

## Chapter 15

# *Ecosystems*

A California sea otter wakes up from a nap and unwraps itself from the large frond of kelp that was keeping it from floating away while sleeping. The playful sea otter dives to the ocean floor, looking for tasty sea urchins that are feeding on the kelp. After bringing a sea urchin to the surface, the sea otter floats on its back in the sunshine, opens the urchin by banging on it with a rock, and eats it. The ocean water, kelp, sea urchins, sea otter, sunshine— indeed, all of the living and nonliving things that interact in this coastal marine area— make up an *ecosystem*. What types of ecosystems are found where you live?



### **Key Questions**

1. *What is an ecosystem?*
2. *What is a common way to show “who eats whom” in an ecosystem?*
3. *Why are ecosystems in a “delicate balance”?*

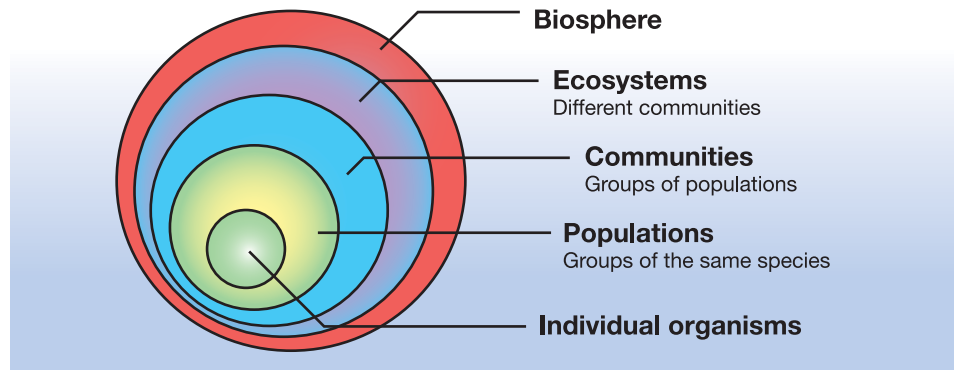


## 15.1 Ecosystems and Energy

Did anyone ever ask you the question: “Where do you get your energy?” Energy enters our world from the Sun—but how does the Sun’s energy become your energy? Read this section to find out.

### What is an ecosystem?

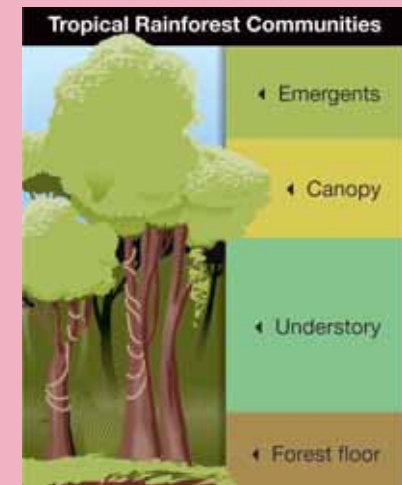
**Organizing living things** Individual living things can be grouped into higher levels of organization. Living things of the same type are grouped into *populations*. Populations of different types of living things are grouped into *communities*. Different communities form *ecosystems*, which make up the *biosphere*.



**Ecosystems** A tropical rainforest is an example of an ecosystem. An **ecosystem** is made up of a group of living things and their physical surroundings. A tropical rainforest ecosystem is made up of the plants and animals that live there, plus nonliving things like soil, air, water, sunlight, and nutrients. The living and nonliving parts of an ecosystem work together like a team.

### ! CHALLENGE

Research, list, and describe at least two populations that make up each of the four tropical rainforest communities.



### ã VOCABULARY

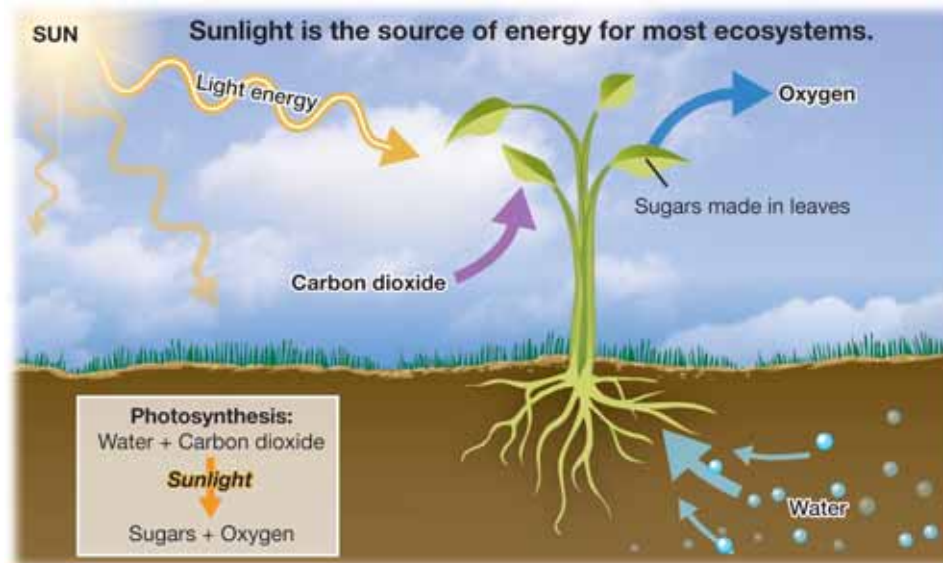
**ecosystem** - a group of living things and their physical surroundings.



## Photosynthesis and energy

**Sunlight** Sunlight is almost always the first type of energy to enter an ecosystem. How is energy from the Sun useful to an ecosystem? You may already know that some living things, like plants, are able to capture the energy from sunlight (Figure 15.1). When another living thing in an ecosystem eats a plant, it is gaining energy that came first from the Sun.

**Photosynthesis** **Photosynthesis** happens when a plant uses the Sun's energy to turn water and carbon dioxide into useful molecules such as sugars and starches. A company that bottles orange juice once advertised that there is a little sunshine in every bottle. There is some scientific truth to that advertisement!



### VOCABULARY

**photosynthesis** - the process plants use to make food from sunlight, water, and carbon dioxide.



**Figure 15.1:** Ferns can survive with very little sunlight. A cactus needs a lot of sunlight to grow.

## Living parts of an ecosystem

**Producers** Most ecosystems get their energy first from sunlight. A **producer** is a living thing, like a plant, that can take the Sun's energy and store it as food. Another word for "produce" is *make*. Producers make their own food. Kapok and banana trees are common producers in a tropical rainforest ecosystem.

