

Molecular Marine Biology
BI 457/557 Winter 2017

Syllabus

This course introduces students, whose primary interests are in marine biology, especially at organismal and ecosystem level, to molecular methods. The course offers hands-on experience with basic universally applicable molecular techniques in the context of small-scale research projects focused on marine organisms. Students practice DNA extraction, gel electrophoresis, PCR, and DNA sequence analysis, generate novel sequence data, and learn to analyze it using public databases and a variety of sequence and phylogenetic analysis software. Most of the class time is spent on laboratory exercises, tutorials, lectures, and paper discussions. Each week students read and discuss scientific papers that illustrate use of molecular methods in the field of marine biology. Each student is expected to maintain a detailed laboratory notebook. Students write a final research project paper, and present results to the class.

Learning goals:

1. Become familiar with how molecular techniques are applied in marine biology by reading and discussing relevant scientific literature and participating in research projects.
2. Gain laboratory experience and become comfortable with basic molecular techniques.
3. Be able to analyze DNA sequence data using a variety of software tools.
4. Be able to keep an informative laboratory notebook.
5. Gain or improve skills writing a scientific report paper.

Instructor: Dr. Svetlana Maslakova svetlana@uoregon.edu

Teaching Assistant: Kara Robbins (krobbin3@uoregon.edu)

Class meets in the McConnaughey teaching lab at the OIMB
9:00 - 17:00 Wednesdays
11:00 - noon Fridays

Office Hours: by appointment

Required reading: Download weekly assignments from Canvas.

Week 1 (Jan 11, Jan 13) Introduction to course and individual research projects (identification of planktonic larvae using DNA sequence data). **Lecture:** Molecular methods in marine biology. **Lab:** Choose samples for DNA-barcoding. (micro)Pipetting practice. DNA extraction from individual planktonic organisms using InstaGene matrix. **Assignment 1** - choose papers for discussion (see Canvas). **Due by Wed Jan 18. Sign up for the first discussion by end of 1/11.** **Friday:** paper discussion - species identification using DNA-barcoding.

Week 2 (Jan 18, Jan 20) Lecture: Polymerase Chain Reaction (PCR). Lab: PCR, gel electrophoresis: amplify two standard “barcoding” gene markers from DNA extracted during Week 1. Meet individually with instructor for notebook review and advice. Interpreting PCR results from agarose gels, troubleshooting strategies. Friday: PCR troubleshooting.

Week 3 (Jan 25, Jan 27). Quiz 1: Interpreting results of PCR. Lecture: DNA sequencing. Lab: PCR product purification and quantification. Sample prep for sequencing. **Assignment 2 (due Feb 1)** - explain the results and propose troubleshooting strategies for each of your PCR samples. Friday: paper discussion - species delimitation.

Week 4 (Feb 1, Feb 3) Lab: DNA extraction using column-based methods (Qiagen DNEasy kit). Tutorial: DNA sequence analysis (using Codon Code Aligner software, NCBI Blast web-tools). Choose group research projects, define research groups. **Assignment 3 (due Feb 8)** - Individual project write-up (1 page); sequence analysis (chromatogram quality, trimming primer sequences, Blast) and 5 min presentation of results. Friday: paper discussion - identification of gut contents.

Week 5 (Feb 8, Feb 10) Students present results of individual research projects (5 min each). Lab: Begin work on group research projects (sample collection, DNA extraction, PCR). Friday: paper discussion -population connectivity.

Week 6 (Feb 15, Feb 17). Quiz 2 - sequence analysis. Lecture: Sequence alignment, measuring change. Lab: Sequence alignment, using ClustalX; tree-viewing software. Continue work on research projects (PCR troubleshooting; PCR product purification, quantification, prep for sequencing). **Assignment 4 (due Feb 22)** - sequence alignment. Friday: paper discussion - marine microbiology.

Week 7 (Feb 22, Feb 24) Lecture: Phylogenetic analysis using parsimony, consensus trees, clade support. Lab: Using PAUP software. Continue working on projects (Sequence analysis; PCR product purification, quantification, prep for sequencing). **Assignment 5 (due Mar 1)** - distance trees (Neighbour-Joining) and parsimony phylogenetic analysis using PAUP. Friday: paper discussion - marine conservation.

Week 8 (Mar 1, Mar 3) Quiz 3 - phylogenetic analysis. Lecture: Analysis of protein coding sequences. Lab: Continue work on projects (sequence analysis). Tutorial: TCS - building haplotype networks using statistical parsimony. Friday: paper discussion - phylogeny and evolution.

