Integrative Biology 200A "PRINCIPLES OF PHYLOGENETICS: SYSTEMATICS" Syllabus • Spring 2012

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Class meeting time: Tu-Th, 12:30 - 3:30 pm in 3083 VLSB. Most lab exercises will be done on personal computers -- you need to have access to one to bring to class, preferably a laptop! Labs might sometimes meet in computer room 3056. 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.

Our class web page is: **http://ib.berkeley.edu/courses/ib200a/** -- please check this often as it will have class announcements and answers to questions about the course material.

Tentative schedule:

Jan. 17: Introduction - contemporary issues in systematic biology - what is at stake? (DRL, BDM, KWW, & MJL)
LAB: discussion: student interests; get acquainted roundtable; virtual museum tour

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

Jan. 24: The Hennig Principle: Homology; synapomorphy; rooting issues; Character analysis -- what is a data matrix? (BDM)
LAB: A simple parsimony algorithm by hand (BDM)

Jan. 26: Morphological data I -- ontogeny & structure of animals (DRL)
LAB: Introduction to PHYLIP

Jan 31: Morphological data II -- ontogeny & structure of plants (BDM)
LAB: **PROJECT TOPIC DUE -- discuss in class**

Feb. 2: Morphological data III -- Character coding [primary homology, polarity, additivity, etc.]; (KWW)
LAB: Introduction to Mesquite

Feb. 7: Morphological data IV -- the importance of incorporating fossils into phylogenetics (DRL)
LAB: Introduction to TNT

Feb. 9: Molecular data I -- General introduction; types of molecular data (immunological distance; DNA hybridization; allozymes; restriction sites, DNA sequences, ESTs; genomics) (BDM)
LAB: Introduction to PAUP; Nexus, Newick, FASTA files, gene-order data

Feb. 14: Molecular data II -- Sequence alignment (KWW)
LAB: GENBANK; Clustal; sequence analysis and alignment processing

Feb. 16: Phylogenetic trees I: reconstruction; models, algorithms & assumptions (BDM)
LAB: discussion of molecular application papers (**students to bring papers from their groups**)

Feb. 21: Phylogenetic trees II: Phenetics; distance-based algorithms (DRL)
LAB: UPGMA and neighbor-joining using PAUP

Feb. 23: Phylogenetic trees III: Parsimony (BDM)
LAB: Introduction to POY; CIPRES supercomputer web interface

Feb 28: Phylogenetic trees IV: Maximum likelihood; molecular evolution and phylogenetics (KWW)
LAB: Maximum likelihood applications using PAUP and Modeltest

March 1: Phylogenetic trees V: Measures of support; methods of testing robustness and threshold values (KWW)
LAB: Bootstrap, jackknife, and Bremer support

March 6: Phylogenetic trees VI: Bayesian methods (MJL)
LAB: Mr Bayes

March 8: Phylogenetic trees VII: Dating in the 21st century: divergence times, clocks, & calibrations (DRL)
LAB: R8S, BEAST

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March 13: Phylogenetic trees VIII: Tree-to-tree comparisons; consensus methods (KWW)
LAB: Tree comparisons & consensus; tree viewing & manipulating (FigTree, TreeGraph 2, etc.)
March 15: Classification I -- introduction to phylogenetic classifications (monophyly, information content) (DRL)
LAB: **discuss progress on projects in class; present initial analysis of project dataset**

March 20: Classification II - integrating fossils into classifications (DRL)
LAB: **QUIZ 1** (covers through March 13th)
March 22: Classification III -- phylogenetic taxonomy; Phylocode (DRL)
LAB: discussion of phylogenetic taxonomy

March 26-30: SPRING BREAK

April 3: Classification IV - DNA barcoding and DNA taxonomy (KWW)
LAB: basic intro to scripting in R and Mesquite
April 5: Classification V -- nomenclature; Zoological & Botanical Codes; practical systematics, monography (KWW)
LAB: Online systematic databases: nomenclature, specimens, geography, phylogeny

April 10: Classification VI -- species concepts (BDM)
LAB: discussion of species concepts
April 12: Phylogenetic trees IX: Below the "species level;" phylogeography; dealing with reticulation (BDM)
LAB: **discuss progress on projects in class**

April 17: Morphometrics (DRL)
LAB: morphometrics
April 19: Historical Biogeography (KWW)
LAB: Biogeographic software; COMPONENT, DIVA, Lagrange. etc.

April 24: Introduction to macroevolution (diversification, extinction, coevolution) (DRL)
LAB: Concluding discussion: the central role of phylogenetic systematics in comparative biology -- future directions? (DRL, BDM, KWW, & MJL)
April 26: Introduction to comparative methods for evolution, ecology & behavior (BDM)
LAB: **QUIZ 2** (covers March 15th through 26th)

April 30 - May 11: READING & FINALS WEEKS
-- draft projects due April 30th @ 5:00pm for peer review
-- student minisymposium ca. May 2nd (final date TBA later)
-- peer reviews due May 4th @ 5:00pm
-- final projects due May 9th @ 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. We will have a graded peer-review process as well; each student will do an anonymous peer review of two other student's papers following procedures of a professional journal.

($^1/_3$) **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 Jan. 31**. 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 data and 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 Hofstadter's Law"*** (Hofstadter's Law -- from his Gödel, Escher, Bach).

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