Water Water, Everywhere

Lesson Focus: Water pollution and its sources

Learning objectives:

- Students will be able to identify point and nonpoint source pollutants and understand the cumulative effects of nonpoint source pollution
- Students will acquire the following vocabulary and use it correctly: point source pollution, non-point source pollution, evaporation, condensation, precipitation, saturation, percolation, aquifer

Enduring Understandings for the lesson:

- Water is a limited resource and is essential for life.
- Human activities can affect the quality of water.
- Understanding the watershed concept and how pollution enters our waterways are the first steps to helping reduce the negative human impact on our water environment.

Georgia Performance Standards Addressed:

ELA6-7-8RC3 The student acquires new vocabulary in each content area and uses it correctly.

a. Demonstrates an understanding of contextual vocabulary in various subjects
b. Uses content vocabulary in writing and speaking

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 Ocean, rivers, lake, underground water, and ice

S6CS10 Students will enhance reading in all curriculum areas by:

a. Reading in all curriculum areas
c. Building vocabulary knowledge
d. Establishing context

Grade level: 6th

Materials:

- LCD projector
- Computer with internet access
- Prepared Reading Selections attached
- Art Supplies
- Posterboard

Time needed: One or two periods

Background information:

A **watershed** is the land area from which water drains into a single body of water, such as a stream, river, or Ocean. The two largest watersheds in the United States are the Pacific Ocean Watershed and the Atlantic Ocean Watershed, separated by the Continental Divide amidst the Rocky Mountains. But a watershed can also be as small as the water draining into a puddle in the back yard. Small watersheds generally drain into larger ones, such as a stream progressing from its headwaters at a spring flowing from a mountainside toward a creek, then into a stream, into a river, and finally into the Ocean.

Pollution entering a water body can be classified into two categories. **Point source** pollution enters a stream (river or other body of water) from a well-defined location, such as a pipe. This source can be traced back to its origin, and the producer of the pollution can be notified so that the problem can be corrected. **Nonpoint source pollution** is much more difficult to combat because it involves any pollutant that enters the stream by way of surface runoff. The pollutant might originate anywhere in the watershed, near the stream or miles away. Nonpoint source pollutants are often substances that are not intrinsically toxic, but if collected in enough concentration they can be detrimental to the ecosystem. Fertilizers (nitrates and phosphates) and soil sediment are examples of common nonpoint source pollutants.

Sediment is comprised of soil particles that are suspended in water as a result of erosion. It is a form of nonpoint source pollution that is difficult to control. While sediment fences are not very expensive, they can be overwhelmed by heavy rains and the laws for them are not always enforced. Sediment is harmful to the stream ecosystem because:

- It makes the water opaque and blocks out the light that aquatic plants need to grow. Aquatic plants contribute oxygen for the animals to breathe. Without aquatic plant life, many water animals also have nothing to eat.
- Sediment clogs up fish gills so they cannot breathe. This would be like human beings trying to breathe in the middle of a dust storm.
- Fish eggs need to have clean, clear water flowing over them in order to grow and hatch. Sediment can smother and kill the eggs leading to lower population numbers.

The riparian zone is the area of land adjacent to a stream or river. A healthy, functioning riparian zone is characterized by a diversity of plants, including trees, understory, and herbaceous species. The presence of a wide riparian zone ensures a healthy stream ecosystem in a number of ways and is the best method known for reducing the threat of nonpoint source pollution.

- The widespread roots of the trees, warm-weather grasses and other herbaceous plants help to hold the soil in place, especially along the banks of the stream.
- Leaves and branches of the plants break the force of falling raindrops, reducing the energy of the moving water. Slower-moving water is less likely to cause erosion and carry soil particles into the stream.
- Trees in the riparian zone absorb excessive nutrients, such as nitrates and phosphates, which may have been carried with rainwater from farmers' fields or residential lawns. These nutrients become bound in the growth of the tree and are held "in storage" until such time as leaves and branches fall to the ground or into the stream. There, with the help of decomposers, the nutrients are slowly released and recycled into the system through the food chain.
- The basic needs of many wildlife species are provided in a diverse, well-vegetated riparian zone.

