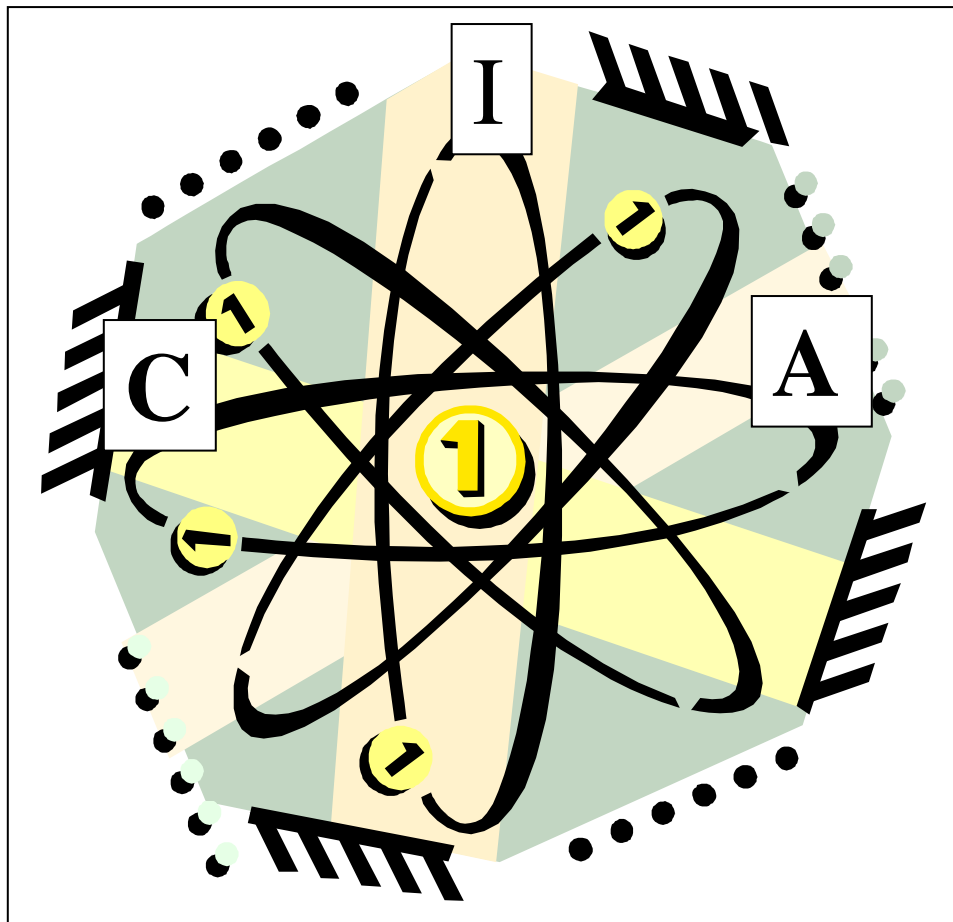


Curriculum, Instruction, Assessment (CIA) Alignment

Science, Grade 5 Unit 3: Ecosystems

Task Analysis and Hands-on Investigations



**Ronald Blocker, Superintendent
Orange County Public Schools
Orlando, Florida**

2003-2004



Subject Area: Science
Strand G: How Living Things Interact with Their Environment
Grade: 5

Benchmarks

- SC.B.1.2.1: The student knows how to trace the flow of energy in a system (e.g., as in an ecosystem).
- SC.B.2.2.1: The student knows that some source of energy is needed for organisms to stay alive and grow.
- SC.F.1.2.2: The student knows how all animals depend on plants.
- SC.G.1.2.1: The student knows ways that plants, animals, and protists interact.
- SC.G.1.2.3: The student knows that green plants use carbon dioxide, water, and sunlight energy to turn minerals and nutrients into food for growth, maintenance, and reproduction.
- SC.G.1.2.4: The student knows that some organisms decompose dead plants and animals into simple minerals and nutrients for use by living things and thereby recycle matter.
- SC.G.1.2.5: The student knows that animals eat plants or other animals to acquire the energy they need for survival.
- SC.G.1.2.6: The student knows that organisms are growing, dying, and decaying and that new organisms are being produced from the materials of dead organisms.
- SC.G.1.2.7: The student knows that variations in light, water, temperature, and soil content are largely responsible for the existence of different kinds of organisms and population densities in an ecosystem.
- SC.G.2.2.3: The student understands that changes in the habitat of an organism may be beneficial or harmful.

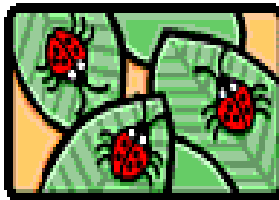
TASK ANALYSIS	
The student...	ECOSYSTEMS
	<ul style="list-style-type: none"> organizes important levels for structure and function to include cells, organs, tissues, organ systems, whole organisms, and ecosystems.
	<ul style="list-style-type: none"> describes an ecosystem as a community of living and nonliving organisms and their immediate surroundings (e.g., air, rocks, soil) driven by the sun's energy.
	<ul style="list-style-type: none"> explores how the existence of different kinds of organisms and population densities in an ecosystem depends on variations in light, water, air, and soil content.
	<ul style="list-style-type: none"> determines that for any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
	<ul style="list-style-type: none"> recognizes that some source of energy is needed for all organisms to stay alive and grow.
	<ul style="list-style-type: none"> identifies the major source of energy of ecosystems as sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.
	<ul style="list-style-type: none"> explains how green plants use carbon dioxide, water, and sunlight energy to turn minerals and nutrients into food for growth, maintenance, and reproduction.

TASK ANALYSIS

The student...

- categorizes populations of organisms by the function they serve in an ecosystem: plants and some microorganisms as *producers* that make their own food; animals, including humans, as *consumers*, which obtain food by eating other organisms; and *decomposers*, primarily bacteria and fungi, recyclers that break down dead plant and animal materials into elements that return to the soil, water, and air for use again.
- examines patterns of interdependency in ecological systems by analyzing relationships in food webs among producers, consumers, and decomposers and discovers that no matter how distant the relationship may seem, all things are connected.
- infers that changes (e.g., natural hazards, such as earthquakes, landslides, wildfires, volcanic eruptions, floods, storms) in an ecological system usually affect the whole system, because one part of the environment cannot be altered without affecting the others.
- classifies changes in an ecosystem as either beneficial or harmful to specified organisms.
- values humans as part of the web of life, in which everything is connected and recognizes the need to live in ways that respect the interconnectedness of all things.

HABITAT, SWEET, HABITAT



BENCHMARK and TASKS

SC.G.1.2.7 The student knows that variations in light, water, and soil content are largely responsible for the existence of different kinds of organisms and population densities in an ecosystem.

- The student organizes important levels for structure and function to include cells, organs, tissues, organ systems, whole organisms, and ecosystems.
- The student describes an ecosystem as a community of living and nonliving organisms and their immediate surroundings (e.g., air, rocks, soil) driven by the sun's energy.
- The student explores how the existence of different kinds of organisms and population densities in an ecosystem depends on variations in light, water, air, and soil content.
- The student determines that for any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.

KEY QUESTION

What evidence of plant and animal life can be found in the microhabitats in your schoolyard?

BACKGROUND INFORMATION

Different types of **organisms** are adapted to different types of **habitats**. A habitat is a place where a plant or animal lives and can get everything that it needs (e.g., food, water, oxygen, shelter, space, sunlight, appropriate temperature, humidity levels it can tolerate). Habitats come in all sizes and types of conditions. Some habitats may be huge, like deserts or forests, and some habitats may be small, like backyards or ponds.

Smaller areas of a habitat in which the temperature, humidity, light, and other conditions are significantly different from the rest of the habitat are called microhabitats. The microhabitats will have variations in light, moisture, temperature, and soil content, but the variations might be only slight. The different conditions may make it possible for certain living things to grow and survive but keep others from doing so. Most plants and animals are able to survive in only a very specific habitat, where conditions are suited to them. For example, earthworms live in moist soil because they have delicate, moist skin. Organisms, such as beetles found in drier habitats, often have thick, hard, outer shells to prevent them from drying out.

MATERIALS

Per group

1 thermometer
sticks or spoons for digging

Per student

Habitat, Sweet, Habitat observation sheet
clipboard (optional)
1 hand lens

Per class

camera (optional)

Per teacher

Under One Rock: Bugs, Slugs, and Other Ughs, Anthony D. Fredericks, 2001, Dawn Publications
Field Detectives: Investigating Playground Habitats, 1998, AIMS Education Foundation

TEACHING TIPS

1. Before starting the activity, walk along the school property and look for different types of microhabitats. Look around trees, rocks, water faucets, shady areas, and close to buildings. Check for potential hazards such as stinging insects or dangerous debris.
2. Encourage respect for living organisms by reminding students not to disturb organisms or destroy their homes.
3. If a camera is available, students can take pictures of the microhabitats they are exploring and add them to their science journals. Pictures can be taken at various intervals if the same habitat will be observed over a period of time or throughout the school year.
4. The AIMS publication, *Field Detectives: Investigating Playground Habitats*, 1998, AIMS Education Foundation, www.aimsedu.org would be a useful resource for the whole Ecosystems unit of study.

