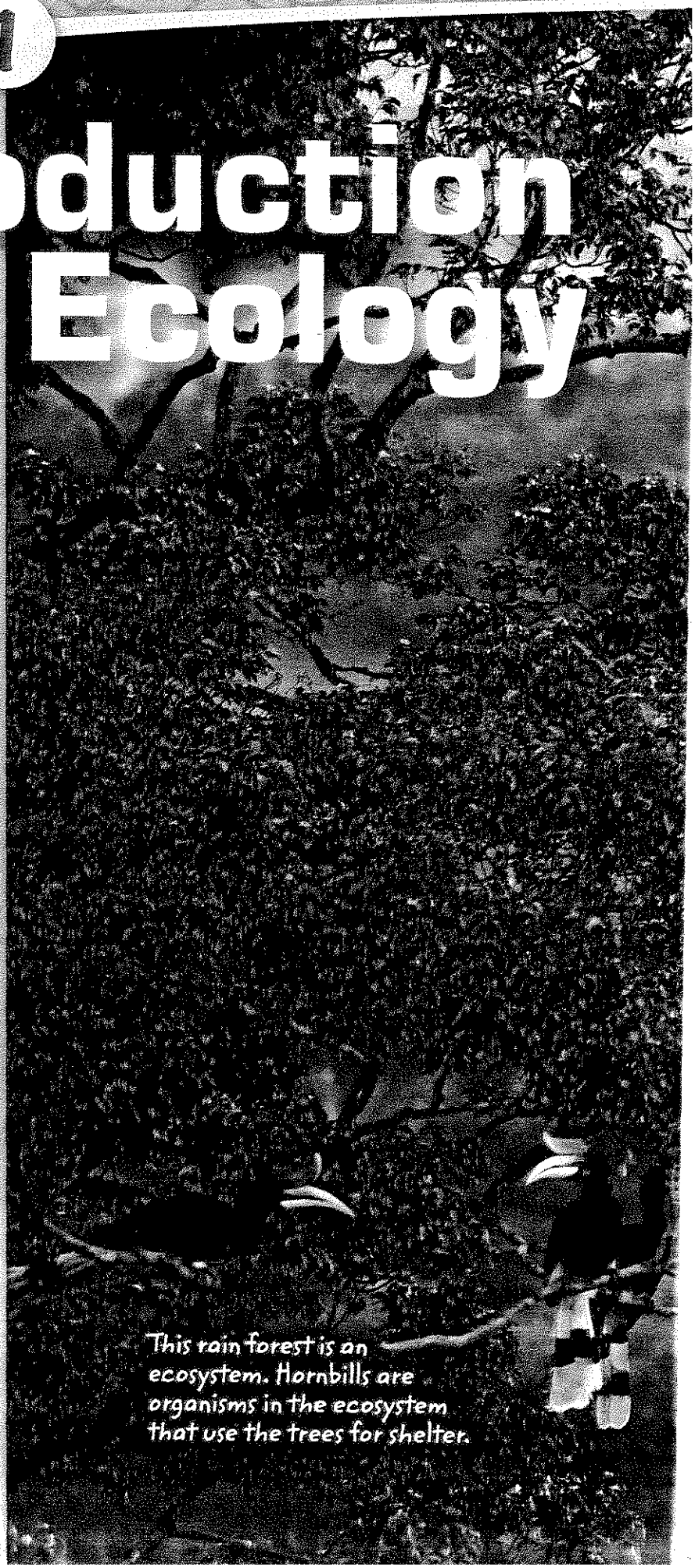
Lesson 1

Introduction to Ecology

ESSENTIAL QUESTION

How are different parts of the environment connected?

By the end of this lesson, you should be able to analyze the parts of an environment.



This rain forest is an ecosystem. Hornbills are organisms in the ecosystem that use the trees for shelter.

Lesson Labs

Quick Labs

- Which Abiotic and Biotic Factors Are Found in an Ecosystem?
- Which Biome?

Field Lab

- What's in an Ecosystem?

Engage Your Brain

1 Describe In your own words, write a list of living or nonliving things that are in your neighborhood.

2 Relate Write a photo caption that compares the ecosystem shown below and the ecosystem shown on the previous page.

Active Reading

3 Synthesize You can often define an unknown word or term if you know the meaning of its word parts. Use the word parts and sentence below to make an educated guess about the meaning of the term *abiotic factor*.

Word part	Meaning
a-	without
bio-	life

Example sentence

In an ecosystem, rocks are an example of an abiotic factor since they are not a living part of the environment.

abiotic factor:

Vocabulary Terms

- **ecology**
- **biotic factor**
- **abiotic factor**
- **population**
- **species**
- **community**
- **ecosystem**
- **biome**
- **habitat**
- **niche**

4 Apply As you learn the definition of each vocabulary term in this lesson, create your own definition or sketch to help you remember the meaning of the term.

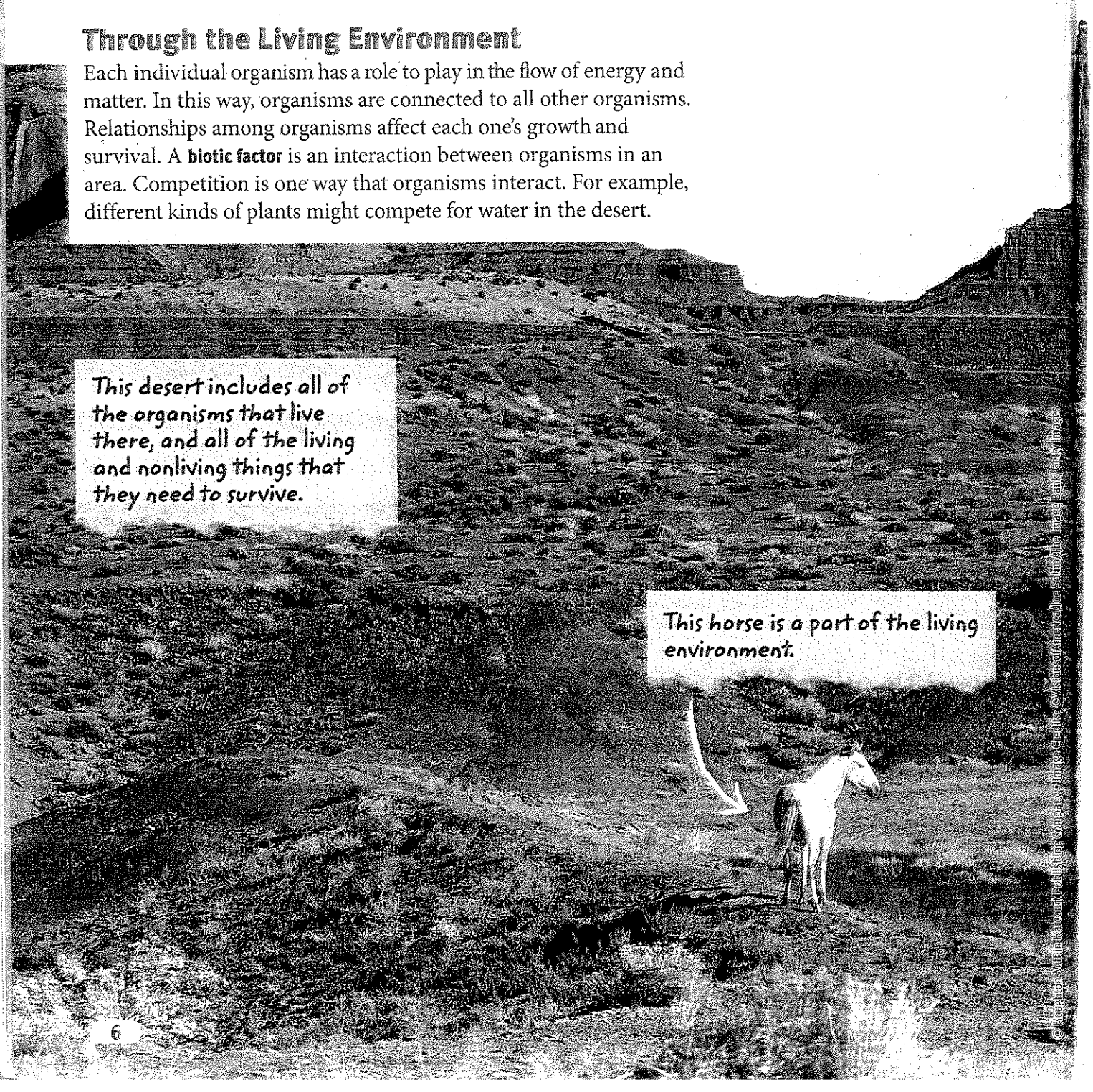
The Web of Life

How are all living things connected?

Organisms need energy and matter to live. Interactions between organisms cause an exchange of energy and matter. This exchange creates a web of life in which all organisms are connected to each other and to their environment. **Ecology** is the study of how organisms interact with one another and with the environment.

