Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
1997 Volume VI: Global Change, Humans and the Coastal Ocean

Nonpoint Source Pollution in Long Island Sound: A Collaborative Teaching Unit for the Reading Lab.

Curriculum Unit 97.06.09
by Mary-Alice Howley

The Reading Laboratory at Betsy Ross Arts Magnet School provides extra tutoring for students who are reading one to two years below their grade level. Typically, these students are frustrated in their academic classes because the assigned text is written at a reading level which is too difficult for them. They benefit from how-to instruction that emphasizes organization. Their lessons employ several learning modalities because the more ways visual, oral, tactile, that are used to give these students information , the better they learn. Repetition helps them as does peer interaction.

This collaborative science unit has been created to help these remedial reading students succeed in their earth science class, specifically with the lessons that focus on Long Island Sound—its geologic history, watershed and pollution. This unit has seven objectives. The first five concern areas of acquired factual knowledge. The last two concern the development of research skills that can be applied to ongoing science reports and to future learning situations. The fieldtrips motivate as they introduce the students to essential concepts through hands on application. In so doing, the fieldtrips support all seven objectives.

The first objective is to expand the students' point of view through time—200 million years in the past, to their own present, and beyond to their futures. Educators are forever being exhorted to expand students' minds. What better way to do so then to present them with a temporal perspective at the very start of a teaching unit? If the unit is to be a study of Long Island Sound, begin 200 million years ago with the continental drift, a time when Pangaea began to break apart and the Atlantic Ocean was being formed. Erosion was creating the continental shelf and a river flowed in the valley which was to become L.I.S.

The glaciers of subsequent ice ages pushed sedimentary rock and sediments off of the bedrock to form deposits in long piles or moraines. These piles of rocks and sand form the hills of Long Island. When the glaciers began to melt about 22,000 years ago, the runoff formed a huge fresh water lake in the old river basin. Sedimentation over time caused this lake to drain. 8,000 years ago it filled with sea water at the races when the sea level rose due to ongoing glacier melt. With the Hell Gate opening at the western end, the sound became an estuary, an arm of the sea where fresh water rivers flow into saltwater tides.

For the past 4,500 years these conditions have remained relatively stable. And that is why Betsy Ross Arts Magnet School was built 50 years ago on saltwater tidal marshland . And that is why fifty years later the BRAMS class of 1998 are studying the sound in the Quinnipiac Basin and neighboring coastal ecosystems. The

class will monitor the rise and fall of Long Island tides, check its salinity, observe its biotic life, repair pollution damage and prevent future pollution. In so doing the BRAMS students will become a part of the history of L.I.S. as they preserve L.I.S. for their children.

The second objective is to expand the students' point of view from their neighborhood to the world. New Haven is a city situated on Long Island Sound in coastal Connecticut where the Quinnipiac and Mill Rivers form a basin as they enter Long Island Sound. This sound and the students' backyards were created eons ago by glaciers which covered most of the world's land mass. Several factors resulted in the formation of these glaciers. Variations in the earth's orbit and tilt chilled the planet. Another cause was plate tectonics which located the continents in a glacier forming pattern. In addition, the erosion of mountains throughout the world reduced the amount of carbon dioxide in the atmosphere. And, finally, the sun's energy fluctuated. All of these factors working over time, chilled the surface of the earth to such an extent that glaciers formed.

As these factors changed, the glaciers melted. All over the globe the sea level rose forming the sound as we know it, an estuary which is open at each end to the Atlantic ocean. It is a body of water where the fresher water from the East River mixes with the saltier water from the Atlantic's continental shelf. The Atlantic Ocean in turn is connected to the Pacific and other oceans of the world. Its currents unite continents and effect climate. Its water temperature effects winds and weather around the world. So when the students of Betsy Ross study the sound as it is today, that study is part of a global picture.

