

**The Department's Educational Philosophy**

We believe that students should be exposed to the process of scientific inquiry so they can acquire and interpret scientific knowledge, and begin to realize the wider applicability of scientific problem-solving methods. By making the laboratory the focal point of learning, we seek to foster students' appreciation for the experience of doing science.

**Guiding Principles**

- Students must be able to collect and analyze data and formulate hypotheses.
- Inductive and deductive problem-solving skills are central to science education.
- An effective program in science addresses the limitations of data and conclusions.
- Students should be able to use or design a strategy for testing scientific concepts.
- A comprehensive science program will emphasize the delicate checks and balances in man's abiotic and biotic environments and the stresses upon these ecosystems, which could affect the destiny of the world.
- Science is integrally related to mathematics.
- An effective science program builds students' ability to communicate accurately and precisely.
- An effective science program stresses both cooperative and independent learning.

## OCEANOGRAPHY & MARINE BIOLOGY: COURSE #466

**Course Frequency:** Semester course, five times per week

**Credits Offered:** 2.5 credits

**Prerequisites:** None

### Background to the Curriculum

Oceanography & Marine Biology is an unleveled semester elective course that will cover the following topics in detail: ocean chemistry and physics, ocean zones, marine invertebrates, fishes, marine mammals, coastal ecosystems, polar biology.

### Core Topics/Questions/Concepts/Skills

Core Topics	Questions	Concepts
I. Ocean Chemistry & Physics	<ul style="list-style-type: none"><li>• What groups or individuals have made major contributions to the study of oceanography?</li><li>• What are the chemical properties of seawater?</li><li>• What are the physical properties of seawater?</li><li>• How do scientists measure the properties of seawater?</li><li>• What causes currents, waves, and tides?</li><li>• What properties guide ocean circulation and stratification?</li></ul>	History of oceanography; marine tools; properties of seawater; salinity; ocean layers; water physics; currents; waves; tides; ocean circulation
II. Ocean Zones	<ul style="list-style-type: none"><li>• How is the ocean zoned?</li><li>• Into what ecological groupings are marine organisms classified?</li><li>• What role do microorganisms play in the sea?</li><li>• What techniques do scientists employ to study marine sediments?</li><li>• How do various marine food chains compare?</li><li>• How does bioluminescence influence</li></ul>	Ocean life zones; neuston, pelagic, benthic, a deep sea ecosystems; bioluminescence, marine plankton; marine primary productivity; algae; ocean sediment; hydrothermal vents

	<p>marine life?</p> <ul style="list-style-type: none"> <li>• Why is the Gulf of Maine an important resource for Massachusetts residents?</li> <li>• What crucial discoveries have scientists made at hydrothermal vents?</li> </ul>	
<b>III. Marine Invertebrates</b>	<ul style="list-style-type: none"> <li>• What characteristics distinguish marine invertebrates from marine vertebrates?</li> <li>• How are marine invertebrates classified?</li> <li>• How do marine invertebrates eat and respire?</li> <li>• What reproductive strategies do marine invertebrates employ?</li> </ul>	Classification, diversity, evolution, anatomy, behavior, and ecology of: sponges, cnidarians, ctenophores, marine worms, mollusks, marine arthropods, and echinoderms
<b>IV. Fishes</b>	<ul style="list-style-type: none"> <li>• What characteristics distinguish cartilaginous fish from bony fish?</li> <li>• How are fish classified?</li> <li>• Why are fins useful tools for swimming?</li> <li>• What is the internal anatomy of a fish?</li> <li>• What reproductive strategies do fish employ?</li> <li>• What myths surround sharks and rays?</li> <li>• What effects do over-fishing and marine pollution have on fish populations?</li> </ul>	Classification, diversity, evolution, anatomy, behavior, and ecology of: sharks, rays, and bony fish; shark attacks; marine conservation; marine policy
<b>V. Marine Mammals</b>	<ul style="list-style-type: none"> <li>• What characteristics distinguish marine mammals from terrestrial mammals?</li> <li>• How are marine mammals classified?</li> <li>• Why is blubber a crucial adaptation?</li> <li>• What effect has whaling had on whale populations?</li> <li>• How is animal husbandry practiced?</li> <li>• What effects has marine mammal conservation had on marine mammal populations?</li> </ul>	Classification, diversity, evolution, anatomy, behavior, and ecology of: cetaceans, pinnipeds, and sirenians; animal husbandry; history and economics of whaling; marine mammal conservation
<b>VI. Coastal Ecosystems</b>	<ul style="list-style-type: none"> <li>• How are beaches composed?</li> </ul>	Beaches; tidal zones; coastal zone

