LESSON 3: Cycles in Nature and Red Worm Development

Note: For this lesson, you will need the items you buried approximately one month ago in "Preparing the Decomposition Experiment" (page 106).

LESSON'S CONCEPTS

- "All organisms create waste through the use of natural resources, and that waste is cycled through natural systems." ("Conceptual Matrix for Waste Management")
- In the cycles that occur in nature, materials, such as nutrients, are recycled. Worms play an important role in recycling nutrients.

PURPOSE

Students will learn about the role of cycles in nature by observing the stages and results of decomposition.

OVERVIEW

In this lesson students will:

- Examine the stages of decomposition of the items they buried at the beginning of this unit.
- Design a game to model the water cycle and identify a water cycle in the worm bin.
- Illustrate the stages of growth of a red worm.
- Determine the role red worms play in the nutrient cycle.
- Make a mural of cycles in a well-functioning vermicomposting bin.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND FRAMEWORKS

- Students identify the cycles they observe occurring in nature and in a well-functioning vermicomposting bin.
  - "Cycles, such as the water cycle and the nutrient cycle, are characteristics of environments that support life." (*Science Framework*, page 136)
  - "Plants and animals have predictable life cycles" (which students need to understand). (*Science Content Standards, Grades K–12*; Grade 2; Life Sciences, Standard 2)
  - "Each species has its own life cycle." (*Science Framework*, page 139)
  - "To develop historical literacy, students must . . . understand the meaning of time and chronology." (*History–Social Science Framework*, page 13)
- Students examine stages of decomposition and locate evidence of animal waste.
  - "All organisms create waste through the use of natural resources and that waste is cycled through natural systems." ("Conceptual Matrix for Waste Management")

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

VOCABULARY

cycle, decompose, decomposers, life cycle, nutrient cycle, water cycle

PREPARATION

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

___ **2.** Locate an area on the school grounds or in the school's neighborhood where students can find organic items (from living things or things that used to be living), such as leaves and animal droppings (e.g., from dogs) that are rotting or decomposing.

MATERIALS

For "Pre-Activity Questions"

___ A potted plant

For "Part I, Examining Decomposition"

___ The pieces of trash buried in soil from "Preparing the Decomposition Experiment"

___ Rubber or plastic gloves for students to use when sorting the trash buried in soil

___ The piece of bread in the resealable plastic sandwich bag prepared in "Preparing the Decomposition Experiment"

For "Part II, Acting Out the Water Cycle"

___ Quart jar

___ Plastic wrap to go over the opening of the jar

___ Rubber band

___ Two or three tablespoons of water

For "Part III, Observing and Identifying the Stages in the Life Cycle of a Red Worm"

___ Paper plates (up to the number of students in your class)

___ A handful of contents from a worm bin for each pair of students

___ One magnifying lens for each pair of students

PRE-ACTIVITY QUESTIONS

A. Ask students to look at the potted plant and then discuss the following:

- What will we probably do with this plant when it dies? *Throw it into a garbage can; feed it to the red worms.*
- What would happen to this plant if it lived outside and died? *The street cleaners would pick it up; it'll just lie there; something might eat it.*
- What would happen to this plant if it grew and died in a forest? *Something might eat it; it might turn into soil.*
- What can help turn plant parts into soil? *Bugs and small things, red worms, bacteria and fungus.* (Students might not know the answer to this until the end of this lesson.)
- 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.*

B. 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.*

C. Ask students to work in groups to develop their definitions of a cycle, and then have them share their definitions with the rest of the class. Post these definitions on a wall display about cycles.

PROCEDURE

Part I, Examining Decomposition

A. Tell students that in this lesson they will learn about the decomposition process.

B. Remind students of what they predicted and drew in "Preparing the Decomposition Experiment" concerning what will or will not decompose. Show them the butcher paper with their predictions and their illustrations.

C. Dump the contents of the container set up in "Preparing the Decomposition Experiment."

- Have students use gloves to locate the various pieces of trash that were buried.
- Ask students to describe what they see. Then ask:
  - Which items look as if they are decomposing?
  - Did any item totally decompose? If so, why do you think this happened?
  - Which items do not look as if they are decomposing? Why do you think this happened?

- Have the class design a chart that shows what decomposed, what started to decompose, and what did not decompose. Compare this chart to what students predicted in "Preparing the Decomposition Experiment."

