WATER BENEATH MY FEET

Overview

Students will become familiar with unconfined and confined aquifers and identify different aquifers in Kansas. In addition, students will also construct a model landfill.

Suggested Grade Level:
3rd-5th

Time:
1 hour and 45 minutes
+ 10 minutes per day for 10 days

Subjects:
Language Arts
Science
Social Studies

Objectives

1. Students will explain the difference between an unconfined aquifer and a confined aquifer.
2. Students will develop a map that shows a Kansas aquifer and list the major characteristics of this aquifer.
3. Students will construct a model landfill and study the model to determine the effects it has on the water supply.

Background Information

Many of Kansas' water resources are underground, so they can't be seen by people. These naturally-stored underground water resources are known as aquifers. There are two major types of aquifers beneath most of the land in the United States; unconfined aquifers and confined aquifers.

An aquifer is a body of saturated rock through which water can easily move. Visualize them as a sponge made up of sandstone, broken limestone, sand and gravel. Groundwater has to squeeze through the pore spaces of rock and their particles in order to move through the aquifer. The particles act as a filter trapping sediment and bacteria. Groundwater moves faster through aquifers with larger pores.

An unconfined aquifer is an aquifer that does not have rock layers over the top of it that trap or confine water under pressure. Unconfined aquifers are usually covered by sand, gravel or sediment and they are the most common type of aquifer in the United States. Water found in unconfined aquifers is often considered very young in geological time because it may have arrived recently by percolating through the sand and aquifer layers. Water in an unconfined aquifer is free to flow and establishes an equilibrium level affected by gravity and atmospheric pressure.

A confined aquifer exists where groundwater is trapped beneath layers of impermeable materials. When an opening is created in the aquifer, pressure causes the water to rise above the top of the aquifer.

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Background Information Continued

There are hundreds of aquifers in Kansas, depending on how the specific aquifers are identified and described. Aquifers in which wells can produce a few gallons of water per minute (gpm) may be adequate for domestic or livestock water supplies, but they would be inadequate for irrigation or municipal supply use where well yields of thousands of gallons per minute may be required. In addition, aquifers that discharge water over long periods of time may see the water table fall so that some wells stop producing water for a short period of time.

There are three types of Kansas aquifers: alluvial, bedrock and glacial drift. Alluvial aquifers are the largest and most productive aquifers in Kansas. They were formed during recent geological time, and they are found in clay, silt, sand or gravel deposited by running water in the bed of a stream or on its floodplain.

The High Plains aquifer is a major regional aquifer, which can be broken down into separate aquifer units. Alluvial aquifers included in the Kansas portion of the High Plains aquifer include the Ogallala aquifer, Great Bend Prairie aquifer and the Equus Beds aquifer. The High Plains aquifer is a major regional hydrologic unit that underlies parts of eight states, including Kansas, and it can be broken down into different geologic aquifer units formed at different times in various locations. This aquifer is a main source of groundwater.

Bedrock aquifers are aquifers that contain water trapped in layers of solid rock, and most serve as local sources of water. The water quality of bedrock aquifers may vary. In Kansas the Flint Hills aquifer, Osage aquifer and Ozark aquifer are bedrock aquifers.

Glacial drift aquifers are found in glacial debris that trap and hold water or in ancient river valleys buried by debris left behind when the continental glaciers melted and receded from northeastern Kansas. Glacial drift aquifers do not cover large areas.

A landfill is a place where wastes, such as trash and garbage, are dumped and covered with a layer of soil each day. The soil layer keeps pests like insects and small animals away and it prevents pollutants from washing off the site when it rains or when snow melts. Open dumps are locations where people place trash in places like ravines or roadside ditches rather than properly disposing of the trash in a landfill. Although landfills are more regulated and more organized than open dumps, both can cause pollution problems.

Since water is able to percolate through the sand, sediment or gravel layers, unconfined aquifers are susceptible to harmful pollutants that may result from landfills or open dumps. Therefore, Kansans must take the necessary steps to prevent contaminants from moving into our aquifers.

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Vocabulary

Alluvial Aquifer: An aquifer that was formed in recent geologic time by sediment that is loosely arranged but not cemented together and has a water table that is fairly close to the surface of the land.

Aquifer: A natural underground storage area for water.

Bedrock Aquifer: Water trapped underground in layers of solid rock; often used as local sources of water.

Confined Aquifer: Groundwater that is trapped beneath layers of impermeable materials; may be under pressure. It can recover water slowly from an underground river, lake, or confined aquifer.

