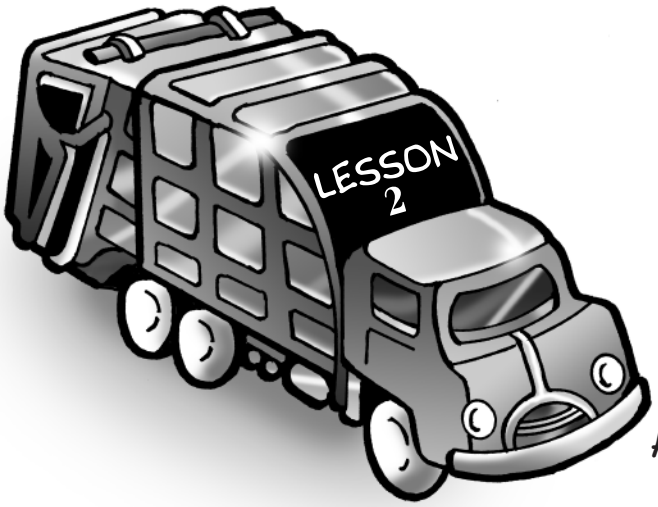



(pre-tour)

# FILL A LANDFILL

## CONCEPTS:

### Students will learn:

- solid waste is composed of a variety of natural resources
- landfills are commonly used to dispose of solid waste
- many natural resources in solid waste are lost once they are buried in landfills
- landfills are designed to protect the environment

## Activity Overview:

Students will:
- determine what natural resources are contained in solid waste products
- construct a model of a landfill and analyze what happens to the waste
- discuss alternatives to burying solid waste in a landfill
- prepare for a field trip to Puente Hills Landfill

## Vocabulary:

- decompose
- disposable
- geotextile
- landfill
- natural resources
- petroleum
- solid waste

## Time Requirement:

- Approximately 60 minutes to construct the model landfills
- Approximately 30 minutes to examine and analyze the contents of the landfill model one month later

## Materials:

☐ The "Class Waste Analysis" from Pre-Tour Lesson 1, if completed.
☐ "Puente Hills Landfill" brochure
☐ "A Day At The Landfill" poster
☐ One-gallon bucket of garden soil (not sterilized potting soil)
☐ Gravel, approximately one half-cup per student group
☐ Clay, approximately one half-cup per student group
☐ Large sheet of felt
☐ Food or lab scale
☐ Transparencies of "Construction of a Landfill in a Bottle" and "Layers in a Landfill"

**For each small group of students (2-4 students per group)**

☐ Two rinsed two-liter beverage containers and caps
☐ One plastic grocery bag
☐ Scissors, tape, two rubber bands, and utility knives
☐ A pair of plastic or garden gloves
☐ Small pieces of assorted clean, nonhazardous waste about one-inch long representing solid waste of various content *(e.g., apple core, banana peel, bread, leaves, aluminum foil, bottle cap, paper clip, penny, rubber band, cloth, nylon stocking, paper towel, newspaper, copy paper, cardboard, candy wrapper, marble, plastic toy, plastic wrap, Styrofoam)*

## Preparation:

☐ Read the "Background Information" at the end of this lesson.
☐ Review the "Puente Hills Landfill" brochure.
☐ Ask each student to bring in a two-liter beverage container and a plastic grocery bag.
☐ For younger students, and if desired for older students, precut the two-liter bottles (see transparency master).
☐ Make a transparency of "Construction of a Landfill in a Bottle" and of "Layers in a Landfill."

