

Hazardous Waste: Cleanup and Prevention



Our lifestyles are supported by complex industrial activities that produce many different chemicals and chemical wastes. The industries that produce our clothing, cars, medicines, paper, food, fuels, steel, plastics, and electric components use and discard thousands of chemicals every year. At home we may use lawn chemicals, solvents, disinfectants, cleaners, and auto products to improve our quality of life. A chemical that presents a threat or unreasonable risk to people or the environment is a hazardous material. When a hazardous material can no longer be used, it becomes a hazardous waste. Hazardous wastes come from a variety of sources, from both present and past activities. Impacts to human health and the environment can result from improper handling and disposal of hazardous waste. Based on its characteristics, a substance is hazardous if it falls into one or more of the following categories:

Corrosive – capable of chemically wearing substances away (corroding) or destroying them. Corrosives can eat through metal, burn skin on contact, and give off vapors that burn eyes. For example, most acids are corrosive.

Ignitable – capable of bursting into flames. Ignitables pose a fire hazard and irritate the skin, eyes, and lungs. Gasoline, paint, and furniture polish are ignitable substances.

Reactive – capable, under normal conditions, of changing into something else in the presence of other chemicals. When this happens a reactive substance can explode or create some poisonous gases. For example, chlorine bleach and ammonia are reactive.

Toxic – poisonous to people and other organisms. Toxics can cause illness—ranging from severe headaches to cancer—and even death if swallowed or absorbed through the skin. Pesticides, weed killers, and many household cleaners are toxic.

Ideally, hazardous wastes are reused or recycled by a manufacturer, or properly stored, transported, and disposed of to prevent their release into the environment. However, this is not always the case. Storage tanks and barrels can catch fire or leak. Spills can occur at a factory or during transportation. The most technically advanced landfill or storage lagoon can leak. Once hazardous wastes are released, they can be moved by wind, water, or gravity. The cleanup of hazardous wastes can become more difficult the farther the waste moves from the source of contamination. Protecting people and the environment by identifying and cleaning the Nation's most serious hazardous waste sites is the major goal of the U.S. Environmental Protection Agency's Superfund program.

This poster displays various hazardous waste sites and different types of cleanup, methods (labeled in red) used on these sites. Also displayed is how hazardous waste moves once it is released in the environment. The poster is folded into 8.5" x 11" panels; the front and back sides can easily be photocopied.

ACTIVITY

Hazardous Waste Cleanup

Introduction

Hazardous waste can enter the environment by improper storage or disposal methods, or by accident. Once hazardous waste is in the environment, it must be removed or contained. Numerous cleanup methods can be used depending upon the type of hazardous waste, the physical and geographic characteristics of the site, the location of the site, and the threat of the hazardous waste to human health and the environment. If there is an immediate threat to people and the environment from a hazardous waste, the waste must be contained, and the cleanup must begin as soon as possible. An example of an emergency is the cleanup of a chemical spill from an overturned truck. The following activity demonstrates the difficulty in cleaning up a chemical spilled on a body of water.

Objective— Students will experience the difficulty of cleaning up contaminated water.

Materials— Each group will need:

1. One cake pan or similar container approximately 20 cm x 20 cm;
2. 480 mL of clean pea-size gravel;
3. 480 mL of water;
4. One 480-mL clear plastic cup;
5. Three pipe cleaners;
6. One eye dropper, or plastic teaspoon;
7. Ten cotton balls;
8. One piece of nylon stocking 10 cm x 5 cm;
9. Four paper towels;
10. One piece of plastic wrap 10 cm x 5 cm;
11. 120 mL of wood chips; and
12. 30 mL of dark olive oil.

Teacher Preparation

1. This activity is designed for students to work in groups of three.
2. Display a copy of the poster titled "Hazardous Waste: Cleanup and Prevention" on the classroom wall several days prior to conducting this activity.
3. Wash the pea-size gravel.
4. Place the 480 mL of pea-size gravel on one side of the 20 cm x 20 cm container, and pour the 480 mL of water on the other side. Make sure that most of the pea-size gravel remains on one side of the container. This material is to represent a river bank, a lake shore, or an ocean beach. See the diagram below.

Procedure

1. Divide the class into groups of three. Provide each group with one 20 cm x 20 cm container prepared as described above, one 480-mL clear plastic cup, three pipe cleaners, one eye dropper or plastic teaspoon, 10 cotton balls, one piece of nylon stocking 10 cm x 5 cm, four paper towels, one piece of plastic wrap 10 cm x 5 cm, and 120 mL of wood chips.
2. Have each student make an animal from the pipe cleaners and lay it on the pea-size gravel next to the water.



3. Explain to the students that they are going to clean up an oil spill that occurred at a local river, lake, or ocean beach (you pick the name). Inform the students that the pea-size gravel represents the bank, shore, or beach of the local water body.
4. Pour 30 mL of olive oil on the water of each group's model. Have one student blow the oil to the pea-gravel to simulate movement of the water. The students should attempt to clean up the water, shore, bank, or beach, and the animals using any of the materials provided. Encourage the students to test each material and to clean carefully so they can determine which material works best. Have the students place any oil and water removed from the container in the 480-mL plastic cup.

