1. Description
Marine Biology-250 is a lecture-laboratory course focusing on physical, chemical, geological and biological aspects of the marine environment. Topics include oceanography, ecology, physiology, behavior, fisheries and conservation.

2. Learning Objectives
This course is aimed at (i) introducing oceanography, ecology, physiology, behavior, fisheries, and conservation, and (ii) developing "higher-level" skills and knowledge that will be important to succeed in your career as a scientist. Specific goals are:
- Describe the major physical and chemical processes in marine environments, and how these processes influence the distribution and abundance of aquatic organisms.
- Recognize the diversity of marine organisms as well as their evolutionary history, biogeography, and interactions with other organisms.
- Analyze and interpret different types of data used in marine biology.
- Form hypotheses about marine-related scientific questions and understand how experiments are executed to test those hypotheses.
- Enhance collaborative skills by group participation in class and laboratory investigations.

3. Course Instructor
José M. Guzmán (he/él)
Aquatic and Fishery Sciences & Marine Biology
Office: FSH204B
Email: jmguzman@uw.edu
Office hours: W 11-12 pm, and by appointment

4. Laboratory and Field Trip Leaders
4.1. Laboratory Leaders/TAs:
Divya Avnoor (she/her)
School of Aquatic and Fishery Sciences
Office: FSH106
Email: davnoor@uw.edu
Office hours: F 12-1 pm, and by appointment

Jeremy Axworthy (he/him)
School of Aquatic and Fishery Sciences
Office: FSH264
Email: jeremyax@uw.edu
Office hours: W 12-1 pm, and by appointment

Zachary Bengtsson (he/him)
School of Aquatic and Fishery Sciences
Office: FTR134
Email: zbengt@uw.edu
Office hours: Tu 1-2 pm, and by appointment

Aspen E. Coyle (she/they)
School of Aquatic and Fishery Sciences
Office: FTR 132
Email: afcoyle@uw.edu
Office hours: Tu 11-12 pm, and by appointment
5. Meeting times:

5.1. Lectures:
All sections: M, W, F 9:30 – 10:20am, Kane Hall (KNE) 110, with José M. Guzmán

5.2. Labs:
- Section DA: Tuesday AM 8:30-11:20 am, FTR 124, with Zach Bengtsson
- Section DB: Tuesday PM 1:30-4:20 pm, FTR 124, with Aspen E. Coyle
- Section DC: Wednesday PM 1:30-4:20 pm, FTR 125, with Kat Panebianco
- Section DD: Thursday PM 1:30-4:20 pm, FTR 124, with Zach Bengtsson
- Section DE: Thursday AM 8:30-11:20 am, FTR 125, with Divya Avnoor
- Section DF: Friday PM 1:30-4:20 pm, FTR 125, with Divya Avnoor
- Section DG: Thursday PM 1:30-4:20 pm, FTR 125, with Jeremy Axworthy
- Section DH: Mondays PM 1:30-4:20 pm, FTR 125, with Aspen E. Coyle
- Section DJ: Thursday AM 8:30-11:20 pm, FTR 124, with Jeremy Axworthy

FTR: Fisheries Research and Teaching Building

5.3. Field Trips

**Friday Harbor Laboratories.** Using Friday Harbor’s R/V Kittiwake, we will be doing several bottom trawls in different locations to see what fish are found in various habitats. You’ll never know what you’ll bring up! Trip Logistics: These will be weekend field trips (leaving on Saturday morning and returning on Sunday afternoon), be prepared to work in the rain and cold!

**Intertidal Survey at Alki Trip.** We will be heading out to Alki (West Seattle) to do a beach survey at night, under the full moon! This trip will involve assessing biodiversity along several different transects. The low tide should provide a wonderful array of life. Trip Logistics: Be prepared to work in the rain and cold!

