GROUNDWATER:

Protecting the Water We Can't See

Grade Level: Elementary, middle school

Duration: 20-30 minutes with activity

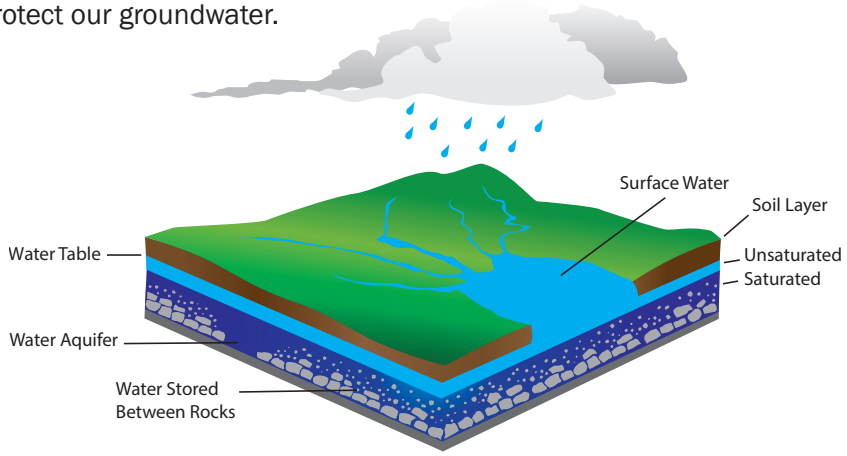
Objective: Build a model aquifer, learn how groundwater is stored, and observe how contaminants above the ground can potentially end up in the water below the ground. It's easier to understand groundwater if we can "see" it.

Key terms: Aquifer, confining layer, recharge, contaminants

Next Generation Science Standards: 5-ESS2-1 Earth's Systems, MS-ESS2-4 Earth's Systems

The Weldon Spring Site actively monitors over 100 groundwater monitoring wells and nearby springs near areas that were contaminated from former production plants associated with World War II and Cold War Era production.

Introduction: Most of the water we see each day is in ponds, rivers, oceans, streams, puddles, and other places on top of the ground. What we don't really see is the water that soaks into the ground. The water that is underground is called groundwater. Groundwater doesn't flow like an underground river. Instead, groundwater moves slowly through layers of soil, sand, and rocks called **aquifers**. Water gets into an aquifer from the land surface. Typically, precipitation (rain or snow) falling onto the Earth's surface soaks into the ground and then into an aquifer. Many people pump water directly from the ground and use it for their drinking water. Unfortunately, groundwater can become **contaminated** by harmful chemicals, such as lawn care products and household cleaners. The use and disposal of contaminants above the ground can potentially end up in the environment (possibly even in drinking water), affecting natural communities. This activity will show how what we do above ground can affect the water underground and prompt students to think about ways they can protect our groundwater.



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Activity: Aquifer in a Cup

Items Needed:

- Clear plastic cup
- Sand (enough to fill 1/3 of the plastic cup)
- Pebbles or small rocks (approximately a handful)
- Clay (1 small piece of modeling clay or play dough)
- Water
- Liquid food coloring (red/blue/green)

1. Fill the clear cup 1/3 full of sand.

2. Add water, filling the cup until the sand is saturated. (There should be no standing water on top of the sand.) Where did the water go? It became groundwater. Groundwater is found underground in **aquifers**: the cracks and spaces between sand and soil.

3. Flatten the piece of clay (like a pancake) and place on top of 1/2 of the sand. Gently press one side of the clay to the side of the cup, sealing off that side. This clay represents a **confining layer.** A confining layer is a layer of material (clay or dense rock, for example) over an aquifer that prevents water or contaminants from passing through.

4. Pour a small amount of water over the clay. What do you think will happen? Did the water sit on top of the clay? Now, tilt the cup gently to the side. Do you expect the water will soak into the sand below? The water represents rain from a storm cloud and the groundwater has now been **recharged**. This is what happens when it rains or snows and surface water sinks into the ground.

5. Place a handful of small pebbles or rocks on top of the saturated sand and clay, completely covering the entire mixture. Push most of the rocks to one side of the cup to create a mountain and valley. Pour more water into your cup until the water begins to resemble a lake filling the valley. The lake is surface water.

