4–6 Module

Unit 3
Composting

Lesson 1
The Nutrient Cycle and Other Cycles

Lesson 2
Scavengers and Decomposers

Lesson 3
What Decomposes?

Lesson 4
What Is Composting and Why Is It Important?

Lesson 5
Promo and Play on Composting

The unit on composting tied in perfectly with our school garden. There is nothing more motivating for students than hands-on science lessons, particularly those that have a certain level of "grossness." We loved checking on our moldy projects after a two week winter break. All of the lessons are well written, detailed, and easy to follow and adapt.

— Barbara Cronin Hershberg, fourth-grade teacher, Holister Elementary School, Goleta Union School District

4–6 MODULE
Unit 3: Composting
Overview

UNIT 3'S CONCEPT

Organic waste can be recycled through composting to enrich soil and save space in landfills.

The five lessons in this unit are described in the outline that follows.

LESSON 1: THE NUTRIENT CYCLE AND OTHER CYCLES

Lesson's concepts:

- ". . . all organisms create waste through the use of natural resources, and that waste is cycled through natural systems." ("Conceptual Matrix for Integrated Waste Management Education")
- Materials in nature, such as nutrients, are recycled.

In Lesson 1 students will:

- Discuss what happens to leaves in natural environments and in urban environments.
- Observe plants' life cycles on the school grounds and/or in pictures.
- Read or listen to the story, *The Fall of Freddie the Leaf* by Leo Buscaglia, and conclude that leaves decompose after falling on the ground and become part of the soil that will provide nutrients to the tree from which they fell.
- Collect leaves in various stages of decomposition and/or conduct an experiment by placing some leaves on top of the soil and burying some leaves to observe and compare the rates of decomposition.
- Identify examples of cycles on the school grounds.
- Read a book about the life cycle of a tree and identify the parts that describe the nutrient cycle.

LESSON 2: SCAVENGERS AND DECOMPOSERS

Lesson's concept: Scavengers and decomposers are essential to the recycling of organic matter.

In Lesson 2 students will:

- Observe evidence of decomposition.
- Locate some scavengers on the school grounds.
- Make a mural of the scavengers they observed.
- Design a habitat in a container for a specific scavenger, collect several scavengers from the school grounds, keep them for observation for 24 hours, and then release them.
- Conduct research, using reference books on a specific scavenger.
- Grow and compare colonies of decomposers, such as molds, yeast, and bacteria.
- Play a game to identify specific scavengers and decomposers.

LESSON 3: WHAT DECOMPOSES?

Lesson's concept: Most organic materials decompose through the actions of decomposers.

In Lesson 3 students will:

- Bury several objects to test them for their tendency to decompose.
- Observe things on the school grounds that are decomposing.
- Collect litter from the school grounds and identify any packaging materials or bring used packaging material from home.
- Separate packaging materials into those that will decompose and those that will not decompose and test different hypotheses by burying small pieces of different packaging materials.
- Relate how the natural recycling process that gets rid of waste (through decomposition) can be used to lower the amount of waste that goes into landfills.

- Write a story with a "fortunately/unfortunately" format about packaging materials made from organic or inorganic materials.

LESSON 4: WHAT IS COMPOSTING AND WHY IS IT IMPORTANT?

Lesson's concepts:

- Composting is a way of recycling organic matter that might otherwise be sent to a landfill.
- Composting reduces the volume of organic waste and saves landfill space; the compost can be used to improve a soil's structure and fertility.

In Lesson 4 students will:

- Conduct experiments to identify the five essential components in the production of compost.
- Identify materials that can be composted and those that should not be composted.
- Classify materials that are considered green organic matter and brown organic matter to use in a compost pile.
- Use two-liter beverage containers to simulate the conditions of a landfill and of a compost pile and compare the decomposition rates of organic materials in both containers.
- Connect the action of composting to reducing the amount of waste that is sent to a landfill.
- Apply what they have learned by writing about composting.

LESSON 5: PROMO AND PLAY ON COMPOSTING

Lesson's concept: People can reduce the volume of household solid waste that goes to landfills by composting organic waste and then using the compost to enrich soil.

In Lesson 5 students will:

- Complete a project on some aspect of composting to make others aware of the importance of composting.
- Write, rehearse, and perform a play, "By the Skins of Our Bananas," to encourage people to divert their food waste through composting.

Required Books to Implement Unit 3

- **For Lesson 1**
  - Buscaglia, Leo. *The Fall of Freddie the Leaf: A Story of Life for All Ages*. Thorofare, N.J.: Slack Incorporated, 1982.
  - Donahue, Mike. *The Grandpa Tree*. Boulder, Colo.: Roberts Rinehart, 1988.

Recommended Books

- **For Lesson 1**
  - Pfeffer, Wendy. *A Log's Life*. Illustrated by Robin Brickman. New York: Simon & Schuster Books for Young Readers, 1997.
  - Tresselt, Alvin. *The Gift of the Tree.* Illustrated by Henri Sorensen. New York: Lothrop, Lee & Shepard Books, 1992.
- **For Lesson 2**
  - May, John, and Jocelyn Stevenson. *The Magic School Bus Meets the Rot Squad: A Book About Decomposition*. New York: Scholastic, Inc., 1995.

PROJECTS

Projects provide experiences in service learning and project-based learning to students and allow them to apply what they have learned in the classroom. The following describe projects and examples of schools that have accomplished projects that address this unit on composting. Teachers are encouraged to select one of these projects to implement or to have their students develop one of their own. If students implement an applicable project, they and their teachers are encouraged to send a description of the project to the California Integrated Waste Management Board, Office of Integrated Education.

- **Project 1:** Students plant seeds from various species of plants outdoors in a planter or in the school's garden to observe the life cycle of the plants. Every week students measure and record plant growth, describe weather conditions for the week, and illustrate the life stages of each plant. They determine the average length of time of the life cycle for each species

planted. They present their data in a chart form and write a conclusion to their observations. (Lesson 1)

- **Project 2:** Students conduct research on what type of composting activities could work at school. They could also consider vermicomposting. Students plan and implement a composting program. (Lesson 4)

Good Shepherd Catholic School, Pacifica[1]

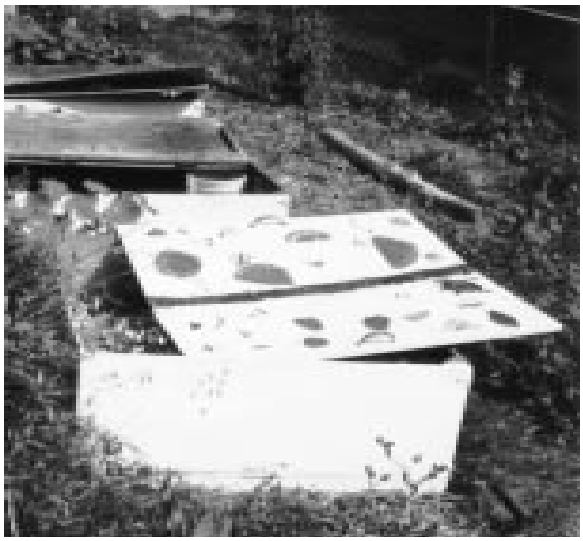
The fifth-grade class at Good Shepherd decreased the amount of food waste going to the landfill through vermicomposting. Groups of students put out collection buckets for food scraps and added them to the worm compost bins after each lunch period. The vermicompost was used to start a school garden.

Rooftop Elementary School, San Francisco Unified School District[2]

Having a well-established garden at Rooftop Elementary School allowed both worm and basic composting to be integrated easily. The school now has three 4- by 4- by 2-foot worm bins for fruit and vegetable scraps and several basic composting bins for garden trimmings. The students eat in the school garden, making collection easy. An average of 15–20 pounds of food waste is collected each week. The worm castings and basic compost are used in the garden.

[1]"Jiminy Cricket's Environmentality Heroes 1994–97." Burbank, Calif.: The Walt Disney Company and the State of California's Environmental Education Interagency Network, 1999, p. 17.

[2]Information provided by Natasha Stillman, School Education Coordinator, Solid Waste Management Program, City and County of San Francisco.



Vermicomposting bins at Rooftop Elementary School, San Francisco Unified School District.

The composting and vermicomposting bins at Lawton Elementary School, San Francisco Unified School District.

- **Project 3:** Students develop a composting plan for the school. The class develops a test to see whether students are disposing food waste properly. (Lesson 5)

Note: Lesson 5 focuses on students conducting a project. A list of projects is provided in that lesson. Students also write and perform a play.

- **Other projects:**

John Muir Elementary School, San Francisco Unified School District[3]

At John Muir Elementary School a fifteen-student "Worm Patrol" team collects food waste from one of the lunch periods. The food is then distributed between a worm bin and a basic composting bin. The worm castings and compost from the basic composting bin are both used as fertilizer and soil amendment in the school's garden, located a half-block away from the school. The garden is used each week by the garden coordinator to teach lessons on gardening and composting to students.

Lawton Elementary School, San Francisco Unified School District[4]

The composting program at Lawton includes two 4- by 4-foot worm bins for vermicomposting and two Smith and Hawken Biostacks for composting. Teams of six students in grades 3–8 rotate over a two week period to monitor the process, collect food, and feed the worm bins. In the 1996–97 school year, an average of 49 pounds of material was composted every week. The compost is used in the school's garden and in the landscaping of the school.

[3]*Ibid.*

[4]*Ibid.*

Valley Springs Elementary School, Calaveras Unified School District[4]

Students at Valley Springs Elementary School recruited the help of parents and local businesses to create a garden in a vacant lot across the street from their school. A composting program was initiated and the compost is being used to enhance the soil in the garden.

Cesar Chavez Elementary School, San Francisco Unified School District[5]

In 1996 a composting program at Cesar Chavez Elementary School was initiated by three teachers as an addition to the garden that was already in place. In 1997 an Americorps volunteer associated with the school took over the project. The school now has seven worm bins, five of which were cut down to accommodate the smaller children. An average of 5–10 pounds of compostable food is collected every week. The worm castings are used as fertilizer in the school's garden.

[4]"Jiminy Cricket's Environmentality Heroes 1994–97." Burbank, Calif.: The Walt Disney Company, Inc., and the State of California's Environmental Education Interagency Network, 1999, p. 25.

[5]Information provided by Natasha Stillman, School Education Coordinator, Solid Waste Management Program, City and County of San Francisco.

Each class at Cesar Chavez Elementary School (San Francisco Unified School District) has a garden area.

The composting and garden area at Laytonville Elementary School, Laytonville Unified School District.

Laytonville Elementary School, Laytonville Unified School District[6]

Putting worms to work has made vermicomposting (composting with worms) successful at the Laytonville Unified School District in Mendocino County. Students from the district's elementary and middle school separate their lunch waste into nonprotein "worm food" (i.e., no meat or dairy products), paper bags, aluminum cans, glass, milk cartons, and garbage. Both the worm food and paper bags (after being shredded) are taken to the worm bins located in the school garden. Under adult supervision, middle school students monitor the bins and record the worms' activities. Students also built four 32-square foot worm bins last spring out of redwood and plywood. A chart showing the amount of compost produced is posted in the cafeteria; the compost and recycling program has reduced school garbage by 60-80 percent.

[6]"Laytonville Composts," *Reusable School News*. Sacramento: California Integrated Waste Management Board (spring 1993).

LESSON 1: The Nutrient Cycle and Other Cycles

LESSON'S CONCEPTS

- ". . . all organisms create waste through the use of natural resources, and that waste is cycled through natural systems." ("Conceptual Matrix for Integrated Waste Management Education")
- Materials in nature, such as nutrients, are recycled.

PURPOSE

Students will learn about the importance of the nutrient cycle and observe the stages and results of the decomposition of leaves.

OVERVIEW

In this lesson students will:

- Discuss what happens to leaves in natural environments and in urban environments.
- Observe plants' life cycles on the school grounds and/or in pictures.
- Read or listen to the story, *The Fall of Freddie the Leaf* by Leo Buscaglia, and conclude that leaves decompose after falling on the ground and become part of the soil that will provide nutrients to the tree from which they fell.
- Collect leaves in various stages of decomposition and/or conduct an experiment by placing some leaves on top of the soil and burying some leaves to observe and compare the rates of decomposition.
- Identify examples of cycles on the school grounds.
- Read a book about the life cycle of a tree and identify the parts that describe the nutrient cycle.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND FRAMEWORKS

- Students identify cycles in nature.
  - "Cycles, such as the water cycle and the nutrient cycle, are characteristics of environments that support life." (*Science Framework*, page 136)
- Students set up an experiment to observe the decomposition process of leaves.
  - "Students will . . . plan and conduct a simple investigation based on a student-developed question and write instructions others can follow in carrying out the procedure." (*Science Content Standards, Grades K–12*; Grade 5; Investigation and Experimentation, Standard 6c)
- Students examine stages of decomposition and locate evidence of plant waste.
  - ". . . all organisms create waste through the use of natural resources, and that waste is cycled through natural systems." ("Conceptual Matrix for Integrated Waste Management")
- Students select a question concerning plant and animal waste or waste that goes into landfills and write an answer to the question in their journals. They share their narratives in groups or with the entire class.
  - Students "use traditional structures for conveying information (e.g., chronological order, cause and effect, similarity and difference, and posing and answering a question)." *(English–Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve*, page 23)
  - Students "make informational presentations." *(English–Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve*, page 27)

- Students listen to or read *The Fall of Freddie the Leaf* by Leo Buscaglia to understand that leaves from a tree die, fall to the ground, decompose, and provide nutrients to the tree. They also read several passages from different books and locate the parts that describe the life cycle of a tree and the nutrient cycle. They compare and contrast the information in these books.
  - Students "compare and contrast information on the same topic after reading several passages or articles." *(English–Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve*, page 22)

SCIENTIFIC THINKING PROCESSES

observing, communicating, comparing, ordering, relating

TIME

20–30 minutes to prepare for the lesson; 45–60 minutes for three or four days to implement the lesson (If doing "Part II" section "B," additional time over several weeks will be needed to observe the decomposition of leaves.)

VOCABULARY

cycle, decompose, nutrient, nutrient cycle

PREPARATION

___ **1.** Read the "Background Information for the Teacher" at the end of this lesson.

___ **2.** Locate areas on the school grounds where students can observe plants in various stages of these plants' life cycles. If the school grounds do not have examples of the different stages of plants' life cycles, obtain pictures of plants to show students plants' life cycles. (See Unit 1, Lesson 3 for an illustration of a plant's life cycle.)

___ **3.** Review "Part II" and decide whether your students will be doing section "A," section "B," or both. If your class will be doing section "B," have students collect 50 leaves. These leaves should be collected from the ground to avoid stripping leaves from living plants, should be fairly uniform in size, and should not yet show signs of decomposition. The leaf collection could be done as a class during a walking field trip on the school grounds, or several students can volunteer to collect leaves from the ground during recess or lunch break. This task can also be assigned as homework.

MATERIALS

For "Pre-Activity Questions"

___ The book, *The Fall of Freddie the Leaf* by Leo Buscaglia
___ A potted plant

For "Part I, Observing Plants and Their Life Cycles"

___ At least two of the following books: *The Gift of a Tree* by Alvin Tresselt, *The Grandpa Tree* by Mike Donahue, or *A Log's Life* by Wendy Pfeffer (or a similar book that describes the life cycle of a tree)
___ If no examples of plants in the various stages of plants' life cycles are present on the school grounds, use pictures of plants.

For "Part II, Studying the Decomposition of Leaves"

Materials for section "B":

___ Leaves (approximately 50 that are uniform in size and not showing obvious signs of decomposition)
___ Several 1-gallon containers (e.g., 1-gallon milk or water jugs with tops cut off) to be used for group study or one large bucket to be used for class study (Commercial 1-gallon pots are too small in circumference for the experiment in this lesson; therefore, the wider 1-gallon milk jug is recommended.)
___ Damp garden soil (not sterilized potting soil) to place in containers into which leaves will be placed (Obtain enough soil to fill each container half full. Make certain that the soil is damp, like a wrung-out sponge.)
___ Spray bottle
___ Rulers

PRE-ACTIVITY QUESTIONS

A. Begin reading *The Fall of Freddie the Leaf* by Leo Buscaglia. Read the first 12 pages (or have students read these in pairs, small

groups, or as a class) up to: "Daniel told Freddie that this wonderful season was called fall." Discuss what the students think will happen to Freddie.

B. Ask students:

- What do you think happens to leaves that fall in people's backyards and on city streets? *They go to a landfill; they are burned; they are composted.*
- What happens to the leaves if they go to a landfill? *They get buried; they disappear.*
- What happens to leaves when they get burned? *They turn to ashes.* What do people usually do with ashes? *Place them in a garbage can that goes to a landfill; put them in a garden.*
- What type of pollution does the burning of leaves create? *Air pollution.*
- What happens to leaves if they get composted? (Discuss what composting means to students.) This topic will be addressed in Lesson 4.

