

**Westbrook Public Schools  
Marine Biology Curriculum  
Grades 10-12**

<b>Unit 1: Introductory to Oceanography</b>	<b>Anticipated Length: 4 weeks</b>
<p><b>Standards:</b></p> <ul style="list-style-type: none"> <li>• Scientific Inquiry</li> <li>• Scientific Numeracy</li> </ul> <p>9.7 - Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles</p>	
<p><b>Knowledge:</b> <i>Students will know/understand:</i></p> <p><b>SCIENTIFIC INQUIRY</b></p> <ul style="list-style-type: none"> <li>◆ Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena</li> <li>◆ Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation</li> <li>◆ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists</li> </ul> <p><b>SCIENTIFIC NUMERACY</b></p> <ul style="list-style-type: none"> <li>◆ Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas</li> <li>• Elements on earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles</li> <li>• The ocean is composed of a mixture of water and numerous elements in varying concentrations</li> <li>• The density of sea water differs from fresh water because of the presence of dissolved chemicals</li> <li>• The chemical composition of sea water affects living things</li> <li>• The seas are divided into areas and regions horizontally and vertically</li> <li>• The geography of the ocean floor has distinct features and structures.</li> </ul>	<p><b>Skills:</b> <i>Students will be able to:</i></p> <ul style="list-style-type: none"> <li>• Identify questions that can be answered through scientific investigation (D INQ1)</li> <li>• Design and conduct appropriate types of scientific investigations to answer different questions (D INQ4)</li> <li>• Identify independent and dependent variables, including those that are kept constant and those used as controls (D INQ5)</li> <li>• Use appropriate tools and techniques to make observations and gather data (D INQ6)</li> <li>• Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms (D INQ8)</li> <li>• Name the chemicals dissolved in sea water</li> <li>• Describe the role of the oceans in the “water cycle”</li> <li>• Define specific gravity and relate it to the density of pure water and sea water</li> <li>• Experimentally determine the density of sea water</li> <li>• Demonstrate an understanding of osmosis</li> <li>• Define hyper-osmotic, hypo-osmotic and iso-osmotic</li> <li>• Describe the physiological changes that occurs in organisms when they are placed in the solutions (hyper-osmotic, hypo-osmotic and iso-osmotic)</li> <li>• Identify and describe the horizontal and vertical regions of the ocean on a diagram and name typical organisms that inhabit these areas</li> <li>• Describe various geological features of undersea geography</li> </ul>

<p><b>Essential Questions:</b></p> <ul style="list-style-type: none"> <li>• How does the chemical and geographic structure of the ocean affect the life within it?</li> </ul>	<p><b>Unit Questions:</b></p> <ul style="list-style-type: none"> <li>• What is the chemical and physical composition of sea water?</li> <li>• How is the ocean divided into regions?</li> </ul>								
<p><b>Expectations for Student Learning Addressed</b> - <i>The Westbrook HS student will...</i>          Demonstrate independence and proficiency in problem solving, reasoning, critical and creative thinking.</p>									
<p><b>Possible Assessments:</b></p> <table border="0"> <tr> <td><input checked="" type="checkbox"/> Teacher Created Tests</td> <td><input type="checkbox"/> Student Presentations</td> </tr> <tr> <td><input type="checkbox"/> Unit Tests</td> <td><input type="checkbox"/> Entrance/exit slips</td> </tr> <tr> <td><input checked="" type="checkbox"/> Quizzes</td> <td><input checked="" type="checkbox"/> Group Projects (Lab exercises)</td> </tr> <tr> <td><input type="checkbox"/> Others</td> <td></td> </tr> </table>		<input checked="" type="checkbox"/> Teacher Created Tests	<input type="checkbox"/> Student Presentations	<input type="checkbox"/> Unit Tests	<input type="checkbox"/> Entrance/exit slips	<input checked="" type="checkbox"/> Quizzes	<input checked="" type="checkbox"/> Group Projects (Lab exercises)	<input type="checkbox"/> Others	
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<p><b>Benchmark Assessment:</b>          Written test on sea water characteristics (chemical and physical)</p>									
<p><b>Performance Task: Model of the Undersea Topography of Long Island Sound</b></p>	<p><input checked="" type="checkbox"/> <b>Required</b>      <input type="checkbox"/> <b>Optional</b></p>								
<p>Goal: To create an accurate 3D model of the floor of Long Island sound</p> <p>Role: A 3D map maker</p> <p>Audience: Entire class (map readers)</p> <p>Situation: Students will prepare both two dimensional and three dimensional models of the undersea topography of L. I. Sound in the Westbrook area. Using nautical charts of L.I. Sound, you will draw a north/south transect from the CT shore somewhere along the Clinton, Westbrook and Old Saybrook shoreline to a point on Long Island. Students are also asked to identify key landmarks, such as reefs, shoals, beach areas, points (e.g. Saybrook Point) in the Sound and the L.I. and CT shoreline. Student will use the chart to determine and record water depths along their transect lines. All students will then prepare a line graph, using the same scaling, that represents the profile of the floor of L. I. Sound. Students will transcribe this profile onto a piece of heavy manila paper and cut out the profile. All students will attach their cut out profiles on a “master copy” of the L. I. Sound chart in the position of their corresponding transect lines.</p> <p>Product, Performance, Purpose: The final product will be a nautical chart with a “three dimensional” model of the floor of L.I. Sound attached, according to geographic location, in a southerly orientation. It will also include areas of the Sound east and west of the Westbrook area and southerly to the L.I. shore.</p> <p>Standards for Success: The map will be successful if all profiles on the chart are to the same scale and fit together on the master chart. Members of the class should be able to describe the three dimensional aspect of the Sound’s basin and all students should be able to point out and describe the landmark features previously identified on their two dimensional charts (using the three dimensional model that is produced).</p>									
<p><b>Assessment Techniques:</b>          School Wide Problem Solving Rubric</p>									
<p><b>Technology Integration:</b> Calculators, SMART board for presentation on undersea physical features and oceanic regions, SMART Board for the reef video</p>									
<p><b>Resources/Materials:</b></p> <ul style="list-style-type: none"> <li>• <b>Texts:</b> <ul style="list-style-type: none"> <li>○ Marine Biology by Sumich</li> </ul> </li> <li>• <b>Internet Sites:</b></li> </ul>									