D. Ask students to look at the bread in the bag and to describe what is happening.

- Lead students to conclude that tiny decomposers, such as bacteria and fungi, are eating the bread and breaking it down into its basic components, including nutrients.
- Ask what we can do with this bread. *It could be buried in soil and checked for decomposition in a couple of weeks; it could be fed to the worms.*

Safety Note: Students should not open the plastic bags if there is evidence of growing mold because high concentrations of spores may be present.

Note: See the 4–6 Module, Unit 3, Lesson 2, for activities on scavengers and decomposers.

E. Lead students on a walking field trip on the school grounds or in the school's neighborhood to observe 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 look for materials that originated from living things.

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

G. Ask students to give an example from the walk of something that is part of a cycle.

Part II, Acting Out the Water Cycle

A. Discuss with students the parts of a water cycle:

- The rain falls down on the Earth.
- The water runs down into creeks and rivers, lakes, and into the ocean.
- Some rainwater seeps into the ground and ends up in groundwater.
- The sunlight evaporates the water into the sky where rain clouds form and rain (or snow) falls on the Earth.

B. Ask students how the water cycle is a "cycle"? *It is a series of changes that go back to the beginning and keep repeating over and over again.*

C. Demonstrate the water cycle by using a jar with a couple of tablespoons of water. Secure, with a rubber band, plastic wrap over the top of the jar and set the jar in a sunny place for about an hour or until some of the water evaporates. Water will condense on the plastic. Move the jar away from the sun, and have students observe the "rain" as the water in the jar cools.

D. Have the class help you come up with a game that can be played outside to show the parts of the water cycle and to show how water cycles from the sky to the ground.

E. Play the game with the class. Adjust the rules of the game, as needed, to make the cycle work.

F. Back in the classroom, have students look for evidence of a mini-water cycle working in the worm bin. Check the lid for condensation. See whether the water is "raining" inside the worm bin.

Part III, Observing and Identifying the Stages in the Life Cycle of a Red Worm

A. Provide a handful of contents (shredded newspaper, red worms, food, worm castings) from the vermicomposting bin and a magnifying lens for each pair of students. Ask them to locate the following:

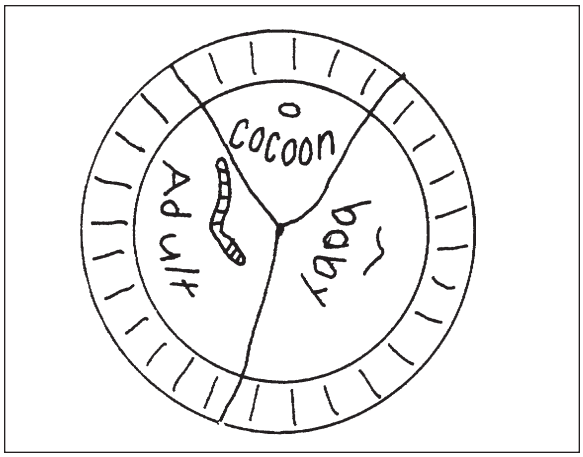
- A worm cocoon. It is the size of a grain of rice and shaped like a lemon. Over time, the cocoons change color from white to yellow to brown. Students might have difficulty locating worm cocoons, so if a student finds one, make sure that the whole class gets to see it. If your worm bin was set up recently, your students might not find any worm cocoons.
- Baby worms. They are whitish in color.
- Adult worms.

Note: If you have access to the Internet, visit www.wormwoman.com to see a baby worm hatch from its cocoon.

B. Ask students to work in pairs or groups of three to describe or show a red worm's life

cycle in one of the following ways (encourage students to use the book *Squirmy Wormy Composters* as a reference):

- Use a paper plate separated into three sections in which each stage of the life cycle (cocoon, baby red worm, adult red worm) is illustrated.
- Compose a poem about a red worm and its life cycle.
- Write a story about a red worm and its life cycle.
- Make a mobile by hanging an illustration of each part of the red worm's life cycle from a piece of cardboard.



Life cycle of a red worm drawn on a paper plate. Submitted by Ted Schut, first-grade teacher, Ripona Elementary School, Ripon Unified School District.

