Molecular Marine Biology
BI 457/557 Fall 2023

Syllabus

This course is designed more like a research apprenticeship, than a typical course. It 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. Each student will conduct one individual research project (weeks 1-5) and participate in a group research projects (weeks 5-10). Students carry out 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 specialized software packages and on-line tools. We read and discuss relevant scientific literature that showcases the utility of molecular methods in the field of Marine Biology. Students write a group project paper, and present results of research projects to the class.

Learning goals:

1. Become familiar with how molecular techniques are applied in marine biology by participating in individual and group research projects, and reading and discussing primary literature.
2. Acquire molecular laboratory experience.
3. Be able analyze DNA sequence data using specialized software and databases.
4. Gain or improve skills writing a research report paper, and presenting results.

Instructor: Dr. Svetlana Maslakova svetlana@uoregon.edu

Teaching Assistant: Nicole Nakata (nnakata@uoregon.edu)

Class meets on Wednesdays 8:30 - 17:00, with a break for lunch 12:00-13:00. All class activities will be **in-person** in the McConnaughey teaching Lab at the OIMB (except for the week of Thanksgiving, when we will meet remotely to analyze data and discuss results).

Attendance: Students are expected to participate in all class activities. Making up lab work is usually not possible. Attendance constitutes 20% of the total grade, so missing one out of ten weeks of class corresponds to 2% of the total grade. Instructor will not discriminate between "excused" or "unexcused" absences, except for the documented and verifiable reasons outlined in the UO policies on religious accommodation, accessible education, or University-sponsored events: **https://provost.uoregon.edu/course-attendance-and-engagement-policy**

Research projects:
The main purpose of this course is to provide a significant hands-on experience with standard molecular laboratory techniques in a context of research projects. We will dive right into **individual research projects** on day 1: DNA-identification of microscopic planktonic organisms. Each student will pick out and extract DNA from 3 different planktonic organisms and attempt to identify these using DNA sequence data. During weeks 1-4 students will learn the relevant techniques, obtain and analyze the sequence data. Each student will report results in a short (5 min) presentation during Week 5. **Group research project**: During Weeks 5-9 the class students will work together as a group (groups) on a research project(s), while continuing to learn methods of DNA sequence analysis.

Laboratory notebook:
All students are expected to maintain a detailed laboratory notebook. The notebook should allow you to be able to 1) reproduce each procedure, and 2) reconstruct exactly how the data were obtained (e.g. which DNA extraction corresponds to which original sample, where that sample came from, which PCR tube corresponds to which DNA extraction, which sequence corresponds to which PCR etc.). It is important to note any deviations from standard protocols and operator errors (mislabeled tubes, uncertainties about labels and so on). The notebook should contain notes on how DNA was extracted (which protocol used), parameters of PCR reactions (primers, annealing temperatures), results of gel electrophoresis (annotated pictures of gels), and so on. Lab notebooks will not be graded. But I am happy to provide verbal feedback to help you learn how to keep a good lab notebook. As a group, we will keep track of samples in the form of shared on-line spreadsheets (Google sheets), but each student will also need to keep track of the samples they work on, individually.

Paper discussions:
Reading and discussing current scientific literature is one of the most intellectually stimulating aspects of this course. There will be a total of 8 discussion sessions (2 papers per week, during weeks 2-9). See separate handout on Canvas that explains student roles during discussion.

Assessment and Grading:

Assignments (6) 50%

1. Sign up for discussion papers (not graded)
2. Interpreting and troubleshooting PCR (10 %)
3. Individual research project (20%)
4. Sequence alignment, building and interpreting phylogenetic trees (10%)
5. Group research project paper **draft** (not graded)
6. Group research paper **final** (10%, group graded)

Quizzes (4) 20%

Attendance (10) 20%

Paper discussions (8) 10%

97-100	A+
93-96.9	A
90-92.9	A-
87-89.9	B+
83-86.9	B
80-82.9	B-
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

Communication and Office Hours: We will post important course announcements on Canvas. Please, make sure to configure your Canvas so that you receive these announcements via e-mail. I will not hold regularly scheduled office hours, but anticipate scheduling meetings with students on a need-basis. Please, contact me to set a time that works for you, if you wish to meet outside regular class hours. These meetings can be in-person or on Zoom. I also welcome questions over e-mail. If you contact me with a question, I will try to respond within one business day. I strive to grade and provide feedback on quizzes and assignments within one week.