Through the Living Environment

Each individual organism has a role to play in the flow of energy and matter. In this way, organisms are connected to all other organisms. Relationships among organisms affect each one's growth and survival. A **biotic factor** is an interaction between organisms in an area. Competition is one way that organisms interact. For example, different kinds of plants might compete for water in the desert.



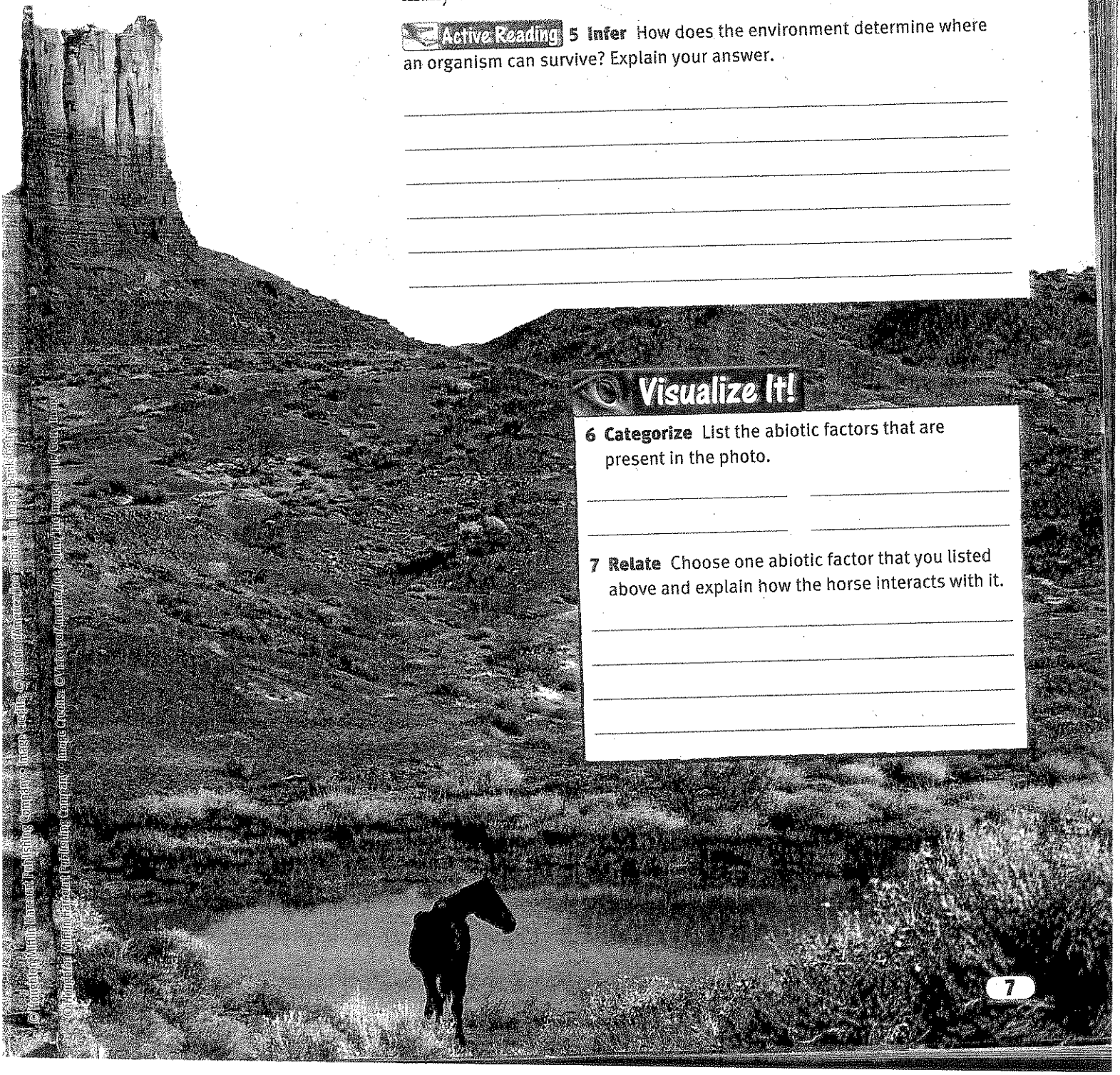
Through the Nonliving Environment

All organisms rely on the nonliving environment for survival. An **abiotic factor** is a nonliving part of an environment, such as water, nutrients, soil, sunlight, rainfall, or temperature. Some of these are resources that organisms need to grow and survive. For example, plants use sunlight, water, and soil nutrients to make food. Similarly, some organisms rely on soil or rocks for shelter.

Abiotic factors influence where organisms can survive. In a terrestrial environment, temperature and rainfall are important abiotic factors. In aquatic environments, the water's temperature, salt, and oxygen content are important abiotic factors. Changes in these basic abiotic factors affect where organisms can live and how many individuals are able to survive in the environment.

The rocks and air are parts of the nonliving environment.

Active Reading **5 Infer** How does the environment determine where an organism can survive? Explain your answer.



Visualize It!

6 Categorize List the abiotic factors that are present in the photo.

7 Relate Choose one abiotic factor that you listed above and explain how the horse interacts with it.

Stay Organized!

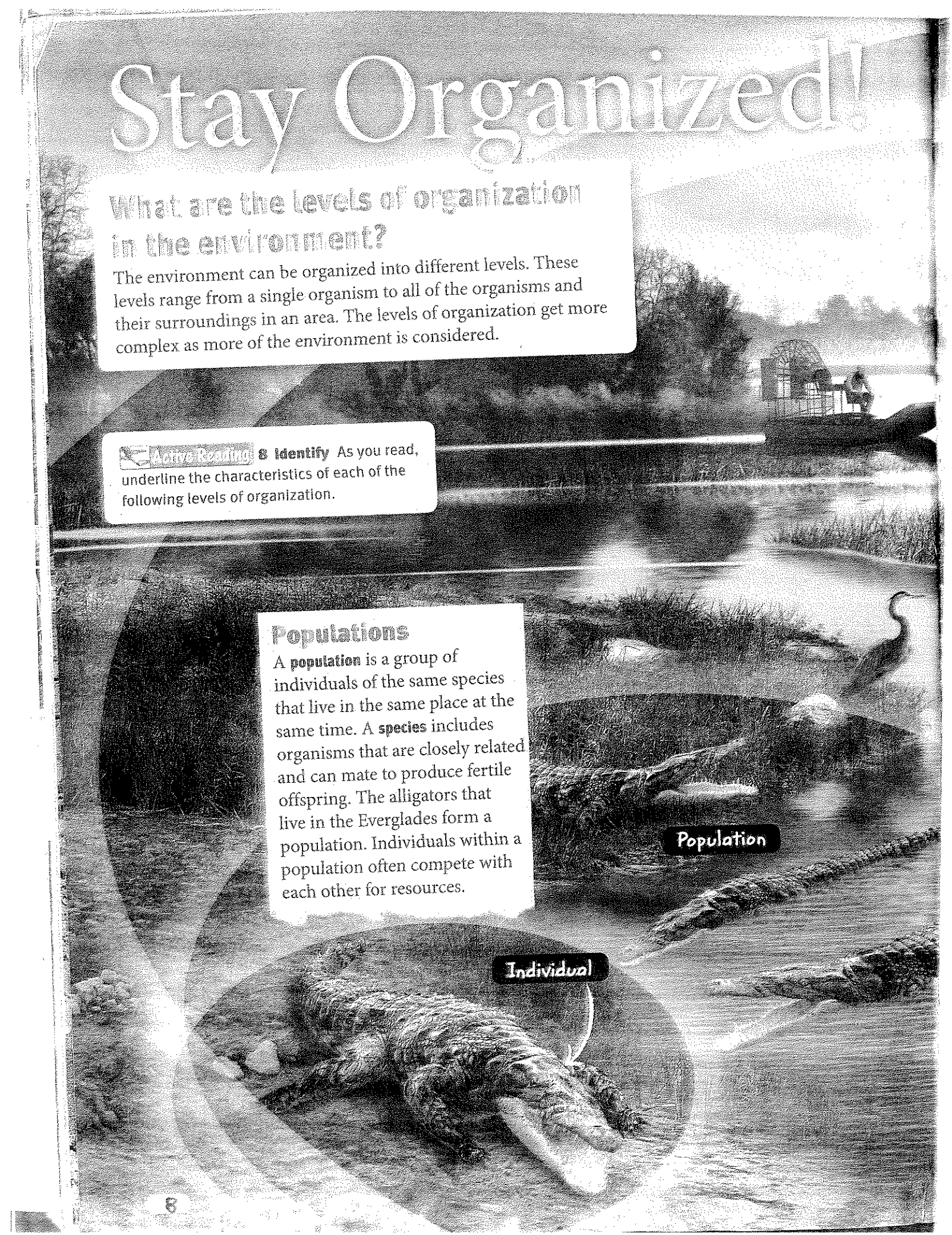
What are the levels of organization in the environment?