**Consumers** Other members of ecosystems cannot make their own food. A **consumer** must feed on other living things to get food and energy. Another word for "consume" is *eat*. Consumers eat other living things. A **herbivore** is a consumer that eats only plants. A **carnivore** is a consumer that eats only animals. A consumer that eats both plants and animals is called an **omnivore**. There are many consumers in a tropical rainforest ecosystem. Insects, caterpillars, and monkeys feed on the plants and trees. These herbivores are eaten by carnivores such as ocelots and pumas. What about you? Are you a herbivore, carnivore, or an omnivore?

**Decomposers** Producers and consumers in an ecosystem create waste and both eventually die. If waste and dead organisms are not somehow broken down, the nutrients they contain would not become available for other living organisms in that ecosystem. The waste would pile up and potentially harm living things. Imagine what it would be like in your neighborhood if the trash was not taken away—you would not be able to stay there for very long without getting sick. A **decomposer** is a living thing that consumes waste and dead organisms to get energy. "Decompose" means to *break down*. Decomposers break down material from waste and dead organisms, and the molecules are returned to the ecosystem. Fungi and bacteria are decomposers in many ecosystems (Figure 15.2). Decomposers are important and can be called *nature's recyclers*.

### VOCABULARY

**producer** - a living thing that can make its own food.

**consumer** - a living thing that eats other living things for food and energy.

**herbivore** - a consumer that eats only plants.

**carnivore** - a consumer that eats only animals.

**omnivore** - a consumer that eats both plants and animals.

**decomposer** - a living thing that breaks down waste and dead things.



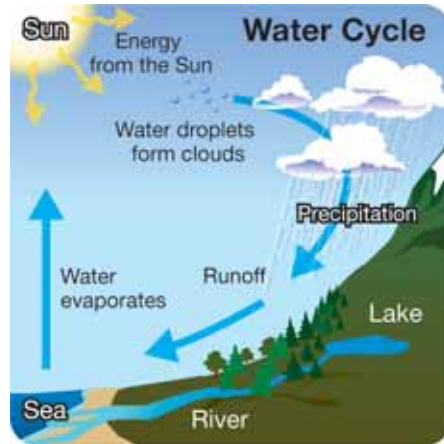
**Figure 15.2:** *Mushrooms are fungi that help decompose fallen branches and leaves on the forest floor.*





## Nonliving parts of an ecosystem

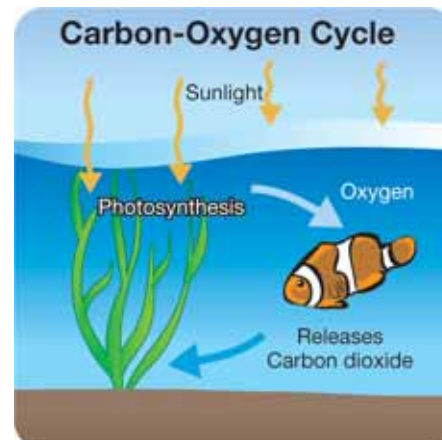
### Water and sunlight



Living things need water and sunlight. The Sun is always there, but what about water? Water supply depends on the *water cycle*. Nature allows water to recycle so it can be used in many ecosystems. Look at the picture to the left. Where does the energy come from to make the water cycle work? That's right, the Sun is the source of energy.

### Carbon and oxygen

Even though we can't see them, carbon and oxygen are important members of ecosystems. The Carbon-Oxygen cycle describes how the ecosystem uses these important elements. Carbon is present in both air and water as carbon dioxide gas. Oxygen is also a gas that is found in air and water. Producers take in carbon dioxide during the process of photosynthesis, and release oxygen. Consumers take in oxygen for their life processes and release carbon dioxide. When you breathe in, your body gets the oxygen it needs. When you breathe out, your body gets rid of carbon dioxide. This carbon dioxide is needed by producers in your ecosystem.