*Student-led option:* You will be able to do this field trip on your own (preferably with a buddy) or with a group of students. We will provide instructions and sampling tools. A list of students who have selected this option will be posted to assist with coordination. Trip Logistics: You will need to plan your trip for a low tide (~0m), make sure to check and plan around tide forecasting websites such as this one

**COASST Bird Trip.** The south coast of Washington is a broad sandy beach which collects a myriad of flotsam and jetsam. We’ll be looking at beached marine birds (yup, that’s right - dead ones) which have washed in on the previous tide as part of the largest beached bird program in the world—Coastal Observation and Seabird Survey Team (COASST). Not for the squeamish, last year’s trip found 173 carcasses of 30 different species. Trip Logistics: You must be able to walk on a beach for up to two miles. ****Note: Attending an orientation training class (90 minutes) before the field trip is required.
Seattle Aquarium. Dip your toes into what it’s like to collect observational data in marine habitats without actually having to get in the water! The Seattle Aquarium’s exhibits include a diversity of habitats, species, and interfaces to observe them. From tropical waters to the Puget Sound, the aquarium provides a look into the varying trophic levels of aquatic ecosystems – from marine mammals to fish, to invertebrates and algae. During this field trip we will focus on observational survey techniques, which touch on identification, behavior, and community composition. **Note: Attending an orientation training class (90 minutes) before the field trip is required.

6. Required Textbook

7. Online Tools and Devices
We will use Canvas to disseminate resources for the class (i.e., learning goals for each session, readings, files, etc.). To access materials on the website, you will need your UW NetID and password. A class email list has been established for notifications. *Please turn on your Canvas notifications and check your UW email regularly.* (There will be no excuses for emails not read!). More information on how to use Canvas. Computers/laptops will be required for this class. If you do not have a personal laptop, you can check out one from the Student Technology Loan Program: https://stlp.uw.edu/

We will use “Poll Everywhere” as an in-class response system. Poll Everywhere accepts responses from SMS text messages, from a web browser, and through our mobile apps.

8. Teaching Methodology
We strive to maximize your learning and retention of knowledge, and to develop your critical thinking skills. Through several years of research, we have found that you learn best by reviewing the topics prior to lecture sessions, and applying your knowledge within those sessions. The class is therefore structured as follows:

**Pre-lecture preparation:** Complete the assigned readings and videos before coming to lectures. The readings are outlined in the schedule below – you will be notified of any changes several days ahead of the lecture. You will then test your understanding of the material with pre-class quizzes on Canvas. Pre-class quizzes are due the night before lecture by 11:59 pm (i.e., Su, Tu, Th by 11:59 pm).

**Lectures:** Class sessions will be used to practice the concepts you have read about using in-class assignments (e.g., worksheets, discussions and hands-on simulations). We will use a combination of individual and group work. Your understanding of the exercises will also be tested by using in-class response systems and you can expect to be randomly selected to report your or your group’s ideas (random call).

**Summary sheets:** To help develop an integrative approach to learning marine biology, each week you will create a summary sheet that synthesizes and integrates your understanding of the week’s material in a pictorial format using flowcharts, diagrams and graphs – rather than text. In addition to implementing deep conceptual learning, this approach allows us to keep track of your learning and misconceptions on a weekly basis. Summary sheets are due every Sunday at 11:59 pm, and submissions will be in pdf and via Canvas.

**Labs:** The lab sessions will comprise a mixture of instruction, guided and independent research. We will scaffold analytical approaches relevant to understand key concepts in marine biology, and ask you to interpret these data. All labs will have a weekly graded assignment that we ask you to submit online. There is no formal lab manual that needs to be purchased for this course. Instead, all of the lab exercises will be available on Canvas. We expect that you will have read the exercise before your lab begins. Your TA may check out this expectation by giving you a quiz at the beginning of your lab.

