

Name \_\_\_\_\_

## Aquifers

**Background Information:** An **aquifer** is any natural material that contains water recoverable in useful amounts by means of wells or natural springs. Aquifers may be fractured zones in otherwise solid rock, layers of solid but porous rock or loose sedimentary materials. Some of the best aquifers are thick beds of sandstone, geologically young limestones and bath salts, sands and gravels. Except in favored areas, most geologic materials are not aquifers. Clay and shale contain water, but unless the beds are fractured, pore openings are too small to allow water movement. Most igneous and metamorphic rock lack pore spaces and contain hardly any water.

### Materials:

|                          |                   |               |
|--------------------------|-------------------|---------------|
| Model bottle with screen | Collection bottle | Food coloring |
| Sand                     | Nail              | Pan           |
| Clear tape               | Film canister     | Candle        |

## Part 1 – Parts of an Aquifer

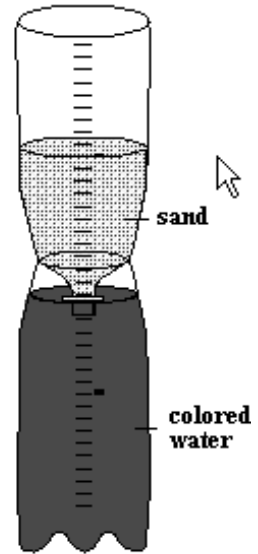
**Background Information:** Whenever water reaches the earth's surface, some of it goes into the ground where it flows through porous rocks. **Groundwater** is divided into layers called the **saturated zone** (full of water), the **water table** (top of the **saturated zone**), and the **unsaturated zone** (everything above the water table). As water flows through the ground some water sticks to the surface of the rocks and soil in the **unsaturated zone**, but the pores in the rock or soil in the zone are filled with air. The water continues to flow down through the water table to the **saturated zone** where all the pores in the rock or soil are filled with water.

**Capillary action** is important for moving water (and all of the things that are dissolved in it) around. It is defined as the movement of water within the spaces of a porous material due to the forces of adhesion, cohesion, and surface tension.

Capillary action occurs because water is sticky -- water molecules stick to each other and to other substances, such as glass, cloth, organic tissues, and soil. Dip a paper towel into a glass of water and the water will "climb" onto the paper towel. In fact, it will keep going up the towel until the pull of gravity is too much for it to overcome.

**Procedure:**

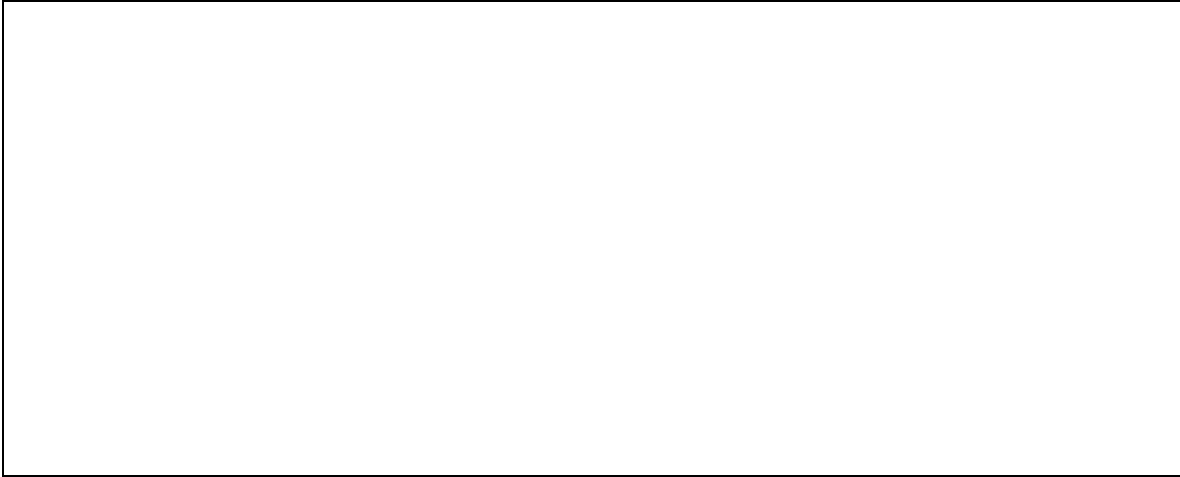
1. Put the screen in the model bottle.
2. Fill your model bottle with sand to the 1,000 mL mark.
3. Slowly pour approximately 1600 mL of water into the collection bottle.
4. Add food coloring to the water (about 6 drops of a dark color).
5. Place the model bottle in the collection bottle. If the opening of the model bottle is not in the water, remove it, add about 200 mL more water to the collection bottle, and replace the model bottle in the collection bottle.
6. Observe. Record your observations in the data section.
7. With your grease pencil, based on your observations and the descriptions above, label the bottle with the following:  
*Water table*  
*Saturation zone*  
*Unsaturated zone*
8. Draw the parts of an **aquifer** in the data section.
9. Approximately how much water was drawn up into the model bottle? (collection bottle start - collection bottle finish = **capillary** action volume)



