

SIO183/283: PHYCOLOGY: Marine Plant Biology

WINTER 2024

LECTURE: Mon, Wed 12:50-1:50, MCTF 140

LAB: Mon, Wed 2:00-5:20, MCTF 140

INSTRUCTOR:

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COLLECTOR:

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GRADING OPTION:

Letter Grade Only

WHAT THIS COURSE IS ABOUT

This course focuses on the biological study of photosynthetic organisms that live in the sea. These include (1) planktonic and benthic prokaryotic and eukaryotic microalgae, (2) benthic macroalgae (seaweeds), and (3) terrestrial plants that have reinvaded the sea (seagrasses). As marine microalgae are treated in other SIO courses and seagrasses are better suited for a general Botany course, this class focuses almost entirely on seaweeds.

During the quarter we will touch on the following themes:

- 1) *The Importance of seaweed***
- 2) *Seaweed diversity, evolution and taxonomy***
- 3) *Anatomy and morphology***
- 4) *Seaweed ecology & physiology***
- 5) *Seaweed uses, climate change & human affairs***

In studying the seaweeds of California in this course, you will learn how to: (1) identify common California seaweed taxa; (2) understand the key processes leading to seaweed taxonomic diversity; (3) explain general seaweed biogeographic and diversity patterns; (4) diagram seaweed life histories as well as seaweed anatomy and morphology; (5) study seaweed biology using microscopic techniques; (6) prepare seaweed herbarium specimens; and (7) conduct intertidal surveys for seaweed diversity, (8) conduct basic laboratory experiments on seaweed ecology and/or physiology, (9) understand the role that seaweeds will play in a sustainable future and (10) appreciate the importance of seaweeds for human societies.



TEXTBOOKS:

There is no single phycological textbook that encompasses all of the subject matter we will cover in this course. As such, the required texts are ***Algae (4th Edition); Graham, Graham, Wilcox and Cook (GGW) (2023)*** and ***Marine Algae of California (MAC), Abbott and Hollenberg (1976)***. *Algae* is only available online and we have uploaded all relevant reading to the course website. I would also recommend ***Pacific Seaweeds by Druehl and Clarkston (2016)***, ***Seaweeds of the Pacific Coast by Mondragon and Mondragon*** and ***Seaweed Ecology & Physiology, Lobban and Harrison (2000)***. I will provide weekly reading materials as PDFs as needed on the class website in addition to the class lectures and lab assignments as outlined below in the class schedule.

Books & Abbreviations (used below):

MAC: Marine Algae of California; Abbott and Hollenberg (1976); GGW: Algae; Graham, Graham and Wilcox (2023); L&H: Seaweed Ecology & Physiology; Lobban and Harrison (2000)

DATE	LECTURE	LAB	READING	Assignments due
Jan 8, 2024	Introduction to the course and Phycology basics	1. Basic laboratory skills; microscope use and care, herbarium presses	GGW Chapter 1 MAC pg 1-19	Excitement for seaweed! :]
Jan 10, 2024	Diversity of algae	2. Use of taxonomic keys; basic vocabulary for seaweed IDs, slide making; overview	GGW Chapter 5 MAC pg 769-781	
Jan 15, 2024	HOLIDAY			
Jan 17, 2024	Taxonomy & Biology of Cyanobacteria	3. Cyanobacterial diversity; possible field trip (-1.02, 5:26)	GGW Chapter 6	Lab 1 and 2
Jan 22, 2024	Taxonomy & Biology of Chlorophytes (green algae) Part 1	4. Overview of green algal classes-green algae Part 1	GGW Chapters 16, 18 MAC pg 51-120	
Jan 24, 2024	Taxonomy & Biology of Chlorophytes (green algae) Part 2	5. Focus on Ulvophyceae-green algae Part 2; Possible field trip(-1.04, 3:01)	GGW Chapter 18 MAC pg 51-120	Lab 3
Jan 29, 2024	Taxonomy & Biology of Phaeophytes (brown algae) Part 1	6. Overview of Phaeophyceae orders Part 1	GGW Chapter 14 MAC pg 121-277	
Jan 31, 2024	Taxonomy & Biology of Phaeophytes Part 2	7. Overview of Phaeophyceae orders Part 2; (-0.79, 1:28)	GGW Chapter 14 MAC pg 121-277	Lab 4 and 5, Paper topics due
Feb 5, 2024	MIDTERM			
Feb 7, 2024	Field trip around SIO, sample collecting Dike Rock: (-1.45, 2:06)	Review all taxa; work on herbaria; check IDs with instructors		
Feb 12, 2024	Taxonomy & Biology of Rhodophytes (red algae) Part 1	8. Overview of red algal classes and orders Part 1-All; (-0.62, 5:02)	GGW Chapter 15 MAC 279-744	Labs 6 and 7
Feb 14, 2024	Taxonomy & Biology of Rhodophytes (red	9. Overview of red algae - Part 2-Floridiophyceae	GGW Chapter 15 MAC 279-744	

