Name Date Class

Section 4.1

Population Dynamics

North Carolina Objectives Objective 5.01 Investigate the interrelationships among organisms, populations, communities, and ecosystems: Carrying capacity

Before You Read

This section discusses populations—how they grow and why they stop growing. The factors that affect how populations grow and why they stop growing are called population dynamics. What populations of living things can you observe where you live? Think about populations of plants and animals near your home. List them below. Have those populations ever increased or decreased? Write down reasons for changes in those populations.

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Read to Learn

STUDY COACH

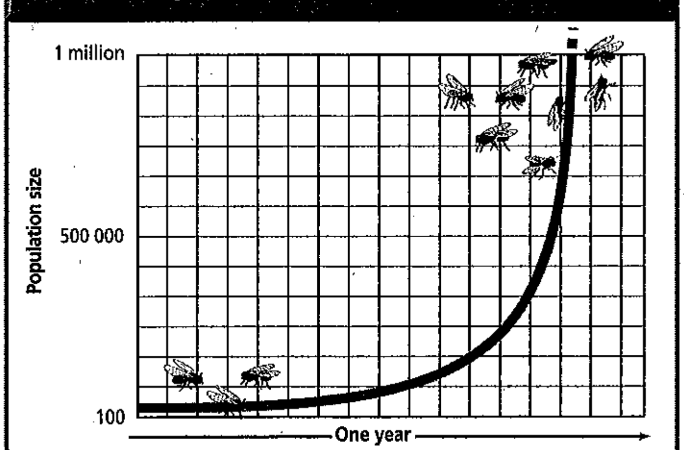
Mark the Text **Identify Growth Factors** Highlight the factors that affect the growth of populations.

Principles of Population Growth

Every organism is a member of a population. A population is a group of organisms of the same species that live in a specific area. You may have a population of grass in your backyard. There also may be a population of ants there. You may even have a population of bacteria on your bathroom door handle.

Populations grow, die, increase, and decrease. Factors that affect the growth rate of populations include food, space, disease, and predators. Scientists have discovered that populations of organisms tend to grow in the same way. Populations start by growing slowly. In the beginning, there are just a few organisms that reproduce. Soon the rate of population growth increases because there are more organisms reproducing.

Population Growth of Houseflies



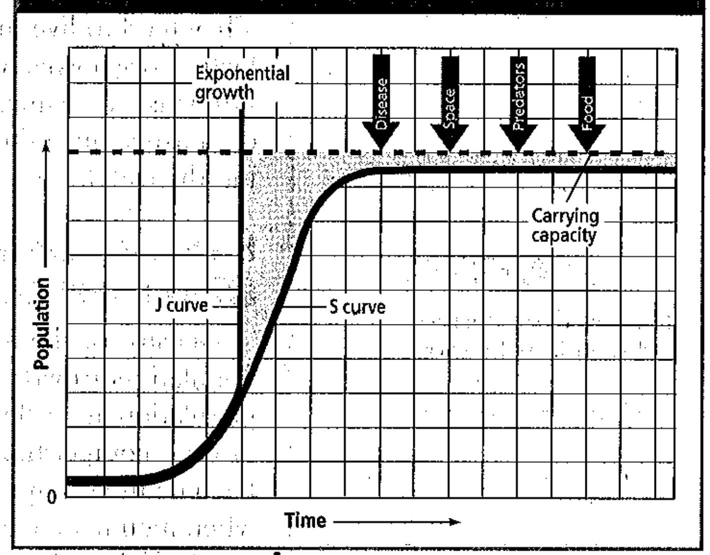
How do populations grow?

Scientists use graphs to show how populations grow. The graph of a growing population looks like a J-shaped curve. The flat part of the J shows slow growth. The part of the J that rises shows rapid growth. The J-shaped curve is a picture of exponential growth. **Exponential growth** means that as a population gets larger, it grows at a faster rate. For example, you may have one dandelion in your backyard. A few weeks later you may have twenty dandelions. A few weeks after that you may have hundreds of dandelions. The reason is exponential growth. One dandelion produces many seeds. Twenty dandelions produce hundreds of seeds.

Can populations grow and never stop growing? No, there are factors that slow down or limit growth. These are called limiting factors. The effects of limiting factors also can be shown on a graph. The J-shaped curve begins to look like an S-shaped curve as population growth slows or levels off.

When populations run out of food or space, growth starts to slow down. Population growth also slows when disease or predators attack populations. Later, you will read about other reasons why population growth slows. ✓

Characteristics of Population Growth



What is an environment's carrying capacity?

The **carrying capacity** of an environment is the number of organisms of one species that can be supported for an unlimited amount of time. Until carrying capacity is reached, there are more births than deaths in the population. If a population grows larger than the carrying capacity of the environment, there will be more deaths than births. The number of organisms in a population is sometimes more than the environment can support and sometimes less than the environment can support.

Reproduction Patterns

An organism's population growth is shaped by its reproductive pattern, or **life-history pattern.** If an organism has a rapid life-history pattern, it will reproduce early in life. It also will produce many offspring in a short period of time. A mosquito is an example of a rapid life-history organism. Rapid life-history organisms have a small body size and a short life span. They live in environments that change extensively. Their populations grow quickly but decline when the environment becomes unfavorable. As soon as conditions are favorable, the small population will grow rapidly.

