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Long Island Sound—Our Heritage

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by Lee B.Hotchkiss

Introduction

There are three basic objectives for this course. They are: (1) to make students aware of their marine environment and its vital relationship to their lives, (2) to help develop potential scientists and (3) to suggest ways to both teachers and students of using marine-related material in nearly all subject areas.

The study of oceanography readily adapts itself to a multidisciplinary and varying classlevel approach. Our life is greatly influenced by the oceans and other aquatic environments; they appear in all areas of our culture: music, art, history, literature, industry and mathematics, as well as the natural sciences. Because we depend so much upon the ocean, we are never too young to learn to appreciate our natural resources or the consequences that can result when we disturb delicately balanced plant and animal dependencies, exploit the aquatic environment or add pollutants to land, air or water. Marine education will help students to later make decisions affecting the protection and conservation of the coastal zone, the oceans and our own fresh water.

The scientist's future is in jeopardy; yet we need a continuing supply of scientificallytrained people to carry on important research. According to Melvin Kranzberg, President of the Scientific Research Society, science enrollments have declined. We must find ways to capture potential scientists for the research that needs to be done for the generations to follow.

It isn't necessary to have to squeeze one more course into a loaded curriculum. It is important to let it flow, so to speak, throughout the total school curriculum so its importance to life will be recognized. We here in Connecticut are extremely dependent upon the sea. In colonial times, goods were traded via the sea routes to the world. At one time, New Haven was very special in having the longest wharf in the United States. The map in Fig. 1 will give you some idea of its extension into the harbor ; why it was needed will be obvious If you look at the 1939 map found in Fig. 2. The study of our harbor in the last hundred years is a fascinating story.

figure available in print form.

figure available in print form.

The learning experiences I want to share are adaptable to various grade levels and learning abilities. Parts of the curriculum may be introduced into any existing course. There will be an introductory section to prepare students for the kinds of physical, chemical, and biological situations that exist in the marine and aquatic ecosystems. There will also be a brief introduction to the early glacial history of Connecticut and to the slow formation of Long Island Sound, We will also study the life forms which madethe transition from fresh, more peaceful tideless waters to different environments, each of which placed different kinds of stress on the various species, Those which adapted survived not only the rigors of tidal living, but also the enmity of currents, winds, storms, and of other organisms—whether predators or competitors for space and food.

Not only did these organisms have to cope with natural enemies; they also had to adjust to the human factor. Surely, at first it was hardly noticeable. Unfortunately, as our population increased, so did our explorations and exploitations. Long Island Sound certainly shows the results of the pressures placed by man. A look at the Sound in Fig. 3 will show the enclosed or congested area at the western end reasons can be seen for the high pollution of this overly-populated end. On the other hand, the eastern end has a good exchange of Atlantic Ocean water and is relatively unpolluted.

Our lives depend upon the sea. It is the ultimate source of our drinking water. One person uses about 30 gallons a day for all water requirements. Seventy percent of the oxygen in the atmosphere is produced by the photosynthesis of phytoplankton. From space, it looks like all our world is water. Actually it does cover about seventyone percent of our surface. Also, most of our world's populations are centered around harbors. Slowly we are realizing the importance of our salt and fresh waters. Instead of giving only sewage back to the waters, we can become informed and make planned use of our water resources.

Students in the course will explore together problems in the marine sciences and will eventually research independently questions they would like to solve. This course is designed to introduce students to many marine oriented subjects. I hone to arrange visits to a marine museum, an art gallery to look at sea paintings, and the library to inspire students to learn about marinerelated topics and seamen's crafts. The library's collections of poetry and sea chanties and its books on macrame and scrimshaw attract even "unscientific" students, At least one field trip to a shore and tide land will be scheduled. If we could spend a day on a boat, we could expand our program by testing more oceanic equipment and learning a little navigation.

The student should be introduced to the diversity of marine related jobs. The marine biologist or oceanographer are only two jobs in a long list of interesting careers. New opportunities are increasing in the fields of fish farming (aquaculture), communications, marine law and education. The marine services—the Coast Guard and the Navy—will be asked what they can offer. I also hope to involve Coastal Management in a discussion of our waters' future.

Marine research probably is the most exciting of an endeavors, for there is a great need to explore the many unknown areas in the relationship of sea plants and animals to their surroundings. The study of the chemistry and physics involved in maintaining life will eventually answer some of the questions of medical research and improve the quality of life on earth. With tagged molecules of radioactive substances, scientists can follow pathways of unseen materials. Using this technique, it was found that seals have evolved a singular method of preventing the dreaded "bends" that scuba divers sometimes experience when they rise to the surface too quickly. The reduced pressure changes the normally dissolved nitrogen in the bloodstream into tiny bubbles in the blood and tissues of the body, which causes severe pains. The diver must either return to the depth he/she was at or come to the surface and be put into a decompression chamber that will help the nitrogen to go back into solution. Yet every day, diving animals seem unmindful of these serious physical conditions. The seal, the animal studies discovered, has a mechanism that allows a minimal amount of blood to flow *only* between the brain and the heart.