- **Videos/DVD (Multimedia):**
  - National Geographic VHS tape “The Coral Reef”.
- **Speakers:**
- **Other:**
  - A NOAA (National Oceanographic and Atmospheric Administration) map of eastern Long Island Sound.

**Sample Lessons/Learning Activities:**

- Lecture/discussion on sea water composition and physical properties
- Lab exercise to determining specific gravity of sea water
- Note taking and vocabulary while watching a video (“Coral Reef”)
- Reaction essay to a viewing of the video “The Coral Reef”
- Preparation of labeled diagram/poster of oceanic regions
- Demonstration and practice of graphing skills in preparation for Performance Task
- Gathering and recording data on a table for use in graphing
- Orientation and practice on the reading and interpretation of a nautical chart:
  - Latitude and longitude
  - Interpreting depth readings
  - Locating landmarks
  - Magnetic north versus true north

**Westbrook Public Schools  
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<b>Unit 2: Marine Life Dissection Skills</b>	<b>Anticipated Length: 12 weeks</b>
<p><b>Standards:</b></p> <ul style="list-style-type: none"> <li>As a result of coordinated structures and functions of organ systems, the internal environment of marine life remains relatively stable despite changes in the outside environment.</li> <li>Marine Life have specialized organ systems that interact with each other to maintain dynamic internal balance.</li> </ul>	
<p><b>Knowledge:</b> <i>Students will know/understand:</i></p> <ul style="list-style-type: none"> <li>The basic levels of classifications for organisms</li> <li>Classifications (Chondrichthyes and Mollusks) based on anatomical features</li> <li>The basic anatomical structures of representative specimens of the various taxonomic groups of marine animals</li> <li>The ecology of a marine reef system, as observed in a marine aquarium display</li> </ul>	<p><b>Skills:</b> <i>Students will be able to:</i></p> <ul style="list-style-type: none"> <li>Follow a set of specific directions, including the correct anatomic vocabulary, to dissect a specimen of a sand shark, squid, and clam</li> <li>Use progressively less specific directions to dissect specimens of a live clam, sand worm, sea urchin, sea star and blue crab</li> <li>Use internet and printed sources to research anatomic diagrams, organ nomenclature and suggested procedures in order to plan the dissection of live clams, sea urchins, sea stars and blue crabs</li> <li>Write their own logical and sequential procedure for the dissection of live clams, sea urchins, sea stars, and blue crabs</li> <li>Integrate technology (word processing, digital photography and video, web based images, diagrams and research) into a document</li> <li>Classify members of the class Chondrichthyes and Mollusks by observing their anatomical features</li> <li>Dissect a specimen from each of the above groups and identify their classifying anatomical features and main organs/systems</li> </ul>
<p><b>Essential Questions:</b></p> <ul style="list-style-type: none"> <li>What characteristics and structures are common or varied in marine animal life?</li> <li>How do we study the anatomy/morphology of an animal?</li> </ul>	<p><b>Unit Questions:</b></p> <ul style="list-style-type: none"> <li>How are animals classified into various groups?</li> <li>What are the anatomical features of the members of the group Chondrichthyes (mollusks, crustaceans, marine annelids, and echinoderms)?</li> <li>How so we systematically study the anatomy of an animal?</li> <li>What is some of the the common vocabulary used to describe anatomical features in an organism?</li> </ul>