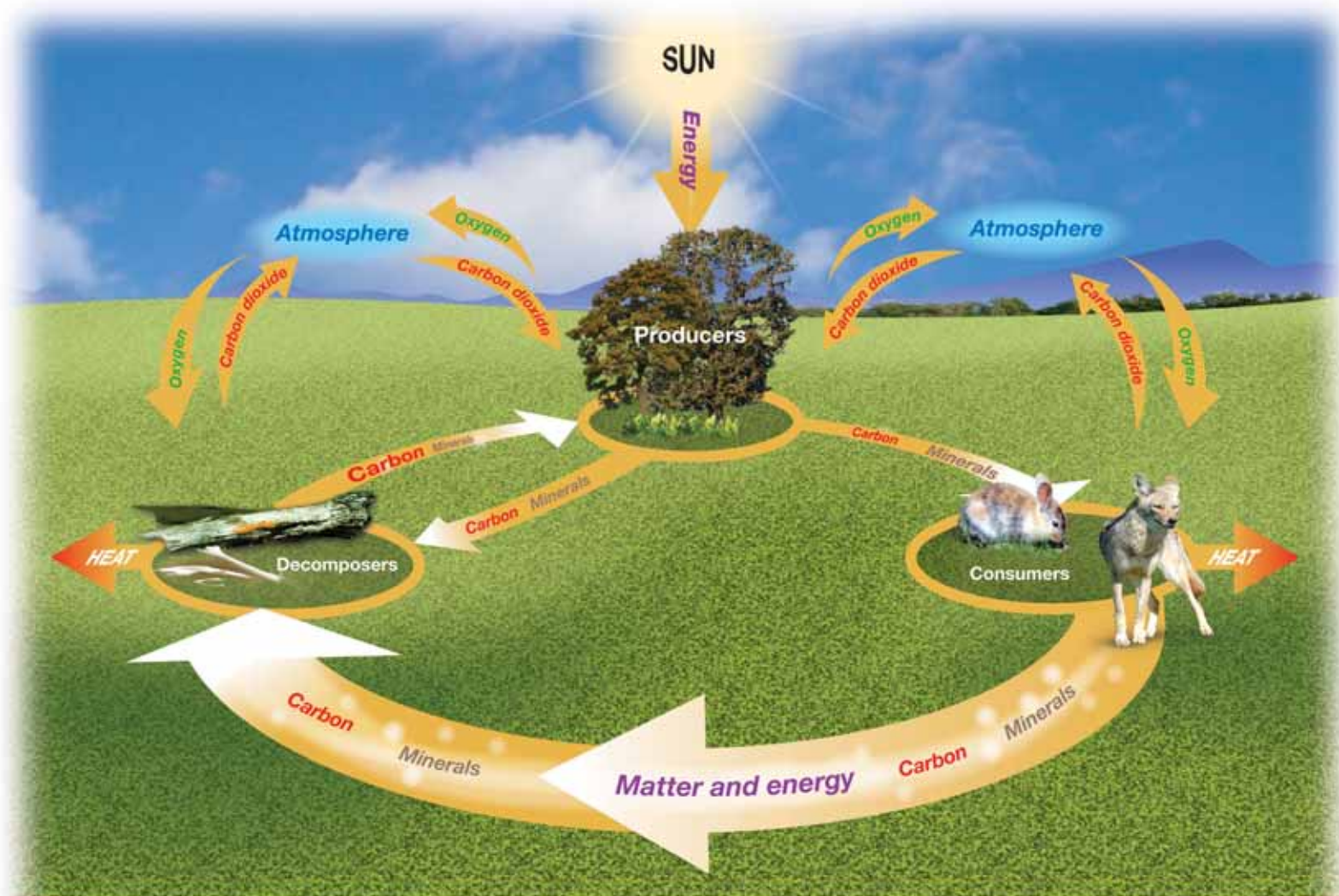
### STUDY SKILLS

#### Understanding a cycle diagram

Refer to the water cycle diagram on this page to practice this study skill.

1. Place your finger on a part of the cycle. A cycle repeats over and over, so it does not matter where you begin.
2. Follow the arrows in the diagram while tracing your finger along the pathway.
3. Read each label and make sure you understand what happens during each step.
4. Refer to the diagram and write down a few sentences about what happens in the cycle from start to finish.

## Living and nonliving parts of an ecosystem



Living and nonliving parts of an ecosystem are linked together by recycling matter and energy.



## 15.1 Section Review

1. What is an ecosystem?
2. Use the terms *producer*, *consumer*, and *decomposer* to label each member of the meadow ecosystem: grass, grasshopper, frog, snake, hawk, and fungus.
3. What process changes light energy into chemical energy (energy that can be used by organisms other than producers) in an ecosystem?
4. How are matter and nutrients cycled back into the ecosystem from which they came?
5. A \_\_\_\_\_ is the type of organism that undergoes photosynthesis, converting energy into a usable form of food for other organisms in an ecosystem.
6. What form of energy is lost by moving from producer to consumer to decomposer in an ecosystem?
  - a. light
  - b. heat
  - c. food energy
7. Research the term *chemosynthesis* on the Internet. After researching the term, explain what chemosynthesis is. Then provide an explanation for why the statement, “all living things require energy from the Sun” is **not true**.
8. BONUS QUESTION: What is the name of the cactus pictured to the right?

### MY JOURNAL



The Sonoran Desert covers about 120,000 square miles in southwestern Arizona, southeastern California, and parts of Mexico. Divide your journal page into two columns labeled *Producers* and *Consumers*. Do some research and list five different common producers and consumers in the Sonoran Desert.

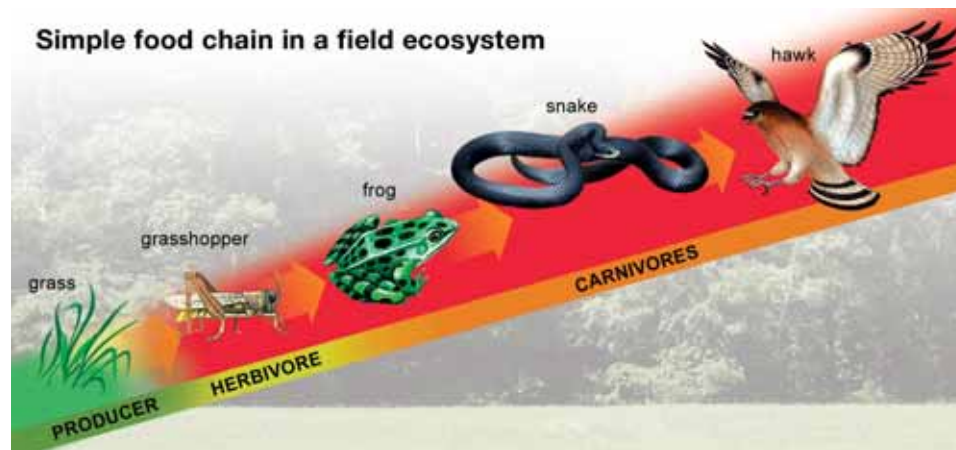


## 15.2 Food Chains and Food Webs

All living things need energy. Off the California coast, an ocean plant called kelp is eaten by sea urchins. Sea otters eat the sea urchins. In turn, a sea otter might be eaten by a shark. The sequence of “who eats whom” is called a food chain.

### What is a food chain?

**A simple food chain** A **food chain** shows how each member of an ecosystem gets its food. A simple food chain links a producer, an herbivore, and one or more carnivores (Figure 15.3). Arrows in the food chain show how energy is passed from one link to another.



**Producers are plentiful** What is the most plentiful member of a field ecosystem? You might answer “carnivores,” since there are three examples of carnivores in the illustration above. However, grasses and other producers are much more plentiful than carnivores. This food chain shows how each member of the ecosystem gets its food. It is not meant to show how many of each type of organism there is in the ecosystem.

### VOCABULARY

**food chain** - shows how each member of an ecosystem community gets its food.



**Figure 15.3:** How would these members of a meadow ecosystem be linked in a food chain?

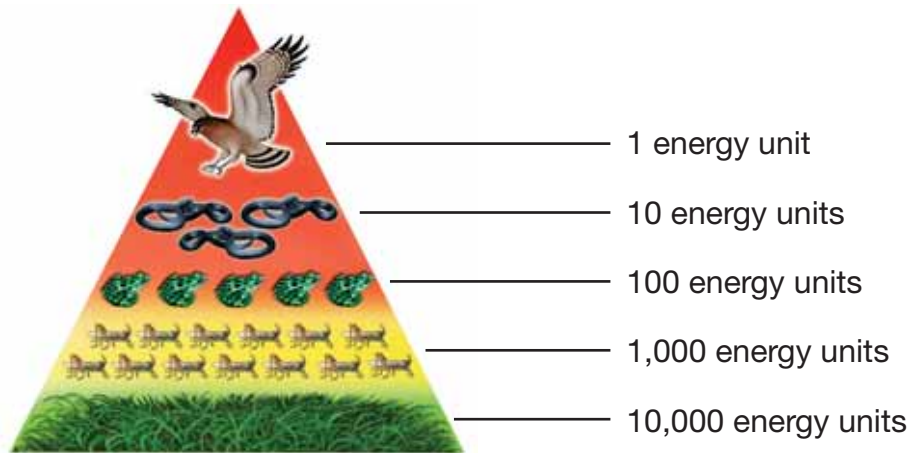




## Energy and food chains

**Energy decreases as you move up in a food chain** There are more producers than herbivores or carnivores in an ecosystem community. When an herbivore eats a plant, only some of the plant's energy becomes part of the herbivore's body. The rest is lost as waste or heat. Also, when a carnivore eats another animal, only some of that energy becomes part of the carnivore's body. The amount of energy that gets passed along from the original producer becomes less and less as you move up a food chain.

