Stream Eco-Adventures
Field Trip

Pre and Post Trip Packet

This field trip leads students on a true adventure through a watershed, along a river, and into a stream. Students are stream ecologists as they gather data and catch and identify water creatures to monitor stream health. The subjects of erosion, pollution, and conservation and the effects they have on our drinking water supply and the habitats of water animals are also addressed. Students gain a real understanding what a watershed is and how all members (including humans) of an ecosystem are connected by their common water source.

A Field Trip for Grades 3 – 7
The State Botanical Garden of Georgia
# Stream Eco-Adventures

## Field Trip

### Pre and Post Trip Activity Packet

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Dear Teacher,

Please find the enclosed activity sheets for suggested pre and post trip activities for your Stream Eco-Adventure field trip to the State Botanical Garden of Georgia. The pre-trip activities will help prepare your students for your field trip, and the post-trip activities will extend the student’s knowledge as they apply what they learned at the Garden to their own school site. Correlations to Georgia Q.C.C.’s and the Georgia Performance Standards are also included.

Before the field trip, students will have the opportunity to learn more about the earth’s water supply, the water cycle, water quality, and the many organisms that live in the water. Students are encouraged to take a look around their school site and home to take notice of water supplies in their area. Are there a lot of plants and trees around this water site? What are some potential pollutants to this water supply? How can students make a difference in conserving water resources?

We look forward to your visit to the State Botanical Garden of Georgia.

Sincerely,

Education Staff
State Botanical Garden of Georgia
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Athens, Georgia 30601
706-542-6156
sbgeduc@uga.edu
Stream Eco-Adventures Field Trip Outline

A typical field trip starts with definitions of a stream and a watershed. Then students participate in the Dirty Water Story using an Enviroscape watershed model. This is followed by the Earth's Water Supply activity and interesting facts about water use. Students then contribute ideas for different ways we can conserve water. If time and group size permits, students are able to make their own personal water meter which they can use to record how much water they use each day.

After these activities, students walk through an actual watershed to the Middle Oconee River and then to a small tributary that feeds into the river. There they collect data about the stream, such as temperature and pH. They then are able to get into the water to collect different creatures that live there to get a closer look at stream life. They find the organisms on a chart to determine the health of the stream.

The activities may change depending on size and age of the group or the weather.

Enjoy your field trip!
QCC’s for STREAM ECO-ADVENTURES Activities

Grade K Science
Strand: Inquiry
1. **Topic:** Science Inquiry, Process Skills and Problem Solving
   **Standard:** Asks questions, makes and keeps simple records of observations, sorts objects, communicates with others, and makes predictions and uses estimation and measurement.
2. **Topic:** Reference Skills
   **Standard:** Uses books and other media to obtain information related to science concepts.
3. **Topic:** Safety
   **Standard:** Identifies and practices accepted safety procedures in manipulating science materials and equipment.
4. **Topic:** Activities/Tools
   **Standard:** Actively engages in the learning process via hands-on/minds-on science activities. Uses appropriate tools to collect and analyze data and solve problems.

**Strand:** Life Science
15. **Topic:** The Living World: Human Body
   **Standard:** Uses senses to sort and classify colors, shapes, sizes, sounds, tastes, odors, textures, and temperatures. Categorizes objects according to color, shape, size, sound, taste, odor, texture, and temperature, using the five senses.
19. **Topic:** Earth Materials
   **Standard:** Recognizes features and characteristics of the Earth's surface. Identifies common surface features such as oceans, lakes, mountains and others through audiovisuals, models or direct observation.

Grade 1 Science
Strand: Inquiry
1. **Topic:** Science Inquiry, Process Skills and Problem Solving
   **Standard:** Asks questions, classifies objects based on similarities and differences, communicates with others, makes inferences and predictions, uses estimation and measurement, uses evidence to construct explanations, and makes sketches and diagrams to explain ideas.
2. **Topic:** Reference Skills
   **Standard:** Uses books and other media to obtain information related to science concepts.
3. **Topic:** Safety
   **Standard:** Identifies and practices accepted safety procedures in manipulating science materials and equipment.
4. **Topic:** Activities/Tools
   **Standard:** Actively engages in the learning process via hands-on/minds-on science activities and experiences. Uses appropriate tools to collect and analyze data and solve problems.

**Strand:** – Life Sciences
16. **Topic:** Earth Processes: Weather and Climate
   **Standard:** Investigates weather events and makes observations using related instruments. Investigates occurrences such as tornadoes, hurricanes, thunderstorms, droughts, showers, fog, and snow.
17. **Topic:** Earth Processes: Weather and Climate
   **Standard:** Compares and contrasts differences in weather by seasons. Constructs weather charts showing daily temperature, changes, precipitation, cloud cover and wind during different seasons.
18. **Topic:** Earth Processes: Weather and Climate
   **Standard:** Makes observations using simple weather-related instruments. Measures weather characteristics using thermometers, weather vanes and rain gauges.

Grade 2 Science
Strand: Inquiry
1. **Topic:** Science Inquiry, Process Skills and Problem Solving
   **Standard:** Asks questions, makes and keeps simple records of observations, sorts objects, communicates with others, makes predictions and uses estimation and measurement, uses evidence to construct explanations, and makes sketches and diagrams to explain ideas.
2. **Topic:** Reference Skills  
**Standard:** Uses books and other media to obtain information related to science concepts.

3. **Topic:** Safety  
**Standard:** Identifies and practices accepted safety procedures in manipulating science materials and equipment.

4. **Topic:** Activities/Tools  
**Standard:** Actively engages in the learning process via hands-on/minds-on science activities and experiences. Uses appropriate tools to collect and analyze data and solve problems.

**Strand:** Physical Science

6. **Topic:** Structure of Matter  
**Standard:** Distinguishes among states of matter (solid, liquid, and gas). Sorts objects according to solid, liquid or gas.

8. **Standard:** Predicts changes in states of matter such as when water is heated or frozen.

**Strand:** Life Science

15. **Topic:** Ecology: Interdependence of Life  
**Standard:** Identifies and describes habitats (desert, woodland, ponds, streams) of plants and animals and their characteristics (light, moisture, temperature).

16. **Topic:** Ecology: Interdependence of Life  
**Standard:** Matches various animals and plants to their habitat based on needs.

17. **Topic:** Ecology: Interdependence of Life

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**Grade 3 Science**

**Strand:** Inquiry

1. **Topic:** Science Inquiry, Process Skills and Problem Solving  
**Standard:** Asks questions, classifies objects and events, communicates with others, makes inferences and predictions, uses estimation and measurement, uses evidence to construct explanations, makes sketches and diagrams to explain ideas, and organizes data into tables and charts to interpret and formulate simple hypotheses.

2. **Topic:** Reference Skills  
**Standard:** Uses encyclopedias, science reference magazines, books, and other media to obtain information related to science concepts.

3. **Topic:** Safety  
**Standard:** Identifies and practices accepted safety procedures in manipulating science materials and equipment.

4. **Topic:** Activities/Tools  
**Standard:** Actively engages in the learning process via hands-on/minds-on science activities and experiences. Uses appropriate tools to collect and analyze data and solve problems.

**Strand:** Life Science

15. **Topic:** The Living World: Animals  
**Standard:** Recognizes and describes a variety of animal and plant life cycles. Illustrates the life cycles of a chicken, butterfly, frog, turtle, grasshopper, dog and fish.