From a medical point of view, scientists at John Hopkins University have found the horseshoe crab a valuable animal. An extract from the horseshoe blood can detect poisons in vaccines called endotoxins. The extract, called limulus amebocyte lysate, or LAL, is simply mixed with the test substance . If clotting occurs, the vaccine is discarded and someone's life is saved. The same substance is also used to diagnose a form of the often fatal spinal meningitis. Research in the marine sciences is beginning to give us rich rewards both by satisfying our curiosity and improving our health.

But for a few species of organisms, all living things have similar requirements. Most important is oxygen; then come food and water and a means of getting rid of body metabolic wastes. (Reproduction is not vital to the individual, but only to the survival of the species.) By observing these organisms and their relation to their environment, we will become more aware of our own place in it.

M *arine Information*

In relation to the ocean, the Long Island Sound is rather young. Figures 3a and b give some idea of the possibility that a freshwater lake preceded the formation of the Sound. The glacier that covered this region left water, sand and gravel in the basin that had previously been formed by erosion from streams and rivers. The shores of the lake were formed by the two long ridges of sediment called moraines. These were formed at two different times. They intersect down in the Norwalk area and also up near Madison. The small islands off these areas are the remains of the moraines. The eastern side of the lake was bounded by another ridge in the area of Mattituck on the Long Island side running across to the Old Saybrook Moraine on the Connecticut side. This is now covered by the waters of the Sound. Most of our shore is covered with the glacial sediments. However, it is easy to see bedrock pushing up through the glacial debris.

figure available in print form.

About 8,000 years ago, the sea level began to rise as the glacier was melting. Salt water entered the region left open when the Mattituck ridge was covered. Sand and sediment were free to enter; an estuary was formed with the mixing of the salt and fresh waters. The study of the bottom sediments of the oceans and other water bodies can reveal much about the earth's history.

The Sound is a very dynamic body of water. There has been a steady, but minute, rise in the sea level for the past 8,000 years. According to scientific information, we have nearly reached a maximum for a midglacial period.

When the Sound became attached to the sea, it also developed increased wave activity and tidal currents. This shifted sands and outwash from the river sediment —called deltas—and formed beaches. This process is continually changing our shoreline.

Twice a day the Sound experiences high tides followed by low tides. These tides help to determine the character of the coast. Tides show the effect on the waters of the gravitational attraction between the sun and moon and between both bodies and the earth. It is apredictable rhythm. Ina similar way, the'position of the moon in relation to the earth informs us when the highest and lowest tides will occur. At both full moon and new moon the combined pull of the position of the sun and moon will be felt. These are called spring tides; they come twice a month. It is then that the greatest tidal rangesfrom very high to very low tides—take place.

When the sun and moon are at right angles to each other the tides are not as high. These are called neap tides and occur twice a month. Some animals' life and reproductive cycles depend on instinctively knowing when these events will occur.

Every 24 hours and 52 minutes, there are two high tides or flood tides followed by two low or ebb tides. There is a strange current phenomenon that occurs in the waters that enter and leave the eastern end called the Race. The ebb current flows to the east from Long Island Sound and west going from the bays off the Vineyard and Nantucket. Off Newport the two ebbing currents join and flow south. The opposite situation occurs during flood tide current as it flows west down the Sound. All seamen are well acquainted with the strong currents at the Race; if they use the proper navigational procedures, they can turn this situation to their advantage,

The salinity of the Sound varies from east to west. As would be expected, the salinity is higher in the eastern end, which is nearer the ocean. The salinity also varies vertically) as the lighter fresh water floats on top of the saltier water. This condition is typical of estuaries; plant and animal life must adjust to these everchanging conditions.

Long Island Sound and its shores contain several varied environments. They shall be considered separately. However, there is almost always a mingling of the features of the different areas. They all share the problems or stresses due to tides, currents, winds, waves, storms, salinity, temperature, pressure, erosion and the unnecessary factor—pollution. This last factor puts the greatest stress on any organism, as the plant or animal must adapt quickly or die. Eventually, no time is left for generations to adapt and live to maintain the species. Whole populations can be wiped out this way.

There are significant differences in the shorelines that are evident at high and low tides. There is a progression of plants and animals living and making their habitat in strips or belts, which are known as zones. Sometimes these zones are difficult to distinguish, but with careful observation they can be identified.

