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Water, Water Everywhere and Not a Drop to Drink

Curriculum Unit 03.05.04
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Overview

I am a fifth and sixth grade science teacher at the Betsy Ross Arts Magnet School in New Haven, Connecticut. It is in a small New England urban community, which sits right near the Long Island Sound with many rivers and tributaries. Upon personal observation, many residents take up fishing as a recreation and from my own individual surveillance I know that many of these game fishermen eat the proceeds of their sport.

I believe it is my duty to educate my students in acquiring enough knowledge to inform the public of the importance in keeping our water safe and clean in order to preserve the wildlife that thrive in our waterways. My curriculum unit is bent on enabling my students to be the advocates of our local waters in an effort to preserve this precious commodity for future generations.

My rationale in developing this curriculum unit is to inform students how vitally important it is for them to take measures to ensure that the waters are safe for their lifetime and beyond. They should realize that water is not constantly being created, simply being recycled over and over again. Since there is only 1% of fresh water that the entire world population is relying on, we must take small steps to make a contribution in conserving and preserving this precious commodity.

The objectives for this curriculum unit will begin with students being made aware of the water cycle and how such a small percent of water is actually useable fresh water for consumption. They will become aware of how nature purifies water through filtration, sedimentation, and distillation. They will be introduced to certain water pollutants that reduce the amount of useable water. Students will engage in researching where pesticides used in agriculture eventually end up, which industries use rivers for dumping toxins or add heat by cooling their machines, and discover which organisms are affected by these various pollutants.

Students will become involved with the term “real pollution incident” by investigating sewer overflow (where does the excess sewage go?), storm water runoff (what happens when we have an abundance of rain?), and failing septic systems in individual homes and/or businesses. They will visit certain sites to learn how to test the health of a local body of water by determining the absence or presence of macroinvertebrates. Macroinvertebrates are animals without backbones and are large enough to be seen without high-powered microscopes. These familiar insects, such as the dragonfly and mosquito, spend the early part of their lives as

aquatic macroinvertibrates.

Students will develop a clear understanding of the harmful effects of water pollution on marine and freshwater organisms and that whatever pollutants pollute the waters will eventually pollute the land. They will study the health risks associated with eating fish or other organisms form the waters, both fresh and salt waters. They will learn of the harmful effects of mercury in the human body as well learn about the positive attributes of eating foods from the waters.

Students will be introduced to the notion that whatever litter is carelessly thrown in the streets eventually makes its way into our waterways. A pollutant such as oil leaking from automobiles, trucks, buses, etc., or those reckless individuals that mindlessly change the oil in their cars and dump this oil into the sewers or unto the streets, will eventually make its way into our waters. Students will see, first hand, how the city of New Haven deals with this problem of keeping our waters clean by visiting a water treatment plant to see the ill-effects of littering and polluting our community by land, sea, and air.

Students will keep a log of their family's daily use of water, if they recycle in their homes, what cleaning products their household uses and to check to make sure these cleaning products are environmentally safe.

Students will form teams whereby one team will research air pollution and how this affects our waters. Another team will research how the manufacturing and the production of goods affect the water pollution problem. Another team will investigate how consumer products affect the water pollution problem.

After all the research has been completed, collected and consolidated, students will strategize on how these problems that face, not only our community but the community as a whole, can be solved. They will embark on creating a brochure on the serious implications of water pollution to be distributed throughout the community. The students will make the public aware of the seriousness of this issue and to try to change the habits and the behaviors of individuals in our community. Brochures will be created, but also posters will be displayed, signs will be painted on the sewers to prevent people from using the sewer inlets as trash receptacles, this is pending collaboration with the Regional Water Authority of New Haven and the "Save the Sound" foundation.

Once this project is underway, students will collaborate with students from neighboring schools and schools in other communities in an effort to get them involved in preserving the waterways in their communities. Students will recognize what happens in our waters here will have a direct impact on those communities downstream from us and all rivers and tributaries in this area that lead to the Long Island Sound.

After completing this unit, students will be able to successfully produce public awareness information, be able to communicate to the public to change behaviors and habits and to teach other students in other neighboring communities of what they did and how these nearby communities can join in their efforts to bring about changes in attitudes about our precious, and ever decreasing, commodity…WATER.