ENGAGE

1. Discuss:
What kinds of animals might live in our schoolyard?
Can you describe the kind of environment in which they might live? (e.g., dry, sunny, wet, sandy)
Can you think of any evidence we might find that would indicate that living things are present or have been around – even if we don't see them? (Clues might include nests or holes in the ground, chewed leaves, tracks, droppings, etc.)
2. Read *Under One Rock: Bugs, Slugs, and Other Ughs* by Anthony D. Fredericks.

EXPLORE

1. Divide students into groups and distribute materials.
2. Take students outside to the schoolyard. Walk around and point out various areas that may be good microhabitats for exploring. Each group should select a microhabitat for exploring.
3. Ask student volunteers to use a thermometer to find the temperature of the outside air while on the playground. Students should record this on their observation sheets.
4. Encourage students to sit quietly near the chosen microhabitat and use their senses to observe for a short period. Ask: *What clues can you find by looking, listening, smelling, and touching?*
5. Students should write down everything they see and make a detailed sketch of the area.
6. Have students record the temperature in the microhabitat. They need to be certain that they place the thermometer directly in the microhabitat being observed (e.g., in a tree, under a log).
7. On the observation sheet students should describe the area in detail, including light (e.g., shady or sunny), moisture (e.g., wet, dry, or moist area), and soil (e.g., compact or loose; sandy or mostly clay).
8. Students should use their hand lenses to explore the microhabitat they have chosen. Remind students that their observations will require patience because they are not only looking for plants and animals, but for evidence of life as well (e.g., nests or holes in the ground,

chewed leaves, tracks, droppings, etc.) Caution students not to place their hands anywhere they can't see, such as under rocks.

9. Ask students to use the sticks or spoons to gently move soil, rocks, etc. to observe more closely in an area but to take care not to damage the habitat. After examining the soil, they should return it to its original place.

EXPLAIN

1. As students report their findings, construct a class data table summarizing the different microhabitats found and the evidence of organisms found in each.

Type of Microhabitat	Organisms	Evidence of Organisms
sunny, moist area	green plant with small leaves	droppings, chewed leaves
oak tree near the building	2 birds, 1 squirrel, oak tree	droppings

2. Discuss:

Describe the types of microhabitats you observed in the schoolyard.

How were the conditions in the microhabitat different from the larger habitat?

What are the essential elements of a habitat? (e.g., food, water, oxygen, shelter, space, sunlight, appropriate temperature)

What kinds of organisms did you actually see in the microhabitat you explored?

What was the dominant kind of plant in the microhabitat?

How many different types of plants did you observe?

What kinds of animals did you observe?

What evidence did you see that animals had been there but were not present in the microhabitat you observed? (nests or holes in the ground, chewed leaves, tracks, droppings, etc.)

Was there any evidence of humans in the area?

What can we do to protect the different microhabitats we discovered? (walk on the sidewalk, do not litter)

EXTEND/APPLY

Have students observe microhabitats in their yards at home and report their findings. Encourage them to think about how the microhabitats in their yards are different from those they observed on the school grounds.

EXTENSION

Have students visit the same microhabitat at different times of the day and/or year and in different weather conditions to see what changes they notice over time.

HABITAT, SWEET, HABITAT



Habitat Observer:

Conditions in the Microhabitat

Temperature:

Outside air:

Microhabitat:

Light:

Soil:

Moisture:

Animals Observed in the Microhabitat

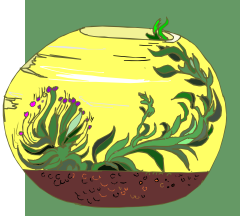
Include the kinds of animals and the number of each.

Plants Observed in the Microhabitat

Include the kinds of plants and the number of each.

Evidence That Organisms Had Been in the Microhabitat but Were Not Present at the Time of the Observation

WATER WORLD



BENCHMARKS and TASKS

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SC.G.1.2.3 The student knows that green plants use carbon dioxide, water, and sunlight energy to turn minerals and nutrients into food for growth, maintenance, and reproduction.

- The student describes an ecosystem as a community of living and nonliving organisms and their immediate surroundings (e.g., air, rocks, soil) driven by the sun's energy.
- The student recognizes that some source of energy is needed for all organisms to stay alive and grow.
- The student identifies the major source of energy of ecosystems as sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.
- The student explains how green plants use carbon dioxide, water, and sunlight energy to turn minerals and nutrients into food for growth, maintenance, and reproduction.
- The student categorizes populations of organisms by the function they serve in an ecosystem: plants and some microorganisms as *producers* that make their own food; animals, including humans, as *consumers*, which obtain food by eating other organisms; and *decomposers*, primarily bacteria and fungi, recyclers that break down dead plant and animal materials into elements that return to the soil, water, and air for use again.
- The student examines patterns of interdependency in ecological systems by analyzing relationships in food webs among producers, consumers, and decomposers and discovers that no matter how distant the relationship may seem, all things are connected.

KEY QUESTION

How do plants and fish survive in a closed aquatic ecosystem?

BACKGROUND INFORMATION

An **ecosystem** is a **community** of living and nonliving **organisms** and their immediate surroundings (e.g., air, rocks, soil) driven by the **sun's energy**. An ecosystem can be as simple as a balanced aquarium or as complex as a whole region.

In this closed ecosystem, students will find that plants and animals exist in a state of interdependence when the amount of food, water, and space is balanced in the community. The amount of oxygen in the air and water is constantly replenished by green plants (elodea), which give

off oxygen when they manufacture food for themselves through the process of **photosynthesis**. The green plants (elodea) carry out the process of photosynthesis by using sunlight, water, and carbon dioxide. The plants, the **producers**, provide animals in this ecosystem with both food and oxygen. The fish, **the consumers**, in this case are plant-eaters and are able to survive in low-oxygen conditions. The snails act as both **consumers** and **decomposers**. The animals (the fish and snail) give off carbon dioxide in this closed aquatic environment.

MATERIALS

Per class

1 resealable baggie
aquatic plant – elodea
animals (pond snail and 3 or 4 mollies)
6-8 cm of sand or gravel
few small rocks
1 large jar with lid (at least 3-4 liters)

Per student

science journal

TEACHING TIPS

1. Pour tap water and let it set for three days before starting this project. In order to maintain a balanced aquatic ecosystem, use the largest jar you can find.
2. Elodea is a good plant choice because it provides animals in the ecosystem with food and oxygen. You can purchase elodea at a fish supply store, or you can often find it growing near docks in a lake.
3. The fish selected must be plant eaters, able to survive in low-oxygen conditions, and salt-tolerant. Snails in an aquatic ecosystem will act as both consumers and decomposers. If the system is balanced, an adequate amount of food will always be available for the fish.

ENGAGE

Ask:

How do you think fish in an aquatic environment can survive?

What do you think aquatic plants need in order to survive?

EXPLORE

1. Have students keep a log of dates and the process involved in setting up the aquatic ecosystem. Students should also draw a picture in their journals, describing in detail the components of the ecosystem.
2. Ask students to help you set up a small aquatic ecosystem for observation in the classroom.
3. Place gravel or sand in the bottom of a large jar.
4. Place some aquatic plants securely in the sediment. Anchor the plants at the bottom by tying them to small rocks for added weight.
5. Add the snail to the jar and then fill it three-fourths full with the aerated water, leaving the remaining space for air.
6. Place the lid securely on the jar. Place the jar near a window but not in direct sunlight or the water temperature will become too high. The aquatic ecosystem must have plenty of indirect light in order to sustain plants.
7. Wait one week until the ecosystem has adjusted to the light source. Fish can be added at this time. Place a sealed bag with water and fish into the ecosystem. Do not release the fish until

the water in the bag becomes the same temperature as the water in the ecosystem. This should take a few hours.

8. Ask students to predict how they think the plants and water will look after one week.
9. Students should keep weekly observations in their science journals.

EXPLAIN

Why is this mini-aquarium considered an ecosystem? (An ecosystem is a community of living and nonliving organisms and their immediate surroundings [e.g., air, rocks, soil] driven by the sun's energy.)

Who are the producers in the mini-aquarium? (green plants)

Who are the consumers in the mini-aquarium? (animals that eat the plants)

How are the animals in the mini-aquarium dependent on the plants? (The plants provide food and oxygen for the animals.)

How are the plants dependent on the animals in the mini-aquarium? (The animals give off carbon dioxide that is used by the plants to carry out the process of photosynthesis.)

What are the essential elements of a habitat? (e.g., food, water, oxygen, shelter, space, sunlight, appropriate temperature)

Do the plants and animals in the mini-aquarium have all the essential elements of a habitat?

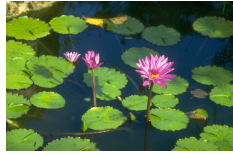
EXTEND/APPLY

Use a flow map to help students trace the flow of energy in the mini-aquatic ecosystem.

EXTENSION

Help students set up and maintain a classroom terrarium that includes all of the essential elements of a habitat. Find some resources as guides for building terraria. Start small, first adding soil and some small plants from the school grounds. Add animals, such as earthworms and pillbugs, a few at a time, always adding food and water and making daily adjustments as needed.

SHED SOME LIGHT ON PHOTOSYNTHESIS



BENCHMARKS AND TASKS

SC.B.1.2.1 The student knows how to trace the flow of energy in a system (e.g., as in an ecosystem).

SC.B.2.2.1 The student knows that some source of energy is needed for organisms to stay alive and grow.

SC.G.1.2.3 The student knows that green plants use carbon dioxide, water, and sunlight energy to turn minerals and nutrients into food for growth, maintenance, and reproduction.

