Name Date

Section 2.1 Summary

Energy Flow in Ecosystems

Textbook pages 56–67

Before You Read

In this section, you will explore food chains and food webs, as well as food pyramids. What are the main differences between a chain and a web? Record your ideas below.

_____

_____

Mark the Text

In Your Own Words

Define the bold terms in this summary in your own words.

How does energy flow in an ecosystem?

Energy flow is the transfer of energy from one organism to another in an ecosystem. Every organism interacts with its ecosystem in two ways:

1. the organism obtains food energy from the ecosystem
2. the organism contributes energy to the ecosystem

How are energy flow and feeding relationships in ecosystems modelled?

Ecologists use three models to illustrate energy flow and feeding relationships in an ecosystem:

1. Food chains: **Food chains** show the flow of energy from plant to animal and from animal to animal. Plants are called **producers** because they "produce" food in the form of carbohydrates during photosynthesis. **Consumers** eat plants and other organisms. Each step in a food chain is called a **trophic level.** ✔

Reading Check

1. What are the different steps in a food chain called?

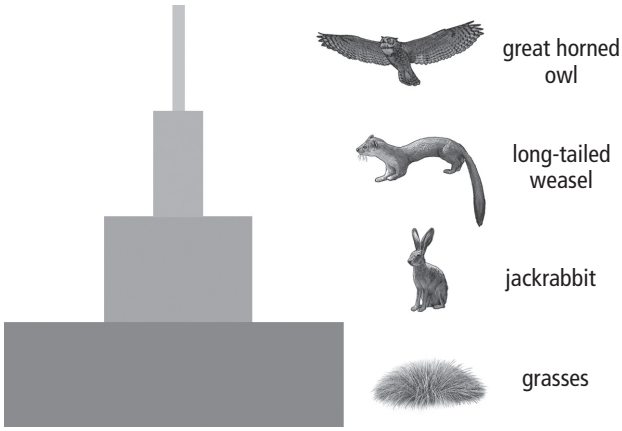
_____

_____

Trophic Level	Type of Organism	Energy Source	Example
1st	**primary producer**	obtain energy from the Sun	grass, algae (plants)
2nd	**primary consumer**	obtain energy from primary producers	grasshoppers, krill **(herbivores)**
3rd	**secondary consumer**	obtain energy from primary consumers	frogs, crabs **(carnivores)**
4th	**tertiary consumer**	obtain energy from secondary consumers	hawks, sea otters (top carnivores)

2. Food webs: Many animals are part of more than one food chain in an ecosystem because they eat or are eaten by several organisms. Interconnected food chains are illustrated in a model called a **food web.** Animals that eat plants and other animals are called omnivores.

3. Food pyramids: A **food pyramid** (or **ecological pyramid**) is a model that shows the loss of energy from one trophic level to another. When one organism consumes another, the energy stored in the food organism is transferred to the consumer. However, not all of this energy is incorporated into the consumer's tissues. Between 80 and 90 percent of it is used for chemical reactions and is lost as heat. This means ecosystems can support fewer organisms at higher trophic levels, as less energy reaches these levels. ✔



Food pyramid

✔ *Reading Check*

1. What does a food pyramid demonstrate?

_____

_____

_____

_____

_____

How do dead organisms contribute to energy flow?

Decomposition describes the breakdown of organic wastes and dead organisms. Energy is released in decomposition. When living organisms carry out decomposition, it is called **biodegradation**.

- **Detrivores**, such as small insects, earthworms, bacteria, and fungi, obtain energy and nutrients by eating dead plants and animals, as well as animal waste.
- **Decomposers**, such as bacteria and fungi, change wastes and dead organisms into nutrients that can once again be used by plants and animals.

Detrivores and decomposers feed at every trophic level.

Name Date

Cloze Activity

Section 2.1

Use with textbook pages 56–64.