Water takes up seventy-five percent of the earth's surface. However usable fresh water makes up a very small percentage, which makes fresh water to be a precious and valuable resource. The oceans make up ninety percent of the water and two percent of fresh water is trapped as ice either in glaciers, snowy mountain ranges or ice caps. That leaves a whopping one percent of usable fresh water. This water is stored in soil (aquifers) or bedrock fractures beneath the ground (ground water) or in lakes, rivers, and streams on the earth's surface (surface water). Water consists of 50-70 percent of weight in plants and animals, including humans. Therefore all living things need water in order to survive.

Just about the same amount of water exists today that existed from the formation of the earth, but the present demand for water has grown faster than the population. Since the 1950's that demand has tripled over the world, therefore all countries are faced with water management issues. The big question arises… "How can we satisfy the human need for water while maintaining the integrity of the ecological balance of the water's natural system?" Thus, water management will continue to face the human race as we go further into the 21st century. These issues are ever-present and can lead to social, cultural, and economic impacts.

Water is a very simple compound that consists of two hydrogen molecules and one oxygen molecule but it is essential to all life here on earth. It can exist in all three states of matter simultaneously, solid, liquid, or gas. Water, although simple, can cause serious alterations to the earth's surface through floods, weather patterns resulting in storms, erosion, and weathering, to name a few. As a result of water existing in three states of matter, what is created is the water cycle. Water is constantly moving. The sun heats bodies of water and it evaporates and rises to the cooler atmosphere where the water vapor condenses, forming clouds. Once the droplets of condensed water get bigger, precipitation takes place.

Vegetation also plays a vital role in the water cycle several ways. When the water is absorbed into the ground and the roots of plants take up the water, through transpiration, water is released from the plants back into the atmosphere. Plants also help to purify water because some harmful pollutants that may exist in water are absorbed by trees and through transpiration, clean water is released back into the atmosphere. Plants also help to cut back on the erosion of soil and reduce runoff. Water that is absorbed into the ground gets filtered through the ground and some water, eventually, makes its way to underground streams or rivers known as groundwater. Wells are tapped into these underground streams for usage.

The largest consumer of fresh water is agriculture. This industry uses about 42 percent. The next largest consumer, at about 39 percent, is with the production of electricity. Urban and rural homes use about 11 percent and the remaining 8 percent is used in mining and manufacturing.

As far as indoor water use, every American uses about 150 gallons of water per day, which translates to about 39 billion gallons per day in the United States. Toilets use up 30 percent, which means about five to seven gallons per flush. Showers and baths use about one-third of household use. A dishwasher uses less water than washing by hand, ten gallons versus 16 gallons, respectively. A leaky faucet wastes 2,300 gallons of water per year.

Pollution enters our waters in one of two ways, point pollution or nonpoint pollution. Point pollution is when pollutants are dumped into water directly through pipes, tunnels, wells, or ditches. This pollution is easy to track and is generally controlled by a municipal wastewater treatment facility. Nonpoint pollution, however, is not easy to find its source and comes from such things as fertilizers and pesticides from agriculture, construction sites, which can cause erosion of soil and heavy deposits of sediments.

Landfills and dumpsites can lead to contamination of surface and groundwater, and the lack of recycling of oil, grease paper, and plastics add to this dilemma. Parking lots add to this problem because of automobiles that drip oil, brake and transmission fluid and coupled with the fact that most parking lots are made of asphalt which makes the surface impenetrable to liquids and during a heavy rain these fluids get washed in with the storm water runoff. Hazardous wastes that are produced as a by-product of manufacturing if not properly stored or disposed of can also make its way into our water supply.

The United States has made great strides in improving water quality since the Clean Water Act has been put in place over thirty years ago. Although it is commendable that great efforts have been made to improve the

quality of our water, it must be noted that over 40% of our nation's monitored waters still do not meet the goals of the Clean Water Act for recreational use and the safety of aquatic life. Every citizen can have a part in insuring that we are made aware of what we can do to keep our waters clean by simply changing some of our actions.

Water purification occurs in nature by many different ways through grasslands, forests, and wetlands, which act like sponges. These ecosystems also help in removing fine sediments and certain pollutants such as radionuclides (radioactive elements) and metals are absorbed in these silt particles. Then there are microbes, whose job it is to eat pollutants such as periphyton, which are slime-like microbes that clean biologically and is known as bacteria or fungi and/or algae. There are macroorganisms that aid in filtration such as the caddisflies, which actually construct a net to catch pollutants. Black flies are in the business of net-building too. Natural woody debris dams act like filters, also, thus beavers also aid in the filtering process by their construction of dams and it has been reported that watersheds that are supported by beaver dams retain up to 1,000 times more oxygen than watersheds without beavers.

