Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2015 Volume III: Physics and Chemistry of the Earth's Atmosphere and Climate

How Humans Impact the Long Island Sound

Curriculum Unit 15.03.04
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Objective

In the curriculum unit, How Humans Impact the Long Island Sound, students will gain an understanding of how the Long Island Sound was formed and trace the history of its health by looking at physical, chemical, and biological tests performed on the Sound. They will look, in particularly at nitrogen and how, through farming and the use of fertilizers, this has affected the health of the Sound.

Introduction

This unit will be taught to four sixth grade general science classes at Betsy Ross Arts Magnet School in the spring when the unit *Science and Technology in Society – How do science and technology affect the quality of our lives? (EARTH)* is taught. This unit will be taught during the fourth marking period in conjunction with Science Standard 6.4./ Students are expected to be able to explain the role of septic and sewage systems on the quality of surface and groundwater and explain how human activity may impact water resources in Connecticut, such as ponds, rivers and the Long Island Sound ecosystem. Most precipitation that falls on Connecticut eventually reaches Long Island Sound, and the same is for most of the wastewater released into Connecticut's environment.

Background Information

A watershed is a given area of land that drains all of the precipitation in an area into streams and rivers that eventually lead to a larger body of water such as a large lake, the ocean, or, in this case, the Long Island Sound. The Long Island Sound watershed is all of the land and water area that feeds into the Sound. The states that are a part of the Long Island Sound watershed are New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, and even Canada. The Connecticut River is the largest river feeding into the Sound and its source is in Canada. This river picks up water from 11,263 square miles of land. The Thames and the Housatonic River basins together add another 3,500 more square miles of watershed to the Sound. No rivers flow from Long Island, but is still part of the watershed that feed the Long Island Sound. The Long Island Sound watershed drains over 15,00 square miles. Winter snow collects on hills and mountains in the New England states. Therefore, levels are lowest for feeding the rivers. When spring comes and the snow melts, levels rise. This causes a spike in water runoff and is referred to as the spring freshet. Rivers provide ninety percent of the freshwater that flows into the Sound.

The Long Island Sound is an estuary, which is a mix of fresh and salt water. The Sound gets its salt water from the Atlantic Ocean and gets its fresh water from the three largest rivers, the Thames, Housatonic, and the Connecticut Rivers. Long Island Sound separates Long Island from Connecticut. The formation of the Sound occurred through glaciation that occurred during the ice age. The glacier cut through hills and land. The weight of the glacier pressed down the land causing a deep groove. When the glacier eventually melted, it formed a freshwater lake. Over time, through erosion from wind and water, the eastern part of the lake opened up to the Atlantic Ocean creating a mix of fresh and salt water forming an estuary we know today as the long Island Sound. This area is known as the Race. The Race is where there is the most turbulent place on the Long Island Sound, where as the rest of the Sound is rather calm. The Long Island Sound watershed was home to many Native Americans who fished and caught game such as deer and pheasants. Then in 1614, Dutch explorer Adriaen Block finished his exploration of the Long Island Sound. His business was fur trading. This opened up the Sound for trade. Dutch settlers inhabited Manhattan Island at the mouth of the Connecticut River. They were soon displaced by English settlers. European settlers, mainly the Puritans, soon cleared the land for farming, trade, fishing, and whaling. The Native American influence dwindled by the late 1600’s.

Commerce grew and this area became home to brass and metal finishing, textiles, hat manufacturing, and fishing for oysters. These commercial businesses put a toll on the Sound and its tributaries. When the Industrial Revolution happened around the 1790’s to the 1830’s. This caused a growth in population and pollution. The New Haven Harbor has been dredged, periodically due to silt being deposited by rivers. The dredged soil from the Harbor was dumped onto land increasing the land mass in New Haven, CT. In the 1950’s the population rose again due to post war housing development. This is also the period of time that water quality testing began to see how humans impacted the environment.

