Exploring Ecosystems

N°. 24

INTERMEDIATE

Science | English/Language Arts

LESSON SUMMARY

Students will understand the interactions of plants, animals and fungi in a forest ecosystem and identify factors that affect the balance among the components of the ecosystem.

FORESTS ONTARIO

Focus on Forests

Activity Information

Estimated Duration: Three class periods (one for introduction and discussion; one for group work; one for student presentations)

Materials: Advertisements (magazines, newspapers), poster paper, paints, crayons, markers, scissors, glue (optional: tape recorder, video camera, digital camera)

Setting: Indoors

Key Vocabulary: Vertebrates, biotic, abiotic, ecosystem, producers, consumers, decomposers, food chains, food web, trophic level, herbivore, carnivore, omnivore, organism

Teacher Background

Imagine your perfect home. Would it be a log cabin in the woods? Would you prefer a cottage on a quiet lake or an apartment in a bustling city? What are the components of your perfect environment?

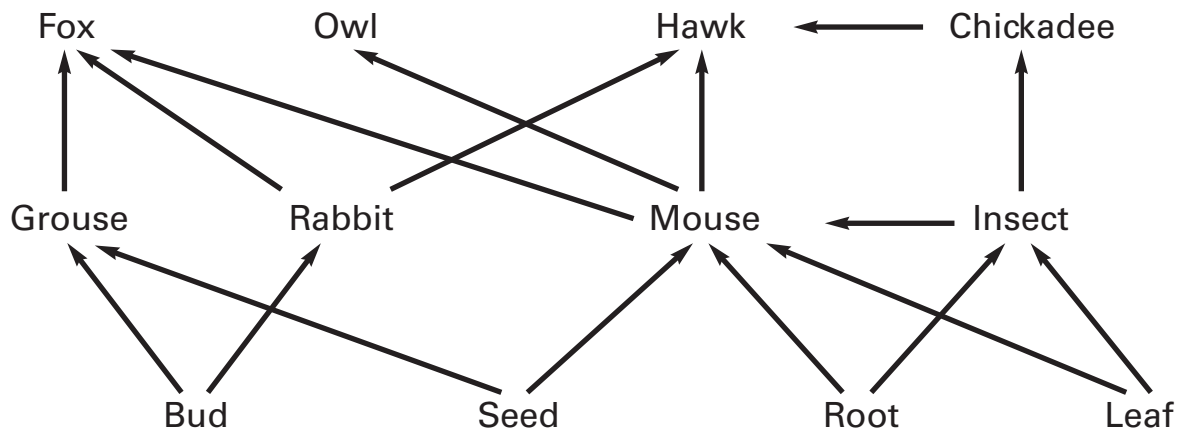
The environment is made up of both biotic (living) and abiotic (non-living) components that combine to make up an ecosystem. In every ecosystem, we find different combinations of factors that support life for different species.

All species require habitats, the places that provide the four essential elements for survival – food, water, shelter and space. A water beetle thrives in a pond or swamp because that is where all of its needs are met. A deer finds a forest environment ideal for providing protection, space and plentiful green food. However, if one or more habitat components is absent, species are often forced to migrate to another, more suitable area. Those not able to relocate may perish.

Most often, the habitats for several species overlap. Think about predator-prey relationships. As one species thrives in its ideal habitat, another species that preys on the first will include that area in its own habitat. Open fields and grasslands provide food, shelter and space to mice and other small animals (herbivores). Hawks (carnivores) that eat small birds and animals require those same grasslands and open fields as hunting grounds. This represents a very small food web.

Food webs and **food chains** portray the numerous interactions that occur between plants and animals in a forest community. The sequential dependence of plants and animals on each other for food makes up a **food chain** (e.g. the sun transfers energy in the form of light to green plants; the energy stored in green plants is transferred to plant-eating animals). When many different species of plants and animals are interdependent (e.g. many animals eating a number of different foods), we speak of a **food web** rather than a food chain. Nature works to keep a balance within the food web.

