Integrative Biology 200A "PRINCIPLES OF PHYLOGENETICS: SYSTEMATICS" Syllabus • Spring 2006

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Class meeting time: Tu-Th, 12:30 - 3:30 pm; lecture is in room 3083. Labs are in either the computer teaching room in front of library (Macs), or room 3056 near the IB office (PCs). Lab time can vary also, but will be announced in lecture. Additional drop-in lab sessions will be set up for students to do homework and/or projects.

Tentative schedule:

Jan. 17: Introduction - contemporary issues in systematic biology - what is at stake? (BDM & NH); What is Systematic Biology? History (BDM)
LAB: discussion: student interests

Jan. 19: What is Systematic Biology? Philosophy (BDM)
LAB: Tour of systematics collections, labs, and resources

Jan. 24: The Hennig Principle: synapomorphy; rooting issues (BDM)
LAB: A simple parsimony algorithm by hand (BDM)

Jan. 26: Homology (BDM)
LAB: Compatibility methods by hand (BDM)

Jan. 31: Character analysis -- what is a data matrix? (BDM)
LAB: Introduction to PHYLIP

Feb. 2: Character coding [primary homology, polarity, additivity , etc.]; (KWW)
LAB: Introduction to PAUP

Feb. 7: Morphological data I -- the importance of incorporating fossils into phylogenetics (BDM)
LAB: Introduction to MacClade

Feb. 9 Morphological data II -- ontogeny & structure of plants (BDM)
LAB: **[PROJECT TOPIC DUE]**

Feb. 14: Morphological data III -- ontogeny & structure of animals (KWW)
LAB: Introduction to WinClada, Nona, TNT

Feb. 16: Morphological data IV -- morphometrics (David Lindberg)
LAB: morphometrics

Feb. 21: Molecular data I -- General introduction; types of molecular data (immunological distance; DNA hybridization; allozymes; restriction sites, DNA sequences; genomics) (BDM)
LAB: GENBANK; sequence analysis

Feb. 23: Molecular data II -- Sequence alignment (KWW)
LAB: Introduction to POY, Clustal

Feb. 28: Classification I -- basic principles (monophyly & information content) (BDM)
LAB: discussion of molecular application papers (students to bring papers from their groups)

March 2: Classification II -- species concepts (BDM)
LAB: discussion of species concepts

March 7: Classification III -- DNA barcoding and DNA taxonomy (KWW)
LAB: **discuss progress on projects in class**

March 9: Classification IV -- nomenclature; Zoological and Botanical Codes; practical systematics (KWW)
LAB: The systematic monograph (students to bring papers from their groups)

March 14: Classification V - phylogenetic taxonomy; Phylocode (BDM)
LAB: discussion of phylogenetic taxonomy (all)

March 16: Phylogenetic trees I: reconstruction; models, algorithms & assumptions (BDM)
LAB: advanced PAUP

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March 21: Phylogenetic trees II: Phenetics; distance-based algorithms (KWW)
LAB: UPGMA and neighbor-joining using PAUP
March 23: Phylogenetic trees III: Parsimony (KWW)
LAB: **QUIZ 1** (covers through March 14th)

March 27 - 31: SPRING BREAK

April 4: Phylogenetic trees IV: Maximum likelihood; molecular evolution and phylogenetics (KWW)
LAB: Maximum likelihood applications using PAUP and Modeltest
April 6: Phylogenetic trees V: Bayesian methods (Jimmy McGuire)
LAB: Mr Bayes

April 11: Phylogenetic trees VI: measures of support; methods of testing robustness and threshold values (KWW)
LAB: **discuss progress on projects in class**
April 13: Phylogenetic trees VII: Tree comparisons; consensus methods (KWW)
LAB: Tree comparisons

April 18: Phylogenetic trees VIII: Below the "species level;" phylogeography; dealing with reticulation (BDM)
LAB: advanced PAUP
April 20: Phylogenetic trees IX: Summary -- what are they, really, and what can go wrong? (BDM)
LAB: discussion on the nature of phylogenetic trees, and problem solving

April 25: Phylogenetics and conservations; biodiversity measures (KWW)
LAB: Phylogenetic biodiversity assessment applications
April 27: Historical Biogeography (KWW)
LAB: Biogeographic software; COMPONENT, DIVA

May 2: Introduction to macroevolution (diversification, extinction, coevolution) (BDM)
LAB: Mesquite
May 4: Introduction to comparative methods for evolution, ecology & behavior (BDM)
LAB: advanced MacClade & Mesquite

May 9: Conclusion. Summary, and discussion: the central role of phylogenetic systematics in comparative biology -- future directions?
LAB: **QUIZ 2** (covers March 16th through May 4th)

May 12-19: FINALS WEEK **-- student minisymposium (date to be chosen later)**
-- projects due (May 19th @ 5:00pm)

Requirements & Grading:

($^1/_3$) **Participation**. Do the reading, come to each class and lab, and participate in discussions. Several homework assignments will also be given. **Phylogenetics Discussion Group**: attendance is requested for this student-run group as well -- it includes other faculty and students but complements our course well.

($^1/_3$) **Quizzes.** Two equally-weighted, one-hour quizzes will be given, that emphasize problem solving and conceptual understanding.

($^1/_3$) **Project**. This will be an analysis of the interrelationships (in all senses) among a set of unit taxa. Students select a study group (with approval of the instructors) **by Feb. 9** containing about 4-6 unit taxa. You must be able to obtain actual samples of each unit taxon, which you will study to discover and describe characters, incorporating pertinent literature, databases, etc. This will be followed by an analysis of interrelationships using all major available methodologies. A written report will be turned in during finals week, in the form of a professional journal publication, that is, with an introduction and literature review, materials and methods section, results, and a discussion (being sure to compare results from the different methodologies applied, and to reach some ecological/biogeographic/evolutionary conclusions if possible). We will schedule a minisymposium at the end of the term where students can give a short presentation of their results. **Begin this project immediately -- *"things always take longer than you think, even when you take into account Hofstaeder's Law"*** (Hofstaeder's Law -- from his Göedel, Escher, Bach).

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