Marine Biology Laboratory

SIO-136
Scripps Institution of Oceanography
University of California, San Diego

Laboratory Manual

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Syllabus

Instructors

Instructor	Module	Email
Dovi Kacev (lead)	Ecology / Physiology	dkacev@ucsd.edu
April Lukowski	Microbiology	alukowski@ucsd.edu
Nick Wegner	Physiology	nwegner@ucsd.edu
IA		
*Elayna Osterman	Rm 130	eosterma@ucsd.edu
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Conor Elliott	Rm 140	celliott@ucsd.edu

* represents the IA that is available outside of class hours

Office hours

By appointment

Class hours

MW 1:00 - 4:50 pm

Required textbooks

Laboratory manual available on Canvas

Course Goals

This course provides an introduction to current principles and techniques in marine biology and consists of both laboratory and field exercises. A third of the course is devoted to pico-, phyto-, and zooplankton, a third to the physiology and biochemistry of marine organisms, and a third to field exercises, which will introduce students to intertidal, nearshore, and other marine ecosystems. This course also provides students with a unique opportunity to experience work at sea on an oceanographic research vessel and allow them to gain hands-on experience conducting research in the intertidal zone.

Learning Objectives

By the conclusion of the course students will be able to:

- Utilize field and laboratory techniques for the study of marine organisms.
- Use common laboratory equipment (ex. micropipettes, spectrophotometers, counting chambers, microscopes).
- Become familiar with equipment and concepts used in oceanographic research (ex. Niskin bottles, trawls, plankton nets, Secchi disk).

- Become familiar with the biology of diverse marine organisms ranging from bacteria to large animals.
- Understand some key physiological adaptations that allow organisms to thrive in the marine environment.
- Understand the interplay between the marine environment and organisms within it.
- Think critically about experimental processes and data collection and synthesize results.
- Find, read and evaluate primary literature.

Course Website

Course materials will be available through the course Canvas website. As students you are responsible for checking the course website frequently for announcements, updates and assignments.

Grading

The three modules within the course (Ecology, Physiology, Microbiology) will consist of six labs each. Within each module students will be required to write one formal lab report, complete two homework assignments and show participation through turning in carbon copies of the laboratory notebook following each lab. At the end of the course there will be a cumulative exam spanning the material from all three modules.

	Points
Formal Lab Reports (Micro & Physio)	200 (100 /Lab report)
Data Visualization (Ecol)	20
Homework (2 per module)	300 (100 / module)
Lab Notebook / Participation	180 (60 / module)
Cumulative Exam	300
Total	**1000**

Lab Participation and Notebooks

Although you will be performing experiments and collecting data with a partner, make sure that you have the opportunity to participate. In other words, share the tasks so that everyone has an opportunity to gain experience. You will be expected to keep a formal laboratory notebook for all of the experimental work you do in lab. Detailed instructions about how to keep a lab notebook are provided below. Make sure that the notebook and other written assignments are in your own words (no plagiarism). Your lab notebook is meant to serve as a reference and will therefore be available for your use on the cumulative exam. However, lecture printouts and other materials cannot be stapled into the lab notebook (only your handwritten notes are allowed, except when data and lab results require a printout that may taped into the lab notebook).

Accommodations for Students with Disabilities

Students requesting accommodations for this course due to a disability must provide a current Authorization for Accommodation (AFA) letter issued by the Office for Students with Disabilities (OSD). Students are required to present their AFA letters to Faculty (please make arrangements to contact an instructor privately) and to the OSD Liaison in the department in advance so that accommodations may be arranged. Contact the OSD for further information: 858.534.4382, osd@ucsd.edu, or http://disabilities.ucsd.edu .

Lab Attendance

Attendance is mandatory. **Two or more unexcused absences will result in an automatic failure for the course**. If you are unable to attend lab for some reason, please email the instructor directly. You must also be on time because that is when experiments will be explained and safety information provided.

We recognize that we are all still operating in a global pandemic which brings instability and concern. If you feel ill or otherwise feel like you may have had COVID exposure, please do not come to class. Rather, please e-mail the instructors if you are unable to attend due to medical issues. You will then be assigned a remote laboratory equivalent for that session.

Similarly, if one of the instructors falls ill either a suitable replacement will be found for that lab or a digital lab will be used in place of the in-person assignment. You will be notified with as much advance notice as is possible under these circumstances.

It is all of our responsibilities to make sure we have a safe campus environment. We pledge to make appropriate decisions to maximize your health and we expect you to the same for your classmates.

Late Policy:
Unless excused by a doctor's note, students will incur a -10% per day penalty on any assignment due.