C. Ask students what happens to leaves in nature, for example in a forest, after they fall on the ground. *They disappear; they break down; some animals eat them.*

D. Ask students to look at the potted plant.

- What will we probably do with it when this plant dies? *Throw it in a garbage can; feed it to the red worms.*
- What would happen to the plant if it lived on the school grounds and died? *The custodian would pick it up and throw it in a garbage can or a compost bin; it'll just lie there; something might eat it.*
- What would happen to the plant if it grew and then died in a forest? *Something might eat it; it might turn into soil.*
- What can make a plant's parts turn into soil? *Bugs and small things, red worms, bacteria and fungus, water.*
- What would happen if everything that ever died (plants and animals) and all the parts of plants (e.g., leaves) and animals (e.g., droppings, feathers, fur) stayed where they were and did not decompose? *We would have a big mess.*

E. Ask students to think of a bicycle. What part of the bicycle is the "cycle"? *The round wheels.* Ask what students think a *cycle* is. *A cycle is something that goes round and round.* (A cycle is a series of changes that lead back to a starting point.) Ask students to think about the seasons: winter, spring, summer, fall, and back to winter. How is that a cycle? *The seasons repeat in sequence and go back to a starting point.*

PROCEDURE

Part I, Observing Plants and Their Life Cycles

A. Tell students that all living things have life cycles. Discuss with students the stages of plant growth from a seed to a mature plant to death. Ask students to offer examples of life cycles of different organisms. (They might select an animal's life cycle).

B. Tell students that they will now focus on plants' life cycles. Lead students outdoors to locate examples of plants in various stages of their life cycles.

- Look for seeds, seedlings, mature plants, and dying and dead plants.
- Select one type of shrub or tree on or by the school grounds which has examples of the various parts of a life cycle of that plant (e.g., seed, seedling, young tree or shrub, mature tree or shrub, dying or dead tree or shrub). Encourage students to observe each stage carefully and to describe what they see. (They can later describe or draw what they saw in their journals.) Return to the classroom.

Note: If you do not have examples of the different life stages of a plant, use pictures.

C. If available, have students skim through the text and look at the illustrations in the following books: *The Gift of a Tree* by Alvin Tresselt, *The Grandpa Tree* by Mike Donahue, *A Log's Life* by Wendy Pfeffer, or similar books that show the life, death, and decomposition of a tree.

- Ask them to describe a tree's life cycle.
- Then have them verbally compare and contrast the information (written and pictorial) from the different books. This can be done in small groups or as a class. Students can focus on how each book described the life cycle and

the similarities and differences in the descriptions and illustrations of the different books.

Homework Assignment: Ask students to draw or write about the life cycle of a tree or other plant.

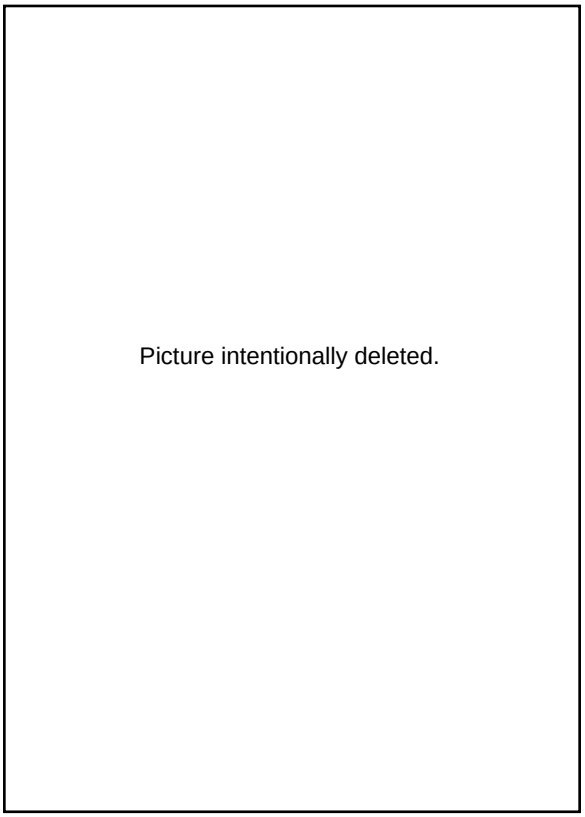
Part II, Studying the Decomposition of Leaves

Do section "A" or section "B" or both.

A. Tell students that they will be observing the decomposition of leaves. Have students make a class collection of leaves in various stages of decomposition.

B. Have students study the stages of decomposition by setting up an experiment. One way to do this is described below:

1. Collect freshly fallen leaves from the same bush or tree and select 50 that are relatively equal in size (or pick 50 leaves from a plant that can spare these). The leaves should not show signs of decomposition.



At the Solar Community Housing Association, Homestead CO-OP, children gather leaves for observation.

2. If you want each group of students to have its own container of leaves to observe, provide a gallon-size container half full of damp soil to each group. If you want to use only one container for a classroom demonstration, use one 5-gallon bucket in which to bury the leaves.

3. Ask students to predict what they think will happen to the leaves. *They will disappear; they will break down; nothing will happen.* Ask them to write their predictions in their journals.

4. If groups will be doing this demonstration:

- Divide the class into five groups.
- Provide a gallon container (from a milk carton) of garden soil to each group.
- Have each group bury five leaves under 3 inches of soil and place five leaves on top of the soil.

5. Have students keep the soil moist, but not soggy. (Use a spray bottle to avoid disturbing the soil or leaves.)

6. After two weeks have students examine the first leaf on top of the soil and the first leaf under the soil. They should remove the leaves from the container and keep them out after their observations. Encourage students to draw what they see. Place the leaves that the students observed in a plastic bag to use in lessons 3 and 4.

7. Have students examine a new leaf on top of the soil and one under the soil every one to two weeks until all ten leaves have been examined. Ask them what they see and have them record their observations in their journals.

8. Ask students to draw conclusions about this demonstration. *Leaves break down. They break down faster when buried in soil.* How do their conclusions compare with their predictions? Discuss what could speed up the decomposition. *More moisture, adding red worms, stirring the soil and leaves to add more air.*

Note: The topic of how to speed up the decomposition process will be further addressed in Lesson 4.

C. Complete the reading of *The Fall of Freddie the Leaf* by Leo Buscaglia. Lead students (using the deduction method through questions) to infer that Freddie the Leaf *decomposed* after dropping to the ground *and became part of the soil.*

Part III, Studying the Nutrient Cycle

A. Ask students what is considered waste in nature. *Leaves, animal droppings.* Why are we not surrounded by nature's waste? *Decomposers decompose waste.* Tell students that plants also create waste. Ask them what this waste could be. *Leaves, branches, flowers.* Explain that when parts of plants fall off the plant, these parts break down through the efforts of bacteria and fungi. Students will study bacteria and fungi in Lesson 2. The broken-down parts become part of the soil, providing nutrients to the tree, thereby continuing the cycle. The nutrients are also used by new plants growing in the area. Nutrients are chemical elements or compounds that an organism must take in to live, grow, and reproduce. Nutrients include protein, vitamins, minerals, and carbohydrates and provide nourishment to sustain an organism. Students will learn more about nutrients in Lesson 2.

B. Have students review or reread *The Gift of a Tree* by Alvin Tresselt, *The Grandpa Tree* by Mike Donahue, or *A Log's Life* by Wendy Pfeffer, and ask them to locate the parts of each book that describe or refer to the nutrient cycle.

DISCUSSION/QUESTION

Ask students to give some examples of cycles in nature. *Water cycle, air cycle, seasons, life cycles.*

APPLICATION

A. Take students on a walk around the school grounds, and ask students to find examples of something that is part of a cycle.

Homework Assignment: Ask students to describe their daily activity cycle. For example, I get up in the morning, wash my face, and brush my teeth. Next I have breakfast. Then I go to school . . ..

B. Encourage students to share their homework assignments.

C. Ask students to write in their journals about one of the following:

- Describe why the Earth is not covered with waste from plants and animals. Include the idea of a cycle in your writing. You can also describe what it would be like if the world was covered with waste from plants and animals. This narrative should be at least two paragraphs long.

Picture intentionally deleted.

Students from Janet Cohen's sixth-grade class at Gold Trail Elementary School reread books about trees and locate parts in the books that refer to the nutrient cycle.

- Describe how humans can use nature's model to lower the amount of waste that goes into landfills. Include the idea of a cycle in your writing. You can also describe what humans are doing with waste that is not like nature's model. This narrative should be at least two paragraphs long.

Note: Students might not yet know about composting. This topic will be covered in Lesson 4.

D. Have students share their narratives in groups or with the entire class. Students can read their narratives or verbally summarize them.

Project Idea: Have students plant seeds from various species of plants outdoors in a planter or in the school's garden to observe the life cycle of the plants. Every week students should measure and record the plants' growth, describe weather conditions for the week, and illustrate the life stages of each plant. They should determine the average length of time of the life cycle for each species planted. They should present their data in a chart form and write a conclusion to their observations.

EXTENSION

Use pumpkins to illustrate a life cycle of a pumpkin.

RESOURCES

Videos

Cycles in Nature. New York: BFA Educational Media, 1980 (9 minutes).

Describes a variety of cycles.

Waste. Take a Look series. Cary, N.C.: TV Ontario, 1986 (10 minutes).

Shows how things decay and the value of recycling.

Books

Allen, Marjorie N., and Shelly Rotner. *Changes*. Photographs by Shelley Rotner. New York: Simon & Schuster, 1991.

Colored photographs show and simple text describes various living things as they go through changes in their lives. For example, the life cycle of a butterfly and a tree throughout the seasons are shown.

Buscaglia, Leo. *The Fall of Freddie the Leaf*. Thorofare, N.J.: Slack Incorporated, 1982.

The story of a leaf named Freddie as he lives through spring and summer and eventually falls to the ground to "serve to make the tree stronger." Colored photographs. Briefly discusses death in a sensitive way.

Donahue, Mike. *The Grandpa Tree*. Boulder, Colo.: Roberts Rinehart, 1988.

Describes the life cycle of a tree and the animals that live in and around it. At the end when grandpa tree falls, the animals make homes in it and the "sawdust mixed with dirt becomes food for flowers."

Johnson, Hannah Lyons. *From Seed to Jack-O'-Lantern*. New York: Lothrop, Lee & Shepard, 1974.

Explains the life cycle of a pumpkin.

Pfeffer, Wendy. *A Log's Life*. Illustrated by Robin Brickman. New York: Simon & Schuster Books for Young Readers, 1997.

Describes the life cycle of a tree and focuses on the life that a log supports.

(Use school's letterhead.)

Dear Parent or Guardian,

Please read the following information with your child:

As part of our composting unit, we are learning about cycles. Please brainstorm with your child his or her daily activity cycle. For example, wake up, get dressed, eat breakfast, go to school, eat lunch, play, do homework, eat dinner, brush teeth, and go to bed. Divide a piece of paper or a paper plate into sections, and help your child draw and label his or her daily activity cycle.

Thank you,

Tresselt, Alvin. *The Gift of the Tree.* Illustrated by Henri Sorensen. New York: Lothrop, Lee & Shepard Books, 1992.

Text and colored paintings describe the life, death, and decomposition of an oak tree.

Audiotapes

Dirt Made My Lunch, recorded by the Banana Slug String Band, 1989.

This tape includes the song "Decomposition" by Steve Van Zandt.

Slugs at Sea, recorded by the Banana Slug String Band, 1989.

This tape includes the song "Water Cycle Boogie" by Steve Van Zandt.

To order the above tapes, call the Banana Slug String Band at 1-888-327-5847.

BACKGROUND INFORMATION FOR THE TEACHER

A cycle consists of a series of changes that lead back to a starting point or involve a continuous sequence of occurrences that are repeated. The water cycle moves water on Earth through living and nonliving things. The life cycle of a tree is a series of changes that the tree goes through from a seed to a mature plant, bearing seeds until the tree dies. Decomposition is part of a cycle that recycles nutrients from dead to living things. A nutrient is any chemical element or compound that an organism must take in to live, grow, or reproduce. Nutrients include protein, vitamins, minerals, and carbohydrates and provide nourishment to sustain an organism. Nutrients are continuously cycled from nonliving things (e.g., air, water, soil) to living things (e.g., plants and animals) and back to nonliving things. These processes are called nutrient cycles.

When a plant or animal dies, decomposers start to use the dead material as food. Decomposers include microscopic organisms like bacteria and fungi (e.g., yeast, mold, mildew). Most of these are not visible with the naked eye. Decomposers break down large organisms made of chemical compounds into smaller and simpler materials, such as nutrients and minerals. This process is called decay, rot, or decomposition. These simpler materials, which are essential for life, can now be used by living plants to grow.

But organisms do not have to die to be part of the nutrient cycle. Waste excreted by animals is also high in nutrients. Plants' parts (e.g., leaves, branches, flowers) that have fallen on the ground contribute to organic material for decomposers to process. Decomposers release these nutrients into the soil. Then plants use these nutrients (along with the energy from sunlight) to live and grow.

Through the process of decomposition, organic waste is converted into resources for living things. If nothing decomposed, the soil would not get back the nutrients that plants need in order to grow. Without nutrients plants could not live, and the animals that depend on the plants for food would die.

All plants have life cycles. For example, an apple tree goes through a series of changes. An apple falls to the ground, and as the fleshy part of the apple decomposes, the seeds remain. A seed germinates in the soil, grows into a seedling, and then into a mature tree which produces seed-bearing fruit that once again fall to the ground and sprout in soil. The tree obtains water, air, and nutrients from the soil.

In this lesson students will look at the nutrient cycle to see how plants' parts that fall on the ground are recycled in nature. In Lesson 2 students will learn about scavengers and decomposers that recycle nutrients. In Lesson 3 students will determine what types of materials decompose.

LESSON 2: Scavengers and Decomposers

LESSON'S CONCEPT

Scavengers and decomposers are essential to the recycling of organic matter.

PURPOSE

Students study about scavengers and see examples of the actions of decomposers.

OVERVIEW

In this lesson students will:

- Observe evidence of decomposition.
- Locate some scavengers on the school grounds.
- Make a mural of the scavengers they observed.
- Design a habitat in a container for a specific scavenger, collect several scavengers from the school grounds, keep them for observation for 24 hours, and then release them.
- Conduct research, using reference books on a specific scavenger.
- Grow and compare colonies of decomposers, such as molds, yeast, and bacteria.
- Play a game to identify specific scavengers and decomposers.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND FRAMEWORKS AND TO *BENCHMARKS FOR SCIENCE LITERACY*

- Students observe ways decomposers change organic matter.
  - "All organisms need energy and matter to live and grow. As a basis for understanding this concept, students know . . . decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals." (*Science Content Standards, Grades K–12*; Grade 4; Life Sciences, Standard 2c)
  - "Organisms in ecosystems exchange energy and nutrients among themselves and with the physical environment. As a basis for understanding this concept, students know . . . over time, matter is transferred from one organism to others in the food web, and between organisms and the physical environment." (*Science Content Standards, Grades K–12*; Grade 6; Ecology, Standard 5b)
  - "Animals and plants sometimes cause changes in their surroundings." (*Benchmarks for Science Literacy,* page 72)
- Students observe scavengers on the school grounds and design habitats for specific scavengers, such as earthworms, sow bugs, beetles, and ants.
  - "All organisms need energy and matter to live and grow." (*Science Content Standards, Grades K–12*; Grade 4; Life Sciences, Standard 2)
  - "By the end of the 5th grade, students should know that . . . Insects and various other organisms depend on dead plant and animal material for food." (*Benchmarks for Science Literacy,* page 116)
- Students write descriptions and facts about specific scavengers. They also write a song about decomposers or scavengers.
  - Students "choose the form of writing (e.g., personal letter, letter to the editor, review, poem, report, narrative) that best suits the intended purpose." *(English–Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve*, page 37)
- Students sing a song about decomposers or scavengers.
  - "Students sing or perform on instruments a varied repertoire of music." (*Visual and Performing Arts Framework,* Music: Creative Expression Component, Goal 3, page 64)

SCIENTIFIC THINKING PROCESSES

observing, communicating, comparing, classifying, relating

TIME

30 minutes to prepare for the lesson; 45–60 minutes per day for six days to implement the lesson; plus time a couple of weeks later to observe the results of decomposers growing

VOCABULARY

decomposition, decomposers, organisms, scavengers

PREPARATION

___ **1.** Read the "Background Information for the Teacher" at the end of this lesson.

___ **2.** Locate an area in the school's neighborhood and/or on the school grounds where students can find scavengers, such as ants, sowbugs, slugs, and worms. Locate rocks, pieces of wood, or paper that students can look under. If your school grounds do not have any rocks or pieces of wood, you will need to find an empty lot within walking distance where these things are present. You could also place (approximately two weeks in advance) some rocks or pieces of wood on the soil, in a planter, or near a corner of a lawn area on the school grounds. (Tell the custodian what you are doing, so the items will not be moved.)

___ **3.** Make two (or more) copies and cut apart the "Scavengers and Decomposers Cards" to provide one card for each student (pages 468-471).

___ **4.** Decide whether you want students to write the results of their investigations in their journals in an open format or have student use the "Decomposers Investigation Sheet." If you decide to use the "Decomposers Investigation Sheet," make a copy for each student (page 472).

