Beach Contamination

Overview

How does hazardous waste end up on our beaches? How easy is it to clean up? In this simulation, students are challenged to find and remove a baking soda contaminant from a plastic shoebox filled with damp sand. Working in groups, they create a plan that has the least impact on the environment and keeps within their budget. Students then conduct the cleanup and learn it may be more difficult than they think to clean up a contaminated beach.

Focus Question

How can hazardous waste be cleaned up with the least impact on the environment while keeping within a budget?

Objectives

Students will be able to:

1. Explain why it is difficult to clean up a contaminated environment.
2. Develop a plan, create a budget, and select appropriate tools to solve a problem.
3. Recognize that there are economic and environmental costs associated with environmental contamination by hazardous waste.
4. Identify individual actions to reduce the amount of hazardous waste.

Background

The Environmental Protection Agency (EPA) defines **hazardous** waste as “waste that is dangerous or potentially harmful to our health or the environment.” Some hazardous waste causes cancer, catches fire easily, explodes, emits toxic fumes, or is corrosive. Hazardous waste can be liquid, sludge, gas, or solid and can include discarded commercial products like cleaning fluids or pesticides as well as by-products of manufacturing processes. Automobile oil, herbicides, pool chemicals, cleaning supplies, paint, gasoline, and compact fluorescent light bulbs (CFLs) are examples of hazardous waste generated by households.

Hazardous waste needs to be specially disposed of and not discarded in regular garbage bins. Sometimes waste can be treated by specially trained hazardous materials (hazmat) teams to physically, chemically, or biologically change the waste into a form that is no longer hazardous. Before and after treatment occurs, however, the waste needs to be stored in containers, tanks, or other storage units, which are often underground. Occasionally, these containers develop leaks, allowing hazardous waste to find its way into the local watershed through groundwater or surface flows, causing **contamination**. Contaminated water may enter agricultural and municipal water systems through wells and irrigation. Cleaning up the contaminated environment is often difficult and costly, both financially and environmentally.

Hazardous waste leaks can be prevented by stricter regulation of waste storage and disposal, limiting amounts of waste produced, and providing incentives for waste reduction. Individuals can help reduce water contamination by reducing the number of hazardous materials we use, buying items with fewer hazardous waste by-products, properly disposing of hazardous household waste (reading labels for how to do so), using all of a product, reusing materials as much as possible and recycling and composting. Educating our friends, families, and neighbors about proper disposal techniques helps, too.

Vocabulary

Contamination: Pollution that harms the environment
Hazardous: Dangerous, causing risk, harmful

Materials

- Cleanup Challenge Instructions
- Shoe box-sized plastic or aluminum roasting pan filled with damp sand/flour*/uncooked rice
- 1-quart bottle filled with water
- Measuring syringe, to inject or withdraw water/chemicals from sand
- Two teaspoons colored baking soda hidden in one spot in the sand/flour/uncooked rice (mix the baking soda with a drop of food coloring)
- Vinegar, for a chemical test (when added to baking soda creates carbon dioxide gas)
- Plastic drinking straws, for coring devices
- Coffee filters or paper towels, to clean contaminated water
- Cotton balls, to clean contaminated water
- Several cups
- String or thread, to lay out a grid of the area for location and/or removal of contamination
- Spoons, to act as bulldozers
- Poker chips or other items to represent money
- Gloves, to remind students the material is potentially hazardous

*If using flour, dampen by using only 1 spoonful of water per 1 cup of flour

Parental Preparation

1. Read over the procedure.
2. Create students' beaches at least an hour before the activity. Pack the sand/flour/rice into the containers. Wet the sand/flour/rice until it is just damp enough to stick together.
3. With a spoon, dig a small hole in the sand/flour/rice and carefully pour in 2 teaspoons of baking soda. Fill in the hole with sand/flour/rice and smooth the surface of each beach.

