2

Population and Health

More people are alive at this time than at any other point in Earth's history, and most of the growth is concentrated in poor countries. Can Earth sustain more than 7 billion people now, let alone the added billions in the future? Geographers have unique perspectives on the ability of people to live on Earth. Indonesia, shown in this image, is the world's fourth most populous country, so it's future population growth will have a major impact on the future population of the world as a whole.

Students walk home from school near Jakarta, Indonesia.

LOCATIONS IN THIS CHAPTER

KEY ISSUES

1

Where Are the World's People Distributed?

Humans are not distributed uniformly across Earth. Rather, they are highly clustered in particular *places*, whereas other places are sparsely inhabited.

2 Why Is World Population Increasing?

Population is growing at different rates in different *regions*. Every place is at some stage in a process known as the demographic transition.

3 Why Do Some Places Face Health Challenges?

Patterns of health and provision of medical care vary across *space*. Health and medical care have improved in the world as a whole, but at the local *scale*, some people are at increased risk.

4 Why Might Population Increase in the Future?

Geographers see strong *connections* between the size and growth of population and the adequacy of resources. Geographers find that overpopulation may be a threat to resources in some regions of the world but not in others.

KEY ISSUE 1

Where Are the World's People Distributed?

- Introducing Population and Health
- Population Concentrations
- Population Density

LEARNING OUTCOME 2.1.1

Understand the distribution of the world's peoples.

▲ **FIGURE 2-1 OVERPOPULATION IN MALI** The Sahel region of Africa, including much of the country of Mali, is threatened by overpopulation. The number of people living here is not very high, but the capacity of the environment to support life is extremely low. These people are chopping down one of the few remaining trees in this region.

As explained in Chapter 1, geographers ask "where" and "why" questions. As we begin our study of the major topics in human geography, note the wording of the four key issues that organize the material in this chapter. The first issue asks a "where" question, and the other three ask "why" questions. These four issues rely on the five basic concepts presented in Chapter 1.

Introducing Population and Health

Geographers study population problems by first describing where people are found across Earth. The location of Earth's 7 billion people forms a regular distribution. The chapter then turns to explaining why population is growing at different rates in different places. With the rate of world population growth slowing in the twenty-first century, geographers are increasingly concerned with differences in the health of people in different places and with the medical care available to them.

The study of population geography is especially important for three reasons:

- More people are alive at this time than at any other point in Earth's long history.
- Virtually all global population growth is concentrated in developing countries.
- The world's population increased at a faster rate during the second half of the twentieth century than ever before in history; the rate has slowed in the twenty-first century but is still high by historical standards.

Geographers are interested in the relationship between population and Earth's resources. **Overpopulation** occurs when the number of people exceeds the capacity of the environment to support life at a decent standard of living. From the perspective of globalization, some demographers argue that the world is already overburdened with too many people, or it will be in the near future. At the scale of local diversity, geographers find that overpopulation is a threat in some regions of the world but not in others (Figure 2-1). The capacity of Earth as a whole to support human life may be high but some regions have a favorable balance between people and available resources, whereas others do not. Further, the regions with the most people are not necessarily the same as the regions with an unfavorable balance between population and resources.

The single most important data source for population geography is the **census**. In the United States, a census of population and a census of housing take place once a decade, in years ending in zero, including 2010. Despite its importance, the census is controversial in many countries, for two reasons:

- **Nonparticipation.** Homeless people, ethnic minorities, and citizens of other countries who do not have proper immigration documents may be less likely to complete census forms. These individuals may fear that the Census Bureau could turn over the forms to another government agency, such as the FBI or the Department of Homeland Security in the United States.
- **Sampling.** Statistical sampling techniques can be utilized to get a more accurate count, as well as to identify detailed characteristics of people, housing, and businesses. The U.S. Supreme Court has ruled that sampling may not be used to redraw Congressional district boundaries. Politicians sympathetic to the needs of the homeless and immigrants have been especially vocal in support of sampling, whereas those from small towns and rural areas, where the census count is more accurate, are more inclined to oppose it.

DISTRIBUTION OF THE WORLD'S PEOPLES

Human beings are not distributed uniformly across Earth. We can understand how population is distributed by examining two basic properties: concentration and density. Geographers identify regions of Earth's surface where population is clustered and regions where it is sparse. Several density measures help geographers explain the relationship between the number of people and available resources.

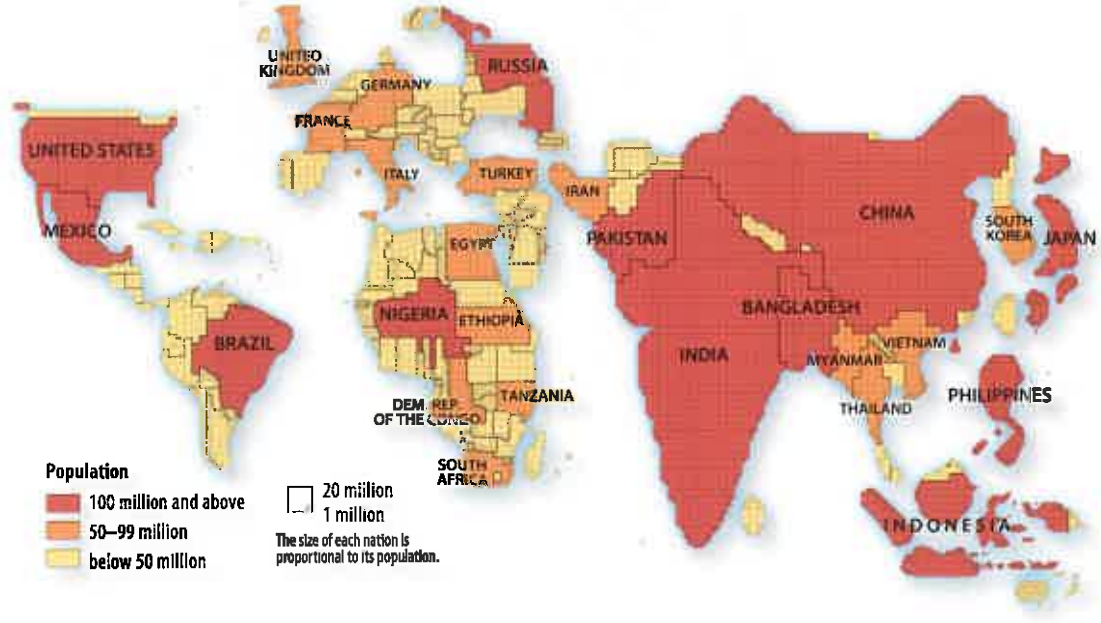
The concentration of the world's population can be displayed by dividing Earth's land area into seven portions, each containing around 1 billion people (Figure 2-2). The combined population of North America, Latin America, the South Pacific, and Greenland (an area of 53 million square kilometers [20 million square miles]) is about the same as the population of eastern China (5 million square kilometers) or of southern India (3 million square kilometers).

Concentration can also be displayed on a cartogram, which depicts the sizes of countries according to population rather than land area, as is the case with most maps (Figure 2-3). When compared to a more typical equal-area map, such as in Figure 2-2, the population cartogram displays major population clusters as much larger. As you look at maps of population growth and other topics in this and subsequent chapters, pay special attention to Asia and Europe because global patterns are heavily influenced by conditions in these regions, where two-thirds of the world's people live.

PAUSE & REFLECT 2.1.1

Compare Figures 2-2 and 2-3. Which depicts the shape of countries more accurately? Why?

◀ FIGURE 2-2 WORLD POPULATION PORTIONS Each of the seven portions indicated by color in this figure contains approximately 1 billion inhabitants.



◀ FIGURE 2-3 WORLD POPULATION CARTOGRAM In a cartogram, countries are displayed by size of population rather than land area. Canada is the world's second-largest country in land area, so it appears quite large on most maps. But it ranks only 37th in population so appears small on this map. Conversely, Bangladesh ranks only 92nd in land area but is 8th in population so appears large on the cartogram. Countries with populations over 50 million are labeled.

Population Concentrations

LEARNING OUTCOME 2.1.2

Understand why some regions have clustered populations and other regions are sparsely inhabited.

Two-thirds of the world's inhabitants are clustered in four regions (Figure 2-4). The four population clusters occupy generally low-lying areas, with fertile soil and temperate climate. Most live near the ocean or near a river with easy access to an ocean rather than in the interior of major landmasses.

FOUR CLUSTERS

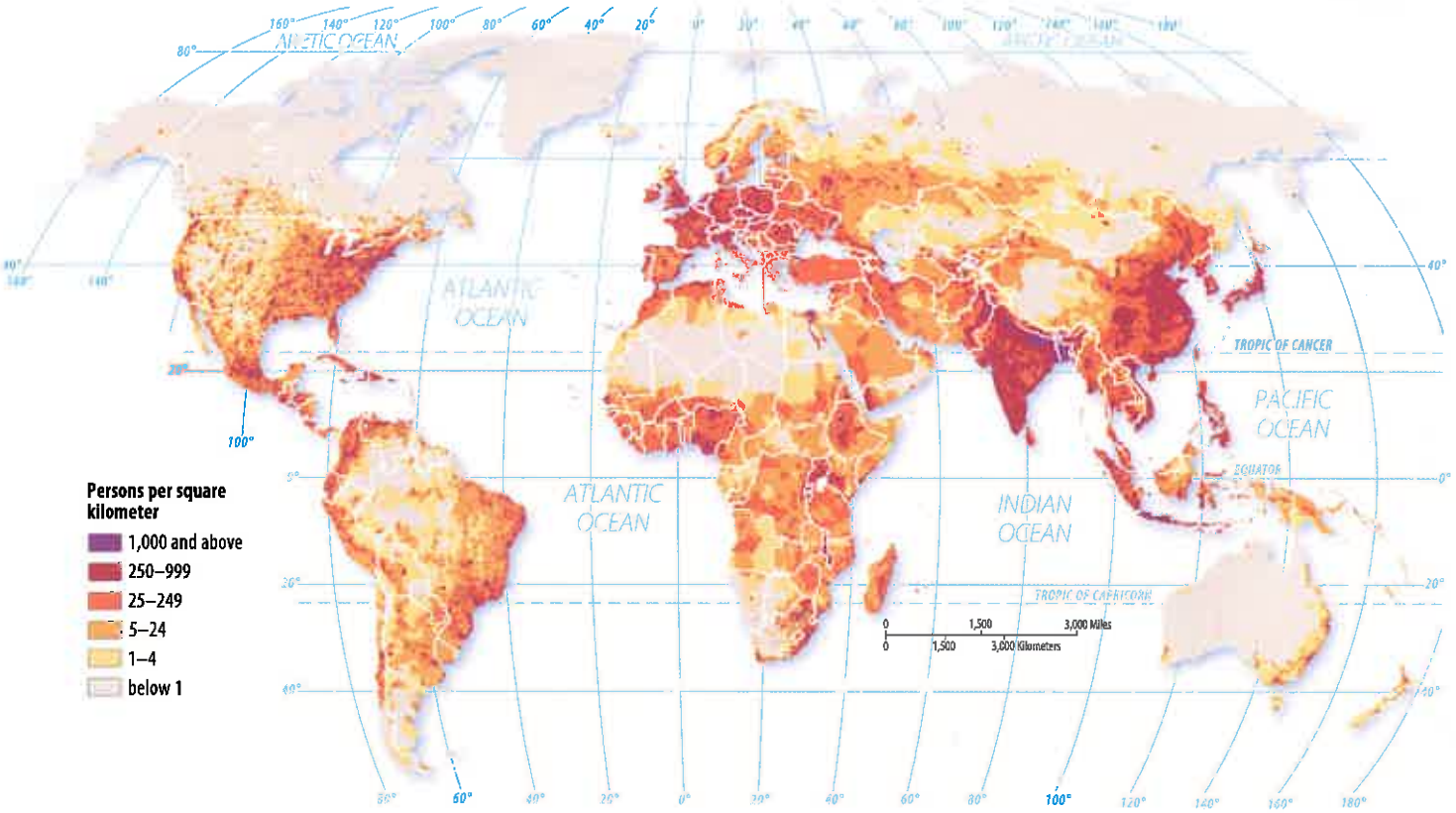
The four major population clusters—East Asia, South Asia, Europe, and Southeast Asia—display differences in the pattern of occupancy of the land.

EAST ASIA. Nearly one-fourth of the world's people live in East Asia. The region, bordering the Pacific Ocean, includes eastern China, the islands of Japan, the Korean peninsula, and the island of Taiwan. The People's Republic of China is the world's most populous country and the fourth-largest country in land area. The Chinese population is clustered near the Pacific Coast and in several fertile river valleys that extend inland, though much of China's interior is sparsely inhabited mountains and deserts. Nearly one-half of the people live in rural areas where they work as farmers. In sharp contrast to China, 93 percent of Japanese and 80 percent of South Koreans are clustered in urban areas and work at industrial or service jobs.

SOUTH ASIA. Nearly one-fourth of the world's people live in South Asia, which includes India, Pakistan, Bangladesh, and the island of Sri Lanka. The largest concentration of people within South Asia lives along a 1,500-kilometer (900-mile) corridor from Lahore, Pakistan, through India and Bangladesh to the Bay of Bengal. Much of this area's population is concentrated along the plains of the Indus and Ganges rivers. Population is also heavily concentrated near India's two long coastlines—the Arabian Sea to the west and the Bay of Bengal to the east. Most people in South Asia are farmers living in rural areas.

EUROPE. Europe includes four dozen countries, ranging from Monaco, with 1 square kilometer (0.7 square miles) and a population of 33,000, to Russia, the world's largest country in land area when its Asian part is included. In contrast to the three Asian concentrations, three-fourths of Europe's inhabitants live in cities, and fewer than 5 percent are farmers. The highest population concentrations in Europe are near the major rivers and coalfields of Germany and Belgium, as well as historic capital cities such as London and Paris.

SOUTHEAST ASIA. Around 600 million people live in Southeast Asia, mostly on a series of islands that lie between the Indian and Pacific oceans. Indonesia, which consists of 13,677 islands, is the world's fourth-most-populous country. The largest population concentration is on the island of Java, which is inhabited by more than 100 million people. Several islands that belong to the Philippines contain high population concentrations, and population is also clustered along several river valleys and deltas at the southeastern tip



▲ **FIGURE 2-4 WORLD POPULATION DISTRIBUTION** People are not distributed uniformly across Earth's surface.

of the Asian mainland, known as Indochina. The Southeast Asia concentration is characterized by a high percentage of people working as farmers in rural areas.

OTHER CLUSTERS. Africa has several population clusters. The two largest—both with around 300 million people—are along the west coast between Senegal and Nigeria and along the east coast between Eritrea and South Africa. As in the three Asian concentrations, most Africans work in agriculture. The largest population concentration in the Western Hemisphere is in the northeastern United States and southeastern Canada. This cluster, containing around 100 million people, extends along the Atlantic Coast from Boston to Newport News, Virginia, and westward along the Great Lakes to Chicago.

SPARSELY POPULATED REGIONS

Human beings avoid clustering in certain physical environments. Relatively few people live in regions that are too dry, too wet, too cold, or too mountainous for activities such as agriculture. The areas of Earth that humans consider too harsh for occupancy have diminished over time, whereas the portion of Earth's surface occupied by permanent human settlement—called the **ecumene**—has increased (Figure 2-5).

PAUSE & REFLECT 2.1.2

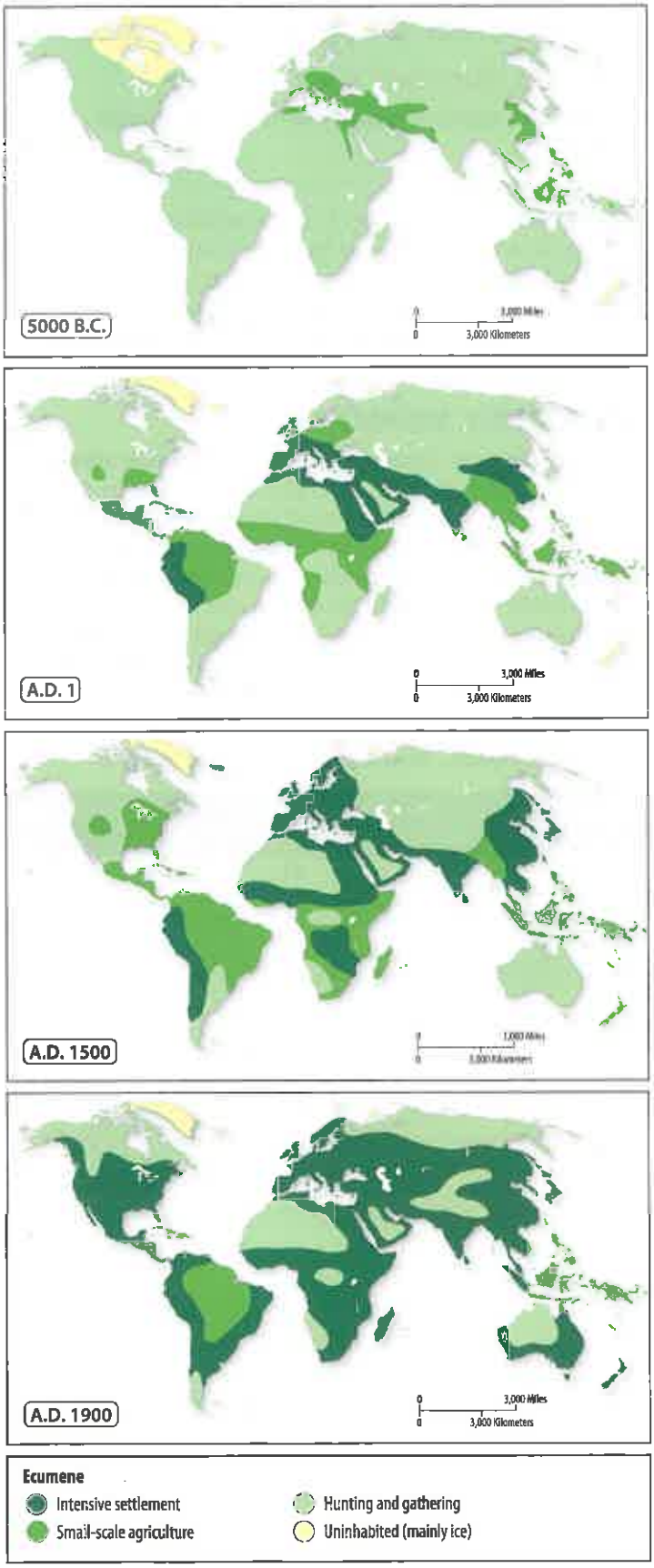
Why are some land areas not part of the ecumene?

