Environmental Interdependence

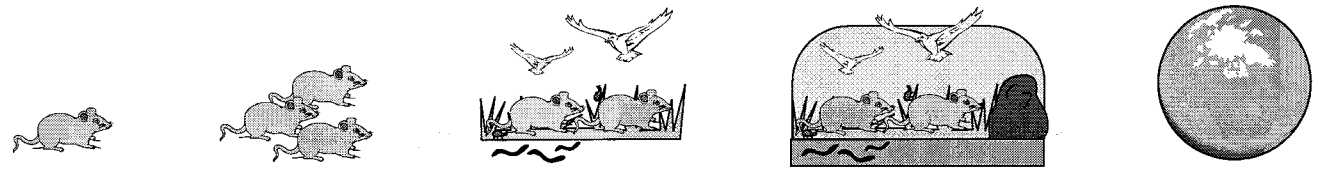
Section 19.1
Introduction to Ecology

Pre-View 19.1

- **Ecology** – the study of living organisms as they interact with their environment
- **Organism** – an individual living thing; examples: a mouse, an ant, a mountain lion
- **Species** – a group of similar organisms that can interbreed and produce fertile offspring
- **Population** – organisms of the same species that live in the same place and at the same time
- **Community** – different populations of different species that live in the same place at the same time
- **Ecosystem** – a community of living organisms plus their nonliving environment
- **Biotic factors** – the living organisms in an ecosystem
- **Abiotic factors** – nonliving parts of an ecosystem; examples: rocks, soil, air, water
- **Biosphere** – all the combined ecosystems of the world where organisms can live
- **Niche** – an organism's role in its ecosystem
- **Habitat** – the place where an organism lives

Ecology studies the relationships between living organisms and their environment. First review some terms that explain what makes up an ecosystem. First, an **organism** is an individual living thing, like a field mouse. A **species** is defined as a group of very similar organisms that can interbreed and produce fertile offspring. Organisms of the same species that live in the same place and at the same time make up a **population**. All the different populations of different species that live in the same place and at the same time make up a **community**. For example, a field of grass, field mice, earthworms, insects, lizards, birds, and buffalo might make up a community. These living organisms are called **biotic factors**. A community of living organisms *and* their environmental surroundings, such as soil, rocks, and bodies of water, make up an **ecosystem.** The nonliving parts of the ecosystem, such as the soil, rocks, water, pH, temperature, atmospheric gases, pollution, etc., are called **abiotic factors**. All of the ecosystems in the world make up the **biosphere**, the part of the earth where living organisms can survive.

Levels of Ecological Organization



Example: A pond ecosystem consists of water, algae, minnows, bass, catfish, water grasses, and a rocky bottom. Which of these are biotic factors and which are abiotic factors?

Biotic factors are the living organisms: algae, minnows, bass, catfish, water grasses.

Abiotic factors are the nonliving items: water and the rocky bottom. It could also include things such as the dissolved oxygen in the water, which can be an important abiotic factor for an pond ecosystem.

When studying ecosystems, you may come across two more terms: niche and habitat. A **niche** is the role that a species plays in an ecosystem. For example, the niche of a mouse might be to live in a grass prairie, to build a nest below the ground, to eat mostly seeds and insects, to disperse seeds, and to provide food for snakes and hawks. These are all roles that the mouse might play in its environment. A **habitat** is the place where a plant or an animal lives. For example, the habitat of the mouse mentioned above is a grass prairie.

Practice 1

Look at each example given below. Determine if the example describes an organism, a population, a community, an ecosystem, a niche, or a habitat. Write the letter that corresponds to your answer choice in the blank. Each choice may be used more than once.

_____ 1. a colony of ants

_____ 2. a colony of ants' role to build underground tunnels in the soil, to aerate the soil, to scavenge for food, and to provide food for spiders and other insects

_____ 3. the living organisms around and in a pond

_____ 4. a pond and the land immediately around the pond, including both biotic and abiotic factors

_____ 5. a grasshopper

_____ 6. the forest where a population of squirrels live

_____ 7. the pond where a population of catfish lives

_____ 8. a neighborhood that includes all the houses, yards, and organisms found in it

_____ 9 the living and nonliving parts of a forest

_____ 10. a house cat

A. organism
B. population
C. community
D. ecosystem
E. niche
F. habitat

Practice 2

Answer the following questions on ecological relationships.

Ⓐ Ⓑ Ⓒ Ⓓ 1. A tundra ecosystem is made up of small plants and mosses, birds, caribou, soil, and snow. Which of the following is an abiotic factor in this ecosystem?

A. small plants B. birds C. caribou D. snow

Ⓐ Ⓑ Ⓒ Ⓓ 2. Which of the following is an example of a population?

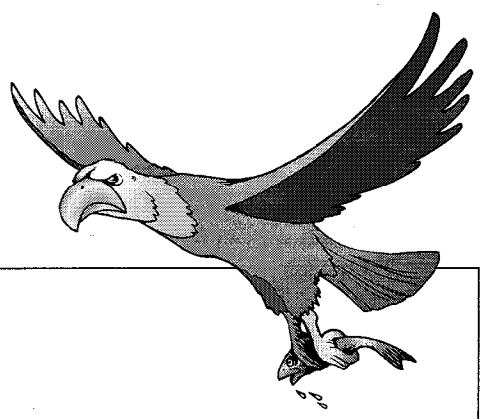
A. eagles that live in the cliffs of a canyon
B. the river that runs through a canyon
C. eagles, snakes, mice, grass, and bushes that live in a canyon
D. eagles, snakes, mice, grass, and bushes plus the rocks and the river in a canyon

Ⓐ Ⓑ Ⓒ Ⓓ 3. Which of the following would BEST describe the niche of a minnow?

