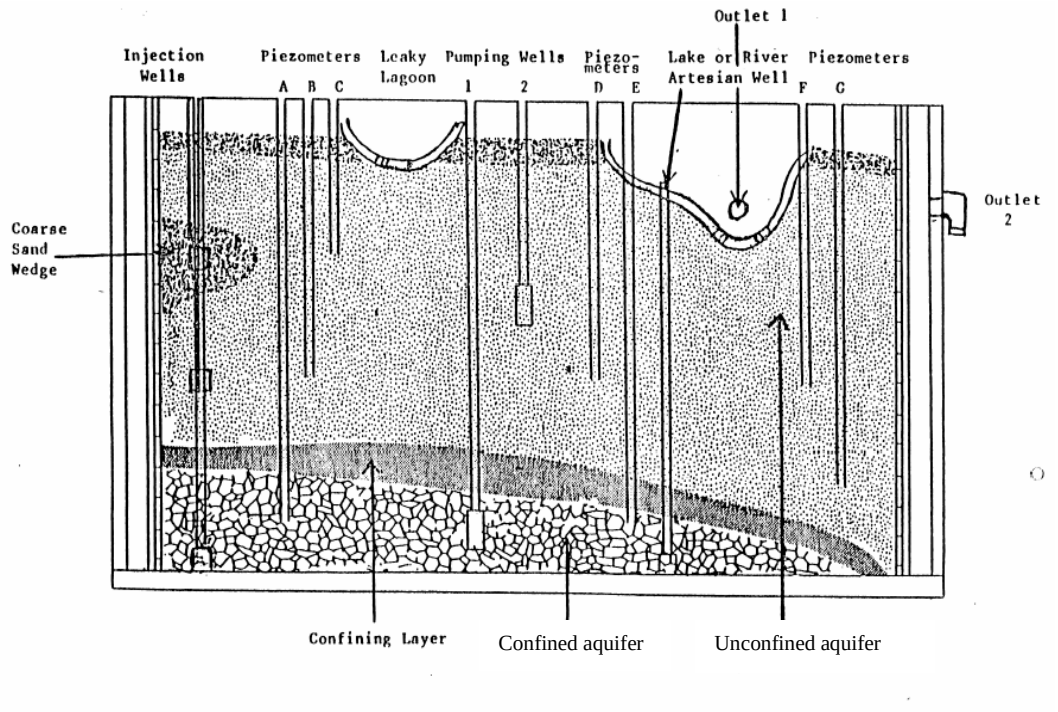
Groundwater Flow Model Exercises



I. GETTING STARTED

1. With both outlets closed, allow model to reach steady state by inverting a bottle of water on each side of the model and allowing water to fill the groundwater model.
2. Using the small syringe inject green dye into the five piezometers (B,C,D,F,G) which are located in the unconfined aquifer (sand layer). The dye makes seeing the water level in the piezometers easier. *The water level in these piezometers represents the water table.*
3. Again using the small syringe inject RED dye into the two piezometers (A,E) that are located in the confined aquifer (gravel layer).
4. Open outlet #1 on the back side of the model and observe the dye as it moves in the direction of water flow.

    - *Where is the groundwater flowing to?*

      _____

5. Use the wet erase marker to draw in the water table for your model. To draw in the water table, connect the water level in the river with that of piezometers B,C,D,F,G) Notice the difference between water levels in the piezometers in the unconfined aquifer versus the confined aquifer.

II. EFFECTS OF GEOLOGY ON GROUNDWATER

1. Inject green dye into each of the three injection wells. Observe that each well discharges into a different area of the model.
2. Observe how quickly the dye moves through the different materials.

    - *In what material is the dye moving the fastest? Sand or Gravel*
    - *Is the dye moving in the confined aquifer? Yes or No*
    - *Why or why not?*
      _____
    - *Is the water level in the confined aquifer piezometers (A,E) higher or lower than the water level in the unconfined aquifer piezometers (B,C,D,F,G)?* _____
    - *What is the cause for the water level difference in the two aquifers?*_____
    - *What are some of the benefits of locating a well in materials where water can move quickly?*
      _____
    - *What are the disadvantages?*
      _____

III. WELLS AND GROUNDWATER

1. To represent the effects of a residential well on groundwater, insert the large syringe into pumping well #2 located in the unconfined aquifer and pull about 30 mL of water from the unconfined aquifer. Observe what happens to the water levels in the surrounding piezometers during pumping and immediately after pumping.
2. Next, create a siphon using the small diameter tubing and a syringe (ask for assistance if you are having trouble. *The pumping well now represents a high capacity well such as a municipal well or irrigation well. .*
3. Now, using a dashed line mark the change in the water table after you begin siphon.

    - *What happened to the water level around the pumping well after you started pumping?*
      _____
    - *What are some possible consequences that might occur from the installation of a high capacity well?*_____
      _____

IV. CONTAMINATION OF GROUNDWATER

1. Shut off your high capacity well by detaching the small diameter tube from the well.
2. Now, fill the leaky landfill ½ full with red dye. *The red dye represents landfill leachate which is often a mixture of many dangerous chemicals.*
3. Observe what happens to the dye as it leaks out of the landfill.

    - *Where will the landfill leachate eventually end up?*_____

    - *Other than leaky landfills what other sources of pollutants are there to groundwater?*_____
      _____

4. Use the large syringe to remove a couple of syringes full of water from the shallow pumping well (pumping well #2).

    - *What happens to the landfill leachate (red dye) while you are pumping the well?*_____

V. EXPLORING THE ARTESIAN AQUIFER

1. Remove the plug from the artesian aquifer.

    - *What happens to the water levels in the two piezometers that are filled with red dye?*_____ _____
    - *What happens to the green dye you put into the injection well earlier? Why?* _____

2. Alternate between pumping the shallow well and the artesian well with the large syringe.

    - *Looking at the piezometers for the aquifer you are pumping, which aquifer responds more to being pumped? Why?*
      _____

3. Place one of the clear pipette tips into the artesian well in the lake. Observe the pipette tip and the piezometers in the artesian aquifer. Continue to add pipette tips and observe until the artesian well no longer flows.

    - *What does this tell you about the pressure of the water in the artesian aquifer?* _____

VI. EXPLORE

1. If time permits, continue to explore the model on your own. What other scenarios or concepts could be demonstrated using the model?

   _____
   _____
   _____
   _____
   _____

NOTES: