

Groundwater Flow Model Demonstration Outline

Materials: 1 groundwater flow models, 1 hand pumps with tubing attached to flask, 2 recharge bottles, 1 squirt bottles, 2 wooden stands, green dye, 1 grease pencil, paper towels.

Setup: How do we find out what it looks like under the ground? We drill a well and note the sediments that we go through as we drill. This groundwater flow model represents what it might look like if you were to sink down in the ground below my feet 200 feet and you had a big light on your head. It's a side view of the ground, called a cross-section.

There are two kinds of wells represented here. There are two pumping wells. These are the wells with the rectangular box at the end. That is a well screen and keeps the sand from coming into the well when we pump it. With grease pencils, we will label pumping wells 1 and 2.

There are also wells called observation wells; they are wells that we use to look at the water level and take hand samples. Label your observation wells from left to right A through G.

Also discuss other features of the model from left to right: (possibly a leaky underground storage tank), recharge basin or wetland, and a lake or river.

There are two groundwater units represented here. **Can you tell me what one of them is made of?** Gravel. **What about the other groundwater unit?** Sand. These are called aquifers. In between these groundwater units there is an impermeable layer made of finer grained material. **What does impermeable mean?** Water can't pass through it. This is called an aquitard.

Where does groundwater come from? Rain

Where does it rain most often around here? Up in the mountains

Put recharge bottles up on left side of model. This is our mountain rain or recharge

Open the valve on the right side of the model

As you watch water bubbling out of the bottle and coming out of the outlet ask the question:

Where is the groundwater? (Point out that there are holes in the column on the left side of the model allowing water to enter). In the spaces between sand grains and other soil particles.

Let's see if we can use our observation wells to see the top surface of the groundwater?

We only want to look at water levels in the wells in the upper groundwater unit (wells B, C D, F and G). Make sure that students look **inside** of the observation wells. If they have a hard time seeing it tell them that their head should be just above the top of the flow model looking down. Also you can show them the water level high on the left side and low on the right side as clues to where the top of the groundwater might be. Have students mark the

levels to the side of the observation wells. When all of the wells in the upper groundwater unit are marked have another student connect up those marks. **What does this line represent?** The top surface of the groundwater or the water table.

Can this water table change? Yes. What would cause it to change? Rain, Pumping, Drought. **If I picked up the left side of the flow model 6 inches what would happen to that line?** It would get steeper.

Right now what is between the grains of sand below this line? Water
What do you think we call this zone? Would it be the dry zone? The saturated zone

Right now what is between the grains of sand above this line? Air
What do you think we call this zone? The unsaturated zone

What do you think makes water flow through this model? the ground? Put green dye in observation wells B, C, and D. Make sure recharge bottle is still flowing and that the valve is still open. Green dye should start to move. Gravity - flows from higher areas to lower areas. If they don't get this, drop a pen and ask why that pen dropped.

What will groundwater move fastest through sand or gravel? Gravel
Why? Because the pore space is greater.

How is groundwater withdrawn from the ground? Using a well installed with a pump and a screen to keep soil from being drawn in with the water.
Pump well number 1, put more green dye in well D and have a few volunteers come up one by one and pump the well. **What happens to the green dye?** Moves into the well. **What happens to the green dye in well D?** It comes back to the well against gravity.

Can wells interfere with each other? Where is the water level in well C now that we've been pumping well 1? Is it dewatered? What if a home owner had a pumping well at D. Could his pumping well affect our pumping well? Yes his or her well is deeper than ours!

Is groundwater and surface water connected? Put dye into the recharge basin/wetland. Dye should move into the groundwater. Yes.

Can human activities at the surface affect groundwater quality? If the dye that we put into the basin was actually cyanide or some other dangerous substance where might that substance end up? We could pump it into a well. **Do we drink water from wells?** Yes we do. It could move through the ground and come out at the land surface, for instance if the model outlet actually led to a river or stream.

Review terminology: **groundwater, aquifers, impermeable layers, water table, saturated zone, unsaturated zone, pumping wells, observation wells, water pollution.**