- The student recognizes that some source of energy is needed for all organisms to stay alive and grow.
- The student identifies the major source of energy of ecosystems as sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.
- The student explains how green plants use carbon dioxide, water, and sunlight energy to turn minerals and nutrients into food for growth, maintenance, and reproduction.

KEY QUESTION

How do green plants manufacture their own food?

BACKGROUND INFORMATION

Green plants have the capacity to convert some of the **energy** from **sun** into food energy. In the presence of sunlight, plants are able to combine water and carbon dioxide from the air to produce glucose. This process is known as **photosynthesis**. Plants take in water through their roots and the water rises to the leaves. Carbon dioxide enters the leaves through pores called stomata. In the presence of chlorophyll, a green pigment, and with energy provided by the sun, the plant manufactures sugars and starches from carbon dioxide and water. The leftover oxygen is released into the air, and much of the water is transpired out through the leaves. The process of photosynthesis is important not only to green plants but to all of life as a source of oxygen and water. Because of this ability to produce their own food, green plants are known as **producers**. All other living things on earth are directly or indirectly dependent upon the food that producers create.

MATERIALS

Per group

80 duckweed plants

1 sheet of black construction paper

water

4 100-mL beakers or other similar containers

masking tape

soil or pond mud

1 container for measuring 60 mL

1 paper clip

1 marker

Per student

observation sheet

Teacher

1 healthy green plant

TEACHING TIPS

1. Duckweed is a good plant for this activity because students can observe dramatic results in a short time. Duckweed plants can be found in freshwater ponds, swamps, and slow-moving streams or purchased at some aquarium supply stores (call first!). You can also search for duckweed online. Some possible online sources are: epondplants.com (\$3.00 per 50); Aquatic Plant Depot (#2.50 per ¼ lb.); www.thewatergardenshop.com (\$2.99 per ½ C). Duckweed is a tiny, floating plant that can be found worldwide. It has light green ovate leaves that bear a single rootlet. It is a notorious reproducer and can overtake a water garden if not controlled. It provides good shade and an enjoyable snack for fish.
2. Ideally, each group should set up the lab, but if materials or duckweed plants are in short supply, have the class work together to set up one or two labs.

ENGAGE

Show students a healthy green plant. Ask: *Is this a healthy plant? What are some observable signs of healthy, growing plants?*

Ask: *Where do plants obtain food so that they can become healthy, growing plants?* (Note: Many children hold the misconception that plants obtain food from soil.)

EXPLORE

1. Students should use the marker and the masking tape to label the four 100-mL-beakers 1-4.
2. Have students pour 60 mL of water into each of the four beakers.
3. Students should place 20 duckweed plants in each beaker.
4. Instruct them to add 1-2 cm of soil or pond mud to Beakers 1 and 3.
5. Have students record the date and their observations of the plants in each beaker on the observation sheet.
6. Students should place Beakers 1 and 2 in a window or somewhere else so they will be exposed to light.
7. Students should place Beakers 3 and 4 in a cupboard or in some other place with no light.
8. After a few days have students again record their observations on the observation sheet.

EXPLAIN

Which beaker contains the greatest number of duckweeds? . . . the least?

Which beaker contains the healthiest duckweeds?

What factors do you think are important for the healthy growth of duckweeds? Why?

What does soil contain that helps duckweeds stay healthy?

Are nutrients necessary for making plant food?

What do you conclude that plants use to make food?

Why are green plants known as producers?

EXTEND/APPLY

Have students observe a plant's need for sunlight to carry out photosynthesis. Students should place pieces of black construction paper over one section or over entire the surface of a leaf and secure the construction paper with a paper clip. Students should set the plant in an area where it will

receive plenty of sunlight. After one to two weeks, students should remove the construction paper, observe the leaf, and note any changes. The covered part of the leaf should have died or turned a lighter shade of green or brown. Blocking the light alters the process of photosynthesis.

ASSESSMENT

Which of the following living things in a pond ecosystem uses the energy from the sun to make its own food?

- A) insect
- B) frog
- C) water lily
- D) small fish

SHED SOME LIGHT ON PHOTOSYNTHESIS

Variable Combinations	Date	Number of Duckweeds	Color of Duckweeds	Other Observations
<u>Beaker 1</u> (duckweed, sunlight, water, and soil)				
<u>Beaker 2</u> (duckweed, sunlight and water)				
<u>Beaker 3</u> (duckweed, darkness, water, and soil)				
<u>Beaker 4</u> (duckweed, darkness and water)				



TAKE A LITTLE, GIVE A LITTLE



BENCHMARK and TASK

SC.G.1.2.3 The student knows that green plants use carbon dioxide, water, and sunlight energy to turn minerals and nutrients into food for growth, maintenance, and reproduction.

- The student explains how green plants use carbon dioxide, water, and sunlight energy to turn minerals and nutrients into food for growth, maintenance, and reproduction.

KEY QUESTION

How is the environment affected by transpiration?

BACKGROUND INFORMATION

A plant's roots absorb moisture from the soil. The water passes through the plant's stem or trunk through branches to the leaves. Inside the leaves, the plant uses some of the water to make food for growth during **photosynthesis**, but there is more water in the leaves than the plant needs. The extra water **evaporates** into the air from the surface of the leaves in a process called transpiration. As the water evaporates, it **changes state** from a **liquid** to a **gas**. The change from liquid to gas uses up heat energy in the air, so the air becomes cooler. Stomata cells are located on the underside of leaves, the sides facing away from the sun. These are the cells that regulate evaporation. Air and water move in and out of leaf cells through the stomata cells. More than 99 percent of the water drawn up into a tree is transpired out through the leaves.

MATERIALS

Per pair of students

1 gallon-size plastic bag with twist tie
1 small rock
1 graduated cylinder
1 leaf
1 microscope or Magiscope
twig covered with leaves

Per student

science journal

TEACHING TIP

If you have a limited number of microscopes, set up one or more in various parts of the room and allow student pairs to rotate to the stations at different times.

ENGAGE

Have students tear a leaf in half and use a microscope to observe along the tear. Have students sketch and describe what they see. Explain that the tiny openings on the underside of the leaf are called stomata. Plants breathe through the stomata.

EXPLORE

1. Find a healthy tree or shrub.
2. Inflate a dry, plastic bag to make sure it doesn't have any holes. Place the bag over a small twig covered with leaves; count the number of leaves enclosed in the bag. Place a small rock inside the bag so that the bag hangs down. Use a twist tie to securely close the plastic bag around the base of the twig.
3. Examine the bag after 24 hours.
4. Carefully pour the water from the plastic bag into a graduated cylinder and measure the amount of water that has transpired.

EXPLAIN

Did you find any water in the bag? Why do you think water accumulated in the bag? (Plants give off water through the stomata cells on the leaves, the water evaporates into the atmosphere and becomes water vapor, and the water vapor condenses inside the plastic bag. This process is called transpiration.)

How much water was in the bag? (Amounts will vary.)

Did every pair find the same amount of water in their bag? Why do you think the amounts differed? (The amount of water will vary based on the number of leaves, the type of leaves, and how securely the bag was sealed.)

How does plant transpiration affect our environment? (As the water evaporates, it changes from a liquid to a gas. The change from liquid to gas uses up heat energy in the air, so the air becomes cooler.)

EXTEND/APPLY

Discuss: How would transpiration affect the temperature and humidity in a forest area? (When water evaporates, it changes from a liquid to a gas. The changes require heat energy from the surrounding air, so the air becomes cooler. The forest, with so many trees, would be cooler than an area with fewer trees.)

EXTENSIONS

1. Compare the amounts of water transpired during the daylight hours and during the night.
2. Compare the amounts of water transpired on a cloudy day and a sunny day.

ASSESSMENT

Have students respond to the Key Question in their science journals: How is the environment affected by transpiration?

WHAT'S FOR DINNER?

BENCHMARKS and TASKS

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- The student examines patterns of interdependency in ecological systems by analyzing relationships in food webs among producers, consumers, and decomposers and discovers that no matter how distant the relationship may seem, all things are connected.
- The student classifies changes in an ecosystem as either beneficial or harmful to specified organisms.
- The student values humans as part of the web of life, in which everything is connected and recognizes the need to live in ways that respect the interconnectedness of all things.