DISCUSSION/QUESTIONS

A. Ask students what is considered waste in nature. *Leaves, animal droppings.* Why are we not surrounded by nature's waste? *Decomposers, like bacteria and fungus, decompose waste. Red worms and other living things eat waste.*

- Ask whether all animals produce waste. If there were no decomposers, what would the world be like? *The world would be full of animal waste*.
- Tell students that scientists call animal waste scat, droppings, feces, and manure (manure usually describes waste from plant-eating animals). Ask students how scat is part of a cycle. Based on students' responses, explain that animals need to get rid of body wastes. When animals produce scat, they allow more room for new food in their bodies to provide them with nutrients to live. But scat contains nutrients, too. Many small animals (e.g., scarab beetles, sow bugs, red worms) and other living things, like fungus and bacteria, eat scat and manure. The scat decompose and become part of soil to provide nutrients to plants that in turn feed animals that produce more waste. This is why many farmers use manure from cows, horses, and sheep as fertilizer for their crops.

B. Tell students that plants also drop their waste on the ground. Ask them what this waste could be. *Leaves, branches, flowers.* Ask them to explain what happens to plants' parts (e.g., leaves, branches, flowers) when they fall off the plant. Lead students to the following answer: *The plants are decomposed by bacteria and fungi, and their nutrients become part of the soil again, providing nutrients to other plants, thereby continuing the cycle. The nutrients are also used by new plants growing in the area.*

APPLICATION

A. Ask students to identify the types of natural cycles that exist in a well-functioning vermicomposting bin. *Water cycle, nutrient cycle, oxygen cycle, life cycles.* Discuss:

- What do you need to monitor in the bin to make certain that all cycles are working? *Monitor for moisture (water cycle), food (nutrient cycle), worms (life cycles).*
- What is one way that you can make sure that there is an adequate supply of oxygen for the worms? *Keep the paper strips fluffed up so air can move around them. Make sure that the worm bin has air holes.*
- What will happen to the red worms if the cycles in the worm bin do not work? *The red worms will die, and there might not be any eggs in the bin to hatch to replace them.*

B. Make a mural of cycles in the vermicomposting bin or a mural of the vermicomposting cycle. This could be done as a class or in groups.

- Cycles in the vermicomposting bin would include the water cycle, nutrient cycle, oxygen cycle, and life cycle.
- The vermicomposting cycle would include building a bin, preparing the bedding, adding the worms, adding

the food waste, harvesting the castings, fertilizing the garden, growing vegetables, eating the vegetables, and feeding vegetable waste to the worms.

C. Have students discuss as a class one or two student volunteers' daily activity cycles. For example, wake up, get dressed, eat breakfast, go to school, eat lunch, play, do homework, eat dinner, brush teeth, go to bed, wake up . . ..

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

Note: For younger students describe someone's daily cycle together as a class.

D. Ask students:

- What are some examples of cycles in nature? *Water cycle, season, life cycle.*
- How does vermicomposting keep food wastes in a cycle instead of a one-way route to the landfill? (Help students come up with the italicized answers.) *It allows people to recycle food wastes; and once it is added to soil, it recycles nutrients. These nutrients can be used to grow plants we use for food.*

E. Have students review their definitions of cycles, which they developed in their groups at the beginning of this lesson, and encourage them to modify these if they think it is necessary. Ask the groups to share their present definition and to explain why they decided on the present version.

F. Ask students to write a sentence or two in their journals about what they have learned in this lesson. They can also draw pictures. Have them share their journal entries in small groups. Check each student's writing.

EXTENSIONS

A. Students can make certain that adequate oxygen is available to the red worms and other living things in the worm bin by keeping the paper fluffed up. They can regularly measure the thickness of the paper strips in the bin to determine when the paper is becoming compacted (thus, the amount of oxygen would be reduced).

B. Illustrate a life cycle of a pumpkin.

C. Learn and sing with the class the songs "Decomposition" and the "Water Cycle Boogie" by the Banana Slug String Band.

RESOURCES

Videos

Cycles in Nature. 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*. 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.

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 the grandpa tree falls, the animals make homes in it, and the "sawdust mixed with dirt becomes food for flowers."

Gomi, Taro. Translated by Amanda Mayer Stinchecum. *Everyone Poops.* Brooklyn, N.Y.: Kane/Miller Book Publishers, 1993.

In simple text and colored illustrations, the author describes various animals and their droppings.

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

Explains the life cycle of a pumpkin.

Kalman, Bobbie, and Janine Schaub. *Squirmy Wormy Composters.* New York: Crabtree Publishing Company, 1992.

Describes red worms and how to set up a vermicomposting bin. Contains ideas for activities for students to learn more about worms.

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.

Viorst, Judith. *The Tenth Good Thing About Barney.* Illustrated by Erik Blegvad. New York: Macmillan Publishing Company, 1975.

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

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.

