

SECTION 2

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 km², or about four football fields). In the year 2050, each person might get 4.8 acres of land (0.016 km², 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.



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.

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 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 water-borne 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 shantytowns 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.



FIELD ACTIVITY

Does Your Local Area Have Population Pressures? Take an informal survey of your community's population trends. Gather information by taking a walk, reading the local newspaper, or by contacting your local government or chamber of commerce offices.

Try to answer the following questions:

- Is your local population growing or shrinking? How much change is due to migration?
- What growth-related problems are citizens and government planners aware of?
- What solutions are being proposed or debated?

Record your results in your **EcoLog**.

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.



International Development

The United Nations (UN) has an important role in understanding and assisting the development of nations. The UN holds conferences, publishes research, creates treaties, manages international programs, and dispenses funds.

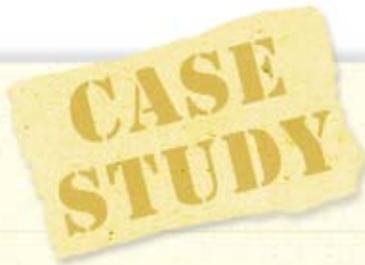
The UN also creates formal designations, such as *least developed countries*. Demographers, foreign aid programs, and international treaties may use these designations.

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.



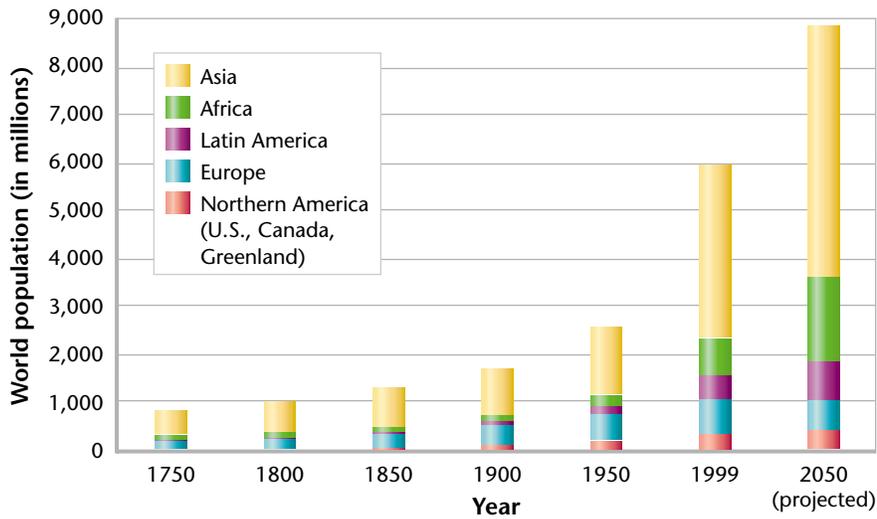
Thailand's Population Challenges

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.

Figure 14 ▶ Different regions of the world are growing at different rates. Which regions will contribute the most growth?



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.

Figure 15 ▶ China has implemented a long campaign to reduce birth rates. Their strategies have included economic rewards to promote single-child families and advertising such as the billboard shown here.



Table 1 ▼

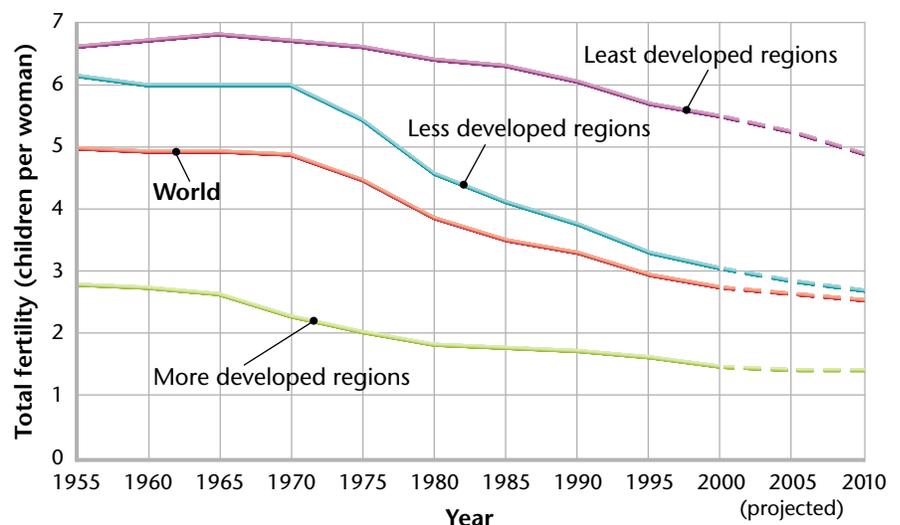
ICPD Goals for 2015
<ul style="list-style-type: none"> • Provide universal access to a full range of safe and reliable family-planning methods and related reproductive health services. • Reduce infant mortality rates to below 35 infant deaths per 1,000 live births and mortality rates of children under 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.

