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This Is Geography

What do you expect from this geography course? You may think that geography involves memorizing lists of countries and capitals. Perhaps you associate geography with photographic essays of exotic places in popular magazines. Contemporary geography is the scientific study of where people and activities are found across Earth's surface and the reasons they are found there.

Luxembourg City, including St. John Church, built in 1606.

LOCATIONS IN THIS CHAPTER

KEY ISSUES

1

Why Is Geography a Science?

Prehistoric humans were the first people to make maps. Contemporary tools enable cartographers—and anyone else who has access to electronic devices—to make precise maps.

2 Why Is Each Point on Earth Unique?

Geographers understand why each ***place*** on Earth is in some ways unique. Each area or ***region*** on Earth also possesses a unique combination of features.

3 Why Are Different Places Similar?

Many features are organized in a regular manner across ***space***. Some regularities are global in ***scale***, whereas others have distinctive local character.

4 Why Are Some Actions Not Sustainable?

Distinctive to geography is the importance given to **connections** between human activities and the physical environment. Some human activities are sustainable, but others are not.

KEY ISSUE 1

Why Is Geography a Science?

- Introducing Geography
- Cartography: The Science of Mapmaking
- Contemporary Geographic Tools
- Interpreting Maps
- The Geographic Grid

LEARNING OUTCOME 1.1.1

Summarize differences between geography and history.

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.

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 the locations. Human geographers ask two simple questions: Where are people and activities found on Earth? Why are they found there?

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 and explain why human activities are located beside one another.	identify the dates of important events and explain why human activities follow one 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 that 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.

Introducing Geography

To introduce human geography, we will 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 locations of the most important economic activities, including agriculture, manufacturing, and services.

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 every place 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 every place 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.
- 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 North America and Latin America.

To explain why different places 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

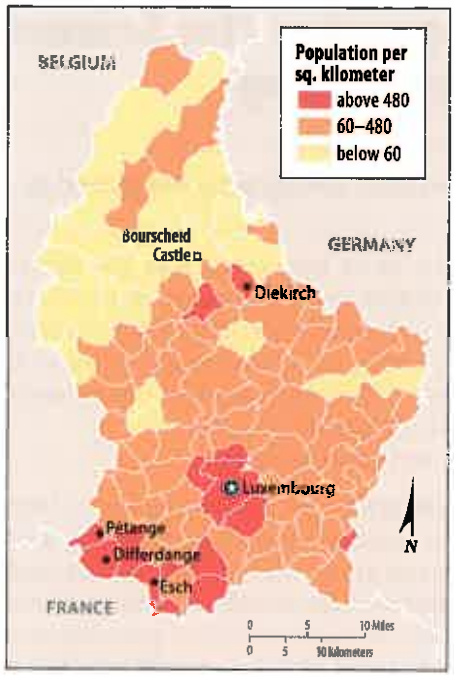
FIGURE 1-1 PLACE The place of the City of Luxembourg is atop a hill overlooking the Alzette River.

▲ **FIGURE 1-2 REGION** Luxembourg is part of the region of Europe.

that affect humanity's occupation of Earth are global in scale, such as climate change and depletion of energy supplies. At the same time, local-scale processes—such as preservation of distinctive cultural and economic activities—are increasingly important.

- **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.
- **Connection** refers to relationships among people and objects across the barrier of space. Geographers are concerned with the various means by which connections occur.

Luxembourg can be used to illustrate the five concepts. The City of Luxembourg is a place located on a hillside perched above the Alzette River (Figure 1-1). The City of Luxembourg is the capital of the country of Luxembourg,



▲ **FIGURE 1-4 SPACE** The space occupied by Luxembourgers is primarily houses built close together in cities in the southern half of the country.

located in the world region of Europe (Figure 1-2). Luxembourg plays a major role at a global scale, as one of the principal headquarters of the European Union, which unites 28 countries (Figure 1-3a). At the same time, Luxembourg, like other places, has a distinctive local scale; one example is the availability of distinctive local products not available elsewhere (Figure 1-3b). The space occupied by Luxembourg has distinctive features; for example, most people live in the south of the country, whereas the north is sparsely inhabited (Figure 1-4). Connections between Luxembourg and other places are provided by road, rail, and river (Figure 1-5).

PAUSE & REFLECT 1.1.1

What are the principal connections from your hometown to other places?

▼ **FIGURE 1-3 SCALE** (a) Regional scale: high-rise buildings in the background house offices of the European Union; (b) Local scale: vendor at farmers' market sells food products made in Luxembourg.

(a)

(b)

▼ **FIGURE 1-5 CONNECTION** Luxembourg is connected to other places in Europe by train. European Union offices are in the background.

Cartography: The Science of Mapmaking

LEARNING OUTCOME 1.1.2

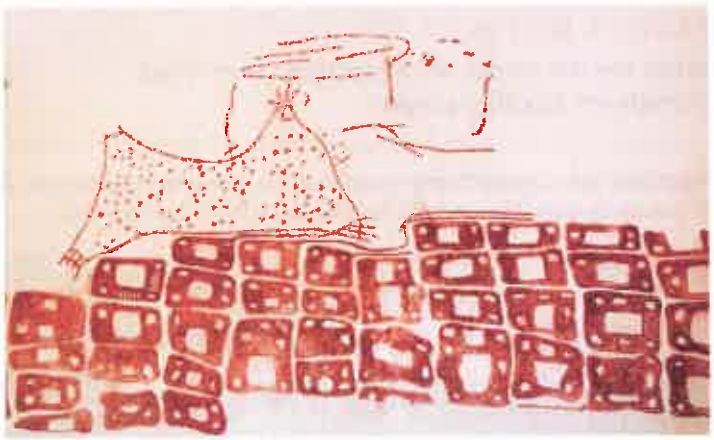
Understand how cartography developed as a science.

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 located, especially in relationship to a place we know, such as a town, body of water, or highway. The maps in an atlas or a smart phone app 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.



▲ FIGURE 1-6 EARLIEST SURVIVING MAP This map, dating from 6200 B.C., depicts the town of Çatalhöyük, in present-day Turkey, and the eruption of the Hasan Dağ (Mount Hasan) twin-peaks volcano, which is actually located around 140 km 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 Archaeological Museum.

GEOGRAPHY IN THE ANCIENT WORLD

The science of geography has prehistoric roots. The earliest surviving fully authenticated map, depicting the town of Çatalhöyük, located in present-day Turkey, dates from approximately 6200 B.C. (Figure 1-6). Archaeologists found the map on the wall of a house that was excavated during the 1960s. Major contributors to geographic thought in the ancient eastern Mediterranean included:

- Thales of Miletus (ca. 624–ca. 546 B.C.), who applied principles of geometry to measuring land area.
- Anaximander (610–ca. 546 B.C.), 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.), who may have been the first to propose a spherical world and argued that the sphere was the most perfect form.
- Hecateus (ca. 550–ca. 476 B.C.), who may have produced the first geography book, called *Ges Periodos* ("Travels Around the Earth").
- Aristotle (384–322 B.C.), who was the first to demonstrate that Earth was spherical on the basis of evidence.
- Eratosthenes (ca. 276–ca. 195 B.C.), 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. 63 B.C.–ca. A.D. 24), who described the known world in a 17-volume work titled *Geography*.
- Ptolemy (ca. A.D. 100–ca. 170), who wrote the eight-volume *Guide to Geography*, codified basic principles of mapmaking, and prepared numerous maps that were not improved upon for more than 1,000 years (Figure 1-7).

China was another center of early geographic thought. Ancient Chinese geographic contributions included:

- "Yu Gong" ("Tribute of Yu"), a chapter in a book called *Shu Jing* ("Classic of History"), which was the earliest surviving Chinese geographical writing, by an unknown author from the fifth century B.C., described the economic resources of the country's different provinces.
- Pei Xiu, the "father of Chinese cartography," who produced an elaborate map of the country in A.D. 267.

GEOGRAPHY'S REVIVAL

After Ptolemy, little progress in mapmaking or geographic thought was made in Europe for several hundred years. Maps became less mathematical and more fanciful, showing

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

Earth as a flat disk surrounded by fierce animals and monsters. Geographic inquiry continued, though, outside Europe. Contributors outside of Europe included:

- Muhammad al-Idrisi (1100–ca. 1165), a Muslim geographer who prepared a world map and geography text in 1154, building on Ptolemy's long-neglected work (Figure 1-8).
- Abu Abdullah Muhammad 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 the Muslim world of northern Africa, southern Europe, and much of Asia.

Making maps as reference tools 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 used information collected by the explorers to create more accurate maps. Influential European cartographers included:

▲ **FIGURE 1-9 WORLD MAP BY ORTELIUS, 1571** This was one of the first maps to show the considerable extent of the Western Hemisphere, as well as the Antarctic landmass.

- Martin Waldseemuller (ca. 1470–ca. 1521), 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."
- 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 (Figure 1-9).
- 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 Ortelius (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.

Contemporary Geographic Tools

LEARNING OUTCOME 1.1.3

Identify geography's contemporary analytic mapping tools.

Maps are not just paper documents in textbooks. They have become an essential tool for contemporary delivery of online services through smart phones, tablets, and computers.

PINPOINTING LOCATIONS: GPS

Our smart phones, 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 three elements:

- Satellites placed in predetermined orbits by the U.S. military (24 in operation and 3 in reserve).
- Tracking stations to monitor and control the satellites.
- A receiver that can locate at least 4 satellites, figure out the distance to each, and use this information to pinpoint its own location.

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. GPS can also be used to find the precise location of a vehicle, enabling a motorist to summon help in an emergency or a customer to monitor the progress of a delivery truck or position of a bus or train.

Thanks to GPS, our electronic devices provide us with a wealth of information about the specific place on Earth we currently occupy. Cell phones equipped with GPS allow individuals to share their whereabouts with others. Geographers find GPS to be particularly useful in coding the precise location of objects collected in fieldwork.

The locations of all the information we gather and photos we take with our electronic devices are recorded through

DOING GEOGRAPHY Data Collection & Mental Mapping

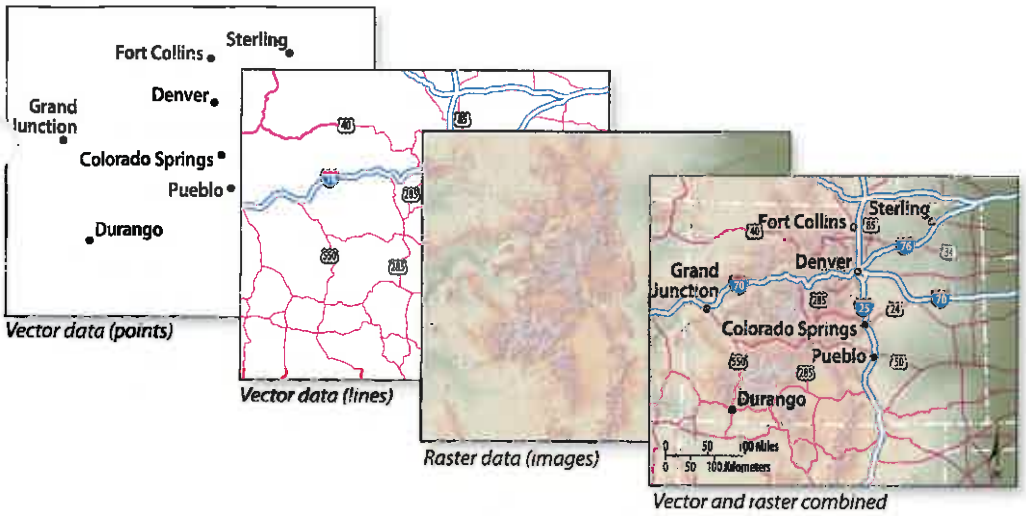
Most of the maps and other information fed into handheld electronic devices is provided by three companies. Google supplies Android devices, TomTom (formerly Tele Atlas) supplies Apple devices, and Nokia (formerly Navteq, now owned by Microsoft) supplies Microsoft products. These companies get their information from what they call "ground truthing." Hundreds of field researchers drive around, building the database. One person drives, while the other feeds information into a notebook computer (Figure 1-10). Hundreds of attributes are recorded, such as crosswalks, turn restrictions, and name changes. Thus, electronic navigation systems ultimately depend on human observation.

▲ **FIGURE 1-10 GOOGLE STREET MAPPING** Jaraíz de la Vera, Spain.

What's Your 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 a mental map depicting your route between two familiar places, such as between home and school or dorm room and geography class. Show the paths (roads or walkways) and important 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. How accurate is your map? Did you forget something important or put something in the wrong place?
4. At OpenStreetMap, see if your route has been mapped. If so, are important landmarks included? If your route has not been mapped, or if important landmarks are not included, you are free to place them on the map by following OpenStreetMap instructions.



▲ **FIGURE 1-11 GIS** Geographic information systems involve two types of data: vector and raster. Vector data consists of points (for example, for cities) and lines (for example, for highways). Raster data consists of images such as landforms.

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.

ANALYZING DATA: GI-SCIENCE

Geographic Information Science (GIScience) is 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. A map is created by retrieving a number of stored objects and combining them to form an image. Each type of information is stored in a layer (Figure 1-11). For example, separate layers could be created for boundaries of countries, bodies of water, roads, and names of places. A simple map might display only a single layer by itself, but most maps combine several layers, and GIS permits construction of much more complex maps than can be drawn by hand.

The acquisition of data about Earth's surface from a satellite orbiting Earth or from other long-distance methods is **remote sensing.** Remote-sensing satellites scan Earth's surface and transmit images in digital form to a receiving station on Earth's surface. At any moment, a satellite sensor records the image of a tiny area called a picture element, or pixel. Scanners detect the radiation being reflected from that tiny area. A map created by remote sensing is essentially a grid containing many rows of pixels. The smallest feature on Earth's surface that can be detected by a sensor depends on the resolution of the scanner. Geographers use remote sensing to map the changing distribution of a wide variety of features, such as agriculture, drought, and sprawl.

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. For example, a map showing where life expectancy is low (such as in Figure 1-24) can be combined with layers showing the location of people with various incomes and the location of crimes.

COLLECTING AND SHARING DATA: VGI

Smart phones, 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 trends 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. For example, OpenStreetMap (OSM) is VGI intended to develop a free base map of the world. Individuals can contribute to OSM at OpenStreetMap.org (see Doing Geography and What's Your Geography? feature).

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 Google Earth. The term *mashup* refers to the practice of overlaying data from one source on top of one of the mapping services; the term comes from the hip-hop practice of mixing two or more songs.

A mashup map can show the locations of nearby pizza restaurants, the locations of commercial airplanes currently in flight, or traffic conditions on highways. 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. An API for mapping software is available at such sites as developers.google.com/maps.

PAUSE & REFLECT 1.1.3

State a question you have about the area where you live. Describe a mashup that you could create using GIS that would answer your question.

Interpreting Maps

LEARNING OUTCOME 1.1.4

Understand 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).

For more details about cartography, see Appendix A.