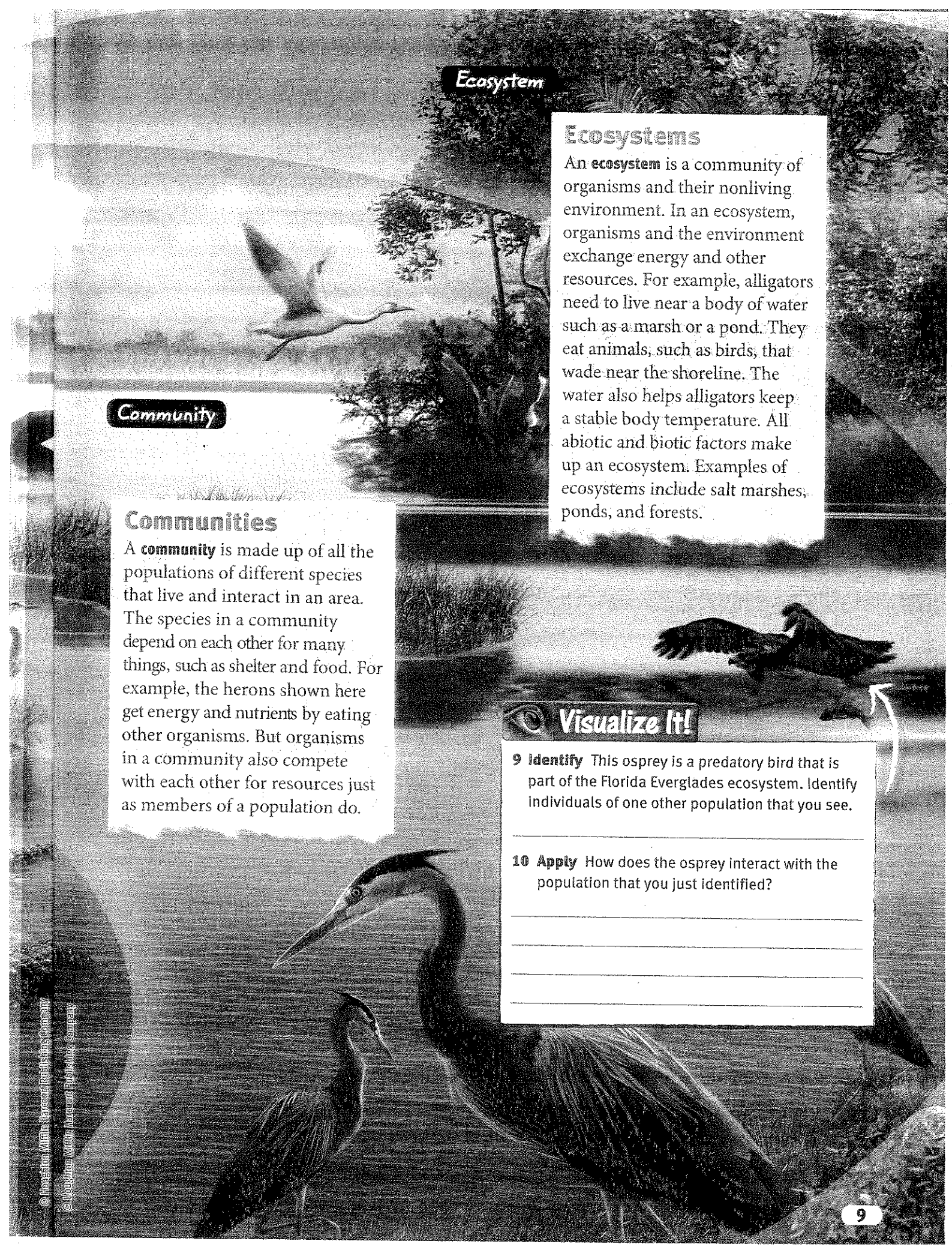
The environment can be organized into different levels. These levels range from a single organism to all of the organisms and their surroundings in an area. The levels of organization get more complex as more of the environment is considered.

Active Reading **& Identify** As you read, underline the characteristics of each of the following levels of organization.

Populations

A **population** is a group of individuals of the same species that live in the same place at the same time. A **species** includes organisms that are closely related and can mate to produce fertile offspring. The alligators that live in the Everglades form a population. Individuals within a population often compete with each other for resources.





Ecosystems

An **ecosystem** is a community of organisms and their nonliving environment. In an ecosystem, organisms and the environment exchange energy and other resources. For example, alligators need to live near a body of water such as a marsh or a pond. They eat animals, such as birds, that wade near the shoreline. The water also helps alligators keep a stable body temperature. All abiotic and biotic factors make up an ecosystem. Examples of ecosystems include salt marshes, ponds, and forests.

Communities

A **community** is made up of all the populations of different species that live and interact in an area. The species in a community depend on each other for many things, such as shelter and food. For example, the herons shown here get energy and nutrients by eating other organisms. But organisms in a community also compete with each other for resources just as members of a population do.

Visualize It!

9 **Identify** This osprey is a predatory bird that is part of the Florida Everglades ecosystem. Identify individuals of one other population that you see.

10 **Apply** How does the osprey interact with the population that you just identified?

Think Globally!

What is a biome?

Each ecosystem has its own unique biotic and abiotic factors. Some ecosystems have few plants and are cold and dry. Others have forests and are hot and moist. This wide diversity of ecosystems can be organized into categories. Large regions characterized by climate and communities of species are grouped together as **biomes**. A biome can contain many ecosystems. Major land biomes include tropical rain forest, tropical grassland, temperate grassland, desert, temperate deciduous forest, temperate rain forest, taiga, and tundra.

What characteristics define a biome?

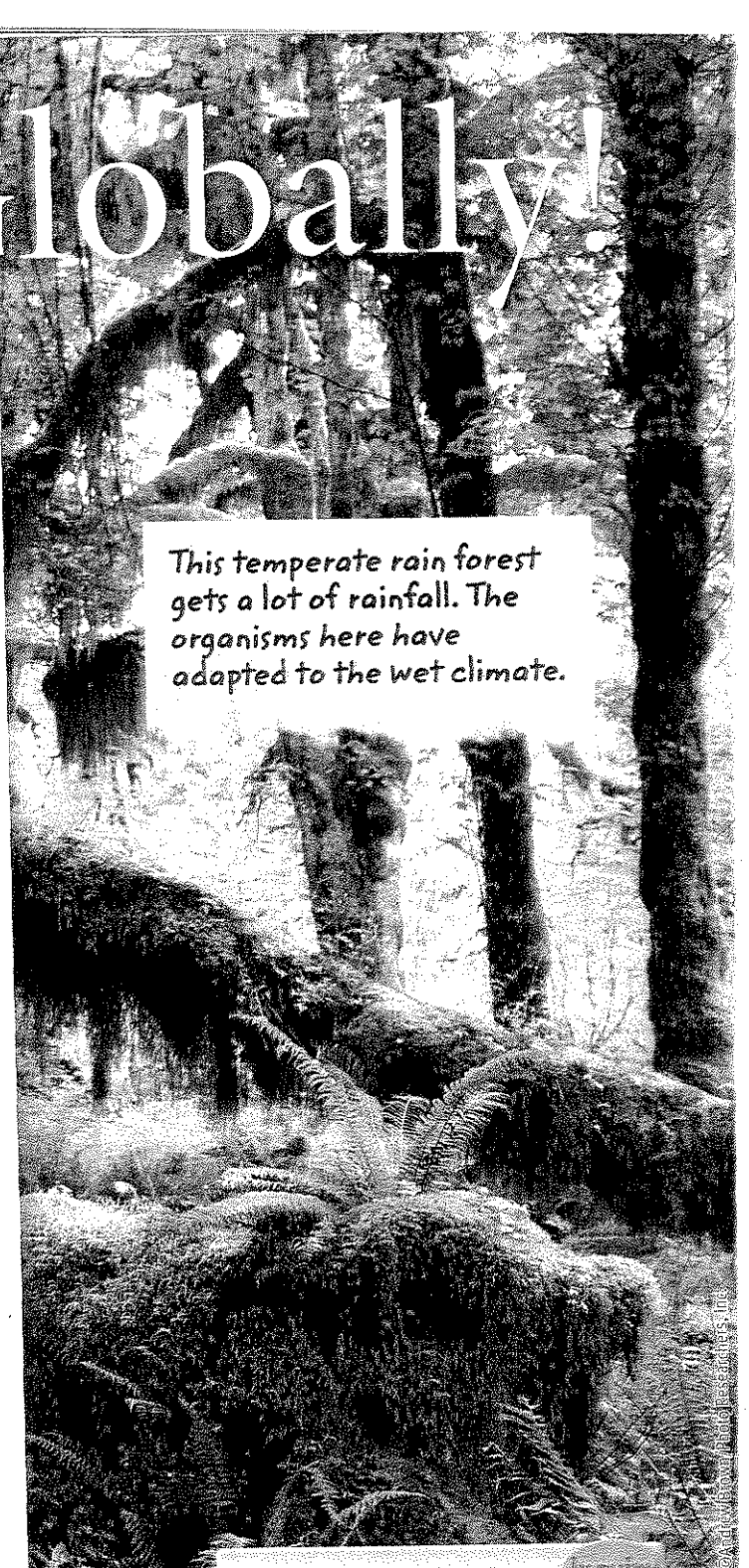
All of the ecosystems in a biome share some traits. They share climate conditions, such as temperature and rainfall, and have similar communities.