The third objective corresponds to an objective in the science curriculum. Increase students' knowledge of the geologic history of Long Island Sound. That history and its global scope has been summarized in the previous paragraphs. The third objective has an added emphasis on the granite, basalt, sandstone and shale which line the shoreline of the sound and make up the pebbles and sand of its beaches. The granite and basalt was formed in the mantle and exposed by glacier action which scraped away less ancient layers. Eons of sedimentation under pressure formed the sandstone and shale. Samples of these rocks, as well as, minerals derived from them such as quartz, and mica can be gathered on a field trip to any local beach.

The fourth objective is also taken from the science curriculum. Increase the students' knowledge of the Long Island Sound watershed. For this objective the reading students will read maps of New England. They will trace the courses of the Housatonic, Thames and Connecticut Rivers. The Connecticut River flows through most of New England. Its headwaters begin in Canada. From there it flows south between Vermont and New Hampshire across Massachusetts into Connecticut. They will locate the tributaries of these rivers. And they will study firsthand the Quinnipiac River which empties into New Haven Harbor. The importance and the composition of marshlands and aquifers will be duly noted.

A study of Long Island Sound's watershed leads directly to the fifth objective which is students will increase their understanding of the nonpoint pollution of Long Island Sound. The two largest sources of nonpoint pollution are atmospheric deposition and storm sewer runoff. In the first case, pollutants such as lead, nitrogen and sulfur are washed by rainwater from the air. These pollutants then travel by means of the watershed to the sound. In rural areas, storm sewer runoff deposits sediment, pesticides, and fertilizers in the sound. In urban areas the storm sewer runoff contains floatable plastic debris, raw sewage, oil, lead, and lawn fertilizers and pesticides. It should be noted that in times of storms, storm sewers that are attached to the sewer systems of towns and cities become sources of point pollution because they overflow directly into the sound at fixed points, drainage outlets.

Such pollution hampers the recreational and the commercial uses of the sound. Ironically, those who use the sound and have a real interest in keeping it a viable body of water, even these users, pollute the sound.

Together the recreational and commercial users of Long Island Sound have increased the human impact on the sound. The popularity of boating and water sports has given rise to the tourist industry along the Connecticut coast. Marinas, amusement parks, quaint preserved villages. colonies of rental cottages, camp grounds, charter fishing businesses, seafood restaurants, real estate agencies all invite summer people to use the sound. But more people bring more car exhaust, litter and sewage. Boaters flush. Boat engines leak. And the bottom of every recreational user's boat is painted with toxins to discourage seaweed and barnacle growth.

At the same time commercial fishermen cull the sound's waters and use them as a nursery for ocean going fish . They plant oysters, clams and scallops in beds in the shallows. Tugboats with strings of barges haul trap rock in the channels. Oil tankers travel on the sound's relatively calm waters to ports like New Haven. The Queen Elizabeth cruises to no where on Long Island Sound. And for centuries factories along the sound and along the rivers leading into the sound have used the sound as an inexpensive depository for industrial waste.

Problems arise when a recreational boater catches his keel on the towline between barge and tug, when beaches are closed due to floating sewage, when scallop beds are contaminated or when the QE II hits an uncharted rock. Law suits fill the courts over access the private, town and state beaches. Interstate 95 is a solid traffic jam on summer weekends. Marshland is either being bought up and built on or added to land trusts with no parking lots. The fish stocks are being depleted. Hurricanes and noreasters race through in their seasons wrecking boats, beaches, homes and piers, toppling tree and power lines, flooding the coastal lands. Oil tankers spill, and gas station tanks leak. Tourists step into "black mayonnaise" and are affronted by unseemly plastic debris. Swimmers drown.

The problems of the human impact on Long Island Sound and its pollution is a very complex problem that the Betsy Ross students need recognize and study because chances are they will be dealing with these problems and their global implications as future citizens of Connecticut and the world.

The sixth objective gives the students guidelines on problem solving using research. Increase the students' ability to research in the field, in the library and on the Internet. The students will be taught how to research following the Big Six model which uses collaborative learning.

The Big Six steps are listed as follows:

1. Task definition

2. Information seeking strategies

3. Location and access

4. Information use

5. Synthesis

6. Evaluation

They were developed by Micheal B. Eisenberg and Robert E. Berkowitz to organize the research process. (Michael Eisenberg/ Robert Berkowitz - School for Information Studies, Syracuse University, 1991) The City of New Haven and Library Power have funded workshops to familiarize New Haven teachers with this approach to information problem solving. It is a particularly appropriate methodology for a collaborative teaching unit

such as this one because the skills taught can be carried over into other classes.