Academic Integrity Statement:
Integrity of scholarship is essential for building an academic community. The University expects that both faculty and students will honor this principle and in so doing protect the validity of all intellectual work. For students, this means that all academic work must be done by the individual to whom it is assigned, without unauthorized aid of any kind.

Any required work submitted for this course may be subjected to textual similarity review (e.g. Turnitin.com) for the detection of plagiarism. Note that students who facilitate academic integrity violations (e.g., giving their paper to another student) are also violating academic integrity standards. The instructors of this course are professionally and ethically compelled to report all possible integrity violations to the Academic Integrity Office.

Those students found to have violated academic integrity will face administrative sanctions imposed by the University and academic sanctions imposed by the instructors of this course. See the University Sanctioning guidelines at http://academicintegrity.ucsd.edu/_files/Sanctioning-Guidelines.pdf. These sanctions are not at the discretion of your instructors. However, academic sanctions (grade penalties) are at the discretion of the instructors of this course.

Note that any use of technology and AI must be done with integrity and reflect the students intellectual property and understanding of course material.

Tools for Academic Success:
Instructors of this course and the University are committed to providing every student with the opportunity for success in this course. The University provides tools to help with writing, tutoring, and additional tips for success at:
https://students.ucsd.edu/academics/success/index.html.
Additionally, if you need help or have a question, please reach out to the course instructors. It is best to do this well before assignments are due.

Counseling and psychological services - UCSD CAPS - https://caps.ucsd.edu/

Respect for Diversity:
It is our intent that students from all backgrounds and perspectives be well served by this course, and that students' diverse learning needs will be addressed both in and out of class. We will endeavor to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. In addition, if any of our class meetings conflict with your religious events, please let us know so that we can make arrangements for you. Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) are welcome and encouraged to communicate these, in advance if possible, to the instructors.

Lab Schedule

Week	Date	Day	Module	Lab	Instructor
1	9/30	M	Intro	Intro/R Intro*	Kacev
1	10/2	W	Micro	Introduction to basic laboratory techniques	Lukowski
2	10/7	M	Micro	Microbiology at the land ocean interface I	Lukowski
2	10/9	W	Micro	Microbiology at the land ocean interface II	Lukowski
3	10/14	M	Micro	Antibiotics and chemical Ecology	Lukowski
3	10/16	W	Micro	The Eukaryotic Phytoplankton	Lukowski
4	10/21	M	Micro	The Prokaryotic Phytoplankton	Lukowski
4	10/23	W	Physio	Fish Morphology	Wegner
5	10/28	M	Physio	Respirometry I	Wegner
5	10/30	W	Physio	Respirometry II	Wegner
6	11/4	M	Physio	Sensory Physiology	Kacev
6	11/6	W	Physio	Macroalgae Photosynthesis	Kacev
7	11/11	M	Physio	Veteran's Day	Kacev
7	11/13	W	Ecol	Urchin Fertilization	Kacev
8	11/18	M	Ecol	Rocky Intertidal data collection	Kacev
8	11/20	W	Ecol	Biodiversity Metrics (HW)	Kacev
9	11/25	M	Ecol	Rocky Intertidal data analysis (Data visualization)	Kacev
9	11/27	W	Ecol	Mark Recapture(HW)	Kacev
10	12/2	M	Ecol	Behavioral Ecology/Shipboard Operations	Kacev
10	12/4	W		Final	

Materials required by first meeting:

1) Bound laboratory notebook (bookstore) - (Does <u>not</u> need to be carbon paper)

2) Lab coat (bookstore has cheap ones)
3) Safety glasses (optional, at bookstore)
4) Appropriate clothing (closed-toe shoes and long pants)
*Bring computer (Should probably bring them every day, but keep them in your bag until they can appropriately be used on the lab benches)

Laboratory Notebook Expectations

A fundamental skill in laboratory science is good record keeping. This is especially important when working in a business environment. Four key functions of a notebook are listed below:

1) It allows one to keep detailed notes about your experiments, thus keeping them organized and on track. In addition, in the case an experiment does not work, the notes can be used to track potential errors and assist in designing new approaches. Furthermore, scientific data is "real" only if it can be reproduced. A good lab notebook is essential to experimental reproducibility and precision.

2) The laboratory notebook is a receptacle for new ideas. Details of an experiment can be discussed, expanded or altered only if thorough records are maintained.

3) Because science is often collaborative, a clear notebook allows one to easily share data with collaborators without having to make a formal presentation.

4) A well-maintained notebook can support patent applications. For example, a notebook can make or break a contested patent. If a patent lawyer can point to a clear time of inception of an experiment by referring to a notebook, it could help to bolster a patent claim.

This laboratory course requires you to keep a lab notebook to demonstrate participation in the data collection and analysis for each lab. Although laboratory notebooks are often individualized, and science is undoubtedly a creative pursuit, certain critical information should be included in all notebooks.