Food Web



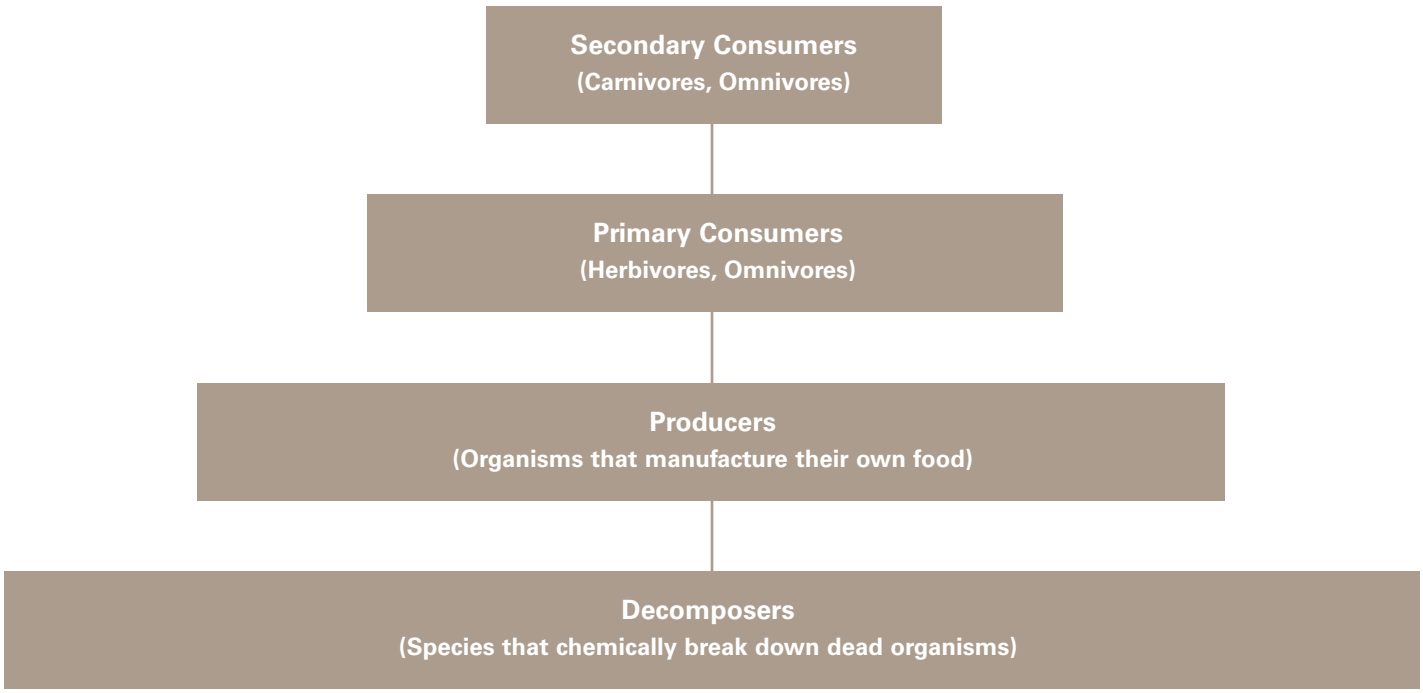
Habitats are sensitive to change. They can be altered by factors such as fire, weather change, parasites and human activity. Even the simple introduction of a new and invasive species to an area can cause irreversible harm, as it competes with native species for their habitat. Zebra mussels, purple loosestrife and Asian longhorn beetles are just three of the thousands of invasive species that have migrated to new habitats and changed them, to the detriment of the native species that rely on that area for survival.

Humans, as one of the most common species on the planet, are part of numerous ecosystems, influencing and changing the habitats of countless species. Effects on the environment can range from the obvious physical impacts of activities, such as road construction or mineral extraction, to the more subtle effects of air pollution. Recreational activities may lead to noise pollution, garbage and the disruption of wildlife travel corridors. Depending on the level and extent of various activities, the effects on the habitats of species and on the environment may be short or long term.