The first step, Task Definition, has the study group get a very clear understanding of the problem or assignment. In this case the students are asked to formulate a question on the nonpoint pollution of Long Island Sound. They are to fill out 10 notecards of research on their question. They are to investigate at least 5 resources. The group is to produce a poster board that illustrates their findings with pictures, maps, charts or graphs. The group is to write a 3 minute speech to educate others on their findings. These speeches are to be delivered by the group's chosen spokesperson in front of the combined reading, study skills and science classes at a culminating town meeting on nonpoint pollution.

What aspect of nonpoint pollution in Long Island Sound the students choose to research is their decision. They will be given guidance in writing out their research question so that it is neither too narrow nor too broad. By giving the students ownership of the research question and by making the project a group effort, the students' motivation is increased. Small on site field trips to points around New Haven and the Quinnipiac Basin will also reinforce the motivation by making this collaborative group science unit a part of the students' lives.

The second step, Information Seeking Strategies, forces the group to think about how they are going to attack the problem. This step eliminates wasting time on tangential lines inquiry and starts the group moving on task. First the group lists possible sources of information, and then it prioritizes the list . Sources can range from on site field notes, lab notes, interviews, atlases, books and newspapers to software, videos, and the Internet.

The third step, Location and Access, involves finding the information. For example, once a student decides to use and atlas, he must visit a library, find out where the atlases are kept in the library, take an atlas with a map of L.I.S. in it off of the shelf or out of a drawer, and open it. Then the student must use the index to find the page where the L.I.S. map is located. This act involves knowledge the alphabet, skill in scanning and use of synonyms. "Estuaries" or "Connecticut" are entry words that might lead to a more helpful map.

If the source is computer driven, locating the information involves selecting an appropriate CD. The commands have to be worded in such a way that the student is not overwhelmed with useless information. For example, using "sound" as a key word would generate pages of facts on noise. The student needs to learn how to narrow his requests and to do a Boolean search.

Once the information is physically located step four, Information Use, comes into play. The student must read, listen to or watch the information while asking, 'How can I use these facts?'. If the fact is pertinent, then the student needs to get a copy. The student with the atlas needs to make a copy of his map. He'll need a few nickels and he'll have to know how to use a copier machine.

For a book of print, data retrieval is complicated by hand copying out facts onto notecards. Title, author, publisher, and page number must be included for the source to be referenced. It's necessary to read the material, understand it, summarize it or use direct quotations with the required punctuation. An alternative is to make a copy and highlight, but this skill too must be taught. In a given paragraph what information is important? A student needs to evaluate what he reads. He needs to be taught to distinguish details from general statements and facts from opinions.

Step 5, Synthesis, involves creating something be it a video, a collage, a research paper or, as for this assignment, a poster board and a speech. The students need to learn how to organize information. They need to categorize and analyze. There are graphic organizers to help with these tasks. The rational behind narrative

sequence needs to be taught. For the poster board, a lesson on putting information into graphs is relevant. They will get a lesson on poster layout and lettering from an art teacher. The students need to take facts from a variety of sources, think about them, and synthesize them so that other students can learn form the presentation.

The last step is Evaluation. Here the students judge their work against clear standards. The teachers will provide them with an evaluation matrix when the assignment is first given so that there will be no surprises at the end. The students will know exactly what they will be evaluated on by the teachers and they will know what questions to ask themselves. The additional self evaluation is important because it enables the students to learn from their mistakes. The final presentation at the town meeting will also be evaluated by an audience of their peers.

The Big Six steps take the students through a collaborative group research project. The whole process is broken down into easily identifiable tasks. The students are lead through the process a manageable step at a time. In so doing the remedial reading students are more likely to have a successful experience which will lead to a more successful completion of their science project on nonpoint pollution. And they will have learned the process of research which will enable them to fearlessly tackle their oceanography reports.

Because the Big Six Steps are applied in a collaborative group research project the entire activity reinforces the seventh and final objective for this teaching unit—increase the students ability to work in a study group. The ability to work with others is a key skill for the American work force now and in the future. This unit will give the students experience in the skill of getting along with others, listening to others, sharing with others, and working with others.

Outside of the classroom the research and learning will be reinforced by mini fieldtrips to local points around the sound. The trips will take four to eight students at a time and will last one to two hours. They will take place during and after school. The students will choose from the following list of field trip options. All of the trips include an activity, recorded observations, and a film record of video, prints or slides.

Betsy Ross is situated next to Interstate 91 at exit 8. It is a quarter of a mile from the Quinnipiac Basin and the city dump lies just across the interstate. The fist field trip will take a group across Route 80 to a dusty lot next to the new super K-Mart. Here marshland was filled in for development. On the fringes of the lot phragmites still grows in ditches and cracks. At the back of the lot is the site of a year old oil spill. Students will observer the booms and other paraphernalia which was used to contain the spill. Samples of the water will be taken and observations will be made and recorded on the waters appearance, smell and feel. These samples will be further studied under a microscope in their science class, and tests for oil, microorganisms and salinity will be run. A core sample of the mud will also be taken and examined.

If permission can be obtained, the students will go on a tour of the landfill for another fieldtrip. Prior to the trip they will research back issues of the New Haven Register to find the story of how their school was closed for a week in November while teams of experts tried to discover what was polluting the air. The landfill was cited as a contributing factor to the school’s and the neighborhood’s air pollution problem. Raw sewage was mixed with cement to cap the landfill and it ended up causing more problems than it solved. The students will take a core sample and see for themselves one cause of the problem. They will also make observations on how the landfill covers wetlands.

Another landfill to visit is the recycling center in Branford. Here trash is sorted. Paper, metal, glass, and plastics are recycled. Trees and brush are chipped into mulch. Other trash is buried in a huge landfill. The

students will visit Waverly Woods to see a stream that flows from the landfill directly into marshlands which connects to Long Island Sound. They will take samples of this water, and in their science class test it for microorganisms, nitrates, and minerals.

The students will visit what is left of the marsh in the Quinnipiac Basin. They will identify the plants, marine life, birds etc,. The value of marsh land as a water purifier, a home to wildlife, a storm buffer and a nursery for fishes will be noted. Prior to the trip the student will read about what they can expect to find in a marsh, fiddler crabs, tiny shrimp, minnows, muskrats, seagulls, herons, mud snails, plovers, cordgrass, sea lavender to name a few. Samples will be photographed and identified . Some samples will be returned to science class if they cannot be identified in the field. Students will record which species were absent from the marsh and theorize as to why that might be?

The students will visit the Quinnipiac River or the Mill River and take samples of salinity at different tides. They will make observations on the clarity and the viability of the rivers and compare the water in the rivers with the water in the basin. If litter is a problem along the river banks, they will pick up the trash that they find and keep a record of what was found, where it was found and when it was found. This litter log will be added to by other groups and the findings over a month will be charted.

On another trip to a local beach the students will make another litter log . They will be educated to the dangers that balloons, fishing lines and plastic six pack rings have for fish and aquatic birds and mammals.

The beach at Crescent Bluff in Indian Neck, Branford, is an interesting location to study beach erosion. Old photographs form the 1950’s will show how high the sand was and the students will be able to see how the level of sand has fallen three to four feet. The cause is obvious. A beach club put in iron plate barriers to hold the sand in front of its property. As a result the sand on the beaches to the east of the club was not replaced by new sand. The level of sand on those beaches decreased while the eastward moving currents piled sand up in front of the club. The students will see old jetties and note how it is now against the law to build new jetties. Before the students take this beach walk they will do a classroom experiment on erosion where dried soil is mounded in one end of a pan. Sand and water are added to the other side. When the pan is rocked to simulate wave action, the soil is broken down into the water.