	algae) Part 2			
Feb 19, 2024	HOLIDAY			
Feb 21, 2024	Ecology: Rocky Intertidal	10. Field trip-Intertidal Surveys-Dike Rock, collections (-0.9, 3:02)	GGW Chapter 22; supplemental reading TBD	Labs 8-9
Feb 26, 2024	Taxonomy & Biology of Rhodophytes (red algae) Part 3	11. Overview of red algae - Part 3 – Floridiophyceae; Set up Grazing experiment	Chapter 15 MAC 279-744	Enter Lab 11 Survey Data into Google Sheets
Feb 28, 2024	Ecology: San Diego Kelp Forest Ecology	12. Review Intertidal Survey Data (Lab 11); Break down grazing expt; Set up Eutrophication & Climate Change Lab	GGW Chapter 1.6, 3.4, 22; supplemental reading TBD	Lab 10; Enter lab 12 grazing data into Google Sheets
Mar 4, 2024	Ecology: Phytoplankton Ecology and Blooms (Andrew Barton)	13. Discuss grazing expt data; Check on other experiments; Lab Make-up, Work on Herbarium samples	GGW Chapter 21 supplemental reading TBD	Labs 11 & 12
Mar 6, 2024	Seaweed Physiology	14. Break down climate change experiments; Seaweed Physiology & Climate Change Lab	Chapter 1.5, Ch 22	Species profile due to peers; Enter lab 14 physiology data into google sheet
March 11, 2024	Algae Drugs from the Sea (Brad Moore Lab)	Review Physiology Lab; Group presentation of results; Field trip/Open lab (-1.5, 2:41)	GGW pg 61-78; supplemental reading TBD	Lab 13; return species profile feedback to peers
March 13, 2024	Algae and Biofuel: Guest Lecture- (Stephen Mayfield, TBD)	Class Presentations	GGW pg 61-78; supplemental reading TBD	Lab 14, Species profile due, class presentations
March 18, 2024	Seaweeds & Sustainability	Finish presentations & Herbarium collections; Herbarium Checklist		Class presentations
March 20, 2024	Final Exam	Lecture Final & Lab Practical		
FINALS WEEK: TBD	Herbaria Due	Celebration of Seaweed in Human Societies: Arts, Food & Culture		Seaweed projects to share with the class!

Key to the Syllabus:

Yellow = good low tide during class

Light Gray = field trip to the intertidal

Dark Gray = exam

Green = Guest Lectures

Blue = Holiday

EXAMS & GRADING:

- Midterm & Lab Practical: 10% each
- Final Exam: 25%
- Lab Notebook: 15%
- Species Profile: 10%
- Class Presentation: 5%
- Herbarium Collection: 15%
- Celebration of Seaweed Project: 5%
- Participation: 5% - Engagement in Class Activities

Midterm: The midterm will be broken down into a written component and a lab practical component. The written component will be first and will focus on material largely covered in lecture. We will use the regularly scheduled lecture time for this exam and it will be closed book and in the lecture hall **(10% of total grade)**. The lab practical component will be in the lab with stations similar to regular lab activities. You will be required to use microscopes and you will need to bring your Marine Algae of California book for keying exercises. **We will have the whole lab time to work on the practical and students will be allowed to use their lab notebooks (10% of total grade).**

Final Exam: The final exam will be scheduled for the last regular class of the quarter (week 10) and will consist of both new material and material from the beginning of the quarter. The final exam will be a hybrid of lecture and lab questions with a practical component. We will run this exam in the lab classroom and the two components- lecture and lab will run concurrently. **(25% of total grade)**

Lab Notebook: All lab assignments will be recorded in your lab notebook. This will include answers to questions as well as drawings of specimens from the week's lab. Participation and performance in lab will be evaluated through collection and assessment of the lab notebooks. It is expected that students will keep their notebooks up to date with completion of each of the daily assignments. You will keep your notebook with you throughout the quarter. To grade notebooks, the teaching assistants will collect digital copies (i.e. take a photo) of your lab notebook so make sure that it is neat and legible! Grades will be given based upon clarity and completeness of the daily assignments. **(15% of total grade)**

Species Profile Description: This year, as a class, we will be working together to build a Seaweed Identification Guide for the common seaweeds of San Diego County!!! Each student will select a seaweed by selecting a number (1-60) on the first day of class which will correspond to a particular seaweed species. You will then need to gather information on that species including pictures in the field and the lab, biogeography information, basic taxonomy, ecology and importance, etc. **Students will have until week 9 to work on this project.** All of the details that you will need to provide are included in the template which is on Canvas under "Assignments". You will be required to trade profiles with one of your peers one week before the due date so that you can provide/receive peer review. Once all profiles have been submitted, instructors will grade and then compile all profiles into one large document which will be distributed to the class to serve as a field ID guide for the Seaweeds of San Diego! **(10% of total grade)**