A. lives in a pond
B. lives with biotic factors of algae, mosquito larvae, aquatic grasses, and other types of fish
C. lives with biotic and abiotic factors of algae, mosquito larvae, aquatic grasses, and other types of fish in pond water with a sandy bottom
D. lives in a pond where it eats mostly algae and small insects and is eaten by larger fish

Environmental Interdependence

Section 19.2
Ecological Relationships



Pre-View 19.2

- **Herbivore** – an animal that eats plants
- **Predator** – an animal that catches and eats another animal
- **Prey** – an animal that is subject to being caught and eaten by another animal
- **Carnivore** – an animal that eats only other animals
- **Omnivore** – an animal that eats both plants and animals
- **Competition** – the conflict between organisms when they try to use the same resources at the same time
- **Competitive exclusion** – the idea that if two different species compete for the same resources, one will survive and the other will not
- **Cooperation** – the relationship among members of a population that helps one another; example: hunting as a pack
- **Symbiotic relationship** – the relationship between two species that live closely together
- **Mutualism** – a symbiotic relationship in which both species benefit
- **Commensalism** – a symbiotic relationship in which only one species benefits but the other is neither helped nor harmed
- **Parasitism** – a symbiotic relationship in which one species benefits and the other is harmed
- **Parasite** – an organism that gets its nutrients by feeding on another living organism
- **Host** – an organism on which a parasite feeds

Organisms co-exist in an ecosystem by forming certain types of relationships. These relationships can be helpful to one another, or they can be harmful.

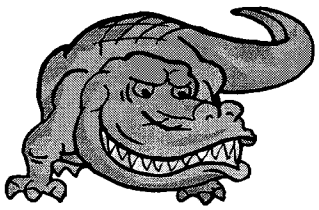
Plant-Herbivore

One type of relationship is between plants and the animals that eat plants. Plant-eating consumers are called **herbivores**. A cow eating grass is an example of a plant-herbivore interaction.

Predator-Prey

Another type of relationship is a **predator-prey** relationship. **Predators** are members of a species that capture and eat members of another species, the **prey**. Predators that eat only other animals are called **carnivores**. Some animals eat both plants and other animals, and these animals are called **omnivores**. A fox is an omnivore; it will eat mice, squirrels, and snakes, but it will also eat seeds and berries.

Example 1: A hawk hunting and consuming a rabbit would be an example of a predator-prey relationship, and the hawk is a carnivore.



Competition

Some relationships in a community or ecosystem are due to **competition**. Whenever organisms try to use the same resources, such as light, food, water, or space, at the same time and in the same place, they must compete with each other for the use of the resources. Competition may exist for the organisms within the same population, or there may be competition between different species. The extinction of one species in an area due to competition with another species is called **competitive exclusion.**

Example 2: Two male alligators compete for territory and for females. One male will be more dominant than the other and better able to survive.

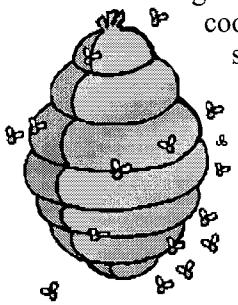
The alligators are an example of competition within a population. Both alligators belong to the same species.

Example 3: Two different species of birds compete with each other for the same nesting space, food source, and water supply. One of the species will be more successful than the other species, and the other species may fail to survive.

The birds represent competition between two different species.

Cooperation

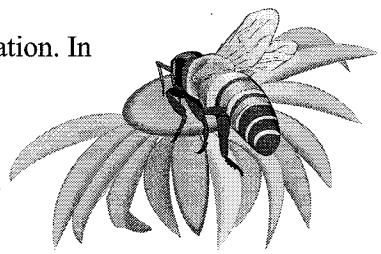
Not all interactions among organisms is negative. **Cooperation** is a relationship within certain populations to work together for a common goal. Social insects, such as honeybees, termites, and ants, show a form of cooperation. They form colonies and divide labor so that the entire colony benefits. For example, some gather food, some rear young, and some defend the nest. Another example of cooperation can be seen in pack animals.



Example 4: Wolves form a pack, which is similar to a family. The wolf pack has a hierarchy of dominance, but they cooperate together to hunt and to kill prey. They also help one another rear their young.

Mutualism

There are several types of relationships called **symbiotic relationships** that result when two species live together very closely. The word *symbiosis* means *living together.*



One type of symbiosis is **mutualism**, which is sometimes considered a type of cooperation. In a mutualistic relationship, two different species benefit from their relationship to one another. The relationship between flowering plants and their pollinators is an example of mutualism. Many flowers have bright colors and are sweet-smelling to attract insects. The flowers provide the insects with nectar and pollen. In turn, the insects go from flower to flower and help pollinate the plants. Both the plants and the insects benefit.

Commensalism

Sometimes only one species is helped in a symbiotic relationship, and the other species is neither helped nor harmed. This type of relationship is called **commensalism**.

Example 5: A small crustacean called a barnacle lives attached to rocks, wood, shells, or other things that are in the ocean, including whales. The whales do not benefit from having the barnacles attached to them, but the barnacles benefit since the water movement of the swimming whales carries food particles to the barnacles.