The land also provides a way to help purify water. Water absorbed into the soil makes its way into plants, which return water back to the atmosphere through respiration. Plants also help to hold the soil in place and keep good topsoil from washing away. Water travels through the soil and is filtered along the way as it makes its way to underground aquifers.

It must be understood that since nature has its built-in mechanism to purify water, protection of these built-in systems must be made. It is estimated that once one of these ecosystems are lost, the cost for a man-made filtration plant costs from $6 to $8 billion dollars. There have been efforts made to construct wetlands as an alternative to a wastewater treatment plant. Efforts must be made to educated ourselves in the value of keeping our water as clean as possible because the more polluted the water, the more costly it is for us to clean it. Therefore, the natural ecosystems that help to purify our waters must be preserved.

It is with all of this in mind that the lessons should reflect a thorough investigation of the uses of water and to educate students to become wise consumers of water and to be mindful to preserve this precious commodity on this, our BLUE PLANET called Earth!

Lesson Plans

I. Water of the World

Objectives:

- To recognize that although there is a lot of water on earth, very little of that water is drinkable.

- To realize ground water is a very small percentage of the earth's water.

- To understand that we take care of our water.

Materials:

1. Globe

2. 5 gallons of water

3. Tablespoons

4. Container (such as aquarium)

5. Droppers

6. Graph paper

7. Small containers (quart jars)

8. Copies of activity handout (Appendix A)

Part A - Exploring the Globe

1. Look at the globe with the students. See if they can find where they live on the globe. Have them point out lakes, rivers, and oceans. Explain that these are called surface waters.

2. Ask the students if they know which kinds of water bodies are salt water and which are fresh water? Have they ever tasted salt water? Was it good?

3. Ask the students if they think there is more water or land on the globe. Is there water beneath the surface of the ground that we cannot see on the globe?

Part B - Aquarium Demonstration

As you do this experiment, stress that the amounts represent relative quantities of different types of water, not actual amounts.

1. Put 5 gallons of water in an aquarium or other container. Tell students to imagine the container represents all the water in the world.

2. Have students remove 34 tablespoons of the water and put them in a cup. Tell them this amount represents all the water in the world that is not the ocean

3. Have the students remove 26 tablespoons of water and then another 8 tablespoons of water from the cup containing the 34 tablespoons of water. Put each into separate cups. The 26 tablespoons represent the world' ice caps and glaciers. The 8 tablespoons represent the world's fresh water. A fraction of a tablespoon (1/10) represents the world's fresh water lakes and rivers. Of that, all rivers amount to less than a drop.

4. Be sure to recycle the water. Use it to water plants.

Part C - Work Sheet: All the Water in the World (Appendix A)

1. Ask students to complete the activity work sheet.

2. The answers to drinking water percentages: 0.419% total and 2.799% grand total.

3. Ask students if the numbers surprised them. Did they realize that such a small percentage of the water in the world is fresh?

Part D - Bar Graph

1. Distribute graph paper.

2. Ask students to create a bar graph that shows 97% ocean, 2% ice caps and glaciers, and 1% fresh water.

Follow-up Questions

1. Why isn't all fresh water usable? *Some is not easy to get at; it may be frozen or trapped in unyielding soils or bedrock fractures. Some water is too polluted to use.*

2. Why do we need to take care of the surface water/ground water? *Water is very important for humans, plants/crops, and animals. If we waste water or pollute it, we may find that there is less and less of it available for us to use.*

II. The Water Cycle

Objectives

- Students will understand that water on earth moves in a continuous cycle.

- Students will be able to explain the stages of the water cycle.

Part A - Evaporation Activity

Materials

1. Small dishes or jar lids (2 per group)

2. Tablespoons (1 per group)

3. Water

4. Light source (sun or lamp/light) (1 per group)

5. Plastic wrap and or lids to cover dishes

Procedure

1. Divide the class into pairs.

2. Have each pair of students get two dishes.

3. Put one tablespoon of water in each dish.

4. Place one dish in the sunlight or under a light source.

5. Let students decide if they want to cover their dishes or leave them uncovered.

6. Place the other dish in the shade.

7. Have each pair of students observe and record what happens to the water.

Discussion Questions

1. Which dish evaporated faster?

2. Where did the water go?

3. How did the water evaporate?

Part B - Condensation Activities

Materials (for groups of 2-3 students)

1. A clean, clear 2 liter plastic bottle for every 3 students

2. A box of wood matches for every 3 students

3. A thermometer strip for every bottle (available at fish stores)

4. An eye dropper

5. A strip of tape

6. A notebook to record data

Procedure

Session 1: Temperature changes in a closed bottle

1. Tape the temperature strip into the bottle so that you can read it.

2. Screw the bottle cap on tightly.

3. Lay the bottle on its side so you can easily read the temperature strip.

4. Read and record the temperature of the air inside the bottle.

5. Use both hands to squeeze the bottle as hard as you can.

6. After about 1 minute read the strip.

7. Then stop squeezing the bottle and read the temperature strip after 1 minute.

8. Record what happened to the temperature when you squeezed the bottle and when you stopped squeezing the bottle.

Session 2: Making a cloud-in a-bottle

1. Open the bottle and pour in a few drops of water. Screw the bottle cap on tightly. Swirl the water around the inside of the bottle so that most of the inside of the bottle is wet.

2. Squeeze the bottle and observe the temperature again. What happened?

3. Lay the bottle on its side, open the bottle and push down to flatten the bottle to about ½ its normal size.

4. Have someone light a match, blow it out, and put the match inside the bottle while it's still smoldering. Quickly release the sides of the bottle and put the cap on tightly.

5. Squeeze the bottle as before very tightly for about 1 minute. Quickly let it pop open.

6. Record your observations. Hopefully you saw a cloud form.

Explanation

When you squeezed the bottle the air pressure in the bottle increased, which raised the temperature. The warmer air caused the water in the bottle to evaporate (it became water vapor) and you could see it. When you let the bottle pop out, the air pressure in the bottle was lowered and so was the temperature. This caused the water molecules to condense into a cloud.

Part C - Precipitation Activity

Materials

1. A heat source to boil water

2. A pot in which to boil water

3. A Pyrex or other container with a handle

4. Ice cubes

5. A pie pan or other container

Procedure

1. Have students gather around you to see what happens to the pot with ice in it and to the moisture that drips form the pot into the pie tin.

2. Place a pot of water on the heat source until it comes to a boil.

3. Fill the Pyrex pot with ice.

4. Once the water is boiling, hold the bowl of ice over the steam.

5. Place the pie tin so that the water, which drips from the bottom of the bowl, will collect in the tin.

6. Continue to hold the pot of ice over the boiling water until all the students have a clear view of what is

happening on the surface of the pot with the ice.

Discussion Questions

1. What did you see happening on the bottom of the bowl?

2. What do you see happening in the pie tin?

3. How did the water get on the bowl?

4. Were the water drops on the side of the bowl the same size? Why?

5. Which drops looked like rain?

6. Which drops looked like a cloud?

7. How were the big drops formed?

Explanation

The small misty drops, which have condensed onto the side of the bowl of ice, represent a cloud. The winds in a cloud blow the small drops around so that they collide with others making bigger and bigger drops. When the drops become so large that the upward motion of the air cannot keep them in the sky, the drops fall as precipitation. If the temperature is cold enough, the drops will freeze as crystals, making snow. If the drops get together first and then freeze, the precipitation will be hail.

III. Water Usage

Objectives

- To identify ways in which water is used.

- To determine how much water families use each day

- To recognize the importance of conserving water

- To determine ways in which water can be conserved

Part A - Detective Work

Materials

- Copies of activity handouts (Appendix B,C, and D)

Procedure

1. Tell students that today they are going to be water detectives who have been called in to solve a case of mysterious occupants.

2. Distribute the copies of the case story and survey.

3. Be sure students write down their hypotheses before completing their surveys.

4. Explain how to fill out the survey. Explain how to make tally marks each time the activity takes place. Ask students to ask their family members to help complete the survey for one day-families can become more aware of how much water they use in the process.

5. After students have completed the survey, discuss the results.

Part B - Brainstorming About Water Conservation

1. Have students look at their water use surveys. Ask them to consider what their families could do to reduce the amount of water they use. How much water would that conserve? If everyone in class followed that practice, how much water would it save in a year?

