

Water Quality Module

I. Introduction: “Water” Waste

(Activity adapted from “Concerned about Conserving Water”, from Kentucky’s Wonderful Commonwealth of Water, published by KEEC and Eastern Kentucky PRIDE.)

Background:

Slightly more than 70 percent of the Earth’s surface is covered in water. Water can also be found in places less obvious, such as in the atmosphere as vapor, in the earth as soil moisture, and in aquifers (underground water sources). *Even* with all this water only about 1 percent of the world’s H₂O supply is suitable for human consumption. Of the usable water on Earth, approximately 99 percent is present in groundwater sources, while less than 1 percent is available in lakes and rivers.

Just How Much Water Is There On (and In) Earth?

- The total water supply of the world is 326 million cubic miles (a cubic mile is an imaginary cube (a square box) measuring one mile on each side).
- A cubic mile of water equals more than one trillion gallons.
- The 48 contiguous United States receives a total volume of about 4 cubic miles of precipitation per day.
- Each day, 280 cubic miles of water evaporate or transpire into the atmosphere.
- If all of the world’s water was poured on the United States, it would cover the land to a depth of 90 miles.
- 80 percent of the water we use in everyday life comes from surface water sources such as rivers, streams, lakes, and reservoirs. The other 20 percent comes from groundwater.

For more information on water quality visit the following websites:

- www.keec.ky.gov/waterunit.htm
- <http://ga.water.usgs.gov/edu/earthhowmuch.html>

Subject Area: Practical Living, Science, Math, Writing

Kentucky Connections:

- Learner Goal: #1, #2, #6
- Academic Expectations: 1.3, 1.11, 2.2, 2.3, 2.29, 2.30, 6.1, 6.3
- Core Content: AH-05-1.3.2, AH-05-3.3.1, PL-04-31.04, PL-05-3.1.04, , SC-04-2.3.1, SC-04-4.7.1, SC-05-4.7.1, SS-04-3.1.1, MA-EP-4.1.1, MA-EP-4.1.2, MA-EP-4.1.3, MA-04-4.1.1, MA-04-4.1.3, MA-04-4.1.2

Materials:

- Paper
- Pencil
- Chart paper
- Calculators
- Computer (optional)

Length of Lesson: The initial activity will require 60 minutes, homework, and a 30 minute follow-up.

Vocabulary Words:

- Conservation: The protection or wise use of a natural resource that ensures its continuing availability to future generations; the intelligent use of natural resources, such as water, for long-term benefits.
- Consumption: The amount of any product or resource (e.g., water) used in a given time by a given number of consumers.
- Water quality: The properties of water that determine how it is used.

Essential Question: Why is water conservation important?

Guiding Questions/Outcomes:

- Students will collect amount of water usage at home.
- Students analyze results from a survey to see how their family can conserve water.
- Students will create skits and posters demonstrating water conservation.

Skills Used:

- Analyzing
- Discussion
- Collecting

- Graphing
- Communication
- Observing
- Computing
- Technology

Activity:

Day 1

- Begin this activity with a discussion of water and why it is important for plants and animals. Conclude the introduction by discussing why water is important to people. Ask students what would happen to them if all the water disappeared.
- Explain that the students will be making a list of ways that they use water each day. After the list has been compiled, show the students how to arrange the list into a survey to be completed by their family. (A sample chart, “Water Used at Home”, is included.)
- Send the survey home with the students. Explain to students that the chart needs to be completed with the help of their family members and returned to school the next day. It would probably be best to make this a weekend assignment.

Day 2

- If the students have graphing programs installed on their classroom computers have them enter their data in order to visually compare the amounts of water used in their homes.
- If computers are not used, have students conduct bar graphs, line graphs, or pie graphs to illustrate the data collected.
- As a class, compare the different graphs and discuss how water can be conserved.

TMMK Connections

Water conservation is very important at TMMK. So important, in fact, that the amount of water conserved annually is enough to supply 950 households- each with a family of four- for an entire year!

How do you conserve H₂O? Here is an example from TMMK:

TMMK recycles rainwater and some of the water used in manufacturing processes. This water is filtered thoroughly and then reused to help heat and cool the facility.

This process and others like it help TMMK protect natural resources in the local community. You can do the same. It's as simple as turning the faucet off every time you brush your teeth or wash your hands. Just remember- *every* drop counts!



Assessment:

- Use a calculator to total the amount of water used by each student each week, month, and year. Then, calculate the amount that can be saved by conservation.
- Have each student conduct a survey of water usage in their homes.
- Have each student create a poster showing how much water can be saved if people conserve water when doing daily home activities.
- Create skits about water conservation and perform them for the PTO, SBDM, or other classes in your school.

