

Overview:

Students participate in a scavenger hunt to identify and review roles of organisms in a local ecosystem.

Objectives:

The student will:

- identify concepts and components of their local ecosystem.

Targeted Alaska Grade Level Expectations:**Science**

- [8] SC3.1 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by stating that energy flows and that matter cycles but is conserved within an ecosystem.
- [8] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

Vocabulary:

carbon dioxide – a heavy odorless colorless gas formed during respiration and by the decomposition of organic substances; absorbed from the air by plants in photosynthesis

carnivore – animals that eat other animals

commensalism – a relationship in which one organism takes something of need from another organism, where the second organism neither benefits nor harms it.

consumer – a living thing that can only survive by consuming other plants, animals, or organisms

detritivore – organisms that eat dead or decaying material

ecosystem – a system formed by the interaction of a community of organisms with their physical environment

erosion – condition in which the earth's surface is worn away by the action of water and wind

fungus – a parasitic plant lacking chlorophyll and leaves and true stems and roots and reproducing by spores

herbivore – organisms that eat plants

interdependence – a reciprocal relation between interdependent entities (objects or individuals or groups)

invertebrate – an animal with no backbone

mammal – warm-blooded animals that give birth to live young.

organism – a living thing that has (or can develop) the ability to act or function independently

oxygen – odorless, colorless, tasteless gas important for animal life on earth. Oxygen is made by plants during the process of photosynthesis

mutualism – the relationship between two different species of organisms that are interdependent; each gains benefits from the other

nonliving element – a thing which never has been, nor ever will be alive

omnivore – an animal that eats both other animals and plants

parasitism – the relationship between an organism called a parasite, that lives in or on a host (another animal or plant). the parasite gains nourishment from the host without benefiting or killing the host

photosynthesis – the ability of plants to turn sunlight, carbon dioxide, and water into energy

predation – the act of preying by a predator who kills and eats the prey

producer – a plant or organism that produces energy from non-living things, such as sunlight.

recycle – the act of processing used, abandoned or dead material for use in creating new material

respiration – the bodily process of inhalation and exhalation; the process of taking in oxygen from inhaled air and releasing carbon dioxide by exhalation

symbiosis – the relationship between two organisms that provide benefits to each other without any negative impact on either organism

Materials:

- STUDENT WORKSHEET: “Ecosystem Scavenger Hunt”
- STUDENT INFORMATION SHEET: “Ecosystem Scavenger Hunt List”
- STUDENT INFORMATION SHEET: “Elements of Ecosystems: 5 Living Kingdoms”
- STUDENT INFORMATION SHEET: “Ecosystems – Community Connections”
- TEACHER INFORMATION SHEET: “Living things in their Habitats”

Activity Preparation:

1. Before distributing the scavenger hunt list, add specific animals, plants or other items which represent your local area.

Activity Procedure:

1. Review the list of items together. Help students define unfamiliar terms.
2. Explain that some items on the “Ecosystem Scavenger Hunt List” require creative thinking. For example, students may not see specific animals, but they could find animal signs such as droppings, browse marks or tracks. Similarly, students will not see carbon dioxide, but they can deduce its presence by their own presence or the presence of animals that breathe it out, or by plants which use it in photosynthesis and respiration.

Evidence of symbiosis might include a parasitic growth on a plant, a deer or moose (which requires microscopic organisms to digest its food), a swallow (which must have holes in trees made by woodpeckers or fungi to survive), or seeds that stick to someone’s socks.
3. Explain the rules:
 - a. Although students can review the Alaska Ecology Cards or the Glossary, they may not write anything down until the hunt begins.
 - b. When students find an item, they are to write each “find” on their list rather than collecting it.
 - c. Students can use the same item more than once on the list as long as the item fits more than one category.
 - d. The search ends when any team finds one example of each item on the list, or at the end of a specified time.
4. Once the class is outside, set clear boundaries for the hunt. Remind students to respect wildlife and the local ecosystem by leaving plants as they find them.
5. When the search ends, the first team finished reads aloud its list, explaining why their items are examples or evidence. Other teams follow with items that they found which were different from the first team’s list.
6. All teams cross from their list anything that another team also listed. Any incorrect answers must also be crossed off. Each team then adds the number of allowed items remaining on its list and scores one point per item. The team with the most points wins

Evaluation:

Students write a description of their local ecosystem using the scavenger hunt list. Students explain the interconnections.

This lesson adapted with permission from Alaska Department of Fish and Wildlife’s *Alaska’s Ecology* curriculum. (2005).

ECOSYSTEM SCAVENGER HUNT

STUDENT WORKSHEET

NAME(S): _____

Find examples or evidence of the following and list them in the space at the right or on another sheet of paper:

a producer

a carnivore

a symbiosis

photosynthesis

parasitism

an insect

a detritivore

an herbivore

mutualism

predation

commensalism

an omnivore

an animal

a fungus

a plant

microscopic organisms

a nonliving element

an invertebrate

a mammal

interdependence

a consumer

a tree

water

erosion

a bird

oxygen

humans

carbon dioxide

recycling of minerals

a tree that died

moss

ELEMENTS OF ECOSYSTEMS: 5 LIVING KINGDOMS

Living Things – 5 Kingdoms






To the various nonliving environments we now add a cast of living things. Living things can move in response to their surroundings they grow and they reproduce. The presence or absence of certain nonliving things dictates which living creatures will survive in a certain area.

Stars are Easier to Count. It is said that scientists have a better understanding of how many stars are in our galaxy than how many species are on Earth. Estimates range from two million to 100 million. New species are still being discovered.

Hey, You! Only 1.4 million species have been named. Only a small fraction of the insects, fish, and non animal species have been scientifically described and catalogued.

Naming Things. The Swedish naturalist, Carolus Linnaeus, was the first person to devise a method of naming living things. Linnaeus used two categories or **kingdoms** to classify all living things: **Plants** and **Animals**. His system has been modified many times, evolving along with the expanding knowledge of biologists.

More Kingdoms. While scientists are still debating about how to classify some organisms, they now agree on the following five classifications of living things:

-  monerans (one-celled organisms such as blue-green algae and bacteria)
-  protists (one-celled organisms including algae and protozoans)
-  fungi (such as mushrooms and lichens)
-  plants
-  animals

The following fact sheets explain the characteristics of each kingdom and highlight some of its members found in Alaska.

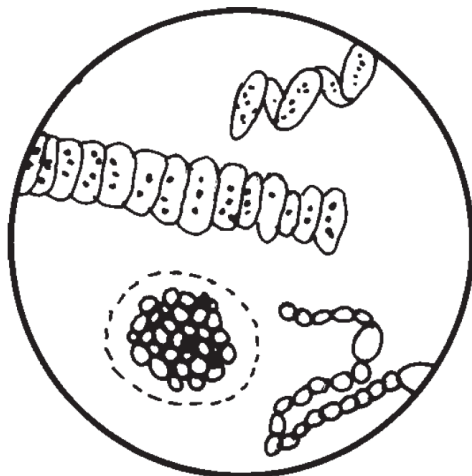
1 AND 2 – MONERANS AND PROTISTS

Small but mighty

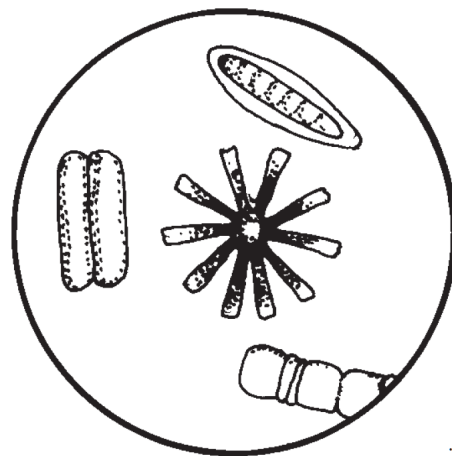
Monerans and protists create soil and clean up plant debris. Until recently, these microscopic living things were considered to be small versions of plants and animals. But the more scientists learned about them, the less they seemed to fit in either category.

Given Their Own Kingdoms. Some not only make their own food, like plants, but also move around and catch and eat other living things. Additionally, their cell structure is quite different from those of either plants or animals.

MONERANS, the smallest and most primitive microscopic organisms, are **prokaryotic** (they lack a cell nucleus). **Bacteria** and **cyanobacteria** (or **blue-green algae**) are examples of monerans. Some live together in colonies or in **symbiosis** with other living things. *A million monerans would fit on the head of pin.*



Microscopic organisms are abundant and important in all ecosystems. The majority are detritivores that replenish the soil with recycled nutrients



PROTISTS are larger microscopic organisms that have cell nuclei (they are **eukaryotic**). These include **algae**, **paramecia**, **amoebas**, and many others. They move by use of flagella, cilia, or pseudopodia. Some do not move.

Ecological Roles. Some monerans and protists are **producers**. Like plants, they are able to photosynthesize (to make food from air, water, and sunlight) and are food for very small animals. Others are **herbivores** or **carnivores**.

Unsung Heroes. The majority, however, are **decomposers** and **detritivores**, especially monerans. Some are “nitrogen-fixers,” taking nitrogen from the air and converting it to a form usable by plants. These unsung heroes recycle waste and dead

3 – FUNGI

An out-of-body phenomenon

Fungi are prolific **decomposers** and **detritivores**. Mushrooms, shelf fungi, and less noticeable molds, mildews, yeasts, and rots are some examples.

Fungi are similar to plants in that they are immobile. In fact, scientists used to consider them to be plants. But fungi are very different from plants in cell structure and in the ways they live, so scientists now place them in a separate kingdom of living things.

More Than Meets the Eye. Usually, we see only the fruiting, or reproductive part of a fungi (a mushroom, for example). Its main body is hidden from view. The body of a fungus is made up of **hyphae**, microscopic hair-like structures that reach out through the wood, soil, leaf litter, roots, or other material on which the fungi is growing. A handful of forest soil may contain over two miles of fungal hyphae!

Unusual Way of Eating. Fungi use their hyphae and digest their food outside their bodies! The cells of fungal hyphae give off digestive enzymes like those found in human stomachs. These enzymes break down wood, leaves, and other material. Then the fungal hyphae absorb the scattered sugars and minerals and use them to grow.



Mushrooms are the fruiting, or reproductive parts of a certain fungi. Tiny hair-like structures, called hyphae, are the main body of many fungi.



Lichens are the most visible fungi in forest ecosystems

Trading Minerals for Sugars. Some fungi form symbiotic associations with plants and help them obtain needed minerals (*nitrogen, potassium, phosphorus*) from the soil in exchange for the sugars the plant produces. More than 90 percent of the plants in Alaska, including all our trees and berry producing plants, could not grow without these mycorrhizal fungi.