One of the major problem is a decrease in dissolved oxygen, killing organisms that live in the water. This is caused by increased levels of nitrogen, a nutrient that plants thrive on. This condition is known as hypoxia. It causes an overproduction of growth among plants, algae and plankton. This overproduction of plant and plant-like organisms then leads to death and decay, which in turns, leads to a growth in the bacteria that consumes the dead and decaying organisms and these bacteria use up the oxygen in the water. Some of this decrease in dissolved oxygen is a natural process, but efforts are being made to decrease human impact. The natural occurrence known as natural stratification happens in late summer where the surface water is warmed and floats on top of the more dense colder, saltier water which sinks. These distinct density levels is known as pycnocline .and it keeps the two layers from mixing.

In the 1970’s, the Clean Water Act was established. In 1985 Congress established the Long Island Sound Study (LISS). In 1994 the LISS adopts the Comprehensive Conservation Management Plan (CCMP) to restore and protect the Sound. The plan was to reduce toxic substances and pathogens, look into the hypoxia dilemma, and to protect natural habitats. In 1998, Connecticut, New York, and the Environmental Protection Agency

(EPA) set limits on the amount of human sources of nitrogen pollution and to restore 2,000 acres of natural habitats. In 2001, the EPA approves New York and Connecticut's goal of reducing "Human Maximum Daily Load" of nitrogen to the Sound. In 2003, the LISS adopts the Long Island Sound Agreement to contribute to the health of the Sound by 2014, four hundred years after Captain Block finished his exploration of the Sound.

> In 2008, LISS establishes the Sentinel Monitoring Work Group to examine the effect of climate change in different areas of the Sound and its coast. The LISS is also responsible for uncovering the fact that nonpoint source of pollution biggest contributor comes from the drainage basin into the Sound. [1]
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> In New York harbor, sewage contains compounds that combine directly with the oxygen and deplete it from the water. Eventually, the bottom waters are stripped of oxygen and the coastal sea dies. Unfortunately, the cost of eliminating the nutrients is so great, that it is not clear that society is willing to pay the price of cleanup. Right now, the trend is discouraging, our waters are losing more and more oxygen. [2]

In 1992, 93,600 tons of nitrogen was dumped into the Long Island Sound per year. Out of that, 39.900 tons occur naturally and cannot be controlled. The remaining 53,700 tons come from human activities such as sewage being dumped into the Sound. This type of pollution is known as point source pollution.

Point Source Pollution

Point source pollution can be directly traced to a particular source, such as a sewage pipe leaking wastes into a body of water, or a factory discharging wastes in the same manner. Nitrogen is the by-product of human and animal waste (sewage).

Nitrogen makes up about 78 percent of our air. Humans and other organisms cannot use the nitrogen in the air known as free nitrogen, but we need nitrogen in order for us to carry out our bodily processes. We obtain this nitrogen through the foods we eat. How this nitrogen is converted to nitrogen we can use, known as fixed nitrogen, is by lightning that fixes free nitrogen, or by nitrogen fixing bacteria found on the plant roots of legumes such as clover and alfalfa. We eat the plants or the animals that eat the plants and obtain the nitrogen that way. When we die and decompose or produce waste, the nitrogen is returned to the soil by bacteria that decomposes dead and decaying organisms. When it precipitates, runoff from the land washes into rivers and streams and eventually makes it to the Sound. Fertilizers, either from natural sources such as manure, or manmade, in the case of synthetic fertilizers add to the increase of nitrogen to an environment. Fertilizers are used on farms and lawns. This type of pollution is nonpoint source of pollution. Efforts are being made to reduce the amount of nitrogen load to the Sound.

Oil spills have destroyed thousands of seabirds and millions of sea creatures. For our dependence on oil, our thirst for it has put our waterways in danger. The first disaster happened in 1967 when the tanker, the Torrey Canyon hit a reef and cracked open spilling oil on the shores of the British Isles. There have been many accidents since such as the Exxon Valdez which hit a reef in 1989 and spilled oil on one of the most productive and scenic coast along the Pacific Ocean. Of course the disaster of the oil rig that spewed gallon and gallons of oil into the Gulf of Mexico.

