Protecting Our Watershed

Curriculum Unit For

Grades 6 - 9

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Essential Concept: Cause/Effect

Length of Unit: 2 – 3 weeks

Disciplines Included – Core Content Standards:

Science:

5.1 All students will learn to identify systems of interacting components and understand how their interactions combine to produce the overall behavior of the system.

- 5.1-4 Describe the components of a system and how they influence one another.

5.10 All students will gain an understanding of the structure, dynamics and geophysical systems of the earth.

- 5.10-10 Investigate the composition, cycling and distribution of the world's oceans and other naturally occurring sources of water.

5.12 All students will develop an understanding of the environment as a system of interdependent components affected by human activity and natural phenomena.

- 5.12-4 Evaluate the impact of personal and societal activities on the local and global environment.
- 5.12-5 Compare and contrast practices that affect the use and management of natural resources.
- 5.12-6 Recognize that individuals and groups may have different points of view on environmental issues.

5.12-7 Analyze the components of various ecosystems and the effects of those components on organisms.

Social Studies

6.1 All students will learn democratic citizenship and how to participate in the constitutional system of government of the United States.

6.1-7 Locate, access, analyze, organize and apply information about public issues, recognizing and explaining multiple points of view.

6.6 All students will acquire historical understanding of the economic forces, ideas and institutions throughout the history of New Jersey, the United States and the world.

6.6-10 Evaluate a decision about the balance between economic growth and environmental preservation.

6.9 All students will acquire geographical understanding by studying the environment and society.

6.9-5 Explain and predict how the physical environment can accommodate, and be affected by human activity.

Language Arts

3.1 All students will speak for a variety of real purposes and audiences.

3.1-15 Speak before a group to defend an opinion.

3.1-16 Conduct an informational interview.

3.3 All students will write in clear, concise, organized language that varies in content and form for different audiences and purposes.

3.3-16 Write technical materials that include specific details.

3.3-17 Cite sources of information.

3.4 **All students will read a variety of materials and texts with comprehension and critical analysis.**

3.4-25 **Gather and synthesize data for research from a variety of sources, including print materials, technological resources, observation, interviews, and audiovisual media.**

3.5 **All students will view, understand and use nontextual visual information.**

3.5-13 **Choose and use multiple forms of media to convey what has been learned.**

Essential Understanding:

Students will learn that the watershed in which they live has an impact on their daily lives and that their actions affect the watershed.

Essential Questions:

1. **What is a watershed?**
   How can we identify a watershed?
   Where is our watershed?
   Where are the other watersheds in New Jersey?

2. **Why is our watershed (Barnegat Bay) important to me, my family and my community?**
   What are the many ways we use water in our daily lives?
   What are the economic benefits of a healthy watershed?
   What might happen if our watershed is not healthy?
   How is our watershed used for recreation?
   What health risks might occur in a polluted watershed?
   How might an unhealthy watershed affect other living things?

3. **How do our actions affect the watershed?**
   What are activities that have a negative impact on the watershed?
   What can we do to protect our watershed at school, at home, in our community?
   What does our government do to protect our watershed?
   Are there additional things our government should do to protect our watershed?

Essential Questions and Activities:

"Barnegat Bay Watershed On The Edge"
(introductory educational video - 22 minutes) enclosed

Introductory activity (WOW! The Wonders of Wetlands)
By Environmental Concern, Inc &
The Watercourse, 1995 enclosed

1. **What is a watershed?**
   Identifying Watersheds
   (see watershed maps and overhead enclosed)
   Wetlands in a Pan (page 212)
   Wetland Habitats (page 87)
2. **Why is our watershed important to me, my family and my community?**
   Treatment Plants (page 120)
   Marsh Mystery (page 116)
   Drop in the Bucket (page 158)
3. **How do our actions affect the watershed?**
   Soil Activity (attached)
   We All Live Downstream (attached)
   Water Conservation Home Survey (attached)
   Clean Water Video
   (see resource list and student viewing guide attached)

Culminating Activity:

There are six choices included as sample culminating activities. There are many other activities included in the enclosed materials.

Assessment:

Student learning will be assessed based on their participation in the various activities, the individual or group products from the culminating activities and by written answers to the essential questions.

Resources:

A resource list and glossary are attached. Listed are both the materials included with this curriculum and other materials that are available by mail, on the internet or through public and school libraries.

BARNEGAT BAY WATERSHED ON THE EDGE VIDEO

MultiMedia Communications

To the Teacher:

Barnegat Bay Watershed On The Edge is a 22-minute video to be used as an introduction to the Protecting Our Watershed curriculum unit. Generic watershed elements are discussed in the video, which cites the Barnegat Bay Watershed as an example. A student video guide is included.

Introduction:

Water moves in a cycle from the ocean to the sky (atmosphere) to the earth to the ocean to the sky . . . and so on. Some water may seep down into the ground. Many times there is too much water for the soil to absorb. Or rain lands on a surface that cannot absorb water and the water runs downhill over the surface of the land. If you stand at the top of a small hill and watch the raindrops fall, some of the drops will roll down one side of the hill. Other drops roll down the other side of the hill. The top of the hill is the dividing line between two watersheds. The land area where all the water drains into one main river or bay is called a watershed or a basin.

Some watersheds are big, like the Atlantic Coastal Basin Region. Other watersheds are smaller, like the Barnegat Bay Watershed. There are even small watersheds inside bigger watersheds. But all watersheds are the same. They are made up of:

- The land which drains water into a valley bottom,
- The streams, rivers, bays, or lakes that you see,
- The water that flows out of sight under the ground.