MAP SCALE

The first decision a cartographer faces is how much of Earth's surface to depict on the map. Is it necessary to show the entire globe, 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 1-12):

- **Ratio.** A ratio or fraction shows the numerical ratio 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.

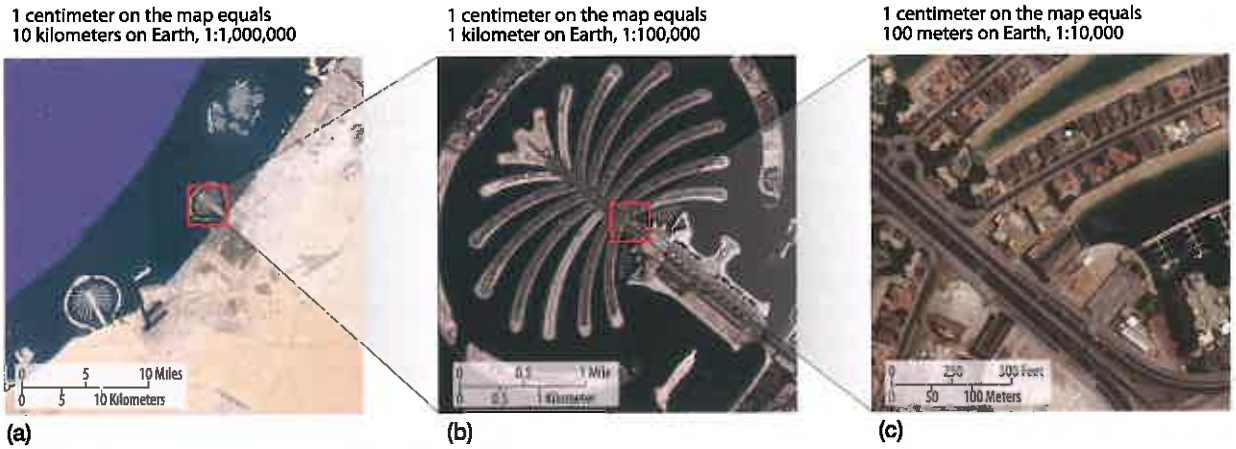
Maps often display scale in more than one of these three ways.

The appropriate scale for a map depends on the information being portrayed. A map of a neighborhood, such as Figure 1-12c, may have a scale of 1:10,000, whereas a map of a city (Figure 1-12a) may have a scale of 1:1,000,000. One inch represents about 1/6 mile on Figure 1-12c and 16 miles on Figure 1-12a.

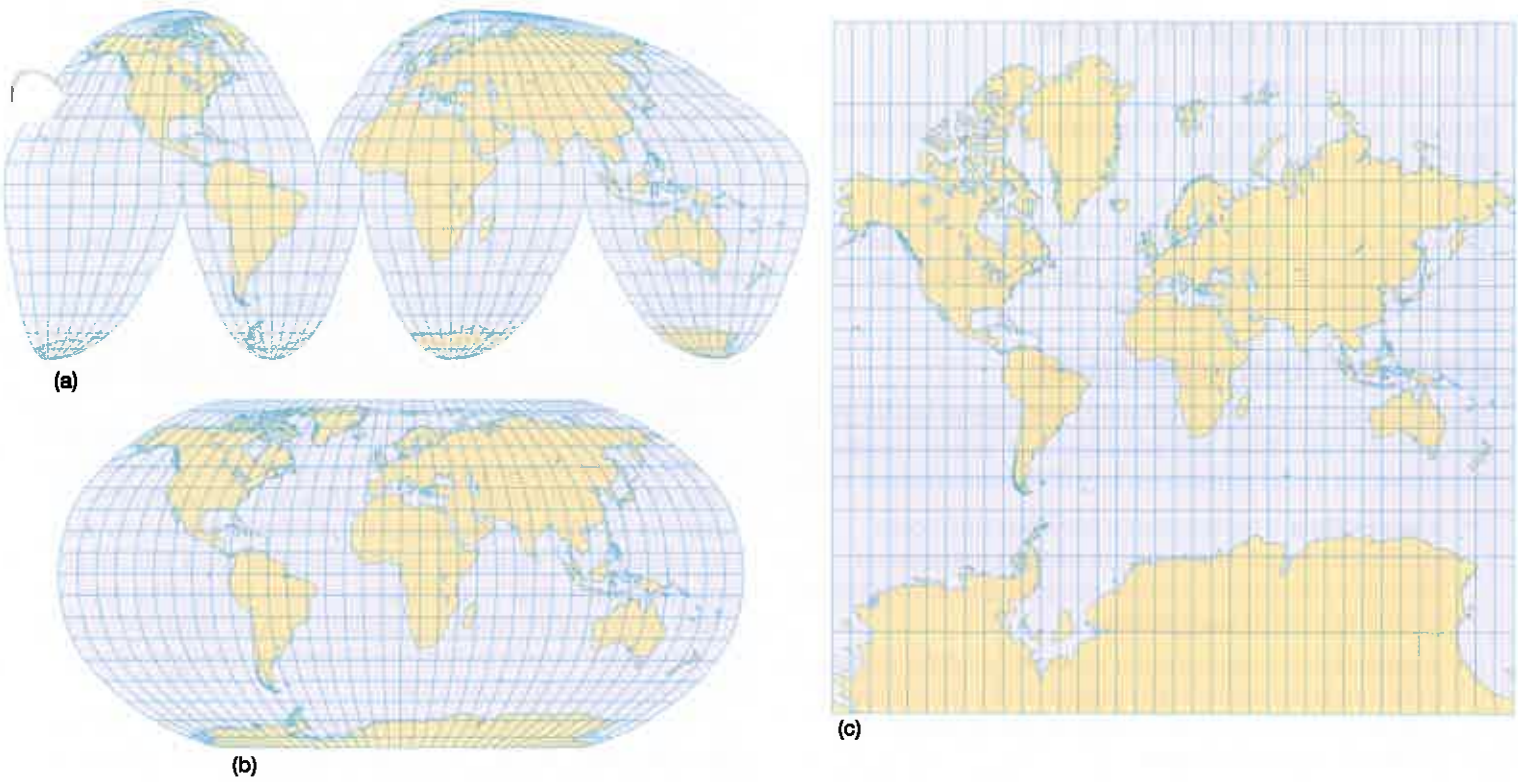
At the scale of a small portion of Earth's surface, such as a downtown area, a map provides a wealth of details about the place. At the scale of the entire globe, a map must omit many details because of lack of space, but it can effectively communicate processes and trends that affect everyone.

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.



▲ **FIGURE 1-12 MAP SCALE** The three images show the city of Dubai, in the United Arab Emirates, Emirates at three scales.



▲ **FIGURE 1-13 PROJECTIONS** **(a)** Goode Homolosine, an equal area projection; **(b)** Robinson, an uninterrupted projection; **(c)** Mercator, featuring accurate shapes and directions.

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 1-13).

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 it is 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 while it is in reality smaller.
4. The *direction* from one place to another can be distorted.

Most of the world maps in this book, such as Figure 1-13a, are equal area projections. The primary benefit of this type of projection is that 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.

To largely preserve the size and shape of landmasses, however, the projection in Figure 1-13a forces other distortions:

- The Eastern and Western hemispheres are separated into two pieces, a characteristic known as interruption.
- The meridians (the vertical lines), which in reality converge at the North and South poles, do not converge at all on the map. Also, they do not form right angles with the parallels (the horizontal lines).

The Robinson projection (Figure 1-13b) is useful for displaying information across the oceans. Its major disadvantage is that by allocating space to the oceans, the land areas are much smaller than on interrupted maps of the same size.

The Mercator projection (Figure 1-13c) has several advantages: Shape is distorted very little, direction is consistent, and the map is rectangular. Its greatest disadvantage is that relative size is grossly distorted toward the poles, making high-latitude places look much larger than they actually are.

PAUSE & REFLECT 1.1.4

Compare the sizes of Greenland and South America on the three maps in Figure 1-13. Which of the two landmasses is actually larger? How do you know?

The Geographic Grid

LEARNING OUTCOME 1.1.5

Explain how latitude and longitude are used to locate points on Earth's surface.

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.

LATITUDE AND LONGITUDE

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 (Figure 1-14):

- A **meridian** is an arc drawn between the North and South poles. The location of each meridian is identified on Earth's surface according to a numbering system known as **longitude.**
- 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.**

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. For example, Belo Horizonte, Brazil, is located at 44° west longitude and Baghdad, Iraq, at 44° east longitude.

The equator is 0° latitude, the North Pole 90° north latitude, and the South Pole 90° south latitude. Nicosia, Cyprus, is located at 35° north latitude and Buenos Aires, Argentina, at 35° south latitude.

▲ **FIGURE 1-14 GEOGRAPHIC GRID**

Latitude and longitude are used together to identify locations. For example, Denver, Colorado, is located at 40° north latitude and 105° west longitude. The mathematical location of a place can be designated more precisely by dividing each degree into 60 minutes (') and each minute into 60 seconds ("). For example, the official mathematical location of Denver, Colorado, is 39°44' north latitude and 104°59' west longitude. The state capitol building in Denver is located at 39°42'2" north latitude and 104°59'04" west longitude. GPS typically divide degrees into decimal fractions rather than minutes and seconds. The Colorado state capitol, for example, is located at 39.714444° north latitude and 84.984444° west longitude.

Measuring latitude and longitude is a good example of how geography is partly a natural science and partly a study of human behavior. Latitudes are scientifically derived via 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 and the international agreement was made.

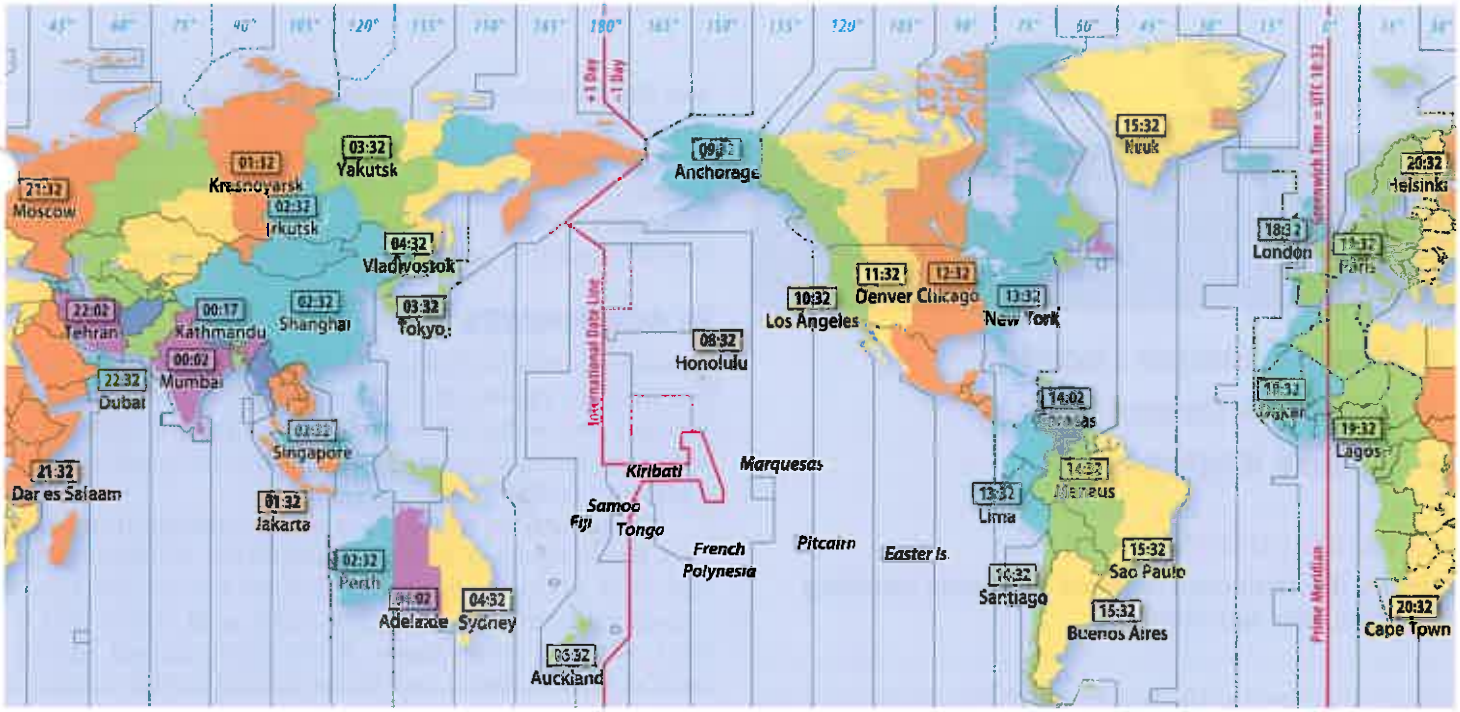
TELLING TIME

Longitude is the basis for calculating 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, **Greenwich Mean Time (GMT),** or Universal Time (UT), 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 1-15). The eastern United States, which is near 75° west longitude, is therefore 5 hours earlier than GMT (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) GMT. 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 i 6:32 p.m. GMT, the time in New York City is 2:32 p.m.

When you cross the **International Date Line,** which, for the most part, follows 180° longitude, you move the clock back 24 hours, or one entire day, if you are heading eastward, toward America. You turn the clock ahead



▲ **FIGURE 1-15 TIME ZONES** The United States and Canada share four standard time zones: Eastern (5 hours earlier than GMT, near 75° west), Central (6 hours earlier than GMT, near 90° west), Mountain (7 hours earlier than GMT, near 105° west), and Pacific (8 hours earlier than GMT, near 120° west). The United States has two additional standard time zones: Alaska (9 hours earlier than GMT, near 135° west) and Hawaii-Aleutian (10 hours earlier than GMT, near 150° west). Canada has two additional standard time zones: Atlantic (4 hours earlier than GMT, near 60° west) and Newfoundland (3½ hours earlier than GMT). The residents of Newfoundland assert that their island, which lies between 53° and 59° west longitude, would face dark winter afternoons if it were in the Atlantic Time Zone and dark winter mornings if it were 3 hours earlier than GMT.

24 hours if you are heading westward, toward Asia. 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.

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 enacted the Longitude Act, which 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 using the connection between longitude and time. He invented the first portable clock that could keep accurate time on a ship—because it did not have a pendulum. 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

Where in the world, other than Newfoundland, is standard time on the half-hour rather than the hour? Why might that country prefer not to be on the hour?

CHECK-IN KEY ISSUE 1

Why Is Geography a Science?

- ✔ **Geography has ancient and medieval roots.**
- ✔ **Maps are tools of reference and increasingly tools of communication.**
- ✔ **Reading a map requires recognizing its scale and projection.**
- ✔ **Contemporary mapping utilizes electronic technologies, such as GPS and GIS.**

KEY ISSUE 2

Why Is Each Point on Earth Unique?

