CHAPTER 1

# INTRODUCTION:
## Some Background Basics

*The imprint of human activity created by this windfarm dominates this California landscape.*



## AP Learning Objectives

- Identify types of maps, the types of information presented in maps, and different kinds of spatial patterns and relationships portrayed in maps.
- Identify different methods of geographic data collection.
- Explain the geographical effects of decisions made using geographical information.
- Define major geographic concepts that illustrate spatial relationships.
- Explain how major geographic concepts illustrate spatial relationships.
- Define scales of analysis used by geographers.
- Explain what scales of analysis reveal.
- Describe different ways that geographers define regions.

# 1.1 Getting Started

The fundamental question asked by geographers is, "What difference does it make where things are located?" For example, it matters a great deal that languages of a certain kind are spoken in certain places. But knowledge of the location of a specific language group is not of itself particularly significant. Geographic study of a language requires that we try to answer questions about why and how the language shows different characteristics in different locations and how the present distribution of its speakers came about. In the course of our study, we would logically discuss such concepts as migration, acculturation, the diffusion of innovation, the effect of physical barriers on communication, and the relationship of language to other aspects of culture. As geographers, we are interested in how things are interrelated in different regions and give evidence of the existence of "spatial systems."

## What Is Geography?

Many people associate the word *geography* simply with describing *where* things are and the characteristics of things at particular locations; where are countries such as Myanmar and Uruguay, what are the populations of cities such as Timbuktu or Almaty, or where are large deposits of **natural resources** such as petroleum or iron ore? Some people pride themselves on knowing which are the longest rivers, the tallest mountains, and the largest deserts. Such factual knowledge about the world has value, permitting us to place current events in their proper spatial setting. When we hear of an earthquake in Turkey or an assault in Timor-Leste, we at least can visualize where they occurred. Knowing *why* they occurred in those places, however, is considerably more important.

Geography is much more than place names and locations. It is the study of spatial variation, of how and why things differ from place to place on the surface of the Earth. It is, further, the study of how observable spatial patterns evolved through time. Just as knowing the names and locations of organs in the human body does not equip one to perform open-heart surgery, and just as memorizing the periodic table does not enable one to formulate new medications, so knowing where things are located geographically is only the first step toward understanding why things are where they are, and what events and processes determine or change their distribution. Why is Chechnya but not Tasmania wracked by insurgency, and why do you find a concentration of French speakers in Quebec but not in other parts of Canada? Why are famines so frequent and severe in East Africa and why, among all the continents, has African food production and distribution failed to keep pace with population growth over the past half century?

In answering questions such as these, geographers focus on the interaction of people and social groups with their environment—planet Earth—and with one another; they seek to understand how and why physical and cultural spatial patterns evolved through time and continue to change. Because geographers study both the physical environment and the human use of that environment, they are sensitive to the variety of forces affecting a place and to the interactions among them. To explain why Brazilians burn a significant portion of the tropical rain forest each year, for example, geographers draw on their knowledge of the climate and soils of the Amazon Basin; population pressures, landlessness, and the need for more agricultural area in rural Brazil; the country's foreign debt status; midlatitude markets for lumber, beef, and soy beans; and economic development objectives. Understanding the environmental consequences of the burning requires knowledge of, among other things, the oxygen and carbon balance of the Earth; the contribution of the fires to the greenhouse effect, acid rain, and depletion of the ozone layer; and the relationship among deforestation, soil erosion, and floods. Thus, one might say that geography is the "study of the Earth as the home of humanity."

Geography, therefore, is about geographic space and its content. We think of and respond to places from the standpoint not only of where they are but, rather more importantly, of what they contain or what we think they contain. Reference to a place or an area usually calls up images about its physical nature or what people do there and often suggests, without conscious thought, how those physical objects and human activities are related."Colorado," "mountains," and "skiing" might be a simple example. The content of area, that is, has both physical and cultural aspects, and geography is always concerned with understanding both (**Figure 1.1**).

Although space is central to geography, time is important, too. How do places change over time, how do structures and processes change location over time, and how do patterns of interaction change over time? Buffalo, New York, was one of the ten largest cities in the United States around 1900. Its location at the western terminus of the Erie Canal, and then along rail lines for transporting the manufacturing and agricultural products of the Midwest, attracted job seekers and investors. Now it is around the 80th largest city in the United States and continuing to shrink in population (in both absolute terms and relative to fast-growing cities such as Houston and Phoenix). Manufacturing in the United States decreased dramatically at the end of the 20th century, and agricultural products have found other routes to move. In other words, geography is about both static and dynamic aspects of space and place.

## Evolution of the Discipline

The fundamental inspiration for geographical thought probably originated with the recognition of *areal differentiation*—that one place is different than another. Climate varies, plants vary, people vary. This insight surely occurred in prehistoric times. Early developments in the study of geography took place in ancient Egypt, China, Mesopotamia, the Arab world, Greece, and Rome. This early work was motivated by practical problems in astronomy, land surveying and agriculture, trade, and military activity. From the beginning, geographic thought was characterized by three scholarly traditions: a literary tradition, including travel logs written about foreign places; a cartographic tradition, in which places were mapped; and a mathematical tradition, which involved measuring and calculating spatial and nonspatial information about places. Although their relative importance to

**Figure 1.1** The ski development at Whistler Mountain, British Columbia, Canada, site of 2010 Winter Olympic events, clearly shows the interaction of physical environment and human activity. Climate and terrain have made specialized human use attractive and possible. Human exploitation has placed a cultural landscape on the natural environment, thereby altering it.



geographic scholarship has varied over time, all three traditions are still active parts of the study of geography.

Geography, the "mother of sciences," initiated in antiquity lines of inquiry that led to the development of separate disciplines such as anthropology, demography, geology, ecology, and economics. Geography's combination of interests was apparent even in the work of the early Greek geographers who first gave structure to the discipline. Geography's name was coined by the Greek scientist Eratosthenes more than 2,200 years ago from the words *geo,* "the Earth," and *graphein,* "to write." From the beginning, that writing focused both on the physical structure of the Earth and on the nature and activities of the people who inhabited the different lands of the known world. To Strabo (*ca.* 64 BCE–CE 20), the task of geography was to, "describe the several parts of the inhabited world . . . to write the assessment of the countries of the world [and] to treat the differences between countries." Even earlier, Herodotus (*ca.* 484–425 BCE) had found it necessary to devote much of his book to the lands, peoples, economies, and customs of the various parts of the Persian Empire as necessary background to an understanding of the causes and course of the Persian wars.

Greek (and, later, Roman) geographers measured the Earth, devised the global grid of parallels and meridians (marking latitudes and longitudes—see Section 1.4), and drew upon that grid surprisingly sophisticated maps of their known world (**Figure 1.2**). They explored the apparent latitudinal variations in climate and described in numerous works the familiar Mediterranean basin and the more remote, partly rumored lands of northern Europe, Asia, and equatorial Africa. Employing nearly modern concepts, they described river systems, explored causes of erosion and patterns of deposition, cited the dangers of deforestation, described areal variations in the natural landscape, and noted the consequences of environmental abuse. Against that physical backdrop, they focused their attention on what humans did in home and distant areas—how they lived; what their distinctive similarities and differences were in language, religion, and custom; and how they used, altered, and perhaps destroyed the lands they inhabited. Strabo, indeed, cautioned against the assumption that the nature and actions of humans were determined solely by the physical environment they inhabited. He observed that humans were active elements in a human–environmental partnership.

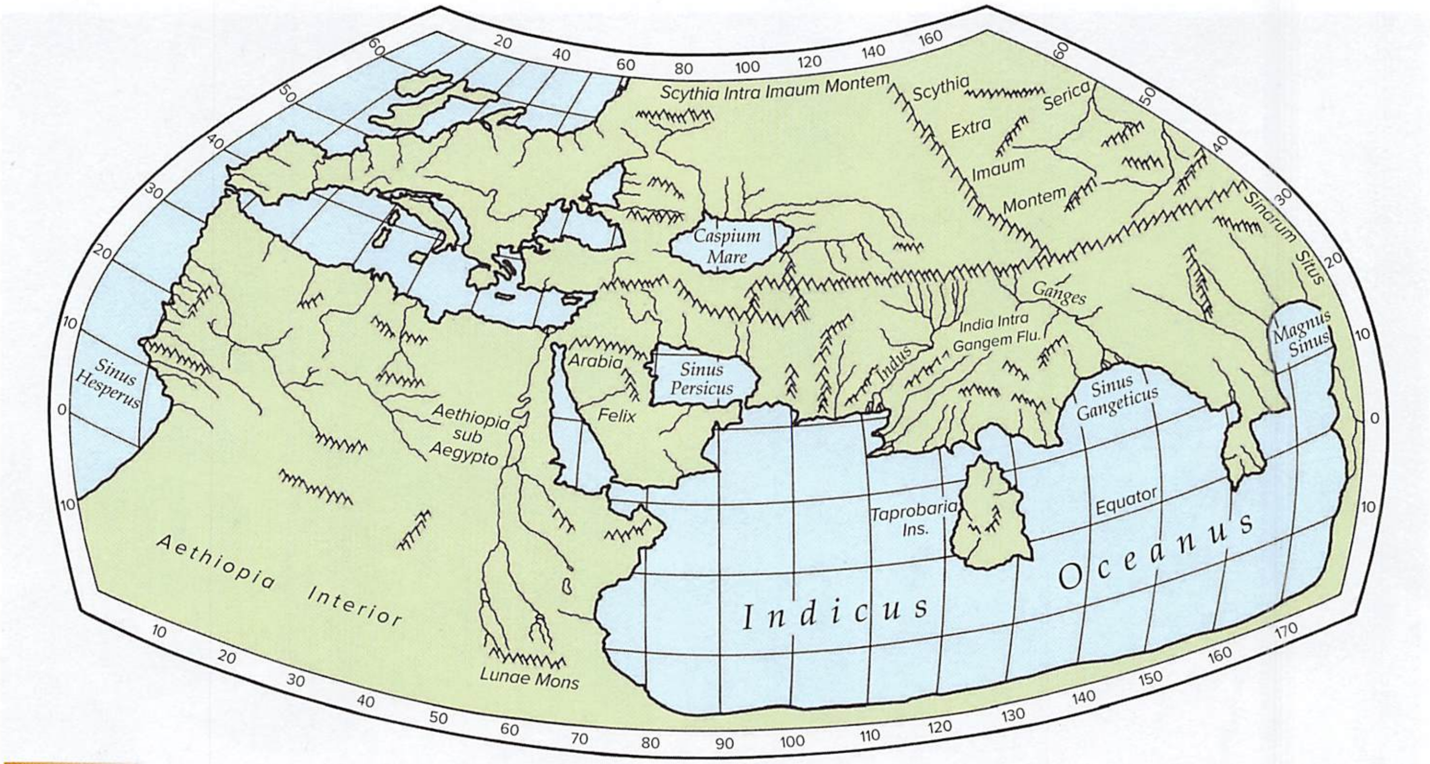



**Figure 1.2** World map of the 2nd-century CE by Greco–Egyptian geographer–astronomer Ptolemy. Ptolemy (Claudius Ptolemaeus) adopted a previously developed map grid of latitude and longitude based on the division of the circle into 360°, permitting a precise mathematical location for every recorded place. Unfortunately, errors of assumption and measurement rendered both the map and its accompanying six-volume gazetteer inaccurate. Ptolemy's map, accepted in Europe as authoritative for nearly 1,500 years, was published in many variants in the 15th and 16th centuries. The version shown here summarizes the extent and content of the original. Its underestimation of the Earth's size convinced Columbus that a short westward voyage would carry him to Asia.

These are enduring and universal interests. The ancient Chinese, for example, were as involved in geography as an explanatory viewpoint as were Westerners, though there was no exchange between them. Further, as Christian Europe entered its Middle Ages between CE 500 and 1400 and lost its knowledge of Greek and Roman geographical work, Muslim scholars—who retained that knowledge—undertook to describe and analyze their known world in its physical, cultural, and regional variation (see the feature "Roger's Book").

Modern geography had its origins in the surge of scholarly inquiry that, beginning in the 17th century, gave rise to many of the traditional academic disciplines we know today. In its European rebirth, geography from the outset was recognized—as it always had been—as a broadly based integrative study. Patterns and processes of the physical landscape were early interests, as was concern with humans as part of the Earth's variation from place to place. The rapid development of geology, botany, zoology, and other natural sciences by the end of the 18th century strengthened regional geographic investigation and increased scholarly and popular awareness of the intricate interconnections of items in space and between places. By that same time, accurate determination of latitude and longitude and scientific mapping of the Earth made assignment of place information more reliable and comprehensive.

During the 19th century, national censuses, trade statistics, and ethnographic studies gave firmer foundation to human geographic investigation. By the end of the 19th century, geography had become a distinctive and respected discipline in universities throughout Europe and in other regions of the world where European academic examples were followed. The proliferation of professional geographers and geography programs resulted in the development of a whole series of increasingly specialized disciplinary subdivisions.