The following simple model is the "pyramid of biomass". Biomass is the weight of living matter. This pyramid quantifies all of the living biomass found in each "trophic level" – the group of organisms that occupy the same position in a food chain – including:

- Carnivores (a species that eats only meat, e.g. other animals)
- Herbivores (a species that eats only plants)
- Omnivores (a species that eats plants and meat)
- Producers (organisms that manufacture their own food, e.g. any of the plants that carry out photosynthesis)
- Decomposers (a species that chemically breaks down dead plants and animals, releasing important materials for use by other living things)

A simple version of a biomass pyramid looks like this:



In this activity your students will create a map of components of each trophic level. They will develop an appreciation of the complexity of ecosystems and examine and discuss the impact of human activities.

Teacher Background

Photocopy ***Ecosystem Base Map-Student Resource Sheet*** and ***Ecosystem Element List*** one set per student team. (Optional: create large hand-drawn map – see Part One.)

ACTIVITY - Part One

Step 1 Divide your class into teams of three to four students each. Each team will represent a working team of biologists who are trying to learn about the ecology of the area.

Step 2 Provide each group with the ***Ecosystem Base Map-Student Resource Sheet.***

Step 3 Explain to each team that it will need to look at the species on the ***Ecosystem Element List***. On its ***Ecosystem Base Map***, the team must find the most suitable habitat for each species. Review each of the headings on the ***Ecosystem Base Map*** and label the map, ensuring that the students understand the trophic levels as outlined in Teacher Background.

NOTE: The teams should select Team Leaders to present their final results to the class.

Step 4 Once the teams have completed their assignment, ask each team to explain where it has included two or more elements on its ***Ecosystem Base Map***. What is the team's rationale for the placement of its chosen species?

NOTE: Overhead acetate sheets or a large-hand drawn map would be useful for each Team Leader's presentation.

ACTIVITY - Part Two

Step 1 Assign each team one of the following activities:

- A wildlife management unit popular for hunting and trapping (Areas 1 and 2 on *Ecosystem Base Map*)
- A resort development on private land promoting skiing in the winter, remote hiking and fishing in the summer and hunting in the fall (Area 2 on the *Ecosystem Base Map*)
- A small sawmill operation producing pine lumber (Area 1 on the *Ecosystem Base Map*)
- A recreational fishing area, active in both summer and winter (Area 3 on the *Ecosystem Base Map*)

NOTE: Depending on the number of teams you have, more than one activity might be explored.

Step 2 Ask each team to discuss the following and prepare a brief report on their findings and conclusions:

- Potential impacts of the activity on their ecosystem (soil erosion, river siltation)
- Potential issues relating to the effects of the activity on the ecosystem (hunting pressure on wildlife populations, loss of habitat, waste disposal)
- How to mitigate these impacts to ensure the activity is sustainable

Evaluation

Ask the students to write a brief newspaper article for a local paper using the information they learned about the potential impacts and issues that might arise due to human activity. They should describe the forested area, talk about the anticipated human impact and explain how negative impacts could be alleviated or reduced.

Extensions

This involves studying and understanding the long term effects of major disturbances on an ecosystem. Student teams will prepare a report in the form of a television news commentary or an interview. Depending upon the scenario assigned, students can take on roles such as area foresters, biologists, fire specialists, fishery biologists, etc.

Ask each team to consider the effects of the following disturbance on their original ***Ecosystem Base Map*** and answer the associated questions:

A) A forest fire is caused by a careless camper.

i. What effect could the fire have on the ecosystem? (Consider both positive and negative impacts.)

ii. Considering the negative impacts, could the organisms in your ecosystem recover from this disturbance?

iii. How long might it take for the original ecosystem to re-establish itself in this area?

