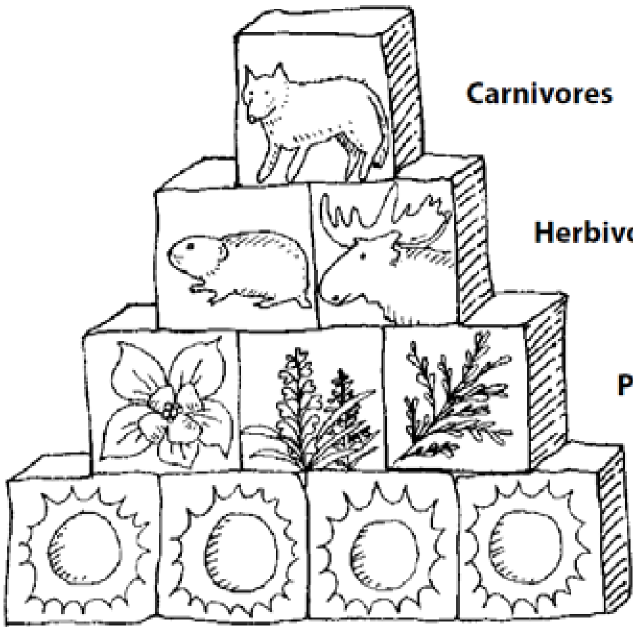
Who Eats Whom?

4 EXTENSIONS ***ALERT: ALASKA ECOLOGY CARDS OPTIONAL***



Section 2
ECOLOGY ACTIVITIES

Grade Level: K - 8

State Standard: S A-14
NGSS: K-LS-1,5-LS2-1,MS-LS1-6 MS-LS2-1,MS-LS2-2,MS-LS2-4

Subject: Language arts, science, math

Skills: Classifying, listening, observing

Duration: 60 minutes

Group Size: Any

Setting: Indoors

Vocabulary: Carnivore, consumer, detritivore, food chain, food pyramid, herbivore, producer

Objective:
Students will describe how energy is passed from producers to consumers in food chains.

Teaching Strategy:
Students build a biotic pyramid with milk carton blocks to model a food chain.

Complementary Activities:
"Take a Deep Breath" *in Section 1. All the* "Investigating (Living Things)" *activities,* "What Makes an Ecosystem," *and* "Ecosystem Scavenger Hunt" *in Section 3. Also* "Create and Destroy" and "Spinning a Yarn about Ecosystems" in Section 4.

Materials:
For the class: 10 empty paper milk cartons (quart or half gallon size); pictures of plants, seeds, algae, herbivores, carnivores, humans (*see following pages* or *Alaska Ecology Cards)*, construction paper – yellow and other colors, scissors, pencils, markers, rulers; yarn or string, pencil and paper.

Background:
See INSIGHTS *Section 2, Ecosystems – Community Connections* and its *"Track the Energy"* fact sheet.

Procedure:
NOTE: Teachers of younger students may need to build the boxes in Steps 4 and 5 *in advance.*

1. Hold a class discussion about students' favorite foods and list them on the board. How many of the listed foods are made of plants (**producers**)? How many are from animals that eat plants (**herbivores**)? How many of the listed foods are from animals that eat other animals (**carnivores**)? *(For example, arctic char and trout eat insects.)*

2. Through class discussion, follow some of the students' favorite foods back through a **food chain** so students recognize that all the food we eat is ultimately based on the consumption of plants. Plants, in turn, depend on the **nonliving** environment *(sun, water, and nutrients).*

3. Tell students they will build an example of a food web to follow the path of the sun's energy through an ecosystem.

4. Working in pairs, students cut the top off a milk carton and measure one side of the bottom of the carton. Using that measurement from the bottom of the carton, measure the same distance up the sides of the carton. Cut the carton to get two square boxes, one open on both ends, and the one open on just one end.

5. Stuff the open-ended box sideways into the other box to form a cube. Tape the cube so that it is closed. The class should make 10 milk carton cubes to complete the set.

6. Decorate four of the cubes with pictures of the sun or put yellow paper on all sides.

7. Paste or draw pictures of Alaska plants and seeds on three of the cubes.

8. Put pictures of plant-eating animals (such as moose or caribou) on two cubes, and use the last block for meat-eating animals. Encourage students to include humans in these last two steps.

9. Have students build a food pyramid as a class. Place the four sun cubes side-by-side as the base, then stack the three plant cubes on top of the sun cubes. Place the herbivore (plant-eating) cubes on the third layer, and the carnivore (meat-eating) cube on top. Discuss what the class has created.

10. Discuss why there are more plants and seeds than plant-eating animals, and why there are even fewer carnivores. *The amount of available energy limits the number of living things in a particular ecosystem. Less energy is available to pass on at every link of a food chain. As a result, carnivores are less numerous than herbivores, and food chains rarely have more than four links.*

11. Ask students to take away one plant block. *At least part of the structure should fall.* What happens when you remove a sun block? What happens if you take out a meat-eater? (*It's not a pyramid anymore.*)

12. Talk about the biotic pyramid as a model of the balance worked out by nature. What happens to that balance if there are no meat-eaters? (*The population of herbivores would eat all the plants, because predators would not limit the population.*)

13. Explain that nature is not as simple as their model of the biotic pyramid. What major role is missing? (*Something to recycle dead things –* **detritivores**.*) There are so many connections that a* **food web** *is a more accurate model to show how energy and minerals are passed from the nonliving surroundings to living things.*

VARIATION
Cut strips of construction paper one-half inch wide; use one color *paper (except yellow)* for each level of the food chain pyramid. Write the name, or draw or glue a picture of a living thing on each strip. Staple or glue the strips together to form chains.

When each student (or pair) has finished making a chain, ask where the chains really start. What is missing from the chains? (*The sun's energy.*) Use a large yellow circle as the sun, and have students attach their chains to the sun with a yellow link. Hang across a corner or from the ceiling to model several food chains.

Evaluation:

1. Given a list of producers, omnivores, carnivores and the sun, students will draw their own food chains or biotic pyramids and label the different levels.

2. *For older students:* Students list the different levels of a biotic pyramid. They explain why a food chain or a food web is a better model for showing the connections between the levels.

3. Give each student a piece of lined paper and strips of construction paper, including yellow. List an example of each of the five food chain levels on the board (producers, herbivores, carnivores, omnivores, detritivores). Have students build their chains independently. What would happen if another chain were added? (*It would become a food web.*) What would happen if you took a link away? What link represents the most energy consumption and why?

EXTENSIONS:

A. **Role play the layers of a biotic pyramid.** Students become the "cubes" of the food pyramid by stacking themselves on top of one another on their hands and knees. Students wear name tags that indicate whether they are producers, herbivores, or carnivores.

B. **Expand knowledge of food chains.** Ask students if they know a name for animals which eat both plants and animals (**omnivores**). Ask what fungi eat or what scavenging herring gulls eat. How do these living things fit in a food chain? *Explain that dead things and wastes from all levels of the pyramid return energy and nutrients to the soil where the energy becomes available again to producers. Suggest fertilizer as an example of waste that provides nutrients for producers.*

C. **Research their cube organisms.** Older students might research organisms for their cubes, to determine living and nonliving things that their plants or animals need to survive.

D. **Complete food chain worksheets.** Students complete one of the food chain worksheets (*following pages*).

Credits:

Adapted with permission from Earth Child by Kathryn Sheehan and Mary Waidner. Tulsa: Council Oak Books, 1992.

Curriculum Connections:

(See appendix for full citations)

Books:

Ecology (Pollock)

Food Chains (Silverstein)

The Hunt for Food (Ganeri)

The Magic School Bus Gets Eaten: A Book About Food Chains (Reif)

What are Food Chains and Webs? (Kalman)

Who Eats What? Food Chains and Food Webs (Lauber)

Media:

All Things are Connected (Video) (North Carolina Wildlife Commission)

Into the Forest, Krill, Onto the Desert, Predator (Nature's Food Chain Games) (Ampersand Press)

The Magic School Bus Gets Eaten (Video)

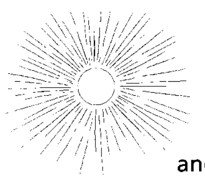
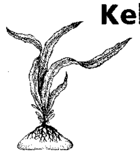
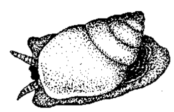
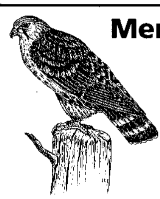
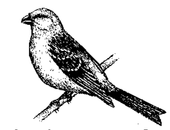
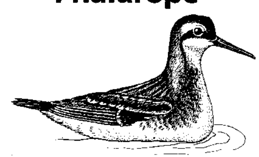
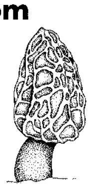
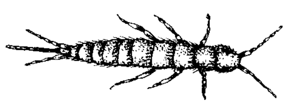
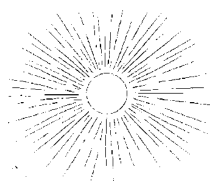
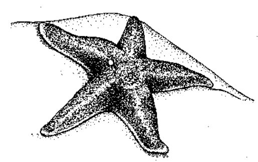
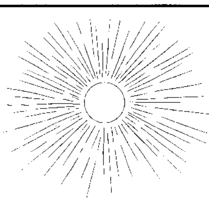
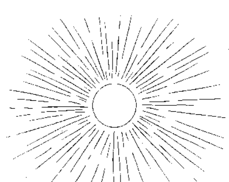
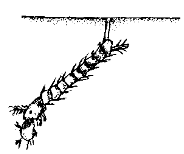
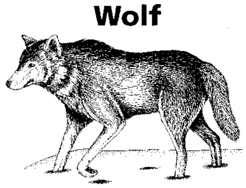
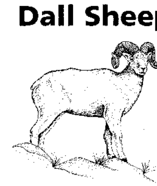
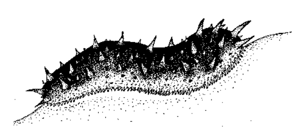
Teacher Resources:

(See appendix)

K-3 Food Chains

Name: ____

Color and cut out the cards below and put them in order to make 4 food chains found in Alaska ecosystems.

1	2	3	4
 and minerals	**Kelp**  I make food from energy and minerals.	**Snail**  I eat kelp.	**Dwarf Dogwood**  I make food from energy and minerals.
Merlin  I eat pine grosbeaks.	**Pine Grosbeak**  I eat the berries of a dwarf dogwood.	**Bacteria**  I eat waste. I live in a wetland.	**Phalarope**  I eat mosquito larvae.
Mushroom  I eat dead things in forests.	**Springtail**  I eat dead things on the tundra.	 and minerals	**Sea Star**  I eat snails.
 and minerals	**Alpine Sunflower**  I make food from energy and minerals.	 and minerals	**Mosquito Larvae**  I eat algae.
Wolf  I eat Dall sheep lambs.	**Algae**  I make my food from energy and minerals.	**Dall Sheep**  I eat moss campion.	**Sea Cucumber**  I eat wastes in the sea.

4-8 Food Chains

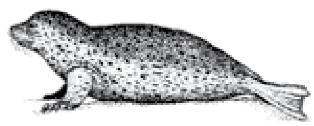
DIRECTIONS: Color the producer cards green, the herbivore cards yellow, the carnivore cards red, and the detritivore cards blue. Then cut the cards apart, find the four food chains, and paste the food chains onto another sheet of paper. Write your name on your food chain paper.

This is a diatom.
It photosynthesizes its food.

This is a redpoll.
It eats birch seeds.

This is a Pholiotus mushroom. It gives off chemicals that digest dead plants and wastes. Then it soaks up the digested material.

This is a copepod.
It eats diatoms.



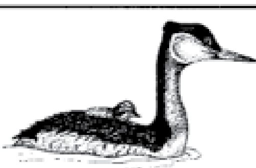
This is a harbor seal. It eats ocean fish such as herring.

This is a birch tree. It photosythesizes its food.

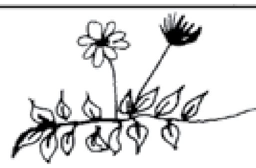
This is a Dall sheep. It eats low-growing alpine plants like alpine avens.

This is a merlin.
It eats small birds.

This is a crab. It eats dead things and waste material on the ocean floor.



This is a grebe. It eats small fish like sticklebacks.



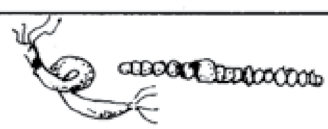
This is an alpine avens.
It photosynthesizes its food.

This is a killer whale. It eats fish and sometimes other marine mammals.

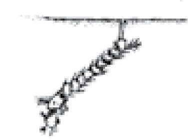
This is a raven.
It feeds on dead animals.

This is algae, a type of protist.
It photosythesizes its food.

This is a dragonfly larvae. It eats the aquatic larvae of other insects such as mosquitos.

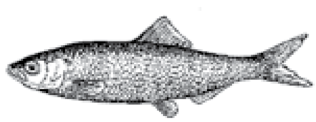


This is bacteria. It feeds on dead plants and animals and waste materials.

