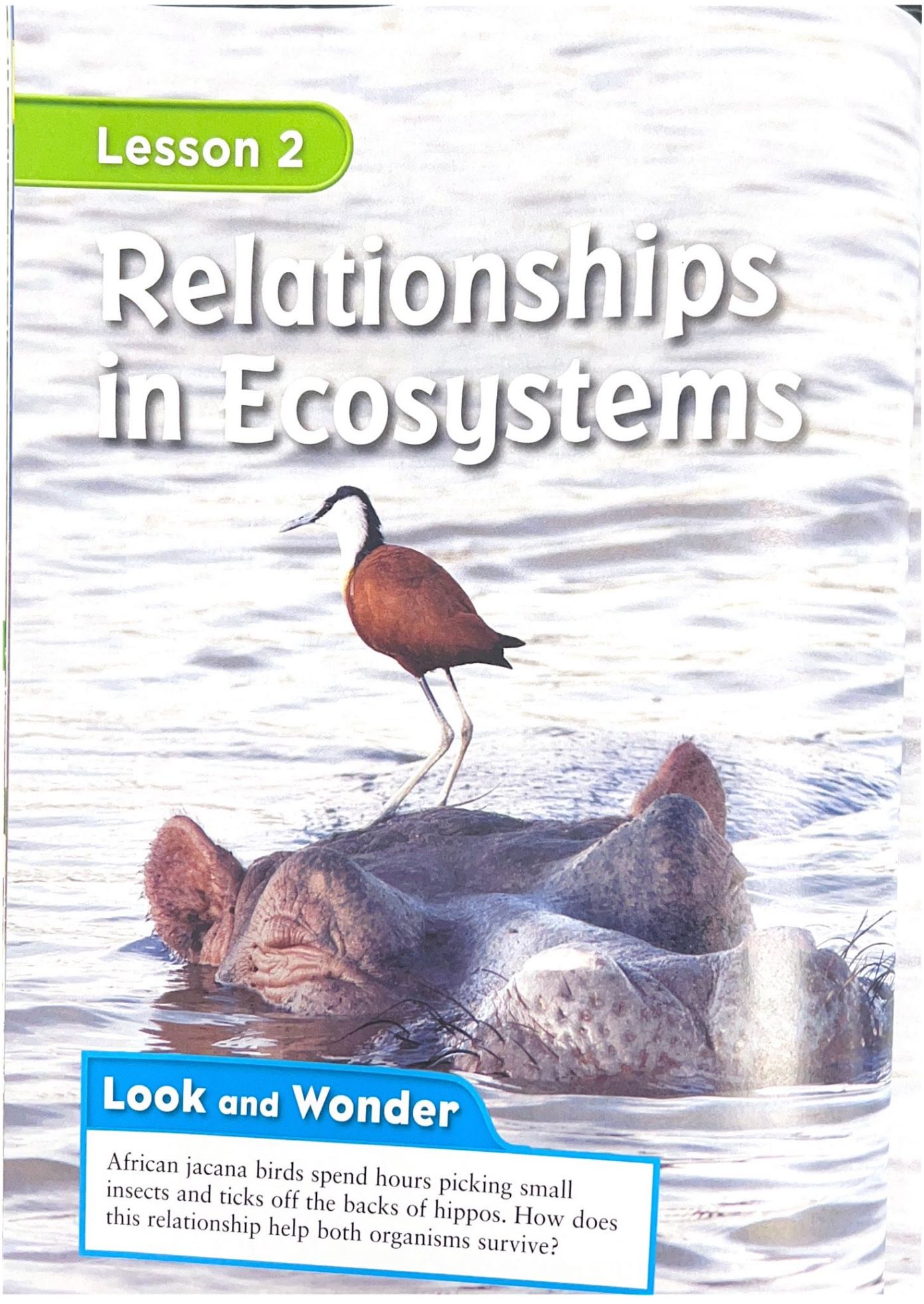
Lesson 2

Relationships in Ecosystems



Look and Wonder

African jacana birds spend hours picking small insects and ticks off the backs of hippos. How does this relationship help both organisms survive?