Nonpoint Source of Pollution

Nonpoint source pollution poses as many problems as point source pollution by adding bacteria, nutrients, sediment, pesticides, and toxic materials to the Sound.With the increase of population in New York and Connecticut and the building of superhighways, which added more pollutants to the waterways leading to several beach closings during the summer. The Long Island Sound is a cesspool of many contaminants including heavy metals such as lead, copper, and mercury leading to bioaccumulation in organisms. Bioaccumulation occurs when fish ingest these heavy metals. Other organisms that digest these fish accumulate these heavy metals and the more digestion leads to more and more metals in the tissues of these organisms. The overpopulation and urbanization of this estuary leads to eutrophication. Eutrophication is the process by which there is a buildup of organic matter in an ecosystem. This can lead to the death of a lake or pond.

Construction of houses, buildings, and the paving of streets increases stormwater runoff which does not have the benefit of the natural filtration process associated with the absorption of precipitation through soil leading to groundwater aquifers. Stormwater runoff picks up trash, oil from cars, sediments, and other pollutants that are piped directly to rivers and eventually to the Sound.

Atmospheric deposition is another source of nonpoint source pollution to the Long Island Sound, This comes from pollutants in the air that fall to the Sound when it precipitates. When factories were built, an attempt to keep air pollution from being at ground level by building smoke stacks. Little did they know that the smoke would travel up into the atmosphere and would make its way back down to the surface of the land, rivers and the Long Island Sound? This is another example of nonpoint source pollution.

Floatables are another form of pollutant that affects the Long Island Sound. This term refers to water-borne debris in the form of plastics, paper, cigarette filters, and other material. These floatables have killed numerous seabirds and other animals that live in the sea.

Pathogens are another pollutant that plagues the Long Island Sound. These are microorganisms that can cause diseases such as diarrhea, dysentery, cholera, typhoid fever, and hepatitis. Pathogens find their way to the Sound through sewage treatment plants, malfunctioning septic tanks, sewer overflow, and runoff from animal wastes.

Then there are organic substances, which means a substance containing carbon and hydrogen.These substances are produced naturally by plants and animals, but are also synthetically manufactured as in the case of polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). Pesticides can be either naturally produced or synthetically produced. PCBs and certain pesticides such as DDT have been banned because of its major health risks such as the risk of causing cancer and birth defects.

The History of Farming

Agriculture started from the beginning of time. From the first book of the bible, Genesis, makes reference to the "Garden of Eden." Early man was a hunter-gatherer. Hunter-gatherers were people who lived off the land foraging wild berries, edible plants, as well as, hunting wild animals. But the question remains, "Why did mankind switch from hunting and gathering to farming?" Was it the fact that, in nature, mankind longed to gather possessions and it was difficult to hold on to possessions if there was constant migration following a particular herd, as such? The groups of hunter-gatherers were rather small in number because of the constant mobility. After the last Ice Age, climates, globally, became much milder and wild grasses that produced seeds sprung up to fill in the new niches. The hunter-gatherers soon discovered these seeds were good to eat and these fertile areas would entice these nomads to return back each season. With an abundance of food in these areas would lead to an increase in population, which, in turn would lead to an increase of food production. Thus agriculture was started with the domestication of species, both plants and animals.

Archaeologists discovered that farms began in the Near East, in particular, Jericho in Southwest Asia. Another theory is that these hunter-gatherers were into mood-altering religious rituals. They discovered plants that would alter their moods such as cannabis, coca leaves, and fungi. They also discovered fermentation of fruits, roots and seeds high in sugar yielded alcohol.

Although there is no clear explanation as to why humans began farming, it is clear to note that all over the world farming began. Although the resources in the different locations differed, certain components remained the same such as certain grasses were domesticated, sown and harvested, grains were able to be stored more easily than soft-tissue plants, and these grains were used to make bread and beer. Agrarian societies took up residence near rivers because of the need of water for both humans and plants. The rich silt deposits full of minerals is a natural fertilizer, as well, as a good supply of water for the crops made it an ideal place for early farming. Egyptians used the Nile River, the Chinese Empire along the Huang River, the Mesopotamian Empire along the Euphrates and Tigris Rivers, the Harappa culture along the Indus River. These ancient societies realized that in order to have a healthy farm, there was a need to have compost pits, lots of domesticated animals for manure, and crop rotation. As populations grew, however, the rivers soon became unfit for human consumption, thus fermented drink helped to keep people from getting sick. From the heating of the water while brewing and the added alcohol made the unsanitary water safe for people to consume, including the children.