Procedure

1. *Introduce the focus question*: How can hazardous waste be cleaned up with the least impact on the environment while keeping within a budget? Give students time to write their initial thoughts down or discuss with a partner. Depending on their prior knowledge, you may need to spend some time exploring the concept of contamination first.
2. *Introduce the concept of hazardous waste; lead a discussion about waste.* Questions may include: What are some of the kinds of waste you produce at your house? What items can you recycle? What can you compost? What can you throw away? How come you can't dispose of hazardous household products like cleaners, aerosol cans, batteries, oil and paint in the regular garbage? What about the large amounts of hazardous waste that some businesses and factories produce? Where does it go?
3. *Discuss how ground and water contamination occur.* Tell students that sometimes hazardous wastes are stored in underground containers or other places and may occasionally leak into our watershed, ending up on our beaches and in the ocean. Introduce the word "contamination." An area is contaminated when dangerous or harmful substances are introduced into that environment. Sometimes those substances are liquids or in other forms that are difficult to clean up. Ask students: How are contaminated areas cleaned up? Do you think the cleanup process is simple or difficult?
4. *Pass out contaminated beaches.* Give brief instructions; they need to locate the contaminant (baking soda) on their beaches and then clean it up. Their cleanup method needs to stay within a budget and affect the environment as little as possible. They also need to safely dispose of the contaminant. They will receive a budget of $10,000 for methods and materials. If you are using poker chips to represent money, pass them out now.
5. *Demonstrate methods available for students to use.* Show the available tools to the students. Describe how the tools can be used and how much each use will cost. Refer to the following list for suggestions.
    a. Bulldozers = Spoon — Cost/unit: $5000/scoop
    b. Core samplers = Plastic straw — Cost/unit: $500/core sample
    c. Grid markers = String/thread — Cost/unit: $50
    d. Chemical tests/decontaminants = Vinegar — Cost/unit: $250/test, $5000/ml
    e. Filtration devices = Coffee filters/towels — Cost/unit: $1000/filter
    f. Extraction devices = Syringe — Cost/unit: $500/use
    g. Absorbents = Cotton balls — Cost/unit: $250/cotton ball
    h. Holding containers = Cups — Cost/unit: $500/container
6. *Students develop a draft of their cleanup plan.* Have the students first predict what they think the best materials and methods will be and then create a plan outlining how they will find, remove, and safely dispose of the contaminant. Be sure they include a budget for necessary materials. Review the students' proposals before allowing them to begin excavating. Send them back to the drawing board if the proposal doesn't meet the

criteria (economic, best for the environment, safe disposal). Collect the appropriate fees for the materials needed for each plan.

7. *Students conduct contamination removal and cleanup.* Provide the materials the students included in their budget. Once they have found the baking soda, they should clean it up (place it in a container) and then figure out how to clean the contaminated sand and water. They may choose to use the coffee filters, cotton balls, vinegar, or other materials to make the water and sand/flour/rice clean again.
8. *Discuss the results and student findings.* Ask questions like; Which materials and methods worked the best? At what economic cost? At what cost to the environment? How DO you measure the cost to the environment? How important is it to carefully store hazardous waste? What kinds of difficulties and issues arose during the activity? Are there other ways to purify water and sand? What impact may hazardous waste have on plants and animals?
9. *Return to the focus question.* Now that students have conducted the contamination removal and clean up, have them revisit the question: How can hazardous waste be cleaned up with the least impact on the environment while keeping within a budget?

Beach Contamination Activity
Location: Indoors or outdoors
Duration: 1-2 hours

Cleanup Challenge

Find the hazardous material (baking soda) on your contaminated beach and completely remove it from the beach. Your method must:

- Be as economical as possible.
- Impact the environment as little as possible.
- Safely dispose of the contaminant once it has been removed.

1. Develop a plan.
    - How are you going to locate the contaminant? What materials and procedures might you use?
    - Once you locate the contaminant, what materials and procedures are you going to use to get it out of your beach?
    - Once you remove the contaminant, what materials and methods are you going to use to clean and dispose of the polluted sand/flour/rice and water?
    - Are you under budget? Are there any ways to reduce your overall cost?

Available Tools	Simulated Item	Cost/unit
Bulldozers	Spoons	$5000/scoop
Core samplers	Plastic straw	$500/core sample
Grid markers	String/Thread	$50
Chemical tests and decontaminants	Vinegar	$250/test, $5000/ml
Filtration devices	Coffee filters/Paper towels	$1000/filter
Extraction devices	Syringe	$500/use
Absorbents	Cotton balls	$250/cotton ball
Holding Containers	Cups	$500/container

2. Submit your plan and receive approval.
    - Did you stay within your budget?
    - Did you allow for unexpected expenses and outcomes?
3. Monitor the procedure.
    - Do you need to buy additional materials? Why or why not?
    - How are your procedures working? Explain.
4. Summarize and evaluate the results of the cleanup.
    - What worked well?
    - What would you do differently next time?
    - What advice would you give to people when they are disposing of hazardous waste?
    - What makes cleaning up an area contaminated by hazardous materials difficult?