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**Grade 4 Science**

**Strand:** Inquiry

1. **Topic:** Inquiry, Process Skills, and Problem Solving  
**Standard:** Asks questions, makes inferences and predictions, uses estimation and measurement, uses evidence to construct explanations, makes sketches and diagrams to explain ideas, organizes data into tables and charts for interpretation, reads and interprets various types of graphs, formulates simple hypotheses, identifies and controls a limited number of variables, and designs a simple experiment.

2. **Topic:** Reference Skills  
**Standard:** Uses encyclopedias, science reference magazines, books and other media to obtain information related to science concepts.

3. **Topic:** Safety  
**Standard:** Identifies and practices accepted safety procedures in manipulating science materials and equipment.

4. **Topic:** Activities/Tools
**Standard:** Actively engages in the learning process via hands-on/minds-on science activities and experiences. Uses appropriate tools to collect and analyze data and solve problems.

**Strand:** Life Science


**Standard:** Discusses causes and possible solutions for pollution. Identifies types of pollution, such as air pollution, water pollution and noise pollution, and discusses how overpopulation contributes to pollution. Formulates ideas for solutions to existing pollution problems.

**Strand:** Earth/Space Science

28. **Topic:** Earth Processes: Weather and Climate

**Standard:** Demonstrates and describes the water cycle and the role of evaporation, precipitation and condensation. Examines the process of change as it relates to water in the atmosphere.

29. **Topic:** Earth Processes: Weather and Climate

**Standard:** Uses weather instruments to collect data and measure factors (such as temperature, humidity, air pressure, wind speed and direction).

31. **Topic:** Earth Processes: Weather and Climate

**Standard:** Differentiates between weather and climate and identifies Earth's climate zones.

**Grade 5 Science**

**Strand:** Inquiry

1. **Topic:** Science Inquiry, Process Skills and Problem Solving

**Standard:** Asks questions, makes and keeps records of observations, classifies objects and events, communicates with others, makes inferences and predictions, uses estimation and measurement, uses evidence to construct explanations, makes sketches and diagrams to explain ideas, organizes data into tables and charts for interpretation, reads and interprets various types of graphs, formulates simple hypotheses, identifies and controls a limited number of variables, and designs a simple experiment.

2. **Topic:** Reference Skills

**Standard:** Uses encyclopedias, science reference magazines, books and other media to obtain information related to science concepts.

3. **Topic:** Safety

**Standard:** Identifies and practices accepted safety procedures in manipulating science materials and equipment.

4. **Topic:** Activities/Tools

**Standard:** Actively engages in the learning process via hands-on/minds-on science activities and experiences. Uses appropriate tools to collect and analyze data and solve problems.

**Strand:** Physical Science

6. **Topic:** Structure of Matter

**Standard:** Investigates characteristics of length, mass, volume, density, alkalinity/acidity and temperature. Uses balance scales, thermometers, rulers, litmus paper and containers to compare characteristics of various objects.

**Strand:** Earth/Space Science

33. **Topic:** Earth Processes: Oceanography

**Standard:** Recognizes and describes the ocean's many valuable resources, some of which may be threatened by pollution, excessive harvest and harmful mining techniques.
GPSs for STREAM ECO-ADVENTURES Activities

**Kindergarten:** Earth Science
**SkE2. Students will describe the physical attributes of rocks and soils.**
c. Recognize earth materials – soil, rocks, water, air, etc.

**First Grade:** Life Science
**S1L1. Students will investigate the characteristics and basic needs of plants and animals.**
a. Identify the basic needs of a plant (air, water, light, nutrients).
b. Identify the basic needs of an animal (air, water, food, shelter).

**Second Grade:** Earth Science
**S2E3. Students will observe and record changes in their surroundings and infer the causes of the changes.**
a. Recognize effects that occur in a specific area caused by weather, plants, animals, and/or people.

**Third Grade:** Life Science
**S3L1. Students will investigate the habitats of different organisms and the dependence of organisms on their habitat.**
d. Explain what will happen to an organism if the habitat is changed.
**S3L2. Students will recognize the effects of pollution and humans on the environment.**
a. Explain the effects of pollution (such as littering) to the habitats of plants and animals.
b. Identify ways to protect the environment (conservation of resources and recycling of materials).

**Fourth Grade:** Earth Science
**S4E4. Students will differentiate between the states of water and how they relate to the water cycle and weather.**
d. Explain the water cycle (evaporation, condensation, and precipitation).

**Life Science**
**S4L1. Students will describe the roles of organisms and the flow of energy within an ecosystem.**
c. Predict how changes in the environment would affect a community (ecosystem) of organisms.

**Fifth Grade:** Earth Science
**S5E1. Students will identify surface features of the Earth caused by constructive and destructive processes.**
b. Identify and find examples of surface caused by destructive processes (erosion, weathering).

**Sixth Grade:**
**S6E3. Students will recognize the significant role of water in earth processes.**
a. Explain that a large portion of the Earth’s surface is water, consisting of oceans, rivers, lakes, underground water, and ice.
**S6E5. Students will investigate the scientific view of how the Earth’s surface is formed.**
h. Explain the effects of human activity on the erosion of the earth’s surface.
i. Describe methods for conserving natural resources such as water, soil, and air.

**Seventh Grade**
**S7L4. Students will examine the dependence of organisms on one another and their environments.**
c. Recognize that changes in environmental conditions can affects the survival of both individuals and entire species.
**Stream Eco-Adventures Field Trip**

**Introduction:**

This field trip leads students on a true adventure through a watershed, along a river, and into a stream. Students are stream ecologists as they gather data and catch and identify water creatures to monitor stream health. The subjects of erosion, pollution, and conservation and the effects they have on our drinking water supply and the habitats of water animals are also addressed. Students gain a real understanding what a watershed is and how all members (including humans) of an ecosystem are connected by their common water source.

There are many steps that take place in nature that lead to clean water in an ecosystem. Rain falls on the earth and begins its journey downhill. Some soaks into the ground and is taken up by the roots of plants. Water is always flowing to a lower point. Crevices form that through time become tributaries that lead to a river. In a watershed, the river is the lowest point. The river then gets larger and larger until it reaches the ocean. Once in larger bodies without tree cover, water evaporates and condenses into clouds that eventually start the process over again as rain.

As the water moves over the ground, the soil (kept in place by plant roots) acts as a filter to remove impurities. This process can be called water purification. Although an essential part of life on earth, water purification is only one aspect of the many systems that have to continue in good working order in a healthy environment. An ecosystem is a lot like an intricate machine with many parts or a large company with many employees – each with an important job to do. We like to call this the Water Purification Department of an ecosystem. The people of an ecosystem can play an important role in keeping their ecosystem healthy also, by being good stewards.

The activities of this booklet may be used to prepare students for their field trip at the State Botanical Garden and then for review of the concepts learned during the field trip. Some of the activities will be conducted while on the field trip. Which of these activities are chosen to do with your group will depend on its size. We will not have time for all activities in the “At the Garden” section of the table of contents, so please review these also. There may be one you would like to conduct post trip on your school site.

**Background Information:**

**Major Concepts**

- Fresh water makes up only 3% of the water on Earth, usable fresh water is only 1% (97% is salt water).
- Toxic substances or other pollutants often end up in water.
- Water cycles through the atmosphere and is purified as it turns from a liquid to a gas and back again.
- Wetlands, some of the most productive habitats in the world, can remove many harmful substances from water and are threatened by destruction due to filling and development.
- The area in which surface water flows downhill to one common point is called a watershed.
- Any action in a watershed can impact the water quality of that watershed.
- Aquatic ecosystems provide habitat for many organisms, including immature insects.