- Place: A Unique Location
- Region: A Unique Area
- Culture Regions

LEARNING OUTCOME 1.2.1

Identify the distinctive features of a place, including toponym, site, and situation.

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

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.

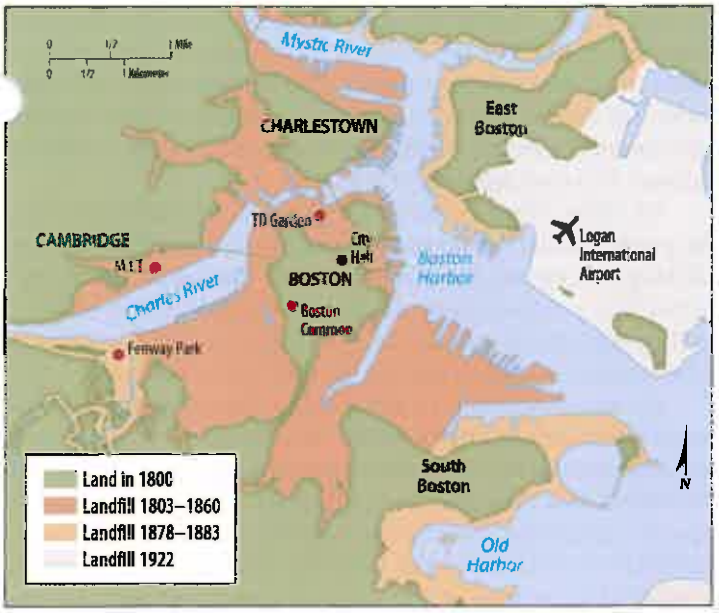
A place name may also indicate the origin of its settlers. Place names commonly have British origins in North America and Australia, Portuguese origins in Brazil, Spanish origins elsewhere in Latin America, and Dutch origins in South Africa. Some place names derive from features of the physical environment. Trees, valleys, bodies of water, and other natural features appear in the place names of most languages (Figure 1-16).

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 1-16 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, the climber of mountains, the land-swallower who travelled about, played his nose flute to his loved one."



▲ **FIGURE 1-17 CHANGING SITE OF BOSTON** The site of Boston has been altered by filling in much of Boston Harbor. 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.

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 1-17). 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.

SITUATION

Situation is the location of a place relative to other places. 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.** Situation helps us understand the importance of a location. Many locations are important because they are accessible to other places. For example, because of its situation, Istanbul is a center for the trading and distribution of goods between Europe and Asia (Figure 1-18). Istanbul is situated along the Bosphorus strait, which connects the Mediterranean and Black seas. The Bosphorus is especially important route for ships traveling to and from Russia.

(a)

(b)

▲ **FIGURE 1-18 SITUATION OF ISTANBUL** Istanbul is situated along the Bosphorus, a waterway between the Black and Mediterranean seas. Europe lies to the west and Asia to the east. **(a)** Satellite image of Istanbul; **(b)** Istanbul looking east from Asia toward Europe.

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 defined by one or more distinctive characteristics. Geographers identify three types of regions: formal, functional, and vernacular.

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.

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 (1880–1950). Sauer defined cultural landscape as an area fashioned from nature by a cultural group. "Culture is the agent, the natural area the medium, the cultural landscape is the result."

People, activities, and environment display similarities and regularities within a region and differ in some way from those of other regions. A region gains uniqueness from possessing not a single human or environmental characteristic but a combination of them. Not content to merely identify these characteristics, geographers seek relationships among them. Geographers recognize that in the real world, characteristics are integrated.

FORMAL REGION

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 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.

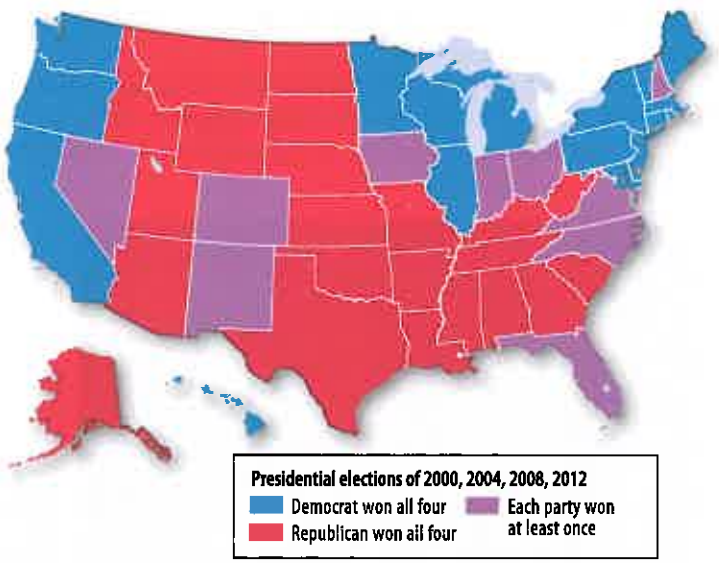
Some formal regions are easy to identify, such as countries or local government units. Montana is an example of a formal region, characterized with equal intensity throughout the state by a government that passes laws, collects taxes, and issues license plates. The formal region of Montana has clearly 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. For example, we can distinguish formal regions within the United States characterized by a predominant voting for Republican candidates, although Republicans do not get 100 percent of the votes in these regions—nor in fact do they always win (Figure 1-19).

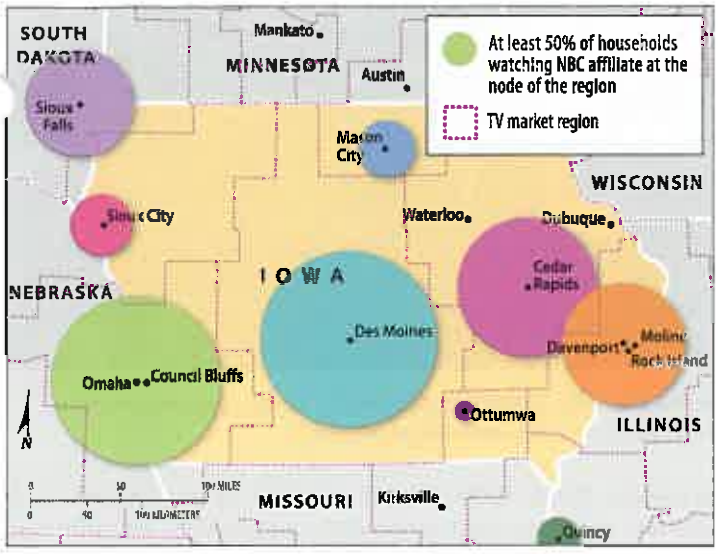
A cautionary step in identifying formal regions is the need to recognize the diversity of cultural, economic, and environmental factors, even while making a generalization. Problems may arise because a minority of people in a region speak a language, practice a religion, or possess resources different from those of the majority. People in a region may play distinctive roles in the economy and hold different positions in society based on their gender or ethnicity.

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 o functional associations.



▲ FIGURE 1-19 FORMAL REGION The U.S. presidential election map is divided into formal regions based on party preference. The South and Plains states typically give a majority to the Republican candidate and the Northeast and West Coast states typically give a majority to the Democratic candidate. Although Republican George W. Bush won in 2000 and 2004 and Democrat Barack Obama won in 2008 and 2012, 40 of the 50 states (as well as the District of Columbia) gave a majority to the same party in all four elections.



▲ **FIGURE 1-20 FUNCTIONAL REGION** Designated market areas (DMAs) within Iowa are examples of functional regions. In several of the functional regions, the node—the TV station—is in an adjacent state. Functional regions frequently overlap the formal regions delineated by state or national boundaries. The state of Iowa is an example of a formal region.

Geographers often use functional regions to display 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. A TV station's signal is strongest at the center of its service area (Figure 1-20). 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. Similarly, a department store attracts fewer customers from the edge of a trading area, and beyond that edge, customers will most likely choose to shop elsewhere.

New technology is breaking down traditional functional regions. TV stations are broadcast to distant places by cable, satellite, or Internet. Through the Internet, customers can shop at distant stores.

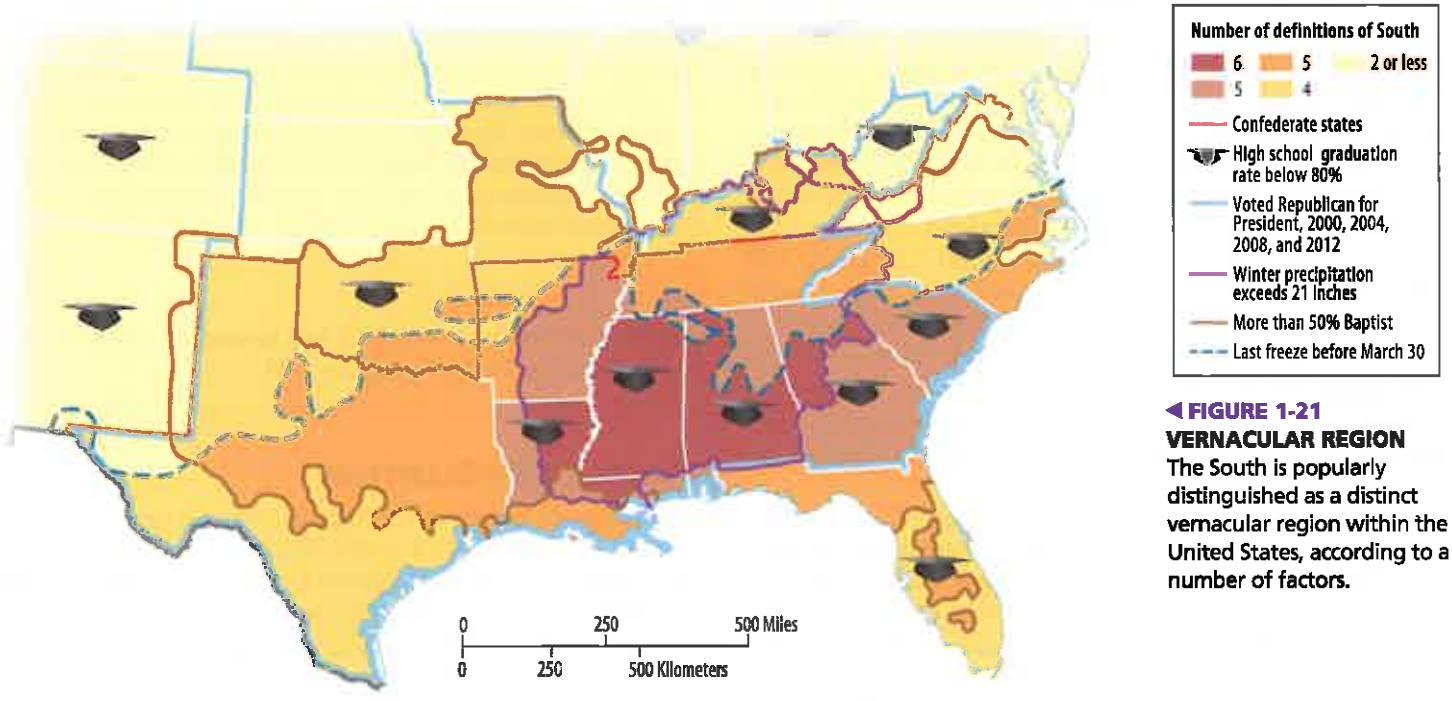
VERNACULAR REGION

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 1-21). 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 preference for Republican presidential candidates, relatively low rates of high school graduation, 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 the U.S. Midwest?



◀ **FIGURE 1-21 VERNACULAR REGION** The South is popularly distinguished as a distinct vernacular region within the United States, according to a number of factors.

Culture Regions

LEARNING OUTCOME 1.2.3

Describe two geographic definitions of culture.

In thinking about why each region on Earth is distinctive, geographers refer to **culture,** which is the body of customary beliefs, material traits, and social forms that together constitute 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.

In everyday language, we think of *culture* as a 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.

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 both an excellent way of identifying the location of a culture and 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 (Figure 1-22). 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 encompasses a group's language, religion, and other cultural values, as well as its physical traits. A group possesses these cultural and physical characteristics as a product of its common traditions and heredity. 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.

▲ **FIGURE 1-22 CULTURAL DIVERSITY** Languages, religions, and cultures mix in a Jerusalem street market.

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 (Figure 1-23), 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 9.

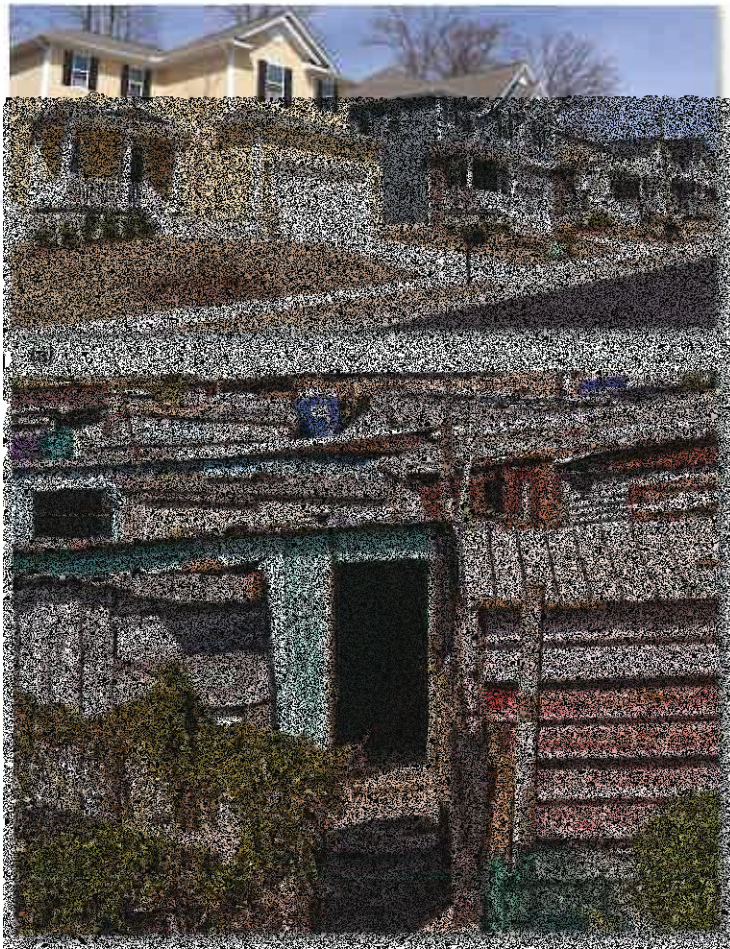
Possession of wealth and material goods is higher in developed countries than in developing countries because of the different types of economic activities carried out in the two types of countries. Most people in developing countries are engaged in agriculture, whereas most people in developed countries 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 10 through 13.

PAUSE & REFLECT 1.2.3

Describe differences that you see between U.S. and South Africa suburbs in Figure 1-23.

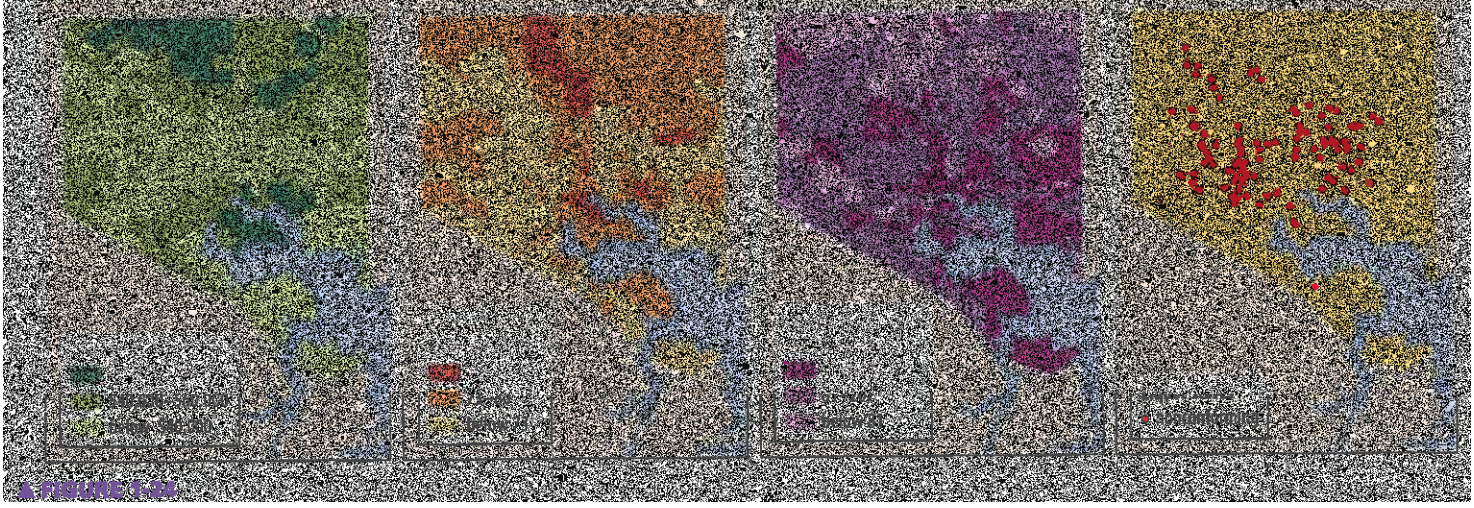
SPATIAL ASSOCIATION

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** occurs 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.



▲ FIGURE 1-23

Why Is Each Point on Earth Unique?



▲ FIGURE 1-24

KEY ISSUE 3

Why Are Different Places Similar?

- Scale: Global and Local
- Space: Distribution of Features
- Space: Cultural Identity
- Space: Inequality
- Connections: Diffusion
- Connections: Spatial Interaction

LEARNING OUTCOME 1.3.1

Understand global- and local-scale changes in economy and culture.

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 why similarities among places and regions result from regularities rather than coincidences.

Scale: Global and Local

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.

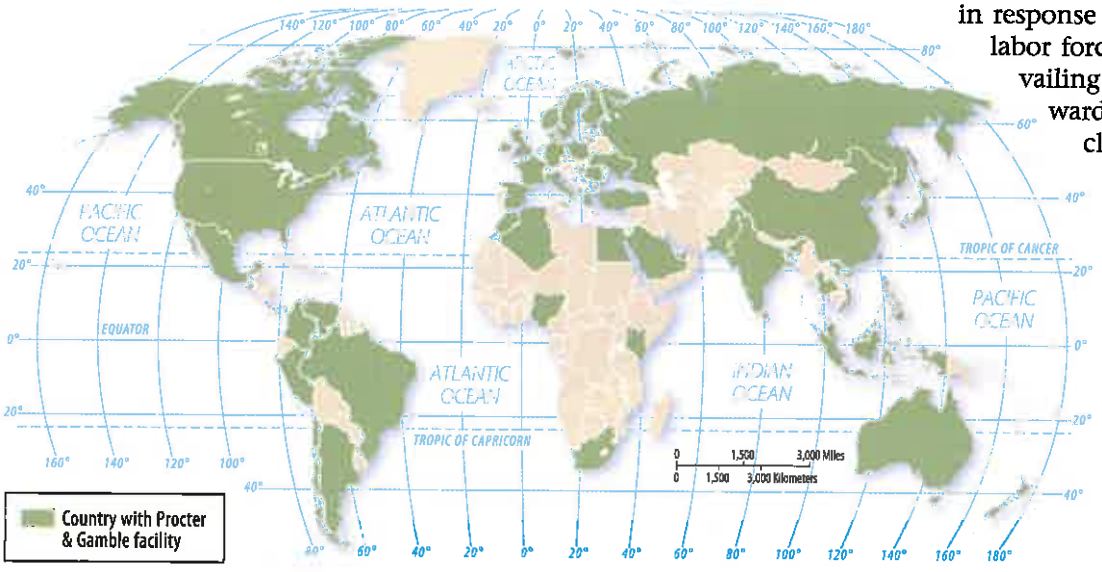
ECONOMIC GLOBALIZATION AND LOCAL DIVERSITY

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 markets elsewhere. A factory is located to facilitate bringing in raw materials and shipping out products to the markets.

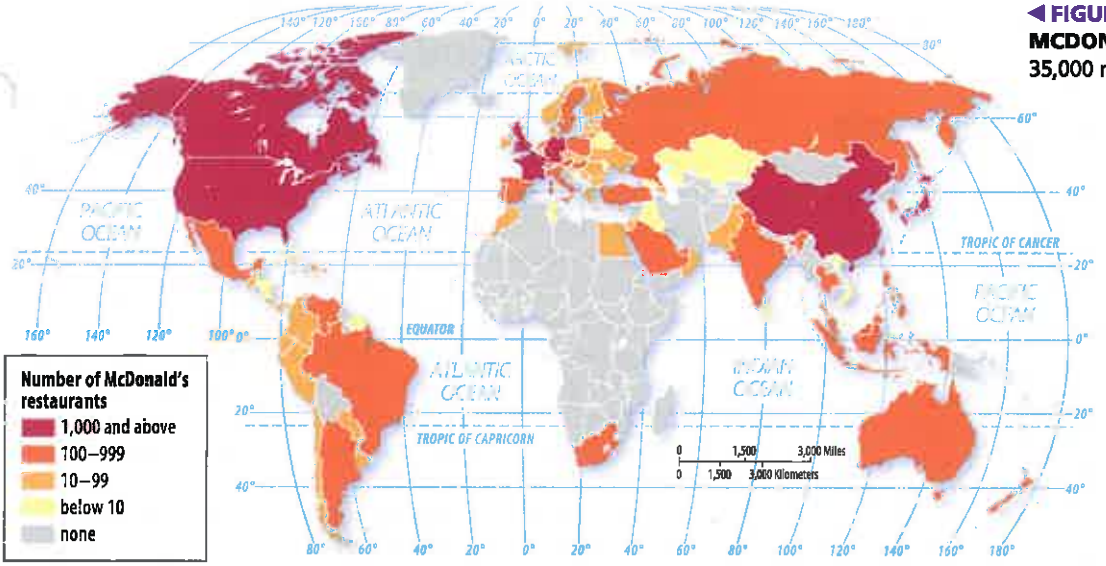
Globalization of the economy has been led primarily by transnational corporations, sometimes called multinational corporations. A **transnational corporation** conducts research, operates factories, and sells products in many countries, not just where its headquarters and principal shareholders are located. Examples include Procter & Gamble (Figure 1-25) and McDonald's (Figure 1-26).

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 concentrated in specific geographic areas.



◀ FIGURE 1-25 GLOBAL ECONOMY: PROCTER & GAMBLE P&G employs around 61,000 workers at 134 factories in 42 countries.



◀ **FIGURE 1-26 GLOBAL ECONOMY: MCDONALD'S** McDonald's has around 35,000 restaurants in 120 countries.

CULTURAL GLOBALIZATION AND LOCAL DIVERSITY

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 (Figure 1-27). 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 are threatened with extinction. The survival of a local culture's distinctive beliefs, forms, and traits 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.

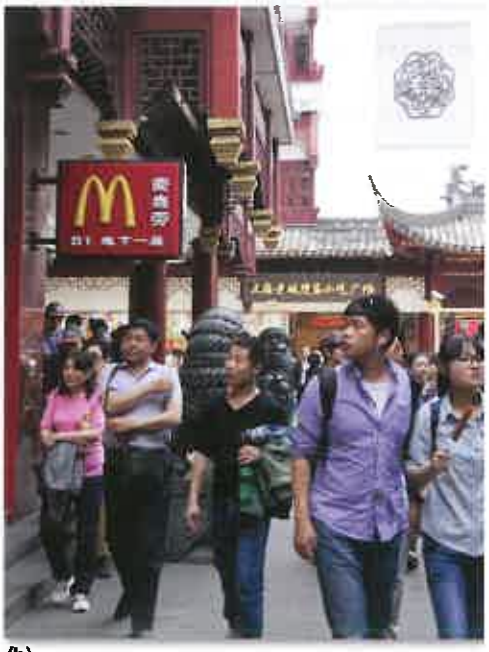
Yet despite globalization, cultural differences among places not only persist but actually flourish in many places. Global standardization of products does not mean that everyone wants the same cultural products. The communications revolution that promotes globalization of culture also permits preservation 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 with someone who prefers skirts. In a global culture, companies can target groups of consumers with similar tastes in different parts of the world.

PAUSE & REFLECT 1.3.1

Give examples of changes in economy and culture occurring at global and local scales.

(a)



(b)

◀ **FIGURE 1-27 GLOBAL CULTURE** (a) Youths in China wear Western jeans and hoodies. (b) Youths in Shanghai, China, patronize a McDonald's.
1. What might be the attraction of jeans and McDonald's for young people in China? **2.** If you visit another country, would you wish to wear jeans? Would you wish to go to McDonald's? Why or why not? **3.** How do you know from the image on the right that the store is a McDonald's?

Space: Distribution of Features

LEARNING OUTCOME 1.3.2

Identify the three properties of distribution across space.

Space was defined at the beginning of the chapter as the physical gap or interval between two objects. 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. Geographers think about the arrangement of people and activities found in space and try to understand why those people and activities are distributed across space as they are.

Look around the space you currently occupy—perhaps a classroom or a bedroom. Tables and chairs are arranged regularly, perhaps in a row in a classroom or against a wall at home. The room is located in a building that occupies an organized space—along a street or a side of a quadrangle. Similarly, the community containing the campus or house is part of a system of communities arranged across the country and around the world.

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. The arrangement of a feature in space is known as its **distribution.** Geographers identify three main properties of distribution 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 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 500 persons per square kilometer is much higher than China's 140 persons per square kilometer. The reason is that the land area of China is 9.3 million square kilometers, compared to only 42,000 square kilometers for the Netherlands.

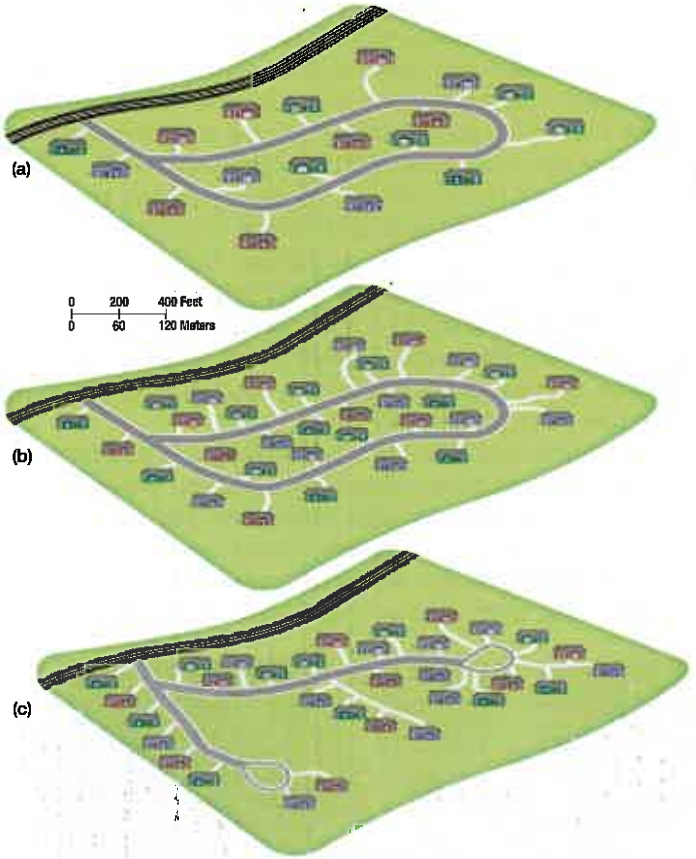
High population density is also unrelated to poverty. The Netherlands is one of the world's wealthiest countries and Mali one of the world's poorest. Yet the Netherlands' density of around 500 persons per square kilometer is much larger than Mali's density of 13 persons per square kilometer (see Chapter 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.

Concentration is not the same as density. As Figure 1-28 shows, 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 is shared as a community park.



▲ **FIGURE 1-28 DENSITY AND CONCENTRATION OF HOUSES** Neighborhood **(a)** has a lower density than neighborhood (b)—18 houses compared to 32 houses on the same 82-acre piece of land—but both have dispersed concentrations. Neighborhoods **(b)** and **(c)** have the same density (32 houses on 82 acres), but the distribution of houses is more clustered in plan (c). Neighborhood (c) has shared open space, whereas plan (b) provides a larger, private yard surrounding each house.

▲ **FIGURE 1-29 CHANGING DENSITY AND CONCENTRATION OF BASEBALL TEAMS** These 6 teams moved to other cities during the 1950s and 1960s: Braves—Boston to Milwaukee in 1953, then to Atlanta in 1966 • Browns/Orioles—St. Louis (Browns) 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/Twins—Washington (Senators) to Minneapolis (Minnesota Twins) in 1961 These 14 teams were added between the 1960s and 1990s: • Angels—Los Angeles in 1961, then to Anaheim (California) in 1965 • Rangers—Washington (Senators) in 1961, then to Arlington (Texas) 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 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 As a result of these relocations and additions, the density of teams increased, and the distribution became more dispersed.

The distribution of Major League Baseball teams illustrates the difference between density and concentration (Figure 1-29). 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, all the teams were clustered in the northeastern United States, but the moves dispersed several teams to the West Coast and Southeast. These moves, as well as the spaces occupied by the expansion teams, resulted in a more dispersed distribution.

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.

Objects are frequently arranged in a square or rectangular pattern. Many American cities contain a regular pattern of streets that intersect at right angles at uniform intervals to form square or rectangular blocks; this is known as a grid pattern. The system of townships, ranges, and sections established by the Land Ordinance of 1785 is another example of a square or grid pattern (Figure 1-30).

PAUSE & REFLECT 1.3.2

How would you describe the density, concentration, and pattern of chairs in your classroom?

◀ **FIGURE 1-30 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.

