LESSON 1

Trends in Human Population Growth

Guiding Question: Why do we study human populations?

Knowledge and Skills

- Describe how technological advances have contributed to human population growth.
- Explain recent trends in population growth.
- Identify characteristics of human population that are studied by demographers.

Reading Strategy and Vocabulary

Reading Strategy Before reading, scan the lesson. Write a few sentences that predict what you think the lesson is about. When you finish reading, rewrite your sentences to better summarize the lesson.

Vocabulary Industrial Revolution, infant mortality, life expectancy, growth rate, demography

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8.1 LESSON PLAN PREVIEW

Real World Students discuss how advances in medical technologies could affect their lives and the global population.

Differentiated Instruction Struggling students discuss the main ideas of human population growth trends.

Inquiry Students calculate how many bags of rice hold 7 billion grains to better understand the size of the human population.

8.1 RESOURCES

Paper and Pencil Activity, *Longevity* • Bellringer Video, *Long Live America* • Real Data Online • Real Data Math Worksheet • Lesson 8.1 Worksheets • Lesson 8.1 Assessment • Chapter 8 Overview Presentation

FOCUS Watch the ABC News video **Long Live America,** which introduces the term *life expectancy* and explores factors that have lengthened life expectancy in the United States.

ABOUT 6.8 BILLION … and counting. That is the approximate size of the human population as of 2010. Just how great a number is 6.8 billion? Even the number 1 billion is difficult to picture. If you started to count once each second without ever stopping to sleep, it would take you more than 30 years to reach just 1 billion.

Although the rate of human population growth is slowing, actual growth does continue. Every person who is born needs food, water, and space. How long will population growth continue? How much food, water, and space can Earth provide? These are questions that some environmental scientists seek to answer.

History of Human Population Growth

Technological advances, especially in agriculture and industry, changed the ways people lived and triggered remarkable increases in population size.

Over just the past 300 years, the human population has undergone tremendous growth that dwarfs all previous growth during our 200,000 years of existence. The population didn't reach 1 billion people until about 1800. Yet, there are now about 6.8 billion people. Advances in agriculture and industry gave the human population the means to expand so quickly over a relatively short period of time.

Development of Agriculture

About 10,000 years ago, many human societies changed from roaming hunter-gatherers to settled farmers. As people began to grow crops and raise domestic animals, they met their nutritional needs more easily. As a result, people lived longer and more children survived to adulthood. Eventually, some people began trading and purchasing food from other people. Because their time was freed from growing food, they could pursue crafts and trades. As shown in **Figure 1,** the size of the human population began to slowly increase. Diseases such as smallpox and plague still claimed many lives.

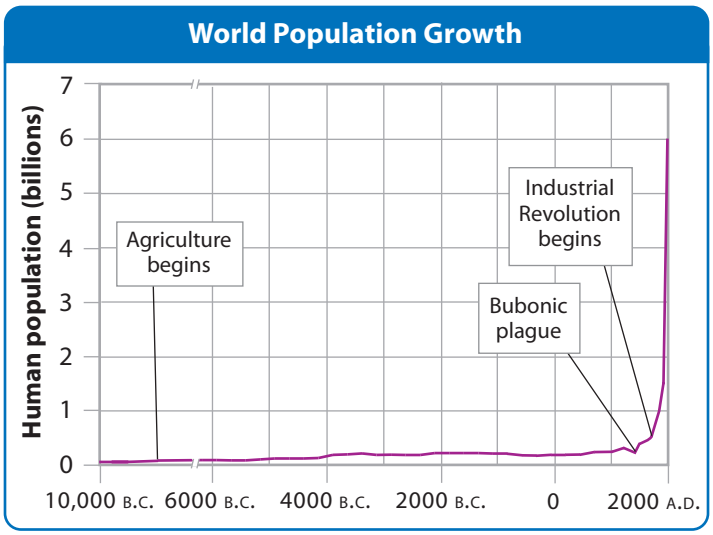


FIGURE 1 Human Population Size For a great part of human history, the population was small and fairly stable. Widespread agriculture and, especially, the Industrial Revolution caused it to skyrocket to 6 billion by the year 2000.

Industrial Revolution

During the **Industrial Revolution,** which began in the mid-1700s, many societies started to shift from a rural life focused on agriculture and goods made by craftspeople to urban societies powered by fossil fuels. Besides changing daily life, the Industrial Revolution led to improvements in sanitation, medical technology, and the ability to mass produce food that contributed to the human population explosion.

▶ *Sanitation*

During the time of the Industrial Revolution, Louis Pasteur and other scientists developed the germ theory of disease. People began to understand that many deadly diseases are caused by organisms (germs) that spread from person to person. Previously acceptable behaviors, such as throwing garbage and human waste into public waterways, were no longer tolerated. As a result, living conditions in cities became cleaner. Also, doctors began washing their hands before moving from one patient to the next. This greatly reduced deaths from infections, especially deaths related to childbirth. Mass production of soap and cotton clothes, which were less likely than woolen clothes to attract lice, also helped slow the spread of disease.