6. Squeeze a few drops of food coloring on to the very top of the rock mountain as close to the inside wall of the cup as possible. The food coloring represents **contaminants** that were introduced through human activity. What are some types of contaminants that could be introduced to the environment? (Examples: oil spills, fertilizer from farming, trash, road salt, etc.) What do you see happening? What do you expect will happen when the contamination reaches the confining layer?

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7. Watch to see how the contaminants eventually spread and seep into the lake and then eventually into the sand that represents the ground. Did the contaminants that were introduced at the surface contaminate the groundwater? How will that affect the water in the water cycle? Pour, sprinkle, or use a spray bottle to add more water to the cup. This water represents rain continuing to recharge the environment. Does the contamination spread faster or slower?

8. If time allows, encourage the students to find a safe place for their aquifer in a cup and observe it over time to see if the contaminants completely fill the environment.

FURTHER INVESTIGATION:

1. Decreased groundwater flow to surface waters can affect aquatic ecosystems (plants, animals, and other organisms) that rely on a continuous supply of groundwater to keep aquatic habitats healthy and streams flowing. What do you think could cause changes in groundwater levels? Would changes in groundwater levels also affect water quality?

2. Some human activities can have harmful impacts on the groundwater. Do you think oil leaking from a car on to the street could end up in our water supply? Can you think of other human activities that could contaminate groundwater?

3. There are many ways we can all do our part to keep our water clean. Recycling or disposing of all trash properly is a good example of preventing contamination from reaching our waterways. What other ways can you help to keep our groundwater clean?

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Activity: Edible Aquifer

(Make substitutions as needed. Some examples provided.)

Items needed:

- Clear plastic cup
- Ice cream scoop
- Spoon
- Drinking straw
- Blue/red/green food coloring (alternatives: Kool-Aid, maraschino cherry juice, dark soda pop)
- Vanilla ice cream (or any flavor)
- Clear soda pop
- Variety of small gummy bears, chocolate chips, crushed cookies, chopped fruit, crushed ice, or marshmallows
- Variety of colored cake decoration sprinkles and sugars, graham cracker crumbs, or crushed cookies

1. Begin constructing the edible **aquifer** by filling a clear plastic cup 1/3 full of a variety of small gummy bears, chocolate chips, crushed cookies, chopped fruit, crushed ice, or marshmallows (represents sand and rock in the aquifer).

2. Add enough clear soda pop to just cover the candy/fruit/ice. The clear soda pop represents groundwater. Observe how the "water" fills in the spaces around the "sand and rock."

3. Spread a layer of ice cream to serve as a **confining layer** over the water-filled aquifer. A confining layer is a layer of material (clay or dense rock) over an aquifer that prevents water or contaminants from passing through. The water is confined below this layer.

4. Next add more "sand and rock" (variety of small gummy bears, chocolate chips, crushed cookies, chopped fruit, crushed ice, or marshmallows) on top of the confining layer.

5. A variety of colored sugars and sprinkles, graham cracker crumbs, or crushed cookies represents soils and can be sprinkled over the top to create a top layer.

6. Add the food coloring (or alternative) to the clear soda pop. The food coloring represents **contaminants** that were introduced through human activity. What are some examples of contaminants that could be introduced to the environment? (Examples: oil spills, fertilizer from farming, trash, road salt, etc.)

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7. What do you see happening? What do you expect will happen when the contamination reaches the confining layer? Did it sit on top or travel around it to the “sand and rock” below? The same thing happens when contaminants are spilled on the Earth’s surface.

8. Using a drinking straw, drill a well into the center of the aquifer.

9. What do you expect will happen when you pump the well by sucking on the straw? Does the contamination begin to move?

10. Notice how the contaminants can get sucked into the well area and end up in the groundwater by leaking through the confining layer.

11. Now add more clear soda pop . Pretend the soda is rain from a storm cloud. The groundwater supply has now been **recharged**. Does the contamination spread faster or slower? That is what happens when it rains or snows and water sinks into the ground.

12. Think about ways you can help keep our groundwater clean while you enjoy eating your edible aquifer!

FURTHER INVESTIGATION:

1. Some human activities can have harmful impacts on the groundwater. Do you think chemicals sprayed on a lawn could end up in our water supply? Can you think of other human activities that could contaminate groundwater?

2. There are many ways we can all do our part to keep our water clean. Picking up after your dog in the park is a good example of preventing contamination from reaching our waterways. What other ways can you help to keep our groundwater clean?