MATERIALS

For "Pre-Activity Questions"

___ Examples of nutrients or things that can represent nutrients, such as compost, plant fertilizer, vitamins, a protein drink, a piece of fruit, a leaf, and a stuffed animal to represent a dead animal

___ Butcher paper for a mural

For "Part I, Learning About Scavengers"

___ Quart-sized jar or other transparent container with lid for each group of students

___ Soil, rocks, and other materials for habitats (for scavengers) in containers

For "Part II, Growing Decomposers"

___ One resealable plastic sandwich bag for each group of two or three students

___ Masking tape and marker

___ Half cup of garden soil

___ Piece of bread and pieces of fruits and vegetables

___ Wet paper towels

___ Two slices of a banana

___ Teaspoon of active yeast

___ Four tablespoons of cottage cheese

___ Magnifying lenses (one for each pair of students)

___ Students' journals or a copy of the "Decomposers Investigation Sheet" for each student

For "Part III, Playing a Game About Scavengers and Decomposers"

___ Two or more copies of "Scavengers and Decomposers Cards" (to provide one card for each student)

___ Masking tape or a clothespin to tape or pin a card on the back of each student

PRE-ACTIVITY QUESTIONS

Day 1

A. Tell students that in this lesson they will learn more about decomposers, the organisms that decompose organic material. They will also learn about scavengers, animals that eat dead things or the wastes of living things. Ask students:

- What are nutrients? Show examples of nutrients that you obtained (see "materials" list). *Nutrients include protein, vitamins, minerals, and carbohydrates and provide nourishment to keep an organism alive.*
- How do plants get the nutrients that they need in order to grow? *They get them from the soil.*

- How do the nutrients get into the soil? *Through the work of scavengers and decomposers*. (Students might not know this at this time. Record their answers and refer to their answers at the end of this lesson.)

B. Lead students on a walk around the school's neighborhood and/or on the school grounds to locate organisms (living things) that live under leaves, rocks, or pieces of wood. Students should record in their journals what they see. Was there anything growing on any of the rotting or decomposing things; e.g., mold?

Note: Ask students not to pick up the organisms but, instead, to point out to other students what they found.

C. Go back in the classroom and ask students to draw what they saw, which could include animals, such as ants, sow bugs, and millipedes.

D. To illustrate what the students observed, have them make a mural on a piece of butcher paper, using the drawings of what they observed on the school grounds.

PROCEDURE

Day 2

Part I, Learning About Scavengers

A. Ask students, "What are scavengers?" *They are animals that eat dead things*. Have students look up the word *scavenge* in the dictionary. They should find out that "to scavenge" means to clean away or feed on carrion or refuse; therefore, scavengers feed on dead things. Ask students to name some scavengers and to describe what they eat. *Vultures, crows, seagulls, coyotes, and ants eat dead animal bodies. Some scavengers, like earthworms, eat and break down dead plant parts.*

B. Ask students to look at the mural of the organisms they observed on the school grounds. Tell them that most of the animals they saw are called scavengers. They scavenge through organic matter and eat it. These include worms, beetles, sow bugs, millipedes, slugs, and ants. Where do scavengers live? *In and on top of soil, in logs, under rocks, in damp places.*

C. Lead students on a walk on the school grounds to look for additional scavengers under pieces of wood, newspapers, rocks, and other debris. Look for sow bugs, millipedes, worms, and beetles. Tell students to pay particular attention to each scavenger's habitat (area where it lives), because they will be designing a habitat for them in a container.

D. Back in the classroom, ask how many more scavengers students found the second time. Why did they see more scavengers? *They knew where to look and what to look for.*

E. Have students add drawings of scavengers to the mural.

Homework Assignment: Ask students to begin designing a habitat in which to keep some scavengers. They can draw these, labeling what they will put in the container to make certain that their scavenger is provided with its basic needs (i.e., air, food, water, and shelter).

Day 3

F. Ask students to share their homework assignments. Tell students that they will work in groups to design habitats, where they will keep some scavengers for 24 hours.

Note: The 24-hour rule of keeping an organism provides opportunities for students to observe closely an animal in a humane manner (without causing the animal undue stress or death) and teaches students to respect other living things. After 24 hours each animal should be released in the exact spot where it was found.

- Have students use quart jars or other containers with lids in which to design a habitat for their scavengers. Lids should have holes punched in them to allow air into the containers.
- Ask groups of students to select a specific scavenger and to make a habitat for this organism in the container. Students must make certain that the scavenger is provided with air, food, water, and shelter.
- Tell students that they cannot collect their scavengers until all the habitats they created have been approved by you.

G. When all groups have completed designing the habitats, lead them on a collecting expedition on the school grounds and allow each group to collect two to five scavengers. Students should record in their journals the exact location where they found their

organisms and the type and number of organisms they collected.

Note: The containers should be kept away from direct sunlight.

H. Back in the classroom, organize a viewing and explanation exhibit. Make sure to allow time for students to observe all of the scavengers that were collected.

Day 4

I. On the following day have the students observe their scavengers, sketch them, and write two descriptive sentences about them.

J. Then ask students to release their organisms in the exact location where they were collected.

K. Decide with the class what to do with the soil and plastic containers. *Reuse the soil; reuse or recycle the plastic containers.*

Part II, Growing Decomposers

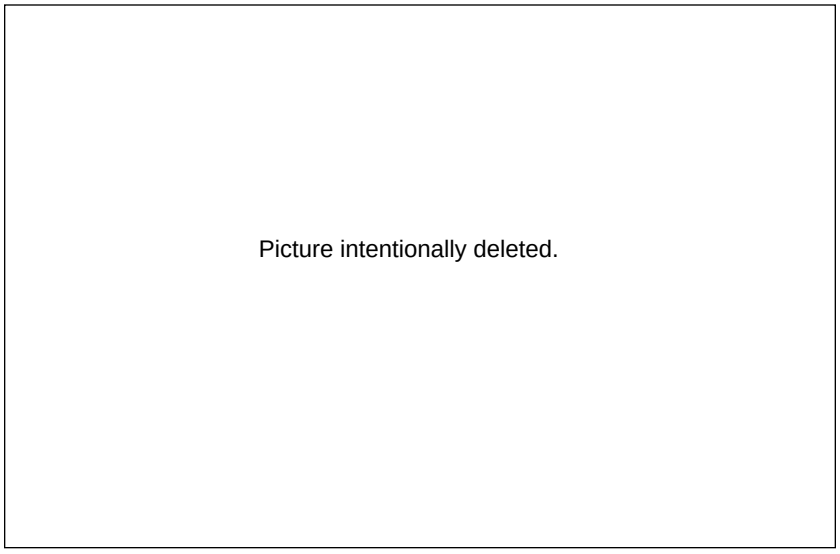
Day 5

A. Set out the materials, including pieces of bread, fruit, and vegetables, yeast, cottage cheese, and plastic resealable sandwich bags.

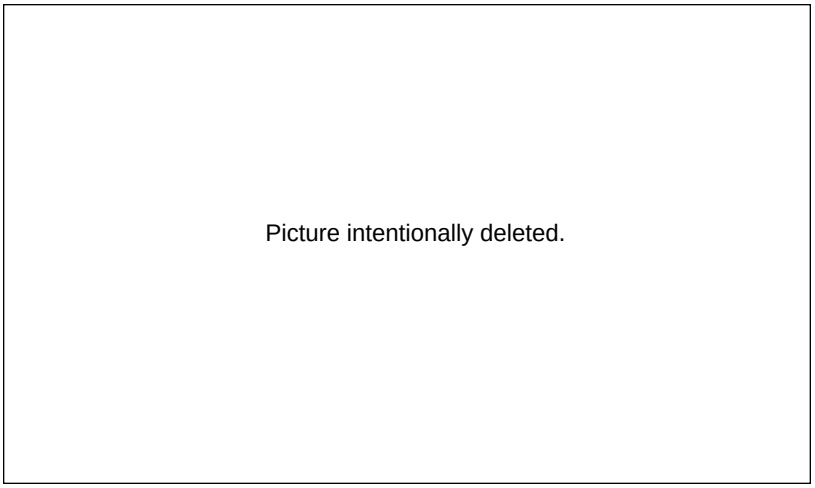
B. Ask students whether they have found food in the refrigerator that had mold or slimy stuff on it. Explain that these are decomposers eating and decomposing the food.

- Tell students that they will try to grow different decomposers in a plastic bag.
- Separate the class into groups of two or three students.
- Provide a plastic resealable sandwich bag to each group of students and a piece of tape on which students should use a marker to write their names and the numbers of their bags.

C. Assign one or two groups to each bag and give them directions (listed below) on how



Two students from Janet Cohen's sixth-grade class at Gold Trail Elementary School place bread in a plastic bag to observe how the bread will change over time.



Two students from Janet Cohen's sixth-grade class at Gold Trail Elementary School place soil in a plastic bag to observe evidence of decomposers growing in the soil over time.

to set up each bag. Ask students to describe in their journals the appearance of the items in the bag and predict how these items will change over time.

Bag 1: Place a piece of bread or pieces of vegetables and a wet paper towel in the plastic bag. Seal the contents, describe the appearance of the items in your journals, and store the bag in a dark place.

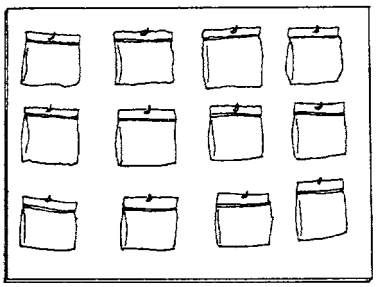
Bag 2: Either drag some pieces of food scraps in the dirt outside or add a half teaspoon of soil to the bag. Moisten the contents. Seal the contents, describe the appearance of the items in your journals, and store the bag in a dark place.

Bag 3: Place a slice of a banana inside a plastic bag and sprinkle the banana with a half teaspoon of active yeast. Seal the contents, describe the appearance of the items in your journals, and store the bag in a dark place.

Bag 4: Sprinkle some garden soil or dirt from the school grounds on a couple of tablespoons of cottage cheese in a plastic bag. Seal the contents, describe the appearance of the items in your journals, and store the bag in a dark place.

Bag 5: Add a half cup of garden soil to a plastic bag. Add water to make the soil moist, but not soggy. Seal the contents, describe the appearance of the items in your journals, and store the bag in a dark place.

Note: The bags can be kept in the dark by storing them in a box with a lid. The bags can also be stored on a board in which small hooks are affixed. A hole can be punched in each bag and the bags hung on the hooks. The entire board can be placed in a dark area or covered with cloth or butcher paper.



D. After students have described the items in the bags, place the bags back in a box or hang the bags on the hooks and leave them undisturbed for a week.

Day 12

Safety Caution: Do not to open the plastic bags. These bags may contain high concentrations of spores, which may be harmful if inhaled or exposed to an open cut or abrasion. Students should be cautioned not to open or puncture the bags. Students should report any accidental opening to the teacher.

E. At the end of a week, redistribute the bags and have students describe what they see without opening the bags.

- Provide magnifying lenses for students to take a closer look at the contents of the bags through the plastic.
- Ask students to draw and describe in their journals what they see. Or distribute the "Decomposers Investigation Sheet" for student to complete. If using the investigation sheets, collect these for students to use in a week.
- Place the bags back in the box or hang the bags back on the hooks and leave them for another week.
- Advise students to wash their hands after returning their bags.

Day 19

F. At the end of week two, redistribute bags and magnifying lenses and have students make their final observations of the contents of their bags without opening them.

- Ask students to draw and describe in their journals what they see. Or redistribute the "Decomposers Investigation Sheet" for student to complete.
- Direct students to carefully return their unopened bags to the teacher for proper disposal. If the contents of the bags are not to be composted, then it would be prudent to attach a note for the janitor to read informing him or her that the trash bags contain student projects of decomposing food, which may contain high concentrations of spores that should not be inhaled.

G. Tell students that they may not be certain what decomposers are growing in their bags, but most likely there will be some of the following:

- **Mold**. Mold is a thread-like organism; some threads will have dark round sacs

that contain spores. Spores make new cells.

- **Yeast**. Yeast cells are shaped like an egg. Some have little bumps on them called buds. These buds grow bigger and break away to become new yeast cells.
- **Bacteria**. Although mold and yeast will also grow in the cottage cheese, there might be small colonies of bacteria that are yellow, cream-colored, or red that look shiny and moist. The grayish cobweb-like look in soil indicates the presence of actinomycetes, a type of bacteria.

H. Have students describe in their journals what they saw in their bags and compare their findings to what they predicted would be in the bags.

I. Conduct a discussion on what the students observed.

Part III, Playing a Game About Scavengers and Decomposers

Day 6

A. Use the cards in this lesson and go over each living thing with the class.

B. Provide one card to each student and ask students to find out two facts about their organisms. For example, what does this organism eat and where does it live? Ask students to write the facts on the backs of their cards.

- Allow students to go to the library or provide books for students to use in their research (see "Resources" at the end of this lesson).
- If students have access to the internet, they can obtain information on the computer.
- If two students have the same organism, they can work together, but they will need to research a total of four facts about their organism.

C. After students have completed their research, ask them to report the information to the class.

D. Gather all the scavenger and decomposer cards and shuffle them. Tell students that they will now play a game. Each student will get a card placed on his or her back. Students will need to ask questions from other students to try to determine what decomposer or scavenger cards they have on their backs.

1. You will need to model the kinds of questions to ask that will lead students to guess the identity of the organism on a student's back. Students should not try to guess the name right away by saying, "Am I a red worm?" Instead they should ask questions that will begin to eliminate some of the organisms. For example, "Do I have legs?" "Am I microscopic in size?"
2. Using tape or a clothespin, place a card on the back of each student. Have students ask questions of other students to guess what decomposer or scavenger cards are on their backs.
3. When students have guessed what cards were on their backs, they can return their cards and get new ones.

E. After the game is over, discuss what type of questions were asked most often to find out about what organisms' cards were on their backs. Have students verbally share something with the class that they learned in this game. Then ask students to write in their journals one fact that they did not know before about one of the organisms.

DISCUSSION/QUESTIONS

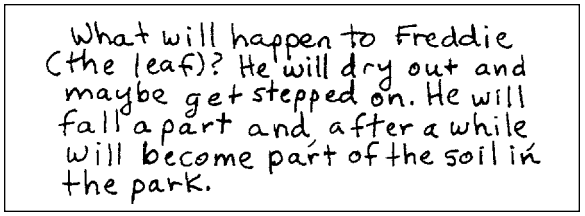
A. Ask students:

- How do the nutrients get into the soil? *Through the work of scavengers and decomposers*. Have students compare their answers to the answers to the same question recorded at the beginning of this lesson.
- What is the role of scavengers and decomposers in nature? *They break down or decompose organic material.*
- What would happen if there were no scavengers or decomposers? *We would be surrounded by dead animals and plants.*
- How do decomposers help plants? *They decompose organic materials into simpler parts that plants can use for growth.*

B. Remind students of the story, *The Fall of Freddie the Leaf,* that they heard in Lesson 1. Ask students what will happen to Freddie. (Older students can write their responses in their journals.) *He will be eaten by scavengers and decomposed by decomposers and will become part of the soil.*

C. Discuss with students:

- Why do metals, plastics, and other human-made things not decompose? *They*



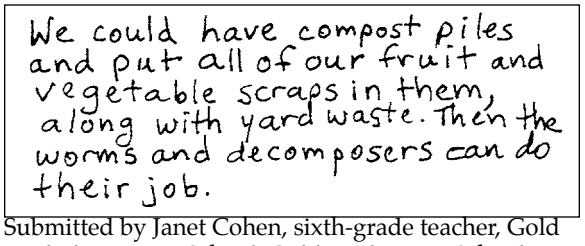
Submitted by Janet Cohen, sixth-grade teacher, Gold Trail Elementary School, Gold Trail Union School District.

are usually not organic. There are no known living things that can eat them and break them down. (This topic will be addressed in Lesson 3.)

- How could people use scavengers and decomposers to reduce the amount of waste going into landfills? (Older students can write their responses in their journals.) *People can keep organic waste out of the landfills and have scavengers and decomposers decompose the organic waste by composting.*

APPLICATION

A. Ask students to write a song about decomposition, decomposers, or scavengers, using



Submitted by Janet Cohen, sixth-grade teacher, Gold Trail Elementary School, Gold Trail Union School District.

a tune everyone in the class knows, such as "Three Blind Mice" or "Old McDonald Had a Farm."

For example:

Decomposition

(Sung to the tune of "Three Blind Mice")
De-compo-sition, de-compo-sition,
See how things rot,
See how things rot.
There's mold, bacteria, and yeast around.
They decompose things into the ground.
They can create a big soil mound.
De-compo-sition.

Homework Assignment: Ask students to look for signs of decomposition and of scavengers on their way to and from school or in their neighborhoods. Caution students not to touch decaying matter. Also, ask students to place back in its original position any rocks or pieces of wood they overturned while looking for scavengers. That way the scavengers will still have their shelter. Students can draw or describe in writing what they saw.

Day 7

B. The following day ask students to share their homework assignments.

EXTENSIONS

A. Read with students the book, *A Log's Life* by Wendy Pfeffer. Ask students to help you list the scavengers that lived in the log and what they eat, as described in the book. *Pillbugs eat dead leaves; millipedes eat decaying plants.*

B. Read with students the book, *The Magic School Bus Meets the Rot Squad* by John May and Jocelyn Stevenson. Have students write and draw a similar story about their own class.