DRY LANDS. Areas too dry for farming cover approximately 20 percent of Earth's land surface. Deserts generally lack sufficient water to grow crops that could feed a large population, although some people survive there by raising animals, such as camels, that are adapted to the climate. Dry lands contain natural resources useful to people—notably, much of the world's petroleum reserves.

WET LANDS. Lands that receive very high levels of precipitation, located primarily near the equator, are often inhospitable for human occupation. The combination of rain and heat rapidly depletes nutrients from the soil and thus hinders agriculture.

COLD LANDS. Much of the land near the North and South poles is perpetually covered with ice or the ground is permanently frozen (permafrost). The polar regions are unsuitable for planting crops, few animals can survive the extreme cold, and few humans live there.

HIGH LANDS. The highest mountains in the world are steep, snow covered, and sparsely settled. However, some high-altitude plateaus and mountain regions are more densely populated, especially at low latitudes (near the equator) where agriculture is possible at high elevations.



▲ **FIGURE 2-5 ECUMENE** Seven thousand years ago, humans occupied only a small percentage of Earth's land area, primarily in Southwest Asia, Eastern Europe, and East Asia. Even 500 years ago, much of North America and Asia lay outside the ecumene. Still, approximately three-fourths of the world's population live on only 5 percent of Earth's surface. The balance of Earth's surface consists of oceans (about 71 percent) and less intensively inhabited land.

Population Density

LEARNING OUTCOME 2.1.3

Define three types of density used in population geography.

Density, defined in Chapter 1 as the number of people occupying an area of land, can be computed in several ways, including arithmetic density, physiological density, and agricultural density. These measures of density help geographers describe the distribution of people in comparison to available resources.

ARITHMETIC DENSITY

Geographers most frequently use **arithmetic density**, which is the total number of objects in an area. In population geography, arithmetic density refers to the total number of people divided by total land area (Figure 2-6). To compute the arithmetic density, divide the population by the land area. Table 2-1 shows several examples.

Arithmetic density enables geographers to compare the number of people trying to live on a given piece of land in different regions of the world. Thus, arithmetic density answers the "where" question. However, to explain why people are not uniformly distributed across Earth's surface, other density measures are more useful.

PHYSIOLOGICAL DENSITY

Looking at the number of people per area of a certain type of land in a region provides a more meaningful population measure than arithmetic density. Land suited for agriculture is called arable land. In a region, the number of people supported by a unit area of arable land is called the **physiological density** (Figure 2-7).

Comparing physiological and arithmetic densities helps geographers understand the capacity of the land to yield enough food for the needs of the people. In Egypt, for example, the large difference between the physiological density and arithmetic density indicates that most of the country's land is unsuitable for intensive agriculture. In fact, all but 5 percent of Egyptians live in the Nile River valley and delta because it is the only area in the country that receives enough moisture (by irrigation from the river) to allow intensive cultivation of crops.

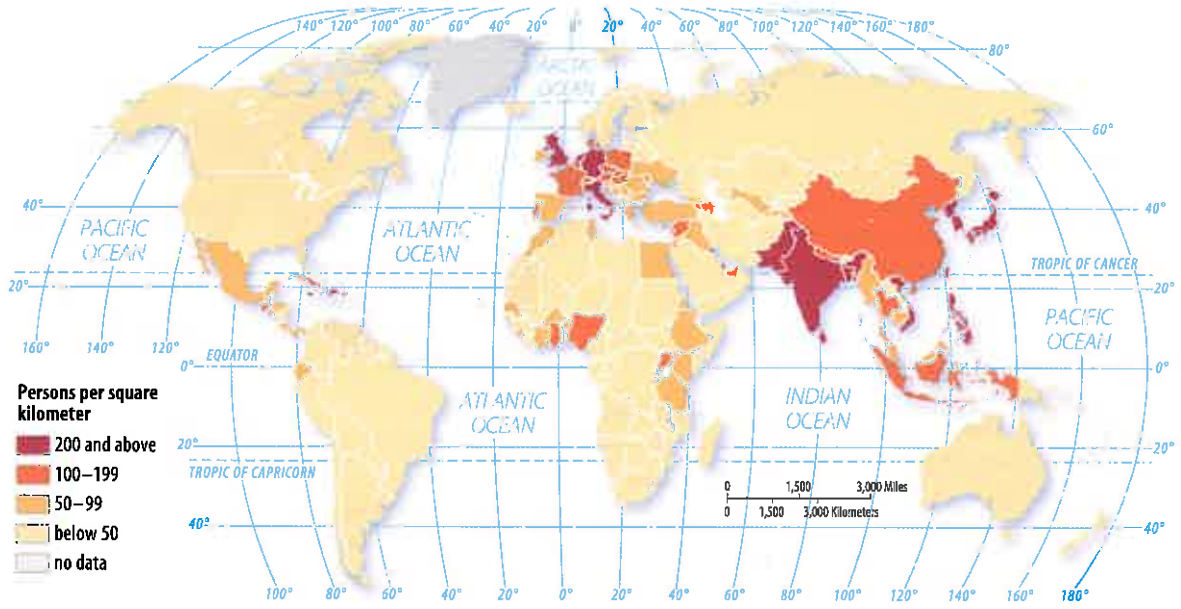
AGRICULTURAL DENSITY

Two countries can have similar physiological densities but produce significantly different amounts of food because of different economic conditions. **Agricultural density** is the ratio of the number of farmers to the amount of arable land (Figure 2-8). Table 2-1 shows several examples.

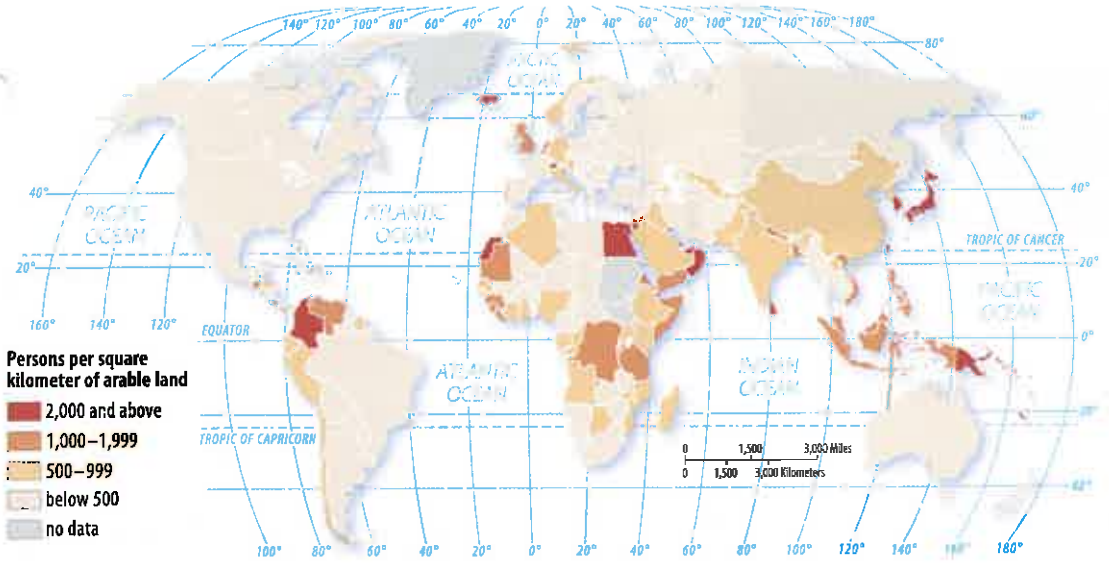
Measuring agricultural density helps account for economic differences. Developed countries have lower agricultural densities because technology and finance allow a few people to farm extensive land areas and feed many people.

TABLE 2–1 Density Measures for Four Countries

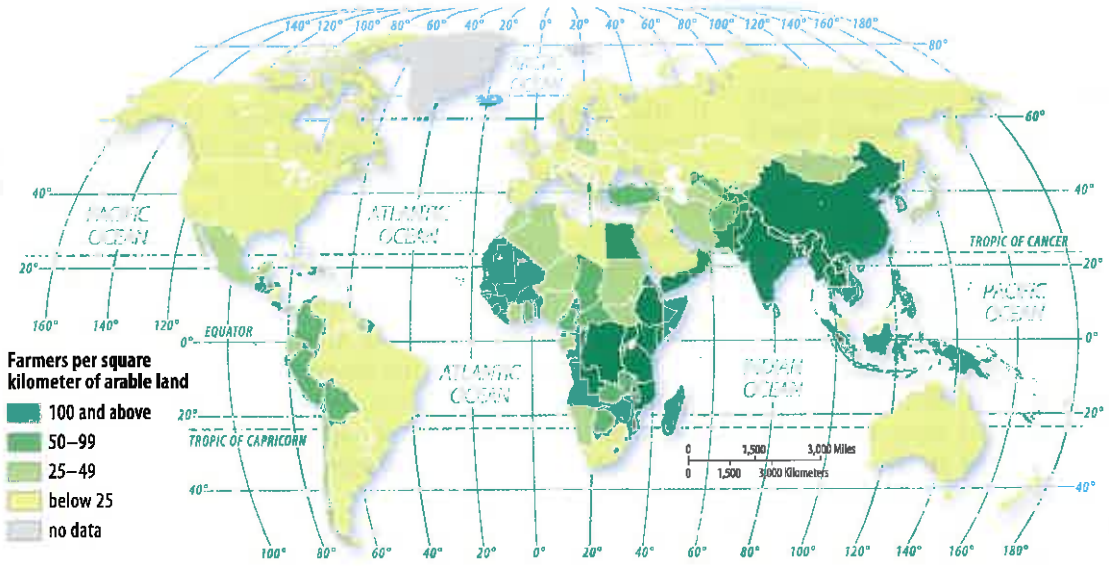
Country	Arithmetic Density	Physiological Density	Agricultural Density	Percentage Farmers	Percentage Arable Land
Canada	4	83	1	2	5
United States	35	199	3	2	18
Netherlands	498	1,610	26	3	31
Egypt	87	3,011	273	29	3



▲ **FIGURE 2-6 ARITHMETIC DENSITY** Geographers rely on the arithmetic density to compare conditions in different countries because the two pieces of information—total population and total land area—are easy to obtain. The highest arithmetic densities are found in Asia, Europe, and Central America. The lowest are in North and South America and the South Pacific.



▲ **FIGURE 2-7 PHYSIOLOGICAL DENSITY** Physiological density provides insights into the relationship between the size of a population and the availability of resources in a region. The relatively large physiological densities of Egypt and the Netherlands demonstrate that crops grown on a hectare of land in these two countries must feed far more people than in the United States or Canada, which have much lower physiological densities. The highest physiological densities are found in Asia, sub-Saharan Africa, and South America. The lowest are in North America, Europe, and the South Pacific.



▲ **FIGURE 2-8 AGRICULTURAL DENSITY** The highest agricultural densities are found in Asia and sub-Saharan Africa. The lowest are in North America, Europe, and the South Pacific.

To understand relationships between population and resources in a country, geographers examine a country's physiological and agricultural densities together. For example, the physiological densities of both Egypt and the Netherlands are high, but the Dutch have a much lower agricultural density than the Egyptians. Geographers conclude that both the Dutch and Egyptians put heavy pressure on the land to produce food, but the more efficient Dutch agricultural system requires fewer farmers than does the Egyptian system.

PAUSE & REFLECT 2.1.3

Which density measure differs most between Egypt and Ethiopia? What might account for this difference?

CHECK-IN KEY ISSUE 1

Where Is the World's Population Distributed?

- ✔ **The world's population is highly clustered in four regions.**
- ✔ **The physical environment discourages population concentrations in some regions.**
- ✔ **Arithmetic, physiological, and agricultural densities describe the distribution of people.**

KEY ISSUE 2

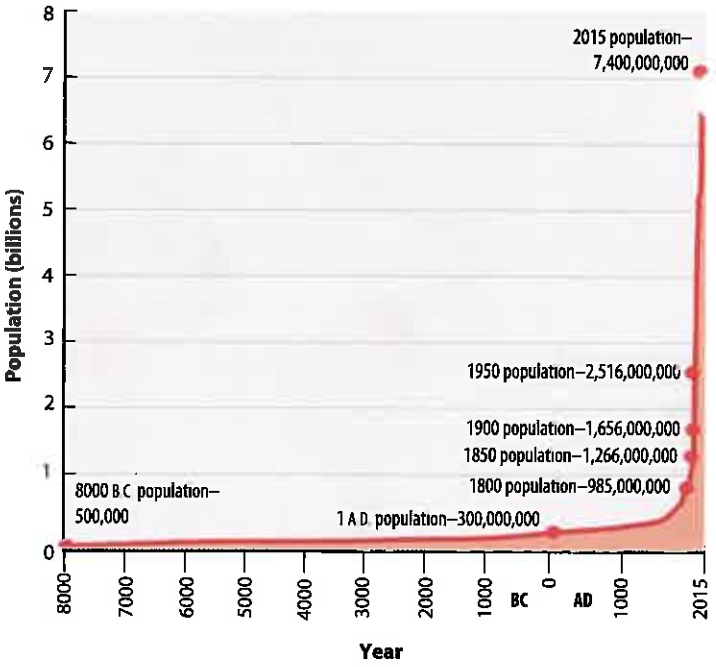
Why Is World Population Increasing?

- Natural Increase
- Births and Deaths
- The Demographic Transition

LEARNING OUTCOME 2.2.1

Understand historical and recent rates of natural increase.

For most of human history, Earth's population was unchanged at perhaps a half-million. In contrast, about 75 million people are now being added to the population of the world annually.



▲ **FIGURE 2-9 WORLD POPULATION THROUGH HISTORY** Through most of human history, population growth was virtually nil. Population increased rapidly beginning in the eighteenth century.

Natural Increase

The **natural increase rate (NIR)** is the percentage by which a population grows in a year. The term *natural* means that a country's growth rate excludes migration. During the twenty-first century, the world NIR has been 1.2, meaning that the population of the world has been growing each year by 1.2 percent.

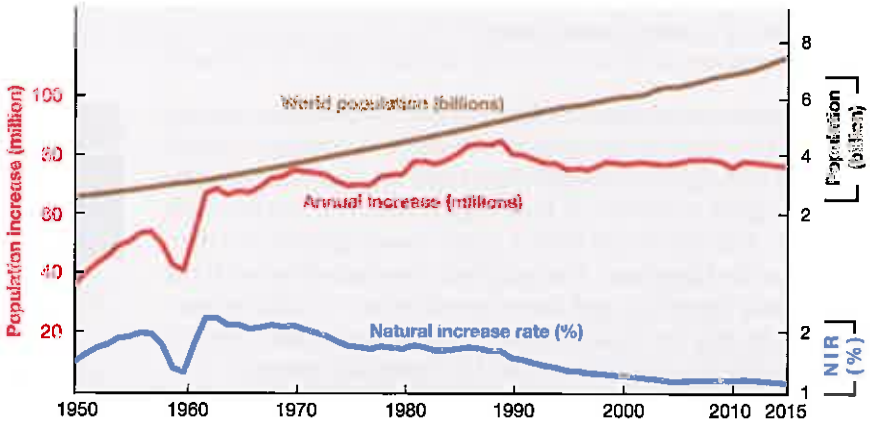
POPULATION GROWTH IN HISTORY

The NIR was essentially zero for most of humanity's several-hundred-thousand-year occupancy of Earth (Figure 2-9). The world NIR is lower today than its all-time peak of 2.2 percent in 1963, and it has declined since the 1990s. However, the NIR during the second half of the twentieth century was high by historical standards.

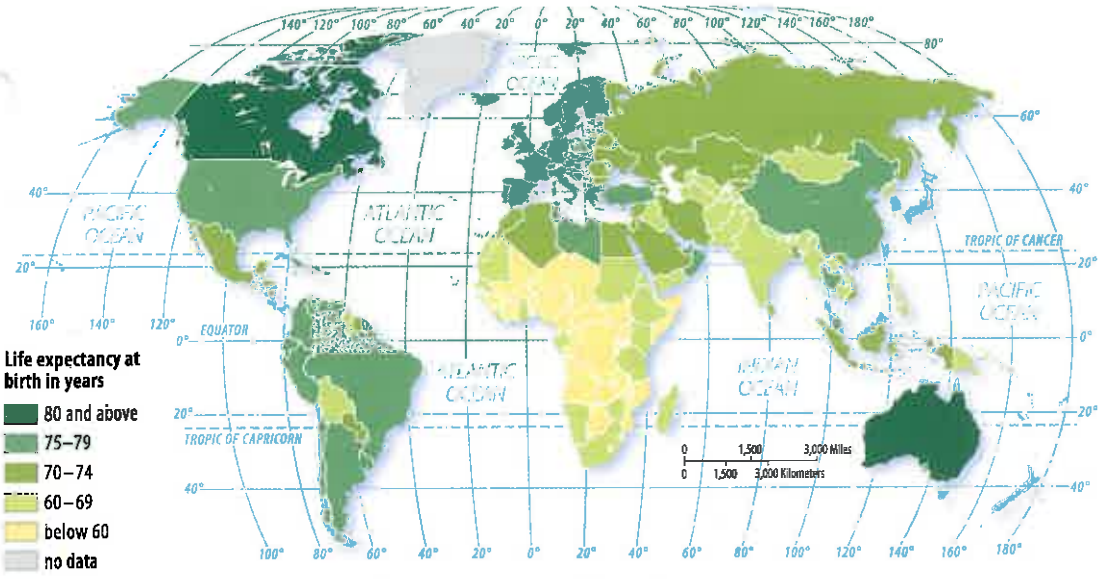
The number of people added each year has dropped from a historic peak of 88 million in 1989 to the current 75 million. The decline of this number is less sharp than the decline of the NIR because the population base is much larger now than in the past. World population increased from 3 to 4 billion in 14 years, from 4 to 5 billion in 13 years, from 5 to 6 billion in 12 years, and from 6 to 7 billion in 12 years. As the base continues to grow in the twenty-first century, a change of only one-tenth of 1 percent can produce very large swings in population growth (Figure 2-10).

The natural increase rate affects the **doubling time**, which is the number of years needed to double a population, assuming a constant rate of natural increase. At the current rate of 1.2 percent per year, world population would double in about 54 years. If the same NIR continued through the twenty-first century, global population in the year 2100 would reach 24 billion. When the NIR was 2.2 percent in 1963, doubling time was 35 years. Had the 2.2 percent rate continued into the twenty-first century, Earth's population would currently exceed 10 billion instead of 7 billion. A 2.2 percent NIR through the twenty-first century would produce a total population of more than 50 billion in 2100.