Field Trip Observations

Name _____

While visiting the Toyota plant, you will learn what it means to be an environmental leader in the automotive industry. Look closely at the processes it takes to build each vehicle, and be sure to use all of your senses while touring the facility. Answer these questions following your trip. (Hint: You may need to refer to the “Toyota Connections” section to help you find some of the answers.)

1. How much water is conserved annually at TMMK?

2. What could happen if we do not conserve water and other natural resources we depend on?

3. Why is it important to protect our water supply, such as lakes, rivers, and groundwater sources?

4. Name 3 ways you can conserve water at home or school.

1. _____

2. _____

3. _____

5. Describe groundwater:

a. Where can it be obtained? _____

b. How does it get there? _____

c. What is used for? _____



II. Conclusion: “Water” Waste

(Activity adapted from, “(Hazardous) Waste Not”, from The Quest for Less, published by EPA)

Background: Gravity pulls water from the surface toward the center of the Earth, causing surface water to leak through the Earth’s underground layers. The layer of rock below our feet is called bedrock. Bedrock layers are made up of many different types of rock, some more permeable than others. The more porous the rock, the more water can be absorbed underground. For example, because limestone is prevalent in Kentucky, groundwater resources are abundant. In fact, nearly 2 million Kentuckians get their drinking water supply from groundwater sources. Limestone, which characterizes approximately half of Kentucky’s topography, is not just permeable; it is actually *absorbed* by water, creating plenty of opportunity for surface water to seep below the ground.

Groundwater can be contaminated by industrial, domestic, and agricultural resources. Many people fail to realize that washing the car, fertilizing the lawn, and using pesticides and herbicides can damage their water supply. In rural areas that have no sewage treatment facility, bacterial contaminants from failing septic tanks cause major water quality problems.

Not only can contamination cause problems for our current supply of drinking water, it can impact the quality of water that exists millions of years in the future. Because the Earth is considered a “closed system” (like a terrarium), the Law of Conservation of Matter says we cannot create or destroy water. In other words, water continuously cycles in and out of different forms. This means the water we use today is the same water that existed millions of years ago; and the water used today, thanks to the water cycle, will be the same water people use millions of years from now.

For more information of water quality visit the following websites:

- www.water.ky.gov
- www.uky.edu/WaterResources/
- www.epa.gov/safewater/dwinfo/ky.htm
- http://www.water.ky.gov/gw/GWB-GW_awareness.htm

Subject Area: Practical Living, Science, Math, Writing

Kentucky Connections:

- Learner Goals: #1, #2, #6

- Academic Expectations: 1.1, 1.16, 1.2, 2.2, 2.3, 2.29, 2.30, 6.1, 6.2, 6.3
- Core Content: PL-EP-3.1.04, PL-04-3.1.04, PL-05-3.1.04, SC-04-4.7.2, SC-04-4.7.1, SC-05-4.7.1, SS-EP-4.4.4, SS-EP-5.1.1, SS-04-4.1.1, , RD-EP-2.0.7, RD-04-2.0.7, RD-05-2.0.7, MA-EP-2.2.2, MA-04-2.2.2

Activity Description/Goals: Students will make an aquifer and demonstrate how hazardous waste could seep into ground water.

Materials:

- Clear plastic cup for each student
- “What’s Going on Underground” diagram for each student- [Click here to download](#). Click on “Waste”; the diagram is located on page 27.
- Molding clay (enough for each student to have a ½ inch by ½ inch square)
- One-quart container filled with sand
- Container of small pebbles (enough for ½ cup for each student)
- Bucket of water and ladle
- Red food coloring

Length of Lesson: 60 minutes.

Vocabulary Words:

- Aquifer: Soil or rock that is capable of yielding enough water for human use.
- Hazardous waste: Waste that is often produced in large quantities by businesses and industrial facilities that can be defined as toxic, ignitable, corrosive, or reactive.
- Byproduct: Excess material or waste produced in addition to the primary product.
- Regulation: Rule or order issued by an executive authority.
- Groundwater: Water stored in porous spaces of soil and rock underground.
- Saturated zone: Portion of the underground that contains ground water.
- Porous: Having holes or cavities through which fluids can move.
- Water table: The water level of an unconfined aquifer, below which the pore spaces are generally saturated.
- Watershed: A piece of land in which runoff drains to a body of water.
- Surface water: Water that is stored in water sources (e.g., lakes, rivers, or oceans) on Earth’s surface.

Essential Question: What could happen to groundwater if hazardous waste were not regulated?

Guiding Questions/Outcomes:

- Students will interpret a local map by identifying all waterways.
- Students will create a local source of potential hazardous waste and trace the path it would take if not regulated.
- Students will explain how above-ground activities affect groundwater.
- Students will construct an aquifer.
- Students will determine the need for government regulations for disposal of hazardous waste materials and identify the agency that provides that regulation.