Mutual Symbiosis. Lichens, one of the most visible fungi, are actually a partnership between a fungus and algae or cyanobacteria (moneran). The fungus provides the structural protection, and the alga produces the food.

4 – PLANTS

From small to tall

Plants are visually dominant in ecosystems and produce the food for other life forms. This kingdom includes small to tall – mosses, liverworts, ferns, and horsetails to spruce and birch trees.

Green Producers. These organisms have cells with nuclei and cell walls and a highly organized arrangement of their many cells. All are green and capable of photosynthesis. Except for the mosses and liverworts, all have leaves, roots, stems, and a system for transporting water and organic materials among the cells.

Help Accepted. All plants live a stationary life. Many rely on wind, insects, birds, and some mammals to pollinate their flowers or to help carry their seeds to new areas. Plants can live for a remarkably long time. Some bristlecone pines are more than 4,000 years old.

Ecological Champions. Plants are extremely important ecologically. (1) **Pioneer** plants help create the organic soils that all other plants need before they can become established in a new location. (2) They are the major **producers** (of food) in terrestrial ecosystems. Without them, the animal kingdom would not survive.



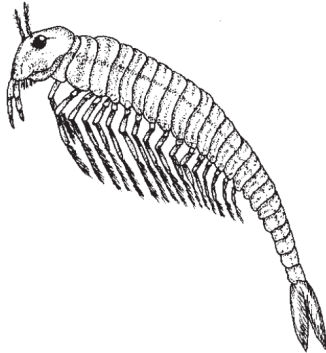
5A – ANIMALS (INVERTEBRATES)

Mind-boggling multitudes

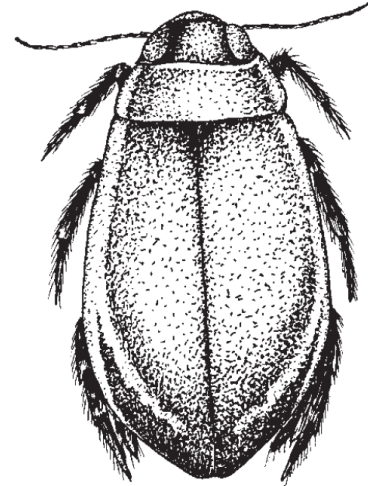
Invertebrate animals are multicellular organisms that lack backbones or spinal columns. They make up the majority of the animal kingdom, both in number of species and in populations.

Like other animals, invertebrates obtain energy and minerals by eating other living things – plants, fungi, or other animals. They are **consumers**. Many also function as **detritivores**, helping to recycle the minerals and nutrients in dead organic material.

Need External Warmth. Invertebrates need external warmth to function. The majority of invertebrates are only active during the warmer months which in Alaska is limited to a few summer months. Even then, despite their numbers, few humans notice them.



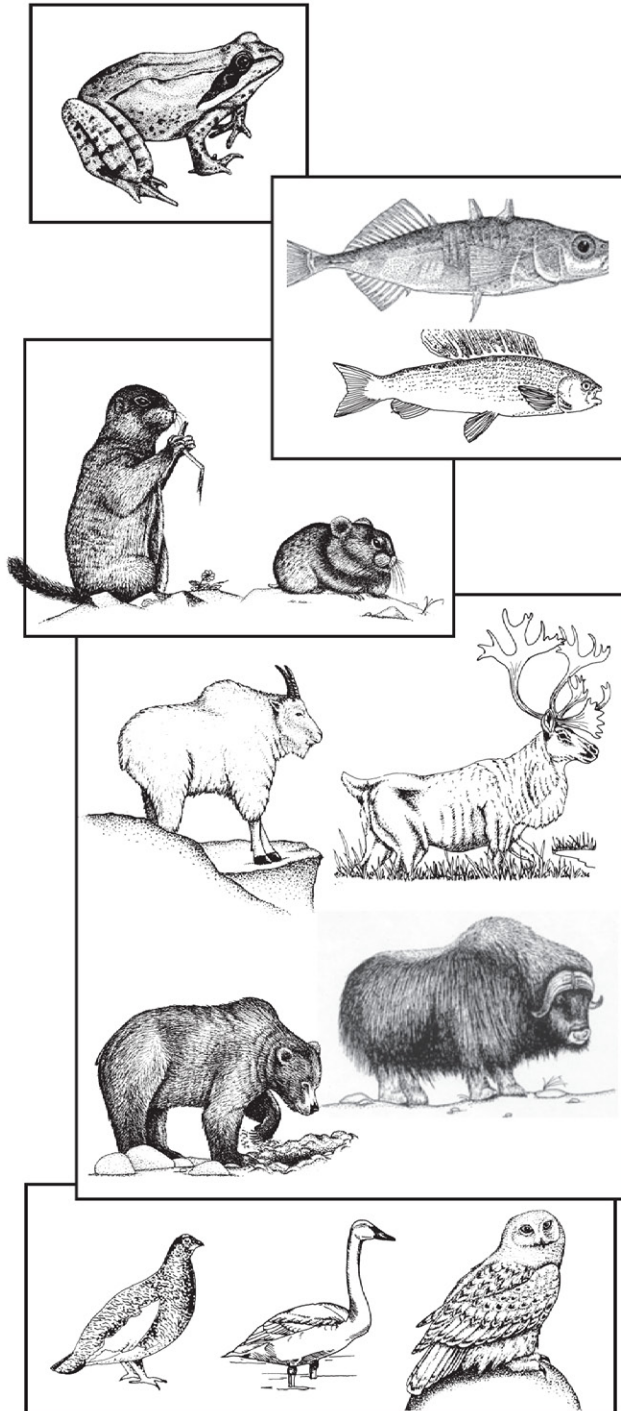
Mosquitoes and Much More. Arthropods (*spiders, centipedes, millipedes, and insects*) are the most conspicuous. Flying insects include butterflies, bumblebees, moths, wasps, crane flies, and midges. Mosquitoes, blackflies, and other biting flies can occur in great abundance.