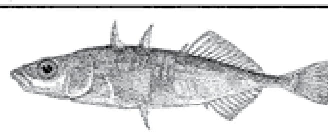


This is mosquito larvae. It eats protists such as algae.

This is a wolf. It eats moose, caribou, and sheep, especially young animals.



This is a herring. It feeds on zooplankton such as copepods.

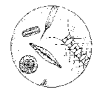
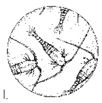
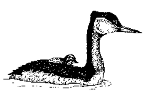
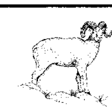
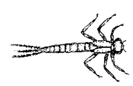
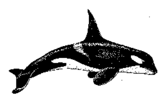
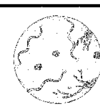
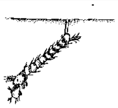
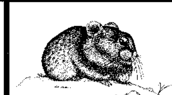
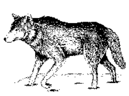
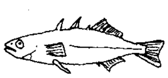
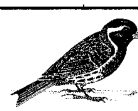
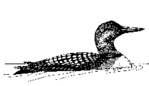


This is a 3-spine stickleback.
It eats aquatic insects like dragonfly larvae.

This is a fox. It eats just about anything it can catch, including small mammals, small birds, bird eggs, and dead animals.

9-12 Food Chains

Place a P next to the producers, an H next to the herbivores, a C next to the carnivores, a D next to the detritivores, and an O next to the omnivores. How many food chains can you find on this worksheet? On a separate piece of paper, diagram an ocean, wetland, forest, or tundra food web that shows all the organisms (pictured or listed) on this worksheet, plus at least 10 others that you know.

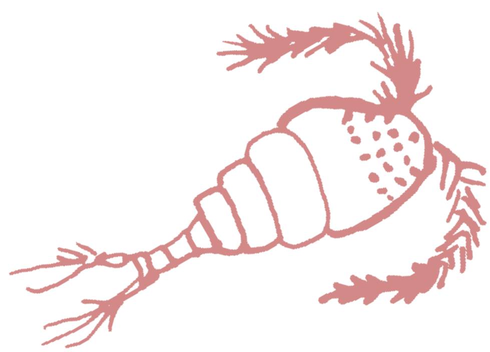
	This mushroom secretes chemicals to digest dead plants and wastes. It absorbs the digested material.		This a diatom, a type of protist. It photosynthesizes its food.
	This is a copepod. It eats diatoms.		This is a redpoll. It eats the seeds of birch, willow, and other shrubs and trees.
	This is a birch tree. It photosynthesizes its food.		This is a harbor seal. It eats ocean fish such as herring.
	This is an alpine avens. It photosynthesizes its food.		This is a Tanner crab. It eats dead things and waste material on the ocean floor.
	This is a grebe. It eats small fish, like sticklebacks in fresh water, or sandlance in ocean water.		This is a Dall sheep. It eats low-growing alpine plants like alpine avens.
	This is a merlin. It eats small birds in forests or tundra areas.		This is a dragonfly larvae. It eats the aquatic larvae of other insects such as mosquitos.
	This is algae, a type of protist. It photosythesizes its food.		Killer whales eat fish (herring and salmon especially) and sometimes seals, sealions, and other whales.
	This is a raven. It feeds primarily on dead things (called "carrion").		This bacteria lives in the soil. It feeds on dead plants and animals and waste materials.
	This is a mosquito larvae. It eats protists such as algae.		This pika is a small mammal that lives in alpine areas and feeds on grasses and herbs.
	This is a wolf. It eats moose, caribou, and sheep, especially young animals.		Red foxes eat just about anything including small mammals, small birds, bird eggs, berries, and dead animals.
	This is a sandlancel It feeds on zooplankton such as copepods, amphipods, and euphausids.		Marmots are small mammals that live in alpine areas and feed on grasses and herbs.
	This is a 3-spine stickleback. It eats aquatic insects like dragonfly larvae.		Golden eagles live in alpine areas and feed on ptarmigan, small mammals, and (occasionally) newborn Dall sheep lamb, mountain goat kid, and caribou calf.
	This is a shrike. It eats small birds, insects, and small mammals in tundra and forest areas.		Adult longspurs feed on insects and the seeds of various tundra plants.
	This is a loon. It eats mainly small fish in fresh and saltwater. They occassionally eat large aquatic insects.		This amoeba eats other protists, including algae and protozoans.

Answers to Food Chain Worksheets

Grades K-3: The four food chains all begin with sunlight and minerals. After these two cards they are as follows: 1. kelp—snail—sea star—sea cucumber; 2. dwarf dogwood—pine grosbeak—merlin—mushroom; 3. algae—mosquito larvae—phalarope—bacteria; 4. alpine sunflower—Dall sheep—wolf—springtail.

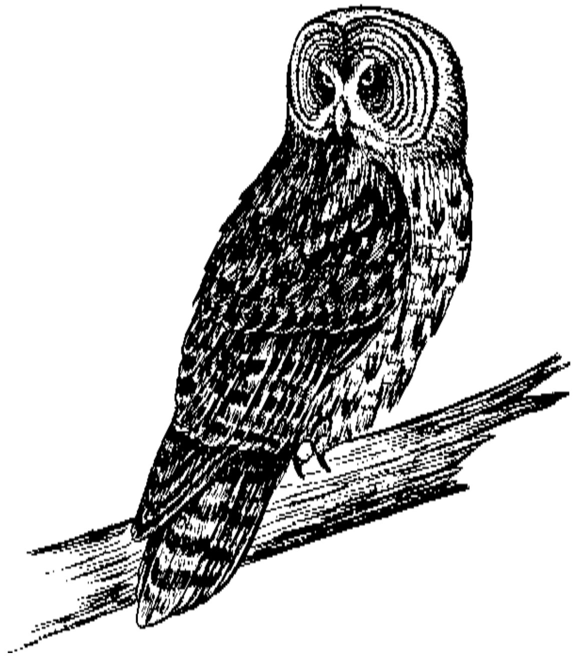
Grades 4-8: 1. diatom—copepod—herring—seal—killer whale—crab; 2. birch—redpoll—merlin—mushroom; 3. alpine avens—Dall sheep—wolf —raven; 4. green algae—mosquito larvae—dragonfly larvae—stickleback—grebe—fox—bacteria. The bacteria and raven can be interchanged.

Grades 9-12: 1. mushroom-D, copepod-H, willow-P, alpine avens-P, grebe-C, merlin-C, green algae-P, raven-D, mosquito larvae-H, wolf-C, sandlance-C, stickleback-C, shrike-C, loon-C, diatom-P, redpoll-H, seal-C, crab-D, Dall sheep-H, dragonfly-C, killer whale-C, bacteria-D, pika-H, red fox-O, marmot-H, golden eagle-C, longspur-O, amoeba-C.



Follow a Food Chain

2 EXTENSIONS ***ALERT: ALASKA ECOLOGY CARDS OPTIONAL***



Section 2
ECOLOGY ACTIVITIES

Grade level: K - 12

State Standard: S A-14
NGSS: K-LS-1,-LS2-1,MS-LS2-1. MS-LS2-2,HS-LS2-4.

Subjects: Science, language arts, math

Skills: Dissecting, observing, inferring, listening, measuring, puzzle-building

Duration: 50 minutes

Group Size: Any

Setting: Inside

Vocabulary: Carnivore, detritivore, food chain, herbivore, owl pellets, predator, prey, producer

Objectives:

1. Students observe one link in a food chain by examining owl pellets. They use this evidence to infer other links in the chain.

2. Students will work in cooperative groups to make observations and collect data and draw conclusions.

Teaching Strategy:
Students dissect owl pellets, put together a skeleton of owl prey, and identify prey animals.

Complementary Activities:

"Investigating Birds" *and* "Investigating Mammals" *in Section 3. Also* "Create and Destroy" and "Spinning a Yarn about Ecosystems" in Section 4.

Materials:

One owl pellet (**see note at end of activity*) per pair of students, dissecting tools (or toothpicks), diagrams of small animal skeletons and skulls. Glue for mounting, sample data sheet (*following*). Guided Imagery *(following).* OPTIONAL: Poster board, *Alaska Ecology Cards.*

Background:

See INSIGHTS *Section 2, Ecosystems – Community Connections* and the *"Owl Food Web"* fact sheet.

Natural History Tips:

Owls usually eat all of their **prey**. Often they swallow small prey whole – feathers or fur and all. What they cannot digest, the owl spits up or "casts" in a pellet 12-16 hours after each meal. These "packages" contain remnants of the birds, small mammals, and insects the owl ate. Pellets reveal the secrets of the owls' diets.

Scientists *(and students)* can learn about owls and their prey by examining and classifying the contents of pellets. The remains of animals found in pellets tell researchers what animals are found in an owl's hunting territory.

Pellets also give clues about growth and decline of rodent populations. For example, if a vole population changes from abundant to scarce, over time fewer vole bones would be found in owl pellets in the area.

Constructing **food chains** based on animals found in an owl's pellet can lead backward to green plants eaten by a vole. Predators on owls include ravens that eat owl eggs and other owls. **Detritivores** always are the last link in the chain.

Procedure:

1. Read the guided imagery. Ask students to predict what they will find in their owl pellets. Write these predictions on the board.

2. Students work in pairs or small groups with specific roles such as chief investigator, supply manager, skeleton construction expert. Remind students that they are to use proper laboratory procedures, which include not eating or drinking while working, and washing hands before and after examining the owl pellet.

3. Distribute one data sheet per group. Ask students to collect some data before dissecting the pellet. Compare each group's observations of pellet length, circumference, shape, texture, and color.

4. Ask students to separate fur or feathers from the bones. Every member of each group should participate in bone classification. Try to identify the teeth and/or skulls of the animal meal. The skulls and teeth will give clues about the owner's identity and its eating habits. Provide posters of rodent, shrew, and bird skeletons as references to aid in identification. A bone-sorting chart is available from Pellets, Inc. (*see* Teacher Resources *in the Appendix*).

Feathers give clues about the size of the bird eaten by the owl. Pellets that have feathers in them may also have bird bones. The longer, larger bird bones can be distinguished from mammal bones because they are hollow and light.

6. Check to see whether there are remains of more than one animal in each pellet. Try to figure out how many of each type of animal is present.

7. Try to set out the bones to form a skeleton of the prey animal. Glue the bones to poster board, if desired.

8. Have groups compare the number and type of different skulls found in each pellet. Results can be compared on a chart or graph.

9. Review each group's data and hold a class discussion. What causes the differences in the appearance and content of the pellets? Why are different animals and different numbers of each type of animal found in each pellet?

10. Focus the class discussion on food chains. What evidence of a food chain is found in an owl pellet? What do owls' prey eat? Extend the discussion of the food chain until students include sun, plants, and **detritivores**.

11. Ask students to draw a food chain based on the evidence they found in their owl pellets. What happens to owl pellets in the wild?

Evaluation:

1. Students draw a food chain to show the owl, what it ate and what the prey ate. Compare chains made by other students in the class.

2. Give students a list of 5-10 things an owl eats. Students build at least two food chains using paper and pencil or 3-dimensional construction showing the missing links in the chain.

EXTENSION:

A. **Study owl pellets as a scientist.** *For older students:* Students design an in-depth study of owl pellets using the scientific method. The question for analysis might be "What are the most common prey of owls?" The study design should include a sample size *(number of pellets analyzed)*, methods section, results and discussion, conclusion, and literature cited.

B. **Analyze the results mathematically.** Prey remains can be sorted into large categories such as mice, birds, and shrews. If a biologist or expert is available, the remains may be analyzed to determine species. Can students determine the mean number of prey per pellet? What is the mean ratio of bone weight to total pellet weight?

Credits:

Adapted with permission from "Owl Pellets," Project WILD, Western Regional Environmental Education Council, 1992. Shaw, Donna Gail, "Sample Lesson Plan – Owl Pellets," Associate Professor, School of Education, University of Alaska, Anchorage, 1992.

Curriculum Connections:
(See appendix for full citations)

Books:
All about Owls (Arnosky) (Gr. K-3)

Book of North American Owls (Sattler)

Guide to the Birds of Alaska (Armstrong)

Owl (Steffof)

Owl Moon (Yolen)

Owls: A Wildlife Handbook (Long)

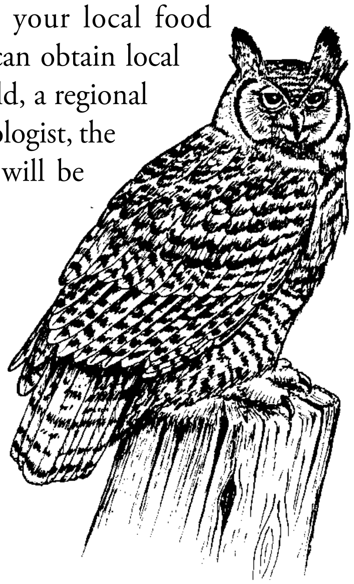
What are Food Chains and Webs? (Kalman)

Teacher Resources:
(See appendix)

NOTES ON PELLETS

Where to obtain pellets
Pellets can be collected below roosting sites *(tall rocks or tundra tussocks, trees, or cliff edges),* from a raptor rehabilitation center, or from a scientific supply house *(see appendix for* Teacher Resources).