Week 9 (Mar 8, Mar 10) Quiz 4 - protein coding sequences. Lecture: Species delimitation. Lab: Continue work on projects. Discuss project results. Draft final paper. Friday: paper discussion - marine drug discovery.

Week 10 (Mar 15, Mar 17) Lab: Archive project samples and data. Lab clean up. Work on final paper, each research group meets with instructor to get feedback on project outcome, plan for presentation, class paper. Friday: **Group research project presentations** (15 min each group, including time for questions).

***** **Project papers and notebooks are due Mar 22** *****

Participation in class

Students are expected to keep track of class schedule and participate in all class activities, including the final lab clean up. If you are unable to attend some activity, notify the instructor as soon as possible to discuss how you can make up missed class. Tardiness and absences without a respectable reason or prior approval from instructor will negatively effect the grade.

Research projects

The main purpose of this course is to provide a significant laboratory experience and exposure to standard molecular laboratory techniques. It is much more interesting to learn techniques while using them for something meaningful - e.g. in a context of a research project. We will dive right into **Individual research projects** on day 1: DNA-identification of planktonic larvae of marine invertebrates. Instructor and TA will provide the samples. Each student will get 2-4 unidentified larval samples to extract DNA from, and work individually to attempt to identify them using DNA sequence data in subsequent weeks. Each student will report results in a short (5 min) presentation during Week 5. **Group research project:** During Week 5 students will split into groups (3-5 per group) and being to carry out research projects of their choosing (prior consultation and approval by instructor is required to ensure feasibility) utilizing laboratory methods learned in weeks 1-4. Because it is often difficult for students to come up with a feasible research project on their own, instructor will make suggestions.

Laboratory notebook

Students are expected to maintain a high-quality laboratory notebook. The notebook should contain notes on where, when, how and by whom the samples were collected and stored, how DNA was extracted, parameters of PCR reactions, including primer names and sequences, results of gel electrophoresis: annotated pictures of gels (so it is clear which band on the picture corresponds to which sample) and so on. Be as detailed as is necessary for you to be able to 1) repeat each procedure independently, and 2) reconstruct exactly how the data was obtained and, which tube in the freezer corresponds to which sample. It is important to note deviations from the standard protocols and operator errors (mislabeled tubes, uncertainties about labels or compositions of reaction mixtures and so on). It is not necessary to copy standard protocols into the notebook. Simply attach the protocol, and refer to it. *During Week 2 we will have brief one-on-one meetings with the instructor to review the notebooks.*

Paper discussions

Reading and discussing current scientific literature is one of the more intellectually stimulating aspects of this course. We will use a strategy called "jigsaw" (see separate handout) to break up into small groups for discussion (3 papers per week). Points to consider when reading and presenting a paper: What is the topic/main question/purpose of the study? What are the methods? What are the main findings? Is there any controversy in the interpretation?

Assessment and Grading:

Assignments (5) 25%	97-100 A+
Quizzes (4) 20%	93-96.9 A
Lab notebook 10%	90-92.9 A-
Participation in group research project 15%	87-89.9 B+
Participation in paper discussions 10%	83-86.9 B
Final group presentations 10%	80-82.9 B-
Final group papers 10%	77-79.9 C+
	73-76.9 C
	70-72.9 C-
	67-69.9 D+
	63-66.9 D
	60-62.9 D-
	<59.9 = F

According to UO Graduate School rules issued in summer 09, the GTF has the following limitations and opportunities. The Marine Molecular Biology BI 457/557 will adhere to these policies:

GTFs may not be involved in any aspect of the evaluation of graduate students. More specifically, they are prohibited from:

- o Evaluating graduate student work.
- o Teaching classes to graduate students.
- o Organizing and facilitating discussion sections in which other graduate students participate.
- o Entering grades for graduate students.

GTFs assigned to graduate-level courses are permitted to:

- o Answer questions that clarify the structure of class assignments.
- o Organize assigning students to project work groups.
- o Provide an initial review of email messages, forwarding any questions about the academic content of the course to the instructor. They may answer administrative questions.
- o Handle and monitor paper submission and return (as long as grades are not visible).
- o Be the first source of information for students about deadlines, format requirements, and any non-content issues.
- o Monitor, but not participate in, Blackboard discussions in a manner that does not involve evaluating academic content of conversations.
- o Monitor attendance.
- o Participate in other classroom management duties that do not involve the academic content of the course or evaluations of student mastery of that content.