KEY ISSUE

1.1 | Why Is Geography a Science?

The word *geography*, invented by the ancient Greek scholar Eratosthenes, is based on two Greek words. Geo means "Earth," and graphy means "to write." Geography is the study of where things are found on Earth's surface and the reasons for their locations. Human geographers ask two simple questions: Where are people and activities found on Earth? Why are they found there?

Geography's Basic Concepts

Learning Outcome 1.1.1 Summarize geography's basic concepts.

Thinking geographically is one of the oldest human activities. Perhaps the first geographer was a prehistoric human who crossed a river or climbed a hill, observed what was on the other side, returned home to tell about it, and scratched the route in the dirt. The second geographer may have been a friend or relative who followed the dirt drawing to reach the other side.

Geography & History

Human geography and history both rely on the collection of evidence about human activity. In his framework of all scientific knowledge, the German philosopher Immanuel Kant (1724–1804) compared geography and history:

Geographers . . .	Historians . . .
identify the location of important places.	identify the dates of important events.
explain why one human activity is found near another.	explain why one human activity follows another chronologically.
ask where and why.	ask when and why.
organize material spatially.	organize material chronologically.
recognize that an action at one point on Earth can result from actions at another point, which can consequently affect conditions elsewhere.	recognize that an action at one point in time can result from past actions and can in turn affect future ones.

History and geography differ in one especially important manner: A geographer can drive or fly to another place to study Earth's surface, whereas a historian cannot travel to another time to study other eras firsthand. This ability to reach other places lends excitement to the discipline of geography – and geographic training raises the understanding of other spaces to a level above that of casual sightseeing.

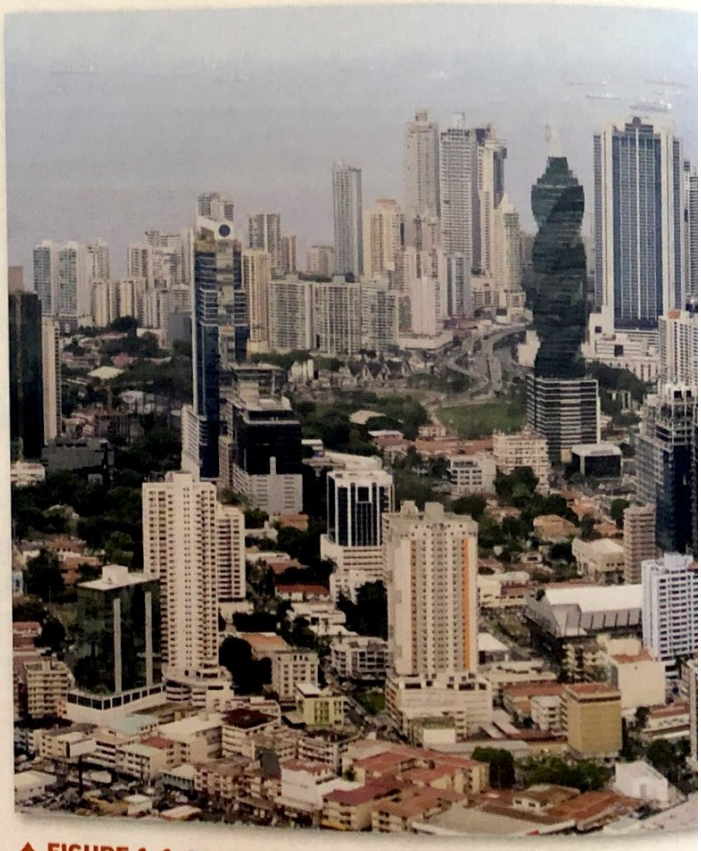
To introduce human geography, we concentrate on two main features of human behavior – culture and economy. The first half of the book explains why the most important cultural features, such as major languages, religions, and ethnicities, are arranged as they are across Earth. The second half of the book looks at the distribution of the most important economic activities, including agriculture, manufacturing, and services.

Everywhere Is Unique

This chapter introduces basic concepts that geographers employ to address their "where" and "why" questions. To explain where things are, one of geography's most important tools is a map. Ancient and medieval geographers created maps to describe what they knew about Earth. Today, accurate maps are generated from electronic data.

Geographers employ several basic concepts to explain why everywhere on Earth is in some ways unique and in other ways related to other locations. Many of these concepts are commonly used English words, but they are given particular meaning by geographers. To explain why everywhere on Earth is unique, geographers have two basic concepts:

- A **place** is a specific point on Earth, distinguished by a particular characteristic. Every place occupies a unique location, or position, on Earth's surface. Panama City, the capital of the country of Panama, is uniquely situated on Panama Bay, which opens out into the Pacific Ocean (Figure 1-1).



▲ **FIGURE 1-1 PANAMA: PLACE** Panama City, the capital of the country of Panama, has 1.5 million inhabitants in its metropolitan

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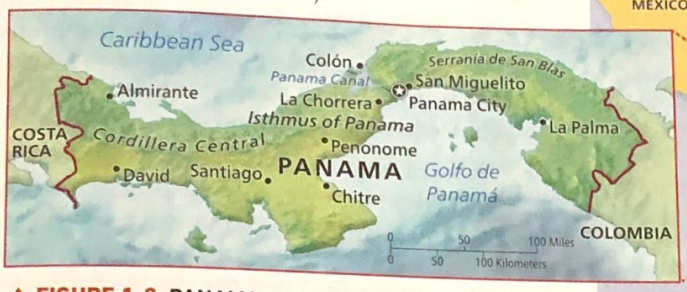
- A **region** is an area of Earth defined by one or more distinctive characteristics. Geographers divide the world into a number of regions, such as Latin America, which includes Panama (Figure 1-2).



▲ **FIGURE 1-2 PANAMA: REGION** Panama City is part of the world region of Latin America.

All Locations Are Interrelated

To explain why different locations are interrelated, geographers have three basic concepts:

- **Scale** is the relationship between the portion of Earth being studied and Earth as a whole. Geographers study a variety of scales, from local to global. Many processes that affect humanity's occupance of Earth are global in scale, such as climate change and depletion of energy supplies. At the same time, local-scale processes are increasingly important, such as preservation of distinctive cultural and economic activities (Figure 1-3).
- **Space** refers to the physical gap or interval between two objects. Geographers observe that many objects are distributed across space in a regular manner, for discernible reasons (Figure 1-4).
- **Connection** refers to relationships among people and objects across the barrier of space. Geographers are concerned with the various means by which connections occur (Figure 1-5).

Pause & Reflect 1.1.1 What are the principal connections from your hometown to other places?

▲ **FIGURE 1-3 PANAMA: SCALE** At a local scale, a craft market in Panama City features distinctive crafts made by the Kuna Indigenous people. At a global scale, the principal customers for the crafts are tourists from other countries.

▲ **FIGURE 1-4 PANAMA: SPACE** The gap between places can be minimal or substantial. The distance between the Panama City market in Figure 1-3 and the Barro Colorado Nature Monument is only 50 kilometers (30 miles), but it takes at least two hours to travel that distance via a busy toll road and a ferry.

◀ **FIGURE 1-5 PANAMA: CONNECTIONS** The Panama Canal connects the Atlantic and Pacific oceans. The Puente Centenario (Centennial Bridge) spans the Panama Canal, providing connections for people between the two sides of the canal.

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Mapping

Learning Outcome 1.1.2 Explain the development of the science of cartography.

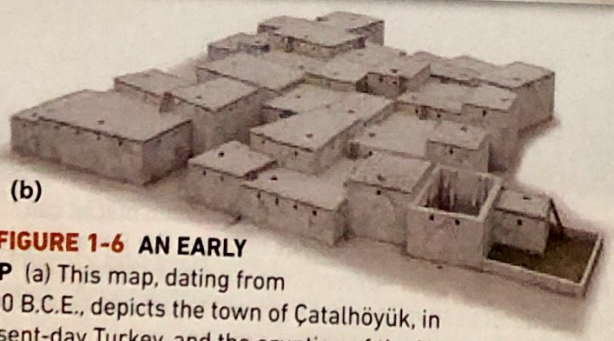
Geography's most important tool for thinking spatially about the distribution of features across Earth is a map. A **map** is a two-dimensional or flat-scale model of Earth's surface, or a portion of it. Geography is immediately distinguished from other disciplines by its reliance on maps to display and analyze information.

A map serves two purposes:

- **As a reference tool.** A map helps us to find the shortest route between two places and to avoid getting lost along the way. We consult maps to learn where in the world something is found, especially in relationship to a place we know, such as a town, body of water, or highway. The maps in an atlas or a road map are especially useful for this purpose.
- **As a communications tool.** A map is often the best means for depicting the distribution of human activities or physical features, as well as for thinking about reasons underlying a distribution.

A map is a scale model of the real world, made small enough to work with on a desk or computer. It can be a hasty here's-how-to-get-to-the-party sketch, an elaborate work of art, or a precise computer-generated product. For centuries, geographers have worked to perfect the science of mapmaking, called **cartography**. Contemporary cartographers are assisted by computers and satellite imagery.

(a)



(b)

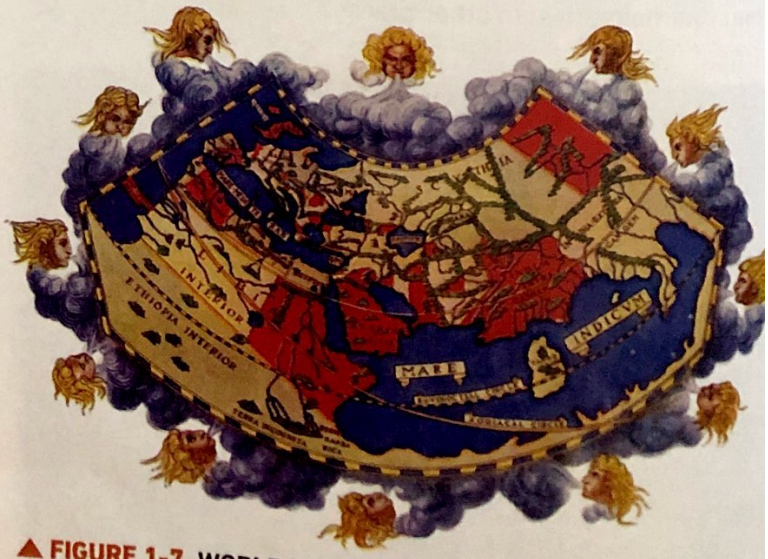
▲ **FIGURE 1-6 AN EARLY MAP** (a) This map, dating from 6200 B.C.E., depicts the town of Çatalhöyük, in present-day Turkey, and the eruption of the Hasan Dağı (Mount Hasan) twin-peaks volcano, which is actually located around 140 kilometers (87 miles) northeast of the town. Archaeological evidence indicates that the volcano did erupt around the time that the map was made. The map is now in the Konya Archaeology Museum. (b) Artist's impression of Çatalhöyük, created from details on the map.

Geography in the Ancient World

The science of geography has prehistoric roots. One of the earliest surviving fully authenticated maps, depicting the town of Çatalhöyük in present-day Turkey, dates from approximately 6200 B.C.E. Archaeologists found the map on the wall of a house that was excavated during the 1960s (Figure 1-6).

Major contributors to geographic thought in the ancient eastern Mediterranean included:

- Thales of Miletus (ca. 624–ca. 546 B.C.E.), who applied principles of geometry to measuring land area.
- Anaximander (610–ca. 546 B.C.E.), a student of Thales, who made a world map based on information from sailors and argued that the world was shaped like a cylinder.
- Pythagoras (ca. 570–ca. 495 B.C.E.), who may have been the first to propose a spherical world, arguing that the sphere was the most perfect form.
- Hecataeus (ca. 550–ca. 476 B.C.E.), who may have produced the first geography book, called *Periodos Ges* ("Journey Around the Earth").
- Aristotle (384–322 B.C.E.), who was the first to demonstrate that Earth was spherical on the basis of evidence.
- Eratosthenes (ca. 276–ca. 194 B.C.E.), the inventor of the word "geography," who accepted that Earth was round (as few others did in his day), calculated its circumference within 0.5 percent accuracy, accurately divided Earth into five climatic regions, and described the known world in one of the first geography books.
- Strabo (ca. 64 B.C.E.–ca. 24 C.E.), who described the known world in a 17-volume work titled *Geographica* ("Geography").
- Ptolemy (ca. 100–ca. 170 C.E.), who wrote an eight-volume *Geographia*, codified basic principles of mapmaking, and prepared numerous maps that were not improved upon for more than 1,000 years (Figure 1-7).



▲ **FIGURE 1-7 WORLD MAP BY PTOLEMY, CA. 150 C.E.** The map shows the known world at the height of the Roman Empire, around the Mediterranean Sea and Indian Ocean.

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Geography's Revival

After Ptolemy, little progress in mapmaking or geographic thought was made in Europe for more than 1,000 years. Maps became less mathematical and more fanciful, showing Earth as a flat disk surrounded by fierce animals and monsters. Geographic inquiry continued, though, elsewhere in the world. Ancient and medieval contributors outside Europe included:

- "Yu Gong" ("Tribute of Yu"), written by an unknown author in the fifth century B.C.E., described the economic resources of the country's different provinces; it was a chapter in a book called *Shujing* ("Book of Documents"), considered one of five classics of ancient Chinese literature.
- Pei Xiu (224–271 C.E.), the "father of Chinese cartography," who produced an elaborate map of the country in 267 C.E.
- Muhammad al-Idrisi (1100–1165), an Arab geographer whose extensive travels through Southwest Asia & North Africa informed his creation of a world map and geography text in 1154, building on Ptolemy's long-neglected work (Figure 1-8).
- Ibn Battuta (1304–ca. 1368), a Moroccan scholar who wrote *Rihla* ("Travels") based on three decades of journeys covering more than 120,000 kilometers (75,000 miles) through northern Africa, southern Europe, and much of Asia (Figure 1-9).

▲ **FIGURE 1-8 WORLD MAP BY AL-IDRISI, 1154** Al-Idrisi built on Ptolemy's map, which had been neglected for nearly a millennium.

▲ **FIGURE 1-9 IBN BATTUTA** Ibn Battuta on horseback in front of a map of his journeys, illustrated by twentieth-century Polish artist Hanna Balicka-Fribes.

The making of maps as reference tools was revived during the Age of Exploration and Discovery. Columbus, Magellan, and other explorers who sailed across the oceans in search of trade routes and resources in the fifteenth and sixteenth centuries required accurate maps to reach desired destinations without wrecking their ships. In turn, cartographers took information collected by the explorers to create more accurate maps. Influential European cartographers included:

- Martin Waldseemüller (ca. 1470–1520), a German cartographer who was credited with producing the first map to use the label "America"; he wrote on the map (translated from Latin) "from Amerigo the discoverer . . . as if it were the land of Americus, thus America" (Figure 1-10).
- Abraham Ortelius (1527–1598), a Flemish cartographer, who created the first modern atlas and was the first to hypothesize that the continents were once joined together before drifting apart.
- Bernhardus Varenius (1622–1650), who produced *Geographia Generalis*, which stood for more than a century as the standard treatise on systematic geography.

Pause & Reflect 1.1.2 What is one main difference between the world maps of Ptolemy (Figure 1-7) and of Waldseemüller (Figure 1-10)?

▲ **FIGURE 1-10 WORLD MAP BY WALDSEEMÜLLER, 1508**

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Contemporary Geographic Tools

Learning Outcome 1.1.3 Identify geography's principal contemporary mapping tools.

Maps are not just paper documents in textbooks. They have become essential for delivery of contemporary online services through smartphones, tablets, and computers. Location data used in applications and devices are collected through electronic tools. While these digital systems allow geographers to explore more of Earth, they still rely on field work to collect data and ground-truth conclusions. They interview people, conduct surveys, take photographs, and have informal observations of the landscape around them.

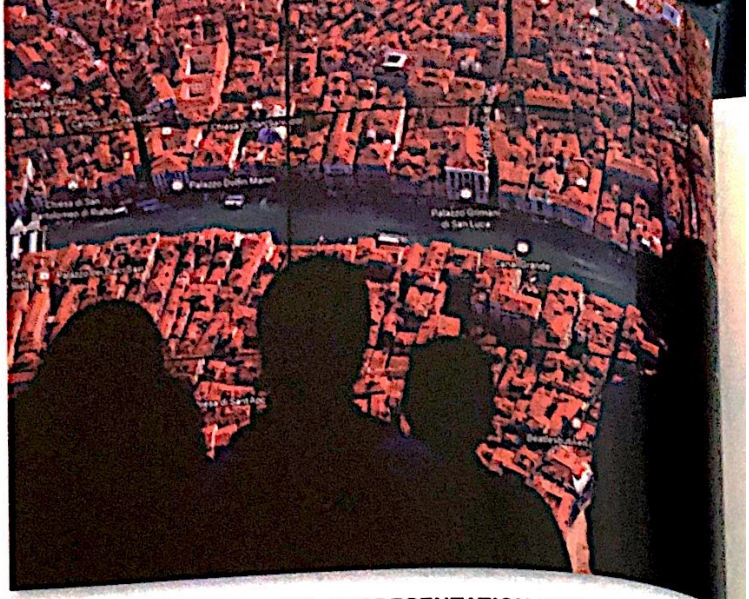
GIScience: Analyzing Data

Geographic information science (GIScience) is the analysis of data about Earth acquired through satellite and other electronic information technologies. A **geographic information system (GIS)** captures, stores, queries, and displays the geographic data. GIS produces maps (including those in this book) that are more accurate and attractive than those drawn by hand. Each type of information is stored in a layer.

Some of the data used in GIS come from photos. The science of taking measurements of Earth's surface from photographs is called **photogrammetry**. The acquisition of data about Earth's surface from a satellite orbiting Earth or from other long-distance methods is **remote sensing**. At any moment, an aerial sensor attached to a satellite, airplane, or drone may be recording the image of a tiny area on Earth's surface (Figure 1-11).

▲ **FIGURE 1-11 PHOTOGRAMMETRY** A drone records images of Earth's surface.

Note: *This is a digitally altered image.*



▲ **FIGURE 1-12 3D VIRTUAL REPRESENTATION MAP** A 3D Google Earth image of Venice, Italy, is projected on a large screen at the Whitney Museum of American Art, New York.

1. *Give an example of how you, as the owner of a business, might use a 3D aerial image of a place.* **2.** *Give an example of how a government might use such images.*

AP® **Skills:** 4.A, 4.E **Reasoning:** 2.iv

Corporations and government agencies use photogrammetry and remote sensing to create high-quality 3D virtual representations of portions of Earth. These maps can depict the distribution of a wide variety of urban and rural features (Figure 1-12).

GIScience helps geographers create more accurate and complex maps and measure changes over time in the characteristics of places. Layers of information acquired through remote sensing and produced through GIS can be described and analyzed. GIScience enables geographers to calculate whether relationships between objects on a map are significant or merely coincidental.

GPS: Pinpointing Locations

Our smartphones, tablets, and computers are equipped with **Global Positioning System (GPS)**, which is a system that determines the precise position of something on Earth. The GPS in use in the United States includes two dozen satellites placed in predetermined orbits; a series of tracking stations to monitor and control the satellites; and receivers that compute position, velocity, and time from the satellite signals.

GPS is most commonly used for navigation. Pilots of aircraft and ships stay on course with GPS. On land, GPS detects a vehicle's current position, the motorist programs the desired destination into a GPS device, and the device provides instructions on how to reach the destination.

Thanks to GPS, our electronic devices provide us with a wealth of information about the specific place on Earth we currently occupy. The locations of all the information we gather and photos we take with our electronic devices are recorded through **geotagging**, which is identification and storage of a piece of information by its precise latitude and longitude coordinates. Geotagging has led to concerns about privacy (refer ahead to Debate It! feature on page 33).

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VGI: Making Maps Yourself

Most of the maps fed into our electronic devices are provided by a handful of companies (Figure 1-13). However, smartphones, tablets, and computers enable individuals to make maps and share them with others. **Volunteered geographic information (VGI)** is the creation and dissemination of geographic data contributed voluntarily and for free by individuals. VGI is part of the broader trend of **citizen science**, which is scientific research by amateur scientists, and **participatory GIS (PGIS)**, which is community-based mapping. Citizen science and PGIS collect and disseminate local knowledge and information through electronic devices.

A **mashup** is a map that overlays data from one source on top of a map provided by a mapping service, such as Google Maps or Bing Maps. The term comes from the hip hop practice of mixing two or more songs.

▲ **FIGURE 1-13 GOOGLE STREET MAPPING**

Individuals can create mashups on their personal computers because mapping services provide access to the application programming interface (API), which is the language that links a database such as an address list with software such as mapping software (see Doing Geography feature).

Pause & Reflect 1.1.3 What is an example of a mashup done for your community?

DOING GEOGRAPHY

Participatory GIS & Hurricane Maria

AP® **Skills:** 1.D, 2.A, 3.A, 3.C, 4.F, 5.A, 5.B **Reasoning:** 1.iv, 1.v

After Hurricane Maria devastated Puerto Rico in September 2017, geographers at Miami University mapped a southeastern section of the island. Using software from the Humanitarian OpenStreetMap Team, the geographers placed on the map outlines of buildings from satellite imagery taken before the hurricane. The Red Cross requested the map to help identify where to respond first (Figure 1-14).

▲ **FIGURE 1-14 PARTICIPATORY GIS** Miami University geographers help the Red Cross map devastation in Puerto Rico from Hurricane Maria.

Crowdsourcing Hurricane Maria
https://goo.gl/EYFhBv

What's Your **HUMAN** Geography?

A **mental map** is a personal representation of a portion of Earth's surface. A mental map depicts what an individual knows about a place, and it contains personal impressions of what is in the place and where the place is located.

1. Draw on paper a mental map depicting your route between two familiar places, such as between home and geography class. Show the paths (roads or walkways) and landmarks along the route, such as buildings or shops.
2. Compare your mental map to those made by others in your class. How detailed is your depiction of paths and landmarks compared to those of others? At school, for example, a senior is likely to have a more detailed map than a newcomer.
3. Compare your mental map to a map of the same area from Google Maps or Bing Maps. How accurate is your map? Did you forget something important or put something in the wrong place?
4. At OpenStreetMap.org, see if your route has been mapped. Click the Directions arrow icon to the right of "Go." Enter your starting and ending addresses. Choose car, bicycle, or foot. Press "Go." Is this your preferred route? Why or why not (Figure 1-15)? Are any landmarks you consider important on the map? Why or why not?

▲ **FIGURE 1-15 OPENSTREETMAP, WASHINGTON, D.C.** The path by foot from the Association of American Geographers office (green pin) to the National Geographic office (red pin) passes several landmarks, including churches, memorials, and embassies.

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Making Maps

Learning Outcome 1.1.4 Explain the role of map scale and projection in reading maps.

To make any map, a cartographer must make two decisions:

- How much of Earth's surface to depict on the map (map scale).
- How to transfer a spherical Earth to a flat map (projection).

Map Scale

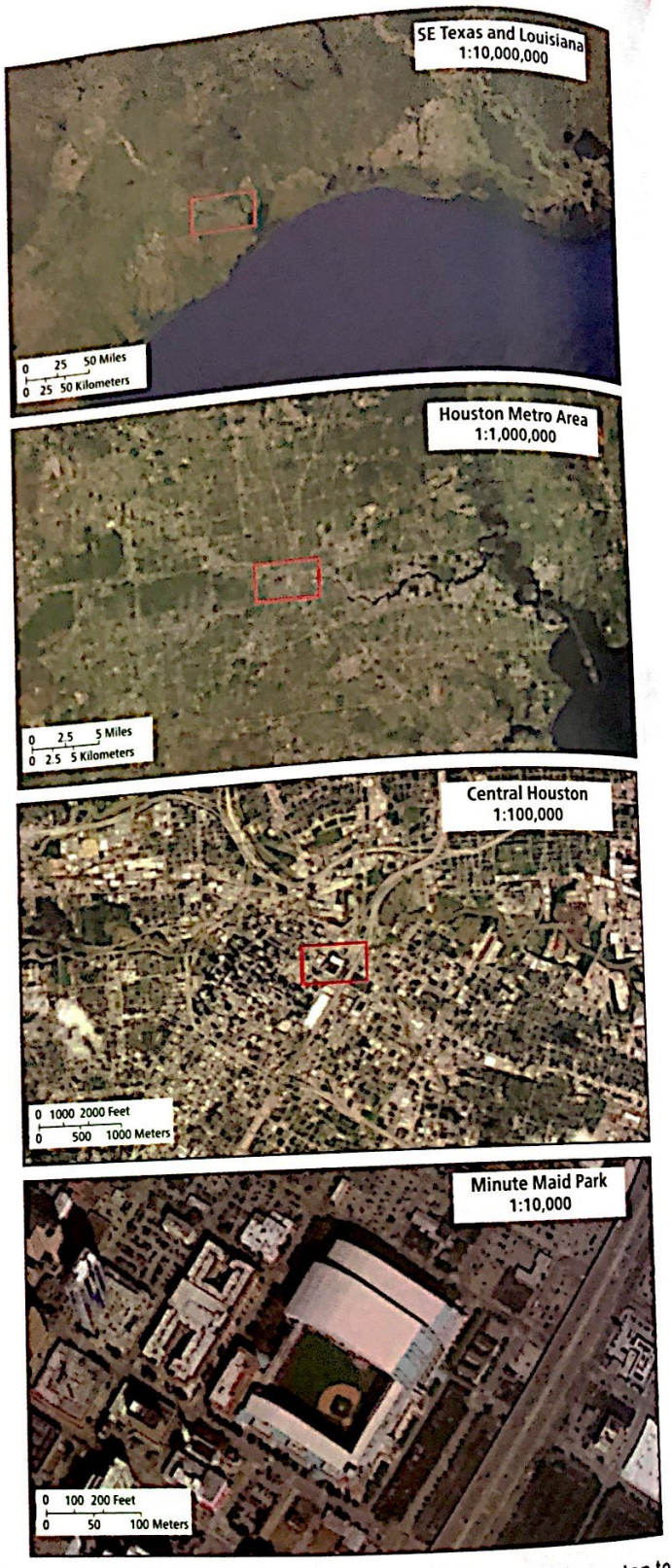
What is the purpose of the map? Is it necessary to show the entire globe on a map, or just one continent, or a country, or a city? To make a scale model of the entire world, many details must be omitted because there simply is not enough space. Conversely, if a map shows only a small portion of Earth's surface, such as a street map of a city, it can provide a wealth of detail about a particular place.

The level of detail and the amount of area covered on a map depend on its **map scale**. When specifically applied to a map, map scale refers to the relationship of a feature's size on a map to its actual size on Earth. Map scale is presented in three ways (Figure 1-16).

- **Ratio.** A ratio or fraction shows the numerical relationship between distances on the map and Earth's surface. A scale of 1:1,000,000 means that 1 unit (for example, inch, centimeter, foot, finger length) on the map represents 1 million of the same unit on the ground. The 1 on the left side of the ratio always refers to a unit of distance on the map, and the number on the right always refers to the same unit of distance on Earth's surface.
- **Written.** A written scale describes the relationship between map and Earth distances in words. For example, in the statement "1 centimeter equals 10 kilometers," the first number refers to map distance and the second to distance on Earth's surface.
- **Graphic.** A graphic scale usually consists of a bar line marked to show distance on Earth's surface. To use a bar line, first determine with a ruler the distance on the map in inches or centimeters. Then hold the ruler against the bar line and read the number on the bar line opposite the map distance on the ruler. The number on the bar line is the equivalent distance on Earth's surface.

Maps often display scale in more than one of these three ways.

The appropriate scale for a map depends on the information being portrayed. A map of a downtown area, such as Figure 1-16 (bottom), may have a scale of 1:10,000, whereas a map of southeast Texas, such as Figure 1-16 (top), may have a scale of 1:10,000,000. One inch represents about 800 feet on the Minute Maid Park map and about 158 miles on the southeast Texas map.



▲ **FIGURE 1-16 MAP SCALE** The four images show (from top to bottom) an area centered on Houston, Texas, at progressively larger scales: (top) southeast Texas, (second) the city of Houston, (third) central Houston, and (bottom) Minute Maid Park. Each map includes ratio and graphic scales.

At the scale of a small portion of Earth's surface, a map can provide detailed information about an area such as a city's downtown. At the scale of the entire globe, the amount of detail must be greatly reduced, but the map can still effectively communicate processes and trends that affect everyone.

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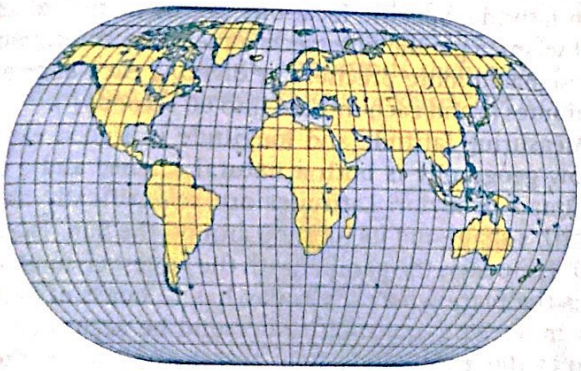
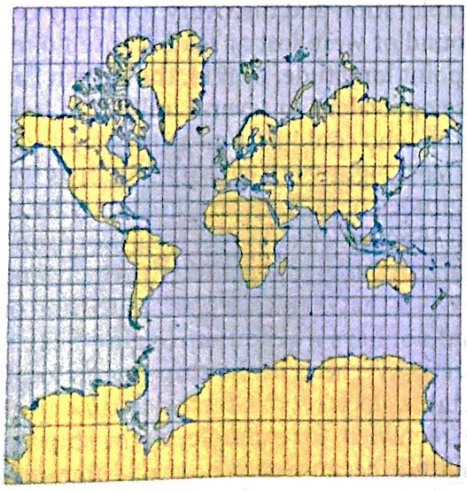
Projection

Earth is very nearly a sphere and is therefore accurately represented with a globe. However, a globe is an extremely limited tool with which to communicate information about Earth's surface. A small globe does not have enough space to display detailed information, whereas a large globe is too bulky and cumbersome to use. And a globe is difficult to write on, photocopy, display on a computer screen, or carry in the glove box of a car. Consequently, most maps – including those in this book – are flat. Three-dimensional maps can be made but are expensive and difficult to reproduce.

Earth's spherical shape poses a challenge for cartographers because drawing Earth on a flat piece of paper unavoidably produces some distortion. Cartographers have invented hundreds of clever methods of producing flat maps, but none has produced perfect results. The scientific method of transferring locations on Earth's surface to a flat map is called **projection**.



▲ **FIGURE 1-17 WINKEL PROJECTION** The relative sizes of the landmasses on the map are the same as in reality. The projection minimizes distortion in the shapes of most landmasses. Areas toward the North and South poles, such as Greenland and Australia, become more distorted, but they are sparsely inhabited, so distorting their shapes usually is not important. However, by allocating space to the oceans, the land areas are much smaller than on interrupted maps of the same size.



Animation

Map Projections
https://goo.gl/48NNbb

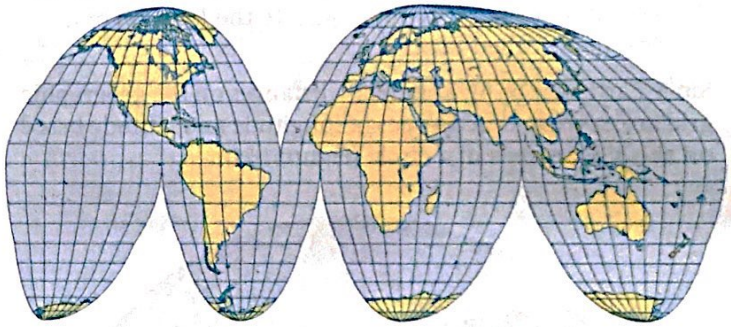
▲ **FIGURE 1-18 MERCATOR PROJECTION** Shape is distorted very little, direction is consistent, and the map is rectangular. However, relative size is grossly distorted toward the poles, making high-latitude places such as Antarctica look much larger than they actually are.

The problem of distortion is especially severe for maps depicting the entire world. Four types of distortion can result:

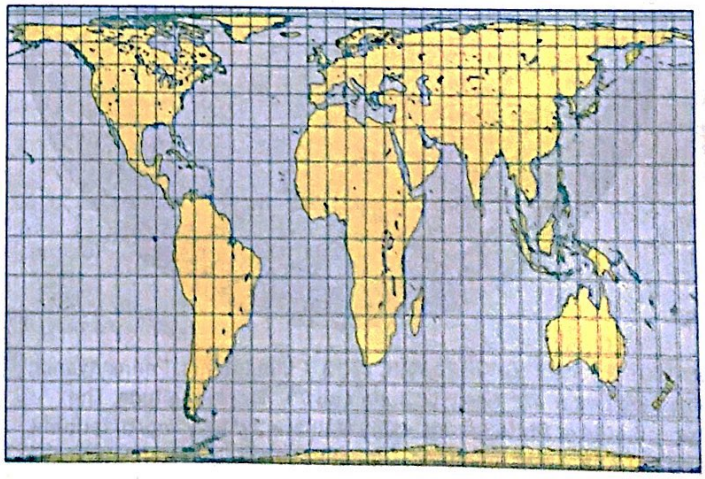
1. The ***shape*** of an area can be distorted, so that it appears more elongated or squat than in reality.
2. The ***distance*** between two points may become increased or decreased.
3. The ***relative size*** of different areas may be altered, so that one area may appear larger than another on a map but is in reality smaller.
4. The ***direction*** from one place to another can be distorted.

Most of the world maps in this book use the Winkel equal area projection (Figure 1-17). Other common world projections are Mercator (Figure 1-18), Goode Homolosine (Figure 1-19), and Gall-Peters (Figure 1-20).

Pause & Reflect 1.1.4 Compare the sizes of Greenland and South America on the four maps on this page. Which of the two landmasses is actually larger? How do you know?



▲ **FIGURE 1-19 GOODE HOMOLOSINE PROJECTION** This projection separates the Eastern and Western hemispheres into two pieces, a feature known as interruption. It gives more prominence to the landmasses. The meridians (the vertical lines), form right angles with the parallels (the horizontal lines) on a globe, but not in this projection.



▲ **FIGURE 1-20 GALL-PETERS PROJECTION** This projection does not distort relative size but does distort shape.

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Interpreting Maps

Learning Outcome 1.1.5 Explain how the geographic grid locates points on Earth's surface and helps to tell time.

Geographers can create a wide variety of maps. The most suitable variety of map depends on the type of data to be displayed.

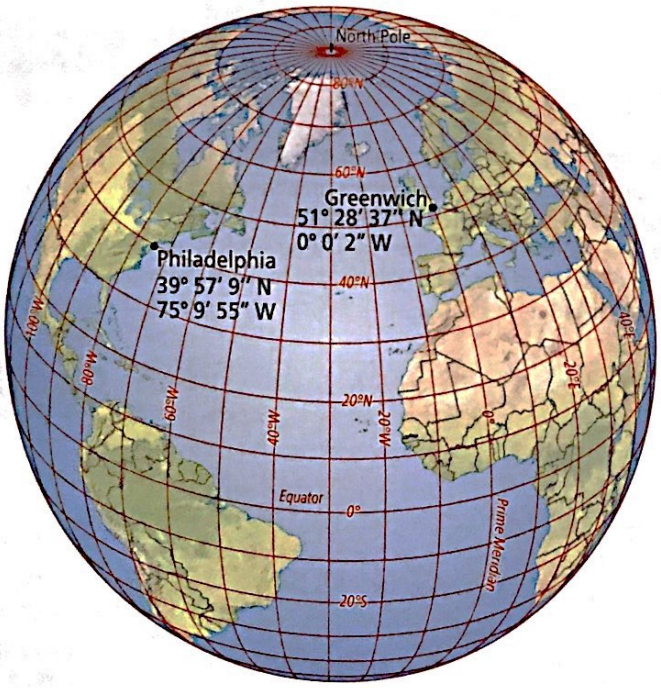
The Geographic Grid

The geographic grid is a system of imaginary arcs drawn in a grid pattern on Earth's surface. The geographic grid plays an important role in telling time.

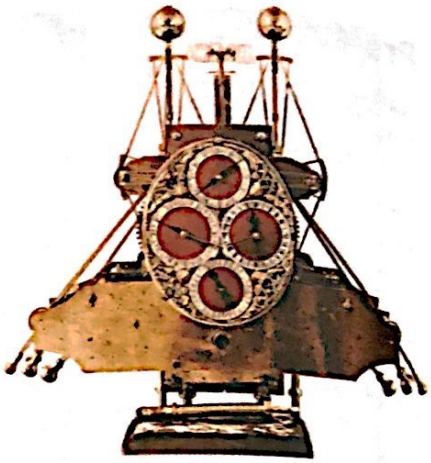
The location of any place on Earth's surface can be described precisely by meridians and parallels, two sets of imaginary arcs drawn in a grid pattern on Earth's surface:

- A **meridian** is an arc connecting the North and South poles. The location of each meridian is identified on Earth's surface according to a numbering system known as **longitude**. Longitude is the basis for telling time (see page 42).
- A **parallel** is a circle drawn around the globe parallel to the equator and at right angles to the meridians. The numbering system to indicate the location of a parallel is called **latitude**.

Since Earth is roughly spherical, distances on the geographic grid are expressed in degrees of longitude and latitude based on the 360 degrees in a circle (Figure 1-21).



▲ **FIGURE 1-21 GEOGRAPHIC GRID** Philadelphia, Pennsylvania, is located near 40° north latitude and 75° west longitude. The coordinates of Philadelphia's City Hall are 39°57'9" north latitude and 75°9'54" west longitude. Global Positioning Systems typically divide degrees into decimal fractions rather than minutes and seconds. Philadelphia's City Hall is located at 39.952583° north latitude and 75.165222° west longitude.



▲ **FIGURE 1-22 JOHN HARRISON'S CLOCK** This clock helped people in the eighteenth century calculate longitude.

The meridian that passes through the Royal Observatory at Greenwich, England, is 0° longitude, also called the **prime meridian**. The meridian on the opposite side of the globe from the prime meridian is 180° longitude. All other meridians have numbers between 0° and 180° east or west, depending on whether they are east or west of the prime meridian. The equator is 0° latitude, the North Pole 90° north latitude, and the South Pole 90° south latitude. Specific locations can be identified as the point where a parallel intersects a meridian. A location can be designated more precisely by dividing each degree into 60 minutes (') and each minute into 60 seconds (").

Measuring latitude and longitude is a good example of how geography is both a natural science and a study of human behavior. Latitudes are scientifically derived by Earth's shape and its rotation around the Sun. The equator (0° latitude) is the parallel with the largest circumference and is the place where every day has 12 hours of daylight. Even in ancient times, latitude could be accurately measured by the length of daylight and the position of the Sun and stars.

On the other hand, 0° longitude is a human creation. Any meridian could have been selected as 0° longitude because all meridians have the same length and all run between the poles. The 0° longitude runs through Greenwich because England was the world's most powerful country when longitude was first accurately measured.