Rocky shore environments can easily be found along the Connecticut coast. Life found here must be able to adapt to drying, fresh rain water, cold and the power of waves. The animals have developed either threads to fasten themselves to rocks or astrong glue to' hold their coverings in place, like mussels and barnacles. The plants present have evolved strong holdfasts and air bladders to keep them in place, like Eucus. Some animals have evolved devices for retaining the water within their soft tissues so that they don't dry out. Periwinkles have a little operculum that can close, shutting bits of seaweed and salt water inside. Little sponges can be found at the bases of rocks; they are protected by the toughness of their outer covering. Limpets are well constructed for their life in the middle of the tidal zone. Each limpet has a powerful grasping foot, which gives it the very descriptive name of Chinaman's Hat. Animals that look more like plants are firmly attached by their basal discs. They are exciting to watch feeding; they are found in water left by the ebbing tide—a tidal pool. Many hours of fascinating study are in store if you will observe some scraping from pilings or look into a tidal pool with a magnifying instrument. This is a difficult habitat to live in, but an exciting one to observe . We can learn how these organisms carry on their life functions and how they help one another to survive.

It takes about two thousand years to build up a salt marsh through the steady deposit of mud and sediment brought in by the tides. Marshes are formed by the growth of certain grasses and changes in sea levels. When the first settlers came to the New England coast, they harvested marsh grass. (This plant is commonly called salt hay; biologists call it Spartina patens.) Plants and animals have evolved delicate mechanisms to control the salinity of their habitat; these make interesting study material. Too many people think of a tide marsh as a wasteland; but in truth, these marshes have a definite role in the balance of nature. Marshes are the nursery for life. In these shallow and protected waters food and game fish spend much of their lives. There are great numbers of animals living in close association with the plants. It is a beautiful and highly productive ecosystem that must be preserved. There is a great deal of literature available to inspire people to help protect this vital land.

At first glance, a sandy beach may seem barren of animal life. The gulls and terns seem to own the beach. A gleam from the scales of a minnow might be the target for a swooping tern. The beach grass is what holds it all together. This grass is the first to grow, making the land more stable for other plants. Animals here have adapted by acquiring digging techniques. The Mole crab is a master of this. It can be found running down a slope of receding water, moving its sievelike antennae to catch plankton, the tiny plant and animal forms in the water. Color adaptation is necessary for these animals to hide from their predators by blending into the sand. At the tide line live the burrowers—the clams, the crabs and the sand dollars. One of the greatest enemies of these animals is the tremendous heat generated by pollutants and industrial waste.

A fourth kind of habitat is the benthos or sea bottom. Some animal specimens are adapted to lie on the sea floor. The flounder has adapted by lying on its side; the former bottomside eye has moved to the upper side of its head. New Haven Harbor is quite heavily populated with benthic animals because its shallow bottom ensures the availability of oxygen and food. Many of these animals live on dead material or detritus. Detritvores, as these animals are called, are a great link in the food chain; they recycle the temporarily "dead" energy of detritus, making it available to other organisms.

Some of the benthic animals burrow into the sediment. Surface dwellers are called epifauna; infauna is the name given to the animals that live in the sea sediment. The most numerous of the infauna are the twoshelled mollusks or bivalvesthe clams and oysters. Most of the infauna feed by filtering the sediment; they often ingest pollutants and turn poisonous. This is killing the local oyster industry.

There is another group of benthic organisms that can carry on life without oxygen. These are bacteria that help break up organic matter for reuse.

The last habitat to consider is the constantly moving water, where freely swimming organisms of fairly good size can be found. The minute organisms—both plants and animals—collectively called plankton, swim or float in this area that is not far from the sun's rays. It is the phytoplankton—tiny plant plankton—which convert chemicals with the aid of sunlight into the important first food in a long food chain. The fish you eat is ultimately dependent upon animals that have eaten this food. The stresses that disturb or destroy this environment and all its inhabitants are all of human origin. A few of these are sewage, oil, and the excess heat generated and pumped into the water by the electric companies.

These are the ocean habitats that we can find around Connecticut. Some of these ecosystems can be simulated in the classroom. If field trips are impossible either for classes or for individual students, slide presentations or movies can be effective substitutes. Your students will then be able to see what they are reading about.

With a little instruction, both a tide pool and parts of a marsh can be set up for a real "hands on" approach. The marine aquarium can be simply a gallon jar containing small plant and animal organisms. (A word of caution: Never have any seaweed but the green lettuce of the sea, the Ulva, because other seaweed can produce substances that are antibiotic. Ulva is the best oxygenator.)