**Energy pyramid** A diagram in the shape of a pyramid is a good way to show how energy moves from one feeding level to the next in a food chain. Why is the pyramid a good shape for the diagram? Because a pyramid is wide at the base and narrow at the top. As you move up the pyramid from producer to consumer, the diagram gets smaller and smaller to show how less and less energy is available.



An energy pyramid shows how many units of energy there are at each level of a food chain.

### VOCABULARY

**energy pyramid** - diagram that shows how energy moves from one feeding level to the next in a food chain.

### SOLVE IT!

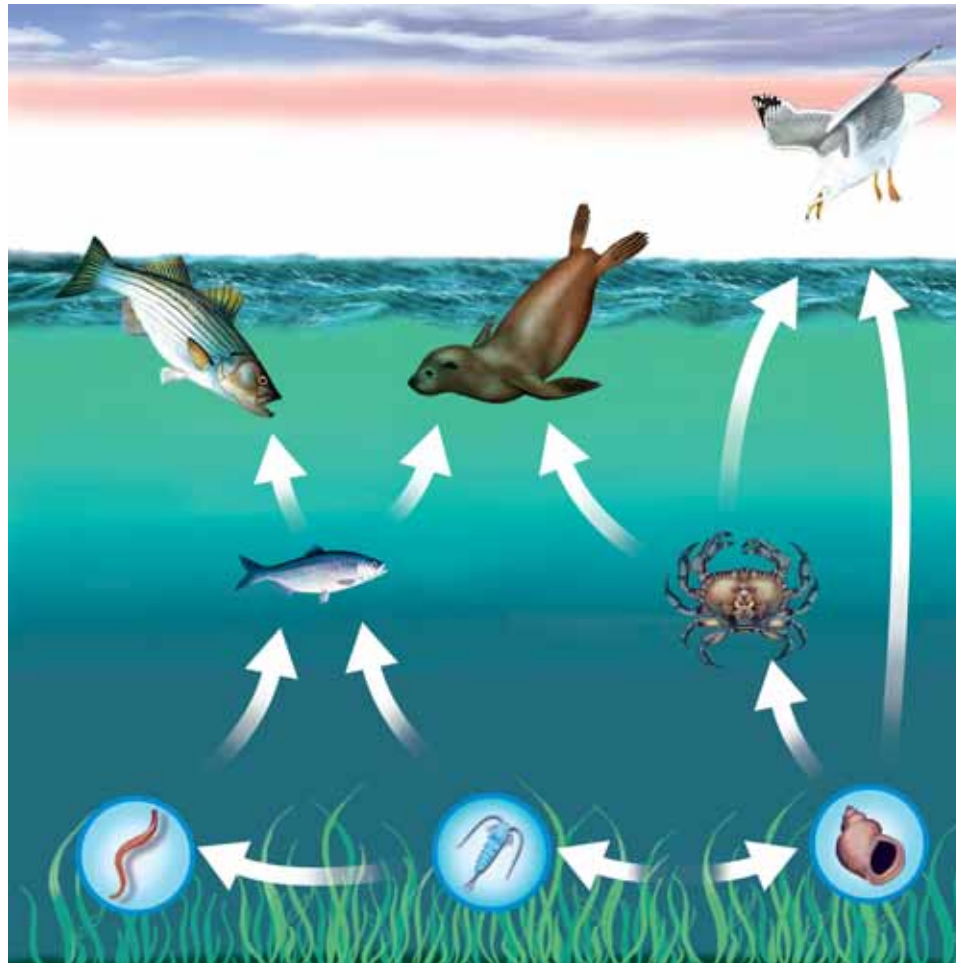
There cannot be too many links in any food chain because the animals at the top of the energy pyramid would not get enough energy to stay alive.

1. Describe a pattern that you see in the pyramid's energy unit numbers.
2. How many times more energy units does the grass have than the grasshopper?
3. How many times more energy units does the frog have than the snake?

## Food webs

**What is a food web?**

Most animals are part of more than one food chain. They eat more than one kind of food to get enough energy and nutrients. You can connect many food chains to form a food web. How many simple food chains are shown in the food web below?



## VOCABULARY

**food web** - a group of overlapping food chains in an ecosystem.

## MY JOURNAL

The food web members pictured on this page are: seaweed, worm, zooplankton (tiny floating animals that eat producers), snail, crab, sardine (small fish), striped bass (large fish), seal, and gull. Make a sketch of each simple food chain that makes up the web, and label each member with its common name.



## 15.2 Section Review

1. How is a food web different from a food chain?
2. Circle all of the terms that apply to the organisms in Figure 15.4:
  - a. Field mouse: consumer, omnivore, herbivore, carnivore, producer, photosynthesizer, plant, animal
  - b. Red fox: consumer, omnivore, herbivore, carnivore, producer, photosynthesizer, plant, animal
  - c. Green plant: consumer, omnivore, herbivore, carnivore, producer, photosynthesizer, plant, animal
  - d. Snake: consumer, omnivore, herbivore, carnivore, producer, photosynthesizer, plant, animal
3. Sketch the correct food chain for the organisms pictured in Figure 15.4. (Hint: foxes are known to eat reptiles!)
4. Name a marine animal that could be at the top of the marine food web pictured on the previous page, with arrows linking it to both the sea otter and striped bass.
5. Why is a pyramid a good shape for a diagram that shows how energy moves from one feeding level to the next in a food chain? Be sure your answer includes the word *energy*.



**Figure 15.4:** Use this figure to answer questions 2 and 3.



## 15.3 Ecosystems—A Delicate Balance

The ways that living things in an ecosystem relate to one another creates a natural balance. Most of the relationships in an ecosystem involve food. Other interactions are affected by human activity in positive and negative ways.