Look in Damp Places. Invertebrates also include segmented worms, snails, and slugs. Sawflies, aphids, bark beetles, carrion beetles, and ground beetles are among the insects that live on plants or in the leaf litter. *For a more complete list and illustrations, see the Alaska Ecology Cards.*

5B – ANIMALS (VERTEBRATES)

Frogs, Bats, Hummingbirds – in Alaska!



Vertebrate animals are multicellular organisms with backbones or spinal columns. Alaska's vertebrate animals include humans and other mammals, birds, fishes, and all five of the state's amphibians (wood frog, spotted frog, western or boreal toad, long-toed salamander, and rough-skinned newt).

Reptiles are the only major group of vertebrates absent from Alaska's ecosystems.

No Producers, Only Consumers. All vertebrates obtain energy and minerals by eating other living things – plants, fungi, or other animals. They are mainly **herbivores** and **carnivores**. Vertebrates can move about and actively search for food.

Like Cold or Flee. Some Alaska animals, such as polar bears, caribou and ptarmigan, adapt to the cold. Others such as gray whales, ducks, and robins migrate elsewhere to avoid the coldest months. Even some fish migrate. They hatch in our streams and then spend several years in the ocean before returning.

For more animal facts and illustrations, see the Alaska Ecology Cards.

ECOSYSTEMS - COMMUNITY CONNECTIONS

STUDENT INFORMATION SHEET

Ecosystems - Community Connections

Where the next meal comes from is a constant priority in any organism's life. The following pages trace how energy is transferred in ecosystems and how materials are recycled. (Recycling in ecosystems is not just an option, but is critical to continued survival.)

Food Webs - Who Eats Whom?

[See the "5 Living Kingdoms" fact sheets in INSIGHTS, Section 1, and the Alaska Ecology Cards for species illustrations.]

Producers. A plant is exquisitely equipped to convert the nonliving – air, water, minerals, and sunlight – into food for itself and others through **photosynthesis**. Plants and algae that make food from nonliving materials are called **producers**.

Consumers. All other living things in an ecosystem depend on food manufactured by producers. Called **consumers**, they use a process called cellular respiration to convert the carbohydrates, fats, and proteins found in plants or other animals into another form of energy that their cells can use (see INSIGHTS Section 1: "Energy")

Consumers are divided into four groups:

- **herbivores:** organisms that eat plants
- **carnivores:** animals that eat other animals
- **omnivores:** animals that eat both animals
- **detritivores:** organisms that eat dead or decaying material

The pathway of **energy** and **minerals** from the nonliving environment, through producers, to consumers, and back again through detritivores creates a **food chain**. All the food chains of an ecosystem are connected into a **food web** – the energy circulatory system of that ecosystem.

Energy. At each intersection of the web, some energy is returned to the nonliving environment as heat. That energy is not passed on and cannot be reused by living things. The lost energy is replaced during photosynthesis by the capture of energy from the sun.

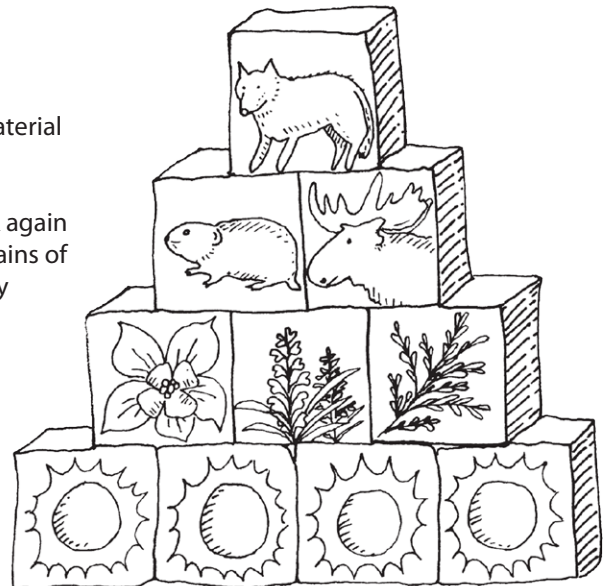
Minerals. Minerals are always passed along at each web intersection until the detritivores return them to the environment in their original form. The producers can use them again to make new food.

Producers Convert Raw Materials

Using the process of **photosynthesis**, producers combine energy from sunlight with carbon dioxide from the air and minerals from water, soil, and rocks to produce the sugars and oxygen that help all other living things survive. They are the first living link in all food chains.

Plants are the main producers in forest and tundra ecosystems, while algae (including seaweeds) are the main producers in ocean ecosystems. Both plants and algae are important in wetlands. Some monerans are also producers.