2. Are there ways to conserve water that would not be a good idea (e.g., not brushing teeth or washing)?

3. Give each student a copy of the "Water Conservation Tips" activity handout. Look it over as a group to see how it compares with your list. Suggest that students take it home and post it in the bathroom or kitchen.

Adapted from: Water Cycle Teachers Page. *Water: A Never -Ending Story.* http://www-k12.atmos.washington.edu/k12/pilot/water cycle/teacherpage.html>

Note: For a map of the United States that shows the amount of water used in a day, visit

http://ga.water.usgs.gov/edu/mapuscototfresh.html

Note : For a graph that shows the amount of freshwater withdrawals in the United States, state by state, visit http://water.usgs.gov/outreach/poster1middle_school/Page6.html

IV. Water Purification

Objective

To use the example of natural water purification to show students that healthy ecosystems provide services to people that are essential to life.

Part A - Our Local Watershed

Procedure

1. Have students visit EPA's Surf your Watershed website and type in their zip code to find their watershed.

2. Have them click on the Index of Watershed Indicators and then the Impaired Water map to see the general condition of their watershed.

3. Have a list of zip codes for neighboring suburbs and rural areas for them to review and compare.

Discussion

1. What is the condition of streams in urban, suburban, agricultural or rural watersheds?

2. What kinds of pollution could you expect in these different kinds of areas?

3. Where would you expect the most nutrient pollution? The most pesticides and herbicides?

4. What watersheds probably have the most sedimentation, heavy metal pollution and thermal (heat) pollution?

5. Where might you expect to find the most pathogens in the water?

Part B - Are We Dry or Wet?

Procedure

Have students look at the USGS Water Watch site and judge whether or not their region is presently dry, wet, or average.

Discussion

1. What effect might a drought have on natural purification of waters? (Hint: Pollutants already in the water could be concentrated, but runoff from roads, lawns, and agricultural fields would likely be much lower).

2. What effect might a flood have? (Hint: It depends on whether or not there are healthy ecosystems surrounding the water body).

Adapted from: Science Netlinks. *Ecosystem Services - Water Purification.*
http://www.sciencenetlinks.com/lessons_printable.cfm?DocID=275

V. Water Quality and Monitoring

Objectives

- To learn about and be able to recognize local aquatic life

- To understand why certain aquatic organisms no longer exist in our local waters

Materials

- Body of water

- Small fish nets

- Collection device

- Field Guide

- Classification Key

- Magnifying glasses

- Plastic bug boxes

Procedure

1. Reinforce the concept of an ecosystem in a visual way.

2. Discuss pollution of watersheds as it pertains to a lake, pond, or river

3. Fill up the collection trays with water from the pond. Remind students that aquatic animals must remain in water to breathe.

4. Using the net, scrape along the underside of plants, skim the surface of the water, or collect gumball-size mounds of mud from the bottom

5. By turning the net inside out, transfer any collected critters and debris into the collection trays. Repeat this collection and transfer several times

6. For field analysis, have students re-group in a designated “Research Station” area.

7. Have students identify and record the numbers of the macroinvertebrates they collected. Make sure all macroinvertebrates and debris are returned to the pond in a timely manner.

8. Have students rinse out the nets and collection containers well; collect gear together.

9. Compile the lists of types of animals found and look up the class to which each one belongs. (This can be done in the classroom or in the field.)

10. Have the students write up their results and discuss their differences.

Adapted from: HI Field Science Programs Teacher Resources . *BUGS! Clues to the Environment.*

http://www.yni.org/hi/resources-teacher/post-trip/bugs.html

Appendix A

Activity: All the Water on Earth

DID YOU KNOW….?

- Earth is called the water planet

- Between two-thirds (2/3) and three-fourths (3/4) of the earth’s surface is covered with water.

- The earth has different types of water:

Oc **eans** 97.2% of total water

Ice caps/glaciers 2.38%

Ground water 0.397%

Surface water (e.g., lakes, rivers, streams, ponds) 0.022%

Atmosphere 0.001%

Add up the percentages for water available for drinking.

Ground water _____

Surface water _____

Total _____

Add ice caps/glaciers _____

Grand Total _____

Remember: Only a small percentage of water is fit for humans to drink. Not all of the water in lakes and rivers or in the ground are clean enough to drink or easily accessible. Ice caps and glaciers are mostly inaccessible for humans, plants and animals use. Some efforts are being made to take the salt out of ocean water, but that is a very expensive project.