FIGURE 2 Sanitation Improvements Products of the Industrial Revolution, such as cheap soap, contributed to more sanitary conditions.

▶ *Medical Technology*

The advances in industry made it possible to mass produce medical instruments and, most important of all, medicines such as antibiotics and vaccines. Antibiotics treat bacterial infections and vaccines help to prevent or reduce the severity of both viral and bacterial infections. In less than a hundred years, these developments have saved millions of lives.

▶ *Changes in Agriculture*

How was it possible to feed this quickly expanding population while fewer people were devoting their lives to growing food? The Industrial Revolution led to the invention of large fossil-fueled machines that make it possible to plant and harvest food in mass quantities. Pesticides were developed which reduced competition from weeds and killed insects that destroy crops. Synthetic fertilizers were also invented that enabled farmers to grow more food from the same amount of soil.

Real Data

Population Growth Rates

Not every nation's population is growing at the same rate, or growing at all. In fact, some are increasing quickly, while others are actually decreasing. The table shows 2008 estimates of growth rates and population sizes for several nations and the world.

1. **Interpret Data** Which nation is growing the fastest? Explain your answer.
2. **Infer** What is happening to Hungary's population size?
3. **Calculate** Which nation will likely add the most people to the world over the course of a year?
4. **Infer** In 1970, China's population growth rate was 2.8 percent. Do you think China's population control policies have been effective? Why or why not?

Population Growth Rate of Selected Nations and World, 2008

	Annual Population Growth Rate	Population Size (millions)
China	0.6%	1345.8
Hungary	−0.2%	10.0
India	1.4%	1198.0
Madagascar	2.7%	19.6
United States	1.0%	314.7
World	1.2%	6829.3

Source: World Population Prospects, the 2008 Revision.

ANSWERS

Real Data

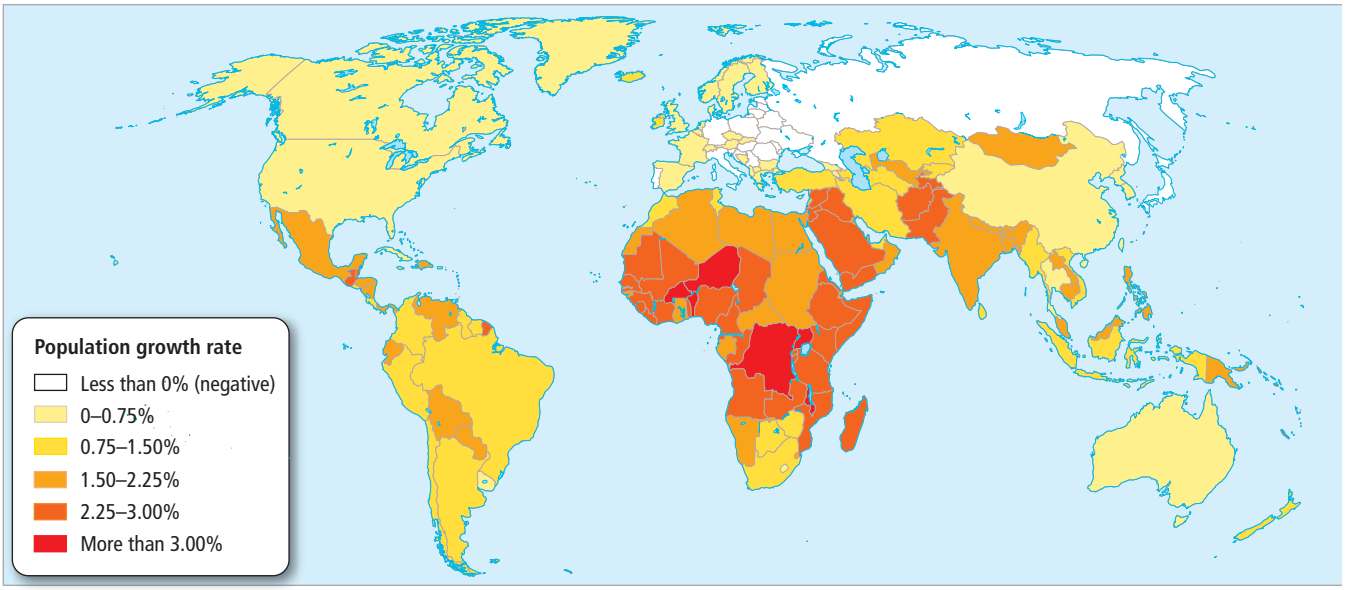
1. Madagascar; it has the highest population growth rate of all the nations in the table.
2. It is decreasing.
3. India; at a growth rate of 1.4 percent its population will increase by almost 17 million people in a year.
4. Students will likely infer that the policy has been effective at controlling population growth because the annual growth rate dropped from 2.6 percent in 1970 to 0.6 percent in 2008.