## Geography and Human Geography

Geography's specialized subfields are not entirely distinct but are interrelated. Geography in all its subdivisions is characterized by three dominating interests. The first is in the areal variation of physical and human phenomena on the surface of the Earth. Geography examines relationships between human societies and the natural environments that they occupy and modify. The second is a focus on the spatial systems[1] that link physical phenomena and human activities in one area of the Earth with other areas. Together, these interests lead to a third enduring theme, that of regional analysis: geography studies human-environment—*ecological*—relationships and spatial systems in specific locational settings. This areal orientation pursued by some geographers is called **regional geography.** Similar to many of the articles in *National Geographic Magazine*, regional geography typically focuses on a comprehensive understanding of physical and human characteristics of particular regions. For some, the regions of interest may be large: Southeast Asia or Latin America, for

[1]A *system* is simply a group of elements organized in a way that every element is to some degree directly or indirectly interdependent with every other element. For geographers, the systems of interest are those that distinguish or characterize different regions or areas of the Earth.

## Roger's Book

The Arab geographer Idrisi, or Edrisi (*ca.* CE 1099–1154), a descendant of the Prophet Mohammed, was directed by Roger II, the Christian king of Sicily in whose court he served, to collect all known geographical information and assemble it in a truly accurate representation of the world. An academy of geographers and other scholars was gathered to assist Idrisi in the project. Books and maps of classical and Islamic origins were consulted, mariners and travelers interviewed, and scientific expeditions dispatched to foreign lands to observe and record. Data collection took 15 years before the final world map was fabricated on a silver disc some 200 centimeters (80 inches) in diameter and weighing more than 135 kilograms (300 pounds). Lost to looters in 1160, the map is survived by "Roger's Book," containing the information amassed by Idrisi's academy and including a world map, 71 part maps, and 70 sectional itinerary maps.

Idrisi's "inhabited earth" is divided into the seven "climates" of Greek geographers, beginning at the equator and stretching northward to the limit at which, it was supposed, the Earth was too cold to be inhabited. Each climate was then subdivided by perpendicular lines into 11 equal parts beginning with the west coast of Africa and ending with the east coast of Asia. Each of the resulting 77 square compartments was then discussed in sequence in "Roger's Book."

Though Idrisi worked in one of the most prestigious courts of Europe, there is little evidence that his work had any impact on European geographic thought. He was strongly influenced by Ptolemy's work and misconceptions and shared the then common Muslim fear of the unknown western ocean. Yet Idrisi's clear understanding of such scientific truths as the roundness of the Earth, his grasp of the scholarly writings of his Greek and Muslim predecessors, and the faithful recording of information on little-known portions of Europe, the Near East, and North Africa set his work far above the mediocre standards of contemporary Christian geography.

example; others may focus on smaller areas differently defined, such as Alpine France or the Corn Belt in the United States.

Other geographers choose to identify particular classes of things, rather than segments of the Earth's surface, for specialized study. These **systematic geographers** may focus their attention on one or a few related aspects of the physical environment or of human populations and societies. In each case, the topic selected for study is examined in its interrelationships with other spatial systems and areal patterns. **Physical geographers** practice systematic geography by directing their attention to the natural environmental side of the human-environment structure. Their concerns are with landforms and their distribution, with atmospheric conditions and climatic patterns, with soils or vegetation associations, and the like. The other systematic branch of geography—and the subject of this book—is **human geography.**

## Human Geography

Human geography deals with the world as it is and with the world as it might be made to be. Its emphasis is on people: where they are, what they are like, how they interact over space, and what kinds of landscapes of human use they erect on the natural landscapes they occupy. It encompasses all those interests and topics of geography that are not directly concerned with the physical environment or, like cartography, are concerned with geographic techniques that apply to all domains of geography. Its content provides integration for all of the social sciences, for it gives to those sciences the necessary spatial and systems viewpoint that they might otherwise lack. For example, economists are often concerned with trends and patterns over time but do not fully appreciate that many of their interests concern patterns over space, too. Similarly, psychologists have long been interested in mind and behavior but have often failed to recognize the spatial context of this mind and behavior. At the same time, human geography draws on other social sciences in the analyses identified with its subfields, such as *behavioral, political, economic,* and *social geography* (**Figure 1.3**). As Figure 1.3 suggests, human

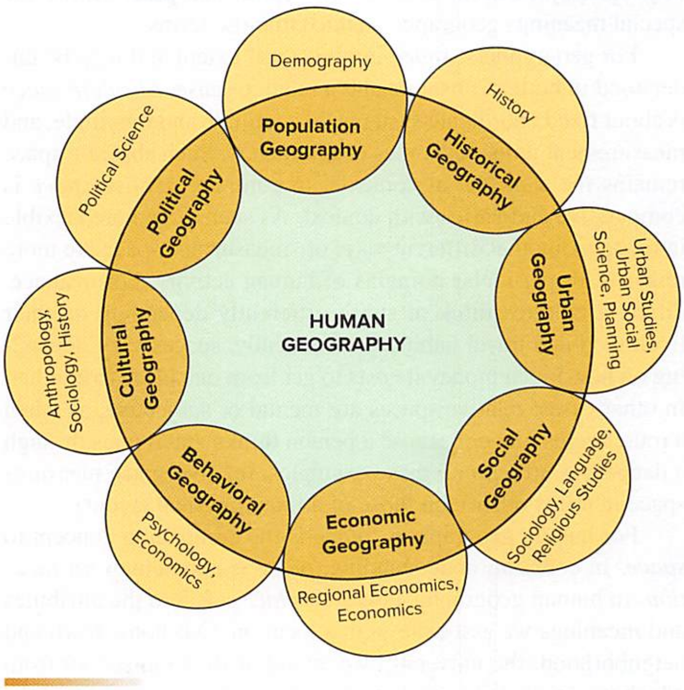



**Figure 1.3** Some of the subdivisions of human geography and the allied fields to which they are related. Geography retains its ties to them and shares their insights and data, reinforcing its role as an essential synthesizer of data, concepts, and models that have integrative regional and spatial implications.

geographers also carry out work in areas traditionally recognized as part of the humanities, including history, philosophy, languages, and literature.

Human geography admirably serves the objectives of a liberal education. It helps us to understand the world we occupy and to appreciate the circumstances affecting peoples and countries other than our own. It clarifies the contrasts and similarities in societies and cultures and in the human landscapes they have created in different regions of the Earth. Its models and explanations of how things are interrelated in particular places and regions give us a clearer understanding of the economic, social, and political systems within which we live and operate. Its analyses of those spatial systems make us more aware of the realities and prospects of our own society in an increasingly connected and competitive world. Our study of human geography, therefore, can help make us better-informed citizens, more able to understand the important issues facing our communities and our countries and better prepared to contribute to their solutions. Importantly, it can also help open the way to wonderfully rewarding and diverse careers as professional geographers (see the feature "Careers in Geography").

*background basics*

# 1.2 Core Geographic Concepts

The topics included in human geography are diverse, but that very diversity emphasizes the reality that all geographers—whatever their particular topical or regional specialties—are united by the similar questions they ask and the common set of basic concepts they employ to consider their answers. Of either a physical or cultural phenomenon they will inquire: What is it? Where is it? How did it come to be what and where it is? Where is it in relation to other things that affect it or are affected by it? How is it changing? How is it part of a functioning whole? How do people affect it? How does its location affect people's lives and the content of the area in which it is found? These and similar questions are rooted in geography's central concern with **space** and **place** and in the special meanings geographers attach to those terms.

For geographers, *space* implies areal extent and may be understood in both an absolute and a relative sense. *Absolute space* is about fixed coordinate systems, like latitude and longitude, and measurement units, like miles or kilometers. Such absolute space remains the same in all contexts. In contrast, *relative space* is comparative and varies with context. As such, it is more flexible in recognizing that different ways of "measuring" space are more relevant for particular domains of human activity. For instance, different cultures think of space differently depending on their livelihood and travel habits. Economically, spaces vary depending on how much money it costs to get from one place to another. In other cases, relative spaces are mental or subjective, as when a route seems longer because a person thinks that it goes through a dangerous area. In all these examples, relative space measures space in terms other than those of a fixed physical layout.

For human geographers, *place* is the companion concept to *space.* In common understanding, *place* is a synonym for *location.* In human geography, however, *place* refers to the attributes and meanings we associate with a location. Our home town and neighborhood, the university we attend or the high school from which we graduated, a favorite downtown shopping area, and the like are all examples. Clearly, our *sense of place*—the impressions, feelings, and attitudes we have regarding specific locations and their complex of attributes—is unique to each of us, though we often share some aspects of our sense of place with other members of our culture or subculture. And clearly, too, we can even have a well-developed sense of place about locations we may never have personally experienced: Rome or Mecca or Jerusalem, for example, or—closer to home—Mount Rushmore or the Washington Mall. Of course, our sense of place may largely reflect a **place stereotype** rather than reality.

Our individual or group sense of place and attachments can, of course, set us off from others. Our home neighborhood that we find familiar and view favorably may equally be seen as alien and, perhaps, dangerous by others. The attributes and culture of places shape the lives and outlooks of those who inhabit them in ways basic to the socioeconomic patterning of the world. The viewpoints, normative behavior, religious and cultural beliefs, and ways of life absorbed and expressed by a middle-class, suburban American are undoubtedly vastly different from the understandings, cultural convictions, and life expectations of, for example, a young, unemployed male resident of Baghdad or the slums of Cairo. The implicit, ingrained, place-induced differences between the two help us understand one reason for the resistance to the globalization of Western social and economic values by those of different cultural backgrounds and place identification.

The sense of place is reinforced by recognized local and regional distinctiveness. It may be diminished or lost and replaced by a feeling of **placelessness** as the uniformity of brand-name fast-food outlets, national retail store chains, uniform shopping malls, repetitive highway billboards, and the like spread nationally and even internationally, reducing or eliminating the uniqueness of formerly separated locales and cultures. We'll examine some aspects of the sense of place and placelessness as we look at folk and popular cultures in Chapter 7.

Geographers use the word *spatial* as an essential modifier in framing their questions and forming their concepts. Geography, they say, is a *spatial* science. It is concerned with *spatial behavior* of people, with the *spatial relationships* that are observed between places on the Earth's surface, and with the *spatial processes* that create or maintain those behaviors and relationships. The word *spatial* comes, of course, from *space,* and to geographers, it always carries the idea of the way items are distributed, the way movements occur, and the way processes operate over the whole or a part of the surface of the Earth. The geographer's space, then, is Earth space, the surface area occupied or available to be occupied by humans. Spatial phenomena have locations on that surface, and spatial interactions occur among places, things, and people within the Earth area available to them. The need to understand those relationships, interactions, and processes helps frame the questions that geographers ask.

Additionally, those questions have their starting point in basic observations about the location and nature of places and about how places are similar to or different from one another. Such observations, though simply stated, are profoundly important to our comprehension of the world we occupy.

- Places have location, direction, and distance with respect to other places.
- A place has size; it may be large or small. Scale is important.
- A place offers both a physical setting and a social setting.
- The attributes of places develop and change over time.
- Places are connected to other places.
- The content of places is structured and explainable.
- Places may be generalized into regions of similarities and differences.

These are basic notions understandable to everyone. They also are the means by which geographers express fundamental observations about the Earth spaces they examine and put those observations into a common framework of reference. Each of the concepts is worth further discussion, for they are not quite as simple as they at first seem.

## Geographic Features

Of course, space and (especially) place are not empty. **Geographic features** include natural features such as mountains, rivers, forests, oceans, and atmospheric fronts. They also include cultural features such as buildings, roads, cornfields, cities, and countries. Although all geographic features, like all material entities of any kind, are in reality three-dimensional, we often think of them or depict them on a map as if their dimensionality were less. So zero-dimensional features are thought of as points; an example might be a water well or a mountain peak. One-dimensional features are like lines, whether curved or straight; an example might be a river or a highway. Two-dimensional features are like areas or polygons; an example might be a forest or a neighborhood. Finally, some features are best thought of as being fully three-dimensional or volumetric. An oil deposit and a cloud are examples of this. It is important to recognize that the most appropriate way to think about a feature's dimensionality can depend greatly on the scale with which you examine it. A city may be a point when looking at a map of an entire country, but it becomes much more like an area when you zoom in to it.

Our discussion of feature dimensionality suggests something else about the way we conceptualize geographic features. They are typically thought of as being like discrete objects or like continuous fields. **Objects** are discrete entities that we think of as having sharp boundaries and being separated by space that may be conceived of as empty. Features like mountain peaks or roads are objects. **Fields** are continuously varying surfaces on the Earth that we think of as completely covering the space of the landscape they occupy without overlapping other fields. Features like average precipitation and landform elevations are fields. The distinction between objects and fields is admittedly abstract, and there are features like water bodies that can readily be thought of in either way, or as a combination of the two. Human population is another intriguing example. At one scale, people are discrete objects; but at another scale, we can treat populations as a density field that may be said to have a nonzero value anywhere that is inhabited. However, it usually seems to make more sense to treat features and properties as more like objects or more like fields, even if we accept that this is sometimes imperfect. And if the distinction seems esoteric, we discuss below how it is quite important for the practical issue of how best to represent and model the world in computerized geographic information systems.