Non-local diets from commercial sources
Pellets from commercial sources may include small mammals that do not live in your area. This may make inferring about your local food chain difficult. If you can obtain local owl pellets from the wild, a regional raptor center, or area biologist, the impact of your lesson will be more direct.



*****IMPORTANT SAFETY NOTE*****
Any commercial owl pellet supplier should guarantee that their pellets have been sterilized. If you collect owl pellets on your own, sterilize them to kill bacteria that can be passed on to anyone who handles the pellets. Microwave on "high" for 20 seconds for about five pellets. Or place on a cookie sheet in a 350-degree oven for 20 minutes. Don't overcook.

To ensure the safety of students *(especially when using pellets from the wild)*, also have students soak the pellets in a water/chlorine solution which prevents dust. Students then strain the solution so they can pick through the remaining wet hair and bones.

Guided Imagery: An Owl

Adapted from "Flight of Fancy" by Donna Gail Shaw and reprinted with permission from Ranger Rick's NatureScope, *"Birds, Birds, Birds!"*

Close your eyes. You are going to make a flight to a fantasy world. Before you go, though, your body must change because you are much too heavy to fly.

Let's start the change with your feet. Think about your feet and notice how they feel. Wiggle your toes and bend your ankles. Now imagine that each foot is being squeezed together and stretched until it is long and skinny and extends upward like a leg. Your ankle looks like a knee, but it bends the wrong way. You must stand and walk on your toes, but there are only four of them. One has disappeared. You have unusual control of the four that remain. Three face forward and one sticks out the back, but you can move the outer toe on the front so that it sticks out the back, too. A sharp, curved toenail or talon grows from the end of each toe. The skin on your feet and ankles changes from smooth skin to rough, bumpy scales.

Now your legs become shorter and your knees pull up close to your body. You feel your body grow shorter and your insides shrink.

Suddenly your hands and arms start to change. Your fingers must dissolve and your hands grow until they are long, flat and wide. Your hands and arms have become wings. Flap them a few times and feel how they move.

Now your head begins to change. Your teeth disappear and your nose and mouth grow together to form a hard, strong, sharp, hook-like beak. Your eyes become more difficult to turn in their sockets. You must turn your head to look around. Now your chin disappears and your outer ears fall off. Nevertheless, you're able to hear quite well.

More changes happen very quickly now. Each lung changes and air sacs appear in many places in your body. They are like balloons connected to your lungs. Your bones grow hollow to make them much lighter than they were. The small hairs all over your body begin to change into feathers. Soft downy feathers grow close to your body, and longer, wider feathers cover them. Larger feathers give shape to your wings.

Your body change is complete and you hop to the nearest open door. As you face outside, the wind calls to you and you jump, flapping your wings quickly with great force but hardly any sound.

As evening approaches, you feel extremely hungry. For some reason a mouse sounds like it might taste good. Funny, you've never wanted to eat a rodent before. In the gathering darkness, you hear a soft rustle of the leaves and you spot a mouse. You swoop down, grab it, and fly to a nearby tree to find out you've forgotten all your manners – you swallow the mouse whole! You think to yourself – I can't believe I ate the whole thing – hair, bones, and all! You find that you're still hungry and you're not satisfied until you eat two more small mammals and a bird.

You tire and fly back to your house to rest. Several hours later something begins to happen. You cough hard and, suddenly, you realize what you have become – you're an owl and you have just coughed up your first owl pellet. You wonder to yourself, what would I find inside the pellet if I were to examine it?

Think.

Slowly return to yourself and open your eyes. Today we are going to examine owl pellets (*write owl pellets on the board*). What do you think we will find?

Data Sheet: Owl Pellets

Before dissecting the pellet.

1. Length of pellet: __________

2. Circumference of pellet (use string): __________

3. Draw the shape of the pellet:

4. Colors(s) of pellet: ____

5. Texture of pellet: ____

Begin dissecting a pellet.

6. Number of skulls found in pellet: _________

7. Describe the kinds of animals found:

____

____

____

8. Describe things other than bones or fur found in or on the pellet:

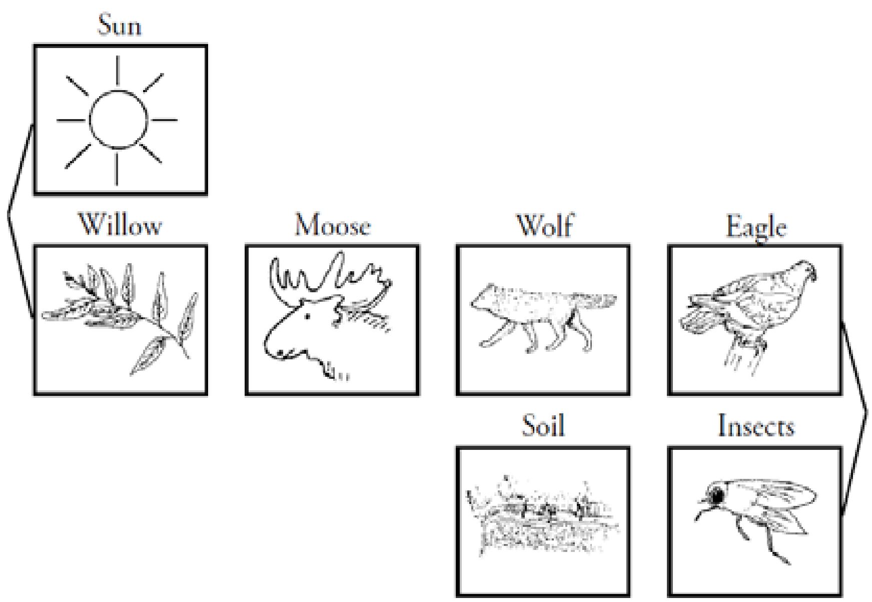
____

____

____

What's For Dinner?

2 EXTENSIONS ***ALERT: ALASKA ECOLOGY CARDS REQUIRED***



Section 2
ECOLOGY ACTIVITIES

Grade Level: 3 - 8

State Standard: S A-14
NGSS: 5-LS2-1, MS-LS2-1, MS-LS2-2

Subjects: Science

Skills: Organizing, synthesizing, analyzing

Duration: 50 minutes

Group Size: 2-4

Setting: Indoors

Vocabulary: Consume, consumer, predation, predator, prey

Objective:

1. Students will identify consumer – consumed relationships.

2. Students will construct their own food relationships and construct their own food chain using only those interactions.

Teaching Strategy:

Student groups brainstorm and create the longest consumer-consumed food chain possible using either magazine pictures or research materials.

Complementary Activities:

All the "Investigating" activities and "Ecosystem Scavenger Hunt" *in Section 3. Also* "Create and Destroy" and "Spinning a Yarn about Ecosystems" in Section 4.

Materials:

Alaska Ecology Cards, wildlife and nature magazines, 5 x 8 index cards, tape, research materials.

Background:

See INSIGHTS *Section 2, Ecosystems – Community Connections.*

Procedure:

1. Define the terms **predator**, **prey**, **consumer**, and **consumed** with the class. Brainstorm examples of consumer-consumed relationships.

2. Ask each group to make the *longest* possible food chain to illustrate consumer-consumed relationships. *For example, an insect like an aphid consumes plants; the aphid is eaten by a spider; the spider is eaten by a bird; the bird is eaten by a goshawk....*

3. Students cut out or draw pictures of each animal in their chain from magazines (or use *Alaska Ecology Cards)* and tape one stage of the food chain on each 5 x 8 index card.

4. Connect the cards with tape or string. The students should either use the *Ecology Cards*, other resource materials, or ask the teacher to verify that each consumer-consumed relationship could exist.

If appropriate, students indicate which relationships are predator-prey as they make their chains.

5. Each group presents their completed and verified food chain to the rest of the class. The group with the longest chain of consumption gets a hand from the class!

Evaluation:

1. Students define predator, prey, consumer, and consumed.

2. Students give two examples of consumer-consumed relationships.

EXTENSION:

A. **Guard against predation.** Brainstorm with students the various ways animals protect themselves from predation. For instance, a bee stings, a skunk squirts a foul smelling liquid, and many animals such as snakes, moths, and lizards use camouflage.

B. **Sing a food chain.** Read or sing the folk song, "I Know an Old Lady Who Swallowed a Fly." Students replace items eaten in this consumer-consumed chain with Alaskan creatures. Sing the new version of the song in the class. If possible, obtain the Pacific Northwest version of the tale, *I Know an Old Lady Who Swallowed a Trout,"* for the students to look at afterward.

Credit:

Activity contributed by Steve Kemp, Anchorage, Alaska.

Curriculum Connections:

(See appendix for full citations)

Books:

The Case of the Missing Cutthroats (George)

Food Chains (Silverstein)

I Know an Old Lady Who Swallowed a Fly (Westcott)

The Old Lady Who Liked Cats (Greene)

There Was an Old Lady Who Swallowed a Trout (Sloat)

What are Food Chains and Webs? (Kalman)

Who Eats What? Food Chains and Food Webs (Lauber)

Who Really Killed Cock Robin? an Ecological Mystery (George)

Media:

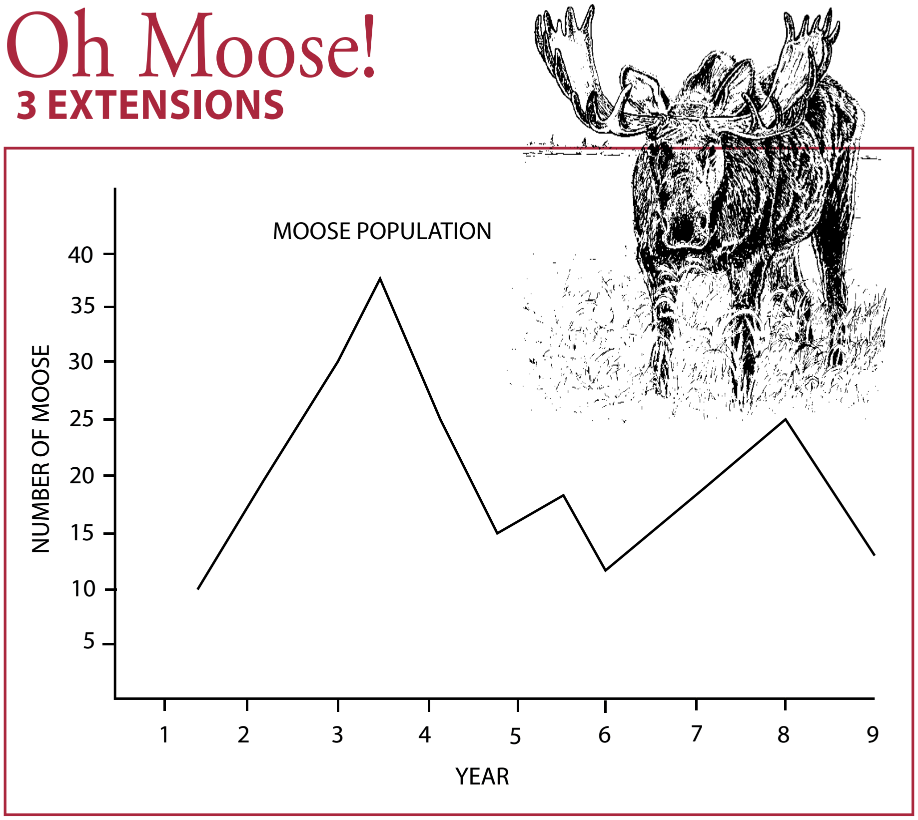
Into the Forest, Krill, Onto the Desert, Predator (Nature's Food Chain Games) (Ampersand Press)

Teacher Resources:

(See appendix)

Oh Moose!

3 EXTENSIONS



Section 2

ECOLOGY ACTIVITIES

Grade level: 4 - 12

State Standard: M A-3, M A-4, M A-6, S A-14

NGSS: MS-LS1-5,MS-LS2-1,MS-LS2-2,MS-LS2-4, HS-LS2-1. HS-LS2-2, HS-LS2-6.

Subjects: Science, math, social studies, physical education

Skills: Applying, comparing, generalizing, graphing, observing

Duration: 45-60 minutes

Group Size: 15 or more

Setting: Indoors/ outdoors (large area)

Vocabulary: Ecosystem, habitat, herbivore, limiting factors, population, predator

Objectives:

1. Students will identify at least three things in an ecosystem necessary for an animal to survive.
2. Students will define "limiting factors," and identify which parts of an ecosystem can limit the growth of a population.
3. Students will describe how and why a population changes as its ecosystem changes.

Teaching Strategy:

Students participate in a game which shows how populations change in relation to the supply of food, water, and shelter.

NOTE: This activity is simplified to cover the basic concepts of habitat and limiting factors. For older students, please refer to the Extensions on page 17.

Complementary Activities:

"Create a Classroom Compost Box" *in this section.* "Investigating Mammals" *in Section 3. Also* "Create and Destroy" and "Spinning a Yarn about Ecosystems" in Section 4.

Materials:

Large area for running or walking; flip chart or chalkboard; writing materials.

Background:

See INSIGHTS *Section 2, Ecosystems – Community Connections.*

Procedure:

1. Ask students what animals need to survive? Review that all animals need **habitat** (*food, water, shelter, and space in which to live*). If animals do not have these necessities, they will die. Tell students that this activity involves finding these essentials for moose.

