**The Evolution of Eukaryotes**

Course number: 11:216:401
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Summary of content:
The last decade has seen remarkable advances in our understanding of eukaryote origins and the tree of life. Phylogenetic, molecular genetic, and in particular, genomic work have allowed researchers to erect sophisticated hypotheses about the branching order of eukaryotes, the role of gene transfer in shaping genomes, and the endosymbiotic origin of the mitochondrion and the plastid. These research areas impinge directly on the ecology and evolution of organisms, both uni- and multicellular and their phylogenetic interrelationships. In the course, each of these broad areas will be looked at in detail through lectures, paper-readings, and discussions.

Learning Goals:

-Describe the evolutionary origins, processes and patterns over geologic time.
-Think critically and solve problems using evidence-based reasoning.

Student audience:
Both advanced undergraduate and graduate students at SEBS or SAS will benefit from training in approaches to understanding eukaryote phylogeny from their birth to the interrelationships of extant clades.

Credits: 3 (2 lectures/week)

Prerequisites: Two semesters of general biology (01:119:101/102) or equivalent, AND Fundamentals of Evolution 11:704:251 or equivalent

Course website and online content: A course website will be developed using the ecollege course shell and include readings, gradebook, links to online resources such as websites, articles, interactive materials, and videos, and also contain online self-assessment quizzes and forums for discussions of particular topics.

Course assessment:
2 exams, 2 take-home assignments (one each on phylogenetics & phylogenomics), and 1 larger essay on the evolution of a selected taxonomic group.

Readings: A variety of selected textbook chapters, scientific articles, and writings from popular press.

Evaluation and Grading:

Take-home assignment 1: 10%
Take-home assignment 2: 10%
Midterm 1: 30%
Final exam 2: 30%
Essay: 20%

Hands-on, practical content:

Take-home assignment of a phylogenetic analysis using datasets of DNA sequences from about 20 species using freely available software programs (assignment already developed and implemented in Advanced Plant Systematics). Covers DNA alignment, sequence analysis, and phylogenetic analysis.

Take-home assignment of a phylogenomic analysis using datasets and freely available software programs.

Lectures will incorporate hands-on examples of organismal groups whenever possible.

Lecture content (preliminary):

1. Origin of life (the first DNA/RNA, the first cell, when/where?)
2. Tree of life through history, what have scientists hypothesized?
3. Endosymbiosis and organelle origins
4. Basic phylogenetic methods, concepts and inference of evolution
5. Introduction to take-home assignment in phylogenetics (software demo, etc.)
6. Formation of species, punctuated equilibrium,
7. Extinction, surviving living fossils
8. Genomics as a tool for Tree of Life inference
9. Genomic change through evolutionary time: chromosomal rearrangements, polyploidy
10. Introduction to take-home assignment in phylogenomics
11. Evolution of Life on Earth, a time-line (geological and temporal framework)
12. The major branches of the eukaryote tree of life and their synapomorphies and key evolutionary innovations: Chromalveolates, Rhizaria (ciliates, brown algae, dinoflagellates, etc.)
13. Mid-term exam
14. The major branches… : Chlorobionta I (early plants: red algae, green algae, bryophytes, etc.)
15. The major branches… : Chlorobionta II (early vascular plants: clubmosses, ferns, conifers, etc.)
16. The major branches… : Chlorobionta III (flowering plants)
17. The major branches…: Fungi (suggested guest lecturer: Jim White or other mycologist)
18. The major branches…: Metazoa I (early animals: sponges, cnidarians, early Bilateria, early Protostomia, mollusks, etc.) (possible guest lecturer: David Howe or Karl Kjer)
19. The major branches…: Metazoa II (higher Protostomia: arthropods, arachnids, insects, crustaceans) (possible guest lecturer: David Howe or Karl Kjer)
20. The major branches…: Metazoa III (early Deuterostoma: Echinodermata, early vertebrates, sharks, fishes) (possible guest lecturer: David Howe)
21. The major branches…: Metazoa IV: later Vertebrates: amphibians, dinosaurs, reptiles, birds, turtles, mammals (marsupials etc.,) (possible guest lecturer: Kathleen Scott or Karl Kjer)
22. The major branches…: Metazoa IV: mammals (possible guest lecturer: Kathleen Scott or Karl Kjer)
23. Origin of viruses (suggested guest lecturer: Siobain Duffy)

24. Symbiosis and co-evolution, horizontal gene transfer
25. Evolution of eukaryotic diseases and parasites (malaria etc)
26. Final exam