

Tracking Pollution ~ A Hazardous Whodunnit

INTRODUCTION:

This activity presents the student with a real world problem and provides a simple, but not always accurate tool for investigating the problem.

The problem is that a town's drinking water is contaminated. In many small towns like Riverville, every home and most businesses have a private well. Lab results from several wells showed that the ground water has been contaminated with a kind of fuel stored by three companies. Of the three possible suspected sources of contamination, each suspect has a reasonable argument as to why they are not responsible for the problem:

1. The Heating Oil Company is the prime suspect since they store the most fuel and sell it to the other two suspected companies.
2. The Heating Oil Co. has just tested their tanks and knows they are safe. They argue that the Trucking Company is the source of pollution.
3. The Trucking Co. says the source could just as likely be the Heating Oil Co. or the Gas Station. They claim there is no proof that they are responsible.

The only way to find out who is responsible is to produce some evidence to help decide which of these is the actual source of contamination. Emphasizing the expense of cleaning up ground water contamination and the need for certainty before forcing a business to begin cleaning up lets the student know that there is often a lot at stake in this kind of investigation.

OBJECTIVE:

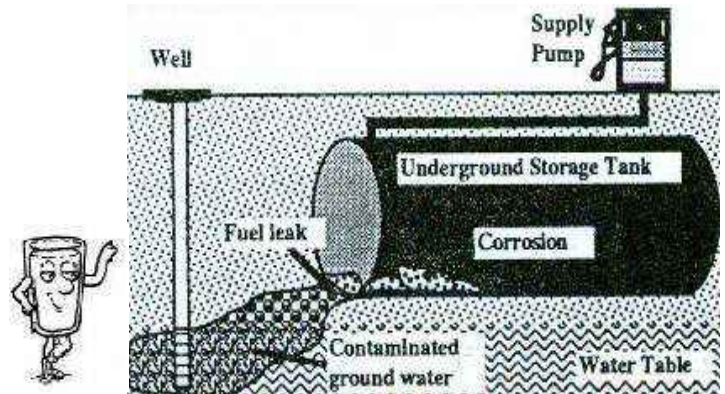
Students will make a topographic map, use it to predict ground water flow and investigate the most likely source of ground water contamination.

GENERAL PROCEDURES:

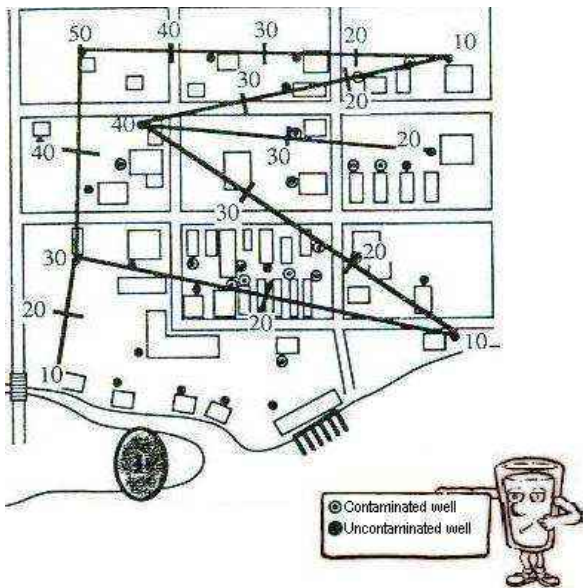
1. It will be best for students to work together in groups of at least two. Each group will need:

- A medium sized rubber band about 1/8 inch in width
- A ruler, pencil and pen
- Student activity sheet

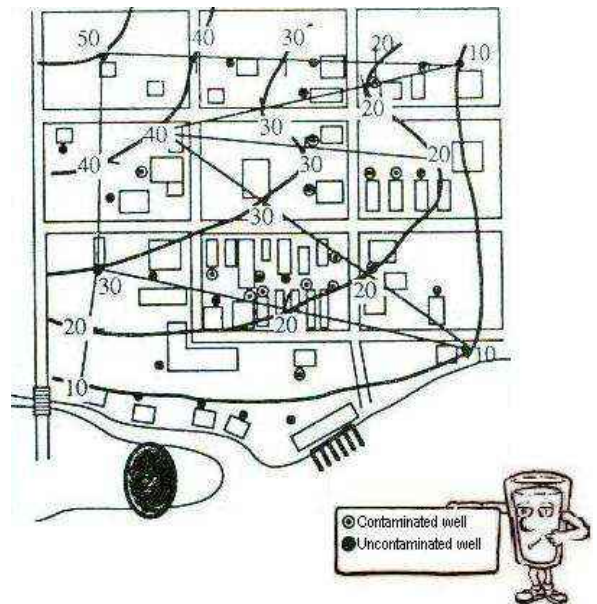
2. Read over with the class the Introduction on the Student Activity Sheet. Ask them which of the three they think is the actual source and have them write down their best guess.



3. You might also explore whether anyone can think of any simpler ways of finding out the source of contamination than by doing this activity. Point out the fact that another way of finding out whodunnit is to test the contaminated wells again to find out which wells have more contaminant in the water. The wells nearest the source should have the highest levels; those farthest from the source will be lower. This can be expensive though, since lab tests are between \$100 to \$200 apiece.
4. The contours of a landscape can be estimated even if the elevation is known for only a few points, provided the points are well scattered around the area. The procedure used here assumes a constant slope between these known points. If one point is at 10 ft. above sea level and another point is at 50 ft., then when the distance between the points is divided into four equal segments, the elevation will increase 10 ft. over the length of one segment. This process is described in more detail on the next page.
5. The rubber band is used to divide lines into equal segments, depending on the difference in elevations of the endpoints of the line. This process of dividing the lines can be very tedious if done mathematically, and diverts from the point of the activity. Using the rubber band method simplifies the process considerably. Cut the rubber band open and lay it out flat, without stretching it, along the edge of a ruler. With a pen, make at least five marks 1/2 inches apart beginning from about the middle of the band. Step 6 on the next page describes how to use it to divide a line.

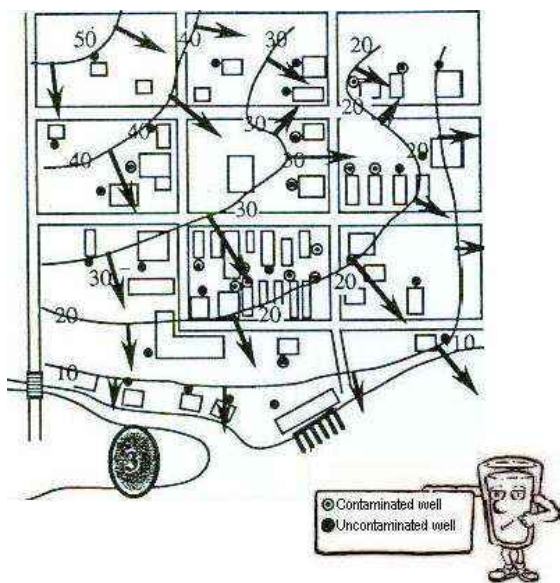


6. LIGHTLY, with pencil, draw lines between each well and its nearest neighbors having at least a 20 foot difference in elevation. To divide these lines into equal segments representing 10 ft. increases in elevation, stretch the marked rubber band so that a mark is over each well at the line's endpoints, with the necessary number of marks between to allow you to count up by tens from one well to the next. For example, a line between the two wells at 10 and 40 ft. needs two marks between the wells.

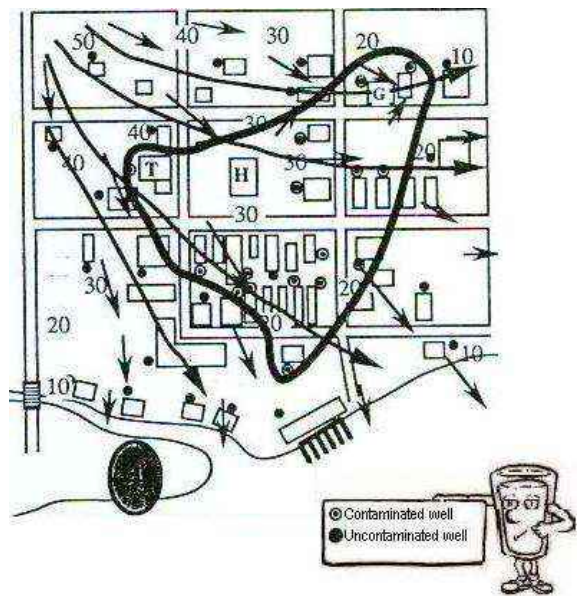


Stretch the band so that a mark falls at each endpoint on the line and two marks lie between the endpoints. Make marks on the line at each of the two intervening marks on the stretched band. Label these marks 20 and 30 ft. Repeat for each line.

7. LIGHTLY draw smooth curved lines connecting all wells and marks having the same elevations. These are contour lines.



8. Using a PEN, every half inch or so along each contour line, draw short arrows outward perpendicularly from one contour line to the contour line having the next lowest elevation. It is important that these arrows be as perpendicular as possible to give the best estimate of the direction of ground water flow. Erase the contour lines and other penciled-in lines to make the map less confusing. To get a better sense of overall direction of flow, you might want to draw a few longer arrows which average out the shorter ones.



9. Draw a loop that groups together all of the contaminated wells. From the flow arrows, note that the plume has spread in two directions, to the top right corner and to the lower left. It should be clear that the Trucking Co. (T) is the source of pollution. Also, the uncontaminated well found within the cluster of contaminated wells is a newer, deep well which taps an aquifer protected by an underground layer of dense rock (shale) which keeps fuel out. This may serve as a lead-in to the Resource Management Activity.