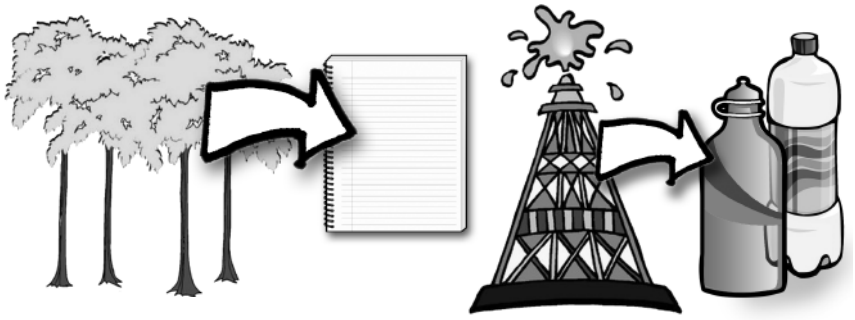
# PROCEDURES

## I. DETERMINE WHAT SOLID WASTE IS AND WHERE IT GOES

(approximately 10-15 minutes)

**A.** Ask students the following questions.

1. **What kinds of items do we commonly throw into the trash can?**
   (***Note:*** *If your class did* ***Pre-Tour Lesson 1: Class Waste Audit****, use the "Class Waste Analysis" chart that students completed in that lesson; otherwise, list items on the chalkboard as students name them.)*
2. **What are these trash items, called solid waste, made from; that is, what natural resources are contained in each item?**



(***Briefly*** *discuss the natural resource base for each category of waste:*

| ***Product*** | ***Natural Resource Base*** |
|---|---|
| *paper* | *trees* |
| *glass* | *sand* |
| *aluminum and other metals* | *mineral ore* |
| *plastic and synthetic fabrics* | *petroleum* |
| *food* | *plants and animals)* |

3. **Where does all this solid waste go after being picked up and hauled away by the disposal company?**
   *(Allow either "landfill" or "dump" as an answer at this time; the difference will be explained when students construct their models.)*

**B.** Have students write and/or draw what they believe a landfill looks like. Encourage them to be descriptive. When students have completed their descriptions, collect their papers to take on the tour to the landfill.

## II. CONSTRUCT LANDFILL MODELS

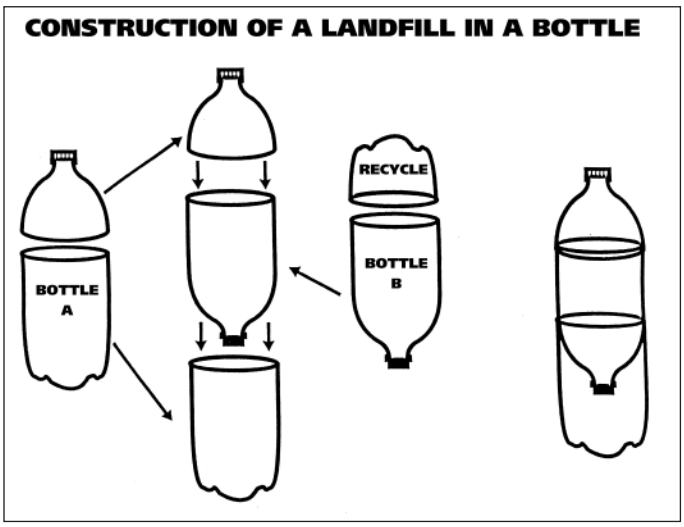
(approximately 30-45 minutes)

**A.** Display the "A Day At The Landfill" poster and have students read the information at the top of the poster.

**B.** Tell students that they are going to be constructing models of sanitary landfills. Remind them that landfills are not "dumps"– areas where waste was once deposited in open piles on unused land. Explain that unlike a "dump," which is no longer legal in the United States, a landfill contains many systems to help protect the environment. Tell students that they will be learning about some of these systems as they build their models.

**C.** Arrange students into small groups (2-4 students) and hand out the materials listed for each group. Project the transparency "Construction of a Landfill in a Bottle" and follow the directions below to have students build their landfill sites:

1. Cut Bottle A 9 inches from the bottom. Cut Bottle B 9 inches from the cap. For safety, make an incision with the utility knife and then let the students cut around the bottles with scissors (or precut the bottles for younger students.) If the edges are jagged, trim them with scissors and place masking tape over them.