The following information might be helpful in setting up an aquarium. The aquarium must not be made of metal or have any metal introduced into it. Leftover bits of food should be removed. The water should be kept as cool as possible, between 15° and 25°C. Try to keep the temperature as near to the collection site of the animal as is possible. When the water level in the tank goes down, add only distilled water to the original level. Also, keep the tank well aerated by using an underground filter. Check the pH and specific gravity daily. Don't place the tank in direct sunlight. And last, don't overcrowd the tank.

Classroom aquaria can help students to see and to appreciate the ecology of these organisms. Watching the behavior of a specific organism is really rewarding. Controlled experiments in pollutants can be recorded and analyzed. Questions can be asked. The kind of aquarium you set up is limited only by your sophistication and budget. There is plenty of material to help you get started; some of this is included in the bibliography.

Course Outline

I. INTRODUCTION TO THE GLACIAL HISTORY OF LONG ISLAND SOUND

- A. Students will become aware of the formation of this basin of water from a freshwater lake.
- B. Students will, through maps, identify specific areas.

II. INTRODUCTION TO COASTAL ECOSYSTEMS OF NEW HAVEN HARBOR AND ADJACENT COASTLINES

- A. The purpose of this study is to give students the opportunity to examine the different environmental changes on the shoreline. These are dramatic and critical changes resulting from changes in sea level, wind, waves, temperature, salinity, pH, oxygen content, pressure and people.
- B. Shore areas include:
  - 1. Intertidal pools and rocky shores.
  - 2. Sandy beaches and dunes.
  - 3. Salt marshes and mud flats.
  - 4. Estuaries, where fresh and salt water meet.
- C. Open water ecosystems:
  - 1. Fish and plankton and floating organisms.
- D. Benthos or sea bottoms:
  - 1. Important for mollusks, bottom fish and the decomposers in the food chains.

III. PHYSICAL OCEANOGRAPHY

A. Experiments into the physical and chemical parts of water:

1. Determining oxygen content both quantitatively and qualitatively.
2. Determining salinity of water.
3. Determining nitrate and phosphate content.
4. Testing for heavy metals.
5. Testing for other signs of pollution.

B. Learning to use and make some oceanographic instruments:

1. Nasen bottle for collecting water at certain levels.
2. Using pH paper and meter (if on boat).
3. Learning to read a DO meter for measuring dissolved oxygen in sea water.
4. Recognizing a relationship between depth and pressure.
5. Making a hydrometer and gathering data.
6. Setting up an osmometer.
7. Examining the relationship between temperature and salinity.

IV. BIOLOGICAL OCEANOGRAPHY

A. Studying the life cycles and food and reproductive habits of several animals:

1. Comparing animals in different habitats.
2. Comparing animals of the same phylum.
   a) Clam and squid of Phylum Mollusca, anatomy and life functions compared.
   b) Fish anatomy.
3. Comparing populations and communities.

B. Study animal behavior:

1. Periwinkle and its response to water and food.
2. Mole crab.
3. Hermit crab.
   a) Story of Pogoo.
4. Fish response to changing water temperatures.
5. Observations and classification of a marine aquarium.

			a) Learning to use a Dichotomous Key for identifying unknown species.
	C.	Identify food chains and webs in a community:	
			a) Use of a food chain game.
			b) Identify the producers, consumers, first and second orders and the decomposers.
			c) Follow pollution through the food chain.
	D.	Basic navigation and seamanship:	
			a) Preparation for open sea trip.
V.	PLANNING FOR THE FIELD TRIP (SEE ACTIVITY #3)		
	A.	Prepare students with slides of areas to be visited:	
		1.	Slides available for tide marsh and rocky coast.
	B.	Learn how to read a Tide Table.	
	C.	Learn preparatory tests, both chemical and physical.	
VI.	SOCIAL AND ECONOMICAL ISSUES CONCERNING THE ENVIRONMENT		
	A.	Saving the Wetlands—understanding problems.	
	B.	Sharing marine knowledge with other students and schools.	
	C.	Gathering literature of legislation that is concerned about preserving our natural resources.	
VII.	CAREER OPPORTUNITIES		
	A.	Examining the range of jobs available.	
	B.	Having speakers or visiting people in the marineoriented fields of work.	
	C.	Preparation for jobs researched.	
VIII.	THE PROJECT		
	A.	Requirements	
		1.	Can be in any marine related field.
		2.	Examination of possibilities for research.
		3.	Deadlines set early in the course.
		4.	Ultimate goal—material to become an integral part of future courses.