**Field trip:** Each student is required to participate in one field trip. There are five separate field trips, each described on the course website (Overnight Intertidal Survey at Alki Beach trip, COASST Bird trip, Friday Harbor Lab Fish Trawl trip and Seattle Aquarium). Which trip you participate in will be decided by a combination of preference and lottery. We will attempt to accommodate each of you to the best of our abilities. If you cannot make any of the field trips, you will be granted the opportunity to do an individual student-led field trip – material (transects, guides,
quadrats, etc.) will be provided by the teaching team. Once you are assigned to a field trip, you are not eligible to request a change - unless some student is willing to swap their spot with you. Most field trips meet early (7:00 or 8:00am) Saturday or Sunday morning and return around 8:00pm for day trips. All Friday Harbor trips are overnight. They will leave on Saturday and return on Sunday. You will receive specific instructions the week of the trip. There will be 24-40 of you on each trip, plus one or two lab leaders, instructors, and other expert guests as required. We will be providing all necessary scientific gear. You will need to provide adequate clothing and personal items – be prepared to be outdoors and get dirty and wet. Field Trip activities will vary widely by trip. In general, we will be learning about a specific habitat and how to sample the organisms in that habitat. All students will be collecting data, which we will examine as a group. Depending on the trip, we may have lectures from on-site experts, or from guests assisting us. There will be a written assignment specific to each trip, which will be due a maximum of two weeks after your trip. You will find out the specifics on these assignments the week of the trip.

Exams: Exams will be in person and will consist of a series of multiple-choice, although it may also include short-answer questions, sketch and drawing exercises. Midterm I: Exam will include questions from all lecture and reading material covered until this point. Midterm II: Exam may include questions from all lecture and reading material covered until this point. The primary focus will be on material covered from the first midterm through to the second. Final Exam: The final will be comprehensive and may include questions from all lecture and reading material covered. Though the primary focus of the final will be on material from the second midterm to the end of the class.

9. Coursework Grades and Dropping Scores
9.1 Grades will be based on the following breakdown:

- Pre-class quizzes: 8%
- In-class Poll Everywhere questions: 8%
- Weekly summary sheets: 8%
- Lab assignments: 15%
- Field trip: 12%
- Midterm I: 12%
- Midterm II: 12%
- Final exam: 25%

9.2. Drop Policy
We will drop – i.e., it will not be considered for your overall score in this class:

- The lowest grade of you lab assignments
- The lowest grade of you summary sheets
- The three lowest grades of your pre-class quizzes
- The three lowest grades of your in-class Poll Everywhere questions

Note: The drop policy does not include exams or field trips

9.3. Final Grade
We do not grade on a curve, but set the grade based on equal categories between the top grade and the passing grade. This means that your grade is only affected by the top grade. You do need 50% of each grading category, and 50% of the marks overall to pass this class.

10. Inclusivity
In an ideal world, science would be objective. However, our experiences and backgrounds mean that scientific thought and the interpretation of science can be subjective. We aim to create a learning environment that supports a diversity of thoughts, perspectives and experiences, and honors everyone’s backgrounds and identities. To help accomplish this goal, we will foster a culture in which each class member is able to respect and hear each other. We ask for everyone to be considerate of each other’s views and be mindful of your own.

There are uncomfortable situations that may arise in class, and sometimes these occur despite the intentions of your colleagues or your instructors. There are several steps we can take towards alleviating some of this discomfort. Please come and discuss the situation with us or, if you prefer, we will be happy to direct you to resources within SAFS or The University.
11. Class Attendance and Policy on Late Submission
This class is conducted in-person, and students are expected to participate in class to fully benefit from course activities and meet the course’s learning objectives. Students should only register for this class if they are able to attend in-person. Students are required to wear a mask over their nose and mouth in class, labs and field trips. To protect their fellow students, faculty and staff, students who feel ill or exhibit possible COVID symptoms should not come to class. For chronic absences, the instructor may negotiate an incomplete grade after the 8th week, or recommend the student contact their academic adviser to consider a hardship withdrawal (known as a Registrar Drop).