### Interactions

**Competition** Members of an ecosystem often compete for food. **Competition** happens when two or more species depend on the same food source or any limited resource. For example, on Sable Island off the coast of Nova Scotia, gray seals and harbor seals compete for the same food (Figure 15.5). Both types of seals feed on tiny fish called *sand lances*. Scientists have discovered that gray seals dig into the ocean floor to find the fish hiding there. Harbor seals follow schools of sand lances and eat fish that wander away from the school. The gray seals are thriving, but the harbor seal population has been decreasing. The gray seals seem to have a more successful feeding behavior, and they are winning the competition.

**Predator-prey relationships** Sharks in Sable Island's offshore waters are known to eat seals. Animals that feed on other animals are called **predators**. In this example, the sharks are predators and the seals are **prey**. The sharks like to eat both kinds of seals, but harbor seals are smaller and easier to catch. Predator-prey relationships help keep a natural balance in an ecosystem.

**Symbiosis** There are many cases where two different types of living things live closely together for long periods of time. This type of interaction is called **symbiosis**. In symbiosis, at least one member always benefits from the interaction. A remora is a small fish that follows sharks around and eats their scraps. The remora benefits from the shark, but the shark does not benefit from the remora.

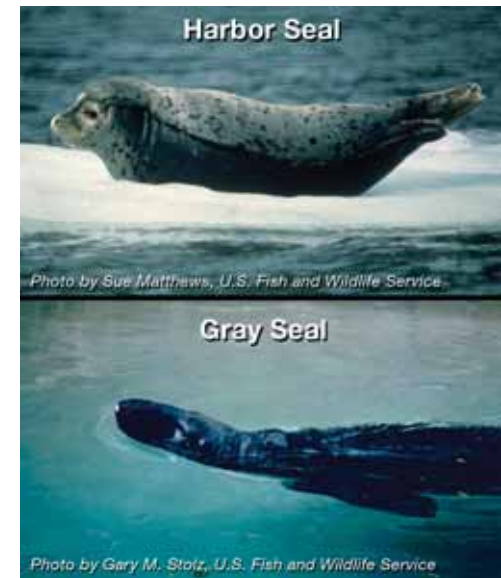
### VOCABULARY

**competition** - happens when members of an ecosystem depend on the same limited supply of food.

**predators** - animals that feed on other animals.

**prey** - animals that are killed for food by a predator.

**symbiosis** - an interaction where two species live together for a long time and at least one of the species benefits.



**Figure 15.5:** Gray seals and harbor seals compete for the same food off the coast of Sable Island in Nova Scotia.



## Pollutants

**What is a pollutant?** Human activities affect ecosystems in both positive and negative ways. One negative effect is pollution. A **pollutant** is something that causes harm to a living thing. Three things often determine how harmful a pollutant is:

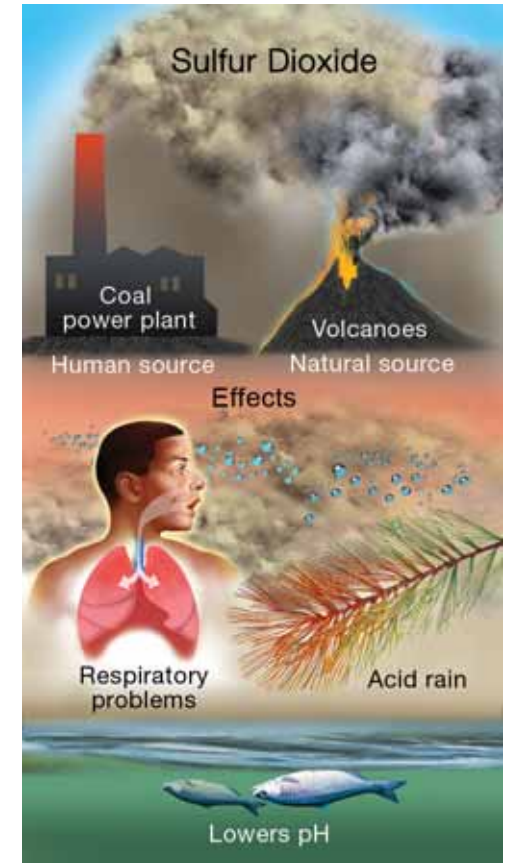
1. the pollutant's ability to cause harm
2. the amount of pollutant in the air, water, or soil
3. how long the pollutant stays in the air, water, or soil

**Sulfur dioxide is a pollutant** Sulfur dioxide is a chemical that is a good example of a pollutant (Figure 15.6). When sulfur dioxide is present in large amounts in the air, it can make breathing difficult even for healthy people. It also reacts with water in the atmosphere to make acid rain. Acid rain can kill trees and harm life in lakes, ponds, and streams. Sulfur dioxide enters the air from fossil fuel power plants, automobiles, and even volcanoes.

**Mercury is a pollutant** Mercury is an element that can be found naturally in an ecosystem. Human activities like industry also cause the release of mercury into the environment. It is taken in by members of an ecosystem and it builds up in their bodies. When the amount of mercury in a living organism gets high enough, the animal or plant can be harmed and may even die. Mercury is commonly found in fish. Because mercury is stored up in the fatty tissues of the fish over its entire lifetime, the level of the mercury in the fish may be thousands of times higher than the level of the mercury in the water (this is also known as biomagnification).

### VOCABULARY

**pollutant** - a variable that causes harm to an organism.



**Figure 15.6:** Sulfur dioxide is a pollutant.

## Sea otters and the marine ecosystem

**California sea otters** California sea otters are playful members of the California coastal marine ecosystem. They are listed under the federal Endangered Species Act, and they are called a “fully protected mammal” under California state law. What happened to cause the sea otters in California to become endangered? They were hunted by humans until the population became very small. Since 1977, the number of sea otters has been growing, but they are still considered a “threatened” species.

**Keystone species** Sea otters are called a *keystone species*. This means that they are very important members of the marine ecosystem. The feeding habits of sea otters directly affect animals and plants that are lower in the food chain. Sea otters play an important role in maintaining the healthy balance of the kelp community. Kelp is a large sea plant that can form underwater forests (Figure 15.7).

**The ecosystem balancing act** Sea otters are important to the health of a kelp forest because they eat sea urchins, abalone, and other shellfish that feed on the kelp. Without sea otters, the shellfish population would eat too much of the kelp and destroy the kelp forest. Why is the kelp forest important? It is home to many fish, shellfish, and other marine life. Can you see how an ecosystem and all of its members interact in a delicate, natural balancing act?



