

Chapter

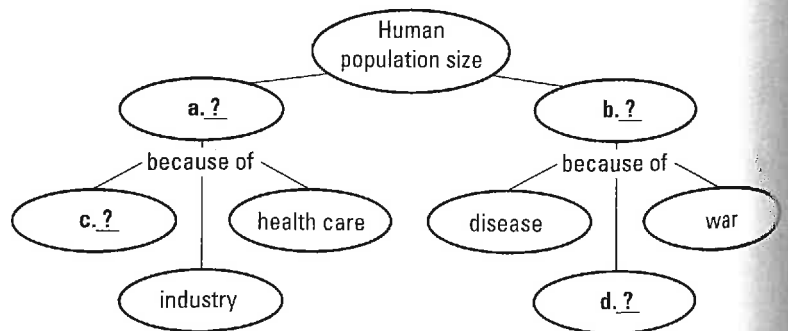
13

# Human Population

- 13.1 HISTORY OF THE HUMAN POPULATION
- 13.2 GROWTH AND CHANGING NEEDS
- 13.3 CHALLENGES OF OVERPOPULATION

Thousands of runners throng the deck of the Verrazano Narrows Bridge at the start of the New York Marathon. They represent only a tiny fraction of Earth's total human population of more than 6 billion.

Copy the concept map about human population into your notebook. As you read, fill in the concept map, then give it a title.



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## 13.1 HISTORY OF THE HUMAN POPULATION

**OBJECTIVE** • Describe the major events that have affected the rate of human population growth throughout history.

The issue of overpopulation has been a subject of concern for at least four centuries. In the 1500s, English statesman Thomas More portrayed the ideal state in his book *Utopia*. In More's ideal state, population is kept constant, crops are controlled, and food is distributed at public markets and in common dining halls.

Some of the best-known ideas about population growth in the past two centuries were proposed by British economist Thomas Malthus. Writing in 1798, Malthus argued that population growth was not always desirable. Malthus pointed out that populations tend to increase geometrically (1, 2, 4, 8, 16...) whereas the food supply tends to increase arithmetically (1, 2, 3, 4, 5...). The human population, therefore, has the potential to increase at a much faster rate than the food supply. Malthus believed that the tendency of the human population to outgrow its resources would lead to such conditions as famine, war, and other human suffering. To avoid such outcomes, Malthus advocated practices that would reduce the population growth rate, including late marriages and small families. These ideas have been widely discussed and debated ever since.

### Increases in Growth Rate

Scientists estimate that the first modern humans evolved on Earth approximately 100 000 years ago. Scientists can only guess about population size and growth during the early stages of human history. However, there is some agreement that during this time, the population consisted of hunter-gatherers who lived in small families or tribal groups.

When humans roamed the forests and plains as hunter-gatherers, populations grew slowly. Starvation, predation, and disease prevented people from living long lives—35 may have been considered very old. These conditions kept the infant mortality rate high as well. Between 10 000 and 20 000 years ago, some people began to establish permanent settlements. Evidence suggests that these people did not cultivate food, but they did store food they gathered. Food storage reduced the threat of starvation and lowered the death rate, causing an increase in population size.

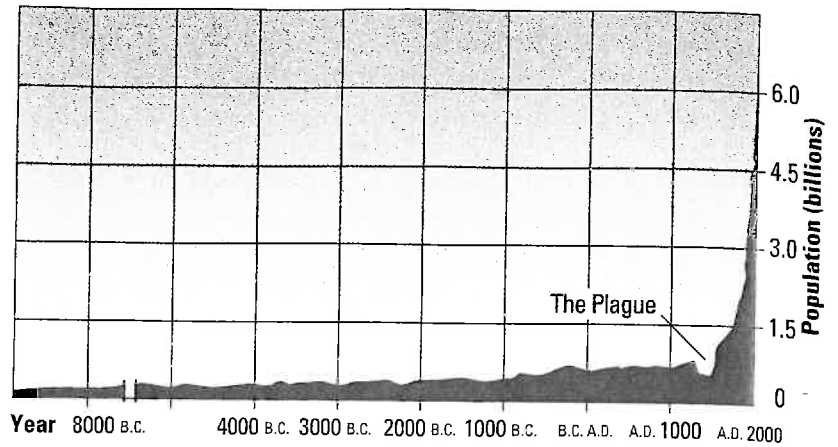
**Agriculture** A major period of population growth occurred around 10 000 years ago when people began to cultivate crops and domesticate animals. *This shift from harvesting wild food sources to producing food through the techniques of farming and herding is known as the agricultural revolution.* As agriculture spread and dominated