Appendix B

Activity: The Case of the Mysterious Occupants

THE CASE OF THE MYSTERIOUS OCCUPANTS

Scenario:

Mrs. Adams has called the water detectives to help her solve a serious problem. She was told they have an excellent track record for solving mysteries.

“What seems to be the problem?” asked one of the water detectives.

“Well,” said Mrs. Adams, “as you know, I rent out several apartments to college students. I never permit more than four students to stay in one apartment. But, in Apartment 320, I know there are more than four people. I just can’t prove it.”

One of the water detectives interrupted her with a question, “Have you ever tried making a surprise visit?”

“Yes,” she answered, “but every time I go there, four people or less are at home. Those college students come

and go at all hours of the day and night. It's impossible for me to keep track of how many students share the apartment."

"Very interesting." Said one of the detectives. "I think we can help you, but first we will need to see last month's water bill for that apartment."

"How will that help?" she asked.

"We will be able to see how many gallons of water were used last month," said another water detective.

Mrs. Adams found the bill. It showed that last month the occupants used 12,000 gallons.

"Let's see," said one of the detectives. "Last month was April, which has 30 days. If we divide 12,000 gallons by 30 days, we know that they used 400 gallons per day.

"Yes," said Mrs. Adams, but is that a little or a lot?"

"We'll have to investigate and get back to you on that. We will do a survey to find out how much the average person uses," said the detective.

With that, the water detectives left Mrs. Adams with a promise to return with an estimate of how many people are actually sharing the apartment. The water detectives decided that they needed to do some research to figure out how much water people use in one day. In order to come up with an estimate, they decided to find out how much water their own families use in one day. Here's how:

Appendix C

Activity: the Case of the Mysterious Occupants

HOW MUCH WATER DO YOU USE?

Directions:

We are doing a water survey to find out how much water we use in a day. Place a tally mark in the Times/Day column each time someone in your family does the activity.

		Times/Day	Total
Toilet Flushing	5 gallons	X_____	=_____
Using Dishwashe	20 gallons	X_____	=_____
Washing Dishes with running water	30 gallons	X_____	=_____
Washing Dishes by filling a basin	10 gallons	X_____	=_____
Short Shower	25 gallons	X_____	=_____
Tub Bath	35 gallons	X_____	=_____
Teeth Brushing	2 gallons	X_____	=_____
		Grand Tota	=_____

NOTE: Washing clothes in a washing machine is not included in these calculations-a typical wash cycle uses 40 gallons of water. Another seasonal water use is lawn and garden watering. This survey deals with daily water use in the home, but most of us use additional amounts of water at school, work, and other places throughout

the day.

To find the average use per person in your family, divide the grand total by the number of people in your family. The answer is: _____

Follow-up Questions:

1. In your home, which activity happened most often?_____

_____

2. Which activities use the water each time they occur? _____

_____

3. What other activities at home uses large amounts of water? _____

_____

Appendix D

Activity: The Case of the Mysterious Occupants

DID YOU KNOW THAT ALL WATER IS RECYCLED?

We drink the same water that the dinosaurs drank, and future generations will drink that same water. That's why it is our job to use water wisely and protect water supplies wherever and whenever possible. If we all save a small amount of water per day, we could save up to millions of gallons each year, collectively.

Water conservation can save on water and sewer fees. In addition, when you save on water, you save on fuel costs, as well. Even if you use well water, saving water lowers both electric costs and the waste load going into your septic system.

WATER CONSERVATION TIPS

Bathroom

Two thirds of the water used in the average home is used in the bathroom, mostly for flushing the toilets, showers and baths.

- **Turn off the water when you are not using it** . Don't let it run while you brush your teeth or shave.

- **Flush the toilet less often** . Put used tissues, trash, hair, paper towels, etc. in the wastebaskets instead of flushing them.

- **Fix leaks and drips** . This is often simply a matter of changing the washer.

- **Retrofit older plumbing fixtures with flow-reducing devices.**

- **Take shorter showers** . Less than 5 minutes is sufficient.

- **Take baths** . A partially filled tub uses less water than a shower.

Kitchen and Laundry

- **Use appliances efficiently** . Run full loads in the dish or clothes washer.

