

## Vertebrate Evolution: Fall quarter, 2005

### Program Overview

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Program website: <http://academic.evergreen.edu/curricular/vertebrateevolution/>

Familiarize yourself with the website, and check the announcements page often.

**Prerequisites:** Junior or senior standing. At least one year of college-level biology, preferably two. Solid upper-division level writing and library research skills.

**Credit:** 16-units of upper-division science credit will be awarded in evolutionary biology, vertebrate zoology, comparative anatomy (and maybe physiology), and philosophy of science. Lower-division work will be awarded lower-division credit.

### Cautions (or, Is this the program for you?):

Evolution is the cornerstone of modern biology. Forms are modified over time as lineages branch and speciate; natural selection is the primary process that allows lineages to become more complex and fit over time. There was no guiding hand, no grand plan, that produced the forms that we see on the Earth today. Natural selection is definitionally a directionless, aimless process. While religious belief is not contraindicated by evolution—several brilliant evolutionary biologists have been religious—belief in a higher power who had humans in mind all along is not consistent with an evolutionary world view. We are but one of many extant species sharing this planet today, and hold no special place in evolutionary history, but for the fact that we can study and reflect on it. Science and religion do not operate by the same processes; your religious views may well coexist with the study (and acceptance) of evolution. But if you believe in the fixity of life forms, or the predestination of certain forms to exist, or see the evolution of vertebrates as inexorably leading to humans as the pinnacle of life, you should find another program.

In order to truly appreciate the diversity both within and between species, anatomical dissection is the best tool we have. Computer simulations are not an adequate replacement. If you have religious or moral objections to dissection, you should find another program. If you have ecological or health concerns associated with the anatomy lab, you should talk to me about them, but the likely outcome is that I will recommend that you find another program.

Finally, this is an upper-division science program, which has two implications here. First, you should expect to work very hard in this program, both in and outside of class. There are several large, multifaceted assignments that you will be responsible for, as well as abundant weekly tasks. Furthermore, while “science” is not about a litany of memorized facts, but rather about the careful inductive and deductive processes by which we arrive at an increasingly accurate model of the truth, there is, nonetheless, a lot of terminology both in the science of macroevolution and in vertebrate zoology. You will need to learn these terms and concepts quickly. Second, you are expected to embrace the scientific method: understand its inefficiencies and its strengths; and become comfortable and confident formulating hypotheses, determining the predictions of your hypotheses, and trying to falsify your own ideas. If this sounds unfamiliar, read Platt 1964 (see website under Resources); if this description of science does not match your educational goals, you should find another program.

## **Texts and Other Required Purchases and Expenses**

- Dawkins, R. 2004. *The Ancestor's Tale: A Pilgrimage to the Dawn of Evolution*. Houghton Mifflin, New York. ISBN: 0-618-00583-8.
- Brooks, D. R. and McLennan, D. A. 2002. *The Nature of Diversity: An Evolutionary Voyage of Discovery*. University of Chicago Press, Chicago. ISBN: 0-226-07590-7.
- Kardong, K. and Zalisko, E. J. 2005. *Comparative Vertebrate Anatomy: A Laboratory Dissection Guide*, 4th ed. McGraw-Hill Science. ISBN: 0-07-252831-1.
- Lincoln, R. J., Boxshall, G. A. and Clark, P. F. 1998. *A Dictionary of Ecology, Evolution and Systematics*, 2nd ed. Cambridge University Press, Cambridge. ISBN: 052143842X.
- Dissection kit, available from LabStores.
- \$60 submitted to the Cashier, into your student account (take your A#), for lab fees.

## **Readings**

There are a lot of assignments, especially in the first few weeks, and they include substantial readings from the primary literature, which can be quite dense. You are all adults. I expect you to figure out when you already know something (and can therefore skim a section), and when you aren't getting it (and need to go back and reread). Assigned readings in the second half of the quarter will be lighter to allow you to focus more time on your other work in this program.

## **Lecture**

It is my hope that lectures will involve a lot of back-and-forth and questions. You don't want me to just talk at you for several hours each week, and neither do I. Some lectures will include workshops, to help you wrestle with the ideas in a different format. Attendance is required at all lectures, and you are expected to do the reading before showing up. I will rarely reiterate material from the readings during lecture, as that seems like a waste of all of our time, so I will assume that you are familiar with the reading material, and will build on concepts found in the text during lecture.

## **Weekly Quizzes and Study Questions**

For seven weeks during the quarter, you will be given take-home quizzes and study questions on Thursday, both of which will be due the following Monday. The quizzes will be short essays on some topic that we covered the previous week, and I will collect these on Monday mornings to evaluate them individually. Study questions will be more variable and more numerous, and you will discuss your written answers in small groups on Mondays before we reconvene as a class to talk about the material together.

## **Anatomy Lab**

There will be anatomy lab on Monday afternoons, with open lab on Wednesday afternoons. Weeks 1 – 3 will involve skeletal materials—primarily skulls—of a variety of vertebrates. Weeks 4 – 9 will comprise shark and cat dissections and analysis of major anatomical systems. There will be a mini lab-practical at the beginning of lab in week 6, and a comprehensive lab practical in week 10.

## **Computer Lab**

The generation of plausible evolutionary trees using modern theory is made possible with the help of computers. We will spend three weeks in the computer lab working with MacClade, a software program well suited to learning how to manipulate trees. There will

be two homework assignments, and an additional, longer assignment in which you analyze data that you have generated in the anatomy lab.

### **Student-generated lectures**

In teams of two, students will research, prepare and present 30 minute lectures on an anatomical and/or physiological system that they sign up for. Each lecture should cover the basic function of the system in question, and survey major changes in vertebrate evolution within that system. To help focus your efforts, I will provide a list of 5-10 terms that must be covered for your particular system. In addition, several good evolution and anatomy texts are on permanent reserve at the library to use as initial source material in your research. Additional research must include at least four primary sources, and annotated bibliographies will be due on the day the lecture is given. Material from student-generated lectures may show up in quizzes and study questions.

### **Research project**

Each student will choose a topic relevant to this program which is limited in scope, about which substantial research has already been done, but about which there is not complete agreement in the literature. In other words, look for and pick a topic that is still “live,” intellectually and scientifically speaking. Furthermore, you should be able to phrase your topic in the form of a hypothesis, and then set out to falsify or defend that hypothesis by garnering all available research that pertains to it. Your research will include the use of at least 15 primary sources, and will result in both a short research paper (6 - 8 pages), and a poster presentation in week 9. Peer review of your research will occur throughout the quarter. We will discuss details further on Thursday (April 3).

### **Field Activities**

There will be weekly, optional, nature walks led by two of your peers in the program. Details coming soon! The originally planned four day field trip was cancelled due to logistical difficulties.

### **Student Evaluations will be based on:**

- 7 take-home quizzes
- 7 sets of study questions
- One in-class quiz (week 2) on chordate phylogeny (a memory quiz)
- Anatomy lab: two practicals, plus weekly dissection skills and participation
- Computer lab: performance on 3 assignments, and participation during labs
- Student lecture on assigned system in anatomy or physiology, including annotated bibliography
- All aspects of independent research project, including research papers, poster presentations, and peer review
- Attendance at and timeliness in all aspects of the program
- Engagement with the material during lectures, workshops, and other class activities, and willingness to help others learn

The quality of your work, level of understanding, effort, and extent of improvement will all be important in your evaluation.