Parasitism

The other type of symbiotic relationship is parasitism. In **parasitism**, one organism benefits at the expense of another organism. The **parasite** lives in or on another organism called a **host** and gets its nutrients from the host. The host is not usually killed but is weakened. For example, the roundworms that can live inside dogs and cats are parasites.

Practice

Relationships among organisms are described below. Identify the type of relationship being described.

A. Plant-Herbivore
B. Predator-Prey
C. Competition
D. Cooperation
E. Mutualism
F. Commensalism
G. Parasitism

_____ 1. Egrets follow cattle and eat insects that are disturbed by the cattle's grazing. Egrets benefit from the cattle, but the cattle receive no benefit from the egrets.

_____ 2. A deer tick attaches to a deer and receives a blood meal.

_____ 3. Two male lions fight over territory.

_____ 4. A deer eats leaves from trees.

_____ 5. Dolphins work together to "herd" herring into a bait ball. The dolphins take turns eating from the ball. (Choose a relationship other than predator-prey.)

_____ 6. A lion stalks, kills, and eats an antelope.

_____ 7. Termites live in colonies. A king and a queen produce young. Workers gather food. Soldiers defend the colony.

_____ 8. Zebra mussels and Mississippi River mussels eat the same types of food and live in the same types of habitats. When zebra mussels are introduced into a habitat, Mississippi River mussels decline.

_____ 9. A bumblebee gathers nectar from cucumber plants, and as a result, the bumblebee cross-pollinates the plants.

_____ 10. An oak tree grows beside a pine tree. Eventually, the oak tree overshadows the pine tree, and the pine tree dies.

_____ 11. The fungi that causes ringworm grows on human skin.

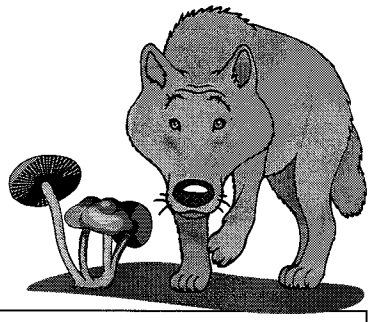
_____ 12. An eagle dives, captures, and eats a fish from a local pond.

_____ 13. Aphids make a substance called "honeydew" that is eaten by ants. In return for the honeydew, the ants protect the aphids from predators, and they also move the aphids to better food supplies.

_____ 14. A tapeworm receives nutrients from the intestines of a cat.

Environmental Interdependence

Section 19.3
The Flow of Energy In Ecosystems



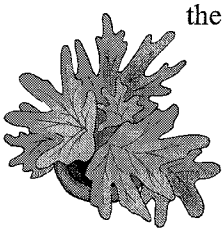
Pre-View 19.3

- **Producer** (or **autotroph**) – organism that makes its own food usually by using energy directly from the sun
- **Consumer** (or **heterotroph**) – organism that cannot make its own food and must get energy by eating producers or other consumers
- **Primary consumer** – a consumer that eats producers (usually plants)
- **Secondary consumer** – a consumer that eats a primary consumer
- **Tertiary consumer** – a consumer that eats a secondary consumer
- **Decomposer** (or **saprotroph**) – organism that eats dead or decaying organisms

All organisms must have energy to live, but where does that energy come from? Think about how much energy you have used today by the time you read this sentence. Where did you get that energy, and where did it go when you used it? If these questions bring to mind cellular respiration and photosynthesis as you reviewed in Section 8, you are definitely on the right track. Let's look at where energy comes from and how it flows through living organisms.

Producers/Autotrophs

The ultimate energy source for life on earth is the sun. Less than 1% of the energy that reaches earth from the sun is used by living organisms, but that small percentage fuels life.

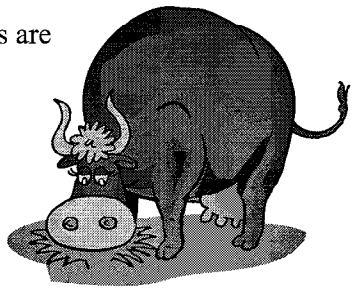


Producers are organisms that can use energy directly from the sun to produce simple sugars that other organisms can use as food. Plants are probably the most familiar producers on earth. Producers are also called **autotrophs** because they make their own food and do not need to "eat" other organisms to survive. Autotrophs capture energy from the sun, and they use the sun's energy to make organic compounds (sugar and other carbohydrates) out of inorganic materials (carbon dioxide and water). This conversion usually happens by photosynthesis, a process that should be familiar to you.

Consumers/Heterotrophs

Consumers are organisms that get their energy by eating either producers or other consumers. The cells of consumers do not contain chloroplasts, so they cannot make their own food. Consumers are also called **heterotrophs** because they must depend on other organisms for their food.

Think about a cow, which eats grass. The cow doesn't make its own energy; it gets energy from the grass it eats. A cow is a consumer. The grass contains energy in the form of carbohydrates. Through the process of cellular respiration (reviewed in Section 8.2), the cow breaks down the carbohydrates to obtain energy to live.



Since cows consume producers, they are called **primary consumers**. Primary consumers are often herbivores, eating only producers. A primary consumer may also be an omnivore, eating both producers and other consumers, but in the role of primary consumer, the omnivore must eat plants (or other producers). Primary consumers are never carnivores.

A wolf may then eat the cow, and the cow becomes the source of energy for the wolf. The wolf is also a consumer, but when it eats a primary consumer like a cow, it is called a **secondary consumer**. Secondary consumers are often carnivores, but they also may be omnivores. An omnivore that acts as a secondary consumer will eat another consumer.

