Mini Groundwater Model Teacher's Guide

Pre-lab Discussion: *(Perhaps this could be done at the end of the previous class session???)*

• What is it Like Underground?
Q. How far does the dirt we see at the surface go down?
A. First of all, scientists, farmers, and gardeners all call it Soil, not dirt. Some soils are thin (10 centimeters) and some are thick (3 meters). It depends on the location. Steep slopes, high mountains, and deserts typically have thin soils. Flat land in rainy, wet parts of the country have thicker soils.

Q. What is under the soil?
A. Lots of rock! Tens of kilometers of rock. It looks just like the rock you see exposed in ditches, road cuts, or state parks.

Q. I know that water can go through soil, but can it go through rock?
A. Yes, water can flow through cracks and pores. Pores are tiny holes like you have on your skin. Water can slowly pass through these holes, much like the water that come through your skin pores when you sweat. Water can flow through some rocks better than others. Rocks deeper than about 15 km are being squeezed so much that pores close and no water can pass through them (kind of like squeezing a sponge).

Q. Where does Groundwater come from?
A. Groundwater comes from rain and snow melt. Water soaks into the ground and gravity pulls it deeper slowly. The amount of groundwater available is directly linked to the amount of rain and snow we get.

Q. Is all groundwater fresh (not salt water)?
A. Most groundwater is fresh, but near big underground salt deposits, the groundwater is salty.

Q. Do underground rivers exist?
A. Yes, but only in certain parts of the world where the bedrock is made out of

Limestone. The majority of groundwater moves very slowly through connected pores in solid rock.

Q. Is an underground river called an **Aquifer**?
A. Any naturally occurring underground supply of water is called an aquifer. The answer is yes, but water moving through tiny pores or cracks within rock is also called an aquifer.

Q. What is frozen groundwater called?
A. Permafrost.

Q. How does groundwater get polluted?
A1. *Surface spills:* oil and antifreeze from cars, chemicals that businesses use, such as dry cleaning fluid, solvents used for removing paint, and pesticides and fertilizers, poorly designed landfills, truck/train accidents, Humans and animals peeing or pooping near streams or lakes, illegal dumping of waste, waste water from mining operations.

A2. *Underground leaks:* Leaking septic tanks, gas station tanks, heating oil tanks, factories that store chemicals in underground tanks, sewer pipes, oil pipes.

Segue into groundwater model activity... *(about 1 hour???)*

Once a leak or spill happens, how can we track where it goes?

Post-lab group experiment: *(Beginning of next class session???)*

Q. How does groundwater fit into the water cycle?

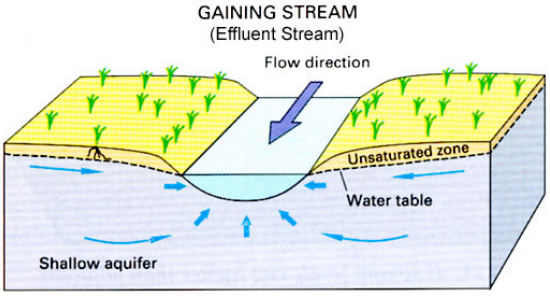
Long Answer: We have learned that groundwater comes from precipitation (rain and snow melt). We have also learned that effluent rivers can flow even when it is not precipitating. Groundwater entering effluent rivers or streams, or entering lakes, or coming out of springs can then begin to evaporate back into the atmosphere. Humans pump water out of the ground and use it for different purposes, many of which involve lots of evaporation.

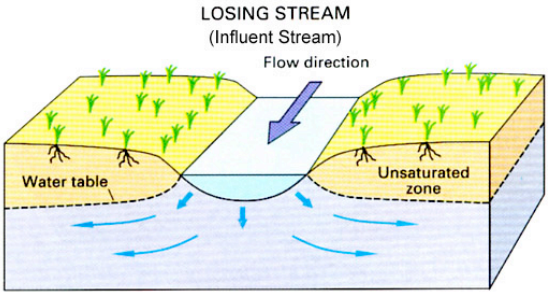
Our lawns seem to dry out quickly in the hot summer months due to evaporation. But how far down does evaporation occur?

