FOCUS ON SCIENCE

Symbiosis and Biodiversity

Advanced Level

Life Science
Animals and Plants in Their Environment

FOCUScurriculum

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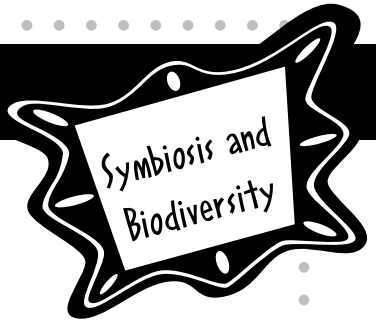


Scientific Inquiry

The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.

Design charts, tables, graphs, and other representations of observations in conventional and creative ways to help them address their research question or hypothesis.

Organize results, using appropriate graphs, diagrams, data tables, and other models to show relationships.

Interpret the organized data to answer the research question or hypothesis and to gain insight into the problem.

Formulate and defend explanations and conclusions as they relate to scientific phenomena.

Form and defend a logical argument about cause-and-effect relationships in an investigation.

Make predictions based on experimental data.

Life Science

Individual organisms and species change over time.

Human decisions and activities have had a profound impact on the physical and living environment.

A population consists of all individuals of a species that are found together at a given place and time. Populations living in one place form a community. The community and the physical factors with which it interacts compose an ecosystem.

Given adequate resources and no disease or predators, populations (including humans) increase. Lack of resources, habitat destruction, and other factors such as predation and climate limit the growth of certain populations in the ecosystem.

In all environments, organisms interact with one another in many ways. Relationships among organisms may be competitive, harmful, or beneficial. Some species have adapted to be dependent upon each other with the result that neither could survive without the other.

Some microorganisms are essential to the survival of other living things.

The environment may contain dangerous levels of substances (pollutants) that are harmful to organisms. Therefore, the good health of environments and individuals requires the monitoring of soil, air, and water, and taking steps to keep them safe.

English Language Arts

The following is a selective listing of the competencies and indicators addressed in this book.

Literacy Competencies

Word Recognition

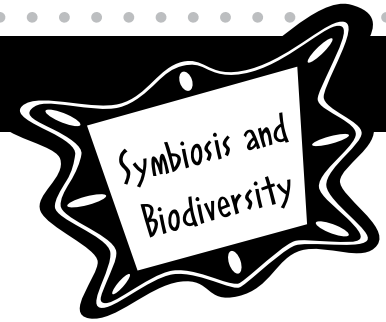
- Use word recognition skills and strategies quickly, accurately, and automatically when decoding unfamiliar words

Background Knowledge and Vocabulary Development

- Extend knowledge of word meaning through direct and indirect means

Comprehension Strategies

- Read grade-level texts and answer literal, inferential, analytic, and evaluative questions



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How to Help Your Students Make the Best Use of This Book

Encourage students to develop nonfiction literacy skills by using the Active Reader questions and activities. Also suggest that they . . .

- Underline main ideas in paragraphs.
- Circle details that support the main ideas.
- Write down questions as they read.
- Circle key words as well as unfamiliar words.

Printing Instructions

Student Book: print pages 5–32
Assessments: print pages 33–36
Answer Key: print pages 37–40

FOCUS ON SCIENCE

Symbiosis and Biodiversity

How does the transfer of matter and energy through biological communities support diversity of living things?

Every ecosystem is home to a large community of organisms. Living things in an ecosystem are continually interacting with each other, as well as with their non-living environment, such as the atmosphere. The study of these interactions is called *ecology*, and scientists who study them are called *ecologists*.

Look at the picture showing birds on a hippopotamus. How are these living things interacting with each other? Do each they benefit from each other? Read on to learn more about how living things interact with each other and their environment.

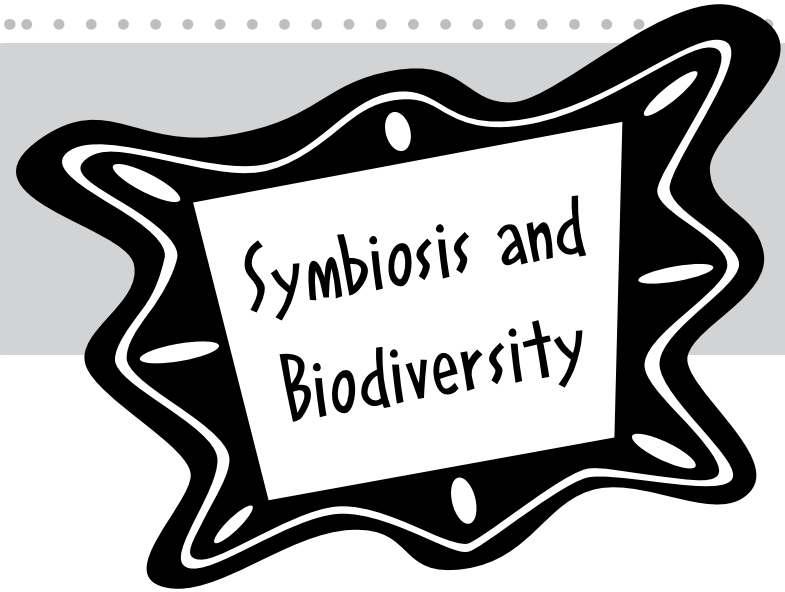


Table of Contents

Starting Points

Build Background

Use Your Knowledge

Throughout the day, as you work and play, you use energy. Where does your energy come from? What helps you keep going all day long? Write a sentence telling where you think your energy comes from.

Label It

Here are three groups of words that have to do with ecosystems. Add a word to each list. Then, write a label in the gray box that describes the words in the list.

①	②	③
trees	convert	leaves
mammals	transfer	roots
bacteria	adapt	seeds

Hands On Science

Investigate a Micro-habitat

An ecosystem is like a city because it consists of interconnected neighborhoods. The neighborhoods within an ecosystem are called habitats. A micro-habitat is a small area within a habitat, such as the banks of a pond or the shady area beneath trees. In this activity you will investigate a micro-habitat in a park, at school, or in your own backyard.

1. **Mark out a square area of ground about 3 feet on each side.**
2. **Closely examine everything within your chosen area. What kinds of living things do you find? What non-living things do you find? Use a magnifying glass and/or a trowel to search for everything that is there.**
3. **Record your observations in the chart on the next page. List what you find. If you find insects, for example, tell what kind and how many there are. Write down questions you have about your observations for further research.**
4. **If the area is covered with grass, use a shovel to carefully cut and lift off sections of sod so that you can replace them later. Dig carefully into the soil. Describe the soil. Is it wet or sandy? List safety precautions you and others should follow.**

Micro-habitat Questions and Observations

	Living Things	Non-living Things	Soil Characteristics
At the Surface			
Below the Surface			

Starting Points

Key Vocabulary

Rate Your Knowledge

The words below have to do with ecosystems. Each is important to know, but some may be new to you. Read each word. Rate your knowledge of each by putting a check or a few words in the appropriate column.

	I don't know it.	I've seen it, and I think it means . . .	I know it well. It means . . .
organism			
germinate			
producer			
consumer			
decomposer			
photosynthesis			
carnivore			
omnivore			
herbivore			
symbiosis			
commensalism			
parasitism			

Use Roots to Unlock Meaning

Knowing Greek and Latin roots can help you unlock the meanings of many science terms. Read the prefixes and roots below. Write a word from the chart above that contains the roots and a definition to show what you think it means.

1. ***photo*** (Greek root meaning "light") plus ***syn*** (Greek prefix meaning "together")

   word: _____

   definition: _____

2. ***carn*** (Latin root meaning "flesh") plus ***vorare*** (Latin root meaning "to gobble up")

   word: _____

   definition: _____

Key Concepts

What Organisms Need

Organisms are living, or biotic, resources. Bacteria, fungi, plants, and animals are organisms. You are an organism, too. Organisms need both living and non-living resources in order to survive and reproduce. Living resources include plants and animals, such as grasses and birds, that provide energy in the form of food. Non-living, or abiotic, resources include things in the environment that keep organisms alive and healthy, such as air and water.

What living and nonliving resources do you rely on every day? Complete the following chart. In constructing your list, think about the food you eat, the clothes you wear, and how you stay warm.

Resources I Rely On to Survive	
Living Resources	Non-living Resources

Plants have their own survival needs. Complete the following chart by listing the resources that are essential for plants to survive. Consider where plants get their energy, how they produce food, what they need in order to grow, and how they reproduce.