C. Have students participate in a science fair by doing a project on scavengers or decomposers.

D. Organize a decomposer and scavenger appreciation day.

E. Have students compare a red worm to a night crawler.

RESOURCES

Videos

Life on the Forest Floor. New York: BFA Educational Media, 1989 (12 minutes).

The importance of the forest floor and its inhabitants is explained.

Soil and Decomposition. New York: BFA Educational Media, 1986 (16 minutes).

Shows how plant fertilizer is made by nature and how it is manufactured by people. Time-lapse photography shows the decomposition process of dead leaves changing to fertilizer.

Soil and Water: A Living World. Irwindale, Calif.: BARR Films, 1984 (16 minutes).

Shows animals that live in the soil.

Worm Bin Creatures Alive Through a Microscope. Kalamazoo, Mich.: Flowerfield Enterprises, 1998 (31 minutes).

Through a video microscope, a variety of decomposers (e.g., various fungi and bacteria) and scavengers (e.g., red worms, nematodes, sow bugs, and millipedes) are shown.

Slide Set

"The Decomposer Food Web." D.L. Dindal, 1990. Available from J. G. Press, Inc., 419 State Ave., Emmaus, PA 18049; (610) 967-4135.

Contains 70 slides and a script on scavengers and decomposers.

Books

Anderson, Lucia. *The Smallest Life Around Us: Exploring the Invisible World of Microbes with Eight Easy at-Home Experiments.* Illustrated by Leigh Grant. New York: Crown Publishers, Inc., 1978.

Colored illustrations and text (suitable for upper elementary school students) describe various types of microbes, such as molds, yeast, and bacteria.

Donahue, Mike. *The Grandpa Tree*. Boulder, Colo.: Roberts Rinehart, 1988.

Describes the life cycle of a tree and the animals that live in and around it. At the end when grandpa tree falls, the animals make homes in it and the "sawdust mixed with dirt becomes food for flowers."

Forey, Pamela, and Cecilia Fitzsimons. *An Instant Guide to Insects*. New York: Bonanza Books, 1987.

Colored illustrations and text describe insects, including many scavengers.

Henwood, Chris. *Earthworms*. Keeping Minibeasts series. London: Franklin Watts, 1988. Other titles in the Keeping Minibeasts series include: *Ants; Beetles;* and *Snails and Slugs*.

Jaspersohn, William. *How the Forest Grew*. Illustrated by Chuck Eckart. New York: William Morrow & Company, Inc., 1980.

Describes the succession from a grassland to a forest. Also describes the process of decomposition that occurs on the forest floor.

Kalman, Bobbie, and Tammy Everts. *Bugs and Other Insects*. New York: Crabtree Publishing Company, 1994.

Provides information on insects, such as beetles, flies, ants, and termites. Shows the life cycle of a butterfly.

Landry, Sarah B. *Urban Wildlife*. Peterson First Guides series. New York: Houghton Mifflin Company, 1994.

Contains a section that describes the kingdoms of life on Earth. Provides information and colored pictures of many invertebrates that can be found in soil. Also describes vertebrates commonly found in an urban setting.

Lavies, Bianca. *Compost Critters*. New York: Dutton Children's Books, 1993.

Colored photographs and text describe organisms that live in compost.

May, John, and Jocelyn Stevenson. *The Magic School Bus Meets the Rot Squad: A Book About Decomposition*. New York: Scholastic, Inc., 1995.

Ms. Frizzle's class learns about decomposition.

Milne, Lorus J., and Margery Milne. *A Shovelful of Earth.* Illustrated by Margaret LaFarge. New York: Henry Holt and Company, Inc., 1987.

Describes soil; useful as a reference.

Mound, Laurence, and Stephen Brooks. *Insects*. DK Pockets series. New York: Dorling Kindersley Publishing, Inc., 1995.

Colored photographs and text describe a variety of insects. This book contains chapters on specific habitats and associated animals.

Pfeffer, Wendy. *A Log's Life*. Illustrated by Robin Brickman. New York: Simon & Schuster Books for Young Readers, 1997.

Describes the life cycle of a tree and focuses on the life that a log supports.

Pringle, Laurence. *The Hidden World*. New York: Macmillan, 1977.

Describes and illustrates some animals that live in soil.

Silver, Donald M. *One Small Square Backyard*. Illustrated by Patricia J. Wynne. New York: W.H. Freeman and Company, 1993.

Colored illustrations and text describe plants and animals that can be present in a yard, including those found in soil.

Viorst, Judith. *The Tenth Good Thing About Barney.* Illustrated by Erik Blegvad. New York: Macmillan Publishing Company, 1987.

A child's cat, Barney, dies and his father asks the child to determine ten good things about Barney. The tenth good thing is that Barney will enrich the soil in which plants will grow.

Audiocassette

Dirt Made My Lunch, recorded by the Banana Slug String Band, 1989. Distributed by Music for Little People.

Includes the song "Decomposition" by Steve Van Zandt.

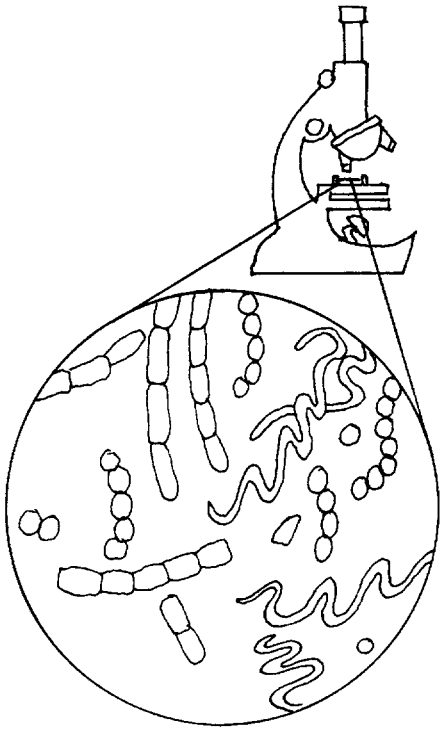
Magazine Article

Johnson, Cecil E. "The Wild World of Compost," *National Geographic,* Vol. 158 (August, 1980), 272–84.

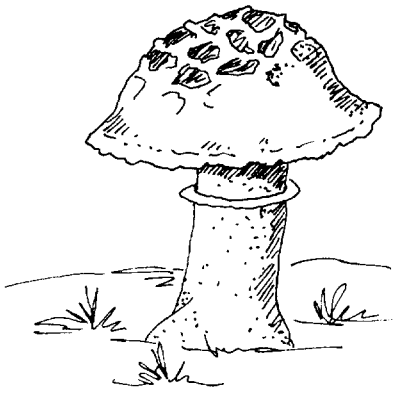
Contains photographs of a variety of scavengers.

SCAVENGERS AND DECOMPOSERS CARDS

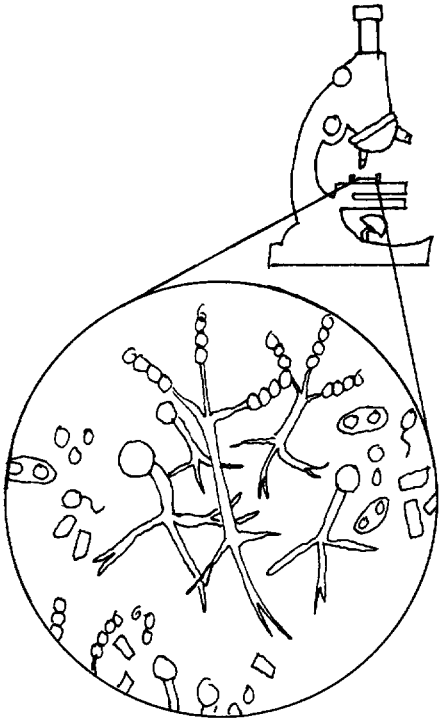
1. Bacteria



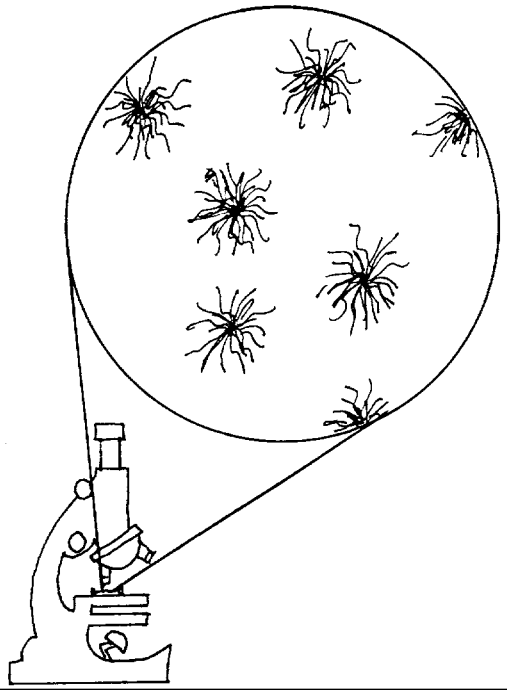
2. Fungus—mushroom



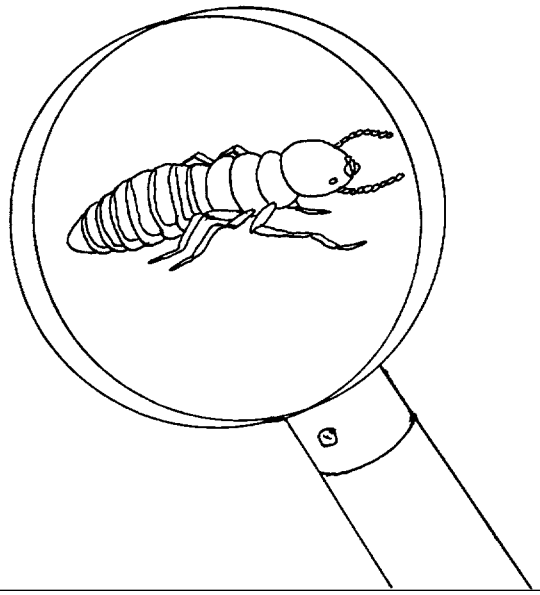
3. Fungus—mold



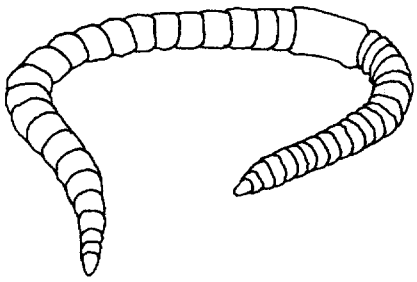
4. Actinomycetes



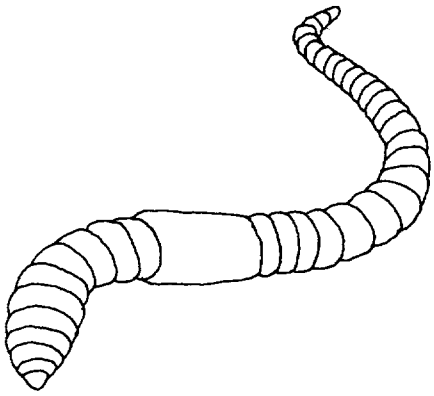
5. Termite



6. Red worm

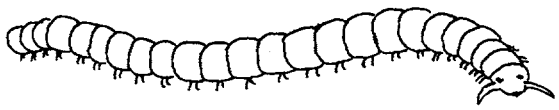


7. Night Crawler

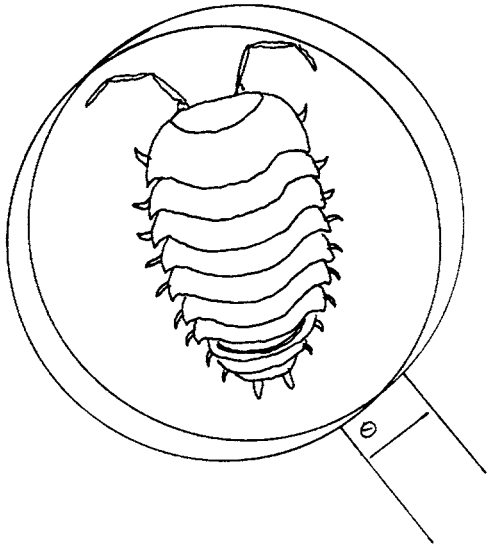


8. Fruit fly

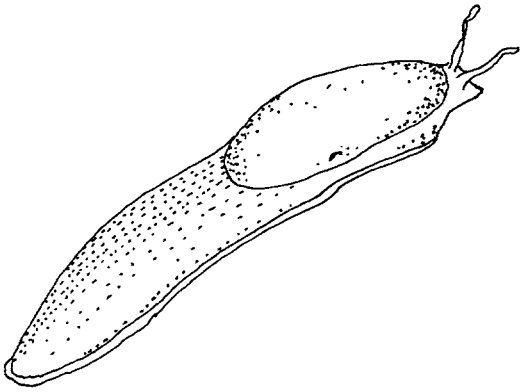
9. Millipede



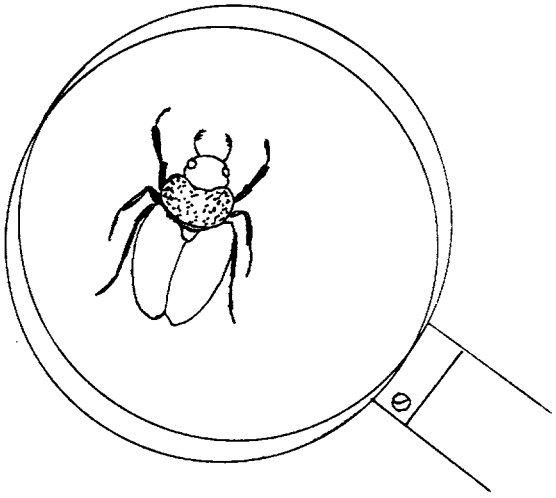
10. Sow bug



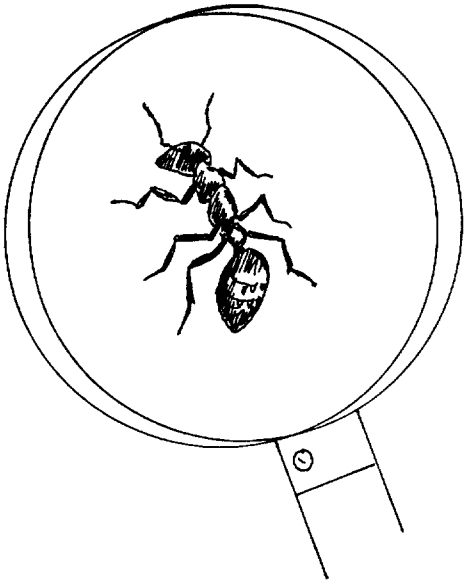
11. Slug



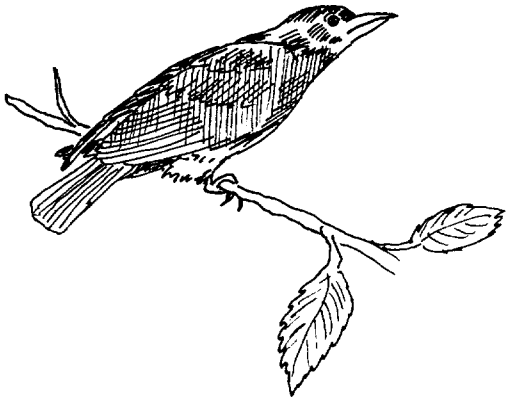
12. Scarab Beetle



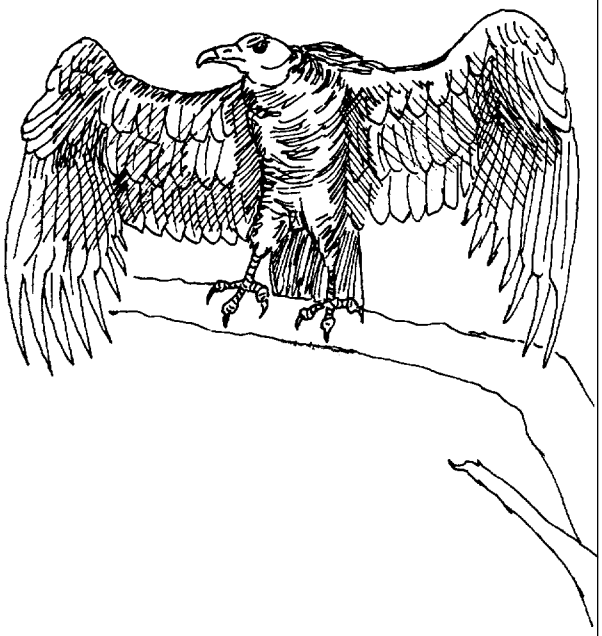
13. Ant



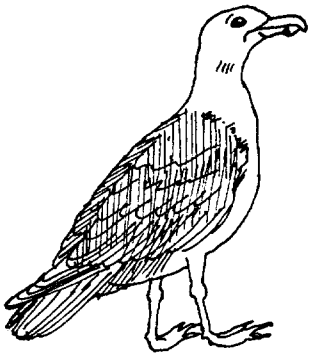
14. Crow



15. Turkey vulture



16. Gull



Name: _____

DECOMPOSERS INVESTIGATION SHEET

A different type of decomposer has been introduced into each of the bags. Each decomposer has specific characteristics that scientists use to figure out their type. Use the hand lens, and **without opening the plastic bag**, observe the contents in each bag. Try to see any difference in growth patterns among the types of decomposers. Record the date and what you observed today on the lines below. Use the back of this sheet if you need more room to write.