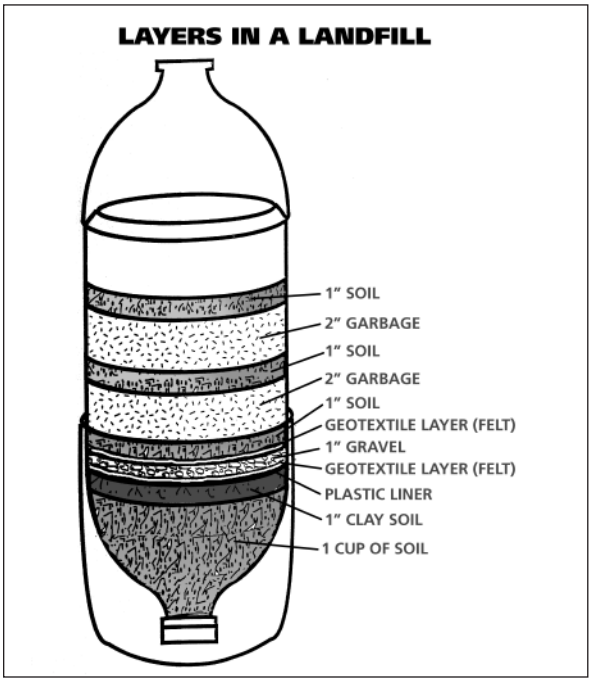
2. Use the bottom of Bottle A as the base of the landfill.

3. Turn the top portion of Bottle B, with the cap, upside down and place it on top of the base. Secure with a rubber band.

4. Recycle the bottom portion of Bottle B.

5. After filling the landfill (see following procedure), place the top of Bottle A, without the cap, on top of the inverted Bottle B. Secure with a rubber band.

D. Project the transparency "Layers in a Landfill" and have students follow the diagram to fill their landfills. Walk younger students through each step. Discuss each of the layers as students are working.




1. *Put about a cup of **soil** at the bottom of the landfill.*
   The soil represents the ground.

2. *Mold the **clay** into a one-inch layer and place on top of the soil. Cut a piece out of the **plastic** bag to fit on top of the clay. (Use the bottom of the bottle as a guide to measure the size.)*
   Clay and a heavy (80 mil HDPE) **plastic liner** are placed on top of the ground to help keep any water that seeps through the waste from reaching the groundwater.

3. *Measure and cut out a piece of **felt** to fit on top of the plastic.*
   In most new landfills, a geotextile layer – like the felt – is placed above the plastic liner. Geotextile is a tough, durable fabric that looks like outdoor carpet. In some landfills, a geotextile layer is also placed below the plastic liner. The geotextile keeps rocks from piercing the liner.

4. *Add about one-inch of **gravel.***
   A layer of gravel or sand collects any liquids – mostly rainwater – that pass through the garbage. Pipes in this layer drain the liquid from the landfill.

5. *Cut and place another piece of **felt.***
   This layer of geotextile separates the gravel and the soil.

6. *Add about one-inch of **soil.***
   Soil acts as the foundation on which the solid waste will be placed.

   All the materials from #2, the clay, through #6, the soil, represent the landfill's ***liner system***.

   (***Note:*** Before proceeding to step 7, have students weigh their solid waste pieces on the food or lab scale and also determine the volume of the waste – that is, how much space it takes up. Tell students that garbage trucks are weighed at the landfill and their drivers pay to dispose of their loads based on the weight of the solid waste, so weight is important. Explain, however, that volume is more important than the weight because it is the volume of solid waste that takes up space.)

7. *Pile the **solid waste pieces** that have been collected about 2-inches deep on top of the soil.*
   The pieces of solid waste represent the variety of products that get buried in landfills every day. Heavy machinery is used to compact the solid waste so that it takes up as little space as possible.

8. *Add another inch of **soil**, more **solid waste** pieces, and finally another inch of **soil.***
At the end of each day, a layer of soil – about 9 to 12 inches – is put over the solid waste. Sometimes a substitute cover – such as ground or chipped old tires, green waste (leaves and grass), or special woven tarps made from plastic – may be used if soil is not available. The next day, more solid waste is spread over the ground, compacted, and then covered by another layer of soil.

