Vertebrate Evolution Program Description
Fall Quarter 2005

This program provided a detailed exploration of the theoretical and philosophical underpinnings of the study of macroevolution. Some of the questions investigated included "how do we evaluate evidence and truth in a historical science like evolution?", "what is a species?", and "what are the tests of homology in assessing hypotheses of relationship?". Vertebrates provided the empirical model for these investigations. Throughout the quarter, we tracked the innovations found in vertebrates, including the origin of jaws, bone, the amniotic egg, and endothermy; and modifications of character functions, such as in the number of chambers in the heart, the role of lungs/swim bladder in respiration and buoyancy, and the elaboration of major brain regions in various vertebrate clades. The diversity of extant vertebrates was reviewed, with a focus on morphological characters and how those characters enabled organisms to expand into new environments. Extinct forms were discussed for some important transitions, such as the move to land in basal sarcopterygians.

Class sessions primarily entailed interactive lectures and workshops, weekly anatomy labs, and computer labs. Early focus on the vocabulary of phylogenetic systematics (e.g. synapomorphy, homoplasy) and the best current reconstruction of the vertebrate evolutionary tree allowed discussions to quickly expand into topics such as the modes of speciation in vertebrates, and how we can use Agassiz's three-fold parallelism to assess phylogenetic hypotheses. The primary texts used by students were Dawkins' (2004) The Ancestor's Tale; Brooks and McLennan's (2002) The Nature of Diversity; and in the lab, Kardong and Zalisko's (2005) Comparative Vertebrate Anatomy. In computer labs, students learned MacClade, and used this software both to interpret existing datasets, and to analyze their own data, which they generated from skull collections. In the weekly anatomy labs, students studied the skull anatomy of several vertebrate species, and dissected lampreys, salamanders, and cats, focusing on visceral, muscle, circulatory, respiratory, and neuro- anatomy.

Comprehension of the program materials was assessed in multiple ways. Weekly take-home quizzes and study questions were designed to encourage synthesis of theoretical and empirical material, and students were expected to use outside sources in this work. Students also completed three phylogeny (MacClade based) assignments, and an in-class quiz in week 2. There were several in-class workshops, including one on the evolution of flight, feathers, homeothermy, and arboreality in birds. Two lab practicals were given to assess mastery of the material from the anatomy lab. In pairs, students researched and presented 30-minute lectures on an assigned system in anatomy or physiology, and turned in annotated bibliographies from that research. Throughout the quarter, students worked with the primary literature to research a yet unresolved question in vertebrate evolution. Students worked in small groups to peer-review early drafts of each other's work, culminating in research papers and poster presentations in the final week of the quarter.

SUGGESTED COURSE EQUIVALENCIES (in quarter hours): Total: 16

*6 Evolutionary biology
*4 Vertebrate zoology
*4 Comparative anatomy and physiology
*2 Philosophy of science