Recent Trends in Human Population Growth

In recent years the human population growth rate has decreased, but the population still continues to grow.

Results of the Industrial Revolution such as more food and fewer deaths from disease led to decreased infant mortality and increased life expectancy. **Infant mortality** is the number of babies out of 1000 that die during their first year of life. **Life expectancy** is the average number of years an individual is expected to live. When babies have a greater chance of survival and adults live longer, a population is likely to grow … and possibly grow quickly. Understanding human population growth is important for many reasons. This knowledge helps us understand how differences in populations affect human communities and environments.

FIGURE 3 Fast-Growing India Indian women wait in line for immunizations for their babies. India is on course to surpass China as the world's most populous nation.



Data from Population Reference Bureau. 2009. *2009 World population data sheet.*

FIGURE 4 Population Growth Rates Vary Population growth rates vary greatly from place to place. Shown here are rates of population change due to births and deaths. The data do not include increases from immigration or decreases from emigration.

Growth Rate Has Slowed

For much of the twentieth century, the human population growth rate rose from year to year. **Growth rate** refers to how a population changes in size during a specific period of time. Recently, it has started to decline. During the 1960s, the growth rate peaked at 2.1 percent. Since then, it has slowed to about 1.2 percent. To put these rates into perspective, at 2.1 percent, it takes 33 years for a population to double. At 1.2 percent, it takes 58 years for it to double. To estimate how long it would take any population to double, divide the number 70 by the annual percentage growth rate.

Growth Rates Vary by Region

As shown in **Figure 4,** annual growth rates differ greatly around the globe. Some nations, like Germany and Russia, have a negative population growth rate. That is, their populations are decreasing. Other populations continue to increase at rates much greater than the average global rate. In the next lesson, you'll read about the factors that contribute to these variations among regions.

How Long Will Growth Continue?

We have technology that allows us to manipulate our environment in ways that other species cannot. For example, the abilities to build shelters that can be heated and to transport food and water mean we can live comfortably just about anywhere. Such advances have allowed people to temporarily increase the species' *carrying capacity*—the number of organisms that an environment can support.

Technology has taken people a long way, but at some point, environmental factors such as food, water, and land will limit human population growth. Recall that when a species reaches carrying capacity, the population neither increases nor decreases. Growth rate becomes zero. No one knows what the maximum population size will be before the growth rate is zero. However, we do know that the population cannot grow forever.

Reading Checkpoint *What is the relationship between carrying capacity and population growth?*

BIG QUESTION

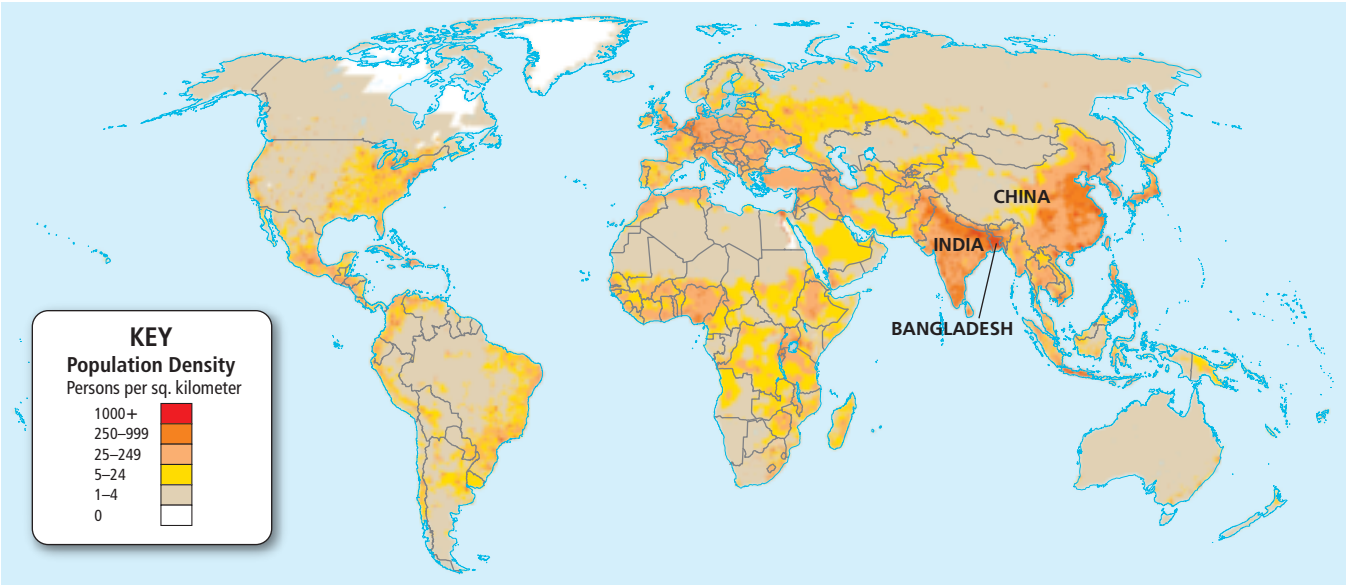
How does the human population affect the environment?

