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This is a resubmission for the course a-g Marine Biology

Teacher Contact

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* **Course Title:**	a-g Marine Biology
* **Transcript Title /Abbreviation:**	**Transcript Title /Abbreviation: Course Code** a-g Marine Biology
* **Seeking "Honors" Distinction:**	No
* **Subject Area:**	Laboratory Science
* **Category:**	Biological Science
* **Grade Level for which this course has been designed:**	☐ 9 ☐ 10 ☑ 11 ☑ 12
* **Unit Value:**	1.0 (one year, 2 semesters, or 3 trimesters equiv.)
* **Is this course classified as a Career Technical Education**	N

Is this course classified as a Career Technical Education: No

Brief Course Description

This second-year biology course builds upon and extends biological concepts encountered during the student's first-year biology class. Marine Biology is lab-based class that will enlighten and engage students as they delve into the many wonders of marine organisms and the remarkable environments in which they live. Through the use of a variety of class activities, students will systematically examine the diversity and unique adaptations of the ocean's organisms and investigate how these organisms interact within the marine environments in which they are found. Students will build a greater understanding of the physical, chemical, and geological factors that comprise aquatic ecosystems and influence life in the sea. Special attention will focus students on specific organisms; from phytoplankton and invertebrates to fishes, marine reptiles and mammals. Labs will allow students to closely scrutinize a variety of organisms via dissection, experimentation, data collection and analysis, all of which will develop scientific thinking and investigation skills. At least one field lab will provide students the opportunity to practice direct observation and scientific inquiry while familiarizing themselves with significant marine habitats and ecological issues of the region. Readings from the textbook, periodicals, viewings of documentaries and online resources, class activities, laboratory dissections, and field analyses will all promote student understanding of the principles of Marine Biology.

Pre-Requisites

Algebra I with a C or better - Required

Biology with a C or better - Required

Co-Requisites

Algebra II - Recommended

Context for Course (optional)

This course was desiged to appeal to those students who enjoyed their general biology class and wish to continue to expand their knowledge of biology. California's environment, even for those of us living inland, is so strongly influenced by the Pacific Ocean. Students find the ocean to be an engaging area of interest on many levels, and study of marine biology affords California students to know more about their state and intellectually connects them to the wider world. This course also offers students additional opportunities to hone their laboratory, critical thinking and communication skills through participation in a wide variety of activities throughout the course.

History of Course Development (optional)

Textbooks

TEXTBOOK 1

* **Title:**	Introduction to the Biology of Marine Life
* **Edition:**	10th
* **Publication Date:**	2010
* **Publisher:**	Jones and Bartlett
* **Author(s):**	John F. Morrissey and James L. Smith
URL Resource:	biology.jbpub.com/marine10e
* **Usage:**	Primary Text Read in entirety or near entirety

Supplemental Instructional Materials

Supplemental materials will be used extensively thoughtout the course. Students are regularly provided with a rich variety of materials including field guides, internet resources, documentaries, journals and magazine articles, a class website, podcasts, and various other media resources.

* **Course Purpose**

First and foremost, this course seeks to appeal to students who enjoyed their general biology class and wish to continue to expand their knowledge of biology through the compelling topic of marine biology. Through class activities, course readings, labs and field studies, this course will build upon and deepen student understanding of a number of broad biological concepts, such as classification, adaptation, ecology, biogeochemical cycles, reproduction, consumption, and sustainability, as well as gaining a more intimate knowledge of the unique marine species and habitats sitting just off our coast.

Secondly, California's environment, even for those who live inland, is strongly influenced by the Pacific Ocean. By gaining a deeper understanding of the complexities of this at once immediately accessible and inaccessible realm,

complexities of this at once immediately accessible and inaccessible realm, students, when they become voting adults and parents, will have the necessary tools to make wiser choices in respect to decisions about the use and protection of marine resources. Through first hand field studies, research projects and other class activities, students will improve their ability to make informed and thoughtful choices for themselves and future generations.

Marine Biology offers many opportunities to develop scientific thinking skills, improve and sharpen lab techniques, gain a greater understanding and appropriate application of scientific method through the development of individual student designed lab investigations. Students will become more proficient in developing hypotheses and testable questions, improve observational skills, record and interpret data, and communicate their findings by both written and oral reporting. By participating in these activities, students become more capable and confident in their ability to perform meaningful scientific inquiry.

This course also offers students additional opportunities to hone their critical thinking and communication skills through participation in a wide variety of activities throughout the course. Students will generate, gather, organize and interpret data, make observations and comparisons, respond in writing to magazine and journal articles, participate in case studies, peer teach, use a variety of technological resources, and present projects to the class. The culminating research project affords students the ability to delve deeply into a topic they find compelling and requires skills such as writing and formatting, research and proper citation, creating a visual aid following a rubric, and public speaking as they present their project to their peers.

Course Outline

The following topics are covered in depth throughout the text, lecture and lab work. Each topic is reviewed in class, with student assignments including reading, responding in writing to section, chapter and unit review, demonstrating knowledge through class prestentation, and completing lab reports.

Topics inlclude:

SEMESTER ONE:

UNIT 1:The Ocean As A Habitat

Goals: By the end of this unit, students will be able to discuss the distribution of continents on Earth today, as well as describe how volcanism and plate tectonics led to that distribution. Students will be able to label a diagrammatic cross-section of the benthic features of the ocean, as well as discuss how this model helps us categorize the sea floor. They can describe SONAR and its contributions to scientific understanding of the dimensions of the ocean basin. They can name the key??

properties of pure water, and compare that to the major physical and chemical features of seawater at various levels in the water column. They will compare and contrast the osmotic changes of organisms that routinely travel from marine to freshwater environments. They will discuss how the heating of the Earth is similar to the heating of a greenhouse, describe how the buffering effect of seawater is similar to that of their own blood. They will describe and define spring and neap tides and know why they both occur twice each month.

UNIT 2:Patterns of Associations

Goals: By the end of this unit, students will be able to identify and link a variety of marine organisms to the dominant marine habitat in which they are found at specific life stages.?? They will categorize differences between major taxonomic groups and compare and contrast the three divisions of Monera. They will describe and detail the processes of photosynthesis and respiration in marine plants and generate a list of times and places that anaerobic respiration is common. They will use common names to provide examples of each of the following roles in a marine ecosystem: producer, consumer, photosynthesizer, chemosynthesizer, heterotroph, herbivore, carnivore, detritivore, suspension feeder, predator and symbiont.

UNIT 3:Phytoplankton and Marine Plants

Goal: By the end of this unit, students will correctly state that the majority of marine photosynthesizers are unicellular. They will describe the pattern of cellular reproduction observed in diatoms. They will define biological magnification and describe in detail the causes and ramifications of this phenomenon in enabling toxic unicellular dinoflagellates to harm humans. They will summarize how antisinking strategies are used by phytoplankton.???? They will discuss in detail compensation depth and describe its significance to phytoplankton communities.?? Regarding marine plants, students will understand the pollination strategies of subtidal seagrasses and detail the reasons that manatees and dugongs are restricted to subtropical waters. Students can depict the complex community of fishes and invertebrates that are adapted to living amongst pelagic seaweeds. They will diagram and discuss variations of the life cycle consisting of gametophyte and sporophyte generations among and between different divisions of seaweeds. Students will detail the process of upwelling of the Peru Current and its link to the El Nino phenomenon. They will describe how the formation and thawing of sea ice

affects primary production in the Arctic and Antarctic.

UNIT 4: Microbial Heterotrophs and Invertebrates

Goals: At the conclusion of this unit, students will know why protists are classified

in the same kingdom as photosynthetic diatoms and dinoflagellates. Students will know some of the basic structural features that have long served as defining patterns of relationships between animal phyla, as well as the challenges being presented by the new molecular comparison techniques. Students will understand and compare the distinction between animals and plants and will recognize and elaborate on the survival advantages of radial and bilateral symmetry. Students will compare and contrast the locomotion methods of used by a variety of marine mollusks. They will also be able to list and discuss the advantages and disadvantages of a rigid arthropod exoskeleton in comparison with the fluid hydrostatic skeleton of annelid worms.?? Students will also discover and subsequently explain when humans possess a dorsal hollow nerve cord, pharyngeal gill slits, and a postanal tail.

