



LEAKY LANDFILLS

OBJECTIVES

The students will do the following:

1. Define the terms landfill, open dump, and sanitary landfill.
2. Construct and observe a model landfill.
3. List potential water pollution problems associated with unlined or leaking landfills.

BACKGROUND INFORMATION

Americans throw out more trash every day than any other nation in the world. On the average, each American discards four pounds (1.8 kg) of trash per day or 1,460 pounds (660 kg) a year! The United States currently relies on landfills to dispose of almost 160 million tons (320,000,000,000 pounds or 144 million metric tons!) of municipal garbage every year. However, in recent years, many questions have arisen about whether trash disposal in conventional landfills is the best possible solution. Unless wastes are carefully managed, they may contaminate drinking water supplies, release toxic vapors into the air, create explosive conditions, or otherwise threaten public health. Landfills are not a bad option if they are designed, constructed, and managed properly.

A poorly designed and run landfill can be unsafe or hazardous to the health of people and wildlife in the vicinity. When rain percolates through decomposing garbage in a landfill, it forms a liquid called leachate. This liquid can percolate through the ground into an aquifer or other body of water such as a stream or lake and pollute the water. Well-designed landfills are watertight to avoid contamination of underground water. Current United States Environmental Protection Agency standards now require double liners and leak detection systems in addition to groundwater monitoring for new landfills. This prevents landfills from polluting the land, air, and water. Unfortunately, properly operated landfills preserve garbage. The best alternatives for tomorrow's waste challenges will include reducing the amount of waste generated, reusing and recycling products, and using other waste disposal alternatives such as composting. In some areas, there are already programs in place which require citizens to recycle certain products.

ADVANCED PREPARATION

- A. Make transparencies of groundwater illustration (included in "Danger—Pesticides!") and "Cross-Section of a Landfill" (included).

SUBJECTS:

Science, Social Studies, Language Arts

TIME:

2 class periods

MATERIALS:

illustration from "Danger—Pesticides!"
illustration (included)

large clear plastic containers (liter bottles)
or plastic cups (for each student)

student sheet (included)

heavy duty scissors

masking tape

permanent ink pen

cotton, paper towels, or coffee filters

large spoons

potting soil

small pieces of plastic (e.g., pieces of broken plastic spoons), pieces of fruit or vegetable, styrofoam, and aluminum foil

vegetable oil

watering can with small holes or spray bottles

newspaper

stick

1 garbage bag

2 cardboard boxes

- B. Have the students collect 1- or 2-liter bottles and bring them to class.
- C. Make copies of the student sheet "Leaky Landfills" (included).
- D. Gather other materials needed.

PROCEDURE

I. Setting the Stage

- A. Discuss what happens to the items they don't need any longer.
 - 1. Ask the students how many trash cans they have in their homes.
 - 2. Ask them what happens to the trash in those cans.
 - 3. Explain that trash or garbage from their homes that is transported in a garbage truck is probably taken to a landfill.
 - 4. Discuss litter and how it contributes to nonpoint source pollution.
- B. Explain that a landfill is a place where wastes (trash and garbage) are dumped, then covered with a layer of soil each day. The soil helps to keep away pests like bugs and rats and prevents pollutants from washing off the site when it rains. (Use a transparency of the teacher sheet, "Cross-Section of a Landfill.")
- C. Open dumps are where people pile up trash in places such as ravines or along roadsides. Landfills look neater than the open dumps, but both can cause pollution problems.
 - 1. Ask students to describe what pollution problems they think landfills might cause.
 - 2. Explain that even though landfills appear nicer than open dumps, underground they can be "leaking" leachate into underground water. When rainwater percolates through decomposing garbage, it forms leachate which can contain harmful bacteria and chemicals.
 - 3. U.S. laws now require liners that prevent leachate from seeping into the ground and polluting groundwater.
 - 4. If the liner breaks, however, the liquid can seep through the opening. To discover a leak in the liner, the groundwater around the landfills is tested on a regular basis. If pollution is found, then it is suspected that the liner has a leak and authorities take the necessary steps to correct the problem.
- D. Display the groundwater illustration from "Danger—Pesticides!"
 - 1. Point out the landfill.
 - 2. Emphasize that chemicals, oil, and other poisons that are put in unlined or leaking landfills can seep through the ground, under and around the landfill, and into the water.
 - 3. If water which supplies home or public wells gets contaminated, people using this water can get sick.