IX. EVALUATION

A. Student standpoint:

1. Suggestions for changes in curriculum.

B. Proposed outlines for future courses.

Classroom Activities

Activity #A— *Planning for the Field Trip*

1. Planning for the field trip, whether actual or simulated, students should examine photographs, films or specimen s of the plant and animal organisms they are likely to encounter.
2. Variations in times of tides and depth of tidal changes as well as distance from the open water should be discussed.
3. Students should be able, by reading a tide table of the local area, to determine the best time for viewing specific habitats.
4. Students should be able to collect and record pertinent data.
5. Students should become familiar with the special habitat or habitats to be visited. (Bibliographic references)
6. Students should be equipped to return samples of soil and water as well as specimens of biological importance.
7. Students should be familiar with special testing equipment.
8. Students should make classroom preparation for maintaining live specimens.
9. Students should learn to make as much of their own equipment as is possible.
10. Students should wear proper clothing and have some food with them if they are to be gone for any length of time.

The Field Trip **(coastal intertidal field trip)**

Problem:

What are the biological effects of tidal changes on the organisms in tide pools on rocky coasts?

Information:

1. Tidal changes occurring twice daily in salt water environments. Organisms that have adapted by living where they can survive exposure during low tide. Plants and animals may be found:
a) Mud flats and tide marshes.
b) Sandy beaches.
c) Rocky coastlines and tide pools.
d) Bays and estuaries.
2. Each of these localized ecosystems have formed communities that provide environmental stability and make good breeding areas for animals that become parts of food chains that eventually can include our food. Light energy can be stored by marine plants and become the first food producers for the many consumers to follow.
3. Definitions:
a) Littoral Zone = Intertidal Zone.
b) Supralittoral Zone = above high water; get sea spray.
c) Sublittoral Zone = only exposed at spring tides.

Objectives:

1. Students will be able to collect data from sites showing tidal changes.
2. From their research and specific generalizations, the students will be able to prove or disprove the statements from the data they have collected.
3. Students will be able to demonstrate or discuss some of the adaptations that some species possess to help them withstand the stress of tidal changes.
4. Students will be able to do a transect across a tide pool for zonation.
5. Students will be able to record temperature and salinity of water.
6. Students will collect specimens, both plant and animal.
7. Students define a rocky tide pool and the zonation of life.
8. Students will classify the organisms seen using a dichotomous key. (pictures for younger students)
9. Students will explain how the animals adapt to other variables they have to live with.
10. Students will be able to discuss the ecological relationship among the dominant species.

Materials for Field Trip:

Notebook or clipboard, pencils.

Data recording sheets (supplied by teacher).

Thermometer.

Field identification guides (supplied by teacher).

Magnifying glass.

Hydrometer.

Microscope.

Tape measure and string.

Dip net and plankton net (made by students).

Collecting bottles and bucket.

FIELD TRIP QUESTIONS

Be ready for discussion on the following questions, based on your observations and data.

1. In which zone do you find the greatest number of animals? What do you think is the reason for the larger number in that zone?
2. Which animals predominated each zone?
3. How do the shells of some of these animals differ? Are these differences related to the places in which the animals live?
4. Did you see mussels bound to rocks by tough threads? How would this arrangement help the mussels when the tide came in?
5. When you looked at some of the animal shells, how are they adapted to protect the animals?
6. What other animals were able to anchor themselves in any way?
7. How do the animals here eat?
8. Are any animals dependent on other animals?
9. What is the evidence that some animals feed on plants? If so, what plants do they eat?
10. Were there some plantlike animals? Describe.
11. How do you think these animals survive and reproduce?

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Procedure:
1. Collect data from two or more sites and record on enclosed sheet.
2. Do a transect across the rocky site for observing specific plants and animals in the zonation.
3. Record the temperature and salinity, if possible.
4. Record the most dominant plant species.
5. Record the most dominant animal species.
6. Collect plankton and use microscope. Make sketches and try to determine if phytoplankton or zooplankton.
7. Record depth of water.
8. Record if water level is rising or falling.

Evaluation:

1. Students evaluation will be by means of a written test taken directly from the behavioral objectives.
2. Students will be evaluated on a research paper based on their data and including suggestions for additional research.

For the Teacher:

1. It is advisable that beginning students confine their observations to conspicuous macroscopic organisms.
2. Collect species of algae (seaweed) and let the beginning student make up a system of classification for the identification of these organisms.

3. Make herbarium sheets of algae with mimeograph paper. Cover with wax paper and press between sheets of newspapers weighted with books. Cover with saran wrap.
4. What common foods are made with algae?
5. Make up a food chain or a web game—who eats whom.
6. Make a mural with different species done separately and added to the “rocky coast.”
7. Suggestions for class discussion:
a) Will sewagepolluted water affect the organism population in a different manner from changes in the water level?
b) What effect could there be on populations of organisms if tide lands are destroyed or bulkheaded?
8. Start a library of marineoriented books and pamphlets.
9. Join an environmental group that is concerned about our wetlands.

