CHANGING GROUNDWATER LEVELS – HOW DOES A WELL WORK?

Objectives:

Students will:

- investigate changing groundwater levels and why they change,
- offer suggestions of how to keep groundwater levels from rapid decline,
- determine how different rock layers affect groundwater levels.

Materials:

- Soda bottle with bottom cut off (used in "Getting the Groundwater Picture)
- Cup of sand
- Cup of gravel
- Cup of water
- Pump (like a hand lotion pump)
- Piece of cheesecloth or pantyhose

Procedure:

1. Review the activity "Getting the Groundwater Picture."
2. Discuss wells with the students and have them predict what will happen to their aquifer when they begin to use the pump on their well to draw water from the ground.
3. Put a small piece of pantyhose on the bottom of the pump tube so it does not suck in soil or sand. Tape the pump to the side of the bottle so the pump is above and pointing out of the cut end of the bottle. Fill the bottle one-half full of small gravel and pour sand on top of that.
4. Have a student slowly fill the bottle until it is about half full of water. Have the students locate the top of the aquifer or watertable.
5. Have a student begin pumping water from the aquifer into a glass. At certain intervals, have the students locate the top of the watertable.
6. How does the water get back into the well after it has been pumped up? (rain, snowmelt, surface water returning to the soil, water can seep in from other aquifers, etc.)
7. Have the students discuss how different substrata would affect the pump. Would it ever bring up mucky water? Would certain rock types mean you would have to put the pump deeper to get water? Would it be easier to get water from shale or limestone? What if the well were to go through a cave?
8. Imagine you are in a farming community.
   - Will irrigation have an effect on your well?
   - What about use of fertilizers or pesticides?
   - Will you always be able to get water at the depth you first drilled to?
   - Would a drought effect your water supply? How would the balance in the watertable be maintained?
   - Will wells from the surrounding area (farms or cities) impact your water supply?
9. Consider the following:

- Will the effects of local industrial practices effect your water quality?
- Dumping oil into the ground, dumping chemicals into nearby rivers?
- Dumping waste directly into old wells?

10. Discuss that the watertable is not level, so all wells will not be at the same depth even if they are close to each other. The watertable will mimic the surface above, having hills and valleys. Water can dip where the land above does, or it can dip where a well has been pumping water out. In the experiment with the spray pump, as water was pumped, the water level dropped. Water drops more rapidly near the well than away from it. Often the replacement water cannot return as quickly as water is being taken out. Most rainfall is evaporated or used by plants, some goes into rivers or streams and only about 1% of water returns to the watertable directly.
11. What are some of the problems with getting water from a well? (Depth of water, hard rock to break through to get it, cost, chance of well drying if not deep enough, etc.)
12. Does the placement of the well matter? Have the students guess, thinking of their own homes, how far a well should be from the following: septic tank, livestock yards, silos, septic leach fields, petroleum tanks, manure storage, pesticide and fertilizer storage and handling. Soil is a filter, but it can only clean so much. After the students have made their guesses, tell them a well should be at least 25 feet from a septic tank; 50 feet from a livestock yard, silos, and septic leach fields; 100 feet from petroleum tanks, manure storage, pesticide and fertilizer storage and handling; 250 feet from manure piles. If a well is not carefully placed or is misused, anything from the surface can get directly into the water supply without ever passing through the ground.
13. If two wells were placed close together, could this cause a problem? What if one of the wells was contaminated? What if one well connected two aquifers could there be positive effects? How about negative effects? (Wells generally have casing, like a straw around your pump tube that would not allow water from another aquifer to travel down the hole for your pump and pollute the new well or aquifer. However, if these casings don't go down far enough, polluted water can enter your new aquifer. State laws vary on how deep these casings have to be. What if the length the law requires is not far enough to protect your well?) Considering all of these factors, how would you decide where is the best place to put your well?