- **Clean vegetables and fruit efficiently** . Use a brush for thorough cleaning.

- **Buy a water saver-select new appliances that are designed to minimize water use.**

- **Keep a bottle of drinking water in the refrigerator** . Avoid running the tap to cool down water for drinking.

- **Use garbage disposals infrequently** . Start a compost heap or give leftovers to a dog, cat, horse, pig, etc.

Lawn and Garden

- **Wa** t **er the lawn and garden only when needed** . Early morning or evening are the best times. Let grass grow higher in dry weather. Mulch trees and plants. Avoid watering sidewalks and driveways.

- **Deep-soak lawn** . Allow the moisture to soak down to the roots. A light watering evaporates quickly.

- **Wash your car with sense** . Clean the car with a bucket of soapy water and use the hose only for a quick rinse.

- **Plant drought resistant trees and plants** . Many trees and plants thrive on less water.

References

1 HI Field Science School Programs Teacher Resources, BUGS! Clues to the Environment

http://www.yni.org/hi/resources-teacher/post-trip/bugs.html

2 Project Learning Tree. *Environmental Activity Guide.* American Forest Foundation: (Washington, D.C. ,1993), 142.

3 Project Wet. *Curriculum & Activity Guide.* The Watercourse and the Council for Environmental Education: (Bozeman, MT, 1995), i.

4 Ibid, 25.

5 Project Learning Tree, 142

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Student Books

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Barss discusses the problem of maintaining a clean water supply and relates this issue to such topics as pollution, depletion of sources, and other environmental issues.

Berger, Melvin. *The New Water Book* : Thomas Y. Cromwell Company: New York, 1973.

Berger explains water from the molecule to the properties of water and the many uses of water. He clearly states the role water plays in our lives and our environment and concludes with water pollution.

Corral, Kimberly. *A Child's Glacier Bay.* Watts Publishing Group: London, 1997.

Grade 4-7-Told from the point of view of 13-year-old Hannah, this photo-essay documents the Corral family's 200-mile kayaking/camping trip around this remote, spectacular national park.

Dorrors, Arthur. *Follow the Water from Brook to Ocean (Let's Read and Find Out Science Book).* HarperCollins Publishers: New York, 2000.

Dorrors explains how water shapes the earth and the importance of keeping our water clean. He engages his reader to become curious in following the flow of water when it rains.

Fink Martin et al., *Animals That Walk on Water* . Watts Publishing Group: London, 1997.

This book beautifully illustrates animals that walk on water and investigates the different species that spend their entire existence on the surface of water.

Fiarotta, Noel. *Great Experiments With H2O* . Sterling Publications: New York, 1997.

This is a good resource book for students who want to learn about aquatic organisms.

Hibbert, Adam. *A Freshwater Pond (Small Wonder).* Crabtree Publishers: New York, 1999.

Hibbert describes the plants, animals, and insects that live in a fres water pond and how they adapt to environmental chages due to the changes in the seasons.

Muzik, Katy. *At Home in the Corral Reef.* Charlesbridge Publishing: Watertown, MA, 1992.

Muzik vibrantly explains and illustrates the underwater world of corral reefs in a way to capture the attention of the intended reader.

Pulley Sayre, April. *River and Stream.* Twenty-first Century Books: New York, 1996.

Pulley Sayre warns the reader about pollution of our rivers and how that can affect our way of life. She touches on disease-causing microbes, large amounts of sewage, overloaded treatment plants, toxins and temperature, and runoff from urban areas.

Reidel, Marlene et al., *From Ice to Rain.* Lerner Publications Company: Minn. MN, 1981.

Reidel describes the water cycle from ice on a pond to how that same water turns to clouds in the sky. She talks specifically of the changes of state of water from ice (solid); which melts to water (liquid); which, in turn, evaporates to water vapor (gas); back to condensation (precipitation).

Simon, Seymour. *Icebergs and Glaciers.* HarperCollins Publishers: New York, 1999.

A beautifully illustrated book which depicts the icy mountaintops and polar regions of the earth. Simon draws the reader's attention to how sheets of ice, known as glaciers, move so very slowly, yet are such a powerful force that they shape the earth, not only beneath them but also around them.

Simon, Seymour. *Water on Your Street.* Holiday House: New York, 1974.

Simon teaches how students can find out where water comes from and where does it go once it rains on their streets. By making observations , students are taken on a journey around their homes and in their neighborhood to find the mystery of water travel.