As farming grew, the labor was very intensive and many cultures incorporated slavery or serfdom to tend the fields. In the 1700's there was an agricultural revolution, largely due to production of large crops such as potatoes and corn. Then in the 1850's, the industrial revolution had a an impact on the agricultural field. Farming incorporated machines which increased the production yields of crops. most of the new machines used oxen and horses to power them and crop rotation was implemented (which actually had its start as early as the ancient Roman and Chinese people understood), along with better soil preparation. Later on, steam power replaced the animals and then came gas-powered machines. But still, there was never enough manure to satisfy the demand on food production and many people abandoned their farms and flocked to the cities. Now the food shortage was even more acute. The ideal yield for farmers was one acre of farming could feed ten people, but this was still not enough.

Then in 1898, Sir Walter Crookes, incoming president of the British Academy of Sciences announced, "England and all civilized nations stand in deadly peril."

> “As mouths multiply,” he said, “food sources dwindle.” the number of mouths had been increasing for some time thanks to advances in sanitation and medical care, from the installation of improved water systems to the introduction of antiseptics. These were great triumphs for humanity. But they carried with them a threat. While population increased, land was limited; there were only so many farmable acres on earth. [3]

Crookes concluded that the only possible answer to this dilemma was to create vast amounts of fertilizer by the thousands of tons. Was there a way to make this amount in factories? Could it be made synthetically?

> “It is through the laboratory, “ he said, “that starvation may ultimately be turned into plenty.” “It is the chemist, he said, “who must come to the rescue...Before we are in the day of famine to so distant a period that we and our sons and grandsons may legitimately live without undue solicitude for the future.” [4]

Throughout history, the quest to find the best fertilizers in the world was in hot pursuit. Alchemists of the day realized there was a connection between certain types of salt with gunpowder and fertilizer. The Chinese alchemists called this particular salt *huo yao* . The Romans called it *sal petrae* . known as saltpeter, which became the West’s gunpowder. With the advent of gunpowder, it change the nature of war. Still there was not enough of it. Therefore, artificial means to produce saltpeter more rapidly than it occurring naturally in salt mines was the way to go. Trenches were built filled with a mixture of soil, manure, ashes, and garbage. It was moistened with sewage and urine. Still, this was not enough to feed the countries that ruled by gunpowder might. The quest for saltpeter meant the takeover of weaker nations by stronger nations such as the takeover of India by England.

In 1835, the Iquique people in the South American desert, in a place known as Tarapaca. The land was a total wasteland and the only means of survival for these people was that their village was perched on the richest fishing area of the world. Also, a whitish, rocklike crust was found in the desert. The Indians called this substance *caliche* . This was their source of saltpeter, or salitre, as they called it. This salitre is what chemists call sodium nitrate. But for the greedy European nations, this was still not enough.

Their attention soon focused on islands a few hundred miles north of Tarapaca. These islands are known as the Chinchas Islands, just off the coast of Peru. What lied on these islands was the world’s best fertilizer, known as *guano* . What was packed on these islands was the manure of seabirds. One U.S. expert estimated that this guano was thirty-five times more powerful than standard barnyard manure. [5] So many ships from around the world flocked to this port to gather this precious guano. It was more precious than gold. Soil that was once poor in nutrients could be revitalized by this precious commodity and yield substantial crops. The country of Peru grew rich, but eventually, it stopped. The source had run out by the late 1850’s, but not before the Spanish conquistadores turned Peru into a slave nation. The quest to find guano worldwide took place and in 1856 the U.S. Congress passed the Guano Island Act, which meant any U.S. citizen could lay claim to any deserted island that had guano on it. Under this law, the United States made claim to ninety-four islands, rocks, and keys. Although none of these islands had the quality of guano found on the Chinchas Islands, it allowed the U.S. to lay claim to islands that would serve the purpose of setting up military bases for World War II.

