13.4 Food Chains and Food Webs

VOCABULARY

food chain
carnivore
detritivore
specialist
trophic level
herbivore
omnivore
decomposer
generalist
food web

KEY CONCEPT **Food chains and food webs model the flow of energy in an ecosystem.**

MAIN IDEAS

- A food chain is a model that shows a sequence of feeding relationships.
- A food web shows a complex network of feeding relationships.

Connect to Your World

What if you were to write down the names of ten people you know, and then each of them wrote down ten more people, and so on? Very quickly a complex web of relationships would form. Like those in human communities, relationships among organisms in an ecosystem are very complex. These relationships are often described as chains or webs, connecting many species together.

MAIN IDEA

A food chain is a model that shows a sequence of feeding relationships.

The simplest way to look at energy flow in an ecosystem is through a food chain. A **food chain** is a sequence that links species by their feeding relationships. Rather than describe every potential relationship, this model chain only follows the connection between one producer and a single chain of consumers within an ecosystem. For example, in a desert ecosystem, a desert cottontail eats grass. The food chain is, therefore, grass–desert cottontail. If another consumer such as a Harris's hawk eats a desert cottontail, the food chain gets longer: grass–desert cottontail–Harris's hawk, as shown in **FIGURE 4.1.**

FIGURE 4.1 Food Chain

Energy flows through a food chain.

Grama grass, a producer, obtains its energy through photosynthesis.

The desert cottontail, a consumer, obtains its energy by eating the seeds of plants, such as grama grass.

The Harris's hawk, a consumer, obtains its energy by eating other animals, such as desert cottontails.

Types of Consumers

As you read in Section 3, consumers are organisms that eat other organisms. All consumers, however, are not alike.

- **Herbivores,** such as desert cottontails, are organisms that eat only plants.
- **Carnivores** are organisms that eat only animals. Harris's hawks are carnivores that eat desert cottontails.
- **Omnivores** are organisms that eat both plants and animals. Kangaroo rats are omnivores that eat both seeds and insects.
- **Detritivores** (dih-TRY-tuh-VOHRZ) are organisms that eat detritus, or dead organic matter. A millipede is a detritivore that feeds on particles of detritus on the ground.
- **Decomposers** are detritivores that break down organic matter into simpler compounds. Fungi, for example, are decomposers. Decomposers are important to the stability of an ecosystem because they return vital nutrients back into the environment.

READING TOOLBOX

VOCABULARY

Most words for consumers come from Latin words.

- *Voráe* means "to swallow or devour."
- *Herba* means "vegetation."
- *Carnus* means "flesh."
- *Omnis* means "all."
- *Détrere* means "to wear away."

FIGURE 4.2 Florida snail kites are specialists that rely on apple snails as their primary food source.

Food chains are especially helpful in describing feeding relationships among extremely selective eaters, known as specialists. A **specialist** is a consumer that primarily eats one specific organism or feeds on a very small number of organisms.

Specialists are very sensitive to changes in the availability of prey. For example, the Florida snail kite, shown in **FIGURE 4.2,** is a specialist that depends on the apple snail as its main source of food. In the early 1900s, apple snails became less common in Florida as a result of land development. Florida snail kite populations declined suddenly, and in 1967, the bird was listed as an endangered species. Currently, the snails and the birds continue to survive in lower numbers in protected areas, such as the Everglades.

Most species do not rely on a single source of food. These species are called generalists. **Generalists** are consumers that have a varying diet. For example, the diet of a gray wolf may include a number of animals, including elk, moose, white-tailed deer, beavers, and even mice.

Trophic Levels

Trophic levels are the levels of nourishment in a food chain. For example, the producer–herbivore–carnivore chain has three trophic levels. Carnivores are at the highest trophic level. Herbivores are at the second trophic level. Producers are at the first, or bottom, trophic level. Energy flows up the food chain from the lowest trophic level to the highest.