Resources Plants Rely On to Survive		
for Energy	for Growth	for Reproduction

ACTIVE READER

1 Define *Explain biotic resources and abiotic resources. Give an example of each type.*

_____

_____

_____

_____

_____

_____

Good to Know

In addition to food, clothing, and shelter, animals also need relationships with others in order to survive. Many newborns, for example, cannot thrive and grow without the help of adults. Some plants cannot reproduce without the help of birds and insects. Most populations of organisms, plants and animals included, have developed relationships with other organisms.

Chapter 1 How Organisms Interact

FOCUS

The underlined sentences state important ideas about how organisms interact. As you read, find out what types of organisms compete and what they compete for.

Competition

Organisms living together in an ecosystem have many different ways of relating to each other. Sometimes organisms compete for such essentials as water, food, space, and sunlight. Other times they cooperate in ways that benefit one or both of them.

Plants Compete

Plants compete for resources. For example, green plants in a forest compete for available sunlight. They cannot survive for very long without sunlight and they become unhealthy without proper minerals and water. When plants grow close together, the tallest plants will receive the most sunlight. The smaller plants receive less sunlight because the taller plants shade them from the sun's rays.

Ecologists say that nearly all of the plants in the forest are in competition with each other; they are struggling to get adequate sunlight. In a dense forest, many seedlings that **germinate**, or sprout, in the spring may not survive the winter because they do not receive enough sunlight to make and store food.

Animals Compete

Animals compete with other members of their own species and with members of different species in order to survive and reproduce. Animals compete within their own species for territory, food, mates, and survival against predators. For example, if an antelope can outrun others in its group, it won't be eaten by the lion chasing them.

Animals compete with other species when they fight over a common food source or breeding area. A blue jay might dive bomb a squirrel to get it to drop an acorn it is carrying. If the bird is unsuccessful, it might watch to see where the squirrel buries the nut and dig it up when the squirrel leaves. Birds also compete for the best places to build their nests. A common starling might chase off woodpeckers to build its nest in a tree hollow.

ACTIVE READER

1 Extend *Think of another example of competition among different animals, and an example of competition among plants within an ecosystem. Write your ideas below.*

Animal: _____

competes with _____

for _____

Plant: _____

competes with _____

for _____

Sable Island is a remote place in the North Atlantic near Nova Scotia. Both gray seals and harbor seals live there and feed on the same prey—a tiny fish called sand lances. Recently, gray seal populations have done very well, but harbor seals have declined. Use the Internet to find out more about how these two species of seals compete and why gray seals are doing better than harbor seals.

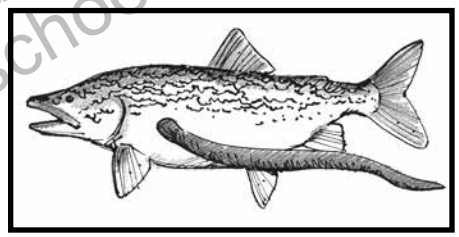
Competing for Limited Resources

The number of plants that an ecosystem can support depends on the resources available, including space, sunlight, minerals, and water. The plants and animals that live together in an ecosystem have adapted to each other over a long period of time so that they can make the best use of available resources. For example, some forest animals will eat only the green leaves of plants, while others will eat only the fruit and seeds. Each animal occupies a particular place, or niche, in the food web. In this way, there is enough food for all the populations.

Plants and animals also adapt to the general conditions found in their environment. For example, cactus plants and reptiles are well suited to life in a desert. Reptiles are cold-blooded, meaning their body temperature changes as the surrounding temperature changes. Polar bears and seals are warm-blooded and maintain a constant body temperature. They can thrive in an icy ocean environment. When there is a change in the ecosystem, this balance of nature can be upset.

For example, improvements made in the 1920s to the canals between Lake Ontario and Lake Erie allowed sea lampreys to enter and populate the Great Lakes. Sea lampreys are parasites that attach themselves to larger fish and feed off their blood and other body fluids. They also reproduce in large numbers. Sea lampreys have upset the balance of nature in the Great Lakes, significantly reducing the fish population.

FOCUS QUESTIONS



Sea lamprey attached to its host

1. What types of organisms compete? Why?

_____

_____

2. What do they compete for?

_____

_____

ACTIVE READER

1 Explain *What determines how many organisms an ecosystem can support?*

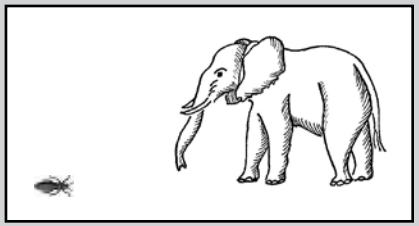
_____

_____

Good to Know

Both the huge elephant and tiny termite consume the woody parts of trees. Both are herbivores, or plant-eaters. Carnivores are meat-eaters.

Our world is filled with an amazing diversity of life. There are even creatures living in the deepest ocean that don't rely on sunlight. Instead, they convert sulfuric acid for their energy needs.



FOCUS

The next part of the chapter explains how energy moves in an ecosystem. As you read find out how energy enters an ecosystem and how the interactions of organisms transfer that energy throughout the ecosystem.

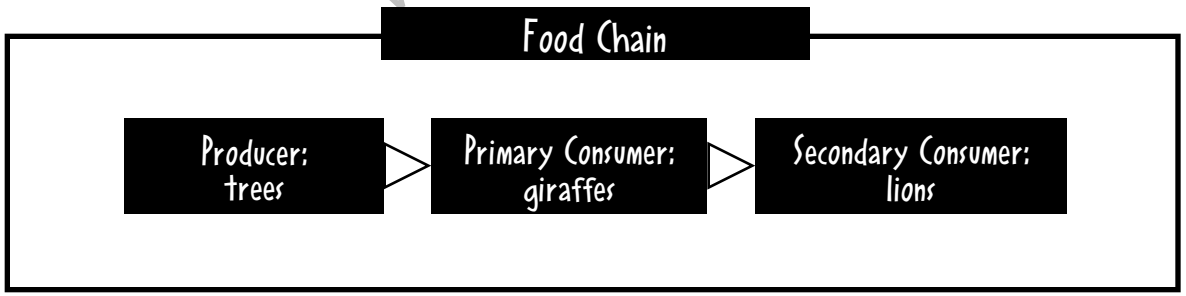
Producers and Consumers

Energy in most ecosystems begins with sunlight. In such an ecosystem, **producers** (plants) convert the sun's energy into food through **photosynthesis**. Some animals in the ecosystem gain their energy by feeding only on the producers. These animals are the herbivores, or primary consumers. Ecologists call the herbivores primary consumers because they gain their energy by eating plants, which have converted the sun's energy into plant material.

Predators and Prey

Herbivores, the primary consumers, become the food of carnivores, the secondary consumers. Most carnivores are predators, and they are adapted to catch and kill their prey. The secondary consumers feed on the bodies of the primary consumers. In this way, energy is transferred from the producers to the primary consumers to the secondary consumers.

A food chain shows how each living thing gets its food. Some animals eat plants and some animals eat other animals. For example, a simple food chain links the trees, the giraffes that eat tree leaves, and the lions that eat the giraffes. Each link in this chain is food for the next link. A food chain nearly always starts with plant life and usually ends with an animal.



ACTIVE READER

1 Explain *What is a primary consumer?*

_____

_____

2 Compare *What is the difference between a producer and a consumer?*

A producer _____

_____

_____

A consumer _____

_____

_____

3 Question *A question about competition I still need to answer is . . .*

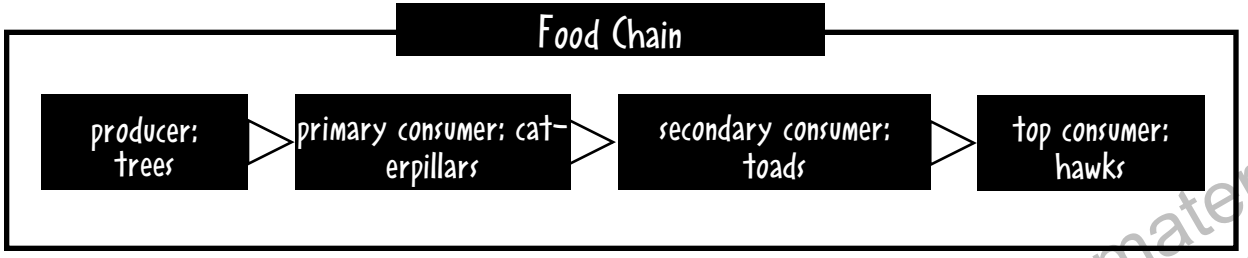
_____

_____

_____

_____

Carnivores are secondary consumers. But many ecosystems have more than one carnivore. For example, a caterpillar eats tree leaves, a toad eats caterpillars, and a hawk eats toads. The top consumer is the animal that has no predators. In this example, the hawk is the top consumer.



As the energy is passed along a food chain much of it is used for living and growth, or it is lost as heat. Therefore, the number of organisms in a food chain is limited no matter what the habitat. The top level consumer gets only a fraction of the energy provided by the sunlight to the producers.

The final links in the chain involve the **scavengers** and **decomposers**. A scavenger is an animal that eats the remains of other animals. Decomposers, such as earthworms, eat decaying vegetable matter as well as what the scavengers leave behind. They also break down the waste of other organisms. Decomposers are very important for any ecosystem. They return essential nutrients to the soil. If they weren't in the ecosystem, the plants would not get these nutrients, and dead matter and waste would pile up.

Feeding Relationships

Most animals are able to eat a variety of foods. A successful herbivore or carnivore is an animal that is able to change its diet and eat what is available at any particular time, this means it can survive when other animals do not due to limited foods. An animal that commonly eats both plants and animals is called an **omnivore**. A successful predator will also hunt prey that is easy to catch, such as an old or injured animal. It would be a waste of energy to hunt and chase prey for a long time.

ACTIVE READER

1 Hypothesize *The root omni means "everything." The root vorare means "to gobble up." How does knowing this help you figure out what an omnivore is?*
Give an example of an omnivore.

_____

_____

_____

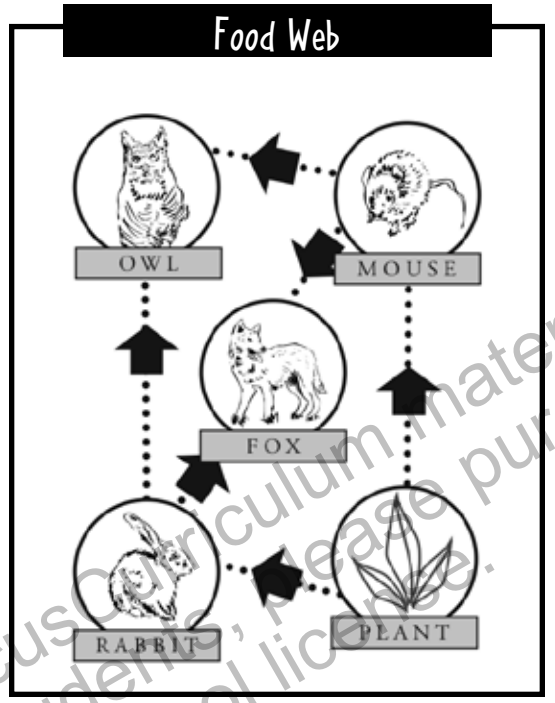
_____

_____

Food Webs

Ecologists often show the feeding relationships among organisms as food webs. A food web shows the feeding relationships among organisms living in a community. In the food web shown at the right, the rabbit and mouse are herbivores. The fox and owl are carnivores. Do you know why there are more herbivores than carnivores?

When a herbivore is eaten by a carnivore, it passes only a small amount of energy that it has received to the carnivore. Of the energy transferred from the herbivore to the carnivore, some energy will be "wasted" or "used up" by the carnivore. The carnivore then has to eat many herbivores to get enough energy to grow.



FOCUS QUESTIONS

1. **How does energy move in an ecosystem? Does it move in one direction or more?**

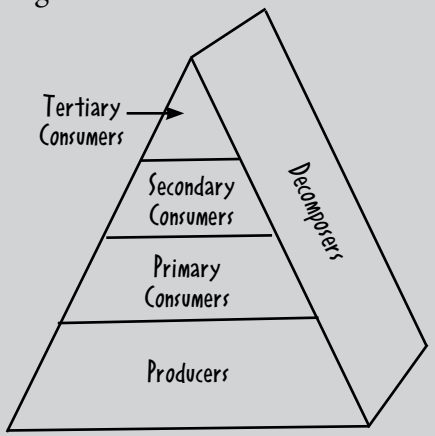
2. **How do the interactions of organisms transfer energy through an ecosystem?**

ACTIVE READER

1 Analyze Note one difference between the primary and the secondary consumers.

Good to Know

Drawing a trophic pyramid is a good way to show how much energy is lost as you pass through the various levels in an ecosystem. Only about ten percent of the energy at each level is available for the organisms at the next higher level.



Stop and Think

This page will help summarize what you have read so far.
Use the tips to help you answer the questions.

Tip:
Look back through the text to find a heading related to the question. Reread that section.

1. Which organism in this food chain diagram would be considered the top consumer?

producer ▶ primary consumer ▶ secondary consumer ▶ tertiary consumer

(1) producer
(2) primary consumer
(3) secondary consumer
(4) tertiary consumer

2. When a giraffe eats the leaves from the top of a tall tree, energy is transferred from a—

(1) producer to a primary consumer.
(2) primary producer to a secondary producer.
(3) producer to a secondary consumer.
(4) primary consumer to a secondary consumer.

Base your answers to questions 3 and 4 on the information below and on your knowledge of science.

Many animals depend on plants or other animals for their food.

3. How would a major flood affect predators? In your answer, consider how the effect of the flood on predators might differ from that of their prey.

_____

_____

4. What is one way predators could get food after a major flood?

_____

_____

Dear Ms. Understanding,

OK, so I read that plants are producers because they make their own food through photosynthesis, right? Well, then, consider the Venus Flytrap. It captures insects and gobbles them up. What's that all about?

Confused in Canarsie

Dear Confused,

Good question, Confused. The Venus Flytrap is a carnivorous plant. However, it still produces energy from photosynthesis. Carnivorous plants grow in places where the soil is poor in nutrients. They capture and digest insects to get the nutrients and minerals they need.

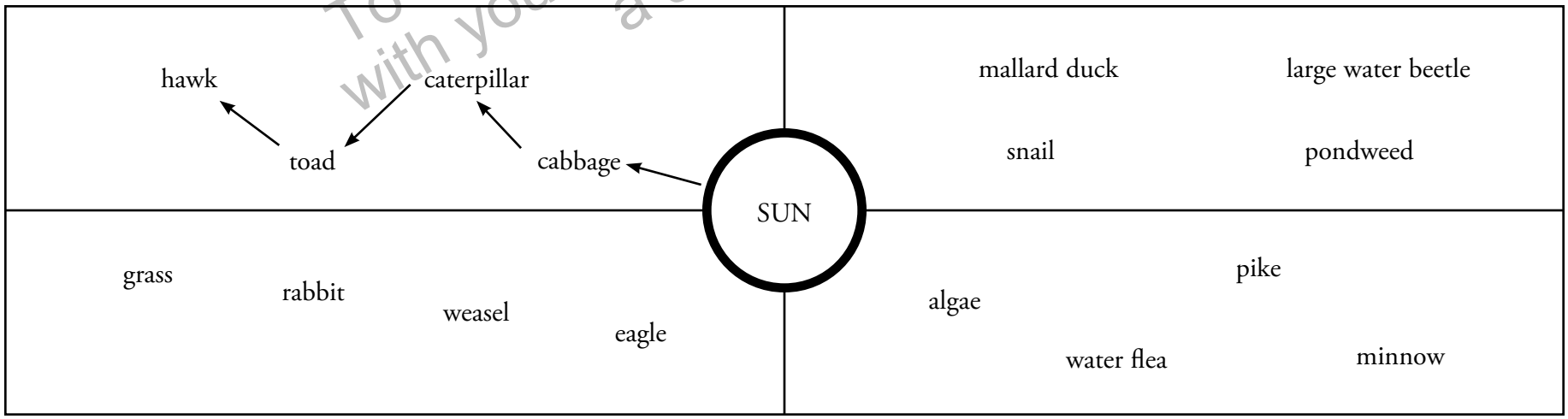
Ms. Understanding

Think Like A Scientist

Classify Classify the following list of organisms by writing an X in the table to identify the feeding level of each organism. You can identify an organism in multiple categories.

	Producer	Primary Consumer	Secondary Consumer	Scavenger	Decomposer
cow					
buttercup					
lion					
lettuce					
earthworm					
caterpillar					
vulture					
bacteria					
fox					

Draw Food Chains Use arrows to illustrate a food chain for each group of organisms. Then circle the top consumer in each food chain.



Chapter 2 Interdependence

FOCUS The underlined sentence states an important idea about how organisms depend on each other. As you read, find out about two types of interdependence between organisms.

Symbiosis

Some organisms living together in an ecosystem develop special types of interdependent relationships. **Symbiosis** is a word that describes this interdependence. In fact, some species of plants and animals have become so dependent on each other that one could not survive without the other. What would happen to flowering plants if the bee population declined? What would happen if bees became **extinct**? The ability of flowering plants to complete their life cycle would be severely threatened.

There are three basic types of symbiotic relationships: mutualism, commensalism, and parasitism.

Mutualism

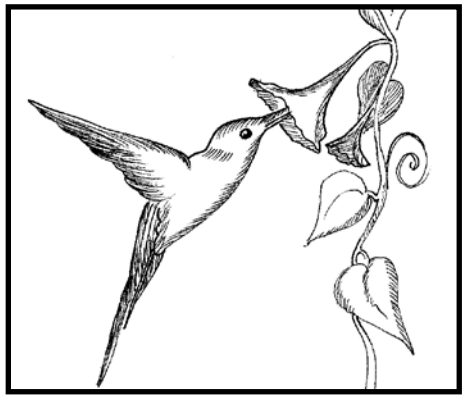
A relationship between organisms in which both benefit is called **mutualism**. The relationship between bees or hummingbirds and flowering plants is a good example of mutualism. Bees collect nectar and pollen from the flowers and use it to feed themselves and their young. In the process, they pollinate the flowers and enable them to reproduce.

Like bees and hummingbirds, clownfish also participate in a mutual relationship with another organism. Clownfish are small colorful fish that can often be found among the tentacles of the sea anemone. These tentacles contain poisonous stingers, but the clownfish secretes a shield of mucus around its body. The poisonous sea anemone provides a protective home for the clownfish. In return, the clownfish fends off butterfly fish, which prey on the anemone.

Mutualism Between Clownfish and Sea Anemone	
Ways Clownfish Benefit	Ways Sea Anemone Benefit

ACTIVE READER

1 Extend *How would the disappearance of bees affect humans? Animals?*



The hummingbird and the morning glory, shown in the picture above, have a mutually beneficial relationship.

Commensalism

In some symbiotic relationships, one partner benefits, but the other is neither harmed nor helped. For example, hermit crabs use the discarded shells of gastropods, such as marine snails, to protect themselves. This type of symbiotic relationship is called commensalism.

Another example of commensalism is when one organism attaches itself to another for transportation. Tiny mites do this with larger insects and birds. One type of scorpion-like animal conceals itself under the wing of a large beetle and gains the advantage of being dispersed over a wide area. The beetle is unaffected by the presence of the hitchhiker.

Burdock seeds need to be dispersed over a wide area. Their seeds have adapted to this need by evolving velcro-like hooked spines. These spines attach themselves to the fur of a passing animal or the pantleg of a passing human, and are carried to a new place.

Still another type of commensal relationship involves mimicry. The Viceroy butterfly has evolved to look very much like a Monarch butterfly. Why? They ingest and store a substance that is poisonous to vertebrates. This poison makes them bad-tasting, and vertebrates learn to avoid eating them. Because the Viceroy looks so much like a Monarch, vertebrates avoid them, too, even though they are neither bad-tasting nor poisonous.

The Monarch, in the picture at the left, is slightly larger than the Viceroy, shown at the right.

ACTIVE READER

1 Define *Explain the term mimicry.*

_____

_____

_____

2 Recall *Who benefits if the relationship between two organisms is mutual?*

_____

_____

_____

FOCUS QUESTIONS

1. Why is the relationship between the Monarch and the Viceroy butterflies a commensal relationship?

_____

2. What might need to change to make this relationship mutual?

_____

FOCUS

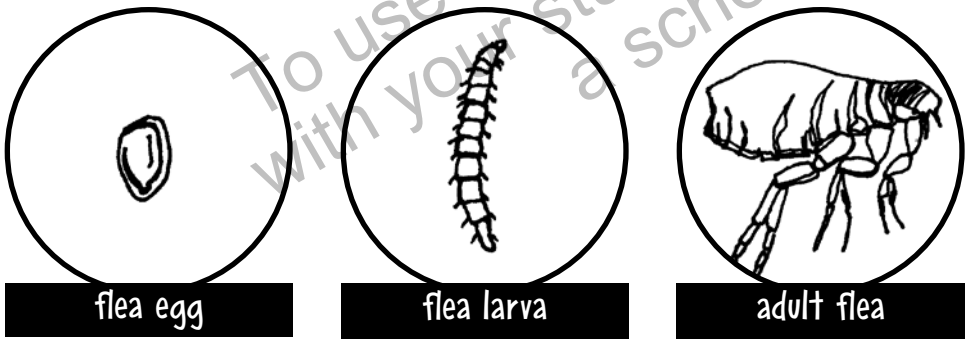
Read the next section about parasitism, another type of symbiotic relationship. As you read, compare parasitism with the predator/prey relationship.

Parasitism

A relationship between organisms in which one benefits but the other is harmed is called **parasitism**. In this type of relationship, the **host** organism is almost always larger in size than the **parasite**. The parasite exploits the host and usually weakens it, making it less fit to raise its young, reproduce, or escape predators. Parasites usually exploit a host over a long period of time, and sometimes severely weaken it.

Fleas are a common parasite found living on dogs and cats. They are often referred to as "hit and run" parasites because they live on the dog for a brief period and then move on to another with or without killing the first. Both parasite and host must evolve to ensure the survival of both. If the parasite kills its host before it can move on, it destroys its own meal ticket.

In addition to the skin irritations caused by flea bites, they can also transmit diseases to their host. Typhus, tapeworms, and even bubonic plague can be caused in this way. The flea itself carries a parasite in its body. The flea becomes a carrier of this tiny organism that is passed on to the host, causing disease.



The life cycle of a parasite usually includes several stages.

Besides disease, some infections are caused by parasites. These types of infections happen when a parasite attacks a host and begins to multiply.

ACTIVE READER

1 Research *Why do mosquitos bite humans? What problems can mosquitos cause for humans?*

_____

_____

2 Hypothesize *Many parasites, such as the tapeworm, are more successful if they do not kill their host. What hypothesis could explain why this is true?*

_____

_____

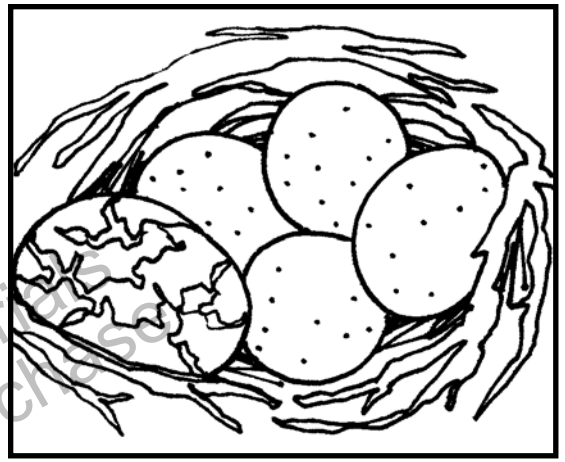
_____

Web Quest

Mites are parasites, tapeworms are parasites, bacteria and viruses are parasites, but are there any plants that are parasites? Search the term Plant Parasites and find out.

Cuckoo birds and cowbirds are sometimes **brood parasites**. Instead of building a nest and caring for their young, they lay their eggs in the nests of other bird species. The babysitter birds then raise and care for the cuckoos or cowbirds as if they were their own. The young foster chicks may even remove the original eggs or chicks from the nest so that they will better benefit from the care of the adult babysitter bird.

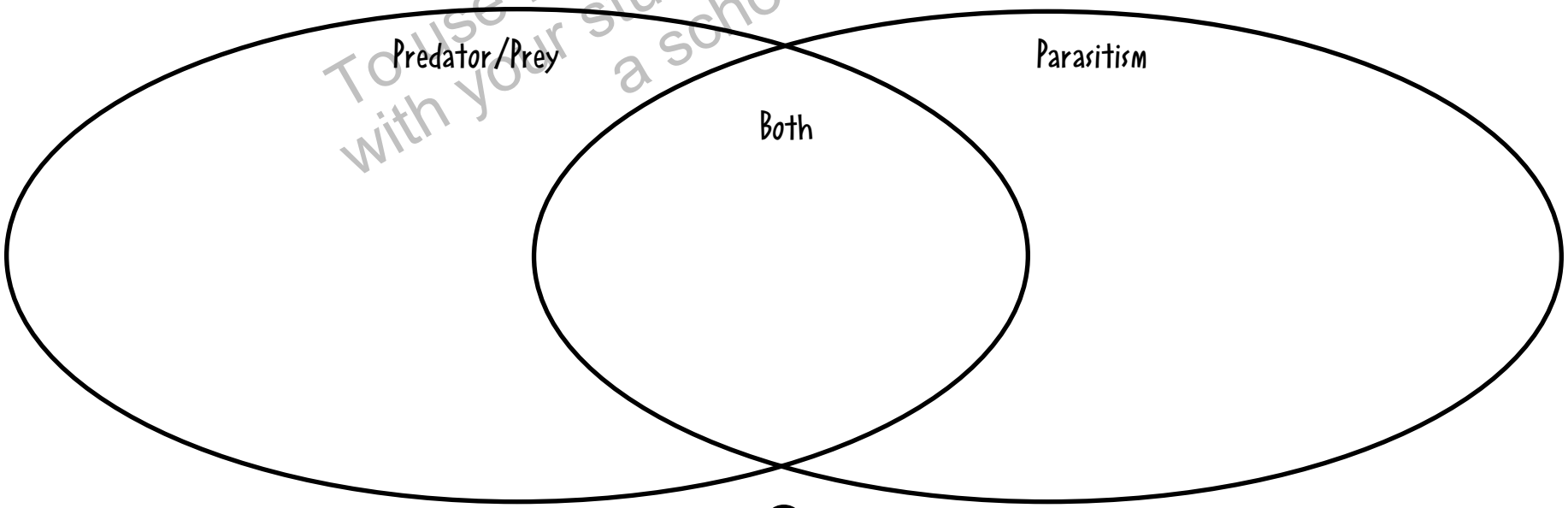
Some host species have developed defense strategies against brood parasites and brood parasites have countered with strategies of their own. Many hosts of the cuckoo birds, such as the Great Reed Warbler, learned to recognize the parasitic eggs and would eject the eggs from their nests. The cuckoos countered by evolving eggs that mimicked the look of the host so well scientists have trouble differentiating the two by site alone.



The larger cowbird egg, shown at the far left, has been laid in the nest of another species of bird.

FOCUS QUESTIONS

1. **Complete the Venn diagram to explain how the predator/prey relationship compares with parasitism. Think about these questions: How many parties are involved in the relationship? How is the parasite like a predator? How is the host like prey? How are the relationships different? List the characteristics of each relationship under the correct heading.**



Stop and Think

This page will help sum up what you have read so far.

1. Which interaction between organisms is parasitic?

(1) humans growing wheat for food
(2) Spanish moss growing from tree branches in the forest
(3) a lamprey feeding on the blood of a fish
(4) barnacles attaching themselves to the flukes of a whale to get a free ride

2. Which interaction between organisms is commensal?

(1) a plant dispersing its seeds on the fur of a rabbit
(2) a hummingbird feeding on nectar of a cow
(3) a tick feeding on the blood of a cow
(4) a tickbird feeding on ticks found on the skin

Base your answers to questions 3 and 4 on the information below and on your knowledge of science.

Hyenas eat the meat off the bones of a dead antelope, which was killed by a lion.

3. Why the relationship between the hyena and the lion considered to be commensal?

_____

_____

4. How would you describe the relationship between the lion and the antelope?

_____

_____

Dear Ms. Understanding,

My little sister has a pet goldfish. She feeds it regularly and cleans its bowl every week. It seems to me that this fish is nothing but a parasite. Goldie gets food and a nice bowl to live in while my sister does all the work. She gets real angry when I say this, but am I right?

Searching for Truth in Saratoga

Dear Searching,

Sorry, Search, but you owe your sister an apology. Goldie is not a parasite. The benefit your sister gets from the relationship may be hard to quantify, but think of how much pleasure having Goldie as a pet gives her. Their relationship is clearly one of mutualism. Try feeding and cleaning Goldie's bowl yourself for a few weeks. Maybe you'll come to love the little guy.

Ms. Understanding

Observe Animal Adaptations

Choose three different animals you can observe in their natural habitat either directly, on a video, or on a Web site.

1. **Note the animal's body covering. Does it have soft porous skin, fur or hair, or a hard protective shell? What color is it? Are other members of the same species similar in color?**
2. **Observe and be able to describe how the creature moves.**
3. **Research information about the animal. Find out what it eats and what, if anything, eats it.**
4. **Identify other creatures commonly found in the same habitat.**
5. **Complete the chart below.**

Animal	Body Covering	What It Eats	What Eats It	Other Creatures It Lives With

6. **On the lines below, describe any symbiotic relationships you observe. Identify each as mutualism, commensalism, or parasitism.**

7. **Describe how the organisms listed in the table move, and how their movement affects their relationships with other animals.**

Chapter 3 What Happens When Organisms Interact?

FOCUS

This chapter tells the story of the many organisms that live together on and around a milkweed plant. As you read, look for examples of symbiotic relationships.

Nature in Balance

When an ecosystem contains the right amount of living and non-living resources to support its various populations of producers, herbivores, carnivores, omnivores, scavengers, and decomposers, the ecosystem is said to be in **equilibrium**. Ecosystems can exist on a large scale. The major biomes of the world are large ecosystems where organisms live together in a certain type of climate. Arctic tundra, boreal forests, tropical rainforests, grasslands, deserts, and mountains are some of the world's major biomes. But biomes are made up of a collection of smaller habitats. The study of a milkweed plant provides a fascinating example of symbiosis in a micro-habitat.

A **micro-habitat** is a very small area which is home to a community of organisms. The milkweed plant grows to about 3 ft (90 cm) in height. It produces a white liquid, called sap, when its stem is cut or broken. Many animals live their lives on the milkweed plant, or visit it to feed on leaves or its sap.

The milkweed flowers produce a scent and sugary nectar to attract insects such as the honeybee and the bumblebee during the day. At night, the flowers attract moths. When moths and bees visit the milkweed plant for its nectar, they get covered in pollen. Once the insects are done drinking, they fly off and spread the pollen to other milkweed plants.

Monarch caterpillar on a milkweed plant

ACTIVE READER

1 Connect *Name a word that is a synonym for balance.*

_____

2 Differentiate *Name a difference between the two liquids produced by the milkweed plant.*

_____

_____

_____

Good to Know

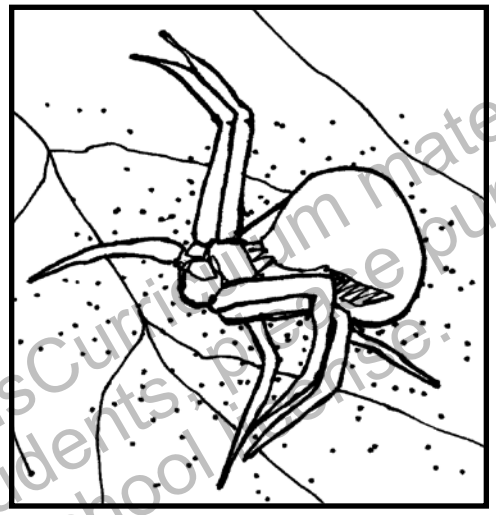
The caterpillars of the Monarch butterfly only eat the leaves of the milkweed plant. The leaves contain a special chemical which makes the larvae and the adult butterfly unpleasant to eat. This gives them protection from predators. The plant may lose some leaves, but it is unharmed.

The crab spider is white in color, which camouflages it when it is on the milkweed flower. The crab spider preys on insects that visit the milkweed. When the milkweed flowers are in bloom, the crab spider can eat enough prey to increase its mass from 40 mg to 400 mg in two weeks.

The remains of the crab spider's prey fall to the ground. These **carcasses** become the food for a scavenger called the **harvestman**. At night, the harvestman climbs up the stem of the milkweed to feed on the carcasses that did not fall to the ground.

The crab spiders lay their eggs on the underside of the milkweed flower petals. The eggs are grouped together in an egg sac. Some flies and small wasps lay their own eggs in the crab spider's egg sacs. When the larvae of the flies and wasps hatch, they grow by eating the eggs of the crab spider in the egg sac.

The seeds of the milkweed develop in pods. Each pod contains 100 to 200 seeds which are dispersed by the wind. Finally, aphids use their pointed mouthparts to pierce the stems and suck out the white sap.



Crab spider on a milkweed leaf

FOCUS QUESTIONS

Write a word or phrase to identify the relationship that exists between the following pairs of organisms.

1. the moth and the milkweed plant _____
2. the harvestman and the crab spider _____
3. the crab spider and insects that visit the milkweed plant _____
4. the crab spider and small wasps _____
5. the Monarch caterpillar and the milkweed plant _____

ACTIVE READER

1 Infer *What color is the milkweed flower?*

_____

2 Restate *Use context clues to write a definition of the word carcasses.*

_____

_____

_____

_____

_____

3 Explain *What does the milkweed avoid by using the wind to disperse its seeds?*

_____

_____

_____

_____

_____

FOCUS

The underlined sentences state important ideas about how organisms thrive in an ecosystem. look for reasons why habitats may lose their abilityto support many different living things.