## Location, Direction, and Distance

*Location, direction,* and *distance* are everyday ways of assessing the space around us and identifying our position in relation to other items and places of interest. They are also essential in understanding the processes of spatial interaction that figure so importantly in the study of human geography.

### Location

The location of places and objects is the starting point of all geographic study, as well as all our personal movements and spatial actions in everyday life. We think of and refer to location in at least two different senses, *absolute* and *relative.*

**Absolute location** is the identification of place by some precise and accepted system of coordinates; it therefore is sometimes called *mathematical location.* We have several such accepted systems of pinpointing positions. One of them is the global grid of parallels and meridians (discussed later, beginning in Section 1.4). With it, the absolute location of any point on the Earth can be accurately described by reference to its degrees, minutes, and seconds of **latitude** and **longitude** (Figure 1.4).

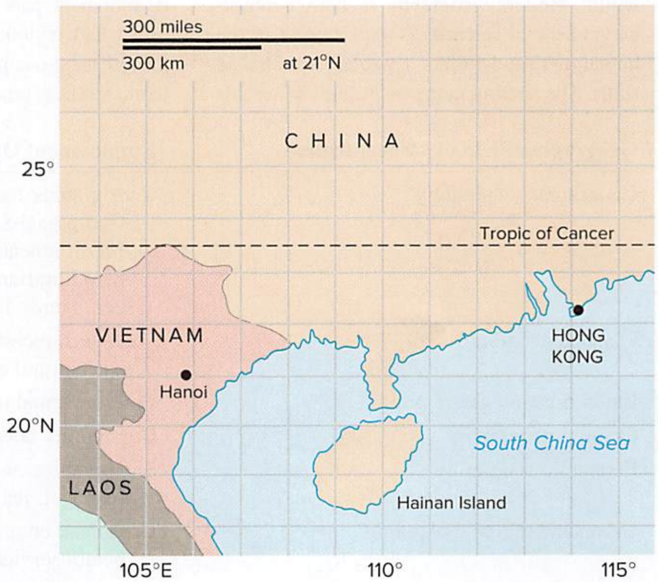



**Figure 1.4** The latitude and longitude of Hong Kong is 22° 15′ N, 114° 10′ E (read as 22 degrees, 15 minutes north; 114 degrees, 10 minutes east). The circumference of the Earth measures 360 degrees; each degree contains 60 minutes, and each minute has 60 seconds of latitude or longitude. What are the coordinates of Hanoi?

# Careers in Geography

The study of geography is an essential part of a liberal arts education and helps students become better citizens as they come to understand local, national, and global issues.

Can it, as well, be a pathway to employment for those who wish to specialize in the discipline? The answer is "Yes," in a number of different types of jobs. One broad cluster is concerned with supporting the field itself through teaching and research. Teaching opportunities exist at all levels, from elementary to university postgraduate. Teachers with some training in geography are increasingly in demand in elementary and high schools throughout the United States, reflecting geography's inclusion as a core subject in the federally adopted *Educate America Act* (Public Law 103-227) and the national determination to create a geographically literate society. At the college level, specialized teaching and research in all branches of geography have long been established, and geographically trained scholars are prominently associated with urban, global, community, and environmental studies, regional science, locational economics, and other interdisciplinary programs.

Because of the breadth and diversity of the field, training in geography involves the acquisition of techniques and approaches applicable to a wide variety of jobs outside the academic world. Modern geography is both a physical and social science, as well as part of the humanities, and fosters a wealth of technical skills. The employment possibilities it presents are as many and varied as are the agencies and enterprises dealing with the natural environment and human activities, and with the acquisition and analysis of spatial data.

Many professional geographers work in government, either at the state or local level, or in a variety of federal agencies and international organizations. Although many positions do not carry a geography title, physical geographers serve as water, mineral, and other natural resource analysts; weather and climate experts; soil scientists; and the like. An area of recent high demand is for environmental managers and technicians. Geographers who have specialized in environmental studies find jobs in both public and private agencies. Their work may include assessing the environmental impact of proposed development projects on such things as air and water quality and endangered species, as well as preparing the environmental impact statements required before construction can begin.

Human geographers work in many different roles in the public sector. Jobs include data acquisition and analysis in health care, transportation, population studies, economic development, and international economics. Many geography graduates find positions as planners in local and state governmental agencies concerned with housing and community development, park and recreation planning, and urban and regional planning. They map and analyze land-use plans and transportation systems, monitor urban land development, make informed recommendations about the location of public facilities, and engage in basic research.

Most of these same specializations are also found in the private sector. Geographic training is ideal for such tasks as business planning and market analysis; factory, store, and shopping-center site selection; community and economic development programs for banks, public utilities, and railroads; and similar applications. Publishers of maps, atlases, news and travel magazines, and the like employ geographers as writers, editors, and mapmakers.

The combination of a traditional, broadly based liberal arts perspective with the technical skills required in geographic research and analysis gives geography graduates a competitive edge in the labor market. These field-based skills include familiarity with geographic information systems (GISs), cartography and computer mapping, remote sensing and photogrammetry, and competence in data analysis and problem solving. In particular, students with expertise in GIS, who are knowledgeable about data sources, hardware, and software, are finding that they have ready access to employment opportunities. The following table, based on the booklet "Careers in Geography,"* summarizes some of the professional opportunities open to students who have specialized in one (or more) of the various subfields of geography. Also, be sure to read the informative discussions under the "Careers in Geography" option on the home page of the Association of American Geographers at *www.aag.org/*.

| Geographic Field of Concentration | Employment Opportunities |
|---|---|
| Geographic technology | Cartographer for federal government (agencies such as Defense Mapping Agency, U.S. Geological Survey, or Environmental Protection Agency) or private sector (e.g., Environmental Systems Research Institute, ERDAS, Intergraph, or Bentley Systems); map librarian; GIS specialist for planners, land developers, real estate agencies, utility companies, local government; remote-sensing analyst; surveyor |
| Physical geography | Weather forecaster; outdoor guide; coastal zone manager; hydrologist; soil conservation/agricultural extension agent |
| Environmental geography | Environmental manager; forestry technician; park ranger; hazardous waste planner |
| Cultural geography | Community developer; Peace Corps volunteer; map librarian |
| Economic geography | Site selection analyst for business and industry; market researcher; traffic/route delivery manager; real estate agent/broker/appraiser; economic development researcher |
| Urban and regional planning | Urban and community planner; transportation planner; housing, park, and recreation planner; health services planner |
| Regional geography | Area specialist for federal government; international business representative; travel agent; travel writer |
| Geographic education or general geography | Elementary/secondary school teacher; college professor; overseas teacher |

*"Careers in Geography," by Richard G. Boehm. Washington, DC: National Geographic Society, 1996. Previously published by Peterson's Guides, Inc.


**Figure 1.5** The reality of *relative location* on the globe may be strikingly different from the impressions we form from maps with conventional projections like the Mercator. The position of Russia with respect to North America when viewed from a polar perspective emphasizes a closer relative location than many people realize.

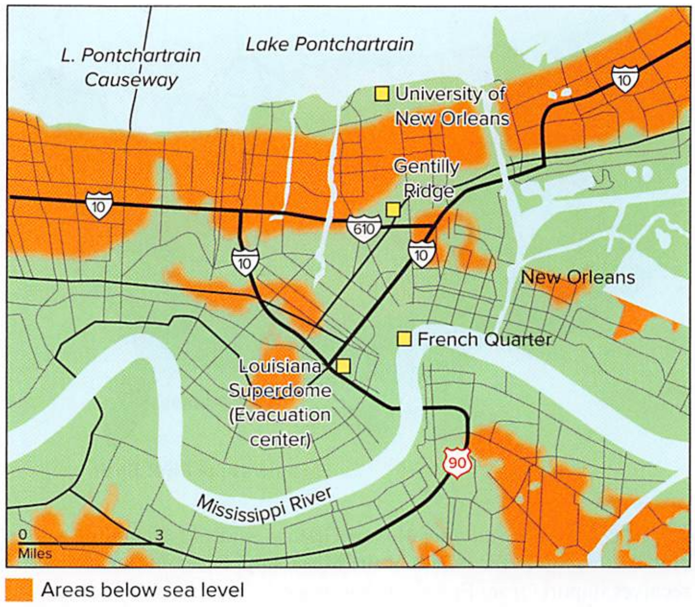



**Figure 1.6** The *site* of New Orleans is hardly ideal for building a city. The city was built by the French on the most suitable high ground they could find near the mouth of the Mississippi River. The site extends north from the "high ground" along the Mississippi River to former swamp and marshland near Lake Pontchartrain. Much of the city and its suburbs are located below sea level on sinking soils composed of soft sediments deposited by past river floods.

Other coordinate systems are also in use. Survey systems such as the township, range, and section description of property in much of the United States give mathematical locations on a regional level, while street address precisely defines a building according to the reference system of an individual town. For convenience or special purposes, locational grid references may be superimposed on the basic global grid. The Universal Transverse Mercator (UTM) system, for example, based on a set of 60 longitude zones, is widely used in geographic information system (GIS) applications and, with different notations, as a military grid reference system. Absolute location is unique to each described place, is independent of any other characteristic or observation about that place, and has obvious value in the legal or scientific description of places, in measuring the distance separating places, or in finding directions between places on the Earth's surface.

When geographers—or real estate agents—remark that "location matters," their reference is usually not to absolute but to **relative location**—the position of a place in relation to that of other places or activities (**Figure 1.5**). Relative location expresses spatial interconnection and interdependence and may carry social (neighborhood character) and economic (assessed valuations of vacant land) implications. On an immediate and personal level, we think of the location of the school library not in terms of its street address or room number but where it is relative to our classrooms, or the cafeteria, or some other reference point. On the larger scene, relative location tells us that people, things, and places exist not in a spatial vacuum but in a world of physical and cultural characteristics that differ from place to place.

New York City, for example, may in absolute terms be described as located at (approximately) latitude 40° 439 N and longitude 73° 589 W. We have a better understanding of the *meaning* of its location, however, when reference is made to its spatial relationships: to the continental interior through the Hudson–Mohawk lowland corridor or to its position on the eastern seaboard of the United States. Within the city, we gain understanding of the locational significance of Central Park or the Lower East Side not solely by reference to the street addresses or city blocks they occupy, but by their spatial and functional relationships to the total land use, activity, and population patterns of New York City.

In view of these different ways of looking at location, geographers make a distinction between the *site* and the *situation* of a place. **Site** refers to the physical and cultural characteristics and attributes of the place itself. It is more than mathematical location, for it tells us something about the internal features of that place. The site of New Orleans, for example, extends from the natural levee on the Mississippi River to Lake Pontchartrain, much of which lies below sea level (**Figure 1.6**). **Situation,** on the other hand, refers to the external relations of a locale. It is an expression of relative location with particular reference to items of significance to the place in question. The situation of New Orleans might be described as being as close as possible to the mouth of the Mississippi River, which drains 41percent of the land area of the continental United States, taking in much of the area from the Appalachian Mountains to the Rocky Mountains. Waterways on the Upper Mississippi, Missouri, Arkansas-Red-White, Ohio, and Tennessee River systems drain through the Lower Mississippi, connecting New Orleans to many of the country's important agricultural and manufacturing regions

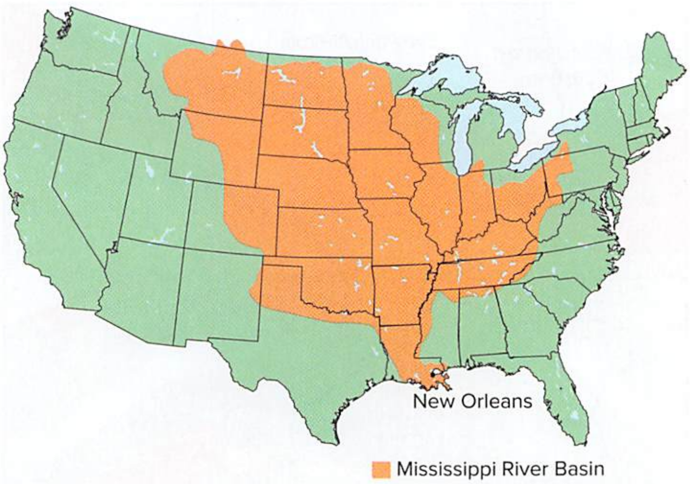



**Figure 1.7** The *situation* of New Orleans is ideal for building a city. As the port at the mouth of the Mississippi River, New Orleans receives imports from Europe, Latin America, Asia, and Africa and exports grain, other food products, and petroleum from the United States. New Orleans is connected to 14,500 miles (23,335 km) of waterways as the Mississippi River drains a basin that stretches from the Rocky Mountains to the Appalachian Mountains.