Activity l— *How To Use A Tide Table*

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To see the animals that live in the intertidal zone, visit the shore when the tides are at their lowest ebb.

Bridgeport is the harbor nearest to the New Haven area. The high tide is 10 minutes before Bridgeport.

During the period of Daylight Time, add 1 hour to all times.

Low water will be about 6 hours and 12 minutes after high water.

When Barometric Pressure is lower than normal, the heights of tides will be higher.

Tides will be higher at high tide and lower at low tide when the moon is full or new.

Terms

Flood—High Tide

Ebb—Low Tide

Ht—(Height Col. 4)

Directions: Use the above information to answer the questions

1. Which dates in September show the lowest tides?
2. During the school year, which date would be the best for a field trip to the shore?
3. On that day, at approximately what time could you see half of a rocky coast shore covered with water?
4. On that same day, at what time should you arrive at a salt marsh to examine the wildlife, soil and the estuary water **salinity and** specific gravity?

Activity #2— *What Determines the Pressure in Water* ?

Materials:

1 meter stick, glass tubing, rubber tubing, thistle tube, 2 clamps, ring stand, water, salt.

Procedure:

1. Bend a piece of glass tubing into a Ushaped manometer tube with arms equal.
2. Support the manometer with a ring stand and clamps. (see diagram below).
figure available in print form.
3. Pour water into tube until it is half full.
4. With the rubber tubing, connect the thistle tube to the manometer. Keep it out of water.
5. Read the levels at A and B with a meter stick.
6. Keep a record of readings with the thistle tube in the air, and at varying levels down the water cylinder.
7. Make a scale and plot the data as depth versus pressure

Questions:

1. What would be your readings if you substituted salt water for fresh?
2. Make a comparative table of the same kind of data as in procedure #6.

Activity 3— *How You Measure the Salinity of Seawater* ?

To Make a Hydrometer

Materials:

2 pencils, baby jars or beakers, metal weight or a metal nut, and string.

Procedure:

Tie a weight to a pencil, or screw a pencil into a metal nut

Fill a onequart bottle with tap water

Float the pencil in the water.

Observe the level to which it sinks.

Mark it off with a notch.

Repeat this experiment in a container of salt water.

figure available in print form.

Questions:

1. Is the water line on the stick different in salty and fresh water?
2. What do you think causes the difference?
3. Get a marked unknown (to you) concentration of a salt solution. Can you guess the salinity of this solution? Compare with a hydrometer.
4. Which is more dense, salt or fresh water?
5. Can you design an experiment to prove or disprove your hypothesis?

Activity #4— *Pollution*

Concept : Pollutants may slow down or destroy all life.

Information : The difference between life and death for most organisms is the availability of oxygen. Aquatic animals must have their oxygen dissolved in water to be used for respiration. The concentration of dissolved oxygen in an aquatic environment is a significant measure of its ability to support life.

The amount of dissolved oxygen (abbreviated DO) varies with temperature and the salinity of the water and depth. The higher the temperature and the greater the salinity, the less oxygen will the water hold. A low DO content indicates low water quality due to pollution and high temperatures.

Dissolved oxygen can be measured qualitatively and more accurately, quantitatively. Methylene blue can be used qualitatively as a method of measurement. Qualitative methods such as measuring, by titration and recording the amounts of dissolved oxygen by converting the number of drops of a chemical (sodium thiosulfate) needed for a color change.

For those who do not want to make up solutions and reagents, there is a dissolved oxygen kit available from the Hach Chemical Company (P.O. Box 970, Ames, Iowa, 50010).

Objectives:

At the completion of this learning experience, the student will be able to:

1. Determine qualitatively the presence of dissolved oxygen by using the methylene blue method.
2. Recognize the relationship between water quality and dissolved oxygen.
3. Recognize the relationship between the types of plants and animals living in the water and the amount of DO present.

Determination of DO by the Methylene Blue Method

Materials:

4 test tubes

250 ml beaker for test solution

250 ml beaker for methylene blue solution

tap water

water samples

test tube holder

test solution

methylene blue solution

To make the test solution, heat 8 grams of KOH in 300 ml of water. Cool and stir in 10 g of dextrose (glucose). To make the methylene blue solution, mix 0.25 grams methylene blue in 100 ml water.

