# The Human Population

1 Studying Human Populations

2 Changing Population Trends

## PRE-READING ACTIVITY

**FOLDNOTES**

**Table Fold** Before you read this chapter, create the **FoldNote** entitled "Table Fold" described in the Reading and Study Skills section of the Appendix. Label the columns of the table fold with "Changes in Human Population," and "Effects of Population Change." Label the rows with "Before 1700," "From 1700 to 2000," and "From 2000 to 2050 and Beyond." As you read the chapter, write examples of each topic under the appropriate column.

China has one of the largest populations in the world, with more than 1 billion people. However, China's population is projected to stop growing by the year 2050, mostly because Chinese families are having fewer children.

# Studying Human Populations

The human population of Earth grew faster in the 20th century than it ever has before. However, this rapid growth has led to environmental problems around the globe. Thus, we must try to understand and predict changes in human populations.

Demography is the study of populations, but most often refers to the study of human populations. Demographers study the historical size and makeup of the populations of countries to make comparisons and predictions. Demographers also study properties that affect population growth, such as economics and social structure. Countries with similar population trends are often grouped into two general categories. *Developed countries* have higher average incomes, slower population growth, diverse industrial economies, and stronger social support systems. *Developing countries* have lower average incomes, simple and agriculture-based economies, and rapid population growth.

## The Human Population Over Time

After growing slowly for thousands of years, the human population grew rapidly in the 1800s, as shown in **Figure 1.** The human population underwent *exponential growth,* meaning that population growth rates increased during each decade. These increases were mostly due to increases in food production and improvements in hygiene that came with the industrial and scientific revolutions. However, it is unlikely that the Earth can sustain this growth for much longer.
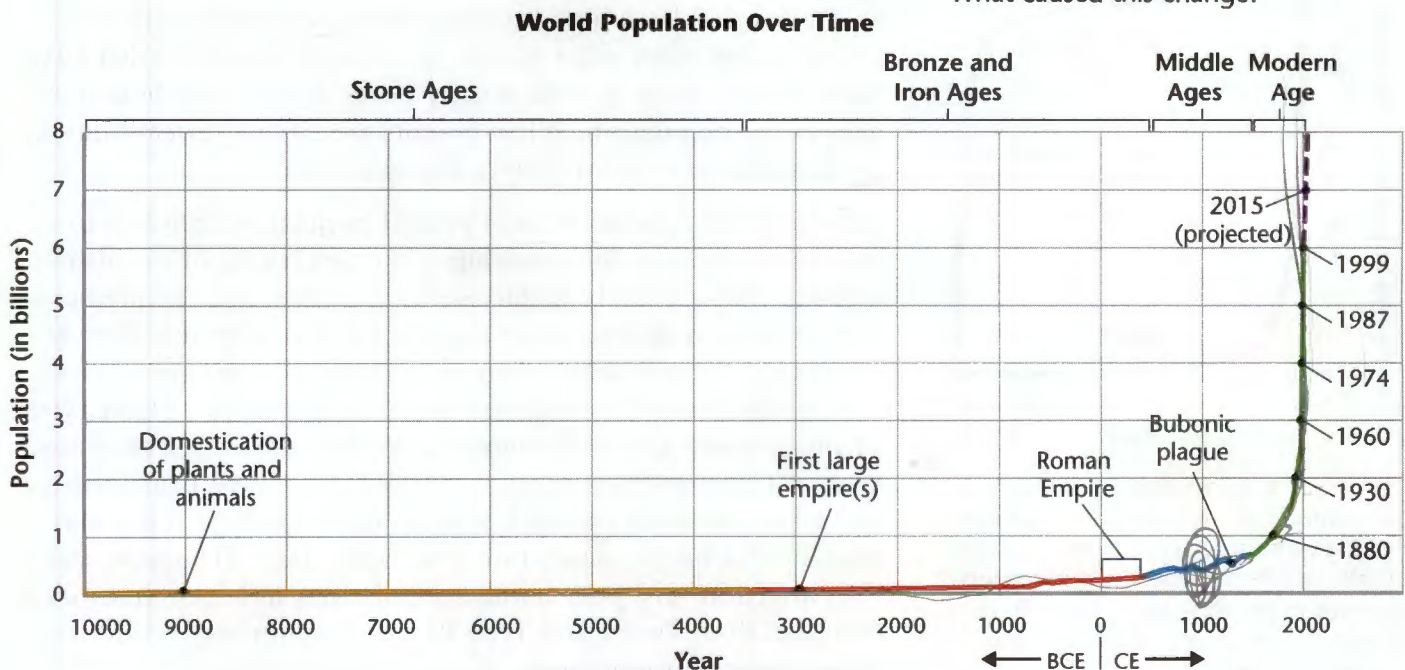
## Objectives

▶ Describe how the size and growth rate of the human population has changed in the last 200 years.

▶ Define four properties that scientists use to predict population sizes.

▶ Make predictions about population trends based on age structure.

▶ Describe the four stages of the demographic transition.

▶ Explain why different countries may be at different stages of the demographic transition.

## Key Terms

demography
age structure
survivorship
fertility rate
migration
life expectancy
demographic transition

**Figure 1 ▶** After growing slowly for thousands of years, the human population grew rapidly in the 1800s. What caused this change?



**World Population Over Time**

**Rapid Growth—Least Developed Nations**

**Slow Growth—Transitional Nations**

**Zero or Declining Growth—Most Developed Nations**

Age: 80+, 75–79, 70–74, 65–69, 60–64, 55–59, 50–54, 45–49, 40–44, 35–39, 30–34, 25–29, 20–24, 15–19, 10–14, 5–9, 0–4

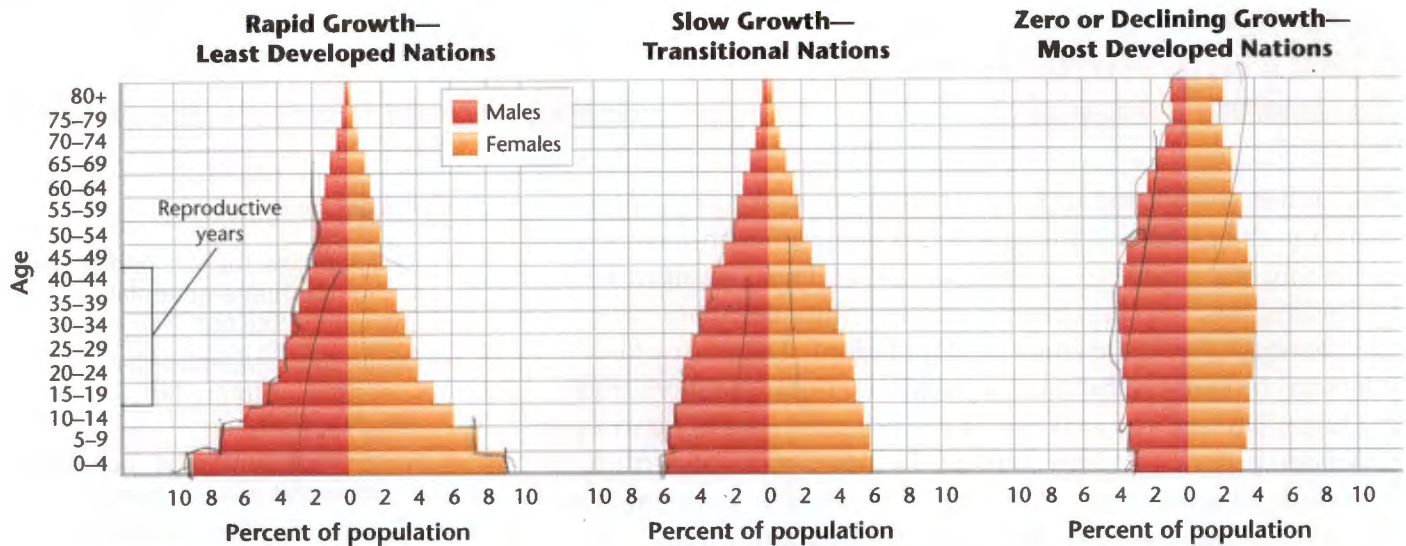Reproductive years

■ Males
■ Females

Percent of population

**Figure 2 ▶ Age-Structure Diagrams** These graphs allow demographers to compare the distribution of ages and sexes in a population. Each graph shows a typical shape for a population with a particular rate of growth. Note that people between 15 and 44 years of age are most likely to produce children.