Glacial Drift Aquifer: An aquifer found in glacial debris that traps and holds water or in an ancient river valley buried by debris left behind when the continental glaciers melted and receded.

High Plains Aquifer: A major regional hydrologic unit that underlies parts of eight states, including Kansas.

Hydrologic Unit Code: A number that identifies drainage basins within a watershed based on a classification system for dividing hydrologic regions.

Impermeable: Not allowing liquid to pass.

Landfill: A place where wastes, such as trash and garbage, are dumped and covered with a layer of soil each day.

Open Dumps: Locations where people illegally deposit trash.

Sediment: Solid organic or mineral particles such as sand, clay or silt that are deposited in a new location by wind, water or ice.

Unconfined Aquifer: An aquifer that does not have rock layers over the top of it that trap or confine the water under pressure; covered by sand, gravel or sediment. These aquifers can receive water from the earth's surface.

Water Table: The top elevation of water stored in an aquifer.

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Activity 1

Materials

- Flags or cones for start and finish lines
- Timer
- Paper
- Pen
- Sticky notes

Procedures

1. Organize students into groups of threes.
2. Assign group one to be gravel particles, group two to be sand particles and group three to be clay particles.
3. Instruct students to race for the fastest time as a group. Students representing gravel to sprint, the students who are sand to skip and the students who are clay to hop with their two feet together.
4. The clay group (hopping) should go first and the teacher will time them as a group, to see how fast or slow water moves through clay.
5. The sand group (skipping) will then go second and the teacher will record their time as a group.
6. The gravel group (sprinting) will go last and the teacher will time them as a group also.
7. Next have one person from each group form a new group called “Water.” Each of these students will represent a water drop.
8. Have the gravel group sit criss-cross applesauce on the ground an arm’s width apart with their backs facing the “water” group. Have the sand group sit in front of gravel, elbow width apart three feet behind the gravel group and with their backs facing “water”. Have clay group sit together with their knees touching three feet behind the sand group and with their backs facing the “water”.
9. Water drops will write on colored sticky notes pollutants such as, bacteria, sediment, pesticides and phosphorous. Line up water drops.
10. On the word go, “water” tries to move through the aquifer, starting at gravel. Each of them will need to leave one sticky note on gravel, two sticky notes on sand and three sticky notes on clay. Sticky notes should be placed on the students’ backs.
11. Have students answer the following discussion questions below to prepare them for the next activity.

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Conclusion Questions

1. Which group had the fastest time? And the slowest?
Gravel. Clay.

2. Why would water flow through gravel faster than sand or clay?
Gravel is bigger in size therefore there is more space between gravel pieces.

3. In an aquifer, what do you think is at the bottom (closest to the water)?
Gravel because it is heaviest and the last material the water passes through. Sand would be in the middle and clay would be at the top. Water travels though clay very slowly, sand faster and gravel fastest due to particle size and pore space.

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Activity 2

Materials

- Clear plastic container
- Blue colored water
- Clear plastic cup
- Pebbles
- Soil
- Grass clippings

Procedures

1. Gather the materials in the front of the classroom so all students can see.
2. Pour pebbles into the plastic container. Slope the pebbles to make a hill at one end of the container.
3. Layer soil over the pebbles and pat it down to keep from eroding.
4. Place grass clippings at the top of the hill only.
5. Place the cup over the hill and begin pouring water into the cup to demonstrate rainfall.
6. Have the students describe what they see (where the water is and where it is going.)
7. Using the included worksheet “Kansas Aquifer Showcase”, have the students identify the closest aquifer to the school.
8. Once found, have the students color it on the map and answer the remaining questions found on the worksheet.

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Activity 3

Materials

- 2-liter bottles without labels
- Nylon stocking knee-highs
- Cotton, paper towels or Coffee filter
- Soil
- Baby diaper bits
- Food bits or packing peanuts
- Vegetable oil
- Warm water

Procedures

1. Using the pictures provided, make two model landfills- one that leaks and one that doesn't so the two can be compared. (Use the bottle cap to keep the one from leaking and a nylon stocking to allow for the other to leak).
2. Each group will be able to decide how much of each product (diapers,food oil, etc.) they want to place into their landfills and what order they will be placed in. These materials will hopefully be breaking down over time just like in a real landfill.
3. Pour two cups of water over each landfill to simulate rainfall; cap each landfill with the top half of the original bottles.
4. Have the students keep a log and describe what happens each day.