We have designed this course to maximize your learning of the subject matter and advance your skills through a variety of activities. Therefore, our specific attendance policy is aimed at supporting our educational goals.
- Assignments designed to help you prepare for class (e.g., online pre-class quizzes, discussions or homework due in class or section) or work scheduled to be presented or performed in class (e.g., Poll Everywhere questions, presentations, leading discussions) will not be accepted after the due date and time.
- Lab assignments, summary sheets and field trip reports that are submitted late will incur a 15% deduction for every 24-hr period that the work is late, starting from the deadline given in class. In other words, if you are given a deadline of 5:00pm, and you hand in the assignment at 5:01pm, you will lose 15%.
- Exam Attendance: Exams are only offered on the scheduled dates and “make up” exams will not be offered.

Excused absences: Our attendance and participation policies are flexible only under specific circumstances. Excused absences are religious holidays, pre-approved professional activities, injury or illness of student or immediate family member. Verification of these events will be needed. We strongly encourage you to give us notification of anticipated absences as early as possible.

12. Accommodations:
It is crucial that all students in this class have access to the full range of learning experiences. At the University of Washington, it is the policy and practice to create inclusive and accessible learning environments consistent with federal and state law. Full participation in this course requires the following types of engagement:

<table>
<thead>
<tr>
<th>Course component</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lectures</strong></td>
<td>The ability to attend tri-weekly lectures of 50 minutes with 250 other students. The ability to collaborate in teams; includes worksheets, short discussions of data, the ability to talk in public.</td>
</tr>
<tr>
<td><strong>Labs</strong></td>
<td>The ability to manipulate lab equipment; includes repetitive motions, use of microscopes and standing for 3 hours. The ability to manipulate and dissect live and preserved specimens. The ability to spend 3 hours in computer labs to analyze data. The ability to collaborate in teams; includes 10–15-minute data presentations and discussions.</td>
</tr>
<tr>
<td><strong>Field trips</strong></td>
<td>The ability to manipulate equipment; includes repetitive motions, and standing for extended periods of time regardless the weather condition and the time of the day. The ability to collaboratively collect, analyze and interpret data and primary literature; involves computer work, creating text, uploading assignments.</td>
</tr>
<tr>
<td><strong>Exams</strong></td>
<td>The ability to answer a set of multiple choice and short-answer questions designed to be completed within 50 or 90 minutes on Canvas.</td>
</tr>
</tbody>
</table>

If you anticipate or experience barriers to your learning or full participation in this course based on a physical, learning, or mental health disability, please immediately contact the instructor to discuss possible accommodation(s). A more complete description of the disability policy of the College of the Environment can be found [here](http://www.uw.edu/students/drs). If you have, or think you have, a temporary or permanent disability that impacts your participation in any course, please also contact Disability Resources for Students (DRS) at: 206-543-8924 V / 206-543-8925 TDD / uwdss@uw.edu e-mail / [http://www.uw.edu/students/drs](http://www.uw.edu/students/drs). All the accommodations granted in this course must be approved by DRS.
Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW’s policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy. Accommodations must be requested within the first two weeks of this course using the Religious Accommodation Request form.

Roles & Responsibilities
Student: please inform the instructor no later than the second week of the quarter of any accommodation(s) you will or may potentially require.
Instructor, lab and field trip leaders: we will maintain strict confidentiality of any student’s disability and accommodation(s) and help all students meet the learning objectives of this course.

13. Academic Integrity
The University takes academic integrity very seriously. Behaving with integrity is part of our responsibility to our shared learning community. If you’re uncertain about if something is academic misconduct, ask the teaching team. We are willing to discuss questions you might have.

Acts of academic misconduct may include but are not limited to:
- Cheating (working collaboratively on quizzes/exams and discussion submissions, sharing answers and previewing quizzes/exams, or using ChatGPT or other AI-power language model)
- Plagiarism (representing the work of others as your own without giving appropriate credit to the original author(s))
- Using or uploading course assignments to online platforms like Course Hero, Chegg, etc.
- Unauthorized collaboration (working with each other on assignments)
- Submitting the same work for separate courses without permission of the instructor(s)

Concerns about these or other behaviors prohibited by the Student Conduct Code will be referred for investigation and adjudication by (include information for specific campus office). The University of Washington Student Conduct Code (WAC 478-121) defines prohibited academic and behavioral conduct and describes how the University holds students accountable as they pursue their academic goals. Allegations of misconduct by students may be referred to the appropriate campus office for investigation and resolution. More information can be found online at https://www.washington.edu/studentconduct/

Our specific policy in the class is to encourage reading of primary literature, and collaboration over data analysis and processing. However, we would like you to present your interpretation of the data independently in the lab sessions. This interpretation may include your own graphics and tables, except where we have asked you to present team-generated work. Instances of plagiarism will result in a zero grade on the relevant assignment. Instances of cheating during an exam will be awarded a zero on that exam.

14. Safety
Call SafeCampus at 206-685-7233 anytime – no matter where you work or study – to anonymously discuss safety and well-being concerns for yourself or others. SafeCampus’s team of caring professionals will provide individualized support, while discussing short- and long-term solutions and connecting you with additional resources when requested.

13. Schedule (updated 2022)

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lecture Topic</th>
<th>Readings</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wk01</td>
<td>W</td>
<td>Introduction</td>
<td>No reading</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>The Scientific Method, Adaptations, Evolution &amp; Biodiversity in the Ocean</td>
<td>Sec. 1.4, 3.2, 3.3</td>
<td>Introduction to data analysis in Marine Biology (online)</td>
</tr>
<tr>
<td>Week</td>
<td>Date</td>
<td>Lecture Topic</td>
<td>Readings</td>
<td>Labs</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>---------------</td>
<td>----------</td>
<td>------</td>
</tr>
<tr>
<td><strong>Wk02</strong></td>
<td>M Oct-2</td>
<td>Oceanography I</td>
<td>Sec. 2.2</td>
<td>Population Variation</td>
</tr>
<tr>
<td></td>
<td>W Oct-4</td>
<td>Oceanography II</td>
<td>Sec. 2.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F Oct-6</td>
<td>Oceanography III</td>
<td>Sec. 1.1, 1.2, 1.3</td>
<td></td>
</tr>
<tr>
<td><strong>Wk03</strong></td>
<td>M Oct-9</td>
<td>Plankton I</td>
<td>Sec. 4.1, 4.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W Oct-11</td>
<td>Plankton II</td>
<td>Sec. 4.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F Oct-13</td>
<td>Oceanography and Primary Production: Case study</td>