Explore

Inquiry Activity

What do organisms need to survive?

Make a Prediction

What do organisms need to survive? Do organisms in an aquatic environment need different things than organisms in land environments? Make a prediction.

Test Your Prediction

1. Make a water environment. Place gravel in one container. Fill the container with pond water. Add water plants and snails.
2. Make a land environment. Place gravel in the other container and cover it with a layer of soil. Add grass seeds and earthworms and cover them with additional soil. Water the seeds.
3. Cover each container with a lid. Place the containers in a well-lit place out of direct sunlight.
4. **Observe** Examine your containers for changes every day for a week. Do the organisms in each environment interact? Record your observations.

Draw Conclusions

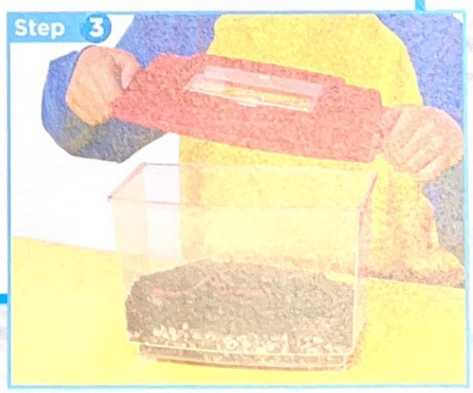
5. What are the abiotic and biotic parts of water and land environments?
6. **Infer** How do the plants help the animals survive in the water environment? The land environment?
7. What would happen to each environment if the plants or animals were removed?

Explore More

What other factors affect an organism's survival? Try adding more plants or animals to your environments. Try placing your environments in the dark for a few days. How do the environments change?

Materials

- gravel
- 2 containers with lids
- pond water
- water plants
- water snails
- soil
- grass seed
- earthworms



Read and Learn

Main Idea

Abiotic factors and interactions between organisms control the size of populations in a community.

Vocabulary

limiting factor, p.156
carrying capacity, p.157
habitat, p.158
niche, p.158
symbiosis, p.160
mutualism, p.160
commensalism, p.161
parasitism, p.162