Climate Conditions

Active Reading **11 Identify** As you read, underline the climate factors that characterize biomes.

Temperature is an important climate factor that characterizes biomes. For example, some biomes have a constant temperature. The taiga and tundra have cold temperatures all year. Tropical biomes are warm all year. In other biomes, the temperature changes over the course of a year. Temperate biomes have warm summers and colder winters. In some biomes, major temperature changes occur within a single day. For example, some deserts are hot during the day but cold at night.

Biomes also differ in the amount of precipitation they receive. For example, tropical biomes receive a lot of rainfall, while deserts receive little precipitation. The taiga and tundra have moist summers and dry winters.



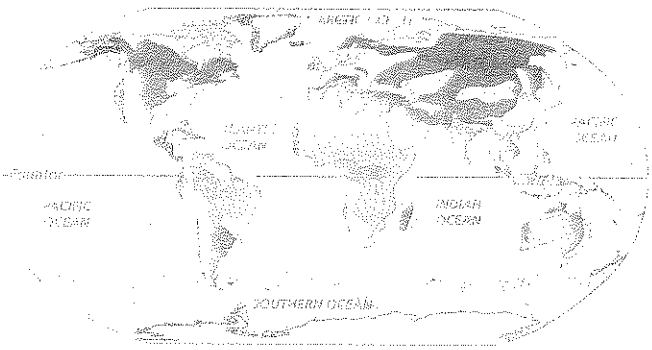
This temperate rain forest gets a lot of rainfall. The organisms here have adapted to the wet climate.

12 Apply What biome do you live in? Describe your climate and make a list of the living things that are found in natural undeveloped areas nearby. Research which biome has these features. Then look at a biome map to see if your observations match the biome that is mapped for your location.

Communities of Living Things

Biomes contain communities of living things that have adapted to the climate of the region. Thus, ecosystems within the same biome tend to have similar species across the globe. Monkeys, vines, and colorful birds live in hot and humid tropical rain forests. Grasses, large mammals, and predatory birds inhabit tropical grasslands on several continents.

Only certain types of plants and animals can live in extreme climate conditions. For example, caribou, polar bears, and small plants live in the tundra, but trees cannot grow there. Similarly, the plant and animal species that live in the desert are also unique. Cacti and certain animal species have adaptations that let them tolerate the dry desert climate.

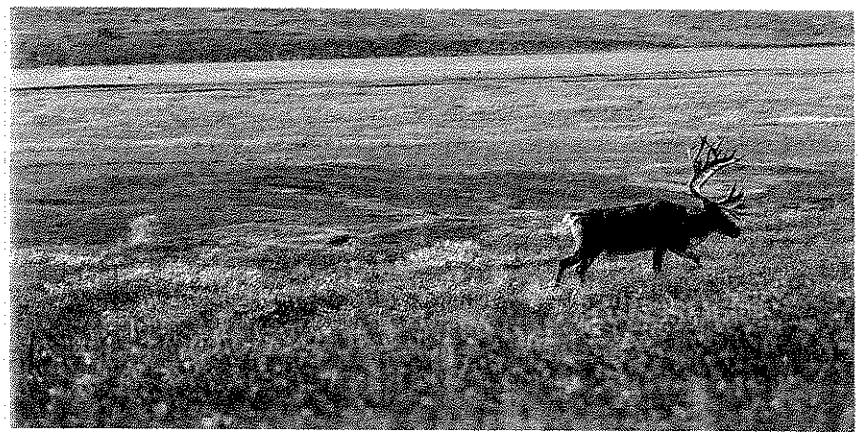


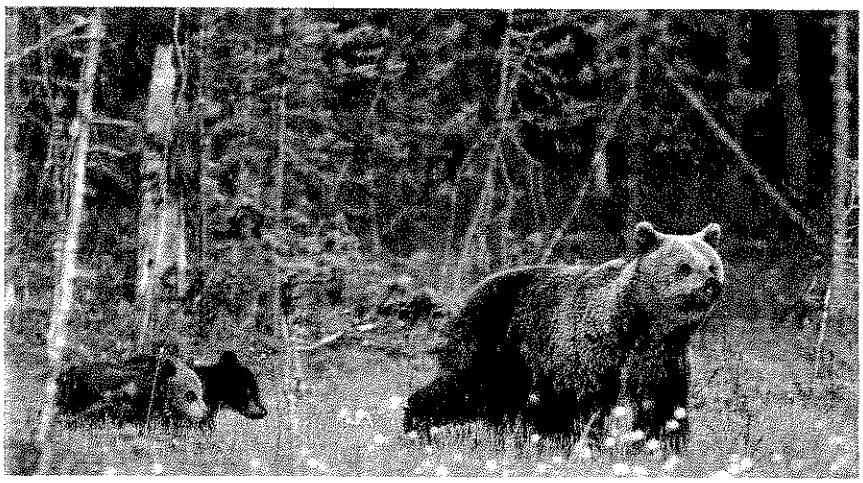
World biomes

- Desert
- Tropical grassland
- Temperate grassland
- Tropical rain forest
- Temperate deciduous forest
- Temperate rain forest
- Taiga
- Tundra

Visualize It!

13 Compare The photos below show two different biomes. Use what you learned about the characteristics of biomes to compare these environments, and then explain why they are categorized as different biomes. Write your answers in the space provided.





Compare: _____

Explain: _____

Home Sweet Home

What determines where a population can live?

Ecologists study the specific needs of different kinds of organisms and the role each species plays in the environment. Organisms that live in the same area have different ways of getting the resources they need.

Niche

Each population in an ecosystem plays a specific role. A population's **niche** (NICH) is the role the population plays in the ecosystem, such as how it gets food and interacts with other populations. For example, one part of a shark population's niche is eating fish.

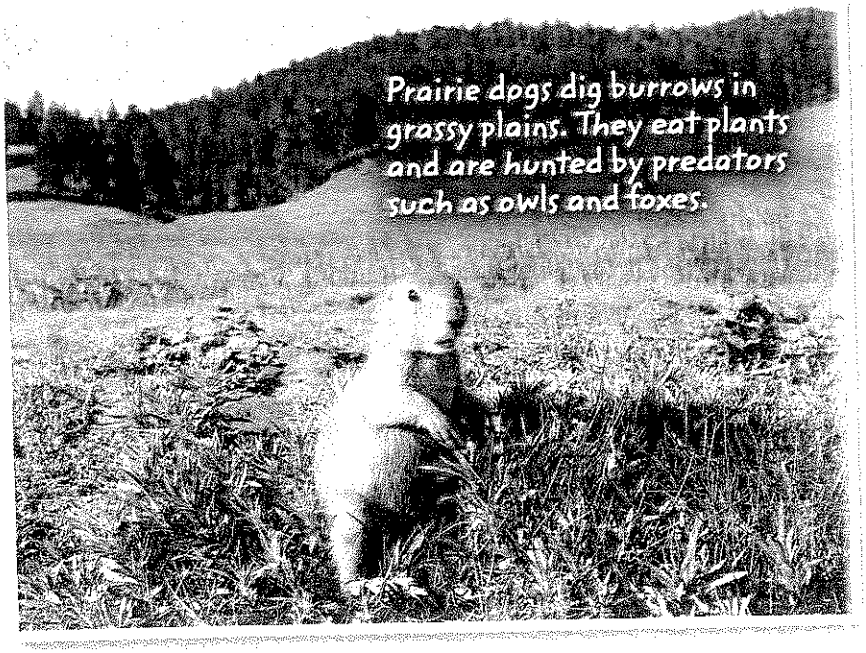
A **habitat** is the place where an organism usually lives and is part of an organism's niche. The habitat must provide all of the resources that an organism needs to grow and survive. Abiotic factors, such as temperature, often influence whether a species can live in a certain place. Biotic factors, such as the interactions with other organisms that live in the area, also play a role. For example, the habitat of a shark must include populations of fish it can eat.

Two populations cannot occupy exactly the same niche. Even small differences in habitats, roles, and adaptations can allow similar species to live together in the same ecosystem. For example, green and brown anoles sometimes live on the same trees, but they avoid competition by living in different parts of the trees.

14 Relate How is a habitat like a person's address? How is a niche like a person's job?

Visualize It!

15 Infer Describe the prairie dog's niche. How does it find shelter and impact the environment?



Why It Matters

EYE ON THE ENVIRONMENT

Lizard Invasion

Green anole lizards (*Anolis carolinensis*) have been part of the South Florida ecosystem for a long time. Recently, a closely related lizard, the nonnative brown anole (*Anolis sagrei*), invaded the green anoles' habitat. How do they avoid competing with each other for resources?

