

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.



Picture intentionally deleted.

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.

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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.