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Reading Skill

Infer

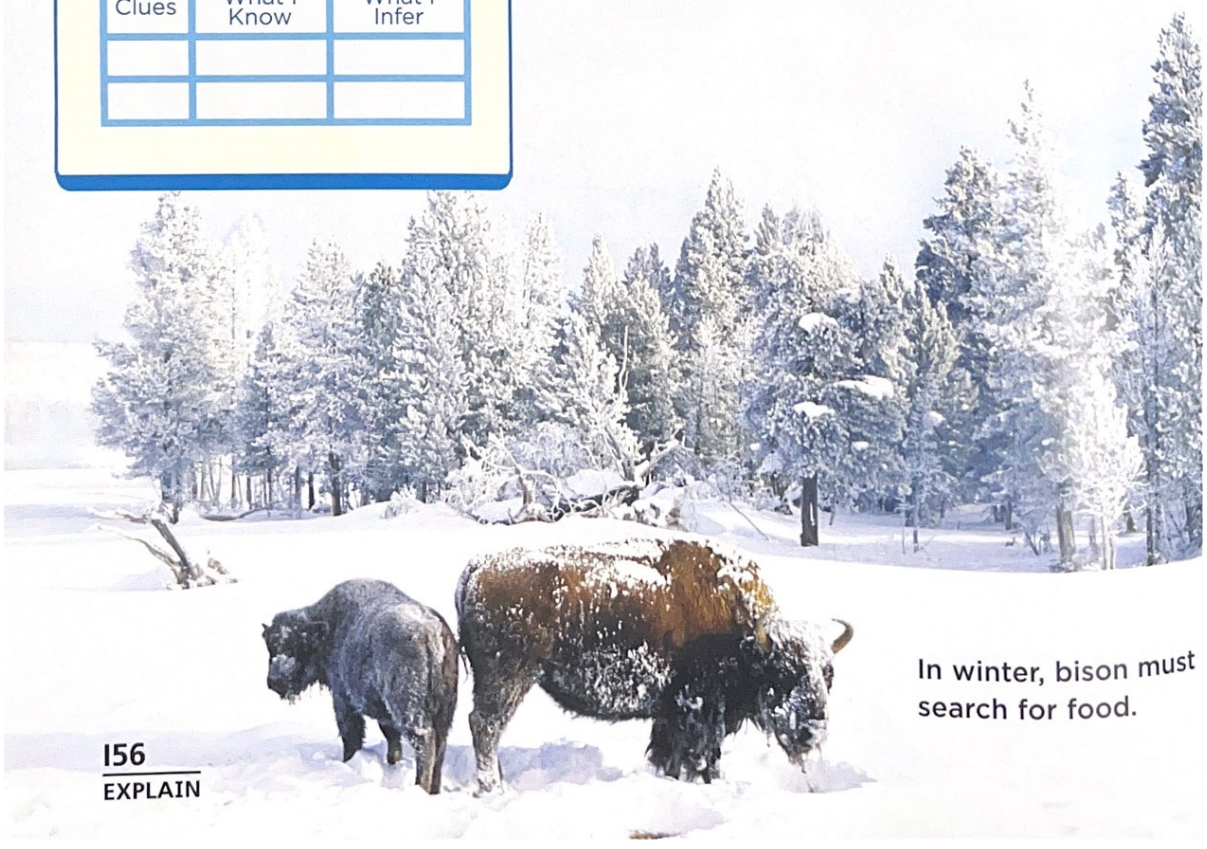
Clues	What I Know	What I Infer

Why do organisms compete?

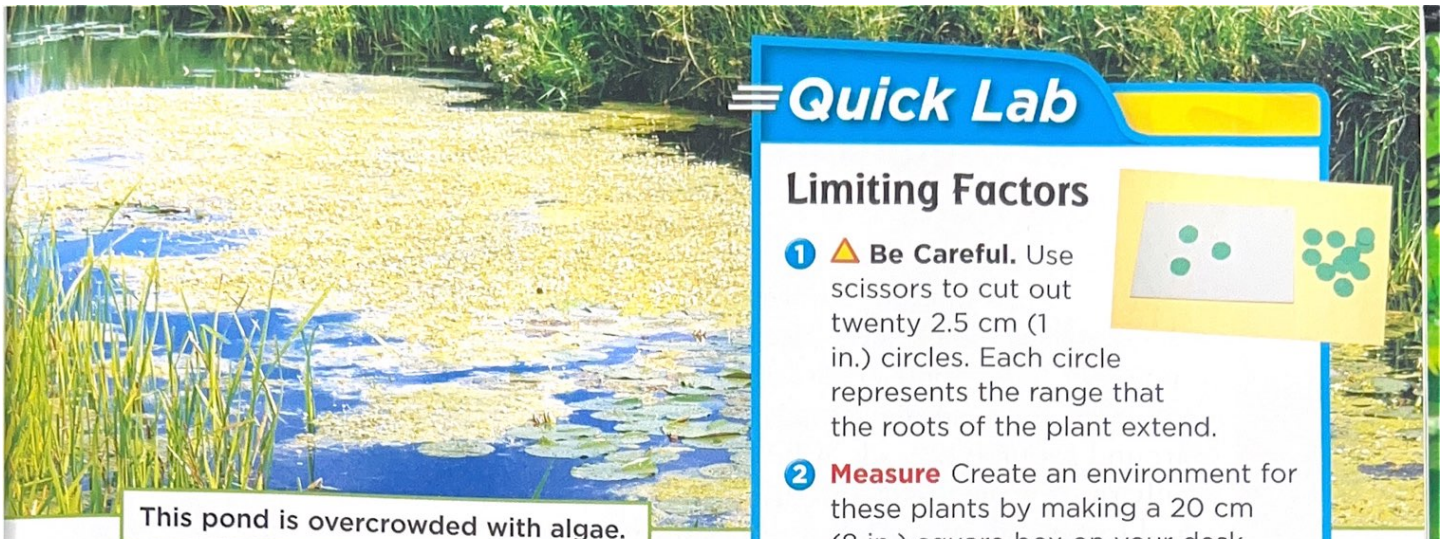
Life in an ecosystem is a constant struggle. Food, water, space, and other resources are restricted. Organisms struggle to get their share each resource. This fight for limited resources is called *competition*.