Home Base
Green anoles live on perches throughout a tree. Brown anoles live mainly on branches that are close to the ground. If they have to share a tree, green anoles will move away from perches close to the ground. In this way, both kinds of anoles can live in the same tree while avoiding competition with each other.

Intrusive Neighbors
Although brown and green anoles can coexist by sharing their habitats, they do not live together peacefully. For example, brown anoles affect green anoles by eating their young.

Extend

Inquiry

16 **Describe** How do green and brown anoles avoid competition? Draw a picture of a tree showing both green and brown anoles living in it.

17 **Research** What are other examples of two species dividing up the parts of a habitat?

18 **Relate** Infer what would happen if the habitats of two species overlapped. Present your findings in a format such as a short story, a music video, or a play.

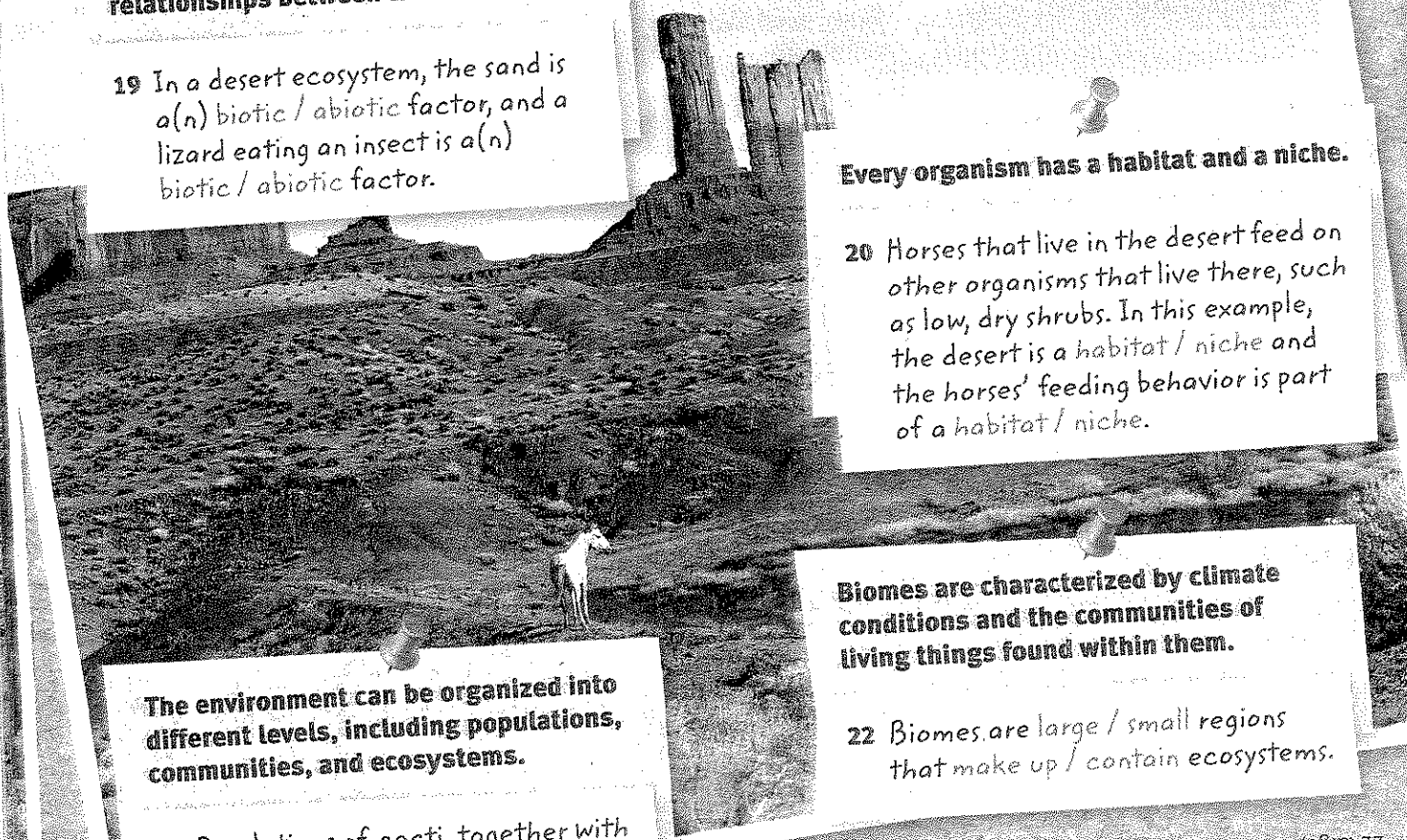
Visual Summary

To complete this summary, circle the correct word. Then use the key below to check your answers. You can use this page to review the main concepts of the lesson.

Ecology and Ecosystems

Ecology is the study of the biotic and abiotic factors in an ecosystem, and the relationships between them.

19 In a desert ecosystem, the sand is a(n) biotic / abiotic factor, and a lizard eating an insect is a(n) biotic / abiotic factor.



Every organism has a habitat and a niche.

20 Horses that live in the desert feed on other organisms that live there, such as low, dry shrubs. In this example, the desert is a habitat / niche and the horses' feeding behavior is part of a habitat / niche.

Biomes are characterized by climate conditions and the communities of living things found within them.

22 Biomes are large / small regions that make up / contain ecosystems.

The environment can be organized into different levels, including populations, communities, and ecosystems.

21 Populations of cacti, together with sand and rocks, are included in a desert community / ecosystem.

Answers: 19 abiotic, biotic; 20 habitat, niche; 21 ecosystem; 22 large, contain

23 **Predict** In the desert ecosystem shown above, name a biotic factor, and describe the effect on the horses if it were removed from the ecosystem.

Lesson Review

Vocabulary

1 Explain how the meanings of the terms *biotic factor* and *abiotic factor* differ.

2 In your own words, write a definition for *ecology*.

3 Explain how the meanings of the terms *habitat* and *niche* differ.

Key Concepts

4 **Compare** What is the relationship between ecosystems and biomes?

5 **Explain** Within each biome, how can the environment be organized into levels from complex to simple?

6 **Infer** How do the populations in a community depend on each other?

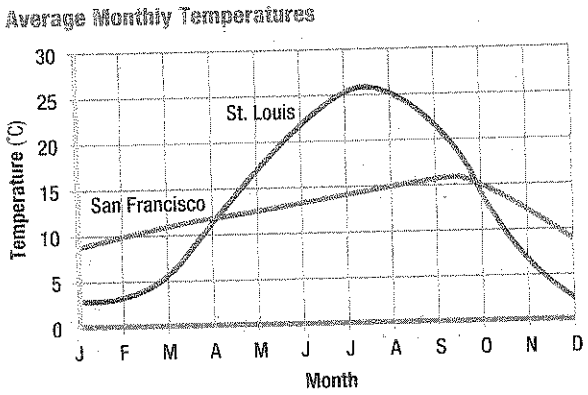
7 **Identify** What factors determine where a population can live?

Critical Thinking

8 **Predict** What might happen in a tropical rain forest biome if the area received very little rain for an extended period of time?

9 **Infer** Owls and hawks both eat rodents. They are also found in the same habitats. Since no two populations can occupy exactly the same niche, how can owls and hawks coexist?

Use this graph to answer the following question.



10 **Interpret** What is the difference in average temperature between the two cities in July?