Food Web
Producers
Consumers
Herbivores
Carnivores
Omnivores
Detritivores
Alaska Food Chain
Track the Energy
Owl Food Web
Growth has Limits
Competition
Symbiosis
Mutualism
Commensalism
Parasitism
Mineral Cycling
Nitrogen Cycle
Carbon Cycle
Composting Basics
As the worm churns

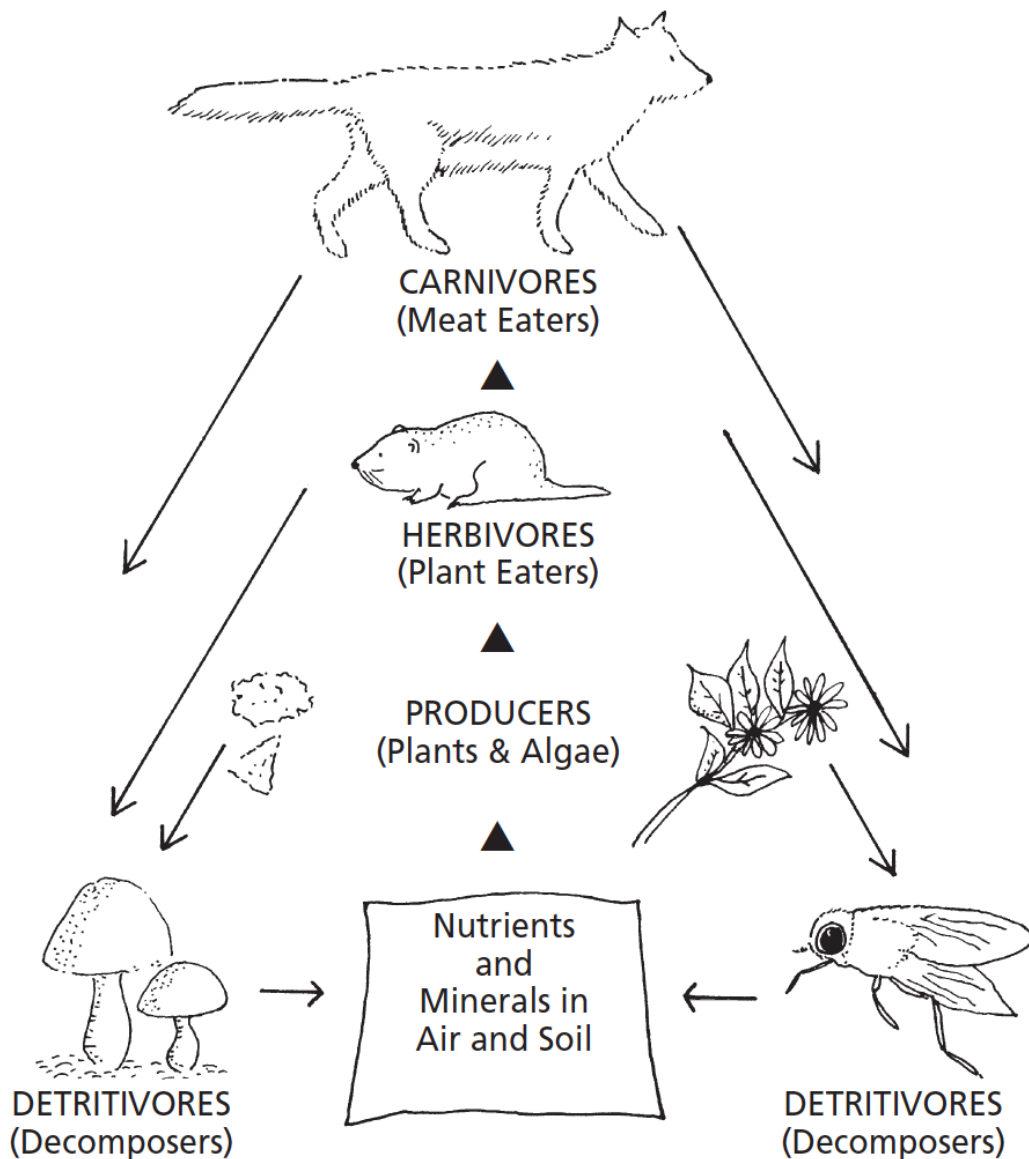


Herbivores Eat Producers

Herbivores are the next link in the food chain and come in all sizes. Moose, deer, and snowshoe hares receive all their nutrition from the stems, bark and leaves of plants. Caribou survive harsh winters by eating lichens. Red squirrels and pine grosbeaks prefer seeds.

Yet, these “common” wildlife examples are overwhelmed in number by the smallest herbivores – the millions of leaf-eating, wood-drilling, sapsucking, twig-boring insects and other often overlooked invertebrates. Each herbivore is adapted to eat specific kinds of plants and cannot live in an ecosystem or area where those plants are absent.

Food Web



Carnivores Eat Herbivores – and Each Other

In the next link in the food chain, the plant-eating herbivores become food for carnivores (flesh-eaters). Owls, spiders, centipedes, woodpeckers, foxes, and wolves are examples of carnivores. Another name for carnivore is **predator**, one that kills and eats other living things.