Procedure:

1. In one test tube, put 5 ml of tap water and 5 ml of test solution. Add one drop of methylene blue solution and mix gently.
a) What color is it? ____________________ Let the solution stand in test tube rack.
b) How long does it take for the color to disappear? _________________ Stopper the test tube and shake for 30 seconds.
c) What is the color of the water? _______________________ Let sit in rack. How long does the color last? ___________
d) What gas was being added to the water by shaking it, do you think?
2. Pour your solution in the test tube back and forth between two test tubes for one minute to aerate the solution.
a) What happened to the color of the solution after oxygen was put back into it? Label this *# 1 room temperature* test tube and save it.
3. Pour 5 ml of tap water into two test tubes. Partially heat one and boil the other for 30 seconds. Add 5 ml of test solution to each test tube. Then add one drop of methylene blue solution to each.
a) What color is the heated solution? _________________
b) The boiled solution? ___________________________________
c) If either blue, how long does the color last ?__________
d) Why doesn't the color last as long as it did in procedure #1______________________________________

Shake all three solutions, *the room temperature* , the *heated* , and the *boiled* , for 30 seconds.

a) Which one does the color last the longest? ____________

b) Which one does the color last the shortest? ____________

Now you know what can determine the amount of oxygen present in some samplings. If you want to measure dissolved oxygen by this method, it is necessary to do the test at the sampling site.

Measure 5 ml of the saline into a test tube. Add 5 ml of the test solution and a drop of methylene blue solution. Shake the test tube once to distribute the methylene blue throughout the solution. How long does the blue color last in each sample? Record your results in the second column of the table below. In column 3, Relative Amount of D) in Water. Assign the number 1 to the sample that had the most D) or longest reaction time, 2 to the sample with the next longest, etc.

Sample No.	Time of Color Reaction Observation from	Relative Amount of D) in water	Source of water

Questions:

1. Did you test any samples of polluted water? ____________ What did your test show about the dissolved oxygen content of the sample? ____
2. What gas is lacking or in reduced amounts in organically polluted water? ____
3. How do you think living organisms are affected living in that water? ____

Conclusion **:**

Look again at Fig. 2, Map of New Haven Harbor in 1939. Where is I95 located? No, not there. Man had to rearrange the contours of the waterfront to make land available. What ecosystems were disturbed?

In order for the next generation to make valid decisions concerning their environment, they must be made aware of the consequences of poor judgment or apathy. Too many wrong decisions could totally upset the balance of nature that is so delicate. Non renewable resources are being used up with no way to replenish them. Technology has shown us ways to harvest many things from the sea, but we must examine carefully its place in this ecosystem, where there is a great interlocking web of dependency. Above all, we must protect the producers of our greatest source of lifegiving oxygen, the photosynthetic processes carried on by those tiny plants of the sea, the phytoplankton. Not only do they insure the quality of our life but they are the big food producers of all sea animals.

It is hoped that by learning and becoming a little more interested in the sea and all that is in it and all that surrounds it, we will have the desire to always protect it. This can only be accomplished by a knowledgeable, sensitive group of people.

Teacher Bibliography

Amos, William H. The Life of the Seashore. New York: McGraw Hill Book Company, 1966.

Excellent book, beautifully illustrated and very readable.

Bachsbaum, Ralph. Animals without Backbones. Chicago: University of Chicago Press, 1948.

Bowditch, Nathaniel. American Practical Navigator. Washington: U.S. Navy Hydrographic Office, 1966.

Carson, Rachel. The Rocky Coast. New York: McCall Publishing Company, 1955.

Originally part of The Edge of the Sea. Beautifully illustrated.

__________. *The Sea Around Us. New York: Simon and Schuster.*

A special edition for young readers. Excellent.

Cooper, Elisabeth K. Science on the Shores and Banks. New York: Harcourt, Brace and World, Inc., 1960.

Useful guide for observing gathering, and studying various forms of plant and animal wildlife in shallow, fresh, and salt waters.

Crowder, William. Between the Tides. New York: Dodd, Mead, and Company, 1931.

Laurie, Alec. The Living Oceans. Garden City: Doubleday and Company, Inc., 1973.

Excellent, intriguing and informative.

MacGinitie, G.E., and MacGinitie, Nettie. Natural History of Marine Animals. New York: McGrawHill Book Company, second edition, 1968.

Superb book for research.

Newell, R.C. Biology of Intertidal Animals. New York: American Elsevier Publishing, Inc., 1970.

Teal, J.M. and Teal, M. Life and Death of a Salt Marsh. Boston: Little, Brown, and Company, 1969.

Excellent and inspiring.

Vevers, H. Gwynne. Strange Wonders of the Sea. Garden City: Hanover House, 1957.

Annotated Student Bibliography

Abbott, R. Tucker. Seashells of North America. New York: Golden Press, 1968.

Very good for easy identification.

Engel, Leonard. The Sea. New York: Time Inc., 1972.

Holling, Clancy. Pagoo. New York: Houghton Mifflin Company, 1957.