On the Limewood Beach in Branford two storm sewers with exposed pipes run directly onto the beach. After a hard rain the students can see how the storm sewer runoff erodes the sand of the beach down to the pebbles. The students will list what is put on the roads and lawns of the homes within sight of the storm sewers. Fertilizers, pesticides, salt, road sand, and oil are a few of the things that can get washed into the sound. Then the students will speculate what happens in a downpour when the sewage treatment plants overflow into the storm sewer system.

At low tide students will wade out onto an exposed sandbar at Limewood Beach. They will observe seaweeds, mud snails, and sand worms. They will dig for clams at squirt holes. And they will use a chicken neck on a string to catch green crabs, hermit crabs and spider crabs. They will take a core sample of the sandbar and record their observations. This core sample can be examined under a microscope in science class.

The students will also observe seabirds on this trip especially the ones that are feeding on the sandbar.

Another beach walk will collect samples of the sand and stones that are common to local shores. Pink granite with quartz and mica, shale, brownstone, basalt and marble can be found. Their pebbles are nicely rounded by the wave action. Back in class, the students will relate their stones to the geologic history of Long Island

Sound. The basalt was formed by magma cooling into solid form. It underlies the Connecticut Central Valley and is mined by the Tilcon Corporation as traprock. The sedimentary rocks, shale and brownstone are formed when rocks breakdown, and reform with minerals and bond with natural cement, all under pressure. The granite, a plutonic rock, was formed under heat and pressure. It contains mica, a complex silicate; quartz, silicon dioxide; and feldspar, a combination of aluminum silicates, sodium, potassium and calcium.. Glacier action exposed the coastal granite to the erosive forces of the waves. The marble, a metamorphic stone was formed by limestone which crystallized under heat and pressure. There is also the possibility that the students will find samples of sea glass or industrial slag.

On the Pine Orchard/ Stony Creek trolley track swamp walk the students will again study a marshland. This one is more extensive than the marsh around the Quinnipiac Basin. It contains woodlands, granite cliff outcroppings, a view of the granite Thimble Islands, tidal creeks, exposed mudbanks with colonies of fiddler crabs, egrets, mallard ducks, Canadian geese, cormorants, terns, seagulls and ospreys. The trail was once an old trolley track and railroad tracks are within sight of the trail. These tracks show some of the history of the marsh and illustrate how it continues to be used today. Also within sight of the trail is the Tilcon facility at Juniper Point. Here barges are loaded with traprock. This fieldtrip offers opportunities for bird watching, crabbing, and fishing. Samples of plants, water and mud can also be gathered.

The final fieldtrip experience is a ride on the Stony Creek ferry. A letter will go home to the parents suggesting that they take their students on a family outing around the Thimbles. A map with directions will be included. The ferry boat captains tell educational as well as entertaining stories about early coastal history. The students will take notes and pictures. This trip involves the students' families in their school work. It will be one option among many.

The field trip groups will bring their notes, pictures and newly acquired knowledge to their study groups. This information will become part of the groups' poster presentations at the town meeting. These posters will contain pictures, graphs, maps, or charts on the Long Island Sound question that the study group researched. Each poster will also have written copy on the topic. And the spokesperson for the group will be prepared to present a three minute informational speech. There will also be an opportunity for the groups to field questions on their topics.

The information gathered on these field trips will be used in other ways. The raw data on litter collection will be configured into a prominently displayed chart. A fieldtrip album will contain a pictorial record of all the fieldtrip locations and participants. The fieldtrips themselves are intended to be a "type A" experience. They will pique the students interest in the sound and give them a practical background to bring to their science class.

This entire reading lab unit is intended to help the remedial reading students in their science class. They will get to used their notes on Long Island Sound in the eighth grade oceanography report. Also the research skills they learned on this collaborative group project in reading will be exercised again, only this time independently, for the science oceanography report. Those students who have drama class will get additional credit for performing at the town meeting. In short, the reading, study skills, drama and science teachers, working together will create an enriched learning experience for the remedial reading students at Betsy Ross Arts Magnet School.

Lesson Plans

Overall objective: to increase the students understanding of the nonpoint pollution of Long Island Sound as apart of the human impact on the sound.

Lesson #1 Small fieldtrips on a weekly basis to a site off of route 80 on the Quinnipiac Basin.