A **tertiary consumer** is one that eats a secondary consumer. Let's say a minnow eats algae, a producer. The minnow is the primary consumer. Then a bass eats the minnow. The bass is a secondary consumer. Next a bear eats the bass. The bear is a tertiary consumer.

Decomposers and Detritivores

Decomposers (sometimes called **saprotrophs**) are a type of heterotroph, but they are not usually considered consumers. Instead of eating other living organisms, decomposers break down dead organisms into matter called **detritus**. The detritus is then eaten by organisms called **detritivores**, which convert the organic material into inorganic material. For example, when the wolf dies, bacteria and fungi are decomposers that break down the dead tissues. Detritivores are usually small invertebrates, like earthworms and nematodes, which further break down materials and return elements to the soil to be used again by producers. Decomposers and detritivores use the energy from the dead material to live. Decomposers and detritivores make use of the lowest energy level. Note that they do not recycle energy, but they do recycle matter, and producers benefit the most from their efforts.

The Flow of Energy and Nutrients

In Section 18, you reviewed how nutrients, such as water, carbon, nitrogen, and oxygen, cycled through an ecosystem. These nutrients are not used up by the living organisms but instead are recycled to be used over and over again.

From sunlight to producers, from producers to consumers, from consumers to other consumers, and from consumers to decomposers, energy flows through an ecosystem. Unlike nutrients, energy flows only in one direction and is not recycled. Although energy is never really "lost," it is eventually converted into heat energy, which cannot be reused by living organisms to make food.

The flow of energy and nutrients is summarized in figure 19-1. Producers get energy from the sun. Consumers get nutrients and energy from the producers. When producers and consumers die, decomposers get nutrients and energy from them. Decomposers break down nutrients into an inorganic form, and those nutrients can then be used again by producers. Producers must then get more energy from the sun to begin the cycle again.

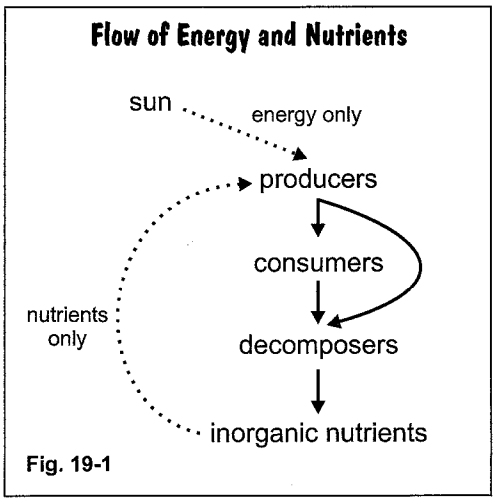


Fig. 19-1

Practice 1

Match each description to the correct term. Some terms may be used more than once. As you read each description, consider a primary consumer as "lower" than a secondary consumer.

_____ 1. the lowest level of consumer for an organism that must obtain food by eating other organisms

_____ 2. an organism that makes its own food

_____ 3. an organism that eats a secondary consumer

_____ 4. an organism that eats consumers that have eaten producers

_____ 5. a consumer that breaks down and obtains food from dead organisms

_____ 6. a plant

_____ 7. the lowest level of consumer for a carnivore

_____ 8. bacteria and fungi

_____ 9. an omnivore that eats berries as a meal

_____ 10. an omnivore that eats a primary consumer as a meal

A. producer/autotroph
B. primary consumer
C. secondary consumer
D. tertiary consumer
E. decomposer

Practice 2

Answer the following questions on the flow of energy in ecosystems.

Ⓐ Ⓑ Ⓒ Ⓓ 1. What is the ultimate energy source for living organisms?

A. energy stored in chemical bonds
B. the sun
C. energy stored in cells
D. nuclear power

Ⓐ Ⓑ Ⓒ Ⓓ 2. Which type of organism receives and uses energy directly from the sun?

A. producers
B. primary consumers
C. heterotrophs
D. decomposers

Ⓐ Ⓑ Ⓒ Ⓓ 3. Which of the following is NOT recycled once it passes from producer to consumer to decomposer?

A. water
B. carbon
C. oxygen
D. energy

Ⓐ Ⓑ Ⓒ Ⓓ 4. Which of the following could be a secondary consumer?

A. a plant
B. an herbivore
C. a carnivore
D. a detritivore

Ⓐ Ⓑ Ⓒ Ⓓ 5. Which of the following is a role of a decomposer?

A. breaking down a dead tree branch
B. eating mushrooms
C. preying on a field mouse
D. eating grass

Environmental Interdependence

Section 19.4
Food Chains, Food Webs, and Energy Pyramids

Pre-View 19.4

- **Food chain** – a simple representation of how energy is passed from a producer to consumers
- **Food web** – a more complex representation of how energy is passed from producers to consumers in an ecosystem
- **Trophic level** – each "step" in a food chain that represents how many times energy has been transferred from one organism to the next
- **Energy pyramid** – a representation in the shape of a pyramid that shows how energy is passed from one trophic level to the next
- **Top consumer** (or **top predator**) – animal at the top of a food chain; usually a carnivore that has no natural predators

Food Chains

The simple explanation for the flow of energy from autotrophs to heterotrophs is called a **food chain**. A simple example of a food chain is shown in figure 19-2.