KEY QUESTION

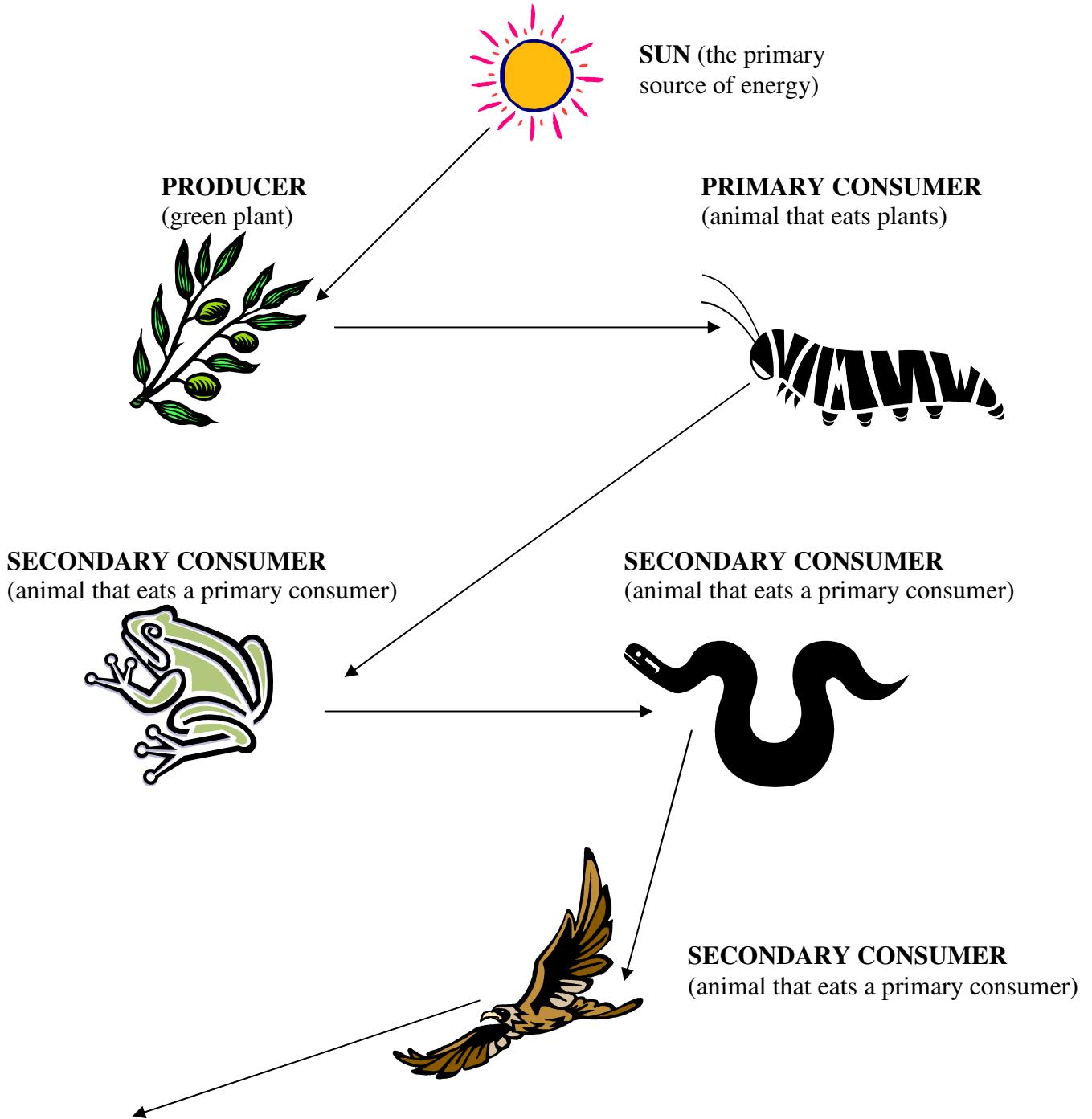
How are plants and animals interdependent?

BACKGROUND INFORMATION

Food webs illustrate the interdependence of life forms in a **community**. Animals are classified according to how they get their food. All green plants are **producers** because they manufacture their own food through the process of **photosynthesis**. Animals that eat plants are called primary **consumers**. Animals that eat primary consumers are called secondary consumers. Animals, including humans, that eat both producers and consumers, are called omnivores. Organisms that feed on the remains or wastes of other organisms are known as **decomposers**. Decomposers are always the final link in a food web. The **sun** is also an important part of all **food webs**. Without the sun, there would be no photosynthesis and no plants. All animals are bound together in a web of interdependency.

Food **energy** transfers in the food web but so do many poisonous substances. Poisons are not used for life processes, so most of the poison consumed is passed along to the next level consumer.

WHO'S WHO IN THE FOOD CHAIN?



The waste products and remains of dead animals and plants are returned to the soil, where the **SCAVENGERS** and **DECOMPOSERS** complete the cycle so that it can begin again.

→ The arrows show the direction in which the energy flows.

MATERIALS

Per class

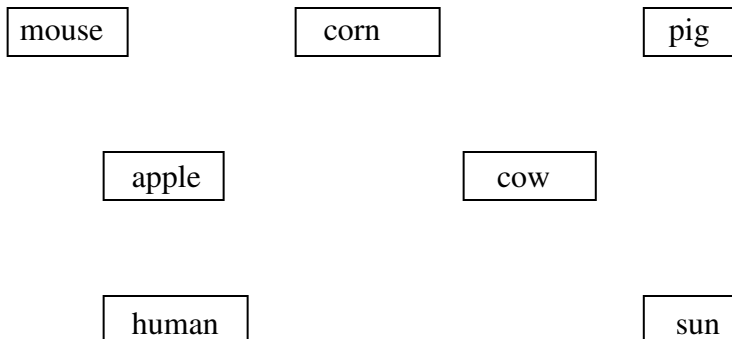
Pass the Energy, Please! Barbara Shaw McKinney, 1999, Dawn Publications

ENGAGE

Use a circle map to assess students' prior knowledge about food chains. Ask students to share what they know about food chains.

EXPLORE

1. On the board, write the names of various plants and animals and the sun inside rectangles.



2. Divide the class into two groups, A and B. Have one member from group A draw a line from something that provides energy to the plant or animal that uses the energy (e.g., from sun to corn; corn uses the sun's energy for photosynthesis).
3. Have a member of Group B do the same. Each time a line is drawn, discuss the relationship briefly with the class.
4. Continue letting members of each team alternate drawing lines until they cannot draw a line they can justify. The group that draws the last line wins. Each group may challenge the opposing group's line. If the group can justify their reason, the line can stay.
5. Have students identify each component of the food web as producer, consumer, decomposer, etc.
6. The game can be repeated for several rounds using other communities

Examples:

grass	sparrow
shrub	insect larva
grasshopper	mouse
rabbit	hawk
caterpillar	berry
frog	crow
snake	man
hawk	leaf
vulture	fox

EXPLAIN

When a round of the game is over, ask students to examine the food web they have constructed.

Discuss:

How is energy transferred from one component to another in a food web?

Where does the energy originate? (with the sun)

What is the role of green plants in a food web? (Green plants use carbon dioxide, water, and energy from the sun to produce their own food for growth and maintenance.)

What is the role of decomposers in a food web?

What would happen if one component of the web were to become extinct?

What other developments would occur if certain components in food webs disappeared?

What are some factors that are harmful to food webs and possibly to humans?

What happens when a poisonous substance becomes part of the food web? (Poisons are not used for life processes, so most of the poison consumed is passed along to the next level consumer.)

EXTEND/APPLY

Read *Pass the Energy, Please!* by Barbara Shaw McKinney.

ASSESSMENT

Have each student create a food chain or web, including himself, other animals, and plants.

WEB OF LIFE

BENCHMARKS and TASKS

SC.B.1.2.1 The student knows how to trace the flow of energy in a system (e.g., as in an ecosystem).

SC.B.2.2.1 The student knows that some source of energy is needed for organisms to stay alive and grow.

SC.F.1.2.2 The student knows how all animals depend on plants.

SC.G.1.2.1 The student knows ways that plants, animals, and protists interact.

SC.G.1.2.5 The student knows that animals eat plants or other animals to acquire the energy they need for survival.

SC.G.2.2.3 The student understands that changes in the habitat of an organism may be beneficial or harmful.

- The student recognizes that some source of energy is needed for all organisms to stay alive and grow.
- The student identifies the major source of energy of ecosystems as sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy passes from organism to organism in food webs.
- The student categorizes populations of organisms by the function they serve in an ecosystem; plants and some microorganisms as *producers* that make their own food; animals, including humans, as *consumers*, which obtain food by eating other organisms; and *decomposers*, primarily bacteria and fungi, recyclers that break down dead plant and animal materials into elements that return to the soil, water, and air for use again.
- The student examines patterns of interdependency in ecological systems by analyzing relationships in food webs among producers, consumers, and decomposers and discovers that no matter how distant the relationship may seem, all things are connected.
- The student classifies changes in an ecosystem as either beneficial or harmful to specified organisms.

KEY QUESTION

How does energy flow through a food chain or web?

BACKGROUND INFORMATION

Every living thing, whether plant or animal, must have food **energy** to live. Plants manufacture their own food from sunlight, air (carbon dioxide) and water through a process called **photosynthesis**. Green plants are called **producers**. Since animals are not able to produce their own food energy, they must obtain it in some other way – by eating other **organisms**, plants and/or other animals. Such animals are called **consumers**. Animals that eat green plants for food are called primary consumers. **Decomposers** are always the final link in a **food chain**. **Protists**, such as fungi, slime molds, and bacteria, are decomposers, organisms that feed on the remains or wastes of other organisms and return the remains to the soil. A food chain is an arrangement of organisms in which each organism feeds on the one below it in the chain. **Food webs** are interconnected food chains.

An **energy pyramid** shows the differences in the numbers of different forms of life at the various levels of a food chain. The base of a food pyramid is the largest and is made up of green plants. The next level of the pyramid is made up of primary consumers (plant eaters). The next level consists of secondary consumers (meat eaters). Creatures at the top of the pyramid are the fewest in number. An energy pyramid also shows energy loss. As energy moves from the **sun** to plants and on to animals, the consumer gains only 10% of the energy of the food it eats.