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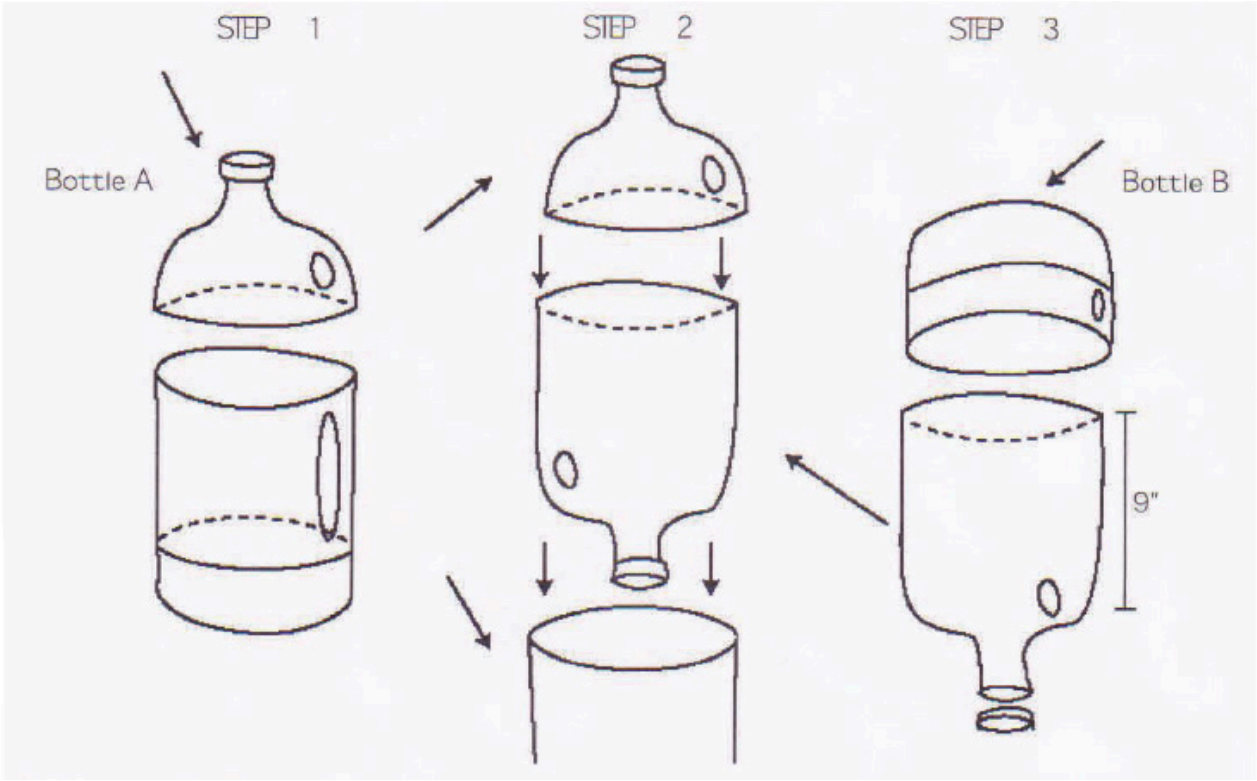

You're going to construct two landfills - one that leaks and one that's sealed so you can compare how each works. You'll need to repeat Steps 1 and 2 to end up with both landfills.

Step 1: Cut two 2-liter bottles in half as shown in the diagram. Cut Bottle B 9 inches from the cap for safety, make an incision with the utility knife and then cut around the bottles with scissors (for younger children the 2-liter bottles will need to be precut.) If anu of the edges are jagged, trim them with scissors: the base of Bottle A will be the base of landfill.

Step 2: Cover the top and neck of Bottle B with a piece of cheesecloth or nylon stocking and secure it with a rubber band.

Step 3: Turn the top portion of Bottle B upside down and place it on top of the base.