(**Figure 1.7**). Although the flood-prone site makes it a challenging place to build a city, the incredible advantages offered by its situation have inspired generations of residents to make it their home.

## Direction

Direction is a second universal spatial concept. Like location, it has more than one meaning and can be expressed in absolute or relative terms. **Absolute direction** is based on global or macroscopic features such as the cardinal points of north, south, east, and west, or on the directions to prominent stars. These appear uniformly and independently in all cultures, derived from the obvious "givens" of nature: the rising and setting of the sun for east and west, the sky location of the noontime sun and of certain fixed stars for north and south, or the direction toward or away from the center of an island.

We also commonly use **relative** or *relational* **directions.** In the United States, we worry about conflict in the "Near East" or economic competition from the "Far Eastern countries." These directional references are culturally based and locationally variable, despite their reference to cardinal compass points. The Near and the Far East locate parts of Asia from the European perspective; they are retained in the Americas by custom and usage, even though one would normally travel westward across the Pacific, for example, to reach the "Far East" from California, British Columbia, or Chile. Another important example of relative directional terms include body-centered terms like *left, right, in front of,* and *behind.*

## Distance

Distance joins location and direction as a commonly understood term that has dual meanings for geographers. Like its two companion spatial concepts, distance may be viewed in both an absolute and a relative sense.

**Absolute distance** refers to the physical separation between two points on the Earth's surface measured by some accepted standard unit such as miles or kilometers for widely separated locales, feet or meters for more closely spaced points. **Relative distance** transforms those linear measurements into other units that could be more meaningful for the spatial relationship in question.

To know that two competing malls are about equidistant in miles from your residence is perhaps less important in planning your shopping trip than is knowing that because of street conditions or traffic congestion, one is 5 minutes and the other 15 minutes away (**Figure 1.8**). Many people, in fact, think of time distance rather than physical distance in their daily activities; downtown is 20 minutes by bus, the library is a 5-minute walk. In some instances, money rather than time may be the distance transformation. An urban destination might be estimated to be a $10 cab ride away, information that may affect either the decision to make the trip at all or the choice of travel mode to get there. As a college student, you already know that rooms and apartments are less expensive at a greater distance from campus. And a walk uphill may well seem longer than one that slopes gently downhill; in some situations, effort is an expression of relative distance between places.


**Figure 1.8** Lines of equal travel time (*isochrones*: from Greek, *isos*, "equal" , and *chronos*, "time") mark off the different linear distances accessible within given spans of time from a starting point. The fingerlike outlines of isochrone boundaries reflect variations in road conditions, terrain, traffic congestion, and other aids or impediments to movement. On this map, the areas within 5–30 minutes' travel time from downtown San Diego are recorded for the year 2002. Note the effect of freeways on travel time.

A *psychological* transformation of distance is also frequent. The solitary late-night walk back to the car through an unfamiliar or dangerous neighborhood may seem far longer than a daytime stroll of the same distance through familiar and friendly territory. A first-time trip to a new destination frequently seems much longer than the return trip over the same path. Distance relationships, their measurement, and their meaning for human spatial interaction are fundamental to our understanding of human geography. They are a subject of Chapter 3, and reference to them recurs throughout this book.

## Size and Scale

When we say that a place may be large or small, we speak both of the nature of the place itself and of the generalizations that can be made about it. In either instance, geographers are concerned with **scale.** Although scale is always about relative size (whether spatial or temporal), we use the term in different ways. We can, for example, study a problem—say, population or agriculture—at the local scale, the regional scale, or on a global scale. Here the reference is purely to the size of unit studied. In this sense, *large-scale* means large units or areas studied, and *small-scale* means small units or areas studied. In a technical, cartographic sense, scale tells us the ratio between the length of physical distance on a map and the actual length of the mapped distance on the surface of the Earth (see Appendix A). Whatever the scale of a map, it is a feature of every map and important to recognizing the areal meaning of what is shown on that map.

In both senses of the word, *scale* implies something about the degree of generalization involved (**Figure 1.9**). Generalization is averaging over details, so that a large-scale unit of study (and a small-scale map) generalizes more than a small-scale unit of study (and large-scale map). Geographic inquiry may be broad or narrow; it occurs at many different size scales. Climate may be an object of study, but research and generalization focused on climates of the world will differ in degree and kind from study of the microclimates of a city. Awareness of scale is very important. In geographic work, concepts, relationships, and understandings that have meaning at one scale may not apply at another.

As another example, the study of world agricultural patterns may refer to global climatic regimes, cultural food preferences, levels of economic development, and patterns of world trade. These large-scale relationships are of little concern to the study of crop patterns within single counties of the United States, where topography, soil and drainage conditions, farm size, ownership, and capitalization, or even personal management preferences, may be of greater explanatory significance.

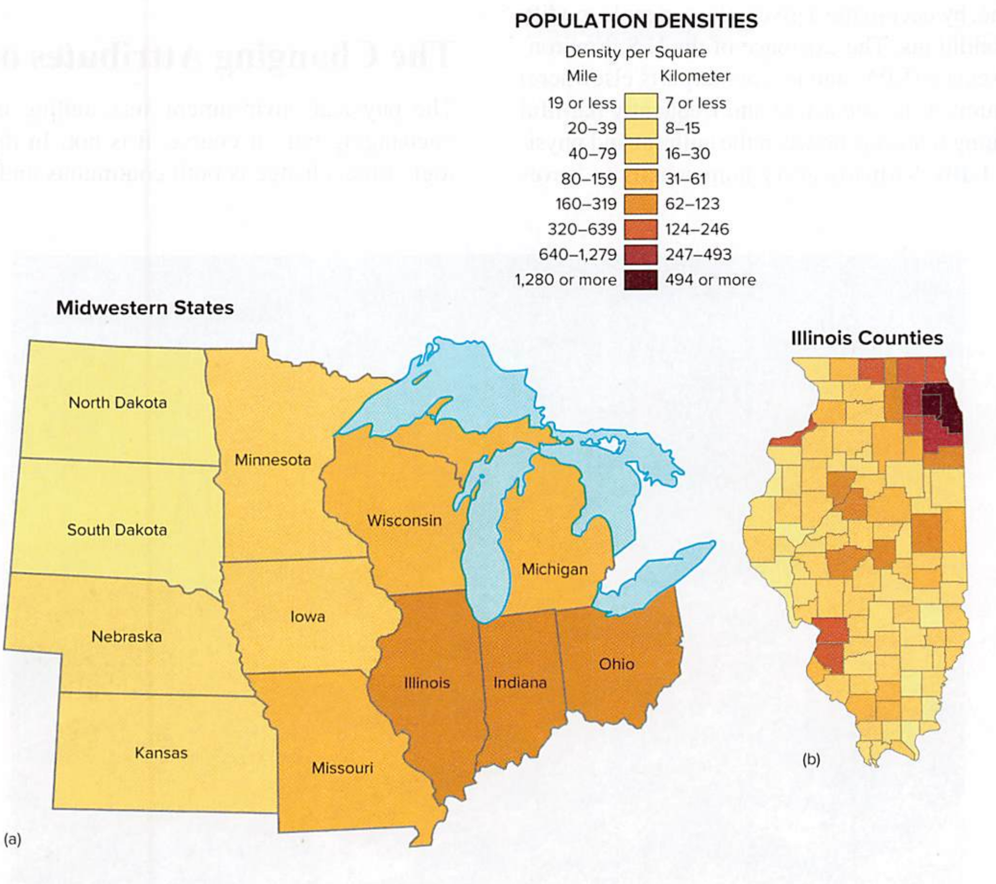



**Figure 1.9** Population density patterns depend upon map scale. "Truth" depends on one's scale of inquiry. Map (*a*) reveals that the maximum year 2010 population density of Midwestern states was no more than 123 people per square kilometer (319 per sq mi). From map (*b*), however, we see that population densities in three Illinois counties exceeded 494 people per square kilometer (1,280 per sq mi) in 2010. If we were to reduce our scale of inquiry even further, examining individual city blocks in Chicago, we would find densities reaching 2,500 or more people per square kilometer (10,000 per sq mi). Scale matters!

## Physical and Cultural Attributes

All places have physical and cultural attributes that distinguish them from other places and give them character, potential, and meaning. Geographers are concerned with identifying and analyzing the details of those attributes and, particularly, with recognizing the interrelationship between the physical and cultural components of area: the human-environmental interface.

Physical characteristics refer to such natural aspects of a locale as its climate and soil, the presence or absence of water supplies and mineral resources, its terrain features, and the like. These **natural landscape** attributes provide the setting within which human action occurs. They help shape—but do not dictate—how people live. The resource base, for example, is physically determined, though how resources are perceived and utilized is, to some extent, culturally conditioned.

Environmental circumstances directly affect agricultural potential and reliability; indirectly they may influence such matters as employment patterns, trade flows, population distributions, and national diets. The physical environment simultaneously presents advantages and drawbacks with which humans must deal. Thus, the danger of typhoons in central China or monsoonal floods in Bangladesh must be balanced against the agricultural bounty derived from the regions' favorable terrain, soil, and moisture conditions.

At the same time, by occupying a given place, people modify its environmental conditions. The existence of the U.S. Environmental Protection Agency (EPA; and its counterparts elsewhere) is a reminder that humans are the active and frequently harmful agents in the continuing interplay between the cultural and physical worlds (**Figure 1.10**). Virtually every human activity leaves its imprint on an area's soils, water, vegetation, animal life, and other resources and on the atmosphere common to all Earth space. The impact of humans has been so universal and so long exerted that essentially no purely "natural landscape" any longer exists. One can even find human-made debris in the middle of the ocean and air pollution in the Arctic.

The visible expression of that human activity is the **cultural landscape.** It, too, exists at different scales and different levels of visibility. Differences in agricultural practices and land use between Mexico and southern California are evident in **Figure 1.11,** while the signs, structures, and people of, for instance, Los Angeles's Chinatown leave a smaller, more confined imprint within the larger cultural landscape of the metropolitan area itself.

Although the focus of this book is on the human characteristics of places, geographers are ever aware that the physical content of an area is also important in understanding the activity patterns of people and the interconnections between people and the environments they occupy and modify. Those interconnections and modifications are not static or permanent, however, but are subject to continual change. For example, marshes and wetlands, when drained, may be transformed into productive, densely settled farmland, while the threat or occurrence of eruption of a long-dormant volcano may quickly and drastically alter established patterns of farming, housing, and transportation on or near its flanks.

## The Changing Attributes of Place

The physical environment surrounding us seems eternal and unchanging but, of course, it is not. In the framework of geologic time, change is both continuous and pronounced. Islands

**Figure 1.10** Sites such as this landfill are all-too-frequent reminders of the adverse environmental impacts of humans and their waste products. Here, bulldozers compact solid waste and spread a daily cover at a "sanitary" landfill.

*©Doug Sherman/Geofile*

**Figure 1.11** This NASA image reveals contrasting cultural landscapes along the Mexico-California border. Move your eyes from the Salton Sea (the dark patch at the top of the image) southward to the agricultural land extending to the edge of the image. Notice how the regularity of the fields and the bright colors (representing growing vegetation) give way to a marked break, where irregularly shaped fields and less prosperous agriculture are evident. Above the break is the Imperial Valley of California; below the border is Mexico.

*Source: NASA*

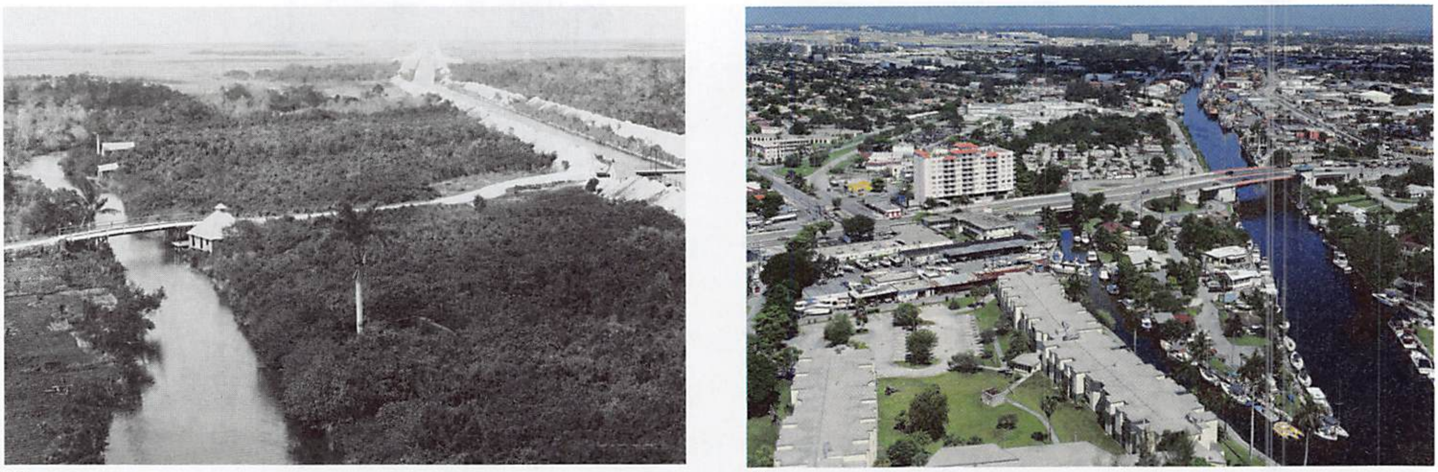
form and disappear; mountains rise and are worn low to swampy plains; vast continental glaciers form, move, and melt away, and sea levels fall and rise in response. Geologic time is long, but the forces that give shape to the land are timeless and relentless.

