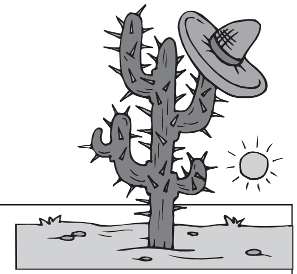
Kingdom Plantae

Section 16.7
Plant Adaptations



Pre-View 16.7

- **Adaptations** – characteristics that help an organism to survive in its environment
- **Adventitious roots** – roots that grow in unusual places, such as on the stem of a plant
- **Prop roots** – roots that grow partially in the air and partially in the ground

Adaptations are physical, chemical, or behavioral characteristics that help an organism to survive in its environment. Let's think about plants a little more. Plants live in all different types of environments, from the hot and dry desert to the cold tundra and everywhere in between. Since most plants live out their lives in one specific place, what adaptations do they have that allow them to survive extreme temperatures, live in very dry areas, live in either salt water or fresh water, or keep them from being consumed by predators? How are they able to reproduce and spread to new areas? These adaptations can be found in their leaves, stems, seeds, flowers, fruits, and roots.

Leaf Adaptations

Leaves are specialized according to where the plant lives. The different sizes, shapes, and structures of leaves allow plants to survive in specific environments. Let's review a few basics about leaves. You should remember these points from previous sub-sections:

Leaf Review

- The primary purpose of a leaf is to absorb light and carry out photosynthesis to make food for the plant.
- For photosynthesis, the leaf must be able to take in carbon dioxide and release oxygen.
- The plant loses water through its leaves during transpiration.
- The stomata allow leaves to take in carbon dioxide and release oxygen, and they control the amount of water that is lost through transpiration.

Many times, the shape and size of the leaves, the number and location of stomata, and the type of cuticle will indicate the type of climate in which a plant can grow. Most plants have stomata on the underside of the leaves where they are protected from the drying effects of wind and sun. Let's consider some specific examples.

Plants that live in habitats where water is scarce may conserve water by having smaller leaves, leaves coated with a thick waxy cuticle, fewer stomata, or stomata that are deep in the leaves. Most cacti growing in deserts have no true leaves. Chloroplasts and stomata are found on their stems, and the stomata are closed during the day and open at night when it is cooler. The spines of a cactus are modified leaves that have no chloroplasts and contain no stomata, so they reduce water loss to the plant. The spines also protect the cactus from herbivores, provide some shade to the plant, and help to channel rain water to the base of the plant.

For conifers, the thin leaves with their waxy coating are an adaptation that helps the plants to conserve water. Many conifers can live in fairly dry climates. They also tolerate colder temperatures. By keeping most of their leaves, these plants can begin photosynthesis very early in the spring when plants without leaves are still dormant. Since they don't have to produce an entire set of new leaves every year, they can grow in habitats where nutrients are not as available.

Adaptations for Obtaining and Eating Food

Many adaptations help animals get food. These adaptations can include the ability to hunt or graze, a keen sense of sight or smell, or even the different types of beaks that allow birds of different species to have very different diets. Some specific examples are given below.

- Rattlesnakes and other snakes called **pit vipers** have special sense organs on each side of the head that alert the snakes to mice or other warm-blooded prey that are nearby.
- Birds have a number of special adaptations that help them obtain and eat food. The keen eyesight of hawks and eagles allow them to spot their prey. Sharp claws called **talons** allow them to grasp their prey, and sharp beaks allow them to tear apart and eat their prey. On the other hand, birds like the finches have short, strong beaks for cracking and eating seeds. Pelicans have large beaks designed to catch and eat fish. Woodpeckers have long, sharp beaks best suited for finding and eating insects. Some of these beak adaptations can be seen in figure 17-3 below.
- Some animals **migrate** in the fall to warmer climates with more plentiful food supplies. They migrate back to their original climates once weather and food conditions improve in the spring. Many different types of animals migrate, including birds, bats, fish, whales, elk, and butterflies. Even underground animals, such as termites and earthworms, “migrate” farther under the soil to find more favorable living conditions.
- Baleen whales are filter feeders and have special structures to strain their food out of the water as they swim.
- Herbivores, animals such as cows that eat only plants, have specially designed teeth to grind grasses and grains and special stomachs to digest them.
- Carnivores, animals like those in the cat family that eat other animals, usually have sharp claws and teeth to catch and eat their prey. They may also have special coloration that camouflages them as they hunt.
- Some animals use **aggressive mimicry** to lure prey to them. For example, the body of the angler fish resembles a rock. It uses a part of its spine as a lure, which looks like a much smaller fish, to lure prey to itself. Other animals may use scent or other signals to lure prey.
- Animals may be **nocturnal**, active at night and asleep during the day, or **diurnal**, active during the day and asleep at night. Since most people are diurnal, we are usually more familiar with diurnal animals, the ones that are awake when we are. But, you probably know some nocturnal animals as well. Many nocturnal animals have extra large eyes to allow them to see their prey at night. They may also have a very keen sense of smell to help them locate food when it is dark.

Examples of Bird Beak Adaptations

short, strong beak for cracking seeds — long, sharp beak for spearing fish — sharp, hooked beak for tearing flesh

Fig. 17-3

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.

Example of a Food Chain

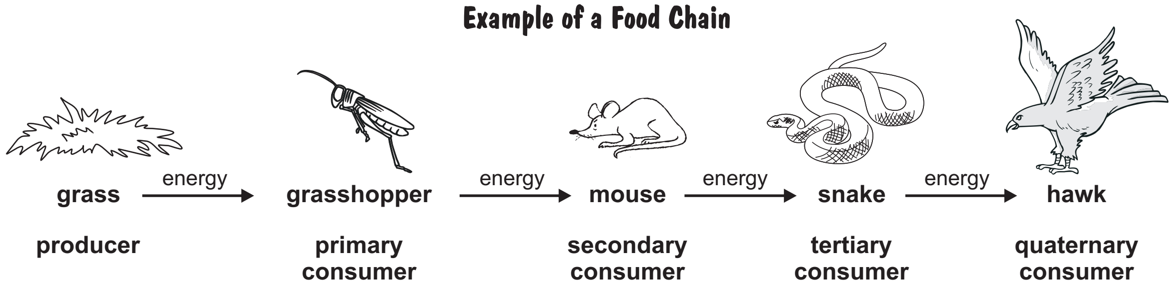


Fig. 19-2

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.

Changes in Ecosystems
Section 21.1
Population Factors

Pre-View 21.1

- **Carrying capacity** – the largest number of organisms that can be supported to live in an ecosystem
- **Logistic growth** – natural population growth the follows an S-shaped pattern
- **Limiting factors** – things that limit how many organisms can live in a population
- **Immigration** – the movement of organisms into an area
- **Emigration** – the movement of organisms out of an area
- **Density dependent factors** – limiting factors that depend on the number of organisms in a population; examples: available food, water, and suitable habitats
- **Density independent factors** – limiting factors that do not depend on the number of organisms in a population; examples: natural disasters or human activities
- **Exponential growth** – unrestricted population growth that follows a J-shaped pattern

Limiting Factors of Populations

Initially, all populations in an ecosystem tend to increase in number. In a population that is new to an ecosystem, the population may grow slowly at first and then more quickly since the population will initially have unlimited resources. After a while, the rate of population growth slows down until it stops or levels off. It levels off when the environment has reached its **carrying capacity**, which is the largest number of organisms of a species that can be supported by the environment. Natural populations have a pattern of growth that follows an S-shaped curve as shown in figure 21-1. This S-shaped pattern is called **logistic growth**.

Natural Population Growth (Logistic Growth)

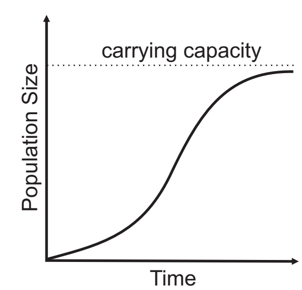
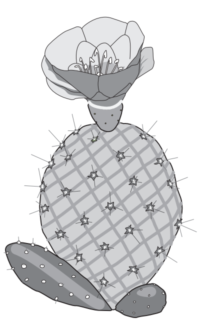


Fig. 21-1

The population growth is limited by several main factors: the birth/death rate of organisms in the population, the number of organisms entering and leaving the population, and the amount of available resources. These factors are called **limiting factors** because they limit how large a population can grow. If the birth and death rates are about even, and the immigration and emigration rates are even, then availability of resources becomes the main limiting factor. (**Immigration** is the movement of organisms into an area, and **emigration** is the movement of organisms out of an area.) Limiting factors can be biotic or abiotic. A biotic factor for animals could be competition for or the availability of food. For plants, these factors might be abiotic, such as sunlight, water, soil, and nutrients.



Example: Cacti grow in desert areas, but they are often well-spaced. Which of the following is the most likely limiting factor for cacti in a desert: sunlight, water, soil, or consumption by herbivores?

In a desert climate, the most common limiting factor for plants is the availability of water. Desert plants get plenty of sunlight and have lots of space and sand to grow. Consumption by herbivores is probably not a main limiting factor. Instead, the number of herbivores that can survive in the desert is most likely determined by the number of plants that can grow to feed them.