SODA SINK

SUBJECTS: Science, Social Studies, English/Language Arts, Arts and Humanities, Health, Physical Education, Consumerism

GRADES: 6-8

DURATION: One 20-30 minute period

GROUP SIZE: One classroom of 25-35 students (or less)

SETTING: Indoors or outside at a table or flat surface

KEY VOCABULARY: Sinkholes, pollution, groundwater, karst, watershed, water table

ANTICIPATORY SET: We are going to look at a karst area and a non-karst area. Does anyone know the features of a karst area? How does a karst area differ from a non-karst area?

OBJECTIVES: The students will be able to: 1) conceptualize the differences between a karst area and a non-karst area after watching the demonstration; 2) make decisions and solve problems related to a karst area and its threats of pollution.

MATERIALS: Four plastic 2-liter bottles, two pieces of ½" PVC pipe (7" long), soil, gravel, pickle relish (rinsed), red food coloring, spoon, Soda Sink Activity Sheet.

SODA SINK

BACKGROUND: Karst is a geologic term that describes special areas with unique concerns. Karst areas are noted for their abundance of relatively pure layers of limestone rock. These limestone layers are protected by a cap rock that can repel water and protect the more soluble underlying limestone layers. This cap rock must be thick enough to prevent water from reaching and dissolving all the softer limestone layers, but must be thin enough to form cracks and fissions as the earth's crust shifts and moves. In south-central Kentucky, the cap rock is 50-60 feet thick and is formed of sandstone and shale.

A watershed is an area of land that collects rainwater and melted snow. Following the properties of gravity, water that falls on a hill or plateau will drain downward to the lowest point. Water collects at the lowest point as a river, lake, or ocean. This is the water table. In the Mammoth Cave area the lowest point is the Green River Valley. The water table is at the level of the Green River.

In a non-karst area, water travels as a surface river or stream for long distances until it eventually empties into a larger river, lake, or ocean found at the water table. However, in a karst area this water more frequently disappears into the earth by flowing into depressions called sinkholes. Sinkholes are landforms that develop when underlying rock layers collapse inward, causing the upper layers to develop cracks and collapse. These cracks and newly formed holes will speed the drainage of the surrounding area. Thus, karst areas are noted for having a dramatic lack of surface water.

Falling rainwater absorbs carbon dioxide from decaying surface vegetation. The absorbed carbon dioxide produces an acidic water (carbonic acid) that can dissolve limestone. This acidic water flows across the earth's surface until it finds a crack or a sinkhole. The water then drains vertically until it reaches the water table. On its downward journey through the layers of rock, the water can begin to seep into cracks located between layers of limestone rock. As the water begins to flow horizontally it dissolves holes in the limestone. These horizontal holes are referred to as caves. The vertical holes are called vertical shafts, or domes and pits.

Water that flows underground must eventually have an outlet. In a karst area, groundwater sometimes travels many miles before exiting as a spring that then flows into a surface river or lake.

All land uses can dramatically affect an area. This is particularly true in a karst area where the abundance of sinkholes can funnel not only surface water but also all types of pollution into the groundwater. A rainstorm within a karst region can swiftly wash soils, agricultural chemicals (fertilizers, insecticides, etc.), oil and gas from roads and railways, animal waste from farms, and sewage from poorly performing sewer/septic systems into the underlying water table. On the way to its outlet, this underground water can be intercepted by residential wells where the waters are collected and consumed without any filtration or cleansing. In a karst area, rainwater is often available for re-use within a matter of hours.

In a non-karst area, the same types of pollution can also be carried by surface streams to the controlling waterways, but water that seeps underground does not have the benefit of caves and cracks to speed it along. In a non-karst area water particles must seep around the molecules making up the soil and solid rock on its way to an underground stream or aquifer. Under normal conditions, this groundwater becomes naturally filtered and emerges in a cleansed state. It takes a long time for water to travel through solid rock layers and it is not unusual for groundwater to take 300 years or more to reach the water table.

In a karst area, groundwater movement is measured in miles per hour. In a non-karst area, groundwater movement is measured in centimeters per year!

SODA SINK

PROCEDURE:

1. A few days before teaching this exercise the teacher will need to make the karst and non-karst watersheds by following directions found in this lesson. The teacher will also need to prepare the "pollution". To make the "pollution", rinse the oils off 1/8 cup of pickle relish. Add several drops of red food coloring and 1/8 cup water to the rinsed pickle relish. Refrigerate until ready to use.

2. The teacher shows the students the model karst watershed and model non-karst watershed, identifying the ground, rock, and water table. After looking at the models the teacher asks the students to predict what will happen when it rains.

3. The teacher then simulates rain by pouring an equal amount of water on the karst watershed and the non-karst watershed, (about 1/4 cup of water on each). After the "rain" is poured over each model the class discusses what happened.

4. After talking about how quickly water traveled to the water table in the karst model the teacher asks what other things may get into the groundwater. The teacher gets out the "pollution" (the colored pickle relish) and puts about 1 tablespoon of "pollution" on the "ground" of each of the two models. The teacher asks the students to predict what will happen during the next rainstorm. The teacher may also ask questions like, "Will the karst watershed or the non-karst watershed become more polluted?"

5. The teacher makes it rain again. The students observe what happens. The class discusses what happened after the second rain.

6. The students now break up into small groups with their activity sheets. After they have answered their questions, the class gathers together to discuss their answers.

CLOSURE: We have seen how easy it is for water or pollution to get into the groundwater in a karst area. We might think about things we can do to help protect groundwater, since it is the water all of us use every day.

EVALUATION: The teacher is able to evaluate the students during the class discussions and from information written on their activity sheets.

EXTENSIONS:

1. Find newspaper articles that address water pollution in your area. How is the water becoming polluted and what can be done to correct the problem?