**Typical Survivorship Curves**

Percent of population surviving: 100, 80, 60, 40, 20, 0

Type I
Type II
Type III

Time

**Figure 3 ▶** Survivorship curves show how much of the population survives to a given age. A Type I curve is seen in populations where most members survive to be very old. A Type III curve is seen in populations where many children die.

# Forecasting Population Size

Will your community need more schools in the next 20 years, or will it need more retirement communities? Will people move in and create demand for more roads and utility services? Demographers look at many properties of populations to predict such changes. Population predictions are often inaccurate, however, because human behavior can change suddenly.

**Age Structure** Demographers can make many predictions based on age structure—the distribution of ages in a specific population at a certain time. For example, if a population has more young people than older people, the population size will likely increase as the young people grow up and have children. Age structure can be graphed in a *population pyramid,* a type of double-sided bar graph like those shown in **Figure 2**. The figure shows typical age structures for countries that have different rates of growth. Countries that have high rates of growth usually have more young people than older people. In contrast, countries that have slow growth or no growth usually have an even distribution of ages in the population. When parents are having fewer children, the population will have fewer young people.
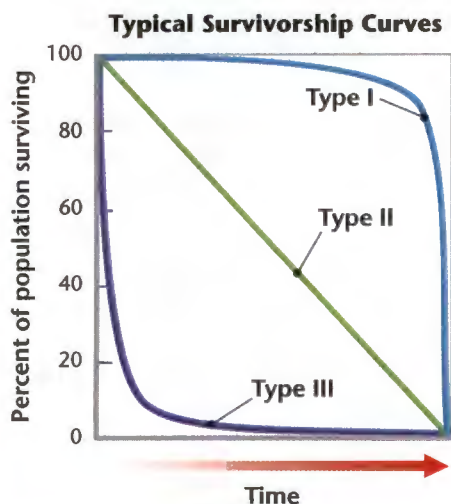
**Survivorship** Another way to predict population trends is to study survivorship. Survivorship is the percentage of members of a group that are likely to survive to any given age. To predict survivorship, a demographer studies a group of people born at the same time and notes when each member of the group dies. The results plotted on a graph might look like one of the types of *survivorship curves* in **Figure 3**. Wealthy developed countries such as Japan and Germany currently have a Type I survivorship curve because most people live to be very old. Type II populations have a similar death rate at all ages. Type III survivorship is the pattern in very poor human populations in which many children die. Both Type I and Type III survivorship may result in populations that remain the same size or grow slowly.
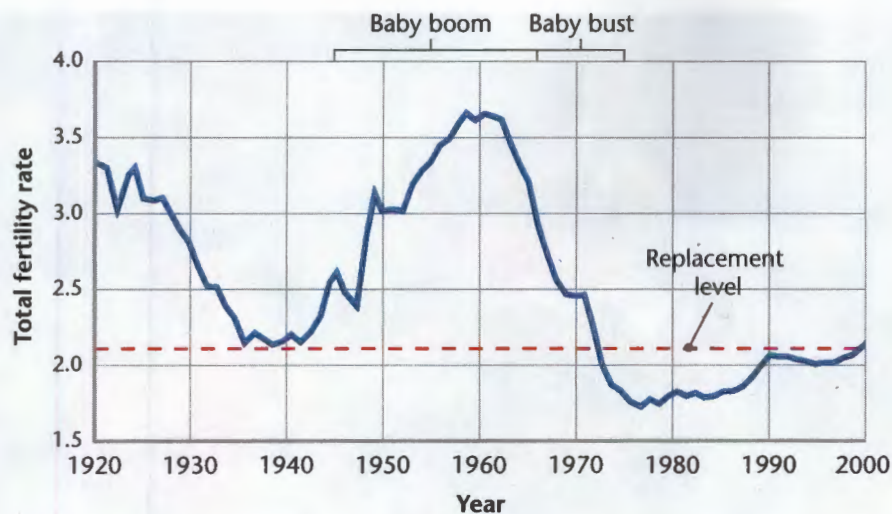
Baby boom  Baby bust

Total fertility rate vs Year graph

**Fertility Rates** The number of babies born each year per 1,000 women in a population is called the fertility rate. Demographers also calculate the *total fertility rate*, or the average number of children a woman gives birth to in her lifetime.

A graph of historical total fertility rates for the United States is shown in **Figure 4.** In 1972, the total fertility rate dropped below replacement level for the first time in U.S. history. *Replacement level* is the average number of children each parent must have in order to "replace" themselves in the population. This number is about 2.1, or slightly more than 2, because not all children born will survive and reproduce.

Total fertility rates in the United States remained below replacement level for most of the 1990s. However, the population continued to grow, as shown in **Figure 5.** One reason for this growth was that the children of the baby boom grew up and had children.

**Migration** Another reason the population continued to grow was that immigration increased. The movement of individuals between areas is called migration. Movement into an area is *immigration* and movement out of an area is *emigration*. Migration between and within countries is a significant part of population change. The populations of many developed countries might be decreasing if not for immigration.
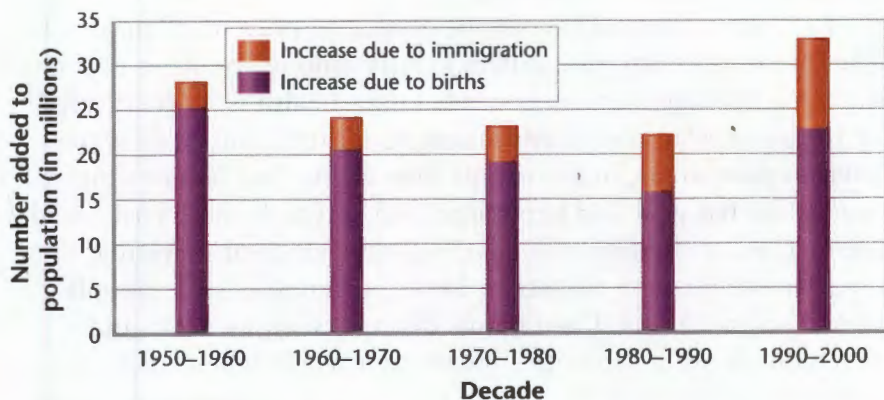
**MATH PRACTICE**

**Extending the Equation for Population Change**
The following equation is a simple way to calculate the change in a population over a period of time:

$$\text{change in population} = (births - deaths)$$

However, this equation does not account for changes due to migration. Rewrite the equation to include *immigration* and *emigration*.

Next, create an example word problem that would require the use of this new equation. Trade problems with a classmate, and try to solve the classmate's new word problem.
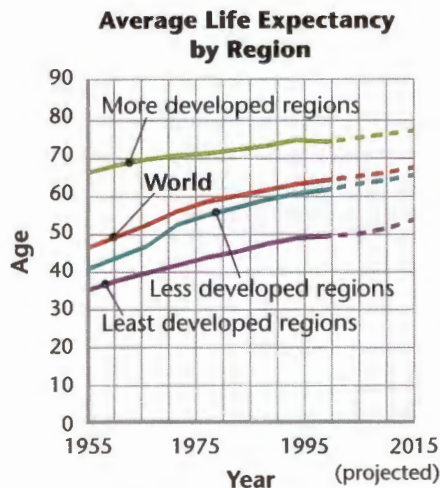
Source: U.S. Census Bureau.

Figure 6 ▶ Today, people usually live longer because of improvements in healthcare, nutrition, and sanitation.

## Declining Death Rates

The dramatic increase in Earth's human population in the last 200 years has happened because death rates have declined more rapidly than birth rates. Death rates have declined mainly because more people now have access to adequate food, clean water, and safe sewage disposal. The discovery of vaccines in the 20th century also contributed to declining death rates, especially among infants and children. These factors are shown in **Figure 6.**

**Life Expectancy** The average number of years a person is likely to live is that person's life expectancy. Life expectancy is most affected by *infant mortality,* the death rate of infants less than a year old. In 1900, worldwide life expectancy was about 40 years and the infant mortality rate was very high. By 2000, the rate of infant mortality was less than one-third of the rate in 1900. The graph in **Figure 7** shows that average life expectancy has increased to more than 67 years worldwide. For people in many developed countries, life expectancy is almost 80 years.

Expensive medical care is not needed to prevent infant deaths. The infant mortality rate differs greatly among countries that have the same average income. Instead, infant health is more affected by the parents' access to education, food, fuel, and clean water. Even in poor areas, many people now know that babies simply need to be fed well and kept clean and warm. If these basic needs are met, most children will have a good chance of surviving.

Meanwhile, new threats to life expectancy arise as populations become denser. Contagious diseases such as AIDS and tuberculosis are a growing concern in a world where such diseases can spread quickly. Life expectancy in sub-Saharan Africa has been reduced in recent decades due to epidemics of AIDS.

Figure 7 ▶ Since 1900, average life expectancy has increased worldwide (red line), although it remains lower in less developed countries (blue and purple lines).

**Average Life Expectancy by Region**



Source: UN Population Division.

# The Demographic Transition

In most developed countries, populations have stopped growing. How can populations quadruple in a single century, then stop growing or even shrink in the next century? The demographic transition is a model that describes how these changes can occur. The model is based on observations of the history of many developed countries. The theory behind the demographic transition is that industrial development causes economic and social progress that then affects population growth rates. The graph in **Figure 8** compares expected trends in birth rates, death rates, and population sizes during each of the four stages of the transition.

**Stages of the Transition**  In the first stage of the demographic transition, a society is in a preindustrial condition. The birth rate and the death rate are both at high levels and the population size is stable. Most of the world was in this condition until about 1700, when the scientific and industrial revolutions began.

In the second stage, a population explosion occurs. Death rates decline as hygiene, nutrition, and education improve. But birth rates remain high, so the population grows very fast. During this stage, the population could double in less than 30 years.

In the third stage of the demographic transition, population growth slows because the birth rate decreases. As the birth rate becomes close to the death rate, the population size stabilizes. However, the population is much larger than before the demographic transition. In most countries that have passed through the transition, the population quadrupled during the 20th century.

In the fourth stage, the birth rate drops below replacement level, so the size of the population begins to decrease. It has taken from one to three generations for the demographic transition to occur in most developed countries.
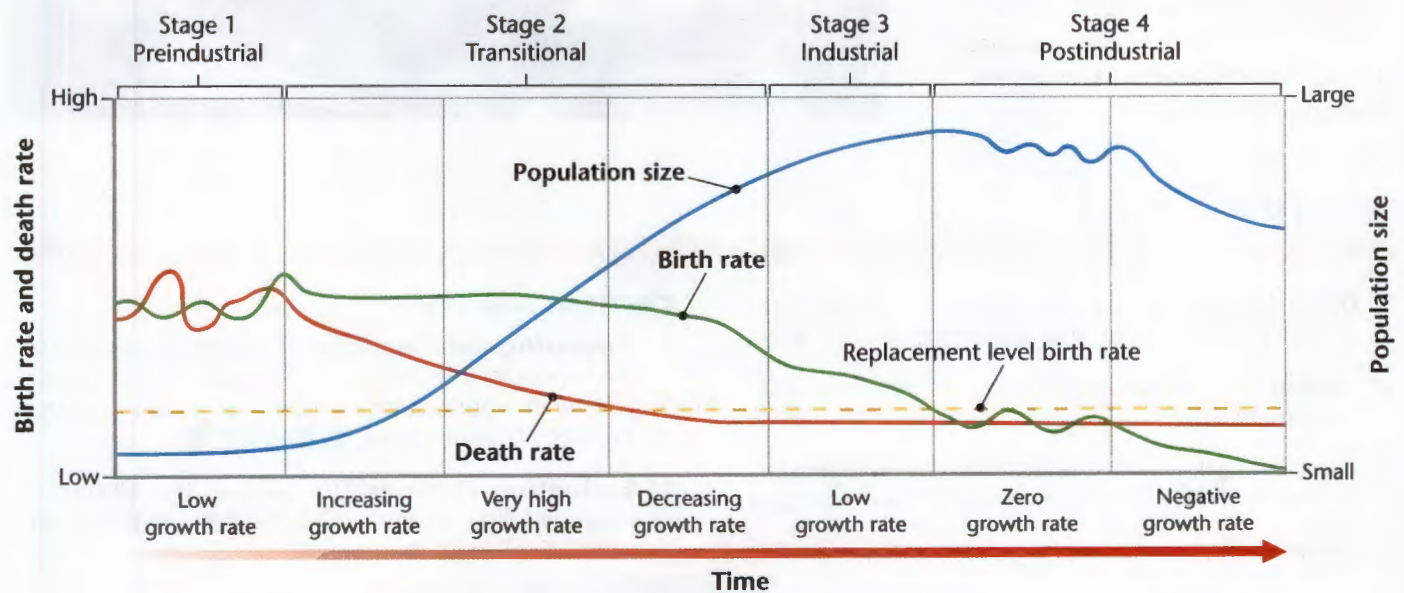
**Ecofact**

**The Population Clock** The Earth's human population is increasing by 2.4 people each second, which accounts for births and deaths. This means Earth gains over 200,000 people per day, or over 75 million per year.

**Figure 8 ▶** The four stages of the demographic transition are shown here. Note the relative changes in birth rates, death rates, and population size. Do you think that all countries will fit this pattern?



| Stage 1<br>Preindustrial | Stage 2<br>Transitional | Stage 3<br>Industrial | Stage 4<br>Postindustrial |

Population size

Birth rate

Replacement level birth rate

Death rate

Birth rate and death rate

Population size

High — Large

Low — Small

| Low<br>growth rate | Increasing<br>growth rate | Very high<br>growth rate | Decreasing<br>growth rate | Low<br>growth rate | Zero<br>growth rate | Negative<br>growth rate |

**Time**

**Internet** connect

**www.scilinks.org**
**Topic: Human Demographics**
**SciLinks code: HE4056**

SCI*LINKS*. Maintained by the National Science Teachers Association

**Women and Fertility** The factors most clearly related to a decline in birth rates are increasing education and economic independence for women. In the demographic transition model, the lower death rate of the second stage is usually the result of increased levels of education. Educated women find that they do not need to bear as many children to ensure that some will survive. Also, the women may learn family planning techniques. They are able to contribute to their family's increasing prosperity while spending less energy bearing and caring for children. Some countries that want to reduce birth rates have placed a priority on the education of females, as shown in **Figure 9**.

