BIO 161. Principles of Evolutionary Ecology

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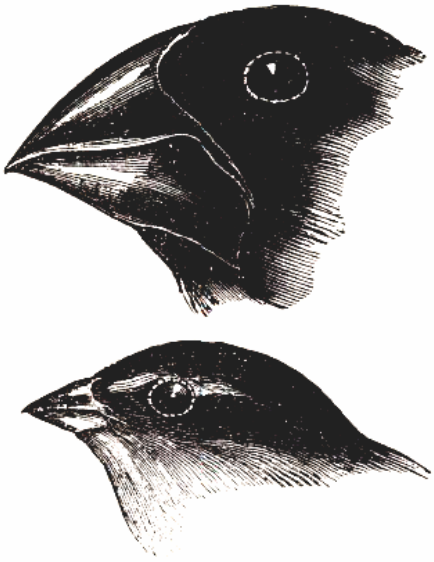

Charles Darwin. 1839. Journal of Researches. Large Ground Finch (above), Small Tree Finch (below)

Course Description

This course, the first in the core curriculum for majors in biology, environmental science, and science education, will center on evolution as the organizing principle of ecological systems and will form the framework for the problems and processes considered in courses that follow.

The course begins with (1) Evolutionary Ecology of Living Organisms and Their Populations, and will explore (a) the biological, physical, and chemical principles that govern a living organism, and the physiological and behavioral responses that enable living organisms to solve ecological problems. These basic functions of living organisms are in part evolved solutions to the ecological problems of homeostasis, resource and mate acquisition, predator avoidance, and reproduction (the results of which passes ecologically favorable characteristics to progeny). In addition, we will explore (b) the organizational "demographic" characteristics and "evolutionary" principles that emerge as groups of individuals multiply, interact, and form populations.

The second part, (2) Biological Evolution, will continue this evolutionary theme and will detail genetic mechanisms of inheritance and the micro- and macroevolutionary processes that result. Students will learn (a) how genetic information is encoded, inherited, and affects organismal structure and function, (b) the evolutionary significance of genetic variation, and (c) how to model the biological processes that create, preserve, or destroy genetic variation and can lead to the origin of species. We will also explore applied topics in biotechnology (e.g., biomedical, agricultural, human eugenics) and the uses of evolutionary knowledge in society.

The third part, (3) Evolutionary Ecology of Communities and Ecosystems, will elucidate organizational principles by which groups of interacting populations form ecological communities and ecosystems. You will learn (a) how physical, biological, and evolutionary processes that affect individual organisms and their populations in turn affect communities and ecosystem structure and function, and (b) the vast interdependencies between our global society and the natural world. Contextual themes for this part of the course include the ecological significance of biodiversity, conservation ecology, and the global ecosystem consequences of our 6+ billion human population.

class#	date	Topic (pp. in Campbell et al., 7th Edition)
		Evolutionary Ecology of Living Organisms and Populations
#1	Fri, Sept 8	Introduction to the Biology Major
#2	Mon, Sept 11	Introduction to Evolutionary Ecology - What is Life? (Ch 1, pp. 2-9)
#3	Wed, Sept 13	The Scientific Method 1 (Ch 1, pp. 19-26)
#4	Fri, Sept 15	The Scientific Method 2
	Fri, Sept 15	noon - Quiz 1
#5	Mon, Sept 18	Individual Ecology - Adaptation & Darwinian Natural Selection (Ch 22, 438-451)
#6	Wed, Sept 20	Darwin's Finches - (The Beak of the Finch, Ch's 1 - 2)
#7	Fri, Sept 22	Physiological Ecology - Adaptation to Diverse Physical Environments on Earth (Ch 50, pp. 1080-1104)
	Fri, Sept 22	noon - Quiz 2
#8	Mon, Sept 25	Animal Behavior (Ch 51, pp. 1106-1132)
#9	Wed, Sept 27	Population Ecology - Evolution defined (Ch 23, 462-466, Ch 52, pp. 1136-1142, The Beak of the Finch, Ch 3)
#10	Fri, Sept 29	Population Growth and Demography
	Fri, Sept 29	noon - Quiz 3
#11	Mon, Oct 2	Population Growth and Regulation (Ch 52, pp. 1142-1156)
#12	Wed, Oct 4	EXAM 1, part 1
	Fri, Oct 6	noon - EXAM 1, part 2
		Biological Evolution
#13	Fri, Oct 6	Mitosis, Meiosis and Genetic Variation (218-226, 239-249)
#14	Mon, Oct 9	Mendel and Probability (251-260)
#15	Wed, Oct 11	Non-Mendelian Genetics (260-268)
#16	Fri, Oct 13	Chromosomes and Linkage (274-281)
	Fri, Oct 13	noon - Quiz 4
#17	Mon, Oct 16	Sex Linkage and Mistakes (282-290)
#18	Wed, Oct 18	History of Evolutionary Thought (438-446)
#20	Fri, Oct 20	Species and Speciation (472-482)
	Fri, Oct 20	noon - Quiz 5
#21	Mon, Oct 23	Mechanisms and Origin of Novelty (482-288)
#22	Wed, Oct 25	Systematics (491-507)