### Biology

In 1838, the ideas of Malthus greatly impressed a young naturalist named Charles Darwin who had recently returned from a sailing trip around the world. Malthus's idea that populations tend to outgrow their resources became a major point in Darwin's theory of evolution by natural selection. According to Darwin's theory, organisms produce many more offspring than can survive. Within the population there are a variety of traits. Those individuals with the most favorable traits are the ones that survive and pass their traits to their offspring. Over many generations, favorable traits accumulate in the population, resulting in evolution.

**Figure 13.1** The human population grew slowly and irregularly for thousands of years. The growth rate has increased dramatically over the last 300 years, since the beginning of the industrial revolution.



## Do It! Field Activity

What was the population of your city, town, or community 50 years ago? 100 years ago?

1. Use library or town hall resources to find out the history of population change in your town or the nearest large city.
2. What factors accounted for the changes?

other means of obtaining food, nomadic hunter-gatherer societies were gradually replaced by small farming communities, each with its own social structure.

Farming provided an increased and steady food supply, which led to an increase of Earth's human population. In addition, social structure caused a general rise in the standard of living, which reduced mortality rates and increased life expectancy. It is estimated that 9000 years ago there may have been between 5 and 10 million people on Earth.

**Industry** Another major period of population growth has occurred during the past 300 years. This period of history, marked by the industrial revolution, has included a number of events that favor population growth. Technological advancements have improved food production and distribution, reduced the length of the work day, and provided people with safer work environments. In addition to a greater availability of goods and materials, there have been major technological advances that have improved the quality of health care and medicine.

**Health Care** The development of the germ theory of disease occurred at the height of the industrial revolution in the late 1800s. *The germ theory of disease identified bacteria and other microorganisms (MY-kro-OR-guhn-izuhms) as the agents responsible for many diseases.* Before the development of the germ theory, people did not recognize the connection between health and hygiene. The germ theory resulted in improved hygiene, sterile surgery, better methods of waste disposal, and water treatment. These developments reduced the death rate, particularly among infants and children.

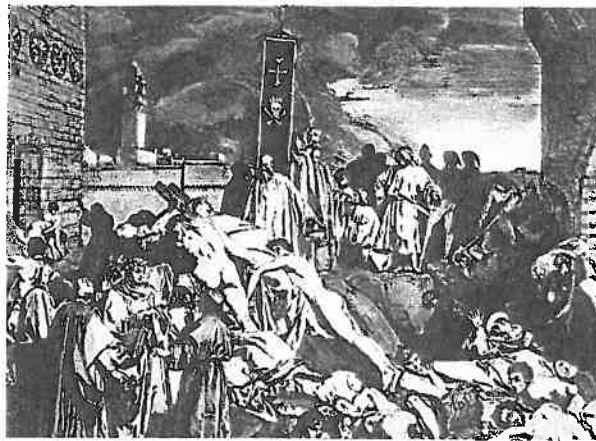
The biomedical revolution of the twentieth century has also resulted in an increase in population growth. During this revolution, death rates continue to decrease as health and hygiene improve. The discovery of antibiotics and vaccines has wiped out or controlled many life-threatening diseases. In particular, infant mortality has decreased due to better prenatal care.

## Declines in Growth Rate

Throughout most of human history, the human population has been increasing. However, population growth has not always been steady and uninterrupted. If you look at the growth curve in Figure 13.1, you will observe a sharp decline in population growth during the mid-fourteenth century. This decline is a result of the bubonic plague, or Black Death, that struck much of Europe and Asia. The plague may have killed more people than any other single disease. So devastating was the plague that within several years it claimed the lives of more than 25 percent of the adult population of Central Europe and Asia. The population of England was reduced by about 50 percent between 1348 and 1379. In addition to the plague, worldwide outbreaks of cholera, typhus, malaria, yellow fever, and smallpox claimed hundreds of thousands of lives. The more densely populated cities became, the more quickly diseases spread.

**Famine** Famine can also devastate human populations. The Irish Potato Famine of the 1840s resulted in the death of more than one million people. At this time, the potato was a main food staple in Ireland. A disease called potato blight destroyed the potato crop, resulting in severe starvation. A famine in China during 1876–1879 was responsible for more than 9 million deaths.

**War** Wars have a destructive effect on human populations. Combat can claim many lives in a short time period. Other factors that reduce populations, such as disease, famine, and environmental destruction, can occur due to military activities. Cutting off food supplies is a common tactic among warring groups. Examples of wars that have taken enormous tolls on human life include the Thirty Years' War (1618–1648), when about one-third of the inhabitants of Germany and Bohemia were killed. Historically, many lives have also been lost in tribal and civil wars throughout Africa, India, China, South America, and the United States. World War I claimed an estimated 21.5 million lives, while an estimated 35–60 million people may have died as a result of World War II.



**Figure 13.2** The death and despair brought on by the bubonic plague were common themes in the art of the Middle Ages.

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## SECTION REVIEW

1. What changes in human society occurred during the agricultural revolution?
2. What are some factors that can result in a decline in human populations?
3. **Analyze** If the human population increased arithmetically instead of geometrically, would the potential for an overpopulation problem still exist? Explain your answer.

## 13.2 GROWTH AND CHANGING NEEDS

**OBJECTIVES** • *Identify factors that affect the size of a population.*  
• *Compare and contrast population growth trends in developing and industrialized nations.*

Many environmentalists believe that overpopulation is one of the most serious problems we currently face. According to this view, many other significant environmental problems may never be resolved unless worldwide population growth is slowed and ultimately reaches a replacement rate of zero.

### Measuring Growth Rate

Determining the rate of population growth is helpful for scientists, urban planners, and others who have to anticipate the needs of the population of the future. Growth rates are determined by subtracting the death rate (number of deaths per one thousand people) from the birth rate (number of births per one thousand people). For example, in recent years the birth rate in Egypt has averaged 29 births per year per 1000 people. The death rate has averaged 8 deaths per year per 1000 people. Thus, the population grew at a rate of 21 persons per year per 1000 people, or 2.1 percent (2.1 persons per 100 people).

The doubling time of a population indicates how long it will take, at the present rate of growth, before a particular population doubles its size. The populations of some cities and countries have doubled in 10 years. The population of Mexico City doubled between 1960 and 1970, and doubled again by 1980. The populations of entire countries, such as Honduras, Kenya, Syria, Iran, and Guatemala, are currently doubling in fewer than 30 years.

Doubling time can be used to illustrate the negative potential of uncontrolled population growth. For example, consider the need to double housing, food supplies, jobs, education, water, energy, and



Most governments conduct a survey called a census every few years to determine the size of the population. Censuses were conducted in ancient Babylonia, Rome, and China. A census is conducted by the U.S. government every ten years to determine the age, sex, employment, and other data about the population. The information is used to determine such things as the number of representatives for each state in the House of Representatives.

**Table 13.1 Doubling Time of the Human Population**

Year	Approximate population size	Doubling time (in years)
8000 B.C.	5 million	1500
A.D. 1650	500 million	200
1850	1 billion	80
1930	2 billion	45
1975	4 billion	55
2030 (projected)	8 billion	

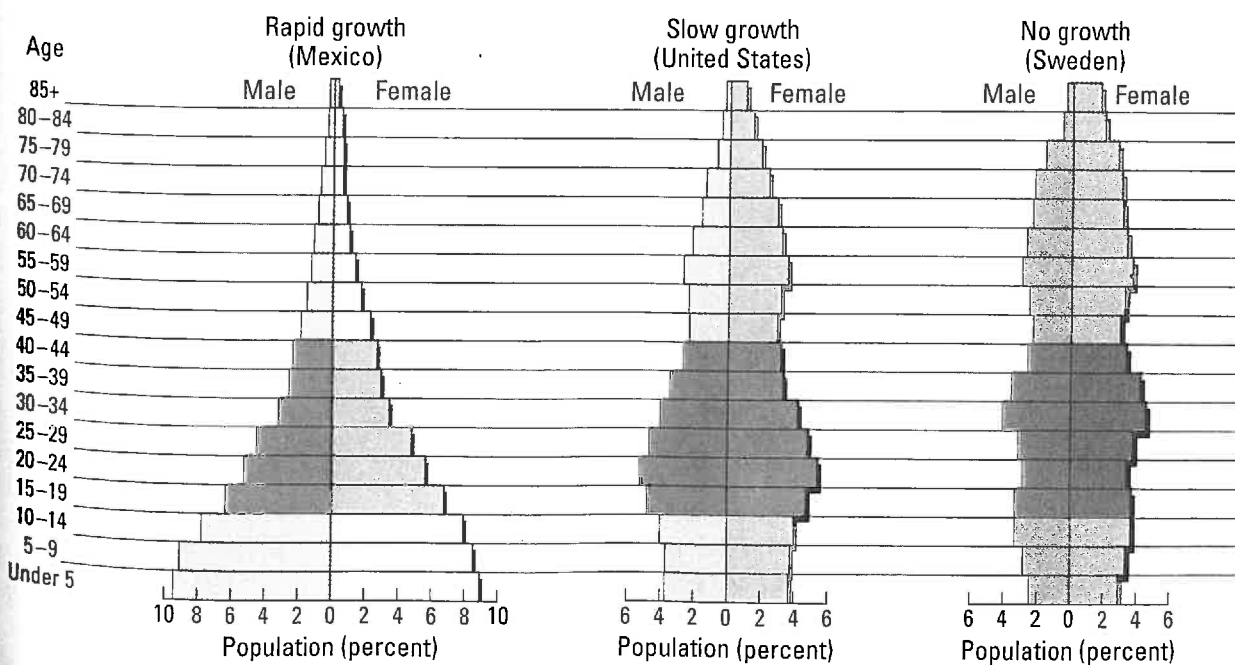
health facilities, just to maintain the present standard of living. Then consider the challenge of attempting to improve that standard of living in the same time period.

When measuring the growth rate of a specific population, births and deaths are not the only factors to be considered. Immigration and emigration can also affect the size of a population. Immigration is the movement of individuals into an area, while emigration is movement out of an area. When determining the size of the human population in a specific area such as a city or nation, the factors of immigration and emigration must be considered. When studying the size of the entire population of Earth, however, these factors do not apply. Humans cannot leave the planet, nor can newcomers arrive from elsewhere.

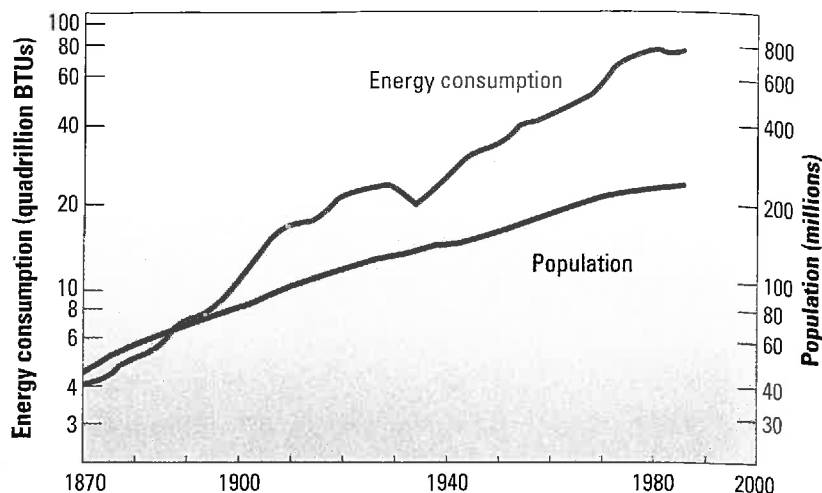
## Demography

When scientists, planners, and policy makers study populations, they need to know not only how many people there are, but also what types of people make up the population. By including such information in their studies, scientists can determine how the population is changing. Are people becoming older, richer, or better educated? Are they having more children? Are there more women than men? These questions can be answered by demographic studies. *The science of the changing vital statistics in a human population is called **demography*** (de-MAH-gruh-fee). Figure 13.3 shows the demographic statistics of population ages in three nations: one growing quickly (Mexico), one growing slowly (United States), and one that is not growing at all (Sweden). Notice how much younger

**Figure 13.3** These charts show the percentage of the population in each age group of three nations: one growing rapidly (Mexico), one growing slowly (U.S.), and one that is not growing at all (Sweden). The darkly shaded areas show people in their child-bearing years.



**Figure 13.4** During the 1900s, the energy consumption of the United States grew faster than the population. What do you think was the reason for the drop in energy use in the 1930s?



the population of Mexico is compared to Sweden. The information in these graphs is much more useful than a simple number showing population size. With the additional information, plans can be made to accommodate the future needs of society such as child care and care for the elderly.

## Changing Needs

It is not difficult to understand that a society with more people has greater needs than a society with fewer people. However, population size is not the only factor that determines the needs of a society. Changes in technology, lifestyles, and standards of living all affect the needs and consumption rates of a population. Notice the change in energy use during the period shown in Figure 13.4. The energy use far outpaced the population growth. Much of this change in usage was due to increased industrialization and modernization. Industrial societies generally use more resources than underdeveloped societies. As more nations of the world develop into industrialized nations, their needs can be expected to increase faster than the population increases. Ironically, it is the least developed nations of the world that are expected to experience the greatest increase in population during the coming decades.

## SECTION REVIEW

1. List four types of information that may be included in demographic studies.
2. What factors are considered when measuring population growth?
3. **Calculate** What is the percentage of population growth in a region if the number of people per 10 000 individuals increases by 330 each year?

# Mobilizing Against Meningitis

**M**eningitis is an infectious disease caused by bacteria. The disease is spread by airborne droplets that are released when an infected person sneezes or coughs. Symptoms of meningitis include headache, fever, vomiting, and a stiff neck. If left untreated, meningitis can be deadly. Even with treatment, 10 percent of the patients may die.

The disease is common in both temperate and tropical regions. In Africa, it is most commonly seen in a 600-km-wide band that reaches across the continent from Senegal and Gambia to Ethiopia. In the 1996 meningitis epidemic in this part of Africa, an estimated 250 000 people were infected, and more than 10 percent of them died.

In 1997, several organizations began to work together to fight the spread of meningitis in Africa. The International Coordinating Group (ICG) included representatives from the World Health Organization (WHO), UNICEF, the International Red Cross, Médecins Sans Frontières (Doctors Without Borders), and the manufacturers of meningitis vaccines. The immediate goal of the ICG was to ensure that the most needy areas got help first.

The ICG launched a two-pronged attack on meningitis epidemics. One action taken was the administration of antibiotics to people who were already infected. This helped speed recovery and reduce the period of time during which a patient can infect others. The other action taken was the vaccination of people who had not yet been infected. Both approaches required the training of many local health-care workers. A critical lesson was learning to store the vaccine correctly. The vaccine must be kept cold, between 2 ° and 7 °C. Many of the areas to which health-care workers had to take the vaccine did not have refrigerators, so the transport and storage of the vaccine had to be carefully planned.

The program was successful. During 1997, there were fewer than 60 000 cases of meningitis. This figure represents a 75 percent reduction in the number of cases from 1996.



In Africa, an aggressive vaccination program was developed to prevent the spread of meningitis.

The long-range goal of the ICG is to improve the monitoring of populations in order to identify epidemics at the earliest possible stage. ICG is working with public health officials in several African countries to develop plans for local programs to predict and deal with meningitis epidemics in the future. If these plans work well, they may be used against other infectious diseases.



## Checkpoint

1. Where in Africa is meningitis most common?
2. Why is it important to develop a way to predict epidemics of such diseases as meningitis?



## 13.3 CHALLENGES OF OVERPOPULATION

**OBJECTIVES** • *Relate* overpopulation to use of natural resources, energy demands, and biodiversity. • *Hypothesize* about the effect of availability of resources on population growth.



**Figure 13.5** The problems of overcrowding can be seen in urban centers throughout the world. In 1970, about 37 percent of the human population lived in cities. This number is expected to climb to more than 60 percent by the year 2025.

### **Dateline 1873**

Ellen Richards became the first woman to graduate from the Massachusetts Institute of Technology, where she was awarded a degree in chemistry. She went on to establish the first modern sewage treatment testing laboratory. She analyzed water and sewage samples in Massachusetts and helped to develop the first water quality standards in the United States. Her work helped reduce the threat of diseases such as cholera, typhoid fever, and dysentery.

Rapid population growth directly affects the global ecosystem. An increase in population places a greater demand on the space needed to sustain large numbers of people. Population growth also places a greater demand on resources, such as minerals, fuels, and food. As humans take up more space on the surface of Earth, there is less land available for the planet's other inhabitants. When this happens, it becomes difficult to convince people to give up the land and other resources they need to survive for the sake of saving wildlife.

As you have read throughout this text, however, all life on Earth is interconnected. Overpopulation and increased use of resources and energy in any country can affect other countries. Countries with growing populations may rely on the resources of other nations. Pollution from one country may affect a neighboring country.

Human health problems can be directly tied to overpopulation. The more crowding there is in a given area, the more contacts people make with other people. For example, people who live in crowded cities are exposed to more illnesses than are people in remote areas. Diseases related to malnutrition, poor hygiene, and a lack of medical facilities are also problems associated with overpopulation.

Overpopulation also causes the harmful effects of the things that people do to the environment to be magnified. For example, exhaust fumes from one car do not pose a serious threat to the environment, but those of several million cars do. Clearing a tract of land to build a house may not seem harmful in an area with several square kilometers of undisturbed grassland or forest. But building a house on the last available tract of land within an ecosystem may have a serious environmental impact, destroying the homes and breeding grounds of several species.

### **Controlling Population Size**

It may seem obvious that controlling the birth rate is the answer to the problems of overpopulation. However, empowering people to control the number of children they have is not easy; convincing them that they *should* have fewer children is even more difficult. Forcing people to limit the size of their families is a step that most people find unethical and unacceptable.

Large-scale efforts are underway in many underdeveloped and developing countries to educate people and provide effective methods of birth control. There are many factors, however, that contribute to people's continuing desire to have children. In many religions, any effort to prevent pregnancy, other than avoiding sexual activity, is considered unacceptable. Also, many people feel that children are a source of pride and joy, and without them their lives would have little meaning. In many societies, a large number of children is considered important for helping to work the family farm or care for aging parents. Such basic cultural beliefs are very difficult to change, even if the change seems to be warranted for the common good.

In several nations, such as Bulgaria, Hungary, and Latvia, the birth rate has fallen below the death rate. Such nations face special challenges due to an aging and declining population. Decreasing numbers of soldiers and working taxpayers threaten to weaken the military and economic strength of these nations. The governments of some nations with a shrinking population offer financial support and tax advantages to encourage couples to have more children. On a global scale the human population continues to increase, but it is also aging. There will be a much higher proportion of middle-aged and elderly adults in the year 2050 than there are today.

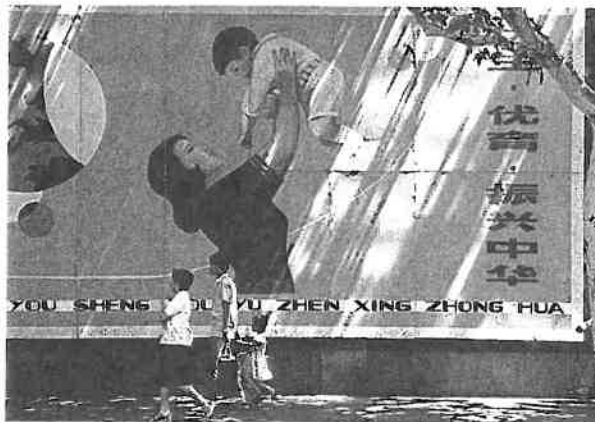
### Is Technology the Answer?

Many of the advances of modern technology have the potential to increase the resources available to humans. New sources of renewable energy, new strains of crops developed through genetic engineering, and other scientific breakthroughs could help relieve many of the problems of overpopulation. Will these solutions be adequate to meet the challenges that lie ahead?

Some researchers believe that the increasing human population is not a problem. More people implies more brain power, and technology will continue to advance. Many environmentalists, however, feel that there is a limit to the number of people that can live comfortably on Earth. Earth's ecosystems can support only a finite number of people on the planet.

### SECTION REVIEW

1. How can overpopulation affect human health?
2. How might overpopulation in one area affect ecosystems in other areas?
3. **Hypothesize** What effect does increasing the resources in an area have on the population in that area?



**Figure 13.6** The government of China strongly encourages couples to have only one child. Incentives to comply with this policy include better housing, longer vacations, and an extra month's pay each year to single-child families.

### Think About It!

How do you think people in the United States would feel about the government limiting the number of children a family could have?

1. Would people feel differently if the limit was one child, two children, or ten children?
2. Explain your answer.

## ACTIVITY 13.1

### Modeling Disease Transmission

#### PROBLEM

How are diseases transmitted?

#### MATERIALS (per student)

- wax pencil
- empty baby food jar
- safety goggles
- rubber gloves
- dropper
- stock solution
- phenol red indicator
- lab apron

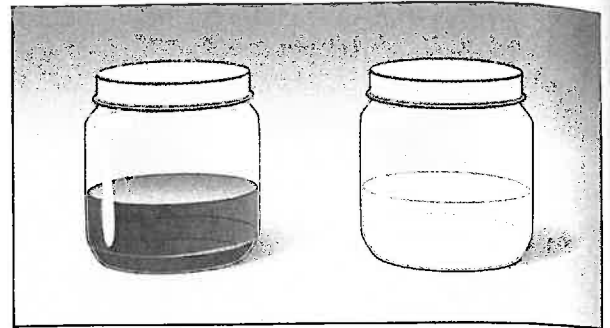
#### HYPOTHESIS

After reading through the activity, write a hypothesis that explains how disease moves through a population.

#### PROCEDURE



1. Write your name on the empty baby food jar with the wax pencil.
2. Transfer to your jar three droppersful of the stock solution provided by your teacher.  
**Caution:** *Wear goggles, gloves, and apron when handling solutions. Do not let skin or clothing come into contact with solutions.*
3. Take one dropperful of solution from the jar of a classmate, and empty it into your own jar. Gently swirl the mixture.
4. Record the other student's name. This person represents your first "contact."
5. Exchange a dropperful of solution with two other students, and record their names.
6. Add one dropperful of phenol red to your jar, and record the color of your solution.
7. You can tell by the color of your solution if you were infected or not. A red solution means you were infected; a yellow solution means you were not. Inform your teacher



if you were infected, and provide the names of your contacts. Your teacher will write the names of all infected persons and their contacts on the chalkboard.

8. After the whole class has completed the experiment and collected all data, work together and deduce who was the original source of infection (there was only one infected source). Then trace the routes of the transmission of the disease.

#### ANALYSIS

1. Draw a diagram that traces the disease transmission in your class.
2. Were you infected? If so, who infected you? How many people did you infect?
3. What is the maximum number of infected persons after two rounds of exchanging solutions? What is the maximum after three rounds?
4. Phenol turns yellow in acidic solutions and red in basic solutions. Which represented the infectious microbe in this model, the acidic or the basic solution?

#### CONCLUSION

1. Using the data you gathered as a class, write a paragraph stating your conclusion including your observation.
2. Suppose you had exchanged solutions with six contacts instead of only three. What would have happened to your chances of becoming infected?

## CHAPTER 13 REVIEW

### KEY TERMS

agricultural  
revolution 13.1

germ theory 13.1  
demography 13.3

### CHAPTER SUMMARY

**13.1** The human population has grown at various rates throughout history. The agricultural revolution, the germ theory of disease, and modern developments in medicine have contributed to a very rapid population growth. Disease, famine, and war are factors that cause the human population to decline.

**13.2** As the human population increases in size, the need for resources also increases. The percent growth rate of the human population can be determined by subtracting the number of deaths per year per 100 people from the number of births

per year per 100 people. Immigration and emigration can affect the growth rate of the population. Demographic studies help planners to anticipate the future needs of a society.

**13.3** Efforts to reduce the growth rate of the human population are difficult to implement. Social and religious beliefs about family size and birth control vary from culture to culture. Technological advances that increase the carrying capacity of Earth by increasing available resources are often followed by spurts in population growth.

### MULTIPLE CHOICE

*Choose the letter of the word or phrase that best completes each statement.*

1. Of the following, the factor most likely to result in a decrease in the size of a specific population is (a) improved medical care; (b) increased food availability; (c) famine; (d) industrialization.
2. The agricultural revolution took place approximately (a) 100 000 years ago; (b) 10 000 years ago; (c) 300 years ago; (d) during the past 100 years.
3. The germ theory of disease established that many diseases are caused by (a) microorganisms; (b) water; (c) poor nutrition; (d) overpopulation.
4. A dramatic decline in the population of Europe in the 1300s was caused by the (a) potato famine; (b) bubonic plague; (c) Thirty Years' War; (d) outbreak of cholera.
5. A nation with a population that is not increasing is (a) Peru; (b) Guatemala; (c) Sweden; (d) Kenya.
6. When calculating global population growth, the death rate is (a) added to the birth rate; (b) subtracted from life expectancy; (c) multiplied by 100; (d) subtracted from the birth rate.
7. At present, the growth patterns of the human population are best described as (a) above carrying capacity; (b) geometric; (c) arithmetic; (d) stable.
8. The greatest growth of human populations today is occurring in (a) industrial societies; (b) tribal societies; (c) developing nations; (d) hunter-gatherer societies.
9. Problems associated with a declining population size include (a) increased famine; (b) decreased health care; (c) loss of habitat; (d) weakened economic strength.
10. The change in energy consumption in the United States during the past 100 years is due to (a) population growth; (b) modernization; (c) both population growth and modernization; (d) neither population growth nor modernization.

## CHAPTER 13 REVIEW

### TRUE/FALSE

Write true if the statement is true. If the statement is false, change the underlined word to make it true.

1. The person who compared the growth of the human population to its food resources was Thomas More.
2. The life expectancy of people in industrial societies has increased over time.
3. A population that shows growth of 24 persons per 1000 has a population growth of 24 percent.
4. The population of Mexico City has doubled within 20 years.
5. The increase in modern machinery tends to decrease the energy needs of a society.
6. The period of the twentieth century marked by huge advances in medicine is sometimes called the biomedical revolution.

### CONCEPT REVIEW

Write a complete response to each of the following.

1. How did the discovery of the germ theory of disease impact society?
2. Describe three factors that can cause a population size to decrease.
3. Why have infant death rates decreased in the past 50 years?
4. Explain the concept of doubling time.
5. Why does an increased number of people affect the availability of resources?

### THINK CRITICALLY

1. Why is the growth rate of the human population difficult to control?
2. Describe three ways that a growing human population affects other organisms.
3. Some scientists consider the hunter-gatherer societies that exist today to be endangered species. How would people living as hunter-gatherers be similar to species of other organisms that are considered endangered?

**Computer Activity** (Use a spreadsheet program to solve the following problem.) Population A and Population B both start with 100 people. With each generation, Population A grows by 2 percent, while Population B grows by 5 percent. How many generations will it take for each population to double?

### WRITE CREATIVELY

Write a fictional story that describes the life of a hunter-gatherer living 10 000 years ago in a

society that is just beginning to establish its first permanent settlement.

### PORTFOLIO

1. The People's Republic of China is one of the few nations in the world that limits family size. Research the changes that have occurred in Chinese society as a result of the one-child-per-family rule. Make a presentation of your findings, including how people in China feel about the rule.
2. There are organizations that enable people in the United States to sponsor a needy child in various parts of the world. Research one such organization and find out how much it costs to sponsor a child, and how the money is used to help the children and their communities.

## GRAPHIC ANALYSIS

Use Figure 13.3 on page 205 to answer the following.

1. Which of the three nations has the highest percentage of children under the age of 15? What does this imply about the amount of money needed for schools and children's services?
2. In which nation would you expect to find the largest population of elderly people?
3. What can you infer about the life expectancy of men compared to women in the three nations shown?
4. In which nation would you expect to find the greatest percentage of children ten years from now? Explain your answer.

## ACTIVITY 13.2

### PROBLEM

What happens when too many people are crowded into a living space, and what are the advantages of careful community planning?

### MATERIALS

meter stick or metric tape measure

### PREDICTION

After reading through the activity, predict how you will feel when restricted to a small area.

### PROCEDURE

1. Measure the length and width of your classroom. Calculate the area of the room using this formula: length (m)  $\times$  width (m) = area (m<sup>2</sup>)
2. Count the number of people in the class. Then calculate the population density (number of people per square meter) using this formula:

$$\frac{\text{number of people}}{\text{area (meters}^2\text{)}} = \text{population density (people/m}^2\text{)}$$

3. Your teacher will draw an imaginary line dividing the classroom in half. Then all students will move to one half of the room. Determine the new population density.
4. Observe your classmates in this restricted environment: note how people talk, sit or stand, what they say, and how the area looks.
5. Again the teacher will draw an imaginary line, this time dividing the classroom into fourths. Repeat steps 3 and 4.

### ANALYSIS

1. After you finish recording your calculations and observations, comment on the behavior of the class members as the available living space got smaller and smaller.
2. Discuss how and why some individual behaviors change as the density increases.

### CONCLUSION

1. What conclusions can you draw from the data you gathered? Does increased population density adversely affect a community?
2. Record how you felt as the classroom got smaller and more crowded.

Population Density Data Table

Classroom Size	Length (m)	Width (m)	Area (m <sup>2</sup> )	Population Density (people/m <sup>2</sup> )
Full				
Half				
Fourth				