MATERIALS

Per group

one 10 x 10 grid (size optional)
1 large piece of paper for food web

Teacher

This Is the Sea That Feeds Us, Robert F. Baldwin,
Dawn Publications

Per class

information sources: Internet, reference books

ENGAGE

1. Write *grass* \Longrightarrow *mouse* \Longrightarrow *owl* on the board. Ask: *What do we call this kind of sequence in nature?* (a food chain)
2. Write the words *cricket* and *chameleon* on the board. Ask: *How could we connect these two animals to this food chain?* (Draw an arrow from the grass to the cricket and an arrow from the cricket to the chameleon.)
3. Ask: *How is this diagram different from a food chain?* (It is a food web. Food webs are interconnected food chains showing a more complex arrangement.)
4. Ask students if they see any other connections that can be made. (e.g., Owls eat chameleons; mice eat crickets.)
5. Ask students how the grass gets its energy. Explain that the grass uses energy from the sun to make its own food, so the sun should also be added to the food web.

EXPLORE

1. Write these words on the board: *owl, mouse, flower, seeds, fruit, fox, robin, earthworm, chameleon, butterfly, cricket, leaves, and sun.*
2. Have students write the words randomly on a large sheet of paper. Students may work individually or in groups.
3. Challenge students to research to find any possible connections and to draw arrows showing all the possible connections between the plants and animals.

EXPLAIN

1. Have individual students or groups share the food webs they created.
2. Discuss:
Are all of the food webs the same? Why do you think so? (The food webs may look different depending on the connections students observed.)
What is the main source of energy for every food web? (the sun)
How can you identify the producers in the food webs? (Producers are green plants.)
How can you identify the consumers in the food webs? (Consumers eat other organisms.)

Do most animals eat one kind of food or a variety? Why do you think so? (Most animals eat a variety of organisms, because if animals depended on only one kind of food, they might starve to death.)

What will eventually happen to those organisms at the top of the food chains? (They will die and eventually decompose. Protists, such as bacteria and fungi, are decomposers that chemically break down the organic matter into nutrients such as nitrogen, phosphorus, and potassium. The nutrients are then made available to the plants growing in the soil.)

EXTEND/APPLY

1. Help students understand that an energy pyramid shows how the number of organisms decreases as well as the amount of available energy.
 - Explain that an energy pyramid shows the differences in the numbers of different forms of life at the different levels of a food chain. The base of a food pyramid is the largest and is made up of green plants. The next level of the pyramid is made up of primary consumers (plant eaters). The next level up consists of secondary consumers (meat eaters). Creatures at the top of the pyramid, such as owls, are the fewest in number.
 - An energy pyramid also shows how the amount of available energy decreases. Explain to students that when a plant uses the energy in sunlight to make its own food, most of that energy is used for the plant's life processes. Only about 10% of the energy that a plant receives from sunlight is stored in the plant. When the mouse eats the plant, it uses most of the food energy it takes in for its own life processes and stores only about 10% of the food energy in its own body. When an owl eats the mouse, the owl gets only about 10% of the food energy the mouse got.
 - Divide the class into teams of three. Give one student on each team a sheet of graph paper. Have the student cut out a 10 x 10 grid of squares. The student with the 10 x 10 grid represents the plant. That student should cut off 10% (a row of 10 squares) and give it to the second student, the mouse. The mouse should cut off 10% (one square) and give it to the third student, representing the owl. Students can see that only a small portion of the original food energy stored in the plant reaches the top consumer.
2. Have students find out more about poisons in food chains. Poisons are not used for life processes, so nearly all of the poison that an animal consumes is passed on to the next-level consumer. Poisons work their way up a food chain and harm or kill animals that were not meant to be poisoned.
3. Share the book, *This Is the Sea That Feeds Us*, by Robert F. Baldwin.

OWL HAVE TO THINK ABOUT THIS!



BENCHMARKS AND TASKS

SC.B.1.2.1 The student knows how to trace the flow of energy in a system (e.g., as in an ecosystem).

SC.B.2.2.1 The student knows that some source of energy is needed for organisms to stay alive and grow.

SC.F.1.2.2 The student knows how all animals depend on plants.

SC.G.1.2.1 The student knows ways that plants, animals, and protists interact.

SC.G.1.2.4 The student knows that some organisms decompose dead plants and animals into simple minerals and nutrients for use by living things and thereby recycle matter.

SC.G.1.2.5 The student knows that animals eat plants or other animals to acquire the energy they need for survival.

SC.G.1.2.6 The student knows that organisms are growing, dying, and decaying and that new organisms are being produced from the materials of dead organisms.

- The student describes an ecosystem as a community of living and nonliving organisms and their immediate surroundings (e.g., air, rocks, soil) driven by the sun's energy.
- The student recognizes that some source of energy is needed for all organisms to stay alive and grow.
- The student identifies the major source of energy of ecosystems as sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.
- The student categorizes populations of organisms by the function they serve in an ecosystem: plants and some microorganisms as *producers* that make their own food; animals, including humans, as *consumers*, which obtain food by eating other organisms; and *decomposers*, primarily bacteria and fungi, recyclers that break down dead plant and animal materials into elements that return to the soil, water, and air for use again.
- The student examines patterns of interdependency in ecological systems by analyzing relationships in food webs among producers, consumers, and decomposers and discovers that no matter how distant the relationship may seem, all things are connected.

KEY QUESTION

What is an owl's role in a food web?

BACKGROUND INFORMATION

Owls are birds of **prey** – raptors, or birds that kill and eat other animals. In the food web, the owl is a secondary **consumer**. The animals that owls prey upon vary with the owl's size and species, but owls eat mostly small mammals, including rabbits, squirrels, mice, rats, shrews, and voles. Owls usually swallow their prey whole. If the prey is too large, the owl can tear it into smaller pieces with its sharp, curved beak. The owl's digestive juices cannot break down the fur, feathers, teeth, or

bones that it swallows, so those indigestible materials are clumped together in the owl's stomach, compressed into pellets, and then regurgitated through the mouth 18-20 hours after feeding. A bird often produces two pellets a day.

Owl pellets usually contain all the bones of one or more prey animals the owl has eaten, making it possible to identify the prey animal and reconstruct its entire skeleton. Owl pellets can also be useful in determining the distribution of rodents in a specific area. Each pellet contains an average of 3.3 animals.

One barn owl in a single year may eat about 1500 mice. Each mouse, in turn, may eat more than 10 kg of green plants, which would amount to about 15,000 kg of plants for all the mice. The number of living things in each link of a **food chain** can be shown as an **energy pyramid** - a pyramid of numbers. The green plants form the base. This means that all animals in the links above the base depend on green plants. There are usually fewer living things in the link next to green plants than there are green plants. With each higher link in the pyramid, the number of living things tends to get smaller and the amount of available **energy** decreases. When the animal at the top dies (e.g., owl), it may become food for small scavengers, such as insects or it may become food for **protists**. Protists, such as fungi, slime molds, and bacteria, are decomposers, organisms that feed on the remains or wastes of other organisms and return the remains to the soil.

Pellets are also made by other raptors, but those made by owls tend to be the most complete. Nearly all of the pellets typically dissected in classrooms are produced by barn owls. This is because barn owls are concentrated in areas more convenient to humans. Barn owl pellets are egg-shaped masses averaging 47 mm in length by 33 mm in width.

Owl pellets themselves are **ecosystems**, providing food and shelter for **communities**, which may include clothes moths, carpet beetles, and fungi. Moth larvae are frequently abundant in pellets, feeding on fur and feathers. The black spheres about the size of periods that are found in the pellets are the droppings of the caterpillars. The larvae metamorphose near the surface of a pellet in cocoons made of the fur.

MATERIALS

Per group

1 owl pellet
toothpicks
gloves (optional)
1 sheet of white paper
1 measuring tape
1 balance and mass set

Per student

1 hand lens
Making Sense of Mystery Pellets observation sheet
1 pair of tweezers

TEACHING TIP

Although owl pellets can often be found on the ground under trees where owls roost, it is preferable to order them from a scientific company because they have been fumigated to eliminate the presence of any insects and individually wrapped for preservation. Students can safely handle these pellets.

ENGAGE

Show students an owl pellet and ask, *What do you think this is?* Record their responses but do not identify the object as an owl pellet.

Tell students they will be dissecting the objects in order to learn more about them.

EXPLORE

1. Instruct students to place the pellet down on the piece of white paper and use the hand lenses to examine it.
2. Have students find the length, width, and mass of the pellet and record this information on the observation sheet, along with coloration, and other observations.
3. Again, ask students to infer about what the mystery pellets may be. Explain that the mystery objects are owl pellets. (See Background information.)
4. Students should then use the tweezers and toothpicks to slowly pry the pellet apart, being careful to save each piece.
5. Group members should each take a piece of the pellet once it has been pried apart and separate and clean all bones, even the tiniest ones, by removing as much of the attached matter as possible. Students should clean the skulls as thoroughly as possible since these are the best bones for identifying the prey.
6. Have students group similar bones together – skulls, femurs, vertebrae, etc. Students should add this information to the observation sheet.

EXPLAIN

What are owl pellets? (Owl pellets are the undigested remains of prey ingested by an owl that are regurgitated through the mouth.)

What did you discover inside when you dissected the pellet? (fur, feathers, bones, teeth)

How many skulls or pairs of jawbones did you discover? How many prey do you think the owl had eaten?

What was the total number of pellets dissected?

What was the size and mass of the pellet you dissected?