Inability to measure longitude was the greatest obstacle to exploration and discovery for many centuries. Ships ran aground or were lost at sea because no one on board could pinpoint longitude. In 1714, the British Parliament offered a prize equivalent to several million in today's dollars to the person who could first measure longitude accurately.

Most eighteenth-century scientists were convinced that longitude could be determined only by the position of the stars. English clockmaker John Harrison won the prize by connecting longitude and time. He invented the first portable clock that could keep accurate time on a ship – because it did not have a pendulum (Figure 1-22). When the Sun was directly overhead of the ship – noon local time – Harrison's portable clock set to Greenwich time could say it was 2 P.M. in Greenwich, for example, so the ship would be at 30° west longitude because each hour of difference was equivalent to traveling 15° longitude.

Pause & Reflect 1.1.5 Use a search tool to find the longitude and latitude of your community.

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Types of Maps

Maps can represent the distribution of data for one or more variables in a variety of ways:

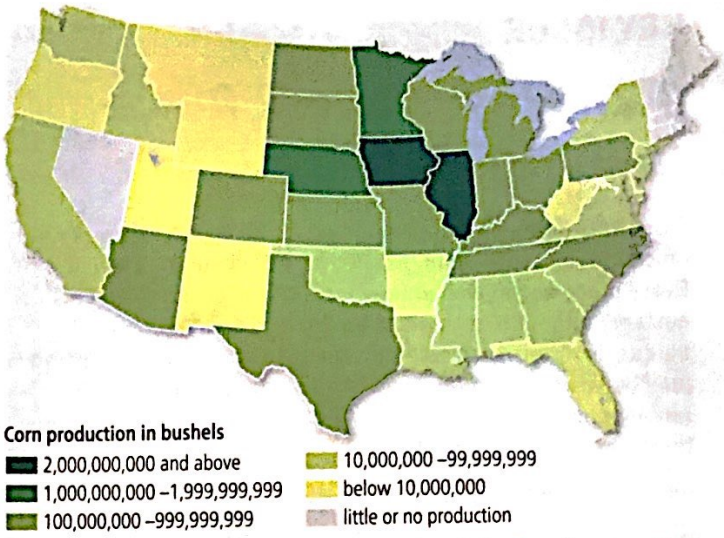
An **isoline map** connects with lines all the places that have particular values (Figure 1-23).

A **dot distribution map** depicts data as points and shows how those points are clustered together or spread out over an area. Each dot represents a predetermined number of observations, which could be one or many (Figure 1-24).

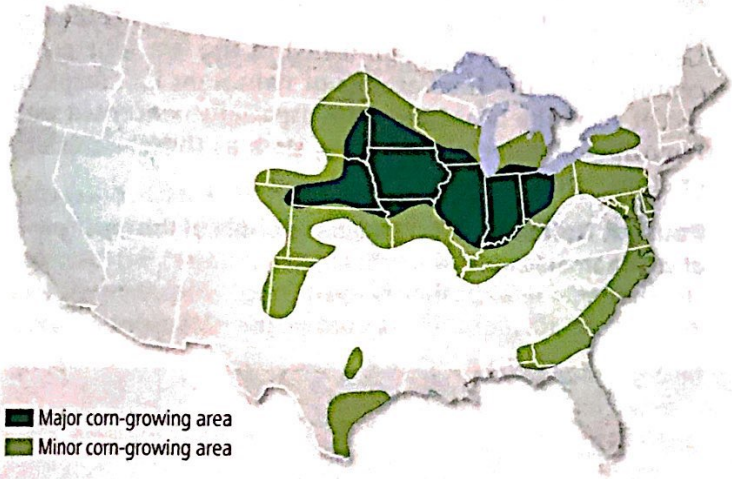
A **choropleth map** is a map where recognizable areas are shaded or patterned in proportion to the measurement of the variable. For example, areas with darker colors may represent the highest range of the data (Figure 1-25).

A **graduated symbol map** displays symbols that change in size according to the value of the variable. A higher value is typically represented by a larger symbol (Figure 1-26).

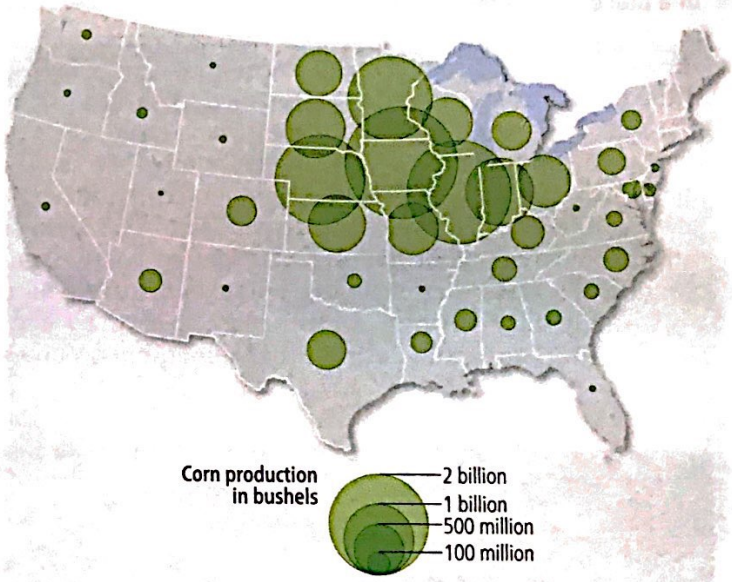
A **cartogram** is a map in which the size of a country or U.S. state is proportional to the value of a particular variable, such as the amount of corn produced, rather than to the actual land area. The cartogram in Figure 1-27 preserves the rough shapes and positions of the states, but distorts their scale: Iowa is much larger than Texas because Iowa produces a lot more corn.



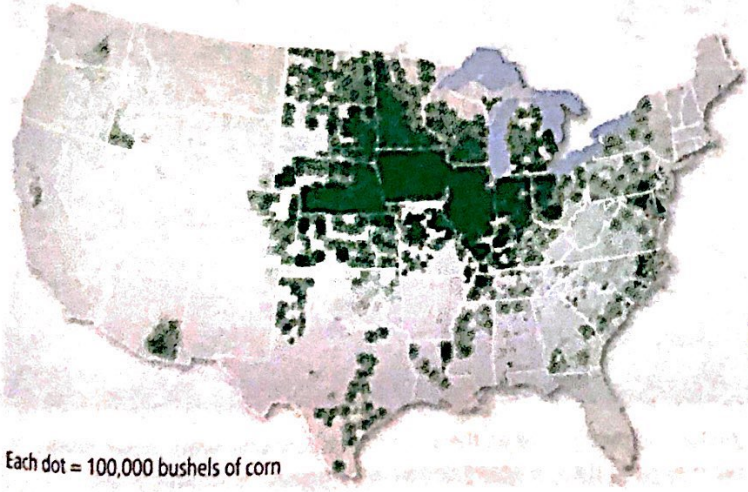
▲ **FIGURE 1-25 CHOROPLETH MAP** The darker the state, the more corn production.



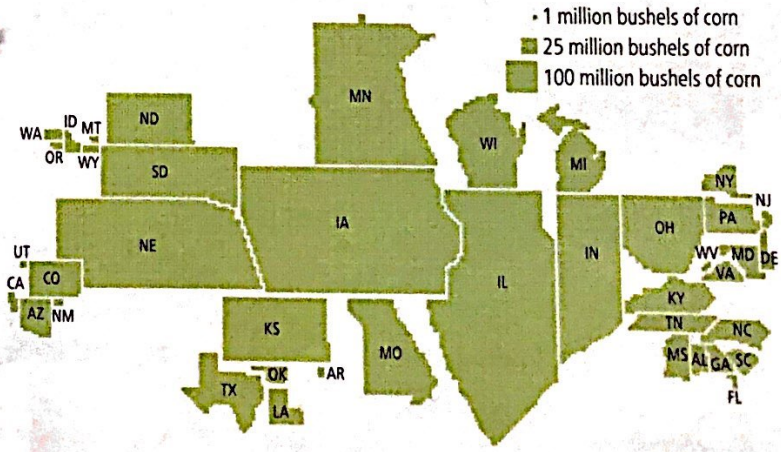
▲ **FIGURE 1-23 ISOLINE MAP** The darker the color, the more important the region for corn production.



▲ **FIGURE 1-26 GRADUATED SYMBOL MAP** The larger the circle, the more corn production.



▲ **FIGURE 1-24 DOT DISTRIBUTION MAP** More dots mean more corn production.



▲ **FIGURE 1-27 CARTOGRAM** The more corn production, the larger the area of the state.

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KEY ISSUE

1.2 | Why Is Every Place Unique?

Place was defined at the beginning of the chapter as a specific point on Earth distinguished by a particular characteristic. Every place occupies a unique location, or position, on Earth's surface. Although each place on Earth is in some respects unique, in other respects it is similar to other places. The interplay between the uniqueness of each place and the similarities among places lies at the heart of geographic inquiry into why things are found where they are.

Place: A Unique Location

Learning Outcome 1.2.1 Identify the distinctive features of a place.

Humans possess a strong sense of place – that is, a feeling for the features that contribute to the distinctiveness of a particular spot on Earth – perhaps a hometown, vacation destination, or part of a country. Describing the features of a place is an essential building block for geographers to explain similarities, differences, and changes across Earth. Geographers think about where particular places are located and the combination of features that make each place on Earth distinct.

Geographers describe a feature's place on Earth by identifying its **location**, the position that something occupies on Earth's surface. In doing so, they consider three ways to identify location: place name, site, and situation.

Place Names

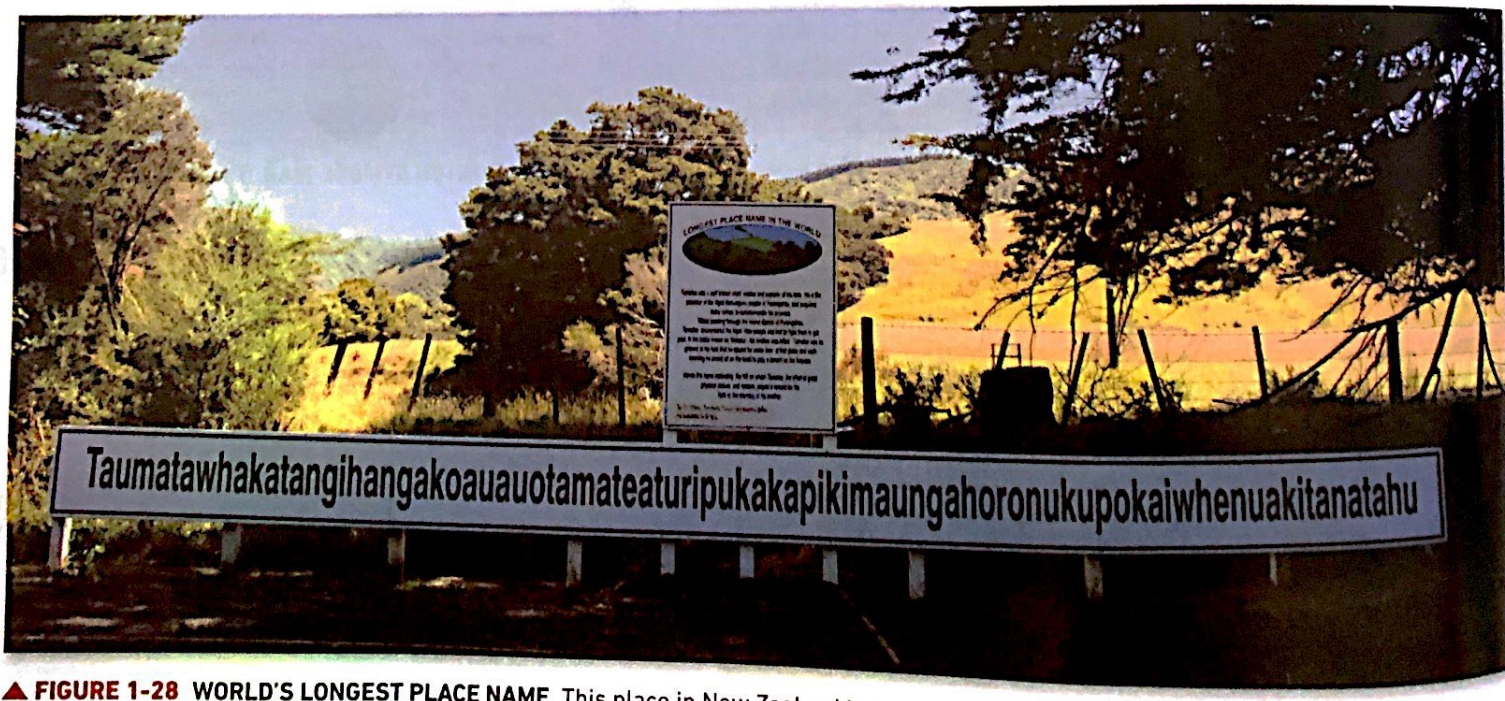
Because all inhabited places on Earth's surface – and many uninhabited places – have been named, the most straightforward way to describe a particular location is often by referring to its place name. A **toponym** is the name given to a place on Earth.

A place may be named for a person, perhaps its founder or a famous person with no connection to the community, such as George Washington. Some settlers select place names associated with religion, such as St. Louis and St. Paul, whereas other names derive from ancient history, such as Athens, Attica, and Rome, or from earlier occupants of the place, such as Milwaukee and Pontiac (Figure 1-28).

A place name may also indicate the origin of its settlers. Place names commonly have British origins in North America and Australia, Portuguese origins in Brazil, Spanish origins elsewhere in Latin America, and Dutch origins in South Africa. Some place names derive from features of the physical environment. Trees, valleys, bodies of water, and other natural features appear in the place names of most languages.

The Board of Geographical Names, operated by the U.S. Geological Survey, was established in the late nineteenth century to be the final arbiter of names on U.S. maps. In recent years the board has been especially concerned with removing offensive place names, such as those with racial or ethnic connotations.

Pause & Reflect 1.2.1 What is the origin of the toponym of your hometown?



▲ **FIGURE 1-28 WORLD'S LONGEST PLACE NAME** This place in New Zealand is recognized as the world's longest one-word place name. It translates from the Maori language as "The summit where Tamatea, the man with the big knees, who slid, climbed, and swallowed mountains, known as the land-eater, played his flute to his loved one."

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Site

The second way that geographers describe the location of a place is by **site**, which is the physical character of a place. Important site characteristics include climate, water sources, topography, soil, vegetation, latitude, and elevation. The combination of physical features gives each place a distinctive character.

Site factors have always been essential in selecting locations for settlements, although people have disagreed on the attributes of a good site, depending on cultural values. Some have preferred a hilltop site for easy defense from attack. Others have located settlements near convenient river-crossing points to facilitate communication with people in other places.

Humans have the ability to modify the characteristics of a site. Central Boston is more than twice as large today as it was during colonial times (Figure 1-29). Colonial Boston was a peninsula connected to the mainland by a very narrow neck. During the nineteenth century, a dozen major projects filled in most of the bays, coves, and marshes. A major twentieth-century landfill project created Logan Airport. Several landfill projects continue into the twenty-first century. The central areas of New York and Tokyo have also been expanded through centuries of landfilling in nearby bodies of water, substantially changing these sites.

▲ **FIGURE 1-29 CHANGING SITE OF BOSTON** The site of Boston has been altered by filling in much of Boston Harbor.

Situation

Situation, also known as **relative location**, is the location of a place relative to other places. **Absolute location** describes the position of a place in a way that never changes, such as geographic coordinates of latitude and longitude. Situation is a valuable way to indicate location, for two reasons:

- **Finding an unfamiliar place.** Situation helps us find an unfamiliar place by comparing its location with a familiar one. We give directions to people by referring to the situation of a place: "It's down past the courthouse, on Locust Street, after the third traffic light, beside the yellow-brick bank." We identify important buildings, streets, and other landmarks to direct people to the desired location.
- **Understanding the importance of a place.** Many locations are important because they are accessible to other places. For example, because of its situation, Gibraltar has become a center for the trading and distribution of goods between Europe and Africa (Figure 1-30). Gibraltar is situated along the Strait of Gibraltar, which connects the Mediterranean Sea and Atlantic Ocean (Figure 1-31). Gibraltar is an especially important route for ships traveling between Europe and the Western Hemisphere.

▲ **FIGURE 1-30 SITUATION OF GIBRALTAR** This satellite image shows why the narrow Strait of Gibraltar has been of great strategic importance for many centuries.

▶ **FIGURE 1-31 STRAIT OF GIBRALTAR: PASSAGE BETWEEN CONTINENTS** The USS George H.W. Bush passes the Rock of Gibraltar as it travels through the Strait of Gibraltar.

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Region: A Unique Area

Learning Outcome 1.2.2 Identify the three types of regions.

The "sense of place" that humans possess may apply to a larger area of Earth rather than to a specific point. Region was defined at the beginning of the chapter as an area of Earth distinguished by one or more distinctive characteristics. People, activities, and environment display similarities and regularities within a region and differ in some ways from those of other regions. A region gains uniqueness from possessing not a single human or environmental feature but a combination of them.

A particular place can be included in more than one region, depending on how the region is defined. The designation "region" can be applied to any area larger than a point and smaller than the entire planet. Geographers most often apply the concept at one of two scales:

- Several neighboring countries that share important features, such as those in Latin America.
- Many localities within a country, such as those in southern California.

Cultural Landscape

A region derives its unified character through the **cultural landscape** – a combination of cultural features such as language and religion, economic features such as agriculture and industry, and physical features such as climate and vegetation. The southern California region can be distinguished from the northern California region, for example.

The contemporary cultural landscape approach in geography – sometimes called the regional studies approach – was initiated in France by Paul Vidal de la Blache (1845–1918) and Jean Brunhes (1869–1930). It was later adopted by several American geographers, including Carl Sauer (1889–1975) and Robert Platt (1891–1964). Sauer defined cultural landscape as an area fashioned from nature by a cultural group. "Culture is the agent, the natural area is the medium, the cultural landscape is the result."

Formal Region

Geographers identify three types of regions – formal, functional, and vernacular. A **formal region**, also called a **uniform region**, is an area within which everyone shares in common one or more distinctive characteristics. The shared feature used to define the region could be a cultural value such as a common language, an economic activity such as production of a particular crop, or an environmental property such as climate. In a formal region, the selected characteristic is present throughout.

Some formal regions are easy to identify, such as countries or local government units. Montana is an example of a formal region, characterized with equal intensity throughout the state by a government that passes laws, collects taxes, and issues license plates. The formal region of Montana has clearly drawn and legally recognized boundaries, and everyone living within them shares the status of being subject to a common set of laws.

In other kinds of formal regions, a characteristic may be predominant rather than universal (Figure 1-32). For example, the North American winter wheat belt is a formal region in which wheat is the most commonly grown crop, but other crops are grown there as well. And the winter wheat belt can be distinguished from the corn belt, which is a region where corn is the most commonly grown crop (refer to Figures 1-23 through 1-27).

In identifying a formal region, it is important to recognize the diversity of cultural, economic, and environmental factors, even while making a generalization. A minority of people in a region may speak a language, practice a religion, or possess resources different from those of the majority. Although a region may be described by certain positions its inhabitants hold in society based on their gender or ethnicity, individuals within that region may not all conform to that description.

▲ **FIGURE 1-32 FORMAL REGION: INDIGENOUS PEOPLES & LANGUAGES OF ALASKA** The language boundaries represent traditional territories at around 1900.

Source: Michael Krauss, Holton, Jim Kerr, and Colin T. West, "Indigenous Peoples and Languages of Alaska."

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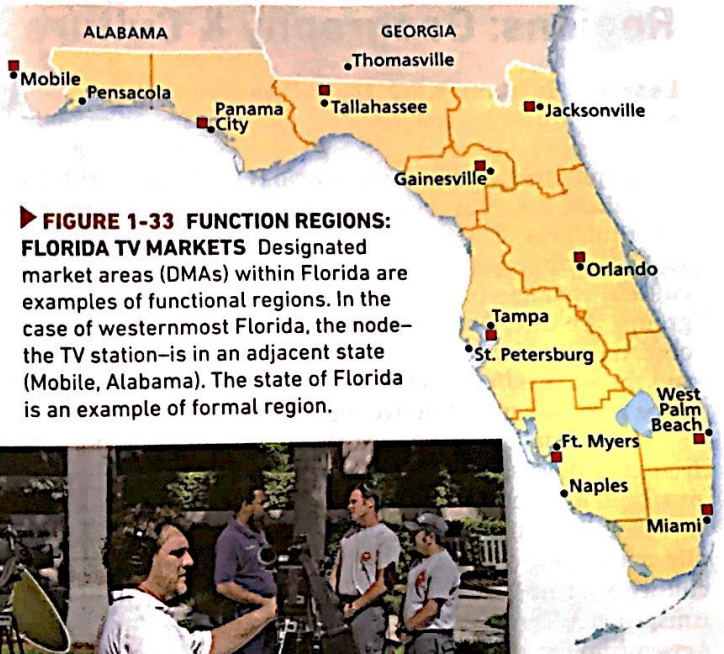
Functional Region

A **functional region**, also called a **nodal region**, is an area organized around a node or focal point. The characteristic chosen to define a functional region dominates at a central focus or node and diminishes in importance outward. The region is tied to the central point by transportation or communications systems or by economic or functional associations.

Geographers often use functional regions to convey information about economic areas. A region's node may be a shop or service, with the boundaries of the region marking the limits of the trading area of the activity. People and activities may be attracted to the node, and information may flow from the node to the surrounding area.

An example of a functional region is the reception area of a TV station. At the center of its service area, a TV station's over-the-air signal is strongest, and the percentage of cable and satellite dish receivers tuned to that station is highest. At some distance from the center, more people are watching a station originating in another city. That place is the boundary between the nodal regions of the two TV market areas (Figures 1-33 and 1-34).

Social media offer numerous examples of functional regions. Although social media can be used to interact equally with someone nearby and someone far away, in reality we interact more with people nearby and less with people far away. Nonetheless, new technology can break down some traditional functional regions. Through the Internet, customers can shop at distant stores, and newspapers composed in one place are delivered to customers elsewhere.



▶ **FIGURE 1-33 FUNCTION REGIONS: FLORIDA TV MARKETS** Designated market areas (DMAs) within Florida are examples of functional regions. In the case of westernmost Florida, the node–the TV station–is in an adjacent state (Mobile, Alabama). The state of Florida is an example of formal region.

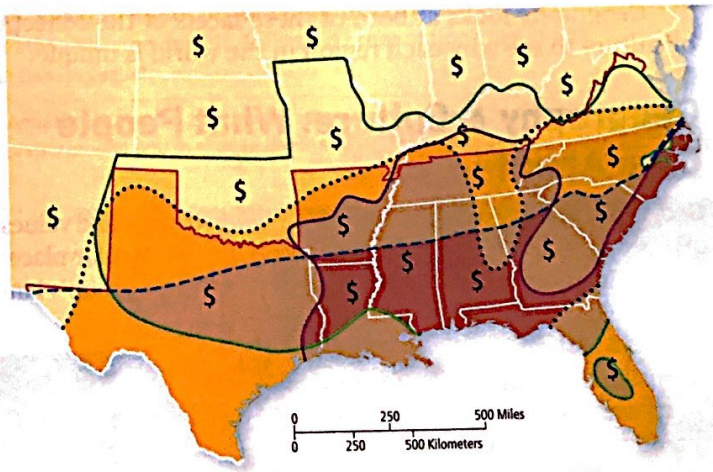
▲ **FIGURE 1-34 FUNCTIONAL REGION: TV STATION** Miami, Florida.

Vernacular Region

A **vernacular region**, or **perceptual region**, is an area that people believe exists as part of their cultural identity. Such regions emerge from people's informal sense of place rather than from scientific models developed through geographic thought.

As an example of a vernacular region, Americans frequently refer to the South as a place with environmental and cultural features perceived to be quite distinct from those of the rest of the United States (Figure 1-35). Many of these features can be measured. Environmentally, the South is a region where the last winter frost occurs in March and rainfall is more plentiful in winter than in summer. Cultural features include relatively high adherence to the Baptist religion and joining the Confederacy during the Civil War.

Pause & Reflect 1.2.2 What environmental and cultural features might help to define the region of New England?



Number of definitions of South
- 6
- 5
- 4
- 3
- 2 or less
- Confederate states
- Y'all used to address a group of people
- $ State with income below the national average
- Average annual precipitation greater than 150 cm (60 in.)
- More than 50% Baptist
- Average January temperature greater than 10°C (50°F)

▲ **FIGURE 1-35 VERNACULAR REGION: THE SOUTH** The South is popularly distinguished as a distinct vernacular region within the United States, according to a number of factors.

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Regions: Geography & Culture

Learning Outcome 1.2.3 Explain two geographic elements in defining culture.

Geographers refer to **culture**, which is the body of customary beliefs, material traits, and social forms that together constitutes the distinct tradition of a group of people. Geographers distinguish groups of people according to important cultural characteristics, describe where particular cultural groups are distributed, and offer reasons to explain the observed distribution. The distribution of cultural groups and the ways different cultures are expressed in the landscape gives rise to distinctive regions.

In everyday language, we think of culture as the collection of novels, paintings, symphonies, and other works produced by talented individuals. A person with a taste for these intellectual outputs is said to be "cultured." Intellectually challenging culture is often distinguished from popular culture, such as TV. Culture also refers to small living organisms, such as those found under a microscope or in yogurt. Agriculture is a term for the growing of living material at a much larger scale than in a test tube.

The origin of the word culture is the Latin *cultus*, which means "to care for." Culture is a complex concept because "to care for" something has two very different meanings:

- To care about – to adore or worship something, as in the modern word cult.
- To take care of – to nurse or look after something, as in the modern word cultivate.

Geography looks at both of these facets of the concept of culture to see why each region in the world is unique.

Geography & Culture: What People Care About

Geographers study why the customary ideas, beliefs, and values of a people produce a distinctive culture in a particular place. Especially important cultural values derive from a group's language, religion, and ethnicity. These three cultural traits are an excellent way of identifying the location of a culture as well as the principal means by which cultural values become distributed around the world.

Language is a system of signs, sounds, gestures, and marks that have meanings understood within a cultural group. People communicate the cultural values they care about through language, and the words themselves tell something about where different cultural groups are located. The distribution of speakers of different languages and reasons for the distinctive distribution are discussed in Chapter 5.

Religion is an important cultural value because it is the principal system of attitudes, beliefs, and practices through which people worship in a formal, organized way. As discussed in Chapter 6, geographers look at the distribution of religious groups around the world and the different ways that the various groups interact with their environment.

Ethnicity is identity with a group of people who share the cultural traditions of a particular homeland or hearth. As addressed in Chapter 7, geographers find that problems of conflict and inequality tend to occur in places where more than one ethnic group inhabits and seeks to organize the same territory.

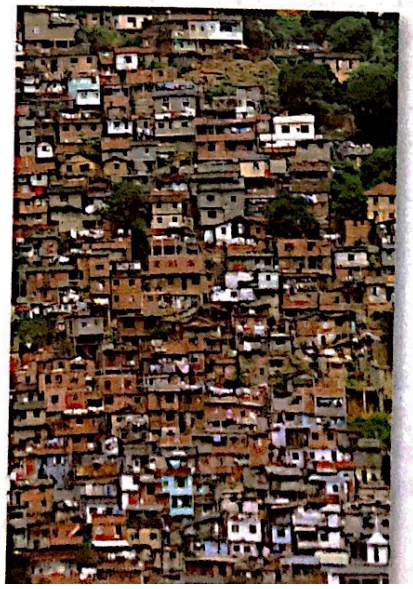
Geography & Culture: What People Take Care Of

The second element of culture of interest to geographers is production of material wealth – the food, clothing, and shelter that humans need in order to survive and thrive. All people consume food, wear clothing, build shelter (Figures 1-36 and 1-37), and create art, but different cultural groups obtain their wealth in different ways.

Geographers divide the world into regions of developed countries and regions of developing countries. Various shared characteristics – such as per capita income, level of education, and life expectancy – distinguish developed regions and developing regions. These differences are reviewed in Chapter 10.

Possession of wealth and material goods is higher in developed countries than in developing countries because of the different types of economic activities carried out in the two types of countries. People in developing countries are more likely to work in agriculture, whereas people in developed countries are more likely to earn their living through performing services in exchange for wages. This fundamental economic difference between developed and developing regions is discussed in more detail in Chapters 9 through 13.

Pause & Reflect 1.2.3 Describe differences that you see in the houses in Figures 1-36 and 1-37.



▲ **FIGURE 1-36** GEOGRAPHY & CULTURE: NEW JERSEY SUBURB

◀ **FIGURE 1-37** GEOGRAPHY & CULTURE: RIO DE JANEIRO, BRAZIL SUBURB

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Spatial Association

A region gains meaning through its unique combination of features. The presence of some of these features may be coincidental, but others are related to each other. **Spatial association** is observed within a region if the distribution of one feature is related to the distribution of another feature. Spatial association is strong if two features have very similar distributions, and spatial association is weak if two features have very different distributions.

To illustrate spatial association, Figure 1-38 displays the distribution of two features related to the opioid epidemic crisis in the United States. Is the spatial association between the two maps strong or weak?

The term opioid encompasses opiates, which are drugs, such as heroin, derived from the opium poppy plant. The term also encompasses synthetic substances manufactured into pain-management medications. The use of opioids increased rapidly in the late 1990s. Many doctors prescribed opioids for their patients, especially those who complained of chronic pain. Opioids became the most prescribed class of medications in the United States. Many of these patients became addicted to the opioids.

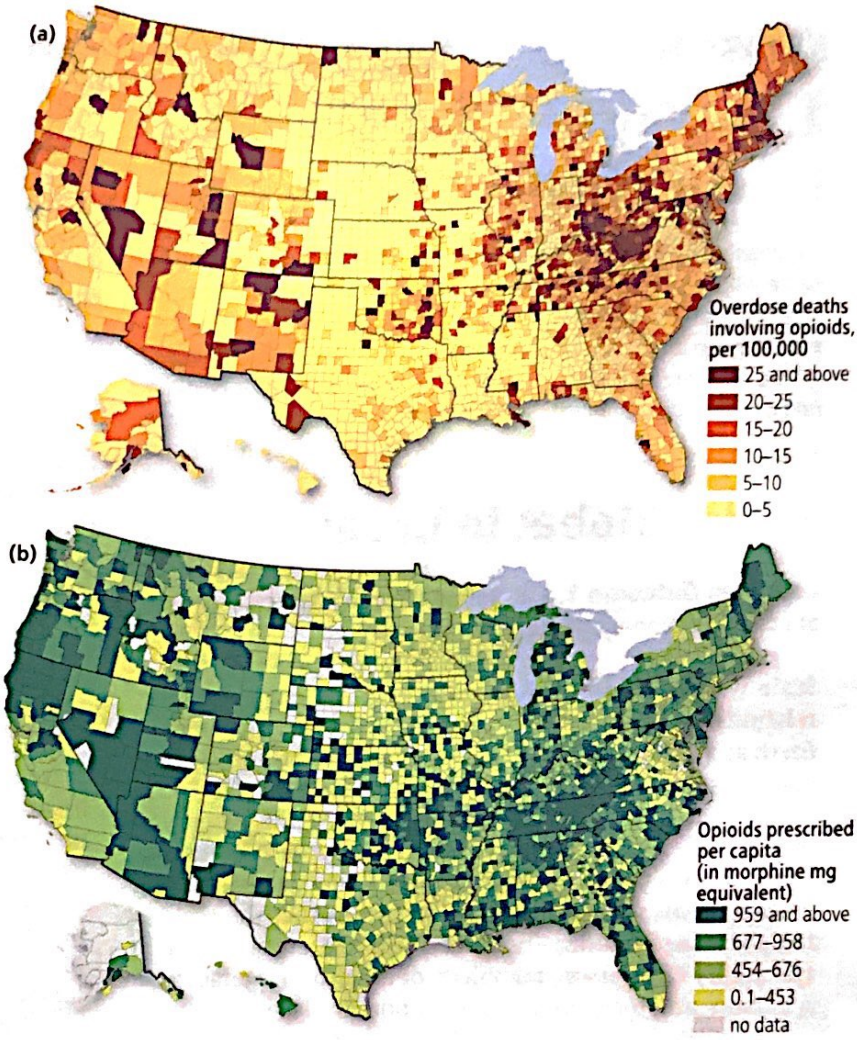
As the number of opioid users has increased in recent years, international criminal organizations known as drug cartels began flooding the United States with imported heroin from Mexico as well as synthetically manufactured opioids such as fentanyl. Addicted individuals found that these illegal sources were cheaper, more potent, and easier to acquire than prescription medications.

In the twenty-first century, drug overdose has become the leading cause of death of Americans under age 50. Two-thirds of overdose deaths are attributable to opioids, which in high doses over a long period can cause respiratory failure.

Figure 1-38a shows the distribution of overdose deaths related to opioids. Though most opioid-related deaths are in heavily populated urban areas (Figure 1-39), the highest per capita rates within the United States are in the Appalachians and the Southwest.

Figure 1-38b shows the distribution of prescriptions written for opioids. Prescription rates vary widely by state and county – three times higher in Alabama than in Hawaii, for example. The distribution of places with relatively high prescription rates is similar to the distribution of deaths from overdose. The two maps together show a strong spatial association between overdoses and prescriptions for opiods.

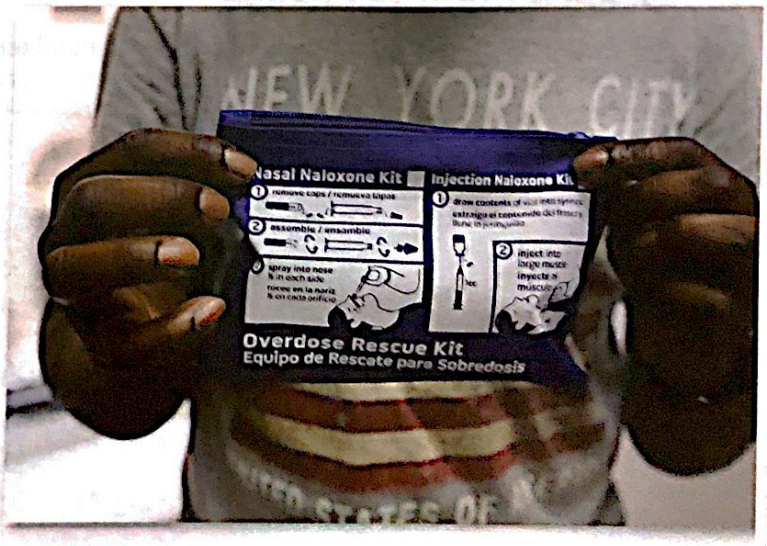
Health issues that cause people pain do not vary much from place to place and do not explain this variability in prescribing. So the variation may be related to regional differences among doctors concerning how much pain medication to prescribe.



▲ **FIGURE 1-38 SPATIAL ASSOCIATION: OPIOIDS, 2016**
(a) Overdose deaths involving opioids, (b) opioid prescriptions per capita.
Source: Centers for Disease Control

1. *In addition to Appalachia and the Southwest, identify another region that has both high rates of opioids prescriptions and overdose deaths.*

AP® **Skills:** 2.D, 3.B, 3.D, 4.B, 4.D
Reasoning: 1.iv, 2.iii



▲ **FIGURE 1-39 FIGHTING OPIOIDS** Naloxone is a medication used to block the effects of opioids. This man completed a training class in New York City on using Naloxone for opioid overdose prevention.

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KEY ISSUE

1.3 | Why Are Different Places Similar?

Geographers recognize that each place or region on Earth is in some ways unique, but they also recognize that human activities are rarely confined to one location. Three basic concepts—scale, space, and connections—help geographers explain that similarities among places and regions result from regularities rather than coincidences.

Scale: Global to Local

Learning Outcome 1.3.1 Relate the geographic concept of scale to economic and culture change.

Scale was defined at the beginning of the chapter as the relationship between the portion of Earth being studied and Earth as a whole. Geographers are especially concerned with contrasts between the local scale and the global scale.

Scale is an increasingly important concept in geography because of **globalization**, which is a force or process that involves the entire world and results in making something worldwide in scope. Globalization means that the scale of the world is shrinking – not literally in size, of course, but in the ability of a person, an object, or an idea to interact with a person, an object, or an idea in another place.

At the same time, geographers recognize the increasing importance of the local scale. In the face of globalization, groups of people are preserving and reviving distinctive cultural characteristics and implementing distinctive economic practices.

Scale & Cultural Change

Geographers observe that increasingly uniform cultural preferences produce uniform "global" landscapes of material artifacts and cultural values. Fast-food restaurants, service stations, and retail chains deliberately create a visual appearance that varies among locations as little as possible. That way, customers know what to expect, regardless of where in the world they happen to be.

Underlying the uniform cultural landscape is globalization of cultural beliefs and forms, especially religion and language. Africans, in particular, have moved away from traditional religions and have adopted Christianity or Islam, religions shared with hundreds of millions of people throughout the world. Globalization requires a form of common communication, and the English language is increasingly playing that role.

As more people become aware of elements of global culture and aspire to possess them, local cultural beliefs, forms, and traits may be practiced less often. The survival of a local culture's unique characteristics may be threatened by interaction with such social customs as wearing jeans and Nike shoes, consuming Coca-Cola and McDonald's hamburgers, and communicating using cell phones and computers.

Yet despite globalization, cultural differences among places not only persist but actually flourish in many places (Figure 1-40). Global standardization of products does not mean that everyone wants to buy the same things. The communications revolution that promotes globalization of culture also permits preservation of cultural diversity. TV, for example, was once limited to a handful of channels displaying one set of cultural values. With the distribution of programming through cable, satellite, and Internet, people now can choose from hundreds of programs in many languages.

With the globalization of communications, people in two distant places can watch the same TV program. At the same time, with the fragmentation of the broadcasting market, two people in the same house can watch different programs. Groups of people on every continent may aspire to wear jeans, but they might live in a situation where it is prohibited by cultural values or economic realities.

Pause & Reflect 1.3.1 Give an example of a cultural activity or preference from another part of the world that has become popular among your friends or in your school.

(a)

(b)

FIGURE 1-40 BUYING FOOD (a) Street market, Kenya. (b) Supermarket, Montana.

