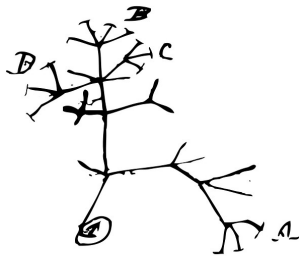


**SIO147-Applications in Phylogenetics: 6 units Winter 2021: Mon. & Wed.****Lecture: 12:30-1:50pm; Lab: 2-5:50pm****Both recorded on Zoom for later access****Location: Zoom****Course Instructor: Greg Rouse: [grouse@ucsd.edu](mailto:grouse@ucsd.edu)****Office hour Friday 1.30-2.30pm; Zoom schedule via email****Teaching Assistant: Marina McCowin: [marruda@ucsd.edu](mailto:marruda@ucsd.edu)****Office hour TBA; Schedule via Zoom***I think*

sciencemercy

This course will review some of the tremendous variety of methods for constructing phylogenetic trees using morphological and molecular data. The various options are outlined and critically examined, along with relevant software. There will be a lectures on a series of relevant topics followed by practical classes where both morphological and molecular data will be explored through a series of exercises. The uses of the resulting phylogenetic trees (e.g., evolutionary and ecological transformations, biodiversity measurements, biogeography, systematics and taxonomy) are further examined through an independent project. A presentation as a talk or poster a short write-up of the project are required at the end.

There is no textbook. Reading will be assigned as needed. If you want to do some background reading, have a look at the free electronic resource through the UCSD library:

E.O. Wiley & Bruce S. Lieberman 2011. Phylogenetics: theory and practice of phylogenetics systematics. 2nd edition <http://roger.ucsd.edu/record=b7094662~S9>

**Assessment****Midterm At Home Quiz in Week 5 = 10%****Practical Work = 20%.** Submit this twice in the Quarter**Project (~5 page max.: 30%); poster/talk presentation (10%) = 40%.****Final exam: At Home Open Book = 30%. Wed. March 17****The project writeup is due Friday March 12 (end of week 10).**

Academic Integrity is expected. Cheating will not be tolerated.

<https://academicintegrity.ucsd.edu/forms/form-pledge.html>

## Lectures

### Week 1.

**January 4** Introduction to systematics, tree-thinking, basic terminology.

**January 6** Morphology, characters and parsimony analysis, similarity and homology-statements, basic tree calculations, tree rooting.

### Week 2.

**January 11** Parsimony, tree searching, multiple equally parsimonious trees & consensus.

**January 13** Assessing support for trees; bootstrap, jackknife. Character coding. Transformations, AccTran, DelTran.

### Week 3.

**January 18** Martin Luther King, Jr. Holiday

**January 20** Molecular sequence data 1. Alignment, Clustal Muscle, MAFFT

### Week 4.

**January 25** Molecular Sequence Data 2. Alternatives to Parsimony: Distance methods, Models and Maximum Likelihood.

**January 27** Molecular sequence data 3. Bayesian methods. (Practice quiz)

### Week 5.

**February 1** Combining data; causes and issues with incongruence

**February 3** Hypothesis testing (and Midterm Quiz =10%).

### Week 6.

**February 8** The comparative method and phylogenetic trees.

**February 10** Historical biogeography/Phylogeography.

### Week 7.

**February 15** Presidents' Day Holiday.

**February 17** Fossils, molecular clocks and dating on trees.

### Week 8.

**February 22** Key innovations/diversification rates/cospeciation.

**February 24** Current Nomenclature; Biodiversity measurement; Surrogacy.

### Week 9.

**March 1** Species.

**March 3** Biodiversity and DNA barcoding.

### Week 10.

**March 8** Next Gen Approaches to Phylogenetics

**March 10** Presentations.

## Practicals

### Week 1

**January 4.** Parsimony analysis. Hand exercises using Caminalacules & Parrots; Taxonomy exercises involving trees.

**January 6.** Introduction to PAUP\* and Mesquite. Data entry, Nexus format, Tree manipulation, Character tracing. Executing files, Managing data (include exclude taxa, characters, annotations footnotes and images). Defining assumptions, Searching for trees. Describing trees, Searching methods under parsimony, Saving trees. Rooting trees. Vertebrates, Parrots.

### Week 2

**January 11.** Continue using PAUP, Mesquite & FigTree to become familiar with the programs. Tree Searching, Consensus trees and Tree support methods; Bootstrap and Jackknife analysis; Beardworms and Ventworms, Vertebrates, Parrots.

**January 13.** Tracing the history of character evolution. Cirratuliform worms; Sharks and Rays. Fruit forms and habitats; Spiders mutilation and cannibalism.

### Week 3

**January 18.** Martin Luther King, Jr. Holiday

**January 20.** Molecular data 1. Basic Alignment and Parsimony Analysis. GenBank. Using Clustal and MUSCLE in Mesquite. Species exercise. What is the status of the Polar bear?

### Week 4

**January 25** Molecular data 2. Distance and Neighbor-Joining. Incorporating models of molecular evolution into datasets. Using jModelTest. Maximum Likelihood in RaXML. Long branch attraction. Ursidae; Strepsiptera.

**January 27** (Practice quiz) Phylogenetic analysis of molecular data 3. MP and Likelihood (Anglerfish) and then Bayesian Statistical approaches to tree building; jModelTest and Bayesian approaches (MrBayes). Primates.

### Week 5

**February 1** Review of methods to date. Giant clams.

**February 3** Midterm Quiz for 10%. Combining Data and Hypothesis testing. Featherworms.  
**Send PracWork as PDF to Marina**

### Week 6

**February 8** Comparative method and trees exercises. Correlated evolution revisited. Syngnathidae and Sea dragons.

**February 10** Integrating geography & DNA I: Historical biogeography Crayfish and Iguanas.

**Week 7****February 15** Presidents' Day Holiday**February 17** Integrating geography and & DNA II: Phylogeography. Sea slugs, featherstars, seastars.**Week 8****February 21** Molecular clocks and divergence times (Primates and boneworms).**February 23** Diversification rates (*Conus*), and cospeciation.**Week 9****March 1** Revise methods session: Penguins/ Start Individual projects.  
**Send PracWork as PDF to Marina****March 3** Individual projects and consultation with Greg and Marina.**Week 10****March 8** Individual projects and consultation with Greg and Marina.**March 10** Presentations/Posters: ~10 minutes each.