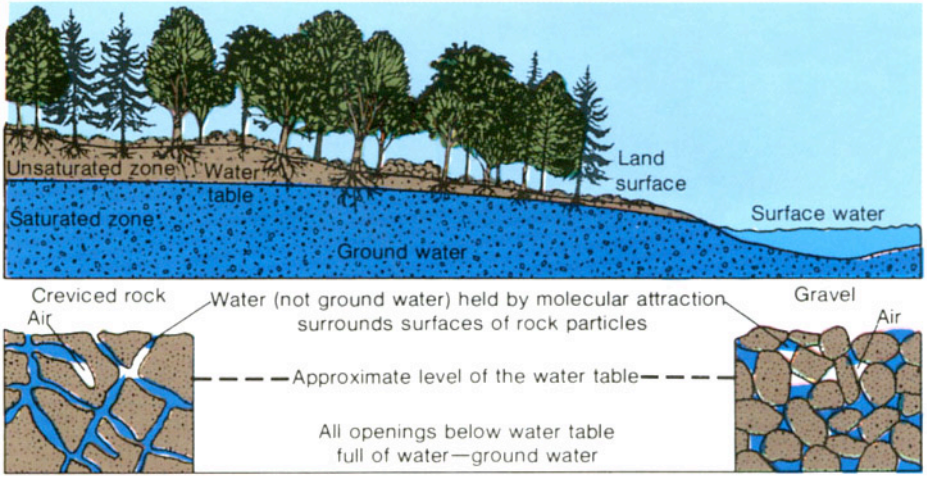
Let's use our groundwater model to answer this question. You can do this as a demonstration.

1. Take a fresh model filled with dry sand and level surface (i.e. no river or hole).
2. Fill a graduated cylinder to 50 ml.
3. Slowly pour water into sand so that it is just saturated, no more, no less.
4. Figure out how much water it took.
5. Take an empty CD case and pour in the same amount of water (but with no sand)
6. Use a transparency marker to mark the level of the water on the case.
7. Set the models side by side.
8. Check on the progress of evaporation each day. Which model evaporates faster, and why?

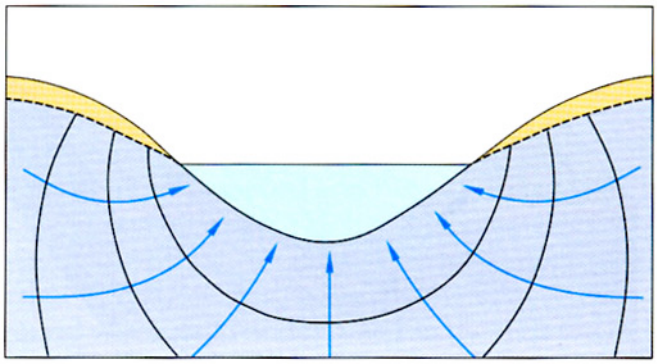
Below about a meter from the ground's surface, there is basically no evaporation. No air circulation. If water evaporates in a pore, there is no place for that water molecule to go.







How ground water occurs in rocks.



Background: groundwater flows due to two variables: 1) gravity, 2) from high pressure to low pressure. Since we keep the water level high on either side of the river in the model, the river is the lowest pressure region in the system. The beauty of the model is that it illustrates the curved flow lines really well.

Extensions

1. Experiment with different sand grain sizes for different groups of students.

2. Layer different grain sizes in one model.

3. Try injecting vegetable oil into a well.

4. Try concentrated salt water.

5. Measure porosity.

6. Measure permeability using a tracer.

7. Convert the river channel into a landfill and make it leak.

8. Convert the river channel into a lake and see its relationship to the water table.