Carnivores do not limit themselves to dining on herbivores. All will eat each other if the opportunity arises. This represents a second carnivore link on longer food chains. Carnivores cannot survive without adequate populations of prey. So the numbers and kinds of herbivores in an ecosystem help to determine the presence and abundance of carnivores.



Opportunistic Omnivores

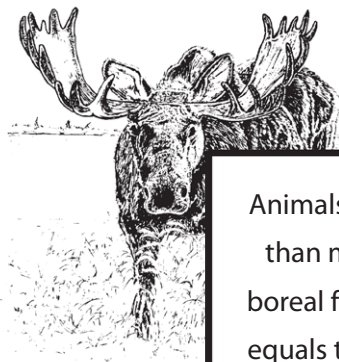
Food in an ecosystem can be scarce, especially for big eaters. Therefore, consumers that eat a variety of foods have a better chance of survival. Bears are good examples. They eat roots, grasses, herbs, and berries as well as small and large mammals, insects, fish, and carrion. With an omnivorous diet, bears are well-adapted to food is available. Chickadees and many other birds eat plant seeds as well as insects. Waterfowl young gain their initial growth from aquatic insects before turning to marsh vegetation later in the summer.

Mosquitoes are infamous for their abundance in Alaska. Both male and female mosquitoes sip plant nectar as herbivores, but the female is omnivorous. She needs a blood meal from a warm-blooded animal to produce the eggs she will lay on the surface of any nearby water.

Detritivores Reuse and Recycle

Last in a food chain – but certainly far from “least” – are detritivores, or decomposers. They obtain their energy by eating waste materials and dead organisms. They overshadow all other consumers in both number and variety.

Detritivores are a critical link in all ecosystems because they return all the minerals stored in the food chains to the soil for reuse by producers. Without detritivores, producers would soon run out of the minerals they need to make food, and an ecosystem would smother in tons of debris.



Bald eagles, crabs, ravens and other large creatures that **scavenge** dead animals are detritivores because they eat dead flesh. But the most important detritivores are tiny, extremely numerous – and ignored. These include animals that live in the soil, slime molds, many **fungi**, and hundreds of thousands of **microscopic organisms**.

Animals detritivores eat more plants than moose! In one square mile of boreal forest, the mass of detritivores equals the body weight of 43 moose.

ECOSYSTEMS - COMMUNITY CONNECTIONS

STUDENT INFORMATION SHEET

Six food chain examples for forest, tundra, wetland, and ocean are show in bold letters. Make food webs by using the other foods of each living thing (listed in small letters below its name) to find other interconnections.

	PRODUCER	HERBIVORE	CARNIVORE 1	CARNIVORE 2	DETRITIVORE
	1. White Spruce 2. Willow 3. Grass Seeds 4. Lingonberry 5. Fireweed 6. White Birch	Red Squirrel <i>berries, mushrooms</i> Snowshoe Hare <i>birch, grass, fireweed</i> Red-backed Vole <i>berries, fireweed</i> Pine Grosbeak <i>spruce and birch seeds</i> Moth <i>flies, beetles</i> Bark Beetles <i>spruce</i>	Marten <i>voles, bird eggs</i> Lynx <i>voles, squirrels</i> Boreal Owl <i>flycatcher, woodpecker</i> Goshawk <i>squirrel, flycatcher, woodpecker</i> Alder Flycatcher Downy Woodpecker <i>moth, berries</i>	Merlin <i>pine grosbeak</i>	Mushroom <i>any dead plant</i> Raven <i>any dead animal</i> Fly <i>any dead animal</i> Bacteria <i>any dead thing</i> Beetle <i>any dead animal</i> Shelf Fungus <i>any dead wood</i>
	1. Lichen 2. Dryas 3. Willow 4. Grass 5. Sunflower 6. Sedge 7. Blueberry	Caribou <i>dryas, willow, sedge, grass</i> <i>blueberry</i> Dall Sheep <i>willow, sunflower, sedge</i> Redpoll <i>willow, sunflower, sedge</i> Singing Vole <i>sedge, sunflower, dryas</i> Butterfly <i>blueberry, mountain avens</i> Marmot <i>grass, sunflower</i> Willow Ptarmigan <i>willow, sedge</i>	Brown Bear Wolf <i>caribou, marmot</i> Arctic Fox <i>singing vole, any dead animal</i> Short-tailed Weasel <i>redpoll</i> Golden Plover <i>fox, any dead animal</i> Wolverine <i>fox, any dead animal</i> Golden Eagle <i>marmot, weasel, sheep (lamb only)</i>	Jaeger <i>redpoll, vole</i>	Bacteria <i>any dead thing</i> Raven <i>any dead animal</i> Flies <i>any dead animal</i> Springtail <i>any dead wood</i> Bacteria <i>any dead thing</i> Mushroom <i>any dead plant</i> Fly <i>dead producers, protozoans</i>
	1. Algae 2. Pondweed 3. Algae 4. Sedges 5. Willow 6. Algae	Water Fleas <i>dead plants, protozoans</i> Pintail <i>algae, seeds of sedges</i> Midge <i>algae, dead plants</i> Muskrat <i>pondweed</i> Moose <i>willow, sedge</i> Mosquito larvae <i>protozoans</i>	Stickleback <i>midge, rotifer</i> Peregrine Falcon <i>phalarope</i> Wood frog <i>flies, mosquitoes</i> Mink <i>stickleback, phalarope</i> Wolf <i>muskrat, pintail</i> Red Phalarope <i>midge, water flea, rotifer</i>	Common Loon <i>frog</i> Sandhill Crane <i>stickleback, sedges</i> Parasitic Jaeger	Bacteria <i>any dead thing</i> Rotifer <i>dead producers, protozoans</i> Water Flea <i>any dead producer, rotifer</i> Bacteria <i>any dead thing</i> Flies <i>any dead animal</i> Protozoans <i>any dead material, algae</i>
	1. Green Algae 2. Kelp 3. Diatom (algae) 4. Sea Grass 5. Brown Algae 6. Red Algae	Sea Urchin <i>kelp</i> Snails <i>green algae</i> Amphipod <i>other algae, kelp</i> Brant <i>green algae</i> Copepods <i>other algae, sea grass</i> Euphausiids <i>other algae, diatoms</i>	Sea Otter <i>crab, sculpin, sea star</i> Sea Star <i>sea urchin, sea cucumber, shrimp</i> Sculpin <i>shrimp, sand lance</i> Bald Eagle <i>herring, guillemot, dead animals</i> Sand Lance, <i>amphipod, euphausiids</i> Herring <i>copepods, sand lance</i>	Sea Anemone <i>sand lance, snails</i> Pigeon Guillemot <i>sculpin, herring</i> Harbor Seal <i>sand lance, flatfish</i>	Tanner Crap <i>any dead animals</i> Flatfish <i>dead animals, snails, fish</i> Shrimp <i>any dead material</i> Marine Worm <i>any dead plant, algae</i> Sea Cucumber <i>any dead thing</i> Gull <i>any dead animal</i>

