Oklahoma Ag in the Classroom

Are You Thirsty?

The effects of pollution on drinking water

Objective

Students will make inferences and draw conclusions using data and evidence collected from the activities and their life experiences related to drinking water.

Background

Americans sometimes take for granted the availability of clean, plentiful and cheap water. The percentage of the Earth's water available for our use is only a small fraction of the total. If five gallons (2,280 tablespoons) represents all the world's water, 35 tablespoons represent water available for humans and other species to use. Take away the ice caps and glaciers and a mere 8.04 tablespoons remain.

Water can be polluted by many sources. These sources are classified according to the way they enter the environment. Point source pollutants can be traced to their original source. Point source pollutants are discharged directly from pipes or spills. Raw sewage draining from a pipe directly into a stream is an example of a point-source water pollutant. Nonpoint-source pollutants cannot be traced to a specific original source. These pollutants can only be traced to a general area. Nonpoint sources of pollution include runoff from backyards, parking lots, farms, mines, construction sites, etc.

Point source pollution is easier to control because its source is easier to locate. In recent years we have done a better job controlling point source pollution through strict regulations and stiff penalties for polluters. For this reason, nonpoint source pollution has emerged as a greater threat.

Agriculture has been one source of nonpoint source pollution, through contamination by sediment, fertilizers, herbicides, insecticides, and animal waste. Conservation of water and other natural resources is important to those involved in agriculture because their livelihood depends on it. As a result, the agriculture community works continually to reduce nonpoint source pollution from agriculture through active research, new technology and farming practices, and regulations for waste management. Precision agriculture, integrated pest management, soil conservation, erosion control and organic farming are some of the methods, which decrease the need for chemicals in farming operations. Animal waste (manure) is managed as a source of nutrients for crops, and the agriculture industry is working to make the best use of this valuable resource before it becomes a pollutant.

Oklahoma Academic Standards

GRADE 6

Number & Operations: 1.3,4; 3.1,3,4; 4.4. Algebra: 3.1
Social Studies Content: 1.1,2,4; 5.5
Life Science: 2-1,4. Earth's Systems: 2-4; 3-3

GRADE 7

Number & Operations: 2.3,5. Algebra: 2.2,3
Social Studies Content: 1.1,2,4

GRADE 8

Number & Operations: 1.3. Algebra: 4.1
Earth Systems: 3-1,4

Other nonpoint source pollutants include runoff from lawns, runoff from oil, grease, and toxic chemicals from roadways, parking lots, and other surfaces, and sediment from improperly managed construction sites, other areas from which foliage has been cleared, or eroding stream banks.

Background Source: Oklahoma department of environmental Quality, http://www.ega.gov; "Pollution Prevention Fact Sheet: Landscaping and Lawn Care," Stormwater Manager's resource, Center for Watershed Protection, http://www.stormwatercenter.net/Pollution_Prevention_Factsheets/LandscapingandLawnCare.htm

Materials

plastic one-gallon container

eye dropper

small metal bucket water

clear measuring cup

food coloring (1 color)

calculators

small plastic bags, one per student

large clear container (e.g, large pickle jar)

coffee filter paper netting or cheese cloth

string or large rubber bands

Math

1. Read and discuss background and vocabulary.
2. Pass out copies of "The World's Water Supply," included with this lesson.
   —Discuss the differences in percentages of water at surface, subsurface, and other water locations.
   —Students will complete the questions at the bottom of the page.
   —Students will discuss their problem-solving methods in small groups or with partners and justify their answers.

Social Studies

1. Students will refer to Question # 3 from "The World's Water Supply" handout as they complete the "drop in the Bucket" activity included with this lesson. Students will conduct the following activity to consider how pollutants enter the water supply.
   —Fill a large transparent bowl with one gallon of tap water.
   —Place items in bags from the list at the beginning of the story "River—Our Precious Water," included with this lesson. Divide items in such a way that each student will have an item to add to the bowl, e.g., divide each substance into 2-3 separate bags.
   —Label the outside of each bag with the letter and pollution contributor, e.g., "A. natural runoff;" "B. family;" "C. farmer," etc.
   —Distribute bags to students, and instruct them to add their "pollutants" to the water when instructed to do so. (Remind students to exercise caution when mixing unlike ingredients together.)
   —Read the story.
   —Students will consider the progression of the settlement and history of the United States as they listen to the story.
   —As you read the story, one student at a time will contribute the contents of one of the bags to the bowl of water.
   —At the close of the activity, ask "Who is responsible for water pollution?" (all of us—home owners, businesses, commuters, farmers, litterers, etc.)
   —Review causes of water pollution from the background discussion (lawn and agricultural fertilizers, sediment, building construction, etc.).
   —Students will discuss ways they personally can help reduce nonpoint source pollution. (Don't litter. Leave grass clippings on the lawn to reduce the need for lawn fertilizer. Have soil tested and use no more fertilizer than necessary. Walk or bike when possible. Dispose of chemicals properly.)