Even within the short period of time since the most recent retreat of continental glaciers—some 11,000 or 12,000 years ago—the environments occupied by humans have been subject to change. Glacial retreat itself marked a period of climatic alteration, extending the area habitable by humans to include vast reaches of northern Eurasia and North America formerly covered by thousands of feet of ice. With moderating climatic conditions came associated changes in vegetation and fauna. On the global scale, these were natural environmental changes; humans were as yet too few in numbers and too limited in technology to alter materially the course of physical events. On the regional scale, however, even early human societies exerted an impact on the environments they occupied. Fire was used to clear forest undergrowth, to maintain or extend grassland for grazing animals and to drive them in the hunt, and later to clear openings for rudimentary agriculture.

With the dawn of civilizations and the invention and spread of agricultural technologies, humans accelerated their management and alteration of the now no longer "natural" environment. Even the classical Greeks noted how the landscape they occupied differed—for the worse—from its former condition. With growing numbers of people and particularly with industrialization and the spread of European exploitative technologies throughout the world, the pace of change in the content of area accelerated. The built landscape—the product of human effort—increasingly replaced the natural landscape. Each new settlement or city, each agricultural assault on forests, each new mine, dam, or factory changed the content of regions and altered the temporarily established spatial interconnections between humans and the environment.

Characteristics of places today are the result of constantly changing past conditions. They are, as well, the forerunners of differing human-environmental balances yet to be struck. Geographers are concerned with places at given moments of time. But to understand fully the nature and development of places, to appreciate the significance of their relative locations, and to comprehend the interplay of their physical and cultural characteristics, geographers must view places as the present result of the past operation of distinctive physical and cultural processes (**Figure 1.12**).

You will recall that one of the questions geographers ask about a place or thing is, "How did it come to be what and where it is?" This is an inquiry about process and about becoming. The forces and events shaping the physical and cultural environment of places today are an important focus of geography. They are, particularly in their human context, the subjects of most of the separate chapters of this book. To understand them is to appreciate more fully the changing human spatial order of our world.



(a) (b)

**Figure 1.12** The process of change in a cultural landscape can be dramatic. (*a*) In 1913, Miami, Florida, was just a small settlement on the banks of the Miami River amidst woodlands and wetlands. (*b*) By the end of the 20th century, it had grown from a few thousand inhabitants to some 350,000, with buildings, streets, and highways completely transforming its natural landscape.

*Sources: (a) Library of Congress, Prints & Photographs Division, Reproduction number LC-DIG-det-4a24101 (digital file from original); (b) South Florida Water Management District*

## Interrelations Between Places

The concepts of relative location and distance that we earlier introduced lead directly to a fundamental spatial reality: places interact with other places in structured and comprehensible ways. In describing the processes and patterns of that **spatial interaction,** geographers add *accessibility* and *connectivity* to the ideas of location and distance.

Tobler's First Law of Geography tells us that in a spatial sense, everything is related to everything else, but that relationships are stronger when items are near one another. Our observation, therefore, is that interaction between places tends to diminish in intensity and frequency as distance between them increases—a statement of the idea of *distance decay,* which we explore in Chapter 3. Think about it—are you more likely to go to a fast-food outlet next door or to a nearly identical restaurant across town? Human decision making is unpredictable in many ways and decisions are frequently made for obscure reasons, but in this case you can see how you will probably frequent the nearer place more often.

Consideration of distance implies assessment of **accessibility.** How easy or difficult is it to overcome the *friction of distance*? That is, how easy or difficult is it to surmount the barrier of the time and space separating places? Distance isolated North America from Europe until the development of ships (and aircraft) that reduced the effective distance between the continents. All parts of the ancient and medieval city were accessible by walking; they were *pedestrian cities,* a status lost as cities expanded in area and population with industrialization. Accessibility between city districts could be maintained only by the development of public transit systems whose fixed lines of travel increased ease of movement between connected points and reduced it between areas not on the transit lines themselves. Later, the invention and widespread adoption of the automobile had its own profound effects on urban form and activity patterns.

Accessibility, therefore, suggests the idea of **connectivity,** a broader concept implying all the tangible and intangible ways in which places are linked: by physical telephone lines, street and road systems, pipelines and sewers; by unrestrained walking across open countryside; by radio and TV broadcasts beamed outward from a central source. Where routes are fixed and flow is channelized, *networks*—the patterns of routes connecting sets of places—determine the efficiency of movement and the connectedness of points. Very rapid and uniform accessibility and connectivity are expected in today's advanced societies. Technologies and devices to achieve it proliferate, as our own lifestyles show. Cell phones, e-mail, broadband wireless Internet access, instant messaging, and more have considerably reduced time and distance barriers to communication that formerly separated and isolated individuals and groups, especially in the developed world, and have reduced our dependence on physical movement and on networks fixed in the landscape. The realities of accessibility and connectivity, that is, clearly change over time (**Figure 1.13**).

There is, inevitably, interchange between connected places. **Spatial diffusion** is the process of dispersion of an idea or an item from a center of origin to more distant points with which it is directly or indirectly connected. The rate and extent of that diffusion are affected by the distance separating the originating center of, say, a new idea or technology and other places where it is eventually adopted. Diffusion rates are also affected by population densities, means of communication, obvious advantages of the innovation, and importance or prestige of the originating *node.* These ideas of diffusion are further explored in Chapter 2.

Geographers study the dynamics of spatial relationships. Movement, connection, and interaction are part of the social and economic processes that give character to places and regions. Geography's study of those relationships recognizes that spatial interaction is not just an awkward necessity but a fundamental organizing principle of human life on Earth. That recognition has become universal, repeatedly expressed in the term *globalization.* **Globalization** implies the increasing interconnection of peoples and societies in all parts of the world as the full range

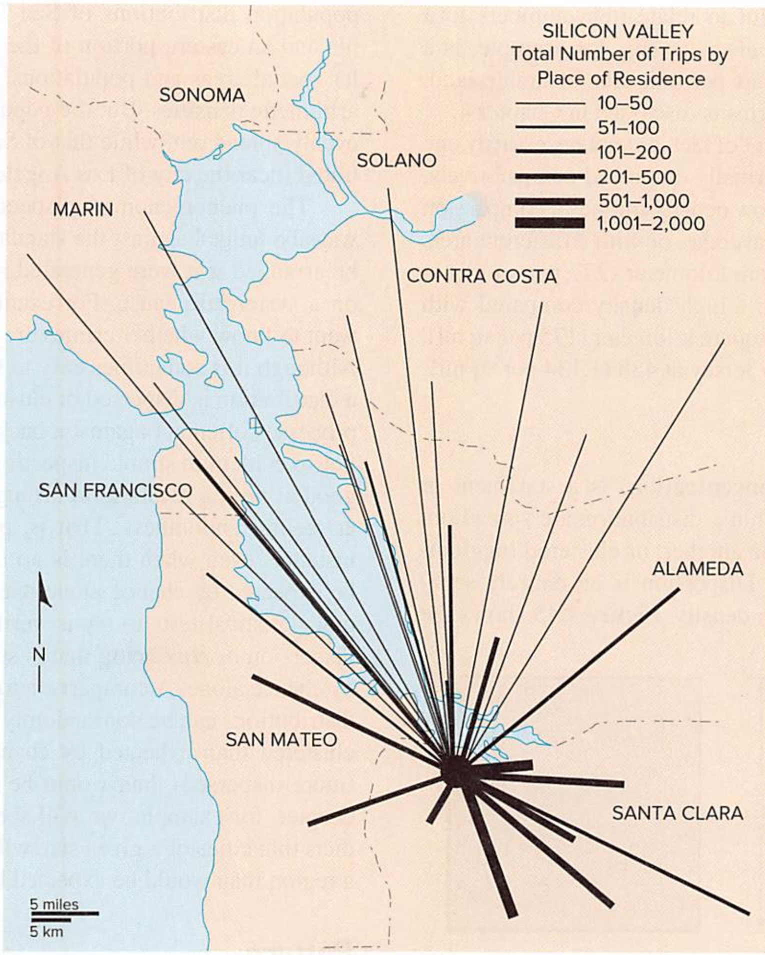



**Figure 1.13** An indication of one form of spatial interaction and *connectivity* is suggested by this map recording the volume of daily work trips within the San Francisco Bay area to the Silicon Valley employment node (geographers sometimes refer to these displays as *spider diagrams,* for obvious reasons). The ends of the lines define the outer reaches of a physical interaction region defined by the network of connecting roads and routes. The region changed in size and shape over time as the network was enlarged and improved, the Valley employment base expanded, and the commuting range of workers increased. The map, of course, gives no indication of the global reach of the Valley's *accessibility* and interaction through other means of communication and interchange.

*Source: Robert Cervero, Suburban Gridlock. Published by the Center for Urban Policy Research, Rutgers, the State University of New Jersey, 1986.*

of social, cultural, political, economic, and environmental processes become international in scale and effect. Promoted by continuing advances in worldwide accessibility and connectivity related in part to developments in the technologies of transportation and communication, globalization encompasses other core geographic concepts of spatial interaction, accessibility, connectivity, and diffusion. More detailed implications of globalization will be touched on in later chapters of this text.

## The Structured Content of Place

A starting point for geographic inquiry is how objects are distributed in area—for example, the placement of churches or supermarkets within a town. That interest distinguishes geography from other sciences, physical or social, and underlies many of the questions geographers ask: Where is a thing located? How is that location related to other items? How did the location we observe come to exist? Such questions carry the conviction that the contents of an area are comprehensibly arranged or structured. The arrangement of items on the Earth's surface is called **spatial distribution** and may be analyzed by the elements common to all spatial distributions: *density, dispersion,* and *pattern.* In addition, pairs or larger sets of distributions often show *spatial association.*

### Density

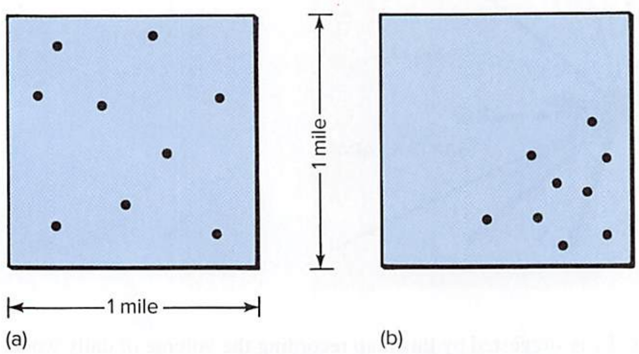
**Density** is usually thought of as a measure of the number or quantity of a specific feature within a defined unit of area. In fact, density does not apply only to areas. Thus, one can speak of the density of point (zero-dimensional) features, like gas stations, within a unit of a linear (one-dimensional) feature, like a highway, or within a unit of an areal (two-dimensional) feature, like a county. Similarly, one can speak of the density of linear features, like highways, within a unit of an areal feature, like a county. It is therefore not simply a count of items but of items in relation to the space in which they are found. When the relationship is absolute, as in population per square kilometer, for example, or dwelling units per acre, we are defining *arithmetic density* (see Figure 1.9).

Sometimes it is more meaningful to relate item numbers to a specific kind of space. *Physiological density,* for example, is a measure of the number of persons per unit area of arable land. Density defined in population terms is discussed in Chapter 4.

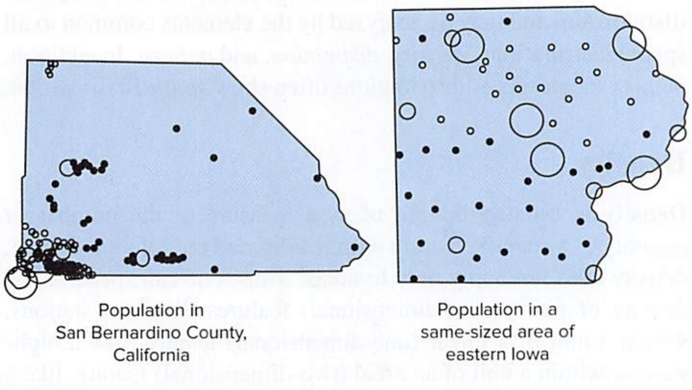
A density figure is a statement of fact, but not necessarily one useful in itself. Densities are normally employed comparatively, relative to one another. High or low density implies a comparison with a known standard, with an average, or with a different area. Ohio, with 107 persons per square kilometer (277 per sq mi) in 2000, might be thought to have a high density compared with neighboring Michigan at 68 per square kilometer (175 per sq mi), and a low one in relation to New Jersey at 438 (1,134 per sq mi).

