9-12: Contamination on the Move

Subject
Science

Skills
Developing models, observing, predicting, using evidence

Materials
For each group conducting experiment
- clear box
- two beakers
- dry, light colored sand
- powdered lemonade
- bright food coloring
- water
- toothpicks
- ruler or cloth measuring tape
- drawing paper
- pH testing paper

Time
Two class periods

Vocabulary
Percolation, precipitation, groundwater, leachate, watershed, soluble, plume

Related Teaching Toxics Activities
4 - 6 Wading Through Water Pollution
7 - 8 Pondering Percolation

Concept
Contamination does not stay in one spot; it moves through the environment.

Objective
Students will see how contaminated water moves in the environment through experiment and discussion.

Background
See Information Section, pages 121-124
How a contaminant moves in the environment is dependent upon a number of factors, including its individual characteristics and the surrounding geographic area. Generally, contaminants spread outward from the point of origin, forming a plume which points to the contamination source.

Procedures and Activities
Considering Contamination
- As a class, discuss the following questions. Do students know of any contaminated sites in the local area? Do students know how contamination is detected? What types of factors do students think would influence how contamination would move through the soil?

Contamination on the Move
- In small groups, have students conduct the Contamination Movement experiment. See the student sheet on the following page. This experiment demonstrates how contamination tends to move in an elliptical plume.
- As a class, discuss the questions on the student sheet.
Common Core Alignments

GRADE 9-10

CC.RST.9-10.3
Reading in Science & Technical Subjects:
Key Ideas & Details

CC.SL.9-10.1
Speaking & Listening:
Comprehension & Collaboration

CC.WHST.9-10.1d
Writing in History/Social Studies, Science & Technical Subjects:
Text Types & Purposes

GRADE 11-12

CC.RST.11-12.3
Reading in Science & Technical Subjects:
Key Ideas & Details

CC.SL.11-12.1
Speaking & Listening:
Comprehension & Collaboration

CC.WHST.11-12.2
Writing in History/Social Studies, Science & Technical Subjects:
Text Types & Purposes

Taking the Next Step

- Challenge the student groups to solve the following problem:

You are the state’s Hazardous Materials Emergency Response Team. Your job is to clean up contamination caused by hazardous materials accidents. Your team just received a call from Haz-Co., a business which has been storing some of its hazardous chemicals in underground storage tanks. They have just discovered that one of their tanks is leaking. Your job is to design a method to determine how far the contamination has traveled. The team can dig some test pits to determine this. However, digging these test pits is very expensive and your team can only dig eight pits. Based on your results from the experiment, draw a diagram of where you would dig the test pits in relation to the leaking tank.

- Have the groups share their ideas in a class discussion.
**STUDENT WORKSHEET**

**Contamination Movement**

**Setting up the Experiment**

1. Fill the clear box with an even layer of dry sand.
2. Tilt the box an approximate 30°- 40° angle (place a ½” - 1” block under the box to achieve this) so that you will be able to see the bottom.
3. In the top-center of the box, make a small depression in the sand.
4. Set up a string of pH testing paper on the desk.

**Procedure**

1. Mix one cup of water, bright food coloring and some powdered lemonade in a jar, representing the contaminated water. The food coloring will make the water visible in the sand. We are using lemonade because its pH will register on the testing paper.
2. Every two minutes, slowly pour ¼ cup of the contaminated water into the depression in the sand. Begin the two-minute interval as you start pouring. After each two-minute interval, check the bottom of the box to see if you can see the water plume.
3. Once visible, measure the length and width of the plume at each two-minute interval. Record your results below.

<table>
<thead>
<tr>
<th>Plume Length</th>
<th>Plume Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interval 1</td>
<td></td>
</tr>
<tr>
<td>Interval 2</td>
<td></td>
</tr>
<tr>
<td>Interval 3</td>
<td></td>
</tr>
<tr>
<td>Interval 4</td>
<td></td>
</tr>
</tbody>
</table>

4. Using a straw, remove several plugs of contaminated sand from the box (rinse the straw with pure water between each sample). Mark where you took the samples with toothpicks. Drop each sample on the pH paper. If the resulting color indicates a drop in pH (detecting the acid from the lemonade), you know that the plume of contaminated groundwater has been found.

Take and test enough sand samples until you can detect the shape of the plume’s movement.

On a separate piece of paper, sketch the plume movement at the four intervals (using a different colored pencil for each interval). Indicate where you find the lowest pH. If you continued this experiment, how would you expect the plume to move?

Write and/or discuss to answer the following questions:

- How would you describe the movement of the contaminated water through the sand?
- Based on you pH samples, where is the plume most highly contaminated?
- What factors in the environment do you think would influence the plume’s movement?
- What does this experiment illustrate about the disposal of household hazardous waste?