**Data:**

| Observations |
|--------------|
|              |

### Labeled Drawing of an Aquifer

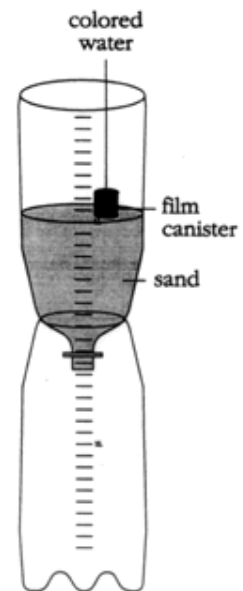


## Part 2 – The Recharge Zone

**Background Information:** Recharge zones (sometimes called green zones) are where water flows into the ground to become groundwater through the recharge system. Recharge adds water to the groundwater system when rainfall, melting snow, surface water, or water from a creek or lake soaks in through the soil and rocks. In a recharge zone, water flows downward through the unsaturated zone, water table, and saturated zone to get to the aquifer.

### Procedure:

1. Put the screen into the model bottle and insert it into the collection bottle.
2. Fill your model bottle with sand to the 1,000 mL mark.
3. Cut the bottom off the film canister and insert it into the sand, next to the wall of the bottle.
4. Slowly pour colored water into the film canister.
5. Observe the flow of the colored water into the sand.
6. Record your observations.
7. With your grease pencil, draw the flow pattern of the water on the bottle.
8. In the data section, draw the flow pattern you saw in the bottle.



Data:

| Observations |
|--------------|
|              |

| Flow Pattern |
|--------------|
|              |

## Part 3 – The Discharge Zone

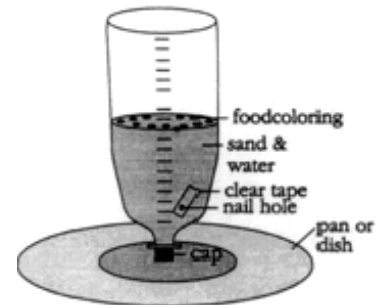
**Background Information:** Sometimes water naturally flows out of the ground, like a spring or geyser; sometimes it is pumped out of the ground with a well. The area where water flows out of the ground is called a **discharge zone**. If the **water table**, the top surface of the **saturated zone** which separates it from the **unsaturated zone**, is to stay level, the amount of water **recharged** (coming in to the ground) must equal the amount of water **discharged** (going out of the ground)



Goggles on while heating the nail!!

### Procedure:

1. Use a candle to heat the end of a long nail.  
Hold one end of the nail with a folded paper towel.
2. Use the hot nail to poke a hole in the model bottle at about the 500 mL mark.
3. Cover the hole with clear tape.
4. Put the cap on the model bottle.
5. Fill your model bottle with sand to the 1,000 mL mark.
6. Slowly pour water into the model bottle, until the sand is completely wet. If the sand were an aquifer, it would be considered full or "saturated" at this point.
7. Place the model bottle in a pan or dish.
8. Place drops of food coloring along the edge of the sand next to the bottle wall (6-8 drops).
9. Remove the tape.
10. Observe the flow of the colored water through the sand.
11. If the water isn't flowing, slowly add some more water to the sand.
12. With your grease pencil, draw the water's flow pattern on the bottle.
13. In the data section, draw the flow pattern you saw in the bottle.



Data:

| Observations |
|--------------|
|              |

| Flow Pattern |
|--------------|
|              |