2. Plan a class trip to a sinkhole. View it and clean up any pollution you might find in the sink.

3. Discuss sinkholes in your area. Are they polluted? What would be an "action plan" to protect your groundwater?

Note: The plans to create the karst watershed and non-karst watershed were taken from Waste: a Hidden Resource in Kentucky *written for the Kentucky Department of Environmental Protection, 1992.*

SODA SINK

ACTIVITY SHEET

Name:_____
Date:_____

1. Draw and label the major features of a karst watershed.

2. Draw and label the major features of a non-karst watershed.

3. What are the differences between a karst and non-karst watershed?

4. List at least four sources of groundwater pollution.

(1.) _____

(2.) _____

(3.) _____

(4.) _____

5. For each type of pollution listed in question four, give a way to either clean up the groundwater or prevent it from becoming polluted.

(1.) _____

(2.)_____

(3.)_____

(4.)_____

SODA SINK

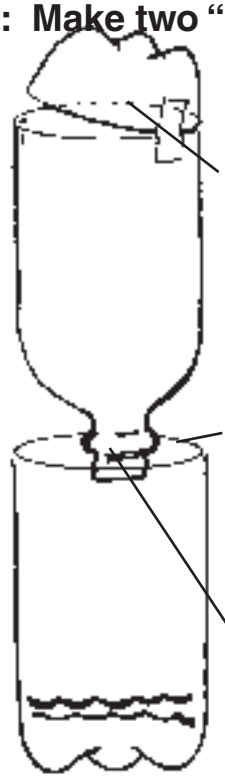
ASSEMBLY INSTRUCTIONS

For "Soda Sink" you will need to construct two simulated environments as demonstration columns.

Materials:

- 4 plastic 2-liter bottles, empty, caps removed
- Two ½" PVC pipes (7 inches long)
- Sod
- Soil
- Gravel

Step 1: Make two "columns."



For each column, cut one bottle 2½ inches from the bottom and reattach the bottom with a hinge made of tape.

For each column, cut off the top of one bottle 3 inches down. Pour 2 inches of water into bottle two.

Bottle 1 will be inserted into Bottle 2 as shown.

Step 2: Prepare Karst Watershed

Insert 7-inch PVC pipe into the neck of Bottle 1.

Pack stones around the pipe, higher at the edges and lower in the center.

Lay sod on top, as shown. Make a hole in the sod to expose the top of the PVC pipe.

Insert Bottle 1 into Bottle 2 as illustrated.

Step 3: Prepare Non-Karst Watershed

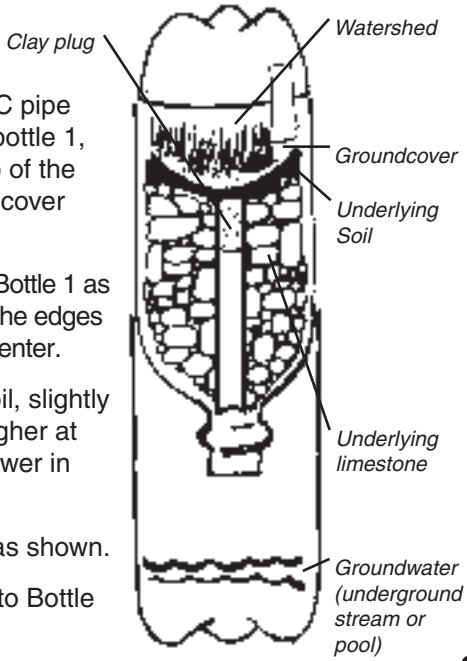
Insert 7-inch PVC pipe into the neck of bottle 1, then plug the top of the pipe with clay or cover with a flat stone.

Pack stones into Bottle 1 as shown, higher at the edges and lower in the center.

Add a layer of soil, slightly packed down, higher at the edges and lower in the center.

Lay sod on top, as shown.

Insert Bottle 1 into Bottle 2 as illustrated.



CORE CONTENT

AH-M-4.1.41 Create art for specific purposes using the elements of art and principles of design to communicate ideas. [PE] (1.13, 2.22)

PL-M-1.8.4 Using appropriate coping strategies (e.g., realistic goal-setting, effective time management, decision-making processes) promotes mental and emotional health.

PL-M-1.1.1 Individuals have personal rights and responsibilities (e.g., cooperation, communication, patience) when dealing with others (e.g., families, classmates, teams).

PL-M-2.3.2 Rules of behavior and fair play (e.g., accepting authoritative decisions, assessing one's own performance level, accepting skills and abilities of others through verbal and nonverbal actions for spectators and/or participants) during games are necessary.

PL-M-3.3.2 Improving environmental conditions (e.g., air and water quality) and preserving natural resources impact personal and community health.

PL-M-3.1.5 Environmental issues (e.g., pollution) should be considered when making consumer decisions (e.g., recycling, reducing, reusing).

SC-M-2.1.5 Water, which covers the majority of the Earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle. Water dissolves minerals and gases and may carry them to the oceans.

SS-M-4.4.4 Individual perspectives impact the use of natural resources (e.g., watering lawns, planting gardens, recycling paper).

SS-M-4.4.2 The physical environment both promotes and limits human activities (e.g., exploration, migration, trade).

WR-M-1.4 Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following:

- letters
- speeches
- editorials
- articles in magazines, academic journals, newspapers
- proposals
- brochures
- other kinds of practical/workplace writing.

Characteristics of transactive writing may include :

- text and language features of the selected form
- information to engage/orient the reader to clarify and justify purposes
- ideas which communicate the specific purpose for the intended audience
- explanation and support to help the reader understand the author's purpose
- well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish a specific purpose
- effective conclusions.