	Fri, Oct 27	*** fall break ***
	Mon, Oct 30	*** fall break ***
#23	Wed, Nov 1	Natural Selection as Mechanism for Evolution (462-470)
#24	Fri, Nov 3	Evidence for Evolution 1, (446-451)
	Fri, Nov 3	noon - Quiz 6
#25	Mon, Nov 6	Evidence for Evolution 2, (446-451)
#26	Wed, Nov 8	Hardy-Weinberg and Changes in Allele Frequency (454-462)
#27	Fri, Nov 10	EXAM 2, part 1
	Fri, Nov 10	noon - EXAM 2, part 2
		Evolutionary Ecology of Communities and Ecosystems
#28	Mon, Nov 13	Evolutionary Population Ecology and Ecological Genetics Reconsidered
#29	Wed, Nov 15	Community Ecology (Ch 53, pp. 1139-1180)
#30	Fri, Nov 17	Competition (reading tba)
	Fri, Nov 17	noon - Quiz 7
#31	Mon, Nov 20	Predation and Parasitism (reading tba)
#32	Wed, Nov 22	Disease (reading tba)
	Fri, Nov 24	*** Thanksgiving break ***
	Mon, Nov 27	Mutualism and Coevolutionary Ecology (reading tba)
#33	Wed, Nov 29	Ecological Disturbance and Regeneration (reading tba)
#34	Fri, Dec 1	Biogeography of Invasion (reading tba)
	Fri, Dec 1	noon - Quiz 8
#35	Mon, Dec 4	Global Ecosystems Ecology (Ch 54, pp. 1184-1208)
#36	Wed, Dec 6	Global Carbon Cycle
#37	Fri, Dec 8	Global Climate Change
	Fri, Dec 8	noon - Quiz 9
#38	Mon, Dec 11	Urban Ecosystems Ecology: Our Last Frontier (Ch 55, pp. 1209-1229)
#39	Wed, Dec 13	Global Ecological Sustainability (reading tba)
#40	Fri, Dec 15	EXAM 3, part 1
	Fri, Dec 15	noon - EXAM 3, part 2
	tba	**FINAL EXAM, Kirkbride Lecture Hall**

Course Objectives.

There are three main objectives of this course:

(1) To improve your biological literacy. This means that you will have an understanding of the physical, chemical, and evolutionary principles that determine how living beings acquire energy and raw materials, assimilate these resources, maintain their bodies, grow, and produce progeny. Biological literacy also includes an understanding of the ecological interrelationships of life on earth. Biological literacy also includes a sense of responsibility for the use of biological knowledge in society.

(2) To improve your understanding of the process of biological inquiry which is the scientific method by which natural phenomena are observed, interpreted, and reported. It is through this process that one gains an understanding of our natural world and the effects of human activities upon it.

3) You will improve your cognitive skills at critical thinking and reflective judgment. As you design, conduct, and present your own ecological research projects in lab, and as you read and critically analyze reference materials, such as your text, to understand the basic molecular, physiological, ecological, and evolutionary principles that govern life, you will be using and improving your higher level thinking and information processing skills.

Over the past half century biology has seen an explosion in academic, social and political activity. Technological advances in biology (especially molecular biology), chemistry, engineering, and computer science, have led to breakthroughs in our understanding of how our bodies work, how and why we resemble our ancestors, and how we can modify and use other living organisms (e.g. bacteria, protists, fungi, plants and animals) to improve our lives.

Yet despite this proliferation of knowledge about living organisms, each new discovery reveals dozens of new questions without answers. Some new questions are purely scientific, such as “how does the brain work?”, or “what are the causes and cures for cancer, AIDS, multiple sclerosis, and a host of other diseases?”

But other questions are of a very different nature, and can only be answered by an examination of our deeply held personal and ethical beliefs, such as “what is life and when is it not worth technologically prolonging it?” “What rights do non-human life forms possess?” Or, “who should have access to our personal medical records that will soon include information about hidden genetic predispositions to expensive diseases that each of us may have?” Thus, like it or not biologists and their applied cousins in the biomedical industry are at the fore-front of major social changes in the new 21st century due to the revolution in biology that occurred in the latter half of the 20th century. It is your responsibility as students in this course to absorb enough understanding of the discipline of biology to become engaged as constructive participants in this debate.

I hope that your experiences in lab this semester will show you first-hand how biological knowledge is constructed from observation and interpretation. It is hoped that you will understand and appreciate the profound and often overwhelming complexity of the living processes within a single organism. I also hope that you will realize the limitations of our present day methods of inquiry. We do not understand from first principles in the vast majority of cases why a living system (cell, tissue, individual, etc.) responds the way it does to any specific environmental factor (e.g. a toxin or disease pathogen). Instead, our knowledge base about biological function, e.g. disease pathology, is almost entirely based upon empirical record-keeping of what worked and what didn't (also known as fishing around in the dark).