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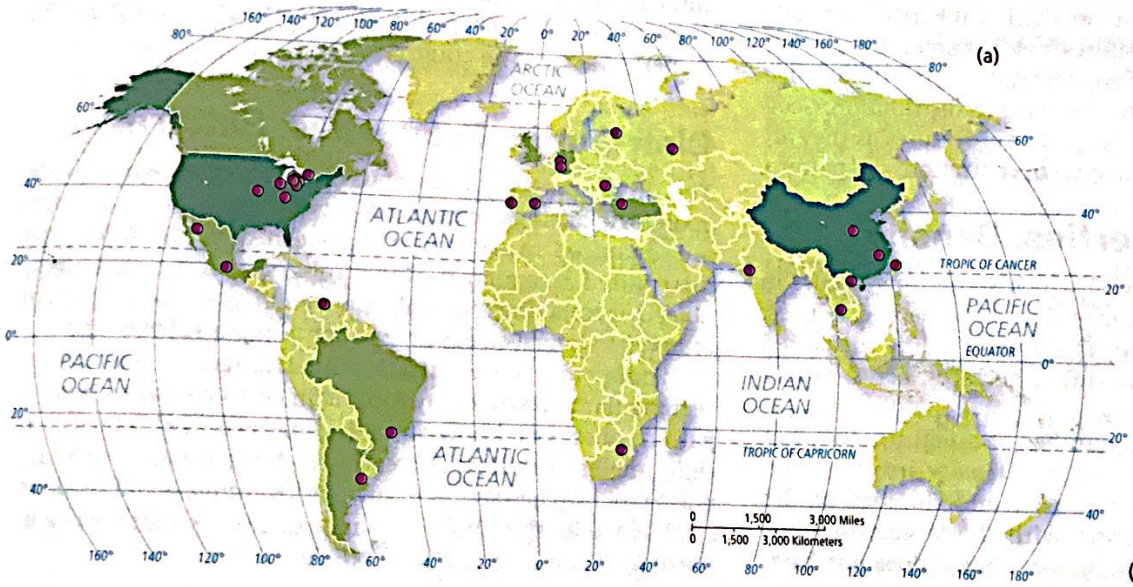
Scale & Economic Change

A few people living in very remote regions of the world may be able to provide all of their daily necessities. But most economic activities undertaken in one region are influenced by interaction with decision-makers located elsewhere. The choice of crop is influenced by demand and prices set in global markets. The factory is located to facilitate bringing in raw materials and shipping out products to the markets.

Globalization of the economy has been led primarily by transnational corporations, sometimes called multinational corporations. A **transnational corporation** conducts research, operates factories, and sells products in many countries, not just where its headquarters and principal shareholders are located. Examples include Ford (Figure 1-41) and McDonald's (Figure 1-42).

Every place in the world is part of the global economy, but globalization has led to more specialization at the local level. Each place plays a distinctive role, based on its local assets, as assessed by transnational corporations. A locality may be especially suitable for a transnational corporation to conduct research, to develop new engineering systems, to extract raw materials, to produce parts, to store finished products, to sell them, or to manage operations. In a global economy, transnational corporations remain competitive by correctly identifying the optimal location for each of these activities. Factories are closed in some locations and opened in others.

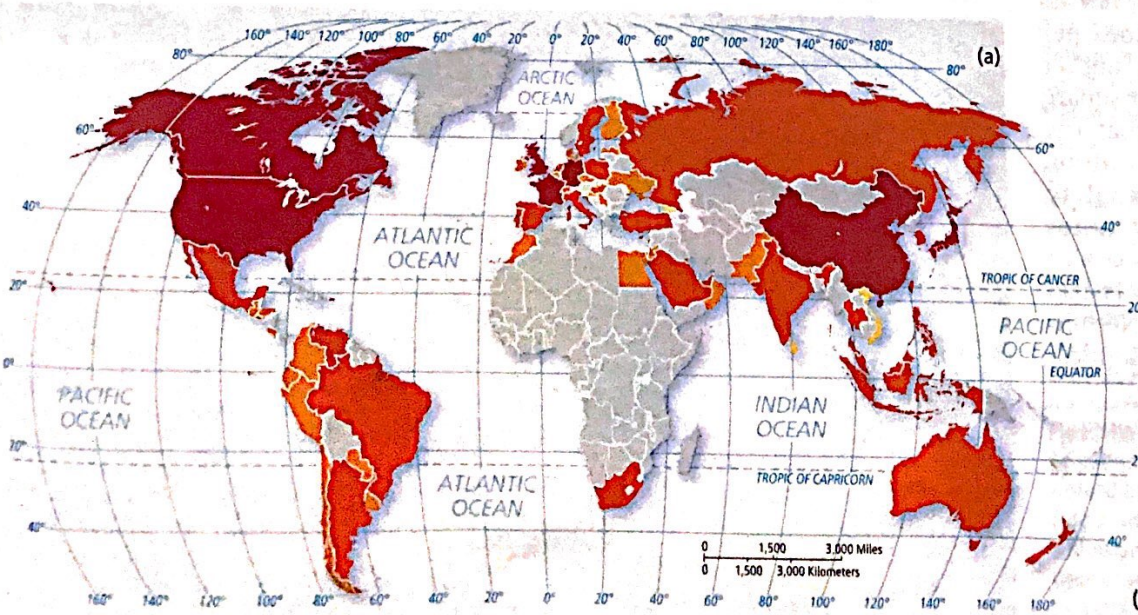
Changes in production have led to a spatial division of labor in which a region's workers specialize in particular tasks. Transnationals decide where to produce things in response to characteristics of the local labor force, such as level of skills, prevailing wage rates, and attitudes toward unions. Transnationals may close factories in locations with high wage rates and strong labor unions. Particular production tasks are clustered in specific geographic areas.



Annual Ford vehicle sales
- over 1 million
- 100,000–999,999
- less than 100,000
- Ford assembly plant

FIGURE 1-41 GLOBAL ECONOMY: FORD MOTOR COMPANY SALES AND VEHICLE ASSEMBLY PLANTS (a) Sales and vehicle assembly plants. (b) Corporate logo on a dealer in Vilnius, Lithuania.

(b)



Number of McDonald's restaurants
- 1,000 and above
- 100–999
- 10–99
- below 10
- none

FIGURE 1-42 GLOBAL ECONOMY: MCDONALD'S (a) Number of restaurants per country. (b) Corporate logo, Fukuyama, Japan.

(b)

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Space: Distribution of Features

Learning Outcome 1.3.2 Compare three properties of distribution.

Space was defined at the beginning of the chapter as the physical gap or interval between two objects. The arrangement of a feature in space is known as its **distribution**. Geographers observe that many objects are distributed across space in a regular manner, for discernible reasons. Spatial thinking is the most fundamental skill that geographers possess to understand the arrangement of objects across Earth. When geographers observe the arrangements of people and activities found in space, they investigate why and how those distributions come to be.

Geographers explain how features such as buildings and communities are arranged across Earth. On Earth as a whole, or within an area of Earth, features may be numerous or scarce, close together or far apart. Geographers studying the arrangement of a feature in space are observing its distribution. Geographers identify three main properties of features as they are distributed across Earth – density, concentration, and pattern.

Distribution Properties: Density

Density is the frequency with which something occurs in space. The feature being measured could be people, houses, cars, trees, or anything else. The area could be measured in square kilometers, square miles, hectares, acres, or any other unit of area.

Remember that a large number of a feature does not necessarily lead to a high density. Density involves two measures – the number of a feature and the size of the land area. China is the country with the largest number of people – approximately 1.4 billion – but it does not have the world's highest density. The Netherlands, for example, has only 17 million people, but its density of around 511 persons per square kilometer is much higher than China's 148 persons per square kilometer. The reason is that the land area of China is 9.6 million square kilometers, compared to only 42,000 square kilometers for the Netherlands.

High population density is also unrelated to poverty. The Netherlands is one of the world's wealthiest countries, and Mali one of the world's poorest. Yet the Netherlands' density of around 511 persons per square kilometer is much higher than Mali's density of 16 persons per square kilometer (see Chapter 2 for more about density).

Distribution Properties: Concentration

The extent of a feature's spread over space is its **concentration**. If the objects in an area are close together, they are clustered; if relatively far apart, they are dispersed. To compare the level of concentration most clearly, two areas need to have the same number of objects and the same size area.

Geographers use concentration to describe changes in distribution. For example, the distribution of people across the United States is increasingly dispersed. The total number of people living in the United States is growing slowly – less than 1 percent per year – and the land area is essentially unchanged. But the population distribution is changing from relatively clustered in the Northeast to more evenly dispersed across the country.

Distribution Properties: Pattern

The third property of distribution is **pattern**, which is the geometric arrangement of objects in space. Some features are organized in a geometric pattern, whereas others are distributed irregularly. Geographers observe that many objects form a linear distribution, such as the arrangement of houses along a street or stations along a subway line.

Some objects are purposefully arranged in a square or rectangular pattern. Many American cities contain a regular pattern of streets, known as a grid pattern, that intersect at right angles at uniform intervals to form square or rectangular blocks. The system of townships, ranges, and sections established by the Land Ordinance of 1785 is another example of a square or grid pattern (Figure 1-43).

FIGURE 1-43 PATTERN: TOWNSHIP AND RANGE The U.S. Land Ordinance of 1785 divided much of the United States into a checkerboard pattern, which is still visible in agricultural areas, including parts of California.

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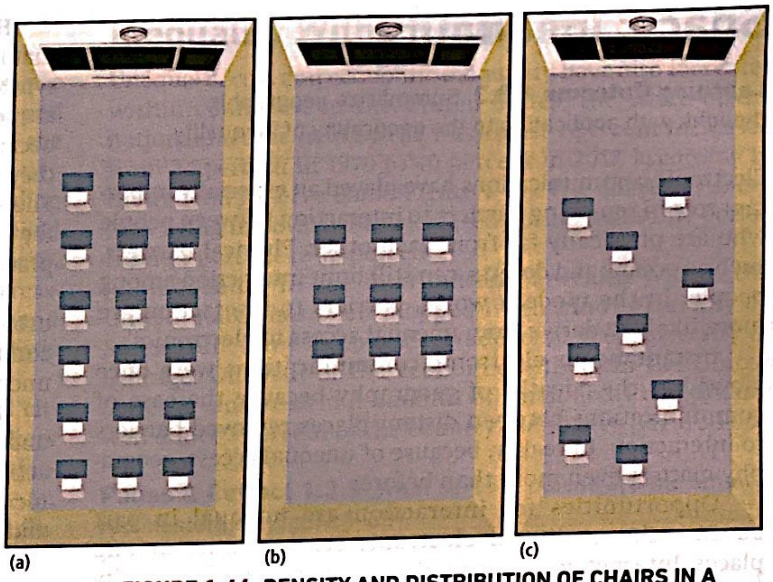
Distribution Properties: Your Space

Look around your classroom. How many people are in the room? That number divided by the size of the room is the density. Are the people spread evenly through the classroom, or are they bunched together in one part of the room? That's the concentration—either clustered or dispersed. Are the desks lined up in rows or distributed randomly around the room? That's the pattern (Figure 1-44).

Pause & Reflect 1.3.2 Describe the distribution properties of your classroom.

Concentration is not the same as density. Two neighborhoods could have the same density of housing but different concentrations. In a dispersed neighborhood, each house has a large private yard, whereas in a clustered neighborhood, the houses are close together and the open space might be shared as a community park.

The distribution of major-league baseball teams illustrates the difference between density and concentration (Figure 1-45). After remaining unchanged during the first half of the twentieth century, the distribution of major league baseball teams changed during the second half of the twentieth century. The major leagues expanded from 16 to 30 teams in North America between 1960 and 1998, thus increasing the density. At the same time, 6 of the 16 original teams moved to other locations. In 1952, every team was clustered in the Northeast United States, but the moves dispersed several teams to the West Coast and Southeast. These moves, as well as the locations occupied by the expansion teams, resulted in a more dispersed distribution.



▲ **FIGURE 1-44 DENSITY AND DISTRIBUTION OF CHAIRS IN A CLASSROOM** Classroom (a) has a higher density than classroom (b)—18 desks and chairs compared to 9 desks and chairs in the same size room—but both have clustered concentrations. Classrooms (b) and (c) have the same density (9 desks and chairs in the same size room), but the distribution of chairs and desks is more clustered in (b) and more dispersed in (c).

◀ **FIGURE 1-45 DISTRIBUTION OF BASEBALL TEAMS** The changing distribution of North American baseball teams illustrates the difference between density and concentration. As a result of these relocations and additions, the density of teams increased, and the distribution became more dispersed.

These 6 teams moved to other cities during the 1950s and 1960s:

Braves—Boston to Milwaukee in 1953, then to Atlanta in 1966
Browns—St. Louis to Baltimore (Orioles) in 1954
Athletics—Philadelphia to Kansas City in 1955, then to Oakland in 1968
Dodgers—Brooklyn to Los Angeles in 1958
Giants—New York to San Francisco in 1958
Senators—Washington to Minneapolis (Minnesota Twins) in 1961

These 14 teams have been added since 1961:

Angels—Los Angeles in 1961, then to Anaheim (California) in 1965
Senators—Washington in 1961, then to Dallas (Texas Rangers) in 1971
Mets—New York in 1962
Astros—Houston (originally Colt .45s) in 1962
Royals—Kansas City in 1969
Padres—San Diego in 1969
Nationals—Montreal (Expos) in 1969, then to Washington (Nationals) in 2005
Brewers—Seattle (Pilots) in 1969, then to Milwaukee (Brewers) in 1970
Blue Jays—Toronto in 1977
Mariners—Seattle (Pilots) in 1977
Marlins—Miami (originally Florida) in 1993
Rockies—Denver (Colorado) in 1993
Rays—Tampa Bay (originally Devil Rays) in 1998
Diamondbacks—Phoenix (Arizona) in 1998

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Space: Inequality

Learning Outcome 1.3.3 Summarize geographic thought, with application to the geography of inequality.

Electronic communications have played an especially important role in removing barriers to interaction between people who are physically far from each other. Physical barriers, such as oceans and deserts, can still limit interaction among people. In the modern world, barriers to interaction are more likely to derive from unequal access to electronics.

Instantaneous electronic communications were once viewed as the "death" of geography because the ease of communications between distant places removed barriers to interaction. In reality, because of unequal access, geography matters even more than before.

Opportunities for interaction are unequal in part because the quality of electronic service varies among places. Internet access depends on availability of electricity to power the computer or recharge a smartphone or tablet. Broadband service requires proximity to a digital subscriber line (DSL), a cable line, or other services. Most importantly, a person must be able to afford to pay for the communications equipment and service. Poorer people may be excluded from financial services, jobs, and information readily available online to more affluent people.

Geographic Thought

Geographers take a range of approaches to cultural identity and space, including those of poststructuralist, humanistic, and behavioral geography. **Poststructuralist geography** examines how the powerful in a society dominate, or seek to control, less powerful groups, how the dominated groups occupy space, and confrontations that result from the domination. Poststructuralist geographers understand space as the product of ideologies or value systems of ruling elites.

Some postructuralist geographers have studied how, although it is illegal to discriminate against people of color, local governments have pursued policies that impose hazardous, polluting industries on minority neighborhoods. For example, the 100,000 residents of Flint, Michigan, were exposed to high levels of lead in their drinking water beginning in 2014, a situation that took many years to address.

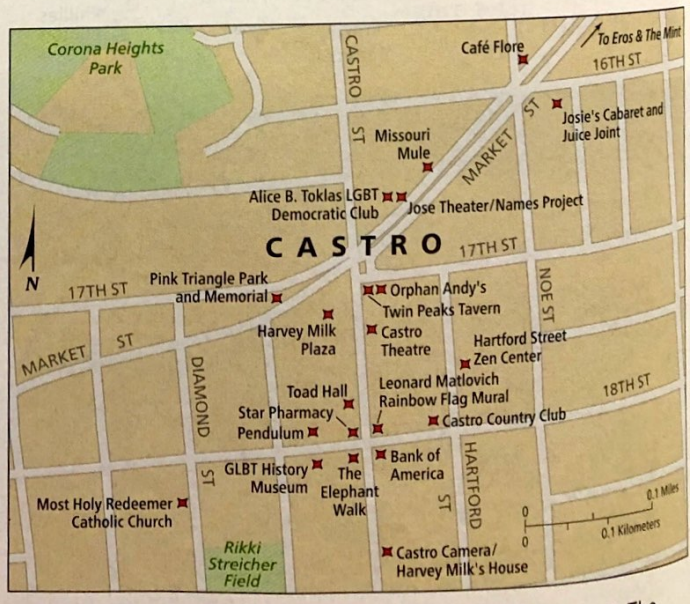
After a state of emergency was declared in 2016, Flint residents were instructed to use only bottled or filtered water for drinking, cooking, cleaning, and bathing. The crisis began when the water department changed its source of water to the Flint River, and failed to treat it properly. As a result, lead from aging pipes leached into the water supply. Critics charged that switching the source of water was done to cut costs in a city comprising more than 50 percent African Americans, an unemployment rate of around 25 percent, and a median income less than one-half the U.S. average (Figure 1-46).

Humanistic geography emphasizes the different ways that individuals form ideas about place and give those places symbolic meanings. For example, LGBTQ people may be attracted to places such as the Castro District in San Francisco because they perceive them as LGBTQ-friendly spaces where they can interact socially with other LGBTQ people (Figure 1-47). The Castro may be seen as offering an accepting location for LGBTQ people through inclusive policies and business practices.

Similarly, African Americans can find themselves in an urban neighborhood they perceive to be "white space." A community that is comfortable for a white person can be uncomfortable and unwelcoming to an African American.

Behavioral geography emphasizes the importance of understanding the psychological basis for individual human actions in space. Distinctive spatial patterns by gender, ethnicity, and sexual orientation are constructed by the attitudes and actions of cultural groups as well as the larger society.

▲ **FIGURE 1-46 FLINT WATER CRISIS** Residents of Flint, Michigan march to the city's water treatment plant, chanting, "No pipes, no peace," demanding swift restoration of drinkable water.



▲ **FIGURE 1-47 THE CASTRO DISTRICT, SAN FRANCISCO** The neighborhood has a large number of places that are significant in the development of identity for LGBTQ people.

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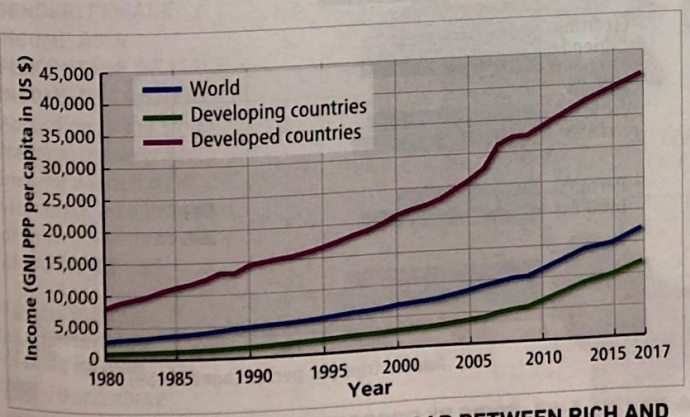
Uneven Development

Global culture and economy are increasingly centered on the three core, or hearth, regions of North America, Europe, and East Asia. These three regions have a large percentage of the world's advanced technology, capital to invest in new activities, and wealth to purchase goods and services. Surrounding the core are developing countries on the periphery with limited access to the world centers of consumption, communications, wealth, and power, which are clustered in the core. The increasing gap in economic conditions between regions in the core and periphery that results from the globalization of the economy is known as **uneven development** (Figure 1-48).

From "command centers" in the three major world cities of New York, London, and Tokyo, key decision makers employ modern telecommunications to send orders to factories, shops, and research centers around the world – an example of hierarchical diffusion (see page 31). Meanwhile, "nonessential" employees of the companies can be relocated to lower-cost offices outside the major financial centers. For example, Apple maintains corporate headquarters in Cupertino, California, but most of the parts in its phones, tablets, and computers are made in Asian countries, primarily China, India, Japan, and South Korea.

People in peripheral regions, who once toiled in isolated farm fields to produce food for their families, now produce crops for sale in core regions or have given up farm life altogether and migrated to cities in search of jobs in factories and offices. As a result, the global economy has produced greater disparities than in the past between the levels of wealth and well-being enjoyed by people in the core and in the periphery.

In a global culture and economy, every area of the world plays some role intertwined with the roles played by other regions. Workers and cultural groups that in the past were largely unaffected by events elsewhere in the world now share a single economic and cultural world with other workers and cultural groups. The fate of an autoworker in Detroit is tied to investment decisions made in Mexico City, Seoul, Stuttgart, and Tokyo.



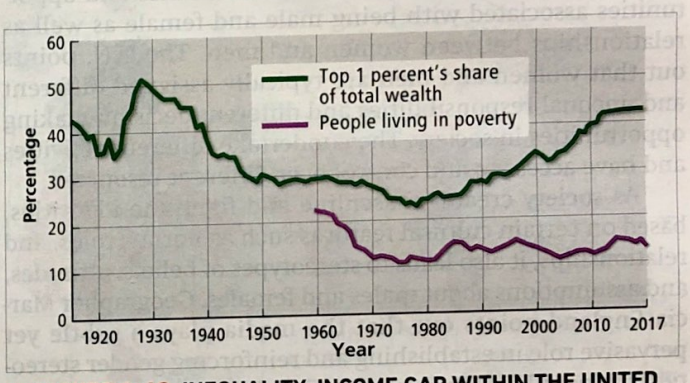
▲ **FIGURE 1-48 INEQUALITY: INCOME GAP BETWEEN RICH AND POOR COUNTRIES** Income per capita has increased much more rapidly in developed countries than in developing ones. Chapter 10 discusses specific ways to measure economic differences, including GNI PPP.

Inequality Within Countries

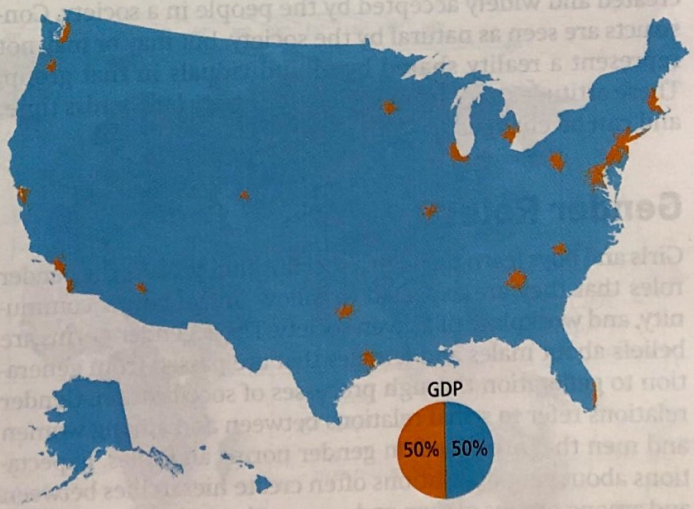
Unequal access and economic inequality have also increased within countries. In the United States, the share of the national income held by the wealthiest 1 percent increased from 24 percent in 1979 to 40 percent in 2017, according to the Federal Reserve Bank (Figure 1-49). The share of Americans living in poverty has increased during that same period from 12 percent to 13 percent.

Inequality in the distribution of wealth within the United States has been mapped in an innovative way by Sasha Trubetskoy as an undergraduate at the University of Chicago. One-half of the economic activity in the United States is clustered in a handful of small areas comprising well under 1 percent of the country's land area (Figure 1-50).

Pause & Reflect 1.3.3 What sorts of places are the small red clusters on Figure 1-50?



▲ **FIGURE 1-49 INEQUALITY: INCOME GAP WITHIN THE UNITED STATES** The share of wealth held by the wealthiest 1 percent in the United States declined from the 1930s through the 1970s and began rising in the 1980s. The percentage of people living in poverty declined during the 1960s but has remained relatively unchanged since then.



▲ **FIGURE 1-50 INEQUALITY WITHIN THE UNITED STATES** The map created by Sasha Trubetskoy shows that one-half of the economic activity in the United States is clustered in a handful of urban areas, especially along the East and West Coasts.

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Space: Gender Identity

Learning Outcome 1.3.4 Analyze geographic approaches to important elements of cultural identity.

Patterns in space vary according to gender, ethnicity, and sexuality. Geographers study these cultural traits because they are important in explaining why people sort themselves out in space and move across the landscape in distinctive ways.

Gender & Sex

People often use "sex" and "gender" interchangeably, but the two terms are actually different. A newborn baby's sex is typically either male or female, depending on biological features. In a small number of cases, a baby is born with biological features of both male and female. The United Nations defines gender as the social attributes and opportunities associated with being male and female as well as relationships between women and men. The U.N. points out that women and men are typically assigned different and unequal responsibilities and different decision-making opportunities in society. They undertake different activities and have access to and control over different resources.

As society creates masculine and feminine identities, based on certain cultural features such as norms, roles, and relationships, it also leads to stereotypes of beliefs, attitudes, and assumptions about males and females. Geographer Marcia England points out that the media plays a subtle yet pervasive role in establishing and reinforcing gender stereotypes in popular TV programs. When individuals do not "fit" established gender stereotypical norms, they can face stigma or exclusion. These groups seek out safe spaces where they are free from discriminatory practices and violence.

Gender is an example of a social construct, a product of our social construction, which is an idea that has been created and widely accepted by the people in a society. Constructs are seen as natural by the society, but may or may not represent a reality shared by all individuals in that group. These attitudes vary from society to society and across time, and can be changed.

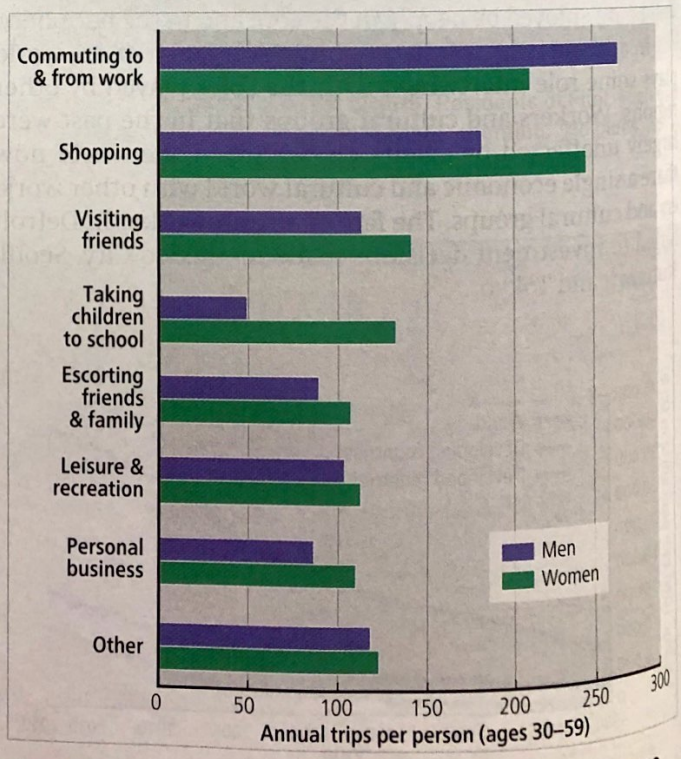
Gender Roles

Girls and boys learn through a socialization process the gender roles that they are expected to follow in the home, community, and workplace of a given society. These gender norms are beliefs about males and females that are passed from generation to generation through processes of socialization. Gender relations refer to social relations between and among women and men that are based on gender norms and roles. Expectations about gender relations often create hierarchies between and among groups of men and women that can lead to unequal power relations, advantaging one group over another.

Distinctive spatial patterns by gender, ethnicity, and sexual orientation are constructed by the attitudes and actions of cultural groups as well as the larger society. For example, consider the implications for gender roles of the spatial patterns associated with some American households:

- Husband: He gets in his car in the morning and drives from home to work, where he parks the car and spends the day. In the late afternoon, he collects the car and drives home. The location of the home may have been selected to ease his daily commute to work.
- Wife: Most American women are now employed at work outside the home, resulting in a complex pattern of moving across urban space. Where is her job located? If the family house was selected for access to her husband's place of employment, she may need to travel across town. Yet the wife is often the one who drives the children to school in the morning, walks the dog, and drives to the supermarket. In the afternoon, she may drive the children from school to Little League or ballet lessons. Who leaves work early to drive a child to a doctor's office? Who takes a day off work when a child is home sick yet may not be entitled to a day off from work to give birth and nurse the newborn child?

The U.K. Department of Transport conducts an annual survey of why people travel in that country. According to the survey, women ages 30 to 59 on average take 17 percent more trips in a year than do men of the same age. Women on average are more likely than men to take trips for shopping, visiting friends, and taking children to school. Men ages 30 to 59 on average take more trips to commute to and from work than do women (Figure 1-51).



▲ **FIGURE 1-51 TRIPS BY PURPOSE AND GENDER, AGES 30-59, UNITED KINGDOM, 2017**

1. *Which activity, proportionally, has the greatest difference between men's and women's trips? The least? Explain.* **2.** *What does this comparison suggest about the relative equality (or inequality) of contemporary gender roles?*

AP® **Skills:** 2.B, 3.D, 4.A, 4.D **Reasoning:** 1.iv, 3.i, 3.iv

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Distribution by Gender

With gender, geographers focus on the distribution of inequality. Gender equality refers to equal chances or opportunities for females to access and control social, economic, and political resources (Figure 1-52). Gender equity refers to the different needs, preferences, and interests of women and men. This may mean that different treatment is needed to ensure equality of opportunity. Any distinction, exclusion, or restriction (such as unfair or unequal treatment) made based on gender norms, roles, and relations prevents women and men from enjoying their human rights. Gender inequality is often perpetuated by legitimizing and institutionalizing stereotypes or norms associated with different ages or groups of men and women.

As discussed in detail in Chapter 10, gender inequality is reflected in numerous factors. The United Nations has not found a single country in the world where the average income earned by women exceeds that earned by men (Figure 1-53). Worldwide, the average income of women is around 55 percent that of men. The average income of women is 58 percent that of men in developed countries and 49 percent in developing countries. At best, women in some countries have achieved near-equality with men. This small group of countries includes Canada, several developed countries in Europe, and a few developing countries with relatively low incomes. The gender equality gap is especially large in Southwest Asia & North Africa, where women's participation in the economy and society are subject to restrictions.

Pause & Reflect 1.3.4 Using your own campus or school as the example, describe how movement across space varies during the day for students and faculty.

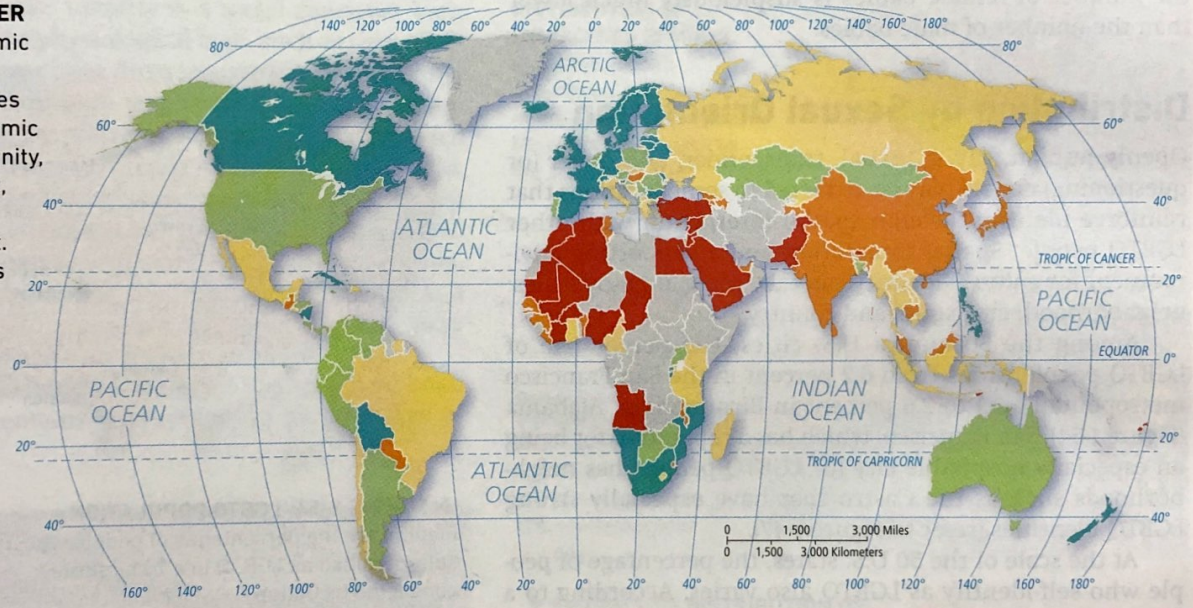

FIGURE 1-52 GENDER GAP The World Economic Forum Gender Gap combines four measures of gender parity: economic participation & opportunity, educational attainment, health & survival, and political empowerment. A lower number means less of a gap between women and men.

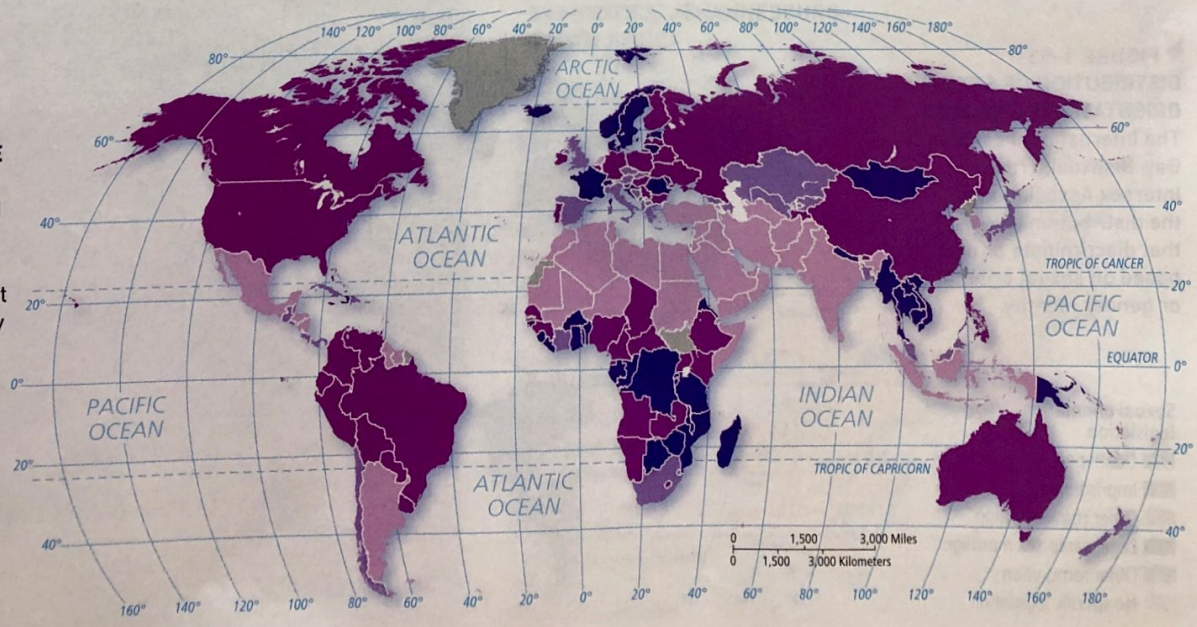

FIGURE 1-53 DISTRIBUTION BY GENDER: FEMALE INCOME AS A PERCENTAGE OF MALE INCOME BY COUNTRY According to the United Nations, the average income earned by women is less than that of men in every country of the world.

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Space: Cultural Identity

Learning Outcome 1.3.5 Discuss geographic approaches to ethnicity and sexuality as important elements of cultural identity.

In addition to race and ethnicity, sex, age, and class are important elements of cultural identity. Geographers study these elements of cultural identity because they help to explain why people sort themselves out in space and move across the landscape in distinctive ways.

The distribution of women does not vary across space like ethnicity and sexual orientation, although some communities such as those with military bases may have a lot more men than women. As discussed in Chapter 2, in some countries, notably the two most populous China and India, the number of female babies is suspiciously much lower than the number of male babies.

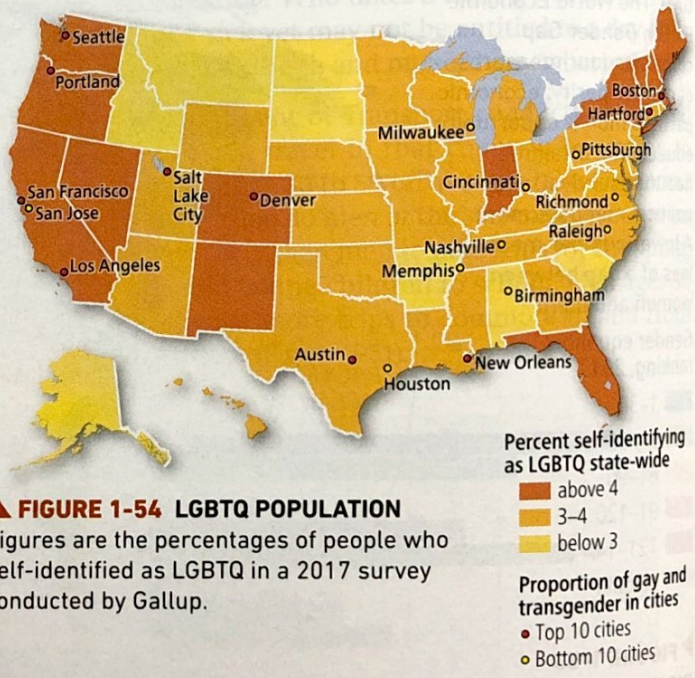
Distribution by Sexual Orientation

Openly lesbian, gay, bisexual, transgender, and queer (or questioning) people may be attracted to some locations that reinforce identity through spatial interaction with other LGBTQ people. Spatial interaction and a supporting environment for cultural identity can take place at many scales: neighborhood, city, state, and country.

Among the 50 largest U.S. cities, the percentage of LGBTQ people varies from 6.2 percent in the San Francisco metropolitan area to 2.6 percent in Birmingham, Alabama (Figure 1-54). San Francisco, which has a reputation for being an especially hospitable city for LGBTQ people, has neighborhoods such as the Castro that have especially strong LGBTQ identities (refer to Figure 1-47).

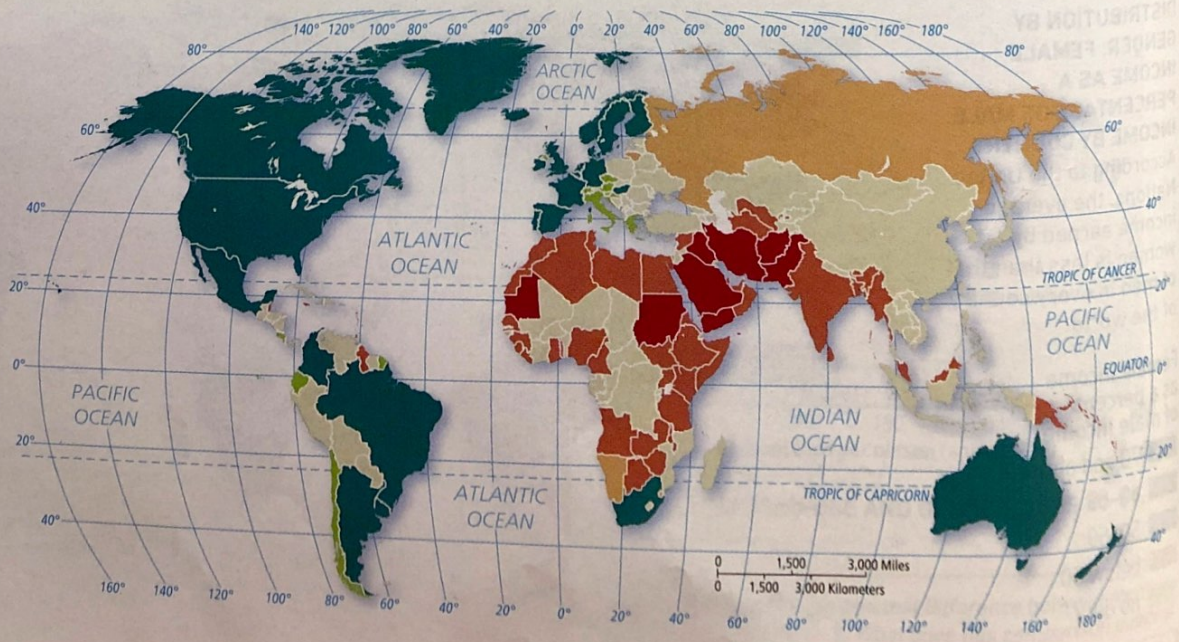
At the scale of the 50 U.S. states, the percentage of people who self-identify as LGBTQ also varies. According to a 2017 Gallup survey, the percentage varies among states from a high of 5.3 percent in Vermont to a low of 2.0 percent in South Dakota. (The District of Columbia has 8.6 percent.) However, the percentage of people who supported same-sex marriage in 2015, a few months before the U.S. Supreme Court legalized it, varied much more widely among states, from a high of 75 percent in New Hampshire to a low of 32 percent in Mississippi.