**Water Cleaning: A Priceless Natural Service**

Water is the most important substance in our everyday lives. The human body is about 90% water. You could survive several weeks without food, but only a few days without water (depending upon the environment). Water is vital to eliminating waste materials from the body.
and maintaining the appropriate temperature. Yet most of the water on earth is unsuitable for drinking. Only 1% is usable for drinking water. Ninety seven percent is salty ocean water and another 2% is fresh water that is tied up in ice and snow in glaciers and icecaps in the polar ice caps.

Nature gives us pure water as a free service. Heat from the sun evaporates surface waters, mostly from the ocean. The salt remains in the ocean and pure water enters the atmosphere, where eventually it falls back to the earth as rain, snow, or ice. The ecosystems of the world also purify water in other ways. Some air pollutants, such as nitrogen and sulfur containing compounds, wash out of the air during rain. Plants, soil organisms and other animals can use these substances as nutrients.

Wetlands, areas that are covered with standing water for extended periods of time, are important water purification sites. Most wetlands are flooded with water from terrestrial areas, especially during periods of heavy rain. This runoff spreads out into the low, flat areas of wetlands. Any nutrients such as nitrogen and phosphorus compounds that are in this runoff water will be taken up by the wetland plants. Other substances in the water, for example metals such as iron or lead and some toxins such as pesticides, will settle out of the water and collect in the sediments of the wetlands. These sediments, called “muck”, contain soil and quite a bit of dead plant material. If too many nutrients or toxic materials enter the wetland, plants and other organisms can be killed and the ability of the wetland to purify water can be destroyed.

Wetlands provide several important services:
1. maintaining water quality for a region;
2. reducing erosion;
3. providing protection from floods;
4. processing airborne and water pollutants;
5. controlling insects;
6. providing habitats for fish spawning and other food and non-food organisms; and
7. producing food, fiber, and fodder (timber, cranberries, cattails).

Although we think of the world’s freshwater as the water in rivers and lakes, nearly 95% of the world’s fresh water (not including permanent ice) is found in groundwater. More than 30 times the volume of water in all the world’s freshwater lakes and rivers is found in groundwater. Groundwater builds up as water percolates through soil, moving until it is trapped by an impermeable rock layer. Large quantities of water can accumulate in a region, when the impermeable layer is overlain by a permeable layer of gravel, sand, or porous rock. These permeable layers, known as aquifers, can be quite large; they can be thought of as underground lakes. Springs are found in areas where groundwater seeps back up to the surface. Although some chemical substances can degrade into harmless materials as they percolate through the soil, other chemicals do not break down as readily. If toxins, such as pesticides or petroleum products such as gasoline, enter the groundwater in excessive amounts, the water quality of aquifers can suffer. The quality of groundwater is important because half of the US population obtains their drinking water from this source.

What is clean water worth? In a recent study, the value of providing water in watersheds, reservoirs and aquifers was estimated at $1.692 billion dollars. That figure is only a fraction of the true value of services that human societies receive from water. It does not include benefits such as waste treatment for nutrient or toxin removal, flood control, food production, or animal habitat. (Costanza et al. 1997. Nature 387: p.253-260).

**Water Cleaning in Your Community**

The water cleaning department runs best when vegetation is left intact. In places where vegetation is removed and the soil exposed, soil can wash away, air pollutants can wash into
streams, and groundwater supplies may diminish due to increased surface runoff. A healthy stand of plants helps absorb rainfall, and soil water helps to maintain plant growth between rainfall events. The presence of trees along streams and rivers, commonly called a “riparian buffer” will trap nutrients that might otherwise runoff the land into the streams. The trees also prevent erosion of the stream bank during high rainfall periods. Can you locate any areas of erosion on your school site? If so what could you do to repair them?

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<td>• Reforestation &amp; Watershed Conservation</td>
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<tr>
<td>• Wetland Destruction</td>
<td>• Proper use and disposal of potentially dangerous chemicals</td>
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**Quiz Yourself**

1. Fresh water makes up only ____% of the water on earth.

2. Water that is obtained from wells, aquifers, and springs, is referred to as _____________.

3. Wetlands provide:   a. flood control.   b. habitat for spawning fish.   c. erosion control.   d. all of the above.

4. True or False. More fresh water is found in groundwater than in all the rivers and lakes on earth.

5. Nitrogen-containing air pollutants:   a. destroy wetlands.   b. can be used as nutrients for plant growth.   c. are not found in wetland habitat.
Earth’s Water Supply

Essential Questions:
Why should we care about the Water Purification Department?
How much of the Earth’s water can we use for drinking?

Background:
Between 2/3 -3/4 of the Earth is surface is water. The Earth’s water can be observed in flowing rivers, ponds, lakes, oceans, locked in the Northern and Southern ice caps, and drifting through the air as clouds. Water that has seeped into the Earth’s crust (groundwater) is more difficult to see yet all these forms of water are part of a dynamic interrelated flow that we call the water cycle. People tend to think that the amount of water on the planet is unlimited, yet the amount of water on the Earth will actually stay the same. Of the water on Earth, 97.3% is oceans, inland seas, and salt lakes, the rest is fresh water (icecaps/glaciers, groundwater, freshwater lakes, atmosphere, rivers). The amount of available fresh water to humans and wildlife depends largely on how its quality is maintained. Human beings have a responsibility to conserve water, use it wisely and protect its quality.

Getting Ready:
This activity can be done as a demonstration to introduce students to the realization that the amount of fresh water available for humans to use is less than one percent of the total Earth’s water. It can also be done with an apple. The apple represents the Earth, and you cut the fractions from the apple stating why we can not use them.

Procedure:
To understand how much of the earth’s water supply is available for our use:
1. Fill a one-gallon container (such as an ice cream bucket) with water.
2. Pour a half-cup of water out of the one-gallon container and into a clear bowl. The water in the bowl represents all of the fresh water on earth, which is less than three percent of the total water on earth. Fresh water is found in lakes, rivers, groundwater, ice and living things.
| % Earth Water: | Oceans 97.3\%, Ice 2.19\%, Groundwater .5\%, Soil Moisture 0.005\%, Atmosphere 0.001\%, Inland Lakes 0.018\% and Rivers 0.000096\%. |

The 15 ½ cups that are still in the one-gallon container represent salt water. We cannot use salt water.

3. With an eyedropper, drop one drop of water from the half-cup onto a small plate. This one dropper represents the freshwater that is available for our use. This water is found in rivers and lakes. The rest of the water in the half-cup is deep groundwater, bound up as soil moisture, biomass water, or water in the atmosphere.

**Discussion/Assessment:**

Where does water come from?
Will we ever run out of water?
Will the freshwater quality always be the same?
Why should we care about water quality?
What threats does the water cycle face?
What can we do to help the Water Purification Department?
The Water Cycle
Looking at Rainwater pH

Essential Question:
*What can rainwater pH tell us about the Water Purification Department?*

Background Information:
Rainfall coming onto your site may already be contaminated. This is because water in the air interacts with carbon dioxide forming dilute carbonic acid. This happens under normal conditions and causes rainwater to be slightly acidic. However, rainfall is often very acidic because of the pollutants put into the air from cars, power plants, and other industries. Scientists have a scale for rating the acid or base content of liquids called the pH scale. Pure water is given a value of 7 which is called neutral. Any liquid that is more acidic may have a value of 1 - 6. Any liquid that has a pH of more than 7 is basic or alkaline. Students may be less familiar with alkaline materials but some examples are chlorine bleach, household ammonia, milk of magnesia and baking soda. Rainfalls of pH 2.0 have been recorded. That's equivalent to raining lemon juice! Although pH 2.0 rainfalls are rare, some locations in the U.S. had rainfalls with an average pH of about 4.0.