Accessing course materials: Download all course materials from Canvas. Log into canvas.uoregon.edu using your DuckID to access our class. If you have questions about accessing and using Canvas, visit the Canvas support page. Canvas and Technology Support also is available by phone or live chat: 541-346-4357 livehelp.uoregon.edu

Inclusive learning environment. The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 360 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu(link sends e-mail)

UO COVID-19 Regulations:

- **Check your symptoms**. Don't come to campus sick
- **Masks are welcome** on campus.
- Students and employees are **highly recommended** to be up to date with their COVID-19 vaccinations.
- If you have tested positive, develop symptoms, or think you have been exposed to COVID-19 follow the Centers for Disease Control and Prevention (CDC) guide to determine whether isolation or testing is needed and appropriate next steps.

See https://coronavirus.uoregon.edu/ and OIMB-specific instructions in your welcome package for more information.

Mental Health and Wellness:

Life at college can be very complicated. Students often feel overwhelmed or stressed, experience anxiety or depression, struggle with relationships, or just need help navigating challenges in their life. If you're facing such challenges, you don't need to handle them on your own — there's help and support on campus.

As your instructor if I believe you may need additional support, I will express my concerns, the reasons for them, and refer you to resources that might be helpful. It is not my intention to know the details of what might be bothering you, but simply to let you know I care and that help is available. Getting help is a courageous thing to do—for yourself and those you care about.

University Health Services help students cope with difficult emotions and life stressors. If you need general resources on coping with stress or want to talk with another student who has been in the same place as you, visit the Duck Nest (located in the EMU on the ground floor) and get help from one of the specially trained Peer Wellness Advocates. Find out more at health.uoregon.edu/ducknest.

University Counseling Services (UCS) has a team of dedicated staff members to support you with your concerns, many of whom can provide identity-based support. All clinical services are free and confidential. Find out more at counseling.uoregon.edu or by calling 541-346-3227 (anytime UCS is closed, the After-Hours Support and Crisis Line is available by calling this same number).

Course outline

Week 1 (Sept 27) Introduction to the course and individual research projects. *Lecture 1:* Molecular Methods in Marine Biology. *Lecture 2:* Barcoding marine larvae. *Lab:* Plankton sorting, selecting and photographic samples for DNA extraction. Pipetting practice. DNA extraction from planktonic organisms using Instagene matrix. **Students sign up for discussion papers (Assignment 1, due by end of Week 1).**

Week 2 (Oct 4) *Lecture 3:* Polymerase Chain Reaction (PCR). *Lab*: Amplifying two DNA-barcoding gene markers from DNA extracted during Week 1. Loading, running and imaging agarose gels. Interpreting PCR results, troubleshooting strategies. *Paper discussion*.

Week 3 (Oct 11). *Lecture 4:* DNA sequencing. *Lecture 5:* Species delimitation. *Lab:* PCR purification, send purified samples for sequencing. **Assignment 2 (due Oct 18)** — explain the results of PCR and propose troubleshooting strategies for each of your samples extracted and amplified during Weeks 1-2. *Paper discussion.*

Week 4 (Oct 18) *Lab:* DNA extraction using a column-based method (Qiagen DNEasy, G-spin Total DNA Extraction kit or an equivalent). *Software tutorial*: DNA sequence analysis: trimming, proofreading, BLASTing (Geneious, NCBI), interpreting results. *Discussion of the group research project(s).* **Assignment 3 (due Oct 25) —** Individual project sequence analysis, write-up (~ 1 page), presentation (~ 5 min). *Paper discussion.*

Week 5 (Oct 25) Students present results of individual research projects. *Lab:* **Group research project** (DNA extraction of previously lysed samples using DNEasy kit, PCR amplification of COI gene). *Paper discussion.*

Week 6 (Nov 1). *Lab*: **Group research project** (PCR amplification of remaining samples, PCR purification of successfully amplified samples, send first round of samples for sequencing, PCR troubleshooting). *Lecture 6:* Sequence alignment, measuring change. *Paper discussion*.

Week 7 (Nov 8) *Lab:* **Group research project** (PCR troubleshooting, PCR purification, send samples off to sequence). *Lecture 7:* Phylogenetic analysis, consensus trees, clade support. *Software tutorial:* Sequence alignment and building distance trees using Geneious, viewing and saving trees. *Paper discussion*. **Assignment 4:** sequence alignment, building and interpreting trees **(due Nov 15)**.

Week 8 (Nov 15) *Lab:* **Group research project** (DNA sequence analysis). *Software tutorial:* Species delimitation using ASAP analysis. Creating a BOLD database for the project. *Paper discussion*.

Week 9 (Nov 22) THANKSGIVING WEEK IS REMOTE. We will meet remotely to work on data analysis, discuss results, archiving project data, writing the final paper, and final project presentation. *Paper discussion*. **Assignment 5 —** Draft of group project paper **(due Nov 29).**

Week 10 (Nov 29). Research project presentation. Draft research project paper(s) due. **Assignment 6 - Final group research paper (due Dec 6).**

Week 11 (Dec 6). Final draft of group research project paper is due.