At the international scale, the International Lesbian, Gay, Bisexual, Trans and Intersex Association (ILGA) identifies laws that discriminate or protect based on sexual orientation or gender identity. Some countries protect LGBTQ people, whereas other countries criminalize them (Figure 1-55). In 2017, the ILGA classified 72 countries as criminalizing LGBTQ people, including eight that imposed the death penalty: Afghanistan, Iran, Iraq, Mauritania, Pakistan, Saudi Arabia, Sudan, and Yemen.



▲ **FIGURE 1-54 LGBTQ POPULATION**
Figures are the percentages of people who self-identified as LGBTQ in a 2017 survey conducted by Gallup.

▶ **FIGURE 1-55**
DISTRIBUTION OF SEXUAL ORIENTATION LAWS, 2017
The International Lesbian, Gay, Bisexual, Trans and Intersex Association maps the distribution of laws that discriminate or protect based on sexual orientation or gender identity.



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Distribution by Ethnicity & Race

Geographers are especially interested in ethnic identity, because ethnicity is closely tied to the cultural traditions of a particular location on Earth, as discussed in more detail in Chapter 7. That chapter also discusses how the distribution of ethnicities in the United States varies considerably at all scales, and how, for historic reasons, African Americans are clustered in the Southeast, whereas Hispanics are clustered in the Southwest. Ethnicities are highly clustered within cities (see Chapters 7 and 13). In Miami, which contains large percentages of African Americans and Hispanics, the major ethnic groups display distinctive distributions (Figure 1-56). African Americans are clustered in the north and Hispanics in the south.

Race, like ethnicity, is a social construct, but the two have different meanings. Ethnic identity is tied to a particular place, whereas racial identity is a social construct built around perception of a physiological trait, such as skin color. However, some cultures have further assigned racial identity a geographic feature through legalizing spatial segregation and other discriminatory practices. For example, as discussed in Chapter 7, South Africa enacted laws, known as apartheid, to separate into different geographic areas four races, known as white, black, colored (mixed race), and Asian. For example, Johannesburg, an urban area of nearly 8 million inhabitants, has extensive neighborhoods that are virtually all black, a legacy of the apartheid era, when the different races were required to live in specific areas (Figures 1-57 and 1-58).

Although South Africa has repealed the apartheid laws, racial segregation remains widespread, in part because of disparities in the average income of different races. For example, the mean annual household income in South Africa is around $30,000 for whites, $18,000 for Asians, $12,000 for coloreds, and $6,000 for blacks.

All academic disciplines and workplaces have proclaimed sensitivity to issues of cultural diversity. For geographers, concern and deep respect for cultural diversity is not merely a politically correct expediency; it lies at the heart of geography's understanding of space. Geographers have deep respect for the dignity and equality of all cultural groups.

Pause & Reflect 1.3.5 Describe the relationship between ethnicity and location or spatial distribution in the area where you live.

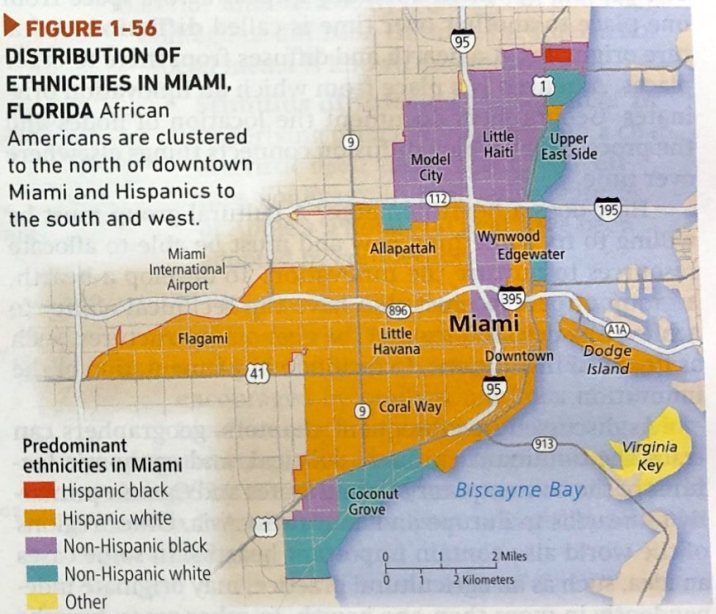

FIGURE 1-56 DISTRIBUTION OF ETHNICITIES IN MIAMI, FLORIDA African Americans are clustered to the north of downtown Miami and Hispanics to the south and west.

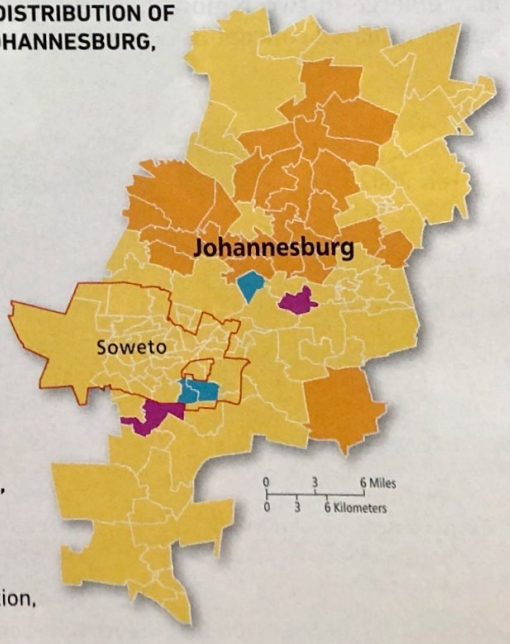

FIGURE 1-57 DISTRIBUTION OF ETHNICITIES, JOHANNESBURG, SOUTH AFRICA

FIGURE 1-58 SOWETO TOWNSHIP, JOHANNESBURG, SOUTH AFRICA Blacks comprise 99 percent of Soweto's population, a legacy of apartheid policies.

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Connections: Diffusion

Learning Outcome 1.3.6 Describe the various ways that features can spread through diffusion.

Connection was defined at the beginning of the chapter as relationships among people and objects that cross the barrier of space. Geographers are concerned with the various means by which connections occur. More rapid connections have reduced the distance across space between places, not literally in miles, of course, but in time.

Hearths

The process by which a feature spreads across space from one place to another over time is called **diffusion**. A feature originates at a hearth and diffuses from there to other places. A **hearth** is a place from which an innovation originates. Geographers document the location of nodes and the processes by which diffusion connects things elsewhere over time.

How does a hearth emerge? A cultural group must be willing to try something new and must be able to allocate resources to nurture the innovation. To develop a hearth, a group of people must also have the technical ability to achieve the desired idea and the economic structures, such as financial institutions, to facilitate implementation of the innovation.

As discussed in subsequent chapters, geographers can trace the dominant cultural, political, and economic features of the contemporary United States and Canada primarily to hearths in Europe and Southwest Asia. Other regions of the world also contain important hearths. In some cases an idea, such as an agricultural practice, may originate independently in more than one hearth. In other cases, hearths may emerge in two regions because two cultural groups modify a shared concept in two different ways.

For a person, an object, or an idea to have interaction with persons, objects, or ideas in other regions, diffusion must occur. Geographers observe two basic types of diffusion – relocation and expansion.

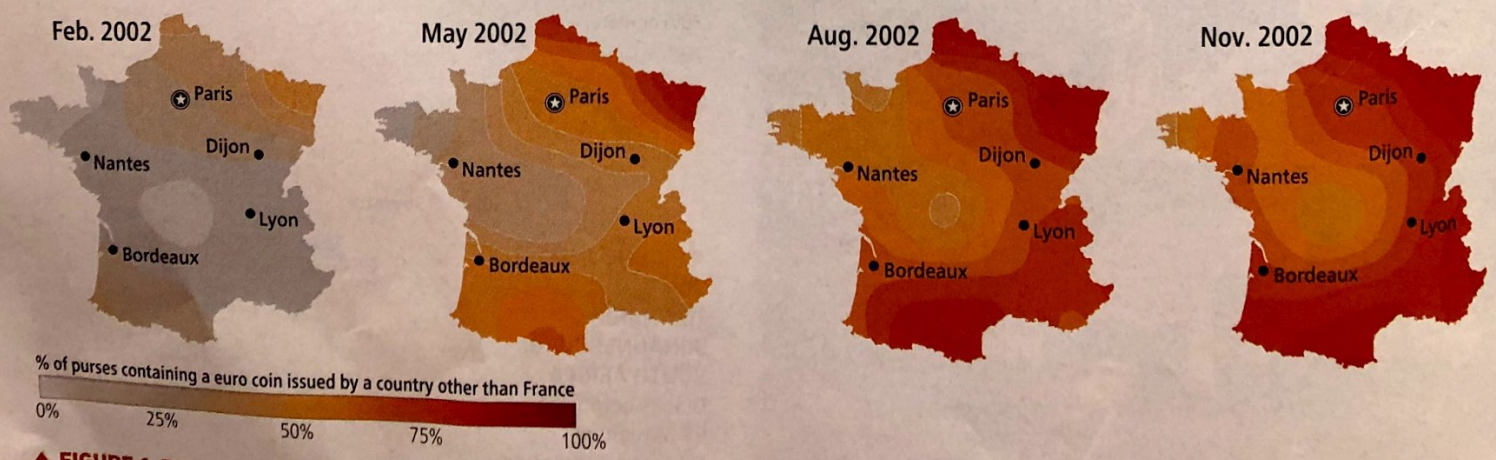
Relocation Diffusion

The spread of an idea through physical movement of people from one place to another is termed **relocation diffusion**. We shall see in Chapter 3 that people migrate for a variety of political, economic, and environmental reasons. When they move, they carry with them their culture, including language, religion, and ethnicity.

The most commonly spoken languages in North and South America are Spanish, English, French, and Portuguese, primarily because several hundred years ago Europeans who spoke those languages comprised the largest number of migrants. Thus these languages spread through relocation diffusion. We will examine the diffusion of languages, religions, and ethnic groups in Chapters 5 through 7.

Introduction of a common currency, the euro, in 12 European countries in 2002 gave scientists an unusual opportunity to measure relocation diffusion from hearths (Figure 1-59). Although a single set of paper money was issued, each of the 12 countries minted its own coins in proportion to its share of the region's economy. A country's coins were initially distributed only inside its borders, although the coins could also be used in the other 11 countries. Scientists in France took month-to-month samples to monitor the proportion of coins from each of the other 11 countries. The percentage of coins from a particular country is a measure of the level of relocation diffusion to and from France.

Pause & Reflect 1.3.6 U.S. coins in general circulation are minted in either Denver or Philadelphia. Take a look at your coins. Do you have more from the mint closer to you? Why might that be?



▲ **FIGURE 1-59 RELOCATION DIFFUSION** Diffusion of euro newly minted coins in France, 2002. Euro coins minted in other countries first appeared in France near its borders with other countries, where connections between people in neighboring countries would be more frequent.

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Expansion Diffusion

The spread of a feature from one place to another in an additive process is **expansion diffusion**. This expansion may result from one of three processes:

- **Hierarchical diffusion** is the spread of an idea from persons or nodes of authority or power to other persons or places (Figure 1-60). Hierarchical diffusion may result from the spread of ideas from political leaders, socially elite people, or other important persons to others in the community. Innovations may also originate in a particular node or core region of power, such as a large urban center, and diffuse later to isolated rural areas on the periphery. Hip-hop or rap music is an example of an innovation that originated in urban areas, though it diffused from African Americans, a cultural group that has not been economically dominant. African Americans have been the source of numerous music and fashion trends in the last century.
- **Contagious diffusion** is the rapid, widespread diffusion of a characteristic throughout the population. As the term implies, this form of diffusion is analogous to the spread of a contagious disease, such as influenza. Contagious diffusion spreads like a wave among fans in a stadium, without regard for hierarchy and without requiring permanent relocation of people. New music or an idea goes viral because web surfers throughout the world have access to the same material simultaneously (Figures 1-61 and 1-62). Contagious diffusion through the Internet or social media is known as a **meme**.
- **Stimulus diffusion** is the spread of an underlying principle even though a characteristic itself apparently fails to diffuse. For example, innovative features of Apple's iPhone and iPad have been adopted by competitors.

Expansion diffusion occurs much more rapidly in the contemporary world than it did in the past. Hierarchical diffusion is encouraged by modern methods of communication, such as computers, texting, blogging, tweeting, and e-mail. Contagious diffusion is encouraged by use of the Internet, especially the World Wide Web. Stimulus diffusion is encouraged by all of the new technologies.

Honda headquarters
- World
- Regional

▲ **FIGURE 1-60 HIERARCHICAL DIFFUSION**
Honda's operations are divided into regional offices that are directed from headquarters in Tokyo.

▲ **FIGURE 1-61 CONTAGIOUS DIFFUSION: ELECTRIC SCOOTER**
The electric scooter was invented in China and quickly diffused to other places.

▶ **FIGURE 1-62 CONTAGIOUS DIFFUSION: MEME OF ALEX**
A customer took a photo of a cashier at Target named Alex and posted it on Twitter. Alex gained nearly one-quarter million followers within one day of the customer's original Twitter posting.

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Connections: Spatial Interaction

Learning Outcome 1.3.7 Explain how places are connected through networks.

The farther away someone is from another, the less likely the two are to interact. Contact diminishes with increasing distance and eventually disappears. This trailing-off phenomenon is called **distance decay**. In the contemporary world, distance decay is much less severe because connection between places takes much less time. Geographers apply the term **space–time compression** to describe the reduction in the time it takes for something to reach another place (Figure 1-63).

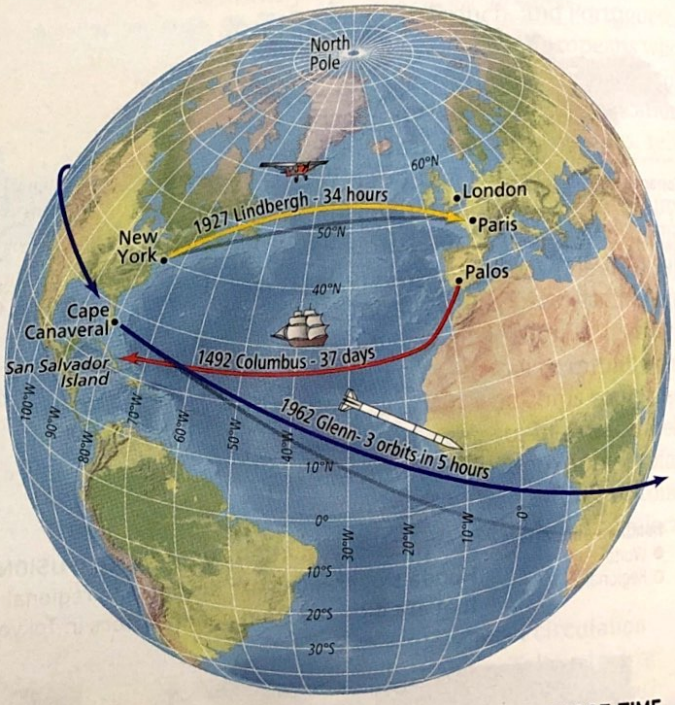
Networks

Interaction takes place through a **network**, which is a chain of communication that connects places. A major airline, for example, typically has a network known as "hub-and-spokes" (Figure 1-64). With a hub-and-spokes network, an airline flies planes from a large number of places into one hub airport within a short period of time and then a short time later sends the planes to another set of places. In principle, travelers originating in relatively small towns can reach a wide variety of destinations by changing planes at the hub airport.

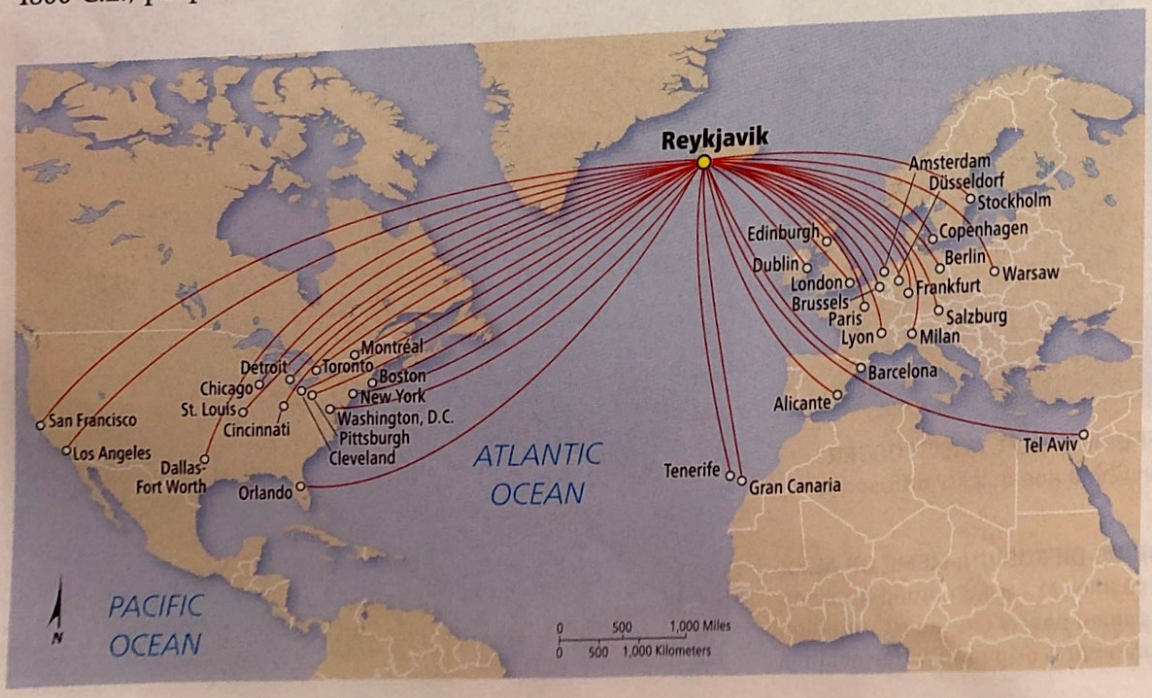
Pause & Reflect 1.3.7 Is your nearest airport a hub? If not, to what hubs is your nearest airport connected?

In the past, most connections among cultural groups required the physical movement of settlers, explorers, and plunderers from one location to another. As recently as 1800 C.E., people traveled in the same ways and at about the same speeds as in 1800 B.C.E. – they were carried by an animal, took a sailboat, or walked.

To be connected with another place in the modern world, we may not need to travel at all. Ideas that originate in a hearth are now able to diffuse rapidly to other areas through communications networks. One example is the TV network (for example, BBC in the United Kingdom, CBC in Canada, NBC in the United States), which comprises a chain of stations simultaneously broadcasting to distant places the same program, such as a football game. Through a communications network, diffusion from one place to another is instantaneous in time, even if the physical distance between places – as measured in kilometers or miles – is large.



▲ **FIGURE 1-63 SPACE-TIME COMPRESSION** Transportation improvements have shrunk the world. In 1492, Christopher Columbus took nearly 900 hours (37 days) to sail across the Atlantic Ocean. In 1927, Charles Lindbergh was the first to fly nonstop across the Atlantic, taking 33.5 hours. In 1962, John Glenn, the first American to orbit in space, crossed above the Atlantic in about 1/2 hour and circled the globe three times in 5 hours.



◀ **FIGURE 1-64 SPATIAL INTERACTION: AIRLINE HUB-AND-SPOKE NETWORK** WOW Air flies planes from a large number of places into a hub airport at Reykjavik, Iceland, and a short time later sends the planes to another set of places.

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Connections & Culture

Connections between cultural groups can have several results:

- **Assimilation** is the process by which a group's cultural features are altered to resemble those of another group. The cultural features of one group may come to dominate the culture of the assimilated group.
- **Acculturation** is the process of changes in culture that result from the meeting of two groups. Changes may be experienced by both the interacting cultural groups, but the two groups retain two distinct cultural features.
- **Syncretism** is the combining of elements of two groups into a new cultural feature. The two cultural groups come together to form a new culture.

Computers, tablets, and smartphones make it possible for individuals to set up their own connections through individually constructed networks such as Facebook and Twitter. At the touch of a button, we can transmit images and messages from one part of the world to our own personalized network around the world.

Modern networks make it possible for us to know more about what is happening elsewhere in the world, and space–time compression makes it possible for us to know it sooner. Distant places seem less remote and more accessible to us. With better connections between places, we are exposed to a constant barrage of cultural traits and economic initiatives from people in other regions, and perhaps we may adopt some of these cultural and economic elements. At the same time, others in the world can learn more about us, whether we like it or not (see Debate It! feature).

DEBATE IT! AP® **Skills:** 1.C, 4.D **Reasoning:** 1.iv, 1.v, 2.iii

GPS location service: On or off? Most of our cell phones have a GPS tracking device that can pinpoint our precise location. By default, most phones have this geotagging feature turned on. Should you leave location service on or turn it off (Figures 1-65 and 66)?

Everyone is Entitled to Privacy

- Protecting individual privacy is part of the service promised by phone companies.
- Once accessible to one agency, phone information may be more easily hacked by others.
- Embarrassing information irrelevant to a criminal case may become public.

▲ **FIGURE 1-65** GPS TRACKING WITH LOCATION SERVICES ON

Criminal Activity Should be Tracked

- Knowledge of a phone's movements helps law enforcement agencies identify, find, and prosecute criminals.
- Criminal activities, such as drug sales, are often done by cell phone.
- Criminal behavior is not an activity that should be protected.

▲ **FIGURE 1-66** GPS OFF

QUESTIONS FOR RESEARCH & ANALYSIS

1. Should laws on the privacy of electronic communications developed decades ago in the age of telephones with landlines still apply to today's smart phones with GPS? Why or why not?
2. Some states have passed legislation protecting cellphone users from unwarranted government surveillance based on cellphone GPS locational data. Search online, or find your state on the map at the QR link, and summarize your findings on the current law in your state.

GPS Privacy
https://goo.gl/Grffap

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KEY ISSUE

1.4 | Why Are Some Actions Not Sustainable?

Geography is distinctive because it encompasses both social science (human geography) and natural science (physical geography). This book focuses on human geography but doesn't forget that humans are interrelated with Earth's atmosphere, land, water, and vegetation as well as with its other living creatures.

Sustainability & Resources

Learning Outcome 1.4.1 Describe the three pillars of sustainability.

A **resource** is a substance in the environment that is useful to people, economically and technologically feasible to access, and socially acceptable to use. **Sustainability** is the use of Earth's resources in ways that ensure their availability in the future.

From the perspective of human geography, nature offers a large menu of resources available for people to use. A substance is merely part of nature until a society has a use for it. Water, minerals, soil, plants, and animals are examples of resources.

Earth's resources are divided between those that are renewable and those that are not:

- A **renewable resource** is produced in nature more rapidly than it is consumed by humans.
- A **nonrenewable resource** is produced in nature more slowly than it is consumed by humans.

Geographers observe that the sustainability of these resources is being damaged by human actions:

- Humans deplete nonrenewable resources, such as petroleum, natural gas, and coal.
- Humans destroy otherwise renewable resources through pollution of air, water, and soil (Figure 1-67).

Geographers also document efforts to improve the sustainability of resources. Recycling paper and plastic, developing new industrial processes, and protecting farmland from urban sprawl are all examples of practices that contribute to a more sustainable future.

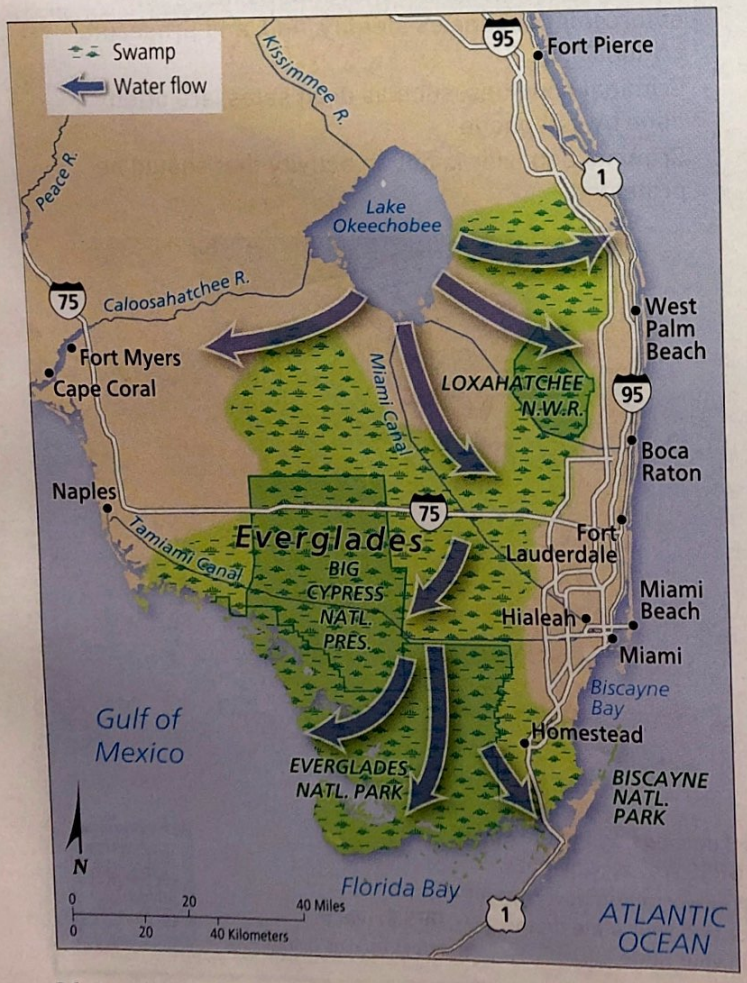


FIGURE 1-67 SOUTH FLORIDA RESOURCE & SUSTAINABILITY Human actions have altered and damaged the Everglades region.

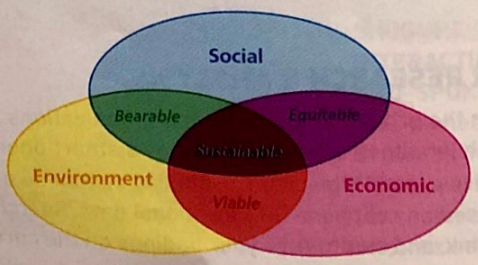
Sustainability's Three Pillars

According to the United Nations, sustainability rests on three pillars: environment, economy, and society (Figure 1-68). The 1987 U.N. report *Our Common Future* is a landmark work in recognizing sustainability as a combination of natural and human elements. The report is frequently called the Brundtland Report, named for the chair of the World Commission on Environment and Development, Gro Harlem Brundtland, former prime minister of Norway.

Sustainability requires curtailing the use of nonrenewable resources and limiting the use of renewable resources to the level at which the environment can continue to supply them indefinitely. To be sustainable, the amount of timber cut down in a forest, for example, or the number of fish removed from a body of water must remain at a level that does not reduce future supplies.

The Brundtland Report argues that sustainability can be achieved only by bringing together environmental protection, economic growth, and social equity. The report is optimistic about the possibility of promoting environmental protection at the same time as economic growth and social equity.

FIGURE 1-68 THREE PILLARS OF SUSTAINABILITY



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Environment Pillar

The sustainable use and management of Earth's natural resources to meet human needs such as food, medicine, and recreation is **conservation**. Renewable resources such as trees and wildlife are conserved if they are consumed at a less rapid rate than they can be replaced. Nonrenewable resources such as petroleum and coal are conserved if we use less today in order to maintain more for future generations (Figure 1-69a).

Conservation differs from **preservation**, which is the maintenance of resources in their present condition with as little human impact as possible. Preservation takes the view that the value of nature does not derive from human needs and interests but from the fact that every plant and animal living on Earth has a right to exist and should be preserved, regardless of the cost. Preservation does not regard nature as a resource for human use. In contrast, conservation is compatible with development but only if natural resources are utilized in a careful rather than a wasteful manner.

Social Pillar

Humans need shelter, food, and clothing to survive, so they make use of resources to meet these needs. Homes can be built of grass, wood, mud, stone, or brick. Food can be consumed by harvesting grains, fruit, and vegetables or by eating the flesh of fish, cattle, and pigs. Clothing can be made from harvesting cotton, removing skins from animals, or turning petroleum into polyester.

Consumer choices can support sustainability when people embrace it as a value. For example, a consumer might prefer clothing made of natural or recycled materials to clothing made directly from petroleum products. They can also choose products that benefit people living in a particular place (Figure 1-69b). Society's values are the basis for choosing which resources to use.

Economic Pillar

Natural resources acquire a monetary value through exchange in a marketplace (Figure 1-69c). In a market economy, supply and demand are the principal factors determining affordability. The greater the supply, the lower the price; the greater the demand, the higher the price. Consumers will pay more for a commodity if they strongly desire it than if they have only a moderate desire. However, geographers observe that some goods do not reflect their actual environmental costs. For example, motorists sitting in a traffic jam do not have to pay a fee for the relatively high level of pollution their vehicles are emitting into the atmosphere.

The price of a resource depends on a society's technological ability to obtain it and to adapt it to that society's purposes. Earth has many substances that we do not use today because we lack the means to extract them or the knowledge of how to use them. Things that might become resources in the near future are potential resources.

Some environmentally oriented critics have argued that it is too late to discuss sustainability. Others criticize sustainability from the opposite perspective: Human activities have not exceeded Earth's capacity, they argue, because resource availability has no maximum, and Earth's resources have no absolute limit because the definition of resources changes drastically and inevitably over time.

Pause & Reflect 1.4.1 What do you think might be the reaction of the farmers in Figure 1-69b to tourists such as those in Figure 1-69c?

(b)

(a) ENVIRONMENT PILLAR: PLANTS AND ANIMALS The Everglades was once a very wide and shallow freshwater river, slowly flowing south from Lake Okeechobee to the Gulf of Mexico. A sensitive environment of plants and animals once thrived in this distinctive landscape, but much of it was destroyed by human actions to promote the economy.

(a)

(b) SOCIAL PILLAR: SUGARCANE FARMERS The U.S. Army Corps of Engineers built levees and canals in the Everglades. These modifications opened up land for growing sugarcane and protected the South Florida's increasing population from flooding. However, the modifications also had unintended consequences, including polluted water and threats to native vegetation and animals.

(c)

▲ **FIGURE 1-69 THREE PILLARS OF SUSTAINABILITY IN THE EVERGLADES** (a) Environment pillar: Plants and animals; (b) Social pillar: Sugarcane farmers; (c) Economic pillar:Tourism.

(c) ECONOMIC PILLAR: TOURISM Everglades National Park, established in 1947, attracts around 1 million visitors a year. The National Park Service tries to provide an enjoyable visit while protecting the area's fragile environment.

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Sustainability & Earth Systems

Learning Outcome 1.4.2 Explain Earth's three abiotic physical systems.

Geographers classify natural resources as part of four interrelated systems. These four physical systems are classified as either biotic or abiotic. A **biotic** system is composed of living organisms. An **abiotic** system is composed of nonliving or inorganic matter. Three of Earth's four systems are abiotic:

- The **atmosphere**: a thin layer of gases surrounding Earth.
- The **hydrosphere**: all the water on and near Earth's surface.
- The **lithosphere**: Earth's crust and a portion of upper mantle directly below the crust.

One of the four systems is biotic:

- The **biosphere**: all living organisms on Earth, including plants and animals as well as microorganisms.

The names of the four spheres are derived from the Greek words for "stone" (litho), "air" (atmo), "water" (hydro), and "life" (bio).

Atmosphere

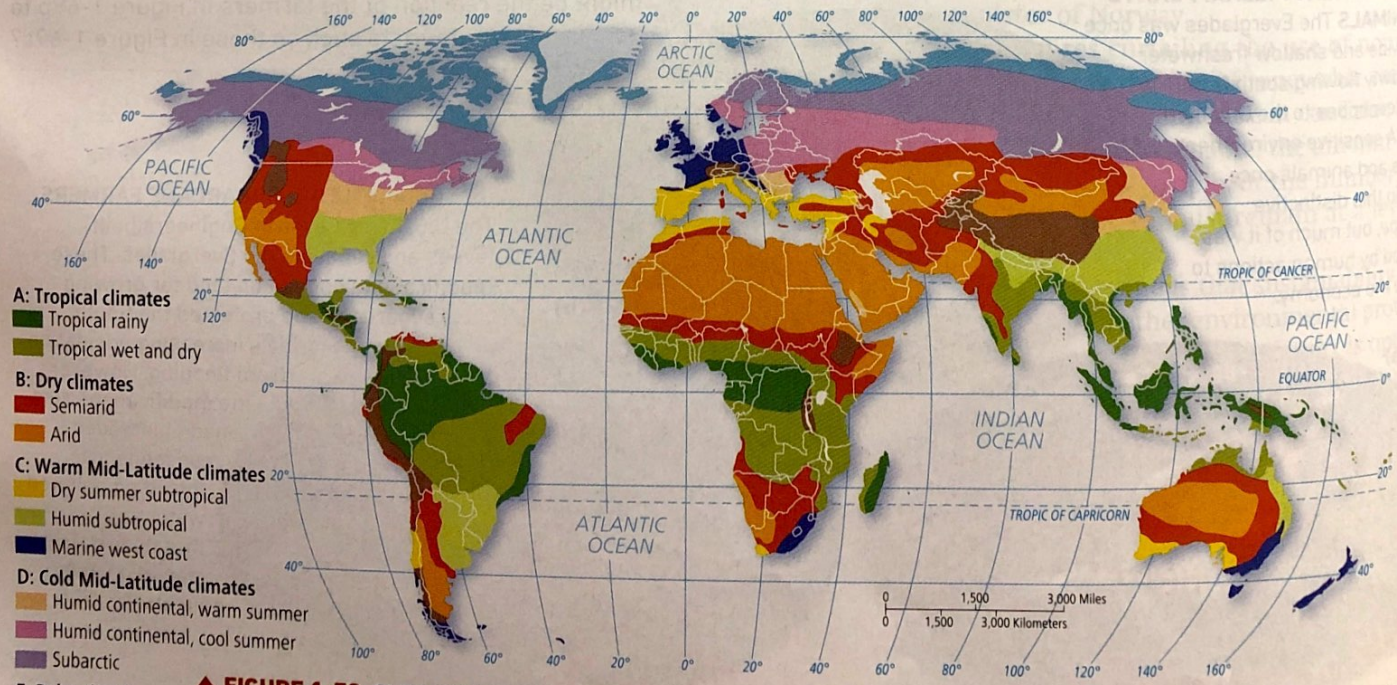
A thin layer of gases surrounds Earth at an altitude up to 690 kilometers (429 miles). Pure dry air in the lower atmosphere contains approximately 78.08 percent nitrogen, 20.95 percent oxygen, 0.93 percent argon, 0.04 percent carbon dioxide, and trace amounts of a few other gases (measured by volume). As atmospheric gases are held to Earth by gravity, pressure is created. Variations in air pressure from one location to another are responsible for producing such weather features as wind blowing, storms brewing, and rain falling.

The long-term average weather condition at a particular location is **climate**. Geographers frequently classify climates according to a system developed by German climatologist Vladimir Köppen. The modified Köppen system divides the world into five main climate regions that are identified by the letters A through E as well as by names:

- A: Tropical climates.
- B: Dry climates.
- C: Warm mid-latitude climates.
- D: Cold mid-latitude climates.
- E: Polar climates.

The modified Köppen system divides the five main climate regions into several subtypes (Figure 1-70). For all but the B climate, the basis for the subdivision is the amount of precipitation and the season in which it falls. For the B climate, subdivision is made on the basis of temperature and precipitation. In addition, "H" denotes highland areas in which climates are cold due to elevation, or local climate variations that are too great to show on the map.

Humans have a limited tolerance for extreme temperature and precipitation levels and thus avoid living in places that are too hot, too cold, too wet, or too dry. Compare the map of global climate to the distribution of population. Relatively few people live in the Dry (B) and Polar (E) climate regions, or in the Highlands.



▲ **FIGURE 1-70 CLIMATE REGIONS** Geographers frequently classify global climates according to a system developed by Vladimir Köppen. The modified Köppen system divides the world into five main climate regions, represented by the letters A, B, C, D, and E, plus H for highlands.

1. *What three climate regions occupy most of the eastern United States?* **2.** *How are these climates similar? How are they different?* **3.** *What factor might explain the main difference?*

AP® **Skills:** 2.A, 2.D, 3.E, 4.E, 5.B **Reasoning:** 1.iv, 3.i

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Hydrosphere

Water exists in liquid form in the oceans, lakes, and rivers as well as groundwater in soil and rock. It can also exist as water vapor in the atmosphere, and as ice in glaciers. Over 97 percent of the world's water is in the oceans. The oceans supply the atmosphere with water vapor, which returns to Earth's surface as precipitation, the most important source of freshwater. Consumption of water is essential for the survival of plants and animals, and a large quantity and variety of plants and animals live in it. Because water gains and loses heat relatively slowly, it also moderates seasonal temperature extremes over much of Earth's surface.

The climate of a particular location influences human activities, especially production of the food needed to survive. People in parts of the A climate region, especially southwestern India, Bangladesh, and the Myanmar coast, anxiously await the annual monsoon winds bringing rain, which is essential for successful agriculture and provides nearly 90 percent of India's water supply (Figure 1-71). For most of the year, the region receives dry, somewhat cool air from the northeast. In June, the wind direction suddenly shifts, bringing moist, warm, southwesterly air, known as the monsoon, from the Indian Ocean. The monsoon brings rain that lasts until September. In years when the rain is delayed or fails to arrive – in recent decades, at least one-fourth of the time – agricultural output falls and famine threatens in the countries of South Asia, where nearly 20 percent of the world's people live. The seasonal rain is so important in India that the words for "year," "rain," and "rainy season" are identical in many local languages.

Pause & Reflect 1.4.2 How do the atmosphere and hydrosphere interact to produce South Asia's monsoon rains?

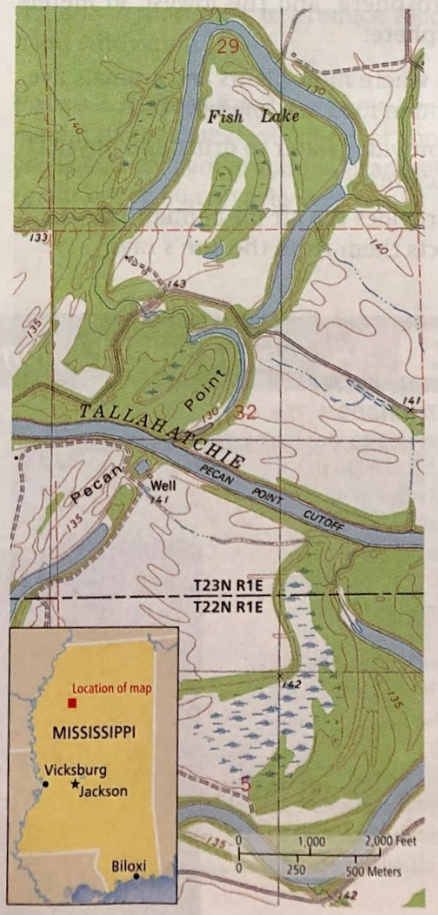
▲ **FIGURE 1-71 RAIN FROM MONSOON WINDS, DHAKA, BANGLADESH**

Lithosphere

Earth is composed of concentric spheres. The inner core is a dense, metallic sphere about 1,200 kilometers (760 miles) in radius. Surrounding the inner core is an outer core, about 2,400 kilometers (1,500 miles) thick, composed mostly of liquid iron and nickel. The next layer is the mantle about 2,900 kilometers (1,800 miles) thick. The outermost layer is the crust, a thin, brittle outer shell 5 to 70 kilometers (3 to 44 miles) thick. The lithosphere encompasses the crust and a portion of the mantle. Powerful forces deep within Earth bend and break the crust to form mountain chains and shape the crust to form continents and ocean basins.

Earth's surface features, or landforms, vary from relatively flat to mountainous. Geographers find that the study of Earth's landforms – a science known as geomorphology – helps to explain the distribution of people and the choice of economic activities at different locations. People prefer living on flatter land, which generally is better suited for agriculture. Great concentrations of people and activities in hilly areas may require extensive effort to modify the landscape.

Topographic maps, published for the United States by the U.S. Geological Survey (USGS), show details of physical features, such as bodies of water, forests, mountains, valleys, and wetlands. They also show cultural features, such as buildings, roads, parks, farms, and dams. "Topos" are used by engineers, hikers, hunters, people seeking home sites, and anyone who really wants to see the lay of the land (Figure 1-72). The brown lines on the map are contour lines that show the elevation of any location. Lines are further apart in flatter areas and closer together in hilly areas.



◀ **FIGURE 1-72 TOPOGRAPHIC MAP** A portion of a topographic map published by the U.S. Geological Survey shows physical features in northwestern Mississippi. Shown here is part of sections 29 and 32 of township T23N R1E and section 5 of township T22N R1E.

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Geography & Ecology

Learning Outcome 1.4.3 Explain how the biosphere interacts with abiotic systems.

Modern technology has altered the historic relationship between people and the environment. People are now the most important agents of change on Earth, and they can modify the environment to a greater extent than in the past. Geographers are concerned that people sometimes use modern technology to modify the environment insensitively. Human actions can deplete scarce environmental resources, destroy irreplaceable resources, and use resources inefficiently.

Ecology & The Biosphere

The fourth natural resource system, the biosphere, encompasses all of Earth's living organisms. Because living organisms cannot exist except through interaction with the surrounding physical environment, the biosphere also includes portions of the three abiotic systems near Earth's surface. Living organisms in the biosphere interact with each of the three abiotic systems. For example, a piece of soil may comprise mineral material from the lithosphere, moisture from the hydrosphere, pockets of air from the atmosphere, and plant and insect matter from the biosphere.

Most of the living organisms interact within the top 3 meters (10 feet) of the lithosphere, the top 200 meters (650 feet) of the hydrosphere, and the lowest 30 meters (100 feet) of the atmosphere:

- The lithosphere is where most plants and animals live and where they obtain food and shelter.
- The hydrosphere provides water to drink and physical support for aquatic life.
- The atmosphere provides the air for animals to breathe and protects them from the Sun's rays.

A group of living organisms and the abiotic spheres with which they interact is an **ecosystem** (Figure 1-73). The scientific study of ecosystems is **ecology**. Ecologists study interrelationships between living organisms and the three abiotic environments as well as interrelationships among the various living organisms in the biosphere.

Human geographers are especially interested in ecosystems involving the interaction of humans with the rest of the biosphere and the three abiotic spheres:

- If the atmosphere contains pollutants, or its oxygen level is reduced, humans have trouble breathing.
- Without water in the hydrosphere, humans waste away and die.
- A stable lithosphere provides humans with materials for buildings and fuel for energy.
- The rest of the biosphere provides humans with food.

Human actions are sustainable if they preserve and conserve elements of the four spheres and unsustainable if they cause destruction. For example, human actions contribute to the destruction of soil, the material that forms on Earth's surface at the thin interface between the air and the rocks. Two sustainability issues arise from the destruction of soil:

- **Erosion.** Erosion occurs when the soil washes away in the rain or blows away in the wind. Farmers contribute to erosion through inappropriate choices. To reduce erosion, farmers can avoid steep slopes, plow less, and plant crops whose roots help bind the soil.
- **Depletion of nutrients.** Soil contains the nutrients necessary for successful growth of plants, including those useful to humans. Nutrients are depleted when plants withdraw more nutrients than natural processes can replace. Each type of plant withdraws certain nutrients from the soil and restores others. To minimize depletion, farmers can plant different crops from one year to the next so that the land remains productive over the long term.

FIGURE 1-73 ECOSYSTEM: WHITE CLIFFS OF DOVER, UNITED KINGDOM The city of Dover, United Kingdom, sits atop a lithosphere of chalky cliffs, beside the hydrosphere of the English Channel, beneath the atmosphere above, and surrounded by a green biosphere. Geographers are especially interested in the ecosystem of a city because more than half of Earth's humans live in urban areas. The lithosphere provides the ground and the materials to erect homes and businesses. The hydrosphere provides the water for urban dwellers to consume. The atmosphere is where urban dwellers emit pollutants. Some plants and other animals of the biosphere thrive along with humans in the cities, whereas others struggle.

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Cultural Ecology

Human geographers are especially interested in the fact that different cultural groups modify the four spheres in distinctive ways (see Sustainability & Our Environment and Figure 1-74). The geographic study of human–environment relationships is known as **cultural ecology**. The roots of cultural ecology reach back more than 200 years, to an era when early scientists traveled the globe, observing how people lived in different environments.

Environmental Determinism. Pioneering nineteenth-century German geographers Alexander von Humboldt (1769–1859) and Carl Ritter (1779–1859) believed that the physical environment caused social development, an approach called **environmental determinism**. According to Humboldt and Ritter, human geographers should apply laws from the natural sciences to understanding relationships between the physical environment and human actions. They argued that the scientific study of social and natural processes is fundamentally the same.

Other influential geographers adopted environmental determinism in the late nineteenth and early twentieth centuries. Friedrich Ratzel (1844–1904) and his American student Ellen Churchill Semple (1863–1932) claimed that geography was the study of the influences of the natural environment on people.

Another early American geographer, Ellsworth Huntington (1876–1947), argued that climate was a major determinant of civilization. For instance, according to Huntington, the temperate climate of maritime northwestern Europe produced greater human efficiency as measured by better health conditions, lower death rates, and higher standards of living.

Possibilism. To explain relationships between human activities and the physical environment, modern geographers reject environmental determinism in favor of possibilism.

According to **possibilism**, the physical environment may limit some human actions, but people have the ability to adjust to their environment. People can choose a course of action from many alternatives in the physical environment.

The climate of any location influences human activities, especially food production. From one generation to the next, people learn that different crops thrive in different climates. For example, rice requires plentiful water, whereas wheat survives on limited moisture and actually grows poorly in very wet environments. On the other hand, wheat is more likely than rice to be grown successfully in colder climates. Thus, according to possibilism, people can choose the crops they grow and yet be compatible with their environment.

Some human impacts on the environment are based on deep-seated cultural values. Why do we plant our front yard with grass, water it to make it grow, mow it to keep it from growing tall, and impose fines on those who fail to mow often enough? Why not let dandelions or wildflowers grow instead? Why does one group of people consume the fruit from deciduous trees and chop down the conifers for building materials, whereas another group chops down the deciduous trees for furniture while preserving the conifers as religious symbols? Are some of these actions more sustainable than others?

A people's level of wealth can also influence its attitude toward modifying the environment. A farmer who possesses a tractor may regard a hilly piece of land as an obstacle to avoid, but a poor farmer with a hoe may regard hilly land as the only opportunity to produce food for survival through hand cultivation.

Pause & Reflect 1.4.3 Give an example of an environmental condition that influences or constrains people where you live. Then identify cultural practices that adapt to this constraint on human activities.

SUSTAINABILITY & OUR ENVIRONMENT

Climate Change & Rising Seas

AP® **Skills:** 2.C, 3.B, 3.E, 4.C, 5.D **Reasoning:** 2.iii, 3.v

Climate change has raised the global sea level about 8 inches since 1880, and by nearly 2 feet along the U.S. East Coast. The interactive map at SurgingSeas.org shows different amounts of flooding, depending on the level of sea level rise.

1. What are some of the features in Miami Beach that would be underwater if the sea level rises 5 feet (Figure 1-74)?
2. Click Property. Are properties in Miami Beach at risk of sea level rise mostly of high value or low value? Why might that be?

Surging Seas
https://goo.gl/MdYULJ.

▲ **FIGURE 1-74 SURGING SEAS, MIAMI**

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Sustainable & Unsustainable Ecosystems

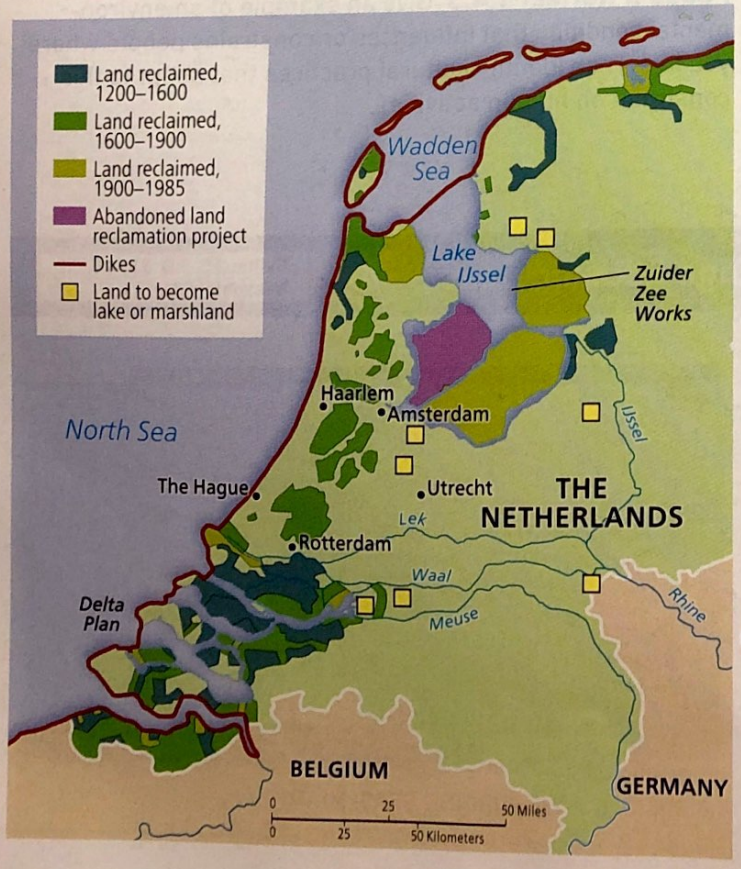
Learning Outcome 1.4.4 Compare ecosystems in the Netherlands and South Africa.

The Netherlands and South Africa have ecosystems that are heavily dependent on human modification of the hydrosphere. The two regions face opposite water issues: the Netherlands has more water than it wants and Cape Town, South Africa, not enough. At this time, the ecological modifications in the Netherlands appear sustainable, whereas those in Cape Town appear unsustainable.

Sustainable Ecosystem: The Netherlands

The Dutch have modified their environment with two distinctive types of construction projects – polders and dikes. A **polder** is a piece of land that is created by draining water from an area. The Netherlands has 6,500 square kilometers (2,600 square miles) of polders, comprising 16 percent of the country's land area (Figure 1-75).

Polders, first created in the thirteenth century, were constructed primarily by private developers in the sixteenth and seventeenth centuries and by the government during the past 200 years. The Dutch government has reserved most of the polders for agriculture to reduce the country's dependence on imported food. Some of the polders are used for housing, and one contains Schiphol, one of Europe's busiest airports.



(a)

The second distinctive modification of the landscape in the Netherlands is the construction of massive dikes to prevent the North Sea, an arm of the Atlantic Ocean, from flooding much of the country. The Dutch have built dikes in two major locations – the Zuider Zee project in the north and the Delta Plan project in the southwest.

The Zuider Zee, a shallow bay of the North Sea, once threatened the heart of the Netherlands with flooding. A dike completed in 1932 caused the Zuider Zee to be converted from a saltwater sea to a freshwater lake called Lake IJssel. Some of the lake has been drained to create several polders.

A second ambitious project in the Netherlands is the Delta Plan. Several rivers that flow through the Netherlands to the North Sea split into many branches and form a low-lying delta that is vulnerable to flooding. After a devastating flood in January 1953 killed 1,836 people, the Delta Plan called for the construction of several dams to close off most of the waterways.

Once these two massive projects were finished, attitudes toward modifying the environment changed. To preserve the IJsselmeer's recreation value, the Dutch scrapped plans to build more polders. The Dutch are deliberately breaking some of the dikes to flood fields. A plan adopted in 1990 called for returning 263,000 hectares (650,000 acres) of farms to wetlands or forests.

Global warming could threaten the Netherlands by raising the level of the sea around the country by between 20 and 58 centimeters (8 and 23 inches) within the next 100 years. Rather than build new dikes and polders, the Dutch have become world leaders in reducing the causes of global warming by acting to reduce industrial pollution and increase solar and wind power use, among other actions.

Pause & Reflect 1.4.4 How might creating new wetlands and lakes rather than dikes or polders help the Netherlands cope with sea-level rise due to climate change?

(b)

FIGURE 1-75 SUSTAINABLE WATER MANAGEMENT: THE NETHERLANDS (a) The Dutch have considerably altered the site of the Netherlands through creation of polders and dikes. (b) Kalverpolder in North Holland has been created by pumping the water from the site into the canal, originally by means of windmills.

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Unsustainable Ecosystem: Cape Town, South Africa

Cape Town, South Africa, an urban area of 3.8 million, has long been regarded as an example of sustainable development. But in 2018, the city nearly ran out of water, and may yet do so.

The city is located at the southwest tip of Africa on the edge of a very dry climate (refer to Figure 1-70). In recognition of the scarcity of water, Cape Town has practiced careful management of water supplies and other strong conservation policies. The city fixed leaks, replaced old pipes, installed meters, and adjusted prices to encourage conservation. Although the city's population doubled between 1990 and 2018, its total consumption of water remained around the same. The city's policies won it international awards for conservation and resource management.

Cape Town's drinking water comes from several reservoirs that fill up with rainwater during the winter rainy season. In 2014, after a rainy winter, Theewaterskloof, the largest of these reservoirs, and the city's principal source of drinking water, was full (Figure 1-76a). Cape Town then suffered through its worst drought in more than 100 years. After two unusually dry years, the reservoir was still mostly full (Figure 1-76b). However, as the drought continued into early 2018, Theewaterskloof was only 13 percent of its level in 2014 (Figure 1-76c).

Faced with a severe shortage of water, Cape Town ordered drastic cuts in water consumption. The result was to cut water consumption by one-half. Still, water supplies ran out periodically, requiring some people to line up for water (Figure 1-77).

Cape Town faces an unsustainable future. Global climate change is making the region around the city drier and warmer. Thanks to higher rainfall, the reservoir level rose in 2018, though still lower than before the drought. But it can't always count on winter rain to refill the reservoirs. The city needs to use groundwater and desalination of the sea water, but these projects are very expensive and would take many years to complete. Consequently, Cape Town – once internationally recognized for its sustainable policies – faces the prospect of recurring water supply crises year after year.

▲ **FIGURE 1-76 THEEWATERSKLOOF DAM, CAPE TOWN** Cape Town's principal source of water (a) January 3, 2014, (b) January 9, 2016, (c) January 14, 2018.

▶ **FIGURE 1-77 COLLECTING FRESH DRINKING WATER, CAPE TOWN, SOUTH AFRICA**

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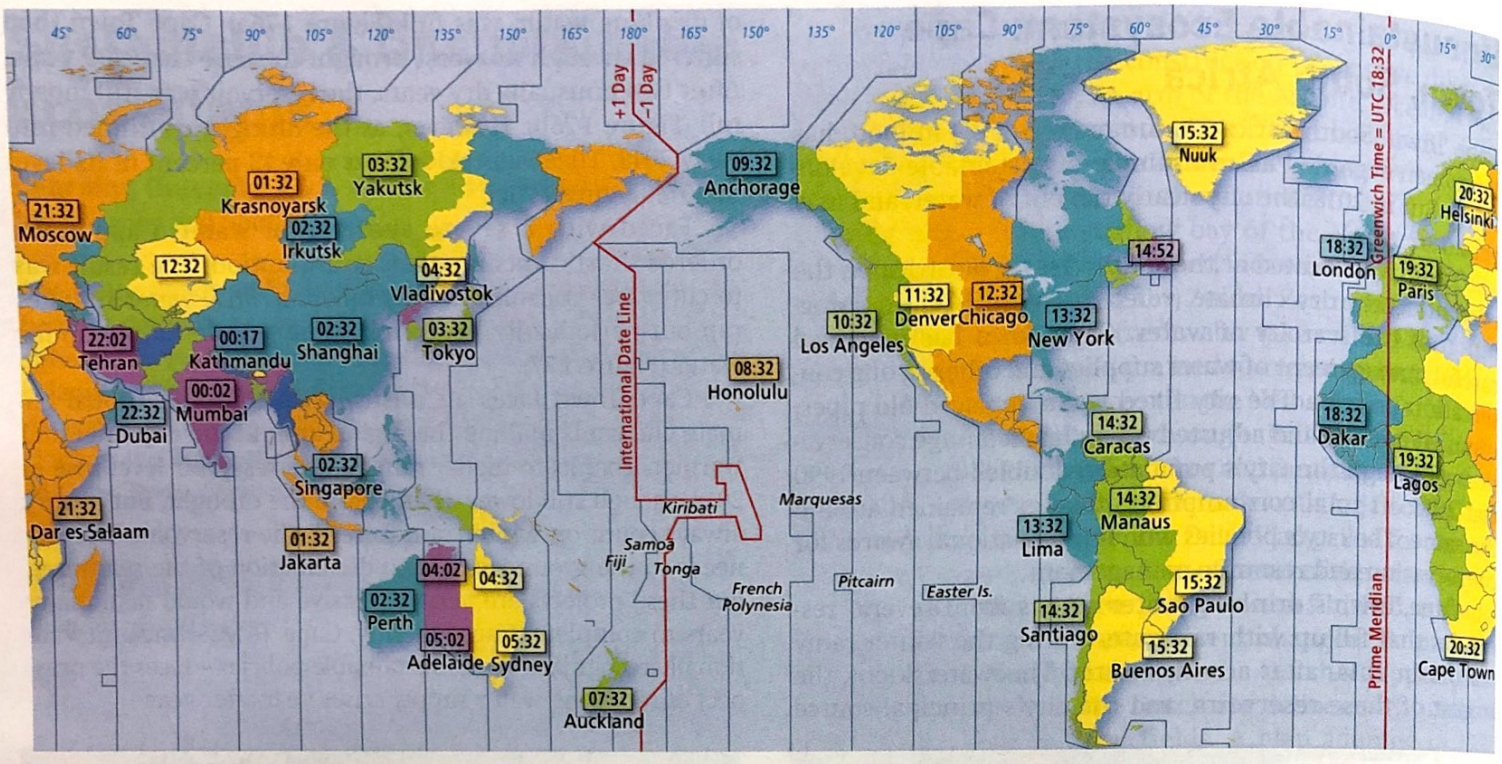

▲ **FIGURE 1-78 TIME ZONES**

Telling Time

Earth as a sphere is divided into 360° of longitude (the degrees from 0° to 180° west longitude plus the degrees from 0° to 180° east longitude). As Earth rotates daily, these 360 imaginary lines of longitude pass beneath the cascading sunshine. If we let every fifteenth degree of longitude represent one time zone, and divide the 360° by 15°, we get 24 time zones, or one for each hour of the day. By international agreement, **Coordinated Universal Time (UTC)**, known informally as Greenwich Mean Time (GMT), which is the time at the prime meridian (0° longitude), is the master reference time for all points on Earth.

Each 15° band of longitude is assigned to a standard time zone (Figure 1-78). The eastern United States, which is near 75° west longitude, is therefore 5 hours earlier than UTC (the 75° difference between the prime meridian and 75° west longitude, divided by 15° per hour, equals 5 hours). Thus when the time in New York City in the winter is 1:32 P.M. (or 13:32 hours, using a 24-hour clock), it is 6:32 P.M. (or 18:32 hours) UTC. During the summer, many places in the world, including most of North America, move the clocks ahead one hour; so in the summer when it is 6:32 P.M. UTC, the time in New York City is 2:32 P.M.

The **International Date Line** is an arc that for the most part follows 180° longitude. When the International Date Line is crossed heading east (toward America), the clock moves back 24 hours, or one entire day. When it is crossed heading west (toward Asia), the calendar moves ahead one day.

To see the need for the International Date Line, try counting the hours around the world from the time zone in which you live. As you go from west to east, you add 1 hour for each time zone. When you return to your starting point, you will reach the absurd conclusion that it is 24 hours later in your locality than it really is. Therefore – if it is 6:32 A.M. Monday in Auckland, when you get to Honolulu, it will be 8:32 A.M. Sunday because the International Date Line lies between Auckland and Honolulu.

The International Date Line for the most part follows 180° longitude. However, several islands in the Pacific Ocean belonging to the countries of Kiribati and Samoa as well as to New Zealand's Tokelau territory, moved the International Date Line several thousand kilometers to the east. Samoa and Tokelau moved it in 2011 so that they could be on the same day as Australia and New Zealand, their major trading partners. Kiribati moved it in 1997 so that it would be the first country to see each day's sunrise. Kiribati hoped that this feature would attract tourists to celebrate the start of the new millennium on January 1, 2000 (or January 1, 2001, when sticklers pointed out the new millennium really began). But it did not.

Explore

The Prime Meridian

Use Google Earth to explore the prime meridian.
Fly to *Royal Observatory, Greenwich, England.*

1. Switch to 2D and zoom in to around 150 meters. What is the precise longitude of the Royal Observatory (Figure 1-79)?
2. Drag the street view icon along the blue lines until you find the location nearest the Royal Observatory that is actually at 0°00'00". In which compass direction did you move to reach the exact prime meridian?
3. Drop the street view icon at 0°00'00". Describe what you see at that location.

▶ **FIGURE 1-79 ROYAL OBSERVATORY, GREENWICH, UNITED KINGDOM**

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Key Terms

Abiotic (p. 36) Composed of nonliving or inorganic matter.

Absolute location (p. 15) Description of the position of a place in a way that never changes, such as geographic coordinates of latitude and longitude.

Acculturation (p. 33) The process of changes in culture that result from the meeting of two groups, each of which retains distinct cultural features.

Assimilation (p. 33) The process by which a group's cultural features are altered to resemble those of another group.

Atmosphere (p. 36) The thin layer of gases surrounding Earth.

Behavioral geography (p. 24) An approach to human geography that emphasizes the importance of understanding the psychological basis for individual human actions in space.

Biosphere (p. 36) All living organisms on Earth, including plants and animals, as well as microorganisms.

Biotic (p. 36) Composed of living organisms.

Cartogram (p. 13) A map in which the projection and scale are distorted in order to convey the information of a variable.

Cartography (p. 6) The science of making maps.

Choropleth map (p. 13) A map in which areas are shaded or patterned in proportion to the measurement of the variable.

Citizen science (p. 9) Scientific research by amateur scientists.

Climate (p. 36) The long-term average weather condition at a particular location.

Concentration (p. 22) The extent of a feature's spread over a given area.

Connection (p. 5) The relationships among people and objects across the barrier of space.

Conservation (p. 35) The sustainable management of a natural resource to meet human needs.

Contagious diffusion (p. 31) The rapid, widespread diffusion of a feature or trend throughout a population.

Coordinated Universal Time (UTC) (p. 42) Informally Greenwich Mean Time (GMT). The time in the zone encompassing the prime meridian, or 0° longitude.

Cultural ecology (p. 39) A geographic approach that emphasizes human-environment relationships.

Cultural landscape (p. 16) An approach to geography that emphasizes the relationships among social and physical phenomena in a particular study area.

Culture (p. 18) The body of customary beliefs, material traits, and social forms that together constitutes the distinct tradition of a group of people.

Density (p. 22) The frequency with which something exists within a given unit of area.

Diffusion (p. 30) The process by which a feature spreads from one place to another over time.

Distance decay (p. 32) The diminished importance and eventual disappearance of a phenomenon with increasing distance from its origin.

Distribution (p. 22) The arrangement of something across Earth's surface.

Dot distribution map (p. 13) A map that depicts data that consists of discrete observations. Each dot represents a predetermined number of observations, which could be one or many.

Ecology (p. 38) The scientific study of ecosystems.

Ecosystem (p. 38) A group of living organisms and the abiotic spheres with which they interact.

Environmental determinism (p. 39) A nineteenth- and early twentieth-century approach to the study of geography which argued that the general laws sought by human geographers could be found in the physical sciences. Geography was therefore the study of how the physical environment caused human activities.

Expansion diffusion (p. 31) The spread of a feature or trend among people from one area to another in an additive process.

Formal region (or **uniform region**) (p. 16) An area in which most people share in one or more distinctive characteristics.

Functional region (or **nodal region**) (p. 17) An area organized around a node or focal point.

Geographic information science (GIScience) (p. 8) Analysis of data about Earth acquired through satellite and other electronic information technologies.

Geographic information system (GIS) (p. 8) A computer system that captures, stores, queries, and displays geographic data.

Geotagging (p. 8) Identification and storage of a piece of information by its precise latitude and longitude coordinates.

Global Positioning System (GPS) (p. 8) A system that determines the precise position of something on Earth through a series of satellites, tracking stations, and receivers.

Globalization (p. 20) Actions or processes that involve the entire world and result in making something worldwide in scope.

Graduated symbol map (p. 13) A map that displays symbols that change in size according to the value of the variable.

Hearth (p. 30) A place from which an innovation originates.

Hierarchical diffusion (p. 31) The spread of a feature or trend from one key person or node of authority or power to other persons or places.

Humanistic geography (p. 24) An approach to human geography that emphasizes the different ways that individuals form ideas about place and give those places symbolic meanings.

Hydrosphere (p. 36) All of the water on and near Earth's surface.

International Date Line (p. 42) An arc that for the most part follows 180° longitude. When the International Date Line is crossed heading east (toward America), the clock moves back 24 hours, or one entire day. When it is crossed heading west (toward Asia), the calendar moves ahead one day.

Isoline map (p. 13) A map that connects places of a particular value by lines.

Latitude (p. 12) The numbering system used to indicate the location of parallels drawn on a globe and measuring distance north and south of the equator (0°).

Lithosphere (p. 36) Earth's crust and a portion of upper mantle directly below the crust.

Location (p. 14) The position of anything on Earth's surface.

Longitude (p. 12) The numbering system used to indicate the location of meridians drawn on a globe and measuring distance east and west of the prime meridian (0°).

Map (p. 6) A two-dimensional, or flat, representation of Earth's surface or a portion of it.

Map scale (p. 10) The relationship between the size of an object on a map and the size of the actual feature on Earth's surface.

Mashup (p. 9) A map that overlays data from one source on top of a map provided by a mapping service.

Meme (p. 31) Contagious diffusion through the Internet or social media.

Mental map (p. 9) A representation of a portion of Earth's surface based on what an individual knows about a place that contains personal impressions of what is in the place and where the place is located.

Meridian (p. 12) An arc drawn on a map between the North and South poles.

Network (p. 32) A chain of communication that connects places.

Nonrenewable resource (p. 34) A resource that is produced in nature more slowly than it is consumed by humans.

Parallel (p. 12) A circle drawn around the globe parallel to the equator and at right angles to the meridians.

Participatory GIS (PGIS) (p. 9) Community-based mapping, representing local knowledge and information.

Pattern (p. 22) The geometric or regular arrangement of something in a particular area.

Photogrammetry (p. 8) The science of taking measurements of Earth's surface from photographs.

Place (p. 4) A specific point on Earth, distinguished by a particular characteristic.

Polder (p. 40) Land that the Dutch have created by draining water from an area.

Possibilism (p. 39) The theory that the physical environment may set limits on human actions, but people have the ability to adjust to the physical environment and choose a course of action from many alternatives.

Poststructuralist geography (p. 24) Geographic approach that examines how the powerful in a society dominate, or seek to control, less powerful groups, how the dominated groups occupy space, and confrontations that result from the domination.

Preservation (p. 35) The maintenance of resources in their present condition, with as little human impact as possible.

Prime meridian (p. 12) The meridian, designated as 0° longitude, that passes through the Royal Observatory at Greenwich, England.

Projection (p. 11) A system used to transfer locations from Earth's surface to a flat map.

Region (p. 5) An area distinguished by one or more distinctive characteristics.

Relocation diffusion (p. 30) The spread of a feature or trend through bodily movement of people from one place to another.

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Remote sensing (p. 8) The acquisition of data about Earth's surface from a satellite orbiting the planet or from other long-distance methods.

Renewable resource (p. 34) A resource that is produced in nature more rapidly than it is consumed by humans.

Resource (p. 34) A substance in the environment that is useful to people, is economically and technologically feasible to access, and is socially acceptable to use.

Scale (p. 5) The relationship between the portion of Earth being studied and Earth as a whole.

Site (p. 15) The physical character of a place.

Situation (or relative location) (p. 15) The location of a place relative to another place.

Space (p. 5) The physical gap or interval between two objects.

Space–time compression (p. 32) The reduction in the time it takes to diffuse something to a distant place as a result of improved communications and transportation systems.

Spatial association (p. 19) The relationship between the distribution of one feature and the distribution of another feature.

Stimulus diffusion (p. 31) The spread of an underlying principle.

Sustainability (p. 34) The use of Earth's renewable and nonrenewable natural resources in ways that do not constrain resource use in the future.

Syncretism (p. 33) The combining of elements of two groups into a new cultural feature.

Toponym (p. 14) The name given to a portion of Earth's surface.

Transnational corporation (p. 21) A company that conducts research, operates factories, and sells products in many countries, not just where its headquarters or shareholders are located.

Uneven development (p. 25) The increasing gap in economic conditions between core and peripheral regions as a result of the globalization of the economy.

Vernacular region (or perceptual region) (p. 17) An area that people believe exists as part of their cultural identity.

Volunteered geographic information (VGI) (p. 9) Creation and dissemination of geographic data contributed voluntarily and for free by individuals.

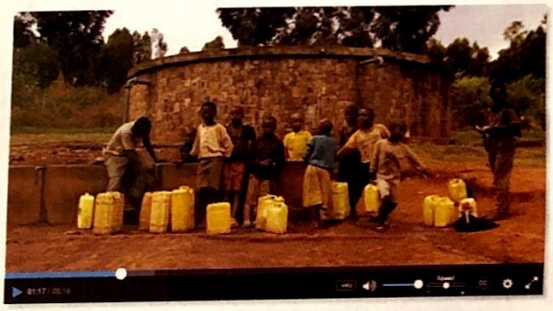
GeoVideo

*Log in to the **Mastering Geography™ Study Area** to view **this video**.*

The Exploitation of Water

Earth has a finite supply of water.

1. What are the principal uses of water?
2. Why is demand for water increasing?
3. Why are people in Mexico struggling to get enough water?



▲ **FIGURE 1CR-5 WATER STRESS IN AFRICA**

Geospatial Data Analysis

AP® **Skills:** 2.C, 3.D, 5.D **Reasoning:** 1.ii, 2.iii, 3.v

*Log in to the **Mastering Geography Study Area** to access **MapMaster 2.0**.*

Environmental Challenges for the Dutch

Add the **Population (Arithmetic)** Density layer. **Click** the **Settings** icon in the Legend and **select** *Show Political Labels*.

Zoom in as far as possible to center the map on the *Netherlands* (northwestern Europe between Belgium and United Kingdom).

Add the *World Elevations* layer and select **Split map** window.

1. Hover over the Netherlands. What is the elevation of this area?
2. Compare the elevation map to the population density map. Describe the distribution of population within the Netherlands (density, concentration, and pattern).
3. What environmental challenges do people living in the Netherlands face? How are the Dutch addressing these challenges? Are these challenges likely to become more severe or less severe in the coming years? Explain your answer.

▲ **FIGURE 1CR-6 ELEVATION AND POPULATION OF NORTHWESTERN EUROPE**

Writing Geographically

AP® **Skills:** 1.A, 1.D, 1.E, 4.E, 5.B **Reasoning:** 1.ii, 2.iii

Sustainability Challenges, Jackson Hole, Wyoming

According to the U.N. report *Our Common Future*, sustainability rests on three pillars. Figure 1CR-7 illustrates the three pillars with images of Jackson Hole, Wyoming.

1. Summarize the three pillars of sustainability.
2. How might the three images in Figure 1CR-7 illustrate each of the three pillars?
3. How might efforts to improve one of the pillars help or harm the other two pillars?

(a)

(b)

(c)

▲ **FIGURE 1CR-7 JACKSON HOLE, WYOMING** (a) Moose in a stream, (b) Tourists on the Snake River, (c) Shop assistant in the town of Jackson.

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KEY ISSUE

2.1 | Where Are People Distributed?

Geographers study population by first describing where Earth's nearly 8 billion people are distributed. 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.

Population & Geography

Learning Outcome 2.1.1 Describe the distribution of the world's population.

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. **Carrying capacity** is the maximum population size of a species that the environment can sustain indefinitely, given the available resources such as food and water. The capacity of the land to sustain human 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. **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 geographers 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. 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 (Figure 2-1). Further, the regions with the most people are not the same as the regions with an unfavorable balance between population and resources.

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. (See Doing Geography feature on the next page.)

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.

Pause & Reflect 2.1.1 What challenges for human populations arise from Earth's carrying capacity?

▼ **FIGURE 2-1 THE CHALLENGE OF BALANCING PEOPLE AND RESOURCES, DELHI, INDIA** People living in parts of Delhi have no running water at home, so they obtain water by filling containers at a truck.

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Population Portions

The world can be divided into seven portions, each containing slightly more than 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) is about the same as the population of India (3 million square kilometers) or eastern China (5 million square kilometers). The small size of the Asia portions shows the large number of the world's inhabitants living there compared with the portion made up of North and South America, Australia, and New Zealand.

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

DOING GEOGRAPHY — The Census

The single most important data source for population geography is the **census** (Figure 2-3). 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. People who are homeless, ethnic minorities, and citizens of other countries who do not have proper immigration documents may be less likely to complete the census form. These individuals may fear that the census 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 people who are 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.

U.S. Census Website
https://goo.gl/LvoeGE

FIGURE 2-3 CENSUS TAKER Florida.

What's Your **POPULATION** Geography?

1. Use your Internet browser to go to census.gov. What are the current populations of the United States and of the world?
2. Select Data, then Data Main, then American Fact Finder. Enter the name of your community. What was the population of your community at the last census?
3. Select Annual Population Estimates. What is the current population of your community? Has the population grown or has it declined in recent years? What might account for the change?

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Population Concentrations

Learning Outcome 2.1.2 Contrast regions of high and low population concentrations.

Human beings are not distributed uniformly across Earth. We can understand how population is distributed by examining two basic properties – concentration (this page) and density (see page 52). Geographers identify regions of Earth's surface where population is clustered and regions where it is sparse.

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

In addition to the world's four most populous clusters, Africa has several concentrations. The two largest are along the west coast between Senegal and Nigeria and along the east coast between Eritrea and South Africa. The largest population concentration in the Western Hemisphere is in the northeastern United States and southeastern Canada.

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.

▼ FIGURE 2-4 WORLD POPULATION DISTRIBUTION What factors explain the clustering of the U.S. population in the eastern half of the country?

SPARSELY POPULATED 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.

EUROPE CLUSTER
Europe includes four dozen countries, ranging from Monaco, with 2 square kilometers (0.8 square miles) and a population of 37,000, to Russia, the world's largest country in land area. The highest population concentrations in Europe are near the major rivers of Germany and Belgium as well as capital cities such as London and Paris.

SOUTH ASIA CLUSTER
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.

EAST ASIA CLUSTER
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.

SPARSELY POPULATED 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.

SPARSELY POPULATED 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.

SOUTHEAST ASIA CLUSTER
Indonesia, which consists of 14,752 islands according to the United Nations, is the world's fourth-most-populous country. The largest population concentration is on the island of Java, inhabited by more than 150 million people. Several islands that belong to the Philippines contain high population concentrations, and population is also clustered along several river valleys and deltas of the Southeast Asian mainland.

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

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Population Cartogram

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 2-5). When compared to a more typical equal-area map, such as the one shown in Figure 2-4, 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.

