DIY Groundwater

LESSON SUMMARY

In this activity, students will make a groundwater model. This model will help them see how water enters an aquifer, how water flows underground, and how groundwater interacts with surface water.

LESSON OBJECTIVE(S)

- Students will create a groundwater model.
- Students will demonstrate how water enters an aquifer.
- Students will demonstrate how groundwater and surface water interact.
- Students will demonstrate how pollution can enter an aquifer (optional)

FOCUS QUESTION(S)

How is groundwater part of the hydrological (water) cycle?
How does surface water and groundwater interact?
How does pollution enter aquifers? (optional)

LEARNING TARGET (I CAN STATEMENT)

I can create a groundwater model and use it to model aspects of groundwater.

STANDARDS ADDRESSED

AR: 6-ESS2-4, 6-ESS3-3, 6-ESS3-4, 7-ESS3-1, ES-ESS2-2, ES-ESS2-5
MS: E.8.9A.7, ESS.3.4
TN: 6.ESS3.1, 6.ESS2.4, 8.ESS3.1, GEO.ESS2.10

MATERIALS

- Student sheet per group
- Container to build model in (examples: plastic shoe box, clear plastic food storage containers)
- Gravel (aquarium gravel works well)
- Soil
- Grass clippings, leaves, etc.
- Dry or wet erase markers (isopropyl alcohol will help remove stubborn marks)
- Well pump (examples: turkey baster, spray nozzle, pipettes)
- Coffee filter
- Rubber band or tape
- Plastic cup with small holes poked in the bottom
- Plastic cup with small holes poked around the sides and bottom
- Water
- Optional: food color to model pollution
- Optional: toy houses and animals

DIY Groundwater

PROCEDURES

1. Before class: Prep a plastic cup by poking holes in the bottom of one cup to be used to simulate precipitation. Prep another plastic cup by poking holes around the sides and bottom to be a well. Take the item you are using for a well pump and cover the end going into the water with the coffee filter securing it with rubber band or tape. This is so it doesn't get clogged from the soil.
2. You can color the water to make it easier to see but be sure if you are doing the optional pollution section that you use complimentary colors, for example blue water and red pollution. This will make it easier to see the mixing.
3. During class: Give each group their supplies to build their model. Monitor students while they are assembling their model (directions on student sheet). Make sure that they:
   - Make a slope when they are putting the gravel in the container
   - Don't use the "rain" plastic cup for their well
   - Pat down the soil
4. Once students have finished assembling the model and answering the questions on the sheet, have them reset the lab for the next group. Have them put the well, well pump, precipitation cup, houses & animals (if used) to the side. Use a bucket with colander or strainer for students to separate the gravel out. You can either dump the soil, water, leaves/grass out into a grassy area or compost.

CLOSURE

Lead a class discussion on what they observed from their model. Potential questions to ask:

- How is groundwater part of the hydrological (water) cycle?
- If the water is moving down, what is that force called?
- If there is a drought what would happen to surface water and groundwater?
- What happens to the water table as water is being pumped out?
- How does pollution enter an aquifer?

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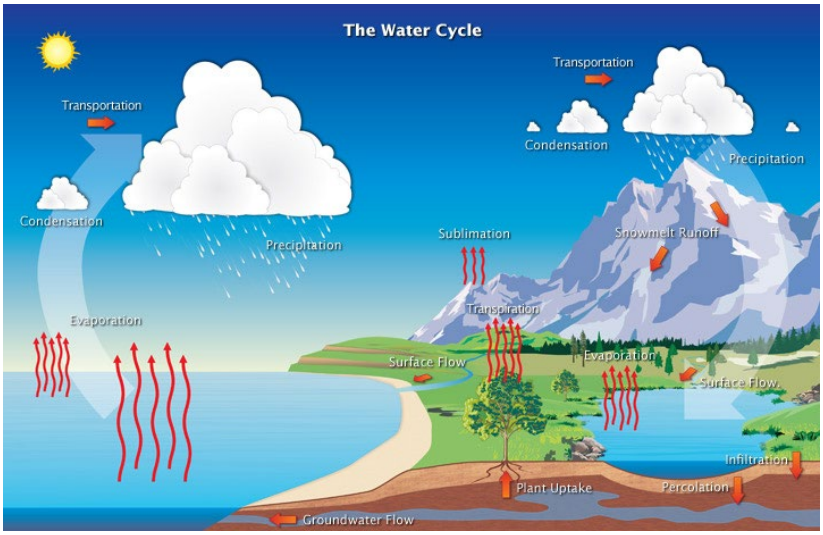
DIY Groundwater Model



Background Information

Water is the ultimate recycled material and is always on the move. We are used to seeing water in clouds, or falling from the sky as precipitation, or in our rivers, lakes, and oceans. However, water is not just in the sky and on the ground, but also under it. Water on the surface will sometimes go into the soil and collect there.

When people think about groundwater, they often think about lakes and streams in caves, but mostly groundwater is water filling the spaces between grains of sand, silt, or rocks. Humans will often pump this water to the surface to use. An estimated 145 million Americans get their tap water from a groundwater source.

In this lab, you are going to create a groundwater model to see how water behaves under the surface.

Key Words:

Aquifer is an area where large amounts of water are stored underground in natural formations of sand, gravel or rock.

Infiltration is when liquid water enters the soil due to the force of gravity.

Percolation is when water flows through the soil due to the force of gravity.

Recharge is the water that infiltrates into the soil and replenishes the groundwater supply of an aquifer.

Water table is the top of the water surface of groundwater that is at atmospheric pressure; the boundary between the soil that is saturated with water and the soil above that is unsaturated

Focus Questions:

- How is groundwater part of the hydrological (water) cycle?
- How does surface water and groundwater interact?
- How does pollution enter aquifers? (optional)

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Materials:

- Container to build model in
- Gravel
- Soil
- Grass clippings, leaves, etc.
- Markers
- "Well pump"
- "Rain" plastic cup (small holes poked in the bottom)
- "Well" plastic cup (small holes poked around the sides and bottom)
- "Holding Tank" plastic cup (no holes)
- Water
- Optional: food color to model pollution
- Optional: toy houses and animals

Procedure:

1. Put the gravel in the container. Slope the gravel on one side of the container. This will represent a lake (surface water).
2. Take the "well" cup and put it partially in the gravel.
3. Add soil on top of the gravel. Try not to let any get into your well. Pat the soil down to reduce the amount of erosion that occurs.
4. Add the grass clippings/leaves/etc. to represent vegetation.
5. If you have toy houses and animals, add them to you model.
6. Hold your "rain" cup over your model and pour water into it. Move the cup around the model. Refill as needed until a small lake forms (a few centimeters deep).

Describe how the precipitation behaved. *Be sure to use words such as runoff and infiltration.*

7. Using your marker, draw a dashed line along the top of the water on the outside of your model. Be sure to include both the lake and your groundwater.
8. Using your marker, mark the height of the water in your well.
9. Using your "well pump" remove water from the well to the "holding tank" cup. Fill it at least halfway up.
10. Using your marker, draw another dashed line to show the new water table height.

Describe your observations of the height change to the water table. *Be sure to include lake, well, and aquifer in your observations.*

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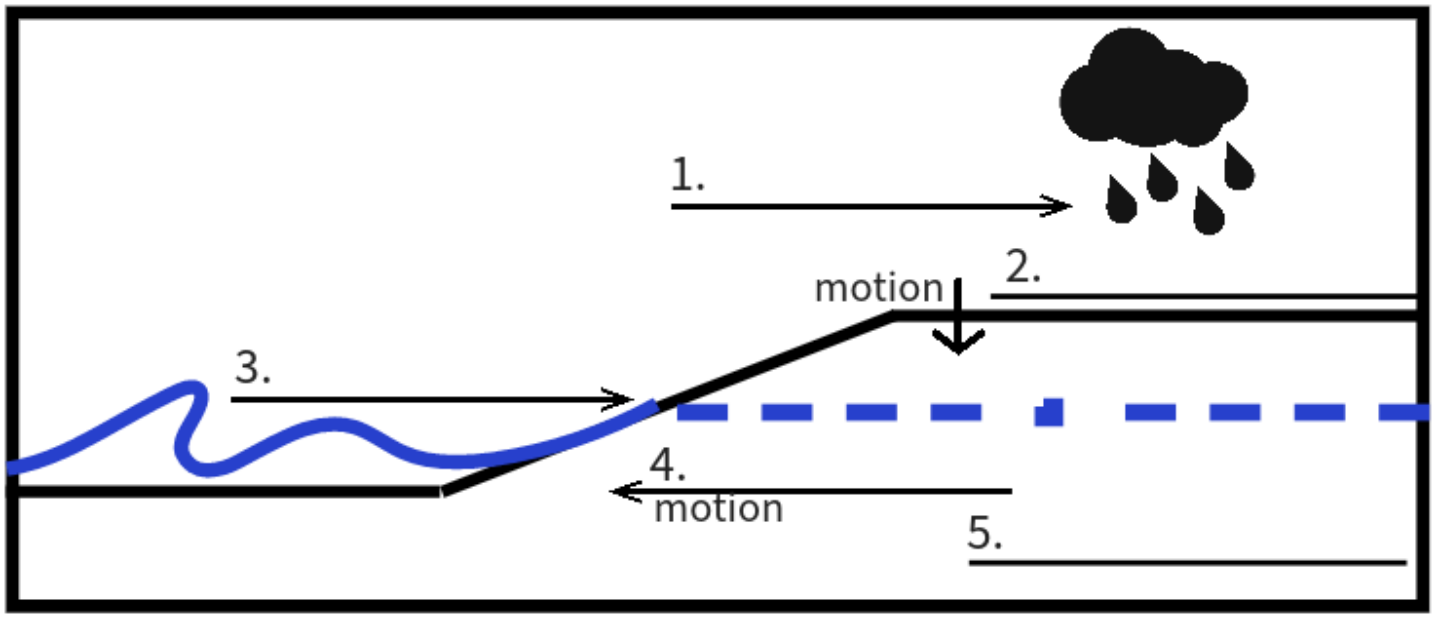
11. Using your "well pump" remove water from your lake to the holding tank. This is simulating a drought. Mark your new water table height.