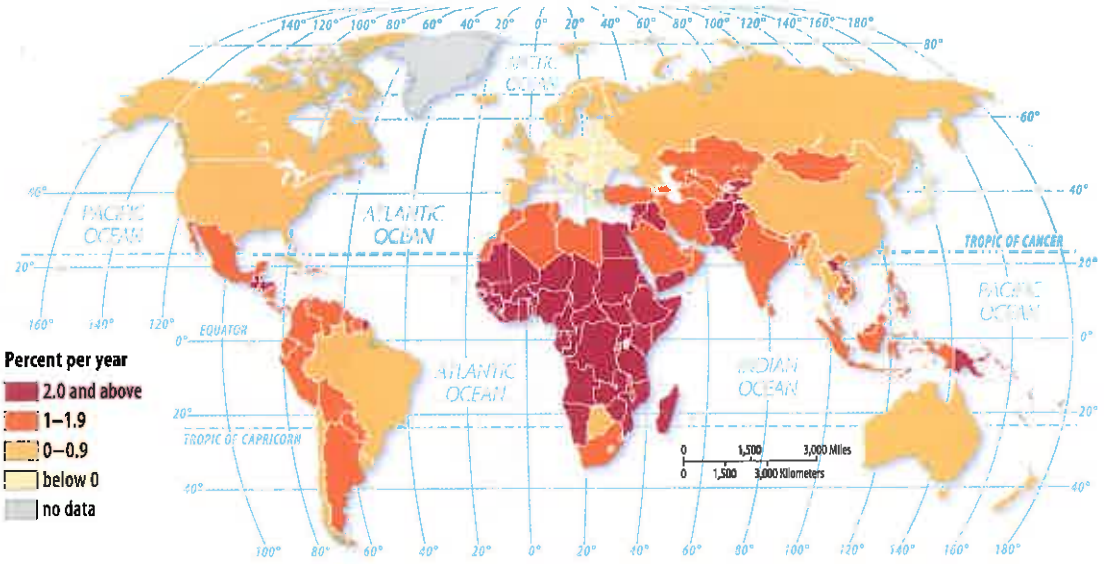
Life expectancy is the average number of years an individual can be expected to live, given current social, economic, and medical conditions. Life expectancy at birth is the average number of years a newborn infant can expect to live.



▲ **FIGURE 2-10 WORLD POPULATION GROWTH, 1950–2015** The NIR declined from its historic peak in the 1960s, but the number of people added each year has not declined very much because with world population increasing from 2.5 billion to more than 7 billion people during the period, the percentage has been applied to an ever larger base.



◀ **FIGURE 2-11 LIFE EXPECTANCY AT BIRTH** The highest life expectancies are in Europe and the lowest are in sub-Saharan Africa.



◀ **FIGURE 2-12 NATURAL INCREASE RATE** The world average is currently 1.2 percent. The countries with the highest NIRs are concentrated in Africa and Southwest Asia.

Babies born today can expect to live to around 80 in the developed countries of Europe but only to around 57 in the developing countries of sub-Saharan Africa (Figure 2-11).

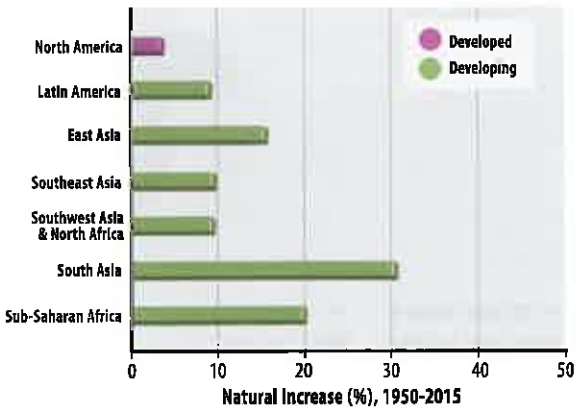
REGIONAL VARIATIONS IN NIR

More than 95 percent of the natural increase is clustered in developing countries (Figure 2-12). The NIR exceeds 2.0 percent in most countries of sub-Saharan Africa, whereas it is negative in Europe, meaning that in the absence of immigrants, population actually is declining.

PAUSE & REFLECT 2.2.1

Which region other than sub-Saharan Africa appears to have the highest natural increase rate?

Since 1980, 67 percent of the world's population growth has been in Asia, 20 percent in Africa, 9 percent in Latin America, and 4 percent in North America (Figure 2-13). Europe (including Russia) has had declining population since 1980. Regional differences in NIRs mean that most of the world's additional people live in the countries that are least able to maintain them. To explain these variations in growth rates, geographers point to regional differences in fertility and mortality rates.



▲ **FIGURE 2-13 REGIONAL DISTRIBUTION OF NATURAL INCREASE, 1950–2015** Europe (including Russia) does not appear on the chart because population has declined in the region.

Births and Deaths

LEARNING OUTCOME 2.2.2

Recognize regional variations in fertility and mortality.

Population increases rapidly in places where more people are born than die, and it declines in places where deaths outnumber births. The population of a place also increases when people move in and decreases when people move out. This element of population change —migration—is discussed in Chapter 3.

FERTILITY

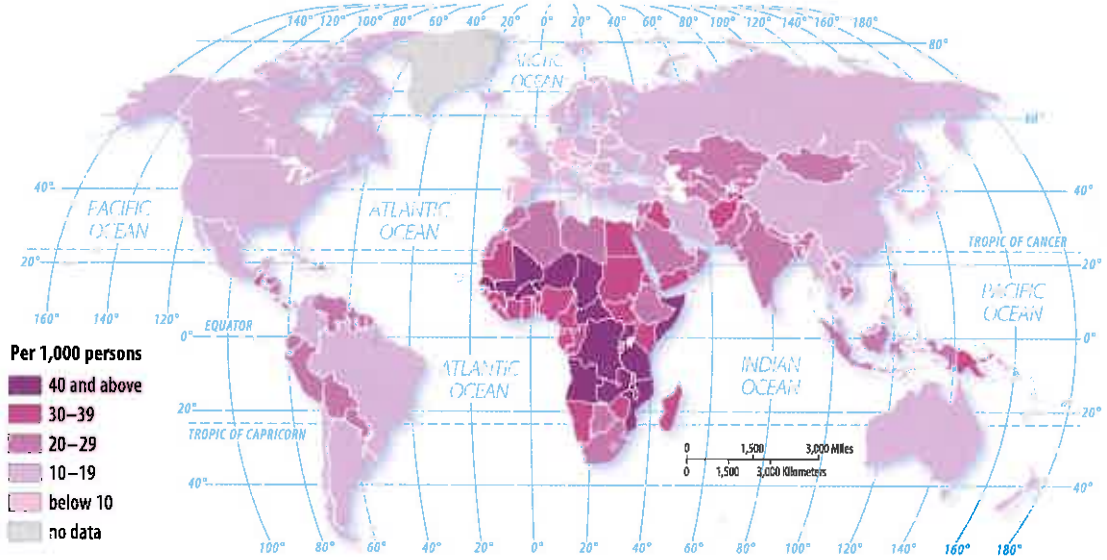
The **crude birth rate (CBR)** is the total number of live births in a year for every 1,000 people alive in the society. A CBR of 20 means that for every 1,000 people in a country, 20 babies are born over a one-year period.

The world map of CBR (Figure 2-14) mirrors the distribution of NIR. As is the case with NIRs, the highest CBRs are in sub-Saharan Africa, and the lowest are in Europe. Many sub-Saharan African countries have a CBR over 40, whereas many European countries have a CBR below 10.

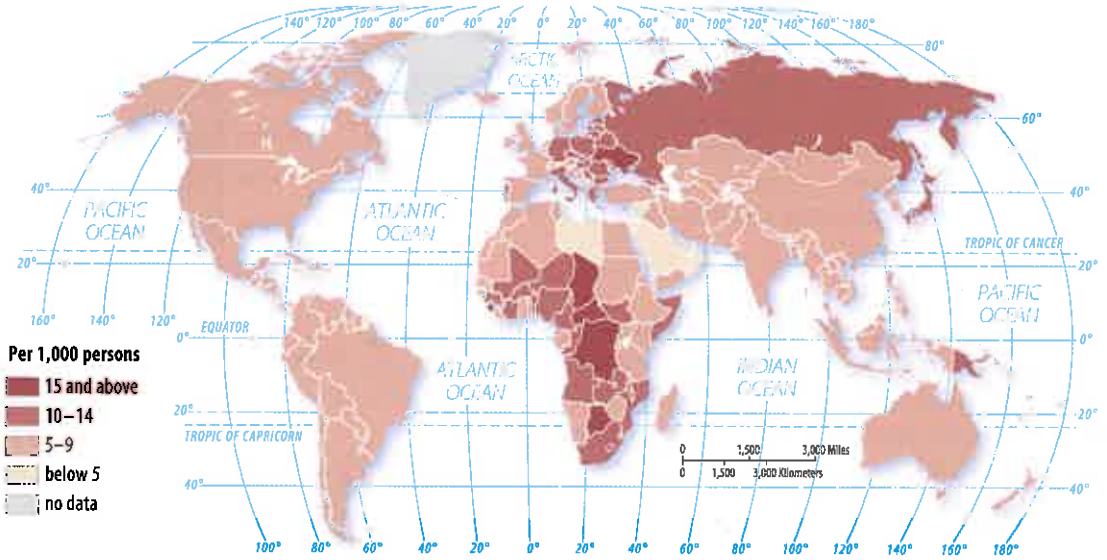
MORTALITY

The **crude death rate (CDR)** is the total number of deaths in a year for every 1,000 people alive in the society. Comparable to the CBR, the CDR is expressed as the annual number of deaths per 1,000 population.

The CDR does not follow the same regional pattern as the NIR and CBR (Figure 2-15). The combined CDR for all developing countries is actually lower than the combined rate for all developed countries. Furthermore, the variation between the world's highest and lowest CDRs is much less extreme than the variation in CBRs. The highest CDR in the world is 21 per 1,000, and the lowest is 1—a difference of 20—whereas CBRs for individual countries range from 6 per 1,000 to 50, a spread of 44.



▶ **FIGURE 2-14 CRUDE BIRTH RATE (CBR)** The global distribution of CBRs parallels that of NIRs. The countries with the highest CBRs are concentrated in Africa and Southwest Asia.



▶ **FIGURE 2-15 CRUDE DEATH RATE (CDR)** The global pattern of CDRs varies from those for the other demographic variables already mapped in this chapter. The demographic transition helps to explain the distinctive distribution of CDRs.

PAUSE & REFLECT 2.2.2

What region of the world appears to have the lowest CDR?

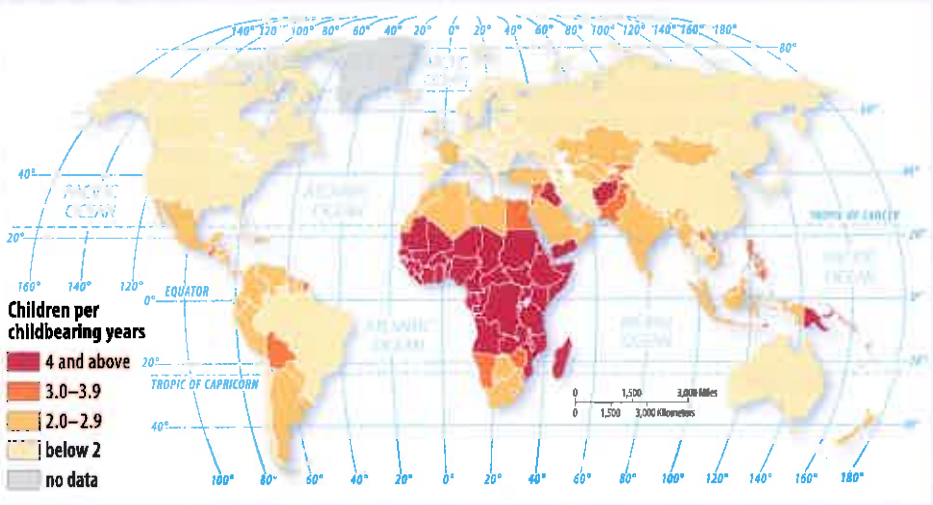
Why does Denmark, one of the world's wealthiest countries, have around the same CDR as The Gambia, one of the poorest? Why does the United States, with its extensive system of hospitals and physicians, have a higher CDR than Mexico and nearly every other country in Latin America? The answer is that the populations of different countries are at various stages in an important process known as the demographic transition, discussed in the next section.

DOING GEOGRAPHY The Future Population of the World

The scientific study of population characteristics is **demography**. Demographers look statistically at how people are distributed spatially by age, gender, occupation, fertility, health, and so on. Geographers are part of the team at organizations that do demographic studies, such as the Population Reference Bureau, the U.S. Bureau of the Census, and the United Nations Population Division.

Demographers can tell us with some precision the current population of the world and of particular places, as well as population in the recent past. Forecasting the future population is much more challenging for demographers, but we need these estimates in order to plan for the future.

Geographers use the **total fertility rate (TFR)** to measure the number of births in a society (Figure 2-16). The TFR is the average number of children a woman will have throughout her childbearing years (roughly ages 15 through 49). To compute the TFR, demographers assume that a woman reaching a particular age in the future will be just as likely to have a child as are women of that age today. Thus, the CBR provides a picture of a society as a whole in a given year, whereas the TFR attempts to predict the future behavior of individual women in a world of rapid cultural change.



▲ **FIGURE 2-16 TOTAL FERTILITY RATE (TFR)** As with NIRs and CBRs, the countries with the highest TFRs are concentrated in Africa and Southwest Asia.

The TFR for the world as a whole is 2.5, and, again, the figures vary between developed and developing countries. The TFR exceeds 5.0 in sub-Saharan Africa, compared to 2 or less in nearly all European countries.

What's Your Population Geography?

The size of the world's future population ultimately depends on decisions made by people of childbearing age concerning the number of children they will have.

1. What is the TFR of your mother? How does that figure compare with those for your grandmothers?
2. How many children do you expect to have? Is that number more, less, or the same as your mother? How confident are you in your answer? What factors make you feel confident or unsure of your answer?
3. Compare your answers with others in your class or with your friends. Calculate the mean response for your group by totaling all the individual answers and dividing by the number of respondents. Compute the TFR separately for the men and the women. Do the figures differ? If so, what might account for the difference?
4. The TFR in the United States is currently 1.9. How does the TFR of your classmates or friends compare with the overall U.S. figure?
5. Demographers explain that a TFR of 2.1 is needed to maintain the same size of population. A TFR of 1.9, as in the United States, means that the number of births is not sufficient to maintain the current size of the U.S. population. Yet the U.S. population is actually increasing by 0.4 percent per year. What accounts for the increasing population, if not the number of births?

The Demographic Transition

LEARNING OUTCOME 2.2.3

Describe the stages of the demographic transition.

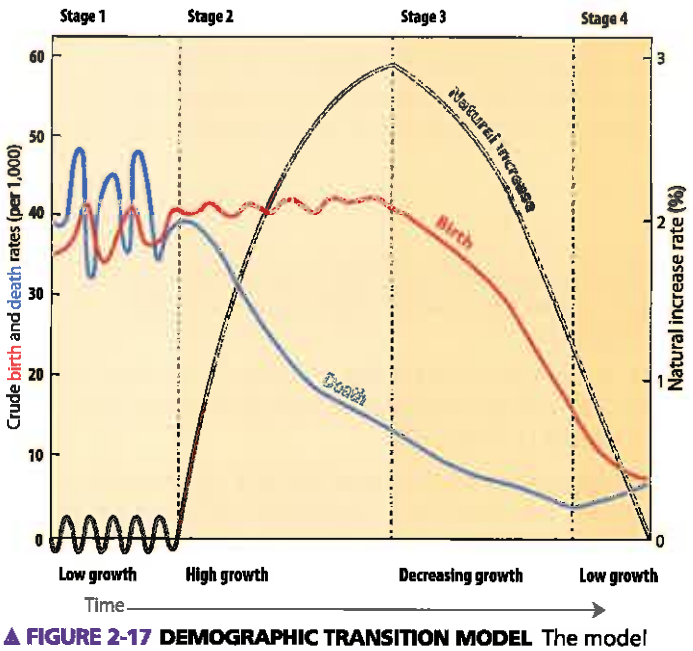
All countries have experienced some changes in NIR, CBR, and CDR, but at different times and at different rates. The demographic transition helps us understand these differences. The **demographic transition** is a process of change in a society's population from high crude birth and death rates and low rate of natural increase to a condition of low crude birth and death rates, low rate of natural increase, and higher total population.

Authoritative demographic sources, such as the Population Reference Bureau, World Bank, and United Nations, currently consider the demographic transition to consist of four stages, (Figure 2-17). As discussed later in this chapter, some demographers expect a stage 5.

STAGE 1: LOW GROWTH

- **Very high CBR**
- **Very high CDR**
- **Very low NIR**

Most of human history was spent in stage 1 of the demographic transition, but today no country remains in stage 1. Every nation has moved on to at least stage 2 of the demographic transition, and, with that transition, has experienced profound changes in population. For most of this period, people depended on hunting and gathering for food (see Chapter 10). When food was easily obtained, a region's population increased; the population declined when people were unable to locate enough animals or vegetation nearby.



▲ **FIGURE 2-17 DEMOGRAPHIC TRANSITION MODEL** The model consists of four stages. A possible fifth stage is discussed in the section on Population Futures.

STAGE 2: HIGH GROWTH

- **High CBR**
- **Rapidly declining CDR**
- **Very high NIR**

Rapidly declining death rates and very high birth rates produce very high natural increase. Europe and North America entered stage 2 of the demographic transition after 1750, as a result of the **Industrial Revolution**, which involved major improvements in manufacturing goods and delivering them to market (see Chapter 11). The result of this transformation was an unprecedented level of wealth, some of which was used to make communities healthier places to live.

Stage 2 of the demographic transition did not diffuse to Africa, Asia, and Latin America until around 1950, and it made that transition for a different reason than in Europe and North America 200 years earlier. The late-twentieth-century push of developing countries into stage 2 was caused by the **medical revolution**. Medical technology invented in Europe and North America has diffused to developing countries. Improved medical practices have eliminated many of the traditional causes of death in developing countries and enabled more people to experience longer and healthier lives.

An example of a country in stage 2 is The Gambia, one of Africa's smallest and poorest countries. As a colony of the United Kingdom until 1965, The Gambia was in stage 1 of the demographic transition. The World Health Organization launched a program during the 1970s to immunize children in a number of countries, including The Gambia. This sent The Gambia into stage 2 because the CDR declined rapidly, whereas the CBR remained high, thus raising the NIR (Figure 2-18a).