Equipment:	Rubber boots, protective gloves, plastic garbage bags, map of the area with a superimposed grid, clipboard, camera
Objectives:	The students will walk the shore and collect litter in the shallows and on the shore.
	The students will number each piece of litter.
	The students will mark with the litter number where they found the litter on the map.
	The students will date the map.
	The students will identify the litter as to material, paper hamburger wrapper, plastic straw, metal soda can, etc.
	The students will identify the source of the litter as nearly as possible, MacDonald's hamburger wrapper, wood scraps from a construction site, rubber tire tread from Interstate 91, etc.

The above objectives, even though they take place in a swamp, are part of the Big Six steps to research. By locating, picking up, and recording information on the litter, the students are in fact doing step 5 of the Big Six, Location and Access of Information.

On going discussions to identify the litter and speculation as to where it came from and how it got there will take place. Useful comments will be recorded, and any mystery objects will be brought to science class for further identification. Pictures will be taken of each expedition. On some trips a video camera will be used.

Lesson #2 Make a pictograph of the litter collected on weekly field trips to the Quinnipiac Basin.

Equipment:	grid maps and field notes on the litter collected on weekly fieldtrips
	graph paper
	computer program with graphic capabilities
Objectives:	Students will look at samples of pictographs.
	Students will categorize the litter by material, organic, plastic, paper, metal, etc.
	Students will total the number of items in each category.
	Students will draw a picture to represent each category.
	Students will decide how many items will be represented by each picture.
	Students will make a legend to explain the pictograph.
	Students will divide the number for each picture into the number of items in each category to find out how many pictures each category will have.
	Students will set up the pictograph with categories going up the left-hand side of the graph and numbers of items extending along the bottom of the graph.
	At least one group of students will put their graph on the computer and print it out.
	Students will draw conclusions on what kind of litter predominates in this area.
	Students will brainstorm for ideas to eliminate the litter.

Another pictograph can be made by changing the categories to places of origin. K-Mart, MacDonalds, Burger King and Dunkin Donuts all have shops in the vicinity. A student delegation could present a pictograph of their findings to the managers of these business establishments along with a letter of praise for the store with the

least amount of litter.

The above lesson uses the Big Six tasks 4 Use of Information and 5 Synthesis. When they categorize the litter, the students used the information by imposing logical criteria on a pile of trash. When they use this organized data in pictographs they synthesize their data to make a point about nonpoint pollution in Long Island Sound. First they show that it exists in their neighborhood. By categorizing the litter by source, they identify the culprits. Then they act on this knowledge by going to the sources to prevent further pollution.

Lesson #3 Make a percent graph of the litter collected on weekly trips to the Quinnipiac Basin.

Equipment: grid maps and field notes collected on fieldtrips to the Quinnipiac River Basin
compass
protractor
colored pencils or magic markers

The above lesson will closely resemble the previous lesson on making a pictograph. The categorizing will be the same. However, the mathematics involved in determining percentages of each category will be different. The students will divide the total number of litter pieces into the total number of pieces for each category to arrive at a percentage. For example if the total number of litter is 141 and the total number of plastic pieces is 47, divide 47 by 141 to get .33. Plastic then is 33% of the total litter problem.

A pie graph is a circle of 360 degrees. The student will draw a circle using a compass and draw a diameter through the midpoint of the circle. The students will figure out that 33% or one third of 360 is 120. Divide 3 into 360. They will then count off 120 degrees using a protractor which is placed on the diameter. This slice of the circle will then be colored and labeled plastics. The students will repeat this process for the other categories of litter.

This graph can be used on the students' posters which will be displayed and explained at the culminating activity, the town meeting.

Lesson #4 Make a line graph of litter collected during weekly field trips to the Quinnipiac River Basin.

