

Cleaning Up Contaminated Soil and Groundwater

Part A - Sites Contaminated by Hazardous Waste

Go to the Environmental Protection Agency (EPA) website, to the page with the address <http://www.epa.gov/superfund/sites/query/queryhtm/nplfin.htm>, and find a map of CERCLA or Superfund sites that have been added to the National Priorities List. Use this site to answer the following questions:

1. How many sites are on the National Priorities List?
2. Which regions of the United States have the highest density of National Priorities List sites?
3. Which state has the largest number of NPL sites?
4. How many sites are listed for your state?
5. Find the Superfund site nearest to your home or school. Click on the site name to find a description of the contamination. Describe the site and the cause of the contamination.
6. Click on the "Site Profile" and read details about the site to answer the following questions. Describe the chemical contaminants at this Superfund site (the one nearest to your home).
7. What will be done to clean up the contamination at this site?
8. How will the land be used after the clean-up is completed?

Part B - Methods to Clean Up Hazardous Waste

Read the handout given to you by your teacher titled, “Natural Attenuation Strategy for Groundwater Cleanup Focuses on Relating Cause and Effect” or go to <http://toxics.usgs.gov/pubs/eos-v82-n5-2001-natural/> in the U.S. Geological Survey website to read an article on the use of bacteria to break down hazardous waste in the soil or in the groundwater. Use the article to answer the following questions.

9. The beginning of the article mentions 300,000-400,000 groundwater contamination sites. Why is this number higher than the number of sites listed on the EPA’s National Priorities List?

10. The beginning of this article refers to groundwater clean-up systems that involve pumping clean water into a region of the soil and pumping water out of another region to extract the contaminated waste water. Why do you think this method of groundwater cleanup is expensive?

11. What do you think are the risks of using this method?

12. What is natural attenuation? (Explain in your own words.)

13. Natural attenuation relies on the native bacteria working without any added nutrients. If nutrients such as nitrogen or phosphorous are added to the soil or water, then the process is called “enhanced bioremediation.” If laboratory-raised bacteria are added to the soil or water, then the process is called “bioaugmentation.” What would be the advantages of using local bacteria that are naturally occurring in the soil and water?

14. The use of bioaugmentation is still in the experimental stage. So far, bacteria grown in the lab do not survive well in the environment. The only class of contaminants for which natural attenuation works well, and is routinely approved by authorities, is petroleum hydrocarbons (gasoline, aviation fuel, diesel fuel). For all other contaminants, natural attenuation is highly questionable and there should be a high burden of proof (but the requirements vary by state). What type of proof would you expect your

state water authority to provide before you felt satisfied that natural attenuation is the best clean-up method for petroleum spills near your home?

15. If using local soil and water bacteria is a natural way to deal with environmental contamination, why do many environmentalists protest natural attenuation?

16. What factors increase or decrease the time that is needed for natural attenuation to occur?

17. Read the section titled, "Fate of Metals from Mine Waste" and study Fig. 2. Use this information to explain how natural attenuation is similar to the Winogradsky column your class set up when you studied water.

Read the handout given to you by your teacher titled, "Phytoremediation: Using Plants to Clean Up Soil" or go to the following address at the U.S. Department of Agriculture site, <http://www.ars.usda.gov/is/ar/archive/jun00/soil0600.htm> to read an article on the use of plants to break down hazardous waste in the soil. Use the article to answer the following questions.

18. What is phytoremediation?

19. Plants that can take up large concentrations of metals that would normally be toxic to other plants are called hyperaccumulators. Describe three different types of contamination situations that can be cleaned up by hyperaccumulators.
 - a.

 - b.

 - c.

20. Once the plants accumulate a toxic metal such as zinc, cadmium or uranium, the metal can be introduced into the food chain if it is consumed by herbivores. Describe a solution to prevent that from occurring (can you think of a way in which this toxin could become a recycled resource?).

21. Using an example, explain why certain plants can hyperaccumulate metals.

In conclusion:

22. Explain how bioremediation techniques (both bacterial and plant) compare to sewage/water treatment techniques.

23. Explore the National Priorities List of sites in your county. Describe a specific site near your house or school that could benefit from one of the clean-up methods that you have learned about today. Be sure to choose a clean-up method that is appropriate for the toxin at the site.