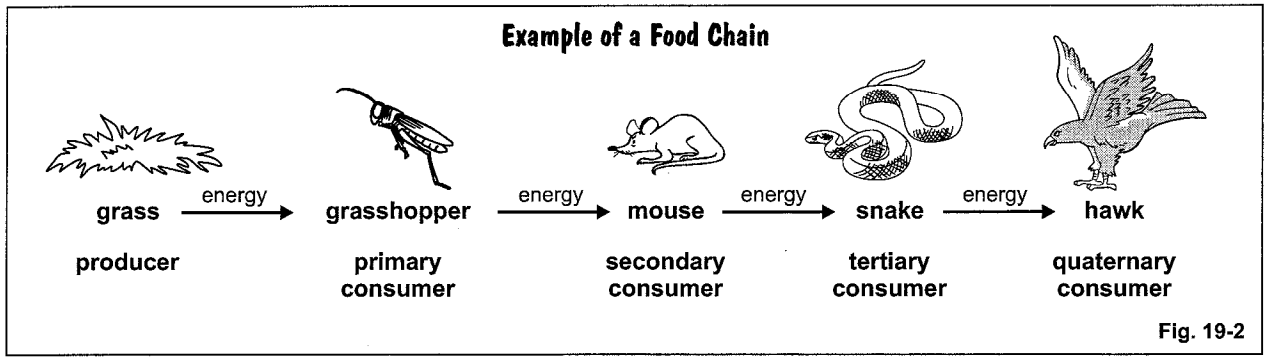


Fig. 19-2

In the food chain shown in figure 19-2, the grass is the producer. The grasshopper eats the grass, so it is the primary consumer. The grass gives energy to the grasshopper. The mouse eats the grasshopper, so the mouse is the secondary consumer. The mouse gets its energy from the grasshopper. The snake then eats the mouse. The snake is the tertiary consumer, which simply means "third level" consumer. The snake is then eaten by the hawk. The hawk is the quaternary consumer, or "fourth level" consumer. So you can see how a food chain represents how energy is passed from one organism to the next.

Note: Don't let the terms "tertiary" and "quaternary" scare you. "Tertiary" is another word for "third." Quaternary is another word for "fourth."

Example 1: In the food chain given in figure 19-2, which organisms are predators? Which are prey?

The mouse, the snake, and the hawk are all predators. The grasshopper is prey for the mouse, the mouse is prey for the snake, and the snake is prey for the hawk.

Food Web

The relationships between the organisms in an ecosystem are usually more complex than a simple food chain. These more complex interactions form a network that can be shown in a **food web**. An example of a simple food web is shown in figure 19-3. Notice that decomposers are also included in this food web.

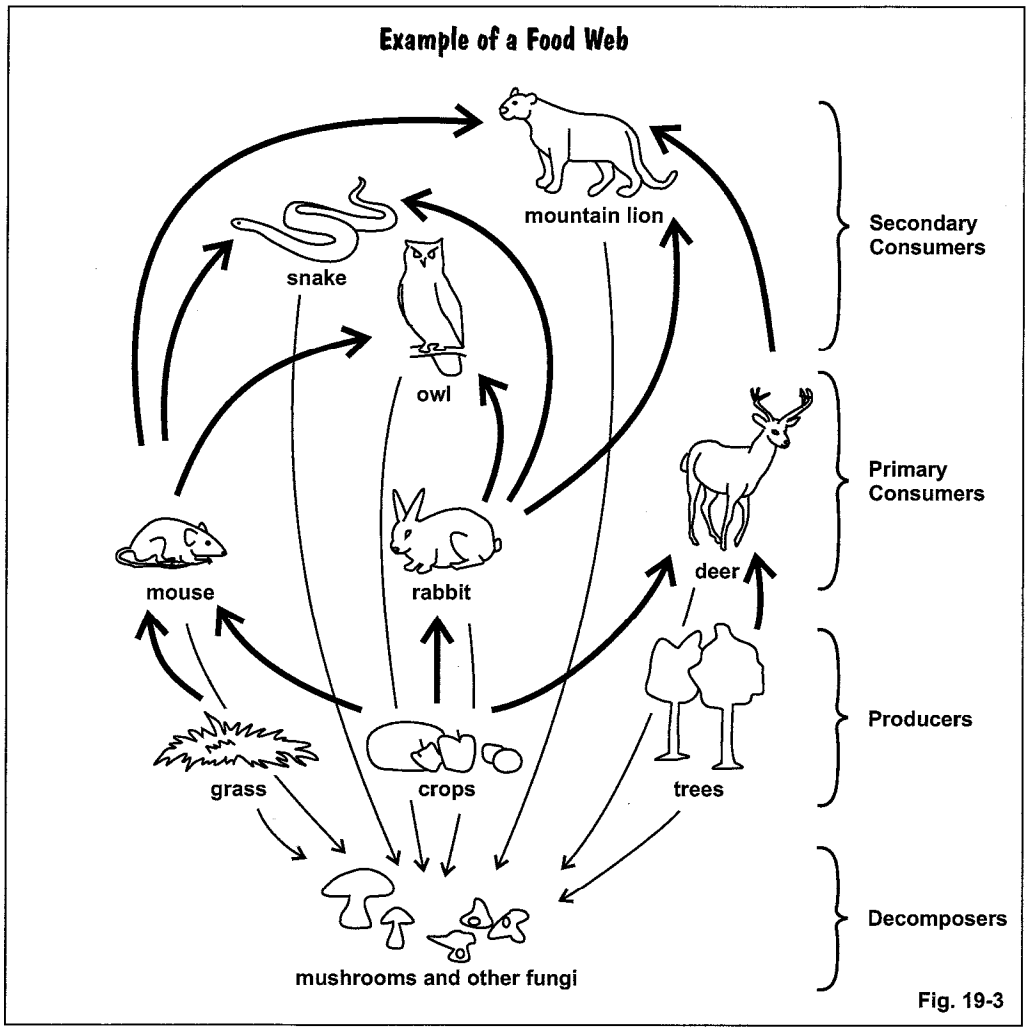


Fig. 19-3

A food web also represents the transfer of energy from one organism to another, but instead of giving one path, it gives a network of paths. In figure 19-3, you can see that an owl may eat a mouse, or it may eat a rabbit. A mountain lion may eat a deer, a rabbit, or a mouse. It can get its energy from any of these other organisms.