Equipment: grid maps and field notes of litter collected on fieldtrips to the Quinnipiac River Basin.
graph paper

Objectives:
Students learn how to transform grid maps and field notes into a line graph which fluctuations in the number of pieces of litter collected on a weekly basis over a month.
Students observe samples of line graphs.
Students set up a line graph . The number of pieces of litter run up the left-hand side of the graph and the dates on which the litter was collected will extend along the bottom of the grid.
Students will tally the number of pieces of litter for each day and place a dot on the graph paper for each total and day.
Students will draw lines to connect the dots. Fluctuations in the litter count will then become clear.
Students will speculate what events might cause the litter to increase and decrease. For example weather, holidays (Halloween), sales, construction all could influence the amount of litter generated and strewn around the Quinnipiac Basin.

The line graph shows littering over time. After the initial litter collection and clean up, subsequent collections should be less if only because they represent a week's worth of litter as opposed to a year's worth of litter.

The real purpose of the graph would be to compare these weeks. If the amount of litter gradually decreases, it may be due to the fact that people are hesitant to litter in pristine places. The students may wish to post a sign saying that the area is maintained be the students of BRAMS to further discourage littering. This line graph could also be used on the group posters on nonpoint pollution. The graph could be presented at the town meeting.

Like the pictographs and the percentage graphs, the line graph exercise is a part of the Big Six approach to research. Task 4 Using Information and task 5 Synthesis both come into play.

It is quite possible that no one class of students will be so interested in graphing information that they will tolerate three such lessons in a row on the subject. Since this unit is a group learning exercise the different groups may use different graphs to illustrate the outcomes of their research questions. So a different lesson on graphing may be presented to each small research group.

Lesson #5 Evaluate a collaborative group learning project on nonpoint pollution in Long Island Sound.

Objectives: The student will evaluate the group's poster presentation.
The student will evaluate the group's poster.
The student will evaluate the group's written speech.
The student will evaluate the research.
The student will evaluate the process of researching.
The student will evaluate the process of working with a group.
The student will evaluate his or her individual contribution to the group effort.

EVALUATION

DIRECTIONS: Answer "yes", "ok" or "no" to the following statements.

1. My group's poster presentation was informative. _____
2. The poster had a clear picture, graph or chart that people could understand._____
3. The copy on the poster was educational and based on solid research. _____
4. The speech was rewritten after a conference with the teacher. _____
5. The group had at least 10 notecards of research. _____
6. Each notecard was referenced. _____
7. The group consulted at least 5 different references. _____
8. The group's research question on Long Island Sound was a good one. _____
9. Everyone in my group worked to the best of his ability. _____
10. I did my best work. _____

The above evaluation requires the students to consider the whole experience of collaborative group learning. By evaluating what they accomplished, the students identify their own weakness and acknowledge their own strengths. In this way the students learn about themselves as they learn about the research process and the global significance of Long Island Sound.

Bibliography

Bell, Michael. *The Face of Connecticut People, Geology and the Land* . State Geological and Natural History Survey of Connecticut, 1985. A section deals with the coast. Also Chapter 6 “A sense of Time” explains Panagea, sediment layers, global history and glaciers.

Ford, Brent A. and Sean Smith. *Project Earth Science: Physical Oceanography* . Virginia: National Science Teachers Association, 1995.

This teachers’ workbook includes activities and information on estuaries, tides, oily spills, and a global view of the ocean.

Connecticut Department of Environmental Protection. *Long Island Sound An Atlas of Natural Resources* . Coastal Area Management Program, 1990. Lobsters, clams, bluefish and other edible resources are illustrated. Life cycles, habitats, diet, etc.. are summarized.

Environmental Protection Agency. *Long Island Sound Study* . 1994. The comprehensive Management Plan is summarized. Fact sheets on various topics from “Floatable Debris” to “Nonpoint Source Pollution in Long Island Sound” are informative and reproducible.

Patton, Peter C. and James M. Kent. *A Moveable Shore* . National Audobon Society and the Connecticut Department of Environmental Protection. Duke UP, 1992. Some of the chapters cover relevant topics such as geologic history, coastal processes, sand, glaciers, beaches, rocks and marshes.

Turekian, Karl K., *Global Environmantal Change Past, Present, and Future* . New Jersey: Prentice Hall, 1996. The scope of this book is mind expanding. From the beginning on to the present, the global perspective is applied over eons.