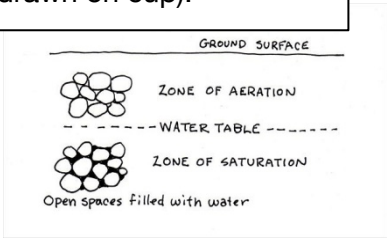
Groundwater Interpretation Models

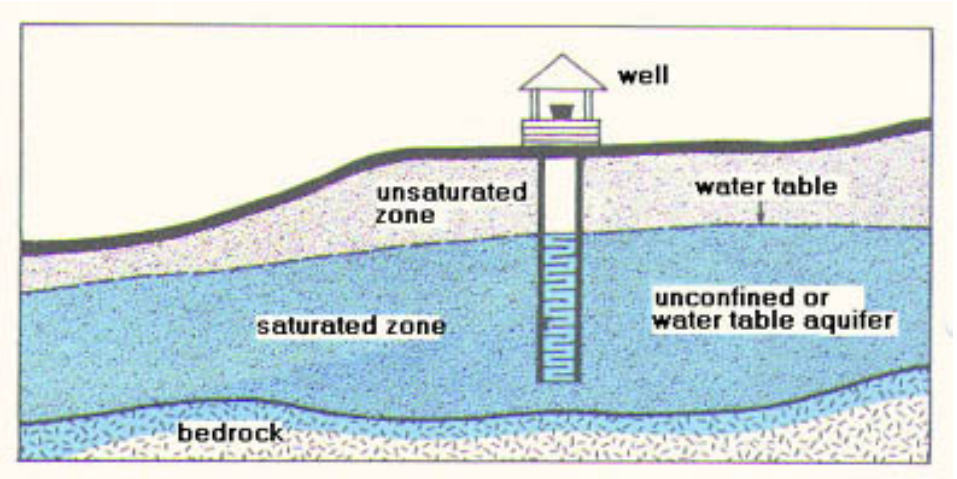
Description: In this activity, students will use clear plastic cups filled with different substances and colored water to visualize how soil and rocks beneath the earth's surface interact with groundwater to form the water table and aquifers.

Directions: The following easily constructed models can be used to demonstrate various aspects of groundwater. For best results, provide each small group of students with the model materials (cups, etc.) when providing explanations. Afterwards have the students point out the various features and name them. For evaluation, have the students label the groundwater features taught on a diagram that does not contain labels.

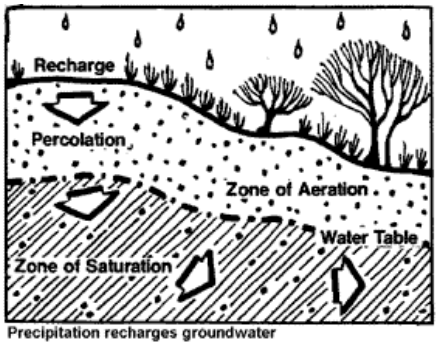
In the cup, the zone of aeration is represented above the water.

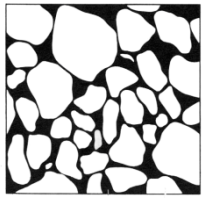
The zone of saturation is represented below the waterline (see line drawn on cup).