Energy flow

Vocabulary	
biodegradation	food webs
biomass	photosynthesis
consumer	primary consumers
decomposers	primary producers
decomposition	secondary consumers
energy flow	tertiary consumers
food chains	trophic
food pyramids	

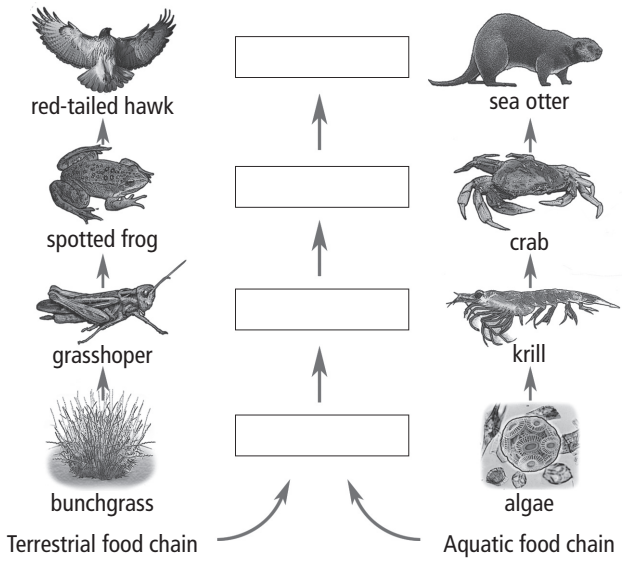
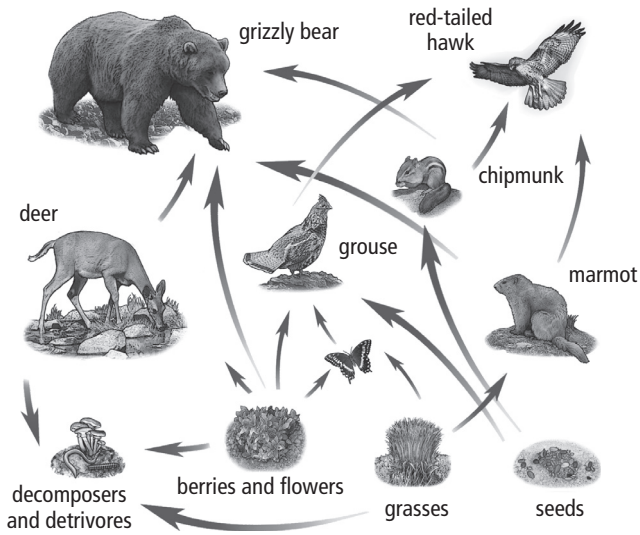
Use terms in the vocabulary box to fill in the blanks. Use each term only once.

1. _____ refers to the total mass of living plants, animals, fungi, and bacteria in a given area.
2. The flow of energy from an ecosystem to an organism and from one organism to another is called _____.
3. Plants are called producers because they "produce" food in the form of carbohydrates during _____
4. An insect, such as a bee, that feeds on a plant is called a _____.
5. _____ is the breaking down of organic wastes and dead organisms.
6. The action of living organisms, such as bacteria, to break down organic matter is called _____.
7. _____ change waste and dead organisms into usable nutrients.
8. _____ are models that show the flow of energy from plant to animal and from animal to animal. Each step is called a _____ level.
9. Plants and phytoplankton, such as algae, are at the first trophic level and are referred to as _____.
10. _____ obtain their energy from primary producers.
    _____ obtain their energy by eating primary consumers.
11. In the fourth trophic level are _____ that feed on secondary consumers to obtain energy.
12. _____ are models of the feeding relationships within an ecosystem.
    _____ show the loss of energy from one trophic level to another.

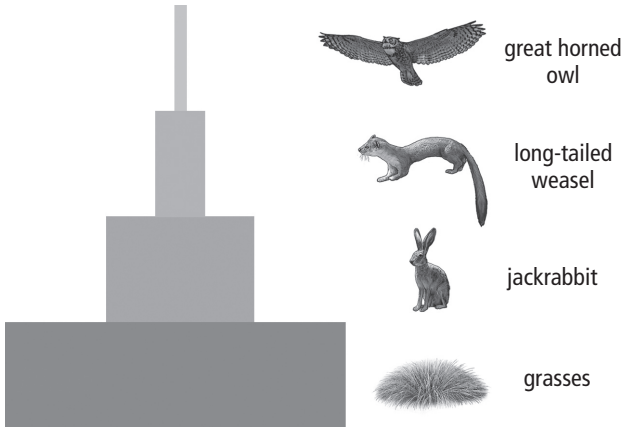
Use with textbook pages 60–64.

Food chains, food webs, and food pyramids

Use the diagrams to help you answer the questions.