Attention went back to the nitrate desert that lied between Peru and Chile. Thus, the nitrate war began in

1879. This area is called the Atacama. A third party in this game of war came from the country of Bolivia, which owned a strip of the desert between Chile and Peru and also had control of a shipping port, as well. Chile was the victor in this war and was about to become rich. The United States and Europe were dependent on the nitrate, not only to grow crops, but for explosives, as well. The nitrates from the Chilean nation helped to build the Panama Canal and to secure the United States Manifest Destiny. The two nations that were the biggest buyers of this nitrate were Great Britain and Germany, where their land was limited but their military might was strong. Great Britain had many colonies, many more than did Germany, so the Germans realized they had to come up with a way to get nitrates, so they turned to the scientists of the time.

At this time, Germany relied heavily on the imported Chilean nitrate, One scientist, by the name of Wilhelm Ostwald, focused on taking the free nitrogen from the atmosphere and fixing it chemically by persuading it to combine with hydrogen gas to make ammonia. His method was to find a balance between heat, pressure, and catalyst. He built a machine to carry out this process and a large German chemical firm, Badische Anilin- und Soda-Fabrik (BASF) was very interested. Basically, Ostwald was on a quest to turn atmospheric nitrogen into gold, as in profiting from this endeavor greatly.Unfortunately, Ostwald had the right idea but the wrong setup and he failed.

Several years later a scientist by the name of Fritz Haber began building a machine that was much more efficient at turning atmospheric nitrogen into ammonia. He had to figure out a way to make his experimental machine to a much larger scale whereby tons of ammonia would be produced. This was a daunting task because with the extreme heat and pressure needed to make the conversion, what large-scale material could hold this together. A team of scientists met to discuss the dilemma and one scientist by the name of Carl Bosch, who was an expert in metals took the challenge. After many failed attempts, Bosch was successful. Synthetic fertilizer was able to be produced on a large scale and this method was called the Haber-Bosch system which gave credit to the researcher as well as to the man who was able to turn the idea into an industrial reality. Then the Germans invaded France and World War I began and the side that would win the war would be the side that had the most fixed nitrogen, BASF, the company that funded the Haber-Bosch system now was in the defense business and Bosch didn’t like the idea. His goal was to produce ammonia for synthetic fertilizer in order to feed people. Now his technology was going to be used to kill people. Historians believe that World War I would have ended one to two years earlier if it wasn’t for the Haber-Bosch system of turning nitrogen into explosives.

With the effort to feed the world’s growing population, the quest to find the best fertilizer has led to many, if not all, of the wars. It has led to the discovery of gunpowder, which led to the making of bombs leading to mass genocides throughout history, including the rise of Hitler. It has taken science to new realms and possibilities, and we as humans have continued to pollute and destroy our planet.

Activities

Activity 1 - Nitrogen Cycle Game – Students would have previously been taught the composition of the atmosphere from the Weather Unit. Students will pretend they are a nitrogen atom. There will be stations set up throughout the classroom. Nitrogen in the atmosphere (free nitrogen), fixing nitrogen (bacteria), animal, soil, lightning, plants such legumes nitrogen-freeing bacteria, waste, decomposers. At each station students will record which station they are assigned to and at each station they will read a card to tell them what the nitrogen atom is doing and tell them which station to travel to next. Ideally students will make it through to each station and see the course that a nitrogen atom goes through. This will be a natural course of nitrogen without the interference of human impact.

Activity 2 - Students will research how humans impact the nitrogen cycle by point and nonpoint pollution. Point pollution caused by sewage being directly dumped into the Long Island Sound and nonpoint pollution by surface runoff from fertilizers used on lawns and farms. Students will make a list of ways they could do to reduce pollution.