STAGE 3: MODERATE GROWTH

- **Rapidly declining CBR**
- **Moderately declining CDR**
- **Moderate NIR**

A country moves from stage 2 to stage 3 of the demographic transition when the CBR begins to drop sharply. The CDR continues to fall in stage 3 but at a much slower rate than in stage 2. The population continues to grow because the CBR is still greater than the CDR. But the rate of natural increase is more modest in countries in stage 3 than in those in stage 2 because the gap between the CBR and the CDR narrows.

A society enters stage 3 when people have fewer children. The decision to have fewer children is partly a delayed reaction to a decline in mortality. Economic changes in stage 3 societies also induce people to have fewer offspring. People in stage 3 societies are more likely to live in cities than in the countryside and to work in offices, shops, or factories rather than on farms. Farmers often consider a large family to be an asset because children can do some of the chores. Urban homes are relatively small and may not have space to accommodate large families.

Most countries in Europe and North America (including the United States) moved from stage 2 to stage 3 of the demographic transition during the first half of the

twentieth century. The movement took place during the second half of the twentieth century in many countries of Asia and Latin America, including Mexico.

Colonial Mexico was in stage 1 of the demographic transition. Mexico entered stage 2 of the demographic transition during the twentieth century, through a combination of a lower CDR and a higher CBR (Figure 2-18b). The government of Mexico believed that higher birth rates would be good for the country's economic growth. A dramatic decline in the CBR and transition into stage 3 came after 1974, when a constitutional amendment guaranteed families the legal right to decide on the number and spacing of children, and the National Population Council was established to promote family planning through education.

STAGE 4: LOW GROWTH

- **Very low CBR**
- **Low or slightly increasing CDR**
- **Zero or negative NIR**

A country reaches stage 4 of the demographic transition when the CBR declines to the point where it equals the CDR and the NIR approaches zero. This condition is called **zero population growth (ZPG)**, a term often applied to stage 4 countries.

ZPG may occur when the CBR is still slightly higher than the CDR because some females die before reaching childbearing years, and the number of females in their childbearing years can vary. To account for these discrepancies, demographers more precisely define ZPG as the TFR that results in a lack of change in the total population over a long term. A TFR of approximately 2.1 produces ZPG.

Social customs again explain the movement to stage 4. Increasingly, women in stage 4 societies enter the labor force rather than remain at home as full-time homemakers. People who have access to a wider variety of birth-control methods are more likely to use some of them.

Denmark, like most other European countries, has reached stage 4 of the demographic transition (Figure 2-18c). Denmark's CDR has actually increased somewhat in recent years because of the increasing percentage of elderly people. The CDR is unlikely to decline unless another medical revolution, such as a cure for cancer, keeps elderly people alive much longer.

PAUSE & REFLECT 2.2.3

Name a country in Latin America that appears to be in stage 2, according to Figures 2-12, 2-14, and 2-15.

A country that has reached stage 4 of the demographic transition has in some ways completed a cycle—from little or no natural increase in stage 1 to little or no natural increase in stage 4. Two crucial demographic differences underlie this process:

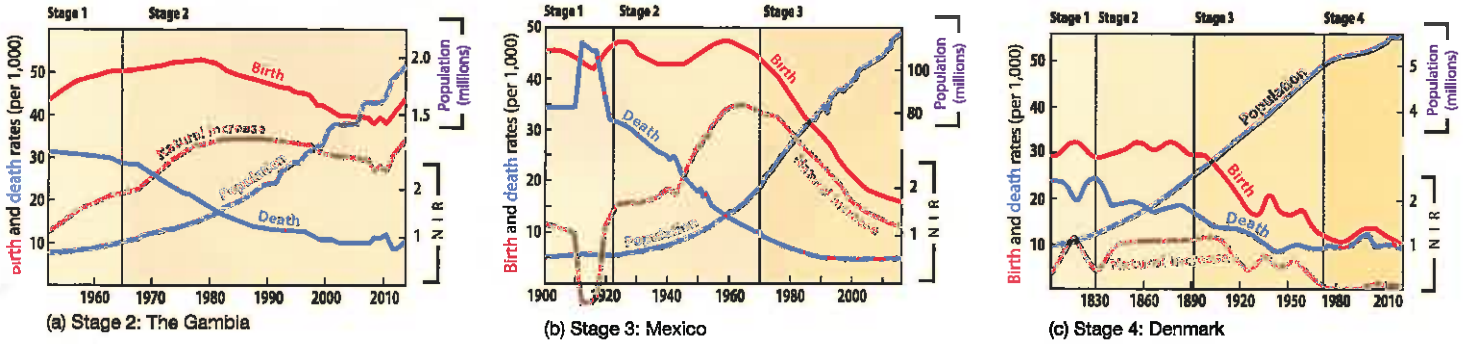
- **Total population.** The total population of the country is much higher in stage 4 than in stage 1.
- **CBR and CDR.** At the beginning of the demographic transition, the CBRs and CDRs are high (35 to 40 per 1,000), whereas at the end of the process, the rates are very low (approximately 10 per 1,000).

The four-stage demographic transition is characterized by two big breaks with the past. The first break—the sudden drop in the death rate that comes from technological innovation—has been accomplished everywhere. The second break—the sudden drop in the birth rate that comes from changing social customs—has yet to be achieved in many countries.

CHECK-IN KEY ISSUE 2

Why is World Population Increasing?

- ✔ **The NIR measures population growth as the difference between births and deaths.**
- ✔ **The crude birth rate and crude death rate are the principal measures of population change in a society as a whole.**
- ✔ **The demographic transition has four stages, characterized by varying rates of births, deaths, and natural increase.**



(a) Stage 2: The Gambia (b) Stage 3: Mexico (c) Stage 4: Denmark

▲ **FIGURE 2-18 DEMOGRAPHIC TRANSITION FOR THREE COUNTRIES** **(a)** Stage 2: The Gambia, **(b)** Stage 3: Mexico, **(c)** Stage 4: Denmark.

KEY ISSUE 3

Why Do Some Places Face Health Challenges?

- Health and Gender
- Health and Aging
- Medical Services
- The Epidemiologic Transition

As world NIR slows and more countries move into stage 3 or 4 of the demographic transition, geographers increasingly turn their attention to the health of the record number of people who are alive. Countries in different stages of the demographic transition possess different resources to meet the needs of women, children, elderly people, and those with medical needs.

Health and Gender

LEARNING OUTCOME 2.3.1

Understand reasons for varying sex ratios and for reduced birth rates.

Females face especially challenging health risks that profoundly affect the size and composition of the population of individual countries and the world as a whole. These health risks derive from the biological fact of being born female. The risk for females is especially acute at childbirth. Both the mother and the baby girl are at risk.

BABY GIRLS AT RISK

Around 700,000 female babies are "missing" every year in China and India, as a result of gender-based selection. The United Nations Population Fund estimates that overall 117 million females have gone "missing" throughout Asia over the past several decades. The females are "missing" either because th fetus was aborted before birth, the female baby was killed in infancy, or the newborn female was whisked away to somewhere remote and not reported to census and health officials.

We know about the large number of "missing" females because of the **sex ratio**, which is the number of males per 100 females in the population. The standard biological level for humans at birth is around 105 male babies for every 100 female babies. Scientists are not sure why a few more males than females are born.

The standard biological ratio at birth of 105:100 (105 males to 100 females) is characteristic of the developed regions of North America and Europe, as well as in the developing regions of Latin America and sub-Saharan Africa (Figure 2-19). However, in the world's two most populous countries—China and India—the sex ratio at birth is 112:100 (112 males to 100 females). The percentage of newborn females in the world's two most populous countries is much too low to be random (Figure 2-20).

The extremely low percentage of female babies in China and India results from cultural preference on the part of parents to have sons rather than daughters. Government policies in these two countries to promote smaller families have encouraged parents to bring into life male babies rather than female babies. Access to ultrasound machines has enabled parents to know the sex of the fetus, and access to medical procedures has enabled them to abort unwanted female fetuses.

The governments of China and India have attempted to prohibit the use of technology and medical procedures. But the bans are ineffective because people instead seek out unregulated providers of these services. The United Nations concludes that a more effective approach is to address what it calls the "root cause" of sex selection—gender inequality. Many Chinese and Indians conclude that if they are going to have a small number of children, they want them to be boys.

Aside from the ethical question, the widespread practice of sex selection in China and India is creating a practical

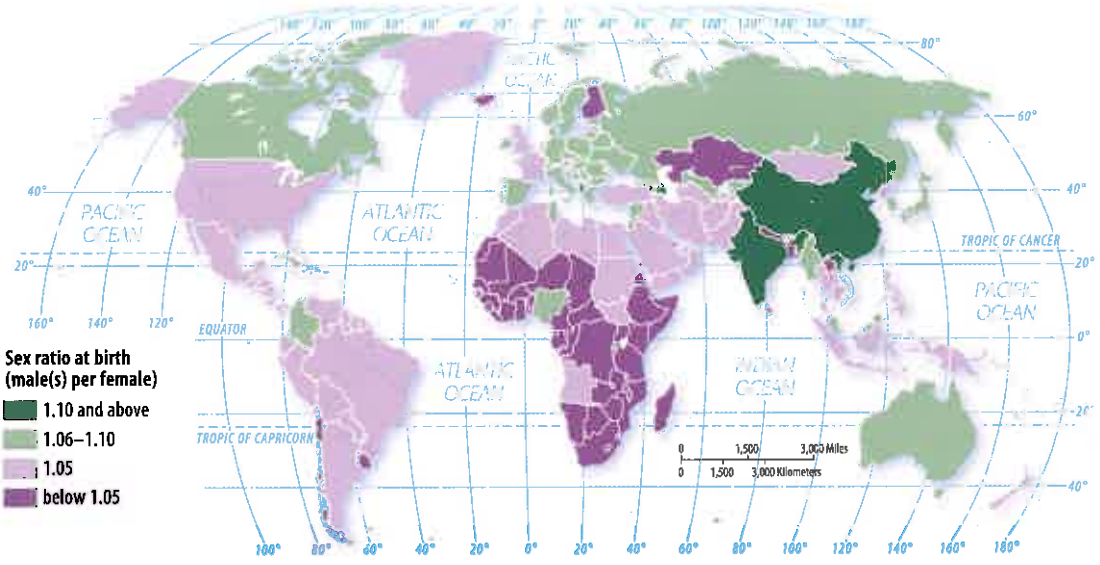
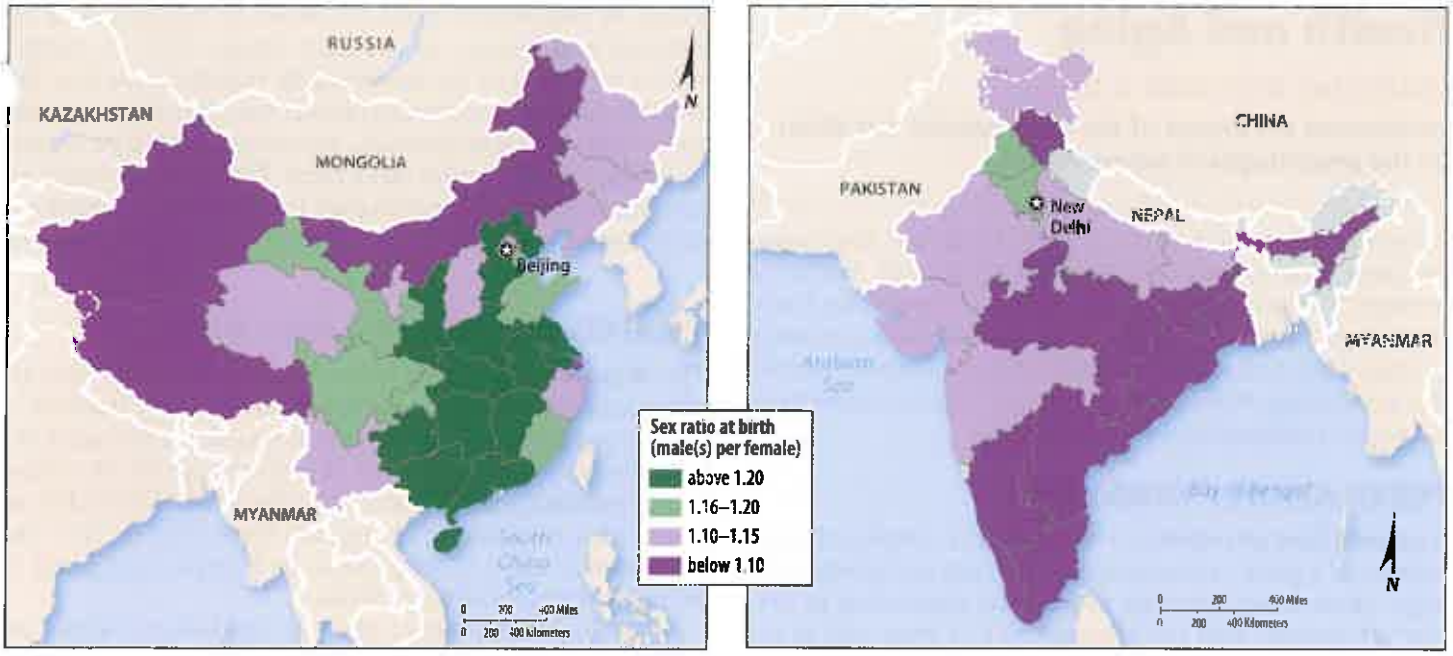


FIGURE 2-19 SEX RATIO AT BIRTH The standard biological ratio is 105:100—that is, 105 male babies for 100 female babies.



(a) China (b) India

▲ **FIGURE 2-20 SEX RATIO AT BIRTH, CHINA AND INDIA** The sex ratio, which is 112:100 in the two countries as a whole, is considerably higher in some regions, especially rural areas.

problem for society. As the babies grow to adulthood, these countries are left with an enormous surplus of men who are unable to find women to marry.

PAUSE & REFLECT 2.3.1

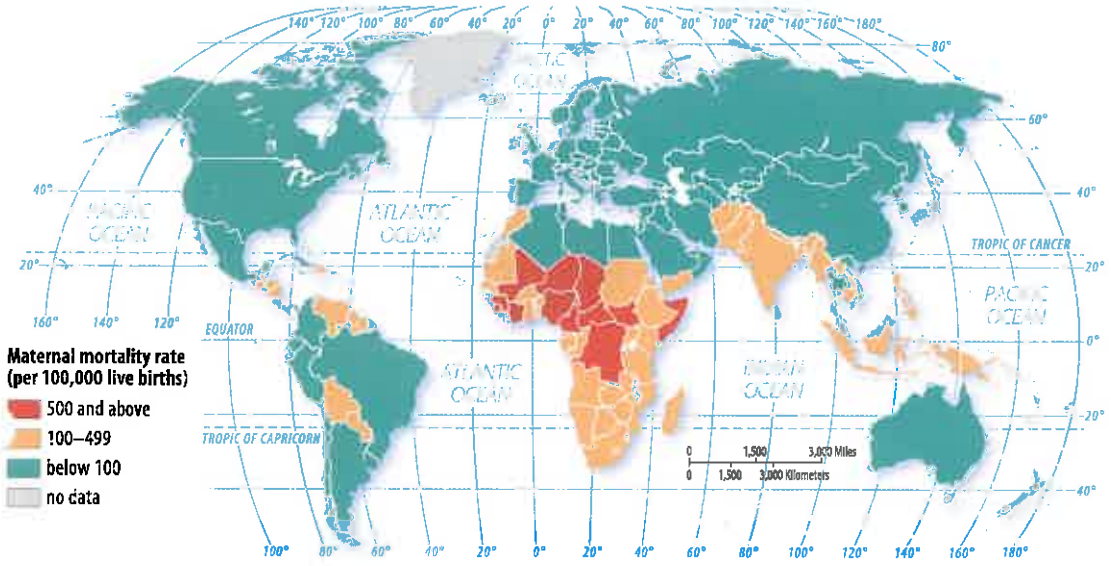
What other countries, in addition to China and India, appear to have "missing" females?

MOTHERS AT RISK

The **maternal mortality rate** is the annual number of female deaths per 100,000 live births from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes). The rate exceeds 100 deaths per 100,000 mothers (in other words, 1 percent) in much of Africa and Asia, compared to fewer than 10 (0.1 percent) in most European countries (Figure 2-21).

According to the United Nations, the most common cause of maternal death in poor countries is obstetrical hemorrhage, followed by hypertensive disorders of pregnancy. Developed countries have medical facilities, advanced technologies, and trained personnel to limit the incidence of life-threatening conditions during childbirth.

The maternal mortality rate in the United States (28) is higher than in other developed countries. The higher rate is attributable to difficulties faced by low-income people in the United States in gaining access to health care. In addition, the United States is one of the few countries that do not mandate paid leave for mothers of newborn infants.



◀ **FIGURE 2-21 MATERNAL MORTALITY RATE** The rate exceeds 100 deaths per 100,000 mothers (in other words, 1 percent) in much of Africa and Asia, compared to fewer than 10 (0.1 percent) in most European countries.

Health and Aging

LEARNING OUTCOME 2.3.2

Understand the impact of the demographic transition on the percentages of young and old.

A country's stage of the demographic transition determines the percentage of people in different age groups. A country in stage 2 of the demographic transition typically has a relatively high percentage of young people, whereas a country in stage 4 has a relatively high percentage of elderly people. The percentage of different age groups helps to understand a country's distinctive health challenges.

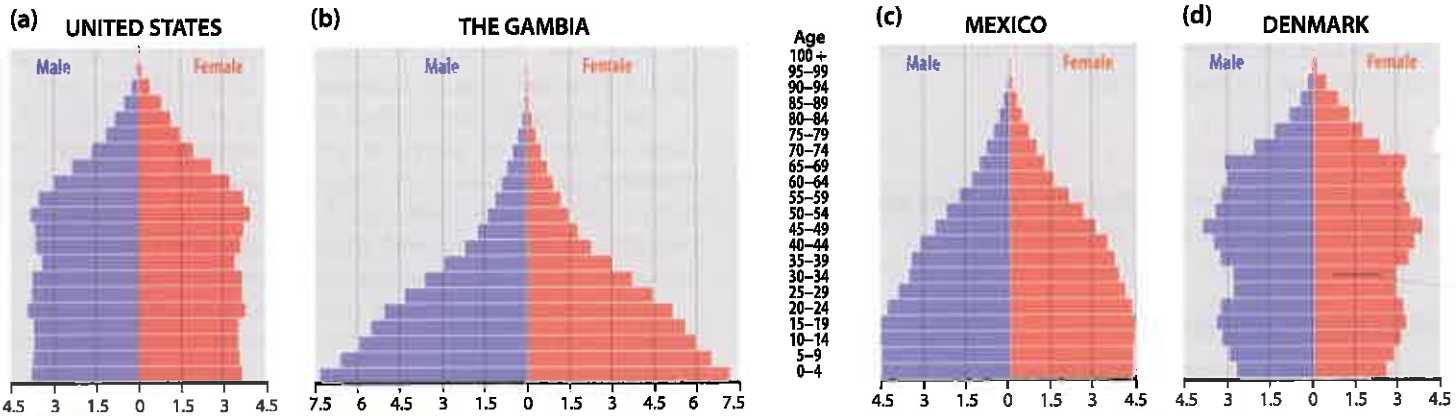
POPULATION PYRAMIDS

A **population pyramid** is a bar graph that displays the percentage of a place's population for each age and gender. The graph shows the percentage of the total population in five-year age groups, with the youngest (0 to 4 years old) at the base and the oldest at the top. The length of the bar represents the percentage of the total population contained in that group. By convention, males are shown on the left side of the pyramid and females on the right (Figure 2-22). A country that is in stage 2 of the demographic transition, such as Th Gambia, has a pyramid with a broader base than that of a country in stage 4, such as Denmark, indicating a higher percentage of young people. On the other hand, Denmark's pyramid extends farther to the right than does The Gambia's, evidence of a higher percentage of women in Denmark than in The Gambia.