Learning Procedure:

1. Opening: As a class create a mind map titled "Importance of Water". In groups, have students brainstorm and jot down ideas. Then have the groups take turns adding one idea at a time to the mind map without repeating a detail. After all ideas have been exhausted instruct students to write three sentences using some of the word splash entries to predict what they think we are going to be reading and learning about. Call on volunteers to share their predictions.
2. Use KWL graphic organizer to introduce and view the video, *Water, Water Everywhere* from http://climate.nasa.gov/esw/videoseries/
3. Divide students into groups based on reading levels and assign one of the attached information articles to read. After they finish reading, each group will create a graphic representation of the group's assigned reading. Words and phrases may be used, but whole sentences should be avoided if possible. This presentation should be finalized into the form of notes. First create the graphic on a piece of notebook paper, and then transfer it to larger construction paper or create a document digitally and print it out for presentation. These notes will be used as referents or talking points as members of the group share their learning with others.
4. Students will then make three minute presentations on what they learned as if they were educating their community on the effects of different sources of pollution on local waterways. Encourage the students to role-play and present in different formats.

Evaluation:

- Concept maps from group readings
- Four Corners: Teacher posts questions, concepts, or vocabulary words in each of the corners of the room. Each student is assigned a corner. Once in the corner, the students discuss the focus of the lesson in relation to the question, concept, or words. Students may report out or move to another corner and repeat. After

students have moved, as a writing assignment they should be encouraged to reflect on changes in opinions or what they have learned.

Extensions:

- Write a short paper on: What are causes, impacts, and solutions to contaminated runoff? or How can citizens help maintain a clean watershed through everyday activities?
- Assign students the task of developing plans to reduce floatable garbage (Styrofoam cups and aluminum cans). These plans may include cleanup activities to prevent trash from entering storm drains, plans to reduce the total amount of non-recyclable items, and plans to create recycling options.

Resources:

What you can do to prevent NPS pollution - www.epa.gov/owow/nps/prevent.html
- Non-pointsource pollution prevention tips from the EPA

Surf your watershed - http://cfpub1.epa.gov/surf/locate/index.cfm
- a creative way to find and learn about your local water community

Lesson developed by: Donna M. Davis, Intervention Specialist, Metter Middle School and Mihkel Allpere, Georgia Aquarium

This activity is a product of the Rivers to Reef Teacher Workshop sponsored by the Georgia Aquarium and Gray's Reef National Marine Sanctuary that the author participated in. For more information about this workshop, Georgia Aquarium, or NOAA Gray's Reef National Marine Sanctuary, please visit our websites at www.georgiaaquarium.org or http://graysreef.noaa.gov/

GEORGIA AQUARIUM
at Pemberton Place

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Reading#1

How everyday chores can harm your streams and lakes.

It's a beautiful Saturday—a perfect day to make some extra spending money by washing cars for family and neighbors, mowing the lawn, laying down some fertilizer on those yellow patches in the yard, walking the dog, and spraying your mom's rosebushes for pesky bugs. Work hard and maybe you can make enough money to spring for movie tickets for you *and* your date. The health of your nearby stream is probably one of the last things on your mind as you tackle your tasks. But guess what! Each of your jobs could harm a nearby stream, lake, or wetland. How?

Washing Cars

Many cleaning products contain phosphates and other chemicals that can make fish and other aquatic life sick. Using a hose to wash off suds creates a stream of wastewater that can travel down your driveway, into the street, and down a storm drain. No problem? Well, what do you think is at the other end of your storm drain? Usually a stream!

Here are some things you can do to clean your car, not your carp:

- Use a bucket instead of a hose to save water and limit flow.
- Wash your car in sections and rinse it quickly using a high-pressure, pistol grip nozzle.
- Use biodegradable soaps.
- Park your car over gravel or your lawn, so wastewater doesn't flow away and soaks into the ground instead.
- Wash your car at a carwash that recycles gray water.

Do you know the difference between a storm drain and a sewer? Storm drains collect water from outside our homes and businesses and carry it, untreated, directly to streams and rivers. Sewers collect waste water from inside homes and businesses and carry it to treatment plants, where it is cleaned before it reaches streams and rivers. So remember, only rain should go into storm drains, not trash, oil, or other pollutants.

Can you identify some the activities that contribute to pollution in your watershed?