Scientific model	Questions
food chain  	1. What plants or animals are the primary producers in this food chain? _____ _____ 2. What trophic level do the frogs and crabs belong to? _____ 3. What do tertiary consumers feed on to obtain energy? _____
food web  	4. What term is used to describe a chipmunk that eats seeds or fruit? _____ 5. What kind of consumers do omnivores eat? _____ 6. Give two examples of detrivores. _____ _____

food pyramid



Food pyramid

7. What is a food pyramid?

_____

_____

8. Which level of a food pyramid stores the most energy?

_____

9. Which level of a food pyramid stores the least amount of energy?

_____

Use with textbook pages 58–64

Modelling a local ecosystem

Reflect on the plants and animals that exist in your local ecosystem.

1. List 12 plants and animals. Remember to represent each of the trophic levels.

_____

_____

2. Organize four of these plants and animals into a food chain.

3. Using all 12 of the plants and animals, design a food web that illustrates the feeding relationships within your selected ecosystem.

4. Organize the plants and animals into a food pyramid that demonstrates the loss of energy as you move from one trophic level to the next.

Use with textbook pages 56–64.

Energy flow in ecosystems

Match each Term on the left with the best Descriptor on the right. Each Descriptor may only be used once.

Term	Descriptor
1. _____ biodegradation **2.** _____ consumers **3.** _____ decomposers **4.** _____ food chain **5.** _____ food pyramid **6.** _____ food web **7.** _____ producers **8.** _____ trophic levels	**A.** a model that shows the flow of energy from plant to animal and from animal to animal **B.** organisms that produce food in the form of carbohydrates during photosynthesis **C.** the breaking down of dead organic matter by organisms, such as bacteria **D.** steps in a food chain that show feeding and niche relationships among organisms **E.** a model that shows the loss of energy from one trophic level to another **F.** an organism that eats other organisms **G.** a model of the feeding relationships within an ecosystem **H.** organisms that break down wastes and dead organisms and change them into usable nutrients

Circle the letter of the best answer.

9. In a food chain, primary producers are usually:

A. amphibians **C.** mammals

B. bacteria **D.** plants

10. What product of photosynthesis supplies energy for life forms?

A. carbohydrates

B. carbon dioxide

C. oxygen

D. water

11. Which of the following organisms are likely to be found in the third trophic level of a food chain?

A. algae **C.** grasshopper

B. frog **D.** hawk

12. Which of the following describes the process of biodegradation?

A. plants using photosynthesis to create food

B. primary consumers eating plants

C. bacteria breaking down organic matter

D. omnivores eating plants and animals

13. In a food pyramid, how much energy is lost from trophic level to trophic level?

A. 20 % **C.** 70%

B. 50 % **D.** 90%

14. In a food pyramid:

A. as the trophic level decreases, the number of organisms supported by the ecosystem decreases

B. as the trophic level increases, the number of organisms supported by the ecosystem increases

C. as the trophic level increases, the number of organisms supported by the ecosystem decreases

D. as the trophic level decreases, the number of organisms supported by the ecosystem increases

Section 1.2 Ecosystems

Comprehension

Parts of an ecosystem

Page 10

1. An ecosystem has abiotic components that interact with biotic components, while a habitat is the place in which an organism lives.
2. Three main abiotic components of ecosystems are (any three of) oxygen, water, nutrients, light, and soil.
3. A population refers to all the members of a particular species within an ecosystem, while a community is all the populations of different species within an ecosystem.
4. Symbiosis is the interaction between members of two different species that live together in a close association.
5. Commensalism is a symbiotic relationship in which one species benefits and the other species is not helped or harmed.
6. Mutualism is a symbiotic relationship in which both organisms benefit, while parasitism is a symbiotic relationship in which one species benefits and the other is harmed.
7. Predation is where one organism eats all or part of another organism.

Interpreting illustrations

Biotic interactions in ecosystems

Page 11

1. I. organism
   II. ecosystem
   III. population
   IV. community
   V. biosphere
2. Largest Biosphere
   Ecosystem
   Community
   Population
   Smallest Organism
3. Lists will vary but should include a variety of plants and animals.

Applying Knowledge

Symbiotic relationships

Page 12

1. Term: Mutualism
   Explanation: Both organisms benefit. The ant gets its food and shelter while the plant is protected from insects.
2. Term: Competition
   Explanation: Harmful interaction between two or more organisms as they compete for the same resource. The knapweed prevents other species from populating the soil by releasing a chemical.
3. Term: Predation
   Explanation: One organism (predator) eats all or part of another organism (the prey). The lynx is the predator and the snowshoe hare is the prey.
4. Term: Commensalism
   Explanation: One species benefits and the other species is not helped or harmed.
   The Spanish moss captures nutrients and moisture from the air with no harmful effects on the trees.
5. Term: Parasitism
   Explanation: One species benefits and another is harmed. The pine beetle has its food source and the pine tree is destroyed.