Reading Check

1. What limits a population's growth?

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Think it Over

2. **Analyze** What type of body size do rapid life-history organisms have? (Circle your choice.)
   a. small
   b. large

Slow life-history patterns belong to large species that have long lives. They usually grow into adults slowly and reproduce slowly. They tend to live in more stable environments. Often, slow life-history organisms will keep their populations at carrying capacity. Humans, elephants, and trees are examples of slow life-history organisms. Slow life-history organisms have far fewer young during their lifetime than do rapid life-history organisms.

How does the number of organisms in an area affect population growth?

Density, or the number of organisms in a given area, affects population growth. Factors that are related to the density of the population are called **density-dependent factors.** They include disease, competition, predators, parasites, and food. These factors become more important as the population increases. For example, when members of a population live far apart, disease spreads slowly. When the members live close together, disease spreads quickly. This is true for both plants and animals. It is true for populations of people. Some scientists think that the presence of HIV/AIDS in populations is a limiting factor in the growth of those populations. ✓

Density-independent factors affect populations, no matter how large or small. Density-independent factors include volcanic eruptions, temperature, storms, floods, drought, chemical pesticides, and major habitat disruption. Imagine a pond containing a population of fish. If a drought caused the pond to dry up, then that population of fish would die. It would not matter if there were 10 or 100 fish in the pond. Drought is a density-independent factor. Human populations also can be affected by density-independent factors. Rivers sometimes overflow their banks after a heavy rain. If a town is flooded, it does not matter how many people live in the town; everyone feels the effects of the flood.

Reading Check

3. Name five density-dependent factors.

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Think it Over

4. Analyze An example of a density-independent factor is (Circle your choice.)

a. a frost that destroys tomato plants.

b. a fungus that spreads from plant to plant.

Organism Interactions Limit Population Size

Populations also are limited by contact with other organisms in a community. The relationship between predator and prey is a good example. A cat controls the population of mice around a house. A swarm of locusts eats and destroys acres of lettuce on a farm. Bears eat the salmon swimming up a river. All of these are examples of interactions between organisms in a community. Sometimes predators can have a large impact on a population. For example, when brown tree snakes were brought to the island of Guam, they had no natural predators on the island. The snake population increased unchecked. As a result, bird populations have been almost completely destroyed by the snakes. When predators consume prey on a large enough scale, the size of the prey population can be greatly reduced. ✓

Sometimes populations of predators and their prey experience changes in their numbers over time. Scientists observe cycles of population increases and decreases. Some are quite regular and predictable. An example is the interaction of the snowshoe hare and the Canadian lynx. The lynx, a member of the cat family, eats the snowshoe hare. As you can see, predator populations affect the size of prey populations.

Reading Check

5. Why did the brown tree snake population on Guam increase unchecked?

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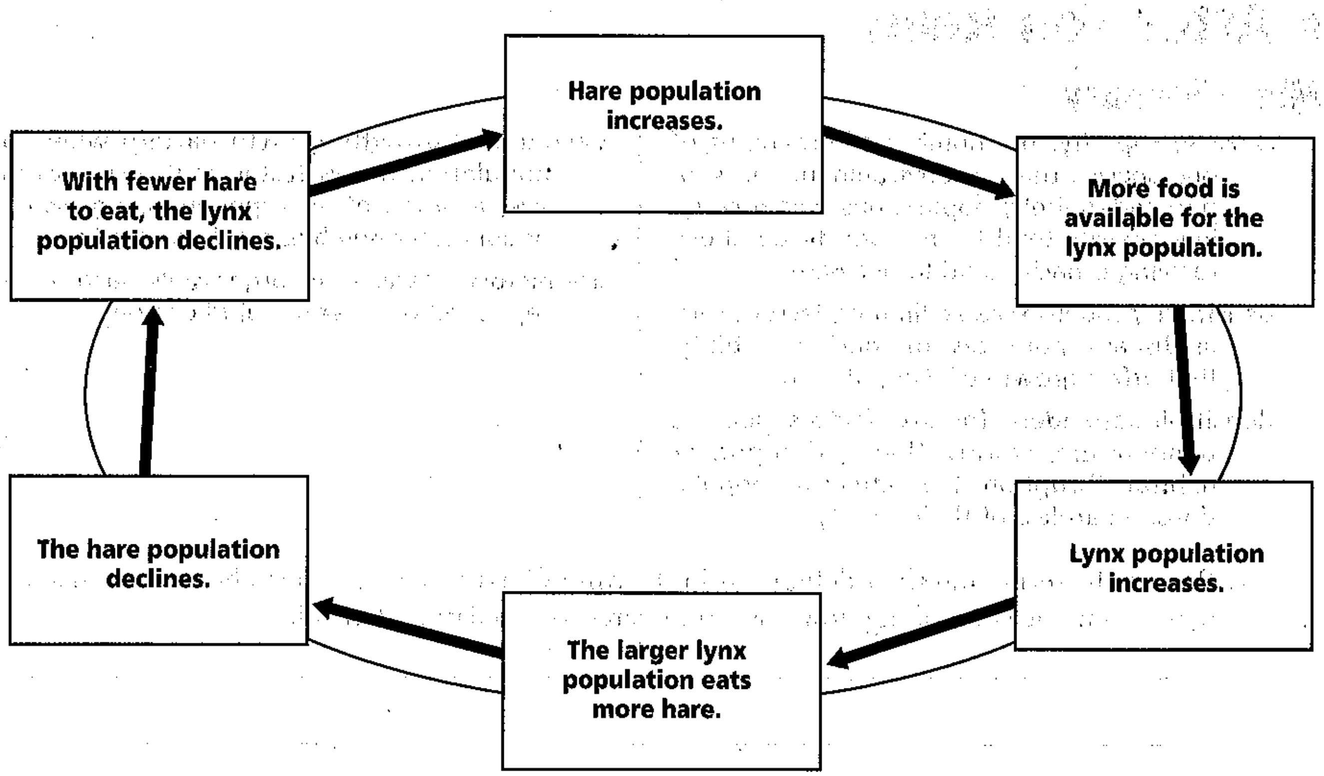