E. Ask students the following questions:

1. **What are some actual items that our sample solid waste might represent?**
(• *<u>food scraps</u> represent all kinds of food;*
• *<u>leaves</u> represent grass, dirt, leaves, branches, and other yard waste;*
• *<u>foil, bottle cap, paper clip, and penny</u> represent products made from metal, including small items such as cans and big items such as refrigerators;*
• *<u>rubber band</u> represents products such as tires;*
• *<u>cloth and nylon stocking</u> represent clothes, drapes, bedspreads, and anything made from fabric;*
• *<u>paper products</u> represent anything made from paper, such as writing paper, computer paper, newspapers, boxes, tissue;*
• *<u>marble</u> represents products made from glass, such as bottles, jars, mirrors;*
• *<u>plastic toy, plastic wrap, and Styrofoam</u> represent anything made from plastic, such as bags, cups, containers, toys, furniture, cameras, computers.)*

2. **Why is the garbage covered with soil at the end of each day?**
*(The soil keeps the trash from being blown by the wind; it keeps the garbage from creating an odor; and it keeps animals away from the solid waste.)*

3. **What is the liner system for?**
*(The liner system prevents any liquid that drains down through the landfill from getting into the ground and into the groundwater.)*

4. **How do you think the garbage will change in a month?**
*(**Note:** Record students' hypotheses to compare with the waste that is uncovered in a month or more.)*

5. **What are some advantages to using a landfill to dispose of our waste?**
(• *A landfill can handle large amounts of waste, keeping it away from where people live.*
• *Placing garbage in a landfill is an easy way to dispose of unwanted items.*
• *The landfill keeps other places waste-free.*
• *A landfill is designed to protect the environment.)*

6. **What are some problems with using a land fill to dispose of our waste?**
(• *A landfill takes up space where an ecosystem existed.*
• *Heavy equipment working in a landfill can create noise and dust.*
• *A landfill can create unpleasant odors.*
• *Materials that end up in a landfill are no longer available for people to use.)*

7. **What alternatives are there to using landfills?**
(• *We can reuse and recycle some waste, but not all of it.*
• *We can reduce the amount of solid waste we create by having fewer disposable products.*
• *We can burn some waste in a waste-to-energy plant.)*

8. **How do you think a landfill site is chosen?**
*(Many factors are involved, such as nearness to homes, ecology of the area, soil quality, seismic conditions, movement of water in the ground, location of groundwater basins, accessibility to transportation routes.)*

9. **Is there any way we can completely get rid of our waste?**
*(No. Not all materials can be recycled or composted or burned, so there will always be a need for disposal sites.)*

F. Show students the schematic of an actual landfill on page 5 in the "Puente Hills Landfill" brochure. Point out and discuss the following environmental controls in the landfill:

1. SUBSURFACE BARRIER - This barrier stops any water that has percolated through the landfill from running into the watershed.

2. GROUNDWATER EXTRACTION WELLS - These wells, which are installed in front of the barrier, remove water that has seeped through the solid waste.

3. GROUNDWATER MONITORING WELLS These wells, which are installed behind the barrier, sample the groundwater to be sure that no polluted water has gotten past the barrier.

4. GAS WELLS, TRENCHES, AND COLLECTION PIPES - When organic waste decomposes, it creates methane gas. A network of wells, trenches, and pipes collects this gas and uses it to generate electricity and to produce a clean-burning vehicle fuel.

5. GAS MONITORING PROBES - Probes are placed at the landfill to measure air quality to make sure that methane is not escaping into the air.

## III. PREPARE FOR FIELD TRIP

(approximately 5-10 minutes)

A. Have students read the information below the picture on the "A Day At The Landfill" poster. As they read each section, have them follow the flow on the poster picture.

B. Allow students to look through the "Puente Hills Landfill" brochure. Have older students read about "Solid Waste: Past, Present and Future" on the back of the poster.

C. Tell students that they will be visiting the Puente Hills Landfill to see first-hand how a landfill operates. Ask students to think of questions that they would like to have answered on the tour. If students are having trouble deciding what to ask, prompt them with a few questions, such as:

- Is there an odor?
- What makes the odor?
- Is every kind of waste allowed at a landfill?
- What happens when the landfill is full?

Create a class list to take on the tour, along with students' descriptions of landfills from earlier in the lesson.