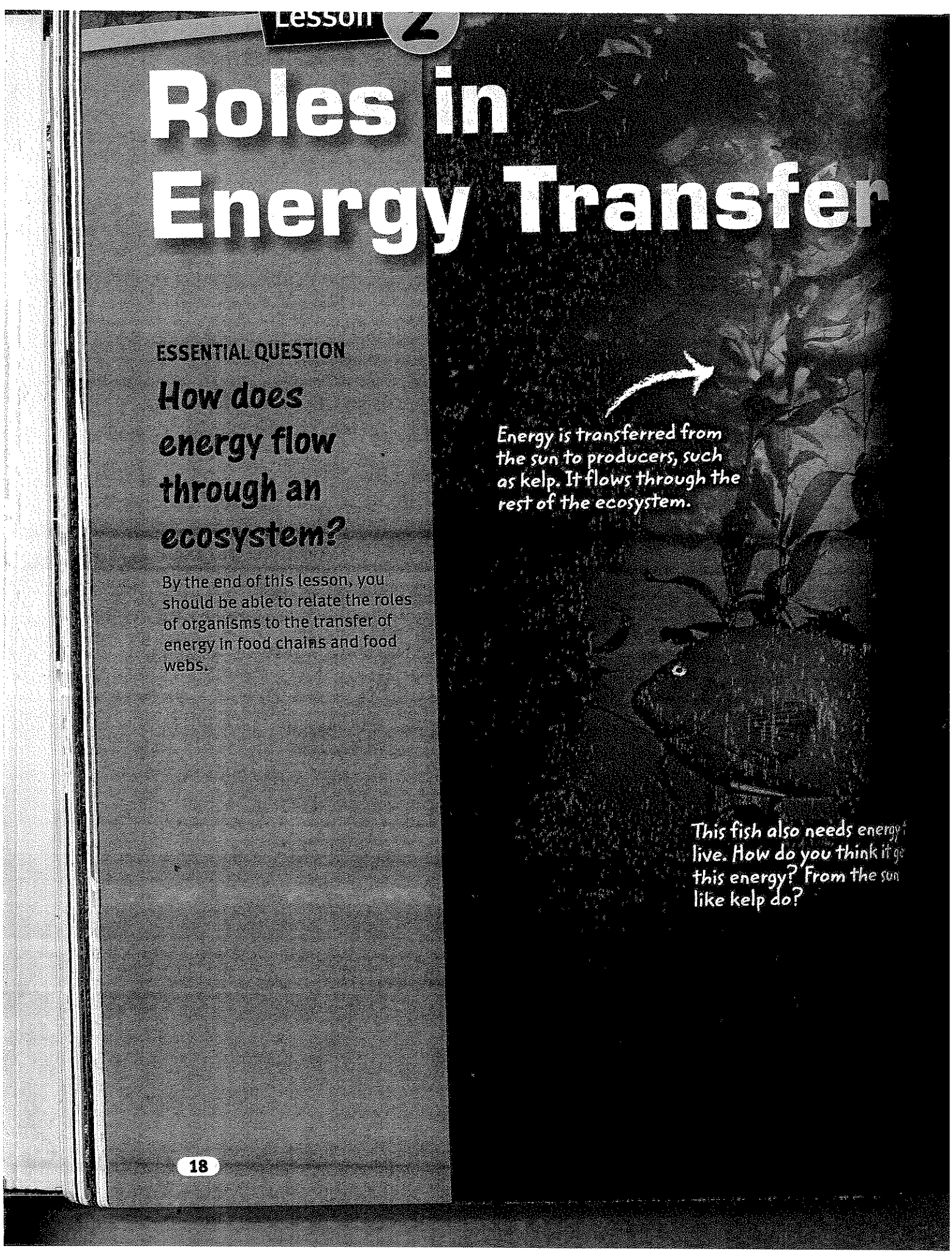
Lesson 2

Roles in Energy Transfer

ESSENTIAL QUESTION

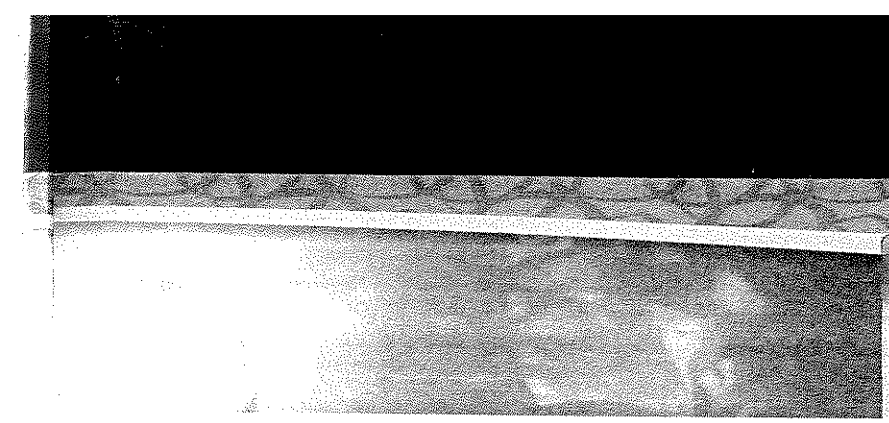
How does energy flow through an ecosystem?

By the end of this lesson, you should be able to relate the roles of organisms to the transfer of energy in food chains and food webs.



Energy is transferred from the sun to producers, such as kelp. It flows through the rest of the ecosystem.

This fish also needs energy t live. How do you think it ge this energy? From the sun like kelp do?



Lesson Labs

Quick Labs
- Making Compost
- Energy Role Game

Field Lab
- Food Webs

Engage Your Brain

1 **Describe** Most organisms on Earth get energy from the sun. How is energy flowing through the ecosystem pictured on the opposite page?

2 **Predict** List two of your favorite foods. Then, explain how the sun's energy helped make those foods available to you.

Active Reading

3 **Synthesize** You can often define an unknown word if you know the meaning of its word parts. Use the word parts and sentences below to make an educated guess about the meaning of the words *herbivore* and *carnivore*.

Word part	Meaning
-vore	to eat
herbi-	plant
carni-	meat

Example sentence
A koala bear is an herbivore that eats eucalyptus leaves.

herbivore:

Example sentence
A great white shark is a carnivore that eats fish and other marine animals.

carnivore:

Vocabulary Terms

- **producer**
- **decomposer**
- **consumer**
- **herbivore**
- **carnivore**
- **omnivore**
- **food chain**
- **food web**

4 **Apply** As you learn the definition of each vocabulary term in this lesson, create your own definition or sketch to help you remember the meaning of the term.

Get Energized!

How do organisms get energy?

Energy is all around you. Chemical energy is stored in the bonds of molecules and holds molecules together. The energy from food is chemical energy in the bonds of food molecules. All living things need a source of chemical energy to survive.

Active Reading **6 Identify** As you read, underline examples of producers, decomposers, and consumers.

5 Apply Record what you eat at your next meal. Where do you think these items come from, before they reach the market?

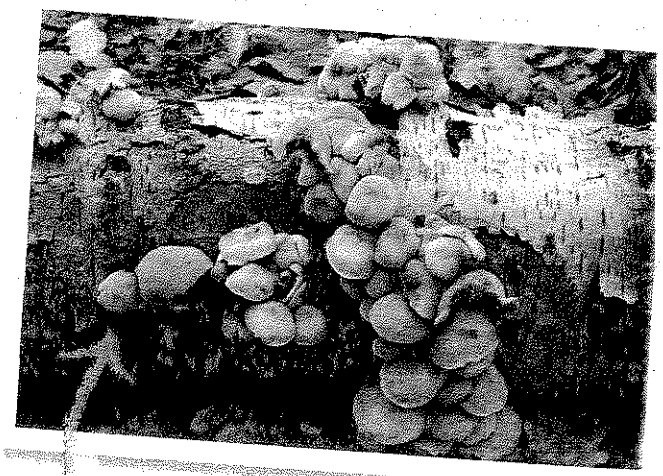
Producers Convert Energy Into Food

A **producer**, also called an autotroph, uses energy to make food. Most producers use sunlight to make food in a process called photosynthesis. The sun powers most life on Earth. In photosynthesis, producers use light energy to make food from water, carbon dioxide, and nutrients found in water and soil. The food contains chemical energy and can be used immediately or stored for later use. All green plants, such as grasses and trees, are producers. Algae and some bacteria are also producers. The food that these producers make supplies the energy for other living things in an ecosystem.

This plant is a producer. Producers make food using light energy from the sun.

Decomposers Break Down Matter

An organism that gets energy and nutrients by breaking down the remains of other organisms is a **decomposer**. Fungi, such as the mushrooms on this log, and some bacteria are decomposers. Decomposers are nature's recyclers. By converting dead organisms and animal and plant waste into materials such as water and nutrients, decomposers help move matter through ecosystems. Decomposers make these simple materials available to other organisms.



These mushrooms are decomposers. They break down the remains of plants and animals.

Consumers Eat Other Organisms

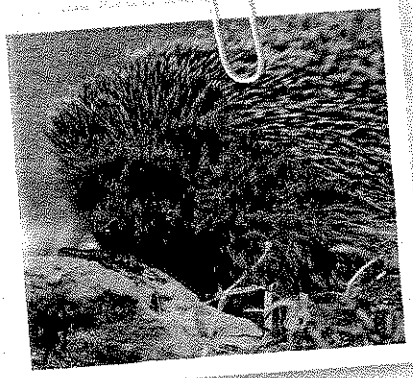
A **consumer** is an organism that eats other organisms. Consumers use the energy and nutrients stored in other living organisms because they cannot make their own food. A consumer that eats only plants, such as a grasshopper or bison, is called an **herbivore**. A **carnivore**, such as a badger or this wolf, eats other animals. An **omnivore** eats both plants and animals. A *scavenger* is a specialized consumer that feeds on dead organisms. Scavengers, such as the turkey vulture, eat the leftovers of the meals of other animals or eat dead animals.

This wolf is a consumer. It eats other organisms to get energy.

Consumers

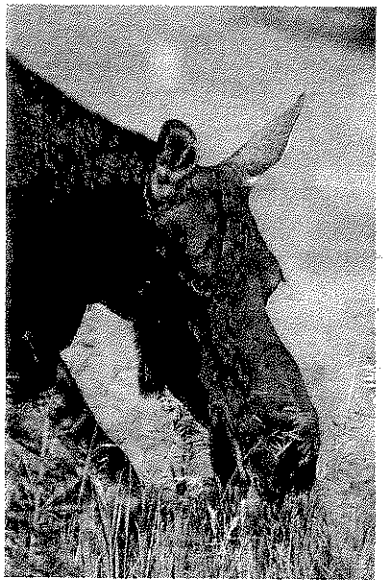
Visualize It!