Procedure:
1. Students will measure the pH of rainfall on the school site. Students will take three measurements from consecutive rainfall events and then average these to obtain a representative value.
2. Place a rain gauge in a convenient location on the school site.
3. Collect rainfall from your site in your rain gauge. If possible, wash the gauge before you expect rain so that your water sample is not contaminated with any dust or dirt.
4. Empty the rain gauge into a clean dry cup or beaker.
5. Remove a strip of pH paper and touch the paper to the water.
6. Remove the paper and let it stand for about one minute.
7. Compare the color of the paper to the colors on the package of the pH paper. Record the value listed for the color that matches your rainwater sample.
8. Record the pH for two additional rainfall events.
9. Average the three pH values to obtain an average pH value. Rainwater pH will likely not be affected from changes on the school site from year to year. However, it is a decent measure of overall air pollution. (Be aware that rain fall on a wetter year may be less acidic that that of a drier year based on the frequency with which pollutants are washed from the air.)

Discussion/Assessment:
Discuss any differences in pH that were recorded and ask the students to make hypotheses about why the pH varied.

Extended Activities:
**Acid Rain: An Air Pollutant** *(See Air Cleaning Department)*
Looking at Rainwater pH

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Water in a Puddle or Downspout

**Essential Question:**
*What part does this body of water play in the school site ecosystem?*

**Background Information:**
Even if there is not a stream running through your campus, there is sure to be water. Even if there is only water on the school site immediately following a rain event, that water is providing a service to the school site ecosystem. It waters the plants, provides drinking water for wildlife, and provides habitat for aquatic plants and animals. Students can learn about these ecosystem services by observing the water on their school site no matter how much of it there is. For activities that address wetlands and streams see the Garden Earth Activities: *Wetland Study, Discovering Aquatic Insects, and Go with the Flow.*

**Getting Ready:**
This activity contains three options for observation depending on the facilities on or near your school site. Choose the one that works best for you or adapt it to suit your site. You might want to try more than one if you have available resources.

**Procedure:**
*Options for school site water surveys include:*

1. **PUDDLE IN THE PARKING LOT OR ON THE SCHOOL YARD**
2. **WATER FROM A DOWNSPOUT FROM MY SCHOOL**
3. **AQUARIUM**

**OPTION 1: PUDDLE IN THE PARKING LOT OR ON THE SCHOOL YARD**

1. Assemble students near the puddle and ask the following questions. Discuss the students’ answers.
   - When we study a pond, wetland area, or this puddle which service department are we investigating? Where did the water in the puddle come from? Did it flow anywhere to get here? Why did it collect here?
2. Assign groups of students to determine answers to the following questions and record the data on a piece of paper.
   - How deep is the puddle?
   - Is it the same depth all over? Why or why not?
   - How long is it?
   - How wide is it?
   - Is this water clean? Give reasons for your answer.
• Do any creatures live in this water? Why or why not?
• If this puddle stayed here for a long time who would be the first to move in?
• What happens to the water in this puddle? Relate this to the water cycle.
• Take a sample of the water with an eye dropper and investigate it under the microscope.

3. Keep a day to day record to determine how long the puddle remains on the school site and the size of the puddle each day. Assign one or two students to observe the puddle each day. If there are several puddles compare and contrast them.

4. If your puddle is on blacktop, sprinkle flour around the edge. Go back later and check to see if there have been visitors to the puddle. Students should record the tracks that they see.

5. Follow the activity by discuss the following with students. How might you use a puddle like this?

**OPTION 2: WATER FROM A DOWNSPOUT FROM MY SCHOOL**

1. Place a container under a downspout to catch runoff from a building.
2. Assemble students at the container and ask the following questions and discuss student answers.
   • When we study a pond, a wetland area, a puddle, or water from a downspout which service department are we investigating?
3. Measure the amount of water you collected in the bucket. This can be measured by depth, volume, or by weight.
4. Assign groups of students to determine answers to the following questions and record the data on a piece of paper.
   • Why do you get more water in the container under a downspout than you would get in a puddle in the parking lot or in the yard?
   • Why do buildings have gutters and downspouts?
   • Does this water have any connection with the water cycle? Explain.
   • Identify what you see in the water.
   • Do any creatures live in this water? Use a microscope to find out.
5. Pour the water into different types of containers. Compare and contrast the temperature and the rate of evaporation in different containers.
6. Cover one container of water with a piece of screen wire, another with a tight lid. Leave one open. Check the containers daily. What changes occur? Keep good records.
7. After completing this activity discuss the following with students:
   • In many places in the world people collect rainwater regularly. Why?
   • How could you use rainwater you collect at home or here at school?

**OPTION 3: AQUARIUM**

1. Assemble students around an aquarium and ask the following question:
   • When we study a pond, a wetland area, a puddle, water from a downspout, or water in an aquarium which service department are we investigating?
2. Assign groups of students to determine answers to the following questions and record the data on a piece of paper.
   - Who lives in this aquarium?
   - How did these life forms get there?
   - Why do you need different kinds of life in an aquarium?
   - How is the water kept clean?
   - Why is temperature important in an aquarium?
   - What would be the effect of putting too much of any one thing or too many of any one creature in an aquarium?

3. Create a chart on the board and compare and contrast the following between a pond and an aquarium:
   - List the kinds of things you have to put into an aquarium to keep it healthy. Compare the indoor aquarium's contents with those of a pond.
   - How do the creatures in the aquarium get food? How does this food differ from food creatures would get in a pond outdoors?
   - If you took the creatures that live in an aquarium and put them in a pond, what do you think would happen to them? What about the reverse? How would pond creatures get along in an aquarium?
   - Compare and contrast the way you would care for an aquarium and the way you would care for a pond outside.
   - Compare the process of keeping the aquarium clean with the process of how organisms keep outdoor water clean.
   - Why is it important to circulate the water in an aquarium? How is water circulated outside?

4. Keep daily records of your care of the aquarium and your observations of life in the aquarium. Explain the causes and effects (inputs and outputs) of the changes.

Discussion/Assessment:
What factors affect the body of water (ecosystem)?
What did you find out about this system?
What other bodies of water are there? What life do they support? What role do they have in the water cycle?
Wetland Study

Essential Question;  
*How can we measure water quality?*

Background Information:  
Water is important to all life. The earth is around 75% water, but very little of that water is fresh water. Freshwater is stored in lakes, ponds, and streams, as well as underground aquifers and in glaciers and ice caps. Almost all living things rely on fresh water.

When thinking about the water that one drinks and relies on to live, it is useful to think in the scale of watersheds. In general, people rely on the water within the watershed that they live. A watershed is an area of land on which water drains to one central point. Activities in the watershed impact the water in the watershed.

The health of a stream, river, or other wetland often reflects the level and types of land use in the watershed. Quantifying the health of a wetland is therefore a good way to alert learners to this connection and to encourage them to consider how their own actions impact their own watershed.