Science

1. Discuss the function of water treatment plants, uncultivated fields, rocks, and sand as filters for groundwater.
—Students will predict which pollutants from the previous activity can be easily stopped by filtration and which would end up in our water supply.
—Attach one of the coffee filters to the top of the pickle jar. Leave some slack so the water has time to run through while larger objects are trapped on top.
—Slowly pour the contents of the bowl from the previous activity into the gallon jar.
—Ask students the following questions:
   - Is the liquid in the jar drinkable?
   - What could be done to make it safe for drinking?
   - If the trapped litter left in the filter were buried for 6 to 8 weeks would it decompose into the soil?
   - If it did decompose would it be toxic to the ground water?

Extra Reading

Ditchfield, Christin, *Water (True Books: Natural Resources)*, Children's, 2003.

Donald, Rhonda Lucas, *Water Pollution (True Book: Environment)*, Children's, 2002.

Gardner, Robert, *Super Science Projects About Earth's Soil and Water (Rockin' Earth Science experiments),* Enslow, 2007.

Lamadrid, Enrique R., Juan Estevan Arrellano and Amy Cordova, *Juan the Bear and the Water of Life: La Acequia de Juan del Oso*, University of New Mexico, 2008.

Toupin, Laurie, *Freshwater Habitats: Life in Freshwater Ecosystems*, Franklin Watts, 2005

Vocabulary

erosion—the wearing away by the action of water, wind, or glacial ice

fertilizer—a substance (as manure or a chemical) used to make soil produce larger or more plant life

herbicide—a chemical substance used to destroy or stop plant growth

insecticide—a chemical used to kill insects

integrated pest management—a pest control strategy that uses an array of complementary methods: natural predators and parasites, pest-resistant varieties, cultural practices, biological controls, various physical techniques, and the strategic use of pesticides

livelihood—what one has to have to meet one's needs

nonpoint source pollutant—pollutants that cannot be traced to a specific original source

nutrient—furnishing nourishment

organic farming—a form of agriculture which avoids or largely excludes the use of synthetic fertilizers and pesticides, plant growth regulators, and livestock feed additives

point source pollutant—pollutants that can be traced to their original source

pollute—to spoil (as a natural resource) with waste made by humans

raw sewage—wastewater contaminated with feces and urine

runoff—water from rain or snow that flows over the surface of the ground and finally into streams

sediment—material (as stones and sand) deposited by water, wind, or glaciers

soil conservation—management strategies for prevention of soil being eroded from the earth's surface

toxic—of, relating to, or caused by a poison or toxin

waste management—the collection, trans- port, processing, recycling or disposal of waste materials, usually ones produced by human activity

Name____

The World's Water Supply

Location	Water Volume (cubic miles*)	Percentage Total Water
Surface Water		
Freshwater lakes	30,000	.009
Salt lakes and inland seas	25,000	.008
Rivers and streams	300	.0001
Total for surface water (rounded to nearest thousandths)	55,300	.017
Subsurface Water		
Soil moisture	16,000	.005
Groundwater within depth of 1/2 mile	1,000,00	.31
Deep-lying groundwater	1,000,000	.31
Total for subsurface water	2,016,000	.625
Other Water Locations		
Ice caps and glaciers	7,000,000	2.15
Atmosphere	3,100	.001
Oceans	317,000,000	97.2
Total for other water locations	324,003,100	99.351

*a cubic mile of water equals 1.1 trillion gallons

Total (rounded)	**326,000,000**	**100.00**

1. **What is the ratio of surface water to subsurface water?**

2. **If all the ice caps and glaciers were to melt into the oceans, what would be the percentage increase in the water volume of the oceans?**

3. **If 5 gallons (2,280 tablespoons) represents all of the world's water, 35 tablespoons represent fresh water available for humans and other species to use. If you take away the ice caps and glaciers, a mere 8.04 tablespoons remain.**
   a.) What percentage of all the world's water is the fresh water total?

   b.) If ice caps and glaciers are not counted, what percentage of all the world's water does the 8.04 tablespoons represent?

4. **Rewrite all water volume values in scientific notation.**

Adapted from "Water of the World," Raymond Nace, U.S. Department of the Interior/ Geological Survey, Publication 1984-421-618/107.