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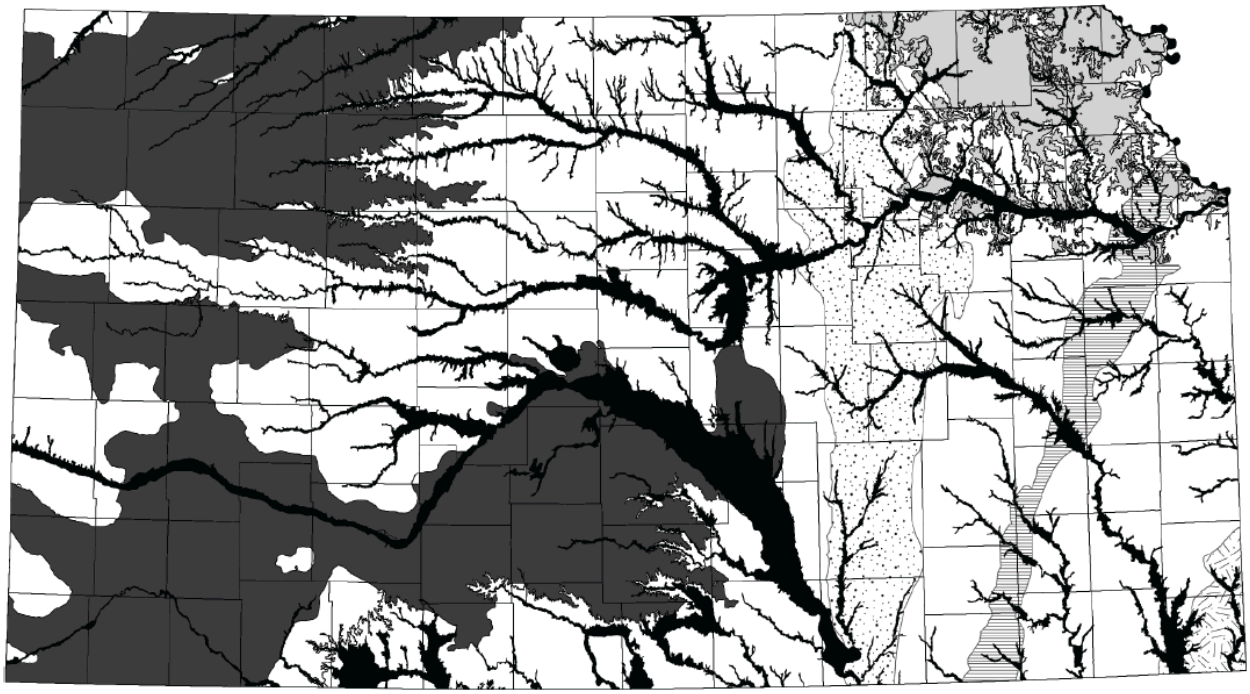
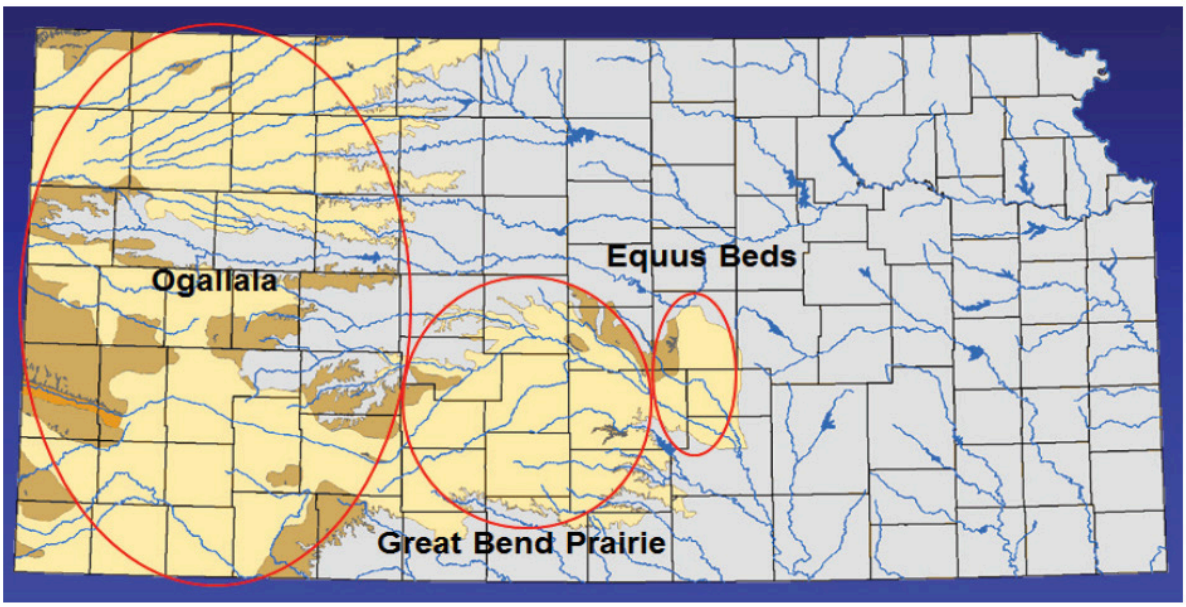
Kansas Aquifers - Student Handout





In Kansas, we consider the High Plains Aquifer to be made up of 3 sub-aquifers known as the Ogallala, Equus Beds and the Great Bend Prairie. They are all hydrologically connected which makes it hard to separate.