To the Students:

Before you watch Barnegat Bay Watershed On The Edge, check the glossary for definitions for the following words. Knowing what these words mean will help you understand the video. You will need these words later to complete the viewing guide.

Aquifer

Estuary

Habitat

Nonpoint Source Pollution

Pollution

Sediment

Watershed

Wetland

Fill in the blanks below as you watch the video.

New Jersey has many, many watersheds, however, the state is broken into five major areas. These areas are: _____, _____, _____, _____, and _____.

The _____ Watershed is located in the Atlantic Coastal Region.

One of the major sources of pollution is _____, often called "people pollution."

The video identifies many sources of Nonpoint Source Pollution. List five things which are NPS.

List five things which you can do to help protect your watershed.

Use the vocabulary words to complete each statement below.

1. **Often drinking water comes from underground reservoirs called _____.**

2. **When the source of pollution is from an unidentified source or a variety of sources, such as run off from our lawns, parks and playgrounds, this is called _____ pollution.**

3. **Our _____, like every other, is a land area that drains into a river, lake, stream, bay, or ocean.**

4. **An _____, is the area where fresh water and salt water mix, usually at the mouth of a river or a bay.**

5. **Barnegat Bay provides _____ for many animals, such as fish, birds, crabs, and clams.**

6. **_____ have the ability to function as a natural filtering system, which protects marine life and the quality of the water by removing pollutants.**

In this video many ways students can help improve our water quality are discussed. List below as many of the ideas as you can.

INTRODUCTORY ACTIVITY:
WATERSHED MANAGEMENT CURRICULUM

Objective: Students will identify the many varied uses for water in their home, school and community.

Divide students into teams of three or four. Give each team a large sheet of newsprint and magic markers. Appoint one student in each group as the recorder.

Write WATER on the chalkboard. Review the rules for brainstorming. Give each team a time limit (3 – 5 minutes) to list as many ways as possible that water is used at home, in school, in the community, for recreation or business.

Have teams feedback the information on their lists to the entire class. If students have not identified all the ways water can be used, provide them with a prompt or clue and allow 1 – 2 minutes more.

Write these categories on the chalkboard; HOME, SCHOOL, BUSINESS, RECREATION, COMMUNITY. Have students categorize their lists under these headings. Remind them that some items may belong in more than one category.

Create a classroom size mindmap. (See attached for mindmap elements and an example) Provide WATER as the central focus and HOME, SCHOOL, BUSINESS, RECREATION, COMMUNITY as branches. Have teams take turns adding uses to each branch until all teams have used all the words on their lists. Display the mindmap throughout the unit as a reminder of the many ways we use water.

As an additional activity, have each student choose one use of water and write a paragraph explaining how life would be different if we did not have enough water for this use.

CREATING A MINDMAP

Mindmaps are a visual way to organize and display information. The key elements of a good mindmap are:

1. **Choose a word or phrase as the central focus. Write it in large letters in the center of the mindmap.**

2. **Use single words or phrases as you add information. Do not write sentences.**

3. **Use drawings, diagrams or symbols to represent information.**

4. **Use color.**

For more information on mindmaps see Mapping Inner Space by Nancy Margulies, Zephyr Press.

IDENTIFYING WATERSHEDS

Adapted from Watershed Science for Educators

Purpose: Ensuring that students understand how stream networks affect watershed boundaries and determining their watershed address.

As a classroom activity, complete the following worksheet using the watershed maps and overhead enclosed.

Names of major watersheds in NJ: _____

Name of your watershed: _____

Where are the headwaters: _____

Where is the water flow end point: _____

What water bodies are included: _____

Streams, Rivers: _____

Ponds, Lakes: _____

Bays: _____

Wetlands: _____

When water leaves your watershed, where does it flow? What ocean will it eventually drain into? Describe its path from your watershed to the sea: _____

Describe your watershed (for example: mountainous, hilly, broad and relatively flat, other): _____

Must all land be part of a watershed? Explain: _____

What land uses do you know of in your watershed? How might these uses affect the quality and quantity of our waters? _____

SOIL COMPACTION / RUN OFF

Adapted from Conserving Soil

Purpose: To understand the way some human land uses affect water quality in a watershed.

Background: A watershed is all of the land area that drains into a particular stream or stream system. Its boundaries are the highest ridges around the stream. Rainfall within a watershed may run off into a waterway or into a lake as surface storage, or it can percolate (seep) through the soil into ground water aquifers. Rivers, reservoirs, and aquifers provide drinking water, and the bays and oceans downstream provide habitat for many animals and fish. When rain percolates through soil, it is cleansed of pollutants and there is less erosion. When rain runs off over land areas, it accumulates nonpoint source pollution. Often the use of heavy equipment for construction of housing developments or shopping centers results in very heavily compacted soils. Large compacted areas upstream generally results in water quality degradation downstream. The goal of proper soil and water management within a watershed is to decrease the rate and volume of runoff.

In the classroom: Students should draw a map of the watershed where the school is located. Indicate on the map where housing, shopping centers, parks, and farms, etc. might be. Students should make a list of all the factors that affect the movement of water in that area. Examples could be drainage ditches to control runoff, woodlots that allow more water to percolate into the soil, and street drains to remove rain.