## Dispersion

**Dispersion** (or its opposite, **concentration**) is a statement of the extent to which features within a distribution are spread out (dispersed or scattered) from one another, or clustered (agglomerated) together (**Figure 1.14**). Dispersion is an entirely separate distributional property from density. **Figure 1.15** shows the




**AP Figure 1.14** Density and dispersion each tell us something different about how items are distributed in an area. *Density* is simply the number of items or observations within a defined area; it remains the same no matter how the items are distributed. The density of houses per square mile, for example, is the same in both (*a*) and (*b*). *Dispersion* is a statement about nearness or separation. The houses in (*a*) are more *dispersed* than those shown *clustered* in (*b*).



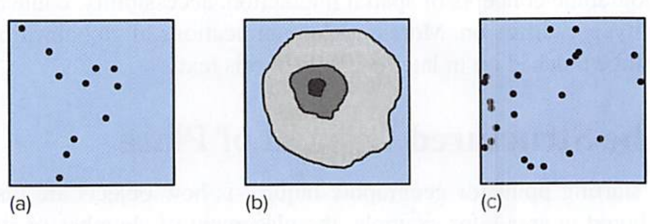

**AP Figure 1.15** Density and dispersion are separate properties of spatial distributions. The population distribution of San Bernardino County, California, on the left is highly concentrated, whereas that of eastern Iowa on the right is highly dispersed, even though both regions have about equal area and population, and thus equal arithmetic density.

population distributions of San Bernardino County in California and an eastern portion of the state of Iowa. Both have similar spatial areas and populations, so that they both have similar arithmetic densities. But the population in eastern Iowa is rather evenly spread out, while that of San Bernardino is quite concentrated (near the city of Los Angeles to the west).

The phenomenon of dispersion or concentration must always be judged against the standard of how a distribution would be arranged if it were generated randomly—if it were not based on a systematic cause. For example, a police department may want to know whether crimes are clustered or randomly located. Although it is sometimes easy to see with the naked eye whether a distribution is dispersed or clustered, often it is not. Systematic processes often act against a background of "noise," so they are not so evident to simple inspection. At the same time, people are good at seeing meaningful arrangements, but they are not good at seeing randomness. That is, people tend to see clusters, for instance, even when there is no more concentration than would be expected by chance alone. Geographers have developed formal statistical tests to try to verify the existence of nonrandom dispersion or **clustering** that is stronger than would be expected by chance alone. A comparison to chance also makes it clear that distributions can be nonrandomly dispersed either by being more clustered than expected by chance, or by being *less clustered* (more dispersed) than would be expected by chance. In a later chapter, for example, we will see that central place theory predicts that cities of a given size will be spread more widely across a region than would be expected by chance alone.

## Pattern

The geometric arrangement of feature in space is called **pattern.** Like dispersion, pattern refers to distribution, but in a way, that emphasizes the design or shape of feature locations rather than just their spacing (**Figure 1.16**). The distribution of towns along a railroad or houses along a street may be seen as *linear.* A *centralized* pattern may involve items concentrated around a single node. A *random* pattern may be the best description of an unstructured irregular distribution. Like dispersion, patterns created by systematic processes are sometimes easy to confuse with unpatterned distributions created by random processes. That is, people tend to see patterns even when no systematic process has operated to create a pattern (for instance, have you ever seen a




**AP Figure 1.16** *Pattern* describes spatial arrangement and design. The *linear* pattern of towns in (*a*) perhaps traces the route of a road or railroad or the course of a river. The urban land use in (*b*) with its categories of residential and commercial activities represents a circular pattern, while the dots in (*c*) are *randomly* distributed.

face in the clouds?). Again, geographers have statistical tests to try to verify the existence of nonrandom patterns that are stronger than would be expected by chance alone.

An example of a patterned distribution includes that resulting from the rectangular system of land survey adopted in much of the United States under the Ordinance of 1785, which created a checkerboard rural pattern of "sections" and "quarter-sections" of farmland (see Figure 7.21 in Chapter 7). As a result, in most American cities, streets display a *grid* or *rectilinear* pattern. The same is true of cities in Canada, Australia, New Zealand, and South Africa, which adopted similar geometric survey systems. The *hexagonal* pattern of service areas of farm towns is a mainstay of central place theory discussed in Chapter 11. These references to the geometry of distribution patterns help us visualize and describe the structured arrangement of items in space. They help us make informed comparisons between areas and use the patterns we discern to ask further questions about the interrelationship of things.

## Spatial Association

Two distributions of features often spatially correspond with each other. That is, places where one feature is found are more likely (or less likely) than chance to be the places where a different type of feature is found. This is **spatial association** or covariation. For example, counties in Texas where consuming alcoholic beverages is allowed by law tend to be the same counties that have a majority of Catholic residents, while so-called dry counties are more likely to have a majority of Protestant residents (**Figure 1.17**). Spatial association is very similar to looking for spatial pattern, except that it is a spatial pattern involving two or more distributions simultaneously. Like pattern, geographers attempt to identify associations that are clearly stronger than would be expected by chance alone. It is critical to remember, however, that finding an association does not in itself tell you *why* two distributions covary—it does not explain what caused it.

## Place Similarity and Regions

The distinctive characteristics of places in content and structure immediately suggest two geographically important ideas. The first is that no two places on the surface of the Earth can be *exactly* the same. Not only do they have different absolute locations, but—as in the features of the human face—the precise mix of physical and cultural characteristics of a place is never exactly duplicated.

Because geography is a spatial science, the inevitable uniqueness of place would seem to impose impossible problems of generalizing spatial information. That this is not the case results from the second important idea: the physical and cultural content of an area and the dynamic interconnections of people and places show patterns of spatial similarity. For example, a geographer doing fieldwork in France might find that all farmers in one area use a similar specialized technique to build fences around their fields. Often, such similarities are striking enough for us to conclude that

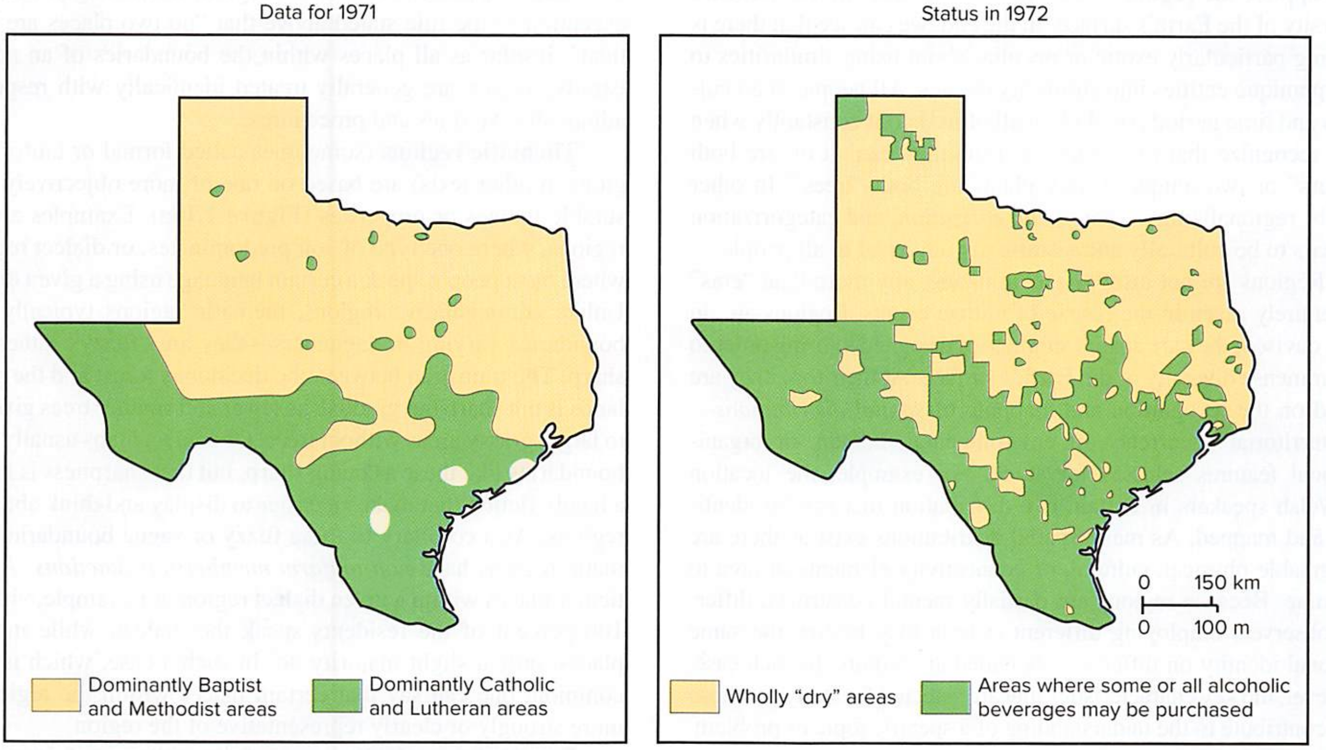



**Figure 1.17** The distributions of religion and alcohol sales in Texas show a spatial correlation. Catholic and Lutheran areas generally choose to be "wet," and Baptist-Methodist areas retain prohibition. Both the Baptist and Methodist churches have traditionally taken a stand against alcoholic beverages. (From 38th Annual Report of the Texas Alcoholic Beverage Commission, Austin, 1972, p. 49; and Churches and Church Membership in the United States: 1971, National Council of the Churches of Christ in the U.S.A., 1974.)

spatial regularities exist. They permit us to recognize and define **regions**—Earth areas that display significant elements of internal uniformity and external difference from surrounding territories. Places are, therefore, both unlike and like other places, creating patterns of areal differences and of coherent spatial similarity.

The problem of the historian and the geographer is similar. Each must generalize about items of study that are essentially unique. The historian creates arbitrary but meaningful and useful historical periods for reference and study. The "Roaring Twenties" and the "Victorian Era" are shorthand summary names for specific time spans, internally quite complex and varied but significantly distinct from what went before or followed after. The region is the geographer's equivalent of the historian's era. It is a device of areal generalization that segregates into component parts the complex reality of the Earth's surface. In both the time and the space needed for generalization, attention is focused on key unifying elements or similarities of the era or area selected for study. In both the historical and geographical cases, the names assigned to those times and places serve to identify the time span or region and to convey between speaker and listener a complex set of interrelated attributes.

All of us have a general idea of the meaning of region, and all of us refer to regions in everyday speech and action. We visit "the old neighborhood" or "go downtown"; we plan to vacation or retire in the "Sunbelt"; or we speculate about the effects of weather conditions in the "Corn Belt" on next year's food prices. In each instance, we have mental images of the areas mentioned, and in each, we have engaged in an informal place classification to pass along quite complex spatial, organizational, or content ideas. We have applied the **regional concept** to bring order to the immense diversity of the Earth's surface. In the end, we can see that there is nothing particularly exotic or peculiar about using similarities to group unique entities into similarity classes. All people in all cultures and time periods (including all of us!) do it constantly when they recognize that two unique objects they can sit on are both "chairs" or two unique woody plants are both "trees." In other words, regionalizing is spatial *categorization,* and categorization appears to be culturally and historically universal to all people.

Regions are not just "given" in nature, any more than "eras" are entirely given in the course of human events. Regions are, in part, devised; they are spatial summaries designed to bring order to the immense diversity of the Earth's surface. At their root, they are based on the recognition and mapping of *spatial distributions*—the territorial occurrence of environmental, human, or organizational features selected for study. For example, the location of Welsh speakers in Britain is a distribution that can be identified and mapped. As many spatial distributions exist as there are imaginable physical, cultural, or connectivity elements of area to examine. Because regions are partially mental constructs, different observers employing different criteria may bestow the same regional identity on differently bounded areal units. In each case, however, the key characteristics that are selected for study are those that contribute to the understanding of a specific topic or problem.

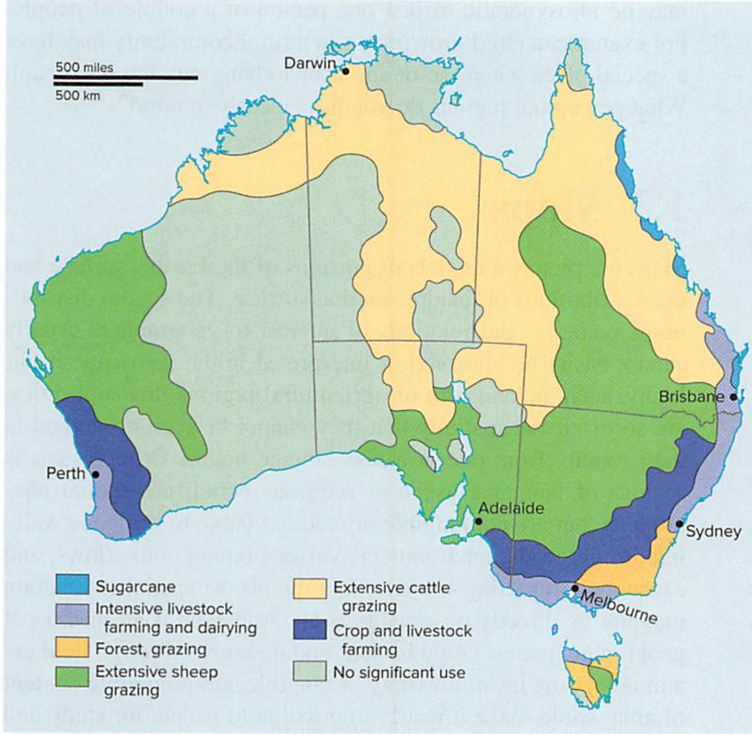
## Types of Regions

All regions share certain properties. They are all two-dimensional geographic features. They all have location and size (area). All regions have boundaries, which divide places inside the region from places outside the region. These boundaries vary in their degree of sharpness or *vagueness,* however, as we discuss below. Regions also vary in the permeability of their boundaries. That is, boundaries allow material, energy, people, and information to move across them more or less easily (with more or less effort, time, and cost), and permeability in one direction may be different than in the other. We also observe that regions are often *hierarchically organized.* Regions at one scale of size or importance are often contained by larger or more important regions in one direction, and contain smaller or less important regions in the other direction. The simplest example of region hierarchies is probably the relationship of larger and smaller political regions: states or provinces are within countries, while entities like counties and cities are within states or provinces.

Regions may be *administrative, thematic, functional,* or *perceptual.* An **administrative region** is created by law, treaty, or regulation. It includes political regions such as countries and states, bureaucratic regions such as school and voting districts, and cadastral (real estate) regions. Even the end zone on a football field is an administrative region. The boundaries of administrative regions are different than the boundaries of the other three types of regions, in that they are as sharp as measurement precision allows, or at least potentially (as soon as someone cares about the location of administrative boundaries, they can be made very precise by diplomats, lawyers, and surveyors). Given these precise boundaries, administrative regions have *uniform membership functions*—every place within the region is fully and equally representative of the region. Interestingly, this is an exception to the rule stated above that "no two places are identical," insofar as all places within the boundaries of an administrative region are generally treated identically with respect to administrative rules and procedures.

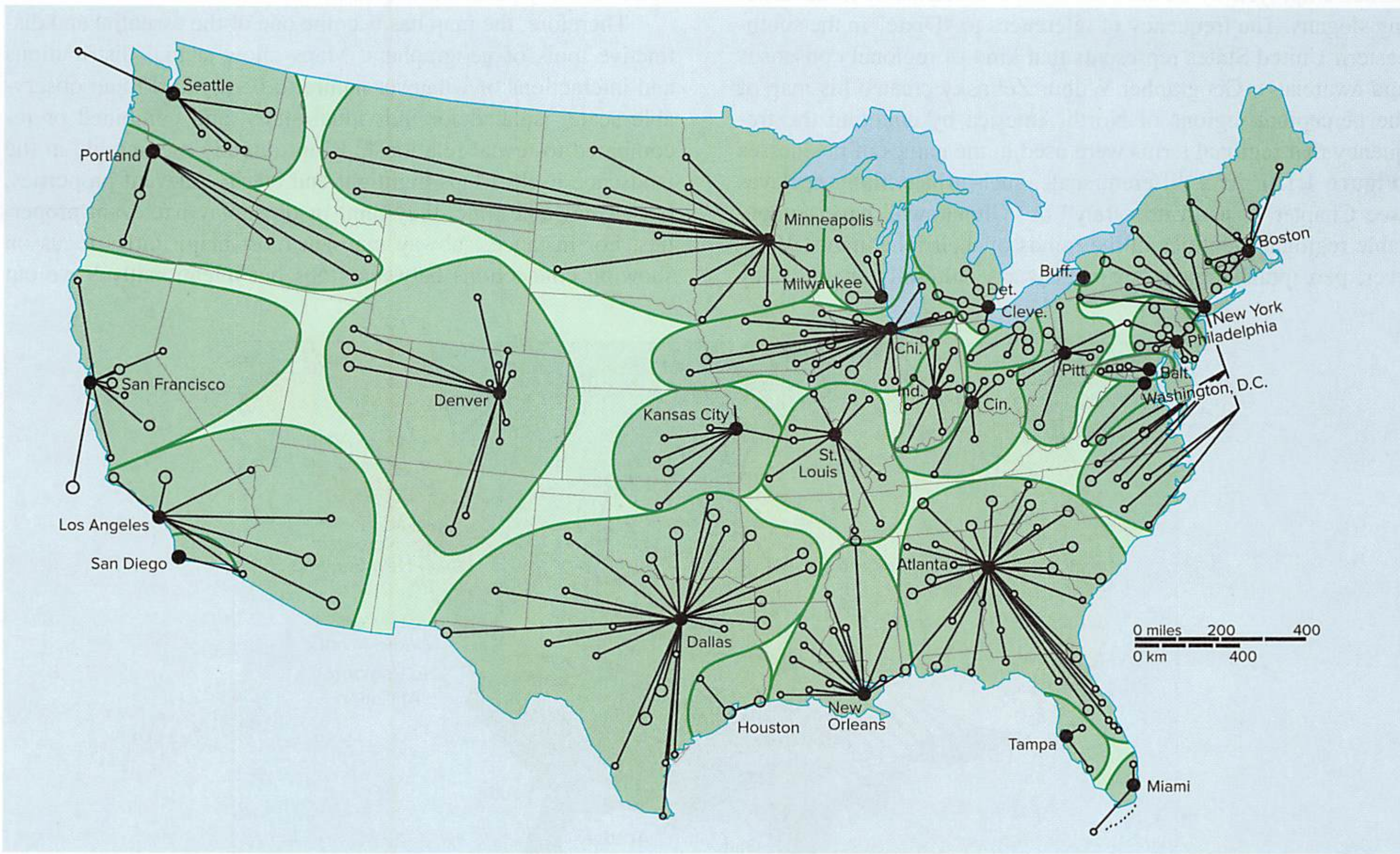
**Thematic regions** (sometimes called formal or uniform regions in other texts) are based on one or more objectively measurable themes or properties (**Figure 1.18a**). Examples are soil regions, where one type of soil predominates, or dialect regions, where most people speak a certain language using a given dialect. Unlike administrative regions, thematic regions typically have boundaries varying in vagueness—they are "fuzzy" rather than sharp. The transition between the deciduous forest and the grasslands is not sharp but gradual, as fewer and smaller trees give way to larger grassy areas without trees. Of course, maps usually show boundaries like these as being sharp, but that sharpness is largely a handy fiction that makes it easier to display and think about the regions. As a corollary to these fuzzy or vague boundaries, thematic regions have *non-uniform membership functions.* At particular places within a given dialect region, for example, virtually 100 percent of the residents speak the dialect, while in other places, only a slight majority do. In such a case, which is quite common, one can say that certain places within the region are more strongly or clearly representative of the region.

**Functional regions** emerge from patterns of interaction over space and time that connect places (**Figure 1.18b**). Examples include the region in which most people shop at a particular shopping center or listen to a particular radio station. In physical geography, the movement of air and water currents defines




(a)

**Figure 1.18** (*a*) This generalized land use map of Australia is composed of thematic *regions* whose internal physical and cultural characteristics show essential similarities, setting them off from adjacent territories of different conditions of use.




(b)

**Figure 1.18** (*b*) The functional (or nodal) regions shown on this map were based on linkages among large banks of major central cities and the "correspondent" banks they served in smaller towns in the 1970s, before the advent of electronic banking and bank consolidation.

*Source: (b)* Annals of the Association of American Geographers, *John R. Borchert, vol. 62, p. 358, Association of American Geographers, 1972.*

functional regions; a watershed is an important example. Often, functional regions have a pointlike core from which interaction originates, and thus they are sometimes called *nodal regions,* but they need not originate from a point. Certain famous wind patterns in various parts of the world form functional regions when they originate from a linear feature rather than a point. Of course, like thematic regions, functional regions generally have vague boundaries and non-uniform membership functions; you can literally hear the "fuzziness" of functional regions defined by radio stations as you drive further from the transmission tower.

Finally, **perceptual regions** (also called *cognitive regions*) are the informal subjective regions defined by people's beliefs, feelings, and images. They reflect the universal tendency for humans to regionalize parts of the Earth's surface, even though the particular regions identified certainly vary across cultures and historical times, even across individual people. Again, like thematic and functional regions, perceptual regions typically have vague boundaries and non-uniform membership functions. Two places may both be thought of as "downtown," for example, but one is seen to represent downtown more clearly than the other. In addition, perceptual regions like downtown are often culturally shared. In this case, perceptual regions may be called *vernacular regions*. Vernacular regions are real in the minds of cultural group members and are often reflected in regionally based names employed by businesses, by sports teams, or in advertising slogans. The frequency of references to "Dixie" in the southeastern United States represents that kind of regional consensus and awareness. Geographer Wilbur Zelinsky created his map of the perceptual regions of North America by counting the frequency that regional terms were used in the names of businesses (**Figure 1.19**). At a different scale, such urban ethnic enclaves (see Chapter 6) as "Little Italy" or "Chinatown" have comparable regional identities in the minds of their inhabitants. However, perceptual regions are not always culturally shared; they may be idiosyncratic to just one person or a couple of people. For example, a child growing up in a rural community may have a special place where he or she goes to hang out and daydream. What perceptual regions do you have clearly in mind?

## 1.3 Maps

Maps are pictorial models of portions of the Earth's surface and the distributions of features on that surface. The spatial distributions, patterns, and relations of interest to geographers usually cannot easily be observed or interpreted in the landscape itself. Many, such as landform or agricultural regions or major cities, are so extensive spatially that they cannot be seen or studied in their totality from one or a few vantage points. Others, such as regions of language usage or religious belief, are spatial phenomena, but are not tangible or readily visible to someone walking around in the environment. Various interactions, flows, and exchanges imparting the dynamic quality to spatial interaction may not be directly observable at all. And even if all matters of geographic interest could be seen and measured through field examination, the infinite variety of tangible and intangible content of area would make it nearly impossible to isolate for study and interpretation the few items of interest selected for special investigation in any particular situation.

Therefore, the map has become one of the essential and distinctive tools of geographers. Maps allow spatial distributions and interactions of whatever nature to be reduced to an observable scale, isolated for individual study, and combined or recombined to reveal relationships not directly measurable in the landscape itself. Maps highlight and clarify relevant properties, but at the same time, they omit or downplay irrelevant properties. For instance, subway maps in most major cities focus on showing connections between stops but intentionally leave out

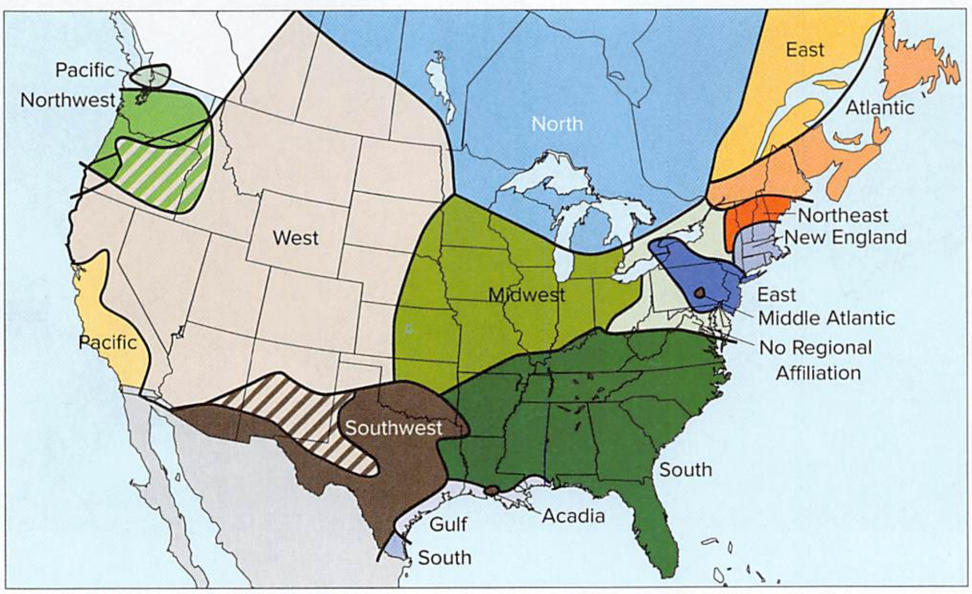



**Figure 1.19** This map of the perceptual (cognitive) regions of North America was created based on the names of local businesses.
*Source:* Annals of the Association of American Geographers, *Wilbur Zelinsky, "North America's Vernacular Regions," Vol. 70, No. 1, p. 14, 1980.*

**Figure 1. 20** A traveler viewing a shematic network map of the Washington, DC, Metro system. The schematic network clearly shows train lines and connections at stations, essential for using the Metro system, but omits quantitative information about distances and directions along the system lines that are of little use to most riders.