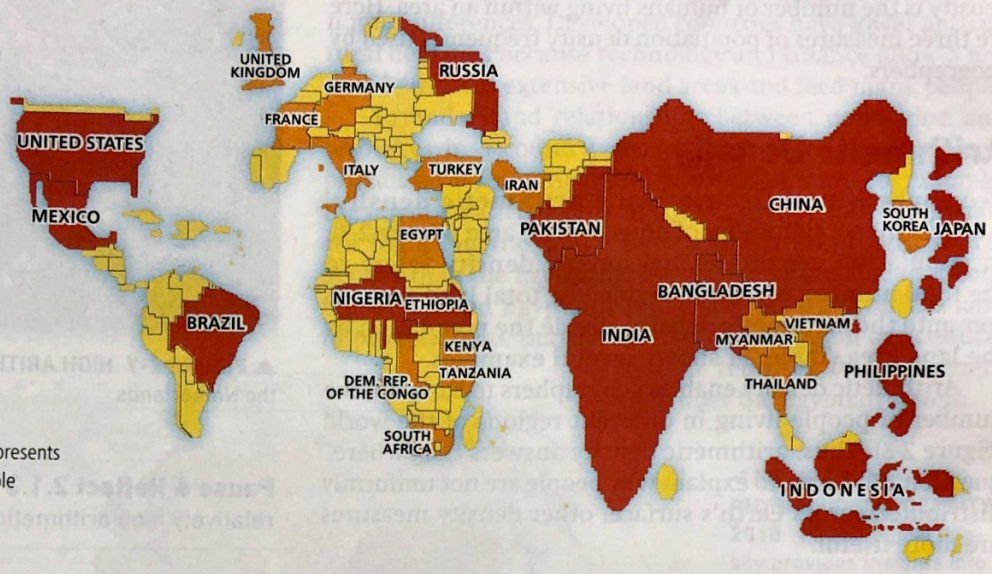


FIGURE 2-5 WORLD CARTOGRAM In a cartogram, countries are displayed by size of population rather than land area. For example, Canada is the world's second-largest country in land area, so it appears quite large on most maps. But it ranks only 38th in population so it appears small on this map. Conversely, 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
- 100 million and above
- 50–99 million
- below 50 million

☐ Each square represents 10 million people

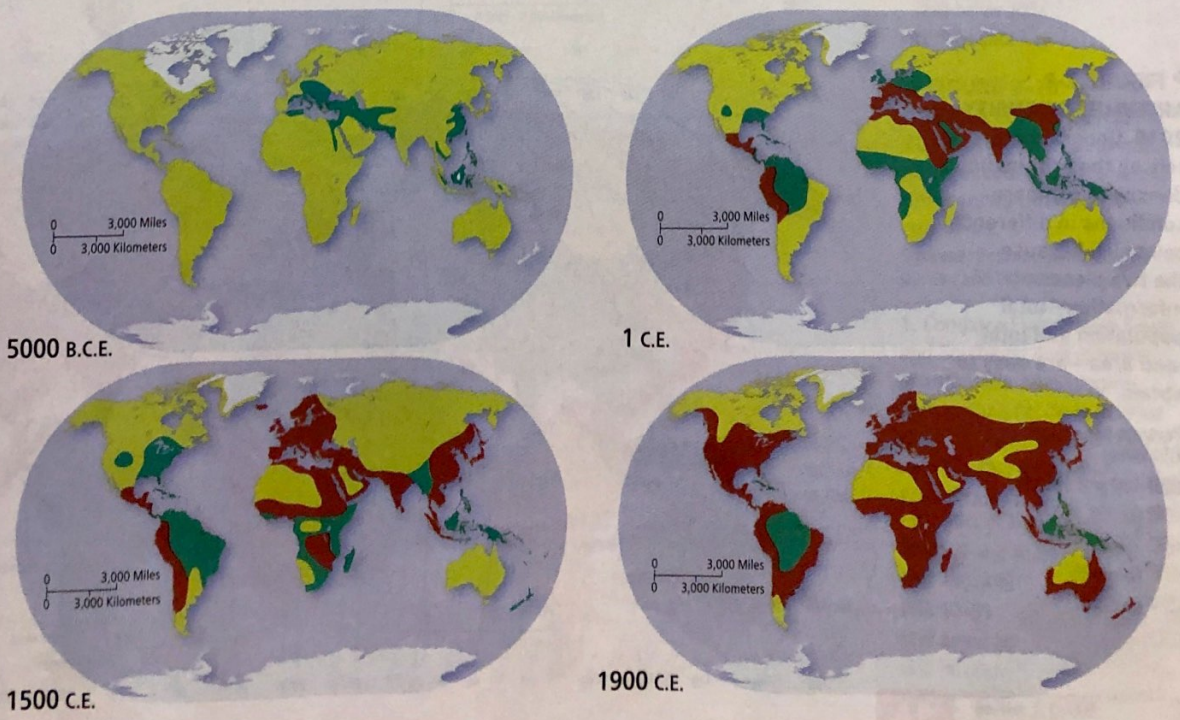
Ecumene

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 2-6).

By 7,000 years ago, humans had occupied most of Earth's land (except Antarctica), but permanent settlements existed 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.

Pause & Reflect 2.1.2 Why are some land areas not part of the ecumene (refer to Figure 2-4)?

FIGURE 2-6 ECUMENE The portion of Earth's surface occupied by permanent human settlement has increased.



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Population Density

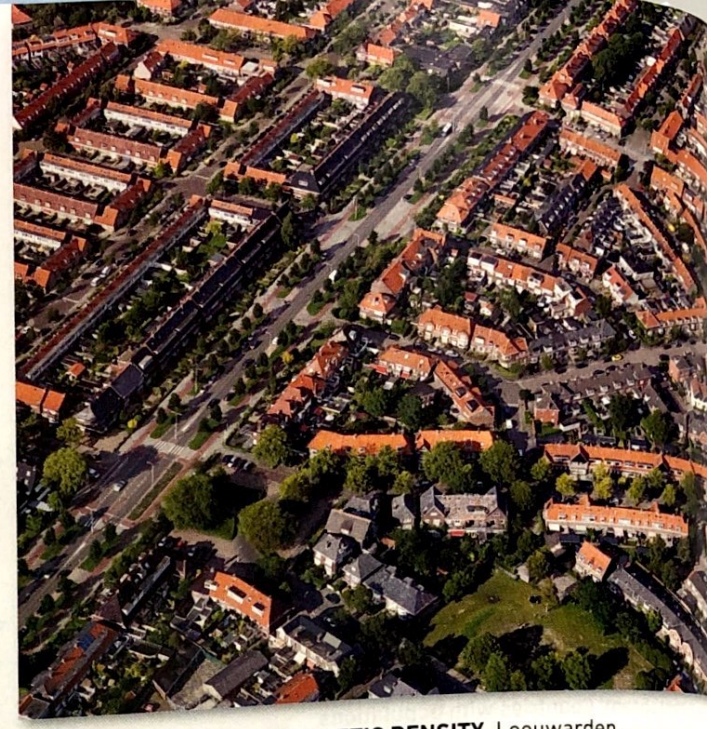
Learning Outcome 2.1.3 Compare different approaches to measuring density.

Density was defined in Chapter 1 as the frequency with which something exists within a given unit of area. Population density is the number of humans living within an area. Here are three measures of population density frequently used by geographers.

Arithmetic Density

Geographers most frequently use **arithmetic density**, which is the total number of objects in an area (Figure 2-7). In population geography, arithmetic density refers to the total number of people divided by total land area. 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 living in different regions of the world (Figure 2-8). 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.

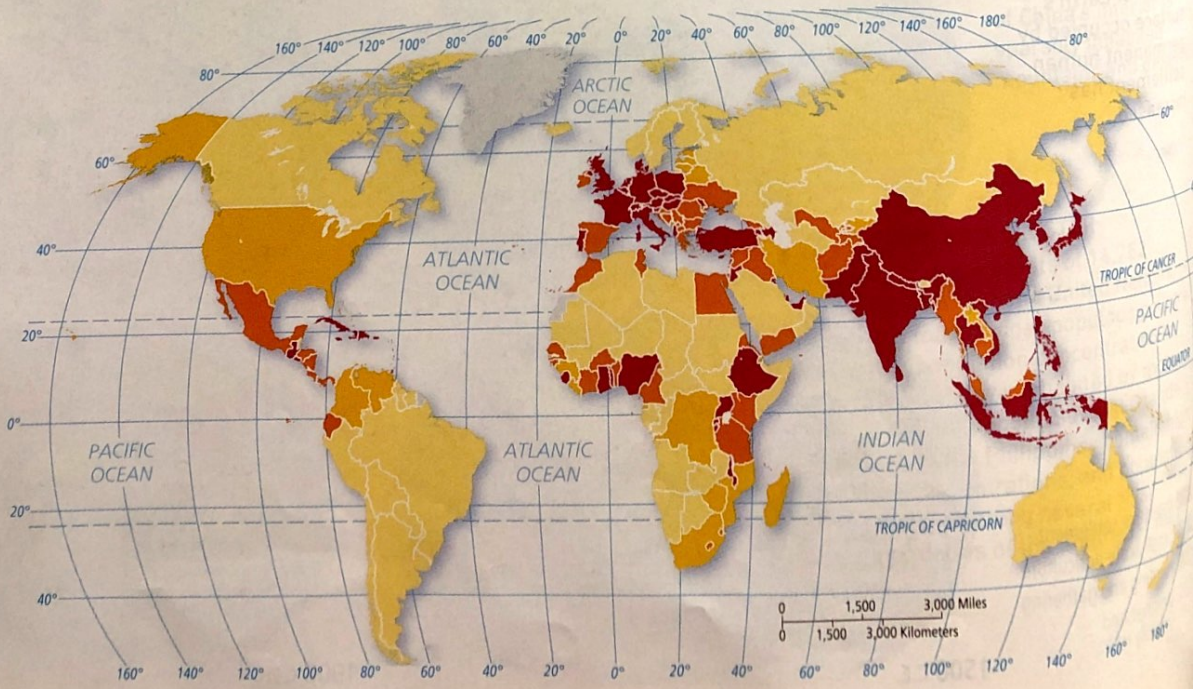


▲ **FIGURE 2-7 HIGH ARITHMETIC DENSITY** Leeuwarden, the Netherlands.

Pause & Reflect 2.1.3 What regions of the world have relatively high arithmetic densities?

TABLE 2-1 | Density Measures for Four Countries

Country	Arithmetic Density	Physiological Density	Agricultural Density	Percentage Farmers	Percentage Arable Land
Canada	4	85	0.8	2	5
Egypt	97	3,350	208	25	4
The Netherlands	511	1,668	9	2	30
United States	36	215	0.4	1	17



▶ **FIGURE 2-8 ARITHMETIC DENSITY, 2018** 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.

Persons per square kilometer
- 100 and above
- 50–99
- 25–49
- below 25
- no data

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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**. The number of people per unit area of arable land is called the **physiological density** (Figure 2-9).

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, as shown in Table 2-1, 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 2-10). 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.

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.

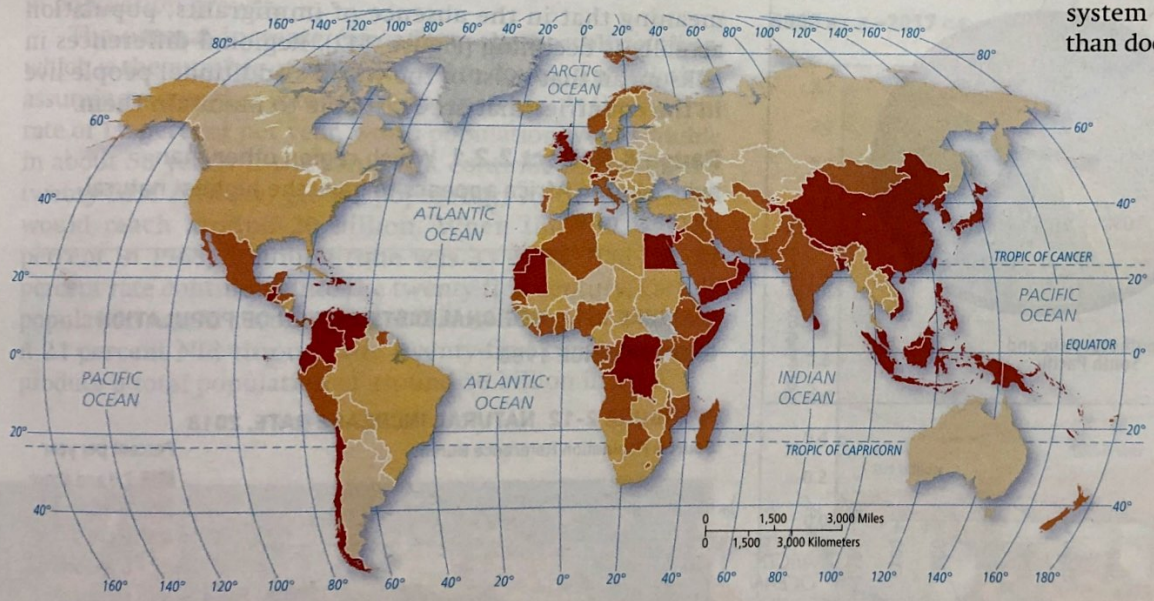

FIGURE 2-9
PHYSIOLOGICAL DENSITY, 2018 Physiological density provides insights into the relationship between the size of a population and the availability of resources in a region.
Source: Population Reference Bureau

Persons per square kilometer of arable land
- 1,000 and above
- 500–999
- 200–499
- below 200
- no data

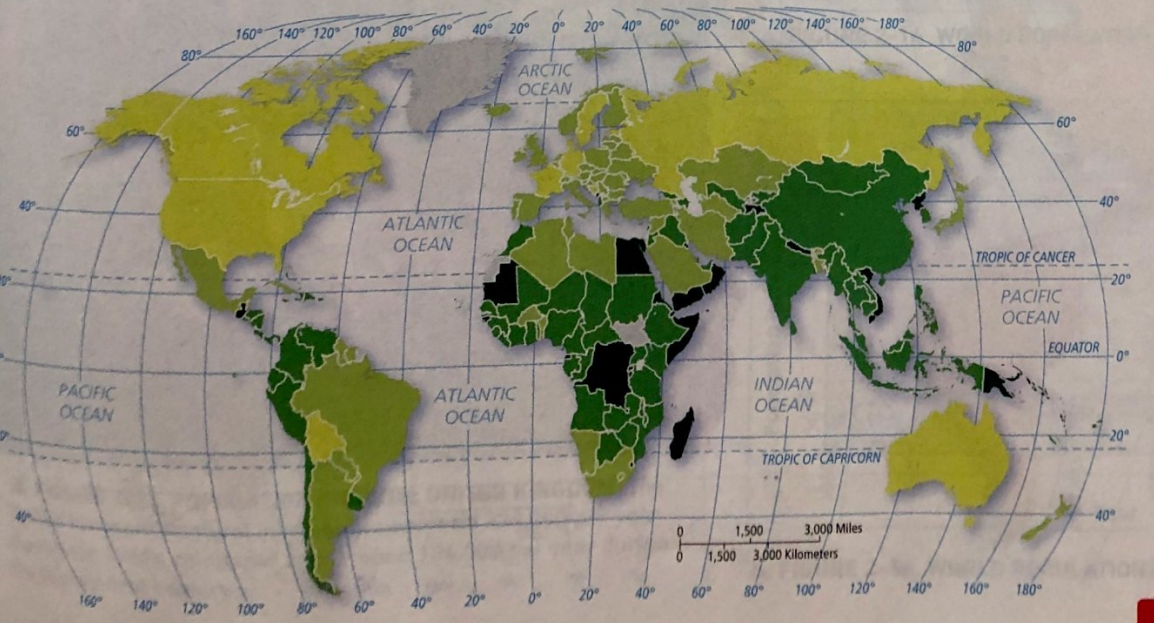

FIGURE 2-10
AGRICULTURAL DENSITY, 2018 Agricultural density helps account for economic differences between countries.
Sources: Population Reference Bureau and World Bank

1. *Compare Europe with South and Southeast Asia in terms of arithmetic, physiological, and agricultural density. What explains the main difference between these regions?*

Farmers per square kilometer of arable land
- 500 and above
- 100–499
- 10–99
- below 10
- no data

AP® **Skills:** 2.D, 3.B
Reasoning: 1.ii, 2.ii, 3.i

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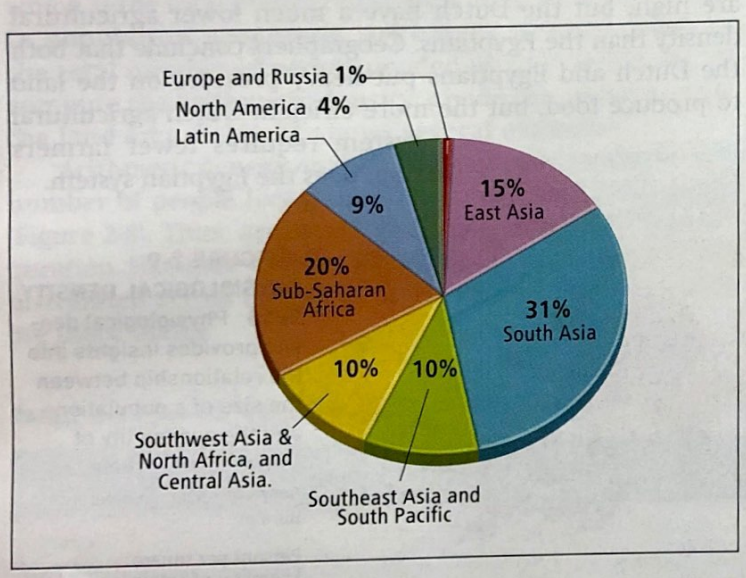
KEY ISSUE

2.2 | Why Is Population Increasing?

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 or decreases as people move in or out. This element of population change—migration—is discussed in Chapter 3. For most of human history, Earth's population was unchanged at perhaps a half-million. In contrast, about 85 million people are now being added to the population of the world annually.



Natural Increase

Learning Outcome 2.2.1 Summarize historical and current rates of population 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%.

More than 95 percent of the natural increase is clustered in developing countries (Figure 2-11). Since 1980, 66 percent of the world's population growth has been in Asia, 20 percent in sub-Saharan Africa, 9 percent in Latin America, 4 percent in North America, and 1 percent in Europe, including Russia (Figure 2-11).

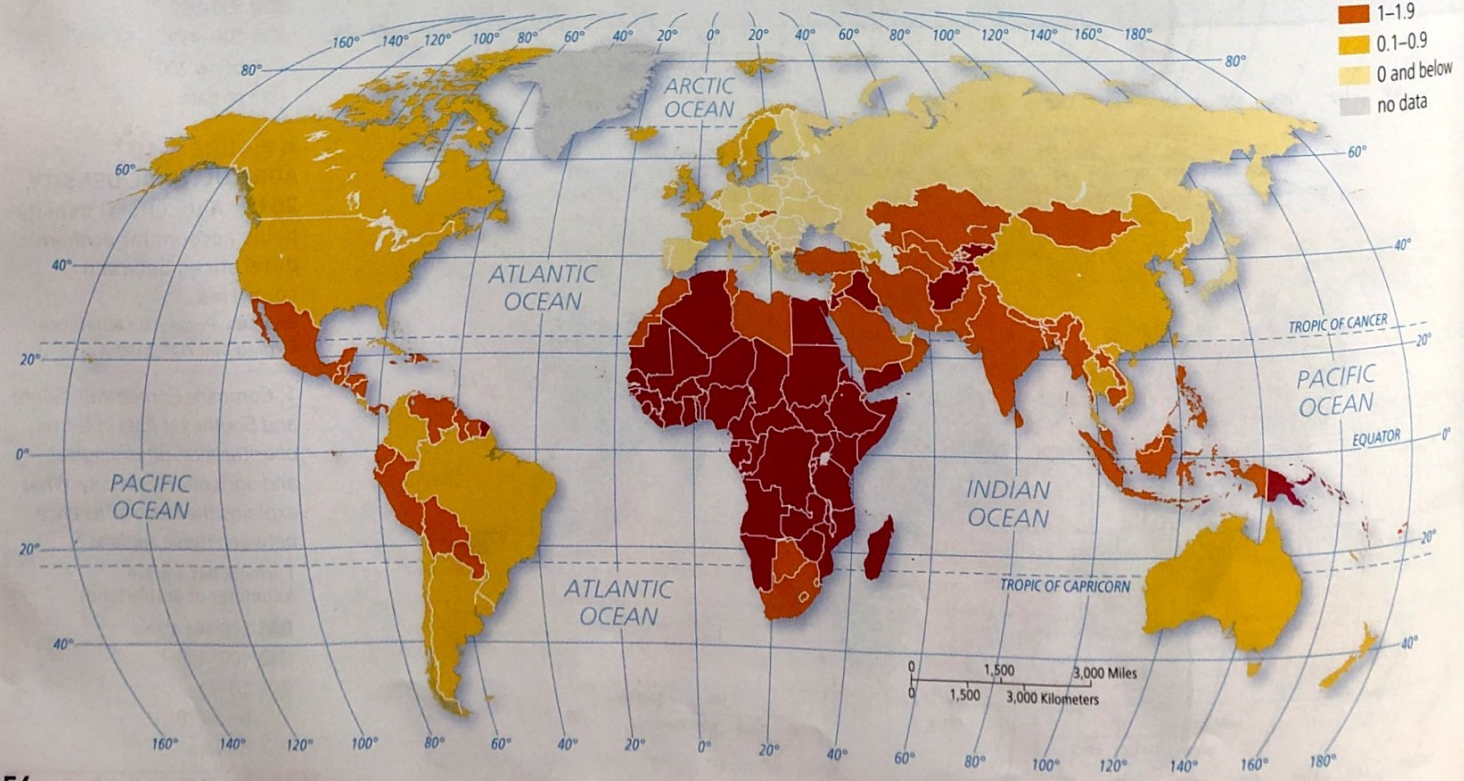
The NIR currently exceeds 2.0 percent in most countries of sub-Saharan Africa, whereas it is negative in Europe, meaning that in the absence of immigrants, population actually is declining (Figure 2-12). Regional differences in NIRs mean that most of the world's additional people live in the countries that are least able to maintain them.

Pause & Reflect 2.2.1 Which region other than sub-Saharan Africa appears to have the highest natural increase rate?

◀ **FIGURE 2-11 REGIONAL DISTRIBUTION OF POPULATION GROWTH SINCE 1980**

▼ **FIGURE 2-12 NATURAL INCREASE RATE, 2018**

Source: Population Reference Bureau



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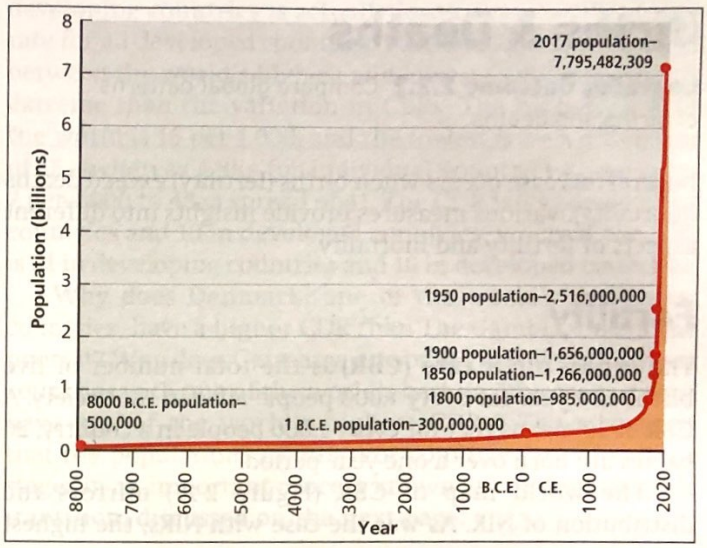
Population Growth in History

The NIR was essentially zero for most of humanity's several-hundred-thousand-year occupancy of Earth (Figure 2-13). The world NIR is lower today than its all-time peak of 2.1 percent in the 1960s, and it has declined since the 1990s (Figure 2-14). However, the NIR during the second half of the twentieth century was high by historical standards (Figure 2-15).

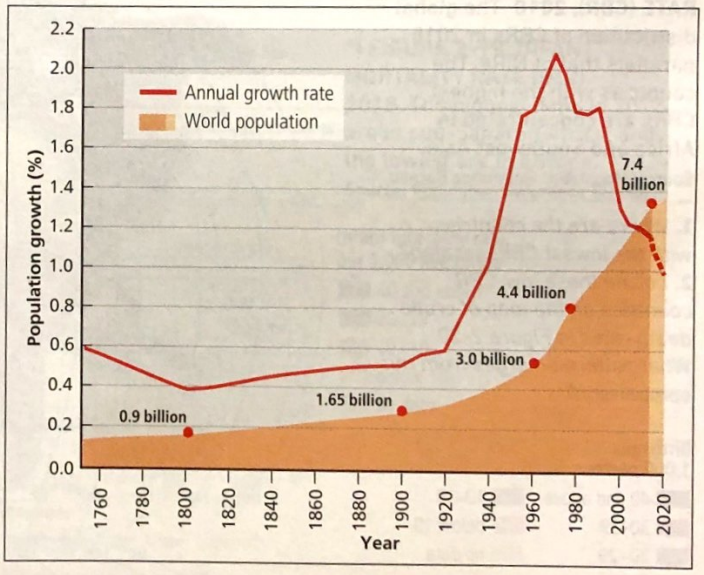
The number of people added each year dropped from a historic peak of 93 million in 1988 to 78 million in 1999. But in the twenty-first century, the number added annually has increased to around 85 million (Figure 2-16). The decline of this number is less sharp than the decline of the NIR because the 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.

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 58 years. If the same NIR continued through the twenty-first century, global population in the year 2100 would reach around 20 billion. When the NIR was 2.1 percent in 1968, doubling time was 33 years. Had the 2.1 percent rate continued into the twenty-first century, Earth's population would currently be 10 billion instead of 8 billion. A 2.1 percent NIR through the twenty-first century would produce a total population of around 56 billion in 2100.

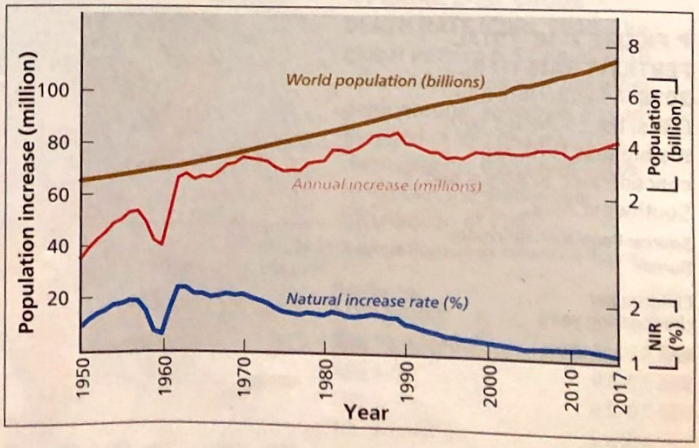
▲ **FIGURE 2-15 POPULATION GROWTH, UNITED KINGDOM** The United Kingdom's natural increase was around 324,000 per year during the 1960s, compared with around 134,000 per year during the twenty-first century.



▲ **FIGURE 2-13 WORLD POPULATION GROWTH 8000 B.C.E.–2017 C.E.**



▲ **FIGURE 2-14 WORLD POPULATION GROWTH 1750–2017**



▲ **FIGURE 2-16 WORLD POPULATION GROWTH 1950–2017**

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Births & Deaths

Learning Outcome 2.2.2 Compare global patterns of births and deaths.

Natural increase occurs when births (fertility) exceed deaths (mortality). Various measures provide insights into different aspects of fertility and mortality.

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 2-17) mirrors the distribution of NIR. As was 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 35, whereas many European countries have a CBR below 10.

The **total fertility rate (TFR)** measures the number of births in a society (Figure 2-18). 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.

The TFR for the world as a whole is 2.4, and, again, the figures vary between developed and developing countries. The TFR is 4.9 in sub-Saharan Africa, compared to 1.6 in Europe.

AP® **Skills:** 2.D, 3.C, 4.A, 4.C, 5.B **Reasoning:** 1.iv, 2.ii

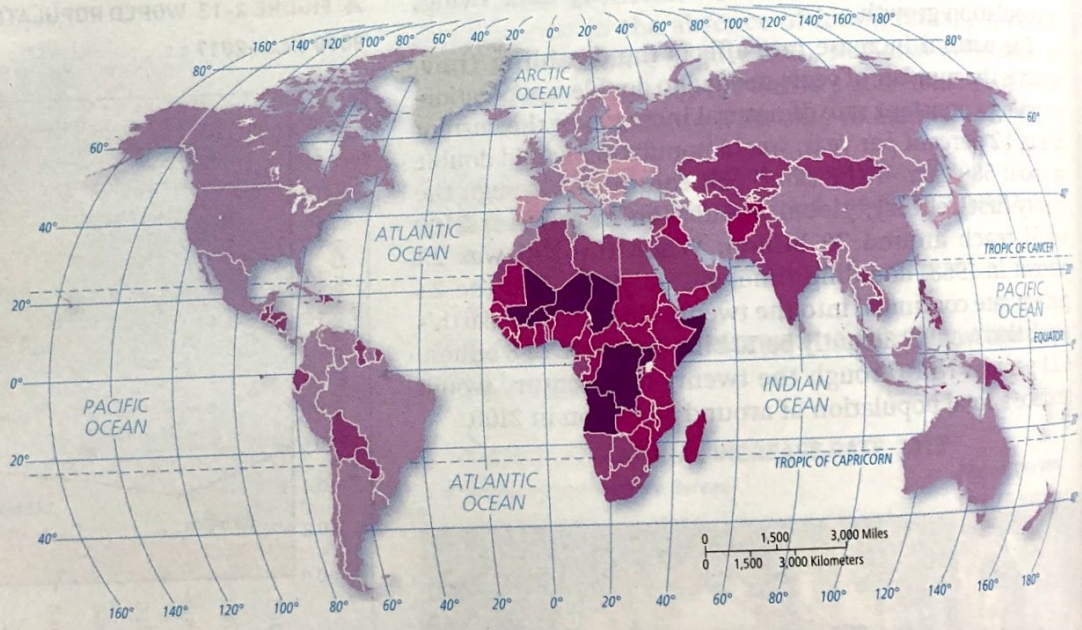

FIGURE 2-17 CRUDE BIRTH RATE (CBR), 2018 The global distribution of CBRs in 2018 parallels that of NIRs. The countries with the highest CBRs are concentrated in Africa and Southwest Asia.
Source: Population Reference Bureau

1. *Where are the countries with the lowest CBRs located?*
2. *Locate these low-CBR countries on the map of crude death rates in Figure 2-20. What pattern emerges from this comparison?*

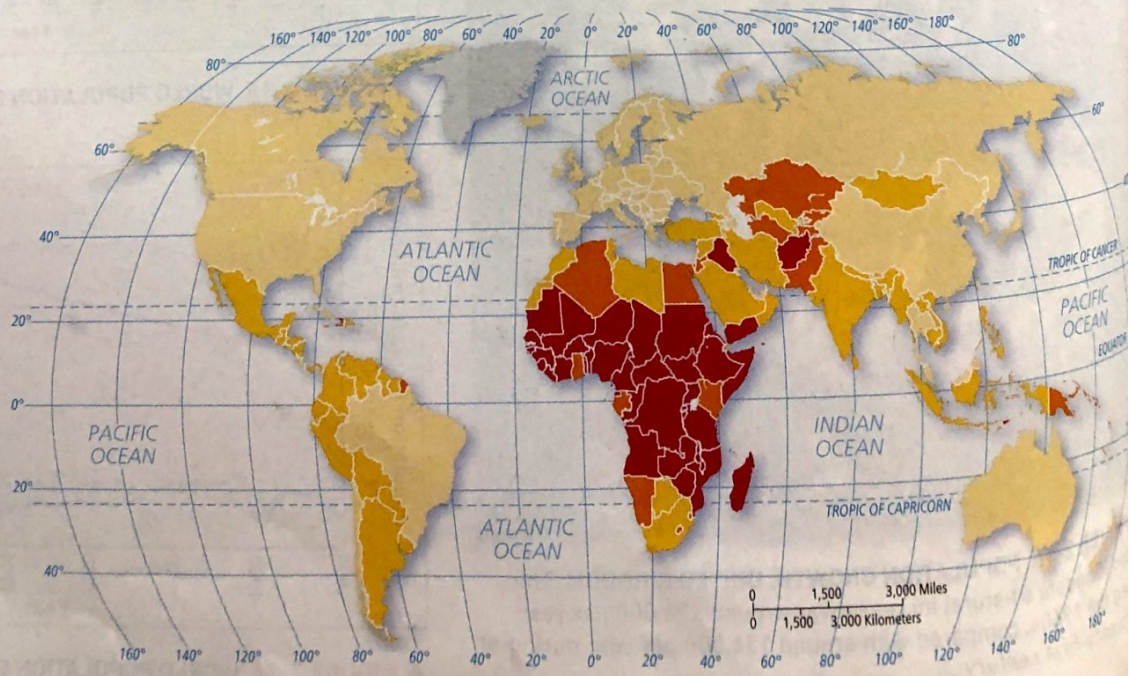

FIGURE 2-18 TOTAL FERTILITY RATE (TFR), 2018 As with NIRs and CBRs, the countries with the highest TFRs are concentrated in Africa and Southwest Asia.
Source: Population Reference Bureau

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Mortality

The **infant mortality rate (IMR)** is the annual number of deaths of infants under one year of age, compared with total live births (Figure 2-19). 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 the quality of 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 Europe, compared with 54 in sub-Saharan Africa. In other words, before reaching their first birthday, 1 in 18 babies die in sub-Saharan Africa and 1 in 250 babies die in Europe.

The **crude death rate (CDR)** is the total number of deaths in a year for every 1,000 people alive in the society. As with the CBR and IMR, 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 2-20). 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 16 per 1,000, and the lowest is 1 – a difference of 15 – whereas CBRs for individual countries range from 7 per 1,000 to 48, a spread of 41. The CDR is 7 in developing countries and 10 in developed countries, whereas the CBR is 21 in developing countries and 10 in developed countries.

Why does Denmark, one of the world's wealthiest countries, have a higher CDR than The Gambia, one of the poorest? Why does Germany, one of the world's wealthiest countries with one of the world's best health-care systems, have one of the world's highest CDRs? The answer is that the populations of different countries are at various stages in an important process known as the demographic transition, discussed on the next page.

Pause & Reflect 2.2.2 What region of the world appears to have the lowest CDR. What might account for that?

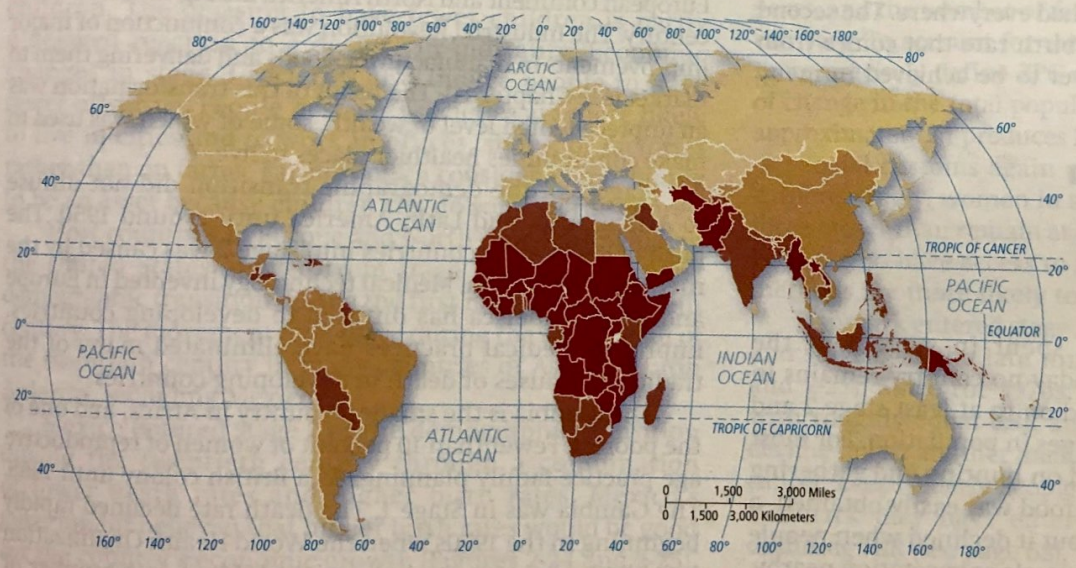

FIGURE 2-19 INFANT MORTALITY RATE (IMR), 2018 The highest IMRs in 2018 are in sub-Saharan Africa, and the lowest are in Europe.
Source: Population Reference Bureau

Infant mortality rate per 1,000 live births
- 40 and above
- 20–39
- 10–19
- below 10
- no data

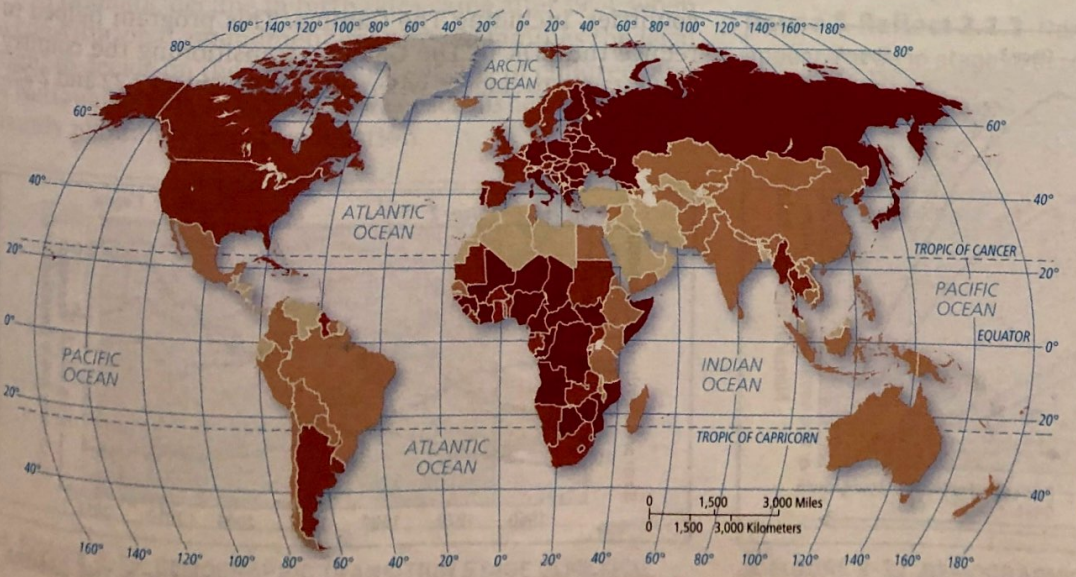

FIGURE 2-20 CRUDE DEATH RATE (CDR), 2018 The global pattern of CDRs in 2018 varies from those for the other demographic variables already mapped in this chapter. The demographic transition helps to explain the distinctive distribution of CDRs.
Source: Population Reference Bureau

Deaths per 1,000 persons
- 10 and above
- 8–9
- 6–7
- below 6
- no data

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The Demographic Transition

Learning Outcome 2.2.3 Explain the stages of the demographic transition model.

All countries have experienced some changes in NIR, CBR, and CDR, but at different times and at different rates. The demographic transition helps to 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.

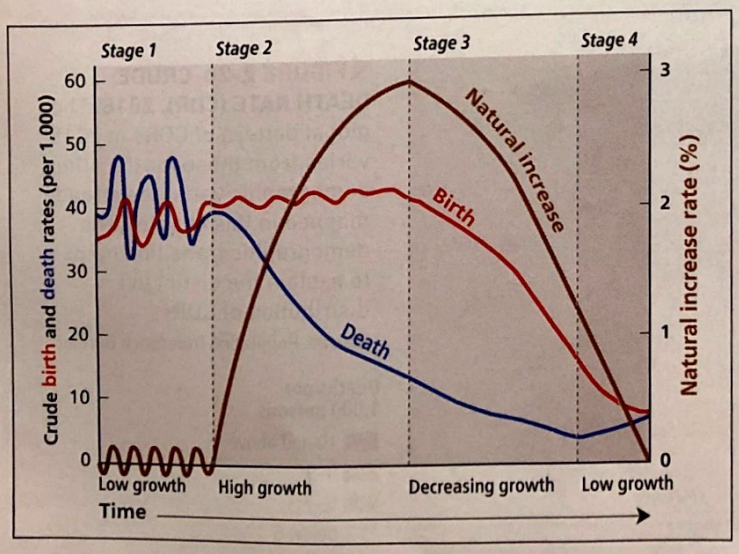
Authoritative demographic sources, such as the Population Reference Bureau, the World Bank, and the United Nations, currently consider the demographic transition to consist of four stages, (Figure 2-21). As discussed later in this chapter, some demographers anticipate a stage 5.