Bag 1. Date: _____

Date: _____

Date: _____

Bag 2. Date: _____

Date: _____

Date: _____

Bag 3. Date: _____

Date: _____

Date: _____

Bag 4. Date: _____

Date: _____

Date: _____

Bag 5. Date: _____

Date: _____

Date: _____

BACKGROUND INFORMATION FOR THE TEACHER

There is no waste in nature; the wastes or dead bodies of one form of life become food or nutrients for other forms of life. When something dies, decomposers use the dead material as food. Decomposers include microscopic organisms, such as bacteria and fungi (e.g., yeast, mold, mildew).

Most decomposers cannot be seen with the naked eye, but their colonies can be observed. For example, the grayish cobweb-like material in compost indicates the presence of a type of bacteria called actinomycetes (pronounced "ak-tin'-o-my-cee'-tees). Actinomycetes and fungi work together to decompose the toughest organic material, such as cellulose and even lignin, which is the main component in paper.

Fungi (pronounced "fun-guy") are not plants or animals; they belong to their own kingdom: Fungi. Fungi means "more than one fungus." Fungi cannot produce their own food because they have no chlorophyll, so they grow on organic materials to survive. Fungi help break down organic matter, such as dead leaves and grass, and turn them into rich dark compost. Molds, mildews, and yeast are fungi. Most fungi have a nucleus (genetic materials surrounded by a membrane) and several other internal parts surrounded by membranes.

Threads of mold, a type of fungi, can be seen with a magnifying lens. Some threads will have dark round sacs that contain spores. Spores are like seeds. They are often spread by wind or by an insect to a favorable area, where they will open and a new thread will grow. A mold colony is formed as the threads become longer and branch into more threads. Molds feed on organic wastes and help to break them down. This action releases nutrients contained in the organic waste to the soil.

Yeast is also a type of fungi. They also depend on other organisms for food. The yeast feeds on organic matter, causing it to decay or break down into smaller parts. A yeast cell is shaped like an egg. Some have little bumps on them called buds. These buds grow bigger and break away to become a new yeast cell.

Bacteria are single-celled microscopic organisms. They are placed in a classification kingdom called Monera. They have no distinct nucleus or other internal parts surrounded by membranes. Some species, called aerobic bacteria, require oxygen to live and others, called anerobic bacteria, do not. Bacteria are eaten by protozoa, worms, snails, arthropods, and other small organisms.

Bacteria are abundant in air, water, soil, and in or on other organisms. Although some can transmit diseases, most act as decomposers and get the nutrients they need by breaking down complex organic compounds in the tissues of living or dead organisms. Bacteria break these organic compounds into simple chemical substances that can be recycled into other organisms.

Some bacteria multiply by a simple division of cells (each cell divides into two). Some species reproduce by budding (a bud forms on a parent cell and then detaches to become a new cell). Still others reproduce by generating spores, which grow into new bacteria cells.

All living things need nutrients to live. Animals get nutrients from the plants and/or other animals they eat. Waste excreted by organisms is high in nutrients. When living things die, their bodies are also high in nutrients. Decomposers can release these nutrients into the soil where they might be held in solution by water. Plant root hairs absorb this moisture full of nutrients, and the nutrients are transported into the stems and leaves of the plant. When leaves and other plant parts fall to the ground, their nutrients are returned to the soil by decomposers. When something organic, like a leaf, decomposes, it is actually recycled.

All previously living things decompose. If nothing decomposed, the Earth would be covered with dead animals and plants. In addition, the soil would not get back the nutrients that plants need to grow.

Decomposition does not happen all at once. It involves many steps in which many living things participate. Organic material is consumed, excreted, and eaten again by different life forms. Scavengers can be seen with the naked eye and are called macroorganisms. Most of these animals cannot eat fresh organic material, like leaves, until it has been broken down by microorganisms, such as fungi and bacteria. Once the organic matter is softened, scavengers, such as red worms, night crawlers, sow bugs, millipedes, slugs, mites, and various types of insects,

such as beetles, termites, and ants, break down the substances into smaller parts. Then decomposers eat these smaller parts and break them down further into simpler components, like nutrient compounds (protein, vitamins, minerals, and carbohydrates). These simpler materials, which are essential for life, can now be absorbed from the soil by plants. Note that only decomposers actually decompose organic material into simpler components.

There are larger animals that play the role of scavengers by eating waste that has begun to decay. These scavengers include crows, turkey vultures, magpies, gulls, and coyotes. They can be called "nature's clean-up crew."

The type of soil, moisture content of the soil, temperature, and kinds of organisms present all contribute to the rate of decomposition in soil. Ideal conditions for aerobic (oxygen-requiring) bacteria, fungi, and other microorganisms include the presence of water and air. Most decomposers live in the soil or leaf litter. However, some molds travel through the air and can decompose fruit and other organic matter that are not in or on top of soil.

Sunlight, water, and air can also break down both organic and inorganic substances. This lesson focuses on living things (scavengers and decomposers) that break down organic matter.

LESSON 3: What Decomposes?

LESSON'S CONCEPT

Most organic materials decompose through the actions of decomposers.

PURPOSE

Students differentiate between materials that decompose (organic) and those that do not decompose (inorganic).

OVERVIEW

In this lesson students will:

- Bury several objects to test them for their tendency to decompose.
- Observe things on the school grounds that are decomposing.
- Collect litter from the school grounds and identify any packaging materials or bring used packaging material from home.
- Separate packaging materials into those that will decompose and those that will not decompose and test different hypotheses by burying small pieces of different packaging materials.
- Relate how the natural recycling process that gets rid of waste (through decomposition) can be used to lower the amount of waste that goes into landfills.
- Write a story with a "fortunately/unfortunately" format about packaging materials made from organic or inorganic materials.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS

- Students work in groups to develop and implement a test to determine what types of materials in packaging (they found on the school grounds) will and will not decompose.
  - "Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept . . . Students will: classify objects . . . based on appropriate criteria." (*Science Content Standards, Grades K–12*; Grade 5; Investigation and Experimentation, Standard 6a)
  - "Students will: . . . formulate predictions and justify predictions based on cause and effect relationships." (*Science Content Standards, Grades K–12*; Grade 4; Investigation and Experimentation, Standard 6c)
- Students write a story with a "fortunately/unfortunately" format about packaging materials made from organic or inorganic material.
  - Students "select a focus, an organizational structure, and a point of view based upon purpose, audience, length, and format requirements." *(English–Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve*, page 23)

SCIENTIFIC THINKING PROCESSES

observing, communicating, comparing, relating

TIME

20–30 minutes to prepare for the lesson; 45–60 minutes for three or four days to implement the lesson (Additional time will be needed three to four weeks later to examine organic and inorganic material.)

VOCABULARY

biodegradable, decompose, inorganic, organic

PREPARATION

___ **1.** Read the "Background Information for the Teacher" at the end of this lesson.

___ **2.** Locate an area in the school's neighborhood or on the school grounds where students can find items, such as leaves, twigs, and animal droppings that are rotting or decomposing.

___ **3.** Locate examples of packaging materials that have become litter on the school grounds that your students can pick up and observe. If your campus is litter free, then you will need to collect several examples of packaging, such as cardboard and plastic, from another area. Also ask students to bring examples of packaging made from different materials.

MATERIALS

Note: With younger students do "Part I"; with older students do "Part I" and "Part II" or only "Part II."

For "Part I, Describing the Differences Between Organic and Inorganic Things"

___ Six objects the size of a postage stamp from each student (Three of the objects should be those that the student believes will decompose and three objects that the student believes will not decompose. Students can use leaves from Lesson 1 as one of their objects.)
___ Soil (approximately one full 2-gallon container)
___ Balance scale
___ Two sandwich-size resealable plastic bags for each pair of students
___ One measuring teaspoon for each pair of students
___ Water in a spray bottle
___ Piece of newspaper on which to spread the contents of the bags for each pair of students
___ Rubber or plastic gloves for each pair of students

For "Part II, Experimenting with the Decomposition of Packaging"

___ Rubber or plastic gloves for picking up litter for each group
___ A litter bag for each group
___ Examples of packaging materials (some that can decompose, such as cardboard cereal boxes and banana peels, and some that do not decompose, such as glass, plastic, and aluminum) (Although students will be assigned to bring these to class, be prepared to bring orange or banana peels in case no students think of fruit and vegetable peels as packaging.)
___ Balance scale
___ Rulers
___ Containers of soil (e.g., gallon milk or water jugs with tops cut off) into which students will bury their packaging materials
___ Water in a spray bottle
___ Jars of water into which students could place pieces of packaging material

PRE-ACTIVITY QUESTIONS

A. Ask students to discuss the meaning of the word *decompose*. *Decompose means to break down, to decay.*

B. Discuss with students how they could tell whether an item can decompose. *Put the item in the ground or on top of the ground; put the item in water.*

- Ask what items might decompose. *Paper, apple cores, leaves*. List on the chalkboard what students say.

What Might Decompose?

- *Carrot*
- *Apple*
- *Peanuts*
- *Steaks*
- *Leaves*
- *Bones—marrow*
- *Sunflower seeds*
- *Dates*
- *Oranges*
- *Cotton*
- *Wood*
- *Clay*
- *Leather*
- *Dead bugs*

Submitted by Janet Cohen's sixth-grade class, Gold Trail Elementary School, Gold Trail Union School District.

- Tell students that one way to tell whether something will decompose is to determine whether it was once alive or is part of a living thing (e.g., hair, feathers, leaves) or was created by the body of a living thing (e.g., animal wastes). Another way to determine whether an item can decompose is to bury it in soil and dig it up after a certain amount of time to see whether it has decomposed or is the process of decomposing.

C. Take students on a walking field trip in the school's neighborhood and/or on the school grounds to locate items, such as leaves and

animal droppings, that are rotting or decomposing. (Do not let students touch any animal's droppings.) On this walk students should also look for any other organic materials (materials that came from living things).

D. Back in the classroom ask students to share what they have observed. How did they know that something was rotting (or decomposing)? *It looks as if it's breaking down; it smells.* What will happen to an item once it has decomposed? *It becomes part of soil.*

PROCEDURE

Note: With younger students do "Part I"; with older students do "Part I" and "Part II" or only "Part II."

Note: Assign the homework assignment the day before you plan to do Part I. You can also have students collect these objects in the classroom and on the school grounds.

Homework Assignment: Ask students to collect three objects, approximately the size of a postage stamp, which they think will decompose and three objects which they do not think will decompose and to bring these to class the following day. (Students can use leaves from Lesson 1 as one of their objects.)

Part I, Describing the Differences Between Organic and Inorganic Things

A. Once students have collected their six objects, ask how they can test whether their items will or will not decompose.

- Allow students to come up with a testing plan. Tell them that they can use a container, soil, and water.
- One way to do the testing, using a sandwich-sized resealable plastic bag, is described below. The objects can also be buried in milk cartons.
- You might wish to have part of the class do the experiment described below and another part of the class follow the plan developed by the students. Then each type of test can be evaluated.

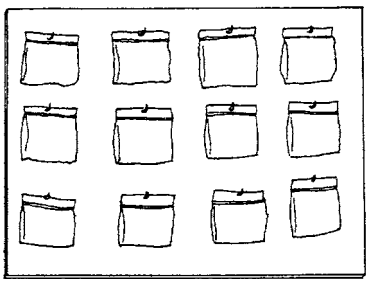
B. Have students work in pairs and ask them to put the objects that they think will decompose into one sandwich-sized resealable plastic bag and label this bag with masking tape on which they write "Items that will decompose."

- Have students place the objects that they think will not decompose into another sandwich-sized resealable plastic bag and label this bag with masking tape on which they write "Items that will not decompose." Students should write their names on pieces of tape affixed to each bag.

C. Ask students to:

- Add equal amounts of garden soil (not sterilized potting soil) to each bag.
- Sprinkle the soil with water to make it moist.
- Seal the bag.
- Open the bag each day and stir the contents to provide oxygen.

Note: For storing, the bags can be punched with a hole on the top and hung on hooks on a board.



D. After approximately three to four weeks, allow students to unbury each item, recording in their journals the descriptions of each item's state of decomposition.

- Ask students to pour the contents of each resealable plastic bag on a piece of newspaper. Then provide them with plastic or rubber gloves to sift through the soil, locating the six items (three from each student) in each bag and describing the condition of each item in their journals. Then they can place all the items back, add water if needed, and wait another two weeks before observing results.

E. If the class used more than one method to test objects for decomposition, encourage students to evaluate and compare the methods. They can also describe what they think is the best way to test whether an object will decompose.

F. Discuss with students the terms organic and inorganic (or biodegradable and nonbiodegradable) and how these apply to the tests of decomposition that they have completed. Make certain that students make the connec-

tion that most organic items will decompose and inorganic items will not decompose. Decomposers can break down organic matter, but not inorganic matter.

Note: *Biodegradable* describes a property of a substance that allows it to be broken down by decomposers. Most organic materials decompose. *Organic* refers to substances which are carbon-based. However, plastics are considered to be organic (because they are made from petroleum products which are carbon-based substances), but they are not biodegradable.

G. Have students design a two-column chart, with items that are organic listed in one column and can therefore decompose and those items that are inorganic listed in the second column. Keep this list for Lesson 4.

H. Two weeks later, have students observe the organic and inorganic items that they reburied for signs of decomposition, and have them list their observations in their journals. Discuss results.

Part II, Experimenting with the Decomposition of Packaging

Note: If your school campus is free of litter, skip section "A" and assign the "Homework Assignment." The following day, do section "B."

A. Tell students that they will be looking for and picking up litter on the school grounds.

- Go over safety considerations concerning the picking up of litter. For example, broken glass, needles, and other potentially dangerous litter should not be picked up by students.
- Provide a pair of plastic or rubber gloves and a litter bag for each group of students.
- Take students on a walk on the school grounds to pick up litter.
- Back in the classroom list what litter was found and its condition.
- Determine how much of the litter was packaging and how much was not packaging. Students should be aware that packaging can be human-made, such as a paper wrapper, or nature-made, such as a banana peel.
- Have students determine the condition of each piece of packaging in terms of signs of decomposition (breaking down).
- Have students indicate on the chart whether the packaging found on the school grounds is organic or inorganic. (Do not correct students if they placed items incorrectly in one of the columns; students will have an opportunity to move items in section "D" from one column to another.)
- Ask students what should be done with the litter that they collected. Can any of it be reused or recycled? You might wish to keep some of the packaging to use in section "B."

Homework Assignment: Ask students to bring examples of packaging. Tell them that tomorrow they will design a decomposition test on the packaging materials that they bring to class.

B. On the following day have students show the class the packaging materials that they brought. Did anyone bring orange or banana peels? If not, have students use the peels you brought. Ask students to:

- Separate the packaging into two piles. One pile should contain packaging that could decompose; and the other, packaging that would probably not decompose.
- Record in the journals the contents of each pile.
- Describe how they can test whether various types of packaging will decompose.
- Design an experiment. Make certain that, in their design, students use the same size and/or weight of each packaging material they want to compare. Students can bury pieces of packaging in soil in a gallon milk or water jug (with the top cut off), labeling the type, size, and weight of each piece of packaging. Students can also place packaging materials in jars of water to see what happens to the packaging.

Note: At least one group should bury a piece of paper bag.

C. After approximately three to four weeks, ask students to look at the condition of their test items. Have students compare packaging that can decompose and packaging that will not decompose.

- What are the characteristics of packaging that can decompose? *They are made from organic material.*

- From what material is this packaging made? *They are made of things that were once living; plant or animal material.*
- Did it originally come from a living thing? *Yes.* If so, what living thing? *It was a tree.*
- What is necessary for decomposable packaging to decompose? *Soil, water, air.*

D. Ask students to add the items they tested to the list of items that are organic or inorganic. Are there any items that they listed before that they would like to change from one column to another? If so, ask students to explain their reasoning for this, and then have them move the item(s) to the other column.

DISCUSSION/QUESTIONS

A. What types of objects decompose? *Food decomposes, leaves decompose, brown paper bags decompose.* If new items are mentioned, have students add these to the chart on what is organic and what is not organic.

B. Instead of placing organic items in landfills, what can be done with these items? *Bury them, compost them.* (Students might not know about composting. This topic will be addressed in Lesson 4.)

C. Discuss what students can do instead of buying disposable non-decomposable packaging that will end up in a landfill. *Buy items that can be reused, such as thermos bottles and cloth grocery bags; buy items that can be recycled, such as aluminum and cardboard.*

APPLICATION

A. Ask students to write in their journals about one of the following; then discuss students' responses:

- How does nature get rid of waste? *Through decomposition.*
- How can humans use nature's model to lower the amount of waste that goes into the landfills? *Bury our garbage; compost.* (Students might not yet know about composting. This topic will be covered in Lesson 4.)