On the school grounds: Take a walking tour identifying highly permeable areas and heavily compacted areas. Examples could be home plate on the baseball field or the grassy front lawn. Dig a small hole 18 inches deep in each area and note how hard the soil is and other soil characteristics. Demonstrate how rapidly water percolates into the soil in each location by selecting an area about a foot from each hole. Remove the ends of a large juice can, place a board on top of the can, and tap the can down into the soil to a depth of about two inches. Do not disturb the soil or grass. Place a ruler against the inside edge of the can. Gently pour one quart of water into the can from a distance of not

more that two inches above the can rim so as not to dislodge any soil particles, and immediately measure the water depth in the can. Then measure the depth of water in the can every minute for the first ten minutes and at ten-minute intervals until the water has drained. Students should plot a graph for depth of water vs. time. Conduct similar experiments in at least two different soil conditions: on a compacted bare path, in a grassy area, etc., recording the data accurately. Record qualitative observations about the ease or difficulty of installing the can two inches into the soil.

NOTE: All cans should be of the same diameter and be larger than a quart. (If different sized cans are used, add the amount of water to make the depths equal between all cans.)

Return to the classroom, compare the data collected and discuss the effect of soil compaction on the percolation rate, noting the relationship of different kinds of soil and drainage. Students should note how this information compares to the land uses outlined on the watershed map, and speculate as to which areas will better protect water quality. Discuss the causes for poorer conditions. For example, large areas of pavement, heavy construction equipment use, and areas with many buildings and streets. Also discuss the possible downstream impacts resulting from water running off each kind of area.

WE ALL LIVE DOWNSTREAM

Adapted from Discovering the Naturalist Intelligence

Purpose: To understand the ways humans affect land use and water quality along a river.

Literature Link: A River Ran Wild by Lynne Cherry

Background: A watershed is the land that water flows across or under on its way to a river, stream, lake or ocean. Water soaks into the ground to form groundwater or it drains to one spot (like a bath tub drain) where it empties into a river, stream or ocean. Large watersheds are composed of many small ones. Point Source pollution is pollution whose source you can identify. Nonpoint Source pollution is pollution you can't identify. It is much harder to clean up or control.

In the field: Students construct a large dirt pile on the playground or school grounds. Use a garden watering can and sprinkle water on the pile to simulate rain. Watch as the water either soaks into the pile (ground water) or runs down and off the pile to the concrete.

In the classroom: Randomly assign each student one of the ten sections of a watershed near a river. Enlarge the sections from the attached page. Ask them to represent in a visual form how they would use this river front property. They must include the items on the cards you distribute and then add whatever else they want. They must identify the pollution their use of the land will cause and write each on a blank card. Then write paragraphs that explain the ways in which their uses of the land will affect water quality in their area and downstream. Lay the 10 sections from the top of the watershed (mountains) to the bottom (mouth) on the floor of the classroom as students read their paragraphs and explain their representations of the pollution. Students should line up along their section of the river and pass the pollution cards toward the mouth as they speak. The person at the mouth ends up with everyone's pollution, which can lead to a discussion of point and nonpoint source pollution and the impact of living downstream.

Reflection Prompt:

People who live near a river need to .....
I think the better way to keep water clean is to .....
I learned that water.....

Possible land uses to distribute to students:

Housing Development	**Nature Center**
Park	**Baseball Field**
Shopping Mall	**Fast Food Restaurant**
School	**Dry Cleaners**
Gas Station	**Marine**
Golf Course	**Nursery, Green House**
Farm	**Church/Synagogue**
Restaurant	**Fish Hatchery**
Fish	**Nesting Place for Ducks**
Hatchery or Aquaculture	**Sewage Treatment Plant**
Water Company	**Downtown Area (shops)**
College	**Gravel Pit or Sand Mining**
Cranberry Bog	**Police or Fire Station**
Hospital	**Wildlife Preserve**
Government Buildings	**Pharmaceutical Plant**
Recycling Center	**Auto Dealer and Repair**

WATER CONSERVATION HOME SURVEY

Adapted from Earth Day 1990 Lesson Plan and Home Survey – 7-12

Purpose: Class discussion about natural resources and the environment. Students will be given a Home Environmental Survey assignment in order to study their own and their families' uses of water. A follow up discussion in the classroom will focus on ways that students can use natural resources more efficiently and the impact of population growth on resources.

Background: Define a resource as a portion of our environment upon which people have placed or assigned value, or see as being available for use. A wide variety of resources exist, including water in many forms. For example: rain, snow, surface water, ground water, etc. Local sources of water might include reservoirs, rivers, and wells. Identify several environmental impacts from using the resource (water). For example: destruction of wildlife habitat, salt water intrusion into ground water, reduction of drinking and agriculture water supplies, etc.

Survey Assignment: Explain to the students that they will be conducting a Water Conservation Home Survey to collect data on their own use of water resources. Upon completion of the survey, the students will compare and graph the results in class and brainstorm ways to enhance the efficient use of water. Encourage the students to involve family members in researching the information for the sake of accuracy, as well as to stimulate discussion about water use by members of the household.

Exercise: Determining how much water your family could save if the shower head(s) in your household were replaced with conservation shower heads. *Note:* Low-flow shower heads, on average, use half as much water as the standard shower head. They do not reduce your comfort level, but still save water, energy, and money. Remember, water heaters are big users of energy. By using less hot water in your shower, you are reducing the amount of energy you are using.