Assessment

Ecosystems

Page 13

1. D **2.** E **3.** B **4.** F **5.** A **6.** C **7.** G **8.** B **9.** D **10.** C

Chapter 2 Energy flow and nutrient cycles support life in ecosystems.

Section 2.1 Energy Flow in Ecosystems

Cloze activity

Energy flow

Page 16

1. biomass
2. energy flow
3. photosynthesis
4. consumer
5. decomposition
6. biodegradation
7. decomposers
8. food chains; trophic
9. primary producers
10. primary consumers; secondary consumers
11. tertiary consumers
12. food webs; food pyramids

Interpreting Illustrations

Food chains, food webs, and food pyramids

Page 17

1. bunchgrass, algae

2. third trophic level
3. secondary consumers
4. primary consumer
5. secondary or tertiary consumer
6. earthworms, beetles, small insects, bacteria, fungi
7. a model that shows the loss of energy from one trophic level to another
8. producers, such as plants
9. carnivores, such as great horned owls

Illustrating Concepts

Modelling a local ecosystem
Page 19

1. Student should include 12 organisms and cover all four trophic levels.
2. Food chain: student should include four trophic levels: primary producers, primary consumers, secondary consumers, and tertiary consumers.
3. Food web: student should include interconnecting arrows between various organisms to demonstrate the feeding relationships.
4. Food pyramid: student should show a series of boxes decreasing in size from bottom to top. The pyramid should include producers, herbivores, carnivores, and top carnivores.

Assessment

Energy flow in ecosystems
Page 20

1. C **2.** F **3.** H **4.** A **5.** E **6.** G **7.** B **8.** D **9.** D **10.** A **11.** B **12.** C **13.** D **14.** D

Section 2.2 Nutrient Cycles in Ecosystems

Comprehension

Nutrient cycles
Page 24

1. Nutrients are stored in Earth's atmosphere, oceans, and land masses.
2. Biotic processes, such as decomposition, and abiotic processes, such as river run-off, can cause nutrients to flow in and out of stores.
3. Photosynthesis converts solar energy into chemical energy. Carbon, in the form of carbon dioxide, enters through the leaves of plants and, in the presence of sunlight, reacts with water to produce carbohydrates and oxygen.
4. Cellular respiration involves carbohydrates reacting with oxygen to form carbon dioxide, water, and energy.
5. Decomposers, such as bacteria and fungi, convert organic molecules, such as cellulose, back into carbon dioxide, which is then released into the atmosphere.
6. Nitrogen fixation is the process in which nitrogen gas is converted into compounds that contain nitrate or ammonium.
7. Denitrification is a process by which denitrifying bacteria, using a series of chemical reactions, convert nitrate back into nitrogen gas.
8. Eutrophication is the process by which excess nutrients result in increased plant production and decay in aquatic ecosystems.

Interpreting Illustrations

The cycling of nutrients in the biosphere
Page 25

1. Human activities that can affect a nutrient cycle could include land clearing, agriculture, urban expansion, mining, industry, and motorized transportation.
2. These human activities increase the amounts of nutrients in a cycle faster than natural biotic and abiotic processes can move them back into stores.
3. Terms and arrows could be similar to Fig 2.17 on page 70. Students may also add other facts or effects that they have thought of.
4. Changes in the carbon, nitrogen, and phosphorus cycles can affect the health and variety of organisms that live in an ecosystem.
5. Answers will vary but they should include a human activity, a description of the activity, and its impact on a specific part of the local ecosystem.

Applying Knowledge

The carbon, nitrogen, and phosphorus cycles
Page 26

The carbon cycle

Why is the carbon cycle important?	cellular respiration provides energy for living things
How is carbon stored?	short term: vegetation, land and marine animals, decaying organic material, carbon dioxide in its dissolved form long term: dissolved carbon dioxide in deeper ocean waters; coal, oil, and gas deposits; marine sediments and sedimentary rock
How is carbon cycled?	photosynthesis, respiration, decomposition, ocean processes, volcanic eruptions, forest fires