TABLE OF CONTENTS: Reserve the first few pages of your notebook for a table of contents. Keep the table of contents updated daily with the title of the experiment and the page number in the notebook. This will help you keep track of and easily reference previous experiments.

DATES: Notebooks should be **organized by date of experiment without blank pages.** Additions or corrections to early experiments can be added to later pages as long as they are marked as such, and dated correctly.

PRE-LAB: We expect a one to two paragraph pre-lab summary recorded in the lab notebook each day. This should summarize the upcoming day's lab from reading the lab manual before each class. This will be checked at the beginning of each laboratory.

BACKGROUND NOTES: Each lab is typically preceded by a lecture. Take your notes in the lab notebook as part of background information for that experiment. This information can be a useful resource during your experiment, or when reviewing past experiments.

PROCEDURES: While lab notebooks will often contain procedures, these are already provided in the lab manual and thus do not need to be rewritten here. These procedures should be read prior to class, but the instructors may have additional directions which can be added either in the lab notebook or within the lab manual itself.

DATA AND OBSERVATIONS: Data and observations for each experiment should be recorded in the lab notebook as the data are collected. Today a large amount of data is digital, and referencing digitized data is acceptable. Data can be written down, or if a digital printout can easily be made, it may be taped into the notebook. Data should be clearly labeled. Follow the instructions for individual labs.

INTERPRETATION and IDEAS: Upon completion of an experiment, the data should be interpreted. Many of the labs ask you to make specific comparisons on generated data and provide interpretations thereof. If the data are unexpected, this section should include some rational explanations as to why the results differed from what would be expected. Based on the results, new experiments or possible directions for future work should be discussed. Finally, new ideas will often come during an experiment; write these down in your notebook.

Laboratory reports

Laboratory reports are expected to have the following sections:

1) Title
2) Introduction
3) Materials and methods
4) Results
5) Discussion
6) Reference

Introduction: The purpose of an introduction is to acquaint the reader with the rationale behind the work, and enough background to enable the reader to understand and appreciate your work. This section describes WHY you did what you did and should include the following:

- Introduction to the main topics, why they are important and why we are interested in studying them
- Explanation of important concepts and terms that are going to be relevant in understanding the report
- Clearly stated question(s) being addressed by your experiment
- Brief overview of what you are going to do to answer this question

Materials and Methods: The purpose of the materials and methods section is to let the reader know how you obtained your results. This section describes HOW you did it and should include the following:

- A summary in paragraph of what you did. This should include all of the relevant information to make your work repeatable (ie. Reagent amounts and concentrations)

Results: The purpose of the results section is to present your results. This section describes WHAT YOU FOUND and should include the following:

- Report of all the findings that are relevant to your initial question. Do not interpret the findings, just state what you found.
- Include figures / tables with captions. Include axes labels and legends on all figures.
- Every figure and table that is included must be referred to in the main text.
- Tables and figures are assigned numbers in the order they appear in the text.
- Never divide a table or figure - confine each figure/table to a single page

Discussion: The purpose of the discussion section is to interpret your results and support your conclusions using evidence from your experiment and generally accepted knowledge, with references. This section describes WHAT IT MEANS and should include the following:

- Discussion of the implications of your Results, and an explanation of why you think you found what you found.
- Relate your findings back to your initial question (from the Introduction). Did you find what you expected? If not, why not?
- Summarize the problems you encountered and how you think things could be done better next time.
- General conclusions and possibly some ideas for interesting follow up experiments.

References: If you cite information from other scientists as background or in support of a conclusion you make, you should provide a reference. Example reference formats are shown below (these are from the APA guidelines).

book:
Author, A. A. (Year of publication). Title of work: Capital letter also for subtitle. Location: Publisher.

journal article:
Author, A. A., Author, B. B., & Author, C. C. (Year). Title of article. Title of Periodical, volume number (issue number), pages.

Mistakes to avoid:

- The lab report should be a cohesive, flowing piece of writing – not just a list of answers.
- Use present tense to report well accepted facts - for example, "*Vibrio fischeri* is…"
- Use past tense to describe specific results - for example, "When we observed the plates, …".
- Do not place a heading at the bottom of a page with the following text on the next page (insert a page break)
- Do not use incomplete sentences, informal wording, jargon, slang terms, or superlatives ("We had the best colony in the class!")
- Avoid referencing the TA or saying things like "in the Bio 300 lab, etc."
- Do not describe figures that are included. Just reference them and report what they are showing. For example, do not say things like "the histogram of X has the highest bar at a frequency of 0.4"… this can be easily seen by someone who looks at the figure. The text should include data interpretation.
- Avoid including arbitrary information (e.g., "We labeled groups A1, A2, B1, B2"), unless this somehow makes things clearer later on. Telling the reader the names you assigned to groups is otherwise not important to understanding the experiment.
- No need to talk about the details of how the data were stored (e.g., "we created columns in JMP labeled A1, A2, etc", unless this will make the methods easier to understand in some way.
- Avoid the use of superfluous pictures, data, etc. – **longer is not always better**!