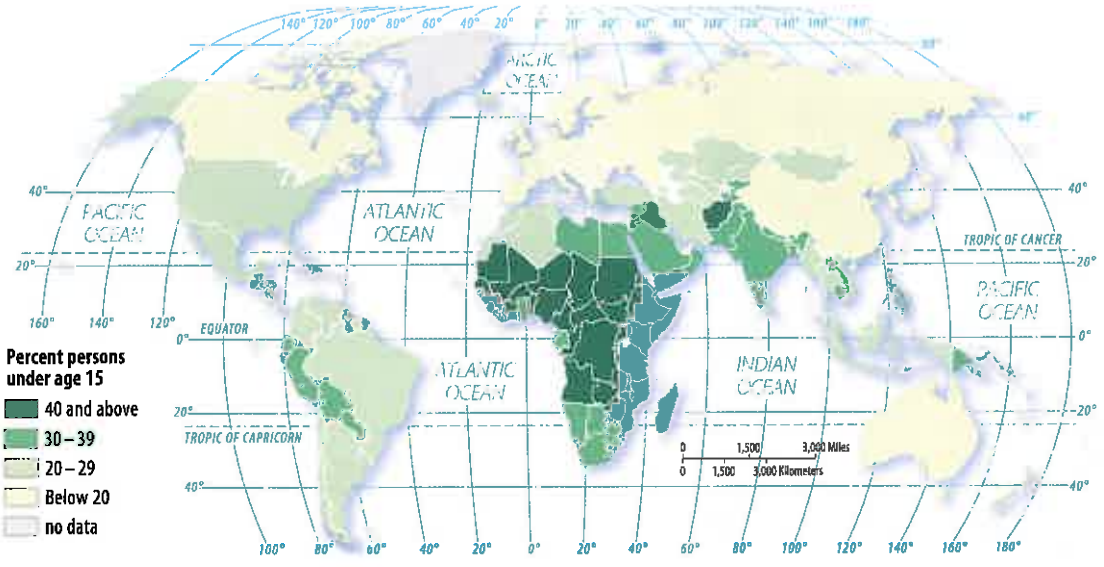
CARING FOR YOUNG AND OLD

The **dependency ratio** is the number of people who are too young or too old to work, compared to the number of people in their productive years. Dependents are normally classified as people under age 15 and over age 65. The larger the dependency ratio, the greater the financial burden on those who are working to support those who do not. The dependency ratio is 47 percent in Europe, compared to 85 percent in sub-Saharan Africa.

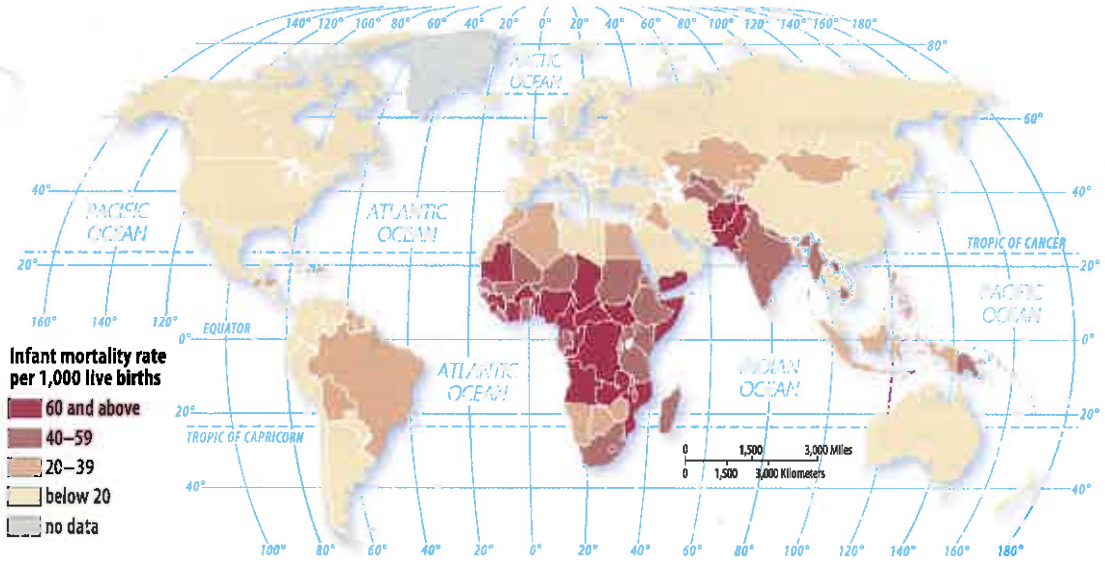
The high dependency ratio in sub-Saharan Africa derives from having a very high percentage of young people (Figure 2-23). Young dependents outnumber elderly ones



▲ **FIGURE 2-22 POPULATION PYRAMIDS FOR FOUR COUNTRIES** **(a)** United States, **(b)** The Gambia, **(c)** Mexico, **(d)** Denmark.



▶ **FIGURE 2-23 POPULATION UNDER AGE 15** Sub-Saharan Africa has the highest percentage of persons under age 15.



◀ **FIGURE 2-24 INFANT MORTALITY RATE (IMR)** The highest IMRs are in sub-Saharan Africa, and the lowest are in Europe.

by more than 14:1 in sub-Saharan Africa, whereas the numbers of people under 15 and over 65 are roughly equal in Europe. The large percentage of children in sub-Saharan Africa strains the ability of these relatively poor countries to provide needed services such as schools, hospitals, and day-care centers. When children reach the age of leaving school, jobs must be found for them, but the government must continue to allocate scarce resources to meet the needs of the still growing number of young people. On the other hand, the "graying" of the population places a burden on developed countries to meet their needs for income and medical care after they retire from jobs.

The **infant mortality rate (IMR)** is the annual number of deaths of infants under 1 year of age, compared with total live births (Figure 2-24). As is the case with the CBR and CDR, the IMR is usually expressed as the number of deaths among infants per 1,000 births rather than as a percentage (per 100). In general, the IMR reflects a country's health-care system.

The global distribution of IMRs follows the pattern that by now has become familiar. Lower IMRs are found in countries with well-trained doctors and nurses, modern hospitals, and large supplies of medicine. The IMR is 4 in European countries in stage 4, compared with 64 in sub-Saharan Africa. In other words, before reaching their first birthday, 1 in 15 babies die in sub-Saharan Africa and 1 in 250 babies die in Europe.

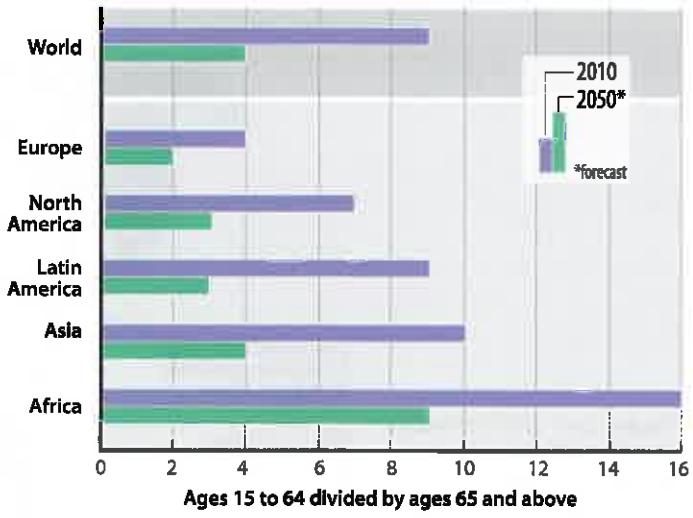
Even if they survive infancy, children remain at risk in developing countries. For example, 17 percent of children in developing countries are not immunized against measles, compared to 7 percent in developed countries. More than one-fourth of children lack measles immunization in South Asia and sub-Saharan Africa.

As countries pass through the demographic transition, hey face increasing percentages of older people, who must receive adequate levels of income and medical care after they retire from their jobs. The "graying" of the population places a burden on governments in developed countries to meet these needs. The **elderly support ratio** is the number of working-age people (ages 15 to 64) divided by the number of persons 65 and older (Figure 2-25).

PAUSE & REFLECT 2.3.2

If the elderly support ratio is declining, does that mean the percentage of elderly people is increasing or decreasing?

The world's elderly support ratio is currently around 9, meaning that there are 9 people of working age for every elderly person. In 2050, the ratio is expected to decline to around 4, meaning that there will be only 4 people of working age available to support elderly people who have retired from work. Thus, as the ratio gets smaller, fewer workers are available to contribute to pensions, health care, and other support that older people need.



▲ **FIGURE 2-25 ELDERLY SUPPORT RATIO** A smaller number means that fewer workers are available to support elderly people.

Medical Services

LEARNING OUTCOME 2.3.3

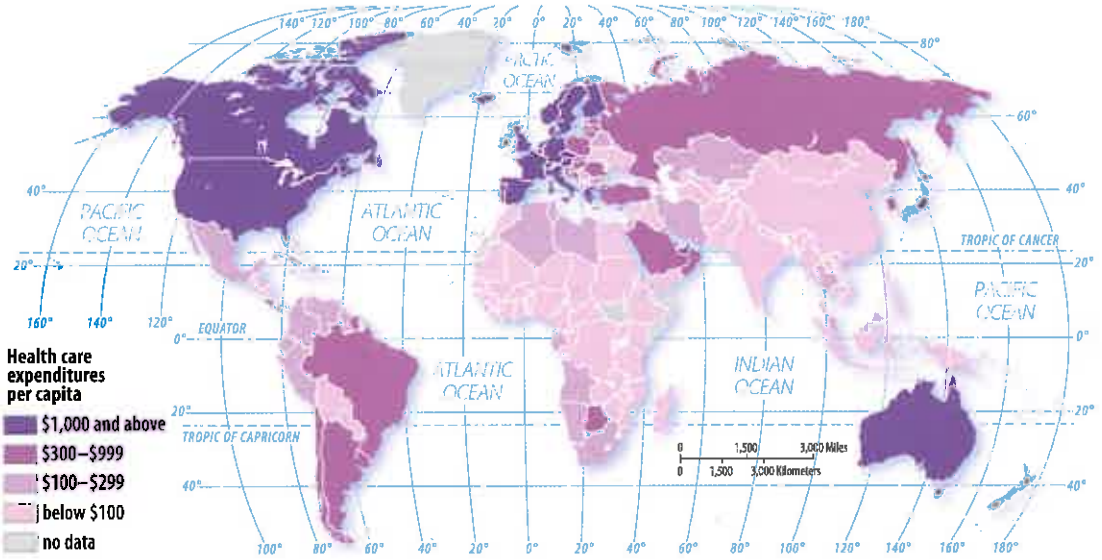
Understand variations in health-care services between developed and developing countries.

Health conditions vary around the world. Countries possess different resources to care for people who are sick.

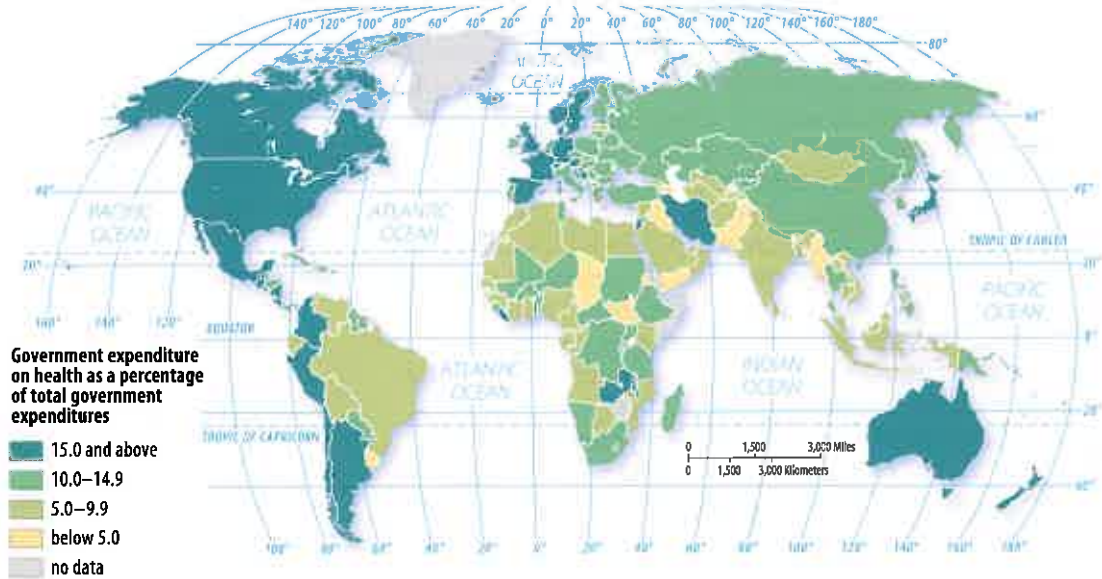
HEALTH CARE

Developed countries use part of their wealth to protect people who, for various reasons, are unable to work. In these countries, some public assistance is offered to those who are sick, elderly, poor, disabled, orphaned, veterans of wars, widows, unemployed, or single parents. Annual per capita expenditure on health care exceeds $1,000 in Europe and $5,000 in the United States, compared to less than $100 in sub-Saharan Africa and South Asia (Figure 2-26).

Expenditures on health care exceeds 15 percent of total government expenditures in Europe and North America compared to less than 5 percent in sub-Saharan Africa and South Asia (Figure 2-27). Countries in northwestern Europe, including Denmark, Norway, and Sweden, typically provide the highest level of public-assistance payments. So not only do developed countries spend more on health care, they spend a higher percentage of their wealth on health care.



▶ **FIGURE 2-26 HEALTH-CARE EXPENDITURES** The lowest levels of per capita health-care expenditures are in sub-Saharan Africa and South Asia.



▶ **FIGURE 2-27 GOVERNMENT EXPENDITURES ON HEALTH CARE** The lowest levels of government support for health care are in sub-Saharan Africa and South Asia.

MEDICAL FACILITIES

The high expenditure on health care in developed countries is reflected in medical facilities. Most countries in Europe have more than 50 hospital beds per 10,000 people, compared to fewer than 20 in sub-Saharan Africa and South and Southwest Asia (Figure 2-28). Europe has more than 30 physicians per 10,000 population, compared to fewer than 5 in sub-Saharan Africa (Figure 2-29).

In most developed countries, health care is a public service that is available at little or no cost. Government programs pay more than 70 percent of health-care costs in most European countries, and private individuals pay less than 30 percent. In developing countries, private individuals must pay more than half of the cost of health care. An exception to this pattern is the United States, a developed country where private individuals are required to pay an average of 55 percent of health care, more closely resembling the pattern in developing countries.

PAUSE & REFLECT 2.3.3

Why might levels of hospital beds and physicians in developed countries of Europe be higher than in North America?

Developed countries are hard-pressed to maintain their current levels of public assistance. In the past, rapid economic growth permitted these states to finance generous programs with little difficulty. But in recent years economic growth has slowed, while the percentage of people needing public assistance has increased. Governments have faced a choice between reducing benefits and increasing taxes to pay for them. In some of the poorest countries, threats to health and sustainability are not so much financial as environmental.

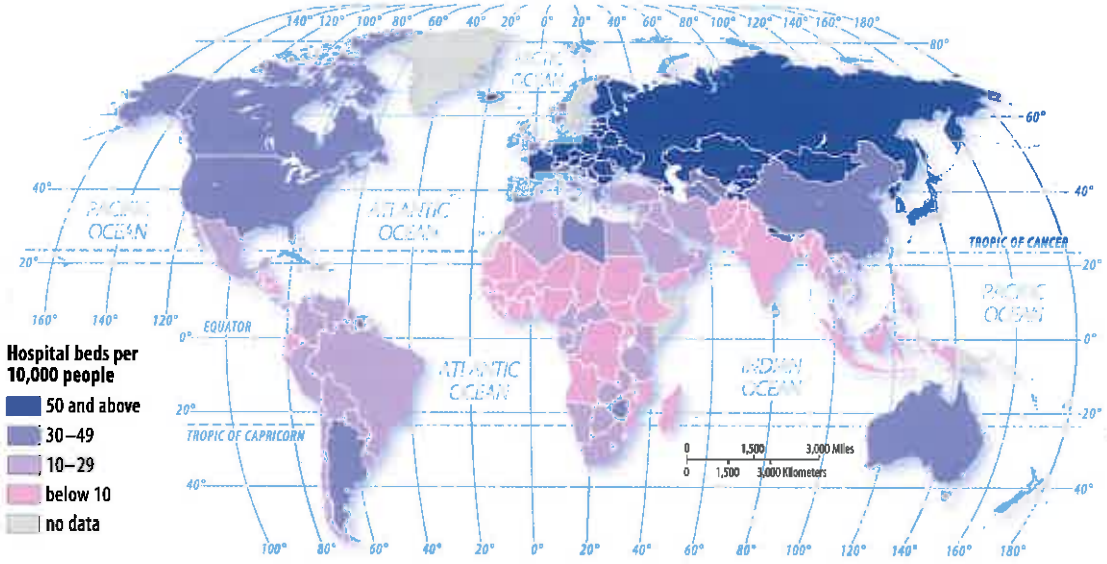


FIGURE 2-28 HOSPITAL BEDS PER 10,000 PEOPLE The lowest numbers of available beds are in sub-Saharan Africa and South Asia.