2. Separate the class so that 1/4 of the class becomes "moose" and 3/4 become the "habitat" components. Mark two lines parallel to each other and 10 to 20 yards apart. The moose stand behind one line. All habitat students stand behind the other line.

3. Each moose needs to find three habitat essentials: food, water, shelter. *In this game, assume that moose have adequate space to live (represented by the 10 to 20 yard space between the moose and habitat).*

- FOOD: When a moose is looking for food, it holds its hands *(hooves)* over its stomach.
- WATER: When a moose is looking for water, it holds its hands over its mouth.
- SHELTER: When a moose is looking for shelter, it holds its hands over its head.

4. At the beginning of each round of the game, a moose can decide what to look for. Once each moose has chosen what to look for, it cannot change until the beginning of the next round. This is very important for the activity to be successful.

5. Each player in the habitat group randomly chooses to be one of the essentials – food, water, or shelter – at the beginning of each round. Once chosen, the habitat essential cannot be changed until the next round. These students use the same hand gestures as the moose to indicate their identity. *If all the habitat players decide to be water one round, they could represent a flood year in that ecosystem.*

NOTE: For younger students, there may be a problem with changing roles during a round. You could hand out color-coded tokens to represent food, water, and shelter. Students choose the color corresponding to their habitat essential at the beginning of each round and return it to the supply at the end.

6. At the beginning of a round, all the students line up on their lines with their backs facing the players on the opposite line.

7. The teacher or leader asks all the players to make the appropriate hand gestures for food, shelter or water.

8. Count "One, Two, Three," and all the students turn around to see the other group. Moose continue to hold their hand gestures and walk to a player at the other line displaying the same habitat hand gesture. They escort the habitat essential person (food/water/shelter) back to the moose line.

- *Successful moose survive and are able to reproduce. If a moose does not obtain its needed essential, it "dies" and turns into a habitat component for the next round.*
- *If more than one moose picks the same habitat element, the one arriving first is the survivor.*
- *If habitat components are not used by the moose, they stay at their line for the next round, when they can choose to represent a different habitat component.*

9. Have one student keep track of the number of moose at the beginning of each round of play. Play the game for 8-15 rounds, keeping track of the numbers of moose.

10. At the end of the game, ask the players to tell what they observed happening to the moose population during the game.

- *They should note that the moose population increased for several rounds, while the herd found plenty of food/water/shelter.*
- *After a few rounds, however, the larger herd would not find enough to satisfy its needs. The moose herd would decrease due to lack of water, food, or shelter.* The causes of the moose population decline are called **limiting factors**.

11. Individually or as a group, students graph the numbers of moose as if each round was a year. The graph will show the ups and downs of the moose population as the supply of food/water/shelter changed. *It is important to realize that a healthy habitat means a healthy wildlife population.*

12. In class discussion, ask what animals need to survive. How does the supply of each habitat component affect the population of moose? Does a population always stay the same? Or is there some other pattern to describe what happens over time? How does the idea of "balance" in nature apply to the habitat and population of an organism? Is there actually a constant balance in an ecosystem or is there another way to describe what actually happens?

Evaluation:

1. Students give three examples of factors that limit the size of a particular population and describe what is meant by the term "limiting factor."

2. Students graph the changes in population numbers over time.

3. Students define a balanced population or "the balance of nature."

EXTENSIONS:

A. **Play the game with predators.** As the game progresses, introduce one predator such as a wolf, bear, or human who has to hop or skip *(for safety)*. A predator can "catch" *(tag)* its moose prey with two hands as the moose runs toward the food/ water/shelter.

Once the moose is tagged, the predator takes the moose off the playing field, to a designated area to eat, cache, or butcher the animal. The "dead"moose then become an additional predator and both predators return to the game.

As with the moose, if a predator does not obtain food, it dies and becomes a habitat component. Have the student recorder keep track of the number of predators as well as the number of moose. Later, this information can be added to the graphs.

With older students, study concepts of predator/prey relations as they effect population, in depth. Have students investigate and discuss the complexities of predator management in Alaska. Allow time for research, opinion writing, and possible debate. For assistance with such resource, contact your local Fish and Game office or the Division of Wildlife Conservation's Wildlife Education Program.

B. **Discuss reproductive capacity (with older students).** In the above activity all moose are treated as females capable of only one offspring. Contact your local Fish and Game office for more information on moose reproduction. Have older students re-design the activity taking reproduction into account with some moose as male, others as female. Identify years where reproductive rates are high or low to illustrate the impacts of reproductivity on population.

C. **Discuss and graph local population data.** Population records may be available for certain species in your area. Contact your local ADF&G office to request this data for use in the activity. Discuss past trends and changes in your local population.

D. **Describe limiting factors for other species.** Students describe some limiting factors of other species including humans. What habitat components are affected by flood, fire, volcanic eruption, pollution, human development, and human recreational activity? How do hunting/trapping/ viewing affect wildlife populations?

Credits:

Adapted from "Oh, Deer!" Project WILD Activity Guide. Western Regional Environmental Education Council, 1992.

Curriculum Connections:

(See appendix for full citations)

Books:

Deneki (Berry)

Disappearing Lake: Nature's Magic in Denali National Park (Miller)

Moose for Kids (Fair)

Our Endangered Planet: Life on Land (Hoff)

Out Among Wolves (Murray) (Essay "The Importance of Predators" by David Rains Wallace and "Thinking Like a Mountain" by Aldo Leopold)

Wolves, Bears, and Their Prey in Alaska by the Committee on management of Wolf and Bear Populations in Alaska.

Media:

Into the Forest, Krill, Onto the Desert, Predator (Nature's Food Chain Games) (Ampersand Press)

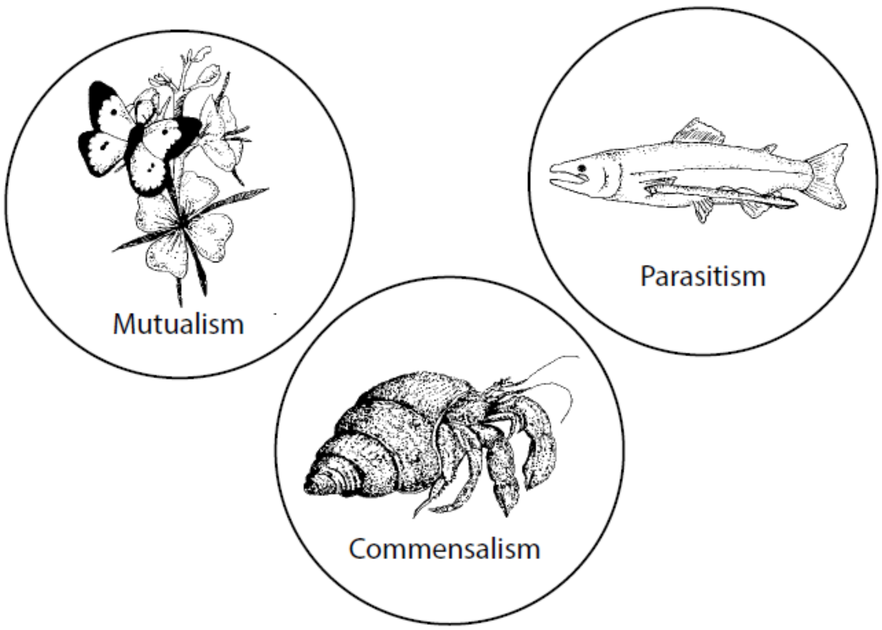
The Wolf Kit. Contact the Division of Wildlife Conservation/Wildlife Education for loan information at (907) 267-2168.

Teacher Resources:

(See appendix)

Ecosystem Partners

4 EXTENSIONS



Section 2
ECOLOGY ACTIVITIES

Grade level: 4 - 12

State Standard: S A-14
NGSS: 5-LS2-1,-LS2-2

Subjects: Science, language arts

Skills: Reading, analyzing, describing, defining, categorizing

Duration: 50 minutes

Group size: 8+

Setting: Indoors

Vocabulary: Commensalism, mutualism, parasitism, symbioses, symbiotic relationship

Objective:

1. Students will define and categorize relationships in which living things depend on one another for food, shelter, and reproduction.

2. Students will identify Alaska examples of three symbiotic relationships: mutualism, commensalism, and parasitism.

Teaching Strategy:

Students play a matching game in which they find pairs of living things that need each other to provide food, shelter, seed transportation, pollination, or spore distribution.

Complementary Activities:

"Follow a Food Chain" *and* "Mineral Cycling" *in this section.* "Ecosystem Scavenger Hunt" *in Section 3.* "Spinning a Yarn about Ecosystems" *in Section 4.*

Materials:

Ecosystem Partner Cards and Practice Worksheets (*following*), bulletin board, pins or tacks, three headings for bulletin board as follows:
Title: "Symbiotic Relationships: Living Closely Together."
(1) **Mutualism:** A relationship where both species benefit and are dependent on each other.
(2) **Commensalism:** A relationship where one species is dependent on another without harming the other species or providing anything in return.
(3) **Parasitism:** A relationship in which one species lives in or on another, getting food and shelter from its host, and causing harm to the host as it does so.

Background:

See INSIGHTS *Section 2, Ecosystems – Community Connections.*

Procedure:

IN ADVANCE: create a bulletin board using the headings described under Materials. Students will later use the board to display examples of these relationships.

1. Review the concept of **ecosystems**.

2. Ask students to brainstorm relationships between organisms *(including humans)* dependent on each other in some way. Make a class list. *(Human relationships might include dog mushers and their dogs.)*

3. Discuss how to categorize the items on the list. Some animals have to compete for limited resources. *(See "Oh Moose")* Other animals have a predator/ prey relationship. *(See "What's for Dinner")*

4. Introduce the idea that some living things cannot live without the help of another. Discuss the terms, **symbiotic relationships**, **mutualism**, **commensalism**, and **parasitism**.

5. Ask students to think of human examples of these types of relationships to reinforce the idea. Ask students if any of the relationships they brainstormed earlier would fit into the three categories of **symbiosis**. You can also discuss the relationships that don't fit into these categories, determining why they don't fit. (*They may be examples of predator-prey or competitive relationships.*)

6. Use the sample worksheet to provide practice for students in classifying the symbiotic relationship between some Alaskan species. Students may work independently, in groups, or as a class to practice using the terms "mutualism," "commensalism," and "parasitism."

7. Distribute one "Ecosystem Partners Card" to each student. Tell them each living thing shown on a card interacts with the other living things that are represented on other cards in the classroom.

8. Explain that there is one special organism with which they have a symbiotic relationship. The object of the activity is for the students to (1) find this special organism, (2) determine what type of symbiotic relationship they have, and (3) explain why.

9. Students circulate the room, looking for their symbiotic organism. (*NOTE: There are symbols on the cards which match, to help younger students to determine their partners more easily.*)

10. Ask each pair to read the cards to the class and explain the interactions of the organisms on the cards. As a group, decide in which symbiotic category to place each interaction.

11. After each interaction is classified, have the pair write the names of the partner organisms under the correct category on the board, or mount the cards in the proper place on the board.

12. Review the different kinds of associations when the board is completed.

VARIATIONS

A. For younger students: Ask one student to stand and read her card, or read it for her. Ask any other student who thinks he has a living thing that helps or is helped by the first to come and link arms with the standing student. Ask the second student to read his card, and have the class decide if it is a good match. If the match is good, the second student stays standing, but if the match is not right, the student returns to his seat. Repeat until a partner is found.

B. Reproduce several decks of cards, each having 20 pairs showing symbiotic relationships. Divide the class into groups of 5 or 6 and give a deck of cards to each group. Play the game "Alaskan Buddies" using the following rules (much like "Go Fish"):

- Deal the cards. Play starts to the left of the dealer and rotates clockwise.
- On your turn, draw a card from the hand of the player to your left. If possible, match it with a card in your own hand *(according to symbiotic relationships)* and lay down the pair.
- When a player lays down all of his or her cards, the game is over. The player with the largest number of pairs is the winner. An extension would be to have students create their own cards for future games.

Evaluation:

1. Students pantomime symbiotic relationships, giving examples of commensalism, mutualism, and parasitism.

2. Students describe symbiotic relationships, give an example of each type of relationship, and identify what makes symbiotic relationships different from competitive or predator-prey relationships.

3. Given some mismatches created by the teacher from the Ecosystem Partner Cards, students can explain why these examples are not symbiotic relationships.

4. Students work in teams of 2-4 to create a mural of certain categories of symbiotic relationships.

EXTENSION:

A. **Add competition and predator-prey relations to the game.** The Ecosystem Partners Cards include examples of competitive and predator-prey relationships. Repeat the game using these cards, allowing the students to establish as many relationships as they can with other organisms. Include bulletin board headings for **competition** and **predation** so students can include these categories as they classify their relationships.

B. **Find schoolyard examples.** Take students outside, looking for examples of interactions within an ecosystem. Challenge students to find evidence of the various types of symbiotic relationships. Examples include mosses that rely on the shade of large trees to keep them moist, plants, and insects that rely on each other for pollination and food, or fungi that obtains its habitat from a dead or live tree. Students list examples and bring the list inside to add to the bulletin board.