Interpretive Questions

1. Which cleanup material proved to be the best for cleaning up the water? Which material worked the best for cleaning up the shore, bank, or beach? For the animals?
2. Was there a difference in cleaning up the water body when the conditions were calm and when the conditions were rough (blowing on water)?

3. Is there any way that a spill can be contained in one area? How could contaminants spread from the area where the spill occurred? Possible answers include:

By a river, a creek, or a stream.
Vapors can be blown by wind.
Wind can blow small soil particles to which the contamination is attached.
Contaminants can move down through the soil and get in the ground water.

4. How might plants and animals be exposed to contaminated sites? Possible answers include:
Plants can become contaminated through air and water.
Animals can eat contaminated plants, drink contaminated water, or breathe contaminated air.
5. How might people be exposed to contaminants? Possible answers include:
Through the water they drink or the air they breathe.
By eating contaminated crops, meat, or fish.
6. What would happen if the oil spill was not cleaned up? Possible answers include:
The land and water would continue to be polluted.
Pollution would spread, threaten other areas, and affect additional plants and animals.

Extension

Lead a class discussion with the students sitting in a group at a location where they can all see the poster titled "Hazardous Waste: Cleanup and Prevention." Begin the discussion by explaining to the students that thousands of chemicals are used every day. When these chemicals are used and disposed of properly, they can be very beneficial to our lives. When a chemical is no longer needed, it can become a hazardous waste. Proper handling and disposal of hazardous wastes are important to our health. When hazardous wastes are not properly transported, stored, or disposed of, they must be cleaned up. Cleanup of hazardous wastes is difficult and expensive, but it can be done in a safe manner. The students experienced some of the difficulties associated with a cleanup by doing the above activity.

Ask the students what the words "hazardous" and "waste" mean. Then ask the students if they know of any types of hazardous wastes. This should link the activity they just completed to the need for clean up of these wastes.

On the poster, have the students locate the following:

1. Identify five ways that the environment is being contaminated.
Answers: 1. Chemical spill from the truck (air, soil, and surface water)
2. The area cleanup (air, soil)
3. Seepage from the storage lagoon at the area cleanup (soil)
4. The tire fire (air, soil)
5. The landfill (ground water, soil)

2. Identify five hazardous waste cleanup sites or activities.
Answers: 1. The tanker truck spill
2. The area cleanup
3. The pond next to the area cleanup
4. The tire fire
5. The landfill

3. Point out the recycling centers on the poster. Lead a discussion as to why products should be taken to recycling centers instead of pouring them down the drain, dumping them on the ground, or throwing them in the trash. Have the students identify five products that should not be poured down the drain, dumped on the ground, or thrown in the trash. Use rooms of the home to assist students with their answers.
Answers: 1. Garage—Auto products (used motor oil, antifreeze, brake fluid), paint, lawn chemicals, stains
2. Kitchen—oven cleaners, floor cleaners
3. Bathroom—disinfectants, drain openers, toilet bowl cleaners
4. Living room—rug and upholstery cleaners, polish

DEFINITIONS

- Aquifer** - An underground body of porous sand, gravel, or fractured rock filled with water and capable of supplying useful quantities of water to a well or a spring.
- Contamination** - The introduction of harmful or hazardous matter into the environment.
- Ground Water** - Water beneath the land surface that moves through porous or fractured rocks and soils.
- Hazardous Materials** - Chemicals that are corrosive, ignitable, toxic, or reactive, that present a threat or unreasonable risk to people or the environment.
- Hazardous Waste** - A hazardous material that can no longer be used.
- Storage Lagoon** - A small pond used for storage of liquid wastes.
- Monitoring Well** - A well used for the purpose of sampling the quality and determining the direction of flow of ground water.
- Precipitation** - Rain, snow, sleet, mist, or hail.
- Superfund** - The Federal law passed in 1980 to investigate and clean up the Nation's most serious abandoned and uncontrolled hazardous waste sites. It is administered by the U.S. Environmental Protection Agency in cooperation with State and Tribal governments.
- Water Table** - The top of the water surface within an aquifer.
- Well** - An opening drilled or dug into an aquifer that is deep enough to go below the water surface.

Poster Series

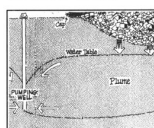
This poster is part of a series of water-resources education posters developed through the U.S. Geological Survey's Water Resources Education Initiative, a cooperative effort between public and private education interests. Partners in the program include the U.S. Geological Survey, Bureau of Reclamation, and the U.S. Fish and Wildlife Service of the U.S. Department of the Interior; the National Oceanic and Atmospheric Administration; the U.S. Environmental Protection Agency; the U.S. Army Corps of Engineers; the Nebraska Groundwater Foundation; and the National Science Teachers Association.