Usually the lynx population catches the young, old, injured, or sick members of the hare population. This makes more resources available for the remaining healthy members of the hare population.

Is there competition among members of the same population?

The lynx and hare are members of different populations, but members of the same population also interact with each other. Populations can increase so that members are competing for food, water, and territory. Competition is a density-dependent factor. When only a few individuals need the available resources, there is no problem. When the population becomes so large that demand for resources is greater than the supply of resources, the population size will decrease.

Sometimes populations become crowded and organisms begin to show signs of stress. Individual animals may become aggressive. They may stop caring for their young or even lose their ability to bear young. Stress also makes animals more at risk for disease. All of these stress symptoms are limiting factors for growth. They keep populations below carrying capacity.

After You Read

Mini Glossary

carrying capacity: the number of organisms of one species that an environment can support indefinitely; populations below carrying capacity tend to increase; those above carrying capacity tend to decrease

density-dependent factors: limiting factors, such as disease, parasites, or food availability, that affect growth of a population

density-independent factors: factors, such as temperature, storms, floods, drought, or habitat disruption, that affect all populations, regardless of their density

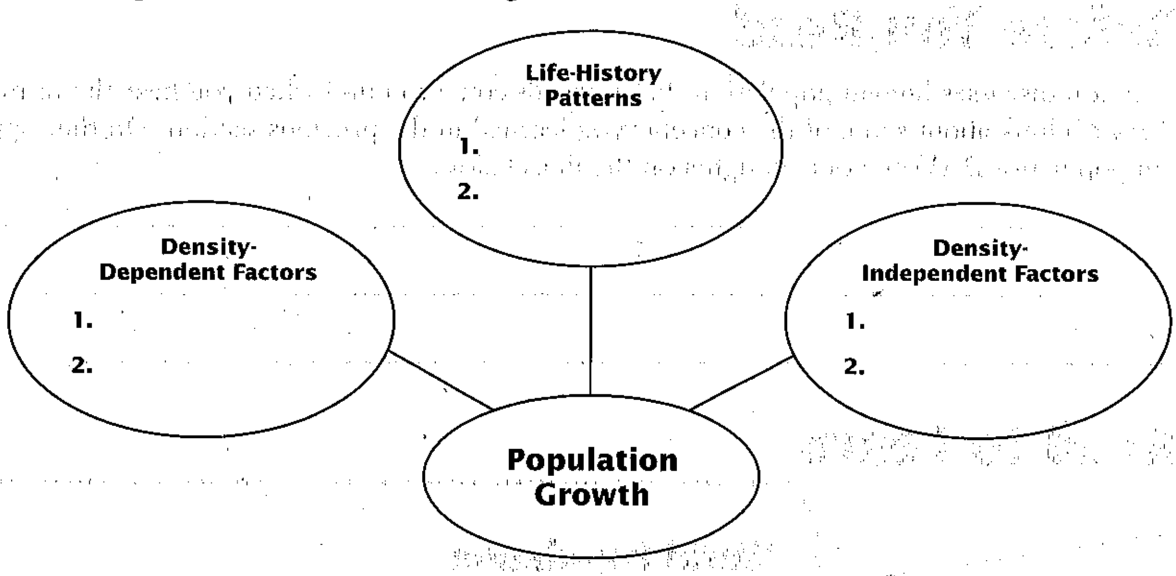
exponential growth: growth pattern where a population grows faster as it increases in size; a graph of an exponentially growing population resembles a J-shaped curve

life-history pattern: an organism's pattern of reproduction; may be rapid or slow

1. Review the terms and their definitions in the Mini Glossary above. Then choose a term and write a sentence describing how the term relates to population dynamics.

Section 4.1 Population Dynamics, *continued*

2. The web diagram below identifies three factors that affect the growth of populations. Write two examples of each factor in the diagram.



Visit the Glencoe Science Web site at **science.glencoe.com** to find your biology book and learn more about population dynamics.