Space: Cultural Identity

LEARNING OUTCOME 1.3.3

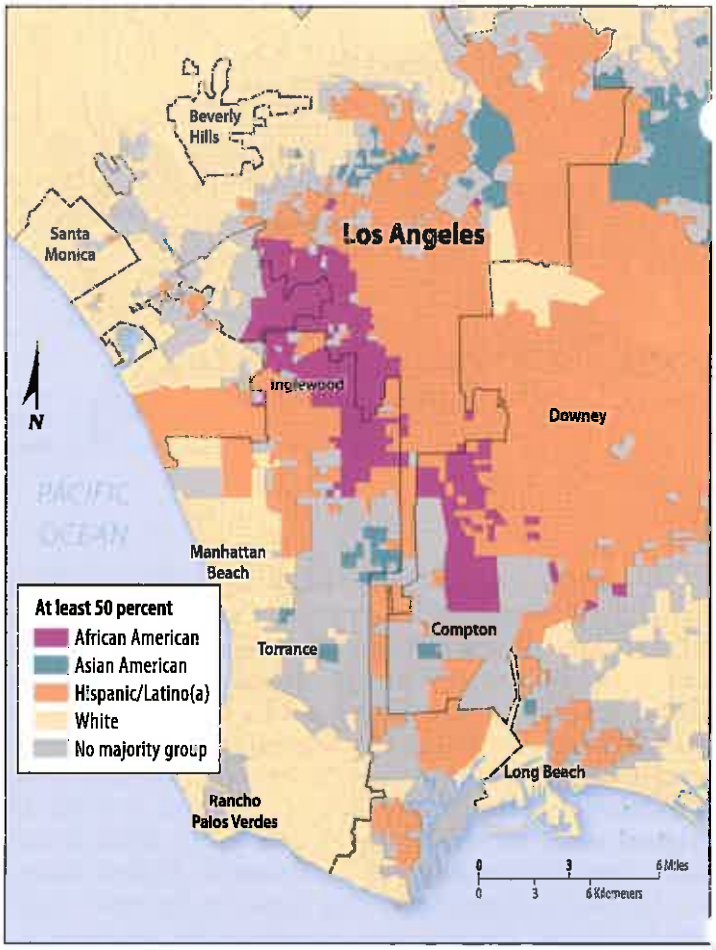
Describe geographic approaches to elements of cultural identity such as gender, ethnicity, and sexuality.

Cultural groups compete to organize space. Some human geographers focus on the needs and interests of cultural groups that are dominated in space, especially women, ethnic minorities, and gays.

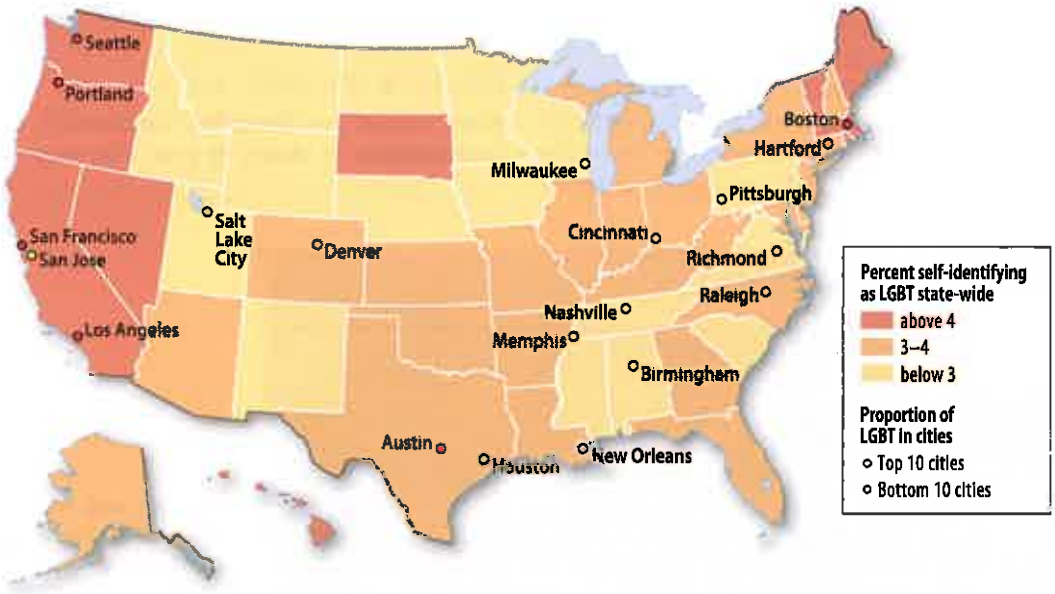
CULTURAL IDENTITY AND DISTRIBUTION ACROSS SPACE

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.

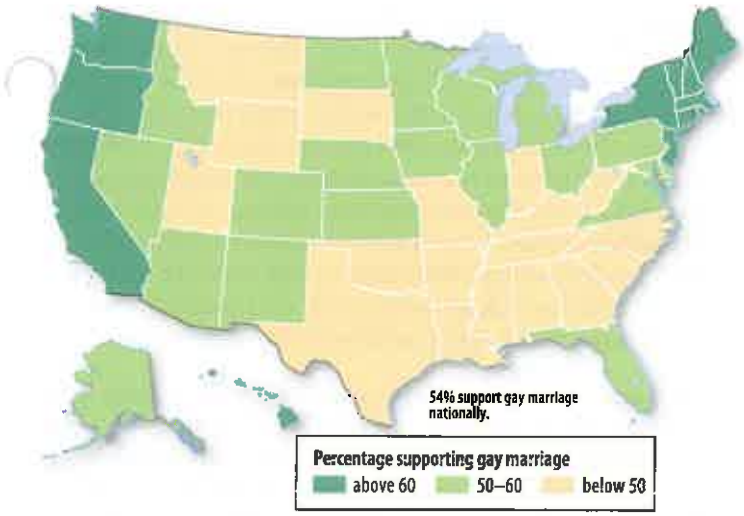
DISTRIBUTION BY ETHNICITY. The distribution of ethnicities in the United States varies considerably at all scales, as discussed in detail in Chapter 7. African Americans are clustered in the Southeast, whereas Hispanics are clustered in the Southwest. Ethnicities are also highly clustered within cities, as discussed in detail in both Chapters 7 and 13. In Los Angeles, which contains large percentages of African Americans, Hispanics, and Asian Americans, the major ethnic groups are clustered in different areas (Figure 1-31). African Americans are located in south-central Los Angeles and Hispanics in the east. Asian Americans are located to the south and west, contiguous to the African American and Hispanic areas.



▲ **FIGURE 1-31 DISTRIBUTION OF ETHNICITIES IN LOS ANGELES** African Americans are clustered to the south of downtown Los Angeles and Hispanics to the east. Asian American neighborhoods are contiguous to the African American and Hispanic areas.



▲ **FIGURE 1-32 LGBT POPULATION PERCENTAGE** Figures are the percentages of people who self-identified as LGBT in a 2015 Gallup survey.



▲ **FIGURE 1-33 SUPPORT FOR GAY MARRIAGE PRIOR TO NATIONWIDE LEGALIZATION** The percentage of people who supported gay marriage prior to the U.S. Supreme Court legalizing it in 2015 varied widely among the 50 states.

DISTRIBUTION BY SEXUAL ORIENTATION. Openly lesbian, gay, bisexual, and transgender (LGBT) people may be attracted to some locations to reinforce spatial interaction with other LGBT people. Among the 50 largest U.S. cities, the percentage of LGBT people varies from 6.2 percent in San Francisco to 2.6 percent in Birmingham, Alabama. San Francisco, which has a reputation for being an especially hospitable city for LGBT people, not surprisingly has the highest percentage of openly LGBT people among the 50 largest U.S. cities, although the percentage is not significantly higher than in other cities (Figure 1-32).

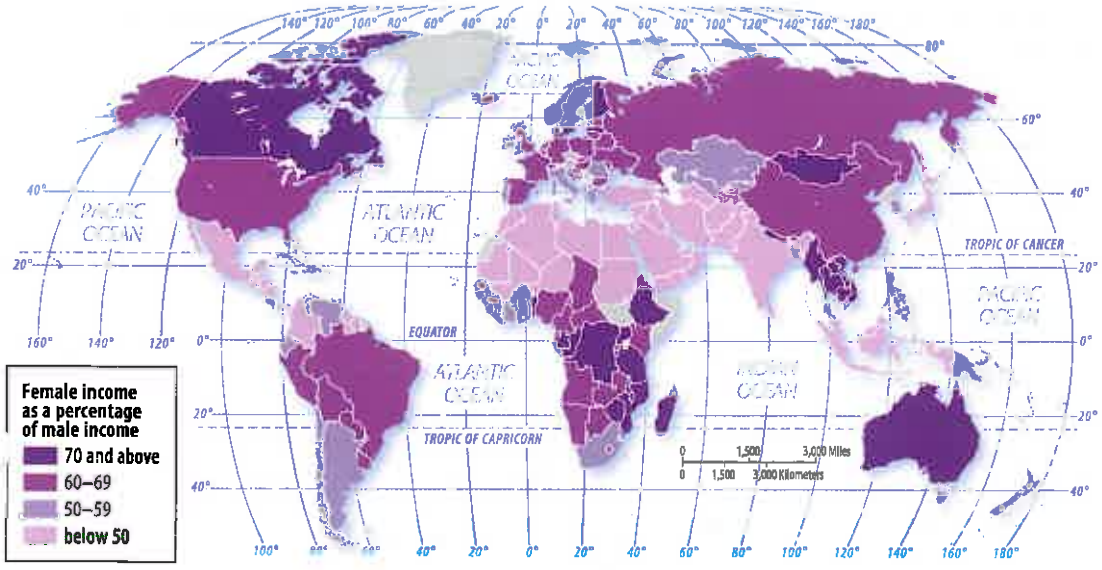
At the scale of the 50 U.S. states, the percentage of people who self-identify as LGBT does not vary widely. According to a 2015 Gallup poll, the percentage varies among states from a high of 5.1 percent in Hawaii to a low of 1.7 percent in North Dakota. (The District of Columbia has 10.0 percent.) However, 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 (Figure 1-33).

PAUSE & REFLECT 1.3.3

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

DISTRIBUTION BY GENDER. 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.

With gender, geographers focus on the distribution of inequality. As discussed in detail in Chapter 9, 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 1-34). Worldwide, the average income of women is around 50 percent that of men. The income gap between women and men is approximately the same in both developed and developing countries. At best, women in some countries have achieved near-equality with men. The countries with near-equality are primarily in poor countries where both male and female incomes are low, and in some European countries. The gap is especially large in Southwest Asia and North Africa, where few women are permitted to work.



◀ **FIGURE 1-34 FEMALE INCOME AS A PERCENTAGE OF MALE INCOME** According to the United Nations, the average income earned by women is less than that of men in every country of the world.

Space: Inequality

LEARNING OUTCOME 1.3.4

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

Cultural characteristics, especially gender, ethnicity, and sexuality, influence the distribution and movement of people across space. The experiences of women differ from those of men, blacks from whites, gays from straights, and boys from girls.

CULTURAL IDENTITY AND CONTEMPORARY GEOGRAPHIC THOUGHT

Geographers take a range of approaches to cultural identity and space, including those of poststructuralist, humanisitic, 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. For example, some researchers 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.

Humanistic geography is a branch of human geography that emphasizes the different ways that individuals form ideas about place and give those places symbolic meanings. For example, openly homosexual men and lesbian women may be attracted to places such as Christopher Street in New York City because they perceive them as gay-friendly spaces where they can interact socially with other gays. Christopher Street may be seen as offering an accepting location for gay men and lesbians through inclusive policies and business practices. But the street also has symbolic meaning for gays: In 1969, the Stonewall Inn was the site of protests that began the gay liberation movement. Tolerance for gays has increased, although legal discrimination persists in some regions.

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. For example, consider the spatial patterns typical of a household that consists of a husband and wife:

- **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?

All academic disciplines and workplaces have proclaimed sensitivity to issues of cultural diversity. For geographers, concern and deep respect for cultural diversity are not merely politically correct expediencies but lie at the heart of geography's understanding of space. Geographers have deep respect for the dignity of all cultural groups.

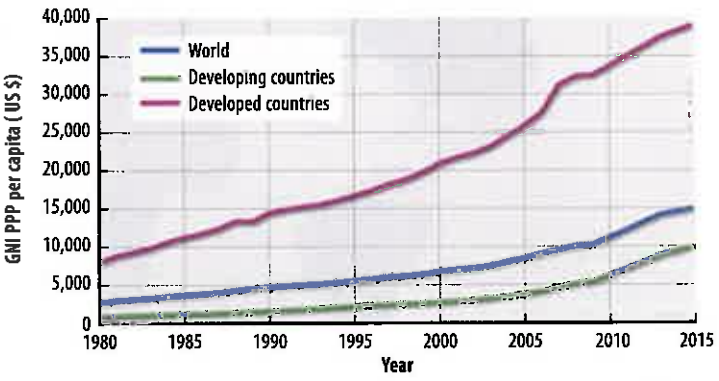
UNEQUAL ACCESS

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 retard interaction among people. In the modern world, barriers to interaction are more likely to derive from unequal access to electronics.

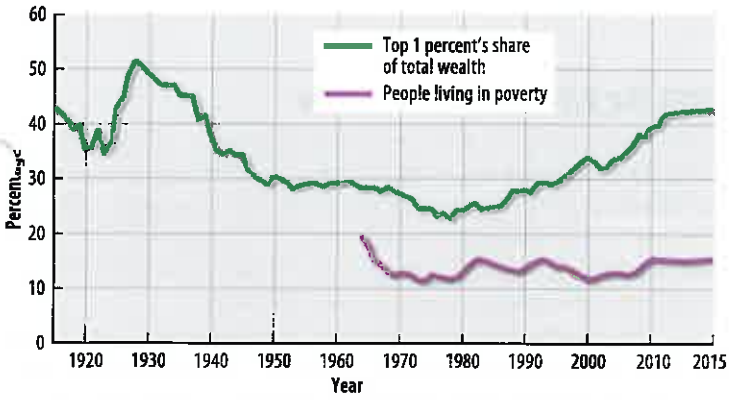
Instantaneous expansion diffusion, made possible by electronic communications, was once viewed as the "death" of geography because the ease of communications between distant places removed barriers to interaction. In reality, because of unequal access, geography matters even more than before.

People have unequal access to interaction in part because the quality of electronic service varies among places. Internet access depends on availability of electricity to power the computer and a service provider. Seconds count. 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.

Global culture and economy are increasingly centered on the three core, or hearth, regions: North America, Europe, and Japan. These three regions have a large percentage



▲ **FIGURE 1-35 INEQUALITY: INCOME GAP BETWEEN RICH AND POOR COUNTRIES** Income has increased much more rapidly in developed countries than in developing ones.



▲ **FIGURE 1-36 INEQUALITY: U.S. WEALTH AND POVERTY** The share of U.S. wealth held by the wealthiest 1 percent 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.

of the world's advanced technology, capital to invest in new activities, and wealth to purchase goods and services. From "command centers" in the three major world cities 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. Meanwhile, "nonessential" employees of the companies can be relocated to lower-cost offices outside the major financial centers. For example, Fila maintains headquarters in Italy but has moved 90 percent of its production of sportswear to Asian countries. Mitsubishi's corporate offices are in Japan, but its electronics products are made in other Asian countries.

Countries in Africa, Asia, and Latin America contain three-fourths of the world's population and nearly all of its population growth. However, these countries find themselves on a periphery, or outer edge, with respect to the wealthier core regions of North America, Europe, and Japan. Global investment arrives from the core through hierarchical diffusion of decisions made by transnational corporations.

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. 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 1-35).

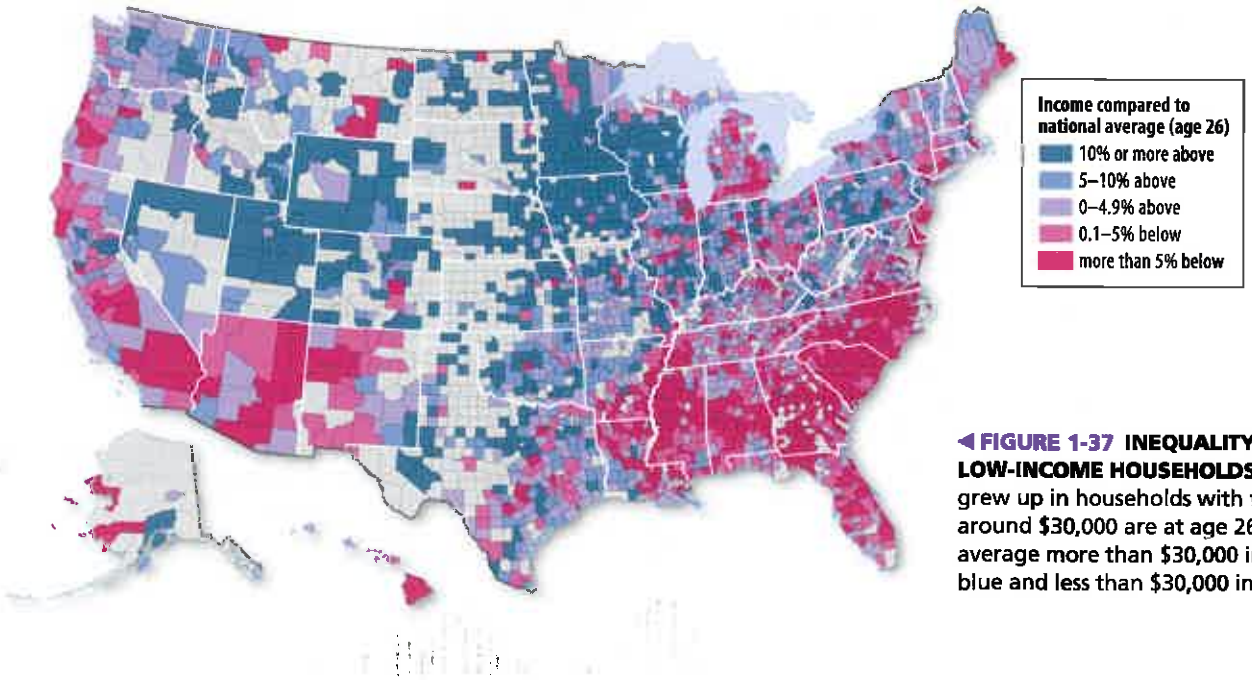
In a global culture and economy, every area of the world plays some role intertwined with the roles played by other regions. Workers and cultural groups that in the past were largely unaffected by events elsewhere in the world now share a single economic and cultural world with other workers and cultural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

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 42 percent in 2014, according to the Congressional Budget Office (Figure 1-36). The share of Americans living in poverty increased during that same period, from 12 percent to 15 percent.

Within the United States, prospects for children of low-income families to escape poverty depend on the community where they spend their childhood. Children who grew up in low-income households in the Midwest and Plains states earn several thousand dollars more per year at age 26 than do children who grew up in low-income households in the Southeast and Southwest (Figure 1-37).

PAUSE & REFLECT 1.3.4

How does the region where you live compare in the percentage of children in poverty?



◀ **FIGURE 1-37 INEQUALITY: CHILDREN IN LOW-INCOME HOUSEHOLDS** Children who grew up in households with family incomes around $30,000 are at age 26 earning on average more than $30,000 in the counties in blue and less than $30,000 in the counties in red.

Connections: Diffusion

LEARNING OUTCOME 1.3.5

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.

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 of the interacting cultural groups, but the two groups retain two distinct culture features.
- **Syncretism** is the combination of elements of two groups into a new cultural feature. The two cultural groups come together to form a new culture.

DIFFUSION

Diffusion is the process by which a feature spreads across space from one place to another over time. Something originates at a hearth and diffuses from there to other places. A **hearth** is a place from which an innovation originates. Geographers document the locations of nodes and the processes by which diffusion carries 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 nurturing 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 implement 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.

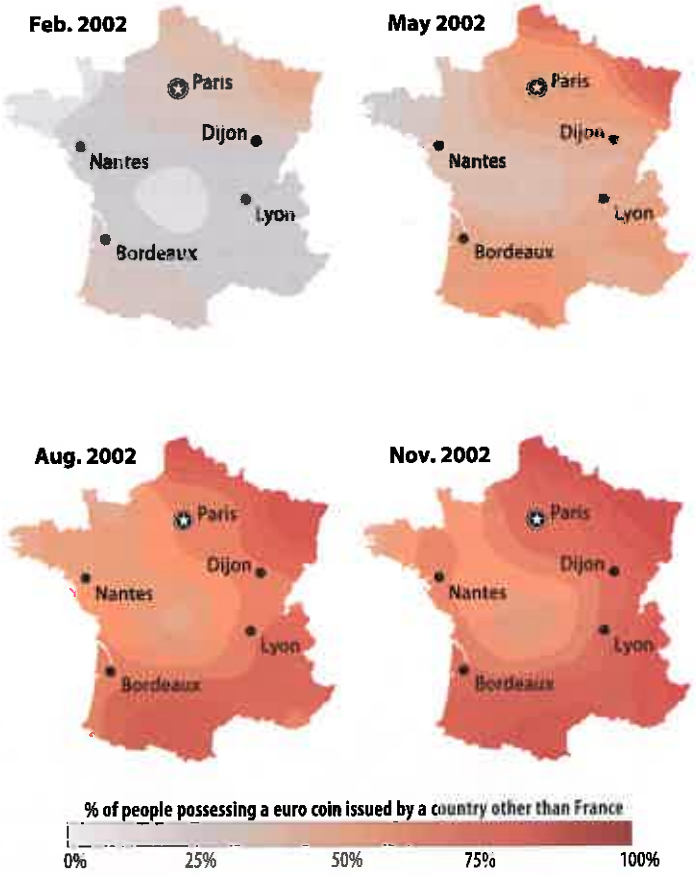
For a person, an object, or an idea to have interaction with persons, objects, or ideas in other regions, diffusion must occur. Geographers observe two basic types of diffusion—relocation diffusion and expansion diffusion.

RELOCATION DIFFUSION

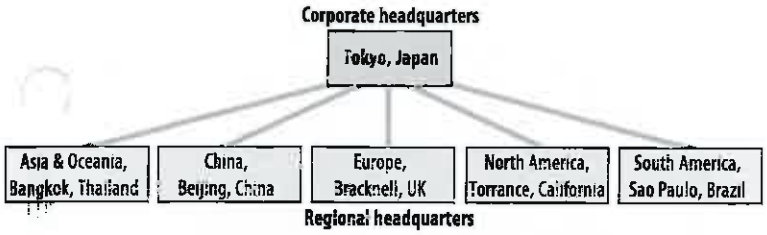
The spread of an idea through physical movement of people from one place to another is termed **relocation diffusion.** We shall see in Chapter 3 that people migrate for a variety of political, economic, and environmental reasons. When they move, they carry with them their culture, including language, 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 ethnicity 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 1-38). Although a single set of paper money was issued, each of the 12 countries minted its own coins in



▲ **FIGURE 1-38 RELOCATION DIFFUSION** Introduction of a common currency, the euro, in 12 European countries in 2002 gave scientists an unusual opportunity to measure relocation diffusion from hearths. 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.



▲ **FIGURE 1-39 HIERARCHICAL DIFFUSION** Honda's worldwide operations are controlled from headquarters in Tokyo, Japan. Officials in regional headquarters oversee operations in several regions and report to corporate headquarters.

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 into France.

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 1-39). 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 low-income African Americans rather than from socially elite people.
- **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 (Figure 1-40).
- **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, Twitter, 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.

PAUSE & 1.3.5

U.S. coins are minted in either Denver or Philadelphia. Take a look at your coins. Do you have more from the mint closer to you?

▲ **FIGURE 1-40 CONTAGIOUS DIFFUSION: WESTERN DANCE MUSIC** Popular dance music originated in the Western Hemisphere and diffused to Europe and Asia beginning in the 1980s.

Connections: Spatial Interaction

LEARNING OUTCOME 1.3.6

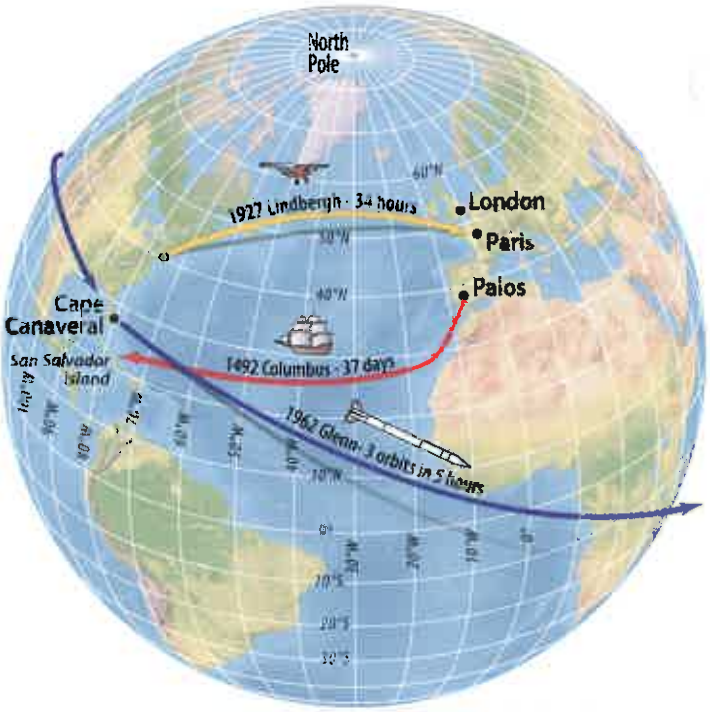
Explain how places are connected through networks, though inequality can hinder connections.

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-spoke" (Figure 1-41). With a hub-and-spoke 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.

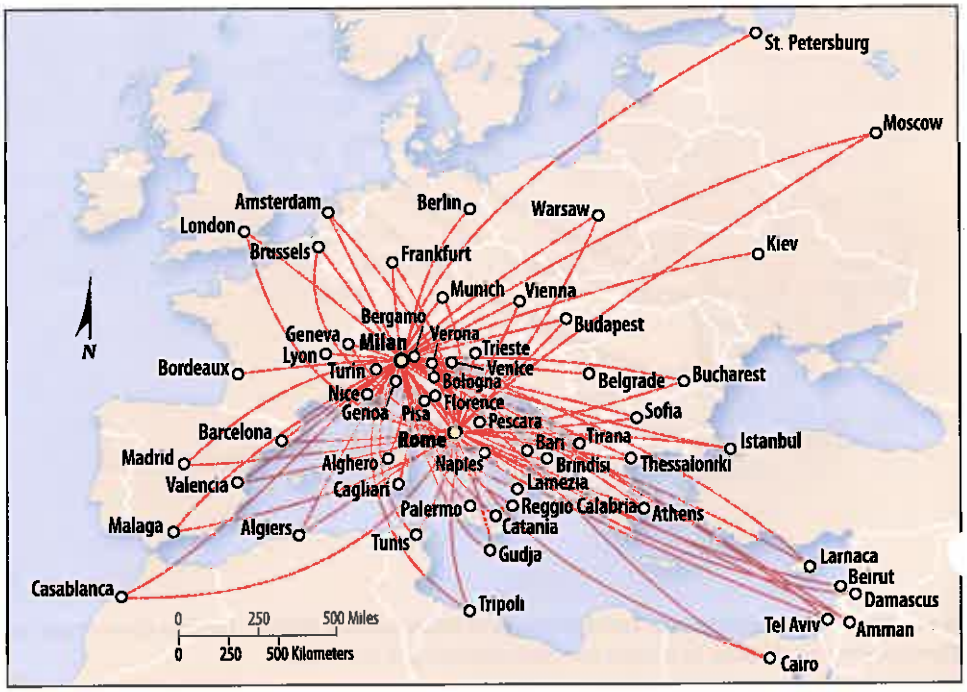
The farther away someone is from another, the less likely the two are to interact. Contact diminishes with increasing distance and eventually disappears. This trailing-off phenomenon is called **distance decay.** In the contemporary world, distance decay is much less severe because connection between 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 1-42).

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 A.D. 1800, people traveled in the same ways and at about the same speeds as in 1800 B.C.—they were carried by an animal, took a sailboat, or walked.

To be connected with another place in the modern world, we do 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 1-42 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 ½ hour and circled the globe three times in 5 hours.



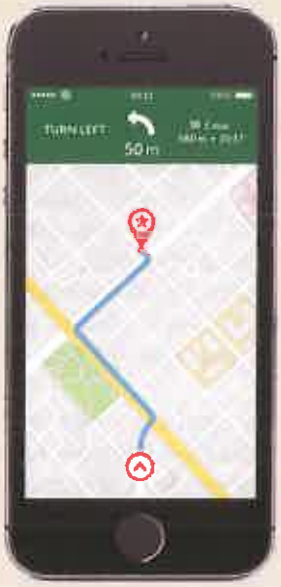
▶ **FIGURE 1-41 SPATIAL INTERACTION: AIRLINE HUB-AND-SPOKE NETWORK** With a hub-and-spoke network, Alitalia flies planes from a large number of places into hub airports at Milan and Rome within a short period of time and then a short time later sends the planes to another set of places. In principle, travelers originating in relatively small towns can reach a wide variety of destinations by changing planes at a hub airport.

DEBATE IT! 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 1-43 and 1-44)?

LEAVE IT ON

- Emergency services will be able to find you.
- You can access maps, get driving directions, and check traffic.
- You can learn when the next bus or train will arrive.
- You can find nearby restaurants, gas stations, and dog parks.



◀ FIGURE 1-43 **GPS TRACKING WITH LOCATION SERVICES ON** Your precise location is known.