Name____

The World's Water Supply (answers)

Location	Water Volume (cubic miles*)	Percentage Total Water
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Total (rounded)	**326,000,000**	**100.00**

1. **What is the ratio of surface water to subsurface water?**

   55,300 / 2,016,000 = 1 / 36.46
   (1 cubic mile of surface water per 36.46 cubic miles of subsurface water)

2. **If all the ice caps and glaciers were to melt into the oceans, what would be the percentage increase in the water volume of the oceans?**

   7,000,000 ÷ 317,000,000 x 100% = 2.20% OR (324000000 - 317000000) ÷ 317000000 = .022 = 2.20%

3. **If 5 gallons (2,280 tablespoons) represents all of the world's water, 35 tablespoons represent fresh water available for humans and other species to use. If you take away the ice caps and glaciers, a mere 8.04 tablespoons remain.**

   a.) What percentage of all the world's water is the fresh water total?

   35 ÷ 2,280 x 100 = 1.5%

   b.) **If ice caps and glaciers are not counted, what percentage of all the world's water does the 8.04 tablespoons represent?**

   8.04 ÷ 2,280 x 100 = .3%

4. **Rewrite all water volume values in scientific notation.**

A Drop in the Bucket

Materials Needed: 1 gallon container, eye dropper, small metal bucket, water

1. **Fill the gallon container so that it is nearly full.**
   This represents the Earth's total water supply (100 percent).

2. **Pour one ounce (1/8 cup) of water from the gallon container into the measuring cup.**
   This represents all the Earth's land water (.65 percent). Land water, for the purpose of this activity, is defined as the water found on and under the earth's land surface that is potentially available for use by humans. This water may or may not be drinkable. Some land water is found in saline lakes. These lakes contain such high concentrations of salts that the water is not potable.

   The water remaining in the gallon jug represents the water stored in the oceans, seas and polar ice caps (99.35 percent).

3. **Remove a dropper full of water from the land water.**
   The water in the dropper represents all good quality water found in the world's freshwater lakes, rivers and ground water.

4. **Put a drop of food coloring into the measuring cup to show that the remaining land water is not drinkable without treatment.**

5. **Release one drop from the water dropper into a small metal bucket. Students must be very quiet so that they can hear the sound of the drop hitting the bottom of the bucket.**
   This drop in the bucket is Oklahoma's share of the world's water. This one drop is precious and must be managed carefully and wisely.

Source: "Teaching Aquifer Protection," Clemson University Cooperative Extension

Oklahoma Ag in the Classroom is a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education.

River—Our Precious Water Supply

Materials Needed– ***What they represent:***

A. leaves, small twigs—*natural runoff*
B. powder detergent—*family*
C. soil, cow manure—*farmer*
D.* paper, pencils—*business
E. gravel, wood chips, insulation—*builder*
F.* candy wrappers, pop cans, pieces of foil, plastic bags, etc.—*litterer
G. motor oil/solvents—*backyard mechanic*
H. vinegar (acid rain)—*commuter*

In the beginning there was the river. Trees grew. Fish grew. One by one, the animals came to drink the water. *(Add substance A.)*

One morning a person appeared. He paddled down the river in a canoe. He knew the river was good. He returned with his family. *(Add substance B.)*

After a while, more people came. They made friends with the first people. They planted gardens on the banks of the river. *(Add substance C.)*

Many more people arrived. They wanted to live on the river too. They brought goods to trade with the others. *(Add substance D.)*

The new people cleared the land. They used the timber to build houses. *(Add substance E.)*

More and more people came. Towns began to grow. The people used the river for fishing, cooking, washing, and traveling. *(Add substance F.)*

New inventions changed life for the people. Steamboats took the place of sailing ships. Automobiles took the place of horses. Trains ran beside the waters. *(Add substance G.)*

The towns grew bigger and faster. More and more warehouses and factories were built. Businesses boomed. *(Add substance H.)*

The animals no longer came to drink. The fish disappeared. There were too many needs. But the people remembered how it had been. The people wanted a change. They tore down some of the factories and researched the needs of the water. They planted trees and discussed ways to protect the water supplies. Time passed. The river rested. The trees grew.

One day a person appeared. She paddled up the river in a canoe. She saw that the river was good. She returned with her family. Again, fish grew big. People took care of the water. There was enough for all.

Life had returned to the river. The people had learned to protect and use the water wisely.

Adapted from *River*, by Debby Atwell, Houghton Mifflin, 1999.

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