SEMESTER TWO:

UNIT 5: Marine Vertebrates

Goals: At the conclusion of this unit, students will list and describe the major evolutionary advances exhibited in the bony fishes, cartilaginous fishes and agnathans. They will compare the osmoregulatory adaptations of marine telosts, sharks, reptiles and mammals. They will summarize the great variety of developmental methods observed in the cartilaginous fishes.?? Students will describe the adaptive significance of salt glands and uric acid secretion for reptiles and birds feeding at sea. They will understand why olfaction is of greater importance to marine fishes as opposed to marine tetrapods and how sharks are able to detect weak electrical fields in the sea. Students will compare and contrast the thermoregulatory strategies of marine birds and mammals, describe how marine tetrapods are able to dive to depths greater than 1000 m. They will discuss two specific structural features that distinguish the following marine mammal groups: baleen whales, toothed whales, sea lions, seals, and manatees.

UNIT 6: Estuaries and Coastal Seas

Goals: At the conclusion of this unit, students will be able to compare and contrast the various types of estuaries and describe the patterns of water

circulation in a typical estuary during periods of high and low tides and high and low river input. They will understand the distribution of salinity values from surface to sediment and from the head of the estuary to its mouth. Students will investigate the variety of sediment types and movement, and relate that to dominant plant and animal types in various zones of the estuary. Students will explain the hallmarks of a benthic environment and describe why most marine animals are found in benthic regions of the ocean, as well as elucidate the advantages of benthic existence. They will distinguish the terms epifaunal,?? infaunal, macrofaunal, meiofaunal and microfaunal organisms and give an

example of each type of animal. Students will compare the diversity of the middle and lower intertidal zones on rocky shores and on sandy beaches, as well as understanding the factors that influence or create these differences. Students will also discuss the ecological relationships between intertidal mussles, barnacles, macroalgae, and sea stars on the temperate rocky coast.

UNIT 7: Coral Reefs and Open Ocean

Goal: At the conclusion of this unit, students will be able to summarize the limitations to coral reef distribution, and explain why coral reefs do not form at all latitudes and depths. They will develop an understanding of the pros and cons experienced by the various members of symbiotic relationships between corals and zoozanthellae and demonstrate that this relationship is mutualistic. They will understand why hermaphroditic spawing is the most common method of sexual reproduction in reef building corals. They will be able to generate a list of potential cues that larval reef fishes could use to locate the coral reef on which they eventually settle. Students will investigate global destruction of coral reef habitats and discuss strategies that might slow or end the current loss of coral reefs.?? Students will investigate the variety of organisms that live in the open sea and be able to summarize the key differences between mesopelagic, epipelagic and coastal fishes. They will be able to describe potential uses of photophores in marine animals. Students will appreciate the differences between holoplankton and meroplankton, and give three well-known examples of each. They will discuss mechanisms used by zooplankton to collect diffuse food and summarize the hypothetical cues used by marine animals to orient in space during their long migrations.

UNIT 8: Deep-Sea Floor and Human Impact on Marine Resources

Goals: At the conclusion of this unit, students will be able to summarize the ambient conditions present on the seafloor at depths of 3000 m, as well as characterize the sediments of the deep sea in terms of composition, source, and particle size. They will understand the implications of the oxygen minimum zone, describe its location and describe how it forms. Students will also be able to describe how different food sources become available to animals of the deep sea

and contrast the nutritional quality of surface water as compared to various depths in the water column, ending with the abyssal plains. Students will compare and contrast the benthic invertebrate fauna of the deep sea with those in the shallow subtidal. Students will discuss the surprising range of diversity of deep-sea animals as compared to that of shallow subtidal communities. Students will explore the remarkable diversity of organisms that thrive in deep-sea hot springs and their associated chemosynthetic-powered communities. As the course concludes, students will plan and complete research projects exploring the impacts of human activity on the quality and diversity of marine resources.