B) An angler spills a bucket of minnows into the lake and releases a non-native fish species into the system.

i. What immediate effect might this disturbance have on the aquatic ecosystem?

ii. Predict the effects of this disturbance on the aquatic community after ten years; include the shoreline area in your discussions.

iii. Should any actions be taken to recover the original lake ecosystem? If so, what actions?

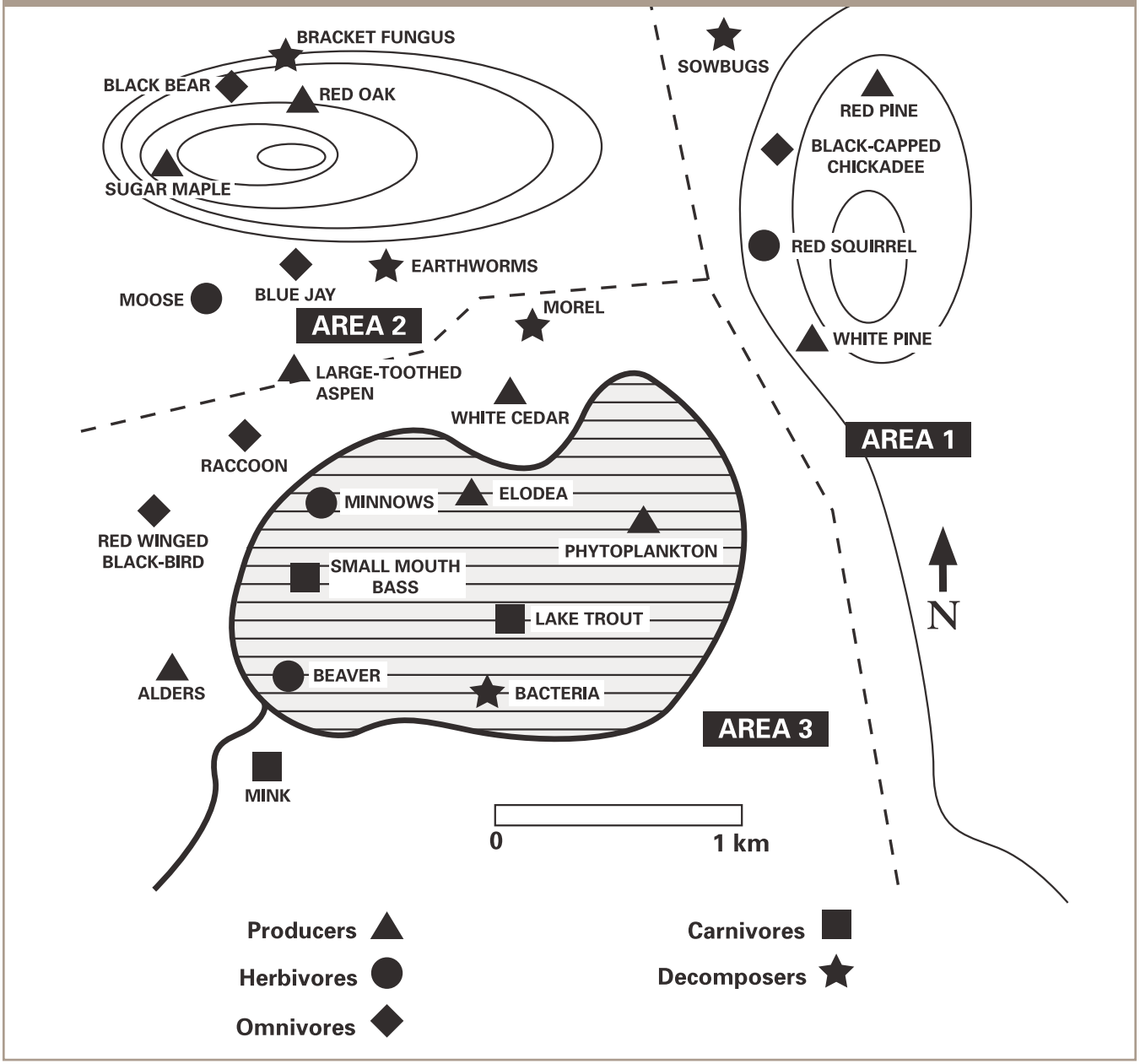
C) A private landowner plants an entire woodlot with elm trees only. A few years later, Dutch elm disease breaks out and spreads to the rest of the forest.