Large families are valuable in communities in which children work or take care of older family members. But as countries modernize, parents are more likely to work away from home. If parents must pay for child care, children may become a financial burden rather than an asset. The elderly will not need the support of their children if pensions are available. All of these reasons contribute to lower birth rates. Today, the total fertility rate in developed countries is about 1.6 children per woman, while in developing countries, the rate is about 3.1 children per woman.



**Figure 9 ▶** These women in Bolivia are learning to read. Many countries include the education of women in development efforts.

## SECTION 1 Review

1. **Describe** how the size and growth rate of the human population has changed in the last 200 years.

2. **Define** four properties that scientists use to predict population sizes.

3. **Explain** what we can predict about a population's likely growth rates based on its current age structure.

4. **Describe** the four stages of the demographic transition.

**CRITICAL THINKING**

5. **Analyzing Relationships** Read the description of life expectancy in this section. Explain why the oldest people in a population may be much older than the average life expectancy. **READING SKILLS**

6. **Evaluating Theories** Do you think that all countries will follow the pattern of the demographic transition? Explain your answer.

# Changing Population Trends

Some countries have followed the model of the demographic transition—they have reached large and stable population sizes and have increased life expectancies. But throughout history, and currently in many parts of the world, populations that have high rates of growth create environmental problems. A rapidly growing population uses resources at an increased rate and can overwhelm the infrastructure of a community. **Infrastructure** is the basic facilities and services that support a community, such as public water supplies, sewer lines, power plants, roads, subways, schools, and hospitals. The symptoms of overwhelming population growth include suburban sprawl, overcrowded schools, polluted rivers, barren land, and inadequate housing, as shown in Figure 10. You may have seen some of these problems in your community.

## Problems of Rapid Growth

People cannot live without sources of clean water, burnable fuel, and land that can be farmed to produce food. A rapidly growing population can use resources faster than the environment can renew them, unless resources come from elsewhere. Standards of living decline when wood is removed from local forests faster than it can grow back, or when wastes overwhelm local water sources. Vegetation, water, and land are the resources most critically affected by rapid growth.

## Objectives

▶ Describe three problems caused by rapid human population growth.

▶ Compare population growth problems in more-developed countries and less developed countries.

▶ Analyze strategies countries may use to reduce their population growth.

▶ Describe worldwide population projections into the next century.

## Key Terms

infrastructure
arable land
urbanization
least developed countries

## Geofact

**Land Area per Person** If each person alive on Earth in the year 2000 was given an equal portion of existing surface land, each person would get about 7.3 acres (0.025 km$^2$, or about four football fields). In the year 2050, each person might get 4.8 acres of land (0.016 km$^2$, or about two and a half football fields).



**Figure 10** ▶ Rapid population growth can put pressure on water sources, land, and materials used for fuel or shelter. The makeshift housing shown here is one consequence of unmanaged growth.

Figure 11 ▶ These women in Myanmar are gathering firewood for cooking and boiling water. Gathering fuel is part of daily survival in many developing countries.

Figure 12 ▶ This woman is washing clothes in the Rio Grande on the U.S.-Mexico border. In areas that have no sewage or water treatment systems, people may use the same water supply for drinking, bathing, washing, and sewage disposal.



**A Shortage of Fuelwood** In many of the poorest countries, wood is the main fuel source. When populations are stable, people use fallen tree limbs for fuel, which does not harm the trees, as shown in **Figure 11.** When populations grow rapidly, deadwood does not accumulate fast enough to provide enough fuel. People begin to cut down living trees, which reduces the amount of wood available in each new year. Parts of Africa, Asia, and India have been cleared of vegetation by people collecting fuelwood.

A supply of fuel ensures that a person can boil water and cook food. In many parts of the world, water taken directly from wells or public supplies is not safe to drink because it may carry waterborne parasites or other diseases. The water can be sterilized by boiling it, but fuel is needed to do so. Also, food is often unsafe or harder to digest unless it is cooked. Without enough fuelwood, many people suffer from disease and malnutrition.

**Unsafe Water** In places that lack infrastructure, the local water supply may be used not only for drinking and washing but also for sewage disposal. As a result, the water supply becomes a breeding ground for organisms that cause diseases such as dysentery, typhoid, and cholera.

Many cities have populations that are doubling every 15 years, and water systems cannot be expanded fast enough to keep up with this growth. In the year 2001, over 1 billion people worldwide lacked safe drinking water and more than 3 million died of diseases that were spread through water. The Rio Grande, shown in **Figure 12,** is one example of an unsafe water source used by many people.

Lima, Peru, is another example of an area with unsafe water. More than half of the population of Lima is housed in shanty-towns that have no plumbing. The bacteria that cause cholera thrived in Lima's unmanaged water sources in 1991. In that year, Lima's population suffered the first epidemic of cholera that had occurred in the Western Hemisphere in 75 years.

**Impacts on Land** Every person needs space to live in, and people prefer to live where they have easy access to resources and a comfortable lifestyle. Growing populations may have a shortage of arable land, which is land that can be used to grow crops. Growing populations also make trade-offs between competing uses for land such as agriculture, housing, or natural habitats.

For example, Egypt has a population of more than 69 million that is growing at 2 percent per year. For food and exportable products, Egypt depends on farming within the narrow Nile River valley, shown in **Figure 13**. Most of the country is desert, and less than 4 percent of Egypt's land is arable. However, the fertile Nile River valley is also where the jobs are located, and where most Egyptians live. Egyptians continue to build housing on what was once farmland, which reduces Egypt's available arable land.

Much of the world's population is undergoing urbanization, which means that more people are living in cities than in rural areas. In the United States, many cities are becoming large metropolitan areas. People often find work in the cities but move into suburban areas around the cities. This *suburban sprawl* leads to traffic jams, inadequate infrastructure, and the reduction of land for farms, ranches, and wildlife habitat. Meanwhile, housing within cities becomes more costly, more dense, and in shorter supply.

**Figure 13** ▶ Egypt's population is mostly crowded into the narrow Nile River valley (green areas in center of photo at right). The United States has more arable land, but suburban sprawl (left) creates many problems.

## A Demographically Diverse World

As you have seen, demographers may categorize countries as either developed or developing. However, demographers may prefer the terms *more developed* and *less developed* to describe countries or regions, because the reality of development is complex and politically sensitive.

Not every country in the world is progressing through each stage of the demographic transition according to the model. Some countries now have modern industries, but incomes remain low. A few countries have achieved stable and educated populations with little industrialization. Some countries seem to remain in the second stage of the model. These countries have rapid population growth, but are unable to make enough educational and economic gains to reduce the birth rate and move into the third stage.

In recent years, the international community has begun to focus on the least developed countries. These countries show few signs of development and in some cases have increasing death rates, while birth rates remain high. Least developed countries are officially identified by the United Nations. These countries may be given priority for foreign aid and development programs to address their population and environmental problems.

## CASE STUDY

## Thailand's Population Challenges

Population growth is a major concern for many developing countries. But the options are limited for a country that has a poor economy and growing demands for limited resources. Thailand is one country that has effectively and purposefully slowed its population growth.

Around 1970, Thailand's population was growing at a rate of more than 3 percent per year, and the average Thai family had 6.4 children. The country had increasing environmental problems, such as air pollution in major cities and unsafe water supplies. Thailand's emissions of carbon dioxide from burning fossil fuels almost doubled between 1990 and 1997. In Thailand's capital, Bangkok, one-ninth of residents



▶ **Bangkok, Thailand** is one of the most crowded and polluted cities in the world. However, population growth is slowing in Thailand, and some environmental problems are starting to be solved.
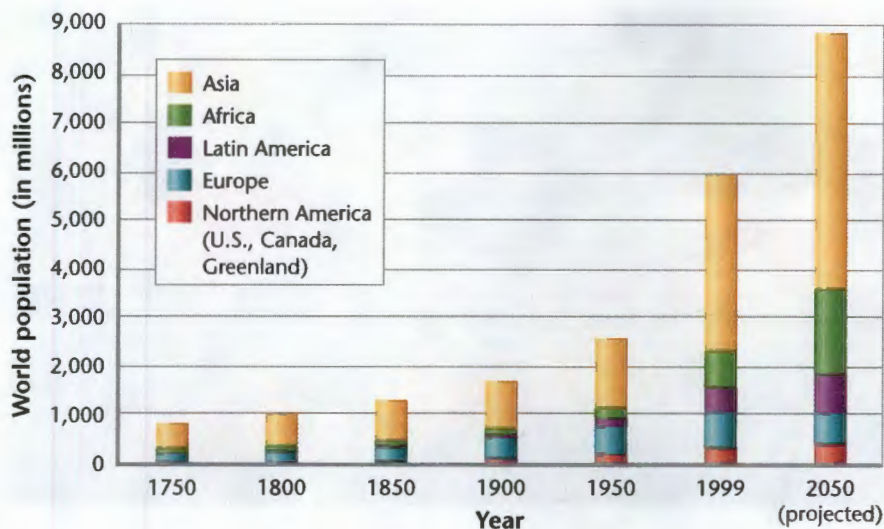
Source: UN Population Division.

Growth rates for different parts of the world are shown in **Figure 14.** Populations are relatively stable in Europe, the United States, Canada, Russia, South Korea, Thailand, China, Japan, Australia, and New Zealand. In contrast, populations are still growing rapidly in less developed regions. Most of the world's population is now within Asia.

## Thailand's Population Strategies

- improved healthcare for mothers and children

- openness of the people, government, and community leaders to changing social traditions

- cooperation of private and nonprofit organizations with the government

- increases in women's rights and ability to earn income

- economic incentives such as building loans for families who participated in the family planning programs

- creative family-planning programs promoted by popular government leaders

- high literacy rates of women (80 percent in 1980 and 94 percent in 2000)

How did Thailand make such major changes with limited resources? Demographers believe the changes are due to the combination of strategies shown in the table at left.

## CRITICAL THINKING

**1. Applying Ideas** For what reasons could Thailand be described as a developing country in the 1970s? In what ways was it able to change?

**2. Expressing Viewpoints** Do you approve of all of the strategies that the government of Thailand employed in order to reduce their population growth? Do the goals justify the strategies they used? Write a persuasive paragraph to defend your opinion. **WRITING SKILLS**

have respiratory problems, and many people die of waterborne diseases each year.

In 1971, Thailand's government adopted a policy to reduce Thailand's population growth. The policy included increased education for women, greater access to healthcare and contraceptives, and economic incentives to parents who have fewer children. Fifteen years later, the country's population growth rate had been cut to about 1.6 percent. By 2000, the growth rate had fallen to 1.1 percent and the age structure was more evenly distributed. These changes also reflected a decline in the infant mortality rate.

**Table 1 ▼**

## ICPD Goals for 2015

- Provide universal access to a full range of safe and reliable family-planning methods and related reproductive health services.

- Reduce infant mortality rates to below 35 infant deaths per 1,000 live births and mortality rates of children under five years old to below 45 deaths per 1,000 live births.

- Close the gap in maternal mortality between developing and developed countries. Achieve a maternal mortality rate below 60 deaths per 100,000 live births.

- Increase life expectancy at birth to more than 75 years. In countries with the highest mortality, increase life expectancy at birth to more than 70 years.

- Achieve universal access to and completion of primary education. Ensure the widest and earliest possible access by girls and women to secondary and higher levels of education.

Source: UN Population Fund.

**Figure 16** ▶ **Worldwide Trends in Fertility** Most countries' fertility rates are dropping toward replacement level.

## Managing Development and Population Growth

Humans throughout history have witnessed the negative effects of population growth. Today, less developed countries face the likelihood that continued population growth will prevent them from imitating the development of the world's economic leaders. Some governments have tried to move forward in the demographic transition by directly reducing birth rates. Countries such as China, Thailand, and India have created campaigns to reduce the fertility rates of their citizens. These campaigns might include public advertising, as shown in **Figure 15,** or family planning programs, economic incentives, or legal punishments.

In 1994, the United Nations held the International Conference on Population and Development (ICPD). This conference involved debates about the relationships between population, development, and environment. **Table 1** shows the main goals that resulted from the conference. Many countries favor stabilizing population growth through investments in development, especially through improvements in women's status. In fact, worldwide fertility rates are dropping, as shown in **Figure 16.**
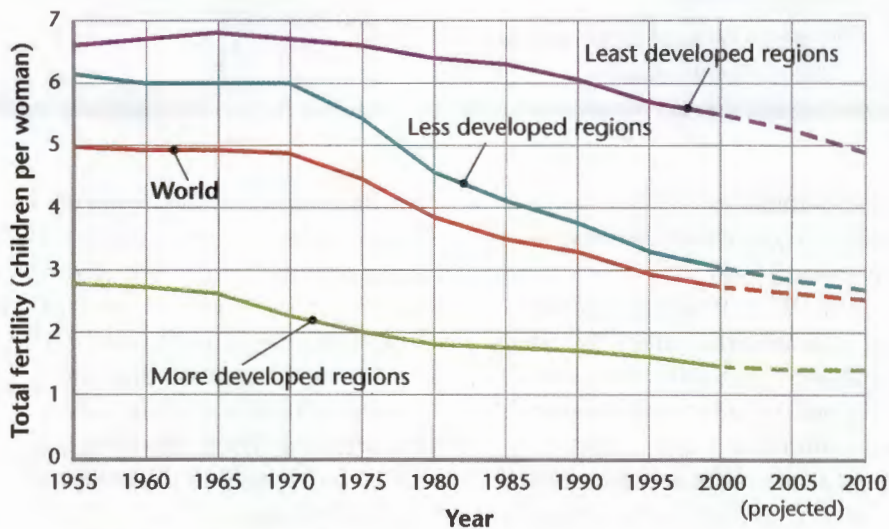


Source: UN Population Division.

# Growth Is Slowing

The human population of the world is now more than 6 billion and is still increasing. The worldwide population growth rate peaked at about 87 million people per year between 1985 and 1990. In contrast, the population grew by only 81 million people per year from 1990 to 1995.
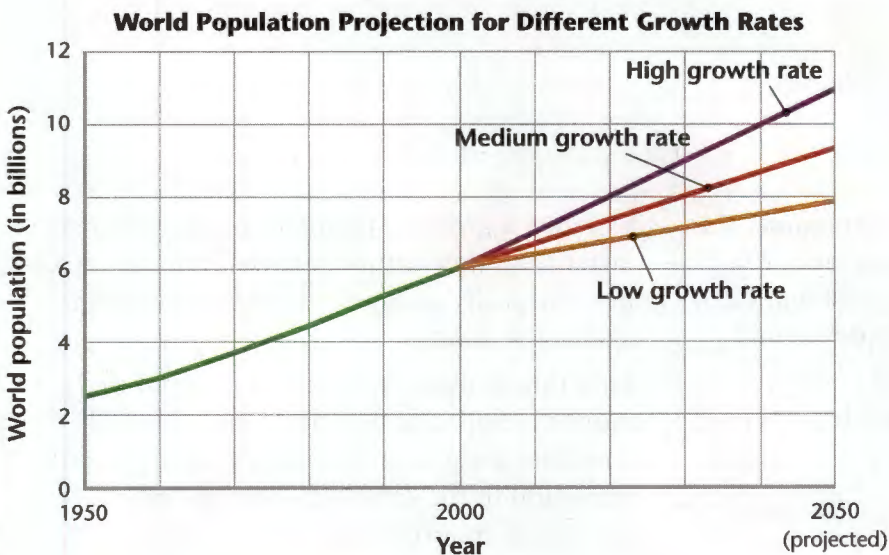
Fertility rates have declined since about 1970 in both more-developed and less developed regions. However, rates are still much higher in less developed regions. Demographers predict that this trend will continue and that worldwide population growth will be slower in this century than in the last century. If current trends continue, most countries will have replacement level fertility rates by 2050. If so, world population growth would eventually stop.

**Projections to 2050** United Nations projections of world population growth to 2050 are shown in **Figure 17**. The medium-growth line assumes that worldwide fertility rates will decline to replacement level by 2050. The high- and low-growth lines would result from higher or lower fertility rates. Most demographers predict the medium growth rate and a world population of 9 billion in 2050.

**World Population Projection for Different Growth Rates**

Source: UN Population Division.

**Figure 17 ▶** Current fertility trends will result in a world population of about 9 billion in 2050 (middle line). Economic or political changes could lead to higher or lower numbers.

# SECTION 2 Review

1. **Describe** three problems caused by rapid human population growth.

2. **Compare** population growth in more-developed countries to population growth in less developed countries.

3. **Describe** worldwide population projections for the next 50 years.

**CRITICAL THINKING**

4. **Analyzing a Viewpoint** Write a comparison of the pros and cons of the strategies nations have used to reduce population growth. **WRITING SKILLS**

5. **Analyzing Relationships** Do you think that simply changing birth rates will cause a nation to undergo further development?

# Highlights

## 1 Studying Human Populations

### Key Terms

demography, 219
age structure, 220
survivorship, 220
fertility rate, 221
migration, 221
life expectancy, 222
demographic
  transition, 223

### Main Ideas

▶ Human population growth has accelerated in the last few centuries. The main reasons for this growth were improvements in hygiene and increases in food production, which accompanied the industrial and scientific revolutions.

▶ Demographers try to predict population trends using data such as age structure, survivorship, fertility rates, migration, and life expectancy.

▶ In the demographic transition model, countries progress through four stages of change in birth rates, death rates, and population size.

## 2 Changing Population Trends

infrastructure, 225
arable land, 227
urbanization, 227
least developed
  countries, 228

▶ When a growing population uses resources faster than they can be renewed, the resources most critically affected are fuelwood, water, and arable land.

▶ In this century, countries may be labeled more developed or less developed. Not all countries are going through the demographic transition in the same way that the more-developed countries did.

▶ Some countries attempt to reduce birth rates directly through public advertising, family planning programs, economic incentives, or legal punishments for their citizens.

## Using Key Terms

Use each of the following terms in a separate sentence.

1. *demography*
2. *demographic transition*
3. *infrastructure*
4. *least developed countries*

For each pair of terms, explain how the meanings of the terms differ.

5. *age structure* and *survivorship*
6. *infant mortality* and *life expectancy*
7. *death rate* and *fertility rate*
8. *urbanization* and *migration*

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### ✔ STUDY TIP

**Quantitative Terms** Look for key terms in the graphs in this chapter. In your *EcoLog,* copy the graphs and write brief descriptions of how key terms may relate to the graphs and to other key terms. For example, copy Figure 3, and write "High infant mortality results in low life expectancy and Type III survivorship."

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## Understanding Key Ideas

9. Age structure data include all of the following *except*
   a. the number of members of a population who are between 5 and 11 years old.
   b. the ratio of males to females in a population.
   c. the amount of population change due to immigration or emigration.
   d. the ratio of older people to younger people in a population.

10. Human population growth accelerated in recent centuries mostly because of
    a. the bubonic plague.
    b. better hygiene and food.
    c. the discovery of electricity.
    d. improved efficiency of fuel use.

11. Which countries have Type I survivorship?
    a. the most developed countries
    b. the least developed countries
    c. countries in the second stage of the demographic transition
    d. countries in the first stage of the demographic transition

12. The demographic transition is a(n)
    a. untested hypothesis.
    b. natural law.
    c. model based on observed patterns.
    d. international law.

13. A country in the second stage of the demographic transition may have all of the following *except*
    a. increasing agricultural production.
    b. improving healthcare and education.
    c. decreasing population size.
    d. decreasing death rates.

14. Which of the following resources is likely to be impacted the most by a rapidly growing population?
    a. clothing
    b. food
    c. housing
    d. water

15. Which of the following diseases is often spread through unsafe public water sources?
    a. dysentery
    b. flu
    c. chickenpox
    d. AIDS

16. Which of the following uses of wood is the most important for basic human needs?
    a. heating the home
    b. boiling water
    c. making tools
    d. building shelter

17. In this century, the world population is likely to
    a. remain the same.
    b. continue to grow exponentially.
    c. decline rapidly because fertility rates are already below replacement level.
    d. stabilize after fertility rates fall below replacement level.

## Short Answer

18. What are the main reasons that life expectancy has increased worldwide?

19. How does the age structure of a population help predict future population growth?

20. What is the relationship between education and fertility rates in a human population?

21. Which properties of a population change during the demographic transition?

22. Which key resources are impacted the most by rapidly growing populations?

23. Which regions of the world are generally more developed? less developed?

## Interpreting Graphics

The graph below shows each region's contribution to world population growth. Use the graph to answer questions 24–26.

24. Which region(s) are projected to increase in population size?

25. Which region(s) are projected to decline in population size?

26. Can you assume that all the countries within each region have the same growth patterns? Explain your answer.

**World Population Growth by Region**
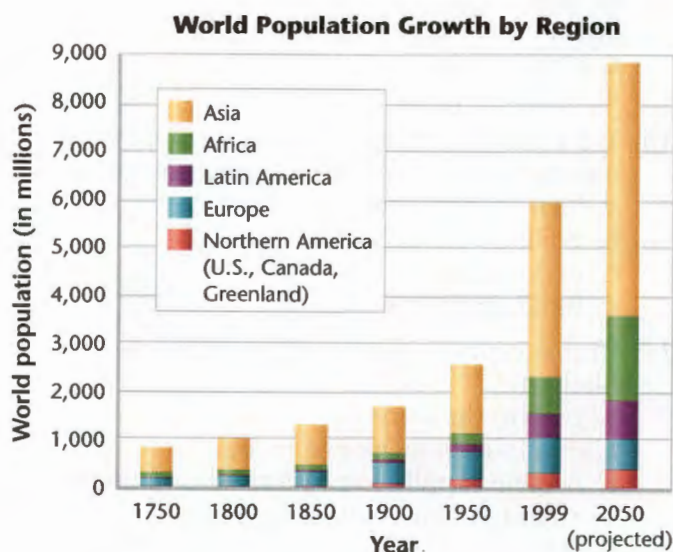


## Concept Mapping

27. Use the following terms to create a concept map: *rapid human population growth, demographic transition, survivorship, fertility rate, fuelwood, water,* and *land*.

## Critical Thinking

28. **Analyzing Predictions** Why are human population trends difficult to predict? Describe an example of an event that would change most demographic predictions.

29. **Analyzing Methods** In what ways does the study of human populations differ from the study of wildlife ecology?

30. **Identifying Relationships** What other factors, besides those already mentioned, might have an effect on fertility rates in a given population?

31. **Evaluating Theories** Write an evaluation of the demographic transition as a theory of how populations will develop. How useful is the demographic transition model in predicting the future? What assumptions are made by the theory? What criticisms could be made of the theory? **WRITING SKILLS**

## Cross-Disciplinary Connection

32. **Careers** Demographers are employed by many kinds of organizations including governments, health organizations, and insurance companies. How can their skills be useful to each of these organizations?

33. **Social Studies** Find out the demographic history, for the last 100 years, of a developing country of your choice. Explain how closely this country's pattern of development follows the demographic transition model.

## Portfolio Project

34. **Research Demographic Trends** Look up population statistics for your local city, county, or state. Read and take notes about recent demographic trends and predictions for the next few decades. Make a summary of your findings. **READING SKILLS**

## MATH SKILLS

Use the graph below to answer questions 35–37.

**35. Analyzing Data** At which times did the fertility rate change most drastically in the United States?

**36. Graphing Data** Sketch a copy of the graph below. Smooth the bumps to give an idea of general trends.

**37. Drawing Conclusions** On your new graph, draw a second line to show the changes in population size that you would predict to result from the given fertility rates over time.
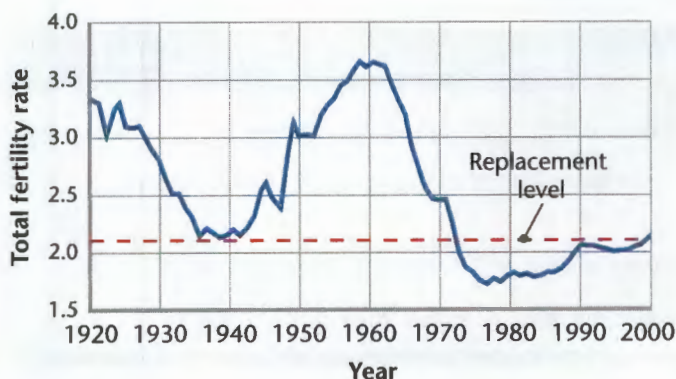


## WRITING SKILLS

**38. Writing Persuasively** Write an opinion article for a newspaper or magazine. Argue either for or against a policy related to immigration or family planning.

**39. Writing Using Research** Look up recent census data from your city, county, or state. Write a paragraph that describes the major demographic trends of the last few years.

### STANDARDIZED TEST PREP

For extra practice with questions formatted to represent the standardized test you may be asked to take at the end of your school year, turn to the sample test for this chapter in the Appendix.

## READING SKILLS

**Read the passage below, and then answer the questions that follow.**

*Excerpt from UN Population Fund,* The State of World Population 2001, *2001.*

Worldwide, women have primary responsibility for rearing children and ensuring sufficient resources to meet their needs. In the rural areas of developing countries, women are also the main managers of essential household resources like clean water, fuel for cooking and heating, and fodder for domestic animals.

Women make up more than half of the world's agricultural workforce. They grow crops for the home and market and often produce most staple crops. In the world's poorest countries, women head almost a quarter of rural households.

However, although women have the primary responsibility for managing resources, they usually do not have control. National law or local customs often deny women the right to secure title or inherit land, which means they have no collateral to raise credit and improve their conditions.

Women often lack rights in other aspects of their lives, reinforcing gender inequalities. High fertility and large families are still a feature of rural life, though the rationale has long since passed. In part, this reflects women's lack of choice in the matter.

**1.** Which of the following are *not* cited in the passage as major responsibilities of women?
   **a.** management of household resources
   **b.** agricultural work
   **c.** government leadership
   **d.** rearing children

**2.** The passage implies that improving women's rights would lead to
   **a.** the ability of women to earn more money.
   **b.** increased availability of fuel.
   **c.** poorer rural households.
   **d.** larger families.

# Skills Practice Lab: MATH/GRAPHING

## Objectives

▶ **USING SCIENTIFIC METHODS** **Predict** which variable has a greater effect on population growth rates.

▶ **Calculate** changes for a given population over a 50-year period.

▶ **Graph** the resulting population's age structure by creating a population pyramid.

▶ **Compare** the effects of fertility variables on population growth rates.

## Materials

calculator or computer
colored pencils or markers
graph paper
notebook
pen or pencil
ruler

▶ **Age Structure** You will make an age-structure diagram, such as this graph of the U.S. population in 2000.

**United States, 2000**



Population (in millions)
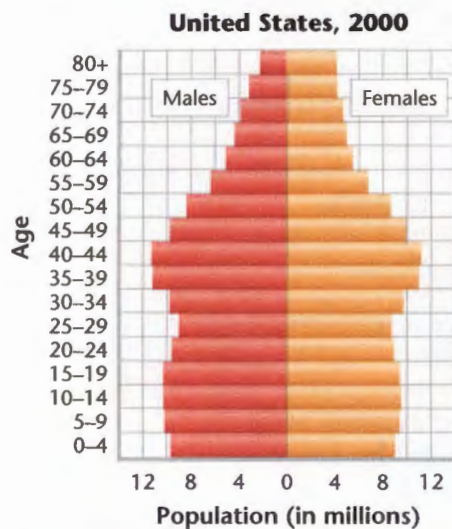
## How Will Our Population Grow?

If you were a demographer, you might be asked to determine how a population is likely to change in the future. You have learned that the rate of population growth is affected by both the number of children per family and the age at which people have children. But which factor has a greater effect? To explore this question, you will use age-structure diagrams—also called population pyramids—such as the one shown below.

## Procedure

1. In this lab you will calculate future population trends for an imaginary city. To compare how fertility variables may affect population growth, each group of students will test the effects of different assumptions. Assume the following about the population of this city:

### Assumptions About the Population

- Half the population is male and half is female.

- Every woman will have all of her children during a given five-year period of her life.

- Everyone who is born will live to the age of 85 and then die.

- No one will move into or out of the city.

2. Your teacher will divide the class into four groups. Each group will project population growth using the following assumptions:

### Assumptions About the Women in the Population

| Group | Each woman gives birth to | While in the age range of |
|-------|---------------------------|---------------------------|
| A | 5 children | 15–19 |
| B | 5 children | 25–29 |
| C | 2 children | 15–19 |
| D | 2 children | 25–29 |

3. Predict which of the four groups will have the greatest population growth in 50 years. Write down the order you would predict for the relative size of the groups from largest population to smallest population.

4. The table at right shows the population of our imaginary city for the year 2000. Use the data in the table to make an age-structure diagram (population pyramid) for the city. Use the example diagram at left to help you.