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.

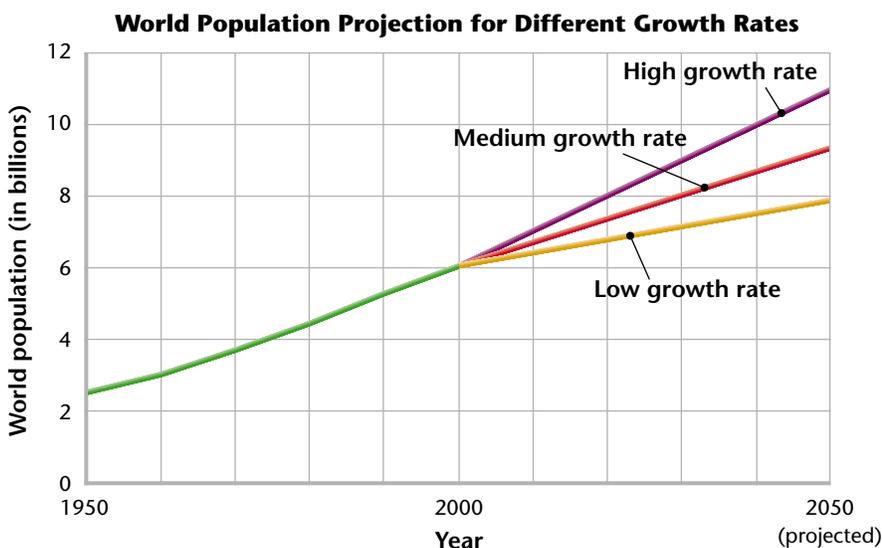
Figure 16 ▶ **Worldwide Trends in Fertility** Most countries' fertility rates are dropping toward replacement level.

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.



Source: UN Population Division.

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?

QuickLAB



Estimating Fertility Rates

Procedure

1. Your goal is to estimate the average fertility rate of the mothers of students in your school. Design and conduct a quick survey of other students in the school.
2. Create one or two survey questions that will collect the needed information. Be sure that the questions are sensitive to personal differences and are not judgmental.
3. Devise a method to make the survey anonymous. You might simply pass out a questionnaire to another class.
4. Get your teacher's approval for your survey questions and method, and then conduct your survey.

Analysis

1. Analyze your results, and prepare a short summary of your findings.

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.

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*



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.”

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 antibiotics.
 - 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.

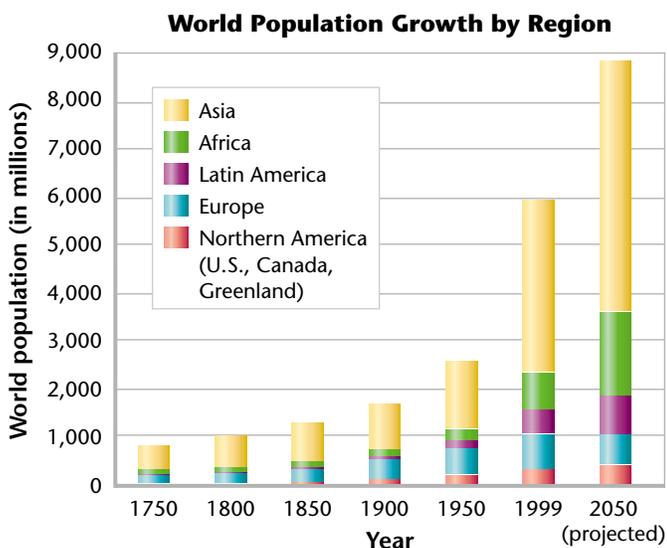
Short Answer

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) have only recently exceeded the other regions 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.