Biodiversity

The milkweed plant represents a habitat that is in balance. It supports a wide variety of organisms, each occupying its own place in the food web. The honeybee, bumblebee, and moth compete with each other for the nectar that the plant produces. The crab spider is a predator that relies on its insect prey for food. The harvestman is a scavenger that eats the remains of the crab spider's prey. The flies and wasps have a parasitic relationship with the crab spider as their larvae crowd out and eat some of the eggs of the crab spider.

Biodiversity is a term that refers to the different species of organisms that can successfully live together in an ecosystem. As you can see from the example of a milkweed plant, even a micro-habitat can support many different species of plants and animals. Generally, the greater the number of different species supported by an ecosystem, the more stable and healthy that ecosystem is. There are several reasons why.

- All species have different responses to changes in the ecosystem. The effect of changes tend to average out if more species are in the ecosystem.
- Diverse communities tend to use resources more completely. Thus, invaders sometimes have less success becoming established.
- A decreased number of competing plant species may allow an abundance of other species to increase.

The diverse populations of plants and animals alive on our planet today are the result of millions of years of evolution. The ability of organisms to establish and benefit from symbiotic relationships has fueled this biodiversity. In other words, because symbiosis helps organisms thrive, our planet has become biologically diverse and varied. Symbiosis is one of the most powerful functions in an ecosystem, because as unrelated organisms begin to depend on each other, new types of life forms originate.

ACTIVE READER

1 Analyze *What two words were combined to create the new word biodiversity?*

_____

_____

_____

A diverse coral reef habitat in the Gulf of Mexico containing many species of fish

Image courtesy of NOAA FGBNMS/UNCW-NURC

How diverse and varied are the organisms that inhabit Earth? So far, ecologists have identified about 1.7 million different species. There are almost a million different insects, a quarter million different plants, and more than 4,000 different mammals. Populations of these organisms live in communities in varied habitats and ecosystems around the world.

Why is diversity a good thing? How does variety help all living things survive and thrive? In the activity below are diagrams of two sections of hardwood forest in Pennsylvania. In both, the original trees were harvested for lumber. In one, the forest was replanted with only ash trees. The other was replanted with a variety of species native to the area. By 2007, both forests had regrown and supported a wide variety of organisms including birds, small mammals, and many insects,

In 2007, the Emerald Ash Borer, an insect from Asia, first infested a Pennsylvania forest. Ash trees that are infested with the insect die within three to five years. Once the Emerald Ash Borer is established in a particular tree, they reproduce, and the offspring then infest nearby ash trees.

The Emerald Ash Borer was first discovered in North America in Michigan in 2002.

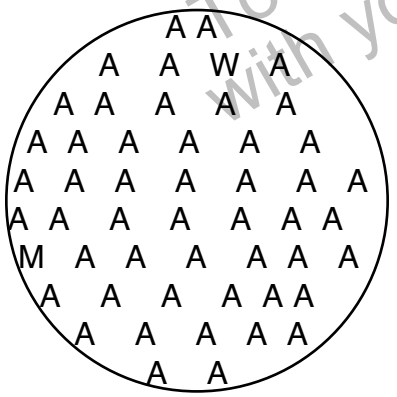
Photo by David Cappaert, Michigan State University, Bugwood.org

Think Like A Scientist

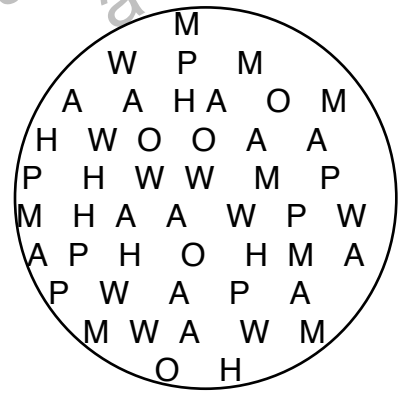
Investigate Biodiversity

Circle the trees that would remain alive today if the Emerald Ash Borer had infested these forest areas in 2007. Complete the Think Like a Scientist activities on the next page.

Forest Area 1



Forest Area 2



Key: A-ash H-hickory O-oak M-maple P-poplar W-walnut

Think Like A Scientist

Investigate Biodiversity

1. Describe the impact of the Emerald Ash Borer on the organisms living in each forest area.

Forest Area 1: _____

_____

Forest Area 2: _____

_____

2. Identify which forest maintained its balance better and explain why. _____

_____

_____

3. Explain how humans affected the forests. _____

_____

_____

4. How did one maple and one walnut tree get into the ash forest? _____

_____

_____

Overpopulation

The mixed hardwood forest, because it had so many different species of trees, was much better able to withstand the effects of the Emerald Ash Borer than was the ash forest. When ecosystems get out of balance, the diversity of organisms the ecosystem supports begins to decline and relationships among the organisms change.

How do ecosystems get out of balance? What events can cause them to change? In the case of the forest areas, an organism from another ecosystem was introduced. This invader, also called an invasive species, had no natural predators, and was able to quickly overpopulate the habitat.

Another cause for imbalance in an ecosystem is climate change. Some animals, especially those that live in the tropics, are very sensitive to temperature changes. Pollution, too, can cause habitat destruction and even lead to species extinction.

The number of organisms present in an ecosystem will depend on how many biotic (living) resources, such as food, and abiotic (non-living) resources, such as water, are available. If there is a good summer and the plants grow well, producing lots of fruits and seeds, the herbivores will flourish. This will eventually benefit all of the animals in the ecosystem through the food web.

The reverse is also true. If a flood, drought, fire, pollution, or disease destroys some of the vegetation, less food will be available throughout the ecosystem. Severe winters can reduce the numbers of both plants and animals. This may result in overpopulation: more organisms than the resources of the ecosystem can now support. Many animals, particularly the young ones, may starve.

Go back to the picture on the front cover of the hippopotamus and the birds. What symbiotic relationship do these two organisms have? What could you do to you find out?

FOCUS QUESTIONS

1. Why do invasive species often overpopulate a habitat?

_____

2. What other factors can affect the biotic and abiotic resources available in a habitat?

_____

ACTIVE READER

1 Explain *Define the term invasive species.*

_____

_____

2 List *What types of pollution can impact the organisms in an ecosystem?*

_____

_____

_____

_____

_____

Stop and Think

This page will help sum up what you have read so far.
Use the tip to help you answer the questions.

Base your answers to questions 1 and 2 on the information below and on your knowledge of science.

Biodiversity is caused by many factors and can have different effects on different habitats.

1. Write in the chart one cause of biological diversity in a habitat.

Cause	Effect
	Biological Diversity

Tip:
An effect is the result of a cause. Reread to recall what causes biological diversity.

2. Explain the effect of biological diversity on a habitat.

3. Which of the following is a sign of a habitat in equilibrium?

(1) increasing parasitism
(2) species diversity
(3) growth in the population of an invader
(4) declining populations of decomposers

Dear Ms. Understanding,

When a habitat is overpopulated because of, say, a drought, only the biggest and strongest organisms will survive, right?

Trying to Figure It Out in Tioga

Dear Trying,

It's not the biggest and strongest that will survive, it's the organisms that are best adapted to the new conditions that will thrive. Plants and animals that can tolerate drought will flourish, while others—even if they are bigger and stronger—will suffer.

Ms. Understanding

Glossary

biodiversity - the range of organisms present in a given ecological community or system.

brood parasite – animals that use animals of another species to raise their young

carcasses – the remains of dead animals

carnivore – an animal that eats other animals

commensalism – a symbiotic relationship between two organisms in which one benefits and the other is not affected

consumer – an animal that feeds mainly on other animals and/or plants to derive its energy

decomposer – an organism that causes organic matter to rot or decay

equilibrium – a state in which all forces or processes are in balance and there is no change

extinct – having died out or ceased to exist

germinate – to start to grow from a seed or a spore

harvestman – a scavenger that inhabits a milkweed plant

herbivore – an animal that eats plants

host – an organism in or on which a parasite lives

invasive species – any species or related biological material, such as eggs or spores, that is not native to the habitat in which it is found, and is likely to cause harm

micro-habitat – a small environment in which a group of interrelated organisms live

mutualism – a symbiotic relationship between two organisms in which both benefit

omnivore – an animal that eats a variety of plants and other animals

organism – a living thing

overpopulation – a state in which the number of individuals of a species living in a habitat is so large that the resources available are insufficient to support them

parasite – an organism that lives in or on a host organism in a way that harms the host

parasitism – a symbiotic relationship between two organisms in which one benefits and the other is harmed

photosynthesis – the process by which plants combine sunlight with carbon dioxide and hydrogen to create food and thereby derive energy