Who competes in an ecosystem? Organisms within a population compete with one another. fox must compete with other foxes to catch rab Populations also compete. Foxes and hawks, fo example, both eat rabbits. Since there is a limit number of rabbits, the two predator populatio compete for food. The rabbits must also compe with other herbivore populations for their food

Ultimately, the survival of populations com down to resources. A **limiting factor** (LIM•i•ting FAK•tuhr) is any resource that restricts the grov of populations. A forest, for example, gets mo rainfall and is much warmer in summer than w In summer, the forest can support many more populations than in winter. In this case, rainfa temperature are limiting factors. Common abi limiting factors include water, temperature, w soil type, space to grow, shelter, and sunlight.



In winter, bison must search for food.



This pond is overcrowded with algae.

Quick Lab

Limiting Factors

1. ⚠ **Be Careful.** Use scissors to cut out twenty 2.5 cm (1 in.) circles. Each circle represents the range that the roots of the plant extend.
2. **Measure** Create an environment for these plants by making a 20 cm (8 in.) square box on your desk.
3. Toss 8 plants into the environment. If a plant does not touch another plant, it "survives." If the plant touches another plant, remove the plant and any plant that it touches. Record your results in a data table.
4. Increase the number of plants that you toss to 10, 12, 14, and so on. Record your results. Which number of plants tossed allows the most plants to survive?
5. **Infer** How can crowding be a limiting factor for a population?

Biotic factors can also limit ecosystems. A prairie ecosystem has more producers than a desert ecosystem. As a result, the prairie can support more herbivores, which support more carnivores. In this case, the amount of available food is the biotic limiting factor for the desert ecosystem. With more available food, the prairie ecosystem can support more populations.

Together, biotic and abiotic factors determine the carrying capacity (KAR•ee•ing kuh•PAS•i•tee) for each population. The **carrying capacity** is the greatest number of individuals within a population that an ecosystem can support. For example, a rain forest can support a certain number of jaguars. If the jaguar population starts to rise, food becomes harder to find. Soon, some of the jaguars die and the population returns to its former level.

Overcrowding also limits growth. An algae population in a nutrient-rich pond may seem like it can grow indefinitely. But the algae will eventually get so thick that they start to use up the oxygen in the pond. Without enough oxygen for respiration, the algae and other organisms begin to die off.

Quick Check

Infer Compared to the surface, the bottom of the ocean is dark and has very few organisms. What might be a limiting factor in this ecosystem?

Critical Thinking Why is a sudden increase in a predator population usually temporary?

FACT Populations cannot grow indefinitely.

How do organisms avoid competition?

An organism avoids competition by having a specific territory and a unique role within its ecosystem. A **habitat** (HAB•i•tat) is the physical place where an organism lives and hunts for food. Some creatures have very small habitats. Pill bugs, for example, spend most of their time under and around a stump or rock. A bee's habitat is larger. It is not only the hive where the bee lives. It also includes the fields and forests where the bee searches for flowers.

A **niche** (nich) is the special role that an organism plays in a community. For example, two birds might live in the same location and eat the same food. But one bird is active at night while the other is active during the day. Therefore, the two birds occupy different niches.

In a similar way, two birds might share the same rain-forest habitat but eat different foods. One bird eats plants while the other eats insects. The two birds occupy two different niches in the community. For example, honeycreepers are a group of related birds found on the islands of Hawaii. These birds all share the same habitat, but are able to avoid competing with each other by eating different foods.

The **akiapolaau** removes insects from beneath tree bark.

The **iiwi** sips nectar from l tube-shaped flowers.

Hawaiian Honeycreepers

The **Maui parrotbill** finds insects and grubs by crushing twigs.

The **Maui creeper** eats insects and grubs it finds on the leaves, branches, and bark of trees.

The **apapane** sips nectar from flowers high in the tree tops of the rain forest.

Read a Photo

Why does each honeycreeper have a uniquely shaped beak?

Clue: Compare the beak shapes with the methods for finding food. How would certain beaks help honeycreepers to obtain different foods?

Quick Check

Infer Two populations share the same food and habitat. What key difference could cause them to occupy different niches?

Critical Thinking What might happen to organisms when their habitats are destroyed?

How do organisms benefit from interactions?

Living things in an ecosystem depend on one another. For example, all animals in an ecosystem depend on plants and other producers for food. Plants depend on animals for carbon dioxide. These interlocking relationships are examples of interdependence. *Interdependence* is the reliance of organisms on other organisms for their survival. Some forms of interdependence are linked more closely than others. **Symbiosis** (sim•bye•OH•sis) is a relationship between two or more kinds of organisms that lasts over time.

These ants are defending an acacia tree from other insects.

Mutualism

A symbiotic relationship that benefits both organisms is called **mutualism** (MYEW•chew•uh•liz•uhm). A pollinator and a flowering plant provide an example of mutualism. The pollinator, usually an insect or bird, gets sweet nectar from the flower. The plant gets its pollen transported to the pistil of another flower. Both organisms gain from the relationship.

A fascinating example of mutualism is seen in the relationship between ants and acacia trees. The tree provides a home and food for the ants. The ants in turn defend the tree against other insect pests. How successful is this relationship? Scientists used chemicals to get rid of the ants on an acacia. Without its ants, the tree soon died!

Another example of mutualism can be seen in lichens. A *lichen* is actually two different organisms—a fungus and an alga—that live together. The fungus provides the alga with a home and nutrients. As a result, the alga does not dry out. The alga, in turn, provides the fungus with food and oxygen.

British soldier liche

Ray and Remora

Read a Photo

What advantage might remoras get by attaching themselves to a ray's body?

Clue: Remoras do not get any nutrition from the ray itself.

Commensalism

Remora are fish that attach themselves to the bodies of rays and sharks. The remora gets food scraps, transportation, and protection from the ray. What does the ray get from the remora? While the remora does not hurt the ray in any way, it does not help the ray either. A symbiotic relationship that benefits one organism without harming the other is called **commensalism** (kuh•MEN•suh•liz•uhm).

Other examples of commensalism include the growth of orchids on trees in the rain forest. Rather than root in the ground, orchids anchor themselves high in a tree. This situation helps the orchid. It does not hurt the tree, so it is an example of commensalism. Barnacles growing on the backs of whales are also commensal. The barnacles gain a home. The whales are not hurt by the barnacles.

Sometimes it is difficult to tell whether a relationship between organisms really is an example of commensalism. The clownfish, for example, lives among the tentacles of the sea anemone. It uses the anemone for protection. When chased by predators, the clownfish retreats to the anemone's tentacles. In this relationship, the clownfish is clearly helped by the anemone. However, it is hard to tell whether the anemone gains from the clownfish. Most scientists think that the relationship is an example of commensalism.