	<ul style="list-style-type: none"> <li>• What are the basic tools of dissection and how are they used?</li> <li>• What are the basic skills needed to carefully, safely, and productively dissect a preserved animal specimen?</li> </ul>										
<p><b>Expectations for Student Learning Addressed</b> - <i>The Westbrook HS student will...</i>          Access and evaluate information obtained through technology and various media.          Communicate and process effectively information.</p>											
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<p><b>Benchmark Assessment:</b>          Students will research, create and publish a dissection guide for an unfamiliar marine specimen. This guide will include a reference section on the biology of the specimen, a set of specific, step-by-step dissection directions (including various forms of digital and non-digital media to document and illustrate/demonstrate the dissection procedures employed) and an assessment of skills and knowledge gained.</p>											
<p><b>Performance Task: Dissection</b></p>	<p><input checked="" type="checkbox"/> <b>Required</b>      <input type="checkbox"/> <b>Optional</b></p>										
<p>Goal: To demonstrate the skills required for dissection of actual specimens</p> <p>Role: A scientist/surgeon performing a delicate procedure on a specimen or patient</p> <p>Audience: Teacher and other members of the class</p> <p>Situation: Students are given paper templates of various shapes and sizes to affix to an inflated balloon. The student is then directed to cut out a design from the template using a new (extremely sharp) scalpel as a tool. The shapes they are directed to cut vary from very simple (square) to very complex (multi-pointed, asymmetric stars). The student is expected to cut out the designs from the templates, which are firmly taped to the surface of an inflated balloon, without cutting (and popping!) the balloon. This demonstrates their readiness to apply this skill to the practical application of dissecting specimens</p> <p>Product, Performance, Purpose: The expected product is a balloon with several templates attached where the student has cut out the designs on the template without bursting (popping!) the balloon.</p> <p>Standards for Success: The student is able to successfully cut out 4 out of 5 designs on paper attached to the surface of a balloon, without causing the balloon to burst.</p>											
<p><b>Assessment Techniques:</b>          School Wide Communication Rubric          School Wide Technology Rubric          Science PLC Collaboration Rubric          Lab Dissection Skill Rubric</p>											
<p><b>Technology Integration:</b> Word Processing, Computer graphing, Computer drawn tables, Calculators, Internet Sites, SMART board</p>											

**Resources/Materials:**

- **Internet Sites:**
  - YouTube video clips of specimens being dissected such as a sea urchins, annelids, clams, squids
- **Videos/DVD (Multimedia):**
  - “Shark Attack”!
  - Various National Geographic Videos, such as “Ocean Drifters”, “The Sharks” and “Creatures of the Shallow Seas”
  - Segments of the “Planet Earth” DVD series
- **Speakers:**
  - Occasional guest speakers from Mystic Aquarium and Center for Research
- **Other:**
  - SMART board technology
    - Paper copies of various dissection guides and diagrams are digitally converted and used in PowerPoint presentations on a SMART board as introduction and a review of the specimen dissections. The SMART board is also used for formative assessments of the students’ progress

**Sample Lessons/Learning Activities:**

- Demonstration of anatomical directions using clay model of a common marine animal such as a shark or a student volunteer
- SMART board presentations covering the anatomy of the various specimens dissected, employing diagrams and photos. Interactive, formative, quizzes are given employing SMART board Smart Notebook technology prior to a practical quiz on an actual specimen
- Guided dissection of the dogfish shark using specific textbook and set of directions
- Student produced poster display of Sea Urchin anatomy in preparation for dissection
- Vocabulary “Scavenger Hunt” of terminology and descriptors for taxonomic groups of marine animals that the students are about to dissect
- Peer critique of collaboratively produced “Dissection Guide” summative projects
- Students will be tested on a one to one basis with the teacher in a “practical” quiz on their dissected specimens. These practical quizzes assess the students’ knowledge of the external and internal anatomy of a variety of specimens
- Culminating collaborative project: Students will research and prepare a biological background packet of an unusual specimen such as a lamprey, sea cucumber or skate. As part of this long-term project they will write a dissection plan for this specimen, dissect the specimen and document it with digital technology. The end result will be the production of a full “dissection guide” for their specimen.