TURN IT OFF

- Information that you wish to keep private is shared with others.
- Your movements, preferences, and friends will be known to others.
- Tracking information can be used in legal proceedings.
- Unwanted advertisements and messages will be sent to your device.

▲ FIGURE 1-44 **LOCATION SERVICES OFF** By default, most phones have the location service on, but it can be turned off.

Computers, tablets, and smart phones make it possible for individuals to set up their own connections through individually constructed networks such as Facebook and Twitter. At the click 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.

PAUSE & REFLECT 1.3.6

Is your nearest airport a hub? If not, to what hub do most flights go from your nearest airport?

CHECK-IN KEY ISSUE 3

Why Are Different Places Similar?

- ✔ **Geographers examine at all scales, though they are increasingly concerned with the global scale.**
- ✔ **Distribution has three properties—density, concentration, and pattern—and different cultural groups display different distributions in space.**
- ✔ **Places are connected through networks, and phenomena spread through relocation and expansion diffusion.**
- ✔ **In spite of space–time compression, peripheral regions in the global economy often have unequal access to the goods and services available in core regions.**

KEY ISSUE 4

Why Are Some Actions Not Sustainable?

- Geography, Sustainability, and Resources
- Sustainability and Earth's Physical Systems
- Geography, Sustainability, and Ecology
- Sustainable Environmental Change

LEARNING OUTCOME 1.4.1

Describe the three pillars of sustainability.

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.

Geography, Sustainability, and Resources

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. Food, 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 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.

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 examples of practices that contribute to a more sustainable future.

▲ **FIGURE 1-45 THREE PILLARS OF SUSTAINABILITY** The U.N.'s Brundtland Report considers sustainability to be a combination of environmental protection, economic development, and social equity.

THREE PILLARS OF SUSTAINABILITY

According to the United Nations, sustainability rests on three pillars: environment, society, and economy (Figure 1-45). The 1987 U.N. report *Our Common Future* is a landmark work in recognizing sustainability as a combination of natural and human elements. It 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.

THE 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 1-46a).

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

(a) (b) (c)

▲ **FIGURE 1-46 THREE PILLARS OF SUSTAINABILITY: CYPRUS** The Troodos Mountains in Cyprus illustrate the three pillars of sustainability. **(a)** The environment pillar. The area is known for its outstanding rock formations. Much of the area is protected as national forests and U.N. World Heritage sites. **(b)** The social equity pillar. Local residents watch tourists pass by. **(c)** The economy pillar: Tourism is a major economic activity. Some of the money generated by relatively wealthy tourists helps make life more comfortable for residents living in a rugged environment.

compatible with development but only if natural resources are utilized in a careful rather than wasteful manner.

THE SOCIETY 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 1-46b). Society's values are the basis for choosing which resources to use.

THE ECONOMY PILLAR. Natural resources acquire a monetary value through exchange in a marketplace (Figure 1-46c). In a market economy, supply and demand are the principal factors that determine 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.

SUSTAINABILITY'S CRITICS

Some environmentally oriented critics have argued that it is too late to discuss sustainability. The World Wildlife Fund (WWF), for example, claims that the world surpassed its sustainable level around 1980. The WWF Living Planet Report reaches its pessimistic conclusion by comparing the amount of land that humans are currently using with the amount of "biologically productive" land on Earth. "Biologically productive land" is defined as the amount of land required to produce the resources currently consumed and handle the wastes currently generated by the world's 7 billion people at current levels of technology.

The WWF calculates that humans are currently using about 13 billion hectares of Earth's land area, including 3 billion hectares for cropland, 2 billion for forest, 7 billion for energy, and 1 billion for fishing, grazing, and built-up areas. However, according to the WWF, Earth has only 11.4 billion hectares of biologically productive land, so humans are already using all of the productive land, and none is left for future growth.

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 unpredictably over time. Environmental improvements, they say, can be achieved through careful assessment of the outer limits of Earth's capacity.

Critics and defenders of sustainable development agree that one important recommendation of the U.N. report has not been implemented—increased international cooperation to reduce the gap between more developed countries and developing countries. Only if resources are distributed in a more equitable manner can we reduce the gap between poorer countries and richer ones.

PAUSE & REFLECT 1.4.1

What do you think might be the reaction of the men in Figure 1-46b to tourists such as those in Figure 1-46c?

Sustainability and Earth's Physical Systems

LEARNING OUTCOME 1.4.2

Describe 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 of 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 "air" (*atmo*), "water" (*hydro*), "stone" (*litho*), and "life" (*bio*).

ATMOSPHERE. A thin layer of gases surrounds Earth at an altitude up to 480 kilometers (300 miles). Pure dry air in the lower atmosphere contains approximately 78 percent nitrogen, 21 percent oxygen, 0.9 percent argon, 0.036 percent carbon dioxide, and 0.064 percent 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.

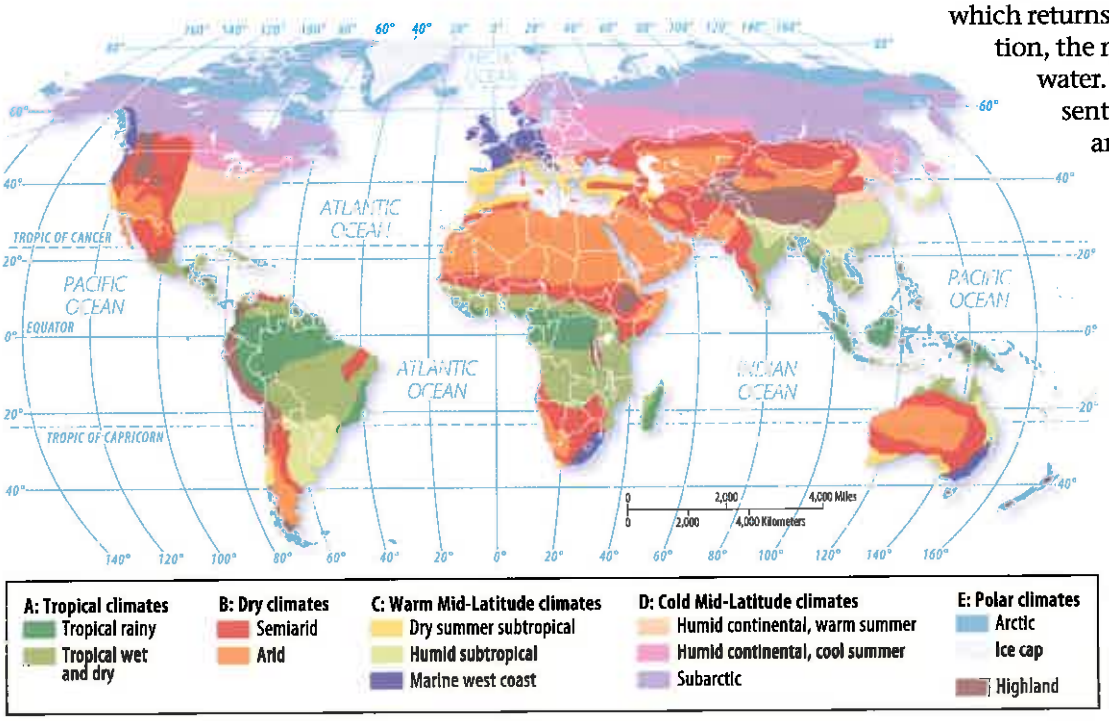
The long-term average weather condition at a particular location is **climate.** Geographers frequently classify climates according to a system developed by German climatologist Vladimir Köppen. The modified Köppen system divides the world into five main climate regions that are identified by the letters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

- A: Humid low-latitude 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 1-47). 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 in Figure 2-4. Relatively few people live in the Dry (B) and Polar (E) climate regions, or in the Highlands.

HYDROSPHERE. Water exists in liquid form in 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 fresh water. 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.



◀ FIGURE 1-47 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.

▲ **FIGURE 1-48 MONSOON IN INDIA** People wade through flood water in Dimapur, India, after heavy monsoon rain.

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 (Burma) coast, anxiously await the annual monsoon rain, which is essential for successful agriculture and provides nearly 90 percent of India's water supply (Figure 1-48). 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 rain lasts until September. In years when the monsoon 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 monsoon rain is so important in India that the words for "year," "rain," and "rainy season" are identical in many local languages.

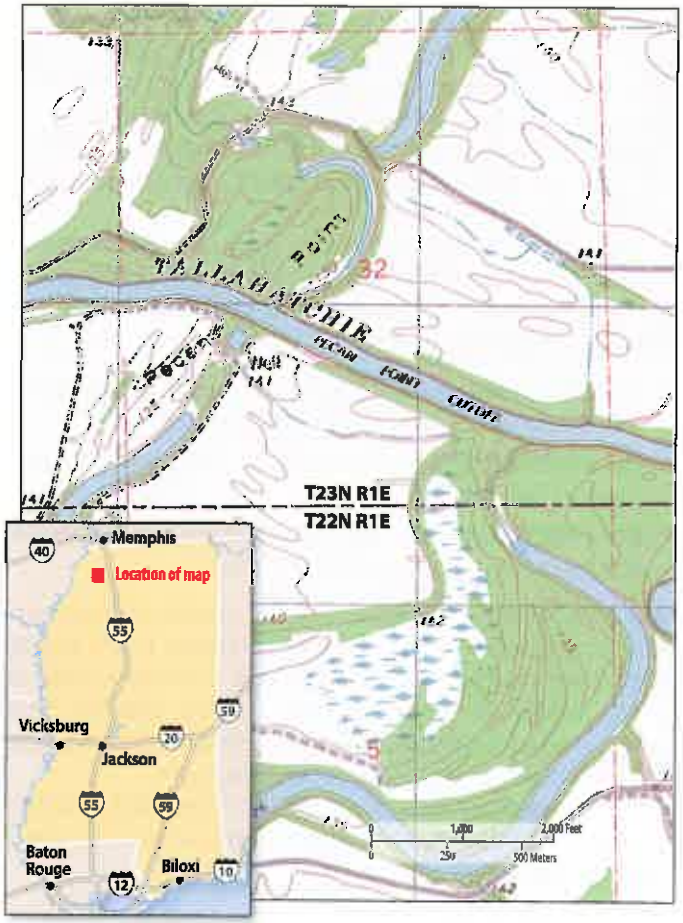
LITHOSPHERE. Earth is composed of concentric spheres. The core is a dense, metallic sphere about 3,500 kilometers (2,200 miles) in radius. Surrounding the core is a mantle about 2,900 kilometers (1,800 miles) thick. The crust is a thin, brittle outer shell 8 to 40 kilometers (5 to 25 miles) thick. The lithosphere encompasses the crust, a portion of the mantle extending down to about 70 kilometers (45 miles). 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 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 1-49). 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.

PAUSE & REFLECT 1.4.2

Why would maps of Earth's hydrosphere, lithosphere, and biosphere be important in the quest for sustainability?



▲ **FIGURE 1-49 TOPOGRAPHIC MAP** A portion of a topographic map published by the U.S. Geological Survey shows physical features in northwestern Mississippi. The brown lines are contour lines that show the elevation of any location. The portion of the topo map shown here is part of sections 29 and 32 of township T23N R1E and section 5 of township T22N R1E.

Geography, Sustainability, and 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 AND 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 1-50). 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:

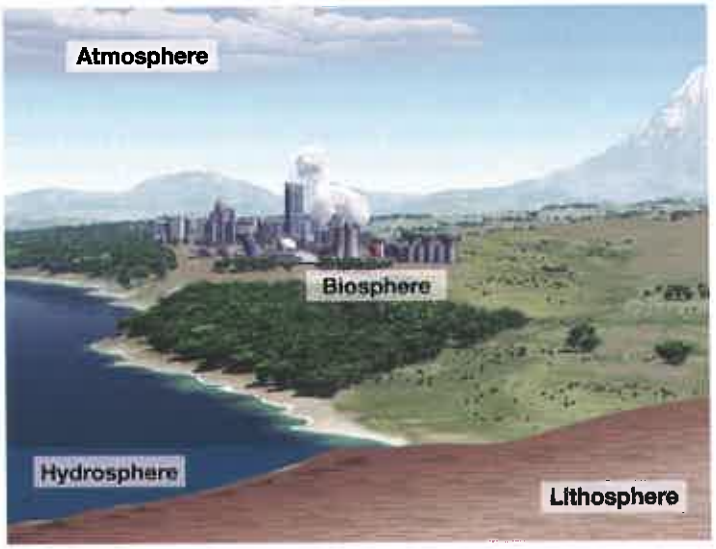
- If the atmosphere contains pollutants, or its oxygen level is reduced, humans have trouble breathing.
- Without water in the hydrosphere, humans waste away and die.
- A stable lithosphere provides humans with materials for buildings and fuel for energy.
- The rest of the biosphere provides humans with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

Human actions are sustainable if they preserve and conserve elements of the four spheres and unsustainable if the 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 soil washes away in the rain or blows away in the wind. Farmers contribute to erosion by making 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 that are 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.

CULTURAL ECOLOGY: INTEGRATING CULTURE AND ECOLOGY

Human geographers are especially interested in the fact that different cultural groups modify the four spheres in distinctive ways. 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.



▲ **FIGURE 1-50 ECOSYSTEMS** Geographers are especially interested in the ecosystem of a city because approximately 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.

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. Natural scientists have made more progress in formulating general laws than have social scientists, so an important goal of human geographers is to discover general laws. Humboldt and Ritter urged human geographers to adopt the methods of scientific inquiry used by natural scientists.

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.

For example, 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—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, under 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 (Figure 1-51)? 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.

POSSIBILISM AND SUSTAINABILITY. Human geographers use the cultural ecology, or human–environment, approach to understand whether particular patterns and processes are sustainable. For example, world population growth is a problem if the number of people exceeds the capacity of the physical environment to produce food. However, people can adjust to the capacity of the physical environment by controlling their numbers, adopting new technology, consuming different foods, migrating to new locations, and taking other actions.

The physical environment is not always the most significant factor in human decisions. People can fashion a landscape by superimposing new forms on the physical environment. For example, the critical factor in selecting a site for a cotton textile factory is not proximity to a place where cotton is grown. A more important factor in selecting a suitable location is access to a supply of low-cost labor. Economic systems, political structures, living arrangements, religious practices, and human activities can produce distinctive landscapes that do not stem primarily from distinctive physical features. The geographer's job is to sort out the associations among various social characteristics, each of which is uniquely distributed across Earth's surface.

(a) (b)

▲ **FIGURE 1-51 POSSIBILISM: ALTERNATIVE BEHAVIORS** (a) Some humans prefer to mow their lawn. (b) Others prefer to let wildflowers grow.

PAUSE & REFLECT 1.4.3

How might a bird interact with each of the four spheres?

Sustainable Environmental Change

LEARNING OUTCOME 1.4.4

Compare ecosystems in the Netherlands and California.

The Netherlands and California are 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 California not enough. At this time, the ecological modifications in the Netherlands appear sustainable, whereas those in California 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 1-52).

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 (Figure 1-53). 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.