C. **Compare an ecosystem to a orchestra.** Brainstorm similarities and differences of an orchestra and an ecosystem. (*In both cases, all the players are a part of the whole; each one does something different, but all are important to one another.*) How does the beauty we perceive when looking at a forest, tundra, ocean, or wetland compare to the beautiful sounds of a symphony? What happens to the music if one or several instruments are removed? How might this relate to what happens in a living ecosystem?

Credits:

Adapted from "Good Buddies," Project WILD, Western Regional Environmental Education Council, 1992.

Curriculum Connections:

(See appendix for full citations)

Books:

Ancient Ones, The World of the Old-Growth Douglas Fir (Bash)

Desert Giant, The World of the Saguaro Cactus (Bash)

Incident at Hawk's Hill (Eckert)

Secret Language of Snow (Williams)

Symbiosis (Silverstein)

Tree of Life, The World of the African Baobab (Bash)

Teacher Resources:

(See appendix)

ANSWER KEY FOR ECOSYSTEM PARTNER CARDS
(to use if the coded graphics are erased from the cards)

Worksheet

1. Tree swallows – Downy Woodpeckers (commensalism)
2. Fireweed – Butterflies (mutualism)
3. Adult lamprey – Salmon (parasitism)

Commensalism, Mutualism and Parasitism Cards

1. Junco – Cowbird (parasitism)
2. Beavers – Goldeneye ducks (commensalism)
3. Bracket fungi – Flickers (commensalism)
4. Birch trees – Mushrooms (mutualism)
5. Mountain goats – Plants with seed hooks (commensalism)
6. Algae – Sea anemone (commensalism)
7. Common eiders – Arctic terns (commensalism)
8. Raspberry – Voles (mutualism)
9. Barnacles – Whales (commensalism)
10. Butterfly pupae – Wasp (parasitism)
11. Hermit crab – Snail (commensalism)
12. Lupine – Bacteria (commensalism)

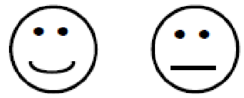
Competitors and Predators

1. Merlins – Pine grosbeaks (predation)
2. Hydra – Protozoans (predation)
3. Marten – Red Squirrels (predation/competition)
4. Bladderwort – Fly (predation)
5. Brown bears – Black bears (predation/competition)
6. Blue mussels – Barnacles (competition)

Ecosystem Partners Practice Worksheet

Read me first: There are three types of symbiotic relationships between pairs of living things on this page:

MUTUALISM
Both organisms benefit.



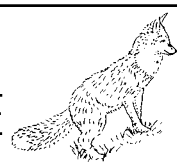
COMMENSALISM
One thing benefits,
the other is unaffected.

PARASITISM
One organism benefits,
the other is harmed.

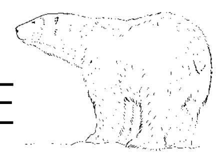
DIRECTIONS: Read about each of the organisms in the pairs below. Write the name that describes the symbiotic relationship between the pair.

example:

Arctic Fox



Polar Bear



Symbiotic Relationship? **Commensalism**

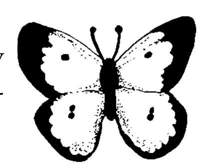
Tree swallows nest in small holes in dead trees, but they cannot dig their own holes.

Downy woodpeckers dig small holes in trees for nesting and roosting. Other small birds can use the holes in the future.

Symbiotic Relationship? ______________________

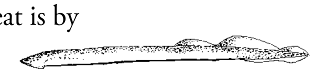
Fireweed needs to have its pollen carried to another fireweed plant. It has nectar to feed the animal that helps spread its pollen.

Butterflies eat flower nectar. They help plants by carrying pollen between flowers.

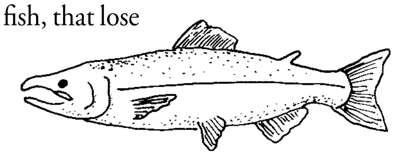


Symbiotic Relationship? ______________________

Adult lamprey fish can not catch their own food. The only way they can eat is by attaching themselves to a larger fish and sucking its blood.



Salmon are a large fish, that lose blood to sucking lamprey.



Symbiotic Relationship? ______________________

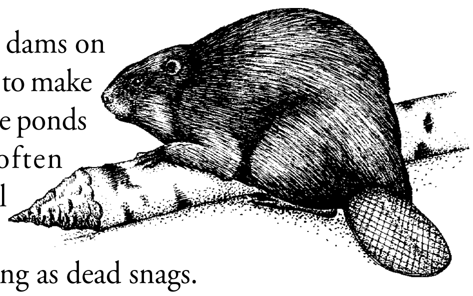
Ecosystem Partners Cards

Mutualism, Commensalism and Parasitism

PHOTOCOPY, LAMINATE, AND CUT-OUT

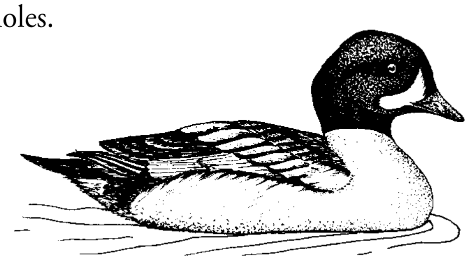
Ravens build nests in trees using sticks and the crotch of a tall tree. From time to time, ravens will abandon their nest, building a new nest in the area.

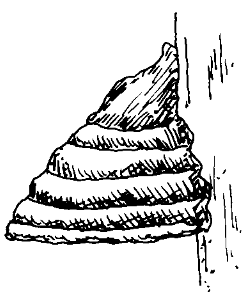
Great horned owls will make their homes in old raven nests, when available.



Beavers build dams on rivers in order to make big ponds. The ponds they make often drown and kill trees that are left standing as dead snags.

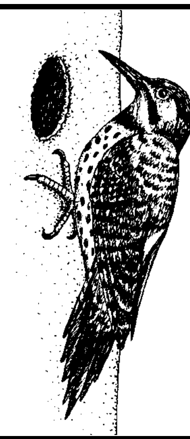
Goldeneye ducks need ponds in the forest and a large hole in a dead tree for nest. They can't dig their own nest holes.



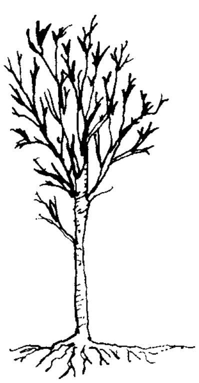


This bracket fungus makes wood soft by eating the wood.

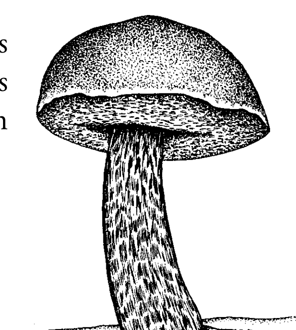
Flickers dig large holes in dead trees for nesting and roosting, but they can only dig in dead, soft wood.



This birch tree needs many minerals from the soil, but its roots can't get enough minerals. It can make food to give to another living organism that helps its roots get minerals.



The underground parts of this mushroom can help the roots of a tree get minerals from the soil.

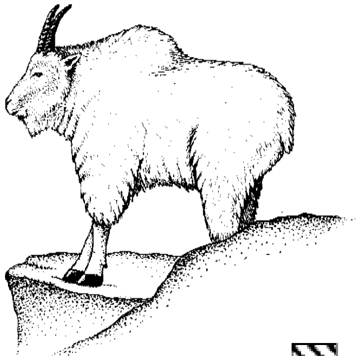


Ecosystem Partners Cards

Mutualism, Commensalism and Parasitism

PHOTOCOPY, LAMINATE, AND CUT-OUT

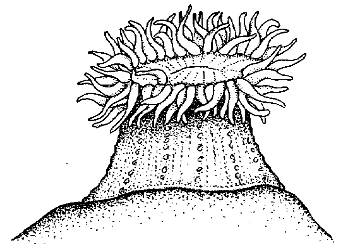
Mountain goats have long, shaggy hair. They travel from one mountain to another in the alpine tundra.



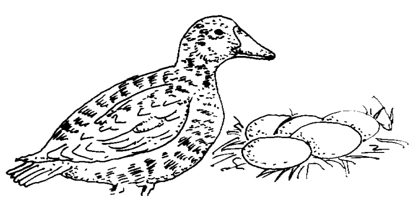
This burr reed's seeds have hooks that get caught on animals that pass by. Those animals then carry the seeds to other areas.

This algae needs a place to live in the ocean where limpets, chitons, sea urchins, and other predators can't reach it. The algae will produce oxygen and food for the living organism that protects it.

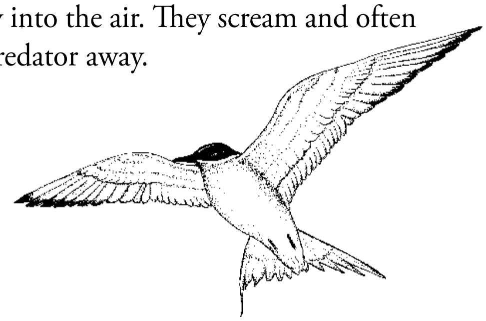
This sea anemone lives attached to rocks in the sea. It allows certain algae to live inside its stinging tentacles. It protects the algae from predators.

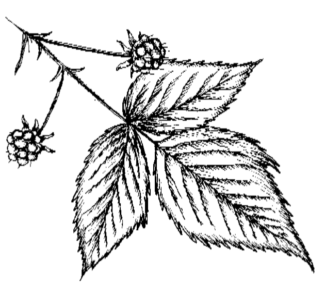


Common eiders nest on the ground in colonies. Foxes and jaegers sometimes get into the colonies and eat the eider's eggs. The eiders need something to warn them if a fox is around and to scare the fox away.



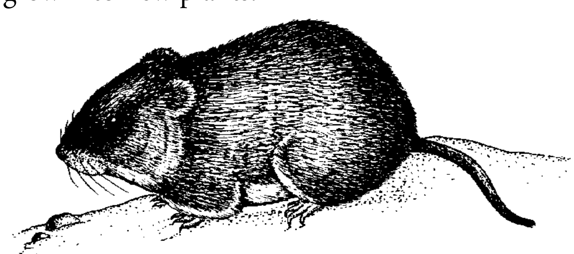
Arctic terns nest in colonies. Whenever a predator, like a fox or jaeger, gets near their nesting colony, all the terns fly into the air. They scream and often chase the predator away.





This raspberry needs an animal to carry its seeds to a new area. Its seeds are inside a big red berry.

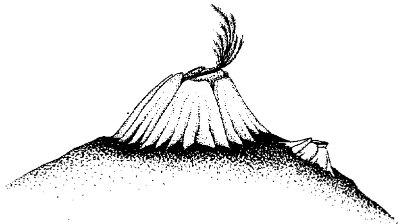
This red-backed vole eats berries for food and nourishment. It then deposits raspberry seeds elsewhere, where they grow into new plants.



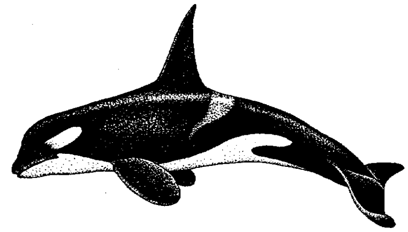
Ecosystem Partners Cards

Mutualism, Commensalism and Parasitism

PHOTOCOPY, LAMINATE, AND CUT-OUT

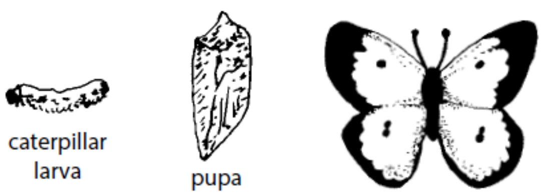


This barnacle eats tiny animals and algae that live in sea water. As an adult it may attach to the skin of an animal that carries it around the sea to good feeding places.

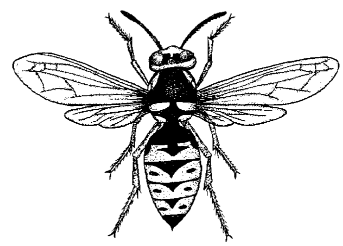


This whale eats small animals that live in the sea. It travels hundreds of miles around the ocean to places where the water is full of tiny animals and algae.

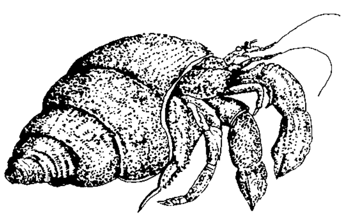
These caterpillar larvae change into pupae. The pupae are encased in a shell and do not move or feed. If they survive, they will become adult butterflies.



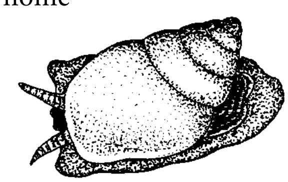
This hornet needs to find a butterfly pupa in order to lay its eggs. When the wasp larvae hatch, they burrow into the pupa. The shell-like case protects them from predators and they eat the butterfly pupa.