**Figure 15.7:** An underwater kelp forest is home to many fish, shellfish, and other marine life.







## Water quality

### Marine and freshwater ecosystems

Perhaps you live in a coastal region, where marine ecosystems are part of your everyday life. But even if you live far inland, you are part of another kind of aquatic environment—a freshwater ecosystem. We depend on fresh water for drinking, for staying clean, and for farming and industries. Humans can't live apart from a freshwater ecosystem!

### Water quality testing

Because clean water is so important to our daily lives, we must protect the health of freshwater ecosystems. Governments and civic groups test the quality of surface water regularly (Figure 15.8).

### Observing a body of water

To learn about the water quality of a pond, river, or lake, you would first make careful observations. You might ask, “What does the pond water look like or smell like? What animals and plants are living in the pond? Where is the pond located? Are there houses or farms nearby? Is the pond near a factory?” Common tests used to see if surface water is healthy are described below.

### Temperature

The water temperature of a pond is measured three or more inches below the surface of the water. The higher the water temperature, the less dissolved oxygen there may be in the water. Dissolved oxygen is needed by most organisms living in the pond.

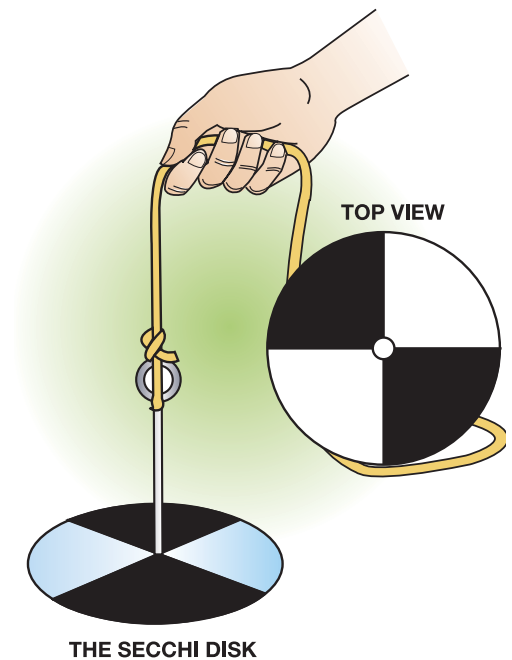
### Turbidity test

The turbidity test measures the cloudiness of water. If the water is cloudy due to suspended sediment, sunlight is blocked, and pond plants do not grow well. This can be harmful, because pond plants are needed as food for other living things in the pond. A *secchi disk* provides an easy way to measure turbidity (Figure 15.9). The disk is lowered into the water until the black and white panels are no longer visible to a person looking into the water. The rope holding the disk is marked at meter and half-meter intervals to measure the depth of the disk when it disappears from view underwater.



Photo courtesy of U.S. Department of Agriculture - IFCS

**Figure 15.8:** Testing water quality in a pond ecosystem.



**Figure 15.9:** A Secchi disk.

## More water quality tests

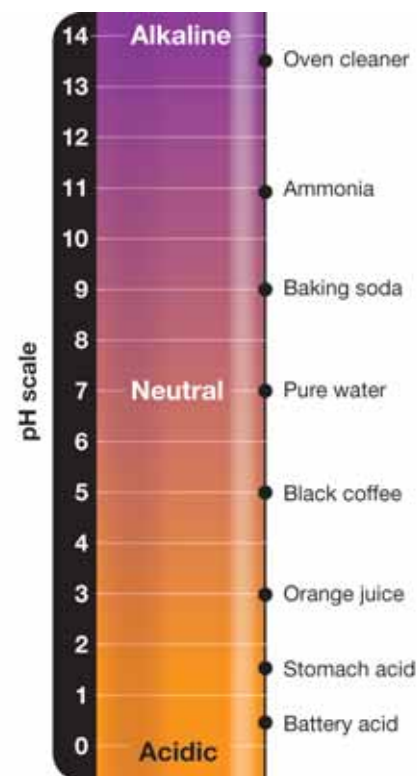
**Dissolved oxygen test** Oxygen enters fresh water from the air and the photosynthesis of aquatic plants and microscopic organisms called phytoplankton. Water quality is higher when dissolved oxygen levels are high. Water samples for a dissolved oxygen test should be taken away from the water's edge and about three inches below the surface.

**Biological oxygen demand test** The biological oxygen demand test is a two-part test. Two water samples are taken at the same time. Dissolved oxygen is measured in the first sample right away. The second sample is shielded from light and measured at a later time. The amount of oxygen in the first and second samples is compared to find out how much oxygen was used by bacteria as they decompose organic material.

**Nitrate and phosphate tests** Nitrates and phosphates are chemicals that can enter ponds that are near farms, fertilized lawns, or septic tanks. Excess nitrates or phosphates can cause large growths of algae, a type of rootless, stemless plant commonly found in ponds. Decomposers feed on the decaying algae and use up valuable oxygen. This endangers the health of the pond ecosystem.

**pH test** The pH scale ranges from 0 to 14 (Figure 15.10). Pure water is pH 7 (neutral). Surface water ranges from about 6.5 to 8.5. Most organisms in an aquatic ecosystem function best when the water pH is about 7. Many life processes do not function well when pH is too high or low. For example, fish have trouble reproducing when the pH of their water environment is too low (acidic).

**Summary** These water quality tests help make sure that the water we need stays clean and safe. When test results show that a body of water is unhealthy, government and civic groups can work together to find the causes and decide on a way to make the aquatic ecosystem healthy once again.



**Figure 15.10:** The pH values of some common solutions. The pH of a solution is a measure of how acidic (pH 0 to 7) or basic (pH 7 to 14) it is.



## 15.3 Section Review

- Read each description of an ecosystem interaction and decide whether it is an example of *competition*, *predator-prey relationship*, or *symbiosis*.
  - Sweet potato plants release chemicals that keep other nearby plants from growing.
  - Tickbirds sit on a black rhinoceros and feed on the ticks that infest the thick skin of the rhino. The rhino benefits because it gets ticks removed from its body; the tickbirds benefit because they have a source of food.
  - A hawk captures and eats a rabbit.
- Name one type of air pollutant and one type of water pollutant. Why are these substances harmful to air and water?
- Water quality is very important to the health of a pond. Complete the water quality test chart that has been started for you. Be sure to fill in all the blanks!