The other posters in the series are entitled "Oceans—Coastal Hazards: Hurricanes, Tsunamis, Coastal Erosion", "Watersheds: Where We Live", "Wetlands: Water, Wildlife, Plants, & People!", "Water: The Resource That Gets Used & Used & Used for Everything!", "How Do We Treat Our Wastewater?", "Navigation: Traveling the Water Highways!", "Ground Water: The Hidden Resource!", and "Water Quality...Potential Sources of Pollution". The posters in the series are designed to be joined to create a large wall mural. A schematic of the wall mural is displayed on this panel. The gray shaded spaces represent the posters listed above. The black shaded space represents this poster.

OCEANS	WATERSHEDS	HAZARDOUS WASTE
WETLANDS	WATER USE	WASTEWATER TREATMENT
NAVIGATION	GROUND WATER	WATER QUALITY

Water-resources topics of the posters are drawn in a cartoon format by the same artist. All poster are available in color. The reverse sides of the color posters contain educational activities: one version for children in grades 3-5 and the other for children in grades 6-8.

Movement



Hazardous wastes released on the land surface can move downward through the ground and into ground water by the force of gravity. Once the wastes are in contact with the ground water, dissolved chemicals move with the water, potentially impacting wells used for drinking water or irrigation. If the wastes are water soluble, they can mix throughout the entire ground-water system. If the wastes are not soluble, they can float on or sink in the ground water.



Hazardous wastes can be released into the air and moved to other locations by wind. Once the wastes are dispersed, they can be breathed by humans and animals. These wastes also can be removed from the air by precipitation and deposited on land or water surfaces where they become available to plants and animals.

Cleaning Up Hazardous Wastes

Before any cleanup takes place at a hazardous waste site, the soil, water, and air are tested to determine what hazardous substances are present and how serious the risk may be to human health and the environment. The type of method used to clean up the waste depends upon the result of the evaluation process. The steps in the cleanup process are: site discovery, assessment, selection of cleanup methods, cleanup, and maintenance.

Response to Emergency



Sometimes hazardous wastes pose an immediate threat to people and the environment. These situations require an emergency response. An example is a truck carrying hazardous waste turning over and spilling the chemicals on the road. Once the immediate danger is dealt with, the site is evaluated to determine if additional cleanup is necessary.

Area Cleanup



When the threat to human health or the environment is not immediate but could occur in the near future, different methods are used to control and clean up the hazardous waste. Sometimes the waste can be cleaned up in a few days, or it might take several years. Cleanup methods are designed to prevent direct human contact with the contaminants from the site, remove the hazardous waste from the site, and prevent contaminants from spreading off the site. For example, leaking barrels full of hazardous wastes could be removed from the area, and the soil could be treated. In certain situations, monitoring wells are installed for the purpose of determining the quality and movement of hazardous waste in ground water.

Containing and Treating



Some hazardous waste sites have been created by years of contamination and require years, even decades, to clean up—such as a leaking landfill containing hazardous wastes. Cleanup can include treating the contaminated ground water and capping the waste materials to prevent additional water from moving hazardous wastes off site.

ORDERING INFORMATION

Copies of all the posters in the series (see Poster Series Panel) can be obtained at no cost from the U.S. Geological Survey. Write to the address below and specify the poster title(s) listed on the Poster Series panel, and grade level(s) desired. The poster "Water: The Resource That Gets Used & Used & Used for Everything!" is also available in black-and-white, intended for coloring by children in grades K-2. In addition, the poster "Water: The Resource That Gets Used & Used & Used for Everything!" with activities intended for grades 3-5 is available in Spanish. There is a minimum shipping charge of \$20.00 or actual cost if greater and \$3.50 handling charge (total \$23.50 in U.S. dollars) applying to ALL orders shipped to locations that are not a U.S. State or Territory.

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U.S. ENVIRONMENTAL PROTECTION AGENCY

The mission of the U.S. Environmental Protection Agency (EPA) is to improve and preserve the quality of the environment, nationally and globally. The EPA works to protect human health and the natural resources on which all human activity depends. In response to growing public concern over health and environmental risks posed by hazardous waste sites, Congress established the Superfund program in 1980 to clean up these sites. The EPA, in cooperation with States and Tribal governments, locates, investigates, and cleans up hazardous waste sites throughout the United States. Superfund's main goal is to protect human health and the environment. It is funded mainly by taxes placed on the chemical and petroleum industries.

U.S. GEOLOGICAL SURVEY

As the Nation's largest water, earth, and biological science and civilian mapping agency, the USGS works in cooperation with more than 2,000 organizations across the country to provide reliable, impartial, scientific information to resource managers, planners, and other customers. This information is gathered in every state by USGS scientists to minimize the loss of life and property from natural disasters, to contribute to the conservation and the sound economic and physical development of the Nation's natural resources, and to enhance the quality of life by monitoring water, biological, energy, and mineral resources.