Working with Motors

Motors must be maintained if you want them to work properly. Oil, gasoline, brake fluid, degreasers, and antifreeze are a few of the products you need. All of these products contain chemicals that can harm aquatic life if they get into a stream, lake, or wetland. One gallon of used oil can ruin a million gallons of fresh water—a year's supply for 50 people. If you accidently spill these products on the ground when you're working, clean them up quickly. If you don't, the next rainstorm will pick them up and carry them to the nearest stream. Some chemicals are acutely toxic and can cause immediate harm or death to insects, fish,

and animals within 96 hours or less (for example, antifreeze, which is toxic to pets, has a sweet taste that cats and dogs love). Others are chronically toxic and cause harm over time.

Here are some things you can do to prevent hazardous substances from getting into natural waterways:

- Use the product only when necessary and use only the amount needed. When it comes to hazardous chemicals, more is not better.
- Clean up any spills immediately. (Wear protective clothing and gloves)
- Never flush chemicals down the toilet or pour them onto the ground or into a storm drain.
- Dispose of used oil and other hazardous products in a safe manner. Participate in collection programs or take products to collection centers for disposal.

Fertilizing the Lawn

Green lawns need lots of fertilizer, right? Wrong! Too much fertilizer applied at the wrong time can actually be very harmful to grass. It can cause disease, weeds, and poor root growth and make your lawn less able to withstand periods of heavy rain or dry weather.

In addition, the same rains that pick up oil, gas, and other hazardous chemicals can also pick up excess fertilizer lying around and carry it to a lake or stream. In addition to making grass grow in your yard, this fertilizer can make algae and weeds grow in the water.

Here are some things you can do to keep your lawn and streams and ponds healthy:

- Use native grasses that do not have high fertilizer requirements nor that need watering.
- Test your soil to find out exactly what nutrients your lawn needs.
- Apply fertilizer only when it is needed, during the right season, and in proper amounts.
- Do not leave fertilizer on driveways and sidewalks where it can be picked up and washed away by runoff from the next storm.
- Do not fertilize if heavy rain is predicted.

Walking the Dog

Don't be embarrassed to say it—*pet poop is potential pollution*. Pet feces, whether from poodles or pachyderms, contain a lot of bacteria that can contaminate streams, lakes, and ponds. One study found that a single gram of dog feces contains 23 million fecal coliform bacteria. In addition, pet poop contains nitrogen and phosphorus; two elements that fertilize algae and other aquatic plants and make them grow out of control. And the more poop, the more bacteria, nitrogen, and phosphorus. In a densely populated watershed in Arlington, Virginia (Four Mile Run), scientists estimate that dogs deposit more than 5,000 pounds of poop each day. The solution is to scoop up after your pet and dispose of feces properly.

Controlling Insect Pests

Pests are a pain, but getting rid of them can be a greater pain if you do it wrong. Using harsh pesticides can be harmful for people and the environment. According to the Federal Centers for Disease Control, 82 percent of Americans already have the widely used insecticide Dursban in their bodies.

A technique known as integrated pest management is usually the best approach to controlling pests and protecting waterways from pollution. Chemical insecticides should be used very sparingly, if at all. The focus is on early identification of pests and natural controls such as introducing predators to feed on the pests and planting plants that are naturally resistant to pests.

One Solution: Storm Drain Stenciling

Most people don't know that storm drains collect storm water runoff and diverts it directly to a stream without any treatment. Stenciling the top of a storm drain inlet with the name of the water body the runoff travels to helps remind people that whatever flows into the drain will end up in a stream that feeds into larger waterways and eventually into our Ocean

Reading #2

Watershed, Sediment, Water Pollution

A watershed is the land area from which water drains into a single body of water, such as a stream, river, or Ocean. The two largest watersheds in the United States are the Pacific Ocean Watershed and the Atlantic Ocean Watershed, separated by the Continental Divide amidst the Rocky Mountains. But a watershed can also be as small as the water draining into a puddle in the back yard. Small watersheds generally drain into larger ones, such as a stream progressing from its headwaters at a spring flowing from a mountainside toward a creek, then into a stream, into a river, and finally into the Ocean.