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* **Laboratory Activities**

SEMESTER ONE:

UNIT 1:The Ocean As A Habitat

Labs:

1. pH of seawater and the effects on pH of increased CO2. /Asking Scientific Questions

Problem: What is the pH of seawater and how does increased CO2 effect the pH of seawater

Overview: Students will review pH and take readings from a sample of seawater. They will then increase the CO2 concentration in their sample and measure the change in pH as they work on asking properly formulated and testable questions.?? They will also explore the carbonate-bicarbonate buffering system.

2. Some Physical and Chemical Properties of Seawater

Problem: What are some problems continually encountered by marine organisms?

Overview: In this lab, students will explore the density of seawater, as well as the relationship of salinity and temperature to density of water. They will also test dissolved oxygen concentrations and examine the relationship that salinity and temperature have on dissolved oxygen levels.

UNIT 2:Patterns of Associations

Labs:

1. Taxonomic Classification and Identification of marine organisms

Problem: What are the dominant kingdoms, phyla, classes and orders of organisms that inhabit our marine ecosystems?

Overview: Students use specimens (living and preserved) of a variety of marine organisms to develop generalizations about taxonomic classification and fit key organisms into the taxonomic system of classification

2. Autotrophic Bacteria

Problem: What are key primary producers in the marine environment?

Overview: Students will isolate photosynthetic bacteria from marine sediments and place them on plates of growth media and after several days of incubation, they will examine the growth, cellular type, arrangement, and motility of the bacteria present on their plates.?? They will prepare hanging drop slides and use microscopes to identify the bacterial forms present.

UNIT 3:Phytoplankton and Marine Plants

Labs:

1. Phytoplankton diversity and analysis

Problem: What are photosynthetic planktonic organisms?

Overview: Students will use microscopes and prepare slides of teacher supplied samples to examine, compare and contrast various specimens of blue-green algae, diatoms, Dinophytes

2. Identification and observation of macroscopic attached marine plants

Problem: What are key species and structures of attached marine plants?

Overview: Students will use a variety of teacher supplied preserved specimens to observe, identify, draw and label a variety of brown, red and green algae.

UNIT 4: Microbial Heterotrophs and Invertebrates

Labs:

1. Physical characteristics of marine mollusks/squid dissection

Problem: What are key features of a representative Cephalopod?

Overview: Students will examine a fresh (not living) squid and examine key anatomical features with both a dissecting scope and as needed, under a microscope. Students will observe, draw and label both exterior and internal features and organs and provide a detailed written description of the squid.

2. Echinoderms/starfish dissection

Problem: What are key features of a representative Echinoderm?

Overview: Students will examine, draw and label a variety of echinoderms. Students will dissect a representative of the class Asteroidea and examine key anatomical features with both a dissecting scope and microscope. Students will observe, draw and label both exterior and internal features and organs and provide a detailed written ??description of the starfish.

SEMESTER TWO:

UNIT 5: Marine Vertebrates

Labs:

1. Cartilaginous Fishes/Dogfish Shark Dissection

Problem: What are key features of a representative cartilaginous fish?

Overview: Students will dissect a representative of the class Chondrichthyes and examine key anatomical features with both a dissecting scope and microscope. Students will observe, draw and label both exterior and internal features and organs and provide a detailed written description of the shark. Students will also learn to use a dichotomous key to common families of Cartilaginous fishes of North America.

2. Exploration of analogous structures in mammals

Problem: What characteristics do marine mammals have in common with their terrestrial relatives?

Overview: Students will use a variety of media and models to compare and contrast the general body forms of the three orders of marine mammals.

UNIT 6: Estuaries and Coastal Seas

Labs:

1. Field Study: Tidal Influences and Fluctuations/Predicting Tides

Problem: How do tides occur and how do they influence marine life in coastal habitats?

Overview: Field studies are an integral part of any course in marine biology. Students will use tide tables and direct measurements to observe changing tidal fluctuation, predict tides, and infer tidal influences on coastal organisms. Students will collect and analyze data, share findings, discuss ramifications of sea level rise.?? Students will use a field notebook to collect data, notes, observations, and conclusions.

2. Field Study: Exploration of Coastal Wetland and Rocky Intertidal Diversity and Adaptation

Problem: What are key biotic and abiotic features of a coastal wetland?