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

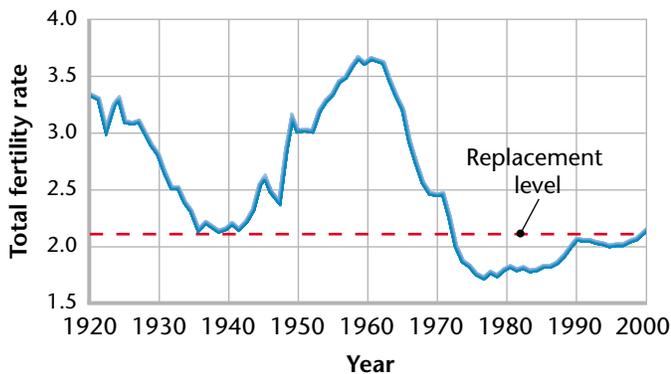
34. **Research Demographic Trends** Look up population statistics for your local city, county, or state. Read and take notes about recent demographic trends and predictions for the next few decades. Make a summary of your findings. **READING SKILLS**



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.



READING FOLLOW-UP

Now that you have read the chapter, take a moment to review your answers to the **Reading Warm-Up** questions in your **EcoLog**. If necessary, revise your answers.

STANDARDIZED TEST PREP

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.

- Which of the following are *not* cited in the passage as major responsibilities of women?
 - management of household resources
 - agricultural work
 - government leadership
 - rearing children
- The passage implies that improving women's rights would lead to
 - the ability of women to earn more money.
 - increased availability of fuel.
 - poorer rural households.
 - larger families.

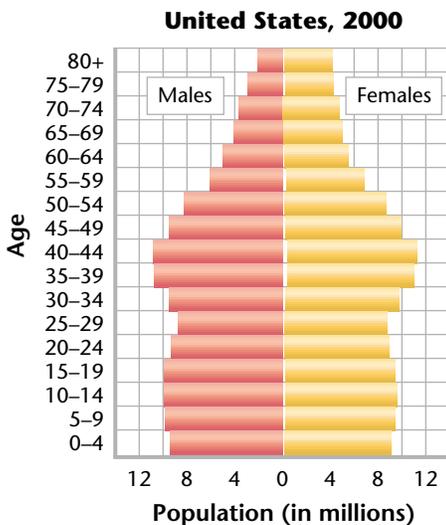
Objectives

- ▶ **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.



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.

- 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.
- 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.
- 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.
- 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.
- Calculate the total population for each five-year period.
- Repeat the process described in steps 3–8 for each column, to complete the table through the year 2050.

Analysis

- Constructing Graphs** Plot the growth of the population on a line graph. You may want to use a computer to graph the results.
- Constructing Graphs** Make a population pyramid for the population in 2050.

Conclusions

- Evaluating Data** Compare your graphs with the graphs of the other three groups. Were your predictions correct?
- 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?
- Interpreting Information** Did any of the groups show no growth in the population? Explain these results.

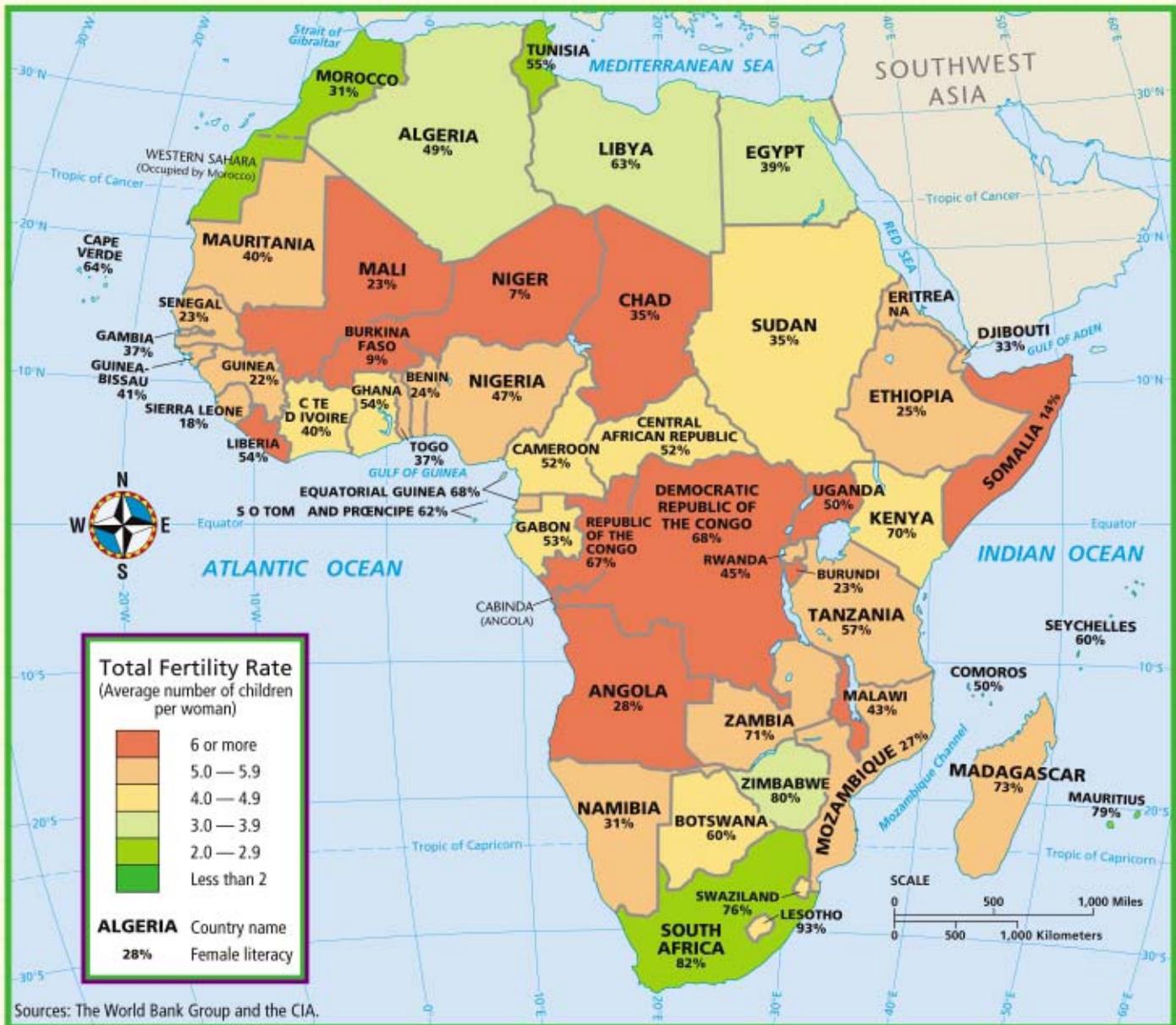
Extension

- 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



MAP SKILLS

Use the map of Africa to answer the questions below.

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

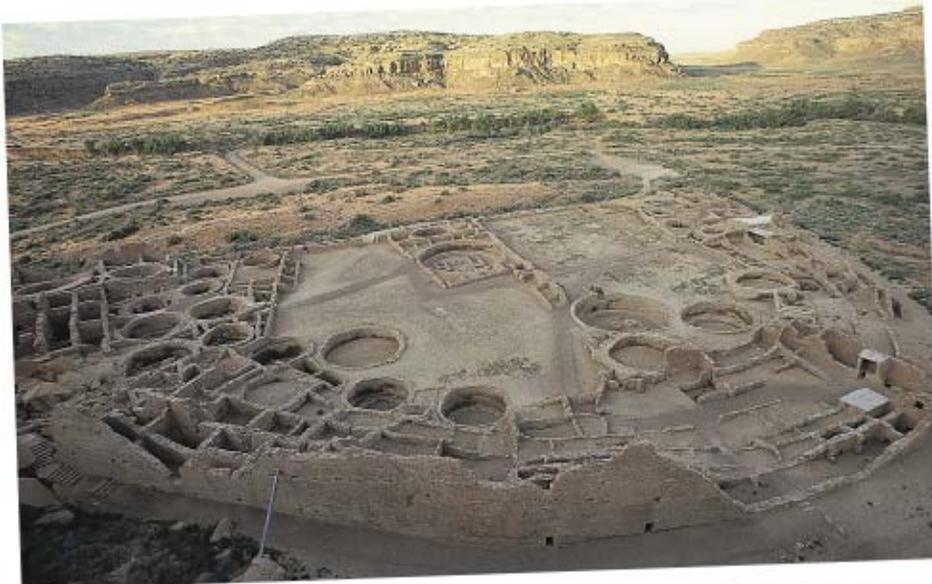


► These large stone figures found on Easter Island were made by a civilization that has disappeared.

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?