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Shoebox Groundwater Model

Adapted with permission from http://www.sara-tx.org/education_outreach/documents/Activity_06.pdf
(downloaded 1/22/2011)

This activity helps students learn how water enters (infiltrates) an aquifer and how water moves (percolates) through an aquifer. Students should also understand through this activity that the level of groundwater (the water table) is closely tied to the water level of nearby rivers, streams, and lakes.

Concepts to learn

- An aquifer is an area where large amounts of water are stored underground in natural formations of sand, gravel, or rock. In our area, much of the water that we drink is pumped from an aquifer through a well.
- Water enters the soil due to the force of gravity after it rains or snows.
- Water flows through the spaces between the grains in the soil due to the force of gravity.
- Recharge is the water that infiltrates into the soil and replenishes the groundwater.
- Groundwater and surface water are connected.

What you will need

- One 6-quart plastic shoebox or other large rectangular plastic container
- Coarse-grained sand and fine gravel to fill about half of the plastic box (AQUIFER). Aquarium gravel works well. A 20-pound bag is enough for three models.
- One 5-oz plastic cup (WELL)
- Small plastic toy people, houses, cars
- A turkey baster (PUMP)

What to do

1. Fill half of the shoebox with sand and gravel.
2. Make sure that the top of the sand is sloped and has a depression in one corner (for a lake). This represents the land surface sloping toward a lake.
3. Place a plastic house, animal, etc. on the "land surface." This makes the shoebox into a "model."
4. Poke many small holes into the bottom and sides of the plastic cup and mark rings inside the cup about ½ inch apart.
5. Scoop a small depression in the gravel and place the cup into the gravel to nearly the bottom of the box. This cup is going to represent a high-capacity water-supply well.
6. Use your turkey baster to sprinkle water on the surface, representing rainfall. Then, add more water (with the baster) near the hill. Water sprinkled on the surface models precipitation, the source of groundwater.

7. Slowly fill the shoebox and gravel with water until the lake in the opposite corner starts to fill. Be careful not to pour water too quickly! Sometimes it takes a long time for water to move through the gravel to the other side of the shoebox. When water moves down into the gravel from above, this is infiltration. When water moves sideways to fill up the gravel in the shoebox, this is called percolation. Groundwater often moves very slowly.
8. Mark the side of the box at the top of the lake and mark the other side at the top of the water in the sand and gravel (the water table). Look into the well (plastic cup) and mark the water level on the inside of the well.
9. Refill the turkey baster and then add that water to the "hill side" of the shoebox to simulate recharge of the aquifer. Note what happens to the water level in the lake and in the well.
10. Use your turkey baster to remove more water from the plastic cup than you added in step 9. This step represents what happens when you pump water out of the aquifer. Watch and note what happens to the water level in the lake and in the well.

Questions to consider

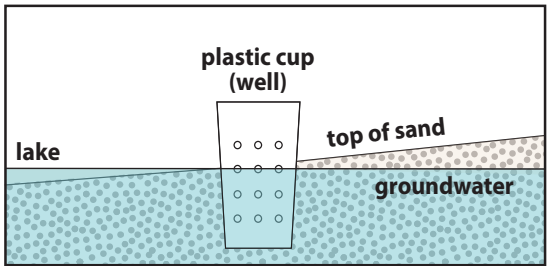
1. What happened to the water level in the lake when you added water to the shoebox through recharge?
2. What happened to the water level in the lake when you removed water from the shoebox through pumping?
3. This system was a model of how aquifers and lakes (and rivers) are related to each other. Can you explain how your experiment might relate to the effect of aquifer water levels on lakes in real life?

Explanation

This activity demonstrates several key concepts about how water moves into and through aquifers. Students should now understand that water enters the ground, and ultimately the aquifer, from the surface. The source of water entering the ground could be rainfall, represented in this model by water being sprinkled on the surface or poured onto the hillside. Through the force of gravity, water moves through the aquifer. The students should have observed this when they watched the water move from the side where they poured water onto the gravel, to the dry gravel and the depression (lake) on the other side of the shoebox. The groundwater and the surface water are connected. Pumping removes water from the aquifer and can lower the water level in nearby lakes and streams.

Big ideas

1. Groundwater comes from precipitation.
2. Groundwater moves through the spaces between the sand grains (pore space). No underground streams or underground lakes are needed for groundwater flow.
3. Groundwater and surface water are connected. Over-pumping groundwater can dry up surface water.



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