<td>No reading</td>
<td></td>
</tr>
<tr>
<td><strong>Wk04</strong></td>
<td>M Oct-16</td>
<td>Midterm I</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>W Oct-18</td>
<td>Intertidal Communities</td>
<td>Sec. 10.4</td>
<td>Dichotomous Keys</td>
</tr>
<tr>
<td></td>
<td>F Oct-20</td>
<td>Marine Macroalgae &amp; Plants</td>
<td>Sec. 5.1, 5.2</td>
<td></td>
</tr>
<tr>
<td><strong>Wk05</strong></td>
<td>M Oct-23</td>
<td>Kelp Forest &amp; Mangrove Ecosystems</td>
<td>Sec. 5.1 (review), 5.3, 5.4</td>
<td>Intertidal Zonation</td>
</tr>
<tr>
<td></td>
<td>F Oct-27</td>
<td>Coral Reefs</td>
<td>Sec. 11.1, 11.2</td>
<td></td>
</tr>
<tr>
<td><strong>Wk06</strong></td>
<td>M Oct-30</td>
<td>Open Ocean I/Halloween parade</td>
<td>Sec. 4.3 (review), 1.3 (review), 12.1, 12.4, 13.2</td>
<td>Bivalve Feeding</td>
</tr>
<tr>
<td></td>
<td>W Nov-1</td>
<td>Open Ocean II</td>
<td>Sec. 12.3, 12.5, 12.6 – up to page 349</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F Nov-3</td>
<td>Deep Sea I</td>
<td>Sec. 13.1, 13.2, 13.3</td>
<td></td>
</tr>
<tr>
<td><strong>Wk07</strong></td>
<td>M Nov-6</td>
<td>Deep Sea II</td>
<td>Sec. 13.4</td>
<td>Online Lab: Polar Seas</td>
</tr>
<tr>
<td></td>
<td>W Nov-8</td>
<td>Ocean Acidification</td>
<td>Sec. 2.2 (review)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F Nov-10</td>
<td>Veterans Day (holiday)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wk08</strong></td>
<td>M Nov-13</td>
<td>Midterm II</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>W Nov-15</td>
<td>Sensory Biology</td>
<td>Sec. 7.8, 12.7</td>
<td>Testing Taxis</td>
</tr>
<tr>
<td></td>
<td>F Nov-17</td>
<td>Osmoregulation &amp; Breathing</td>
<td>Sec. 9.3, 7.7 – until locomotion in the sea (not included)</td>
<td></td>
</tr>
<tr>
<td><strong>Wk09</strong></td>
<td>M Nov-20</td>
<td>Reproduction</td>
<td>Sec. 3.2 (review), 11.1 (only reproduction)</td>
<td><em>No lab this week</em></td>
</tr>
<tr>
<td></td>
<td>W Nov-22</td>
<td>Thanksgiving (holiday)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F Nov-24</td>
<td>Thanksgiving /Native American Heritage Day (holiday)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wk10</strong></td>
<td>M Nov-27</td>
<td>Fish Locomotion</td>
<td>Sec. 7.7 – from locomotion in the sea onward</td>
<td>Anatomy &amp; Fish Collection</td>
</tr>
<tr>
<td></td>
<td>W Nov-29</td>
<td>Harvesting Living Marine Resources</td>
<td>Sec. 15.1, 15.2, 15.3, 15.4, 15.5, 15.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F Dec-1</td>
<td>Commercial Aquaculture &amp; Food Security</td>
<td>Bene et al., 2015. Feeding 9 billion</td>
<td></td>
</tr>
<tr>
<td><strong>Wk11</strong></td>
<td>M Dec-4</td>
<td>Marine Conservation</td>
<td>No reading</td>
<td>Discussion Paper</td>
</tr>
<tr>
<td></td>
<td>W Dec-6</td>
<td>Aquatic Ecotoxicology</td>
<td>Sec. 9.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F Dec-8</td>
<td>Review session</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week</td>
<td>Date</td>
<td>Lecture Topic</td>
<td>Readings</td>
<td>Labs</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>---------------</td>
<td>----------</td>
<td>------</td>
</tr>
<tr>
<td>Wk12</td>
<td>W Dec -13</td>
<td>Final exam (8:30-10:20 am)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
17. Specific Learning objectives per Lecture Topic