Water Quality Test	What it tests for	Results for a healthy pond
Temperature	How warm or cold the water is	Cold water has more oxygen available for living things than warm water
Turbidity	The cloudiness of the water	Clear water allows sunlight to get to the pond plants, which helps them grow
Dissolved oxygen		
Nitrates		
pH		

### ! CHALLENGE



#### Black-Tailed Prairie Dog

The black-tailed prairie dog is a keystone species in a prairie ecosystem. Do some research to find at least three reasons why this animal is considered a keystone species.

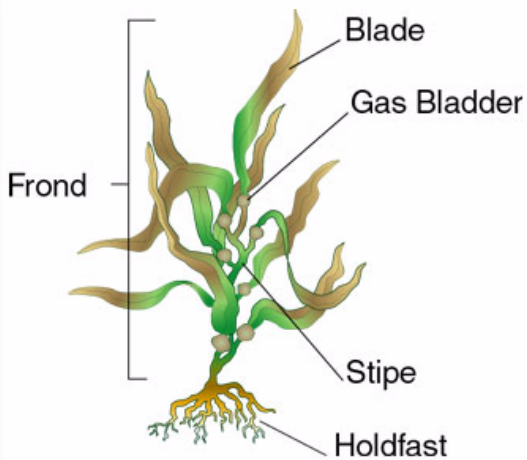




## A Forest in the Ocean

Have you ever taken a hike through a forest? You probably saw many, many trees, tall and short, and animals like birds, chipmunks, snakes, maybe even a deer or a fox. Now, have you ever swum through a forest? Fish do. Sea urchins do. Sea otters do, too. Indeed, the ocean has its own forests—kelp forests—much like forests on land.

### Kelp and its characteristics



Kelp is a type of algae or seaweed that grows in cool, clear ocean water. The three main parts of a kelp plant are the holdfast, the stipe, and the blade. The holdfast looks like a root, but it does not gather nutrients like land-plant roots. Instead, it keeps the kelp plant in place by

growing over rocks and wedging into cracks. The stipe is like a stem; nutrients are transported up and down it. This food transportation system allows kelp to grow larger than other types of algae. The blade is the flattened, leaf-like part of kelp. It is inside the blade that food is made. Here, cells absorb water and chemicals from the ocean and convert them into nutrients.

Kelp forests are found all along the cool waters of the Pacific coast, as far north as Alaska and as far south as southernmost California. Kelp forests are also found along the shores of South America, southern Australia, and South Africa. In general, kelp grows in waters of about 50-60°F.



The waters of the Monterey Bay National Marine Sanctuary off the coast of central California are ideal for kelp forests. The warm waters are pushed offshore by northwesterly winds, to be replaced by the cold, nutrient-rich waters streaming down from Alaska.

The two main types of kelp found in Monterey Bay are giant kelp and bull kelp. Giant kelp is brown with leathery blades, and may grow as large as 100 feet and live as long as seven years. The smaller, sturdy bull kelp has a single stalk with a crown of blades and lives no more than a year.

### The kelp canopy

Imagine you are a fish swimming among swaying stalks of kelp nearly 100 feet high. Above you, rays of sunlight seep through the sea's surface. The kelp forest around you is wide and thick—this is called the forest canopy—and contains both giant and bull kelp. The canopy changes with the seasons. In central California's Monterey Bay area, the canopy is thickest in late summer and thins or disappears over the winter months. Other fish and marine life come and go around you. In spring, the kelp begins to grow again, rapidly. It can sometimes grow up to four inches a day.

### A community of creatures

Kelp forests are home to hundreds of creatures. Sea anemones, sponges, and corals are found on the floor of the kelp forest. Fish swim and settle among the kelp's stipes and floating blades. Sea otters dive and roll at the surface of the forest, or dive to the kelp floor, where they may find treats like sea urchins, clams, crabs, and sea stars. Sometimes the otters wrap themselves in strands of kelp where they sleep. Sharks, rays, sea lions, and harbor seals also may spend time hunting for fish among the kelp.



### Monterey Bay Aquarium

If one day you qualify for scuba diving, you may actually see a living kelp forest and its inhabitants below the ocean surface. Or if one day you travel to Monterey, the Monterey Bay Aquarium houses a kelp forest just like those in nature in the ocean. The huge exhibit tank is 28 feet tall, 66 feet wide, and holds 330,000 gallons of seawater. A constant supply of seawater is pumped into the tank from the bay. During the day, the water is filtered and clear so that

visitors can view the kelp and various sea creatures. At night, unfiltered ocean water full of food and nutrients streams into the tank. The exhibit is a living laboratory where researchers hope to learn more about the seasonal and chemical changes of the kelp forest community.

### Questions:

1. What are the three main parts of a kelp plant and what are their functions?
2. Where are kelp forests found in the world?
3. How does the canopy of the Monterey Bay forest change with the seasons?
4. How is the kelp forest exhibit at the Monterey Bay Aquarium maintained, and what do researchers hope to learn from it?


**CHAPTER  
ACTIVITY**

## Create a Species

Each species that lives in an ecosystem has a unique way in which it interacts with its physical and biological environment, otherwise known as its *niche*. In order to fit into its niche, a species must have certain adaptations to help it survive. For example, a porcupine has sharp quills in order to ward off predators from attacking it. Other examples of adaptations are when species have camouflage to hide from predators or prey. Species do not have just one adaptation to fit into an ecosystem, rather they have several adaptations that allow the organism to find shelter, food, hide from predators, find a mate and many other things that enhance a species' chance of survival.

### What you will do

1. Create a species that is perfectly adapted to its environment. This species should be made up.
2. Design an environment and the characteristics of the ecosystem where your species will live. Use the table at the right to guide you in designing your ecosystem.
3. Now, design your species. Include the adaptations that allow the species to live in its environment successfully. List the adaptations in the bottom rows of the table.
4. Draw your species.
5. Name your species and label it on your drawing. Now take a look at the species that your classmates designed, and see the variety of ideas that other students came up with.

### Applying your knowledge

- a. Why will each of the adaptations you designed for your species help it better survive in its environment.
- b. Think of two adaptations that humans have that better allow them to survive in their environment. Name and describe these 2 adaptations below.

