



*Kentucky Agriculture &
Environment in the Classroom, Inc.*

LESSON

Let's Make Clean Water!

Middle School Science

Students will:

- Identify the various parts of the water cycle.
- Identify and explain how groundwater is created.
- Design and construct an earth system model that will create groundwater.

Kentucky Academic Standards - NGGS

Earth's Systems

MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

Engineering and Design

Materials

- Nail
- Clear Plastic Cups or 2 liter bottles
- Sand
- Water
- Small Pebbles
- Gravel
- Contaminated Water
- Vocabulary Sheet & Water Cycle Diagram
- "Design a Water Filtration Model" Worksheet

NOTE: To make the contaminated water, add dirt, grass, sticks, etc. to clean water. Stir frequently while pouring into water filtration systems.

Background

Looking at satellite photographs of the planet Earth can illustrate the fact that the majority of the Earth's surface is covered with water.

Earth is known as the "Blue Planet." Seventy-one percent of the Earth's surface is covered with water. There also is water beneath the surface of the Earth.

Yet, with all the water present on Earth, water is still a finite source, cycling from one form to another.

This cycle, known as the hydrologic cycle, is an important concept to help understand the water found on Earth.

In addition to understanding the hydrologic cycle, you must understand the different places that water can be found—primarily above the ground (as surface water) and below the ground (as groundwater). Today, we will be starting to understand water below the ground.

Interest Approach

Ask the students to wad up a piece of construction paper. Then flatten out the piece of paper. Explain to the students that this represents the land. The high points are like hills/mountains/peaks and the low points are like valleys. Think about a rainfall. Ask the students where the rain will go. Where would rivers be located? Where would lakes be located? Does all the water stay on the surface of the earth?

Procedure

Explain that this paper represents a watershed. A watershed is the area of land where all of the water that falls in it and drains off of it goes into the same place. A watershed includes all plants, animals, and people that live in that area, as well as non-living components such as soil and rocks.

Water that is part of a watershed either becomes surface water or groundwater. Surface water is water on the surface of the land in places like rivers, lakes, oceans, creeks, etc.

Groundwater is water that collects or flows beneath the Earth's surface, filling the porous spaces in soil, sediment, and rocks. Groundwater originates from rain and from melting snow and ice and is the source of water for aquifers, springs, and wells.

Surface water and groundwater are important parts of the hydrological cycle. This cycle is more commonly known as the water cycle. The water cycle is the cycle of processes by which water circulates between the Earth's oceans, atmosphere, and land, involving precipitation such as rain and snow, drainage in streams and rivers, and return to the atmosphere by evaporation and transpiration.

Both surface water and groundwater can be contaminated by animal waste, human waste, eroding soil, and other types of contaminants. These types of contaminants can be visible in surface water. Although groundwater can be contaminated, it is generally more clear than surface water. This is evident by looking at water from a natural spring. Why? How does the earth act as a natural water purifier? What components within the earth act as a filter for water?

Spring water results from filtration through hundreds of feet of sediment, sand, and gravel — a thorough and extremely slow process. Experts estimate that water moves through most natural sediment filters at a rate of less than 0.1 gallon (0.4 liter) per minute for every square foot of area. As it moves through these layers, solids suspended in the water are trapped in the sediments. Disease-causing microorganisms, such as bacteria, are also trapped, and either die naturally or become food for microorganisms that live in the sediment. In the end, the water that bubbles out of artesian springs or is pumped from aquifers several hundred feet below the surface is on average more than 99.9 percent free of contaminants.

Spring water is extremely clean, but sometimes difficult to find or must be pumped up from an aquifer (well). Surface water is readily available, but often contains contaminants. Using three materials (sand,

small pebbles, and larger gravel) design a water filtration model that functions like the natural layers within the earth to filter surface water. Use the attached page to design the filtration system.

After the design is complete, gather all the needed materials to build the water filtration system. Using a nail, poke 3-4 holes in the bottom of the plastic cup. Begin layering the materials into the cup. Have another empty cup to collect the filtered water.

