

## PCB6677 Molecular Evolution and Phylogenetics

UCF, Fall 2017

**Class Meeting Time:** Monday 5:30 – 8:20pm, BIO 0305

**Instructor:**

Dr. Barbara Sharanowski  
Biology 441/442, phone: 823-0675  
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**Office Hours:** Monday 1:30-3:30pm, Wednesday 1:30-3:30pm, and by appointment

**Scope:**

The practical course will cover theory and practice of phylogenetic inference using molecular data. Students will learn to use common and current bioinformatics software (e.g., for sequence searching, similarity, homology, and alignment) and phylogenetics software for various inference methods (maximum likelihood, Bayesian, parsimony, coalescence). The class will include lecture content to provide background information, but will also include computer time learning to use the relevant software programs. You will be expected to do all *assigned* readings outside of class time and come to class prepared for the day's topic.

**Text Book and materials:**

There is no assigned text, but there will be assigned readings handed out in class. Some textbooks of interest:

1. Lemey, P. Salemi, M. Vandamme, A-M (eds.) 2009. The phylogenetic handbook: a practical approach to phylogenetic analysis and hypothesis testing. Cambridge University Press, Cambridge, 2<sup>nd</sup> ed.
2. Felsenstein, J.(2004). Inferring Phylogenies. Sinauer Associates, Sunderland, MA.
3. Paradis, Emmanuel (2011). *Analysis of Phylogenetics and Evolution with R*. Springer Science & Business Media.
4. Posada, D. (ed). *Bioinformatics for DNA sequence analysis*. New York: Humana Press.

Also included on the syllabus are additional reference materials, websites, and links for downloading computer software.

**Course Philosophy**

***Students' Learning Responsibilities***

Students are expected to practice personal and academic integrity and to take responsibility for one's own personal and academic commitments. Within the context of this class, regular attendance is critical to facilitate effective learning. Participation in class is expected and heavily encouraged. Students should respect others and contribute to cooperative learning by promoting a respectful atmosphere and striving to learn from differences in people, ideas, and opinions. Students are expected to be prepared for class and submit assignments on time. Students are highly encouraged to ask for help under any circumstances, but particularly if having difficulty with material or learning.

**Instructor's Notes:**

The instructor reserves the right to make changes to the syllabus and the management of the class at any time during the semester. These changes will be announced in lecture. If the student is in disagreement with anything contained within the syllabus (e.g. course material, structure, grading policy, etc), it is recommended that the student withdraw from the course prior to the university posted deadline. The instructor also reserves the right to adjust grades up or down upon a request for a re-assessment by the student.

**Student Learning Outcomes:**

After completion of the course, students should be able to:

***(Cognitive)***

- Know what types of molecular data are appropriate for different research questions
- Understand how DNA evolves and its implications for evolution
- Formulate appropriate phylogenetic-based questions relevant to own research
- Understand what types of phylogenetic analysis are appropriate for different research questions
- Know how to interpret and discuss phylogenetic results
- Critically evaluate and discuss theoretical and empirical research articles in phylogenetics and molecular evolution

***(Behavioral)***

- Design effective primers
- Perform bioinformatics searches to retrieve molecular data from relevant databases
- Align different types of molecular data and format files for downstream phylogenetic analysis
- Perform thorough parsimony, Bayesian, maximum likelihood phylogenetic analyses and test the robustness of those analyses
- Estimate divergence times for lineages

***(Affective)***

- Understand the value and importance of phylogenetic research
- Appreciate the importance of a theoretical foundation in phylogenetic research
- Grasp the speed of technological change in molecular biology and its impact on phylogenetic research

**Disability Access Statement:**

The University of Central Florida is committed to providing reasonable accommodations for all persons with disabilities. This syllabus is available in alternate formats upon request. Students with disabilities who need accommodations in this course must contact the professor at the beginning of the semester to discuss needed accommodations. Students who need accommodations must be registered with Student Disability Services, Student Resource Center Room 132, phone (407) 823-2371, TTY/TDD only phone (407) 823-2116, before requesting accommodations from the professor.

**Inquiries to the Instructor:**

Students are encouraged to discuss issues pertaining to assignments with the instructor well in advance of deadlines. While every effort will be made to return student inquiries via email as soon as possible, students should expect a minimum of 24 hours to receive a response. Students are encouraged to drop by the instructor's office for assistance (Room BIO 441/442), particularly during office hours.

### **Instructional Methods:**

This course combines traditional lecture and interactive computer labs to achieve course and learning objectives. Traditional lectures are intended to introduce the major concepts and theory in molecular evolution, bioinformatics, and phylogenetics. During computer lab sessions students will practice analyzing data. Assignments and exams test knowledge related to theory and analysis of molecular data.

### **Late Assignments:**

Late assignments will be deducted 10% of the final grade for that assignment for every 24-hour period it is late. Assignments must be submitted at class time on the date and time due. Late is considered past the set time noted in the due date. Thus, if an assignment is due at 5:30pm and is handed in at 11pm on the same day, it is still considered 1 day late. Late assignments should be handed in to the instructor in class.