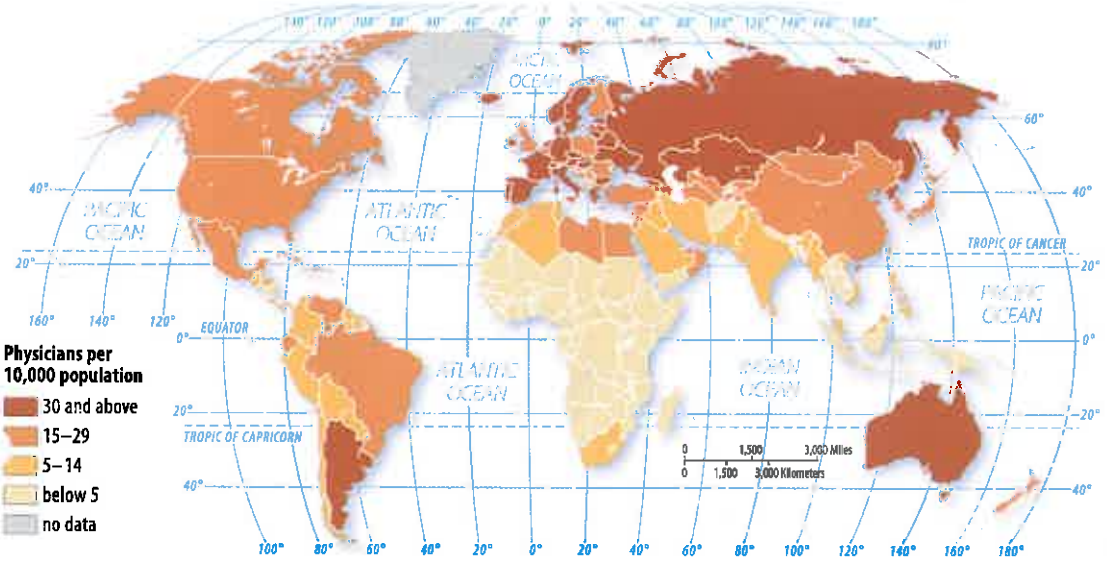


FIGURE 2-29 PHYSICIANS PER 10,000 PEOPLE The fewest available doctors are in sub-Saharan Africa.

The Epidemiologic Transition

LEARNING OUTCOME 2.3.4

Summarize the four stages of the epidemiologic transition.

Epidemiology is the branch of medical science concerned with the incidence, distribution, and control of diseases that are prevalent among a population at a particular time and are produced by some special causes not generally present in the affected place.

The **epidemiologic transition** focuses on distinctive health threats in each stage of the demographic transition. Epidemiologists rely heavily on geographic concepts such as scale and connection because measures to control and prevent an epidemic derive from understanding its distinctive distribution and method of diffusion. The concept was originally formulated by epidemiologist Abdel Omran in 1971.

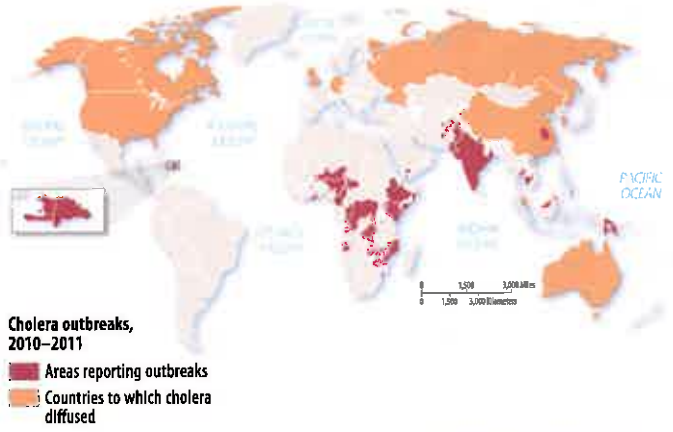
STAGE 1: PESTILENCE AND FAMINE

In stage 1 of the epidemiologic transition, infectious and parasitic diseases were principal causes of human deaths, along with accidents and attacks by animals and other humans. Thomas Malthus called these causes of deaths "natural checks" on the growth of the human population in stage 1 of the demographic transition.

History's most violent stage 1 epidemic was the Black Plague (bubonic plague), which was probably transmitted to humans by fleas from migrating infected rats. About 25 million Europeans—at least one-half of the continent's population—died between 1347 and 1350.

STAGE 2: RECEDING PANDEMICS

A **pandemic** is disease that occurs over a wide geographic area and affects a very high proportion of the population. Stage 2 of the epidemiologic transition is the stage of receding pandemics because improved sanitation, nutrition, and medicine during the Industrial Revolution reduced the spread of infectious diseases.



▲ **FIGURE 2-30 STAGE 2 DISEASE: CHOLERA** Countries reporting cholera in recent years are found primarily in sub-Saharan Africa and South Asia.

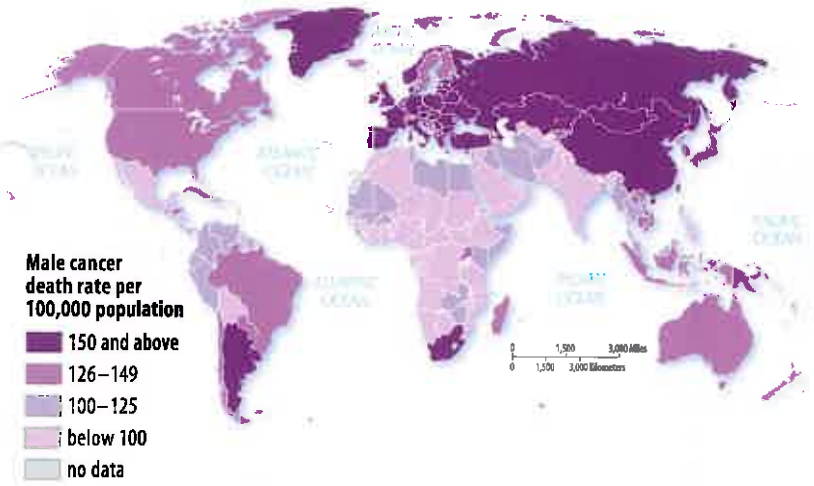
Death rates did not decline immediately and universally during the early years of the Industrial Revolution. Poor people crowded into rapidly growing industrial cities had especially high death rates. Cholera, which was uncommon in rural areas, became an especially virulent epidemic in urban areas during the Industrial Revolution. Construction of water and sewer systems had eradicated cholera in Europe and North America by the late nineteenth century.

Cholera persists in several developing regions in stage 2 of the demographic transition, especially sub-Saharan Africa and South and Southeast Asia, where many people lack access to clean drinking water (Figure 2-30). Cholera has also been found on Hispaniola, the island shared by Haiti and the Dominican Republic, especially in the wake of an earthquake in 2010 that killed 200,000 and displaced 1 million.

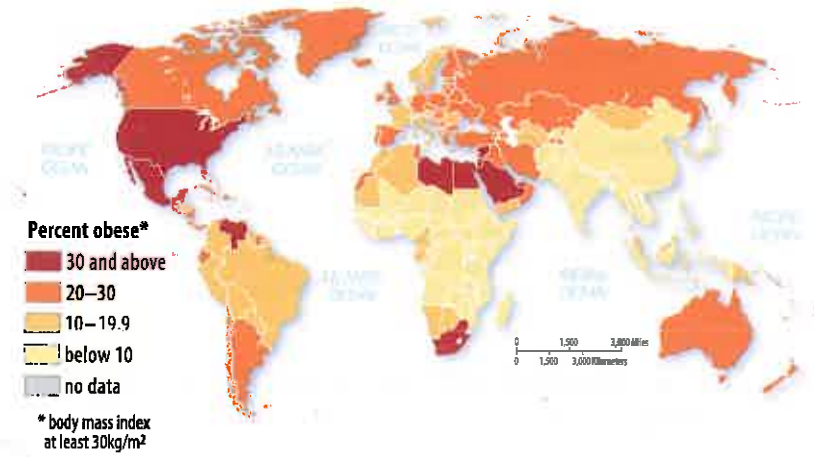
A century before the invention of computers, a mapping technique that anticipated geographic information systems (GIS) helped to explain and battle the stage 2 pandemic of cholera in nineteenth-century London. To understand cholera, Dr. John Snow (1813–1858), a British physician (not a geographer) created a handmade GIS in 1854. On a map of London's Soho neighborhood, Snow overlaid two other maps, one showing the addresses of cholera victims and the other the locations of water pumps—which for the poor residents of Soho were the principal source of water for drinking, cleaning, and cooking (Figure 2-31).

The overlay maps showed that cholera victims were not distributed uniformly through Soho. Rather, they were clustered around one pump on Broad Street. Tests at the Broad Street pump subsequently proved that the water there was contaminated. Further investigation revealed that contaminated sewage was getting into the water supply near the pump.

▲ **FIGURE 2-31 SIR JOHN SNOW'S CHOLERA MAP** Snow's map of the distribution of cholera victims and water pumps proved that the cause of the infection was contamination of the pump near the corner of Broad and Lexington streets.



◀ **FIGURE 2-32 STAGE 3 DISEASE: MALE CANCER** Cancer is an example of a cause of death for men that is higher in developed countries than in developing ones.



◀ **FIGURE 2-33 STAGE 4 DISEASE: OBESITY** Obesity is a health problem in the United States and in Southwest Asia & North Africa.

Before Dr. Snow's geographic analysis, many believed that epidemic victims were being punished for sinful behavior and that most victims were poor because poverty was considered a sin. Now we understand that cholera affects the poor because they are more likely to have to use contaminated water.

STAGE 3: DEGENERATIVE DISEASES

Stage 3 of the epidemiologic transition is characterized by a decrease in deaths from infectious diseases and an increase in chronic disorders associated with aging. The two especially important chronic disorders in stage 3 are cardiovascular diseases, such as heart attacks, and various forms of cancer. The global pattern of cancer is the opposite of that for stage 2 diseases; sub-Saharan Africa and South Asia have the lowest incidence of cancer, primarily because of the relatively low life expectancy in those regions (Figure 2-32).

STAGE 4: DELAYED DEGENERATIVE DISEASES

Omran's epidemiologic transition was extended by S. Jay Olshansky and Brian Ault to stage 4, the stage of delayed degenerative diseases. The major degenerative causes of death—cardiovascular diseases and cancers—linger, but the life expectancy of older people is extended through medical advances. Through medicine, cancers spread more slowly or are removed altogether. Operations such as bypasses repair deficiencies in the cardiovascular system. Also improving health are behavior changes such as better diet, reduced use of tobacco and alcohol, and exercise. On the other hand, consumption of non-nutritious food and sedentary behavior have resulted in an increase in obesity in stage 4 countries (Figure 2-33).

PAUSE & REFLECT 2.3.4

How prevalent are the stage 4 causes of death in your family?

CHECK-IN KEY ISSUE 3

Why Do Some Places Face Health Challenges?

- ✔ **Birth rates have declined in nearly all countries through a variety of family-planning approaches.**
- ✔ **The percentage of younger and older people in a country impacts its provision of health care.**
- ✔ **The provision of health care varies sharply between developed and developing countries.**
- ✔ **The epidemiologic transition has four stages of distinctive diseases.**

KEY ISSUE 4

Why Might Population Increase in the Future?

- Population and Resources
- Population Futures
- Epidemiologic Futures
- Family Futures

Geographic concepts offer insights into future population and health trends. In view of the current size of Earth's population and the NIR, will there soon be too many of us? Or will Earth's population decline in the future?

Population and Resources

LEARNING OUTCOME 2.4.1

Summarize arguments supporting and opposing Malthus's theory of the connection between population and resources.

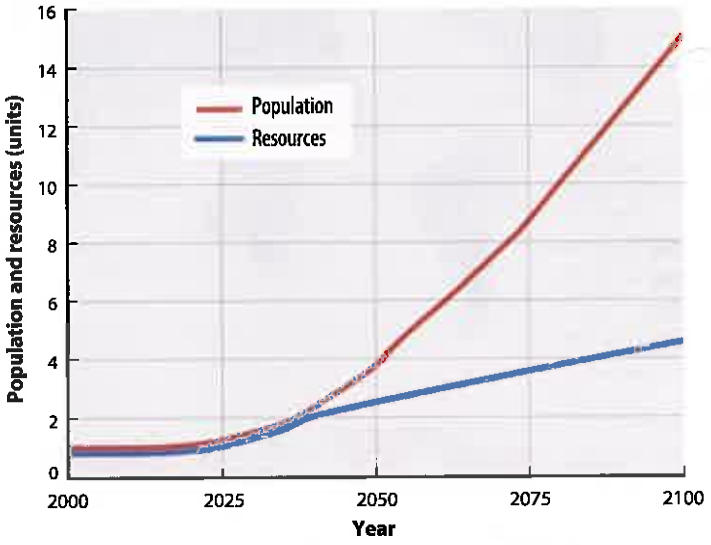
English economist Thomas Malthus (1766–1834) was one of the first to argue that the world's rate of population increase was far outrunning the development of food supplies. In *An Essay on the Principle of Population*, published in 1798, Malthus claimed that the population was growing much more rapidly than Earth's food supply because population increased geometrically, whereas food supply increased arithmetically (Figure 2-34). According to Malthus, these growth rates would produce the following relationships between people and food in the future:

Today:	1 person, 1 unit of food
25 years from now:	2 persons, 2 units of food
50 years from now:	4 persons, 3 units of food
75 years from now:	8 persons, 4 units of food
100 years from now:	16 persons, 5 units of food

Malthus stated these conclusions several decades after England had become the first country to enter stage 2 of the demographic transition, in association with the Industrial Revolution. He concluded that population growth would press against available resources in every country unless "moral restraint" produced lower CBRs or unless disease, famine, war, or other disasters produced higher CDRs.

PAUSE & REFLECT 2.4.1

Calculate the units of population and food that Malthus predicted would exist in 200 years.



▲ **FIGURE 2-34 MALTHUS'S THEORY** Malthus expected population to grow more rapidly than food supply. The graph shows that if in 2000, the population of a place were 1 unit (such as 1 billion people) and the amount of resources were 1 unit (such as 1 billion tons of grain), then according to Malthus's theory, in 2100 the place would have around 15 billion people but only 5 billion tons of grain).

CONTEMPORARY NEO-MALTHUSIANS AND CRITICS

Malthus's views remain influential today. Contempora geographers and other analysts are taking another look at Malthus's theory because of Earth's unprecedented rate of natural increase during the twentieth century. Neo-Malthusians argue that characteristics of recent population growth make Malthus's thesis even more frightening than when it was first written more than 200 years ago. Malthus's theory has been severely criticized from a variety of perspectives. Criticism has been leveled at both the population growth and resource depletion sides of Malthus's equation (see Debate It feature and Figures 2-35 and 2-36).

Evidence from the past half-century lends support to both Neo-Malthusians and their critics. Malthus was fairly close to the mark on resources but much too pessimistic on population growth.

Overall food production has increased during the past half-century somewhat more rapidly than Malthus predicted. In India, for example, rice production has followed Malthus's expectations fairly closely, but wheat production has increased twice as fast as Malthus expected (Figure 2-37). Better growing techniques, higher-yielding seeds, and cultivation of more land have contributed to the increase in the food supply (see Chapter 9). However, neo-Malthusians point out that production of both wheat and rice has slowed in India since 2000, as shown in Figure 2-37. Without new breakthroughs in food production, India might not be able to keep food supply ahead of population growth.

On the population side of the equation, recent evidence indicates that Malthus has been less accurate. His model expected population to quadruple during a half-century, but

DEBATE IT! Can Earth's resources support our growing population?

Some geographers argue that Malthus was right, and that population growth is depleting key resources. Other geographers do not accept this view.

MALTHUSIANS SAY NO

- **STAGE 2 AND DEVELOPMENT.** In Malthus's time only a few relatively wealthy countries had entered stage 2 of the demographic transition, characterized by rapid population increase. Malthus failed to anticipate that relatively poor countries would have the most rapid population growth because of transfer of medical technology (but not wealth) from developed countries. As a result, the gap between population growth and resources is wider in some countries than even Malthus anticipated.
- **RESOURCE DEPLETION.** World population growth is outstripping a wide variety of resources, not just food production. Neo-Malthusians paint a frightening picture of a world in which billions of people are engaged in a desperate search for food, water, and energy.

▲ FIGURE 2-35 **POPULATION OUTSTRIPS RESOURCES** Obtaining drinking water from a lake, Myanmar.

CRITICS OF NEO-MALTHUSIANISM SAY YES

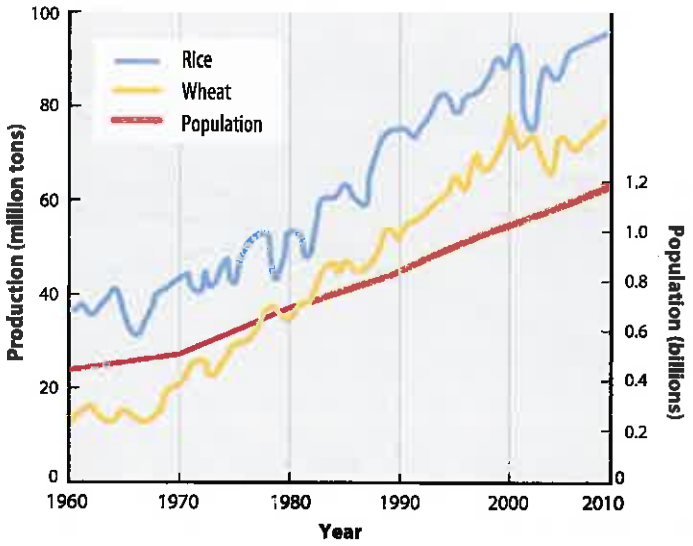
- **EXPANDING RESOURCES.** The world's overall supply of resources is actually expanding rather than fixed, as neo-Malthusians believe. While the supply of some resources is decreasing, other resources are available to replace them.
- **ECONOMIC GROWTH.** Population growth stimulates economic growth, and therefore production of more food. More consumers generate more demand for goods, which results in more jobs. More people means more brains to invent good ideas for improving life.
- **INEQUALITY.** Poverty and hunger result from an unjust society and economic inequality, not population growth. The world possesses sufficient resources to eliminate hunger and poverty, if only these resources are shared equally.

▲ FIGURE 2-36 **EXPANDING RESOURCES** Market, Mahebourg, Mauritius.

even in India—a country known for relatively rapid growth—population has increased more slowly than that, and it has also increased more slowly than the country's food supply.

On the other hand, the track toward overpopulation may already be irreversible in Africa. Rapid population growth has led to the inability of the land to sustain life in parts of the region. As the land declines in quality, more effort is needed to yield the same amount of crops. This extends the working day of women, who have the primary responsibility for growing food for their families. Women then regard having another child as a means of securing additional help in growing food.

Sub-Saharan Africa was not classified in Key Issue 1 as one of the world's population concentrations. Geographers caution that the size, density, or clustering of population in a region is not an indication of overpopulation. Instead, overpopulation is a relationship between population and a region's level of resources. The capacity of the land to sustain life derives partly from characteristics of the natural environment and partly from human actions to modify the environment through agriculture, industry, and exploitation of raw materials.



▲ FIGURE 2-37 **MALTHUS'S THEORY APPLIED TO INDIA** Production of wheat and rice has increased more rapidly than has population—the opposite of Malthus's theory in Figure 2-34.

Population Futures

LEARNING OUTCOME 2.4.2

Understand the future population of the world's most populous countries and elements of a possible stage 5 of the demographic transition.

How many people will inhabit Earth in the future? Future population depends primarily on fertility. How many babies will women in the future bear in their lifetimes? Despite the importance of this question, the answer is unknowable.

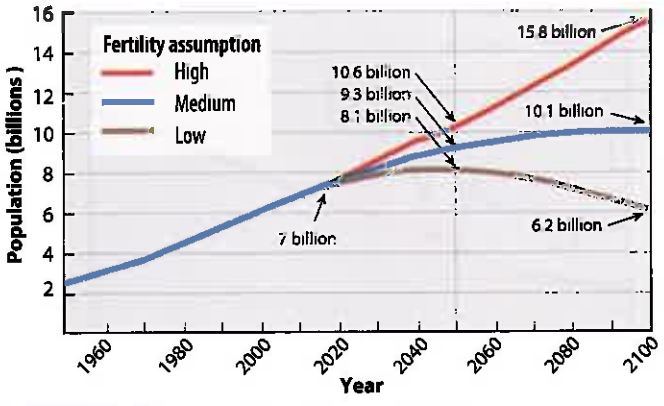
The United Nations estimates that world population in 2100 could increase to 15.8 billion or decline to 6.2 billion. If the UN's high variant is followed, world population would more than double by 2100. If the low variant is followed, world population would actually decline (Figure 2-38).

DEMOGRAPHIC TRANSITION POSSIBLE STAGE 5: DECLINE

- **Very low CBR**
- **Increasing CDR**
- **Declining NIR**

Demographers predict a possible stage 5 of the demographic transition for some developed countries. Stage 5 would be characterized by a very low CBR, an increasing CDR, and therefore a negative NIR (Figure 2-39). After several decades of very low birth rates, a stage 5 country would have relatively few young women aging into childbearing years. As those in the smaller pool of women each chooses to have fewer children, birth rates would continue to fall even more than in stage 4.

Several European countries, notably Russia and other former Communist countries, already have negative NIRs. Russia's high CDR and low CBR are a legacy of a half-century of Communist rule. The low CBR may stem from a long tradition of strong family-planning programs and a deep-seated pessimism about having children in an uncertain world. The high CDR may be a legacy of inadequate pollution controls and inaccurate reporting by the Communists.



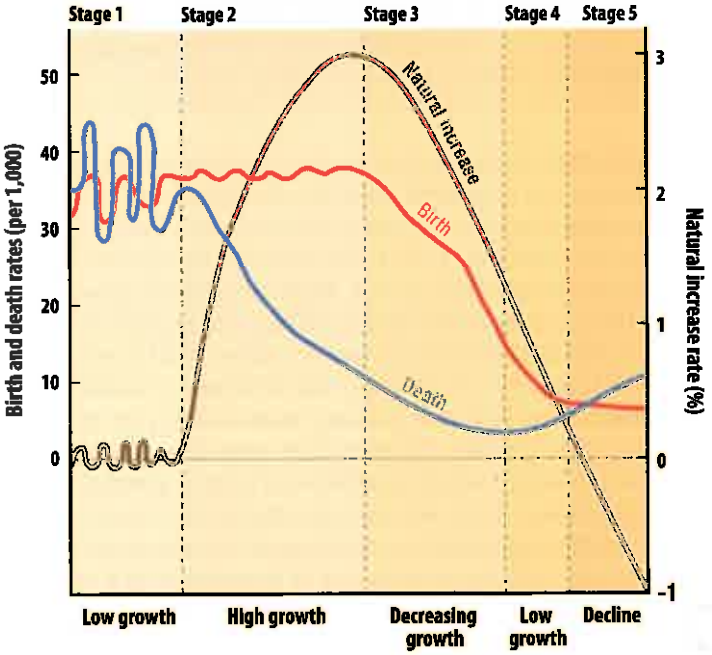
▲ **FIGURE 2-38 UNITED NATIONS ESTIMATE OF FUTURE POPULATION** The high forecast assumes that the current TFR will continue in the future, the medium forecast anticipates a modest decline in the TFR, and the low forecast assumes a sharp decline in the TFR.

CHINA AND INDIA

The world's two most populous countries, China and India, will heavily influence future prospects for global overpopulation. These two countries—together encompassing more than one-third of the world's population—have adopted different family-planning programs. As a result of less effective policies, India adds 12 million more people each year than does China. Current projections show that India could surpass China as the world's most populous country around 2030.

CHINA'S POPULATION POLICIES. China has made substantial progress in reducing its NIR. The core of the Chinese government's family-planning program has been the One Child Policy, adopted in 1980. Under the One Child Policy, a couple needed a permit to have a child. Couples received financial subsidies, a long maternity leave, better housing, and (in rural areas) more land if they agreed to have just one child. To further discourage births, people receive free contraceptives, abortions, and sterilizations. Rules were enforced by a government agency.

Largely as a result of the One Child Policy, China's CBR declined from 18 in 1980 to 12 in 2015, and consequently the NIR declined from 1.2 to 0.5. Since 2000, China has actually had a lower CBR than the United States. The number of people added to China's population each year has dropped by one-half, from 14 million to 7 million, during the past quarter-century.



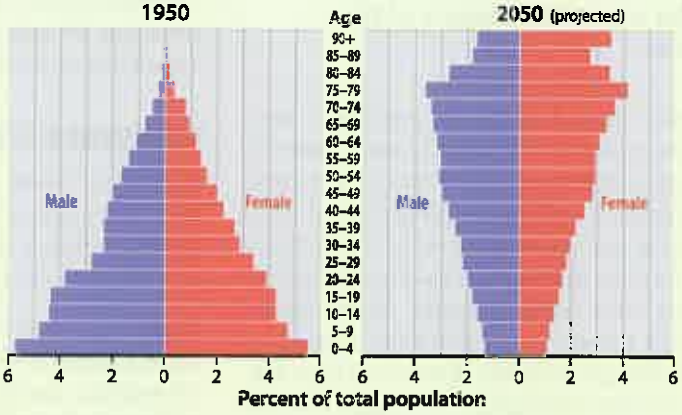
▲ **FIGURE 2-39 FIVE-STAGE DEMOGRAPHIC TRANSITION** Stage 5 of the demographic transition would be characterized by a negative NIR because the CDR would be greater than the CBR.

SUSTAINABILITY & OUR ENVIRONMENT Japan's Population Decline

If the demographic transition is to include a stage 5, Japan will be one of the world's first countries to reach it. Japan's population hit a historic high of 127 million in 2010 and is now starting to decline. The United Nations forecasts Japan's population to fall to 84 million in 2100. With the population decline will come an increasing percentage of elderly people (Figure 2-40).

For planet Earth, a more modest natural increase rate in the coming years reduces the pressure on expanding resources to feed more people. For Japan as a specific country, stage 5 brings economic challenges of sustaining a high standard of living with an aging population and a declining number of people of working age.

Japan faces an unsustainable shortage of workers. Instead of increasing immigration, Japan is addressing its labor force shortage primarily by encouraging more Japanese people to work. Rather than combine work with child rearing, Japanese women are expected to make a stark choice: either marry and raise children or remain single and work. According to Japan's most recent census, the majority of women have chosen to work.



▲ FIGURE 2-40 **JAPAN'S CHANGING POPULATION PYRAMIDS** Japan's population pyramid has shifted from a broad base in 1950 to a rectangular shape today. In the future, the bottom of the pyramid is expected to contract and the top to expand.

With the United Nations now forecasting China to lose population by 2100, the government abandoned the One Child Policy in 2015. But China's CBR is unlikely to increase much because after three decades of intensive educational programs, as well as coercion, most Chinese have accepted the benefits of family planning (Figure 2-41).

INDIA'S POPULATION POLICIES. India was the first country to embark on a national family-planning program, in 1952. The government established clinics, provided information about alternative methods of birth control, distributed free or low-cost birth control devices, and legalized abortions.

Most controversially, during the 1970s India set up camps to perform sterilizations—surgical procedures in which people were made incapable of reproduction. Widespread opposition to the sterilization program grew in the country because people feared that they would be forcibly sterilized, and it increased distrust of other family-planning measures as well.

In the past several decades, government-sponsored family-planning programs in India have emphasized education, including advertisements on national radio and TV networks and information distributed through local health centers. Still, the dominant form of birth control continues to be sterilization of women, though in many cases after the women have already borne several children. Family-planning measures lowered the CBR from 34 in 1980 to 21 in 2015, but India's population increased by 16 million in both 1980 and 2015.

PAUSE & REFLECT 2.4.2

For every 10 baby boys, India has only 9 baby girls. How might population policies be contributing to India having so many more baby boys than girls?

▲ FIGURE 2-41 **CHINA'S ONE CHILD POLICY** Poster in Jiangxi advocates one child.

Epidemiologic Futures

LEARNING OUTCOME 2.4.3

Understand reasons for a possible stage 5 of the epidemiologic transition.

Recall that in the possible stage 5 of the demographic transition, CDR rises because more of the population is elderly. Some medical analysts argue that the world is also moving into stage 5 of the epidemiologic transition, brought about by a reemergence of infectious and parasitic diseases. Infectious diseases once thought to have been eradicated or controlled have returned, and new ones have emerged. Other epidemiologists dismiss recent trends as a temporary setback in a long process of controlling infectious diseases. Three reasons help explain the possible emergence of a stage 5 of the epidemiologic transition: evolution, poverty, and increased connections.

POSSIBLE STAGE 5 CAUSE: EVOLUTION

Infectious disease microbes have continuously evolved and changed in response to environmental pressures by developing resistance to drugs and insecticides. Antibiotics and genetic engineering contribute to the emergence of new strains of viruses and bacteria. Malaria was nearly eradicated in the mid-twentieth century by spraying DDT in areas infested with the mosquito that carried the parasite. However, malaria caused an estimated 118,648 deaths worldwide in 2014, including 30,918 in the Democratic Republic of the Congo. A major reason is the evolution of DDT-resistant mosquitoes.

POSSIBLE STAGE 5 CAUSE: POVERTY

Infectious diseases are more prevalent in poor areas than other places because unsanitary conditions may persist, and most people can't afford the drugs needed for treatment. Tuberculosis (TB) is an example of an infectious disease that has been largely controlled in developed countries but remains a major cause of death in developing countries (Figure 2-42). An airborne disease that damages the lungs, TB (often called "consumption") spreads principally through coughing and sneezing. TB is more prevalent in poor areas because the long, expensive treatment poses a significant economic burden.

POSSIBLE STAGE 5 CAUSE: CONNECTIONS

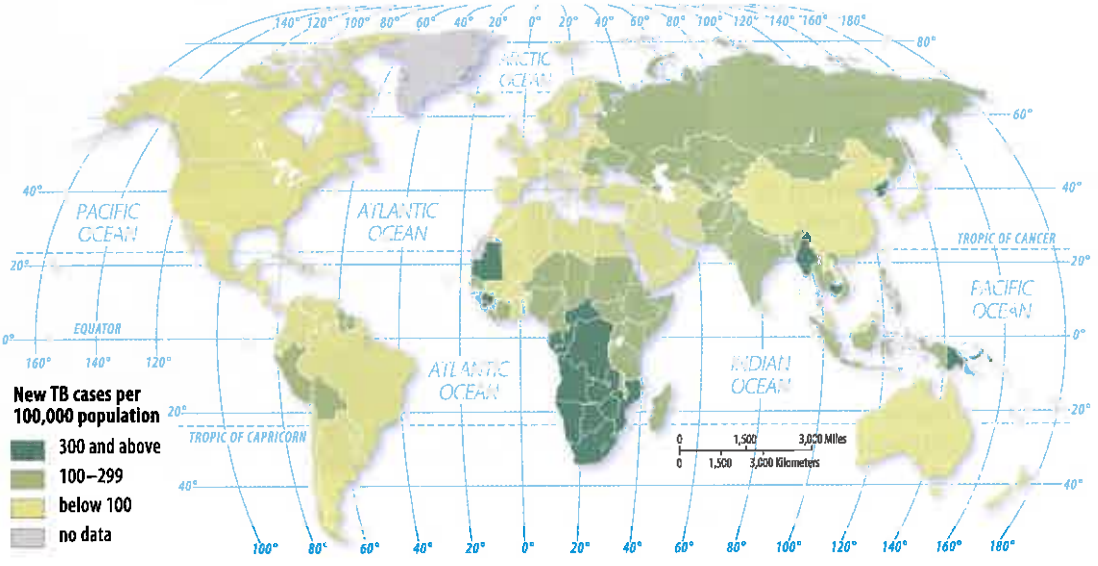
Pandemics have spread in recent decades through the process of relocation diffusion, discussed in Chapter 1. As they travel, people carry diseases with them and are exposed to the diseases of others.

AIDS. The most lethal pandemic in recent years has been AIDS (acquired immunodeficiency syndrome). Worldwide, 39 million people died of AIDS from the beginning of the epidemic through 2014, and 37 million were living with HIV (human immunodeficiency virus, the cause of AIDS). The impact of AIDS has been felt most strongly in sub-Saharan Africa, home to 26 million of the world's 37 million HIV-positive people (Figure 2-43).

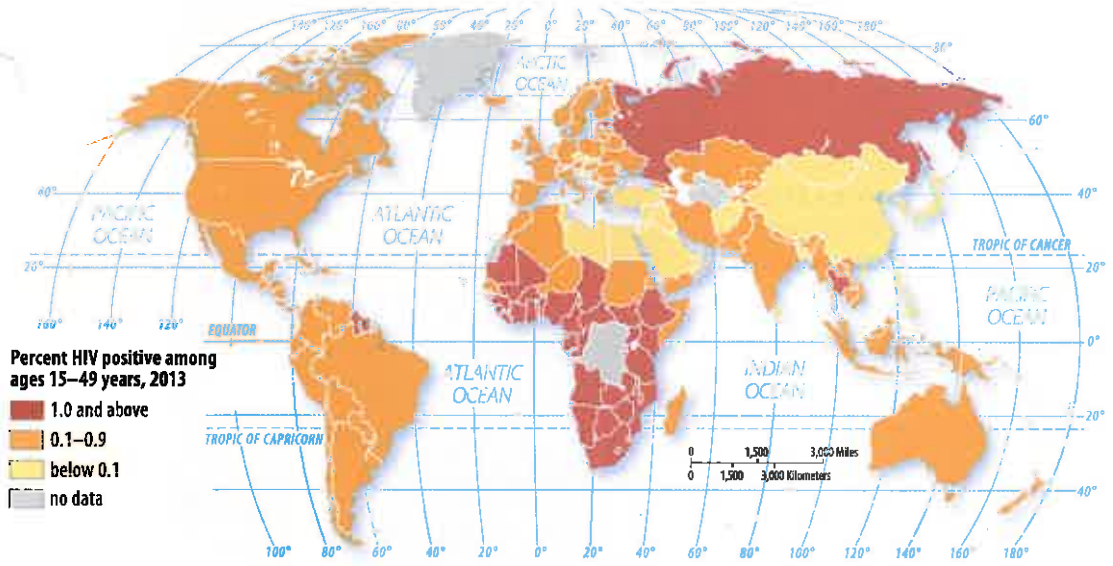
AIDS diffused from sub-Saharan Africa through relocation diffusion, both by Africans and by visitors to Africa returning to their home countries. AIDS entered the United States during the early 1980s through New York, California, and Florida. Not by coincidence, the three leading U.S. airports for international arrivals are in these three states (Figure 2-44). Though AIDS diffused to every state during the 1980s, these three states, plus Texas (a major port of entry by motor vehicle), accounted for half of the country's new AIDS cases in the peak year of 1993.

The number of new AIDS cases has dropped sharply because of the rapid diffusion of preventive methods and medicines such as AZT. The rapid spread of these innovations is an example of expansion diffusion rather than relocation diffusion.

EBOLA. Several dozen "new" pandemics have emerged over the past several decades and have spread through the process



▲ **FIGURE 2-42 TUBERCULOSIS (TB) DEATHS** Deaths from TB are found primarily in poorer countries that are unable to pay for the expensive treatment.



▲ **FIGURE 2-43 AIDS** The highest rates of infection are in sub-Saharan Africa and Russia.

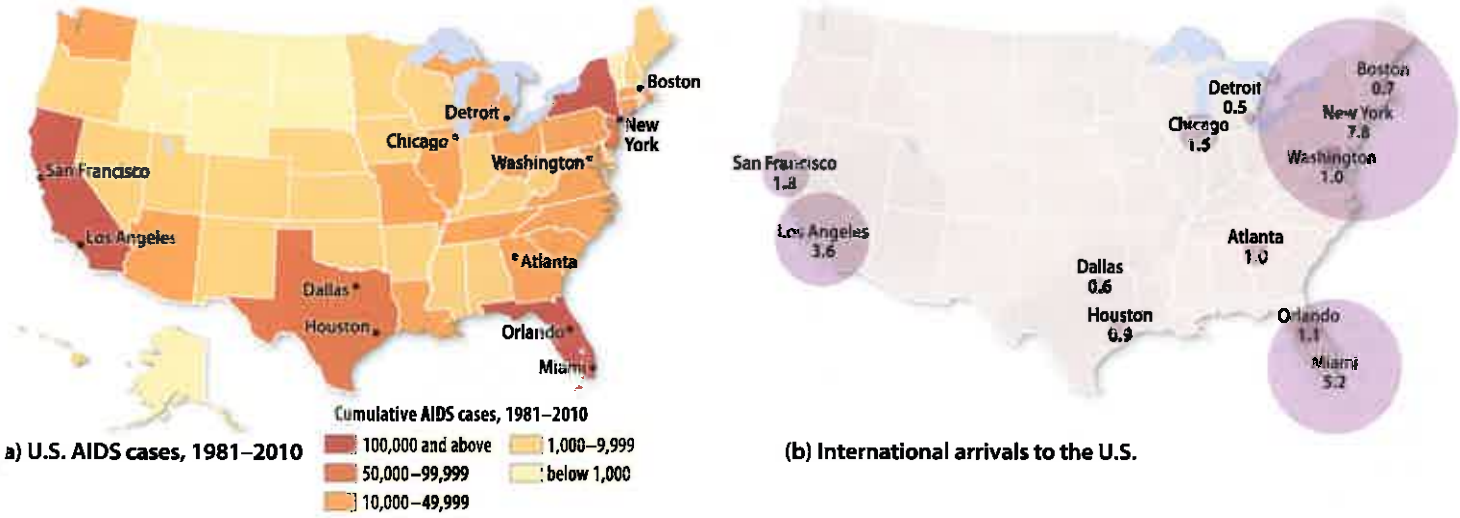
of relocation diffusion. Among them is Ebola. The disease is named for the Ebola River in the Democratic Republic of Congo, where the first known victim was identified in 1976. Mabalo Lokela, the victim, returned to his home village of Yambuku, where he was the school headmaster, after a visit to the Ebola River 150 kilometers from the village. He was originally diagnosed with and treated for malaria.