B. The following can be done in class or assigned as homework. Have students write and illustrate a "fortunately/unfortunately" story about organic or inorganic packaging. Encourage students to come up with original stories.

- You might brainstorm five or six ways to help them start their stories. For example:

  - Fortunately, I had enough money to buy an apple and package of cookies . . .

  - Fortunately, I got to go to the park . . .

- This story can also be written as a class, with each student contributing a line. Students can then draw pictures to illustrate the story. An example is provided below.

  Fortunately, my cookies were packaged to protect them from getting spoiled and crushed. Unfortunately, the cookies inside were wrapped in another package so there would be more garbage to throw away. Fortunately, I unwrapped some cookies to eat and could put the other wrapped cookies in my pocket to eat later. Unfortunately, the wrapper from the cookies I ate fell on the ground. Fortunately, I saw it and picked it up and put it in my pocket. Unfortunately, my pocket had a hole in it . . .

RESOURCES

Video

Soil and Decomposition. New York: BFA Educational Media, 1986 (16 minutes).

Shows how plant fertilizer is made in nature and how it is manufactured by people. Time-lapse photography shows the decomposition process of dead leaves changing to fertilizer.

Book

Emory, Jerry. *Dirty, Rotten, Dead?* Illustrated by T. Taylor Bruce. New York: Harcourt Brace & Company, 1996.

Describes what happens biologically to living things when they die (including people).

BACKGROUND INFORMATION FOR THE TEACHER

Some materials (e.g., wood, paper, food scraps, leaves, fruits, vegetables, cotton, and other plant materials) decompose easily when placed on top of or in the soil. These materials are considered to be biodegradable.

When biodegradable materials are left out in the air, in sunlight, and on top of soil, or when they are buried in soil, they break down (begin to fall apart) or decompose and become part of soil. Biodegradable materials are organic. Organic materials are carbon-based substances that are or were once parts of living organisms.

Many human-made materials (e.g., plastics, metals, and glass) do not break down easily or remain unchanged in soil for many years.

Note: Technically, plastics are considered to be organic materials because they are made from petroleum products, which are carbon-based substances that were once parts of living things. To simplify the definition of *organic* for students, the writers emphasize organics as those materials that are usually biodegradable.

Note: Do not confuse the scientific definition of *organic* to the one often used in grocery or health food stores. In the case of produce (fruits and vegetables), the word *organic* usually refers to produce that was grown without the use of pesticides or petroleum-based fertilizers.

Picture intentionally deleted.

Students from Janet Cohen's sixth-grade class at Gold Trail Elementary School separate packaging according to packaging that could decompose and packaging that probably will not decompose.

If nothing decomposed, we would be surrounded by fallen plant parts, animal wastes, and dead animal bodies. Fortunately, in nature, the leaves and other parts of plants that drop to the ground, the droppings (scats) left by animals, and the remains of dead animals become food for microscopic organisms, such as bacteria, fungi, and other decomposers. These decomposers recycle the nutrients and organic material from parts of plants and animals back into the soil. These nutrients are then used by plants. (Additional information about decomposers is provided in Lesson 2).

Many human-made things, such as aluminum, glass, and plastic and some things found in the natural environment, such as iron and other minerals, do not decompose. These items are also called nonbiodegradable. Although these items will break down with time, they do not break down by the actions of decomposers into nutrients in soil that other living things can use. They break down only into smaller pieces or components. (See the 4–6 Module, Unit 2, Lesson 7, "Plastic Polymers," for more information on "biodegradable" plastic.)

In this lesson the word *decomposition* is defined as a process in which microscopic living things break down material into smaller substances that can be used by plants for growth. This is different from the breakdown of inorganic materials. For example, in the oxidation process on an iron nail, it is oxygen, not decomposers, that corrodes the iron.

Composting is a process whereby organic material, such as grass clippings, leaves, and food waste, is broken down and decomposed by microscopic bacteria and fungi into smaller substances. Given proper conditions, all organic wastes decompose and contribute to the natural recycling process. (Composting is addressed in Lesson 4.)

LESSON 4: What Is Composting and Why Is It Important?

Note: This lesson focuses on indoor composting without using worms. If you are interested in outdoor composting, see the "Resources" section in this lesson and "Appendix D, Setting Up and Maintaining Composting Systems." If you want your students to learn how to vermicompost (compost with worms), see the K–3 Module, Unit 3, Lesson 1 and "Appendix D–II, Maintaining a Vermicomposting System."

LESSON'S CONCEPTS

- Composting is a way of recycling organic matter that might otherwise be sent to a landfill.
- Composting reduces the volume of organic waste and saves landfill space; the compost can be used to improve a soil's structure and fertility.

PURPOSE

Students will be introduced to the basics of composting.

OVERVIEW

In this lesson students will:

- Conduct experiments to identify the five essential components in the production of compost.
- Identify materials that can be composted and those that should not be composted.
- Classify materials that are considered green organic matter and brown organic matter to use in a compost pile.
- Use 2-liter beverage containers to simulate the conditions of a landfill and of a compost pile and compare the decomposition rates of organic materials in both containers.
- Connect the action of composting to reducing the amount of waste that is sent to a landfill.
- Apply what they have learned by writing about composting.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS

- Students write a prediction and design an experiment to compare the kinds of ingredients necessary for composting to occur.
  - "Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept . . . students will: . . . formulate predictions and justify predictions based on cause and effect relationships." (*Science Content Standards, Grades K–12*; Grade 4; Investigation and Experimentation, Standard 6c)
  - "Students will: . . . identify a single independent variable in a scientific investigation and explain what will be learned by collecting data on this variable." (*Science Content Standards, Grades K–12*; Grade 5; Investigation and Experimentation, Standard 6e)
- Students simulate the conditions of a landfill and of a compost pile in two-liter bottles in order to compare the decomposition rates of organic matter in both bottles. They compare the contents of both bottles and describe their findings in writing.
  - "Students will: . . . develop a testable question." (*Science Content Standards, Grades K–12*; Grade 5; Investigation and Experimentation, Standard 6b)
  - Students "write research reports about important ideas, issues, or events by using the following guidelines: (a) frame questions that direct the investigation; (b) establish a controlling idea or topic; and (c) develop the topic with simple facts, details, examples, and explanations." *(English–Language Arts Content Standards for California Public*

Schools, Kindergarten Through Grade Twelve, page 31)

- Students write a poem or description about compost.
  - Students "choose the form of writing (e.g., personal letter, letter to the editor, review, poem, report, narrative) that best suits the intended purpose." *(English–Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve*, page 37)

TIME

20–30 minutes to prepare for the lesson; 45–60 minutes for each part to set up the experiments (Additional time will be needed several weeks later to observe the results.)

VOCABULARY

aerobic, anaerobic, compost, composting,

PREPARATION

___ **1.** Read the "Background Information for the Teacher" at the end of this lesson.

___ **2.** Obtain a box and write the words "Compost Recipe" on it. Write and/or draw each of the five components on an 8½ by 11-inch sheet of paper:

- Decomposers in soil
- Green organic waste
- Brown organic waste
- Water
- Air

___ **3.** Make a transparency of "Materials to Compost and Not to Compost" (page 489).

MATERIALS

For "Pre-Activity Questions"

___ A box with the words "Compost Recipe" written on it, containing a sheet of paper for each of the five key compost ingredients (decomposers, green organic waste, brown organic waste, water, and air)

For "Part I, Experimenting with Different Conditions and Ingredients for Composting"

___ Transparency of "Materials to Compost and Not to Compost"
___ A banana peel
___ Several leaves (The leaves from Lesson 1 could be used.)
___ A handful of finished compost (As a substitute, potting soil or commercial compost can be purchased at a garden supply store.)
___ 12 cups of dried leaves and/or shredded paper
___ 12 cups of vegetable and fruit parts (cut into small pieces and mixed together to provide the same ingredients for each container) or grass clippings with or without the vegetable and fruit parts
___ 2½ cups of garden soil (not sterilized potting soil)
___ Approximately 3 cups of water
___ Six 1-gallon containers (These can be large mayonnaise jars, 1-gallon milk jugs, or 1- gallon water containers, but they should all be the same type of containers, and all of them should have lids. One-gallon milk or water containers should have the top 2 inches cut most of the way around, leaving a hinged top.)
___ Weight scale
___ Measuring cup
___ Stirring spoon
___ Plastic or rubber gloves, one for each group of students
___ Several sheets of newspaper for each gallon container on which to dump contents for observation

For "Part II, Comparing a Landfill to a Compost Pile"

___ The video *Kids Talking Trash* (available from the California Integrated Waste Management Board) or *The Rotten Truth* (See "Resources.")
___ Two 2-liter plastic beverage containers for each group (or other beverage containers; e.g., 1-quart water bottles)
___ Masking tape and marker
___ Organic yard and food waste (leaves, grass clippings, wood ash, sawdust, shredded paper, eggshells, fruit and vegetable food waste)
___ Garden soil or nonsterile potting soil
___ Other materials requested by students
___ Water in a spray bottle
___ Plastic or rubber gloves for each group of students

PRE-ACTIVITY QUESTIONS

A. Ask students what they know about composting and what they would like to know. Make a chart and list the students' responses on the chart.

B. Ask students what we would need if we wanted to make organic material decompose. (They should incorporate what they learned in lessons 1, 2, and 3.)

- List on the chalkboard what the students say.
- Bring out the box with "Compost Recipe" written on it. Inside, have a sheet of paper for each of the five key ingredients to make compost. Pull them out one at a time as you introduce them.
- Compare these with the list on the chalkboard; correct the list as needed.

C. Have students think about the experiment they completed in Lesson 1 on the decomposition of leaves or in Lesson 3 on the decomposition of organic materials and ask them to relate it to the "Compost Recipe." Ask students what they think finished compost would look like.

PROCEDURE

Part I, Experimenting with Different Conditions and Ingredients for Composting

A. Using the class chart on organic and inorganic materials started in Lesson 3, "Part I," brainstorm with the class additional organic materials (those that could be composted) and list these on the chart. Then brainstorm a list of inorganic materials and list these on the chart. Have the class select from the chart what they would like to compost and what they would not want to compost.

B. Show the transparency, "Materials to Compost and Not to Compost," and compare it to the class chart. Add to the class chart. Then have students determine what is considered brown organic material and what is considered green organic material, as listed on the transparency. (The first eight items are "browns" and the last two items are "greens.")

C. Show a banana peel, several leaves, and the finished compost (potting soil can be used as a substitute). Allow students to touch the compost. Ask them how we convert a banana peel and leaves to compost. Review with the students the five components needed to make compost: *Decomposers, green organic waste, brown organic waste, water, and air.*

Students in Joanne Williams's sixth-grade class at Las Palmas Elementary School brainstorm what they know and what they would like to know about composting.

D. Have students hypothesize what they think will happen if any one of the five conditions for composting is missing. Ask students to write their predictions in their journals. Ask them to design an experiment to determine what the ideal conditions are for composting. One way to set up for this experiment is described below. Note that the control in this experiment is "Container 6," which has all five essential ingredients. Each of the other containers has one different variable removed, and these will be compared by visual examination of the decomposition rate and effectiveness of the decomposition to "Container 6." (Another way to do this is to dry and weigh the organic material before placing it in the various containers. Then at the end of the experiment, dry and weigh the remaining organic material and compare these figures to the original weights. The differences in weight is the amount decomposed.)

E. Students can set up six compost containers containing different ingredients and compare the results in four to six weeks**.** Have students hypothesize in which containers the most amount of compost will be created

and in which containers the least amount of compost will be created and to offer their reasons. Ask students to write their predictions in their journals.

1. Each container should have equal amounts of the various components, except for the one ingredient that is not included. (Container 6 will have all of the ingredients. Also, Container 3 will have double the amount of dried leaves, and Container 4 will have double the amount of vegetable and fruit parts or grass clippings to keep the amount of organic materials the same.) One way to determine equal amounts of various components is to weigh all the dry materials; or a measuring cup can be used to measure the volume of the dry materials. Use a measuring cup to measure the amount of water added to each container (except for Container 1).
   - Container 1—**Not enough moisture**: Add 2 cups of dried leaves (brown organic waste), 2 cups of vegetable and fruit parts or grass clippings (green organic waste), and ½ cup of garden soil. Mix every two to three days to add oxygen. Do not add water. Keep the lid resting on the container, but not tightly; or poke holes in the lid.
   - Container 2—**Not enough air**: Add 2 cups of dried leaves, 2 cups of vegetable and fruit parts or grass clippings, ½ cup of garden soil, and ¼ to ½ cup of water (enough to moisten). Compress the contents to push out the air. Do not stir and keep the lid on tightly.
   - Container 3—**Not enough green organic waste**: Add 4 cups of dried leaves, ½ cup of garden soil, and ¼ to ½ cup of water (enough to moisten). Mix every two to three days to add oxygen. Do not add parts of vegetable and fruit or grass clippings. Keep the lid resting on the container, but not tightly; or poke holes in the lid.
   - Container 4—**Not enough brown organic waste**: Add 4 cups of vegetable and fruit parts or grass clippings, ½ cup of garden soil, and ¼ to ½ cup of water (enough to moisten). Mix every two to three days to add oxygen. Do not add dried leaves. Keep the lid resting on the container, but not tightly; or poke holes in the lid.
   - Container 5—**Not enough microorganisms**: Add 2 cups of dried leaves (rinse these in soapy water first to wash off some decomposers), 2 cups of vegetable and fruit parts or grass clippings, and ¼ to ½ cup of water (enough to moisten). Mix every two to three days to add oxygen. Do not add soil. Note that dried leaves will contain some decomposers. Keep the lid resting on the container, but not tightly; or poke holes in the lid. (Another way to do this is to sterilize the soil and the organic waste by microwaving them for several minutes.)
   - Container 6—**Has all five essential ingredients**: Add 2 cups of dried leaves, 2 cups of vegetable and fruit parts or grass clippings, ½ cup of garden soil, and ¼ to ½ cup of water (enough to moisten). Mix every two to three days to add oxygen. Keep the lid resting on the container, but not tightly; or poke holes in the lid.

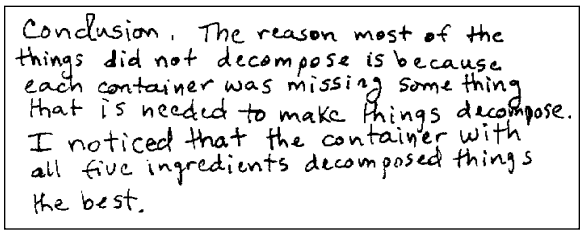
Note: Make certain that you use garden soil, not sterilized potting soil. Also, for all containers in which ingredients need to be mixed, make certain that they are mixed at the same time in the same manner. If the lid is off completely, the compost could dry out too fast.

2. After approximately four weeks, have students examine the contents of the six containers and compare the rates and effectiveness of decomposition among the containers. Provide plastic gloves and have students:
   - Dump the contents on several sheets of newspaper.
   - Compare the color, odor, texture (feel), and the amount of decomposition in each container.
   - Create a chart of results.

- Compare their results to their predictions.
- Discuss what the results mean.

F. Ask students to write in their journals a conclusion to the experiment.

G. Ask students what they could do with the finished compost. Lead students to conclude that the finished compost is a natural fertilizer that could be used to enhance the soil in gardens and flower pots.


Conclusion. The reason most of the things did not decompose is because each container was missing some thing that is needed to make things decompose. I noticed that the container with all five ingredients decomposed things the best.

Submitted by Janet Cohen, sixth-grade teacher, Gold Trail Elementary School, Gold Trail Union School District.

Part II, Comparing a Landfill to a Compost Pile

A. Watch the first part of the video, *Kids Talking Trash,* or the entire video, *The Rotten Truth*. Discuss the video and, as needed, provide explanations to students concerning why things do not decompose rapidly in a landfill. Items buried in a landfill decompose slowly because the conditions are not ideal for rapid decomposition by decomposers, many of which need oxygen and moisture. Note that some decomposers, such as anaerobic (those that do not need oxygen) bacteria also decompose garbage in a landfill. But most landfills are not exposed to air, because the garbage is covered with soil to keep it from smelling and attracting animals (e.g., mice and rats). As a result, organic wastes buried in landfills may take decades to decompose.

B. Tell students that they will work in groups and use two 2-liter plastic beverage containers to compare a landfill to a compost pile. Ask them to develop a question they can answer about landfills and compost piles.

C. Once a group has written a satisfactory question, provide two 2-liter plastic beverage containers to the group.

1. Ask students to use masking tape and a marker to label one "Bottle A" and one "Bottle B" and to write their names on a piece of tape affixed to both bottles.

- In "Bottle A" they will simulate the conditions in a landfill: no air and no water.
- In "Bottle B" they will simulate the conditions in a compost pile with air and water.

2. Allow students to determine how they will set up each bottle. For each bottle, each group should:

- Make a prediction as to how much will decompose.
- Come up with a plan on how each bottle will be set up.
- Draw the layers.
- Describe the ingredients they plan to add.