Rubric Used to Grade Lab Report (100 points / per report)

Component	Points	Notes
Name (5) - Is name on the lab report?		
Title (5) - Sensible title **different** from the lab's title in the manual.		
Introduction (20) - Introduce main topics - Define important concepts - State question(s) being examined - Background info is relatable to questions, Results and Discussion		
Methods (20) - Summarize how the experiment was conducted - Detail sampling approach		
Results (10) - Report findings relevant to the question(s) - Describe figures/tables in detail		
Figures/tables (as part of the results section) (15) - Legible figures - Properly display data - Appropriate axis labels - Legends if necessary - Relevant to study - Well described in text - Captions		
Discussion (20) - Interpret results - Relate results to initial questions (introduction) - General conclusions - Future work		

References (5) - Have at least 3 references - Did the formatting for all references match?		
Other Notes		

Total: _____

Laboratory Safety Rules

Your health and safety are paramount concerns; disregard for them through violation of the following guidelines can constitute sufficient grounds for expulsion from the laboratory until remedial measures are taken.

1. Never work alone in the lab.

2. Know where the exits and staircases are in the building. Walk around and familiarize yourself with the layout of this building.

3. Food and drink (including water) are not to be brought into the lab at any time. Don't place any empty food containers in the trash containers inside the lab. Use a trash container outside the lab. Food items seen in the lab will be confiscated without notice.

4. Wear appropriate clothing in the lab, e.g. no open-toed shoes, shorts or flowing sleeves should be worn. Long hair should be pulled back away from your face. Lab coats and safety glasses are required in this lab, as you may be working with bacteria and some hazardous chemicals. **You are required to supply your own lab coat and safety glasses. You are also required to wear gloves when performing experiments.**

5. Contact lenses can be a serious problem in a lab, as they trap chemicals and are hard to remove in a splash accident, and we **strongly** recommend that you do not wear them to lab.

6. Laboratories contain potentially dangerous materials. Foolish conduct in this environment often leads to injury. Responsible behavior makes working in labs enjoyable for everyone.

7. Note the locations of fire extinguishers. These should only be used on small fires. Also note the location of alarm pull boxes, which will alert the fire department. Each lab, with doors shut, will contain fire for one hour. Leave quickly, using the stairs, and reassemble in the area next to MCTF loading dock. Don't use the elevator during a fire.

8. In the event of an earthquake, take cover under your lab bench during the shaking, leave the lab when the shaking stops and reassemble at above mentioned meeting place. Don't try to get out while the shaking is going on. Again, don't use the elevator.

9. Know the potential hazards of the materials, facilities, and equipment with which you will work. Materials safety data sheets (MSDS) for the chemicals used in the lab are available on line or you can access MSDS sources using EHS website via BLINK **(http://blink.ucsd.edu/Blink/External/Topics/Policy/0,1162,4304,00.html) .**

Your instructor or TA will inform you about proper protection/safety equipment. You are required to follow those instructions.

10. Keep hands away from face, eyes, and body while using solutions, equipment, or materials in the laboratory. Wash your hands thoroughly at the beginning and conclusion of the lab period. Don't apply cosmetics while in the lab.

11. Be careful around open flames. Make sure that you operate the Bunsen burner far away from other lab equipment and ethanol bottles. Keep long hair and loose clothing confined.

12. Do not pipette by mouth. Use only mechanical pipetting devices.

13. Report any accident, unusual occurrence, or injury to your TA, instructor, or prep room personnel immediately. A lab accident report will be filled out, and you will be taken to student health or Urgent Care. Each lab is equipped with a First Aid kit.

14. Remove all broken glass from work area or floor as soon as possible. Never handle broken glass with bare hands (use dustpan and broom). Place broken glass and Pasteur pipettes in the blue/white glass boxes located in each lab.

15. Spills and leaks must be cleaned up without delay. A mop is available in the front of the room. Special lab spill cleanup sheets are available for chemical spills. Report hazardous material spills to your TA immediately and warn people around you of the spill. Send someone to get support staff for decontamination and clean-up. You should not clean up HazMat on your own!

16. Perform only appropriate experiments, and be sure you understand the procedures involved before you begin. If anything unexpected, dangerous, threatening, or unmanageable happens, immediately call your instructor, your TA, or the prep room personnel.

17. Do not use unfamiliar equipment without instruction and permission.