Step 1 – Time or estimate in minutes how much time each member of your family spends in the shower every day.
Family member # 1 (you) _____
Family member # 2 _____
Family member # 3 _____
Family member # 4 _____
(add more if there are more people in your family)

Total Time in minutes _____

Note: **On average, a shower that has a low-flow shower head uses 3 gallons per minute. A regular shower head uses approximately twice as much or 6 gallons of water per minute.**

Step 2 – Multiply the total time your family spends in the shower by 6 gallons of water per minute. _____ **This is approximately how much water your family uses every day in the shower.**

Step 3 – Divide the number of gallons of water used (the answer in Step 2) in half and you will discover how much water your family could save every day by installing a low-flow shower head. _____

How much per week saved? _____
How much per year saved? _____

Bonus Exercise: Can be conducted by students with water conservation shower heads in their homes to support a discussion on various technologies/shower head designs. Find out the exact amount of water that comes through your family's shower head(s) by conduct the following exercise.

Step 1 – Gather the following materials: a stopwatch or a watch with a second hand and an empty ½ gallon milk container with the top cut off.

Step 2 – Turn on the shower and mix hot and cold as you normally do. Wait until the second hand is exactly on the minute and put the milk carton under the shower head so it catches all the water. As soon as it fills, check the number of seconds it took and write that number down.

_____

Step 3 – Divide 30 (60 seconds to calculate for a whole gallon, 30 if you're using a half gallon) by the number of seconds it took you to fill your jug. This is the shower flow rate in gallons per minute. _____

Step 4 – Subtract 3 from the number of gallons per minute you got in Step 3. This is how much water a low flow shower head would save every minute. _____

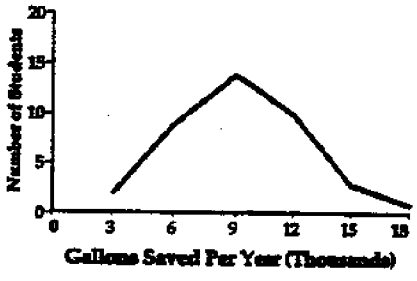
How much would it save every day given your families' use of the shower? (use the total in Step 1 above) _____

How much every week in your house? _____
How much every year? _____

Upon completion of the survey, the students will compare and graph the results in class. The graphing will show how the aggregate of individual actions can affect the environment in a positive or negative manner. Students should brainstorm ways to enhance the efficient use of natural resources (water) and to reduce our negative impact on the environment.

Review and discuss the survey results. Construct a survey polling graph on the blackboard by polling the students. Plot their data on the graph. Find the average by adding up the students totals and dividing by the number of students.

Sample Water Conservation Graph:



Over 70% of the planet's surface is covered by water, most of it salt water oceans. Fresh water, upon which we depend for drinking and agriculture accounts for only 3% of all of the water on earth and 75% of that is frozen in the North and South Poles. If every American household installed a water conservation (low-flow) shower head in its shower(s), they would reduce their water use and hot water heating costs by as much as 50% and as a nation we would save over 900 billion gallons of water every year.

CLEAN WATER VIDEO

Schlessinger Video Productions, Earth At Risk Series

To the Teacher:

Clean Water is a 30-minute video in the Earth At Risk Series. The companion book is Clean Water by Karen Barss. Both are available through the library system. A student video guide is included. Students need the glossary available at the end of this unit to complete some of the activities.

Introduction:

Water is our most precious natural resource. People can live without oil or gold or natural gas, but they can survive only a few days without water. Water has many uses besides simply quenching our thirst. At home, water cleans dishes, clothes, and people. It cooks food, delivers heat to radiators, and carries away sewage. It plays many roles in industrial processes and provides energy through hydropower. It is essential to the growth of plants and, therefore, to the food supply. It supports populations of birds, fish, aquatic plants, and mammals. It offers an alternative to land and air travel that is essential for large cargo. And it has many recreational uses, as well as aesthetic value, in city fountains and woodland streams. Yet for all its vital roles, water is often taken for granted, in part, because it costs so little and the supply seems limitless. People rarely question whether water will flow when they turn on the tap.

From Clean Water by Karen Barss, p. 13

To the Student:

Before you watch Clean Water, check your glossary for definitions for the following words. Knowing what these words mean will help you understand the video. You will need these words later to complete the viewing guide.

Aquifer

Biomagnification

Bioremediation

Effluent

Ground Water

Runoff

Wetlands

Hydrologic Cycle

Nonpoint Source

Point Source

Watershed

Estuary

Nitrates

Nitrites

Fill in the correct percentages as you see the video.

Oceans cover _____% of the earth's surface.

Only _____% of the earth's water is fresh, suitable for drinking and irrigation.

_____% of fresh water is frozen in glaciers and polar ice caps.

Only about _____% of the world's water is available for human use.

This video identifies 3 sources of pollution. As you watch the video, list specific problems under each source.

AGRICULTURAL

INDUSTRIAL

MUNICIPAL

Use the words from the vocabulary list to complete each statement.

1. **Much of our drinking water comes from underground reservoirs called _____.**

2. **These underground reservoirs hold a supply of water called _____.**

3. **When our water is polluted from a specific source such as a dry cleaning plant this is called _____ pollution.**

4. **When the source of the pollution is from an unidentified source or a variety of sources, such as run off from our lawns, parks and playgrounds, this is called _____ pollution.**

5. **Water from rain, snow and ice flows into streams, rivers, lakes and wetlands, often carrying a variety of pollutants into those areas. This is called _____.**

6. **The _____, sometimes called the water cycle, moves water through evaporation, precipitation and runoff.**

7. **Our _____, like every other, is a land area that drains into a river, river system, bay or ocean.**

8. **An _____ is the area where fresh water and salt water mix, usually at the mouth of a river or stream.**

9. **One way to clean up our water supply is through _____, using living organisms or microbes to clean the water or soil.**

10. **As we move up the food chain, little fish eat plants and big fish eat little fish, and we eat big fish, the concentration or harmful chemicals such as DDT or PCB increases. This is called _____.**

11. **When we test rivers and streams, we test for both _____ and _____.**

Students in this video suggest ways we can help improve our water. List as many of their ideas as you can.

Now list some of your own ideas.

Culminating Activity:
Watershed Management Curriculum

Objective: Students will demonstrate an understanding of the importance of their watershed.

Listed below are projects that students can complete at the end of the unit to demonstrate their understanding and apply their knowledge. These projects can be assigned to individual students, partners or cooperative teams.

1. **Your local Watershed Association, for example, the Barnegat Bay Watershed Association, wants to sell posters, T-shirts and bumper stickers at their festival in the spring. Your team will submit a design for each one of these items. Make sure your designs are colorful and attractive and include information about why the watershed is important to all of us. Send copies of your designs to your local Watershed Association.**

2. **The Ocean County Tourism Department wants to distribute a brochure to new residents and visitors to Ocean County that will tell them about the Barnegat Bay Watershed and its importance to our lives. Design a three-panel brochure that is informative, attractive and easy to read. Make sure to include things residents and visitors can do to enjoy and protect the watershed. Send your final product to the Ocean County Tourism Department.**

3. **You are the author of children's books and have decided to write your next book about the Barnegat Bay Watershed. Create a picture book that would appeal to first or second graders. Use drawings, computer graphics or photographs to help the children understand why the watershed is important and what they can do to protect it. Be prepared to share your finished product with some first and second grade students. Donate an autographed copy to the school library.**

4. **You are a concerned citizen. Choose one problem involving your local Watershed, for example the Barnegat Bay Watershed, and write a letter to the editor for publication in your local paper. Be sure to include specific information about the problem and suggest what other citizens can do to help solve the problem. Send your letter to the editor and to your school newspaper.**

5. **Identify something students at your school can do to improve the watershed. Write a specific plan and present the plan to your student council and school administration. Write an article about your plan for the school newspaper. Send copies of your plans to your mayor.**

6. **You have been selected by the Board of Chosen Freeholders as the producer of a public service announcement about the importance of your watershed. Work with a team of students to design the announcement. Include a song or rap and photographs, drawings, maps or other graphics. Be prepared to perform your announcement for the class. Videotape the final performance and send it to your local cable TV station.**

GLOSSARY

Acid rain: Precipitation that forms in the atmosphere when certain pollutants mix with water vapor. The major sources of acid rain are sulfur dioxide and nitrogen oxide emissions from fossil fuel-burning power plants and motor vehicles.

Aquifer: Porous underground rock, sand, or a rock formation that creates a natural underground reservoir holding groundwater.

Bioaccumulation: Substances that increase in concentration in living organisms as they take in contaminated air, water or food because the substances are very slowly metabolized or excreted.

Biodegradable: Having the ability to be broken down into simpler components by living organisms.

Biomagnification: An increase in the concentration of DDT, PCB's and other chemicals in successively higher levels of the food chain.

Bioremediation: The use of living organisms or microbes to clean up soil and water contaminated by toxic waste accidents.

Ecosystem: The interacting system of a biological community and its non-living environmental surroundings

Effluent: A discharge of waste material.

Estuary: An area where fresh water and salt water mix, usually at the mouth of a river or stream.

Food chain: Starts when a small animal eats a plant, then a larger animal eats the small animal, and an even larger animal eats that animal, and so forth.

Fossil fuels: Coal, oil and other energy sources that formed over millions of years from the remains of ancient plants and animals. (Fossil fuel use is a major cause of pollution.)

Groundwater: Water beneath the earth's surface flowing slowly between saturated soil and rock that supplies wells and springs; held in underground reservoirs called aquifers.

Habitat: The place where a population lives and its surroundings, both living and nonliving.

Hazardous Waste: A toxic by-product of society that can pose a substantial or potential hazard to human health or the environment when improperly managed.

Hydrologic Cycle: The specific cycle that water follows from evaporation to precipitation to runoff. This is also called the water cycle.

Leaching: The natural process by which materials on or in soil are dissolved and carried by water seeping through the soil. Leaching may contaminate groundwater supplies.

Nitrate: A compound containing nitrogen that can exist in the atmosphere or as a dissolved gas in water and which can have harmful or beneficial effects on humans and animals.

Nitrite: An intermediate in the process of ammonia in wastewater that eventually becomes a nitrate by bacterial or chemical reactions.

Nonpoint Source: The discharge of pollutants into water from a large, nondistinct area, such as runoff from farmlands and urban areas.

PCBs (polychlorinated biphenyls): Chemicals used in industry that can build up to toxic levels in animal tissue.

Pesticide: Substance intended for preventing, destroying, repelling or mitigating any pest.

Point Source: A single identifiable source, such as a sewer pipe, that discharges pollution into water.

Pollution: A human-caused change in the physical, chemical or biological conditions of the environment that creates an undesirable effect on living things.

Potable Water: Water that is safe for drinking and cooking.

Renewable Resource: A resource that can be replaced through natural processes if it is not overused or contaminated.

