Aquifer in a Pan

(any clear container with a fairly large surface area will work)
(Adapted from USEPA)

Goal: To demonstrate some aspects of the interactions between ground water and surface water. To provide a visual tool to show how water is stored in an aquifer, and how drinking water can become contaminated by human activities that occur near the earth's surface.

Indiana Proficiencies and Competencies:
Middle/Junior High School 1.1, 3.2, 9.2; First year Earth and Space Science 1.1,1.5, 6.2, 7.2; Environmental Science, Advanced 1.1, 1.5, 2.1, 6.1 and 7.1.

Materials needed:

- fish bowl, large plastic storage container, or a baking pan (any clear container with a fairly large surface area will work)
- sand and/or fine gravel - a liter or two
- turkey baster
- square of gauze
- rubber band
- food coloring
- unsweetened powdered drink mix
- spray bottle (mister) of water
- a water source
- paper towels
- clay (optional - any kind will work, but be aware that the clay can't be reused after this activity.)

Procedures: Building the basic model

1. Prepare a simulated well by covering the end of the turkey baster with the square of gauze and securing it with the rubber band. Set aside.
2. Put sand or gravel into the container and shape it into a landscape. Make a pond in part of this landscape.
3. Slowly add water to the container, so that there is a visible "ground water" layer within the sand or gravel and water in the pond.
4. Insert the turkey baster into the landscape for a well.

Working with the basic model:

If you pull some water out with the baster, you are simulating water being pumped out of the ground with a pumping well. In an actual well, the ground water level does not change significantly every time a well pump is activated, because there is a very large reservoir of ground water in most aquifers. In the model you can notice a drop in water level because of the relatively small volume of water in the model and the rather large relative volume of the turkey baster. This phenomenon can be used to demonstrate to the student what can happen when a lot of water is withdrawn from an aquifer that has a small relative

capacity. This drop in the water table occurs when withdrawals are greater than recharge.

How is the aquifer recharged?

5. Use the spray bottle of water to simulate rainfall by spraying it on the model.

In the model, does all the simulated rain infiltrate into the ground? Does some of it run across the surface and flow into the pond? What are the characteristics of a natural system that would produce run-off? Infiltration? What factors exist in a natural system that our model does not take into account? (evaporation and transpiration)

Variations on the theme

Confining layers
This activity can be expanded to demonstrate how confining layers, like clay layers in the soil, reduce the amount of recharge to the aquifer from infiltrating rain. By adding a clay layer either at the surface or slightly below the surface, the simulated rain will tend to run-off rather than infiltrate. By burying the clay layer below the surface, but above the water table, a spring could be simulated.

Infiltration of contaminants
Unsweetened powdered drink mix can be sprinkled on the top of the model. Spraying the model to simulate rainfall will wash some of the coloring from the drink mix into the ground water. (It works best if this is done near enough to the side of the container that the "plume" is visible through the side.)

Contaminants spilled into pond
Drop some food coloring into the pond then pump water from the well. Did you notice any of the contamination showing up in the well water? Relate this to something that could happen in your community.

Surface water can be most effectively studied and observed by using the natural environment. However, here is one activity that can take the observations of students and model them in the classroom.

Surface water and ground water

Because ground water is difficult to observe in the natural environment, the above activities are all based on physical "models." Seeps and springs can be observed on the sides of hills and in ravines in Indiana, and a field trip to observe a spring would be of great benefit to all students.

Ground water and surface water are interrelated. In most areas of Indiana ground water flows into and feeds the streams. The evidence of this phenomenon can be observed in July or August when no rain has fallen in several weeks and there is water continuing to flow in the streams. It can also be observed in winter when the ground is frozen and springs of liquid water flow into the stream beds, or into wetland areas. Simple measurements can be used to back up these observations. Water temperature of streams that have baseflow contributed by ground water will consistently be cooler in the summer and warmer in the winter than the ambient air temperature.