Example 2: In the food web given in figure 19-3, which organisms are shown as herbivores?

Remember that herbivores eat producers. In this food web, the mouse, the rabbit, and the deer are herbivores.

Energy Pyramids

Every step in the food web or food chain represents a **trophic level**. Trophic levels indicate how many times energy has been transferred. The first trophic level is made up of producers (autotrophs). The next levels are made of heterotrophs, or consumers. The organisms in each level obtain energy from the organisms in the level below them.

The way that energy is transferred to each trophic level is often shown in an **energy pyramid**. An example of an energy pyramid is given in figure 19-4. Only about 10% of the energy at each level is transferred to the next higher level. The rest of the energy is used by the organism itself for respiration, metabolism, movement, etc, and some of the energy is lost to the environment as heat. In figure 19-4, only 10% of the energy captured by grass ends up in the tissues of the mouse that eats the grass. Then, only 10% of that energy, or 1% of the original amount, goes to the snake that eats the mouse. Even less energy is then available to the hawk that eats the snake. The higher up an organism is on the energy pyramid, the less energy is available for that organism. A tertiary consumer has less energy available to it than a secondary consumer. Decomposers and detritivores are always on the lowest energy level in any particular food chain or food web. Producers, on the other hand, have the most energy available.

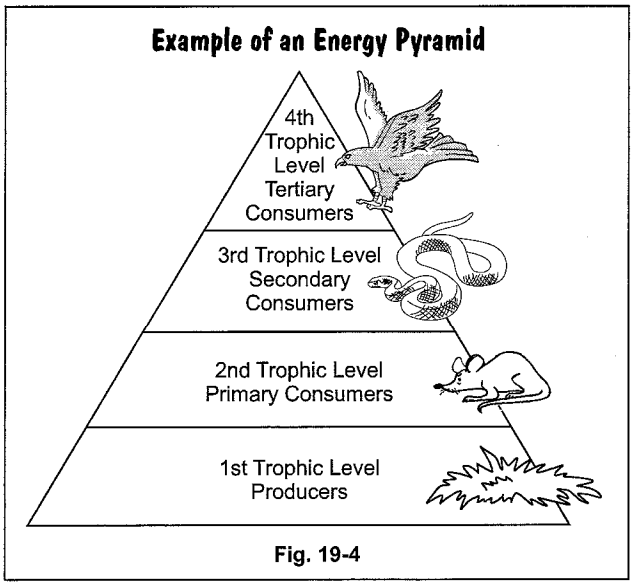


Fig. 19-4

Example 3: For the energy pyramid given in figure 19-4, which organism receives the least energy from producers?

Energy decreases as trophic levels increase. The hawk at the top of the energy pyramid receives the least energy from the grass shown in trophic level one.

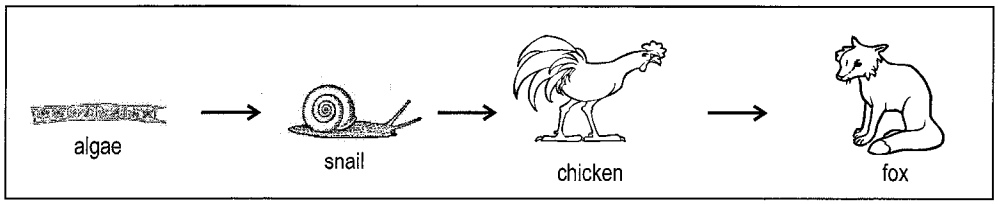
Not only is there less energy available in each level of an energy pyramid, there are also fewer nutrients stored as food in the living tissues. For example in figure 19-4, only a small percentage of the nutrients in the grass will be stored in the tissues of the mouse. Even fewer nutrients will be stored in the snake and the hawk. As a result, an ecosystem will have fewer snakes than mice and fewer hawks than snakes. Think about this another way. One snake must eat several mice to survive, so an ecosystem will support fewer snakes than it will mice. If you suddenly introduced a lot more snakes into an ecosystem, many of the snakes would die for lack of food, and the balance would soon be restored. So remember that the higher an organism is on a food pyramid, the fewer will be present in the ecosystem.

The organism at the top of a food chain or energy pyramid is called the **top consumer** or the **top predator**. A top consumer has no natural predators, so it is not normally eaten by another animal. The top consumer is a usually a large carnivore. Examples include eagles, wolves, tigers, lions, and sharks.

Practice

Answer the following questions on food chains, food webs, and energy pyramids.

Use the food chain below to answer questions 1 through 3.



Ⓐ Ⓑ Ⓒ Ⓓ 1. Which organism in the food chain is a producer?