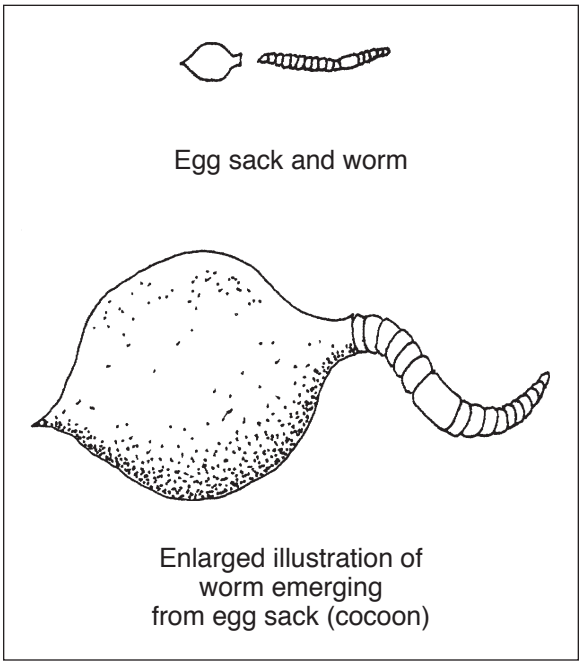
To order the above tapes, call the Banana Slug String Band at 1-888-327-5847.

Web site

www.wormwoman.com

Shows a baby worm hatching from its cocoon.

Additional Web sites are listed in the "Appendix F–VI, Vermicomposting Web sites."



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. Decomposition is part of a cycle in which nutrients are recycled from dead to living things. (A nutrient is any chemical element or compound that an organism must take in order to live, grow, or reproduce.) A water cycle is the movement of water on Earth through living and nonliving things. The life cycle of a red worm begins with an egg, continues with the hatching of the egg, the growth of the red worm into a mature adult, and eventually the production and fertilization of eggs by mating adults. When the worm dies, its body decomposes and enriches the soil.

When any plant or animal dies, decomposers start to use the dead material as food. Decomposers include microscopic living things, like bacteria and fungi (e.g., yeast, mold, mildew). Most of these cannot be seen with the naked eye. Decomposers break down large chemicals 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.

All previously living things decompose. Animals and plants contain nutrients (chemical compounds) and when they die, decomposers can release these nutrients into the soil where they may be held in solution by water. Plant root hairs absorb this moisture full of nutrients, which eventually spread into the stems and leaves of plants and are used by the plant to live and grow.

But organisms do not have to die to be part of the nutrient cycle. Waste excreted by animals is also high in nutrients. Decomposers release these nutrients into the soil. Plant parts (e.g., leaves, branches, and flowers) dropped on the ground by plants contribute to organic material for decomposers to process. For example, when a plant grows in the spring, its roots take in nutrients from the soil. In the fall of the year, leaves from the plant fall to the ground, and as they decompose, the nutrients which were in the leaves are returned to the soil by decomposers. Then the tree uses these nutrients to live and grow.

If nothing decomposed, the soil would not get back the nutrients that plants use to grow. Without nutrients plants could not live, and the animals that depend on the plants for food would not survive.

Natural cycles can completely convert organic waste into nutrients for living things. Humans are the only known species to produce things (e.g., plastics) that cannot be reabsorbed by natural cycles.

The water cycle consists of a continuous sequence of precipitation (rain or snow): evaporation of water from land and from rivers, lakes, and oceans; condensation of water vapor in the sky to form clouds; and back to precipitation on the land and bodies of water. A mini-water cycle can be observed in the worm bin, especially if some water is condensing on the lid and dropping on the paper strips.

Red worms, like all other living things, have a life cycle. Red worms hatch from eggs, and when grown to maturity, produce eggs, which start the cycle again. Each red worm is both male and female. A swollen section or band, called a clitellum, on a red worm's body contains eggs and sperm. A mucous produced by the clitellum allows sperm from one worm to pass to another worm. After two worms mate, each develops a cocoon on its clitellum. As the cocoon comes off the worm, it picks up both the eggs from its body and the sperm (stored in special sac-like openings in the worm's skin) which it received from its mate. The cocoon then slides off the worm's body. The cocoon seals itself and fertilization takes place inside it.

A red worm's cocoon is the size of a grain of rice and shaped like a lemon. Over time, the cocoons change color from white to yellow to brown. One to several baby worms emerge from the cocoon after three weeks. Each is approximately one-half to one inch long. It takes red worms from four to six weeks to mature enough from hatching to start reproducing.

NOTES