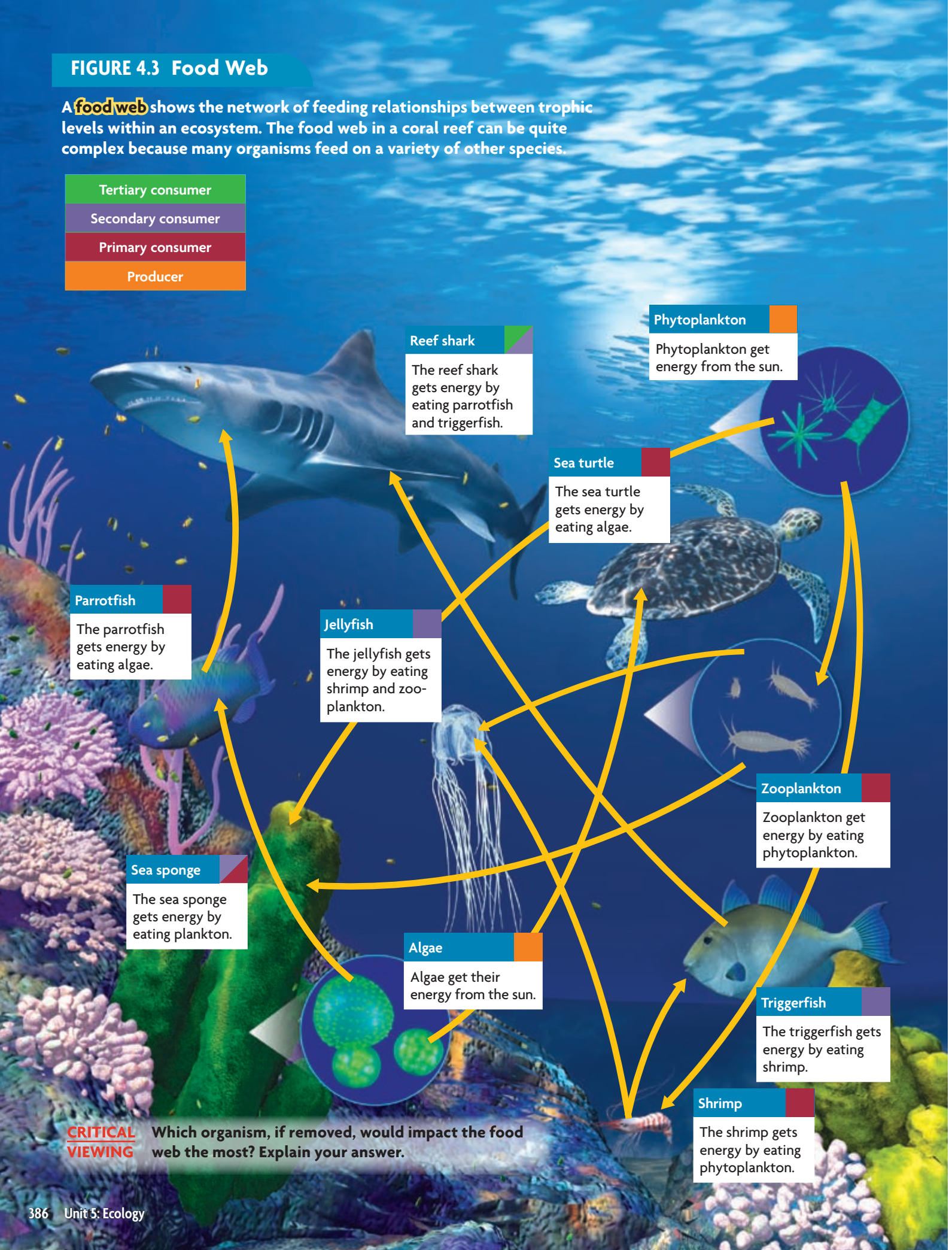
- Primary consumers are herbivores because they are the first consumer above the producer trophic level.
- Secondary consumers are carnivores that eat herbivores.
- Tertiary consumers are carnivores that eat secondary consumers.

Omnivores, such as humans that eat both plants and animals, may be listed at different trophic levels in different food chains. When a person eats a salad, the trophic levels in the food chain are producer–omnivore. When a person eats a steak, the trophic levels are producer–herbivore–omnivore.

Connect **What is the connection between food chains and trophic levels?**

FIGURE 4.3 Food Web

A **food web** shows the network of feeding relationships between trophic levels within an ecosystem. The food web in a coral reef can be quite complex because many organisms feed on a variety of other species.



CRITICAL VIEWING **Which organism, if removed, would impact the food web the most? Explain your answer.**

MAIN IDEA

A food web shows a complex network of feeding relationships.

Generalists may be involved in many food chains, depending on which links are in the chain. Each of the organisms in those links, in turn, may be part of many other food chains. As a result, scientists use food webs to describe these interconnections. A **food web** is a model that shows the complex network of feeding relationships and the flow of energy within and sometimes beyond an ecosystem. At each link in a food web, some energy is stored within an organism, and some energy is dissipated into the environment.

Coral reefs are often referred to as rain forests of the sea, due to the abundance and diversity of species found there. The complex connections in a coral reef ecosystem, illustrated in **FIGURE 4.3**, are created by the feeding relationships within the food web.

The stability of any food web depends on the presence of producers, as they form the base of the food web. In the case of a marine ecosystem such as a coral reef, algae and phytoplankton are two of the producers that play this important role.

An organism may have multiple feeding relationships within a food web. For example, reef sharks are generalists that eat several different food items. When a reef shark eats a parrotfish, it is a secondary consumer, because a parrotfish is a primary consumer that eats algae. However, a reef shark is a tertiary consumer when it eats a triggerfish. This difference in trophic levels occurs because a triggerfish is a secondary consumer that feeds on shrimp. The shrimp, in turn, is a primary consumer that eats phytoplankton. Food webs like this one emphasize both the complicated nature of feeding relationships and the flow of energy within an ecosystem.

Analyze **How might the introduction of a new predator affect the flow of energy through a food web?**

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13.4 Formative Assessment

REVIEWING MAIN IDEAS

1. Why are **food chains** especially useful for describing the relationships of **specialists**?
2. What happens to energy as it flows through a **food web**?

CRITICAL THINKING

3. **Compare and Contrast** Only a small percentage of all consumers are specialists. What danger does a specialist face that a **generalist** does not?
4. **Predict** How might the stability of an ecosystem be affected if all of the **decomposers** were suddenly removed?

CONNECT TO
POLLUTION
5. How might an oil spill in the ocean affect an aquatic food web? What might happen to the food web on land located near the spill? Explain your answers.