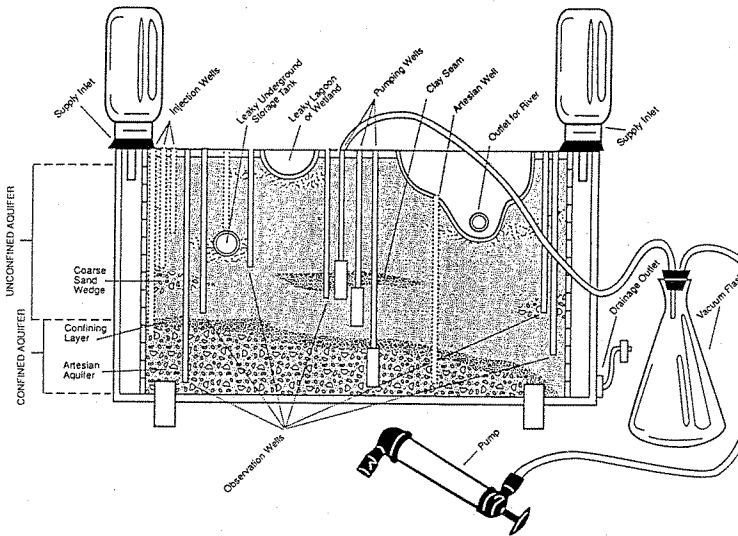


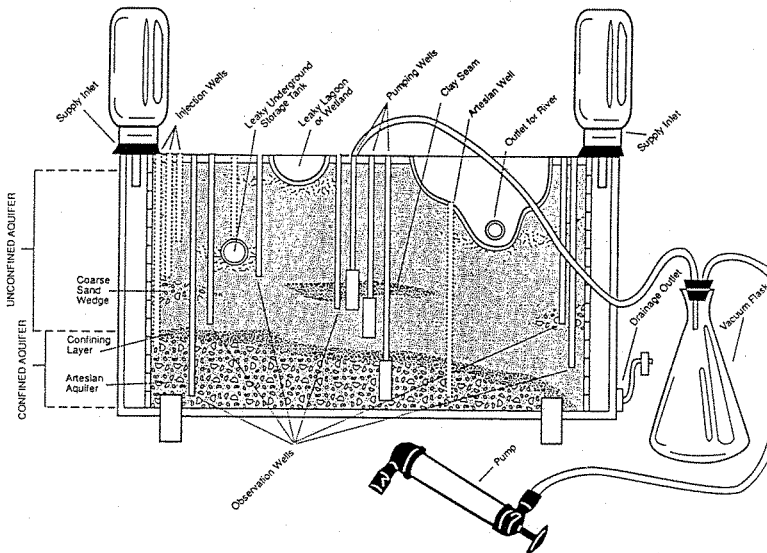
Groundwater Model Exercise

Choose one or two of the Basic Groundwater Concepts to experiment with and record your observations on the following diagrams.



Procedure:

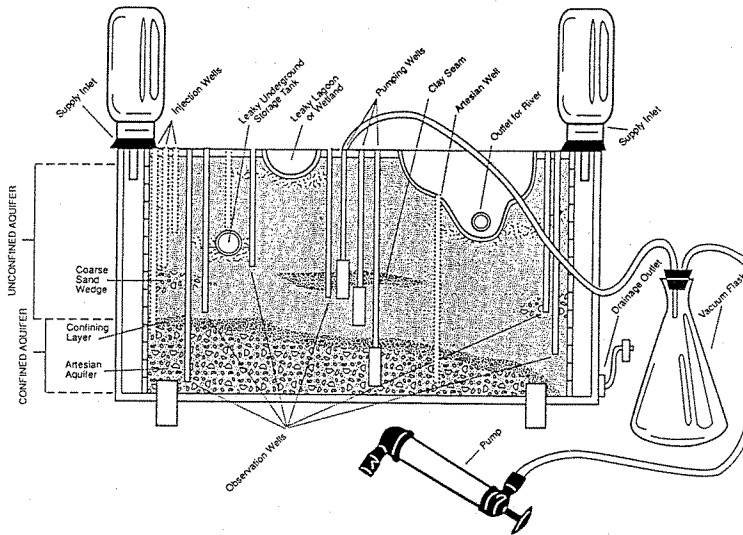
Results:



Procedure:

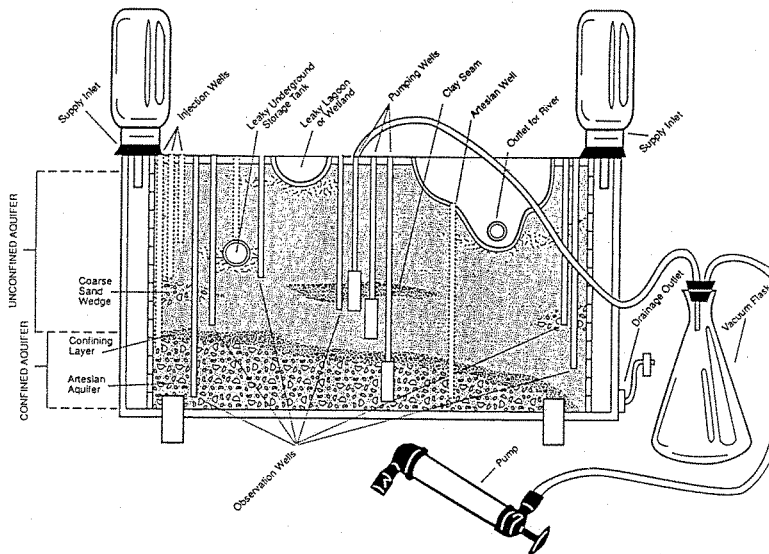
Results

Choose one or two of the Basic Groundwater Concepts to experiment with and record your observations on the following diagrams.



Procedure:

Results:



Procedure:

Results:

Basic Groundwater Concepts that can be demonstrated using the groundwater model.

1. Groundwater often comes from nearby sources: Fill the one-quart widemouth bottle with water and invert it at the left end. What happens?
2. Groundwater is contained underground in the spaces between sand grains and other soil particles, or in cracks and fractures in rocks: Do as in 1. and note your observations as the water reaches the right side.
3. Groundwater flows from upland areas to low areas or from areas of high hydraulic head to areas of lower hydraulic head: Allow water to run through the model and add dyed water to the 7 observation wells, until the dye moves out of the wells into the soil below. What happens.
4. Groundwater is withdrawn from the ground through wells: Use a pump to pump water from the pumping wells. Draw the water level on the outside of the glass with a grease pencil. What shape does the water table have after pumping?
5. Groundwater is related to surface water and to all other forms of water in the hydrologic cycle: Close the lake outlet so that the lake fills with water. Open the outlet on the right side. What happens?
6. Aquifers may be separated by aquitards: Look at the layers in the model and mark water levels. Pump from the well below the aquitard and observe water levels. Then pump from the well in the upper aquifer and observe water levels. What happened in each case?
7. The water table is the top of the saturated zone: Allow water to run through the model with the outlet open and mark the shape of the water table. Add a small block under the left end and note what happens to the slope of the water table.
8. Water in artesian aquifers is under pressure that causes the water level to rise above the top of the aquifer: Note the water level in observation wells A and E and compare to B, C, and D. What is the difference and why?
9. The potentiometric surface is the level to which water will rise in a well penetrating a confined aquifer: Observe the water levels in the 7 observation wells, noting particularly the level of the water in the well penetrating the confined aquifer. What is that level and why?
10. When the potentiometric surface of an aquifer is above the surface of the ground, a flowing well or spring may result: Look at the small tapered tube in the artesian outlet in the lake. Where is the water level? Remove the tube and close the lake outlet. Does water flow from this opening? What happens in the observation well that penetrates the confined layer?
11. The texture of the materials affects the rate of flow through the aquifer: Inject dye into the injection wells at the left end and notice in which material does it move fastest?
12. Water flows into rivers from many directions: add water at the right end of the model. Turn the elbow at the right end upward and the elbow in the river downward and be sure the observation wells are filled with dye. What happens?
13. Pumping wells draw water toward them from all directions: Use the pump to withdraw water from the well in the unconfined aquifer. What shape does the water table take?

14. Drawing water from a well can interfere with the ability of neighboring wells to produce adequate water: Pump well 2 at a rapid rate. What happens to the water level in the other observation wells?
15. Human activities at or near the land surface can contaminate groundwater: Pour dye into the leaky lagoon to a level above the holes drilled in the sides of the lagoon. What happens?
16. Wells can be contaminated by human activities at or near the land surface: Fill the leaky lagoon with dye and pump water from well 2. Which direction/s does the water come from? Can water move 'uphill' in the underground?
17. Pollutants travel with the groundwater, but they may travel at different rates: Observe the plumes of green dye. Have they separated into blue and yellow areas?
18. Contaminated groundwater may pollute surface water: Is the water collecting in the lake clear? Has it been affected by the dye that has been injected?
19. Contaminated surface water can pollute groundwater: Pump well 2 steadily until you see dye being drawn toward it from the river.
20. Groundwater is recharged by precipitation and snowmelt: Use a sprinkling device to add water along the surface of the model (after it has pumped). What happens to the dye plumes?
21. Capillary action can cause upward movement of water and contaminants above the surface of the water table: Observe the dye you added to the leaky lagoon. Has it moved mostly down and to the right or has some moved upward into the upper gravel layer?
22. Water quality can vary within an aquifer: Observe that dye spots when they first enter the aquifer occur only in a narrow zone. What happens as the dye plumes move downgradient?
23. Confining layers that separate aquifers usually leak: Pump water from well 1 and notice that water levels in A & # that extend below the confining layer. What happens to those levels and those in the other observation wells?
24. Wells can cause groundwater pollution: Inject dye into the 7 observation wells or into the 2 pumping wells, filling them until the dye solution reaches all the way to the bottom and begins to spill out below.
25. Sources of groundwater contamination may be continuous or intermittent: Observe that in operating the model, you need to add dye solutions to the piezometers periodically if you want a continuous dye trace.
26. Once groundwater becomes contaminated, the contamination may persist for long periods of time and over long distances: How long does it take to flush the dye out of the model?
27. Groundwater flow lines have curved paths: Observe dye traces that extend from the recharge area to the discharge area. Draw them on the diagrams.