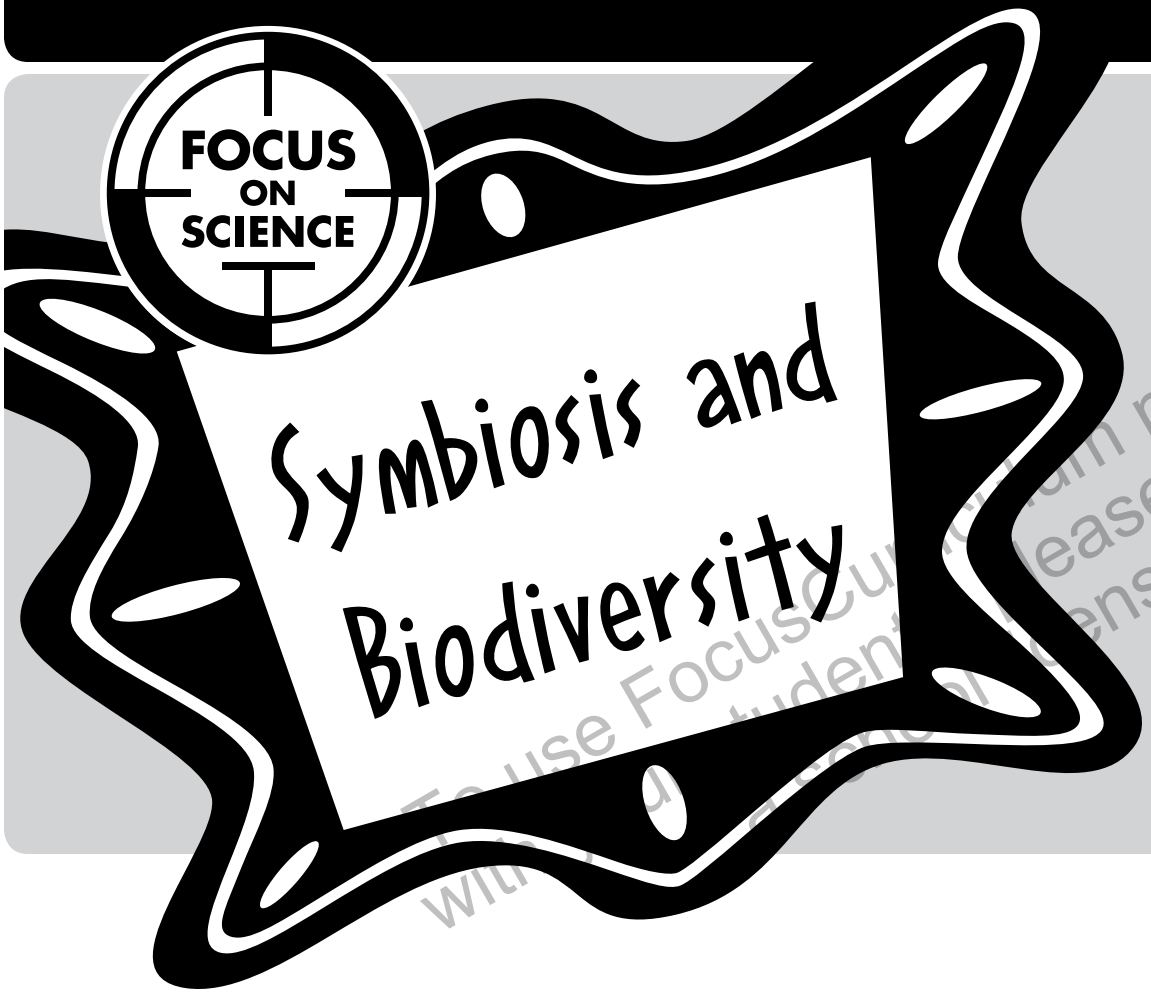
population – all of the organisms living in an area

predator – a carnivorous animal that hunts and kills other animals for food

producers – organisms, such as plants, that create their own food

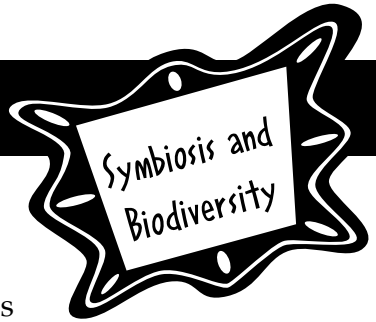
scavenger – an organism that feeds on the dead or rotting flesh of animals

symbiosis – a close association between two organisms that benefits one or both



Assessments

Check Understanding



In the Answer Document on this page, mark your answer in the row of circles for each question by filling in the circle that has the same number as the answer you have chosen.

1. Remora are fish whose dorsal fin has adapted over time so that it forms a sucker. The fish attaches itself to a shark and travels along for the ride. The remora feeds on morsels of food that fall out of the shark's mouth. The shark is not affected by the remora.

   What type of relationship is this?

   (1) predation
   (2) parasitism
   (3) mutualism
   (4) commensalism

2. What interaction between organisms would be described as parasitic?

   (1) a bee stinging a human
   (2) a lion killing and eating an antelope
   (3) tickbirds cleaning the skin of a rhino as they feed on ticks
   (4) a fungus deadly to elm trees spreading to an elm tree by an elm-bark beetle

Answer Document

1.	①	②	③	④	3.	①	②	③	④
2.	①	②	③	④	4.	①	②	③	④

3. Which statement about the relationship between animals that eat fruit from trees and the fruit-bearing tree is accurate?

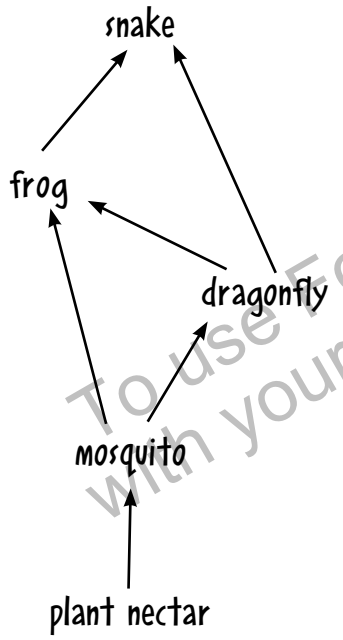
   (1) The animal is considered a predator and the fruit of the tree is considered prey.
   (2) The animal and the fruit-bearing tree have a parasitic relationship because the animal damages the tree when it eats the fruit.
   (3) The relationship is not symbiotic because such relationships exist only between animals, and not between plants and animals.
   (4) The animal and the fruit-bearing tree have a mutualistic relationship because the tree provides food for the animal and the animal disperses the tree's seeds in its droppings.

4. What interaction between organisms would be described as commensal?

   (1) a coyote hunting a rabbit
   (2) a robin building a nest in a maple tree near a park
   (3) a microscopic organism causing malaria in humans
   (4) dwarf mistletoe causing extensive damage to a conifer