i. What could have been done to prevent this outbreak of the disease?

ii. What can be done to fix the problem now?

iii. What other general problems are there with planting non-native species or planting all of one species and limiting biodiversity?

ECOSYSTEM BASE MAP
Teacher Resource Sheet

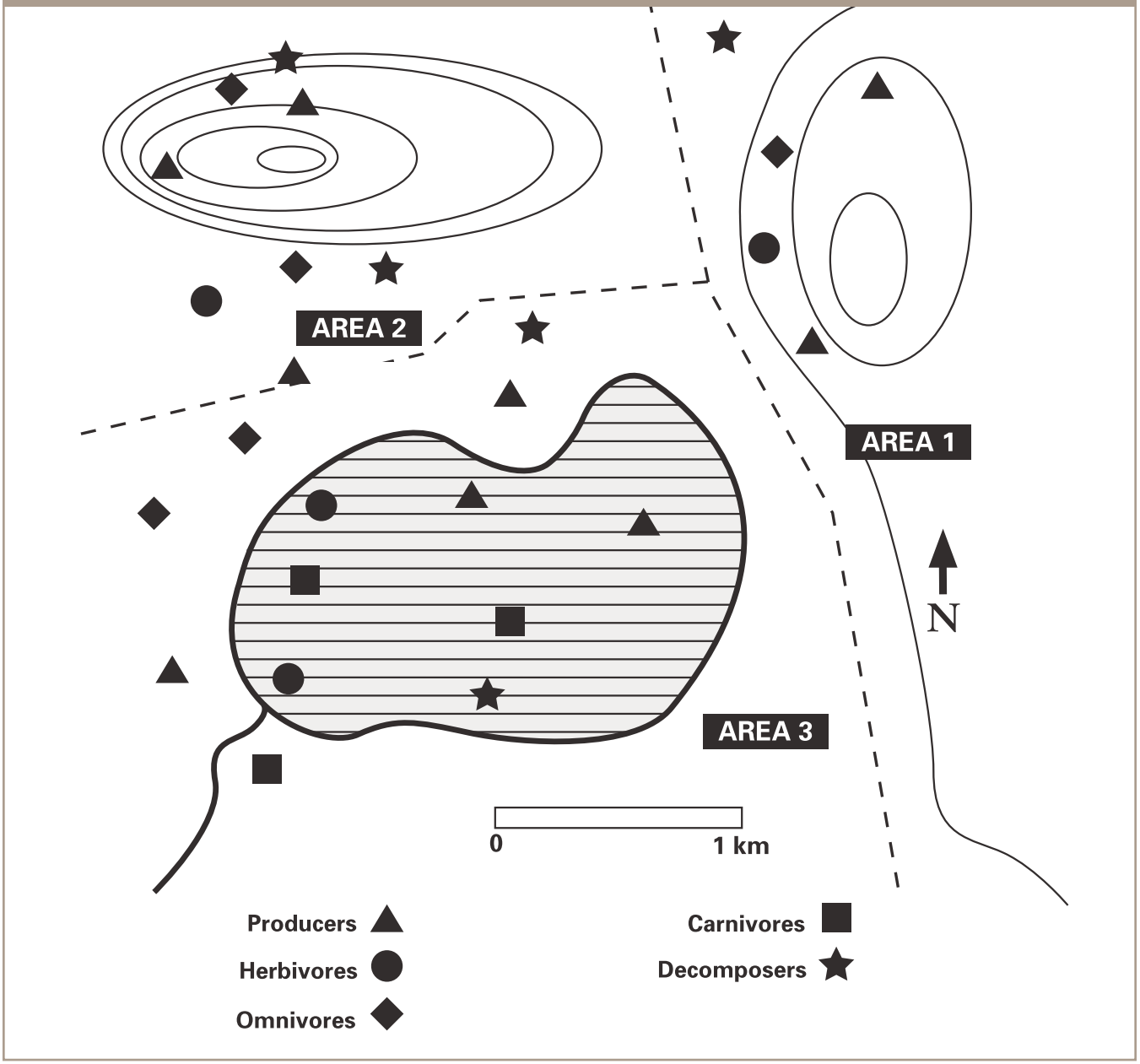


Area 1 is an area of raised flat ground with well-drained sandy soil sloping gradually to the southwest.

Area 2 is a hilly area with moderately moist well-drained soil with rocky outcrops.

Area 3 is a lake environment consisting of a shallow, marshy section at the northern end of the lake, a rocky shoreline to the south and a single outflow at the southwest corner.

ECOSYSTEM BASE MAP
Student Resource Sheet



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ECOSYSTEM ELEMENT LIST
Student Resource Sheet

Trophic Level	Organism	Life Requirements
Producers (green plants that assimilate light's energy to synthesize organic compounds)	Phytoplankton	in photozone of lake; microscopicsubmergent plant; in shallow bays, still water
	Elodea	wet environments, at water's edge; low-growing shrub
	Alder	grows best in rich, well-drained soils; shade tolerant
	Large-toothed Aspen	grows best in well-established, deeper soils, with moderate amount of moisture; shade tolerant
	Sugar Maple	grows best in moderate sunlight/soil conditions, on gentle slopes, along with other coniferous trees
	White Pine	sandy soil; grows in association with White Pine, but on higher, well-drained sites; shade tolerant
	Red Pine	low-lying areas; requires damp environments
	Red Oak	high hills; minimal competition with other plant species; tolerates moderate sun and dry, thin soils