Skills Used:

- Reading
- Observation
- Classification
- Motor skills

Activity:

- Discuss with the students the importance of protecting the aquifer and ground water. Point out that the quality of drinking water is affected by waste that gets into groundwater. (See Teacher Resource Sheet on Royal Spring Aquifer.) Discuss possible sources of hazardous waste.
- Have students conduct research on the 1976 Resource Conservation and Recovery Act (RCRA). What were the two main goals of RCRA? How has this act affected the students and their community?
- Place the containers of pebbles, sand, and water with the ladle on a table.
- Give each student a plastic cup and a ½ inch by ½ inch piece of molding clay.
- Ask each student to fill their cup with approximately ¼ inch of sand. Add just enough water to be absorbed by the sand. Explain to the students that the water in the sand is ground water (water stored in the ground).
- Have the students flatten their clay in the shape of the cup bottom and place it on top of the sand. Attach the clay to one side of the cup but leave the other side open.
- Fill the cup ½ full with pebbles. (Pebbles may be smoothed out or left with hills and valleys.) This layer represents the aquifer. Add a ladle full of water to the aquifer. Water below the pebbles

- represents ground water and any water above the level of the pebbles would represent surface water.
- Discuss with the students the properties (e.g., porosity) of the different layers.
 - How can both surface water and ground water be used for drinking?
 - How could the ground water be contaminated?
 - Tell the students to imagine the following scenario: A factory located near their aquifer produces hazardous waste and there are no disposal regulations. The factory dumps the hazardous materials on the ground around the plant. Ask the students these questions:
 - What happens to these materials when it rains? Will they contaminate the ground water? If so, how?
 - Will they contaminate the surface water? If so, how?
 - Will other communities downstream be affected by the hazardous waste? Why or why not?
 - Pass the food coloring to each student and have them add 2 drops to their aquifer. Explain that the food color represents hazardous waste that has been dumped. Watch what happens to the water as the food color spreads.
 - Discuss how easy it is to pollute and contaminate water. Discuss the need for government regulations about disposal of hazardous waste materials.

Assessment:

- Obtain a local map. Have the students identify all the waterways. Add a local source of potential hazardous waste and trace the path its waste would take if it were not regulated.
- Ask students to explain how activities above ground can affect ground water.
- Ask students to construct an aquifer.
- Ask students to determine the need for government regulations for disposal of hazardous waste materials.

Teacher Resources

Royal Spring Aquifer (Georgetown, Kentucky)

Royal Spring Recharge Area, located in the Inner Bluegrass of Central Kentucky, provides the domestic water supply for Georgetown and the surrounding area.

The groundwater recharge area is underlain by limestone of the Lexington Formation, and has pronounced karst features. Sinkholes are common, and solution cavities and conduits are well developed. Because porosity of the limestone can be large, filtration of water as it moves through the bedrock system to Royal Spring is limited.

Land use and cultural practices within this recharge area have a critical effect and influence on the quality of water provided by the spring. Land use in the recharge area is primarily agriculture and urban. Poor management practices associated with sinkholes also contributes to water quality of the recharge area.

Due to the sinkholes and groundwater movement through well developed fissures and cavities in the limestone, the Royal Spring watershed is extremely vulnerable to the intrusion of pollutants into the groundwater. It is impacted by both point (direct) and nonpoint (indirect) source pollution.

Water Used at Home

Name _____ Date _____

Directions: Work at home, with family members, to complete this chart based on water used during one typical day. Please return this completed chart to school tomorrow. Thank you.

ACTIVITY	Total Number of Times	Estimated Gallons of Water Used With Normal Usage	Estimated Gallons of Water Used With Conservative Usage	Total Gallons of Water Used
Brush Teeth		Water running: 2 gallons	Water turned off: ¼ gallon	
Take a Bath		Full tub: 40 gallons	Low water: 10 gallons	
Take a Shower		Standard shower head: 50 gallons	Low flow shower head: 25 gallons	
Shave		Water running: 15 gallons	Plug & fill basin: 1 gallon	
Flush toilet		Standard flow toilet: 5 gallons	Low flow toilet 1 ½ gallons	
Get a drink		Run water to cool: 1 gallon	Keep water in fridge: 1/16 gallon	
Wash hands or face		Water running: 2 gallons	Plug & fill basin: 1 gallon	
Cook a meal		Water running to wash vegetables: 3 gallons	Wash vegetables in a bowl: 1 gallon	
Wash dishes by hand		Water running: 30 gallons	Wash & rinse in sink: 5 gallons	
Run a dishwasher		Full cycle: 16 gallons	Short cycle: 7 gallons	
Do a load of laundry		Full cycle/top water level: 60 gallons	Short cycle/low water level: 27 gallons	
Watering lawn		300 gallons	Early, shorter watering: 150 gallons	
Washing car		50 gallons	Rinse less often: 25 gallons	
			Total Water Used:	