

Activity: Groundwater Pollution

Objective: To discover the source of a groundwater contamination plume by simulating groundwater testing.

Grade level: 6th

Format: Lab exercise

Materials: For groundwater plume demonstration – one clear glass baking dish, 1 packet unsweetened grape-flavored powdered drink mix, sand to fill baking dish, misting bottle. For activity (per student group) – aluminum baking dish (at least 5 cm deep and sturdy), 1 packet of unsweetened lemonade-flavored powdered drink mix, sand to fill aluminum dish, ruler, 1 straw, 10 pH test papers (or fewer, cut in half), small beaker of water, misting bottle. Materials available in most grocery stores; I used Kool-Aid brand drink mix. I bought sand at a hardware store, and the teacher facilitator provided pH paper. Total cost of supplies was about \$20.

Description: The activity has two parts: a demonstration of a groundwater contaminant plume, and an activity in which student groups hide “contamination” in a tray of sand then trade trays with another group and try to locate the source of the contamination plume.

Procedure for groundwater plume demonstration (15-20 min): Fill the clear glass baking dish 3-4 cm of sand and elevate one end of the dish 5-6 cm. Tell students that the grape powdered drink mix represents a substance that is being stored underground. Dig a hole in the sand at the elevated end of the pan and bury about 1/4 to 1/2 of the drink packet in the hole. Discuss predictions of what will happen to the substance when you spray water on the pan. Spray the pan with water for about 5 min (check underneath to make sure the plume has developed). Show students the contamination plume, discuss their observations and how this type of pollution could affect drinking water.

Procedure for pollution activity (~20 min): Basically, students bury powdered lemonade drink mix in sand then spray the sand with water to create a contaminant plume (for detailed instructions, see attached student handout). Groups then trade sand trays and try to locate the source of the contamination by “drilling” into the sand with straws. The water and sand are tested for acidic lemonade contamination using pH paper. Like in the real world, students’ resources are limited (they are given a limited number of pH papers), so they have to devise a logical method of testing the soil.

Words of wisdom: This activity was exceedingly messy but well worth the trouble. I’d recommend covering desks with newspaper or having paper towels handy. Also, think about how you will dispose of 5 to 10 pounds of used, lemonade-flavored sand (we simply threw it away)! The most difficult part of the activity with 6th graders was getting them to devise a sampling plan, as they tended to start stabbing the straws randomly into the pans. Older students would likely grasp the importance of developing a sampling methodology that maximizes their resources. Be sure to purchase thick, sturdy aluminum pans. We found the activity worked best when students used only 1/2 (or less) of the lemonade packet, as the lemonade can make a yellow stain on the top of

the sand. Lastly, it is important not to over-water or under-water the sand – I'd recommend saturating the soil but there shouldn't be standing water.

Modifications: We discovered by accident that potting soil works just as well as sand for this activity (we ran out of sand halfway through the day). My teacher facilitator and I presented this activity at the 1/2/01 Teacher Workshop at Marshall High School in Portland. The teachers in attendance had many suggestions for modifications of the activity including: focus on developing a sampling method that will cover the most area effectively, then re-evaluate the method in light of how well it worked; effects of different soil types, amounts of water, slope, etc. on the spread of the contaminant; and creating a contour map of equal pH values based on the sampling.

Resources: This activity was modified from "The Pucker Effect," *Project WET Curriculum and Activity Guide* pp. 338-343

Your name and Fellow year: Heather Petcovic, 2000-2001

School or outreach event where activity was used: Gregory Heights Middle School, Portland

Name: _____ Date: _____ Period: _____

GROUNDWATER POLLUTION

A. Pollution demonstration

1. Predict what will happen to the “toxic waste” when we spray the soil with water:

2. Groundwater pollution vocabulary

pH:

contaminant:

plume:

point-source pollution:

B. Groundwater contamination activity

Background: About 15 years ago, Crazy Petcovic Lemonade, Inc. closed its industrial plant here in northeast Portland. Recently, however, local citizens have noticed a strange, sour taste in their drinking water. City environmental officials suspect that when the Crazy Petcovic Lemonade plant closed down, an underground storage tank of highly toxic lemonade drink powder was left behind. Now this tank is leaking toxic lemonade into the city’s drinking water!

Your challenge: The city officials have hired you find the source of the lemonade contamination. Can your team of hydrogeologists drill wells, test the soil, and find the pollution source before your time and resources run out?

Hint: Although the contamination can’t be seen, it becomes highly acidic when combined with water. We can measure the acidity by using the pH scale. Uncontaminated water will turn the pH paper _____ while contaminated water will turn it _____.

Your tools: An environmental testing DRILL RIG (a straw)
The Hygiene-O-Matic CLEANING STATION (a beaker of water)
A multi-million dollar TESTING LABORATORY (pH paper)

Procedure:

1. **HIDE** the contaminant in your industrial site.
 - a. Put a 2 cm piece of masking tape on one end of the baking tray.
 - b. Fill the tray with 4-5 cm of sand.
 - c. With your finger, make a small hole anywhere in the tray – be sure to dig down to the bottom of the tray. Bury 1/2 of the packet of powdered lemonade in the hole.
 - d. Sketch a picture of where you hid the contaminant on the DATA SHEET.
 - e. Place one end of the pan on a block so that it is raised up 4-5 cm.
 - f. Fill the spray bottle with water. Test the pH of the water and record the reading on the DATA SHEET. After the pH paper is dry, tape it to the DATA SHEET. **This is the color of water without contamination.**
 - g. Simulate 15 years of rain by gently spraying the tray with water for about 5 min. **SPRAY SLOWLY** so that there is no surface runoff.
 - h. Fill the CLEANING STATION with 100 ml of water. Rinse the DRILL RIG in the cleaning station.

2. **FIND** the contaminant in another group's industrial site.
 - a. Trade places with another table group.
 - b. Place the DRILL RIG over the soil.
 - c. Press the DRILL RIG down into the soil.
 - d. Cover the top of the DRILL RIG with your finger and lift it from the soil.
 - e. Place a **small** amount of collected sample on the **edge** of the pH paper (TESTING LAB).
 - f. Observe the test results. When the pH paper is dry, tape it to the contaminated site map (Part 2) on the DATA SHEET.
 - g. Rinse the DRILL RIG in the CLEANING STATION.
 - h. Repeat steps **b** through **g** until you run out of pH paper or until you find the source of contamination.
 - i. When you find the contamination site, sketch the location on the Contamination Site Map on the DATA SHEET.

Note: Please be careful with the pH papers. Touch them only at the edges. If you lose any or mess them up, you will NOT receive any more.

3. Check with the group that hid the contaminant to see if you found the right site.

C. Activity Questions

1. Was your group able to find the exact source of contamination? Why or why not?

2. If you had an unlimited supply of pH paper, would your group be able to find the exact location of the contamination? Do you think real scientists have unlimited time, money, and supplies when they are testing groundwater?

DATA SHEET

Group names: _____

pH of normal water: _____ Put pH paper here:

Part 1. YOUR GROUP'S site map:

Part 2. Contaminated site map: