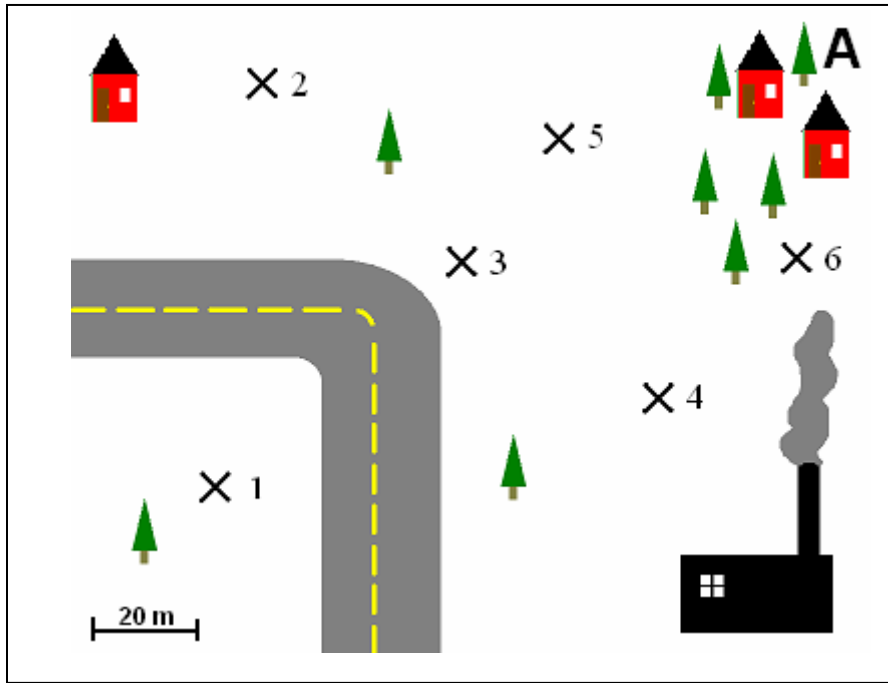


Groundwater Pollution Worksheet



PART 1

- Find the pH at each sample site. Label the *concentration* as high (H), low (L) or none(N). Draw the direction of the contaminated groundwater flow on the diagram.

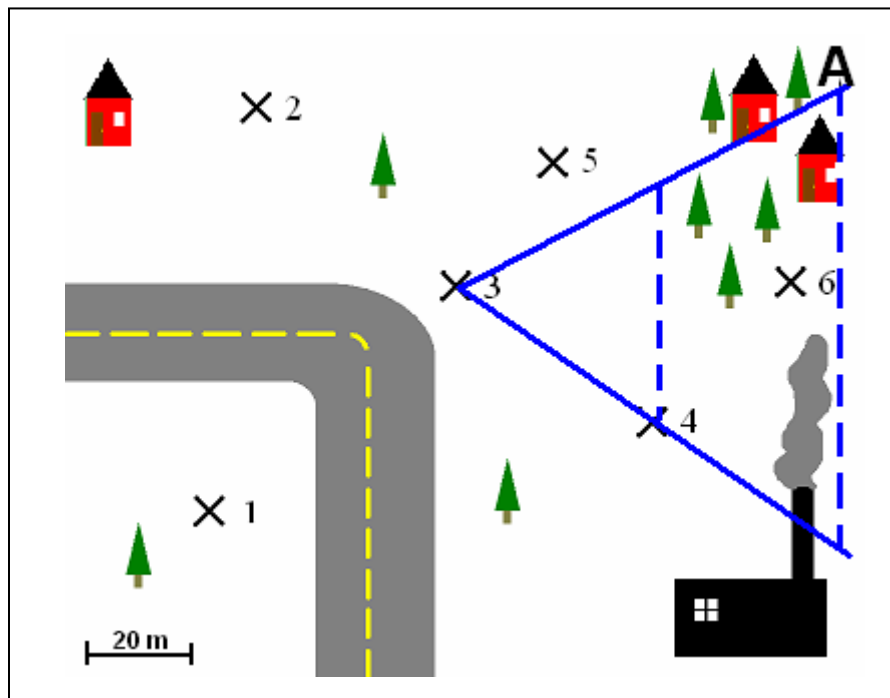
Sample #	pH	Concentration (H, L or N)
1		
2		
3		
4		
5		
6		

- Why might the groundwater flow in that direction?

Name: _____

Date: _____

Now, we are going to *predict* how fast it will take for the contaminant to reach Community A using the diagram below. You will need a ruler.



3. First, soil samples were taken at site #4 over one year. On the 10th month, a rise in the level of contaminants was found. Find the velocity of the contaminant at sample site #4. Remember, Velocity (v) = distance (D) \div time (t).
4. Next, we need to find the area of a cross-section of the contaminant plume at site #4 (shown by the dotted line). Remember Area (A) = width (w) x depth (d). We know that the groundwater is 1 meter in depth.
5. We use the cross section of the area we just found to calculate the Flow (Q) of the groundwater over the whole area. Flow (Q) = Area (A) x velocity (v).

Name: _____

Date: _____

6. Next, we need to find the area of a cross-section of the plume at community A (shown by the dotted line). Remember Area (A) = width (w) x depth (d). We know that the groundwater is 1 meter in depth.

7. Then, we use our flow (Q) from above (assuming the flow is constant) to find the velocity of the contaminant at community A. We rearrange our flow equation to read Velocity (v) = Flow (Q) ÷ Area (A).

8. Lastly, we rearrange our velocity equation to solve for the amount of time for the contaminant to reach Community A. Our equation now reads time (t) = distance (D) ÷ velocity (v).

9. Write your prediction for the time it will take the contaminated groundwater to reach Community A.

Circle the groundwater treatment method you would choose for this site.

Treatment Name	Description	Time
Containment (Physical barriers)	Placing something in the ground to stop the groundwater flow.	1 year
Biological treatment	Adding microorganisms like bacteria that eat the contaminant to make it less toxic.	10+ years
Chemical treatment	Adding chemicals like that react with the contaminant to make it less toxic.	6 months-3 years
Soil vapor extraction	Moving air and vapors through the groundwater in order to remove the contaminant.	3-5 years
Pump and treat	Pumping the contaminated water out of the ground, treat the water and put it back into the ground.	5-10 years

Name: _____

Date: _____

PART 2: Remediation

1. Using the available tools for water treatment, **brainstorm** combinations to get your water sample clean. Make a list of your ideas. Be specific.

2. **Pick one** treatment combination from your above list to test. This is your treatment process. Which treatment process did your group choose and why?

3. **Test** your treatment process and write your observations here.

4. Was your treatment process **effective**? Why or why not?

5. What **improvements** would you make to your treatment process?

6. Test your **modified** treatment process from #5 and write your observations here.

Name: _____

Date: _____

7. Was your second process more *effective* than your first process?

8. What *recommendations* would you make for treatment of this contaminated water?

9. What *constraints* did you consider when you designed your treatment process? (Cost, environmental effects, time, etc.)?