Wetland health can be measured in many ways. Observing the wetland is a good first step in determining the health. The clarity of the water, the amount of silt deposited on the wetland floor, and the balance of algae (plant) and animal life in the wetland can provide vital clues about the health of the wetland as well as the land use in the watershed. Wetland temperature is also affected by the sites around the wetland and can affect the life in the wetland.

Chemical tests can reveal the amount of dissolved oxygen and the pH of a body of water, which both affect the diversity of creatures that can live in the wetland. Chemical tests can also detect unseen pollutants in the water. Collecting and studying the inhabitants of a wetland and their levels of sensitivity to pollution is a useful and easy way to estimate the health of a wetland. Even bodies of water that are very healthy may contain bacteria that are dangerous to humans. Even healthy wetland water should be treated before drinking.

Aquatic Insects:  
Who are they?  Almost all of the young of five orders – Mayflies*, Stoneflies*, Dragonflies* and Damselflies*, and Caddis flies* - are born from eggs laid in the water and spend their immature days as aquatics. Some Dobson flies and Alderflies*,
Springtails, Mole crickets, Spongilla flies (including mosquitoes), beetles, bugs, flies, wasps, and moths spend some of their lifetime in the water.

**Where do they live?** Some mosquitoes and one species of damselfly breed in the water held by pitcher plants. However, insects live mostly in shallow streams and ponds. Some live beneath the surface, while others, like the water striders, live on the surface of the water. Some prefer fast moving streams, others like still ponds.

**How do they get oxygen?** Most of the aquatic bugs and beetles have to come to the surface for air. The aquatic larvae of the groups named above with asterisks*, plus some other species, do not have to do so. Those who do come up for air may have tubes with spiracles at the end that they can push through the surface tension of the water to fill their tracheae with air before submerging. Most aquatic bugs and beetles carry a supply of air down with them. They break the surface tension with their abdomens, antennae, or heads, which have spiracles which draw air down into spaces under the wings. They must replenish this air.

Some insects can create bubbles of air that attach to their underside. They take in air from this bubble in what is called plastron respiration; the air does not have to be replenished. This is because they only breathe in the oxygen, and as it is reduced, the pressure changes and oxygen from the water can diffuse into the ‘bubble’. In non-plastron ‘bubbles’, the insect doesn’t get quite enough oxygen replacement so it has to resurface.

Other insects have gills like fish. Because of the pressure difference between the oxygen in their tracheal system and the water, oxygen may be diffused through tracheal gills (thin-walled structures with many air-filled tracheae). Gills may be internal or external. A few insects have ‘blood gills’ thin-walled extensions of cuticle that contain blood. Their blood has hemoglobin (unusual in insects) which means it can hold more oxygen.

Still other aquatic insects get oxygen from spaces within plant cells by chewing or piercing plant tissue.

**What do they eat?** Aquatic insects such as water striders eat insects that fall and appear on the surface of the water. Those that submerge have varied diets. Some like water boatmen eat plankton (microscopic plants and animals). Some caddis fly larvae filter plankton out of water with the nets they spin. Many aquatic immatures are herbivores, e.g., most mayfly, stonefly, and caddis fly naiads. Some aquatic immatures feed on sewage. Dragonfly naiads are major predators. They lurk, concealed in silt or weeds, can move with jet propelled speed, and have a fanged lower lip that can reach out to snap meals. Predatory aquatic bugs have sharp-edged tibia and piercing beaks. Predator beetles are fast swimmers with powerful grasping jaws.

**Where do they place eggs?** Most aquatic insects attach their eggs to plant tissues, rocks, or other surfaces. Some giant water bug females glue their eggs onto the male. Non-aquatic adult insects may lay eggs on land, on structures overhanging water, on the
surface of water, or drop them into the water. Or they may place them on mats of submerged vegetation, stems, etc. Each species has its own habits.

Where do they emerge as adults? Insect naiads can crawl up onto plants, stones, wood, or banks to emerge. Insects with complete metamorphosis that pupate in the water have the most problems since their pupae have to get to shore. Many insects with complete metamorphosis pupate on shore.

How do aquatic insects travel? Water striders spread out their legs like spiders. Their back legs are flattened and paddle-like for propulsion. Most aquatic bugs and beetles are very streamlined in shape and have at least one pair of legs that are paddle-like. In many, the antennae can fold back into grooves along the head. Non-swimmer beetles have claws to cling to rocks. Larvae mostly swim with side-to-side movements of the abdomen, and a few have abdominal tails or bristles that act as rudders. Dragonfly larvae suck in water through the anus. It passes over the gills allowing respiration, and then it is ejected in a jet that shoots them forward.

Anchorage is important for insects because their trachea is filled with air. Bug and beetle adults have to cling with claws to submerged vegetation. Caddis fly larvae build cases of sand, rocks, or wood which weigh them down. Lateral expansions of abdominal segments help some insects hold to rocks. Plate-like gills and discs in some larvae provide suction. Many adult aquatic insects can also fly.

Getting Ready: Look at what you want to focus on at the stream and copy the suitable worksheets. Students will also require stream critter ID sheets (these work best if laminated).

Procedure:
1. Divide learners into teams that can explore different areas of the stream/wetland.
2. Walk to the side of the wetland area.
3. Ask the students if they think that the water they are looking at is healthy or not. Ask them if they would drink the water? How would they test a stream or other body of water to see if it were healthy? What would make a body of water not healthy? Ask the children if they think that what happens on a farm up the hill from a body of water would affect the water quality.
4. Tell the students that they will be measuring many things in the wetland to determine whether or not it is healthy. First they will be just observing. They will need to sit quietly by themselves next to the stream or wetland for 5-10 minutes. Students should consider what they see, hear, and feel while sitting next to the wetland.
5. Once the time is up reassemble the group. Ask students to share their observations.
6. The group will first test the health of the stream or wetland by catching aquatic animals. Allow students to work in groups to catch animals. Animals should be kept in containers with water so that they will not die. Allow students to collect for 10-15 minutes. Then compare the animals that were found. Based on the diversity of the creatures found, ask the students to determine if they think the water is polluted or
healthy. Students can further determine the water quality based on the sensitivity of the animals captured. Look at the Stream Insects and Crustaceans sheet at the end of this section in the manual. Determine how many of the animals captured are pollution sensitive (group 1 and 2 taxa) or are pollution tolerant (group 2 and 3 taxa). Students should draw conclusion on water quality based on the sensitivity of the organisms captured.

7. Release the animals. The students can now predict the temperature and pH of the stream before measuring them.

8. Ask one student to measure the temperature of the stream or other wetland in two different areas. Choose one area that is moving quickly or in the shade, and one area that is moving slowly or in the sun. Ask the students to record the temperatures on their sheet of paper. Do they think that the fast moving water is usually colder or warmer? How does the sun or shade affect the water temperature?

Show the students the following:

**Temperature Ranges Required for Growth of Certain Organisms:**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Examples of Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 68 degrees F</td>
<td>Much plant life, many fish diseases, bass, crappie, (warm water) bluegill, carp, catfish, caddis fly</td>
</tr>
<tr>
<td>55-68 degrees F</td>
<td>Some plant life, some fish diseases, salmon, trout, stonefly, mayfly, caddis fly, water beetles, water striders</td>
</tr>
<tr>
<td>Below 55 degrees F</td>
<td>Trout, caddis fly, stonefly, mayfly</td>
</tr>
</tbody>
</table>

9. Next the students will measure the pH of the stream or wetland. Explain that pH is a measure of the acidity or alkalinity of the water. An example of an acid is vinegar, and an example of a base or alkaline substance is baking soda. Hand each group of students a piece of pH paper and have each dip it quickly in the water and compare the color to that on the container for the pH paper. Show the following chart of pH ranges that support aquatic life and compare the groups’ results.