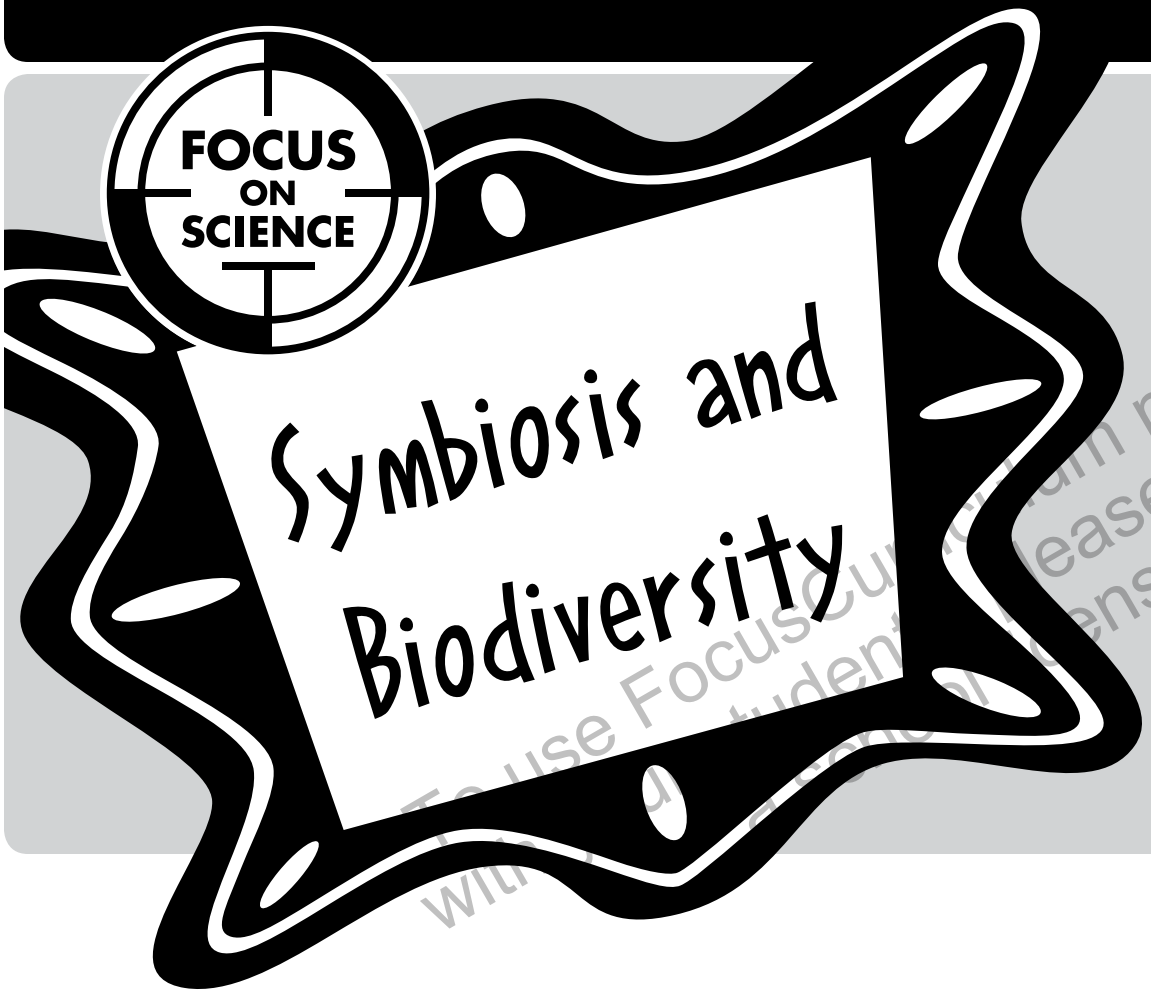
Check Understanding

Base your answers to questions 5 and 6 on the diagram of the food web below and on your knowledge of science.



5. Identify a primary consumer and a secondary consumer shown in the chart.

6. Explain why there are more mosquitos than snakes living near the pond.



Answer Key

Answer Key

Page 8: Starting Points:
Build Background
Use Your Knowledge: Energy comes from the food we eat. Energy in our food has been fueled by the sun.
Label It: 1. Living Things: trees, mammals, bacteria, insects; 2. Words About Change: convert, transfer, adapt, alter; 3. Parts of **Plants:** leaves, roots, seeds, flowers
Hands On Science: Investigate a Micro-habitat: Answers will vary according to the sample the student studied.

Page 10: Starting Points:
Key Vocabulary
Rate Your Knowledge: Answers will vary according to the student's prior knowledge.
Use Roots to Unlock Meaning:
1. photosynthesis, combining light with other things; 2. carnivore, flesh-eater

Page 11: Starting Points:
Active Reader: 1. B birds, A wind, A rocks, B bees, B aphids, B people, A sunlight, A water
Key Concepts Paragraph 2: Living Resources: plants, animals; Non-living Resources: air, light, soil
Paragraph 3: Energy: sunlight; Growth: water, nutrients; Reproduction: birds, bees

Page 12: Chapter 1
Active Reader: 1. In paragraph 2, available sunlight, proper minerals, water; 2. Hawks and foxes compete for small rodents as food.; 3. The first sentence in all paragraphs contains the main idea.

Page 13: Chapter 1
Active Reader: 1. In paragraph 1, The number of plants that an ecosystem can support depends on the resources available, including space, sunlight, minerals from the soil, and water.
Focus Questions: 1. plants and other plants, plants and animals, animals of the same species, animals of other species; 2. Plants: sunlight, nutrients from the soil; Animals: food, mates, space

Page 14: Chapter 1
Active Reader: 1.An animal that gains energy by feeding only on the producers.; 2. A producer makes its own food for energy. A consumer eats plants or other animals to get energy.; 3. Student's questions will vary.

Page 15: Chapter 1
Active Reading: 1. The meanings of the roots tell what the word means.

Page 16: Chapter 1
1. In the food web illustration, P should be near the rabbit and mouse and S should be near the fox and the owl.
Focus Questions: 1. Energy moves from producer to primary consumer to secondary consumer to top consumer.; 2.When one organism eats another, or when an organism dies, energy is transferred through the ecosystem.

Page 17: Chapter 1
Stop and Think: 1. (4); 2. (1); 3. A major flood could eliminate the predator's food source.; 4.: It could get food after the flood by moving to a new habitat or by changing what it eats.

Page 18: Think Like a Scientist
Classify: cow, primary consumer; buttercup, producer; lion, secondary consumer; lettuce, producer; earthworm, decomposer; caterpillar, primary consumer; vulture, scavenger; bacteria, decomposer; fox, secondary consumer and scavenger
Draw Food Chains: Sun, pondweed, snail, large water beetle, duck; Sun, algae, water flea, minnow, pike; Sun, grass, rabbit, weasel, eagle

Answer Key

Page 19: Chapter 2
Paragraph 4: Ways Clownfish Benefit: shelter, protection
Ways Sea Anemone Benefit: protection from prey
Active Reader: 1. If bees disappeared, all plants would have a harder time reproducing. Many would become extinct. All food sources in all food webs would be endangered, including human food sources.

Page 20: Chapter 2
Active Reader: 1.The first sentence in paragraph 1 defines commensalism.; 2. both organisms; 3. Mimicry is the close resemblance of an organism to something else in its environment, a trait that often evolves as a protective strategy.
Focus Questions: 1. In mutualism, both organisms benefit. In commensalism, one benefits and the other is unaffected.; 2. The relationship is commensal because the Viceroy butterfly benefits, but the Monarch is unaffected.

Page 21: Chapter 2
Active Reader: 1. Female mosquito bite people for a blood meal. They need the blood proteins to make fertile eggs. Mosquitoes carry diseases such as malaria, encephalitis,West Nile virus, and Dengue Fever.; 2. The parasite (tapeworm) is dependent on its host for a protective home and food. If it killed its host, it would likely die as well.

Page 22: Chapter 2
Focus Questions: Predator/Prey: The prey is killed for food; Both: Two organisms are involved, only one benefitted; Parasitism: The host is harmed, but not usually killed.

Page 23: Chapter 2
Stop and Think: 1. (3); 2. (1); 3. The hyena/lion relationship is commensal because the hyena benefits and the lion is unaffected.; 4. The lion/antelope relationship is that of predator/prey.

Page 24: Think Like a Scientist
Observe Animal Adaptations: Responses will vary depending on the animals observed.

Page 25: Chapter 3
Active Reader: 1. In paragraph 1, equilibrium; 2. Sap is milky white and produced in the stem. Nectar is sugary and produced in the flower.

Page 26: Chapter 3
Active Reader: 1. white; 2. Carcasses are the remains of prey animals.; 3. Competition among its own offspring for available resources.
Focus Questions: 1. mutualism; 2. commensalism; 3. predator/prey; 4. parasitism; 5. commensalism

Page 27: Chapter 3
Active Reader: 1. biotic, diversity

Page 28: Chapter 3
Think Like a Scientist : Investigate Biodiversity: Forest Area 1 will lose all trees except for the one maple and one walnut. Forest Area 2 will lose its 14 ash trees, but the others will be unaffected.

Page 29: Chapter 3
Think Like a Scientist: 1. The other organisms living in Forest Area 1 will lose their habitat and many will die. Those in Forest Area 2 be much better able to continue. 2. Forest Area 2 will maintained its balance better because the greater diversity of species protected the habitat against loss. 3. Humans used the wood from the forest for a variety of applications such as lumber for building, furniture making, baseball bats (maple and ash) and then replanted the forest with the trees noted in the diagram. The lack of diversity in Forest Area 1 is due to the choice by people to plant only ash trees. 4. Maple seeds are carried by the wind and may have blown into the area. Walnuts are often carried by squirrels and buried to be eaten later. Perhaps a squirrel hid a walnut and it sprouted and grew.

Answer Key

Page 30: Chapter 3
Active Reader: 1. an organism from another ecosystem; 2. water and air pollution
Focus Questions: 1. Because invasive species have no natural predator they use up more and more of the available resources. Their population grows at the expense of other organisms.; 2. climate change, weather changes, pollution

Page 31: Chapter 3
Stop and Think: 1. Cause: symbiotic relationships; 2. Biological diversity leads to a healthy, balanced environment with organisms living in equilibrium.; 3. (2)

Page 35: Check Understanding
1. (4); 2. (4); 3. (4); 4. (2)

Page 36: Check Understanding
5. Identify: The mosquito is a primary consumer and the dragonfly and frog are secondary consumers.; 6. Explain: There are more mosquitos living near the pond than snakes because there is more food energy available for them.