The first known victim in West Africa was a 2-year-old boy in the village of Meliandou, Guinea, who died in December 2013. Ebola is thought to have been carried from the Congo to Guinea by fruit bats. The virus quickly spread in early 2014 to isolated villages in Guinea and the neighboring countries Sierra Leone and Liberia, which are within walking distance of Meliandou. These are some of the poorest places within some of the poorest countries of the world. They lacked the medical care necessary to prevent the spread of the virus and to save those who contracted it.

Ebola was transported from West Africa by health-care workers who traveled to other places while unknowingly infected. However, these places possessed health-care systems that were able to treat patients.

PAUSE & REFLECT 2.4.3

Which region within the United States has the lowest number of AIDS cases? What geographic factors might explain this low level?



a) U.S. AIDS cases, 1981–2010

(b) International arrivals to the U.S.

▲ **FIGURE 2-44 U.S. AIDS AND INTERNATIONAL ARRIVALS** Because AIDS arrived in the United States primarily through air travelers, the distribution of AIDS closely matches the distribution of international air passengers.

Family Futures

LEARNING OUTCOME 2.4.4

Understand reasons for declining birth rates.

The CBR declined rapidly between 1990 and 2015, from 27 to 20 in the world as a whole and from 31 to 22 in developing countries (Figure 2-45). Two strategies have been successful in reducing birth rates.

LOWERING CBR THROUGH EDUCATION AND HEALTH CARE

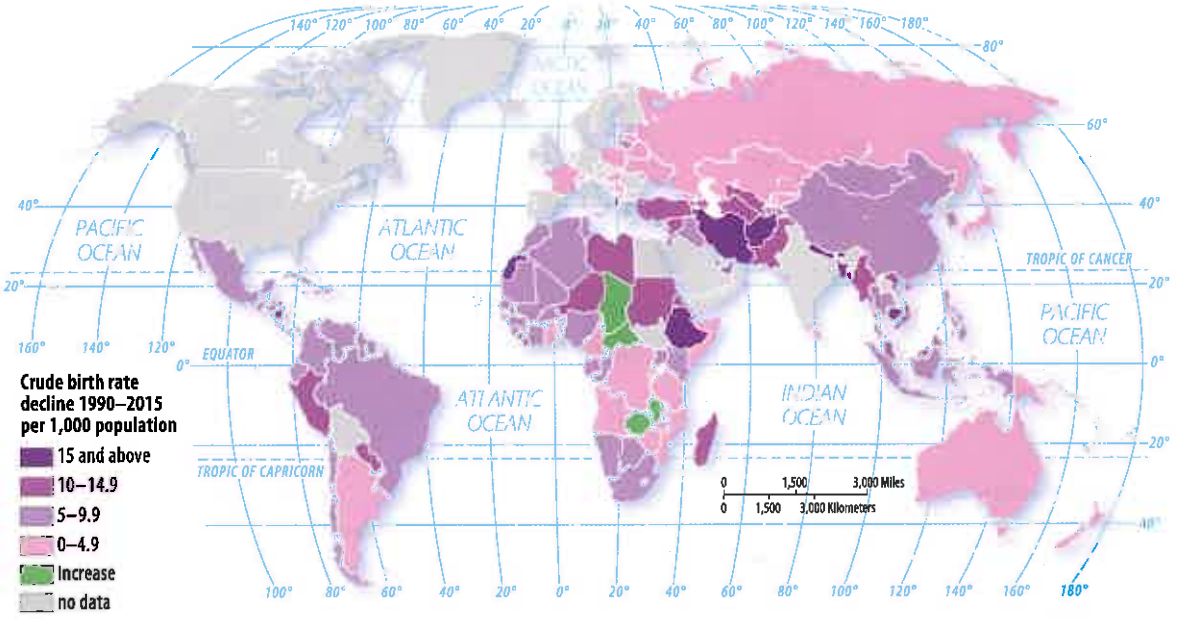
One approach to lowering birth rates emphasizes the importance of improving local economic conditions. A wealthier community has more money to spend on education and health-care programs that promote lower birth rates. According to this approach:

- With more women able to attend school and to remain in school longer, they would be more likely to learn employment skills and gain more economic control over their lives.
- With better education, women would better understand their reproductive rights, make more informed reproductive choices, and select more effective methods of contraception (Figure 2-46).
- With improved health-care programs, IMRs would decline through such programs as improved prenatal care, counseling about sexually transmitted diseases, and child immunization.
- With the survival of more infants ensured, women would be more likely to choose to make more effective use of contraceptives to limit the number of children.

▲ **FIGURE 2-46 INDIA FAMILY PLANNING** Family-planning center, Kolkata, India.

LOWERING CBR THROUGH CONTRACEPTION

The other approach to lowering birth rates emphasizes the importance of rapidly diffusing modern contraceptive methods (Figure 2-47). Economic development may promote lower birth rates in the long run, but the world cannot wait around for that alternative to take effect. Putting resources



▲ **FIGURE 2-45 CBR CHANGE 1990–2015** The CBR has declined in all but a handful of countries. Declines have been most rapid in Latin America and South and Southwest Asia.

into family-planning programs can reduce birth rates much more rapidly. In developing countries, demand for contraceptive devices is greater than the available supply. Therefore, the most effective way to increase their use is to distribute more of them cheaply and quickly. According to this approach, contraceptives are the best method for lowering the birth rate.

Bangladesh is an example of a country that has had little improvement in the wealth and literacy of its people, but 62 percent of married women in the country used contraceptives in 2014 compared to 6 percent in 1980. Similar growth in the use of contraceptives has occurred in other developing countries, including Colombia, Morocco, and Thailand. Rapid growth in the acceptance of family planning is evidence that in the modern world, ideas can diffuse rapidly, even to places where people have limited access to education and modern communications. The percentage of women using contraceptives is especially low in sub-Saharan Africa, so the alternative of distributing contraceptives could have an especially strong impact there. Around 30 percent of married women in sub-Saharan Africa employ contraceptives, compared to 73 percent in Latin America and 66 percent in Asia (Figure 2-48).

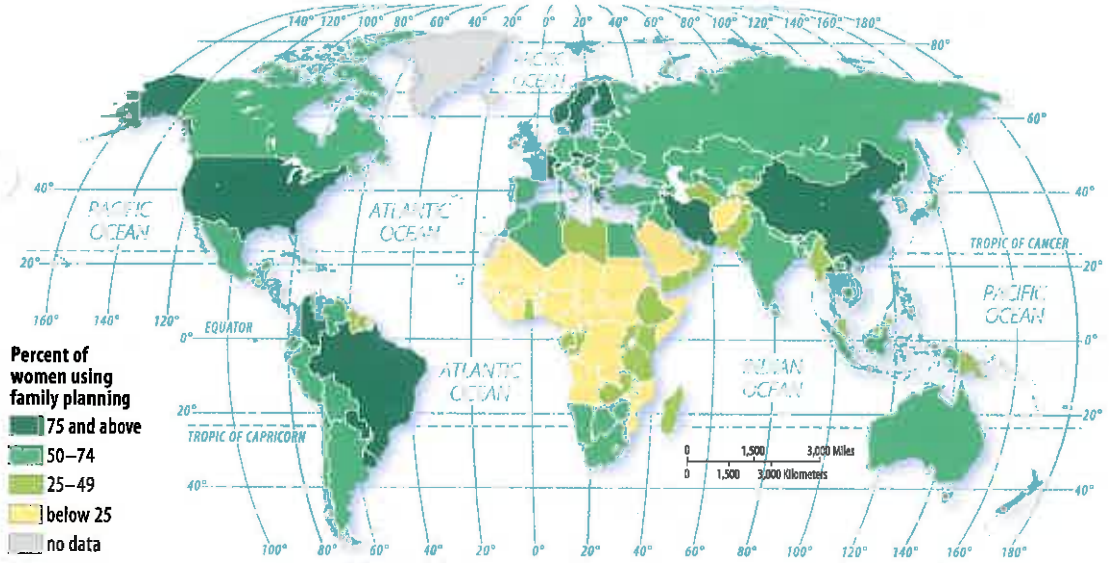
PAUSE & REFLECT 2.4.4

Why might birth rates have declined in most of the world, but not in North America?

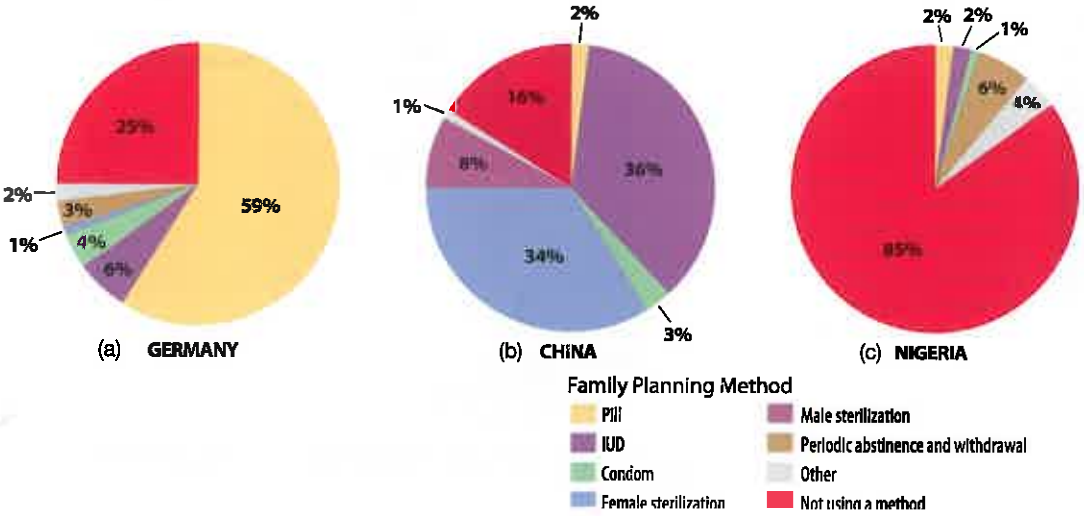
CHECK-IN KEY ISSUE 4

Why Might Population Increase in the Future?

- ✔ **Neo-Malthusians argue that population is outstripping resources, but critics do not agree.**
- ✔ **The demographic transition may display a possible stage 5 of population decline.**
- ✔ **A resurgence of infectious diseases may signal a possible stage 5 of the epidemiologic transition.**
- ✔ **Birth rates have declined in most countries through use of two strategies.**



◀ **FIGURE 2-47 WOMEN USING FAMILY PLANNING** More than two-thirds of couples in developed countries use a family-planning method. Family-planning varies widely in developing countries. China reports the world's highest rate of family planning; the lowest rates are in sub-Saharan Africa.



◀ **FIGURE 2-48 FAMILY-PLANNING METHODS** **(a)** The principal family-planning methods in developed countries like Germany are condoms and birth-control pills. **(b)** The principal methods in China are intrauterine devices (IUDs) and female sterilization. **(c)** People in sub-Saharan African countries such as Nigeria make minimal use of family planning.

Summary & Review

KEY ISSUE 1

Where are the world's people distributed?

Two-thirds of the world's inhabitants are clustered in four regions. Human beings tend to avoid parts of Earth's surface that they consider to be too wet, too dry, too cold, or too mountainous. Several measures of density are used to describe where people live in the world, and the relationship between people and natural resources.

THINKING GEOGRAPHICALLY

▲ **FIGURE 2-49 CENSUS** A woman in the United Kingdom completes that country's 2011 census form.

1. The current method of counting a country's population by requiring every household to complete a census form once every 10 years has been severely criticized as inaccurate. The undercounting produces a geographic bias because people who are missed are more likely to live in inner cities, remote rural areas, or communities that attract a relatively high number of recent immigrants. Given the availability of reliable statistical tests, should the current method of trying to count 100 percent of the population be replaced by a survey of a carefully drawn sample of the population, as is done with political polling and consumer preferences? Why or why not?

KEY ISSUE 2

Why is world population increasing?

The demographic transition helps to explain why regions have varying rates of population growth. Virtually all the world's natural increase is concentrated in the developing countries of Africa, Asia, and Latin America. The difference in natural increase between developed countries and developing countries results from differences in birth rates rather than in death rates.

THINKING GEOGRAPHICALLY

▲ **FIGURE 2-50 AGING BOOMERS** Older runners participate in New York City Marathon.

2. Members of the baby-boom generation—people born between 1946 and 1964—constitute nearly one-third of the U.S. population. Baby boomers have received more education than their parents, and women from this generation were more likely to enter the labor force than women before them. The baby boomers have delayed marriage and parenthood and have fewer children compared to their parents. They are more likely to divorce, to bear children while unmarried, and to cohabit. As they grow older, what impact will baby boomers have on the American population in the years ahead?

KEY ISSUE 3

Why do some places face health challenges?

Countries have distinctive patterns of gender and age, depending on the stage of the demographic transition, and they display different health conditions and medical services. Health care varies widely around the world because developing countries generally lack resources to provide the same level of health care as developed countries.

THINKING GEOGRAPHICALLY

▲ **FIGURE 2-51 U.S. HEALTH CARE CHALLENGES** Incidence of obesity is increasing in the United States.

3. Health care indicators for the United States do not always match those of other developed countries. What reasons might explain these differences?

KEY ISSUE 4

Why might population increase in the future?

Malthus argued in 1798 that population would grow more rapidly than resources. Recent experience shows that population has not grown as rapidly as Malthus forecast. Birth rates have declined in some places primarily through education and health care and in other places primarily through diffusion of contraception. Japan and some European countries may be in a possible stage 5, characterized by a decline in population, because CDR exceeds CBR.

THINKING GEOGRAPHICALLY

▲ **FIGURE 2-52 PROMOTING FAMILY PLANNING** The government of Senegal issued this poster to promote family planning.

4. Given the evidence of declining birth rates around the world, what role should family-planning programs play in developing countries?

KEY TERMS

Agricultural density *(p. 50)* The ratio of the number of farmers to the total amount of arable land (land suitable for agriculture).

Arithmetic density *(p. 50)* The total number of people divided by the total land area.

Census *(p. 46)* A complete enumeration of a population.

Crude birth rate (CBR) *(p. 54)* The total number of live births in a year for every 1,000 people alive in the society.

Crude death rate (CDR) *(p. 54)* The total number of deaths in a year for every 1,000 people alive in the society.

Demographic transition *(p. 56)* The process of change in a society's population from a condition of high crude birth and death rates and low rate of natural increase to a condition of low crude birth and death rates, low rate of natural increase, and higher total population.

Demography *(p. 55)* The scientific study of population characteristics.

Dependency ratio *(p. 60)* The number of people under age 15 and over age 64 compared to the number of people active in the labor force.

Doubling time *(p. 52)* The number of years needed to double a population, assuming a constant rate of natural increase.

Ecumene *(p. 49)* The portion of Earth's surface occupied by permanent human settlement.

Elderly support ratio *(p. 61)* The number of working-age people (ages 15 to 64) divided by the number of persons 65 and older.

Epidemiologic transition *(p. 64)* The process of change in the distinctive causes of death in each stage of the demographic transition.

Epidemiology *(p. 64)* The branch of medical science concerned with the incidence, distribution, and control of diseases that are prevalent among a population at a special time and are produced by some special causes not generally present in the affected locality.

Industrial Revolution *(p. 56)* A series of improvements in industrial technology that transformed the process of manufacturing goods.

Infant mortality rate (IMR) *(p. 61)* The total number of deaths in a year among infants under 1 year of age for every 1,000 live births in a society.

Life expectancy *(p. 52)* The average number of years an individual can be expected to live, given current social, economic, and medical conditions. Life expectancy at birth is the average number of years a newborn infant can expect to live.

Maternal mortality rate *(p. 59)* The annual number of female deaths per 100,000 live births from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes).

Medical revolution *(p. 56)* Medical technology invented in Europe and North America that has diffused to the poorer countries in Latin America, Asia, and Africa. Improved medical practices have eliminated many of the traditional causes of death in poorer countries and enabled more people to live longer and healthier lives.

Natural increase rate (NIR) *(p. 52)* The percentage growth of a population in a year, computed as the crude birth rate minus the crude death rate.

Overpopulation *(p. 46)* A situation in which the number of people in an area exceeds the capacity of the environment to support life at a decent standard of living.

Pandemic *(p. 64)* Disease that occurs over a wide geographic area and affects a very high proportion of the population.

Physiological density *(p. 50)* The number of people per unit area of arable land, which is land suitable for agriculture.

Population pyramid *(p. 60)* A bar graph that represents the distribution of population by age and sex.

Sex ratio *(p. 58)* The number of males per 100 females in the population.

Total fertility rate (TFR) *(p. 55)* The average number of children a woman will have throughout her childbearing years.

Zero population growth (ZPG) *(p. 57)* A decline of the total fertility rate to the point where the natural increase rate equals zero.

EXPLORE

Mahāmīd, Egypt

Use Google Earth to explore Mahāmīd, a town of 45,000 near the banks of the Nile River. Fly to *Mahāmīd, Luxor, Egypt*. Zoom in.

1. What color is most of the land immediately in and around the town? Does this indicate that the land is used for agriculture, or is it desert? Zoom out until you see the entire band of green surrounded by tan.
2. How wide is the green strip? What does the tan color represent? What feature is in the middle of the green strip?

GeoVideo

Log in to the MasteringGeography Study Area to view this video.

White Horse Village Urbanization

New cities being constructed in rural China will bring better jobs and living conditions to millions of farmers and their families but also end an ancient way of life.

1. In general, would the village farmers prefer to work in a new factory or remain on their land? Explain.
2. Do village residents have a choice about whether their land becomes a new industrial city? Explain.
3. In the view of China's economic planners, why is urbanization of the countryside essential?

MasteringGeography™

Looking for additional review and test prep materials?

Visit the Study Area in **MasteringGeography™** to enhance your geographic literacy, satial reasoning skills, and understanding of this chapter's content by accessing a variety of resources, induding MapMaster interactive maps, videos, *In the News* RSS feeds, flashcards, web links, self-study quizzes, and an eText version of *The Cultural Landscape*.

www.masteringgeography.com