What was the average size and mass of the pellets dissected by the whole class?

What was the total number of prey animals found in the pellets?

What was the average number of prey animals per pellet?

What kind of prey seems to be most abundant? Least abundant?

What is the role of an owl in a food web? (The owl is a raptor – a secondary consumer that eats other animals.)

What is the main source of energy in every food chain or web? (sun)

What happens when the owl at the top of the food web or energy pyramid dies? (It may become food for small scavengers, such as insects or it may become food for protists. Protists, such as fungi, slime molds, and bacteria, are decomposers, organisms that feed on the remains or wastes of other organisms and return the remains to the soil.)

Do only owls produce pellets? (Pellets are also made by other raptors.)

What important information can be obtained from owl pellets? (See Background Information)

EXTEND/APPLY

1. Discuss: *How can an owl pellet be considered an ecosystem?* (See Background Information)

2. *Encourage students to find out what animals eat owls, their eggs, and owlets.* (Students will discover that owls have few natural enemies; that is why owls are most often the last consumers in food chains. Animals that prey on owls include eagles and hawks. Snakes and weasels can climb trees and prey on owl eggs and owlets.)
3. If a barn owl produces one pellet each day, estimate how much food the owl would eat in a year.

EXTENSION

Students can place the bones of one type of prey, such as a vole, on a piece of cardstock or cardboard and try to recreate a whole skeleton. The bones should be glued in place once the skeleton is as complete as possible.

ASSESSMENT

Ask students to create a food web using some of the following components: owl, weasel, mole, shrew, rat, songbird, salamander, slug, mouse, caterpillar, centipede, snail, vole, earthworm, green plants, and sun.

MAKING SENSE OF MYSTERY PELLETS



Trace around the pellet and color it.

	YOUR PELLETT	CLASS AVERAGE
MASS		
LENGTH		
WIDTH		
OTHER OBSERVATIONS		

	YOUR PELLETT TOTAL	CLASS TOTAL	CLASS AVERAGE
NUMBER OF SKULLS FOUND			
NUMBER OF PAIRS OF JAWBONES FOUND			

FEASTING ON YEAST

BENCHMARKS and TASKS

SC.B.2.2.1 The student knows that some source of energy is needed for organisms to stay alive and grow.

SC.G.1.2.1 The student knows ways that plants, animals, and protists interact.

- The student recognizes that some source of energy is needed for all organisms to stay alive and grow.
- The student categorizes populations of organisms by the function they serve in an ecosystem: plants and some microorganisms as *producers* that make their own food; animals, including humans, as *consumers*, which obtain food by eating other organisms; and *decomposers*, primarily bacteria and fungi, recyclers that break down dead plants and animal materials into elements that return to the soil, water, and air for use again.

KEY QUESTION

How does yeast react in different liquids?

BACKGROUND INFORMATION

Protists, such as fungi, slime molds, and bacteria, act as **decomposers**. Decomposers chemically break down the organic matter into nutrients such as nitrogen, phosphorus, and potassium. The nutrients are then more available to the plants growing in the soil. Fungi are non-green organisms with no roots, stems, flowers, seeds, or leaves. They lack chlorophyll and cannot make their own food the way seed plants can. They rely on organic matter, living or dead, for nourishment. As long as fungi have a moist environment, they are capable of digesting almost anything. Fungi reproduce by forming spores rather than seeds. Mold, mushrooms, and other fungus spores are in the air all the time, but we only become aware of them when they fall on a suitable material and begin to reproduce. Yeast, a group of microscopic, one-celled fungi, reproduce by budding. A bud, the beginning of a new cell, gradually forms on the surface of the parent cell. When the bud matures, it may break off or it may stay attached and form buds of its own until a whole chain of cells has developed. In its dormant state, yeast can survive for long periods without water or food and at low or high temperatures. When yeast cells are living and growing, they change sugars into alcohol and carbon dioxide gas. Trapped below the surface, the carbon dioxide forms bubbles that make the yeast culture expand. For bakers and wine makers, yeast byproducts are important. The winemaker is interested in alcohol production, and the baker is interested in carbon dioxide that becomes trapped in the dough and causes the dough to rise.

MATERIALS

Per class

various liquids (e.g., grape juice, milk, vinegar, water, soda, coffee, orange juice)

1 measuring cup per liquid

clock

Strega Nona's Magic Lesson, Tomie DePaola

Per group

1 permanent ink pen

3 clear, plastic 9 oz. cups

masking tape

3 tablespoons (or pkgs.) of yeast

Feasting on Yeast observation sheet

3 stirrers

Per student

1 small bit of bread
1 hand lens
science journal

TEACHING TIPS

1. Provide the same amount of yeast for each group. Students can measure one tablespoon per cup of liquid or use one package of yeast in each cup. Three packages of yeast, one per cup, may be easier than having students measure from a jar of bulk yeast, but it will also be more expensive.
2. Make available large containers with various liquids such as grape juice, orange juice, milk, vinegar, water, soda, and coffee. Also, dissolve some sugar in water; use one tablespoon of sugar per two cups of water. **Very important: All liquids must be at room temperature.**
3. Label each of the containers of liquid so that students can copy the words onto the masking tape labels.

ENGAGE

1. Read or tell the story, *Strega Nona's Magic Lesson*. Stress the problem Big Anthony had when he didn't follow directions for yeast.
2. Ask students if they've ever made, or seen anyone make, bread. Give each student a small piece of bread to observe with a hand lens. Ask students what they think made the holes in the bread.
3. Create a circle map for recording students' background knowledge about yeast.
4. Pass some yeast around for students to smell. Tell them they will be observing how yeast reacts when it is put into different liquids.

EXPLORE

1. Show the class the different liquids that are available. They should decide as a group which three liquids they will investigate and then label the cups using the masking tape and the permanent ink pen.
2. Students should measure $\frac{3}{4}$ cup of each liquid into the labeled cups.
3. Have students predict what they think will happen when yeast is added to the liquids.
4. One package (or one Tbsp.) of yeast should be added to each liquid and then stirred.
5. Students should record the time and their observations in the first section of the *Feasting on Yeast* record sheet.
6. Ask: *How does your prediction compare to what actually happened?*
7. Students should observe the cups of yeast and liquid three more times at ten-minute intervals and record.
8. Remind students to also use their sense of smell when making observations.
9. Ask students to compare the contents of the three cups.

EXPLAIN

What changes did you notice when the yeast became active?

In which liquid did you notice the most changes? . . . the least changes?

How long had the yeast been in the liquid before you first noticed any change?

How did the yeast react in each liquid?

*What about the liquid do you think caused the change in the yeast?
Can you identify the odors in some of the liquids?*

EXTEND/APPLY

Discuss:

What liquid would you use if you wanted to get the most reaction from yeast? Why?

After doing this investigation, why do you think bread has holes in it?

Why would a baker use yeast?

EXTENSIONS

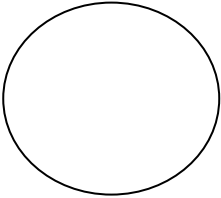
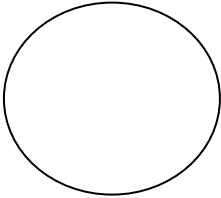
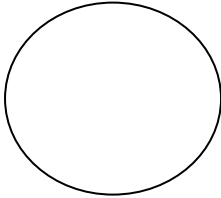
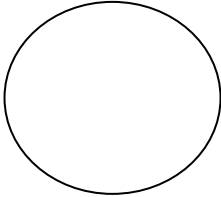
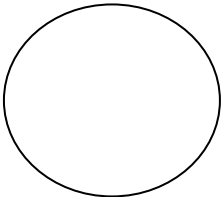
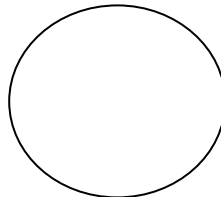
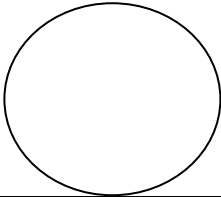
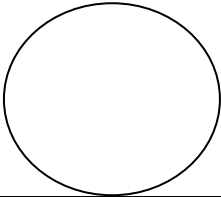
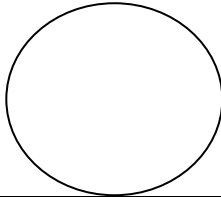
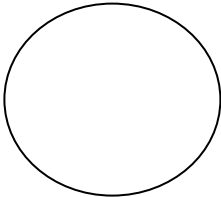
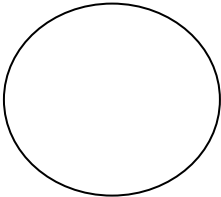
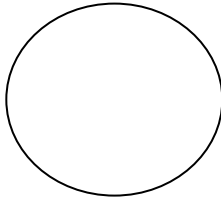
1. Repeat the investigation using rapid-rise yeast.
2. Repeat the investigation using different temperature variables.

ASSESSMENT

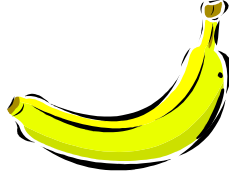
Have students compare and contrast the reaction of yeast in two different liquids. Look for careful observations in the science journals.