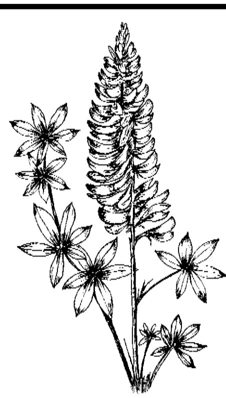
This hermit crab needs a strong shell to protect it from predators.



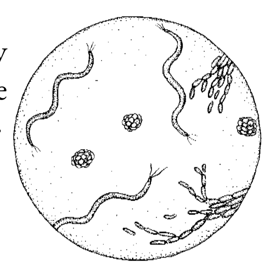
When this snail dies, its body will be eaten by other living things. Its shell is made of strong material that cannot be eaten. The shell could make a home for some other animal.



Lupine plants can only get nitrogen from the soil. But there isn't a lot of nitrogen in the soil where lupine grow.



These microscopic (very small) living organisms are called **nitrogen-fixing bacteria**. These bacteria take nitrogen from the air and put it into the soil.



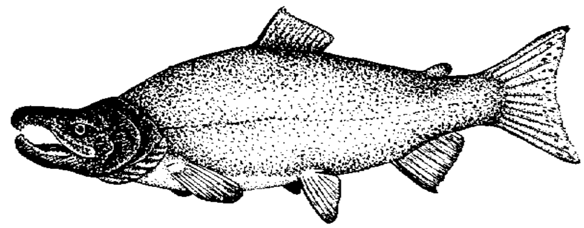
Ecosystem Partners Cards

Mutualism, Commensalism and Parasitism

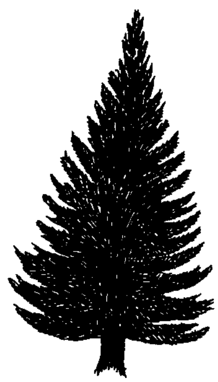
PHOTOCOPY, LAMINATE, AND CUT-OUT

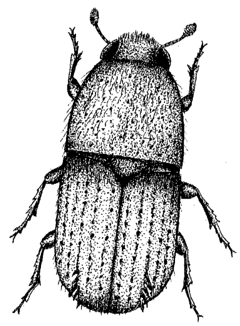
Adult lamprey fish can not catch their own food. The only way they can eat is by attaching themselves to a larger fish and sucking its blood.

Salmon are large fish that lose blood to sucking lamprey.



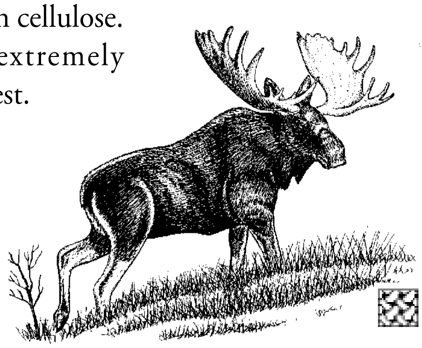
This is a spruce tree.



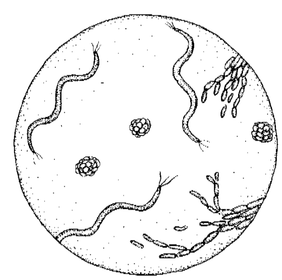


Engraver bark beetles attack and kill weakened spruce trees by laying larvae that feed on the trees.

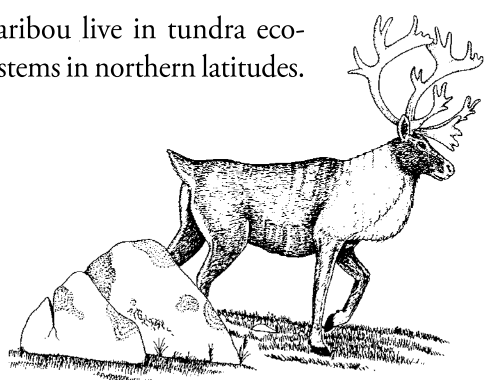
Moose eat plant material which is high in cellulose. Cellulose is extremely difficult to digest.



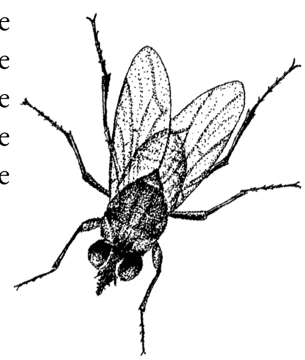
Some kinds of bacteria make their homes inside the guts of moose. These bacteria can digest cellulose and make nutrients available for the moose.



Caribou live in tundra ecosystems in northern latitudes.



Bot flies deposit their larvae in the noses of caribou. The larvae then grow inside the caribou's nasal cavity. Large infestations can impede the caribou's breathing.



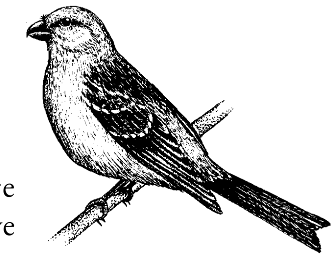
Ecosystem Partners Cards

Competition and Predation

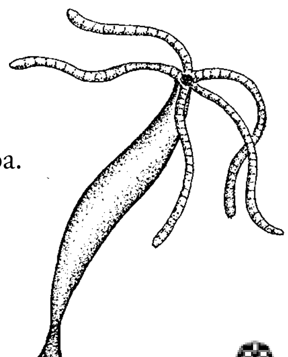
PHOTOCOPY, LAMINATE, AND CUT-OUT

Merlins are birds that live in mixed birch and spruce forests. They eat small birds.

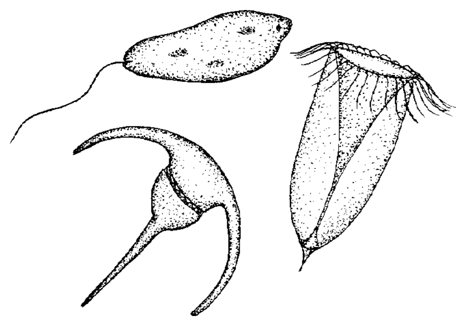
Pine grosbeaks are small birds that live in spruce forests.



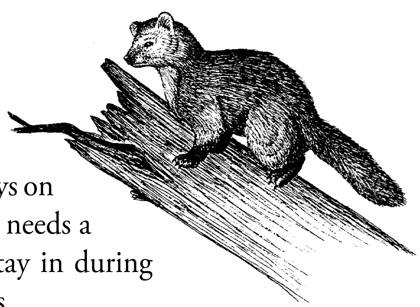
This hydra uses its stinging tentacles to capture protozoa.



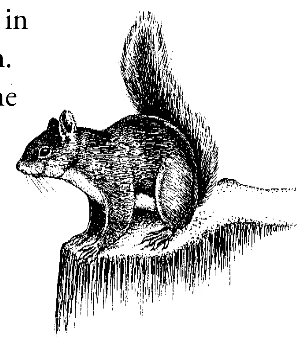
These are protozoa.



This marten preys on squirrels. It also needs a warm hole to stay in during cold winter days.

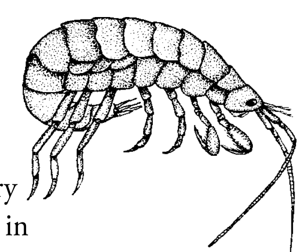


Red squirrels store hundreds of spruce cones in a big pile called a **midden**. They dig holes through the midden. The cone pile insulates the holes from cold air, and therefore creates a warm hole.



This aquatic plant is a bladderwort. It has sticky bladders that trap very small animals. The bladder produces enzymes that digest the insects that get stuck.

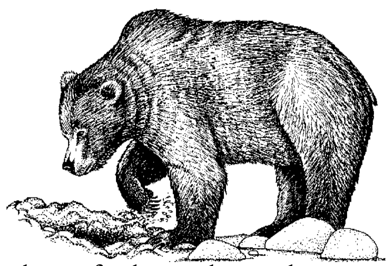
This amphipod is a very small animal that lives in the ocean.



Ecosystem Partners Cards

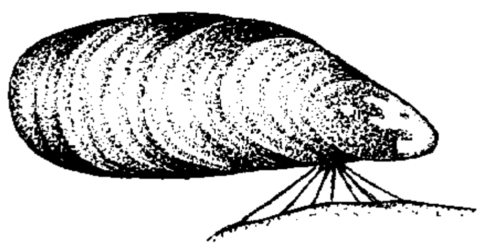
Competition and Predation

PHOTOCOPY, LAMINATE, AND CUT-OUT

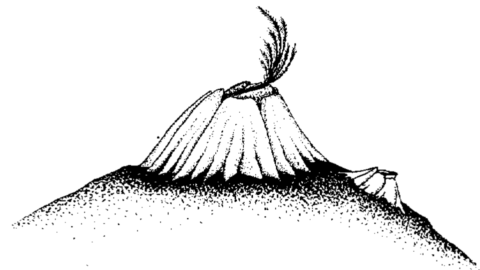


Brown bears feed mainly on the roots of plants and berries. They also eat ground squirrels, fish, moose and caribou calves, and dead animals.

Black bears feed mainly on the roots of plants, and berries. They also feed on fish, small animals, and dead animals.

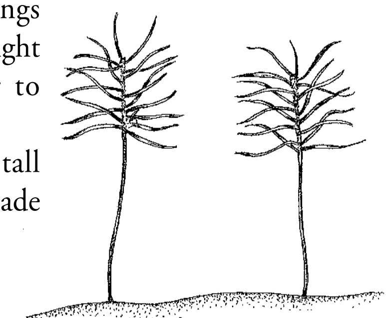


In order to feed and survive, blue mussels must attach themselves to rocks along a wave-washed shore.



In order to feed and survive, barnacles must attach themselves to rocks along a wave-washed shore.

Young spruce seedlings need fresh soil, sunlight and room in order to develop and grow. Once they become tall enough, they can shade out other plants.

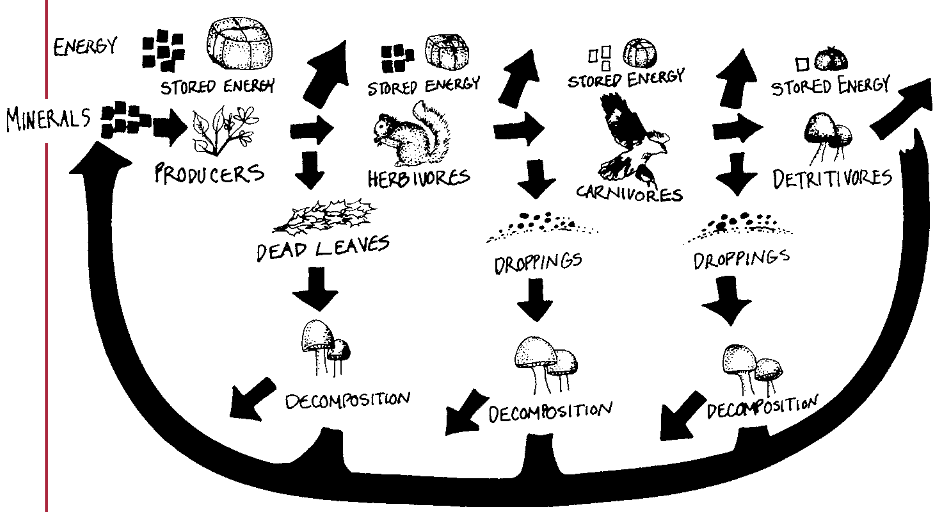


Canada Blue-joint grass grows thick and tall in Alaska if it has lots of light. It often covers the ground densely.

Mineral Cycling through the Ecosystem

3 EXTENSIONS

ALERT: ALASKA ECOLOGY CARDS OPTIONAL



Section 2
ECOLOGY ACTIVITIES

Grade Level: 6 - 12

State Standards: S A-14, Geo C-1

NGSS: MS-LS2-3.,HS-LS2-4.

Subjects: Science, math

Skills: Applying, describing, analyzing

Duration: 60 minutes

Group Size: Whole class

Setting: Indoors /outdoors

Vocabulary: Carbon dioxide, carnivore, cellular respiration, cycle, denitrify, detritus, detritivore, eroded, herbivore, minerals, nitrify, nitrogen, oxygen, producers, solution

Objectives:

1. Students will describe the passage of energy and minerals through a food web.

2. Given a worksheet or through the construction of a diagram, students will demonstrate understanding of the cycles that occur in an ecosystem.

3. Students apply knowledge of mineral cycling to an analysis of current issues which affect ecosystems.

Teaching Strategy:

Students participate in a game that illustrates energy and mineral cycling through a food web.

Complementary Activities:

"Take a Deep Breath" *in Section 1.* "Create a Classroom Compost Box" *in this section.* "*Also* "Watching Your Waste" *and* "Spinning a Yarn about Ecosystems" *in Section 4.*

Materials:

Photocopies of energy and minerals cards *(following),* color coded name tags labeled "producer," "herbivore," "carnivore," and "detritivore" *(see next page for number cards & name tags). For reinforcement or evaluation:* "Ecosystem Cycles Worksheet" *(following),* paper clips, pencils. OPTIONAL: *Alaska Ecology Cards,* "Nitrogen Cycle" and "Carbon Cycle" overhead transparencies or hand-outs *(in* INSIGHTS *Section 2).*

Background:

See INSIGHTS *Section 2, Ecosystems – Community Connections: "Mineral Cycling," "Carbon Cycle,"* and *"Nitrogen Cycle"* fact sheets.