LIVING THINGS IN THEIR HABITATS

What is in your local ecosystem? There is no better way to know your environment than by going out and taking a close look. It can be the beginning of an *ecological study*.

Origins of “Ecology”

The term ecology was introduced in 1866 by a German biologist Ernst Heinrich Haeckel. It is derived from the Greek words for “household” and “economy” giving it a meaning close to the economy of nature.

Ecology is now defined as the study of relationships of organisms to other organisms and their physical environment. The science developed in part from Charles Darwin’s studies of adaptations of organisms to their environment and from plant geographers’ studies of world plant distribution.

Alaska’s earliest scientific study was conducted in 1741 by Georg Steller, the naturalist on Vitus Bering’s voyage. Steller was allowed less than a day ashore on Kayak Island east of Prince William Sound. In that time, however, he determined the land they saw was indeed North America – because he found a bird in the jay family he knew to exist only on this continent. (That bird is now known as the Steller’s jay.)

ECOLOGY TODAY: Modern ecologists are still asking questions about how each organism interacts with its fellow species, with other species, and with all the elements of its nonliving environment.

Support from Many Fields of Study. In the quest for answers, ecology draws on other sciences — geology, climatology, hydrology, oceanography, soil analysis, physics, and chemistry, biology, animal behavior, taxonomy, physiology, mathematics, — and many more.

Types of Ecosystems

Ecologists have identified hundreds of types of ecosystems in the United States and the world, defining many to very specific levels at specific locations. Each system is a collection of interdependent parts functioning as a unit.

Also Called Biomes. Often ecosystems are identified by their biomes – their living community of plants and associated animals. For use in this text, however, we use the concept of ecosystems in order to explore the nonliving components, the interactions, the energy flow, and the mineral cycling.

Alaska has four major ecosystem types: tundra, forests, wetlands, and ocean. Within each major category are further divisions:

TUNDRA: Alaska has both alpine or high elevation (mountain) tundra and arctic or (high latitude) tundra. Alpine tundra exists anywhere in the world there are mountains – even on the equator. Climate and other nonliving elements prevent the growth of trees. The name tundra came from the Finnish word meaning treeless.

Adapted for the Physical Environment. The plants and wildlife that do live in tundra ecosystems have adaptations to survive freezing temperatures, short summers, and slow mineral cycling. Rainfall is so low, tundra would qualify as a desert.

Some birds fly thousands of miles to partake in the tundra’s summer abundance of insect life. These birds and some of the mammals (such as caribou) then **migrate** elsewhere for the winter. Others find life under the snow a cozy way to survive harsh winters.

Where to Find More Information. The Alaska’s Tundra & Wildlife is a companion book in the Alaska Wildlife Curriculum series with detailed information and student activities using tundra environments to study ecology.

FORESTS: Alaska has two main forest ecosystems – boreal forest and temperate rainforest. The boreal forest reaches to the lower edge of the tundra and its organisms face some of the same rigorous climatic conditions.

Trees Protect their Environment. The temperate rainforest fringes the coastline. In keeping with its name, Some coastal rainforest areas collect more than 200 inches of rain. Forests protect our water table and our streams by preventing erosion. Trees also play a major role in the water cycle by returning water vapor to the atmosphere.

More than any other ecosystem, forests help to maintain the balance of oxygen and carbon dioxide in our atmosphere, keeping the air breathable for all living things.

Multiple Layers, Multiple Homes. With many layers – from sky-scraping tree tops to mossy ground cover, forest ecosystems provide homes to a variety of wildlife. The increased plant life supports greater populations of **herbivores** and they, in turn, support more **carnivores** than in tundra ecosystems. The **detritivores** are plentiful – and busy.

Alaska's Forests & Wildlife is a companion book in the *Alaska Wildlife Curriculum* series with detailed information and student activities using forest environments to study ecology.