Overview: Students will survey the major life forms found in both a coastal marsh and a rocky intertidal habitat. They will survey via transect and quadrat methods. They will use field guides and dichotomous keys to identify and chart organisms in both habitats and draw conclusions about how each environment influences the organisms present.

UNIT 7: Coral Reefs and Open Ocean

Labs:

1. Case Study Coral Reefs/Interactive Reef Simulation

Problem: What are the dominant organisms and major interactions in a coral reef habitat?

Overview: Students will use a computer simulation to populate a coral reef. Students will place organisms in the simulated environment and determine where different reef species are found and observe the interactions among and between species. Students will also vary the environmental conditions, such as pH, sunlight and temperature, to observe the outcomes of such influences. ??Students will use a case study focusing on the over use of the coral reefs of Dominica, students will discuss and weigh different approaches to preserving the diversity of coral reefs.

UNIT 8: Deep-Sea Floor and Human Impact on Marine Resources

Lab:

1. Effects of the Deepwater Horizon oil spill/simulation and data collection and?? analysis

Problem: How do oil spills affect marine environments?

Overview: Using a simulated oil spill based on the Deepwater Horizon spill of 2005, students play the role of an oil spill response team to examine and evaluate the damage, and as a team, to problem solve the most effective responses. Teams

will travel to different stations to test how oil interacts with water, calculate where the oil will make landfall, test how oil behaves in different types of sediment and study maps of Mobile Bay to determine the environmental effects of the oil.

* **Key Assignments**

In addition to labs, students will:

Vocabulary Practice:

Students will listen to the words and their definitions being read, they will write?? the names and definitions, and they will read them. Additionally, they will use the publisher's online electronic flash cards to practice the vocabulary terms as part of their homework for each chapter.

Text Reading and Written Practice:

As students read the chapters, they will use an instructor-supplied outline to take notes on important details from the text. Students will respond to questions and solve problems based on the reading of the text on each topic for each section in order to focus on important details and reinforce concepts learned.

Direct Instruction, Videos and Web Responses:

Students will receive direct instruction during classes. Additionally, they will watch direct instruction videos and respond to prompts based on the content of these videos. Students will also respond to journal questions based on pre-selected content that they will read.

Writing Assignments:

There are three main types of writing assignments that students will complete each semester: reflective responses to articles in the media (6-9 per semester), lab reports (4 per semester), and a research paper (1 per semester).

Reflective Responses:

In the reflective responses, students will summarize key points of a magazine piece, journal article, news story, or documentary clip, framing the information in terms of the material they have been studying. They will also reflect on the piece, sharing how it influenced their thinking or understanding of marine biology, predicting its impact in the field, and commenting on the credibility of the science and the resource. This assignment allows students the opportunity internalize the material on a personal level as well as engage with a variety of different types of materials, while becoming more cognizant of the quality of the source of the information, thus allowing the teacher to gain insight in the student's personal level of understanding of the concepts covered in the course. Some of these resources will be used as the key piece for Socratic Discussions (see below).

Lab Reports:

During each semester, students will turn in a typed, full lab write-ups including a Title Page, Abstract, Purpose/Hypothesis, Procedures, Data/Observations, Results/Analysis, and Conclusion. This will be graded based on a rubric that the students will receive at the beginning of the semester.

Laboratory Notebooks:

Students will organize and maintain a lab notebook, which will include all of the lab activities and experiments performed in class. Students will work with instructor directed lab procedures, as well as design their own inquiry-based activities.

Research Paper:

Each semester, students will research and submit a 3-5 page typed research paper??on a topic approved by the instructor. This research is to highlight important current topics in marine biology and demonstrate how the knowledge discovered in this course applies to the future health and appreciation of the world's oceans. Students will use an instructor-supplied rubric for both the written and oral portions of the project. Students will present their research project orally using some type of student-created visual aid. Acceptable visual aids include PowerPoints, Prezis, models, videos, etc.

Possible topics for the research paper include:

- Careers in marine biology field, along with the education and other skills required to enter the field, as well as how the knowledge they gained in class could prepare them.