A charming book about a hermit crab and his life in tidal pool. **S** lides may be borrowed to go with the book.
Zim, Herbert S. and Lester Ingle. Seashores: A Guide to Plants and Animals Along the Beaches. New York: Golden Press, 1955.

Informative and compact.

Maps

The Greater New Haven Chamber of Commerce. 195 Church Street, New Haven, Conn., 06506. (Free)

The United States Department of Commerce, Washington, D.C. ($3.50)

National Geographic Society, Washington. World Map, with Pollution map on back.

Free Material

Coastal Area Management, 71 Capitol Avenue, Hartford, Conn. 06115

1. Model Municipal Coastal Program. Report No. 28.

2. Long Island Sound: An Atlas of Natural Resources. (1 copy).

3. A Citizen’s Handbook to Coastal Management.

Pamphlets and Learning Packets (teacher made)

Marine Career Series: MarineRelated Occupations. A Primer for High School. Marine Memorandum #41. Marine Advisory Service, University of Rhode Island, Narragansett, R.I., 02882.

Plankton Primer, Martek Instruments, Inc., 879 W 16th Street, Newport Beach, CA 92660. ($1.00)

Learning Packets of Coastals Areas and activities on loan from Lee High School.

Appendix

Teaching Ideas

Areas that are available: City Point' fair for observing a sandy beach and tidal land; West Haven Beach, good for sandy beach and marsh land, also showing some tidal animals and plants along the jetties; Lighthouse Park Beach, good; Killams Point in Branford, showing sandy beach, tidal pools and salt marsh, excellent. More areas will be mapped out and examined during the coming year.

Schooner, Inc. has a research sailing vessel that is excellent for studying the harbor and Utilizing curriculum materials in environmental studies, learning research techniques and also acquiring navigation and sailing skills. We are very fortunate to have the vessel, *J . N . Carter* , for the unique experience it offers students and teachers. Contact, Schooner, Inc., 60 Water Street, New Haven, Connecticut.

References

Zinn, Donald J. 1973. *A Handbook for Beach Strollers* . University of Rhode Island, Marine Bulletin #12. $3.00. Order from: Marine Advisory Service, URI, Narragansett Bay Campus, Narragansett, RI. 02882. An excellent reference book, very readable. The New Haven Colony Historical Society on Whitney Ave. has a very interesting book on the Maritime History of New Haven, called *Shallops* , *Sloops* , and *Sharpies* ($2.50). For those interested in the study of land use, write to the Coastal Area Management Program, Dept. of Environmental Protection, 71 Capitol Ave., Hartford, Conn. O6115.

Books for Students

There are many historical and historical fiction books about American ships and sailors between 1750 and 1900. This material is geared to all age levels and interests. Some of the authors are: Kenneth Roberts, Jack London, Herman Melville, C. S. Forester, Jules Verne, Thor Heyerdahl, Ernest Hemmingway, to name a few. To introduce younger students, I recommend three books: *Pagoo* , by Holling, a classic about a hermit crab; *Thy Friend* , *Obadiah* , a story about a herring gull; *The Crab From Yesterda* y, by John F. Waters, a story about the horseshoe crab, a living fossil.

Music and Art

The chanty was very important to the life of a sailor. This bit of folk music told many a tale of the sea or the longing for home. *American Sea Songs and Chanties* by Frank Shay is an excellent source. There are two craft forms that sailors did to pass the long days of sea voyages. Macrame is the fine art of tying knots to make a variety of things. There are many craft books on the subject. Whaling sailors would etch into whalebone and make many beautiful designs by rubbing ink into the grooves that were made in the ivory. m e book, *Scrimshaw* , by Leslie Linsley explains this delicate art in detail. Another form of art originally done by the Japanese is called Gyotaku; it is simply a rubbing of a previouslypainted whole fish that is pressed onto rice or construction paper. Making mobiles from materials gathered on the beach is very effective. The book, *Guide for Mobiles: Experiments with Balance and Making Constructions* , Webster Division, McGrawHill Book Co., New York, is most helpful.

Job Opportunities

Besides trips to the Coast Guard or speakers from the Navy or National Fisheries in Milford, other people can talk to the students about their marineassociated jobs. A very good booklet, *MarineRelated Occupations; A*

Primer for High School Students , by Prentice K. Stout and Sara Callaghan is available from the University of Rhode Island, Marine Advisory Service Narragansett Bay Campus, Narragansett, R.I. 02882, by asking for Marine Memorandum # 41.

Marine Aqua* r *ia

Ocean in Your Classroom , by Barbara S. Waters. Cape Cod Extension Service, Railroad Ave., Barnstable, MA. 02630. This Is highly recommended as an easy way to get started with an aquarium. ($1.25).