Pollution entering a water body can be classified into two categories. Point source pollution enters a stream (river or other body of water) from a well-defined location, such as a pipe. This source can be traced back to its origin, and the producer of the pollution can be notified so that the problem can be corrected. Nonpoint source pollution is much more difficult to combat because it involves any pollutant that enters the stream by way of surface runoff. The pollutant might originate anywhere in the watershed, near the stream or miles away. Nonpoint source pollutants are often substances that are not intrinsically toxic, but if collected in enough concentration they can be detrimental to the ecosystem. Fertilizers (nitrates and phosphates) and soil sediment are examples of common nonpoint source pollutants.

Sediment is comprised of soil particles that are suspended in water as a result of erosion. It is a form of nonpoint source pollution that is difficult to control. While sediment fences are not very expensive, they can be overwhelmed by heavy rains and the laws for them are not always enforced. Sediment is harmful to the stream ecosystem because:

- It makes the water opaque and blocks out the light that aquatic plants need to grow. Aquatic plants contribute oxygen for the animals to breathe. Without aquatic plant life, many water animals also have nothing to eat.
- Sediment clogs up fish gills so they cannot breathe. This would be like human beings trying to breathe in the middle of a dust storm.
- Fish eggs need to have clean, clear water flowing over them in order to grow and hatch. Sediment can smother and kill the eggs leading to lower population numbers.

The riparian zone is the area of land adjacent to a stream or river. A healthy, functioning riparian zone is characterized by a diversity of plants, including trees, understory, and herbaceous species. The presence of a wide riparian zone ensures a healthy stream ecosystem in a number of ways and is the best method known for reducing the threat of nonpoint source pollution.

- The widespread roots of the trees, warm-weather grasses and other herbaceous plants help to hold the soil in place, especially along the banks of the stream.

- Leaves and branches of the plants break the force of falling raindrops, reducing the energy of the moving water. Slower-moving water is less likely to cause erosion and carry soil particles into the stream.
- Trees in the riparian zone absorb excessive nutrients, such as nitrates and phosphates, which may have been carried with rainwater from farmers' fields or residential lawns. These nutrients become bound in the growth of the tree and are held "in storage" until such time as leaves and branches fall to the ground or into the stream. There, with the help of decomposers, the nutrients are slowly released and recycled into the system through the food chain.
- The basic needs of many wildlife species are provided in a diverse, well-vegetated riparian zone.

Reading #3

Water Pollution

Oil spills, leaking toxic waste, and industrial smokestack emissions often make headlines in the news. These kinds of environmental tragedies, where the pollution comes from a specific known source, is called point source pollution. Though these pollution events are highly visible, the truth is that the "nation's leading source of water quality degradation is nonpoint source pollution (NPS) where there is no single point of pollution" (EPA).

Nonpoint source pollution is pollution that comes from everywhere and not a specific source like a drain. Common types of NPS pollution include trash, sediment, nutrients, and contaminants such as pesticide and petroleum products and they are carried to our waterways by rainfall, snowmelt, and surface run off. As runoff travels over land, it picks up soil particles as well as natural and human made pollutants that eventually end up in rivers, lakes, and our Ocean. While some of these contaminants may be harmless when they are in the soil, they can become quite a problem when they become carriers that provide transport to a body of water.

Sediments can come from construction sites, poorly managed farmlands, logging sites and eroded stream banks. Anywhere the soil is exposed to the elements more so than is natural, water will carry soil particles away as it passes over it. Although sediments do not seem like a pollutant, they can cause damage to aquatic organisms by clogging the gills of fish, filling in the gaps in rock and gravel where micro invertebrates live and where fish lay their eggs.

These soil particles can also carry with them phosphates and nitrates. The sources of these nutrients - phosphates and nitrates are fertilizers and animal waste which promote plant growth. These nutrients can be carried from lawns and fields that have too much fertilizer sprayed on them and easily deposited into a body of water. There, they can make algae and other plants grow much faster than normal leading to lower oxygen levels that can have detrimental effects for the animals living in the water.

Did You Know That?

In the chart below, write what you already know about the importance of water in the "K" box. Write what you think you want to know in the "W" box. After we view the video segments you will write what you have learned about the importance of water in the "L" box.

What I….	
<u>K</u>now about:	
<u>W</u>ant to know about:	
<u>L</u>earned about:	