7 List Beside each image, place a check mark next to the word that matches the type of consumer the animal is.



Name: Hedgehog
What I eat: leaves, earthworms, insects

What am I?
- ☐ herbivore
- ☐ omnivore
- ☐ carnivore



Name: Moose
What I eat: grasses, fruits

What am I?
- ☐ herbivore
- ☐ omnivore
- ☐ carnivore

Name: Komodo dragon
What I eat: insects, birds, mammals

What am I?
- ☐ herbivore
- ☐ omnivore
- ☐ carnivore

8 Infer Explain how carnivores might be affected if the main plant species in a community were to disappear.

_____

_____

_____

Energy Transfer

How is energy transferred among organisms?

Organisms change energy from the environment or from their food into other types of energy. Some of this energy is used for the organism's activities, such as breathing or moving. Some of the energy is saved within the organism to use later. If an organism is eaten or decomposes, the consumer or decomposer takes in the energy stored in the original organism. Only chemical energy that an organism has stored in its tissues is available to consumers. In this way, energy is transferred from organism to organism.

Active Reading **9 Infer** When a grasshopper eats grass, only some of the energy from the grass is stored in the grasshopper's body. How does the grasshopper use the rest of the energy?

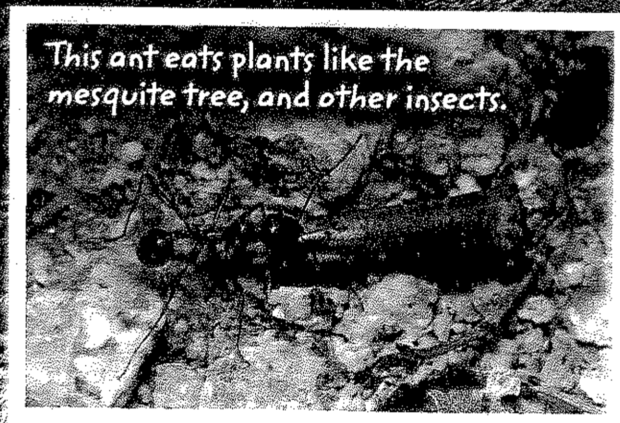
____

____

10 Identify By what process does this tree get its energy?

____

____



11 Apply What type of energy is this ant consuming?

____

____

Energy Flows Through a Food Chain

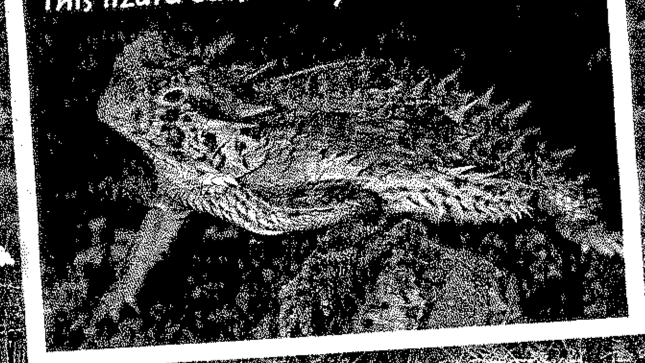
A **food chain** is the path of energy transfer from producers to consumers. Energy moves from one organism to the next in one direction. The arrows in a food chain represent the transfer of energy, as one organism is eaten by another. Arrows represent the flow of energy from the body of the consumed organism to the body of the consumer of that organism.

Producers form the base of food chains. Producers transfer energy to the first, or primary, consumer in the food chain. The next, or secondary, consumer in the food chain consumes the primary consumer. A tertiary consumer eats the secondary consumer. Finally, decomposers recycle matter back to the soil.

This hawk eats the lizard. It is at the top of the food chain.

Visualize It!

The photographs below show a typical desert food chain. Answer the following four questions from left to right based on your understanding of how energy flows in a food chain.



This lizard eats mostly insects.

13 Predict If nothing ever eats this hawk, what might eventually happen to the energy that is stored in its body?

____

____

12 Apply What does the arrow between the ant and the lizard represent?

____

____

How do food webs show energy connections?

Active Reading

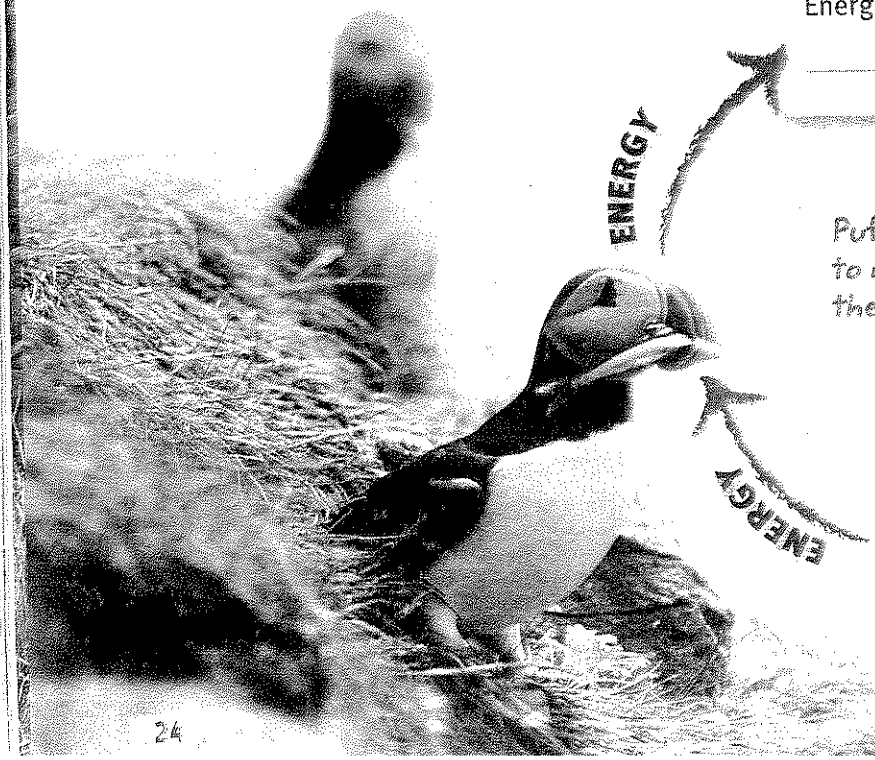
14 Identify Underline the type of organism that typically forms the base of the food web.

Few organisms eat just one kind of food. So, the energy and nutrient connections in nature are more complicated than a simple food chain. A **food web** is the feeding relationships among organisms in an ecosystem. Food webs are made up of many food chains.

The next page shows a coastal food web. Most of the organisms in this food web live in the water. The web also includes some birds that live on land and eat fish. Tiny algae called phytoplankton form the base of this food web. Like plants on land, phytoplankton are producers. Tiny consumers called zooplankton eat phytoplankton. Larger animals, such as fish and squid, eat zooplankton. At the top of each chain are top predators, animals that eat other animals but are rarely eaten. In this food web, the killer whale is a top predator. Notice how many different energy paths lead from phytoplankton to the killer whale.

Visualize It!

15 Apply Complete the statements to the right with the correct organism names from the food web.



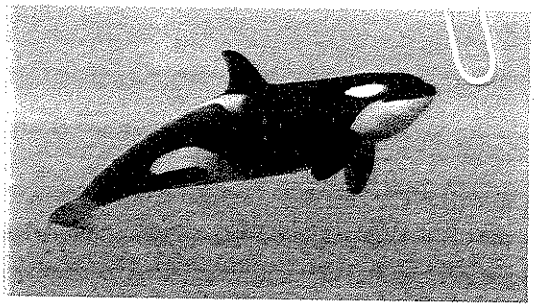
Energy flows up the food web when _____ eat puffins.

Puffins are connected to many organisms in the food web.

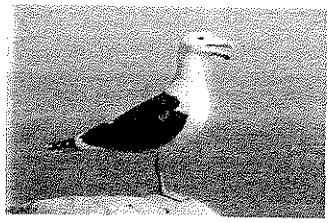
Puffins get energy by eating _____, _____, and _____.

Food Web

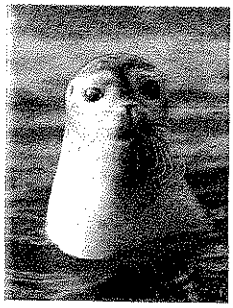
The top predator is shown at the top of the food web. What is the top predator in this food web?