Activity 3 -Students will participate in polluting a Connecticut river by simulating the following pollution added to the river: Trash (paper dots) from careless picnickers near the river who did not properly dispose of their trash; motor oil (pancake syrup) from cars and trucks unknowingly leaking oil onto the roads that are near the river; soil from a newly plowed farm; fertilizer (sugar) from a newly-built lawn community; salt from the roads treated for ice; sewage (red food color) from a malfunctioning sewage treatment plant; and toxic waste (blue or green food coloring) from a leaky barrel buried in the toxic waste dump. Adapted from the script named Fred the Fish from Watersheds as Learning Places: Urban Resource Initiative (URI). Students have been previously taught about the water cycle from the Weather and Ecosystems unit.

Students will work cooperatively to devise a system to clean the river they polluted. After getting background knowledge from textbook reading from Prentice Hall: Earth's Water, students will learn how municipalities deal with cleaning drinking water and wastewater. They will use several methods such as filtration, coagulation, sedimentation, chlorination, evaporation and condensation. Other possibilities could be desalination by freezing or boiling. Once their systems has been designed, students will put their ideas to the test. Note: There will be no complete way to test how efficient their design worked. The water will be judged by its clarity. Students will cooperatively design a brochure to sell their system to a municipality, such as New Haven.

Activity 4 - Students will model a river by using fine sand in a large bin pitched at an angle to show that rivers form at higher altitudes and run downhill due to gravity. The source of the river will come from a plastic water bottle with a small pinhole towards the bottom of the bottle. Once the river process starts and they see how water can transform the land, the students will label meanders; braided forks; the source of the river; deltas; the mouth of the river which is the Long Island Sound which is the ocean or bay. Once all of the labels have been placed in the containers, students will add houses and buildings (Lego pieces) and dams (plastic transparency piece) to see how these obstruct the flow of the river. They will drill a hole in the sand and add yellow food coloring to simulate a defected toxic waste dump that is leaching into the groundwater supply. When it rains (spray bottle with blue food coloring) they will see how it affects the river and the Long Island Sound because the water will turn green. Adapted from River Cutters from Watersheds as Learning Places: Urban Resource Initiative.

Activity 5 - Students will research one of the three main rivers in Connecticut, the Thames, the Housatonic, and the Connecticut Rivers and design a diorama to show the source, what towns the river flows through, and the mouth of the river which is the Long Island Sound. A diorama is a three-dimensional model using a shoebox which depicts a scene in miniature-size by placing objects, figures, etc. in front of a painted background.

Activity 6 - Students will participate in the Connecticut statewide embedded task called "Dig In" where they will test the percolation and absorbency rates of several soil samples in order to research which plants will grow best in the types of soils they test. They will have a sample of sand, clay, potting soil, and soil from the schoolyard. They will identify certain characteristics of each soil type, giving detail descriptions of the properties of the soils such as color, texture, grain size, odor, and streak test. Students will record their observations in a data table.

Ongoing Activity - Throughout the unit students will make matchbook foldables for new vocabulary words. Colorful construction paper will be cut 2 inches by 6 inches. It will be folded almost in half, leaving about ¼ inch at bottom, which will be folded up to look like a matchbook. On the front cover of the matchbook, students will draw a picture of the key term or concept. On the ¼ inch folded flap, the term/concept will be written. On the inside top part of the matchbook, the definition will be added. On the bottom part, students will use the term/concept in a meaningful sentence. These matchbooks will be glued into their science interactive notebooks and can be assigned for homework.

Key vocabulary terms:

- Eutrophication
- Filtration
- desalination
- Chlorination
- Coagulation
- Sedimentation
- Aeration
- Runoff
- Groundwater
- Percolation
- Absorption
- Meander
- Delta
- Evaporation
- Precipitation
- Condensation
- Transpiration
- Reservoir
- Estuary
- Point source pollution
- Nonpoint source pollution

Footnotes

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1. Longislandsoundstudy.net
2. Rachel Carson, *The Sea Around Us,* 239
3. Thomas Hager. *The Alchemy of Air* , 4.
4. Hager, 8
5. Hager, 31

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Andersen, Tom. *This Fine Piece of Water: An Environmental History of Long Island Sound.* : Yale University Press, 2002. This book captures the history of the Long Island Sound and over time its water has become so polluted that it has destroyed much of the marine life and left the Sound almost to the point of utter loss.