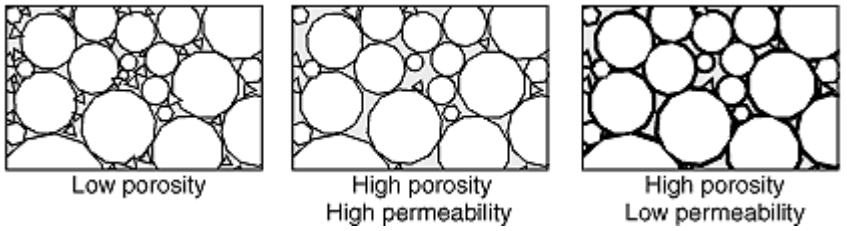




Groundwater Feature	Model Materials	Procedure for making models	Groundwater Feature Explanation	Model Design Constraints
Water table – *The level below which the ground is saturated with water.* *(see diagram above)*	• clear plastic cup • blue dyed water • pea gravel	*1. fill the cup with pea gravel* *2. fill one half of cup with blue colored water* *3. point out top of water as water table*	The top of water under the ground is called the ***water table***.	*The pea gravel represents water bearing rock which could be sandstone which is porous or limestone which has fractures. The water is dyed so the water table can be easily seen.*

Groundwater Feature	Model Materials	Procedure for making models	Groundwater Feature Explanation	Model Design Constraints
Zone of Saturation or Aquifer *is the area in an aquifer, below the water table, in which relatively all pores and fractures are saturated with water*	same as above (see diagram on page 1)	*same as above* *See the permeability activity to also demonstrate that pore spaces are in some rocks.*	The zone of saturation or aquifer is located below the water table. This is where all the spaces that were are not filled with rock are filled with water.	*The zone of saturation is replenished with rainwater that hits the surface above and then percolates downward.* *In some areas, humans are taking out more groundwater from wells than is being replaced naturally by rain infiltrating (filling in).*
Aeration Zone or Unsaturated Zone *(vadose zone) the zone between the land surface and the water table in which the pore spaces between soil and rock particles contain water, air, and/or other gases.* *(see page 1 diagram)*	same as above  Precipitation recharges groundwater	*same as above*	The zone of aeration is located above the water table. This is where the spaces that are not filled with rock are filled with AIR!	*The zone of aeration does have water in it, which percolates downward to reach the zone of saturation. However, it is above the water table and is an insufficient amount to pump.*

Groundwater Feature	Model Materials	Procedure for making models	Groundwater Feature Explanation	Model Design Constraints
Porosity *Porosity is the proportion of open spaces within a given volume of rock or soil. It compares the amount of open space to the amount of solid matter.*	• clear plastic cups • various gravel • various size marbles 	*1. Fill clear plastic cups, each with only one of the following: gravels and marbles* *2. Fill one plastic cup with all the contents above mixed together* *Note: How well the material is packed will affect the porosity. The tighter the material is packed the less the porosity.*	The spaces in each cup that do not contain sediments (which represent sedimentary rocks) have air. These are called pore spaces. The amount of pore spaces available depends on the shape and sorting of the sediments. General rule of thumb: **the more rounded and well sorted (same size) the sediments the more pore spaces there is to hold water.**	*Porosity is a concept that is difficult to comprehend and measure. Use this concept only with older students doing an in-depth investigation of groundwater.* *Have the students pour water into each container and then strain and filter out water and measure the amount that fit into the container. This amount represents the pore spaces available. Compare the amounts from each shape.*
Permeability *Permeability is a measure of how easily water can travel through porous soil or bedrock.*	• Small sandstone rock (about half the size of a computer mouse) • Water (small cups or bottle) • Straws or droppers • Paper towels	*1. Place a piece of sandstone on paper towel.* *2. Use dropper or straw to draw water from container (cup or bottle).* *3. Place drop of water onto sandstone. Observe the water soaking into rock.* *4. Repeat process until water drips though the rock and onto the paper towel.*	As water moves from the dropper into the sandstone it passes through the pore spaces. As more and more drops are added the water pressure will increase and water will eventually pass through and drip out the bottom, thus representing the concept of permeability.	*Sandstone is used for this activity because it is easily available, well sorted and can demonstrate the concept well. Be sure students realize that this is just one example.*



Porosity is the proportion of open spaces within a given volume of rock or soil.
It compares the amount of open space to the amount of solid matter.

Keep in Mind:

Water moves from higher to lower elevations and from higher pressure to lower pressure.

Gravity takes it down underground and pressure brings it back up (i.e., springs).