5. Make a table similar to the one shown at right. Add columns for the years 2005, 2010, and for every fifth year until the year 2050.

6. Calculate the number of 0- to 4-year-olds in the year 2005. To do this, first determine how many women will have children between 2000 and 2005. Remember that half of the population in each age group is female, and that members of the population will reproduce at specific ages. Multiply the number of child-bearing women by the number of children that each woman will have. For example, Group A will have 12,500 new births by 2005.

7. Fill in the entire column for the year 2005. Determine the number of people in each age group by "shifting" each group from 2000. For example, the number of 5- to 9-year-olds in 2005 will equal the number of 0- to 4-year-olds in 2000.

8. Calculate the total population for each five-year period.

9. Repeat the process described in steps 3–8 for each column, to complete the table through the year 2050.

## Analysis

1. **Constructing Graphs** Plot the growth of the population on a line graph. You may want to use a computer to graph the results.

2. **Constructing Graphs** Make a population pyramid for the population in 2050.

## Conclusions

3. **Evaluating Data** Compare your graphs with the graphs of the other three groups. Were your predictions correct?

4. **Drawing Conclusions** Which variable had a greater effect on population growth—the number of children each woman had or the age at which each woman had children?

5. **Interpreting Information** Did any of the groups show no growth in the population? Explain these results.

## Extension

1. From the age-structure diagram on the previous page, what would you predict to happen to the U.S. population in the next 20 years? in the next 50 years? What parts of the age structure are most important to these predictions?

| Population in Each Age Group, 2000–2050 | | | |
|---|---|---|---|
| Age | 2000 | 2005 | 2010 |
| 80+ | 100 | | |
| 75–79 | 500 | | |
| 70–74 | 600 | | |
| 65–69 | 700 | | |
| 60–64 | 800 | | |
| 55–59 | 900 | | |
| 50–54 | 1,000 | | |
| 45–49 | 1,250 | | |
| 40–44 | 1,500 | | |
| 35–39 | 2,000 | | |
| 30–34 | 2,500 | | |
| 25–29 | 3,000 | | |
| 20–24 | 4,000 | | |
| 15–19 | 5,000 | | |
| 10–14 | 6,500 | | |
| 5–9 | 8,000 | 10,000 | |
| 0–4 | 10,000 | 12,500 | |
| Total | 48,350 | | |
| Females that give birth | 2,500 | | |
| New births | 12,500 | | |

▶ **Sample Population Data** Use this table as an example to calculate the age structure for each generation of your imaginary population. Add columns for five-year periods up to 2050. Examples of some of Group A's results are shown in red.

# FERTILITY RATES AND FEMALE LITERACY IN AFRICA

Strait of Gibraltar

MEDITERRANEAN SEA

SOUTHWEST ASIA

TUNISIA 55%

MOROCCO 31%

ALGERIA 49%

LIBYA 63%

EGYPT 39%

WESTERN SAHARA (Occupied by Morocco)

Tropic of Cancer

CAPE VERDE 64%

MAURITANIA 40%

MALI 23%

NIGER 7%

CHAD 35%

SUDAN 35%

ERITREA NA

DJIBOUTI 33% GULF OF ADEN

SENEGAL 23%

GAMBIA 37%

GUINEA-BISSAU 41%

GUINEA 22%

BURKINA FASO 9%

BENIN 24%

NIGERIA 47%

GHANA 54%

CÔTE D'IVOIRE 40%

SIERRA LEONE 18%

LIBERIA 54%

TOGO 37%

GULF OF GUINEA

CAMEROON 52%

CENTRAL AFRICAN REPUBLIC 52%

ETHIOPIA 25%

SOMALIA 14%

EQUATORIAL GUINEA 68%

SÃO TOMÉ AND PRÍNCIPE 62%

Equator

GABON 53%

REPUBLIC OF THE CONGO 67%

DEMOCRATIC REPUBLIC OF THE CONGO 68%

RWANDA 45%

UGANDA 50%

KENYA 70%

BURUNDI 23%

ATLANTIC OCEAN

CABINDA (ANGOLA)

TANZANIA 57%

INDIAN OCEAN

SEYCHELLES 60%

COMOROS 50%

**Total Fertility Rate**
(Average number of children per woman)

- 6 or more
- 5.0 — 5.9
- 4.0 — 4.9
- 3.0 — 3.9
- 2.0 — 2.9
- Less than 2

**ALGERIA** Country name
**28%** Female literacy

ANGOLA 28%

ZAMBIA 71%

MALAWI 43%

MOZAMBIQUE 27%

Mozambique Channel

MADAGASCAR 73%

MAURITIUS 79%

ZIMBABWE 80%

NAMIBIA 31%

BOTSWANA 60%

Tropic of Capricorn

SCALE

0      500      1,000 Miles
0   500   1,000 Kilometers

Tropic of Capricorn

SWAZILAND 76%

LESOTHO 93%

SOUTH AFRICA 82%

Sources: The World Bank Group and the CIA.

## MAP SKILLS

Use the map of Africa to answer the questions below.

1. **Describing Locations** Which regions of Africa have the highest female literacy (percentage of females who can read and write)? the lowest female literacy? Which regions have the highest fertility rates? the lowest fertility rates?

2. **Analyzing Data** Choose 20 countries and make a graph comparing the total fertility rates and female literacy of each country.

3. **Comparing Data** Worldwide, the average total fertility rate is about 2.8 children per woman, and the average female literacy is 74 percent. How does Africa compare with the rest of the world in both aspects?

# LOST POPULATIONS: WHAT HAPPENED?

At various points in human history, entire populations have disappeared and left mysterious remains such as the Egyptian pyramids and the Anasazi pueblos in the southwestern United States. Why did these people and their civilizations disappear? Archeologists often find evidence that environmental destruction was one of the reasons the populations disappeared.

## Easter Island

On Easter Island in the Pacific Ocean, the first European visitors were amazed to find huge stone heads that were miles from the quarries where the heads had been made. It seemed impossible that the islanders could have moved the heads. There were no horses, oxen, or carts on the island and there were also no trees, which could have been used as rollers to move the heads. The islanders were using grass and reeds to make fires because the island was barren grassland. The island had no tree or shrub that was more than 3 m tall.

## A Changed Environment

Researchers have now shown that Easter Island was very different when it was first colonized by Polynesians around 400 CE. In the oldest garbage heaps on the island, archaeologists have found that one-third of the bones came from dolphins. To hunt dolphins, the islanders must have had strong canoes made of wood from tall trees. Pollen grains, which are used to identify plants, show that the island was once covered by a forest that contained many species found nowhere else in the world.

But by 1600 CE, trees were rare and the Easter Island palm tree was extinct. The palm seeds were probably eaten by rats that the Polynesians had brought to the island. With the destruction of the forest, every species of native land



► These large stone figures found on Easter Island were made by a civilization that has disappeared.

bird also became extinct, and the human population crashed.

The people of Easter Island destroyed their environment by overusing its natural resources and introducing new species such as chickens and rats. The people were reduced from a complex civilization to a primitive lifestyle. Easter Island is a small-scale example of what ecologists worry could happen to Earth's entire human population.

► These ruins in New Mexico were built by the Chaco Anasazi civilization around 900 CE. Environmental changes are thought to have affected this population.



## What Do You Think?

Industrialized countries have started to invest in environmental improvements, such as replanting forests that have been destroyed and protecting endangered species. Do you think this makes these countries safe from the kind of environmental disasters that destroyed the Easter Island civilization?