The four-stage demographic transition is characterized by two big breaks with the past. The first break with the past – 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.

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 and has experienced profound changes in population. For most of this period, people depended on hunting and gathering for food (see Chapter 9). When food was easily obtained, a region's population increased, but it declined when people were unable to locate enough animals or vegetation nearby.



▲ **FIGURE 2-21** DEMOGRAPHIC TRANSITION MODEL

▲ **FIGURE 2-22** THE GAMBIA: HIGH CRUDE BIRTH RATE

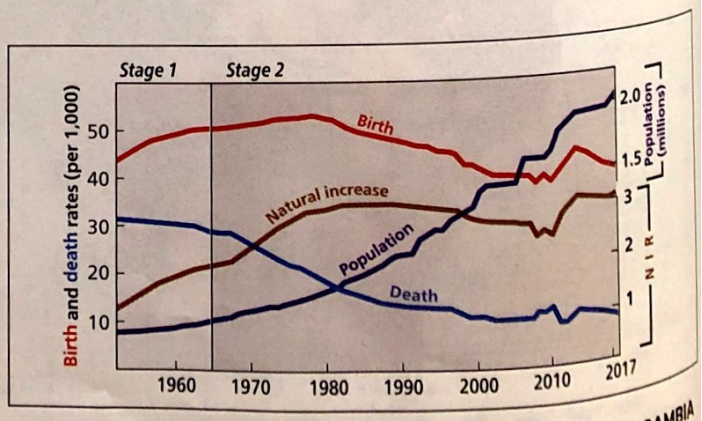
Stage 2: High Growth

- Still high CBR
- Rapidly declining CDR
- Very high NIR

Rapidly declining death rates and very high birth rates produce a 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 began in the United Kingdom in the late eighteenth century and diffused to the European continent and North America during the nineteenth century. The Industrial Revolution was a conjunction of 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. The 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.

The Gambia is the smallest country in Africa, and one of the poorest. Fewer than 10 percent of women of reproductive age practice family planning. As a British colony until 1965, The Gambia was in Stage 1. The death rate declined rapidly beginning in the 1970s when the World Health Organization launched a program to immunize children in a number of countries, including The Gambia. This program helped to reduce the CDR in The Gambia, transitioning the country from stage 1 to stage 2, where it is now (Figures 2-22 and 2-23).



▲ **FIGURE 2-23** DEMOGRAPHIC TRANSITION STAGE 2: THE GAMBIA

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▲ **FIGURE 2-24** MEXICO: MODERATE NIR

Stage 3: Moderate Growth

- Rapidly declining CBR
- Moderately declining CDR
- Moderate NIR

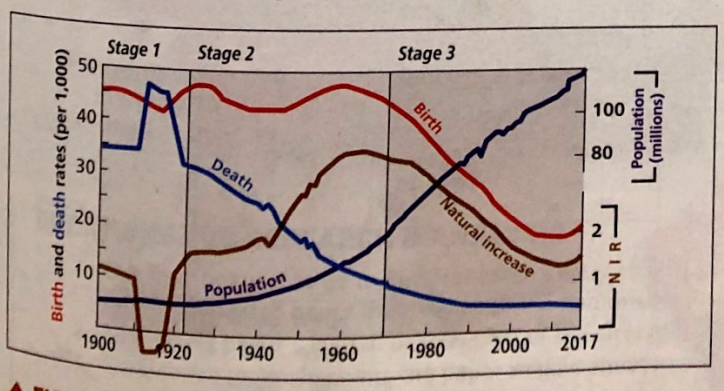
A country moves from stage 2 to stage 3 of the demographic transition when the CBR begins to drop sharply. The population continues to grow because the CBR is still greater than the CDR. But the rate of natural increase is more modest in countries in stage 3 than in those in stage 2 because the gap between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

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.

Mexico entered stage 2 of the demographic transition during the twentieth century through a combination of lower death rates and higher birth rates. Mexico's government believed that higher birth rates would be good for the country's economic growth (Figures 2-24 and 2-25).

A dramatic decline in birth rates came after 1974, when a constitutional amendment guaranteed families the legal right to decide on the number and spacing of children, and a National Population Council was established to promote family planning through education.



▲ **FIGURE 2-25** DEMOGRAPHIC TRANSITION STAGE 3: MEXICO

▲ **FIGURE 2-26** DENMARK: AGING POPULATION

Stage 4: Low Growth

- Very low CBR
- Low or slightly increasing CDR
- 0 or negative NIR

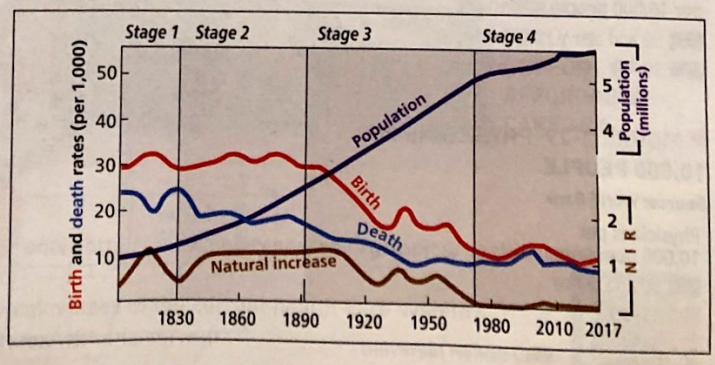
A country reaches stage 4 when the CBR declines to the point where it equals the CDR and the NIR approaches zero. This condition is called **zero population growth (ZPG)**, a term often applied to stage 4 countries.

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 entered stage 2 in the mid-nineteenth century and stage 3 in the late nineteenth century (Figures 2-26 and 2-27). Since the 1970s, Denmark has been in stage 4, with roughly equal CBR and CDR. The CDR is unlikely to decline unless another medical revolution, such as a cure for cancer, keeps elderly people alive much longer (Figure 2-26). Denmark may have entered a possible stage 5, with a declining NIR (see page 68).

Pause & Reflect 2.2.3 Name a country not in Europe that appears to be in stage 4, according to Figures 2-12, 2-17, and 2-20.



▲ **FIGURE 2-27** DEMOGRAPHIC TRANSITION STAGE 4: DENMARK

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KEY ISSUE

2.3 | Why Does Health Vary by Region?

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 care for people who are sick.

Medical Services

Learning Outcome 2.3.1 Describe differences in health-care services among countries.

Developed countries use part of their wealth to provide publicly funded medical care to all citizens. The high expenditure on health care in developed countries is reflected in medical facilities.

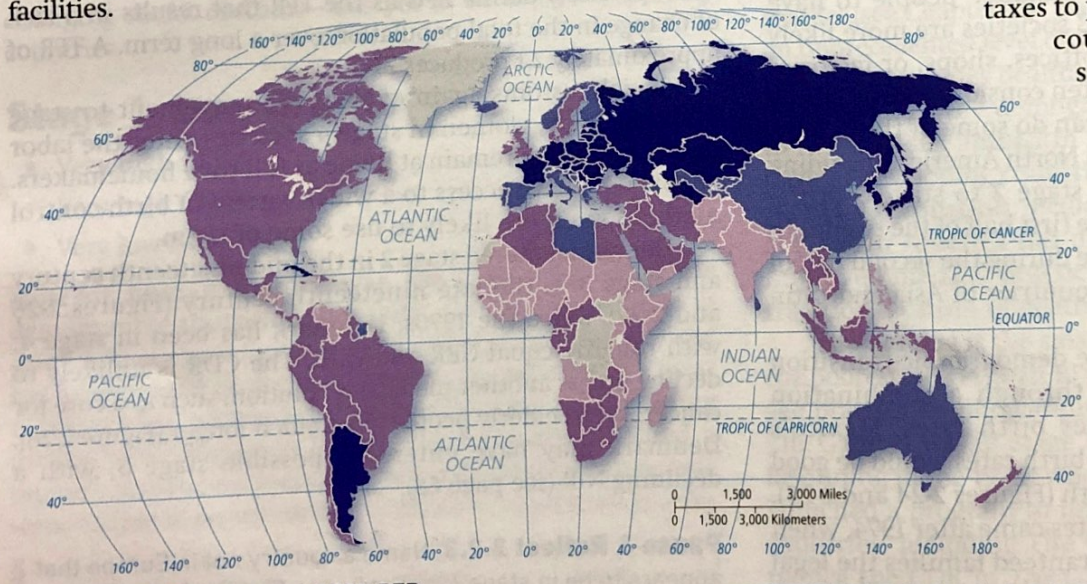
Medical Facilities

Many countries in Europe have more than 50 hospital beds per 10,000 people, compared to fewer than 30 in sub-Saharan Africa and South and Southwest Asia (Figure 2-28). Europe has more than 30 physicians per 10,000 people, 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 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.

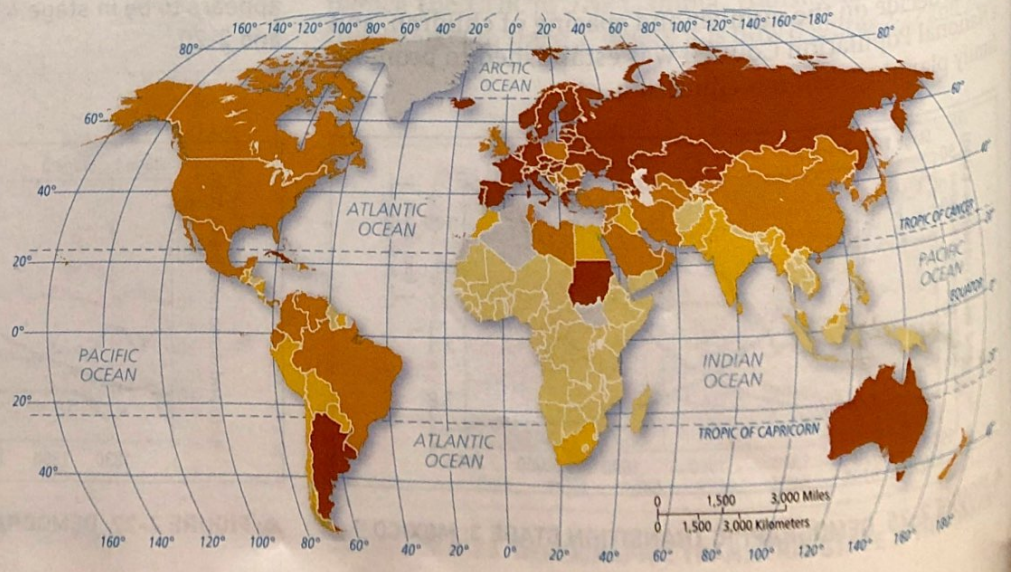
Developed countries are hard-pressed to maintain their current levels of public assistance. In the past, rapid economic growth permitted these states to finance generous programs with little difficulty. But in recent years, economic growth has slowed while the percentage of people needing public assistance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

Pause & Reflect 2.3.1 Why might levels of hospital beds and physicians in developed countries of Europe be higher than in North America?



▲ **FIGURE 2-28 HOSPITAL BEDS PER 10,000 PEOPLE**
Source: United Nations

Hospital beds per 10,000 people
- 50 and above
- 30–49
- 10–29
- below 10
- no data



▶ **FIGURE 2-29 PHYSICIANS PER 10,000 PEOPLE**
Source: World Bank

Physicians per 10,000 population
- 30 and above
- 15–29
- 5–14
- below 5
- no data

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Health Care

Annual per capita expenditure on health care exceeds $1,000 in developed countries, compared to less than $100 in sub-Saharan Africa and South Asia (Figure 2-30). Expenditure on health care exceeds 15 percent of all government spending in Europe and North America, compared to less than 5 percent in sub-Saharan Africa and South Asia. So not only do developed countries spend more on health care, they also spend a higher percentage of their wealth on health care (see Debate It! feature).

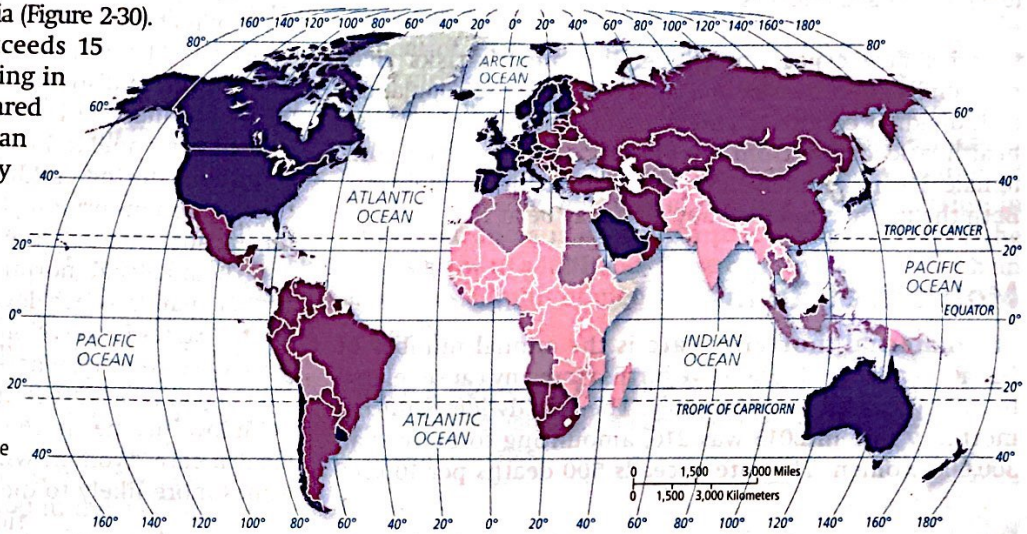

FIGURE 2-30 HEALTH-CARE EXPENDITURE
Source: World Health Organization

Health–care expenditures per capita
- $1,000 and above
- $300–$999
- $100–$299
- below $100
- no data

DEBATE IT!

AP® **Skills:** 1.D, 2.D, 4.D
Reasoning: 1.v, 1.vi, 2.iv, 3.i

Should the United States adopt universal health care? The United States is the only populous developed country that does not have universal health care.

The current system has strengths

- The United States has the world's seven best hospitals and 17 of the top 20, according to the Spanish National Research Council (CSIC) (Figure 2-31).
- U.S. health care can be extended to more people without overhauling the entire system.
- Countries with universal health care may not have enough doctors, leaving patients with long wait times for appointments and operations.

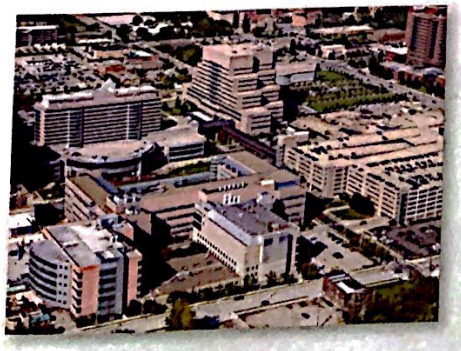

FIGURE 2-31 CLEVELAND CLINIC Ranked #1.

Universal access would cut costs

- Access to health care should be a right of all citizens, but millions of Americans do not have health care (Figure 2-32).
- Per capita spending on health care exceeds $5,000 in the United States, compared with only $1,000 in other developed countries.
- The United States spends around 17 percent of its GDP on health care, compared with around 11 percent in Canada and wealthy countries of Europe.

FIGURE 2-32 RALLY IN SUPPORT OF AFFORDABLE CARE ACT

QUESTIONS FOR RESEARCH & ANALYSIS

1. Use your browser to go to Pew Research Center Health Care or enter http://www.pewresearch.org/topics/health-care/. Select a research paper that relates to U.S health-care issues.
2. What is the paper's overall assessment of the strengths and weaknesses of the current health-care system?
3. Summarize the main points the paper makes about how problems with the current system could be remedied.

Universal Health Care
https://goo.gl/HGT5R3

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Health & Gender

Learning Outcome 2.3.2 Explain reasons for risks to baby girls and mothers.

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 girls may be at risk.

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. The worldwide maternal mortality rate in 2015 was 216, amounting to more than 300,000 women. The rate exceeds 500 deaths per 100,000 live births in sub-Saharan Africa, compared to 8 in Europe (Figure 2-33). Nonetheless, the world has made progress: the world maternal mortality rate was 385 in 1990.

According to the United Nations, the most common cause of maternal death in poor countries is heavy bleeding ("obstetrical hemorrhage"), followed by high blood pressure ("hypertensive disorders of pregnancy"). Developed countries have medical facilities, advanced technologies, and trained personnel to limit the incidence of life-threatening conditions during childbirth. Physicians can monitor and treat conditions prior to delivery and manage complications during and after delivery.

The maternal mortality rate in the United States (14) is higher than in other developed countries. In addition, the United States is one of only a dozen countries, and the only developed country, where the rate has increased since 1990. The higher rate is attributable to difficulties faced by people with low incomes in the United States in gaining access to health care. Women who lack health insurance are four times more likely to die of a pregnancy-related complication than those with insurance.

The maternal mortality rate varies widely among U.S. states. Several southern states have rates that are more than twice as high as the national average (Figure 2-34).

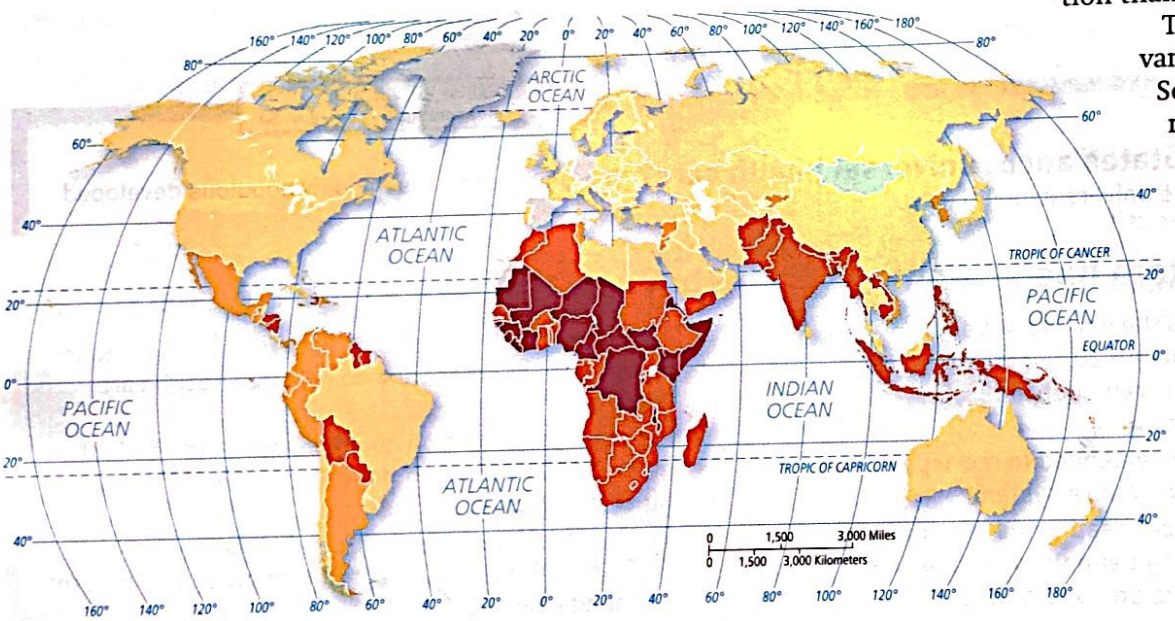

FIGURE 2-33 MATERNAL MORTALITY RATE, 2015
Source: World Health Organization

Maternal mortality rate (per 100,000 live births)
- 500 and above
- 100–499
- 50–99
- below 50
- no data

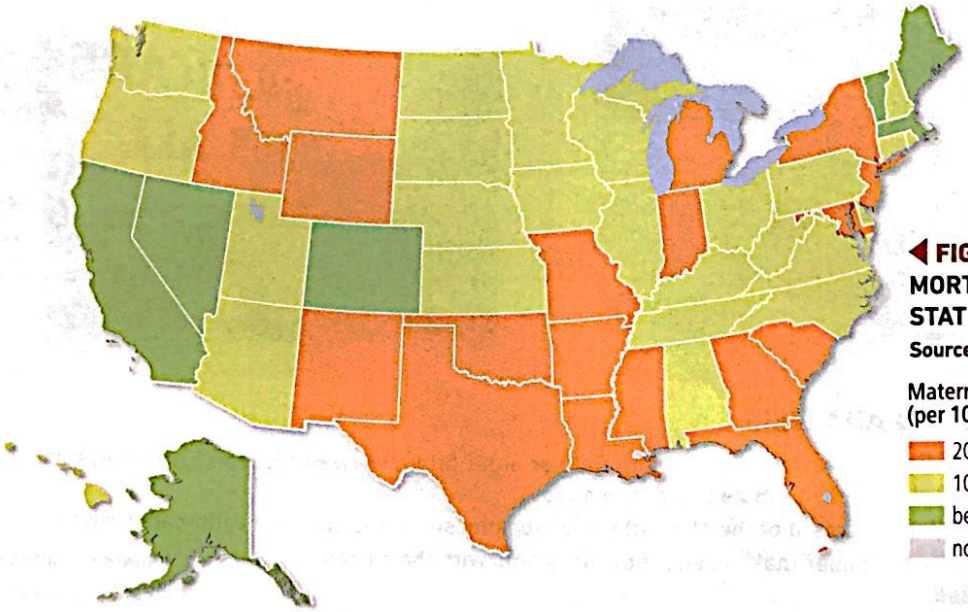

FIGURE 2-34 MATERNAL MORTALITY RATE, U.S. STATES, 2016
Source: America's Health Rankings

Maternal mortality rate (per 100,000 live births)
- 20 and above
- 10–19
- below 10
- no data

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Baby Girls at Risk

Around 700,000 female babies are "missing" every year in China and India as a result of gender-based sex 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 the fetus was aborted before birth, the female baby was killed in infancy, or the newborn female is being raised somewhere remote and not reported to census and health officials.

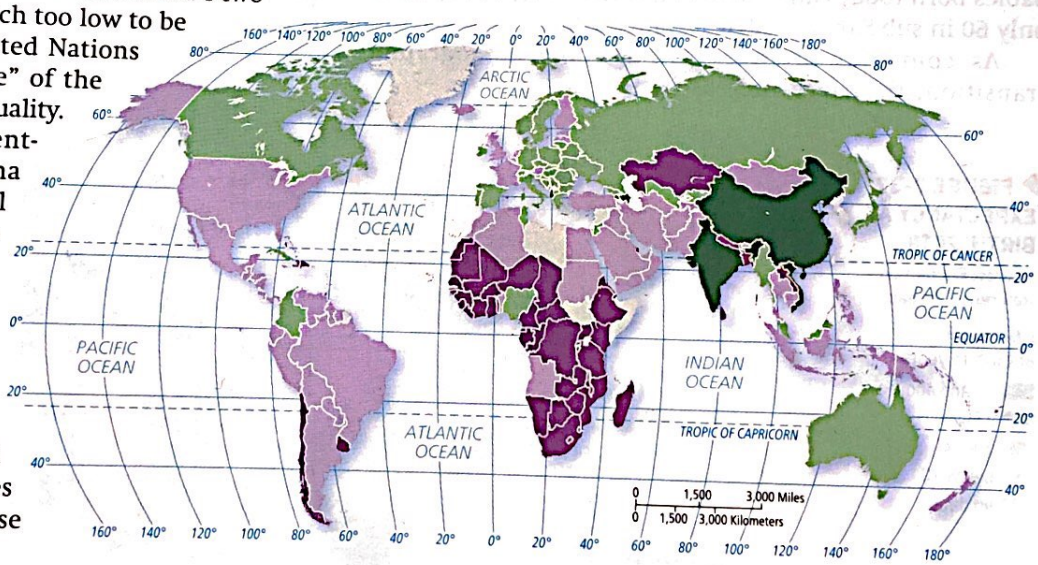
We know about the large number of "missing" females because of the **sex ratio**, which is the number of males per 100 females in the population. The standard biological level for humans at birth is around 105 male babies for every 100 female babies. Scientists are not sure why a few more males than females are born. The standard biological ratio 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. However, the sex ratio at birth is 114:100 in China and 112:100 in India (Figure 2-35). The percentage of newborn females in the world's two most populous countries is much too low to be random (Figure 2-36). The United Nations concludes that the "root cause" of the unequal sex ratio is gender inequality.

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. Sons are regarded as more likely than girls to help the family economically. Government policies in these two countries to promote smaller families have resulted in families with more male babies than female babies. Many Chinese and Indians have decided that if they are going to have a small number of children, they want them to be boys.

Efforts to ban gender-based sex selection have been ineffective because people instead seek out unregulated providers of these services. An ultrasound can reveal the gender of a fetus before birth, allowing parents to abort a baby girl before she is born. If a baby girl is born, her parents may hide her from authorities in a remote rural area, and she may receive less food and health care than a baby boy.

Aside from ethical questions about the devaluation of female lives, the widespread practice of sex selection in China and India is creating a practical problem. 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 2.3.2 What other populous country in Asia, in addition to China and India, appears to have "missing" females?



▲ **FIGURE 2-35 SEX RATIO AT BIRTH**
Source: CIA World Factbook
Sex ratio at birth (male(s) per female)
- 1.10 and above
- 1.06–1.09
- 1.05
- below 1.05
- no data

◀ **FIGURE 2-36 CHINA: MORE BOYS THAN GIRLS** Liufu, China.

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Health & Aging

Learning Outcome 2.3.3 Relate the demographic transition to the distribution of age groups.

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 explain a country's distinctive health challenges.

Caring for Older People

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 measures the average number of years a newborn infant can expect to live at current mortality levels (Figures 2-37). People on average live much longer in wealthy countries than in poorer ones. Babies born today can expect to live to 81 in Europe, but to only 60 in sub-Saharan Africa (Figure 2-38).

As countries progress through the demographic transition, they face increasing percentages of older people who need adequate levels of income and medical care after they retire from their jobs. In the United States, the percentage of the population over 65 varies widely; the highest percentages are in states to which many older people migrate and in states from which many younger people leave (Figure 2-38).

The "graying" of the population places a burden on governments in developed countries to meet these needs. The **potential support ratio** (also known as 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 2-39).

The world's potential 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.

Pause & Reflect 2.3.3 If the potential support ratio is declining, does that mean the percentage of elderly people is increasing or decreasing?

FIGURE 2-37 LIFE EXPECTANCY AT BIRTH, 2018
Source: Population Reference Bureau

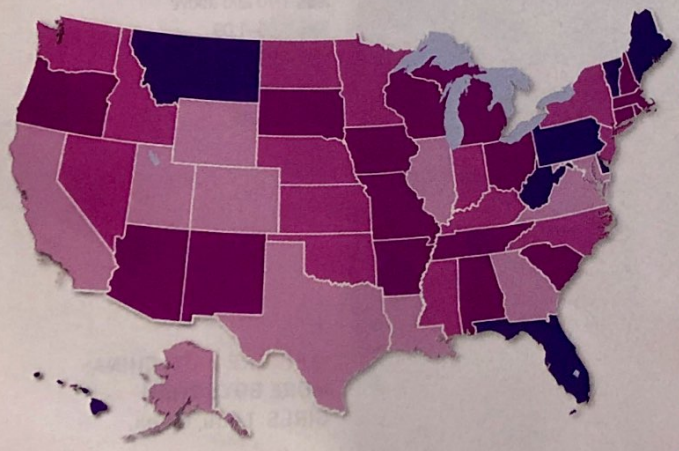

FIGURE 2-38 PERCENT OVER 65 BY U.S. STATE
Source: U.S. Census

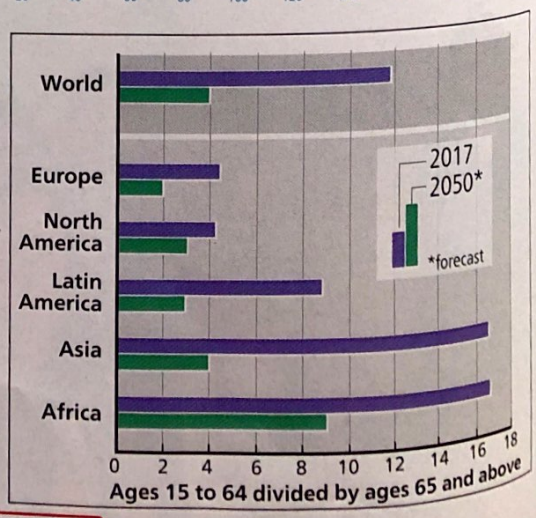

FIGURE 2-39 POTENTIAL SUPPORT RATIO

1. *Approximately what will the U.S. potential support ratio be in 2050?*
2. *What could the U.S. do between now and 2050 to raise its potential support ratio?*

AP® **Skills:** 2.C, 3.C, 3.E **Reasoning:** 1.iv, 3.iii, 3.v

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Caring for Younger People

Developing countries in stage 2 of the demographic transition have higher percentages of young people than do countries in stage 4 (Figure 2-40). This is a consequence of the higher CBR and TFR in stage 2 countries as well as the lower life expectancy. Worldwide, 26 percent are under age 15. Those under 15 comprise 16 percent of the population in developed countries, 28 percent in developing countries, and 43 percent in sub-Saharan Africa.

Comparing Young and Old

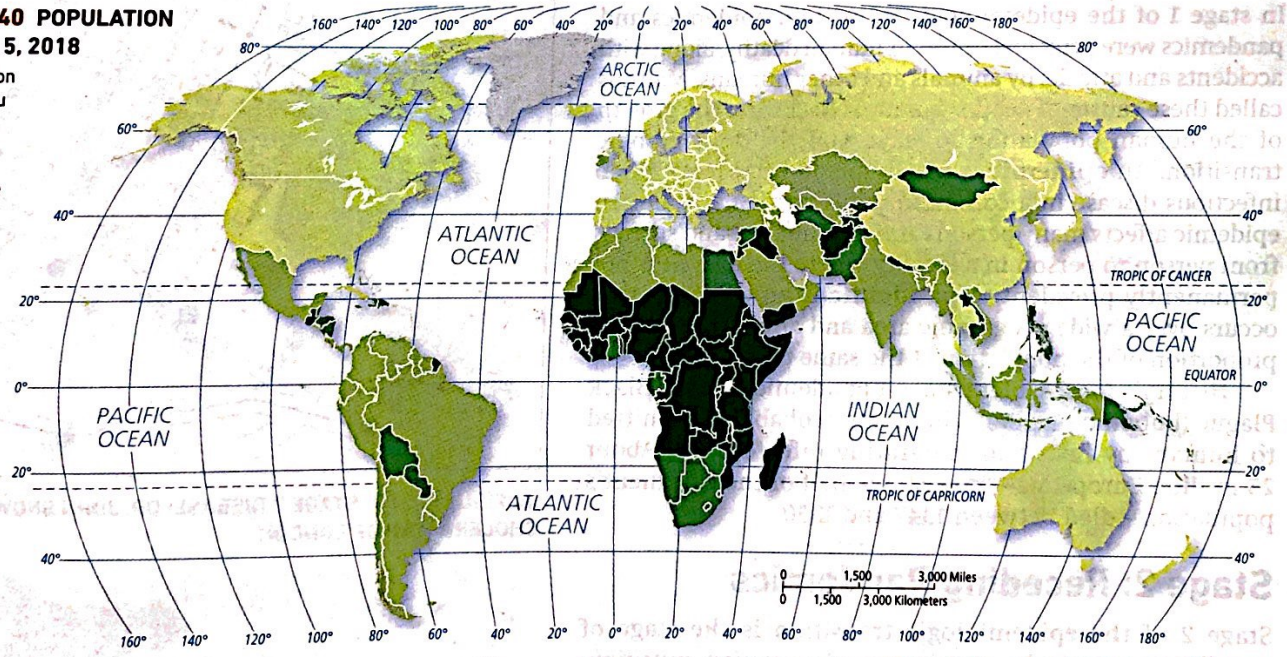
A **population pyramid** is a bar graph that displays the percentage of a place's population for each age and gender. A country that is in stage 2 of the demographic transition, such as The Gambia, has a pyramid with a broader base than that of a country in stage 4, such as Denmark, indicating a higher percentage of young people. In contrast to The Gambia's more evenly tapering pyramid, the highest levels of Denmark's pyramid are wider on the right because in Denmark, women live longer than men (Figure 2-41).

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. 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 **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 52 percent in Europe, compared to 85 percent in sub-Saharan Africa.

FIGURE 2-40 POPULATION UNDER AGE 15, 2018

Source: Population Reference Bureau



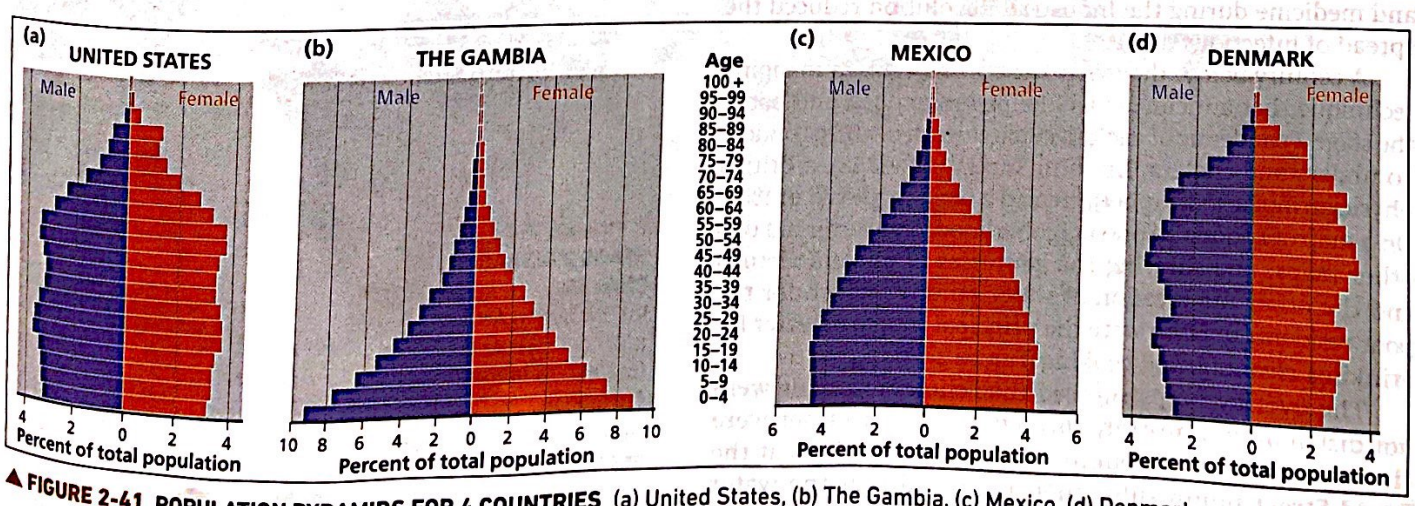


FIGURE 2-41 POPULATION PYRAMIDS FOR 4 COUNTRIES (a) United States, (b) The Gambia, (c) Mexico, (d) Denmark.

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Epidemiologic Transition

Learning Outcome 2.3.4 Explain four stages in 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 & Famine

In stage 1 of the epidemiologic transition, epidemics and pandemics were principal causes of human deaths, along with accidents and attacks by animals and other humans. Malthus called these causes of deaths "natural checks" on the growth of the human population in stage 1 of the demographic transition. An **epidemic** is a widespread occurrence of an infectious disease in a community at a particular time. An epidemic affects many persons at the same time and spreads from person to person in a locality where the disease is not permanently prevalent. A **pandemic** is an epidemic that occurs over a wide geographic area and affects a very high proportion of the population at the same time.

History's most violent stage 1 pandemic 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

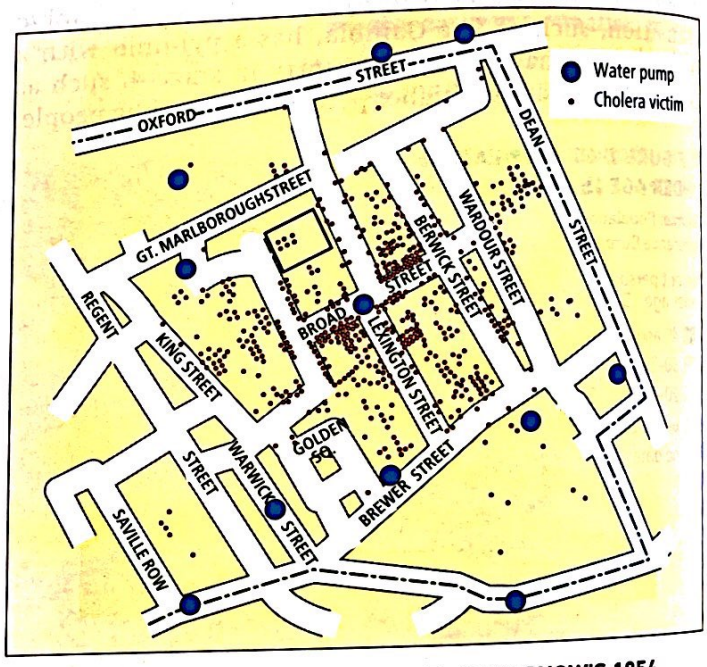
Stage 2 of the epidemiologic transition is the stage of receding pandemics because improved sanitation, nutrition, and medicine during the Industrial Revolution reduced the spread of infectious diseases.

A century before the invention of computers, a mapping technique that anticipated 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 hand-made 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 location of water pumps – which for the poor residents of Soho were the principal source of water for drinking, cleaning, and cooking (Figure 2-42).

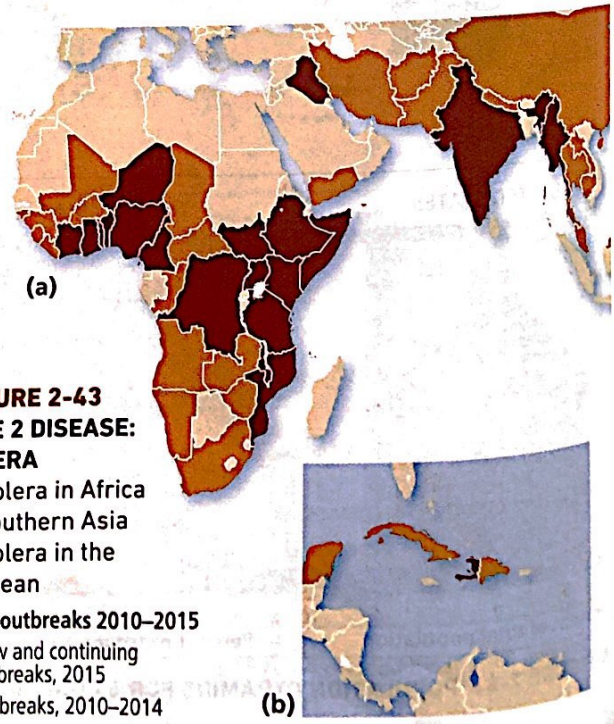
The overlay maps showed that cholera victims were not distributed uniformly through Soho, but rather were clustered around one pump on Broad Street. Tests at the Broad Street pump subsequently proved that the water there was contaminated by sewage. London's poor were disproportionately affected by cholera because they were more likely to have to use contaminated water.