Names _____

FEASTING ON YEAST

Observation #1 Time:	Liquid: Observations: 	Liquid: Observations: 	Liquid: Observations: 
Observation #2 Time:	Liquid: Observations: 	Liquid: Observations: 	Liquid: Observations: 
Observation #3 Time:	Liquid: Observations: 	Liquid: Observations: 	Liquid: Observations: 
Observation #4 Time:	Liquid: Observations: 	Liquid: Observations: 	Liquid: Observations: 

FOOD BREAKERS



BENCHMARKS and TASKS

SC.G.1.2.4 The student knows that some organisms decompose dead plants and animals into simple minerals and nutrients for use by living things and thereby recycle matter.

SC.G.1.2.6 The student knows that organisms are growing, dying, and decaying and that new organisms are being produced from the materials of dead organisms.

- The student categorizes populations of organisms by the function they serve in an ecosystem: plants and some microorganisms as *producers* that make their own food; animals, including humans, as *consumers*, which obtain food by eating other organisms; and *decomposers*, primarily bacteria and fungi, recyclers that break down dead plant and animal materials into elements that return to the soil, water, and air for use again.
- The student examines patterns of interdependency in ecological systems by analyzing relationships in food webs among producers, consumers, and decomposers and discovers that no matter how distant the relationship may seem, all things are connected.

KEY QUESTION

How do decomposers play an important role in our environment?

BACKGROUND INFORMATION

When dead trees fall to the ground, a variety of life starts to grow on the fallen logs. **Protists**, such as fungi, slime molds, and bacteria, act as **decomposers**, which digest matter and return the remains to the soil. As time passes, the decaying process continues.

Fungi are non-green **organisms** with no roots, stems, flowers, seeds, or leaves. They lack chlorophyll and cannot make their own food the way seed plants can. They rely on organic matter, living or dead, for nourishment. As long as fungi have a moist environment, they are capable of digesting almost anything. Fungi reproduce by forming spores rather than seeds. Mold, mushrooms, and other fungus spores are in the air all the time, but we only become aware of them when they fall on a suitable material and begin to reproduce.

Yeast is a microorganism of the fungi group. The yeast feeds on the banana, causing it to break down into smaller parts, producing decay. Decomposers play a very important part in an **ecosystem** because much of the dead material in an **environment** must be broken down into smaller parts and reused by plants and animals. Fertilizers used on plants and in gardens have decomposers in them to make materials usable by plants.

MATERIALS

Per group

2 banana slices	1 marker	1 pkg. dry yeast
2 plastic, resealable bags	2 paper towels	1 teaspoon

Per student

hand lens
science journal

Teacher

slice of moldy bread in a sealed baggie
1 plastic knife

TEACHING TIPS

1. In advance, place a slice of bread in a zip-type baggie and allow it to become moldy.
2. At the beginning of class, prepare the bananas by cutting two slices for each group.

ENGAGE

1. Show students the moldy slice of bread. (Observe through the sealed baggie. Do not allow students to open the baggie!) Have students describe what they see.
2. Explain that mold is a type of fungus. As long as fungi have a moist environment, they are capable of digesting almost anything. Fungi reproduce by forming spores. Mold, mushrooms, and other fungus spores are in the air all the time, but we only become aware of them when they fall on a suitable material and begin to reproduce. Tell the students that they are going to be exploring another kind of fungus during the activity.

EXPLORE

1. Have students wash their hands before setting up the experiment.
2. Give each group two paper towels, each containing one slice of banana.
3. Tell students to sprinkle one teaspoon of yeast on only one of the banana slices. They should put nothing on the other banana slice.
4. Place one banana slice in each bag and seal the bags.
5. Mark the bag containing the yeast with a “Y”.
6. Check the bags daily for one week.
7. Students should NOT open the bags, but should use the hand lenses to observe the contents.

EXPLAIN

Which banana showed the quickest decomposition? (the banana with the yeast)

Why do you think the banana in the bag with yeast decomposed more quickly than the other? (If students do not mention that the yeast is a fungus, share this information with them. Since yeast has no chlorophyll, it must depend on other organisms for food. The yeast eats the banana, causing it to break down or decay.)

Why are decomposers important? (Decomposers play an important part in the environment because they break down dead material so that plants and animals can reuse it.)

EXTEND/APPLY

Ask: Now that you have a better understanding of what decomposers are and the role decomposers play in our environment, can you list some decomposers you might find in a forest ecosystem? (fungi, worms, insects, bacteria)

ASSESSMENT

Have students reflect on the key question in their science journals: How do decomposers play an important role in our environment?

MINI LANDFILLS

BENCHMARK and TASK

SC.G.1.2.4 The student knows that some organisms decompose dead plants and animals into simple minerals and nutrients for use by living things and thereby recycle matter.

- The student categorizes populations of organisms by the function they serve in an ecosystem; plants and some microorganisms as *producers* that make their own food; animals, including humans, as *consumers*, which obtain food by eating other organisms; and *decomposers*, primarily bacteria and fungi, recyclers that break down dead plant and animal materials into elements that return to the soil, water, and air for use again.

KEY QUESTIONS

What kinds of materials are biodegradable?

What conditions are necessary in order for decomposition to take place?

BACKGROUND INFORMATION

Living things in an **ecosystem** do one of three different jobs; they are **producers, consumers, or decomposers**. Producers are green plants that make their own food through a process called **photosynthesis**. Consumers are living things that eat other living things. Decomposers break down dead plant and animal materials into abiotic (nonliving) elements. Decomposers are recyclers that return the nonliving elements to the soil, water, and air to be used again. Decomposers include bacteria, fungi, earthworms, and snails.

Decomposition is the process by which materials break down. For example, air, water, sunlight, and other agents break down nonliving materials such as rocks and metals. Living organisms break down organic materials such as food waste, wood, and dead animals—materials that come directly or indirectly from other living things. Because they're broken down by living organisms, these materials are said to be biodegradable and will eventually decompose, given the proper conditions and enough time. About twenty percent of the garbage that ends up in landfills is organic.

MATERIALS

Per group

2 small, plastic cups and one lid (Use plastic wrap and a rubber band, if lids are not available.)

soil from outdoors, preferably near established bushes or trees

1 plastic spoon

newspaper

“trash” materials such as: crackers, wax paper, Styrofoam, foil, leaves, notebook paper, candy, paper towels, pieces of bark

water (a spray bottle is ideal, but not necessary)

1 ruler

1 balance and mass set

masking tape

1 permanent marker

Per teacher

trash can filled with the trash items listed above

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Per student

Mini Landfills observation chart

1 hand lens

plastic gloves

TEACHING TIP

This activity will take place over a four-week period.

ENGAGE

Place a filled trash can on a table in front of the class and ask students where all the garbage in it will likely be by next week. (in a landfill) *What will this garbage look like in a week? . . . in a month?*

Ask: *What items do you and your family throw away on a regular basis?* On the chalkboard, make a list of common items students and their families throw in the garbage.

EXPLORE (DAY ONE)

1. Divide the class into groups. Give each group two cups and have them use the masking tape and permanent markers to label them as “Cup A” and “Cup B.”
2. Have each group go outside and fill their cups $\frac{3}{4}$ full with soil and then return to the class.
3. Assign each group a trash item (see Materials) and give them two samples of the item.
4. Have students write the names of the items the various groups will bury along the top of the *Mini Landfill* observation chart. In the row labeled Day 1, students should observe and describe the physical characteristics of each of the trash items. Students should be careful to list only features that are observable (e.g., size, weight, shape, color) and not subjective descriptions (e.g., pretty, smelly). Make sure hand lenses, rulers, balances, and other tools are available for making observations.
5. Have the groups share their observations with the class, each student recording results from other groups on their charts in the Day 1 column.
6. Students should bury the trash in their landfills by placing one item in each cup and covering the trash with about an inch of soil.
7. Put a lid on container A and set it aside.
8. Thoroughly moisten (don't soak) the soil in Cup B. At the end of each day, students should lightly wet Cup B and gently shake it to allow some air to get between the particles. Depending upon the humidity, they may want to put a cover on Cup B at night, just to prevent it from totally drying out, but it may not be necessary, and it should be removed each day to allow air flow.
9. Have students predict what they think will happen to the trash over the next few weeks.

AFTER ONE WEEK

1. Have each group cover the work area with newspaper.
2. Students should wear gloves if they will be handling the trash items.
3. Students should carefully remove the trash item from Cup A and observe any changes in the item. Then have them record their observations on their *Mini Landfills* chart in the “End of Week 1” column. Encourage students to look at the observations they made on Day 1 and identify any changes.

4. Ask each group to share their observations with the class so that each student may record the changes for all the trash items on their chart in the same “End of Week 1” column. If no changes occurred, that should also be noted.
5. Students should return the trash to Cup A, cover it with soil, and replace the lid.
6. Repeat the process for Cup B but do not add a lid. If Cup B is dry, add a little water to moisten the soil.

AFTER WEEKS TWO AND THREE

Repeat the same process that was done After One Week.

END OF WEEK FOUR

1. Empty the contents of each cup and examine the trash items for the last time. Record observations on the chart.
2. Have students share observations with the class so they can record the information on their charts.
3. Once all the data has been recorded, analyze the data with the entire class, discussing their earlier predictions and the accuracy of their data.

EXPLAIN

What is decomposition? (Decomposition is the process in which fungi and bacteria break down dead plant and animal materials and animal wastes and release nutrients back into the environment.)

Which items showed signs of decomposition?

Which items did not show signs of decomposition?

What do you think could account for these differences? (Some items were biodegradable while others were not biodegradable.)