Runoff: Water from precipitation and melting ice that flows over the earth's surface into streams, rivers, lakes, reservoirs, and wetlands, sometimes taking with it pollutants or dissolved substances, such as fertilizers or oil and salt from streets.

Sediment: Particles of soil, sand, clay and minerals.

Septic Systems: Homes in rural areas not connected to city sewer have underground tanks and drain lines to treat waste and wastewater from sinks, toilets, showers and tubs.

Solid Waste: Discarded solid or semi-solid material, such as paper, metals, and yard waste.

Stormwater/Rainwater/Runoff: Stormwater flows into underground storm drains that carry the water to a sewage treatment plant or to a waterway. Stormwater runoff may carry toxic chemicals from industrial areas or streets into the storm drain systems.

Surface Water: Oceans, bays, rivers, streams, lakes, and marshes.

Sustainable Development: Development that uses resources in an efficient way and without destroying the basis of their productivity.

Thermal Pollution: Power generating plants and factories discharge heated water to streams, lagoons, reservoirs, and other waterways.

Toxin: A substance which when present above certain thresholds is harmful to life.

Wastewater: Used water from an industry, individual home, a community, or a farm that may contain dissolved or suspended matter.

Watershed: The land area draining into a river, river system, or body of water, bringing with it dissolved substances and sediment, some of which are natural and some are pollutants.

Wetland: An area that is saturated by surface or ground water with vegetation adapted for life under those soil conditions, such as swamps, bogs, fens, marshes and estuaries.

RESOURCE LIST

Resources for Teachers

There are many resources available for teaching about your watershed. Many of them are included with this curriculum. Others are available by writing to local, state and national organizations. Since many of these materials are developed by organizations, they are listed alphabetically by title, rather than by author. Where available, addresses and phone numbers are included.

Adopt a Watershed by Carol Dawes. P O Box 1850, 98 Clinic Avenue, Suite B, Hayfork, CA 96041, 530-628-5334.

America's Wetlands: A Reason to Celebrate. Terrine Institute, 1717 K Street NW, Suite 801, Washington DC 20006, 202-833-8317.

The Clean Water Book. New Jersey Department of Environmental Protection, CN418, Trenton, NJ 08625-0418, 609-292-2113.

Conserving Soil. National Association of Conservation Districts, P O Box 855, League City, TX 77574-0855, 732-246-1662.

Delaware Estuary Issues. EPA Region 3, Center for Environmental Learning, 841 Chestnut Building, Philadelphia, PA 19107, 215-597-9076.

Discovering the Naturalist Intelligence: Science in the School Yard. By Jenna Glock et al. Zephyr Press, 800-232-2187.

Down Jersey, Celebrating Our Sense of Place. Citizens United to Protect the Maurice River and its Tributaries, Inc., PO Box 474, Millville, NJ 08332, 609-327-1161

Earth Day 1990: Lesson Plan and Home Survey – 7-12. P O Box AA, Stanford, CA 94309, 415-321-1990 (Distributed by NJ Education Assn. 609-599-4561)

Experiencing Water Resource: A Guide to Your River Basin by Lana Thomas, et al. Washington State Cooperative Extension Services.

Exploring New Jersey's Watersheds. NJ Project WET, 609-368-1211, or NJ Department of Environmental Protection, 609-633-1179.

Getting to Know Your Local Watershed. US EPA Region 5, 1220 Potter Drive, Room 170, West Lafayette, Indiana 47906-1383, 765-494-9550, http://kyw.ctie.purdue.edu/kyw/kyw.html.

Ocean County Environmental Education Directory: 1998 Edition. Ocean County Soil Conservation District, 714 Lacey Road, Forked River, NJ 08731.

Project Learning Tree: Environmental Education Activity Guide PreK-8. American Forest Foundation, 1111 19th Street NW, Suite 780, Washington DC 20036, 202-463-2452, http://www.plt.org.

Pollution: Problems and Solutions by Judy Braus. National Wildlife Federation, 1400 16th Street NW, Washington DC 20036-2266.

Project Wet: Curriculum & Activity Guide. Project WET, 201 Culbertson Hall, Montana State University, Bozeman, Montana 59717-0570, 406-994-5392, http://www.montant.edu/wwwwet.

Science Demonstration Projects in Drinking Water. EPA, Washington DC 20460.

State of the Environment 1998. EPA Region 2, 290 Broadway, NY, NY 10007-1866.

Toward a Watershed Approach: A Framework for Aquatic Ecosystem Restoration, Protection and Management. Coastal America: A Partnership for Action.

Water in Your Hands. New Jersey Natural Resources Conservation Program. SWCS, 7515 NE Ankeny Road, Ankeny, Iowa 50021-9761, 1-800-THE-SOIL.

Water: The Resource that Gets Used & Used & Used for Everything. Poster Series, US Geological Survey, Box 25286, Denver Federal Center, Denver, Colorado 80225, 800-435-7627.

WATERS: A Watershed Approach to Teaching the Ecology of Regional Systems. New Jersey Audubon Society, PO Box 126, Bernardsville, NJ 07924, 908-204-8998

The Watershed Works: A Learning Resource for the Study of the Fraser River and its Basin. by Linda Bermbach et al. British Columbia Teachers Federation Lesson Aids Service, 100-550 West 6th Avenue, Vancouver, BC V5Z4P2.

The Ways of Water Tour Guide. Washington Waterweeks, PO Box 1354, Olympia, WA, 360-943-3642.

What is a Watershed. US Department of Agriculture, Washington DC 20250, 202-720-7327.