Killer whale

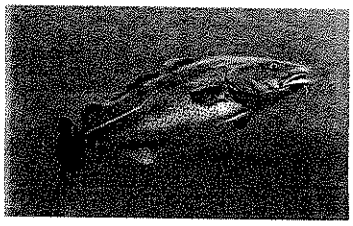


Gull

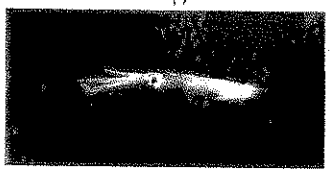


Seal

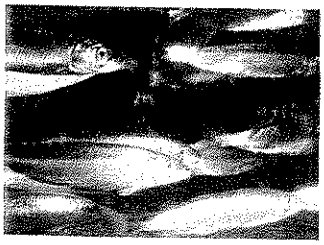
Puffin



Cod



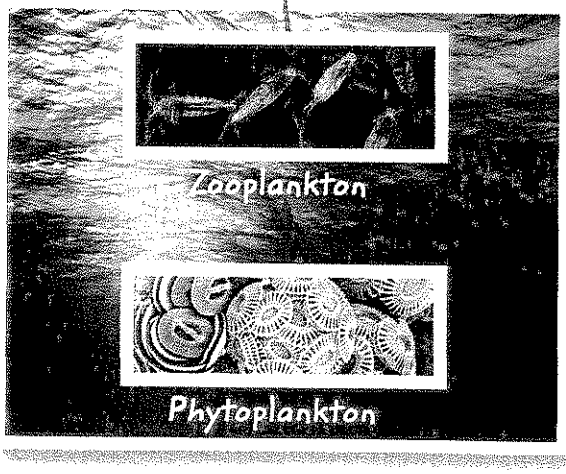
Squid



Herring

Sand lance

Consumers can eat producers and other consumers.



Producers, such as these phytoplankton, form the base of the food web.

How are organisms connected by food webs?

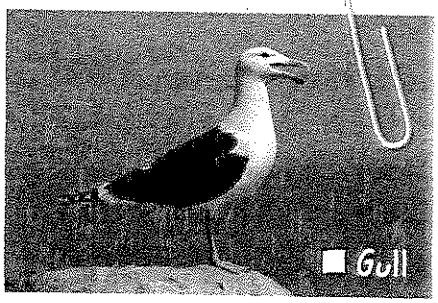
All living organisms are connected by global food webs. Global food webs include webs that begin on land and webs that begin in the water. Many organisms have feeding relationships that connect land- and water-based food webs. For example, algae might be eaten by a fish, which might then be eaten by a bird.

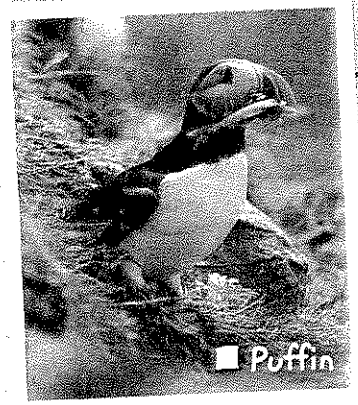
Food webs that start on land may also move into the water. Many insects that eat plants on land lay their eggs in the water. Some fish eat these eggs and the insect larvae that hatch from them. Because the global food webs are connected, removing even one organism can affect many organisms in other ecosystems.

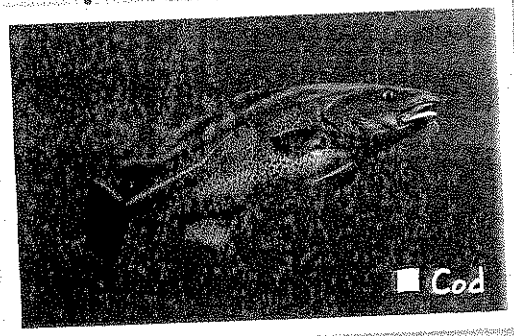
18 Infer Gulls don't eat herring but they are still connected by the food web. How might gull populations be affected?

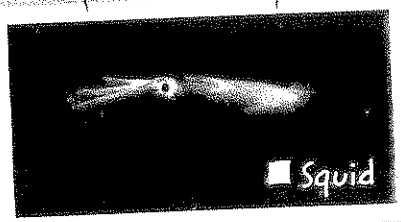
Visualize It!

Imagine how these organisms would be affected if herring disappeared from the food web. Answer the questions starting at the bottom of the page.









17 Predict With no herring to eat, how might the eating habits of cod change?

16 Identify Put a check mark next to the organisms that eat herring.

Why It Matters

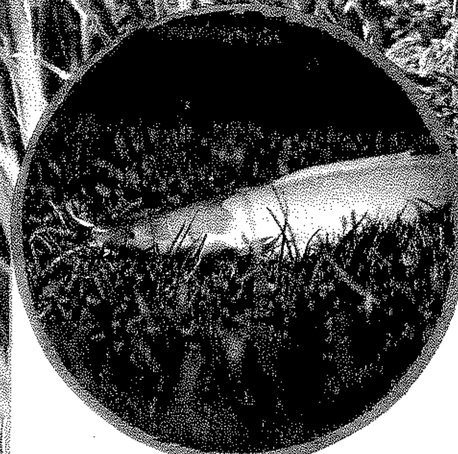
EYE ON THE ENVIRONMENT

Dangerous Competition

Sometimes species are introduced into a new area. These invasive species often compete with native species for energy resources, such as sunlight and food.

Full Coverage

The kudzu plant was introduced to stop soil erosion, but in the process it outgrew all the native plants, preventing them from getting sunlight. Sometimes it completely covers houses or cars!



Destructive Zebras

The zebra mussel is one of the most destructive invasive species in the United States. They eat by filtering tiny organisms out of the water, often leaving nothing for the native mussel species.

Across the Grass

The walking catfish can actually move across land to get from one pond to another! As a result, sometimes the catfish competes with native species for food.

Extend

Inquiry

19 Relate Describe how the competition between invasive and native species might affect a food web.

20 Describe Give an example of competition for a food resource that may occur in an ecosystem near you.

21 Illustrate Provide an illustration of your example of competition in a sketch or a short story. Be sure to include the important aspects of food webs that you learned in the lesson.

Visual Summary

To complete this summary, circle the correct word. Then use the key below to check your answers. You can use this page to review the main concepts of the lesson.

Energy Transfer in Ecosystems

Organisms get energy in different ways.

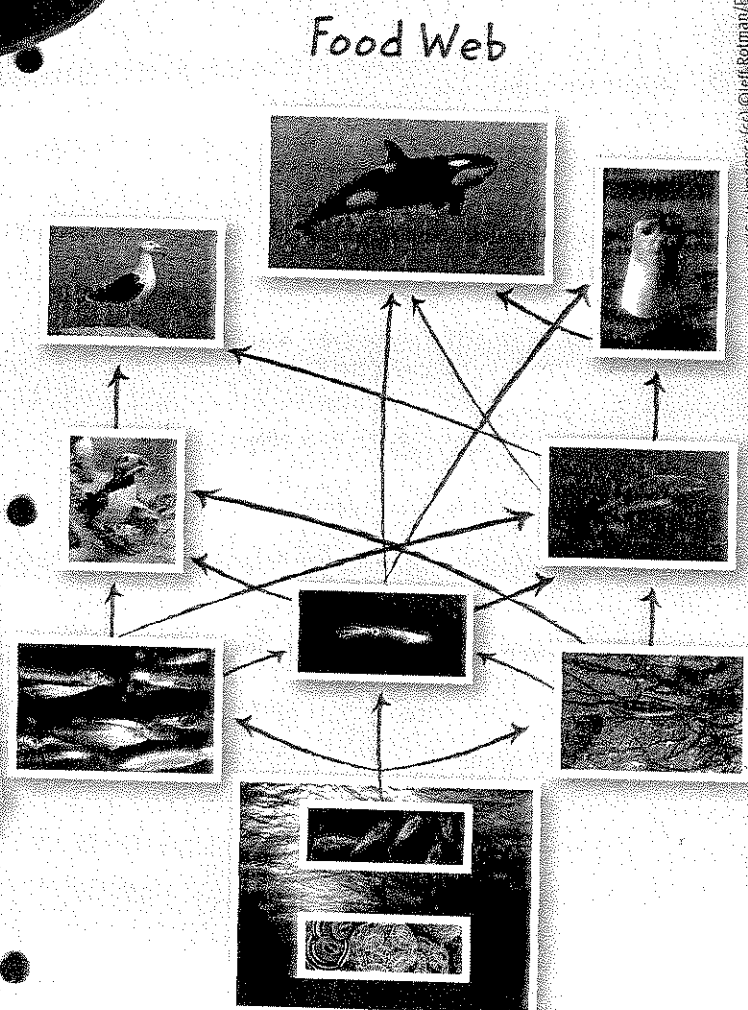
- Producers make their own food.
- Consumers eat other living organisms.
- Decomposers break down dead organisms.

22 *Herbivores, carnivores, and omnivores are three types of producers / consumers / decomposers.*

Food chains and food webs describe the flow of energy in an ecosystem.

23 *All food chains start with producers / consumers / decomposers.*

Answers: 22 consumers; 23 producers



24 Predict Describe the effects on global food webs if the sun's energy could no longer reach Earth.