**pH Ranges Required for Growth of Certain Organisms**

<table>
<thead>
<tr>
<th>pH</th>
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<td>Bacteria</td>
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<td>Carp, suckers, catfish, some insects</td>
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<td>Bass, crappie</td>
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<td>Snails, clams, mussels</td>
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**Discussion/Assessment:**

Is the wetland/stream healthy? What could change in the watershed to make the wetland more or less healthy in the future? Can you drink this water? (Stress all streams can carry bacteria that make humans sick and that water should be treated before it is drunk.)
WETLAND STUDY WORKSHEETS
WATER PURIFICATION DEPARTMENT

Name: ____________________
Date: ____________________
Time: ____________________
Location: ____________________
Weather: ____________________
____________________________
THE STREAM COMMUNITY

Task 1: Use your senses to get to know this area. List three words to describe each item listed below.

PLANTS:

ANIMALS:

WATER:

AIR:

ROCKS/SAND:

HUMAN SIGNS:

OTHER:

Either with words or using a picture, describe the stream and surrounding watershed.
COLLECTING AND RECORDING FRESHWATER LIFE

**Task 2:** Use your field gear to collect as many types of living things as possible. Keep the animals you collect cool and wet. Record a description of the location where each animal was found and an approximate number of each specimen. Use the attached insect ID sheets or another insect ID guide to identify and get to know the organisms you found.

<table>
<thead>
<tr>
<th>Name / Sketch of Organism</th>
<th>Location</th>
<th>Quantity</th>
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<tbody>
<tr>
<td><strong>ANIMAL</strong></td>
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PREDICTION AND MEASUREMENT OF STREAM WATER CHARACTERISTICS

Task 3:
A. PREDICTING WATER CHARACTERISTICS
Based on the aquatic animals you found, use the following charts to predict the pH and temperature of the stream in which you collected animals.

Temperature Ranges Required for Growth of Certain Organisms:

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pH Ranges Required for Growth of Certain Organisms

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</table>

I predict the pH number will be _____ because________________________________________

I predict the water temperature will be _____ because ______________________________________

B. MEASURING WATER CHARACTERISTICS
Using the thermometer and pH paper, determine and record the water characteristics.

Location of Sample: ________________________________________________________________

pH: ___________________________ Water temperature: ___________________________
WRITING A CINQUAIN POEM

**Task 4:** Using words that describe the wetland environment write a cinquain poem about a freshwater community.

*Line 1.* Give your poem a title; this will be two syllables or two words.

________________________________________________________________________

*Line 2.* Provide a description of the title in 4 syllables or words.

________________________________________________________________________

*Line 3.* Describe an action associated with the wetland in 6 syllables or words.

________________________________________________________________________

*Line 4.* Describe a feeling about the wetland in 8 syllables or words.

________________________________________________________________________

*Line 5.* Provide another word for the title in 2 syllables or words.

________________________________________________________________________
### Dissolved Oxygen
The oxygen in solution in water which is available to fish and other aquatic organisms. Measured in terms of parts per million (ppm) where the following scale applies:

- Salmon and trout: 7 ppm (spawning)
- Salmon and trout: 6 ppm (growth)
- Warm water fish (bass): 5 ppm
- Carp: 3-4 ppm
- No fish: below 3 ppm

### Lake
Larger than a pond, the water is too deep for plants to grow except around the shore. The bottom is usually not muddy and the water temperature may vary with water depth.

### Marsh
A type of wetland in which grasses, sedges, cattails or rushes form the dominant vegetation.

### pH
A unit of measurement used to describe the acidity or alkalinity of water, or other solution. Based on a scale of 1-14 in which 1 is very acid, 14 is very alkaline, and 7 is neutral. Most fish live in a range of 6-9.

### Pond
A quiet body of water so shallow that rooted plants grow completely across it. The bottom is usually covered in mud and the water temperature is uniform throughout.

### Stream
A general term for water flowing in one direction, such as a rill, rivulet, brook, creek, or river.

### Succession
The replacement of one kind of community by another involving the progressive replacement and change in vegetation and animals. May culminate in a stable, climax, community. A general example is:

<table>
<thead>
<tr>
<th>Pond</th>
<th>Deep marsh</th>
<th>Shallow marsh</th>
<th>Swamp</th>
<th>Forest</th>
</tr>
</thead>
</table>

### Swamp
A term, of various meanings, but generally referring to an area containing surface water, through much of the year, and where the dominant vegetation is woody shrubs or trees.

### Water Quality
Based on several measurements including temperature, acidity, bacteria count, taste, odor, suspended solids, chemical makeup, etc.

### Watershed
The total area of land surrounding a given body of water which contributes runoff water to that body.
Go With the Flow! Determination of Stream Flow

**Essential Question:**
*How do you measure stream flow?*

**Background Information:**
See *Background Information for Garden Earth: Water Purification Department.*

**Getting Ready:**
Before the activity you may want to find part of a stream where students can easily gain access without getting too deep. They will be measuring depth and width.

**Procedure:**
The worksheets give the students step by step instructions and all the information needed for the calculations.

**Discussion/Assessment:**
Discuss the answers that the class found. How many people could use this stream for water? Ask students to predict the stream flow at different times of the year and to graph their predictions. As an optional activity you may wish to revisit the stream and record stream flow once a month. This data can be compared to the students’ predictions.

**Location:** Near a small river or a stream (at an area where students can walk across the stream)

**Objectives:** Learners will:
1) use simple tools to determine velocity, width, depth, and volume of a stream.
2) determine how many people could live off a stream based on average water use per day.

**Skills:** communication, data collection, analysis,

**Supplies:**
- 100 ft tape measure
- stop watch or other timer
- orange/tennis ball (to throw in the river)
- measuring stick (to measure stream depth)

**Subjects:** science, math

**Time:** 45 minutes
Collecting and Recording Stream Flow
Measurements Worksheet

Name:_________________________
Location:________________________ Weather:________________________

1. Measure and mark a 10 foot distance along a straight section of your stream. Throw an
orange or tennis ball (2 or 3 inches wide) in the water above the upstream marker.
Record the number of seconds it takes to float downstream between the markers. Now
divide the total distance by the total seconds it took the stick to float between the stakes.

\[
\frac{\text{distance (ft.)}}{\text{total seconds to float (ft.)}} = \text{ft. per second}
\]

2. Find the average width of your section of the stream. Measure the width of the stream
at 3 places within the 10 foot area. Divide the total by 3 to get the average stream width:

First measurement \________feet.
Second measurement \________feet.
Third measurement \________feet.
Total \________feet \÷ 3 = \____ ft.

3. Find the average depth of your section of the stream. Measure the depth of the stream
in at least 3 places across the stream in a straight line. Divide the total by 4 to get the
average depth of the stream. (The measurement is divided by 4 to take into consideration
the very edge of the stream where the depth is 0 ft.)

First measurement \________feet.
Second measurement \________feet.
Third measurement \________feet.
Total \________feet \÷ 4 = \____ ft.

4. Find the cubic feet of water per second. Multiply the length of the area tested (10 ft.)
by the average width, and the average depth. That number is then multiplied by the
number of feet the stick floated each second. This measurement is called “stream flow”.

\[
\frac{\text{length (ft.)} \times \text{average width (ft.)} \times \text{average depth (ft.)}}{\text{no. ft/second}} = \text{cubic ft. of water/second}
\]
How Many People could this Stream Support?