	<ul style="list-style-type: none"> <li>• How do coastal zone managers balance human desires with ecological restraints?</li> <li>• What organisms inhabit tidal zones? Coral reefs? Kelp forests? Estuaries?</li> <li>• How are satellites used to study estuaries and coral reefs?</li> <li>• What characteristics distinguish marine plants from terrestrial plants?</li> <li>• Does popular culture depict the ocean realm accurately?</li> </ul>	management; kelp forests; estuaries; coral reefs; marine ecosystems; marine symbioses; sea birds; marine plants
<b>VII. Polar Biology</b>	<ul style="list-style-type: none"> <li>• What characteristics distinguish polar ocean water from temperate ocean water?</li> <li>• How does the Arctic differ from the Antarctic?</li> <li>• How do polar food webs differ from temperate marine food webs?</li> <li>• What characteristics distinguish penguins from other marine birds?</li> <li>• What characteristics distinguish polar mammals from closely related temperate mammals?</li> <li>• What can scientists learn from ice cores?</li> <li>• How has the Earth's climate changed in the last few centuries? Decades? Years?</li> </ul>	Polar sea chemistry; polar ecosystems; anatomy, ecology, and behavior of: penguins, polar bears, and seals; polar research; climate change

## **Course-End Learning Objectives**

### **Ocean Chemistry & Physics**

- 1] How has the history of ocean exploration guided modern marine research?
- 2] What physical and chemical properties of seawater affect marine life?
- 3] What are the dynamics of currents, waves, and tides?

### **Ocean Zones**

- 1] What properties separate the ocean into different life zones?
- 2] How are living things specially adapted for life in each ocean zone?
- 3] How are communities organized at different ocean depths?

### **Marine Invertebrates**

- 1] What characteristics unify and distinguish the various groups of marine invertebrates?
- 2] What adaptations and behaviors do marine invertebrates use to be successful?
- 3] What communities and symbioses do marine invertebrates form?

### **Fishes**

- 1] What characteristics unify and distinguish the various groups of fishes?
- 2] What adaptations and behaviors do fish use to be successful?
- 3] What communities and symbioses do fish form?
- 4] What conservation measures are underway to preserve fish diversity and health?

### **Marine Mammals**

- 1] What characteristics unify and distinguish the various groups of marine mammals?
- 2] What adaptations and behaviors do marine mammals use to be successful?
- 3] What communities and symbioses do marine mammals form?
- 4] What conservation and husbandry measures are underway to preserve marine mammal diversity and health?

### **Coastal Ecosystems**

- 1] What features characterize specific coastal habitats?
- 2] What communities and symbioses are supported by specific coastal habitats?
- 3] What effect does human activity have on specific coastal habitats?
- 4] What conservation measures are underway to preserve specific coastal habitats?

## **Polar Biology**

- 1]** What physical and chemical properties characterize polar seas?
- 2]** What adaptations and behaviors do polar animals use to be successful?
- 3]** What communities and symbioses are supported at the poles?
- 4]** What can polar research tell us about the health of our planet?

## **Assessment**

- Tests: written based on curriculum covered; focus on terms and concepts and applications of these.
- Quizzes: marine identifications; identify and label.
- Laboratory activities: informal with questions; students work in cooperative lab groups.
- Projects: single course project focusing on in-depth research into one aspect of the course content; counts as a test grade
- Homework: unit packets consisting of vocabulary, readings, and unit objective questions.

## **Materials and Resources**

Student text: Life on an Ocean Planet. Current Publishing Corporation (2006).

\* Numerous audio-visual, web sites, and lab materials supplement the material taught in this course.