Class Presentations: We will have a "mini symposium" at the end of the quarter where each student will give a 5-minute presentation on a seaweed related topic of their choice. Students can also work in groups of up to 3 if there is common interest within a group of students but each student will still be required to present for 5 minutes and everyone will be graded individually. We have grouped topics into categories so that the symposium will be organized by theme. These can be found on canvas and sign ups for categories will be in a google document shared with the class. For each presentation the topic should be presented as a question and

each student will present 5 slides to cover their topic. 5 minutes will be strictly enforced to ensure we get through everyone's presentations. Presentations can be in the format of a a) review of a topic, b) summary of some historical aspect of Phycology or c) as a research question/proposal with proposed methods. Presentations should generally follow the following format: For a review: What is the topic/question you are addressing (e.g., what is the most invasive seaweed in the world), why this is important, how you collected information (research papers, news sources), what you found (XXX), and future directions/next steps. For a proposal: What is the topic/question that you are addressing (what is the thermal tolerance of species x), why is this important, proposed methods, expectations, why it matters, etc. **All students will be expected to present in power point or in google slides and these all must be submitted before class meets on the day of the presentations. Practice your talks and make sure that you can get through them in 5 min. (5% of total grade)**

Herbarium Collections: Students will learn to prepare herbarium specimens of California seaweeds. Herbarium collections are the primary way that phycologists study biodiversity, biogeography and morphological and taxonomic aspects of seaweeds, as well as identify new species and to catalog species diversity of particular areas over time. Students in SIO 183 will prepare their own herbarium collections across the three main taxonomic phyla covered in class. Specimens will be graded for quality (cleanliness, correctness, completeness). Correct spelling is required. We will not accept specimens unworthy of ascension into the SIO herbarium (moldy, lacking adequate material to properly ID, etc.). For full credit, a student's herbarium collection must include the following **15 specimens** (parentheses indicate # of specimens per taxonomic group):

1. Chlorophyta: Ulvales/Ulotrichales (1), Cladophorales (1), Caulerpales (1), from any order (1)
2. Rhodophyta: Corallinales (1), Gigartinales (1), Rhodymeniales (1), Ceramiales (1), from any order (2)
3. Phaeophyceae: Ectocarpales (1), Dictyotales (1), Laminariales (1), Fucales (1), from any order (1)

If specimens cannot be found in a given taxonomic group, substitutions can be made at a rate of 3:1. **Students must provide a list (genus and species) of the specimens in their herbarium, and note which of the required taxonomic groups (or substitutions) they belong.** All herbarium specimens must be cleanly and individually mounted on herbarium paper and include a proper herbarium label with all required information. Moldy samples will not be accepted. Student herbaria are due during finals week. **(15 % of final grade)**

*****Make sure to include a table of contents for your samples indicating which samples are being used for the assignment. Don't forget an herbarium label for each of your samples. Finally! Make sure you check Algaebase or the Jepsen Herbarium to get the most currently accepted name for your specimen.***

Celebration of Seaweed Project: For the final class meeting we will celebrate the diversity of uses of seaweed in human society by sharing something that celebrates or honors seaweeds. You are open to being as creative as possible here and points will be awarded for uniqueness. In the past students have shared some of the following as examples: 1) an edible dish containing seaweed that was handmade (no seaweed snacks or purchased sushi), 2) a piece of artwork made with seaweed including paintings, pressings, lanterns, jewelry, pottery, baskets, etc., 3) a seaweed inspired performance (poetry, music, dance), or 4) anything else creative using seaweed that you can think of (seaweed games, infographics, apps, etc.). **This is not meant to be a quick throw away project so please put some time into this. Purchasing seaweed products does not count. As seaweeds have a long history of importance in human societies it seems appropriate to end the quarter with a celebration of the diversity of their uses. Points will be awarded based on creativity and your presentation/story telling. Everyone will present their projects during finals week. (5% of total grade)**

Field trips: We will be taking several MANDATORY field trips around Scripps to view California seaweeds. Two of these field trips will be specifically devoted to sample collection for your class herbarium thus participation is

mandatory. If a student cannot make a particular field trip, it is their responsibility to contact me beforehand. Appropriate clothing and footwear is also required (no bare feet allowed).

SUPPLIES TO PURCHASE

Booties or other water shoes (highly recommended), otherwise closed toe shoes such as old tennis shoes will be required for the field trips – no flip flops!
Seaweed/Marine Organism Field guides (recommended)

HELPFUL WEBSITES:

<http://www.algaebase.org/>
<http://botany.si.edu/projects/algae/prestech.htm>
<http://www.oilgae.com/algae/algae.html>
<http://botany.si.edu/projects/algae/introduction.htm>
<http://www.seaweed.ie/algae/seaweeds.html>
<http://www.cryptogamicbotany.com/oa.html>
<http://www.alga-net.com/artwork/artwork8100.html>
<http://sdplantatlas.org/AlgaSelector.aspx>

Digital Herbarium Collections:

<https://macroalgae.org/portal/index.php>
<https://webapps.cspace.berkeley.edu/ucjeps/publicsearch/publicsearch/>

Name Changes to Marine Algae of California

http://ucjeps.berkeley.edu/californiaseaweeds_refs.html

List of Invasive Seaweeds in California

https://ucjeps.berkeley.edu/seaweedflora/pages/non_native_species.html