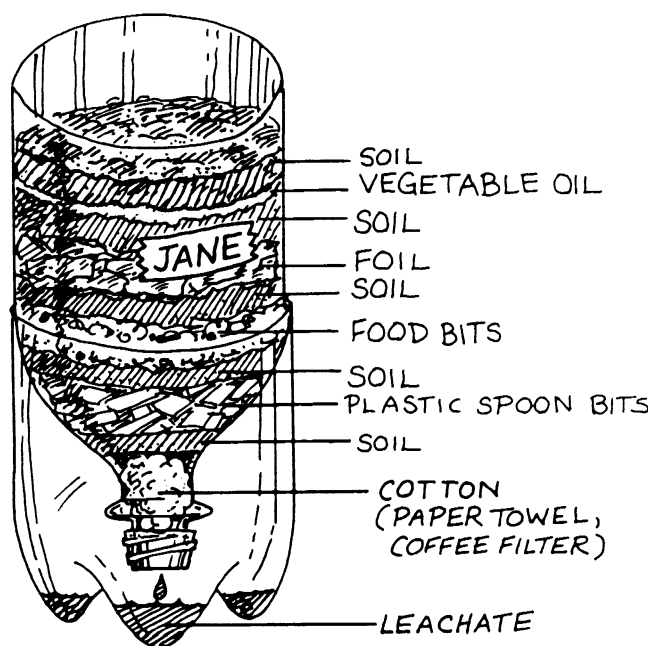
4. Explain that most dangerous wastes are not allowed to be taken to landfills because of the potential of the liner breaking, but some people do not obey the law (or they do not know about them) and they put them in their trash cans anyway. (NOTE: Depending on local, state, or provincial laws, domestic garbage can contain some types of home hazardous wastes.) Until we can find better ways of disposing of dangerous wastes, and until we can get people to learn about laws regarding home hazardous wastes and obey the laws about proper disposal, some harmful wastes will continue to be taken to landfills.

II. Activity

A. Explain that each student is going to do an experiment. Tell them that they are going to make a model landfill.

B. Have each student construct a landfill.

1. Use heavy duty scissors to cut liter bottles into two halves. (NOTE: The teacher should perform this step. You may want to tape the edge if it is jagged to prevent cuts.)
2. Have each student write his/her name on a piece of tape on the upper half of the container with a permanent ink pen. (NOTE: This is the end with the pour spout.)
3. Have the students plug the pour spout with cotton, a paper towel, or coffee filter.
4. Tell them they are going to create a landfill by alternating garbage with soil.
5. Tell them to begin by lining the bottom of the container with soil, and set the top portion into the bottom as shown in the illustration.
6. Use a large spoon to add one of the pollutants, such as plastic spoon pieces, food bits, vegetable oil, or foil, and then cover it with soil.
7. Continue layering soil and garbage until all types of items have been included.
8. Have each student observe his/her landfill for 10 days recording his/her observations on the student sheet. Some will notice the vegetable oil seeping out of the soil. Tell them that the oil represents harmful chemicals or oil which could seep into underground water supplies.
9. During the observation period, sprinkle each landfill with water every other day to keep them damp.
10. After ten days allow students to dump out the contents of their landfills onto newspapers. (NOTE: You may want to do this outside.)



