

## SCIENCE DEPARTMENT

## OCEANOGRAPHY & MARINE BIOLOGY: COURSE #466

### **Contact Information**

Christopher Clinton  
Regional Department Leader, Science  
Acton-Boxborough Regional High School  
36 Charter Road  
Acton, MA 01720  
Telephone: (978) 264-4700, x3412  
E-mail: [cclinton@mail.ab.mec.edu](mailto:cclinton@mail.ab.mec.edu)

### **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 unlevleed 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
<b>I. Ocean Chemistry &amp; Physics</b>	<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
<b>II. Ocean Zones</b>	<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></ul>	Ocean life zones; neuston, pelagic, benthic, a deep sea ecosystems; bioluminescence, marine plankton; marine primary productivity; algae; ocean sediment; hydrothermal vents

	<ul style="list-style-type: none"> <li>• How does bioluminescence influence marine life?</li> <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

<p><b>VI. Coastal Ecosystems</b></p>	<ul style="list-style-type: none"> <li>• How are beaches composed?</li> <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>	<p>Beaches; tidal zones; coastal zone management; kelp forests; estuaries; coral reefs; marine ecosystems; marine symbioses; sea birds; marine plants</p>
<p><b>VII. Polar Biology</b></p>	<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>	<p>Polar sea chemistry; polar ecosystems; anatomy, ecology, and behavior of: penguins, polar bears, and seals; polar research; climate change</p>

## Course-End Learning Objectives:

<u>Learning Objectives</u>	<u>Corresponding state standards*, where applicable</u>
<b><u>Ocean Chemistry &amp; Physics</u></b>	
1] How has the history of ocean exploration guided modern marine research?	HSC III.I, II, III
2] What physical and chemical properties of seawater affect marine life?	B 6.4; C 1.1, 4.5, 7.4
3] What are the dynamics of currents, waves, and tides?	ES 1.4, 1.7, 1.8; P 4.1
<b><u>Ocean Zones</u></b>	
1] What properties separate the ocean into different life zones?	C 1.1, 4.5
2] How are living things specially adapted for life in each ocean zone?	
3] How are communities organized at different ocean depths?	B 6.3
<b><u>Marine Invertebrates</u></b>	
1] What characteristics unify and distinguish the various groups of marine invertebrates?	B 5.1, 5.2
2] What adaptations and behaviors do marine invertebrates use to be successful?	
3] What communities and symbioses do marine invertebrates form?	B 6.3
<b><u>Fishes</u></b>	
1] What characteristics unify and distinguish the various groups of fishes?	B 5.1, 5.2
2] What adaptations and behaviors do fish use to be successful?	
3] What communities and symbioses do fish form?	B 6.3
4] What conservation measures are underway to preserve fish diversity and health?	HSC III.IV, V
<b><u>Marine Mammals</u></b>	
1] What characteristics unify and distinguish the various groups of marine mammals?	B 5.1, 5.2
2] What adaptations and behaviors do marine mammals use to be successful?	
3] What communities and symbioses do marine mammals form?	B 6.3
4] What conservation and husbandry measures are underway to preserve marine mammal diversity and health?	HSC III.IV, V
<b><u>Coastal Ecosystems</u></b>	
1] What features characterize specific coastal habitats?	P 4.1
2] What communities and symbioses are supported by specific coastal habitats?	B 6.3
3] What effect does human activity have on specific coastal habitats?	ES 1.8
4] What conservation measures are underway to preserve specific coastal habitats?	HSC III.IV, V

<p><b><u>Polar Biology</u></b></p> <ol style="list-style-type: none"> <li>1] What physical and chemical properties characterize polar seas?</li> <li>2] What adaptations and behaviors do polar animals use to be successful?</li> <li>3] What communities and symbioses are supported at the poles?</li> <li>4] What can polar research tell us about the health of our planet?</li> </ol>	<p>C 1.1, 4.5, 7.4</p> <p>B 6.3</p> <p>HSC III,IV, V</p>
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**\*B = Biology; C = Chemistry; ES = Earth Science; P = Physics; HSC = Historical & Social Context for Science and Technology/Engineering**

**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.

**Technology and Health Learning Objectives Addressed in This Course**

**(This section is for faculty and administrative reference; students and parents may disregard.)**

<b><u>Course activity: skills &amp;/or topics taught</u></b>	<b><u>Standard(s) addressed through this activity</u></b>
<ol style="list-style-type: none"> <li>1] Word processing, PowerPoint presentations, internet-based activities, internet research, computer probes, databases, spread sheets, computer simulations, microscope skills, water testing, laboratory skills</li> </ol>	

**Materials and Resources**

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

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