What is Water Pollution, Aquatic Animal Adaptations, Taxonomy: The Science of Classification. Virginia Cooperative Extension Service Guides by Barry W. Fox.

The Wonders of Wetlands. by Alan S. Kesselheim, et al, The Watercourse, 201 Culbertson Hall, Montana State University, Bozeman, Montana 59717-0057.

INTERNET RESOURCES

Education Index: This web site provides links to educational resources by subject area including biology, general science, and environmental science. http://www.educationindex.com

IGC: Education & Youth Internet Resources Collection. This web site has an index for environmental education that has links to many environmental and education groups. http://www.igc.org

U S Census Bureau – http://www.census.gov

U S Geological Survey: Click on USGS Information by State and also USGS Educational Sites. http://www.usgs.gov

North American Association for Environmental Education (NAAEE): Established in 1971, NAAEE is a network of professionals and students working in the field worldwide. http://www.naaee.org

Gaia Education Outreach Institute: A nonprofit organization that educates for mindful, sustainable living and a compassionate sense of inter-being with the Earth community. http://www.tellink.net/~geo

Green Map System: A globally connected, locally adaptable framework for community sustainability. Green Maps utilizes icons to chart the sites of environmental significance in urban places around the world. http://www.greenmap.com/indes.html

The Conservation Fund: Seeking sustainable conservation solutions for the 21st century, emphasizing the integration of economic and environmental goals. http://www.conservationfund.org/conservation

The Land Trust Alliance: Promotes voluntary land conservation and strengthens the land trust movement by conserving land for the benefit of communities and natural systems. http://www.lta.org

The Nature Conservancy: The mission is to preserve plants, animals and natural communities that represent the diversity of life on earth by protecting the lands and water they need to survive. http://www.tnc.org

Bridge: Ocean Science Education Teacher Resource Center – The Bridge is a site where teachers find a selection of the best online resources for marine science education. http://www.vims.edu/bridge

National Pollution Prevention Center – http://www.umich.edu/~nppcpub

NOAA: Providing environmental stewardship education information and photos from past centuries to the present. http://www.education.noaa.gov and http://www.photolib.noaa.gov

Watershed Initiatives: Specializing in helping local groups, agencies, industry and others involved in natural resource management and restoration find solutions to difficult challenges. http://www.watersheds.com

EPA: Adopt a Watershed – This site was created by the USEPA in honor of the 25th Anniversary of the Clean Water Act to recognize an support efforts by citizens across the US to protect and restore the waters in their watershed. http://www.epa.gov/surf/adopt/text.html

EPA: Office of Wetlands, Oceans, and Watershed – http://www.epa.gov.owow/

EPA: State Environmental Profiles ~ NJ: Click on the state map to zoom in on your watershed or find environmental information about the watershed. http://www.epa.gov/surf2/states/NJ/index.html

NJDEP: Department of Watershed Management – http://www.state.nj.us/dep/watershedmgt/index.html

NJDEP: Geographic Information System – http://www.state.nj.us/dep/gis/

Revitalizing Science Teaching – Remote Sensing Technology: Ramapo College of New Jersey's watershed instruction program including online satellite images. http://www.rst2.edu/

NJ Audubon Society – What is new in environmental education in NJ. http://www.njo.com/audubon/envired/envired.html

League of Women Voters of the United States: Protecting Our Natural Resources includes water resource programs and policies. http://www.lwv.org/where/protecting/water.html

Chocolay River Watershed Project – A fed/state/local funded, locally administered, water quality project under the Clean Water Act – Section 319. The primary goals and objectives of the project are to eliminate existing sources of nonpoint source pollution (mainly soil erosion and sedimentation), prevent potential sources of pollution, and restore sections of streams that have already been impacted by sedimentation and the resulting negative stream changes. http://www.portup.com/~lindq/

See additional internet references enclosed throughout packet.

ORGANIZATIONS

Concern, Inc., 1794 Columbia Road, NW, Washington, DC 20009, 202-328-8160

Delaware Estuary Program, Public Participation Coordinator, 1211 Chestnut Street, Suite 900, Philadelphia, PA 19107, 1-800-445-4935

Delaware River Basin Commission, PO Box 7360, West Trenton, NJ 08620, 609-883-9500 ext 205

National Institute for Urban Wildlife, 10921 Trotting Ridge Way, Columbia MD 21044

National Sea Grant Depository, Pell Library Bldg, URI Bay Campus, Narragansett, RI 02882-1197, 401-874-6539

National Wildlife Federation, 1400 16th Street, NW, Washington, DC 20036-2266

New Jersey Department of Environmental Protection, 401 E State Street, Trenton, NJ 08625, Public Access Center 609-777-3373, Office of Information and Education 609-984-6295, Pequest Natural Resource Education Center 908-637-6735, Division of Fish, Game and Wildlife 609-748-2031, Office of Watershed Management 609-984-0058, Enforcement 609-984-3285

New Jersey Marine Sciences Consortium, New Jersey Sea Grant College Program, Sandy Hook Field Station, Building 22, Fort Hancock, NJ 07732, 732-872-1300

New Jersey State Aquarium, PO Box 95004, Camden, NJ 08103, 609-365-3300

Riverkeeper Programs:

Delaware Riverkeeper, Box 326, Washington Crossing, PA 18977, 215-369-1188

Hackensack Riverkeeper, 1000 River Rt T-090-C, Teaneck, NJ 07666 201-692-8440

Hudson Riverkeeper, 25 Wing & Wing, Garrison, NY 10524-0130, 914-424-4149

NY/NJ Baykeeper, Bldg. 18, Sandy Hook, Highlands, NJ 07732, 732-291-0055

Raritan Riverkeeper, P O Box 244, Keasbey, NJ 08832, 732-442-0767

Riverkeeper Network/Watershed Association of the Delaware River, PO Box 753, Lambertville, NJ 08530, 609-397-4410

Rutgers Cooperative Extension offices located in each county. See the county government blue pages of the phone book

Rutgers Cooperative Extension, Publications Distribution Office, Cook College, 57 Dudley Road, New Brunswick, NJ 08903, 732-932-9762

Sierra Club, 730 Polk Street, San Francisco, CA 94109, 415-776-2211

US Fish and Wildlife Service, New Jersey Field Office, 927 North Main Street, Pleasantville, NJ 08232, 609-646-9310

US Environmental Protection Agency, Region II, 290 Broadway, New York, NY 10007, 212-637-3000

US Environmental Protection Agency, Region III, Center for Environmental Learning, 841 Chestnut Building, Philadelphia, PA 19107, 215-597-9076

US Geological Survey, 1-800-USA-MAPS

Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314-1994

Water Resources Association of Delaware River Basin, Box 867, Davis Road, Valley Forge, PA 19482, 215-783-0634

Watershed Partnership for New Jersey, C/O Dale Rosselet, Chair, NJ Audubon, Ctr. for Research & Education, 600 Rt. 47 North, Cape May Court House, NJ 08210 609- 861-0700

The Wetlands Institute, Stone Harbor Blvd., Stone Harbor, NJ 08247, 609-368-1211

VIDEOS

These videos are often available through the county or local public library.

Barnegat Bay Watershed On The Edge
Clean Water, Earth at Risk Series
Protecting Our Water: Who's Got The Power?
The Living Planet
Metedeconk River Watershed
Water: A Precious Resource

BOOKS FOR STUDENTS

There are many books available in school and community libraries on water, watershed and wetlands. Listed below are just a few.

Arnold, Caroline. Bodies of Water: Fun, Facts and Activities.

Barss, Karen. Clean Water.

Benyus, Janine M. The Field Guide to Wildlife Habitats.

Bradley, Frank. Water for the World.

Breiter, Herta. Pollution.

Carson, Rachel. The Sea Around Us.

Cherry, Lynne. A River Ran Wild.

Court, Judith. Ponds and Streams.

Dickinson, Jane. The Wonders of Water.

Doros, Arthur. Follow the Water from Brook to Ocean.

Duffy, Trent. The Vanishing Wetlands.

Dugan, Patrick. Wetlands in Danger.

Earthworks Group. 50 Simple Things Kids Can Do To Save the Earth.

Finlayson, Max and Michael Moser. Wetlands.

Gary, Kathlyn, Water Pollution.

Gay, Katherine. Acid Rain.

Graham, Joan Bransfield. Splish, Splash.

Gunston, Bill. Water.

Hammer, Trudy. Water Resources.

Hancock, James. Birds of the Wetlands.

Hoff, Mary King. Our Endangered Planet.

Holmes, Anita. I Can Save the Earth.

Johnston, Tom. Water, Water.

Lambert, Mark. The Future of the Environment.

Leslie, Clare Walker. A Naturalist's Sketchbook.

Leutscher, A. The Ecology of Water Life.

Locker, Thomas. Water Dance.

Lucas, Eileen. Water: A Resource in Crisis.

Lyons, Janet and Sandra Jordan. Walking the Wetlands: A Hikers Guide to Common Plants and Animals of the Marshes, Bogs and Swamps.

Milne, Lorus and Margery. The Mystery of the Bog Forest.

McLeish, Evan. Keeping Water Clean.

National Geographic Society. Wild and Scenic Rivers.

Niering, William. The Audubon Society Nature Guide to Wetlands.

Ocko, Stephanie. Water: Almost Enough for Everyone.

Pringle, Laurence. Estuaries, Where Rivers Meet the Sea.

Reid, George K. Pond Life.

Richardson, Joy. The Water Cycle.

Rothman, Joel. Once there was a Stream.

Sabin, Francene. Ecosystems and Food Chains.

Sauvain, Philip. Water: The Way It Works.

Sayre, April Pulley. Wetland.

Seixas, Judith. Water: What It Is, What It Does.

Schmid, Eleanor. The Water's Journey.

Seed, Deborah. Water Science.

Sette, Mary Lee. Water World.

Smith, David. The Water Cycle.

Staub, Frank. America's Wetlands.

Stone, Lynn. Marshes and Swamps.

Weller, Milton Webster. Freshwater Marshes: Ecology and Wildlife Management.

Welob, Angela. Water.

Wick, Walter. A Drop of Water: A Book of Science.

Teacher Evaluation Form

Please answer the following questions and return via mail, e-mail, or FAX to

Resource Management Program Associate
Rutgers Cooperative Extension of Ocean County
1623 Whitesville Road
Toms River, NJ 08755
LARSON@aesop.rutgers.edu
FAX: (732) 505-8941

1. Were your students able to meet the unit objective?

2. Were the essential questions and related activities presented clearly?

3. Were the introductory and culminating activities engaging and appropriate for your students?

4. Were the additional materials, resource list and glossary helpful?

5. Would you use this curriculum again or recommend it to a colleague?

6. What can we do to improve this curriculum?