Van Cleave, Janet. *Ecology for Every Kid.* John Wiley and Sons, Inc.: New York, 1996.

This is a book of experiments that students can do on their own. They can pick from a series of experiments to do science fair projects that are based on ecology.

Wick, Walter. *A Drop of Water: A Book of Science and Wonder.* Scholastic Press: New York, 1997.

Wick teaches how a drop of water can be broken down to such a small bit that it is invisible to the naked eye. The photography is striking and he illustrates that even the smallest droplet of water that can fit on a pinhead will contain more than three hundred trillion water molecules.

Teacher Resources

Ashworth, William. *Nor Any Drop to Drink* . Summit Books: New York, 1982.

Ashworth argues that we have a water problem on our hands and as concerned citizens we must make every effort to address this crisis. The public must be educated in realizing the limited resource's vulnerability to pollution.

Barber, Jacqueline et al., *Once Upon a GEMS Guide.* Lawrence Hall of Science: Berkley, CA, 1993.

This is a teacher's guide that connects math and science exploration to literacy. It is an effort to expose students to a well-diversified curriculum and can address different learning styles.

Caduto, Michael J. *Pond and Brook* . Prentice Hall, Inc.: Englewoods, NJ, 1985.

Caduto composes a guide that addresses freshwater environments with illustrations of various plant and animal life and has activities to test certain environmental conditions.

Carle, Elizabeth. "How Sound is Long Island Sound?" Available at http://www.dowslane.org/lis.html, 1999.

Carle has developed an activity that involved the internet and is "A Webquest Adventure." There are three phases to this project, one is choosing a partner, the second is researching "pollution incident, and the third is to create a Tri-Fold Brochure in order to inform the class.

Fagin, Dan. “The Evolution of LI Sound”. LI History.Com. Available at http://www.lihistory.com/1/hs/104a.htm, 2002.

This article deals with the glacial impact on the Long Island Sound. Once a river, the glaciers came and scooped up the surrounding land creating a valley and once melted became a huge lake which overflowed the land opening up the lake to the Atlantic Ocean and creating the body of water we know today as the Sound.

Garreis, Mary Jo. *WATER No Longer Taken for Granted.* Gale Group, Inc.: Farmington Hills, MI, 2002.

Garreis argues that with the knowledge that all life needs water to survive, we must realize that in certain parts of the world, water is in short supply, as well as certain parts of this country. Even where there are areas where water is plentiful, our human activities have contaminated it.

HI Field Science School Programs Teacher Resources, BUGS! Clues to the Environment

Available at http://www.yni.org/hi/resources-teacher/post-trip/bugs.html

Klemens, Michael W. “Amphibians and Reptiles of Connecticut and Adjacent Regions”. State Geological and Natural History Survey of Connecticut, 1993.

Klemens analyzes amphibians and how they are particularly sensitive to even slight alterations in their habitat. In studying these sensitive organisms it can be demonstrated that they can be indicators of changes in the environmental quality.

Project Learning Tree. *Environmental Activity Guide.* American Forest Foundation: Washington, D.C. ,1993.

A teacher’s guide on environmental education with activities that are grade-specific. This guide is complete with background information, objectives, the materials needed, the skills that will be taught and concepts that will be addressed.

Project Wet. *Curriculum & Activity Guide.* The Watercourse and the Council for Environmental Education: Bozeman, MT, 1995.

A teacher’s guide that complements curricula that addresses any issue that deals with water whether scientifically, historically, politically, or artistically. The activities are grade-specific and detailed enough to follow.

Kaufmann, Jeffrey et al., *River Cutters* . Lawrence Hall of Science: Berkley, CA, 1989.

A teacher’s guide that provides activities that demonstrates to students how rivers are formed over time from a geological point of view. It is a hands on approach which gets students involved in manipulating materials and recreating how pollution affects water and the land around it.

Sheaffer, John R. and Leonard A. Stevens. *Future Water.* William Morrow and Company: New York, 1983.

Sheaffer and Stevens offer a solution to the water crisis such as using more traditional methods of water sewage treatment. Sludge removed from sewer water is rich, organic material, which is great for soil. In other words, it’s not that we don’t have enough water but it’s the misuse of water that puts us in a crisis. We must learn to recycle our water more efficiently and less expensively.