They should have similar materials in each bottle to compare their decomposition. However, the "A" bottles (landfill) should not have oxygen, water, or be exposed to sunlight. Tell students that in a landfill, soil is used to cover trash at the end of the day. Therefore, all "A" bottles will need to have a layer of soil on top. Students should make certain the contents are stirred in "B" bottles on a regular basis to add oxygen to the system. Also, students should keep the contents of the "B" bottles slightly damp. They might need to use a spray bottle to add moisture.

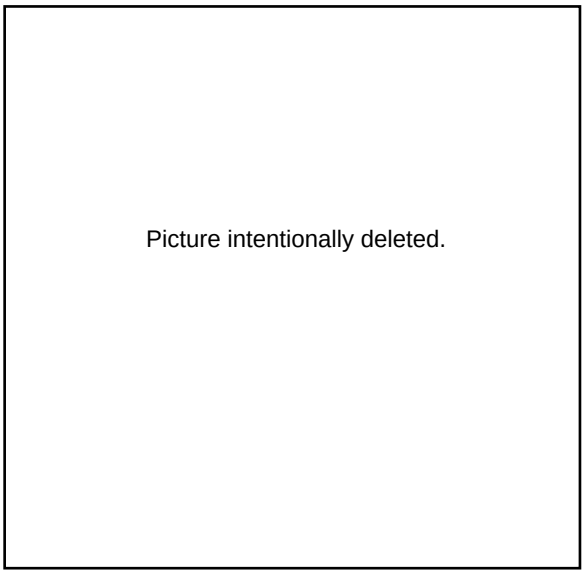
3. Help students acquire the materials to set up their experiments. Students should record all of the materials that they placed in their bottles.

C. After approximately three to four weeks, have students dump the contents of each bottle on a separate piece of newspaper and compare the contents.

- Ask students to write a comparison between the contents of both bottles.
- Was there more decomposition happening in "Bottle B" than in "Bottle A"? Ask students to explain their answers.

DISCUSSION/QUESTIONS

- What is composting and how is it related to recycling? *Composting is a form of recycling in which organic material is decomposed by decomposers.*



Students from Janet Cohen's sixth-grade class at Gold Trail Elementary School add water to the "B" bottle simulating moist conditions in a compost pile.

- What are the benefits of composting? *Composting reduces the volume of waste sent to landfills and recycles nutrients and other components necessary for plants to grow.*

At the end of the experiments (questions for younger students)

Ask students:

- What happens to the food waste and yard clippings put in a compost pile? *They become compost.*
- How do they change*? Decomposers decompose the food waste and yard clippings.*
- Where would the food and yard clippings have gone if they were not composted? *They would have been sent to a landfill.*

At the end of the experiments (questions for older students)

Ask students:

- What are the components necessary in a compost pile? *Decomposers, green organic waste, brown organic waste, water, and air.*
- What did the "control" container in the composting experiment reveal? *When all five ingredients are present, organic materials decompose faster.*
- What types of materials should be and should not be composted? (See "Materials to Compost and Not to Compost.") Why? *Decomposers can decompose organic materials but not inorganic materials.*
- Based on the experiments conducted in Lesson 3 and what you learned in this lesson, which packaging material can be composted? *Paper bags, paper egg cartons, cereal boxes, apple and potato peelings, banana peels.*

APPLICATION

A. In Lesson 3, "Application," students wrote in their journals how nature eliminates wastes or how humans can use nature's model. Ask students to expand on their narratives in their journals concerning ways people can do this. Discuss their responses.

B. Ask students to select one of the following to do individually or in groups:

1. Brainstorm a list of words that describe compost and/or decomposition. Write a poem about compost, composting, or decomposition.

- One idea is to create a cinquain. This type of poem is made up of five lines.
  - The first line: two syllables, a title.
  - The second line: four syllables, describing the title.
  - The third line: six syllables, expressing an action.
  - The fourth line: eight syllables, expressing a feeling.
  - The fifth line: two syllables, a synonym for the title.

For example:

Compost

Dark, moist, moldy,
Decomposing dead stuff
Enriching and enhancing soil,
Humus.

- Another idea is to write an acrostic in which each letter in a word is used to start another word. The example on the next page was written by Natasha Stillman, Cara Morgan, and Olga Clymire.

Decomposition

Decay
Earthworms
Carbon
Organisms
Mold
Peels from fruit and vegetables
Organic materials
Scavengers
Insects
Trash that's compostable
In the soil
Old egg shells, coffee grounds, and bread
Nitrogen

2. Write about the following: If your trash can no longer be picked up and you had to keep your garbage, what would you do? For example, bury food scraps in the compost pile; recycle cans, bottles, paper.
3. Write a paragraph explaining the composting process.

Project Idea: Have students conduct research on what type of composting activities could work at school. They should also consider vermicomposting. Have students plan and implement a composting program.

EXTENSIONS

A. Have students investigate how a material's size affects the rate and effectiveness of decomposition. Students can prepare one compost pile containing large pieces of organic waste and another containing small pieces of the same types of organic waste, or students can cut up fruit into different sizes to test whether smaller pieces decompose faster than larger ones. (The smaller pieces should decompose faster because there is more surface area for the decomposers to attack.)

B. Read to students *Pee Wee and the Magical Compost Heap* by Larraine Roulston. This can be read as guided imagery where students travel into a compost pile.

C. Invite a speaker who composts to talk to your class. (For sources of speakers, check with your city's or county's waste manager or recycling coordinator.)

D. Take your class to see compost bins at a local community garden and have a gardener explain how they work.

E. If your community has a municipal composting center, take a field trip to observe its operation.

F. Collect samples of natural humus from a wooded area. Have students examine the humus for evidence of decomposers (e.g., fungi) and scavengers (e.g., sow bugs, red worms, and insects). Ask students to observe and compare the texture, odor, and color of natural humus to prepared compost.

G. Take students to a local landfill to see what becomes of food and yard waste placed in a landfill. Before the trip, ask students what they predict happens to such waste when it is buried in landfills. If a field trip is not possible, invite a local waste management representative to speak to your class.

Ask the waste management representative during the presentation to explain to students why organic material does not decompose rapidly in a landfill. Also, ask the representative to explain why methane gas, a natural product of the decomposition process by anaerobic bacteria, is present in a landfill.

H. Have students determine the quantity and type of food scraps discarded by the school (school-generated food scraps) and to come up with a plan to decrease the amount of food that is taken to a landfill.

I. List problems of composting and have groups of students figure out how to solve them. For example, suggest a way to help or encourage students to sort compostable materials in the cafeteria.

RESOURCES

Videos

Kids Talking Trash. San Leandro, Calif.: Alameda County Waste Management Authority, 1995 (14 minutes). Distributed by the California Integrated Waste Management Board.

Shows a landfill. Students learn how to make less garbage and protect the environment by practicing the four R's: reduce, reuse, recycle, rot.

Reuse. Protecting Our Environment series. Chatsworth, Calif.: AIMS MultiMedia, 1991 (13 minutes).

Shows how yard trimmings and kitchen scraps can be made into compost.

The Rotten Truth. Pleasantville, N.Y.: Sunburst Communications, 1991 (30 minutes).

Shows the world's largest landfill. Describes how to compost.

Taking Care of Your Own Composting for the 90s. Sacramento: California Integrated Waste Management Board, 1992 (23 minutes).

Describes how to compost at home.

Books

Campbell, Stu. *Let It Rot! The Gardener's Guide to Composting*. Pownal, Vt.: Storey Communications, Inc., 1990.

Provides background information on composting and explains various ways to compost.

Harmonious Technologies. *Backyard Composting: Your Complete Guide to Recycling Yard Clippings*. Ojai, Calif.: Harmonious Press, 1992.

A step-by-step guide on how to compost.

Kalman, Bobbie, and Janine Schaub. *Buried in Garbage*. New York: Crabtree Publishing Company, 1991.

Contains information on composting.

Martin, Deborah L., and Grace Gershuny, ed. *The Rodale Book of Composting; Easy Methods for Every Gardener*. Emmaus, Penn.: Rodale Press, 1992.

A comprehensive book about composting. Includes information on the benefits of composting, life inside a compost heap, methods and use of composting, and large-scale composting.

Roulston, Larraine. *Pee Wee and the Magical Compost Heap.* Toronto, Ontario: Recycling Council of Ontario, 1992.

A fantasy trip into a compost pile by children who shrink in size.

Activity Guides

Compost Module: Composting Activities for Children. British Columbia: BC Environment, 1995.

Contains a variety of activities on composting. Students find out how much garbage they produce, what it consists of, and how to reduce, reuse, and recycle through composting.

Composting Across the Curriculum. A Teacher's Guide to Composting. San Rafael, Calif.: Marin County Office of Waste Management, 1993.

Contains a variety of activities on composting. Includes topics, such as how to connect composting to a teacher's curriculum, how to compost (backyard and vermicomposting), soil and decomposition, and what is waste.

Do the Rot Thing: A Teacher's Guide to Compost Activities. San Leandro, Calif.: Alameda County Waste Management Authority and Source Reduction and Recycling Board, 1997.

Contains a variety of activities on composting. Includes activities, such as identifying what is biodegradable, basic composting, compost critters, building a compost pile, and worm composting. Also describes ways for students to teach others about composting. Contains several songs.

Eulo, Anthony. *Worms, Worms, and Even More Worms: A Guide to Vermicomposting*. Sacramento: California Integrated Waste Management Board, 1999.

Contains background information on how to set up a vermicomposting system and provides ideas for many activities that students could do concerning worms.

Nelson, Cindy; Sarah Shaffer; and Cindy Havstad. *Compost! A Teacher's Guide to Activities and Resources in the East Bay*. Oakland: Alameda County Home Composting Education Program, 1991.

Contains a variety of activities on composting.

Audiocassette

Rot 'N Roll by Stan Slaughter. Includes a song called "The Composters."

Includes a colored workbook, a learning guide, two tapes, and two song books. To order write to Heartland All Species Project, 3517 Virginia, Kansas City, MO 64109.

Websites

See "Appendix F–II, Composting websites" and "Appendix F–VI, Vermicomposting websites."

Transparency

MATERIALS TO COMPOST AND NOT TO COMPOST

Do Compost*

- Wood (e.g., sticks)
- Egg shells
- Fallen leaves
- Tea bags
- Coffee grounds and filters
- Paper products
- Grains, beans, breads
- Straw
- Lawn clippings and young weeds
- Fruit and vegetable trimmings

Do Not Compost

- Rocks
- Plastics
- Glass
- Metal products (e.g., aluminum cans)

**Note*: Some materials should not be composted because they might attract rodents; e.g., meat, bones, or fish; dairy products or grease; dog, cat, or bird feces; and diseased plants.

BACKGROUND INFORMATION FOR THE TEACHER

The capacity of landfills is finite, and the costs of maintaining them—economic, social, and environmental—are growing. By weight, 9.3 percent of the solid waste generated in California is food waste and 21.3 percent is yard waste.[1]

In a natural environment, when dead leaves fall to the ground in wooded areas, they are broken down and decomposed over time by a combination of physical (nonliving) and biological (living) factors. Eventually, the elements and compounds which were once part of the living leaves are released into the air and soil where they can be used in the growth of new plants or other organisms.

Contrary to popular belief, items do not decompose rapidly in a landfill. Items buried in a landfill decompose slowly, because the conditions are not ideal for rapid decomposition by decomposers, many of which need oxygen and moisture. Note that some decomposers, such as anaerobic (not needing oxygen) bacteria also decompose garbage in a landfill. Some drier parts of a landfill may be "mummified" for awhile, but as time goes by moisture in the site moves around to different locations and decomposition takes place. What takes five or ten years in a wet landfill to decompose might take 30 to 50 years in a dry landfill site.[2]

Under ideal conditions, with adequate moisture and oxygen, organic materials can decompose rapidly. Organic materials are carbon-based substances that are or were part of living organisms. When organic materials are sent to a landfill, their decomposition is slow. Furthermore, landfill space is used to bury these materials, and nutrients that could be released by decomposers to be used for plant growth are wasted.

On the average, each person in the U.S. generates about 230 pounds of yard waste per year. Food wastes add another 100 pounds per person per year.[3] Kitchen and yard wastes make up approximately one third of household waste. One way to reduce the amount of trash going to landfills is to divert the organic waste and then compost it.

Composting is a way of recycling organic matter, such as food waste, yard waste, manure, and other organic garbage. When this organic matter is combined and exposed to air and water, bacteria, fungi, and other microscopic decomposers efficiently break them down into compost, which is a soil-like material, rich in nutrients (such as carbon and nitrogen). Compost can be used for amending or conditioning soil in gardens, lawns, and house plants.

Compost added to soil not only provides nutrients but also helps to achieve a desirable texture. The texture of compost is usually good for both aeration and moisture retention, because compost is usually granular, allowing water and air to move through it freely. This improves the water holding capacity of soil.

Composting at home or school saves transportation and disposal costs and provides an environmentally sound way to manage organic wastes. Some other benefits of school composting are listed below:[4]

- On-site composting conserves natural resources, saves landfill space, and reduces the need for centralized collection vehicles and off-site handling and processing.
- By learning how to compost, students can develop a greater sense of personal satisfaction through accomplishment, sense of connection to the cycle of life, and sense of personal responsibility for how their behavior and habits can improve their environment.
- Composting teaches students how to use the natural recycling process to help create a soil conditioner that can be used on flower and vegetable gardens.

[1]"Estimated Average 1995 Residential Disposed Waste Stream Composition." California Integrated Waste Management Board.

[2]Written communication from Joe Haworth, Information Officer, County Sanitation Districts of Los Angeles County, October 22, 1998.

[3]*Composting to Reduce the Waste Stream: A Guide to Small Scale Food and Yard Waste Composting*. Ithica, N.Y.: Northeast Regional Agricultural Engineering Service, Cooperative Extension, 1991, p. 1.

[4]Steven Sherman, "Worm Composting Education in Berkeley Schools: A Food Waste Prevention Strategy." Berkeley: Applied Compost Consulting, April, 1996, page 15.

A properly managed compost pile requires five essential ingredients. These are green organic waste, brown organic waste, decomposers, air, and water. Green and wet waste material high in nitrogen (e.g., kitchen scraps, grass cuttings, garden waste) need to be mixed in equal parts with brown and dry waste material that are high in carbon (e.g., dead leaves, straw, shredded paper). In addition, some garden soil is needed to provide a population of decomposers. Because decomposers need air and water, the compost pile should be kept damp (as moist as a wrung-out sponge) and aerated regularly by turning the pile every two weeks.

A list of organic materials that can be placed in a compost bin and those materials that should not is provided on page 489.

For additional information on composting, several books are listed in the "Resources" section at the end of this lesson. Also, see "Appendix C–VI, Organic Materials." In addition, "Appendix D–I, Constructing Wire Mesh Composting Bins" contains directions on how to make three different types of outdoor wire mesh compost bins suitable for school gardens.

Composting and vermicomposting bins at Cesar Chavez Elementary School, San Francisco Unified School District.

LESSON 5: Promo and Play on Composting

LESSON'S CONCEPT

People can reduce the volume of household solid waste that goes to landfills by composting organic waste and then using the compost to enrich soil.

PURPOSE

Students encourage others to compost organic waste as they complete compost-related projects and produce a play about the importance of composting.

OVERVIEW

In this lesson students will:

- Complete a project on some aspect of composting to make others aware of the importance of composting.
- Write, rehearse, and perform a play, "By the Skins of Our Bananas," to encourage people to divert their food waste through composting.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND FRAMEWORKS

- Students complete a project to make others aware of the importance of composting.
  - Students "choose the form of writing (e.g., personal letter, letter to the editor, review, poem, report, narrative) that best suits the intended purpose." *(English–Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve*, page 37)
- Students work together to write a play about the importance of composting.
  - Students "select a focus, an organizational structure, and a point of view based upon purpose, audience, length, and format requirements." *(English–Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve*, page 23)
- Students perform the play they wrote.
  - "Students convey the emotional qualities of given characters through simple dramatizations." (*Visual and Performing Arts Framework,* Theatre Education: Creative Expression Component, Goal 3, page 83)

SCIENTIFIC THINKING PROCESSES

observing, communicating, ordering, relating

TIME

20–30 minutes to prepare for the lesson; 60 minutes per day for a week to implement the lesson

VOCABULARY

Select vocabulary words that students come across as they complete their projects and the play.

PREPARATION

___ **1.** Read the "Background Information for the Teacher" on page 497.

___ **2.** If possible, videotape some commercials targeted for children. For example, tape some samples from Saturday morning cartoons.

___ **3.** Make a copy of "Project Proposal Form" for each group of students (page 499).

___ **4.** Make a transparency of "The Recycling Logo" (page 498).

___ **5.** Make several copies of "Outline of the Play, By the Skins of Our Bananas" (pages 500-502).

MATERIALS

___ Paper
___ Drawing materials
___ Samples of child-centered logos and slogans from newspaper and magazine advertisements
___ A copy of the "Project Proposal Form" for each group of students
___ Several copies of "Outline of the Play, By the Skins of Our Bananas"
___ The transparency of "The Recycling Logo"

Note: The play will require costumes, scenery, and some props. The specific materials needed for the play will depend on the script written by the students. However, the emphasis should be on good action and dialogue, not on fancy props. Be certain to encourage students to use recyclables, existing materials, and reusable materials—try to avoid new materials—to maintain the spirit of the play's message.