Based on the information below and your stream flow value, you can work out how many people can be supported by this stream.

**Background Information**

- The average person uses about 200 gallons of water a day for home use. This does not reflect each person's share of water used for industrial, public service, and commercial purposes.

- A cubic foot of water is the water in a container 1 foot wide, 1 foot high and 1 foot long and contains 7.48 gallons.

Complete the following calculations. Round off 7.48 to the nearest one-tenth.

\[ \text{stream flow in cu. ft. per sec.} \times \text{gallons in 1 cu. ft. of water} = \text{gallons of water per sec.} \]

\[ \frac{\text{gallons per sec.} \times 60}{\text{sec. in minute}} = \text{gallons of water per min.} \]

\[ \frac{\text{gallons per min.} \times 1440}{\text{no. of min in a day}} = \text{gallons of water per day} \]

\[ \frac{\text{gallons of per day}}{\text{amount of water one person uses per day \times 200}} = \text{people can be supported by the stream} \]
Clean Water Anyone?

Essential Question:
Where does our drinking water come from?

Background Information:
Often we think of water pollution as being something that industry creates and something that we can do nothing to improve. This activity will draw attention to the many sources of water pollution and illustrate that our personal lifestyle can affect the quality of the water.

Getting Ready:
This activity can be done a variety of ways. If you have an Enviroscape model available you can use that instead of the large jar of water. You also have the option of giving every child a container which they add to the large jar of water as the story is being told. Water pollutants will have to be doubled up to do this. A pharmacy or place that develops photos is a great supplier of free film canisters. As you tell the story you may want to add information related to your local environment, for example, when mentioning the deforestation mention the Long Leaf Pine Forest, while adding the pesticide mention DDT.

Procedures:
Tell the following story while adding pollutants to a jar of water.

Start with a jar of clean water. Is anyone thirsty? Before you drink it, let me tell you about the travels of this water.
The journey started when it evaporated from a variety of places including soil, plants, surfaces, fresh or salt water bodies. Only pure water gets into the air as a result of evaporation; everything else is left behind. So it started out clean as a molecule of moisture.

* It needed to condense on a speck of dust to form a raindrop in the cloud but that is natural. (Add spice representing dust to the jar of water)

* As it fell through the atmosphere, it picked up acids (add vinegar) and other industrial pollutants from the air. The pollutants came from the car exhaust pipes and factory smoke stacks from the Big City.

* It fell to earth up in the mountains and entered a small stream. Unfortunately the forested hillside had recently been logged for pulp to make paper for people in the Big City. The soil was bare and the logging roads were unstable so a lot of soil and debris was washed into the stream by the rainstorm that brought the little raindrop. (Add soil and plant debris)

* The small stream joined another to become a little larger creek which ran by a farm where a farmer raised crops to sell in the Big City. The farmer had just fertilized the fields. Some of the fertilizer was taken up immediately by the plants and the organisms in the soil but not all of it. So
when the rain came, it washed some of the fertilizer into the stream. (Add creamer for fertilizer) Fertilizer can make water plants grow well too so the algae in the stream grew rapidly and made the rocks slippery and formed a green scum on the pond behind the little dam on the creek.

* The farmer next door had a problem with insects eating some of his crops so he sprayed an insecticide to kill them. Some of that also washed into the stream (add spice representing insecticide). Unfortunately there were insects in the stream too and many of them died. They were important members of the food web that includes fish, birds, and mammals.

* People from the Big City enjoyed coming to the country on vacations. There were some vacation homes along the stream with septic drain fields. When there were only a few houses, it probably wasn't a problem but now there are so many houses that sewage is percolating through the soil into the water. (Add water with yellow food coloring)

* A little further along, the creek runs through a dairy farm which sells milk in the Big City. The cows are fenced away from the creek which is good but the pastures are right next to the creek. When you get a good rain storm, guess what washes into the stream. (Add instant coffee for manure)

* The creek enters a small river where it runs past the Small Town. They have a primary sewage treatment facility which gets some of the stuff out of the sewage. But the Small Town has been growing at rates faster than the town was prepared. Sometimes the system is overloaded, such as when there is a big rain storm like the one that brought our raindrop, and raw sewage gets dumped into the river. (Add toilet paper)

* The people in the Small Town are employed in a mill which has been dumping wastes into the river for years. It is too expensive to add equipment to clean up the wastes. If they closed the mill, many of the people would be unemployed and the Small Town would probably die. (Add a spice that looks or smells awful to represent industrial waste)

* Next the river runs past a power plant which supplies electricity to the Big City. It doesn't pollute the river with chemicals but it does use the river water to cool the system. When it pumps the water back into the river the temperature is raised a few degrees. Unfortunately warmer water does not hold as much oxygen as cold water and many aquatic organisms can not live in warmer water. (Add steaming water and small plastic fish)

* Finally the water comes to the Big City. The water is pumped from the river into a water purification plant where it is filtered, (strain through a wire mesh strainer and pour through a coffee filter) and chlorinated (add water with blue food coloring to represent bleach).

* And pumped to the homes of the people in the Big City so they can pour a nice tall glass of cool clean water. Is anyone still thirsty?

The moral of the story is: The faucet is just the other end of the drain.

Assessment/Discussion:
What are some sources of pollution? Which pollution could have been avoided? Explain to students that water treatment plants do a decent job of filtering pollutants out of the water, but the more polluted the water, the more difficult it is and the more money it costs to purify the water.
Make Your Own Water Meter!

**Essential Question:**
*How much water do you use in a day?*

**Background Information:**
See *Background Information: Water Purification Department* and *Background Information “Earth’s water Supply”*

**Getting Ready:**
Copy the “Water Meter template” on to white cardstock. Make sure there are enough templates for each student. There are two water meters per page.

**Procedure:**
1. Explain to the students that the Earth has very little fresh water and it is important to conserve water and use it wisely. They are going to make their own water meter to see how much water they use during a day.
2. Hand out one water meter, piece of ribbon and bead to each student.
3. Cut out the water meter and score a line along the two ends of the internal small rectangle (Figure 1). This will allow the ribbon to pass through.
**Figure 1: Where to score the water meter.**

4. Fold the template in half along the black line, so that the two blank sides touch.
5. Unfold the water meter and thread the ribbon through one side and attach it at the back with tape.
6. Put the bead on the ribbon so it will act as a marker on your scale.
7. Thread the other end of the ribbon though the other slit, pull tight and attach with tape.
8. Glue both blank sides of the water meter together. The water meter is now complete and the bead should move up and down the ribbon when pulled.
9. Go over how to use the Water Meter with the students. On the back is a small table. They will use this table to help them work out how much water they use. They will then move the bead to the appropriate amount. Students will record their actions for a day and determine the amount of water that they use.
10. Compile the students’ data. Discuss the results. Also ask the following questions: *Why we should be concerned about water use? How can we make simple changes to save water? What are watering bans?*

11. Have the students record the amount of water they use again after studying the Water Purification Department on their school site. See how much water the students can conserve.

12. Compile this information. Also record any student suggestions for saving water.

13. Record the numbers on the school water meter for a day, from morning to evening, and also for a week.

14. Students may wish to investigate the uses of water in the school building in an attempt to decrease the amount of water used per day. School water usage can be compared each semester/year.