- Research the changes to ocean chemistry as levels of CO2 increase in ocean water, as well as how the ocean has historically provided a CO2 sink for our atmosphere??and what possible changes this might mean for marine life and subsequently for human beings, including an analysis of what might be done to mitigate these changes.

- The adaptation and development of a marine organism, including world-wide distribution, phylogenetic associations, niche, reproductive strategies and unique morphology or behaviors.

- The complexity and diversity of a specific marine habitat, including the unique characteristics and specific interactions of the flora and fauna in the habitat, annual temperature and sunlight ranges, resident as well as transitory species, conservation and special areas of concern for the habitat. Research innovative technology in marine exploration, including how the technology allows scientists to interface in marine environments, what new data and discoveries the technology can facilitate and what habitats and species can be explored.

Oral Presentations:

Each semester, students will be given multiple opportunities to present information orally to the class, either individually or with a partner, on various topics. This will be done as peer teaching, sharing information gleaned from journal and news??articles, and other topics that support the content of the textbook.

Socratic Discussions:

Journal articles, news stories and other media resources will be used as the basis for Socratic discussions (3+ per semester), in which students will read or view and take notes on a specific written piece or video as homework and then will participate in the analysis of the information through discussion and sharing of ideas as they explore key challenges to the health of specific marine environments. Students will gain an understanding of the complexities of marine habitat conservation and restoration, as well as learning techniques to think through complex problems facing marine biodiversity.

Case Studies:

One to two case studies will be used each semester to allow students to explore and discuss issues and challenges in marine ecosystems. These require at home

preparation for participation prior to group activities in class. Specifically, students will explore the Dead Zone in the Gulf of Mexico, the decline of Stellar Sea Lions in Alaskan waters, and Sea Otter ecology in the Pacific Ocean.

Projects:

Within each chapter, students are given the opportunity to process content and demonstrate understanding, by selecting and executing a small-scale project. The project choices will include:

- model building of labeled cross-sections of organisms studied in various chapters, to include major organs in their correct location, important structural features and unique adaptations
- wall or electronic posters of various oceanic zones, processes or interactions in marine habitats, including a complex food web in a specific marine zone showing all trophic levels and key abiotic factors affecting the food web
- creating a marine sight-seeing brochure of a specific marine habitat for local tourists, including pictures and descriptions of the most prevalent and significant organisms that boaters and beach-goers in the region would most likely encounter. *in an explorer's notebook, with written descriptions

  and labeled sketches, students will create their own hypothetical creature, yet to be discovered, that is designed to be highly adapted to thrive in a particular marine habitat, ??and describe its trophic level and feeding behavior, habitat needs, mating and rearing young.

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Instructional Methods and/or Strategies

College Model of Education: Personalized Learning Model emphasizes independent study while attending classes two/three times per week.

Students will use the text as a primary resource.

Direct instruction

Project group work

Independent study

Interactive online instruction: on the web, on the publisher's web page, and on the instructor's web pages

Lab assignments and experiments

Lecture, laboratory experiments, group projects, individual and group research, oral and written presentation will be used to reinforce learning.

Students will summarize each unit and answer questions about each unit, and respond to critical thinking challenges.

Students will respond in writing to journal articles, and other media ??resources, as well as write research paper each semester to demonstrate college preparatory writing ability.

Students will take quizzes, comprehensive midterms and final exams.

* **Assessment Methods and/or Tools**

Exams, homework assignments, discussions, oral presentations, and writing assignments, projects, lab notes/reports are used to assess student progress.

Attendance at Resource Center Lab Classes two/three times per week.

Written assignments evaluated by providing writing rubrics.

Oral presentations evaluated by providing rubric.

Discussions: classroom participation and small group work.

Weekly homework assignments.

Chapter tests, unit exams, consisting of short essay format, labeled diagrams and extensive essay, which emphasize critical thinking and demonstrates analysis and synthesis of ideas/concepts.

Comprehensive semester and course final exams.

Assessment tools may also include the following:

- Participation in Socratic discussions
- Participation in lab activities
- Student demonstrations
- Research projects

Lab notebooks/lab reports

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