- a. Using a stick to prod around the dirt, have students look at each pollutant and discuss any changes. The foil, plastic, and styrofoam will not have changed (decomposed), but the fruits and vegetables will probably have begun to decompose. Did a syrupy liquid form during decomposition?
- b. Ask students why some items have changed and some have not. (some are biodegradable; some are not)
- c. What kinds of harmful things are in garbage? (bacteria, toxic chemicals)
- d. Ask students if they think it is safe to touch rotting garbage. (no) Why not? (may contain harmful bacteria or chemicals)
- e. Would they want to drink water with a couple of drops of the syrupy liquid in it? Why not? (no, because it may contain bacteria or chemicals which could make them sick)

III. Follow-Up

- A. Tell students that landfills are now built with plastic liners to prevent seepage, but the liners could get torn.
- B. Demonstrate by lining a cardboard box with a plastic garbage bag and assembling a landfill similar to the one above in the container. Or, dig a shallow hole outdoors, line it with plastic, bury some trash, and cover with soil. (NOTE: Get permission from the principal first.)
 1. Have the students discuss the pros and cons of landfill liners.
 - a. Explain that a good landfill design attempts to minimize the amount of leachate formed by minimizing infiltration of rainwater and runoff. They also contain, remove, and/or treat the liquid so it cannot contaminate groundwater.
 - b. Individuals can help by not throwing harmful garbage away which might someday leak into groundwater. Home hazardous wastes should be collected and disposed of on community hazardous waste collection days.
 2. What else could we do to reduce the risks of harmful chemicals leaking from landfills into water supplies? (use less harmful chemicals; use incinerators to burn the chemicals instead of landfilling them. NOTE: This may cause air quality problems.) Use bacteria and other organisms to digest the chemicals and convert them to nontoxic waste. (NOTE: This is only appropriate for certain types of chemicals.)

IV. Extension

- A. Instead of dumping the contents of all the students' landfills out after ten days, leave some of the landfills set up for a month or more and then dump the contents out onto newspaper.
- B. Observe what happens. Some materials will be around for years and years to come, others will break apart and go back into the soil.
 1. Find out how many years it takes for different things to decompose.
 2. Have the students observe what happened to glass, plastic, and aluminum.

- a. Talk about how we can reduce the waste we generate.
- b. Discuss how recycling could reduce the amount of wastes going to landfills. For example, people could write on both sides of paper instead of one side. Or waste computer paper could be saved and the backs used as scratch paper.