**Introduction & Scientific Method:**
- Familiarize with the structure of the course
- Use the scientific method to differentiate scientific hypotheses from interesting speculations
- Evaluate the validity of experiments

**Adaptations, Evolution & Biodiversity in the Ocean**
- Use the principles of evolution by natural selection to explain the diversity of life
- Evaluate evidence provided by a data set in conjunction with a phylogenetic tree or a simple cladogram to determine evolutionary history and speciation
- Describe the path of nutrients and energy through an ecosystem

**Oceanography I:**
- Identify the unique properties of water and how they contribute to the physical properties of the oceans

**Oceanography II:**
- Explain the Coriolis Effect and predict the direction of surface water movement and upwelling/downwelling events
- Describe ocean tide and wave formation mechanisms
- Explain how massive volumes of water are moved around the globe at depth, and their implications on global climate

**Oceanography III:**
- Describe the roles of the lithosphere and the asthenosphere in the motion of the plates
- Identify the topographic features associated with plate tectonics, including mid-ocean ridges, deep trenches, and island and volcanic arcs.
- Recall the various zones of the seafloor and water column, and describe how these classifications may affect how marine organisms are distributed

**Plankton I:**
- Compare main features of the major phytoplankton groups: diatoms, dinoflagellates, cyanobacteria, and coccolithophores.
- Predict the appearance of phytoplankton blooms under different environmental conditions

**Plankton II:**
- Evaluate the consequences of primary production changes in marine ecosystems
- Summarize information on the oceanographic conditions in different areas of the world ocean, and relate to the world’s major fishing areas

**Intertidal communities:**
- Recognize the challenges that organisms face in the intertidal zone, and their adaptations to cope with these challenges

**Coral Reefs:**
- Analyze the conditions required for coral reef to survive
- Explain the symbiotic relationship between the coral host and their symbiotic algae
- Identify the threats faced by coral reefs

**Marine Macroalgae and Plants:**
- Compare and contrast the major groups of marine macroalgae and plants

**Kelp Forest and Mangrove Ecosystems:**
- Describe characteristics of kelp forest and examine its ecological importance
- Describe characteristics of mangrove forest and examine its ecological importance

Open Ocean I:
- Describe the living conditions in the epipelagic and mesopelagic zones
- Explain the origin of the oxygen minimum zone in the mesopelagic zone and how it impacts organisms
- Explain why organisms of the open ocean migrate vertically in predictable patterns

Open Ocean II:
- Describe major adaptations of marine organisms use to stay in an optimal zone, find food, reproduce and avoid being eaten in the epipelagic zone

Deep Sea I:
- Discuss mechanisms involved in the transfer of dissolved gasses and food particles from the shallow waters of the phonic zone to the deep ocean
- Describe major life forms inhabiting the vast abyssal plains of the deep ocean, and compare their physiological adaptations to those living in shallower waters

Deep Sea II:
- Describe the living conditions in hydrothermal vents and cold seep communities
- Identify the primary producers supporting hydrothermal vents and cold seep communities

Polar Seas:
- Compare and contrast environmental conditions and sea ice features of the Artic and Antarctic
- Examine seasonal trends in primary production in the polar seas
- Describe the diversity of sea life inhabiting polar seas permanently and seasonally

Ocean Acidification:
- Summarize the seawater carbonate chemistry that lead to a decrease of pH in presence of CO2
- Describe natural and anthropogenic sources of CO2 and their relative importance in ocean acidification
- Predict ways in which individual species and marine ecosystems may respond to ocean acidification

Sensory Biology:
- Describe the way in which light, sound, mechanical forces and chemical signals are sensed by aquatic organisms

Osmoregulation & Breathing:
- Explain how the osmoregulatory challenges of freshwater animals differs from those of marine species
- Describe features of gas exchange surface in fishes

Reproduction:
- Compare sexual and asexual reproduction in terms of requirements, end products, and genetic diversity
- Apply principles of sexual and asexual reproduction to predict population outcomes

Fish Locomotion:
- Discuss the main morphological features that determine maneuverability and cruising in marine fishes
- Justify the habitat in which a fish species lives given its body shape, fin morphology and swimming behavior

Harvesting Living Marine Resources:
- Summarize different wild fishing methods, including efficiency (catch per unit effort), and potential negative impacts on ecosystems.
- Describe the risks and benefits of using aquaculture to produce food instead of harvesting wild marine organisms or producing food terrestrially.
- Describe genetic, physiological and environmental consideration in conservation aquaculture
Commercial Aquaculture & Food Security:
- Critique/defend commercial aquaculture in the frame of food security

Marine Conservation:
- Describe the primary threats to biodiversity
- Understand the tools conservation biologists use to manage declining populations
- Describe the concept of shifting baselines

Aquatic Ecotoxicology:
- Identify key types of environmental toxicant in the marine environment, identify the major factors affecting their fate and transport
- Identify mechanisms of bioaccumulation, biomagnification, and bioconcentration
- Describe the role of aquatic ecotoxicology in major environmental regulations/decision-making frameworks, with emphasis on Puget Sound