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.

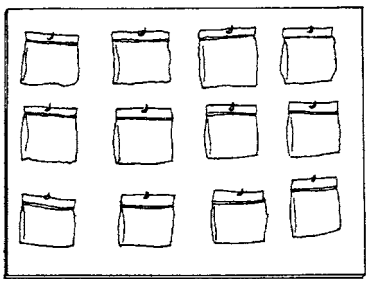
B. Have students work in pairs and ask them to put the objects that they think will decompose into one sandwich-sized resealable plastic bag and label this bag with masking tape on which they write "Items that will decompose."

- 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

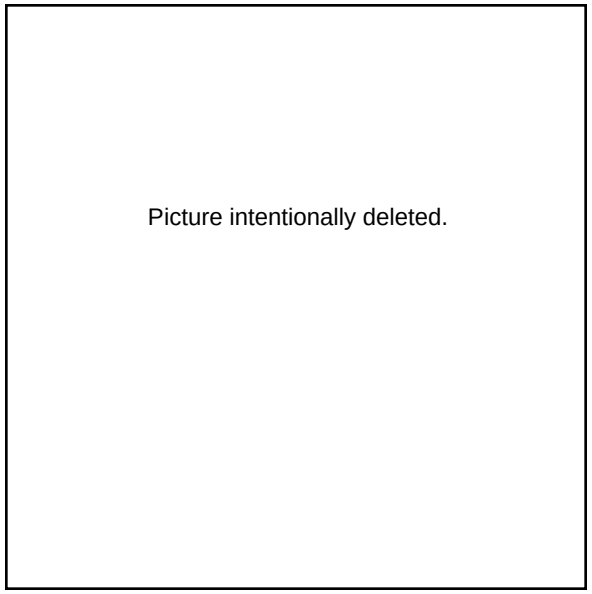
Some materials (e.g., wood, paper, food scraps, leaves, fruits, vegetables, cotton, and other plant materials) decompose easily when placed on top of or in the soil. These materials are considered to be biodegradable.

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.



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.)