### **Missed Assignments:**

To pass the course, all items for which a mark is allocated must be completed and submitted. Unexcused missed assignments will result in a failure of the class. Where assignments are missed and excused through written notification such as a doctor's certification of illness, evidence of death in the family, or other circumstances that are beyond the control of the student, the student may be given the following options:

- 1) Complete the assignment and receive the late assignment penalty as described above,
- 2) Establish a new due date with the instructor and complete the assignment without penalty when handed in by the new due date, or
- 3) The final grade will be determined by increasing the value of the midterm or final exam (for missed assignments or missed class midterm) by the amount that would have been allocated to the missed assignment. **Option three is only viable under extreme circumstances.**

### **Missed Exams:**

See above. However all students must write the final exam. If the final exam has been missed for a valid, documented reason such as illness, or death in the family, another exam date will be set at the discretion of the instructor.

### **Classroom Conduct:**

By enrolling at UCF, all students have agreed to abide by the Golden Rule. Please become familiar with this document at: <http://www.goldenrule.sdes.ucf.edu/>. Please also use common courtesy in class by arriving and departing on time, refraining from sleeping/ talking during class, and **turning off** cell phones, music devices, etc. Students are responsible for all announcements made or assignments given during class. Students who fail to abide by the above may be asked to leave the class.

### **Academic Integrity:**

Plagiarism or any other form of cheating in examinations, term tests or academic work is subject to serious academic penalty. Cheating in examinations or tests may take the form of copying from another student or bringing unauthorized materials into the exam room, including cell phones or computational devices. Exam cheating can also include exam impersonation. A student found guilty of contributing to cheating in examinations or assignments is also subject to serious academic penalty. Plagiarism involves an attempt to pass off the work and ideas of others as one's own and is considered cheating. Citing all sources for ideas, images, or otherwise is essential. Students must cite the source of images used in

their presentations, but are encouraged to take their own photographs. Students should acquaint themselves with the University's policy on plagiarism, cheating, exam impersonation, and duplicate submission (see <http://www.goldenrule.sdes.ucf.edu/>). Electronic detection tools may be used to screen assignments in cases of suspected plagiarism.

### **Assessment and Grades:**

**Assignments:** Each worth 5% - (8 assignments = 40% of final grade)

1. Primer Design Assignment
2. BLAST Assignment
3. Sequence Alignment Assignment
4. MEGA, Model Test, Partition Assignment
5. Tree assignment
6. Parsimony Assignment
7. Bayesian Assignment
8. BEAST assignment

### **Exams:**

1. Midterm Exam (25%)
2. Final Exam (35%)

***Grading Scheme:*** A = 100-90; B = 89-80; C=79-70; D=69-60; E/F (fail) < 60

### **Course Schedule:**

See Handout

### **Software Links:**

- Bioedit (PC): <http://bit.ly/yV1LAP>;
- Primer 3: <http://bit.ly/197ln7>
- EBI Alignment: <http://www.ebi.ac.uk/Tools/msa/mafft/>
- MEGA (for MAC and PC): <http://www.megasoftware.net/>;
- PAUP\* <http://paup.sc.fsu.edu/downl.html>
- PAUPup (PCs): <http://bit.ly/6lzu1C>;
- jModeltest: <http://jmodeltest.org/> - requires registration
- Phylemon: <http://phylemon.bioinfo.cipf.es/> - requires registration
- CIPRES Portal: [http://www.phylo.org/sub\\_sections/portal/](http://www.phylo.org/sub_sections/portal/) - requires registration
- FigTree: <http://bit.ly/2MGHxn>
- MrBayes: <http://mrbayes.sourceforge.net/>
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**Course schedule:** (Note this is tentative and may be subject to change)

Date	Day	Lecture Topic	Hands on Lab	Tests and Assignments
21-Aug	M	Intro, Genes/Genomes, Mutation/PCR/Primer Design	Primer 3 and Bioedit Demo	
28-Aug	M	File formats, Bioinformatics, NCBI	NCBI	Primer Design Assignment
4-Sep	M	Labor Day	NCBI tutorials on your own	
11-Sep	M	Multiple Sequence Alignment	MAFFT, MEGA	Blast Assignment
18-Sep	M	Genetic Distances, Models, Model testing	jModel Test, PartitionFinder	Sequence Alignment Assignment
25-Sep	M	Phylogenetic Theory 1		Model Test Assignment
2-Oct	M	Phylogenetic Theory 2		Tree Assignment
9-Oct	M	History, Parsimony, NJ		
16-Oct	M	Maximum Likelihood	CIPRES, RaxML	Parsimony Assignment
23-Oct	M	Midterm Exam		
30-Oct	M	Bayesian, Tracer	MrBayes	
6-Nov	M	ESA - TBA		Bayesian Assignment
13-Nov	M	Divergence Time analyses	BEAST	
20-Nov	M	Orthology Paralogy, Gene trees, Coalescent Models	ASTRAL	BEAST Assignment
27-Nov	M	ASR, Co-phylogeny	Mesquite, APE	