WETLANDS: Wetland ecosystems are found within tundra and forest ecosystems and many others. Coastal wetlands types include estuaries, river deltas, and saltwater marshes. Inland wetlands include stream and river corridors, marshes, ponds, lake shores, bogs, muskegs.

What Makes It a Wetland? Three factors help to define what makes a wetland:

- (1) how much water is present (the water regime),
- (2) water-retaining soil,
- (3) plants adapted to growing in soils with low or no oxygen.

Alaska's wetland ecosystems are some of the most productive wildlife habitats. For example, many of our commercial fisheries depend on fish hatched in freshwater streams. Alaska's wetlands are also the primary nursery for much of our nation's waterfowl.

Large Food Base. Wetlands are so productive for the larger, more visible wildlife because this ecosystem includes an abundance of microscopic organisms and small invertebrates that serve as food for high level **consumers**.

Wetlands & Wildlife, K-12 Curriculum, is a good source of information and student activities about wetlands by the US Fish & Wildlife Service and the Alaska Department of Fish and Game.

OCEAN: With 34,000 miles of marine coastline, Alaska has all varieties of ocean ecosystems from tidal flats and lagoons to deep sea trenches and sea mount upwellings.

Zooplankton to Whales. The ocean ecosystems are highly productive despite Alaska's harsh climate. They support a food web that ranges from tiny zooplankton to humpback whales.

Millions of seabirds are a vital part of the ocean ecosystem. They spend nine months of the year at sea, coming to land only to nest. Salmon, herring, halibut, and pollock are some of the major fishes.

Calling all Ecologists. But Alaska's marine ecosystems have shown signs trouble. In some areas the once abundant Steller sea lion and sea otter have declined sharply, for reasons yet unclear. Ecologists have been called to discover the causes.

Sea Week Curriculum by the University of Alaska – Fairbanks is a good source of information and student activities about the ocean ecosystem. *Alaska Oil Spill Curriculum* published by the Prince William Sound Science Center is another source, as is *Learn About Seabirds*, by the U.S. Fish & Wildlife Service.

Home Sweet Habitat

Who lives in each ecosystem? Only the organisms that find suitable habitat (food, water, shelter, and space) within a particular ecosystem. (Some wildlife use multiple habitats, either daily, periodically, or seasonally.)

The Right Stuff. Sitka black-tailed deer cannot survive in the arctic tundra ecosystem even though there are food, water, shelter, and space – they are NOT *the right kind* of food, water, shelter, and space for a temperate rainforest mammal. The environment that meets all of the needs of an animal is called its habitat.

The habitat of the red squirrel, for example, is a spruce forest – a place where trees provide plentiful seeds to eat, hiding places to escape from predators, and nesting areas to raise young squirrels.

Different in Different Seasons. An animal's habitat requirements may be different at different seasons and times in its life. Here are two examples. A female polar bear will den (shelter) from November through April to give birth to cubs. After the cubs are old enough to emerge from the den, she will not use a den again until the next time she is pregnant.

A brown bear will dine hungrily on tender roots and sedges in spring when few other foods are available. When salmon swim into nearby streams from the ocean, the brown bear will walk past sedges to fish for the high protein salmon. In early fall, the bear will gorge itself on berries.

Where Do I Find It? The key to understanding habitat – and knowing where to find an animal – is to look at each animal's specific needs and where in nature those needs are met. The Alaska Ecology Cards available as part of this curriculum are handy references for habitat and food requirements of Alaska organisms from all five kingdoms.

Small is Interesting Too – Tips for Investigating

When Alaskans hear the word “animal,” we think about large furry **mammals** such as moose or bears. The investigations included in this section remind students to take a close look at all living organisms to discover the richness of the local ecosystem.

SOIL ANIMALS: There are many animals that live on and in the soil including **insect larvae**, snails, worms, spiders, and small mammals. These animals spend most of their life in the dark, living on other animals or nutrients found in the soil.

Many of the soil critters that students might find have special **adaptations** that allow them to thrive on or in the soil. While investigating the soil habitat, look for evidence left by soil animals, as well as for the animals themselves.

WATER ANIMALS: Not all water animals are fish, ducks, or sea otters. Ponds, streams, rivers, and other wetlands are rich with kinds of animal life that we seldom see.

Each spring as ice thaws, wet areas in Alaska erupt with young **invertebrates** (animals such as worms and insects that have no backbone). These invertebrates are extremely important food sources for many of the fish that other animals eat (including humans).

Don't Forget Mosquitoes! Many of the easily recognizable flying insects in Alaska such as mosquitoes and dragonflies lay their eggs in water. Larvae and pupae develop from these eggs and carry on complex predator – prey, and consumer – consumed relationships.

Investigating water habitats reveals usually hidden creatures that form essential links in the food chains of wetland ecosystems. A pond will never seem so ordinary again!

PLANTS: Within one calendar year **annual plants** grow from seeds or buried roots, flower, produce new seeds, and die. In fall and winter only remnants of annual plants such as dead leaves, tubers, seed pods, and roots are left as evidence of their presence. They are providing energy for the decomposers and detritivores.

While investigating the plants in your local ecosystem, look also for evidence of perennial plants such as fireweed, dwarf dogwood, and cow parsnip. Though their summer appearance is fleeting, plants are vital in the web of ecosystem interactions of living and nonliving things.