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, an arm 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 salt-water sea to a fresh-water 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 nearly 2,000 people, the Delta Plan called for the construction of several dams to close off most of the waterways.

▲ **FIGURE 1-53 SUSTAINABLE ECOSYSTEM: THE NETHERLANDS** The Dutch have considerably altered the site of the Netherlands through creation of polders and dikes.

Once these two massive projects were finished, attitudes toward modifying the environment changed in the Netherlands. The Dutch scrapped plans to build additional polders in the IJsselmeer in order to preserve the lake's value for recreation. 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. Widespread use of insecticides and fertilizers on Dutch farms has contributed to contaminated drinking water, acid rain, and other environmental problems.

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

▶ **FIGURE 1-52 DUTCH POLDER** Kalverpolder in northern Holland has been created by pumping the water from the site into the canal, originally by means of the windmills.

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.

UNSUSTAINABLE ECOSYSTEM: CALIFORNIA

California and neighboring states in the U.S. Southwest have grown rapidly and prospered despite limited supplies of water. An extended drought in recent years has called into question the region's ability to sustain its residents' current lifestyles.

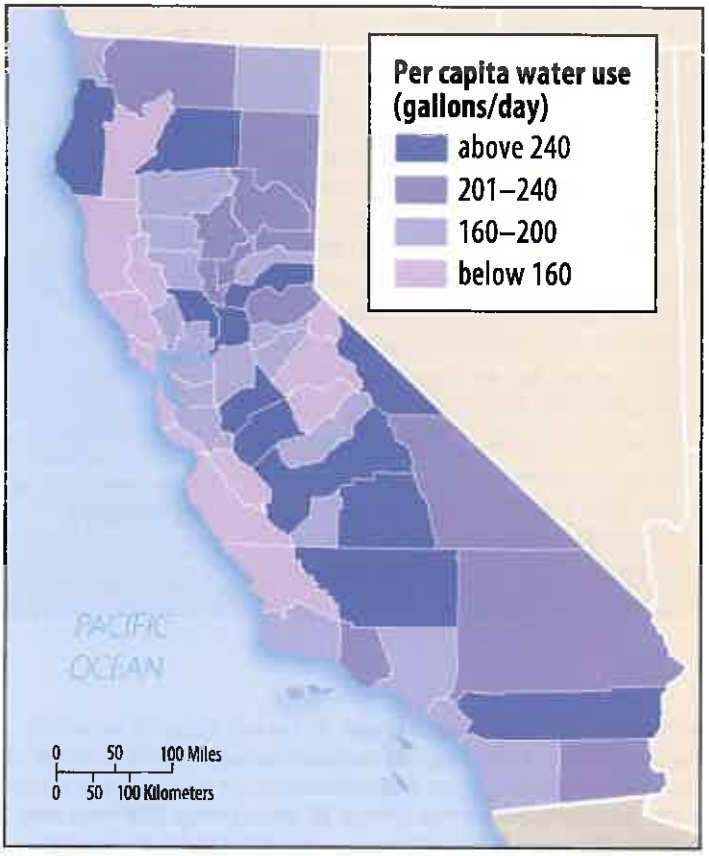
In normal times, California gets around 70 percent of its water from surface water sources, such as melting snow from mountains. Aqueducts and pipes carry water from the Colorado River to cities and farmland hundreds of kilometers away. A 1922 agreement determines how much of the Colorado River is allocated to California, Arizona, and Nevada. The other 30 percent of California's water comes from groundwater sources, which are underground. In recent years, the level of precipitation has been extremely low, so less water has been available from surface sources. As a result, groundwater consumption has been supplying more than 60 percent of California's water demand. Groundwater is being removed more rapidly than it is being replenished.

California's residents and businesses have been required to reduce water usage by 25 percent. Each of the state's 400 local water supply agencies has determined how to meet the reduction in its service area. Half of the residential demand for water is for lawns and gardens. Homeowners and municipalities are replacing grass lawns and annual flowers with native landscapes with rocks and desert plants.

However, residents and businesses use only 20 percent of California's water. The other 80 percent goes to agriculture. The biggest challenge posed to the sustainability of California's ecosystems by the drought is for agriculture. Much of the land used for agriculture in California does not get enough rainfall even in normal times to grow crops. The counties with the highest per capita use of water are the major agricultural counties (Figure 1-54); the fields are irrigated with water brought in from elsewhere (Figure 1-55).

PAUSE & REFLECT 1.4.4

Which is better positioned to face future threats to sustainability, the Netherlands or California? Why?



▲ **FIGURE 1-54 CALIFORNIA PER CAPITA WATER USE BY COUNTY** The lowest per capita water use is in the major cities along the Pacific Coast. The highest demand is in the agricultural counties of the Central Valley.

◀ **FIGURE 1-55 UNSUSTAINBLE ECOSYSTEM: CALIFORNIA** Onion field in the Central Valley.

SUSTAINABILITY & OUR ENVIRONMENT The Everglades

The Everglades was once a very wide and shallow fresh-water river 80 kilometers (50 miles) wide and 15 centimeters (6 inches) deep, slowly flowing south from Lake Okeechobee to the Gulf of Mexico (Figure 1-56). A sensitive ecosystem of plants and animals once thrived in this distinctive landscape, and a portion became a national park, but much of it has been destroyed by human actions.

The U.S. Army Corps of Engineers built a levee around Lake Okeechobee during the 1930s, drained the northern one-third of the Everglades during the 1940s, diverted the Kissimmee River into canals during the 1950s, and constructed dikes and levees near Miami and Fort Lauderdale during the 1960s (Figure 1-57). These modifications opened up hundreds of thousands of hectares of land for growing sugarcane and protected farmland as well as the land occupied by the growing South Florida population from flooding.

▲ **FIGURE 1-56 SOUTH FLORIDA ECOSYSTEM**

But the modification also had unintended consequences for South Florida's ecosystem. Polluted water, mainly from cattle grazing along the banks of the canals, flowed into Lake Okeechobee, which is the source of fresh water for half of Florida's population. Fish in the lake began to die from the high levels of mercury, phosphorous, and other contaminants. The polluted water then continued to flow south into the national park, threatening native vegetation such as sawgrass and endangering rare birds and other animals. Recent plans are attempting to restore a healthy ecosystem to inland South Florida.

▼ **FIGURE 1-57 KISSIMMEE RIVER** To control flooding in central Florida, the U.S. Army Corps of Engineers straightened the course of the Kissimmee River, which had meandered for 160 kilometers. The water was rechanneled into a canal 90 meters wide (300 feet) and 9 meters deep (30 feet), running in a straight line for 84 kilometers (52 miles).

California accounts for 12 percent of all U.S. agriculture, 21 percent of all milk supplies, and 99 percent of such crops as almonds, artichokes, grapes, olives, peaches, rice, and walnuts. The system of industrial agriculture centered on California provides an abundant supply of low-priced food to the United States and other countries. As discussed in Chapter 10, the U.S. industrial agriculture system depends on large quantities of chemicals and energy, as well as water; these practices may not be sustainable in the future.

CHECK-IN KEY ISSUE 4

Why Are Some Actions Not Sustainable?

- ✔ **Sustainability combines environment, economy, and society.**
- ✔ **Earth's resources encompass three abiotic systems and one biotic system.**
- ✔ **Ecology is the study of living organisms and the abiotic spheres with which they interact.**
- ✔ **Ecosystems that may or may not be sustainable.**

Summary & Review

KEY ISSUE 1

Why is geography a science?

Geography is most fundamentally a spatial science. Geographers use maps to display the location of objects and to extract information about places. Early geographers drew maps of Earth's surface based on exploration and observation. Contemporary GIScience, including remote sensing, GPS, VGI, geotagging, and GIS, assist geographers in understanding reasons for observed regularities across Earth.

THINKING GEOGRAPHICALLY

▲ **FIGURE 1-58 CZECH TELEPHONE**

1. Using geographic tools such as maps and GIS is not simply a mechanical exercise. Nor are decisions confined to scale, projection, and layers. For example, should the European country be labeled Czech Republic or Czechia? Czech authorities and citizens do not agree on the proper translation of the country's Czech name Česky into English. **2.** What criteria should geographers use to label maps?

KEY ISSUE 2

Why is each point on earth unique?

Geographers identify unique places and regions distinguished by distinctive combinations of cultural as well as economic and environmental features. Location is the position something occupies on Earth. A region is an area characterized by a unique combination of features. The distribution of features helps explain why every place and every region is unique.

THINKING GEOGRAPHICALLY

3. What are elements of the site and situation of your hometown? **4.** Can you name another place to which your hometown has strong connections? **5.** What is an example of a feature that connects your town to another?

◀ **FIGURE 1-59 SITE AND SITUATION OF BOSTON** The site is Boston Harbor and several rivers. Logan Airport is an example of the connections found in Boston to other places.

KEY ISSUE 3

Why are different places similar?

Geographers work at all scales, from local to global. The global scale is increasingly important because few places in the contemporary world are totally isolated. Because places are connected to each other, they display similarities. Geographers study the interactions of groups of people and human activities across space, and they identify processes by which people and ideas diffuse from one location to another over time.

THINKING GEOGRAPHICALLY

▲ **FIGURE 1-60 HARRY POTTER'S TRANSPORTATION**

6. If you could live anyplace on Earth, where would it be? Why? **7.** How might your choice be altered if you had access to a transportation device (such as available to Harry Potter) that enabled you to travel instantaneously to any place on Earth?

KEY ISSUE 4

Why are some actions not sustainable?

Sustainability is the use of Earth's resources in ways that ensure their availability in the future. Sustainability is based on three interrelated pillars: environmental, economic, and social action. An ecosystem comprises a group of living organisms in the biosphere and their interaction with the atmosphere, lithosphere, and biosphere. The sustainability of some of Earth's resources is being damaged by human actions.

THINKING GEOGRAPHICALLY

▲ **FIGURE 1-61 SUSTAINABLE TRANSPORTATION: BIKING AT THE UNIVERSITY**

8. What activities in your community appear to promote sustainability? Which ones do not?

KEY TERMS

Abiotic *(p. 34)* Composed of nonliving or inorganic matter.
Acculturation *(p. 28)* The process of changes in culture that result from the meeting of two groups, each of which retains distinct culture features.
Assimilation *(p. 28)* The process by which a group's cultural features are altered to resemble those of another more dominant group.
Atmosphere *(p. 34)* The thin layer of gases surrounding Earth.
Behavioral geography *(p. 26)* The study of the psychological basis for individual human actions in space.
Biosphere *(p. 34)* All living organisms on Earth, including plants and animals, as well as microorganisms.
Biotic *(p. 34)* Composed of living organisms.
Cartography *(p. 6)* The science of making maps.
Citizen Science *(p. 9)* Scientific research by amateur scientists.
Climate *(p. 34)* The long-term average weather condition at aparticular location.
Concentration *(p. 22)* The spread of something over a given area.
Connection *(p. 5)* The relationships among people and objects across the barrier of space.
Conservation *(p. 32)* The sustainable management of a natural resource.
Contagious diffusion *(p. 29)* The rapid, widespread diffusion of a feature or trend throughout a population.
Cultural ecology *(p. 36)* 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, social forms, and material traits that together constitute a group's distinct tradition.
Density *(p. 22)* The frequency with which something exists within a given unit of area.
Diffusion *(p. 28)* The process of spread of a feature or trend from one place to another over time.
Distance decay *(p. 30)* 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.
Ecology *(p. 36)* The scientific study of ecosystems.
Ecosystem *(p. 36)* A group of living organisms and the abiotic spheres with which they interact.
Environmental determinism *(p. 37)* 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. 29)* 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 everyone shares in common one or more distinctive characteristics.
Functional region (or nodal region) *(p. 16)* An area organized around a node or focal point.
Geographic information science (GIScience) *(p. 9)* The development and analysis of data about Earth acquired through satellite and other electronic information technologies.
Geographic information system (GIS) *(p. 9)* A computer system that stores, organizes, analyzes, and displays geographic data.
Geotagging *(p. 9)* 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.
Greenwich Mean Time (GMT) *(p. 12)* The time in the zone encompassing the prime meridian, or 0° longitude.
Hearth *(p. 28)* The region from which innovative ideas originate.
Hierarchical diffusion *(p. 29)* 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. 26)* The study of different ways that individuals form ideas about place and give those places symbolic meanings.
Hydrosphere *(p. 34)* All of the water on and near Earth's surface.
International Date Line *(p. 13)* An arc that for the most part follows 180° longitude, although it deviates in several places to avoid dividing land areas. 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.
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. 34)* 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

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How GPS Works

The spaced-based Global Positioning Systems (GPS) can almost instantaneously determine geographic location and time information.

1. Describe the infrastructure that supports GPS devices.
2. According to the video, how accurate is the current GPS system? What are the limits of GPS technology?
3. Based on what you learned in the video, why do you think the U.S. Navy has decided to reinstate celestial navigation? Explain.

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.

Mental map *(p. 8)* 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. 30)* A chain of communication that connects places.

Nonrenewable resource *(p. 32)* Something 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. 23)* The geometric or regular arrangement of something in a particular area.

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

Polder *(p. 38)* Land that the Dutch have created by draining water from an area.

Possibilism *(p. 37)* 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. 26)* The study of space as the product of ideologies or value systems of ruling elites.

Preservation *(p. 32)* 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. 4)* An area distinguished by a unique combination of trends or features.

Relocation diffusion *(p. 28)* The spread of a feature or trend through bodily movement of people from one place to another.

Remote sensing *(p. 9)* The acquisition of data about Earth's surface from a satellite orbiting the planet or from other long-distance methods.

Renewable resource *(p. 32)* Something produced in nature more rapidly than it is consumed by humans.

Resource *(p. 32)* 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. 4)* Generally, the relationship between the portion of Earth being studied and Earth as a whole.

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

Situation *(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. 30)* 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. 18)* The relationship between the distribution of one feature and the distribution of another feature.

Stimulus diffusion *(p. 29)* The spread of an underlying principle even though a specific characteristic is rejected.

Sustainability *(p. 32)* The use of Earth's renewable and nonrenewable natural resources in ways that do not constrain resource use in the future.

Syncretism *(p. 28)* 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. 20)* 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. 27)* 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.

EXPLORE

The Netherlands Coast

Use Google Earth to explore the Netherlands coast.

Fly to *Ouddorp, Netherlands*.

1. Using the ruler, what is the distance (in kilometers or miles) from the pin marking Ouddorp to the coast?
2. How many dams do you see in the image?
3. Drag to enter street view on the dam to the north of the image. What occupies the top of the dam?
4. Which side of the dam is the open sea, and which side is the protected inland waterway? Which side of the dam contains the marinas filled with boats? Why would the boats be on that side?
5. What is the elevation of Ouddorp? What is the elevation of Visschershoek to the west of Ouddorp right on the coast? What is the elevation of Melissant to the east of Ouddorp further inland? Based on these observations, is the elevation further inland higher or lower than on the coast? Why is that the case?

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