PUENTE HILLS LANDFILL

***At least four weeks later…***

## IV. ANALYZE CONTENTS OF MODEL LANDFILLS

(approximately 20-30 minutes)

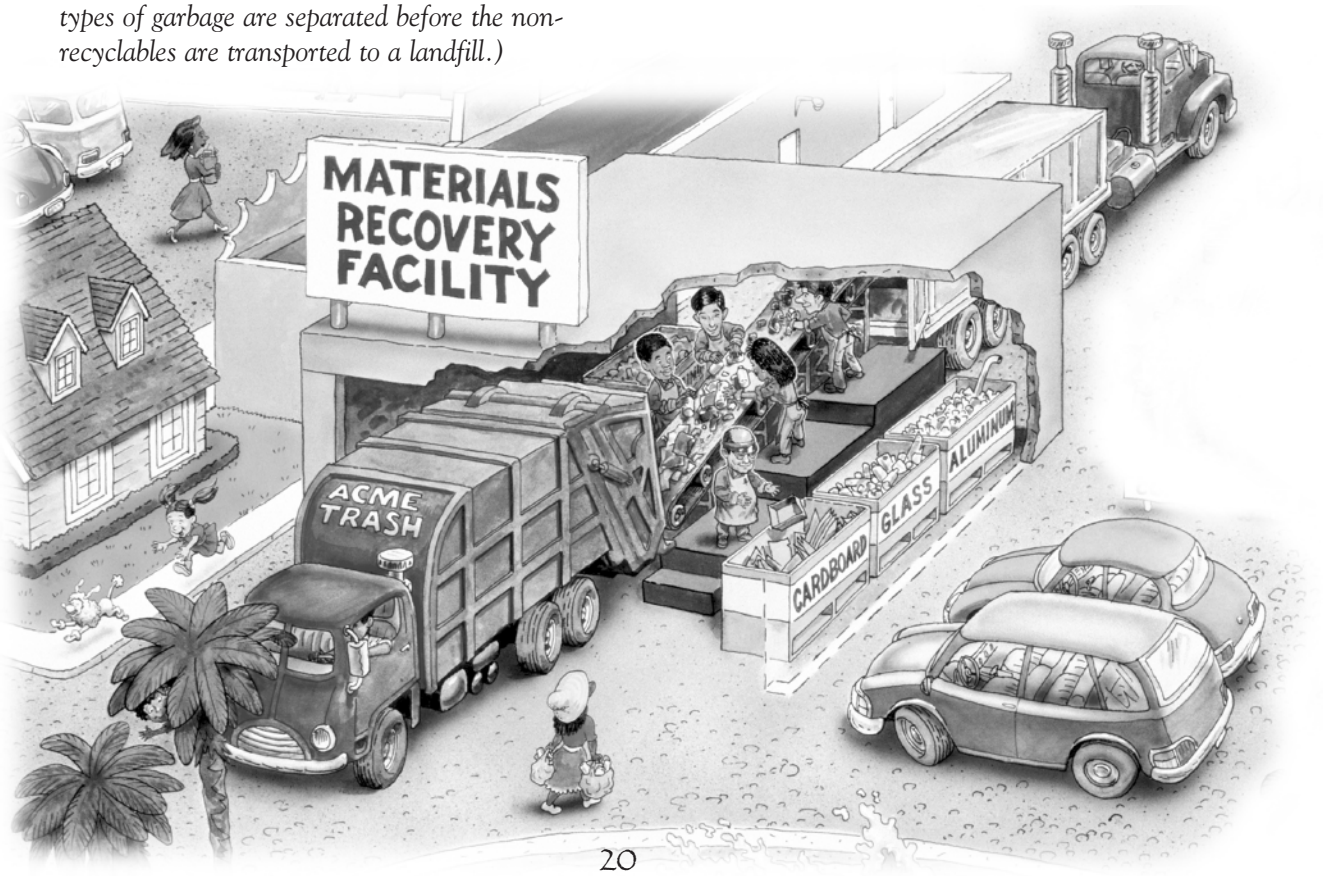
**A.** Provide a pair of plastic or garden gloves to each group of students and have them sort through their landfills. Discuss with students:

1. What is the condition of the items when they are uncovered in their model landfills? Is anything rotting? How does the condition of the items compare to student's hypotheses? *(**Note:** Explain to students that solid waste in landfills also decomposes but the process is slower because not enough air and moisture reaches the waste to help things to break down.)*

2. Is it easy to get the trash out of the model landfills? Would it be easy to try to separate the trash from a real landfill? *(Once the garbage has been covered with soil in a landfill, it is very difficult and would be very expensive to try to remove all the items that could be reused and recycled. Therefore, it is more efficient to separate the recyclable and usable materials before the trash is buried in the landfill, which is what some communities do in a materials recovery facility MRF – where all types of garbage are separated before the non-recyclables are transported to a landfill.)*

3. What solid waste items in the model landfills (including the containers themselves) should be reused, recycled, or put in a landfill after this lesson? *(For example, most communities recycle the polyethylene terephthalate – PETE – bottles; organic wastes, such as banana peels and leaves, can be composted or mulched; pennies can be reused; paper can be recycled; aluminum can be recycled; cloth can be reused or, if made from cotton, silk, wool, or other all-natural fiber, can be composted, where they will break down into their natural elements and compounds.)*

4. How much do all the items weigh that could be reused or recycled, instead of being put in a landfill? What is the percentage of the total weight of the solid waste in the landfill? How much space do you think could be saved if all reusable and recyclable items were kept out of the landfill?



# EXTENSIONS

- **Analyze trash items.** Ask students to select an object discarded in a trash can. Have them describe what natural resources were used to make the object, how the object was made, how it was used, why it ended up in the trash, and what will happen to it now.

- **Conduct a science lab to test decomposition.** Have students choose various materials and test their decomposition rates under various conditions (e.g., exposure to air, exposure to moisture, compaction, in soil with and without worms, in different types of soil). Have students form hypotheses, conduct their experiments, compare the results to their predictions, and then explain what happened and why.

- **Research the history of waste disposal.** Start with the information on the back of the "A Day At The Landfill" poster.

- **Research and report on waste-to-energy plants.**

- **Map current and former landfills in the area.** Have students try to determine why the landfills might have been placed in certain locations and what a landfill's impact has been or might be on the surrounding community. *(Go to www.lacsd.org to find the location of current landfills and waste disposal facilities in Los Angeles County. Go to www.ciwmb.ca.gov to find the location of current and former landfills in California.)*

- *(For younger students)* **Site a landfill.** Break students up into groups and give each group a map of their city. Ask students to find a site for a landfill. Tell them to consider the locations of homes, parks, wildlife areas, major roads, etc. Have each group explain why they decided on their particular site for the landfill. Did where they live influence their choice? As a class, have them choose a location for a landfill.

- *(For older students)* **Simulate the process of siting a landfill.** Divide the class into groups and have each group choose an area that could be a potential site for a new landfill. Have each group research and develop a report for their site considering such factors as:
    - soil type
    - seismic activity
    - surface water and groundwater locations
    - ground slope
    - ecology, including plant and animal life
    - proximity to people
    - proximity to transportation routes

  Have groups present their reports, with both the pros and cons. Discuss each site. Which has the most and the fewest problems? Are some problems worse than others? Have students vote on one site and develop an official Environmental Impact Report (EIR). Explain that according to California law, an EIR must be prepared for proposed projects that have potential adverse environmental affects. The EIR provides information, evaluates environment effects, discusses possible ways to minimize these effects, and analyzes alternatives to the project. *(Search the Internet for sample EIRs; a summary of the Puente Hills Landfill EIR can be found at www.lacsd.org.)*

# BACKGROUND INFORMATION

Californians generate more than 50 million tons of solid waste every year. About a third of this discarded material is recycled or composted. The rest is thrown "away." For most people in California, "away" is the landfill. Every day dump trucks deliver tons of solid waste to landfills, where it is compacted and covered with soil or a substitute cover.