Map source: KGA

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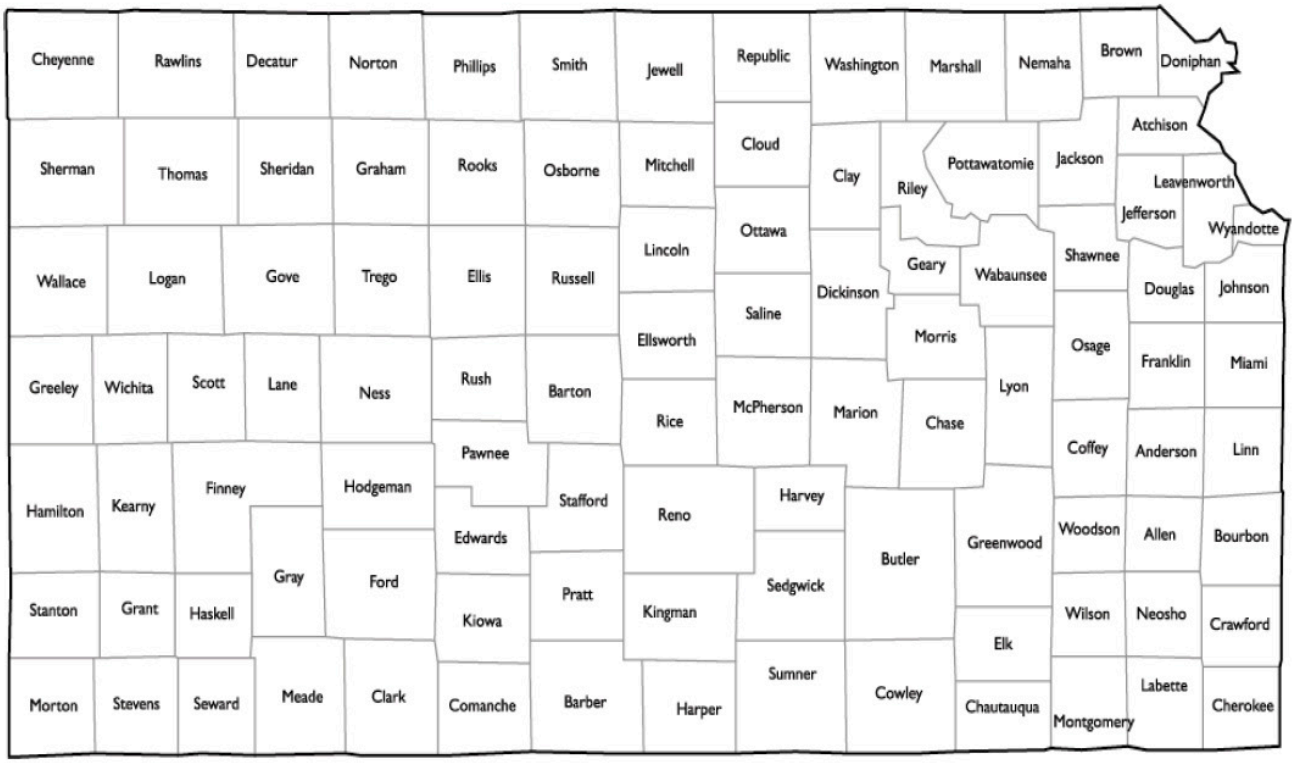
Kansas Aquifers - Student Handout

Find an aquifer near your school and color it on the map.



1. What aquifer did you color in?

2. List all of the countries within your aquifer.

3. Describe an alluvial aquifer.

4. Describe a bedrock aquifer.

5. Describe a glacial drift aquifer.

6. Describe a High Plains aquifer.

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Kansas Aquifers - Student Handout

Name:_____

Fill out the table every day. Describe what you see in both bottles in the space provided.

Day	Leaky Landfill	Sealed Landfill
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

1. After 10 days, describe what occurred in the model landfills.

2. If a liquid was collected from the leaky landfill model, describe it.

3. What items changed? What items didn't? Why?

4. Where is your landfill located?