PRE-ACTIVITY QUESTIONS

A. Pretend to be an advertising executive looking for new television (TV) advertisements.

- Ask students what they know about commercials.
- Show them a couple of commercials taped from a children's TV show.
- Ask them what they remember from the commercials.
- Introduce slogans and logos.
- Show the advertisements again and ask them to raise their hands each time they see a logo or hear a slogan.

B. Discuss with students some other well-known slogans and logos. Show students the transparency of "The Recycling Logo." Ask students:

- What does the recycling logo represent? *It represents an endless cycling of materials.*
- What makes it effective? *It is seen everywhere; it is simple.*
- What does each arrow mean? *The first is don't throw away what can be put in the recycling bin; recycle it! The second is remanufacturing the recyclables. The third is buying recycled goods, which closes the loop. This process is a cycle.*
- How does this symbol apply to composting? *When composting, we recycle; and when we use the compost, we close the loop.*

C. Discuss and write students' ideas on the chalkboard.

- How can we get others to compost?
- How can we sell compost?

Homework Assignment: Ask students to bring in advertisements from magazines or newspapers and to identify the products, ideas, or programs which are being promoted.

D. After students have brought some advertisements to class, discuss the following:

- What is the image or idea used to convince people to buy the product, idea, or program?
- What audience is being targeted in particular; e.g., children, teenagers, women, people who own pets?
- What logos or slogans are used?

PROCEDURE

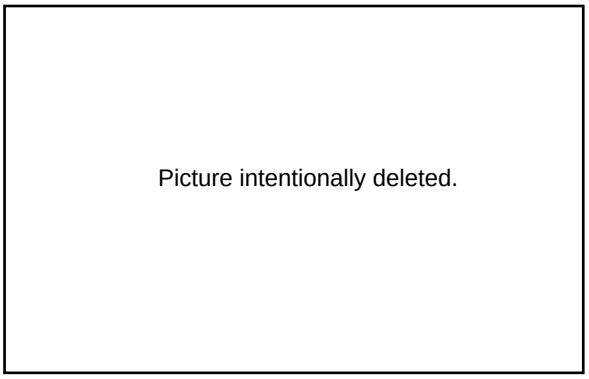
Part I, Completing Compost–Related Projects

A. Ask students to select one of the projects on composting listed below and to work in groups to implement it. Students can also develop one of their own ideas for a project. Provide a copy of the "Project Proposal Form" for each group.

1. Create a logo and/or slogan to encourage people to compost.

2. Create a logo and/or slogan for packaged compost that can be sold as a fund-raiser. (The profits can be used to beautify the school grounds.)

3. Design a package made of recycled materials or reused materials for compost that will be sold. For example, decorate the outside of milk cartons to use as containers for compost.
4. Use compost to enhance soil in planter boxes or the school's garden.
5. Create a brochure and include the following information: What is compost? Why compost? How to compost. Questions and answers about compost.
6. Prepare a "Composting Fact Sheet" and distribute these to classmates and family members.
7. Educate younger students about composting. For example, develop a children's book explaining why and how to compost. (Encourage students to look at other children's books first.)
8. Design posters to display around the school or town about the importance of composting. Students should first brainstorm why people should know about composting. Then they should decide what people should know about composting and develop posters with logos and slogans that advertise one of the key concepts. For example:
   - Kitchen scraps and garden waste can be mixed with soil and decomposed by decomposers to produce compost.
   - Compost is rich in organic matter and soil nutrients and can be used as a soil amendment.
   - Composting kitchen scraps and yard waste saves space in landfills.
9. Decorate compost buckets for the cafeteria to be used for food waste collection.
10. Research, design, and make an outdoor composting bin.
11. Research what other schools are doing concerning compost. Surf the internet for information.
12. Conduct experiments using compost to grow plants.
13. Grow something in compost.
14. Ask students how they could set up a composting bin at school. Ask them to write the pros and cons of doing so.



Students in Carolyn Ann Weiss's fifth-grade class at Jefferson Elementary School give a report to the class about the project on composting that they completed.

B. When students have completed their projects, display their work around the school or conduct an event in which students can share their projects with other students.

C. Discuss with students:
   - How do any of the projects that students did (e.g., designing slogans and logos) help to advertise the importance of composting?
   - What do you think other students will notice about the projects?

Homework Assignment: Ask students to write about the importance of composting.

D. Have students share their homework assignments.

Part II, Producing the Play, "By the Skins of Our Bananas"

Note: Students will write and present the play, "By the Skins of Our Bananas." Make certain to use the talents of everyone in the class—those who are good in art, writing, acting, singing (if you choose to have music), and overall creativity. Try to videotape the play so students are better able to understand the message they are supposed to be conveying and can make adjustments before the final production. Invite a parent or volunteer to help students with the play.

A. Provide copies of the "Outline of the Play, By the Skins of Our Bananas" and allow students to review these. Note that included in the outline of the play are a story idea, a list of characters, and some suggestions for costumes and scenes.

Two buckets painted by students are used in the lunchroom at Cesar Chavez Elementary School.

B. The following are recommended steps that students might want to go through for producing the play. The "Outline of the Play, By the Skins of Our Bananas" can be used as a guide.

1. **Writing the play:** Students should begin by deciding what message they want to convey, who the audience will be, and roughly how many minutes the play will last. Once these decisions are made, a writing team can begin sketching out ideas, based on the existing outline. Students should write stage directions and dialogue for each character.

   Throughout this process, the playwrights should make certain that their script is adaptable to the spoken word. The lines should be easy to say and realistic in terms of who is saying them. One way to make certain that the play works well verbally is to read it out loud at regular intervals throughout the writing process and to make revisions, as necessary. The overall challenge is to craft a play that will be both entertaining and informative.

2. **Casting the characters:** Once the script is finished, students can begin casting the characters. Through this process students are matched with characters in the play.

3. **Rehearsing the play:** Once the characters have been cast, it is time to begin rehearsing. Under the leadership of the stage director, the cast will begin to work through the play, practicing the lines and rehearsing the accompanying actions.

4. **Making the props:** At the time the cast is rehearsing, the stage crew should construct the necessary props and scenery. These preparations will culminate in a dress rehearsal in which the cast and the stage crew run through the entire play together.

5. **Performing the play:** Once all the preparations are complete, the students will perform their play for another class or for the rest of the school.

DISCUSSION/QUESTIONS

After the performance, ask students the following questions:

A. What was the Everybody Family's understanding about solid waste at the beginning of the play? *The family was not aware of the solid waste problem and what it could do to lessen the amount of trash that goes to landfills.*

B. What was the Everybody Family like at the end of the play? *The family realized how easy it is to keep organic waste from going into the landfill by composting.*

C. Have you seen anyone in your life who acts like the Everybody Family at the beginning or the end of the play? What were they doing that reminded you of the Everybody Family? *Yes, my family now recycles and we want to get a worm bin. I have friends that do not think that solid waste is a problem.*

D. What is the difference between organic waste in a compost pile and organic waste in a landfill? *When organic waste is composted, it can be used to enhance soil, which in turn provides nutrients for plants to grow. When organic waste goes to the landfill, it will not be used to enhance soil but remains in the landfill and is essentially "wasted."*

E. What was the most important part of the play for you?

F. What were the major problems and solutions that you encountered while writing the play or making the production materials? *Costumes, props, sets, writing the big ideas for the play.* What do you think caused these problems? *The playwriting process itself was difficult, because we had never written a play before. We had to learn to work as a team and realize that we were all important, whether we had a leading role or not.*

G. How did parents, teachers, students, and others respond to the production?

H. What would you do differently the next time you take on a project like this? *We would write it differently. We would try to find a play that was already written and concentrate on producing the play. We would write the play and then direct another class to perform it.*

APPLICATION

A. In this lesson the projects themselves allow students to apply what they have learned in this unit.

B. Discuss with students how they know whether the message in their play got across to the audience.

Project Idea: Have students develop a composting plan for the school. Encourage the class to develop a test to see whether students are properly disposing of food waste.

EXTENSION

Before presenting the play to the school, coordinate with the food service staff to have students collect waste from the cafeteria at one lunch period. Place two types of clearly marked containers where the trash cans are typically located: one for food waste and one for nonfood waste. Make certain that this activity is announced to all students eating lunch both at the beginning and toward the end of the lunch period; explain the reason for doing it.

- Weigh the food waste and the nonfood waste generated. Go through the nonfood waste to determine how much of the waste could have been recycled.
- Students could present this information to other classes to educate them.
- Repeat this process after the play is presented at school and compare the results.

RESOURCE

Environmental Education Compendium for Integrated Waste Management and Used Oil. Sacramento: California Department of Education and California Integrated Waste Management Board, 1999. Copies are available through the California Integrated Waste Management Board.

Contains information about and evaluations of many curricula on waste management and used oil.

BACKGROUND INFORMATION FOR THE TEACHER

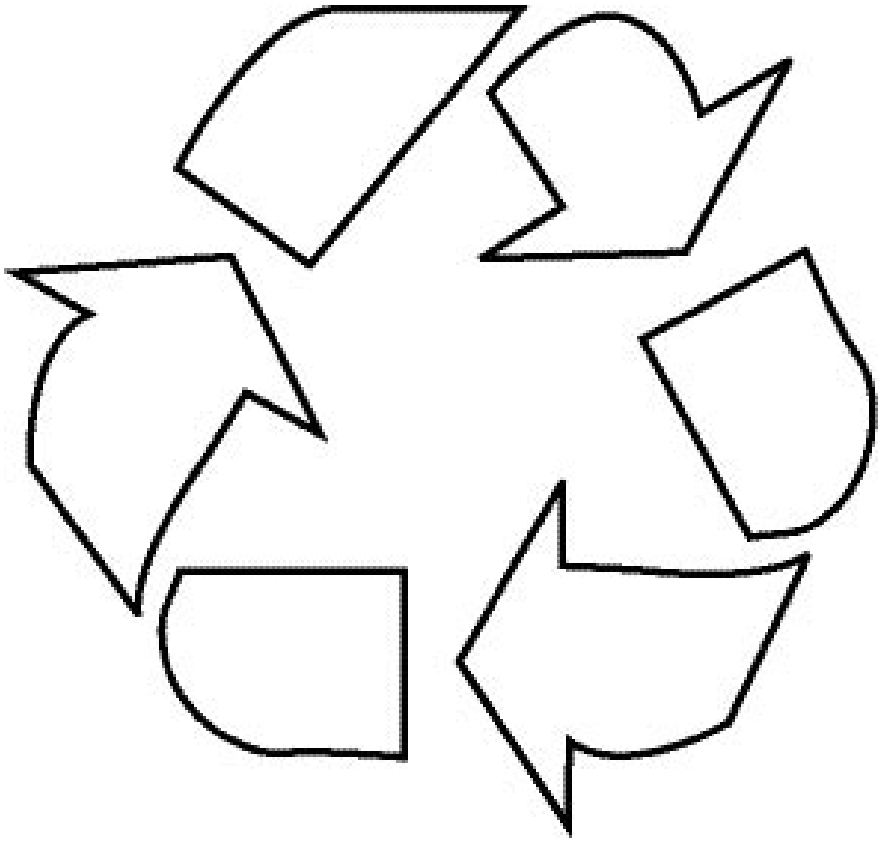
For centuries, people have used posters with pictures, and often with slogans on them in order to advertise products, ideas, or a program. Pictures can show an ideal of some sort, whether it is of physical beauty, good health, or an image of a healthy environment and the actions that go along with it. These ideals, associated with a product, idea, or program are meant to sway one's thoughts about the product, idea, or program so they will buy or accept it. A play can also be used as a form of advertisement.

Slogans (catchy phrases) and logos (simple symbols) are valuable because they promote a program with a simple symbolic representation. They are attractive and grab one's attention. They stimulate instant recall and promote personal identification with the program.

In this lesson students will complete a project to teach others about composting and will also write a play about the importance of composting.

Transparency

THE RECYCLING LOGO



Student's Page

PROJECT PROPOSAL FORM

Name(s): _____ Date: _____

Project name: _____

What is your project? Briefly describe your project in complete sentences:

_____

_____

_____

_____

_____

_____

What will your project look like? Draw a sketch.

What materials will you need? List them.

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

OUTLINE OF THE PLAY, BY THE SKINS OF OUR BANANAS

Comedy About a (Possible) Tragedy

CAST OF CHARACTERS

The Banana Bunch

- Beulah—strong-willed, loud-voiced, a leader
- Bitsy—shy, sweet, small-voiced
- Biggy—big but very agile and sweet tempered
- Bopper—a rocker, a roller
- Blanid—an artist, a dreamer
- Bubba—a joke-teller, a clown
- Bix—musical, mature, easy (This character has a saxophone, clarinet, and flutaphone—wind instrument of choice, real or imagined; the sounds from it are real or vocalized by Bix to sound like the instrument he or she plays.)

They are all dressed as bananas. Being dressed as a banana is hard work, so part of the charm of each character is dealing with the costume while staying in character.

The Landfill

Approximately ten students whose roles are unspoken but central to the play. They are dressed in black trash bag tunics and wear plastic mesh potato or onion sacks over their heads, with the face area cut out in a rectangle so that the audience can see their ever shifting expressions. Throughout the play they stand in a semicircle, absolutely still; they look straight ahead at the audience, never at each other. Their faces bear unhappiness and misery; they are continuously changing, from scowl to scariness, then boredom, anything unpleasant.

The Compost Heap

Approximately ten students who are dressed in newspaper tunics and wear hats adorned with flowers, grasses, wheat, leaves, and other natural materials. Throughout the play they stand in a semicircle and sway gently, their faces full of happiness and pleasure, their expressions continuously changing as they look at each other and at the audience, one bright, content face after another.

The Everybody Family

- Everybody mom
- Everybody dad
- Everybody brother
- Everybody sister

They are dressed in street clothes. They begin as environmentally disrespectful, irresponsible waste-generators and, in the course of the play, grow to become responsible stewards of the Earth's natural resources, beginning with composting banana skins.

The Recycling Worm

Male or female, the Recycling Worm is dressed in recyclables from head to feet. (The challenge to props and costumes is to fashion a body suit and cape that will be both hilarious and instructive; as a suggestion, leaves and other objects representing compost can be pinned to the cape.) The Recycling Worm wiggles, crawls, and gestures. The worm is patient and loving, but firm about getting the Everybody Family to do its part.

The Plants

Several bright flowers
A tree

THE PLOT

The Bananas all want their skins to go to a compost heap, not a landfill. They know that their skins will become part of some wonderful new plant some day. But in the landfill, nothing good will come of them. They will just sit there for years, uselessly. Because the Everybody Family is not informed about composting, nor makes wise choices concerning natural resources, the family throws everything in the trash to go to the landfill.

The Banana Bunch decides to call on the Recycling Worm to help educate the Everybody Family about the virtues of composting and the vices of landfilling those items that can be composted.

In the end the Everybody Family—young and old—understand the importance of composting and begin to run an environmentally responsible household. One by one the banana skins jump gleefully into the compost pile. Immediately afterward, a bright flower and a tree grow up out of the pile.

All is well. The Bananas are together in the compost, and the members of the Everybody Family are model recyclers and waste reducers. The Recycling Worm squirms happily through the audience passing out instructions on how to compost.

SCENE 1

Takes place at a table in the Everybody Family's kitchen. The Banana Bunch all sit "bunched" together, apparently joined at their heads to a common stem. They separate as each disengages to get up and present his or her perspective about wanting his or her banana skin to go to the compost heap, not the landfill, after being used by one of the members of the Everybody Family on breakfast cereals.

The four members of the Everybody Family come in and eat breakfast. Then they throw everything into one trash can, including the banana peels. This is clearly a household waiting for a visit from the Recycling Worm.

SCENE 2

The next day in the Everybody Family's kitchen.

All over the table and floor are pieces of "trash" that they threw into the garbage can. The family members come into the kitchen and are shocked by what they see. The Recycling Worm explains that all of this trash was in the garbage can on its way to the landfill, yet there are items in that trash that could have been reused, and most of the food waste, like the banana peels, could have been composted. "What's composted?" asks an Everybody.

"What's the problem?" asks another Everybody.

"Come with me and let me show you a landfill and a compost heap," says the Recycling Worm.

SCENE 3

The Recycling Worm leads the Everybody Family to the next scene. They watch the conflict between the landfill and the compost heap.

The semicircle of the landfill and the semicircle of the compost heap are the two central images on stage. It is here that the play's main conflict and action take place. The landfill wants the banana peels and so does the compost heap. Each offers reasons why the banana peels should be in placed in its area. With the help of Recycling Worm as a mediator, they eventually come to a compromise. The compost heap will get all of the food waste, and the landfill will get all the nonreusable and nonrecyclable items. After all, if the landfill becomes too big too fast and fills up, no more waste will be taken to it.

SCENE 4

Back in the Everybody Family's kitchen.

Everybodys are sorting their trash, checking with the audience as to where each piece of trash should go. The Recycling Worm, the compost heap, and the landfill look on. All are smiling.

One of the Everybodys places all the banana peels in the compost heap. The Recycling Worm waves a wand and turns the banana peels into compost. Immediately afterward, a bright flower and a tree grow up out of the pile.

All participants clap.