A. algae B. snail C. chicken D. fox

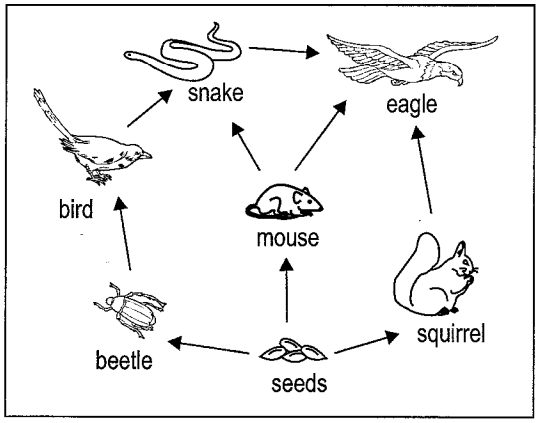
Ⓐ Ⓑ Ⓒ Ⓓ 2. Which organism in the food chain is a primary consumer?

A. algae B. snail C. chicken D. fox

Ⓐ Ⓑ Ⓒ Ⓓ 3. Which organism in the food chain FEEDS on a secondary consumer?

A. algae B. snail C. chicken D. fox

Use the food web below to answer questions 4 through 7.



Ⓐ Ⓑ Ⓒ Ⓓ 4. How many primary consumers does this food web include?

A. one B. two C. three D. four

Ⓐ Ⓑ Ⓒ Ⓓ 5. Which of the following is a tertiary consumer?

A. beetle B. mouse C. bird D. snake

Ⓐ Ⓑ Ⓒ Ⓓ 6. Which organism in the food web is NOT a predator?

A. bird B. snake C. eagle D. squirrel

Ⓐ Ⓑ Ⓒ Ⓓ 7. Which organism in the food web is the top consumer?

A. bird B. snake C. eagle D. squirrel

Ⓐ Ⓑ Ⓒ Ⓓ 8. Why are fungi and bacteria important in a food web?

A. They are an important food source for primary consumers.
B. They are producers.
C. They help to recycle nutrients back into the soil.
D. They are an important food source for secondary consumers.

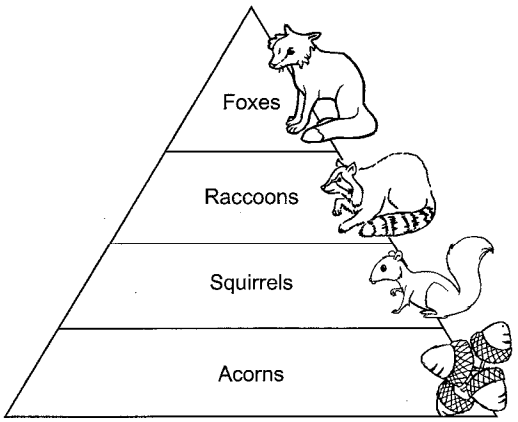
Ⓐ Ⓑ Ⓒ Ⓓ 9. Which of the following will be at the top of an energy pyramid?

A. decomposer B. producer C. herbivore D. carnivore

Ⓐ Ⓑ Ⓒ Ⓓ 10. In general, which types of organisms survive at the lowest energy level?

A. producers
B. primary consumers
C. tertiary consumers
D. decomposers

Use the energy pyramid below to answer questions 11 through 14.



Ⓐ Ⓑ Ⓒ Ⓓ 11. About how much energy is transferred from one level of an energy pyramid to the next higher level?

A. 10% B. 25% C. 35% D. 50%

Ⓐ Ⓑ Ⓒ Ⓓ 12. Which organism receives the LEAST amount of energy from producers?

A. acorns B. squirrels C. raccoons D. foxes

Ⓐ Ⓑ Ⓒ Ⓓ 13. Which organism represented by this food pyramid has the MOST available energy?

A. the squirrels B. the acorns C. the raccoons D. the foxes

Ⓐ Ⓑ Ⓒ Ⓓ 14. A forest ecosystem supports the food chain indicated in the energy pyramid above. Which type of organism would you expect to find the FEWEST of in the ecosystem?

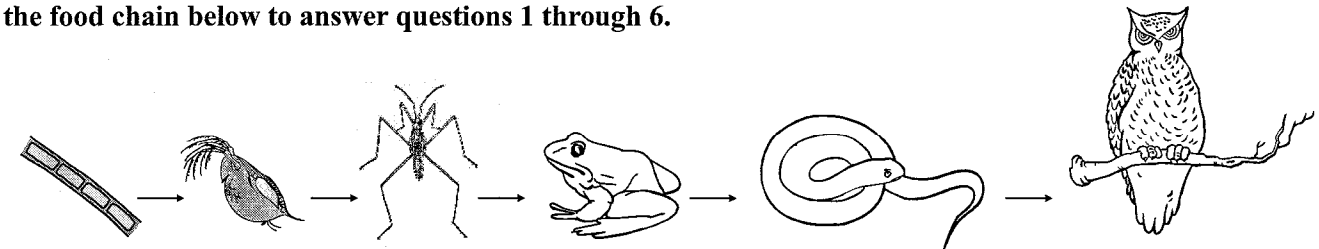
A. acorns B. squirrels C. raccoons D. foxes

Environmental Interdependence

Section 19 Review

Answer the following questions on environmental interdependence.

Use the food chain below to answer questions 1 through 6.