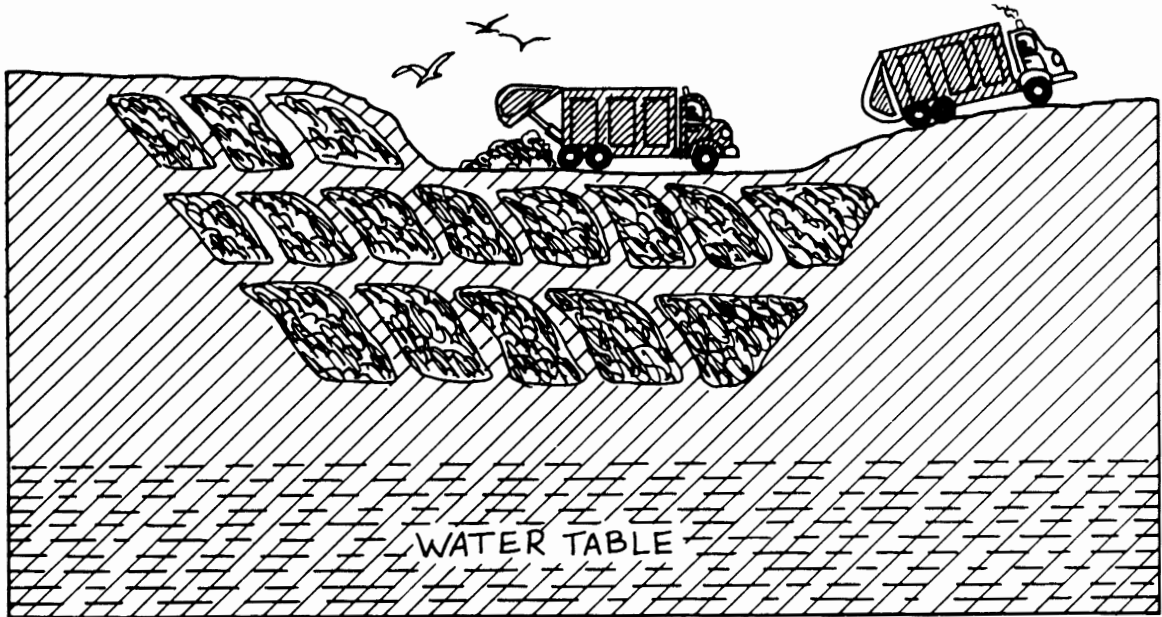
RESOURCES

"Earth Trek. . .Explore Your Environment," United States Environmental Protection Agency, Office of Public Affairs, Washington, DC, 1987.

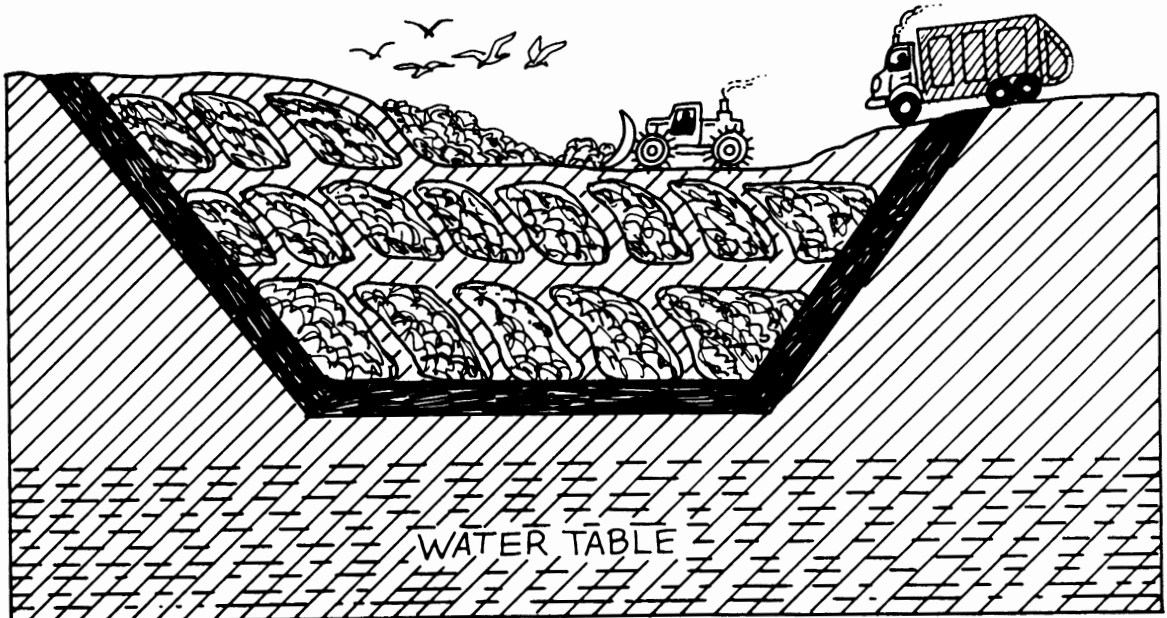
"Groundwater and Land Use in the Water Cycle," poster, University of Wisconsin Extension Service, Madison, Wisconsin, 1984.

CROSS-SECTION OF A LANDFILL

Unlined Landfill



Lined Landfill



Name(s) _____

Date _____

LEAKY LANDFILLS

	Observations
Day 1	
Day 2	
Day 3	
Day 4	
Day 5	
Day 6	
Day 7	
Day 8	
Day 9	
Day 10	

1. Describe what happened. _____

2. Did a syrupy liquid form? _____

3. Which items changed? How? _____

4. Which items didn't change? Why? _____