**Formulating Questions:**
Ask the students to review to themselves the questions that they came up with during the previous activities. Remind the students that these need to be well thought out questions – the kind that scientists might ask. The students should choose the question that they like the best, write it on a slip of paper, and then hand it in to the teacher. These questions can be used as supporting questions and can guide the lessons and activities chosen in the remainder of this unit.

**Discussion/Assessment:**
- Where does water come from?
- Why should we care about water quality?
- What threats does the water cycle face?
- What can we do to help the Water Purification Department?
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<th>Amount of Water in Gallons</th>
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Class Water Usage

Water Usage 1
Date:__________________________________________
Total number of students participating in the survey: ________________
Total water use: __________________________________________
Average water use per student: ________________________________

Water Usage 2
Date:__________________________________________
Total number of students participating in the survey: ________________
Total water use: __________________________________________
Average water use per student: ________________________________

Some class suggestions for conserving water on a personal level were:
_____________________________________________________________
_____________________________________________________________
_____________________________________________________________
_____________________________________________________________
_____________________________________________________________

The School Water Meter
Total Gallons used in one day: __________________________
Date:______________________________________________
Times Measured:____________________________________

Total gallons used in a week: __________________________
Dates:______________________________________________
Times Measured:____________________________________

Formulating Questions
List the “I wonder” questions:
You can always go...Downstream

Essential Question:
What is non-point and point water pollution?

Background Information:
Water pollution occurs when a body of water is adversely affected due to the addition of large amounts of materials to the water. When it is unfit for its intended use water is considered polluted. Two types of water pollutants exist; point source and non-point source. Point sources of pollution occur when harmful substances are emitted directly into a body of water. The Exxon Valdez oil spill best illustrates point source water pollution. A non-point source delivers pollutants indirectly through environmental changes. An example of this type of water pollution is when fertilizer from a field is carried into a stream by rain, in the form of run-off which in turn affects aquatic life. The technology exists for point sources of pollution to be monitored and regulated, although political factors may complicate matters. Non-point sources are much more difficult to control. Pollution arising from non-point sources accounts for a majority of the contaminants in streams and lakes.

Getting Ready:
Prepare 10 sections of a river. Include straight sections, some with islands in the middle, some wide sections, some narrow, end of the stream, etc. Some can have trees already shown, some not. You may want to use a large piece of paper to do this so that you can cut it into ten pieces (see below Figure 1: River Sections for example)

Figure 1: River Sections

![River Sections Diagram]

Procedure:
1. Assign one section of the river per student group.
2. Hand out student directions sheet.

Location: School site

Objectives: Learners will:
1) understand how humans and land use affect water quality.

Skills: communication, observation, analysis

Supplies:
- markers, colored pencils, crayons.
- tape
- 10 sections of watershed

Subjects: language arts, science

Time: 45 minutes
3. After students have made their section, tape all 10 sections together from upstream to downstream.
4. Have students present their section.
5. Discuss the results.
6. For any extra wrap up activity you can have the students stand in a line representing their parts of the watershed. Each group should bring with them one item per pollution they contributed to the river. The items can be pens, pencils, rulers, pencil cases etc. The pollutants are passed down the river until the pollution is collected at the other end. When you look at the pollution that has collected down stream you can separate it. Some items will have obvious owners and can be traced back – this can be related to point source pollution. The other pens and pencils which look very much alike can not be traced back and these represent the non-point source pollution.

**Discussion/Assessment:**
What makes up water pollution?
What is point and non point water pollution?

---

**Student Directions Sheet**

1. Obtain a section of the watershed.
2. Visually represent how this riverfront property will be used if given one million dollars.
3. Write an essay to describe the property, the land use, and an explanation of why the property was developed the way it was. Predict how your property will affect the neighbors.
4. Read and explain the visual representation to the class.
5. Determine any water quality problems caused from the land use in the watershed.
Water Purification Department Map on the School Site

Essential Questions:
How does the Water Purification Department work on our site? Are there any threats to the Water Purification Department?

Background Information:
Water falls as rain on the school site and then flows downhill toward a stream or river. Much of the water is absorbed into the soil where it is used by plants, evaporates at the soil surface, or flows downward into the ground water supply. As water moves across the school site it might become contaminated with eroded soil or other pollutants. Some pollutants are filtered out by plants or the soil on the site. This system can become disrupted when there are too many pollutants, or there are not enough plants to act as water filters, or pavement and compacted soil prevents water from being absorbed into the soil.

A goal of the Garden Earth project is to improve the health of the ecosystem on the school site. In the case of the Water Purification Department this can be done by understanding the watershed that the school is a part of, by conserving water, and by reducing the amount of water pollution coming from your school site. In this activity students will observe water on their school site and determine where the water flows and possible water contaminants. For schools with wetlands, ponds, or streams more in-depth studies are referred to in the Garden Earth activities: Stream Study, Discovering Aquatic Insects, and Go With the Flow: Determination of Stream Flow.

See Also: Background Information for Garden Earth: Water Purification Department

Procedure:

1. Introduction: Ask the students to think about the water on the school site. Ask the following open ended questions: Where does water flow on the school site? Is there water flowing into the school site from another area? Is the rain water that falls on their site clean? Is it pure? What contaminants does the water on their site pick up? Does the water moving across the school site become cleaner or dirtier once it leaves the school site?

Explain to the students that they will be studying the Water Purification Department on their site and monitoring water health. Students will record any “I wonder” questions that they have as they are doing the activity while on the walk.

2. Hand out blank maps or basic school site maps to the students. Explain to the students that they will be observing the Water Purification Department on their site and marking important features on the map. List the features that they will mark on their map and determine symbols to use for each feature:

Location: School site
Objectives: Learners will:
1) make general observations about the Water Purification Department on the school site.
2) understand threats faced to the Water Purification Department on their school site.

Skills: communication, observation, analysis

Supplies:
- basic map of school grounds or blank maps
- pens/pencils
- clipboards

Subjects: language arts, science

Time: 20 minutes
• Land use on the school site (i.e. grassy playing field, parking lot, forested area, overgrown field, garden)
• Highest point on the school site
• Lowest point on the school site
• Direction in which water flows around the site
• Any evidence of erosion on the school site
• Bodies of water (for any bodies of water, record how deep they are and which direction they flow)
• Wetlands
• Places where puddles form when it rains
• Pipes that drain water off of the roof of the buildings
• Water spigots
• Storm sewers
• Ditches

3. Walk around the school site with the students. Stop when appropriate to mark and measure features.
4. When you return to the classroom, combine the students’ maps into one large map. Restate the organizing questions: How does the Water Purification Department affect the school site? How does the school site affect the Water Purification Department?

**Extended Activities:** Locate a topographic map that includes the area around your school site (Quadrangle maps can be purchased at hunting or outdoor shops. State Gazetteers will also work and can be purchased in most Discount Variety Stores). Outline the watershed of which your school is a part by tracing a line between the highest points around your school site. Survey the land uses within your entire watershed (urban areas, roads, agricultural lands, factories, businesses). Discuss the contaminants that enter the watershed at different points and mark these on the watershed map. Discuss actions that can be taken to improve the health of the watershed.

**Discussion/Assessment:**
Was there a general direction in which the water flowed on the school site?
What contaminants does the runoff water pick up?
What helps purify the water on the school site?
What threatens the purity of the water on the school site?
Water Purification Department

Name of group that collected data: _______________________________________

Date: _______________________________________

Water Department Map

Legend: ____________________________  Scale: ____________________________