Were there different degrees of decomposition in different cups? Suggest reasons for these differences.

What might have caused the results you observed?

EXTEND/APPLY

Discuss:

How could what you observed and learned about the mini landfills be applied to county landfills?

What recommendations could you make to a county trash landfill operator who wanted to decompose trash more effectively? (Aerate the landfill, turn soil frequently, be sure to add moisture)

EXTENSION

Create a class compost outside. Students can add biodegradable materials from their lunch leftovers (minus meat products) daily. Start the compost by digging a hole in the ground and adding several layers. Perhaps start with grass clippings and then add wastes such as coffee grounds, apple cores, orange peels, etc. Finally, add a layer of decaying leaves and spread some soil on top. Add worms to the compost to help decompose matter. Water regularly to keep the compost damp but not wet. Students should also turn the soil regularly to stir the compost. Watch for the decomposition of materials and study the soil as it changes. (Note: As an alternative, the compost could be created in a plastic garbage can with many holes punched to allow circulation and a lid.) Stop adding materials when the can or hole is about $\frac{3}{4}$ full. The compost will be ready when it is dark and crumbly. It can be added to a school plant or vegetable garden.

Name _____

MINI LANDFILLS

Item buried								
	A	B	A	B	A	B	A	B
Day 1								
End of Week 1								
End of Week 2								
End of Week 3								
End of Week 4								

COASTAL EROSION



BENCHMARK and TASK

SC.G.2.2.3 The student understands that changes in the habitat of an organism may be beneficial or harmful.

- The student infers that changes (e.g., natural hazards, such as earthquakes, landslides, wildfires, volcanic eruptions, floods, storms) in an ecological system usually affect the whole system, because one part of the environment cannot be altered without affecting the others.

KEY QUESTION

How do waves affect the movement of sand and buildings along a coast?

BACKGROUND INFORMATION

Oceans are the largest geographic feature on the surface of the earth, covering approximately 70 percent of the earth's surface. As a result, oceans have a tremendous impact on the earth, its climate, and its inhabitants. Much of the world's population lives on or near a coast. Coastal **environments** are dynamic, and they constantly change due to natural processes and to human activities.

Storms can change the shape of the shoreline and destroy buildings, roads, and homes. Hurricanes can greatly modify the shape of coastal areas, cause major flooding, destroy property, and take lives. The sediment that forms a beach or dune can come from rivers, cliff **erosion**, waves, or currents that flow along the shore. Extensive beach erosion can cause buildings to collapse into the ocean and dramatically change the shoreline.

Waves are the primary **energy** source that causes erosion of coastal lands; the larger the waves, the greater their erosive power. Most waves are created by winds blowing across the surface of the ocean. Large storms generate destructive ocean waves. Breaking waves can undercut cliffs and break down rocks into smaller and smaller pieces. Sediments can be eroded from one location and deposited in another in a process called **deposition**. Coastal erosion depends on the stability of shoreline sediments, the intensity and frequency of storm waves, and the exposure of coastal lands.

MATERIALS

Per group

- | | |
|--|-----------------------|
| 1 large paint tray or 1 rectangular pan, elevated | gravel (optional) |
| 1 liter of moist play sand | 1 waver (15-cm ruler) |
| 3 blocks to represent houses or buildings
(e.g., cubes, Dominoes) | |

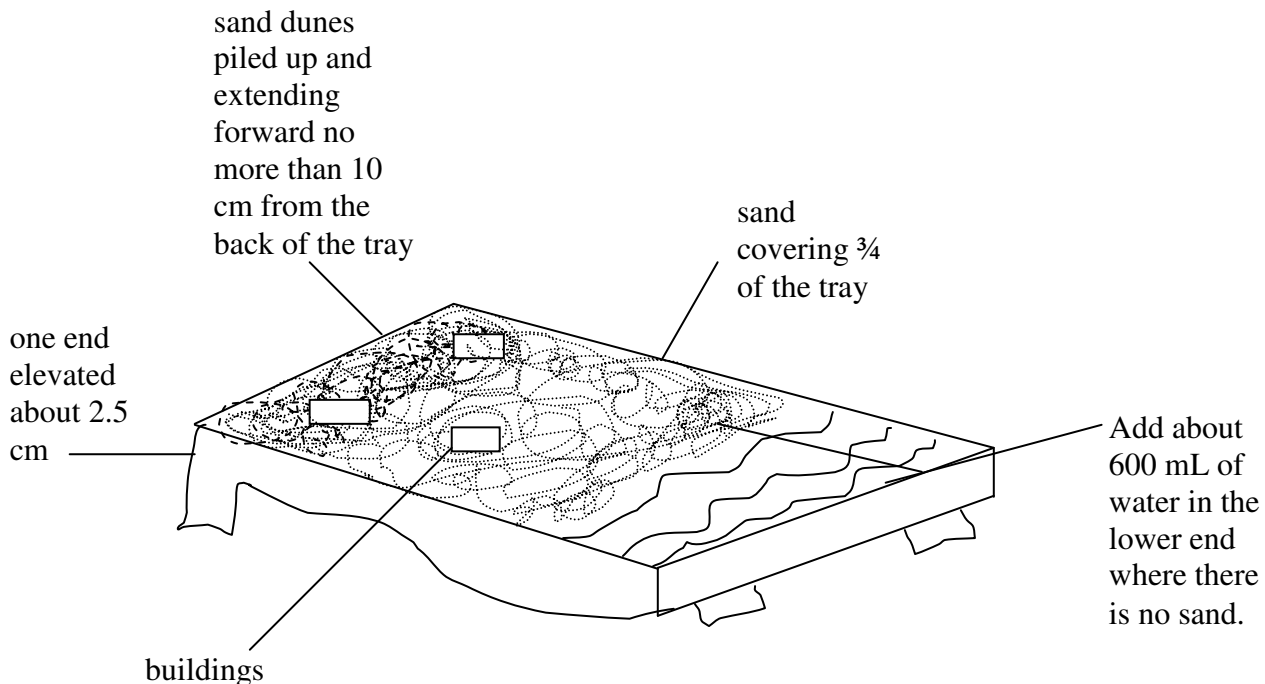
Per student

1 sheet of 11 x 17 drawing paper
crayons/colored pencils
1 ruler

TEACHING TIPS

1. Request a copy of the poster, grades 3-5, entitled *Oceans – Coastal Hazards: Hurricanes, Tsunamis, Coastal Erosion* by writing to: U.S. Geological Survey, Branch of Information Services, Box 25286, Denver Federal Center, Denver, CO 80225 or call 1-888-ASK-USGS. This poster is one in a series of water-resources education posters and contains a visual to accompany the following activity along with the activity written in its entirety.
2. You may wish to set up an area outside for this activity.
3. Assemble one of the models and try the activity prior to the lesson (see diagram):
 - Spread half of the sand evenly over $\frac{3}{4}$ of the elevated section of the paint tray from the top edge down. Leave the lower $\frac{1}{4}$ of the tray empty. (Note: If you are using a large, rectangular pan, elevate one end of the pan about 2.5 cm.)
 - Add the remaining sand to the back 10 cm of the tray to form dunes or cliffs.
 - Place the three blocks and gravel (optional) anywhere in the sand to represent buildings.
 - Add 600 mL of water to the bottom of the pan in the area with no sand.
4. Experiment with the waver before instructing the students in its use.

COASTAL EROSION MODEL



ENGAGE

Begin with this scenario: *This summer during the month of July, I vacationed in a beach house, a place where I've been vacationing for many years. I noticed that the backyard doesn't seem to be as big as it was ten years ago. Is this possible? Why do you think so?*

EXPLORE (Part One)

Instruct students as they build their own coastal erosion model (see Teaching Tips).

EXPLORE (Part Two)

1. Have students divide an 11 x 17 piece of drawing paper into thirds and then in the first section, draw a picture of the model. They should include measurements of the widths of the beach and dunes and the position of the buildings.
2. Demonstrate the use of the waver by holding it horizontally and making short, sharp, pushing motions towards one corner of the tray at an angle. Waves should be small and break on the beach just before reaching the dunes.
3. Have each student per group make twenty waves using the waver. Make sure students always create waves in the same direction.
4. After each student has made waves, have them draw a second picture including the measurements of the widths of the beach and dunes, and the position of the buildings.
5. Repeat step four, but allow students to make waves big enough to reach the dunes. The larger waves represent stronger waves produced by storms.
6. Have students draw a third picture and again include the measurements of the widths of the beach and dunes and the position of the buildings.

EXPLAIN

Look at your first and second diagrams. What changes did you notice in the beach, dunes, or cliffs, and buildings? Tell what caused these changes.

Look at your second and third diagrams. What changes did you notice in the beach, dunes, or cliffs, and buildings? Tell what caused these changes.

What is the process called when earth materials picked up from one place and deposited in a new location? (deposition – see Background Information)

Would you like to live in one of the houses located on your model? Why or why not?

How might animals that live along the shoreline be affected by coastal erosion? Do you think the changes would be beneficial or harmful to their habitat?

Why is it mandatory in certain areas to plant ground cover along the shoreline?

EXTEND/APPLY

Every few years, large ships anchor a short distance from the beach and pump tons of sand from the bottom of the ocean. The sand is pumped to extend the width of the beach. What are some reasons they might need to do this?

ASSESSMENT

Have each group use their observations to explain why they would or would not buy property along the coast.