Integrative Biology 200A   "PRINCIPLES OF PHYLOGENETICS: SYSTEMATICS"   Syllabus • Spring 2010
<u>Professors:</u>
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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 are sometimes in room 3056 near
the IB office. 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.

<u>Tentative schedule</u>:
Jan. 19:   Introduction - contemporary issues in systematic biology - what is at stake? (DRL, BDM, KWW, & NJM)
                LAB: discussion: student interests
Jan. 21:   What is Systematic Biology? History & Philosophy (BDM)
                LAB: Tour of systematics collections, labs, and resources

Jan. 26:   The Hennig Principle: Homology; synapomorphy; rooting issues; Character analysis -- what is a
                    data matrix? (BDM)
                LAB: A simple parsimony algorithm by hand (BDM)
Jan. 28:   Morphological data I -- Character coding [primary homology, polarity, additivity , etc.]; (KWW)
                LAB: Introduction to PHYLIP

Feb. 2:   Morphological data II-- the importance of incorporating fossils into phylogenetics (DRL)
                LAB: **PROJECT TOPIC DUE -- discuss in class**
Feb. 4:   Morphological data III -- ontogeny & structure of animals (DRL)
                LAB: Introduction to Mesquite

Feb. 9:   Morphological data IV -- ontogeny & structure of plants (BDM)
                LAB: Discussion on biodiversity discovery and taxonomy with Quentin Wheeler (he is also giving an
                    IB seminar the day before at 4:00, and joining in a Biosystematists discussion this evening)
Feb. 11:   Molecular data I -- General introduction; types of molecular data (immunological distance; DNA
                    hybridization; allozymes; restriction sites, DNA sequences; genomics) (BDM)
                LAB: Introduction to TNT

Feb. 16:   Molecular data II -- Sequence alignment (KWW)
                LAB: GENBANK; Clustal; sequence analysis and alignment
Feb. 18:   Phylogenetic trees I: reconstruction; models, algorithms & assumptions (BDM)
                LAB: Introduction to PAUP; Nexus, Newick, FASTA files, file formats; Alignment processing
                    & display

Feb. 23:   Phylogenetic trees II: Phenetics; distance-based algorithms (DRL)
                LAB: UPGMA and neighbor-joining using PAUP
Feb. 25:   Phylogenetic trees III: Parsimony (KWW)
                LAB: Introduction to POY

March 2:   Phylogenetic trees IV: Maximum likelihood; molecular evolution and phylogenetics (KWW)
                LAB: Maximum likelihood applications using PAUP and Modeltest
March 4:   Phylogenetic trees V: Measures of support; methods of testing robustness and threshold values (KWW)
                LAB: Bootstrap, jackknife, and Bremer support

March 9:   Phylogenetic trees VI: Bayesian methods (NJM)
                LAB: Mr Bayes
March 11:   Phylogenetic trees VII: Tree-to-tree comparisons; consensus methods (KWW)
                LAB: Tree comparisons

March 16:   Classification I -- introduction to phylogenetic classifications (monophyly, information content) (DRL)
             LAB: **discuss progress on projects in class**
March 18   Classification II - integrating fossils into classifications (DRL)
             LAB: **QUIZ 1** (covers through March 11th)

March 22 - 26:   SPRING BREAK

March 30   Classification III -- phylogenetic taxonomy; Phylocode (DRL)
              LAB: discussion of phylogenetic taxonomy
April 1:   Classification IV - DNA barcoding and DNA taxonomy (KWW)
             LAB: discussion of molecular application papers (students to bring papers from their groups)

April 6:   Classification V -- nomenclature; Zoological & Botanical Codes; practical systematics, monography
                (KWW)
             LAB: basic intro to scripting in R and Mesquite
April 8:   Classification VI -- species concepts (BDM)
             LAB: discussion of species concepts

April 13:   Phylogenetic trees VIII: Below the "species level;" phylogeography; dealing with reticulation (BDM)
             LAB: **discuss progress on projects in class**
April 15:   Morphometrics (DRL)
             LAB: morphometrics

April 20:   Dating in the 21st century: estimating divergence times: clocks & calibrations (DRL)
             LAB: R8S, BEAST
April 22:   Historical Biogeography (KWW)
             LAB: Biogeographic software; COMPONENT, DIVA, Lagrange

April 27:   Introduction to macroevolution (diversification, extinction, coevolution)   (DRL)
             LAB: Concluding discussion: the central role of phylogenetic systematics in
                comparative biology -- future directions? (DRL, BDM, KWW, & NJM)
April 29:   Introduction to comparative methods for evolution, ecology & behavior (BDM)
             LAB: **QUIZ 2** (covers March 16th through 29th)

May 3-14:   READING & FINALS WEEKS   **-- student minisymposium (date to be chosen later)**
                                        -- projects due (May 12th @ 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 suggested 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. 2**. 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 Hofstaeder's Law"* (Hofstaeder's Law -- from his Göedel, Escher, Bach).