Procedure:

1. Review the food web concept. What do the various organisms pass on to one another? Is it only energy?

2. Remind students that our bodies are made of minerals and all living things need **minerals** to survive. These can be obtained from the air, water and food – if they are in a usable form.

3. Introduce the definition of a mineral: *any nonliving substance that occurs naturally as a single element (nitrogen) or as a compound of various elements (water or carbon dioxide.)*

4. Discuss which minerals are most important in living organisms. Ask students to hypothesize where living things get each of these minerals – oxygen, carbon, hydrogen, nitrogen, phosphorous, sulfur. (*This question should stimulate students to wonder where and how abundant these minerals are in the nonliving environment.*)

	Number of students				
	10-14	15-19	20-24	25-29	30-34
Nametags					
Producers	6	10	13	17	20
Herbivores	2	2	3	4	5
Carnivores	1	1	1	1	1
Detritivores	1	2	2	3	3
Cards					
Energy:	30	45	60	75	90
Mineral:	10	15	20	25	30

5. Have the class stand and make a food web to demonstrate the need for recycling minerals. This can be done quickly: begin with one student as the sun, and then ask students to "attach" to the web as they identify a plant or animal which might come next in each food chain. Another option is to assign roles, passing out pre-made, color-coded name tags (*also used in "Spinning a Yarn about Ecosystems," in Section 4*) or *Alaska Ecology Cards*.

6. Once the web is made, give the energy cards to the student representing the sun. Scatter the mineral cards on the floor around the sun.

7. **Explain the following directions to each of the role players:**

Sun:

• Pass out energy cards as needed to the producers.

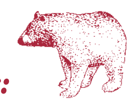
Producers:

• Producers are the only organisms that can obtain energy and most minerals from the nonliving environment. Stand in a large circle within arm's reach of the sun. You represent algae and plants.
• Gather separate energy and mineral cards and paper clip one of each together to represent food. You may use only mineral cards that have not already been clipped to an energy card.
• Producers must make **two** sets (each set has one energy and one mineral card with four squares) during each round to survive.
• Since it takes energy to make food, producers must cross out one of the energy squares on each of the two sets during each round.
• After crossing out energy squares, you should keep one set, and toss the other to the floor as waste.

Herbivores:

• Herbivores should courteously take two sets from the producers.
• Because energy was used to gather food, you must cross out one energy square on each set.
• Drop one set to the floor as waste.
• If you can find only one set by the end of the round, then you die and drop your set to the floor. If no sets are found, you die and must wait until there are enough sets during another round.

Carnivores:



• Carnivores follow the same directions as the herbivores, but they obtain their food sets from the herbivores.

Detritivores:

• Detritivores must pick up two "waste" sets from the floor.
• Due to energy used to consume food, you must cross out one energy square on each set.
• Put the whole set back on the floor where another detritivore can pick it up and cross out energy squares. When the four energy squares are filled, leave the sets on the floor.

8. Call out the beginning of each round. A round ends when either every player has two sets or all the sets at any level are used.

9. Play new rounds until something goes wrong. For example, the producers may run out of minerals and everyone will be unable to get food. How many turns does the game last before all the players are out?

10. Discuss what happened in the game. Lead students to think about why we don't run out of minerals in nature. They should guess one of two reasons: (a) *that there are so many minerals, that organisms never run out*; or (b) *that minerals are recycled.*

11. Discuss the limited availability of minerals in usable forms. For example fresh water, fresh air, and rich soil are limited. Discuss the geological cycle of soil formation (*see also* INSIGHTS *Section 1). Unless something prevents erosion of the fine-grained materials and the subsequent leaching of minerals that can dissolve in water, these elements are flushed out of the area and into another ecosystem (the ocean, for example).*

12. As a group, students diagram the cycling of minerals found in the soil as they travel through the ecosystem. Teachers may choose to use *Alaska Ecology Cards,* the samples of nitrogen or carbon cycling, or the "Ecosystem Cycles Worksheet."

VARIATION
If time permits, replay the game, this time with the detritivores taking the sets apart to illustrate returning minerals to the soil.

Instruct the detritivores to look carefully at the number of "X" marks on each card. If the energy card is filled with four "Xs," remove the paper clip and put the mineral card on the floor. The energy card is "used up," and must be discarded when all four of the energy squares are filled.

How many turns does the game last now? Could it go on indefinitely if the sun was still giving off energy? (*Yes.)*

VARIATION FOR OLDER STUDENTS
Make hand-outs or over head transparencies of the "Nitrogen Cycle" or "Carbon Cycle." Study of these two cycles deepens students' understanding of the interrelationship of the living and nonliving components of ecosystems.

Evaluation:

1. Students construct a diagram to apply the concepts learned in the mineral cycling game to real examples of how minerals cycle through an ecosystem.

2. Students answer the following questions and defend their theory (written or verbal): (a) How does large scale erosion (caused by human or natural causes) change an ecosystem? (b) What would happen to the soils in an area if a farmer, logger, or miner continued to work that area year after year? How can people use the land without stripping the soils away? (*Rotating crops, re-seeding, mitigation following mining are examples.*)

EXTENSIONS:

A. **Write about a mineral as it travels.** Students write an essay about the journeys of a mineral molecule, using "Odyssey" by naturalist Aldo Leopold (an essay in the book *Round River*) as a source of ideas.

Read the first half of the essay to the class (or have a student read it). Discuss Leopold's ideas. Was he writing about a unit of energy? (*No, remember energy is not recycled – it passes through an ecosystem only once.*)

Do students think he was writing about a carbon, water, phosphorous, or nitrogen molecule? Assign students one of these molecules and ask them write their own imaginary story about the journeys of this molecule through the earth's ecosystems. Students could start their story in their local ecosystem.

B. ***Magic School Bus* reading.** For younger grades, read together *The Magic School Bus Inside the Earth.*

C. **Work the worksheet.** Students use the "Ecosystem Cycles Worksheet" to show their understanding of the cycles that occur in nature.

Curriculum Connections:

(See appendix for full citations)

Books:
Ecology (Pollock)

Magic School Bus Inside the Earth (Cole)

Magic School Bus at the Waterworks (Cole)

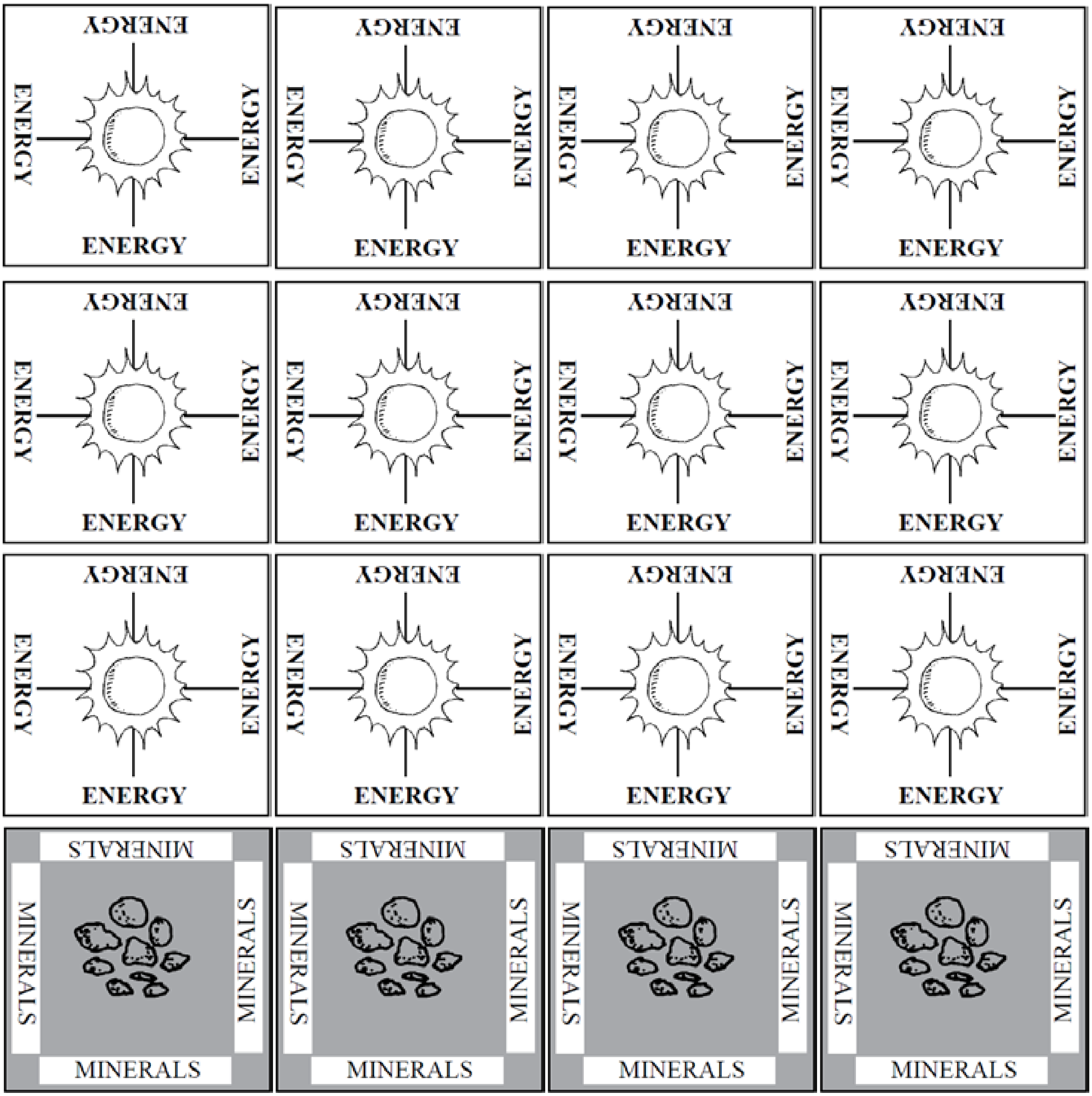
Photosynthesis (Silverstein)

Teacher Resources:

(See appendix)

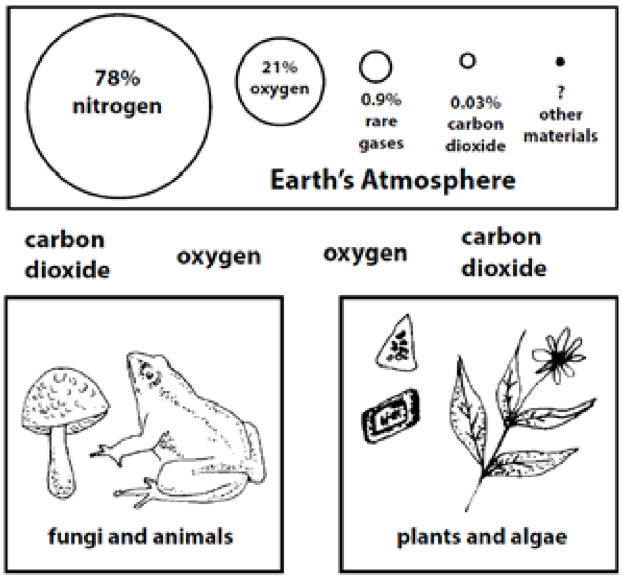
Energy and Mineral Cards

DIRECTIONS FOR THE TEACHER: Photocopy and cut up six sets of cards (for a class of 30) to make 90 energy cards and 30 mineral cards. Laminate and use washable markers so that energy cards can be reused.