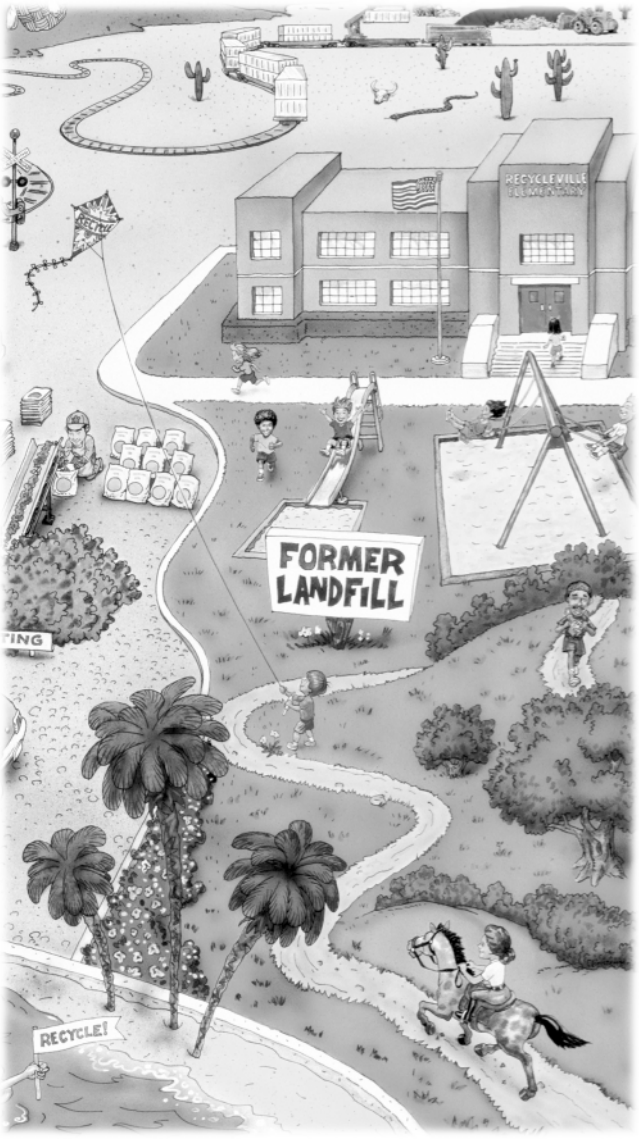
Landfills are essential because people need a place to put their garbage where it can be contained and kept from contaminating the environment. Disposal sites began as just piles of garbage on open land. Terrible odors and rat infestations soon led to burying garbage in pits. But the garbage pits were polluting groundwater. So, garbage that would burn was incinerated in open pits. This definitely reduced the volume of waste, but it also polluted the air. Today when garbage is burned, it is done in waste-to-energy plants, which have strict pollution controls.

Landfills today are required, by law, to incorporate special design features to protect the environment. Layers of impervious clay and a heavy plastic liner, often along with a geotextile layer, keep leachate, which accumulates when rainwater leaches through the garbage, from contaminating groundwater. Systems are in place to monitor the groundwater and surrounding surface waters for contaminants from the landfill. Other systems monitor methane production to ensure that gases given off by decomposition do not become a health risk or pollute the environment. The methane gas at a landfill can actually be collected and used as a source of energy.

