



NSF GK-12 Graduate Fellows Program
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Activities For The Groundwater Model

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Groundwater Exercise

Materials

- Food coloring
- Acidic liquid (lemonade, vinegar, etc.)
- pH paper
- Long cotton swabs
- 4 stopwatches
- 4 funnels

Vocabulary

- Groundwater
- Permeable
- Porous
- Impermeable
- Confined Aquifer
- Unconfined Aquifer
- Perched Aquifer
- Artesian Aquifer
- Hydraulic Gradient
- Confining Layer
- Contaminant Plume
- Point Source Pollution

***Note:** Teacher may want students to read the accompanying background reading material and familiarize themselves with the above vocabulary.



Aquifer Exercise 1: Predictions

After reading the background information provided, label the following parts of the diagram:

Confined Aquifer, Confining Layer(s), Unconfined Aquifer, and Perched Aquifer

Question 1: Do you think any of the wells will have artesian flow? Why or why not?

Question 2: What is the force that causes the groundwater to flow from the surface? _____. Label on your diagram where you think water would flow once it is inside the aquifer system

Do the aquifers look the same? _____ If not, how are they different?

If differences do exist, how do you think they will affect the rate of flow through the aquifer? Explain in detail.



Aquifer Exercise 2: Testing the Model

Now that you have made some predictions as to how the groundwater will flow, it is time to test your hypotheses.

Procedure: Designate one member of your group as a timekeeper. Another person will need to record the data. Two people will need to pour water in the beginning, but then one will move to collect water by the drain spouts. There should be an observer on either side to note changes and flow rates in the aquifers

Step 1: The two group members in charge of adding recharge to the aquifers should each have a large container (400mL works nicely) of different colored water. Place a funnel in wells #1 and #2. When the timekeeper says to go, the two “weather makers” should SLOWLY start to pour water into the funnel. They should keep on pouring until some water reaches the drain. As the water moves through the system, draw arrows on the second diagram to indicate the path the water takes. When the water in each aquifer reaches the drainpipe, record the data.

	Aquifer 1	Aquifer 2
Volume of water added		
Time to drain		

Question 1: In which aquifer did water move the fastest? _____

Did the aquifers absorb the same amount of water until it came out of the drain? If not, what could account for the differences?

Which unit is the most **porous**? _____

Which unit is the most **permeable**? _____

Which unit is the *least* permeable? _____



Does the model reflect your predictions so far? Why or why not?

Step 2: Follow the same procedure for Step 1, but this time in well# 3. Which aquifer does this well drain into? _____ Draw the path of the water onto the diagram.

Repeat for wells #4 and #5. Which aquifers do they drain into? Record the data below.

Well #4 drains into _____

Well #5 drains into _____

Draw the path of flow from these wells onto diagram #2. Does the model still reflect your predictions? Why or why not?

Aquifer Exercise 3: Testing for artesian flow

Procedure: After you have developed an idea of how water flows through the aquifer system, insert the corks into the drain spouts.

In order to test for artesian flow, you will only need to pour water into two wells. Which two are they? _____ & _____ Why are they the only ones we are concerned with?

Pour water into the aquifer until it appears that all **pore spaces** are filled.

Record the volume of water entered into the aquifer _____.
Now add it to the volume entered in Exercise 2.

_____ + _____ = _____

This is approximately the volume of water needed to **saturate** the aquifer



Step 2: Take a sampling swab and insert it into well #1. Remove the swab and measure how many centimeters it is from the top to the **water table**

Well #1 Distance: _____ cm

Do you think the water level in well #5 will be higher/same/lower than well#1 (circle one)?

Now sample Well #5 Distance: _____ cm

What is the difference? _____ Is there artesian flow? _____
Explain why this is so.

Aquifer Exercise 4: Determining Point-Source Pollution

An industry has recently moved into your area and local residents are concerned that their wells may be polluted. The problem is, they don't know nearly as much about groundwater as you do, and need you to test their wells for pollutants.

Procedure: Each group will have to leave the room while the teacher "pollutes" one of their wells by adding an acidic liquid, such as vinegar. The group will then come back and test their wells at three different time intervals. The groups will decide these times based on their own preliminary flow data. Time 0 will be when the students reach their table. The pH level should be recorded in each well

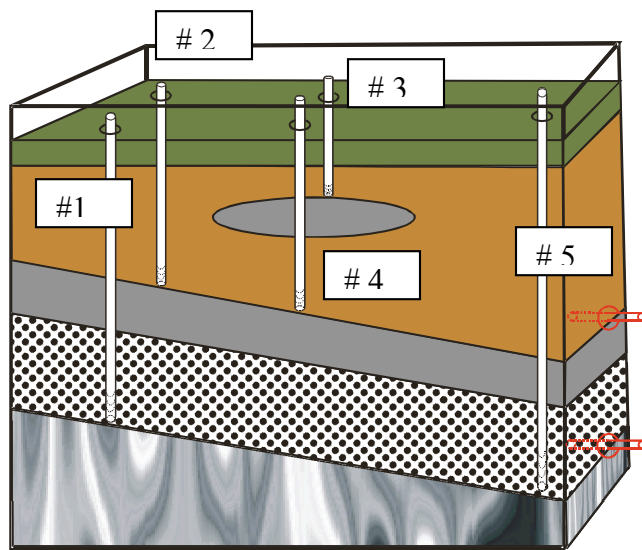
	Well # 1	Well#2	Well#3	Well #4	Well#5
Time 1: _____ minutes					
Time 2: _____ Minutes					
Time 3: _____ Minutes					

Chart the contaminant. For each time, color in the wells that the contaminant reached. Use a different color for each time. Make sure to label on your diagram which colors represent each time.

Which well is your point source? _____. What other wells were most affected, if any? _____



Groundwater Model Diagram



- Topsoil
- Sand
- Clay
- Gravel
- Basement