Death rates did not decline immediately during the Industrial Revolution. Poor people crowded into rapidly growing industrial cities had high death rates. Cholera – uncommon in rural areas – became an virulent epidemic in urban areas. 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 2-43). Cholera is widespread in Yemen as a result of a civil war that has disrupted sanitation services, including provision of clean water and garbage pickup.



▲ **FIGURE 2-42 STAGE 2 DISEASE: DR. JOHN SNOW'S 1854 CHOLERA MAP OF LONDON**



▶ **FIGURE 2-43 STAGE 2 DISEASE: CHOLERA**
(a) Cholera in Africa and southern Asia
(b) Cholera in the Caribbean

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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 2-44).

Stage 4: Delayed Degenerative & Lifestyle 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.

Some behavioral changes have improved health in stage 4 countries. These include better diet, reduced use of tobacco and alcohol, and more exercise. On the other hand, death rates have increased in stage 4 countries through use of prescription and illegal drugs, consumption of nonnutritious food, and sedentary behavior.

Increased deaths related to opioids have been especially challenging in stage 4 countries (Figure 2-45). As shown in Chapter 1, opioid-related deaths have not been distributed uniformly within the United States. Deaths are spatially associated with frequency of prescription of opioids (Figure 1-38).

Pause & Reflect 2.3.4 Why do pandemics decline during stage 2 of the demographic transition?

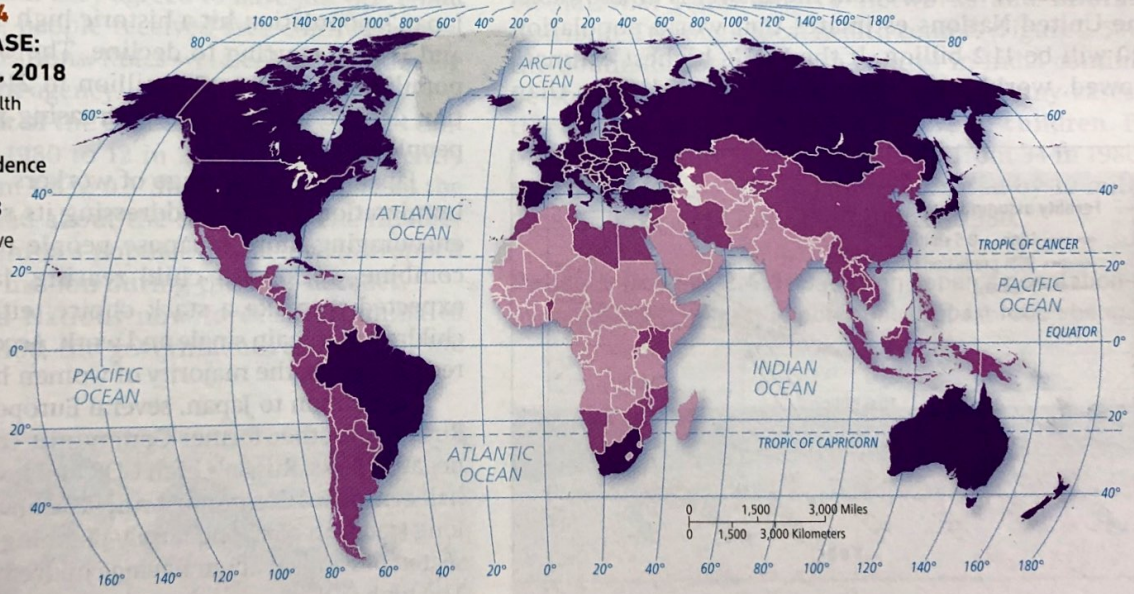

FIGURE 2-44
STAGE 3 DISEASE: MALE CANCER, 2018
Source: World Health Organization

Male cancer incidence rate per 100,000 population, 2018
- 240 and above
- 125–239
- below 125
- no data

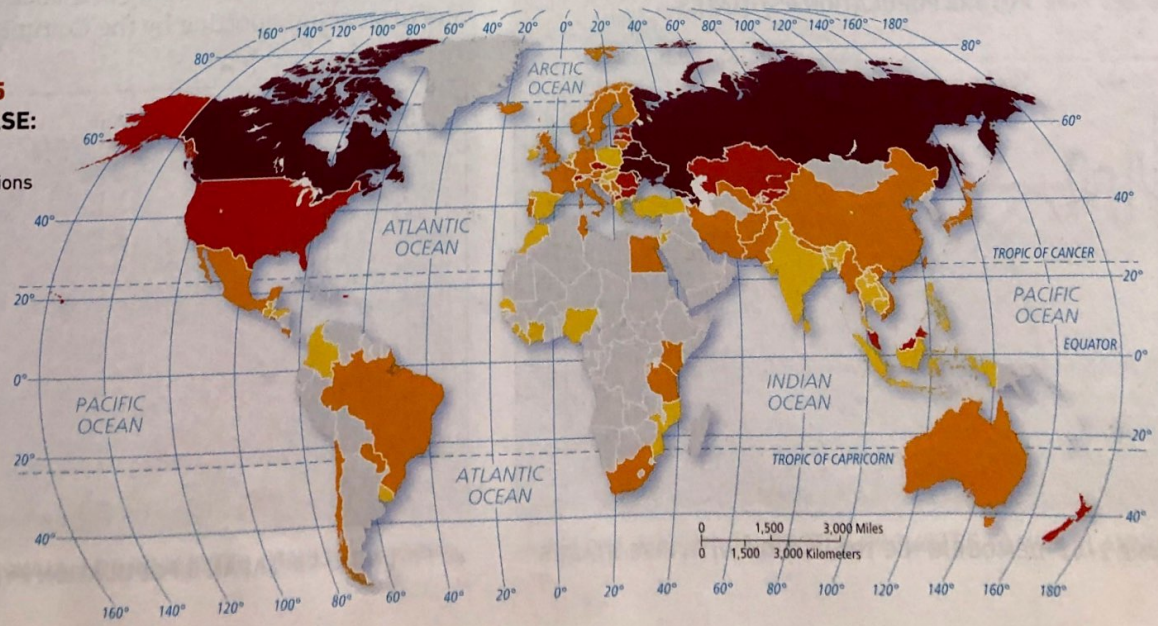

FIGURE 2-45
STAGE 4 DISEASE: OPIOIDS, 2016
Source: United Nations

Percentage using injecting drugs
- above 1.00
- 0.50–0.99
- 0.10–0.49
- below 0.10
- no data

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KEY ISSUE

2.4 | Why Might Population Change in the Future?

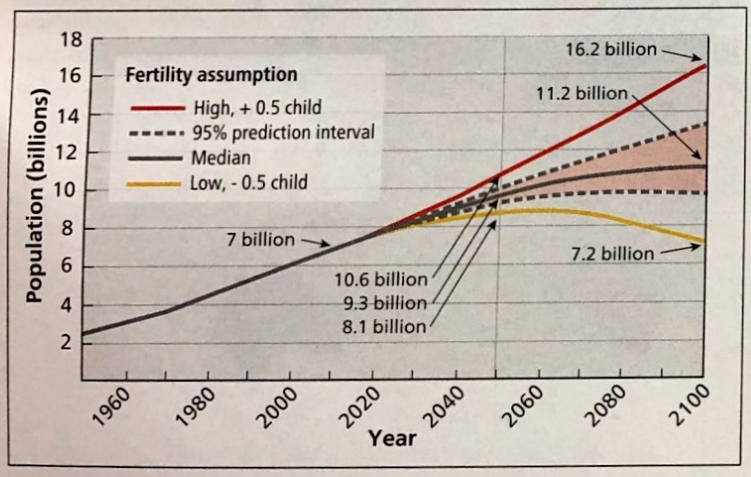
Geographic concepts offer insights into future population and health trends. In view of the current size of Earth's population and the NIR, will there soon be too many of us? Or will Earth's total population stabilize and even decline in the future?

Population Futures

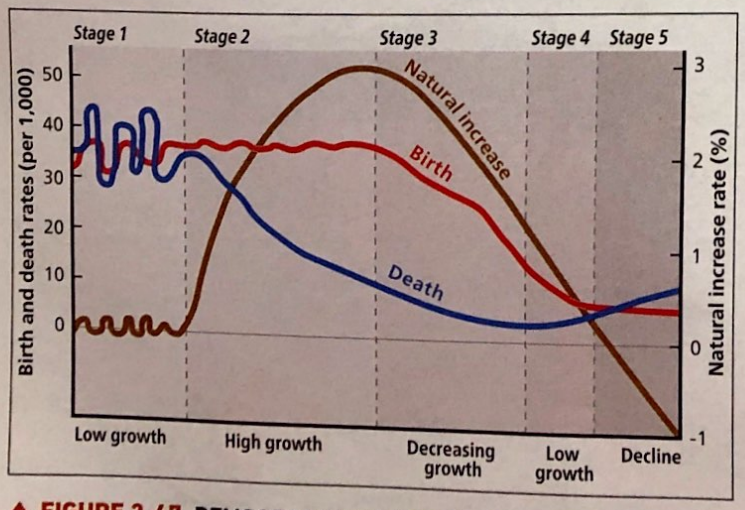
Learning Outcome 2.4.1 Assess a possible stage 5 of the demographic transition.

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 will be 11.2 billion. If the U.N.'s highest estimate is followed, world population in 2100 would more than double to 16.2 billion. If the low variant is followed, world population would actually decline to 7.2 billion (Figure 2-46).



▲ **FIGURE 2-46 FUTURE POPULATION ESTIMATES**



▲ **FIGURE 2-47 DEMOGRAPHIC TRANSITION WITH FIVE STAGES**

Possible Demographic Transition Stage 5

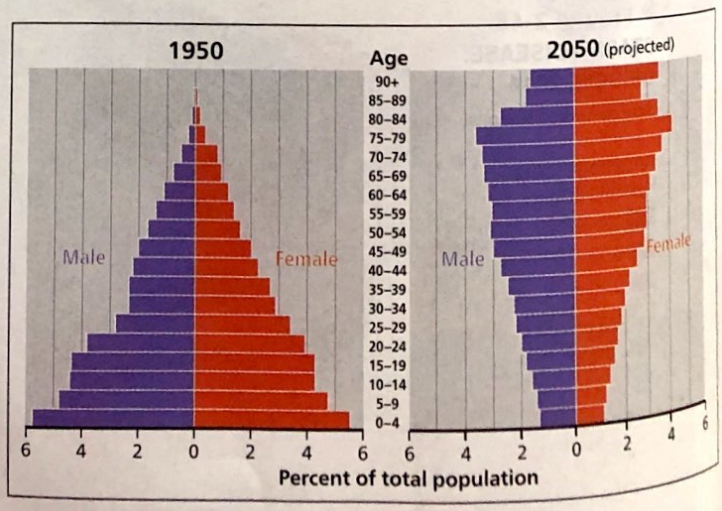
- Very low CBR
- Increasing CDR
- Declining NIR

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 2-47). After several decades of very low birth rates, a stage 5 country would have relatively few young women aging into childbearing years. If those in the smaller pool of women have fewer children, the CBR would fall lower than in stage 4.

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 128 million in 2010 and is now starting to decline. The U.N. forecasts Japan's population to fall to 84 million in 2100. With the population decline will come an increasing percentage of elderly people (Figure 2-48).

Japan faces a shortage of workers. Instead of increasing immigration, Japan is addressing its 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.

In addition to Japan, 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 Communist government.



▲ **FIGURE 2-48 JAPAN'S POPULATION PYRAMIDS**

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China & India

The world's two most populous countries, China and India, will heavily influence future prospects for global overpopulation. A **pronatalist policy** is a government policy that supports higher birth rates, whereas an **antinatalist policy** is one that supports lower birth rates. In recent decades, China and India have both instituted antinatalist policies with varying success. 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 10 million more people each year than does China. Current projections show that India could surpass China as the world's most populous country during the 2020s.

China's Population Policies. China has made substantial progress in reducing its NIR. The core of the Chinese government's family planning program was the One Child Policy, adopted in 1980. Under the One Child Policy, a couple needed a permit to have a child (Figure 2-49). 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 discourage births, people received free contraceptives, abortions, and sterilizations. Rules were enforced with penalties by a government agency.

Largely as a result of the One Child Policy, China's CBR declined from 18 in 1980 to 12 in 2018, and consequently the NIR declined from 1.2 to 0.5. Since 2000, China and the United States have had about the same CBR. The number of people added to China's population each year dropped from 14 million to 7 million during the four decades.

With the United Nations now forecasting China to lose population by 2100, the government relaxed the One Child Policy. 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. As a result of preference for male children, there are fewer young women of childbearing years.

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.

Government-sponsored family-planning programs in India now emphasize education, including advertisements on national radio and TV networks and information distributed through local health centers (Figure 2-50). Still, the dominant form of birth control in India 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 20 in 2018, but India's population increased by 19 million in 2018, compared to only 15 million in 1980.

Pause & Reflect 2.4.1 Based on Japan's population pyramids, how might the potential support ratio change?

▲ **FIGURE 2-49** CHINA: WALL ART PROMOTES FAMILY PLANNING

▲ **FIGURE 2-50** INDIA: POSTER PROMOTES FAMILY PLANNING

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Family Futures

Learning Outcome 2.4.2 Describe two reasons for declining birth rates.

The CBR has declined rapidly since 1990, from 27 to 20 in the world as a whole and from 31 to 21 in developing countries (Figure 2-51). Two strategies have been successful in reducing birth rates.

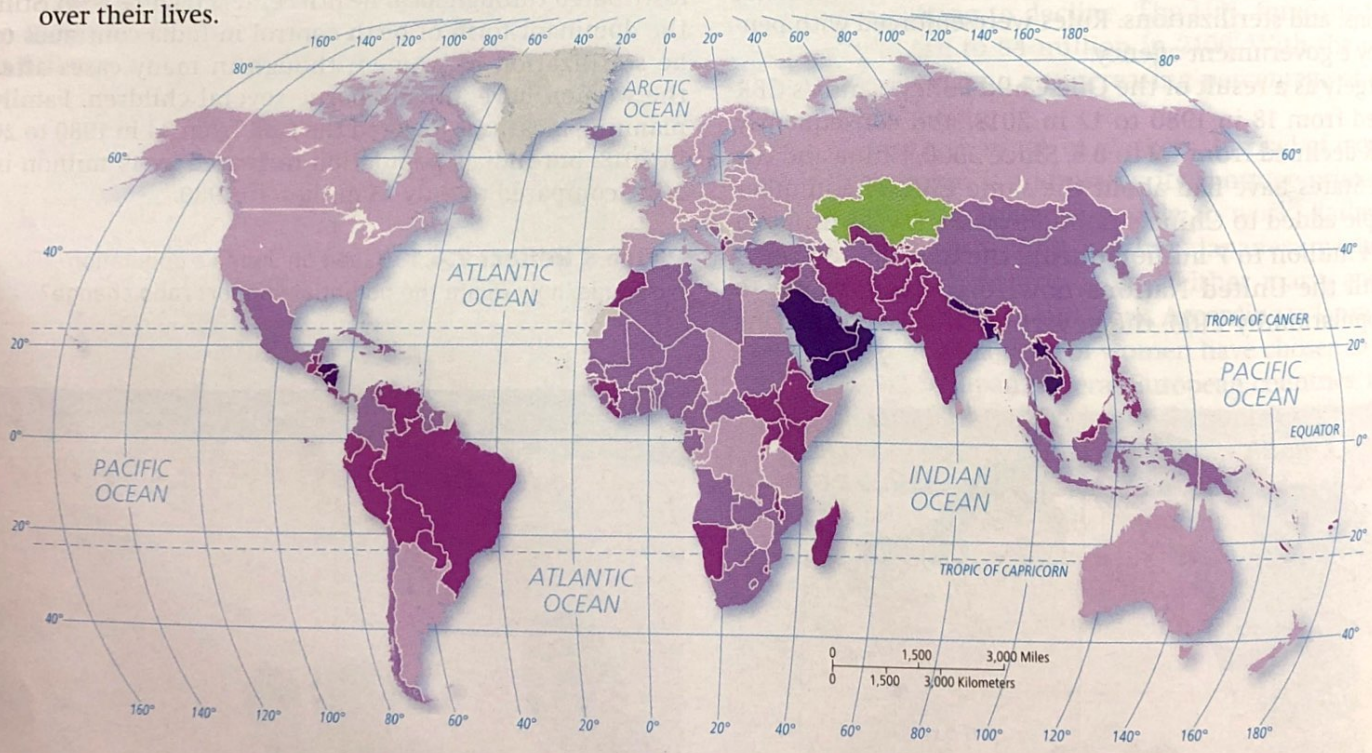
Lowering CBR through Education & Health Care

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 2-52).
- 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 for family-planning.

The United Nations Sustainable Development Goals, adopted in 2015, recognize that women's access to reproductive health care and education plays a key role in the overall quality of life for families (see Chapter 10).

Pause & Reflect 2.4.2 Why might birth rates have declined since 1990 less rapidly in Europe and North America than in other regions?



▲ FIGURE 2-51 CBR CHANGE 1990–2018 The CBR has declined in all but a handful of countries. Declines have been most rapid in Latin America and South and Southwest Asia.
Source: Population Reference Bureau

Crude birth rate decline per 1,000 population, 1990–2018
- 15 and above
- 10–14.9
- 5–9.9
- 0–4.9
- increase
- no data

◀ FIGURE 2-52 FAMILY PLANNING EDUCATION Women talk about birth control at a reproductive health clinic in Kampong Cham, Cambodia.

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Lowering CBR through Contraception

A second approach to lowering birth rates emphasizes the importance of rapidly diffusing modern contraceptive methods (Figures 2-53 and 2-54). 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. Even though economic development may promote lower birth rates in the long run, the world cannot wait around for that alternative to take effect. Allocating resources into family-planning programs can reduce birth rates much more rapidly.

Rapid growth in the acceptance of family planning in a number of developing countries is evidence that in the modern world, ideas can diffuse rapidly, even to places where people have limited access to education and modern communications. 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 2017 compared to 6 percent in 1980. Similar growth in the use of contraceptives has occurred in other developing countries, including Colombia, Morocco, and Thailand. The percentage of women using contraceptives is especially low in sub-Saharan Africa, in part because of reluctance of men to use them. So the alternative of distributing contraceptives could have an especially strong impact there.

Many oppose birth-control programs for religious and political reasons. Adherents of several religions have convictions that prevent them from using some or all birth-control methods. Opposition is especially strong in some countries to terminating pregnancy by abortion.

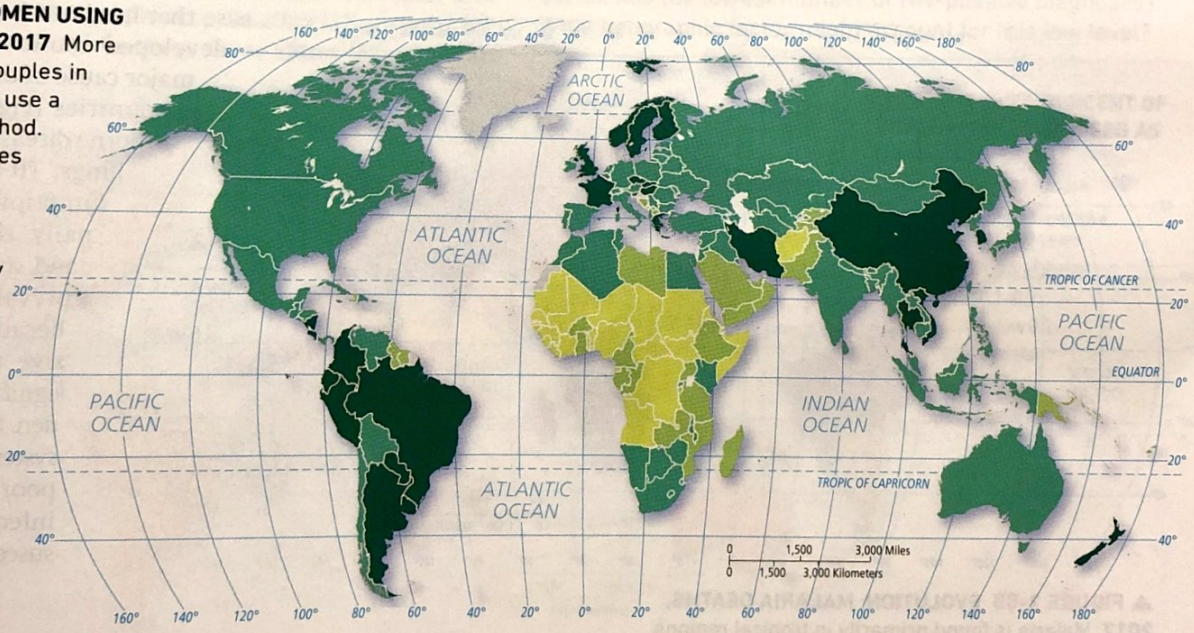

FIGURE 2-53 WOMEN USING FAMILY PLANNING, 2017 More than two-thirds of couples in developed countries use a family-planning method. Family planning varies widely in developing countries. China reports the world's highest rate of family planning while the lowest rates are in sub-Saharan Africa.

Source: Population Reference Bureau

Percent of women using family planning
- 75 and above
- 50–74
- 25–49
- below 25
- no data

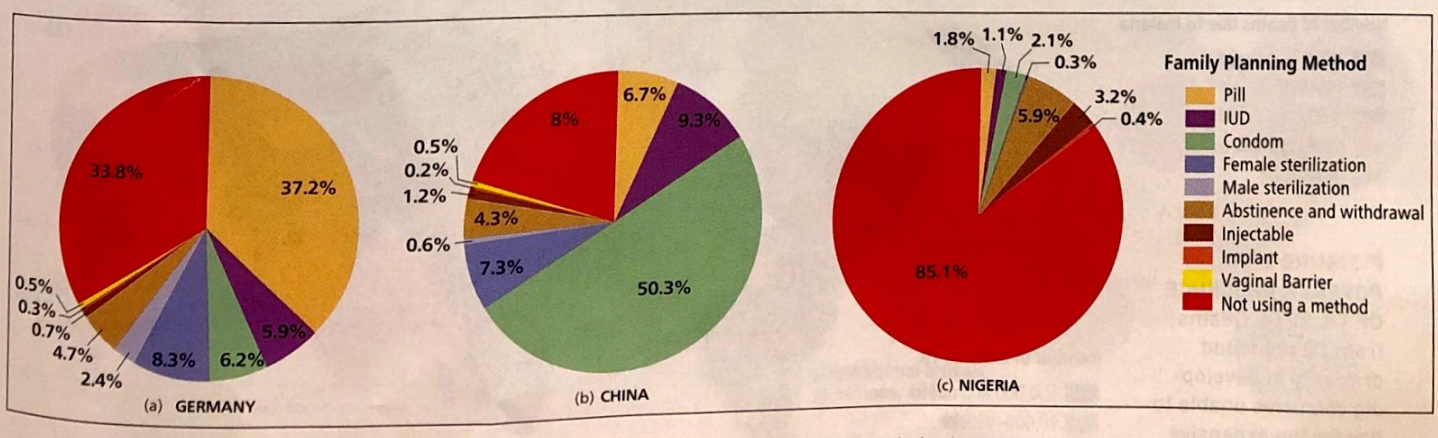

FIGURE 2-54 FAMILY PLANNING METHODS (a) The principal family-planning methods in developed countries such as Germany are condoms and birth-control pills. (b) The principal methods in China are intrauterine devices (IUDs) and female sterilization. (c) People in sub-Saharan African countries such as Nigeria make minimal use of family planning.

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Epidemiologic Futures

Learning Outcome 2.4.3 List reasons for 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 moving into stage 5 of the epidemiologic transition, brought about by a reemergence of infectious and parasitic diseases. Infectious diseases 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.

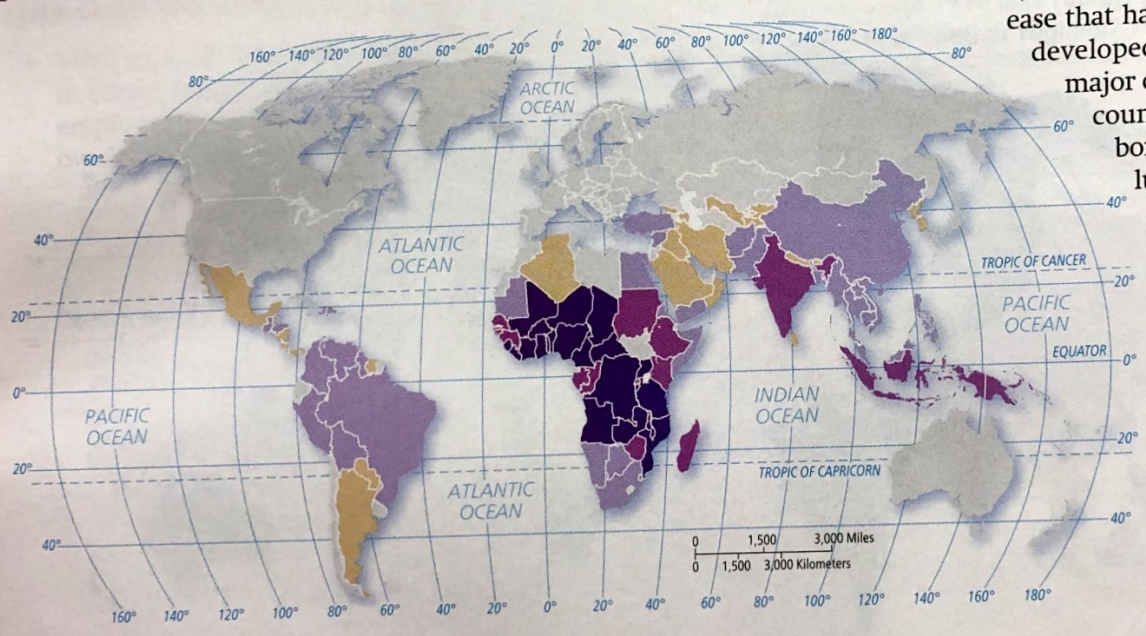
Three reasons help to explain the possible emergence of a stage 5 of the epidemiologic transition: evolution, poverty, and diffusion.

Reason for Possible Stage 5: 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 now causes around a half-million deaths worldwide annually, nearly all in sub-Saharan Africa (Figure 2-55). A major reason is the evolution of DDT-resistant mosquitoes.

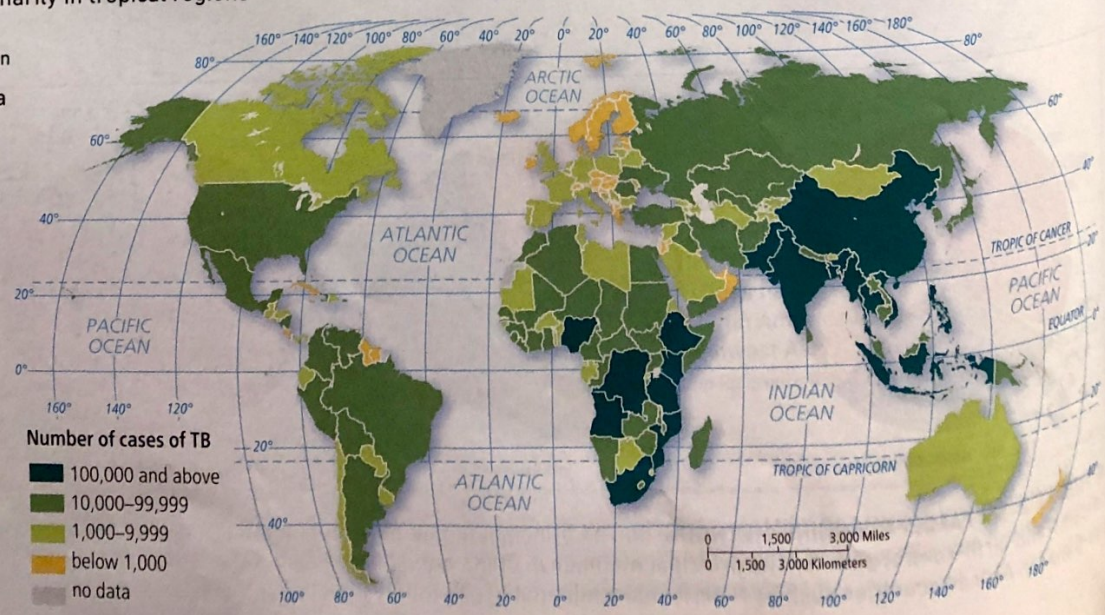
Reason for Possible Stage 5: Poverty

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 2-56). 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. People with immune systems compromised by poor nutrition or HIV infection are especially susceptible to TB.



▲ **FIGURE 2-55 EVOLUTION: MALARIA DEATHS, 2017** Malaria is found primarily in tropical regions of developing countries.
Source: World Health Organization

Number of deaths due to malaria
- 1,000 and above
- 100–999
- 1–99
- none reported
- no data



▶ **FIGURE 2-56 POVERTY: INCIDENCE OF TB, 2016** Deaths from TB are found primarily in developing countries unable to pay for the expensive treatment.
Source: World Health Organization

Number of cases of TB
- 100,000 and above
- 10,000–99,999
- 1,000–9,999
- below 1,000
- no data

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Reason for Possible Stage 5: Increased 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.

The most lethal pandemic in recent years has been AIDS (acquired immunodeficiency syndrome). Worldwide, 35 million people died of AIDS from the beginning of the epidemic through 2017, 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 2-57).

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 2-58). 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 the country's new AIDS cases in the peak year of 1993.

The number of people newly diagnosed with AIDS has dropped sharply because of the rapid diffusion of preventive methods and medicines. The rapid spread of these innovations is an example of expansion diffusion rather than relocation diffusion.

Most people newly diagnosed as HIV-positive are found in large urban areas. However, as a percentage of total population, southern states, led by Louisiana and Georgia, now have the largest rate of new HIV-positive diagnoses. Male-to-male sexual contact remains the principal form of diffusion in the United States.

Pause & Reflect 2.4.3 Which region within the United States has the lowest number of HIV-positive diagnoses? What geographic factor might account for this low level?

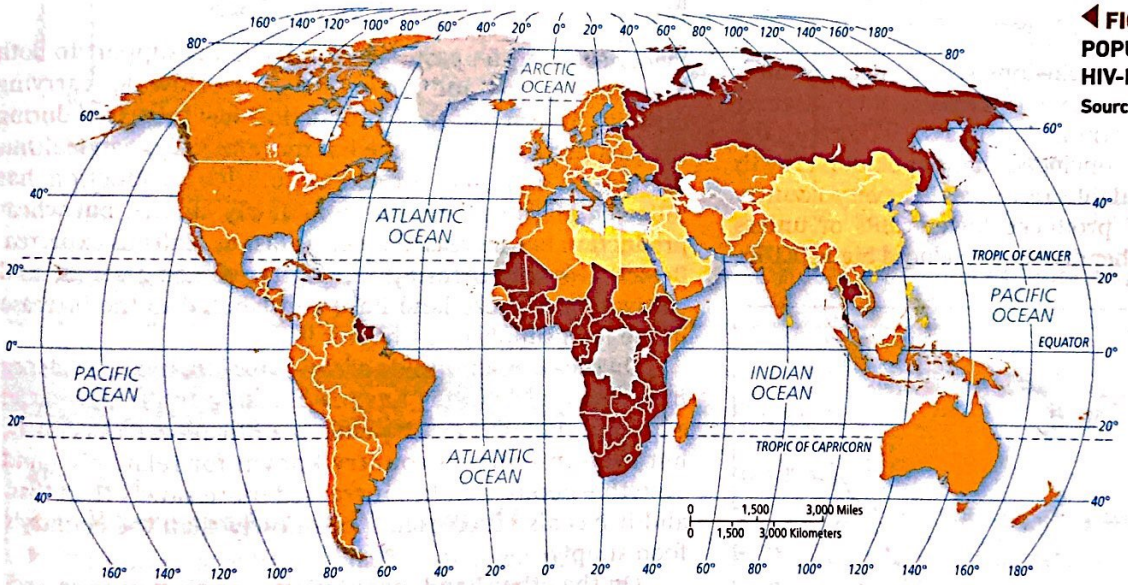

FIGURE 2-57 PERCENT OF POPULATION DIAGNOSED AS HIV-POSITIVE, 2016
Source: CIA World Factbook

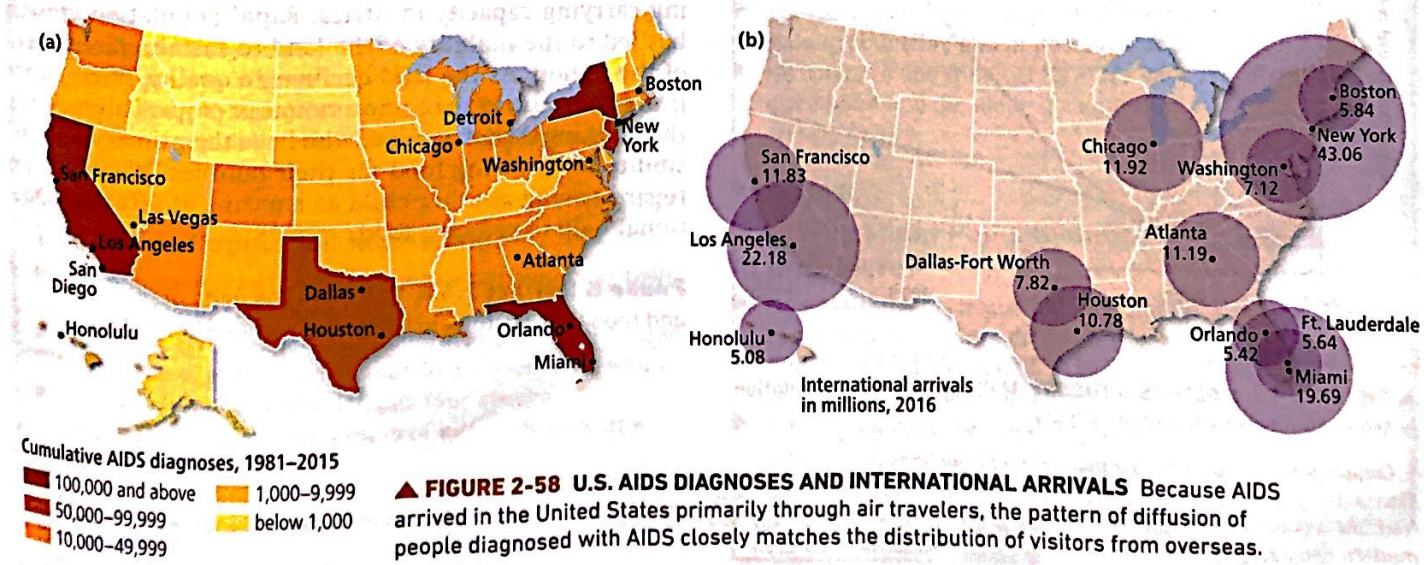

FIGURE 2-58 U.S. AIDS DIAGNOSES AND INTERNATIONAL ARRIVALS Because AIDS arrived in the United States primarily through air travelers, the pattern of diffusion of people diagnosed with AIDS closely matches the distribution of visitors from overseas.

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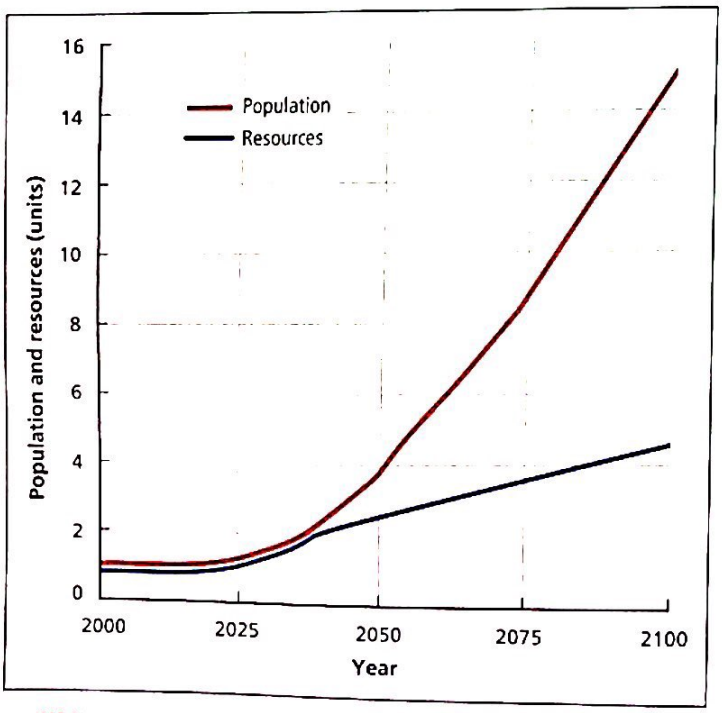
Population & Resources

Learning Outcome 2.4.4 Explain arguments for and against Malthus's theory.

British 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 2-59). 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 made these conclusions several decades after the United Kingdom 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.



▲ **FIGURE 2-59 MALTHUS'S THEORY** Malthus expected population to grow more rapidly than food supply.

1. *Compare this graph with the population projections in Figure 2-46. What assumption did Malthus make that differed from the assumptions made by modern demographers?*

AP Skills: 1.E, 2.D, 3.C, 4.D
Reasoning: 2.ii, 2.iii, 3.v

Neo-Malthusians

Malthus's views remain influential today. Contemporary geographers and other analysts are taking another look at Malthus's views because of Earth's unprecedented rate of natural increase during the late twentieth century. Neo-Malthusians argue that characteristics of recent population growth make Malthus's thesis more frightening than when it was first proposed more than 200 years ago.

In Malthus's time, only a few relatively wealthy countries had entered stage 2 of the demographic transition. Now, relatively poor countries are in stage 2. As a result, the gap between population growth and resources is wider in some countries than even Malthus anticipated.

World population growth is outstripping a wide variety of resources, not just food production, according to Neo-Malthusians. They argue that the world faces a frightening future in which billions of people are in desperate competition for food, water, and energy.

Neo-Malthusians & Critics

Evidence from the past half-century lends support to both Neo-Malthusians and their critics. Worldwide, carrying capacity in terms of 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. Better growing techniques, higher-yielding seeds, and cultivation of more land have contributed to the increase in the food supply (see Chapter 9).

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 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, population growth may be exceeding carrying capacity 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.

Pause & Reflect 2.4.4 Calculate the units of population and food that Malthus predicted would exist in 200 years.

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