Ecosystem feature	What is your ecosystem like?
<b>Climate</b> <ul style="list-style-type: none"> <li>• average temperature of the time of year</li> <li>• precipitation details</li> <li>• altitude, latitude</li> <li>• proximity to water (fresh or salt water)</li> </ul>	
<b>Vegetation</b> <ul style="list-style-type: none"> <li>• amount</li> <li>• color - can be unrealistic!</li> <li>• height</li> <li>• plant type: flower, tree, cactus etc.</li> <li>• leaf type: needles. etc</li> </ul>	
<b>Food source</b> <ul style="list-style-type: none"> <li>• Type of food in environment species may eat</li> <li>• How does it get its food?</li> <li>• Omnivore, herbivore, or a carnivore?</li> </ul>	
<b>Predators</b> <ul style="list-style-type: none"> <li>• What are the predators in the ecosystem that he/she must hide from?</li> <li>• Are there predators?</li> <li>• How many predators?</li> </ul>	
Feature species must adapt to	Characteristic of organism to adapt to features you designed above
Climate	
Vegetation	
Food source	
Predators	

# Chapter 15 Assessment

## Vocabulary

Select the correct term to complete the sentences.

producer	photosynthesis	food web
competition	consumer	energy pyramid
decomposer	predator	carnivore
omnivore	herbivore	symbiosis
ecosystem	prey	pollutant
food chain		

### Section 15.1

1. A \_\_\_\_\_ is a living thing that can take the Sun's energy and store it as food.
2. A consumer that eats only animals is called a \_\_\_\_\_.
3. A(n) \_\_\_\_\_ is made up of a group of living things and their physical surroundings.
4. A consumer that eats both plants and animals is called a(n) \_\_\_\_\_.
5. A \_\_\_\_\_ is a living thing that consumes wastes and dead things to get energy.
6. \_\_\_\_\_ happens when a plant uses the Sun's energy to turn water and carbon dioxide into useful molecules such as sugars and starches.
7. A \_\_\_\_\_ must feed on other living things to get food and energy.
8. A \_\_\_\_\_ is a consumer that eats only plants.

### Section 15.2

9. Another way to represent a food chain is through a(n) \_\_\_\_\_, which shows how energy is lost as you move through the levels.

10. An ecosystem often has several food chains that overlap, which is called a \_\_\_\_\_.
11. A(n) \_\_\_\_\_ shows how each member of an ecosystem community gets its food.

### Section 15.3

12. A hawk captures and eats a mouse. In this case, the hawk would be called a \_\_\_\_\_ and the mouse is its \_\_\_\_\_.
13. \_\_\_\_\_ is an interaction where two species live together for a long time and at least one of them benefits.
14. \_\_\_\_\_ happens when members of an ecosystem depend on the same limited supply of food.
15. Sulfur dioxide is a chemical that is a good example of a \_\_\_\_\_, because when it is present in the air in large amounts, it can make breathing difficult.

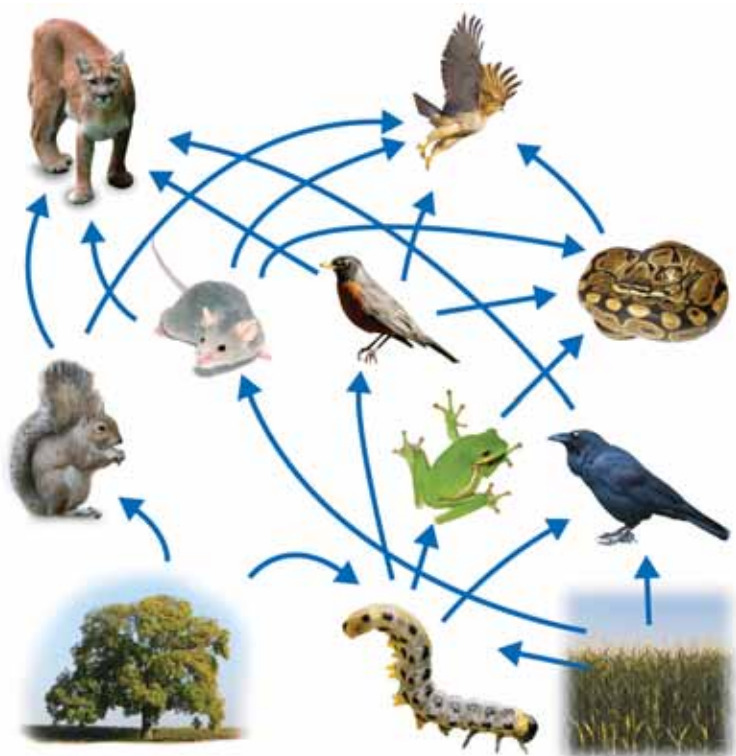
## Concepts

### Section 15.1

1. Arrange this list of organization levels so it goes from the largest category to the smallest category.  
population, community, biosphere, ecosystem, individual organisms
2. Which of the following would be considered an ecosystem? (You may choose more than one.)
  - a. tropical rainforest
  - b. school gymnasium
  - c. desert
  - d. Sun
  - e. rotting log and surroundings
  - f. bean plant
  - g. rock



**Section 15.2**



3. In the food web above, name the 2 producers, the 3 herbivores, the 4 carnivores, and the 2 omnivores.
4. Find a food chain within the food web above that has 5 levels. Diagram the food chain.
5. Why is photosynthesis such an important process in an ecosystem? (hint: what would happen to an ecosystem like the one pictured above if there were no producers?)

**Section 15.3**

6. In the food web above, is the interaction between the snake and the mouse called competition, predator/prey, or symbiosis?

**Math and Writing Skills**

**Section 15.1**

1. Study the diagram called “Living and nonliving parts of an ecosystem” in section 15.1. Write a paragraph that describes what this diagram tells you about matter and energy in an ecosystem. Be specific!

**Section 15.2**

2. Review the energy pyramid pictured in section 15.2. Why is the hawk at the top of the pyramid, and the grass and grasshoppers are at the bottom? Use the word energy in your answer.

**Section 15.3**

3. Study the table below. Name the lake that has poor water quality and explain the reason for your answer.

Water Quality Test Results

Lake	pH	nitrate level	dissolved oxygen
Citizen Lake	7.5	low	high
Lake Armstrong	4.5	high	low

**Chapter Project—Ecosystem Research**

Choose one of the following ecosystems. Research which plants and animals live in that ecosystem. Construct a food chain that has at least five levels. Find a photo or draw a picture of each member of the food chain, and show how the members are connected. Be creative! Display your food chain on a large poster, in a diorama, or a mobile. Ecosystems to choose from: desert, tropical rainforest, prairie, or alpine.