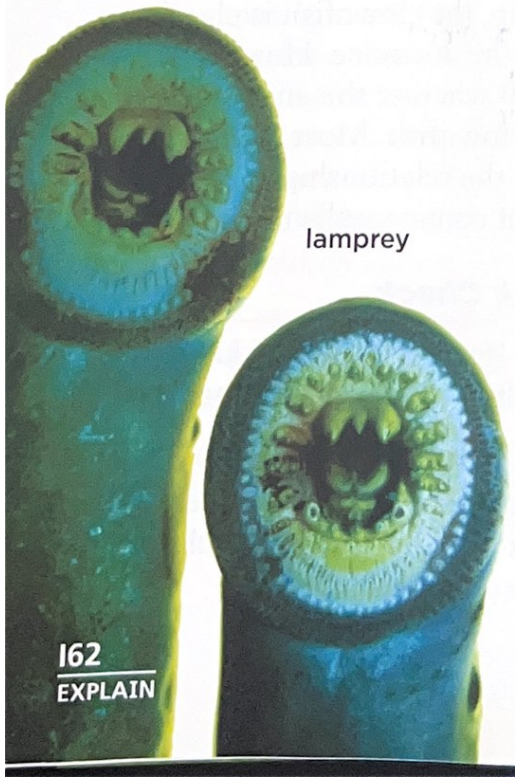
Quick Check

Infer How do algae and fungi benefit from living as a lichen?

Critical Thinking Oxpecker birds eat pests that bother rhinoceroses. Is this an example of mutualism or commensalism? Why?

▲ A magnified view of a wood tick on human skin.

▲ A magnified view of a tapeworm.



lamprey

What are parasites?

Some partnerships are harmful for individuals in the relationship. **Parasitism** (PAR•uh•sye•tiz•uhm) is a symbiotic relationship where one organism benefits and the other is harmed. A *parasite* lives in or on a host organism and benefits from the relationship. For example, ticks are parasites on dogs and other animals. Ticks use their host's body for a home and a food source. A tick attaches itself to a host and harms the host by taking in the host's blood. The tick's host gets no benefit from the relationship.

Some parasites are very harmful for the host organism. Millions of people around the world have parasites called tapeworms. These worms live inside a person's intestinal tract. Tapeworms more than 70 centimeters (2 feet) in length have been found in humans. Tapeworms can harm their hosts by causing fevers and digestive problems. Another dangerous parasite is a lamprey. Lampreys are parasitic fish. They use their suckerlike mouth to attach themselves to other fish. They harm their host by sucking out its blood and other body fluids.

Some parasites are protists, including the species of amoeba that causes a disease called *dysentery* (DIS•uhn•ter•ee). Dysentery amoebas enter the host's body through contaminated food or water. The protist that causes sleeping sickness in Africa lives in the bodies of cows and other large animals. When these animals are bitten by flies, the flies transfer the protist to humans, causing the disease.

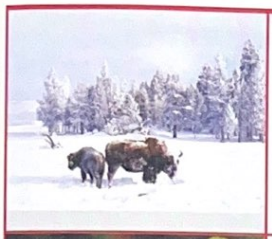
Quick Check

Infer Why do parasites often harm, but no kill, their hosts?

Critical Thinking How is a parasitic relationship like a predator-prey relationsh

Lesson Review

Visual Summary



Competition and **limiting factors** control the size of populations in an ecosystem.

Organisms avoid competition by occupying different **niches** and **habitats**.

Mutualism, commensalism, and parasitism are examples of **symbiosis**.

Make a FOLDABLES™ Study Guide

Make a Three-Tab Book. Use the titles shown. Tell about the topics on the inside of each tab.

Think, Talk, and Write

1. **Main Idea** How can biotic and abiotic factors affect the size of a population?

2. **Vocabulary** The role of an organism in the community is its _____.

3. **Infer** A predator population suddenly decreases even though the prey stays the same. Besides disease, what could explain this change?

Clues	What I Know	What I Infer

4. **Critical Thinking** How do humans change the abiotic factors in their habitat? Explain.

5. **Test Prep** **Which of the following determines the carrying capacity of a population in an ecosystem?**
   - **A** plants and animals
   - **B** abiotic limiting factors
   - **C** biotic limiting factors
   - **D** abiotic and biotic limiting factors

6. **Test Prep** **Which term represents all living things in an ecosystem?**
   - **A** a community
   - **B** a population
   - **C** a limiting factor
   - **D** a habitat

Writing Link

Personal Narrative

What niche do you occupy? Write a personal narrative that tells about your unique "niche."

Math Link

Determine Area

Suppose a wolf's habitat is a rectangle that measures 4.5 km on one side and 6.4 km on the other side. What is the area of this habitat?