---

1. The algae at the beginning of the food chain represents which of the following?

A decomposer
B heterotroph
C producer
D consumer

Ⓐ Ⓑ Ⓒ Ⓓ

2. Which carnivore in the food chain represents the top consumer?

F insect
G frog
H snake
J owl

Ⓕ Ⓖ Ⓗ Ⓙ

3. About what percent of energy from the algae is transferred to the water flea?

A 1%
B 10%
C 50%
D 80%

Ⓐ Ⓑ Ⓒ Ⓓ

4. In this food chain, which organism is FEEDING on a primary consumer?

F water flea
G insect
H frog
J snake

Ⓕ Ⓖ Ⓗ Ⓙ

5. In the food chain above, the energy moves in which direction?

A from the owl to the algae
B from the algae to the water flea
C from the snake to the frog
D from the frog to the water flea

Ⓐ Ⓑ Ⓒ Ⓓ

6. Which trophic level does the insect in this food chain represent?

F first
G second
H third
J fourth

Ⓕ Ⓖ Ⓗ Ⓙ

7. What is the ultimate source of almost all energy in ecosystems?

A complex carbohydrates
B sunlight
C simple carbohydrates
D carbon

Ⓐ Ⓑ Ⓒ Ⓓ

8. What is an organism called that cannot make its own food?

F heterotroph
G chemotroph
H producer
J autotroph

Ⓕ Ⓖ Ⓗ Ⓙ

9. Two species of caterpillar are introduced into an ecosystem. Both species must eat the same kind of leaves from the same kind of tree in order to survive. Which of the following is MOST likely to occur?

A Both species of caterpillar will thrive.
B One species of caterpillar will out-compete the other for the leaves, and the other species will eventually die out.
C One species of caterpillar will change its diet and will begin eating leaves from another kind of tree.
D One species of caterpillar will begin eating the other as a defense mechanism.

Ⓐ Ⓑ Ⓒ Ⓓ

10. What type of relationship is represented by an organism catching and feeding on another organism?

F competition
G cooperation
C mutualism
J predation

Ⓕ Ⓖ Ⓗ Ⓙ

11. Antelope gather in herds to protect one another from predators. How is this relationship among the antelope described?

A predation
B competition
C cooperation
D commensalism

Ⓐ Ⓑ Ⓒ Ⓓ

12. Which of the following is NOT considered a heterotroph?

F herbivores
G carnivores
H decomposers
J producers

Ⓕ Ⓖ Ⓗ Ⓙ

13. Flagellate protozoans live in the guts of termites. The flagellates break down the cellulose that the termites eat, and both organisms benefit from the resulting nutrients. What type of relationship exists between the protozoans and the termites?

A commensalism
B mutualism
C predation
D competition

Ⓐ Ⓑ Ⓒ Ⓓ

14. Which of the following is an example of competition in an ecosystem?

F A flea gets a blood meal from a rabbit.
G A rabbit eats grass and plants.
H Kudzu grows over other trees and plants and prevents them from getting sunlight.
J Zebra mussels attach to the bottom of a boat.

Ⓕ Ⓖ Ⓗ Ⓙ

15. How are energy and nutrients moved differently through living systems?

A Energy flows only one way, but nutrients recycle.

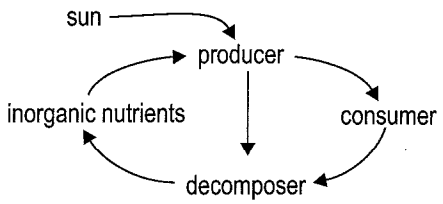
B The amount of energy is limited in the biosphere, but nutrients are always available.

C Nutrients flow in one direction, but energy can recycle.

D Energy forms chemical bonds, but most nutrients are lost as heat.

Ⓐ Ⓑ Ⓒ Ⓓ

16. The diagram below shows the cycling of nutrients in an ecosystem.



What would happen to the transfer of energy if producers were removed from this cycle?

F Consumers would get all their energy directly from the sun.

G The flow of energy in the system would immediately decrease.

H Decomposers would replace producers in the transfer of energy.

J The energy in inorganic nutrients would be transferred directly to consumers.

Ⓕ Ⓖ Ⓗ Ⓙ

17. Which of the following would you expect to find at the top of an energy pyramid?

A A wolf that has no natural enemies.

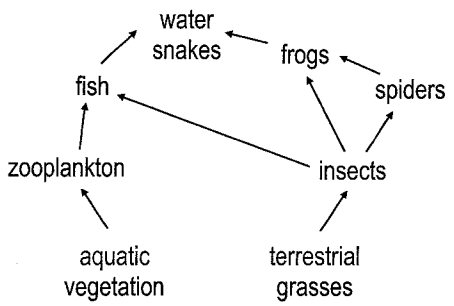
B A tree that produces leaves eaten by deer.

C A mouse that eats small insects and worms.

D An antelope that eats grass.

Ⓐ Ⓑ Ⓒ Ⓓ

Study the food web below and then answer questions 18 through 20.



18. How many producers are shown in this food web?

F 0

G 1

C 2

J 4

Ⓕ Ⓖ Ⓗ Ⓙ

19. Which organisms are found on the first trophic level?

A aquatic vegetation and terrestrial grasses

B zooplankton and insects

C fish and spiders

D frogs and water snakes

Ⓐ Ⓑ Ⓒ Ⓓ

20. Which of the following is NOT a true statement about the relationships represented in the food web?

F The fish represent secondary consumers.

G The water snakes are top predators.

C The aquatic vegetation and terrestrial grasses are producers.

J The insects are decomposers.

Ⓕ Ⓖ Ⓗ Ⓙ