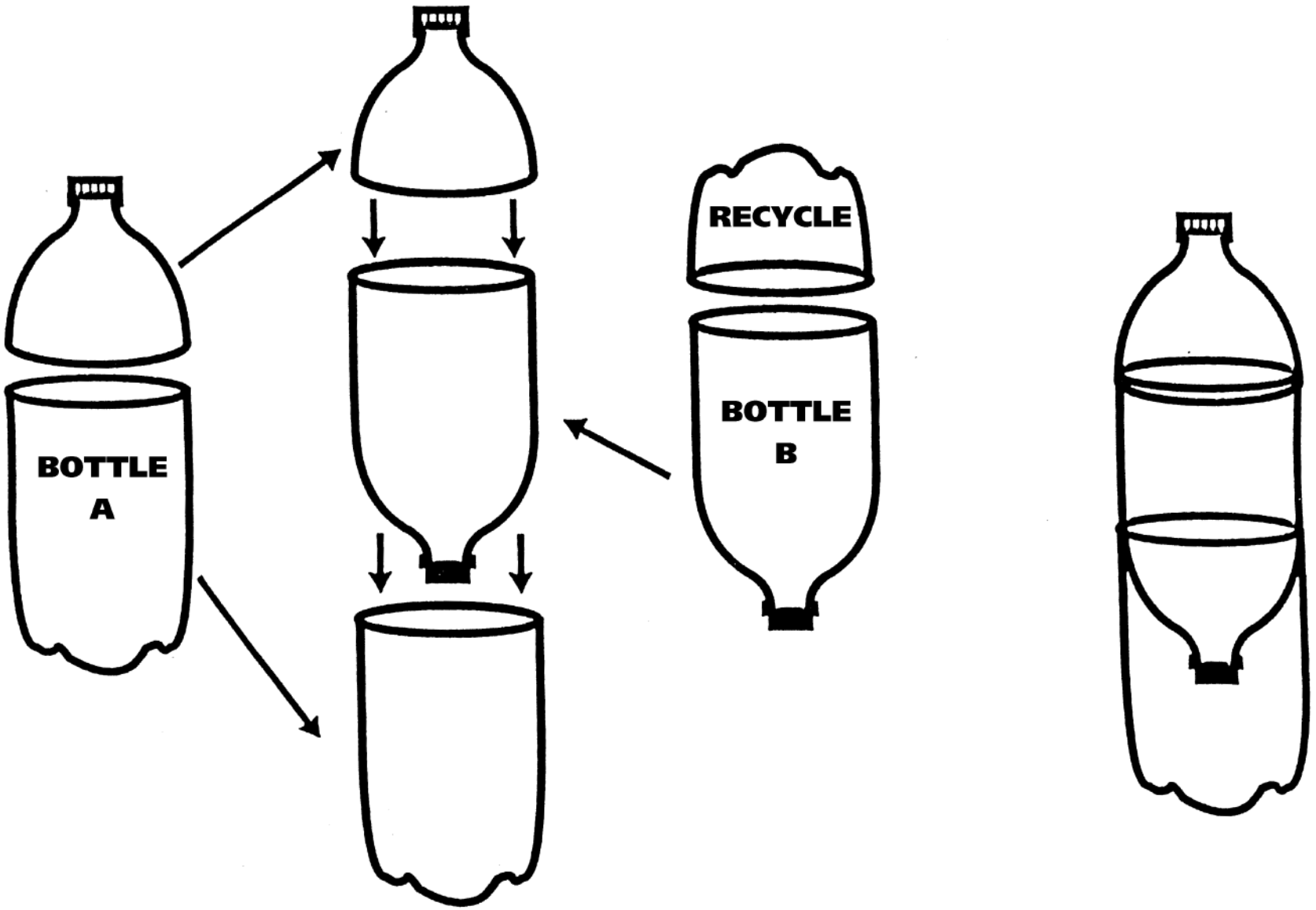
The siting of landfills is a difficult task. Many factors must be taken into consideration when evaluating a potential site, including soil type, climate, hydrology, geology, ground slope, seismic activity, local wildlife, existence of transportation routes, proximity to communities, and proximity to sensitive environments (such as wetlands and flood plains). The pros and cons of each site must be studied and a decision must be made that is ecologically sound, economically feasible, and socially acceptable.

Once landfill sites have reached capacity, they must be capped (closed with layers of clay and soil) and monitored for the buildup of explosive methane gas and for the settling of buried trash. Such sites are often landscaped and used for parks, golf courses, hiking and equestrian trails, and open spaces.

Landfills are necessary for the waste we produce as humans; but landfills are not the best places for waste that can be reduced, reused, or recycled. Once buried in a landfill, some of the natural resources and energy used to make the items can be recovered from the methane gas produced by decomposition; however, many of the natural resources are no longer available.



# CONSTRUCTION OF A LANDFILL IN A BOTTLE



# LAYERS IN A LANDFILL