Carson, Rachel. *The Sea Around Us* . New York: Oxford University Press:, 1951. A book about the natural world looking at the oceans, how they were formed, and the life that exists in them.

Hager, Thomas. *The Alchemy of Air* .New York: Broadway Books, 2008. A historical perspective of how we grow food that, inadvertently, led us into the knowledge of gunpowder and war.

Latimer, James S, Mark A Tedesco, R Lawrence Swanson, Charles Yarish, Paul E Stacey, Corey

Garza. *Long Island Sound: Prospects for the Urban Sea.* : New York, Springer, 2014. This book has been written to show the importance of studying one of the most used estuaries, the long island Sound. It examines nonpoint source pollution, invasive species, Coastal development, and climate change.

Longislandsoundstudy.net. It is a study of the Long Island Sound and nitrogen pollution. It looks at how to protect the Sound and why it is essential to monitor water quality and the lives that are dependent on the Sound.

Sinclair, Tom and Carol. *Bread, Beer, and the Seeds of Change: Agriculture's Imprint on World History* : Cambridge: CABI International, 2010. This book examines the history of agriculture and looks at the ten most powerful societies dealt with technology and food food production.

soundbook.soundkeeper.org. This is an important citizen's guide to protecting the Long island Sound.

Children's Resources

Benoit, Peter. *The BP Oil Spill.* New York: Scholastic Inc., 2011, This book teaches children which wildlife were affected by this oil spill and the methods used to clean up this ecosystem.

Benoit, Peter. *The Exxon Valdez Oil Spill.* New York: Scholastic Inc., 2011 . This book is written for children ages 7 and up and gives an account of the oil spill disaster of the Exxon-Valdez oil tanker off the coast of Alaska.

Cherry, Lynn. *A River Ran Wild.* San Diego: Harcourt Brace & Company, 1992. This is a historical book on how the native Nashua people and the European settlers joned together to clean and restore the Nashua River in Massachusetts.

Donald, Rhonda Lucas. *Water Pollution.* New York: Scholastic Inc., 2001. This book explains to students how water gets polluted and how this affects plants and animals. it has resources for teachers, as well as, activities for students.

Farrell, Courtney. *Save the Planet: Keeping Water Clean.* North Mankato MN: Cherry Lake Publishing, 2010. This is an interactive book that sends the reader into problem-solving and higher-order thinking skills as it teaches students how to care for our water.

Frost, Helen. *Keeping Water Clean.* Mankato, MN: Capstone, 2000. This book explains science concepts related to water in a way that young readers can understand, especially with the wide variety of colorful photographs.

Nelson, Sarah Elizabeth. *Let's Save the Water.* Mankato, MN: Capstone Press, 2006. Between the text and photographs, students learn why it is important to conserve water and gives simple suggestions of how they can save water.

Spilsbury, Louise. *Threats to Our Water Supply.* New York: Rosen Central, 2009. This book explores how humans impact our water on Earth and gives reasonable solutions of how we can offset the negative effects.

Appendix

6.2 - An ecosystem is composed of all the populations that are living in a certain space and the physical factors with which they interact.

Populations in ecosystems are affected by biotic factors, such as other populations, and abiotic factors, such as soil and water supply.

Populations in ecosystems can be categorized as producers, consumers and decomposers of organic matter.

C 4. Describe how abiotic factors, such as temperature, water and sunlight, affect the ability of plants to create their own food through photosynthesis.

C 5. Explain how populations are affected by predator-prey relationships.

C 6. Describe common food webs in different Connecticut ecosystems.

Science and Technology in Society – How do science and technology affect the quality of our lives? (EARTH)

6.4 - Water moving across and through earth materials carries with it the products of human activities.

Most precipitation that falls on Connecticut eventually reaches Long Island Sound.

C 10. Explain the role of septic and sewage systems on the quality of surface and groundwater.

C 11. Explain how human activity may impact water resources in Connecticut, such as ponds, rivers and the Long Island Sound ecosystem.

REQUIRED CMT EMBEDDED TASK: DIG IN