Next, pour the “contaminated surface water” (that has been prepared by the teacher) into the top of the cup. Hold the water filter over the extra cup. Make observations about the filtered water.

Allow students to build a second filtration system to improve on their design and filter the water even more.

Discussion Questions Following Activity:

1. Which material worked best as a filter? Which one worked the least?
2. Which design was most effective to filter water?
3. How could this concept apply to reality?
4. When would be a situation that would require someone to build a water filtration system?

Created by Rachel Wilson, Farm Scholar, LLC for Kentucky Agriculture and Environment in the Classroom. Adapted from:

National Ground Water Association Lesson -

<http://www.ngwa.org/Fundamentals/teachers/Pages/Ground-Water-Introduction-and-Demonstration.aspx>

Wad a Watershed Lesson (Minnesota Ag in the Classroom)

<http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=67>

Water Cycle Vocabulary

Hydrological cycle - the cycle of processes by which water circulates between the earth's oceans, atmosphere, and land, involving precipitation as rain and snow, drainage in streams and rivers, and return to the atmosphere by evaporation and transpiration.

Surface water - is water on the surface of the land in places like rivers, lakes, oceans, creeks, etc.

Groundwater - water that collects or flows beneath the Earth's surface, filling the porous spaces in soil, sediment, and rocks

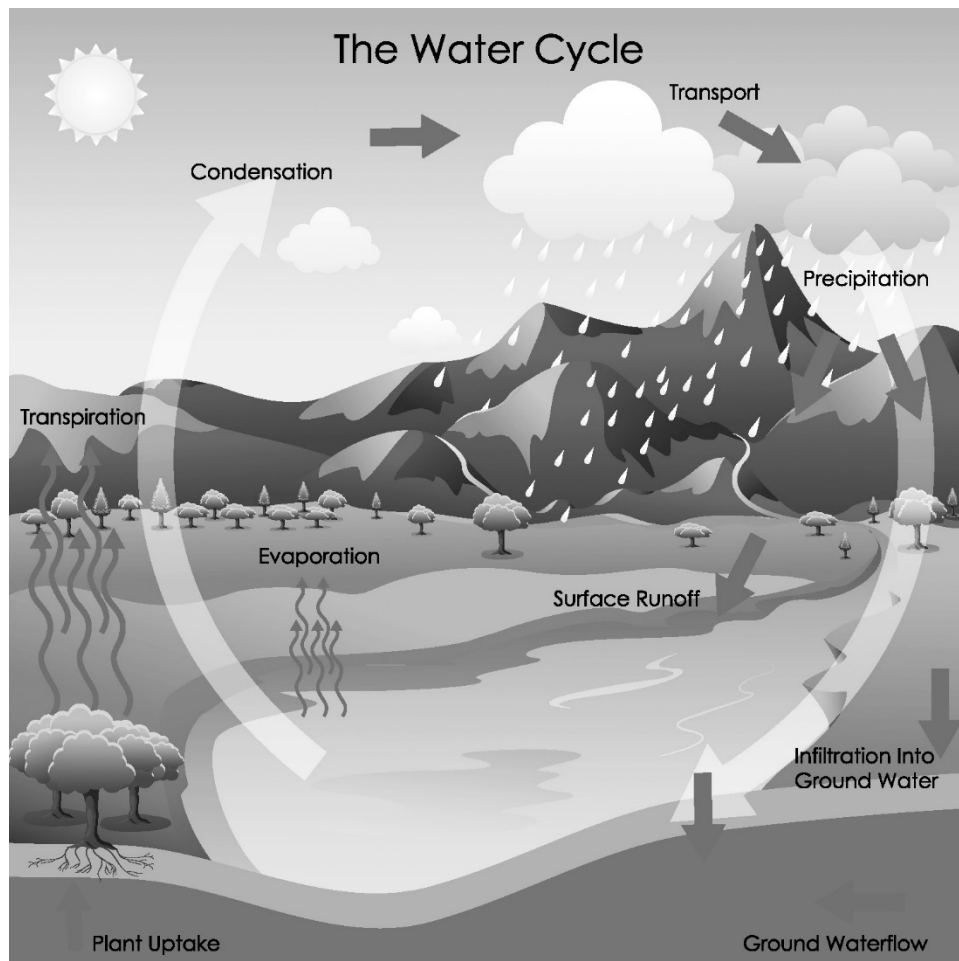
Watershed - area of land where all the water that falls in and drains off goes into the same place