Explanation Help students relate the lesson content to the Big Question by launching a class discussion of human population growth.

Ask Think about the historical and recent trends in human population growth. How may these changes in the population size have affected the environment over time? Encourage students to form a well-reasoned response to the question. Call on several volunteers to share their responses with the class.

ANSWERS

Reading Checkpoint At carrying capacity, there is zero population growth.



Data are for 2000, from Center for International Earth Science Information Network (CIESIN), Columbia University; and Centro Internacional de Agricultura Tropical (CIAT), 2005.

FIGURE 5 Population Density Human population density varies greatly from one region to another. Tundra and desert regions have the lowest population densities, whereas India, Bangladesh, and eastern China—areas of temperate climate—have the highest.

Describing the Human Population

Demographers study the size, density, and distribution of human populations.

The study of human population statistics is called **demography.** *Demographers,* people who study demography, apply the principles of population ecology to humans. For example, they study human population size, population density, and distribution, just as ecologists study these characteristics in other types of populations. The data that demographers collect help them to predict changes in human population and the environmental impacts that can result.

Population Size The human population size is roughly 6.8 billion, but the exact number changes every second. In the time it took you to read the last sentence, people were born and people died—although it is likely that more people were born than died. The size of the human population does not tell the whole story of how the human population affects the environment, however. Demographers also look at where people live and the concentration of people in specific areas.

Population Density Population density describes how many people live per square mile or square kilometer. At the global scale, population density is highest in regions with temperate and tropical climates such as China, Europe, Mexico, and India **(Figure 5).** Population density is lowest in regions with extreme climates such as deserts and tundra. More people live in areas by seacoasts and rivers than in locations far from water. Regionally, populations are dense in cities and suburbs and are spread more thinly across rural areas. Locally, people are grouped in certain neighborhoods and within households.

Reading Checkpoint *Egypt is the northeasternmost nation in Africa. How can* ***Figure 5*** *help you determine where the Nile River flows through Egypt?*

ANSWERS

Reading Checkpoint The area of Egypt where the population is very dense could be where the Nile River flows.

FIGURE 6 Population Distribution **(a)** Clusters of people tend to live along waterways, as shown in this photograph of Bosa, a small city in Italy. **(b)** The population may be more spread out in dry areas, as shown in this photograph taken in Rajasthan, India.

Population Distribution In ecological terms, the human population distribution is clumped, rather than random or uniform. This uneven distribution means that some areas bear more of an environmental impact than others. Major rivers such as the Yellow River in China and the Mississippi River have been negatively affected by clustered human populations and the pollution that comes with them.

The environment can also be harmed when people live in areas that really cannot support them. For example, deserts are easily affected by development that overtakes a large share of limited water supplies. In parts of the Middle East, China, and the United States, some grasslands have been so overfarmed that they have become deserts.

Population size, density, and distribution statistics are like snapshots. They give demographers a "picture" of what the human population looks like at a particular moment in time. Other statistics you will learn about in the next lesson, such as fertility rates, age structure, and sex ratio, give demographers information to predict the future of human populations in different areas of the world.

ANSWERS

Lesson 1 Assessment

1. Advances in sanitation, technology, and agriculture
2. Population *B* would increase by more people than Population *A* (16,200 vs. 14,850). Although Population *B's* growth rate is less than Population *A's* growth rate, its starting population size is much greater.
3. Population density describes how many people live in a given area; population distribution describes where people live.
4. When the human population in a given area becomes less dense, resources such as water and land will be more available to people and other organisms in the ecosystem.

LESSON 1 Assessment

1. **Explain** Describe the main factors that led to a boom in the human population size in the last 300 years.
2. **Calculate** Population *A* contains 450,000 people and has a 3.3 percent annual growth rate. Population *B* has 900,000 people and a 1.8 percent annual growth rate. Which population would increase by more people in one year? Explain.
3. **Compare and Contrast** Describe the relationship between population density and population distribution.
4. Explore the **BIG**QUESTION As people become more concentrated in cities, some pressure on ecosystems in areas that are now less populated eases. Why do you think this is the case?