Herbivores (organisms that mostly eat living plants or their parts	Minnows (some species)	in shallow water environments found along shorelines, in association with aquatic plants
	Beaver	establishes dams at watercourse outlets; feeds on vegetation, particularly Aspen and aquatics
	Moose	lives in mixed wood forests; feeds on broadleaf trees, shrubs and aquatic vegetation
	Red Squirrel	prefers softwoods for cavity nesting; seed and cone eater

ECOSYSTEM ELEMENT LIST
Student Resource Sheet

Trophic Level	Organism	Life Requirements
Carnivores (organisms that mostly eat animal flesh)	Lake Trout	prefers deep, cold water; feeds on other fish
	Smallmouth Bass	rocky shorelines; feeds on smaller fish and crayfish
	Mink	lives close to water's edge; feeds on clams and crayfish
	Great Blue Heron	shorelines; eats small fish and amphibians; prefers areas of still water, such as marshes
Omnivores (organisms whose diet is broad and includes both plant and animal foods)	Wolf	mixed forest environment; feeds on beaver and moose
	Black-capped Chickadee	nests in tree cavities; feeds on seeds, insects
	Blue Jay	prefers mature mixed forest environments; feeds on seeds, insects
	Red-winged Blackbird	lives in marshy areas; feeds on seeds and insects
	Black Bear	lives in mixed forests; feeds on nuts, berries, fungi, insects, grubs, fish and rodents
	Raccoon	lives close to water; feeds on berries, minnows, crayfish
Decomposers (organisms which break down dead plant or animal material into basic elements)	Sowbug	feeds on rotting wood, leaves, etc.
	Earthworm	lives in rich soils that are high in organic matter
	Morel (fungus)	lives on forest floor; requires organic matter and water
	Bracket Fungus	grows on decaying trees
	Bacteria	grows in association with decaying matter, in both aquatic and terrestrial environments