Transpiration - Water released directly into the air from the leaves of trees and plants

Evaporation - When the sun heats up surface water and changes it to water vapor and this water vapor enters the atmosphere

Condensation - Water vapor in the air is cooled, changes back into liquid, and forms clouds

Precipitation - When so much water has condensed and the clouds can no longer hold it, it falls to the earth as rain, sleet, or snow

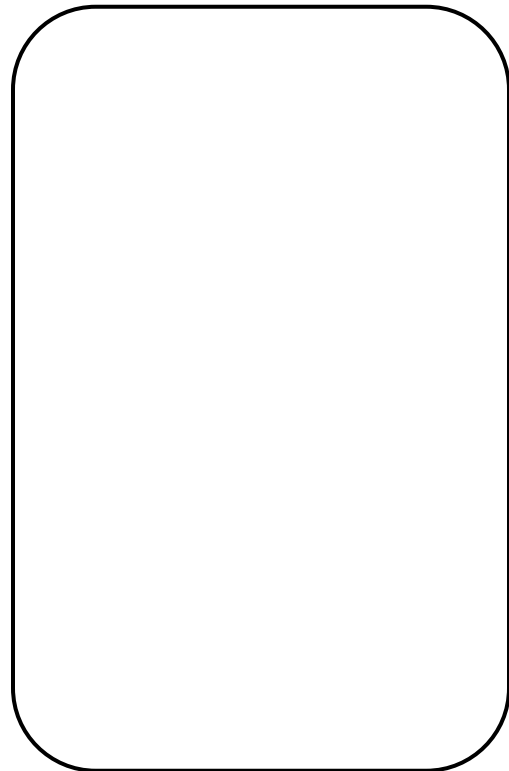
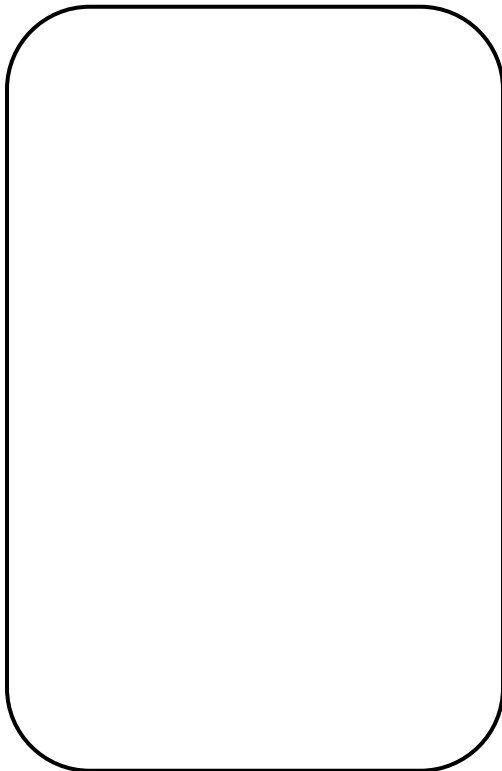


Design a Water Filtration Model

For surface water to become usable water, it must go through a filtration system. Water can be pumped out of a source and treated at a water treatment plant or it can be naturally treated through percolation of surface water and/or run-off to groundwater.

Procedure:

Using the four supplies, build a water filtration system: plastic container, sand, pebbles, and rocks. Find the best arrangement of the three filters in the bottle that will clean water the best. You are NOT required to use all the filters or to FILL up the entire container. Use the space below to design a water filtration model. After testing the first model, use the second space to make modifications.



Questions

1. Why did you choose the filters you used?
2. Why did you arrange the filters in that order?
3. Describe the modifications you made and why.