How does droughts affect groundwater? *Use your observations to defend your answer.*

Label the diagram.

Precipitation	Percolation	Infiltration
Water table	Aquifer	



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Pollution (optional)

12. Using your "rain" cup recharge your surface and ground water until it is back to the original water table height.
13. Take your food coloring and put a few drops near your well to model pollution.
14. Use your "rain" cup and rain around the model.

Write down your observations:

15. Take your "well pump" and remove water from your well till you fill your "holding tank" at least halfway full.

Write down your observations:

How did human activity on the surface affect the quality of the aquifer? *Use your observations to justify your answer.*

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Reflection

1. What conditions could cause the water table levels to increase? Why?
2. What could cause a decrease? Why?
3. What human activities could impact groundwater?
4. How is groundwater part of the hydrological (water) cycle?

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ANSWER KEY

Describe how the precipitation behaved. *Be sure to use words such as runoff and infiltration.*

Students' answers should include that some of the water stay on the surface and moved as runoff towards the lake. Some of the water infiltrated into the soil. They observed both of these from the lake and aquifer filling it up.

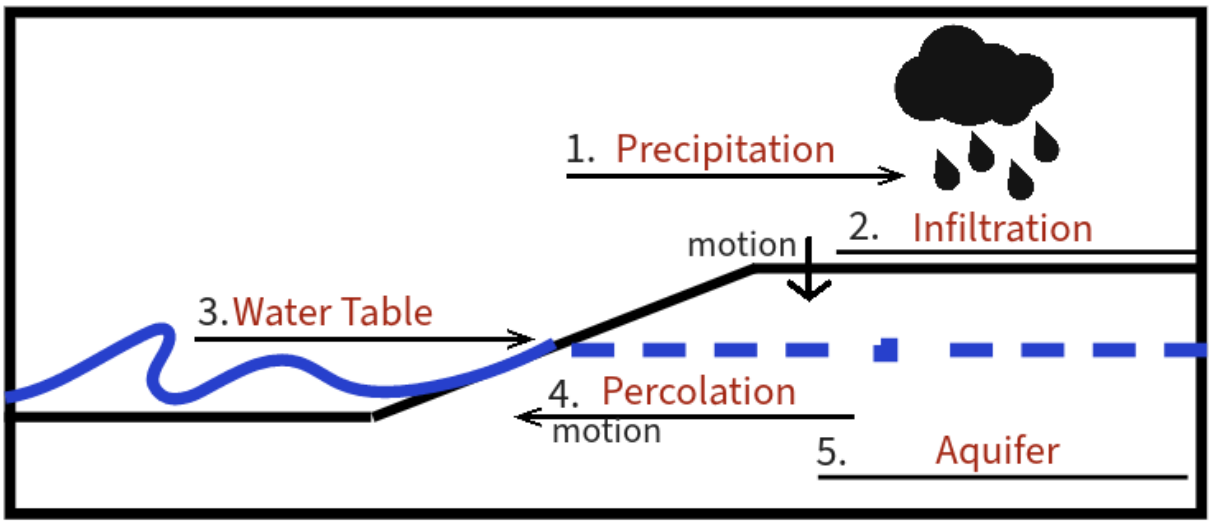
Describe your observations of the height change to the water table. *Be sure to include lake, well, and aquifer in your observations.*

Students should note that even though they took water from the well, that both the lake and aquifer levels decreased.

How does droughts affect groundwater? *Use your observations to defend your answer.*

Students should note that water reducing in the lake cause groundwater levels to also drop. This is due to groundwater recharging the surface water.

Label the diagram.



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Pollution (optional)

Write down your observations:

Students' observations should include that the food coloring mixed with the precipitation and entered the lake from runoff.

Write down your observations:

Student' observations should include that the water in the well also had food coloring in it.

How did human activity on the surface affect the quality of the aquifer? *Use your observations to justify your answer.*

Students should note that though the pollution was at the surface, because of infiltration that pollution went further into the soil. Percolation made it where the polluted water was able to be pumped out of the well.

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1. What conditions could cause the water table levels to increase? Why? Steady rain and flooding could cause an increase in the water table, because more water would enter the ground than usual.
2. What could cause a decrease? Why? Drought could lower the water table. Drought would mean there was less water filtering through the soil to collect. Overuse could also be a cause of a decrease.
3. What human activities could impact groundwater? Humans can overuse water causing levels to significantly decrease levels faster than nature can recharge. They can also cause pollution at the surface which infiltration and percolation can spread through groundwater.
4. How is groundwater part of the hydrological (water) cycle? Groundwater is a major contributor to many rivers and streams. Just like in other parts of the hydrological cycle, water in the ground is moving constantly eventually making it back to the surface. Once it is back in the surface water has the opportunity to evaporate and going to the atmosphere.