This profound level of biological ignorance could not come at a worse time in human history. Due to the unconstrained industries of a few hundred million people in the developed world, and the marginal contribution of 5.5 billion others in the developing world, we now face a planet-wide crisis of environmental degradation. Human caused perturbation of our air, land, and water ...

1. ...threatens our health and productive lifespan,
2. ...threatens the health and function of all life forms in the ecosystems on which we and our domesticated plants and animals depend,
3. ...is presently causing an historically unprecedented rate of global biological extinction, and
4. ...could lead to global climatic warming and the depletion of a thin layer of ozone that protects all surface life from ionizing ultraviolet radiation.

Growing concern over these issues has pushed the science of biology to the forefront of public and political consciousness. Your developing an understanding of biological processes and biological inquiry will equip you with the skills to read global environmental signposts and understand these global threats to the health of ourselves, our children, of other people, of all other organisms as well. Because of the critical role that technology, especially biotechnology, will play in our future if we are to sustain ourselves, your understanding of biology is critical to your evaluating the courses of action we humans need to take in order to competently manage our world.

Course Requirements.

Attendance is required and will benefit your grade. To encourage this, there will be numerous but brief in-class assignments of 10 points each beginning today. But, the bulk of you grade from the lecture portion of this course will be based on your performance in each of the 3 mid-term exams and the final exam (see class schedule).

There is a required lecture text: Campbell and Reese. 2005. Biology. Seventh edition. Pearson/ Benjamin Cummings. New York, NY. This text is well written and well illustrated. I recommend multiple readings of the summaries, "Concept Reviews," at the end of each assigned Ch. For lab we will use an in-house lab manual available for sale from us for $15 during the first week of class.

In addition, there is are required readings in a supplemental text, The Beak of the Finch, by Jonathan Weiner; however, we will place copies on reserve so you will NOT have to purchase this book to complete these assignments (more will be discussed in class).

Regardless of the text readings, you should know that YOUR IN-CLASS NOTES ARE AN IMPORTANT TEXT OF THIS COURSE, and most of your time outside of class should be spent on them using the text Chs as reference. Attached is a little activity that may help you to devise the means to get more out of your in-class notes (lecture_notes.pdf or lecture_notes.doc).

Course Assessment.

The first two lecture exams are worth 100 points, the third is worth 150, and the final exam, which is based on exams 1 and 2, is worth 100 points; thus there is the potential for 450 points from exams. Make up tests are strongly discouraged, however, if you are unable to take a test at the scheduled time AND NOTIFY US ABOUT IT BEFORE THE SCHEDULED EXAM DATE AND TIME, you may set up an appointment to take an essay make-up test during final exam week.

As mentioned above, there will also be numerous 10-20 point in-class quizzes and homework assignments as needed to improve my assessment of your effort and performance in this course. Most of these assignments will be unannounced, and therefore cannot be made up if you missed that class; thus, don’t miss class. These assignments will total 250 points.

Your final grade will be based on your total number of accumulated points, and I will use a +/- grading system. Widener University's policy on cheating and other forms of academic fraud as described in the Student Handbook will be strictly enforced.

We will be enforcing the University-wide class attendance policy as described in the Student Handbook. Students who are absent without a valid excuse (as defined in the Handbook) 4-6 times will receive a 2/3 letter grade reduction, 7-9 times yields a full letter grade, and more than 9 unexcused absences will result in an F. According to the Handbook, if you know you will be absent from class (e.g. due to a prior commitment or lengthy illness) you should notify the Office of the Assistant Provost.

The breakdown of points for this course will be

Exam 1	100 points
Exam 2	100 points
Exam 3	150 points
Final Exam	100 points
In class quizzes and other assignments (TBA)	250 points
total =	700 points

Comments on the Lab Portion of the Course.

The objective of the lab is for you to learn to "do" biology. This means understanding the use of the scientific method in the explanation of biological phenomena.

In the laboratory for this course, you will learn how biological 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. Laboratory activities will span the range from experiences designed to reinforce principles in the lecture portion of the course to more open-ended single and multiweek inquiries during which you will design and conduct experiments and present your results to your peers during in class symposia.

Your syllabus of lab activities will be handed out in lab. Each of the lab exercises has a set of clearly defined expectations and assignments for you to fulfill. Your performance in lab will be assessed by the oral and written reports, assignments, and other evidence over the course of the semester. This will be explained further in lab by your lab instructor. The lab grade accounts for 40% of the total course grade (the exact components of lab assessment will be explained in lab).

Attendance is required in lab. More than 2 unexcused absences results in failure. If you know that you must miss a particular lab, you must make prior arrangements to attend this lab in another section (there are numerous other choices).