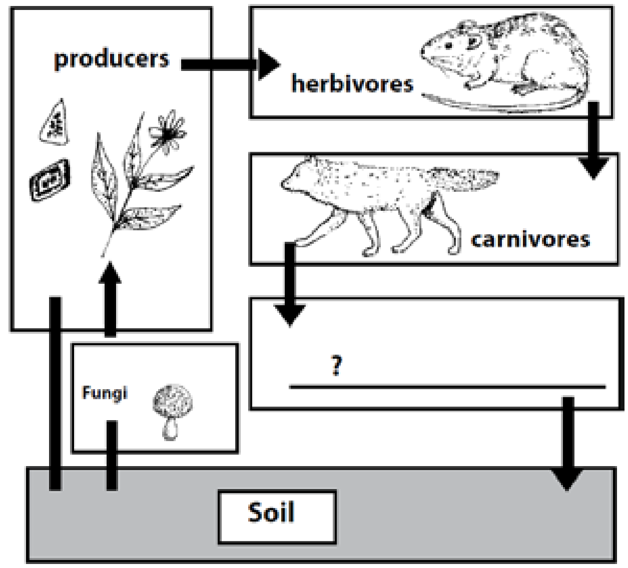


Ecosystem Cycles Worksheet

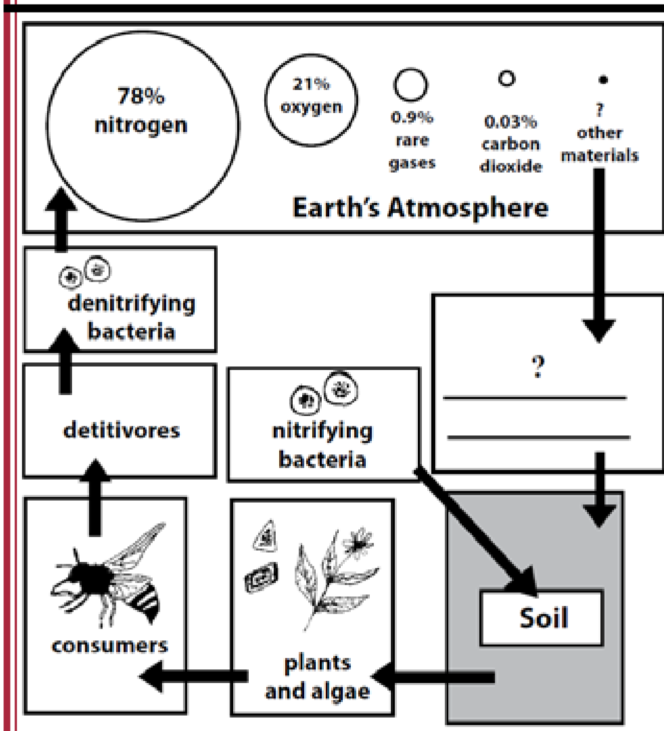
Name: ______________________________



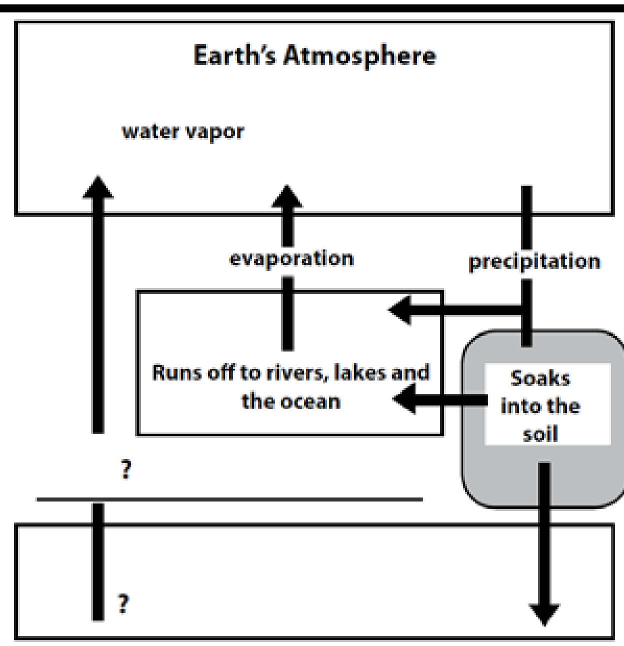
Draw arrows between the atmosphere and these living things to show whether each takes in or gives off oxygen and carbon dioxide. What would eventually happen to the atmosphere if plants and algae stopped growing and reproducing?



What kinds of living things are the missing link in this diagram of the phosphorous cycle in an ecosystem? What would happen if these kinds of living things disappeared?



This shows the nitrogen cycle. If it were not for the activities of the missing living things, plants would soon run out of nitrogen. What are they?



This is a diagram of the water cycle. One part of the cycle involves certain living things. Draw in an example of these living things and name the process by which water is returned to the atmosphere. What happens to the amount of water in the atmosphere if these living things are not present or are removed?

* *Percentages have been rounded up.*

ANSWERS FOR ECOSYSTEM CYCLES WORKSHEET

Top left – fungi and animals breathe in oxygen and give off carbon dioxide; plants and algae actually breathe in and give off both gases, but they give off more oxygen than carbon dioxide.

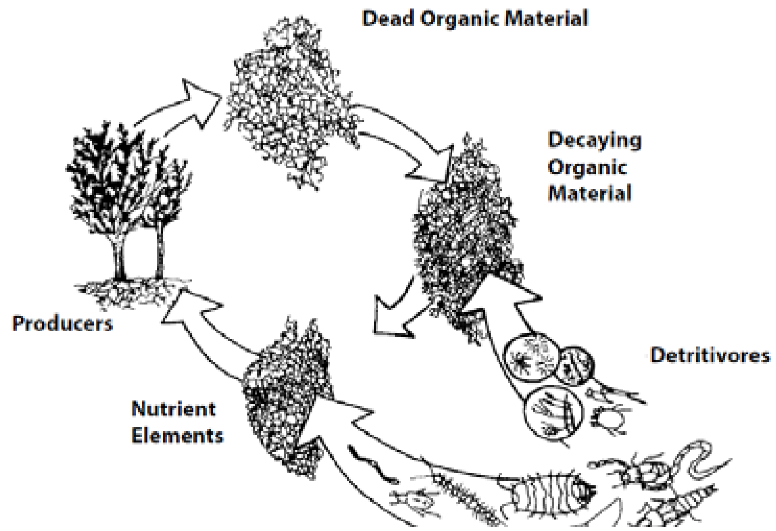
Top right – detritivores – the mineral cycle would break down without them and plants would run out of needed minerals.

Lower left – nitrogen-fixing bacteria.

Lower right – plants, transpiration, the amount of moisture in the air would decrease, meaning less precipitation and more airborne dust.

Creating A Classroom Compost Box

4 EXTENSIONS



Section 2
ECOLOGY ACTIVITIES

Grades: 3 - 12
State Standards: S B-1, S B-5, S B-6
NGSS: 5-LS2-1,MS-LS2-3, -LS2-4.
Subject: Science, language arts
Skills: Observing, analyzing, applying, writing
Group size: Whole class
Duration: Minimum of two 50-minute sessions, plus observation for 6 weeks
Setting: Indoors
Vocabulary: Aerobic, anaerobic, compost, detritivore, decomposition, fertile, gizzard, humus, landfill, nutrients, organic, solid waste

Objectives:

1. Students will understand and be able to describe the decomposition process of organic waste.

2. Students will evaluate the importance of decomposers (detritivores) as contributors to fertile soil.

3. Students will describe the importance of detritivores to ecosystems.

Teaching Strategy:

Students build and maintain a composting worm box to observe and record detritivores as they break down food waste. Students extend this experience by comparing home waste to waste deposited in landfills.

Complementary Activities:

All activities in this section. "Investigating Plant Habitat" *and* "Investigating Animals in Soil" *in Section 3. Also* "Watching Your Waste" and "Spinning a Yarn about Ecosystems" *in Section 4.*

Materials:

- *WOODEN BOX:* about 1-ft. deep, with holes drilled in the bottom panel. *(The size of the box depends on how much composting you want to do. A 2x2 foot box will handle 3.5 pounds of kitchen scraps a week, the amount typically produced by a two- person family. A 2x3 foot box typically suits the organic waste output of a family of four.)* The box should have drain holes, and a tray beneath.
- *BEDDING MATERIALS:* such as torn newspaper, corrugated cardboard pieces, sawdust, peat moss, or leaves. Mix about one-third peat moss into bedding at the beginning to aid in moisture retention. Total bedding should weigh 4-6 pounds for a 2x2 foot box, and 9-14 lbs. for a 2x3 foot box.
- *REDWORMS:* 500 to 1,000 worms. Redworms are available for $15-25 from garden supply companies and through mail order.
- *FOOD WASTE:* 1-2 gallons of finely shredded scraps including vegetables, grains, fruit scraps, breads, coffee grounds and filters. (*NO meat scraps or oily substances*)

- *WATER:* for watering the box and keeping it moist.
- *PAPER and PENCILS:* for student observations.

Background:

See* INSIGHTS *Section 2, Ecosystems – Community Connections: "Composting Basics" and "As the Worm Churns" fact sheets.

Procedure:

1. Hold a class discussion about what happens to plants and animals in nature when they die. What would happen if nothing ever broke down or decomposed? *(What would happen if no one took out the wastebasket all year in the classroom?)*

2. Discuss the process of natural **decomposition** and how dead **organic** matter is recycled by **detritivores** into nutrients and minerals in the soil that plants need in order to grow.

3. How much waste does each household and/or classroom produce? If possible, watch the videocassette "The Rotten Truth" or "Its Gotten Rotten."

4. One way to reduce solid waste and benefit the ecosystem is to compost. Composting mimics the natural decomposition process. Ask students what elements are needed for this process. *(We need a waste-eater or detritivore. We need to make a* **habitat** *suitable for the detritivore by providing it with food, water, shelter and space.)*

BUILD THE "HABITAT"

1. Build a class worm box *(follow instructions in "Materials" section)*. The class can collect bedding, shelter, and food materials (1x3 strips of newspaper and food scraps from lunch).

2. To start the box, add the bedding, along with several handfuls of soil to provide grit for the **gizzards** of the worms. Water the bedding so that it is moist, but not dripping.

3. Add the worms, and stir gently.

4. Weekly add food scraps in the form of small pieces, burying them among the bedding. The smaller the food pieces, the faster they will decompose.

5. **Covering the food waste with a layer of dirt will eliminate any potential aroma from the box.** Usually, the only smell emitted from the box occurs when the topsoil layer is broken to put in new good **solid waste**, or when waste is left on top of the soil.

6. Add eggshells occasionally to add calcium to the soil and to lower the acidity.

7. Keep the bedding moist by watering it as needed. You will not need to water too often, as the fruit and vegetable scraps should provide sufficient moisture. Be careful not to drown the worms!

NOTE: Worms thrive when their environment is warm and dark, so cover the box. Make sure there is adequate air circulation.

STUDENT OBSERVATIONS

1. Students should keep a journal over several weeks. There are two types of observations that can be made about the box:

- *Behavior and description*

(a) Pictures, writings, and predictions about what will happen to the food waste.
(b) Note the appearance and behaviors of the redworms.
(c) Research worm biology, using reference materials.
(d) Do simple experiments that won't harm the worms. *For example, note their reaction to light, certain types of food or soil.*
(e) Write a summary of observations.

- *Measure and quantify*

(a) Observe and record the population growth of the worms. Find a measuring receptacle of known volume that you can reuse *(perhaps a 1-pound coffee can)*.
(b) Randomly sample the compost in the box, filling the measuring receptacle loosely.
(c) Dump the sample onto newspapers and count the number of worms in the contents. *At first you may not find any worms in a sample.* Record this as "zero worms on ____(date)."
(d) Repeat this measurement twice a week and record the findings.
(e) Graph the growth of the worm population on a bulletin board.

2. As a class, weigh the amount of food waste that is added to the box. Compare the amount and type of material with the growth of the population. Develop some hypotheses about the amount of food necessary to keep the population growing.

3. As students observe the redworms, also ask them to note the changes that occur in the *compost* in the worm box. The bedding will get darker and the volume of the box will slowly decrease as waste is digested and worm **castings** increase.

NOTE: You need to add new bedding every four months to keep the balance healthy for the worms. Without new bedding the box will contain only worm castings, as the worms will starve.

4. Harvesting the worms can be done after a few months, if desired. Dump some of the contents of the bin onto a large sheet of plastic, arranging it into small mounds. Shine a light onto a pile, and leave it alone for 5-10 minutes. The worms will dig down to get away from the light. Remove the outer surface material of each pile. Repeat until you have just a pile of worms.

5. Get other classrooms involved by giving them worms for their own box. Or, have students start a compost box at home.

6. Mix your humus with some soil in the schoolyard and plant a tree!

Evaluation:

1. Evaluate journals for thoroughness, quality of observations, and on their summaries and conclusions.

2. Describe the habitat (food, water, shelter, and space) needs of red worms.

3. Write a story about what would happen to soil, plants and wildlife if there were no detritivores. Consider the impact on humans if there were no worms.

4. List three ways that worms have a positive effect on soil.

EXTENSIONS:

A. **Promote school /family composting.** Develop a composting program. **Make sure your compost bins are animal-proof.** In bear country this is especially important! <www.alaska-bears.alaska.gov>

B. **Grow vegetables with your humus.** Use the humus from your compost box to grow radishes, beans, or other plants in the classroom. Experiment with the proportion of soil (inorganic) and organic material for different plants and make observations about the best proportions of each for growing healthy plants.

C. **Expand community awareness.** Sell worms and distribute information to local businesses about composting in an effort to create community awareness and involvement in composting.

D. **Write a big book or story.** Write a big book or children's story about the process of decomposition and the role of detritivores.

Credit:

This activity was researched and modified by Val Chabot, Eagle River.

Curriculum Connections:

(See appendix for full citations)

Books:

Compost Critters (Lavies)

The Worm Cafe: Mid-Scale Vermicomposting of Lunchroom Waste (Payne)

Worms Eat My Garbage (Applehof)

Media:

It's Gotten Rotten (Video) (Gr. 9-12)

The Rotten Truth (Video) (Children's Television Workshop)

Wormania! (Video)

Website:

Alaska Cooperative Extension. *Composting Dog Waste, Fairbanks, Alaska* <www.uaf.edu/coop-ext/compost/dogs.html> *Composting Organic Waste in the Anchorage Area* <www.uaf.edu/coop-ext/compost/anchorage.html>

Teacher Resources:

(See appendix)