb 7 | Quantitative Genetics and Phenotypic Plasticity |
| #11 | Fri, Feb 9 | Journal Club 4 - Conservation Genetics - 1 |
| #12 | Mon, Feb 12 | EXAM 1 |
| lab | Tue Lab, Feb 13 | Evolution in Kin, Groups, Lineages, and Clades |
| #13 | Wed, Feb 14 | Sexual Selection |
| #14 | Fri, Feb 16 | Journal Club 5 - Altruism and Group Selection |
| **On to Macroevolution** | | |
| #15 | Mon, Feb 19 | Coevolution Among Competitors |
| lab | Tue Lab, Feb 20 | Modeling Coevolution - Hosts/Parasites |
| #16 | Wed, Feb 21 | Coevolution Among Predators and Prey |
| #17 | Fri, Feb 23 | Journal Club 6 - Coevolutionary Ecology |
| #18 | Mon, Feb 26 | Coevolution Among Mutualists |
| lab | Tue Lab, Feb 27 | Workshop on the Evolution of Humans |
| #19 | Wed, Feb 28 | Origin of Species |
| #20 | Fri, Mar 2 | Journal Club 7 - Mass Extinction |
| | Mon, Mar 5 | spring break |
| | Tue Lab, Mar 6 | spring break |
| | Wed, Mar 7 | spring break |
| | Fri, Mar 9 | spring break |

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| #21 | Mon, Mar 12 | Origin of the Universe and Our Solar System |
| lab | Tue Lab, Mar 13 | Evidence for Terrestrial Origins to Life on Earth |
| #22 | Wed, Mar 14 | Evidence for the Origins of Biodiversity |
| #23 | Fri, Mar 16 | Journal Club 8 - Venus, Mars, Titan, and Europa |
| **Bioinformatics and Phylogenetic Inference** | | |
| #24 | Mon, Mar 19 | Phylogenetic Inference |
| lab | Tue Lab, Mar 20 | Phylogenetic Inference Mini-projects Begin |
| #25 | Wed, Mar 21 | Phylogenetic Inference Mini-project Work Day |
| #26 | Fri, Mar 23 | Journal Club 9 - Molecular Clocks |
| #27 | Mon, Mar 26 | Phylogenetic Inference Mini-project Work Day |
| lab | Tue Lab, Mar 27 | Phylogenetic Inference Presentation Day |
| #28 | Wed, Mar 28 | Course Project Selection Day |
| #29 | Fri, Mar 30 | Journal Club 9 - TBA |
| #30 | Mon, Apr 2 | EXAM 2 |
| lab | Tue Lab, Apr 3 | Course Project Work Day - Proposals Due |
| #31 | Wed, Apr 4 | Topics in Evolutionary Ecology - TBA |
| #32 | Fri, Apr 6 | Spring Holiday |
| #33 | Mon, Apr 9 | Topics in Evolutionary Ecology - TBA |
| lab | Tue Lab, Apr 10 | Course Project Work Day |
| #34 | Wed, Apr 11 | Topics in Evolutionary Ecology - TBA |
| #35 | Fri, Apr 13 | Journal Club 10 - TBA |
| #36 | Mon, Apr 16 | Topics in Evolutionary Ecology - TBA |
| lab | Tue Lab, Apr 17 | Course Project Work Day |
| #37 | Wed, Apr 18 | Topics in Evolutionary Ecology - TBA |
| #38 | Fri, Apr 20 | University-Wide Undergraduate Projects Day |
| #39 | Mon, Apr 23 | Course Project Work Day - "PROJECT EXAMS" begin |
| lab | Tue Lab, Apr 24 | Course Project Work Day |
| #40 | Wed, Apr 25 | Course Project Work Day |
| #41 | Fri, Apr 27 | Journal Club 11 - TBA |
| #42 | Mon, Apr 30 | Course Project Work Day - "PROJECT EXAMS" due |
| lab | Tue Lab, May 1 | Final Project Presentations |
| #43 | Wed, May 2 | Revisions of "PROJECT EXAMS" Due |

FINAL EXAM date and time TBA during Final Exam Week.