*©PNC/Getty Images*

accurate information about distances and directions because most riders do not need this information (**Figure 1.20**). But maps can serve their purpose only if their users have a clear idea of their strengths and limitations, the diversity of map styles, and the conventions observed in their preparation and interpretation.

## Map Scale

We have already seen that scale is a vital element of every map. Because it is a much reduced version of the reality it summarizes, a map generalizes the data it displays. *Scale*—the relationship between size or length of a feature on the map and the same item on the Earth's surface—determines the amount of that generalization. The smaller the scale of the map, the larger is the area it covers and the more generalized are the data it portrays. The larger the scale, the smaller is the depicted area and the more precisely can its content be represented (**Figure 1.21**). It may seem backward, but large-scale maps show small areas, and small-scale maps show large areas.

Map scale is selected according to the amount of generalization of data that is acceptable and the size of area that must be depicted. The user must consider map scale in evaluating the reliability of the spatial data that are presented. Regional boundary lines drawn on the world maps in this and other books or atlases

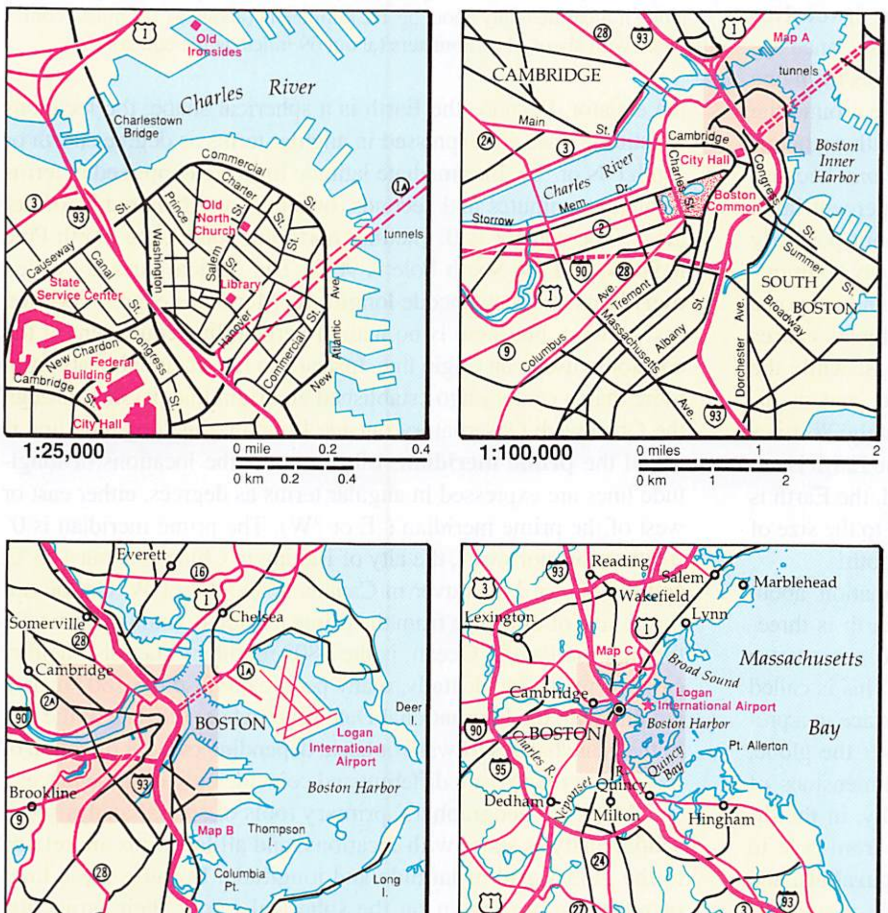



**Figure 1.21** Map scale affects both the areal extent that can be shown and the level of detail. The larger the scale, the greater the number and kinds of features that can be included. Notice how individual buildings are visible in the large-scale map (upper left), while the city of Boston is a mere point symbol in the smallest scale map (lower right). Scale may be reported to the map user in one (or more) of three ways. A *verbal* scale is given in words ("1 centimeter to 1 kilometer" or "1 inch to 1 mile"). A **representative fraction** (such as that placed at the left, below each of the four maps shown here) is a numerical expression of how many linear units on the Earth's surface are represented by one unit on the map. In the upper-left map, for example, one map inch represents 25,000 inches on the ground. A **graphic scale** (such as that placed at the right and below each of these maps) is a line or bar marked off in map units but labeled in ground units.

would cover many kilometers or miles on the Earth's surface. They obviously distort the reality they are meant to define, and on small-scale maps major distortion is inevitable. In fact, a general rule of thumb is that the larger the Earth area depicted on a map, the greater is the distortion built into the map.

This is so not only because geographic features must be generalized more on smaller-scale maps, but because a map has to depict the curved surface of the three-dimensional Earth on a two-dimensional sheet of paper. The term **projection** designates the method chosen to represent the Earth's curved surface as a flat map—to **develop** the Earth's surface. Because absolutely accurate representation is impossible, all projections inevitably distort. To start with, all maps break a continuous Earth surface at some arbitrarily chosen juncture (the places shown on the right and left sides of most maps are next to each other in reality). If that weren't enough, projections also distort one or more of the four main spatial properties of maps—area, shape, distance, or direction.[2] Specific projections may be selected, however, to minimize distortion of a particular spatial property or compromise the amount of distortion in one property by increasing distortion in another.

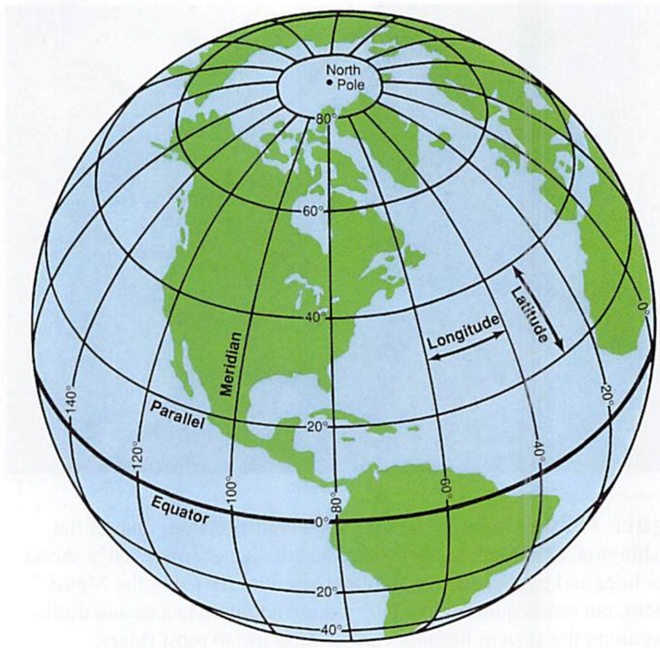



**Figure 1.22** The grid system of parallels of latitude and meridians of longitude. Because the meridians converge at the poles, parallels become increasingly shorter away from the equator. On the globe, the 60th parallel (60°) is only one-half as long as the equator, and a degree of longitude along it measures only about 55 1/2 kilometers (about 34 1/2 miles) compared with about 111 kilometers (about 69 miles) at the equator (0°).

## The Globe Grid

As we have seen, geography is about the planet Earth and the natural and human structures and processes found there. The Earth is the third planet from the sun in our solar system. It revolves around the sun about once every 365 days, and it rotates once approximately every 24 hours around an axis that stretches from one pole to the other. The **equator** is the imaginary circle around the middle that separates the Earth into Northern and Southern hemispheres. The Earth is sometimes called the *water planet* because its surface is about 71 percent water and only 29 percent land. The shape of the Earth is close to a ball, but it is not perfectly spherical; instead, it is a *bumpy oblate spheroid.* We say "bumpy" because of the topographic features like mountains and canyons. We say "oblate" because the physics of spinning objects causes the Earth to bulge slightly around its equator. That is, while the Earth's circumference is about 25,000 miles around, and its diameter is about 8,000 miles, the Earth is approximately 27 miles wider at the equator than it is from pole to pole. So the Earth is not a perfect sphere but a flattened "spheroid." That said, the Earth is very nearly a perfectly smooth ball; if it were shrunk to the size of a billiard ball, it would be as round and about as smooth!

In order to represent and communicate information about the Earth, we construct models of it. Because the Earth is three-dimensional and nearly spherical, it makes sense to construct a three-dimensional spherical model to understand it. This is called a **globe**. In order to identify locations on the Earth surface in a precise and standardized way, a grid of lines is laid over the globe, called the **graticule**. The graticule identifies two dimensions of Earth-surface location with lines running horizontally, in the direction of the equator, and lines running vertically, from pole to pole (**Figure 1.22**). The horizontal lines are called **parallels,** and they encode **latitude,** which refers to locations north or south of the equator. Because the Earth is a spherical shape, the locations of latitude lines are expressed in angular terms as degrees north or south (°N or °S). Intermediate latitude lines are expressed in terms of angular minutes and seconds, or tenths and hundredths of degrees. The equator is 0° (neither north nor south), the North Pole is 90°N, and the South Pole is 90°S. The vertical lines are called **meridians** and they encode **longitude.** Meridians express location east or west, but there is no natural vertical line equivalent to the equator to use as an origin line. Instead, an international treaty from more than a century ago established an origin line passing through the Greenwich Observatory outside London; this longitude line is called the **prime meridian**. Like latitude, the locations of longitude lines are expressed in angular terms as degrees, either east or west of the prime meridian (°E or °W). The prime meridian is 0° (neither east nor west), the city of Beijing in China is about 116°E, and the city of Vancouver in Canada is about 123°W. On the opposite side of the Earth from the prime meridian, running vertically through the Pacific Ocean, is the 180° meridian line (also neither east nor west). Incidentally, many people confuse the 180° meridian line with the International Date Line (where the date of the day of the year changes forward or back, depending on your direction of travel), but the two are different and coincide only in some places.

Maps are geographers' primary tools of spatial analysis. All spatial analysis starts with locations, and all locations are related to the global grid of latitude and longitude. Because these lines of reference are drawn on the spherical Earth, their projection onto a map distorts their grid relationships. The extent of variance between the globe grid and a map grid helps tell us the kind and degree of distortion that the map will contain.

[2]A more detailed discussion of map projections, including examples of their different types and purposes, may be found in Appendix A.

Only the globe grid itself retains all of these characteristics. To project it onto a surface that can be laid flat is to distort some or all of these properties and consequently to distort the reality the map attempts to portray.

## How Maps Show Data

The properties of the globe grid and of various projections are the concern of the cartographer; **cartography** is the art and science of maps and map-making. Geographers are more interested in the depiction of spatial data and in the analysis of the patterns and interrelationships those data present. Out of the myriad items comprising the content of an area, the geographer must, first, select those that are of concern to the problem at hand and, second, decide on how best to display them for study or demonstration. In that effort, geographers can choose among different types of maps and different systems of symbolization. These symbols use properties like shape, color, and size to represent geographic meaning, in somewhat the same way that words represent meaning in language.

Maps can first be classified as either reference maps or thematic maps. **Reference maps** are *general-purpose maps*. Their purpose is simply to show without analysis or interpretation a variety of natural or human-made features of an area or of the world as a whole, including showing the locations of features accurately. Reference maps answer the question, "What is there?" Familiar examples are highway maps, city street maps, topographic maps (**Figure 1.23**), atlas maps, and the like. Until about the middle of the 18th century, the general-purpose or **reference map** was the only type of map, for the function of the mapmaker (and the explorer who supplied the new data) was to "fill in" the world's unknown areas with reliable locational information. With the passage of time, scholars saw the possibility of using the accumulation of locational information to display and study the spatial patterns of social and physical data. The maps they made of climate, vegetation, soil, population, and other distributions introduced the thematic map, the second major class of maps.

**Thematic maps** are *specific-purpose maps*—they present a specific spatial distribution or a single category of data—that is, a graphic theme. Thematic maps could be called *statistical* or *graph maps;* they answer the question, "What is the spatial pattern of this variable?" The way the information is shown on such a map may vary according to the type of information to be conveyed, the level of generalization that is desired, and the symbolization selected. Thematic maps may be either *qualitative* or *quantitative.* The principal purpose of the qualitative map is to show the distribution of a particular class of information. The world location of producing oil fields, the distribution of U.S. national parks, or the pattern of areas of agricultural specialization within a state or country are examples. The interest is in where things are in an approximate way, and nothing is reported about—in the examples cited—barrels of oil extracted or in reserve, number of park visitors, or value or volume of crops or livestock produced.

In contrast, quantitative thematic maps show the spatial characteristic of numerical data. Usually, a single variable such as population, average rainfall, median income, annual wheat production, or average land value is chosen, and the map displays differences from place to place in that variable. Important types of quantitative thematic maps include graduated circle, dot, isoline, and choropleth maps (**Figure 1.24**).

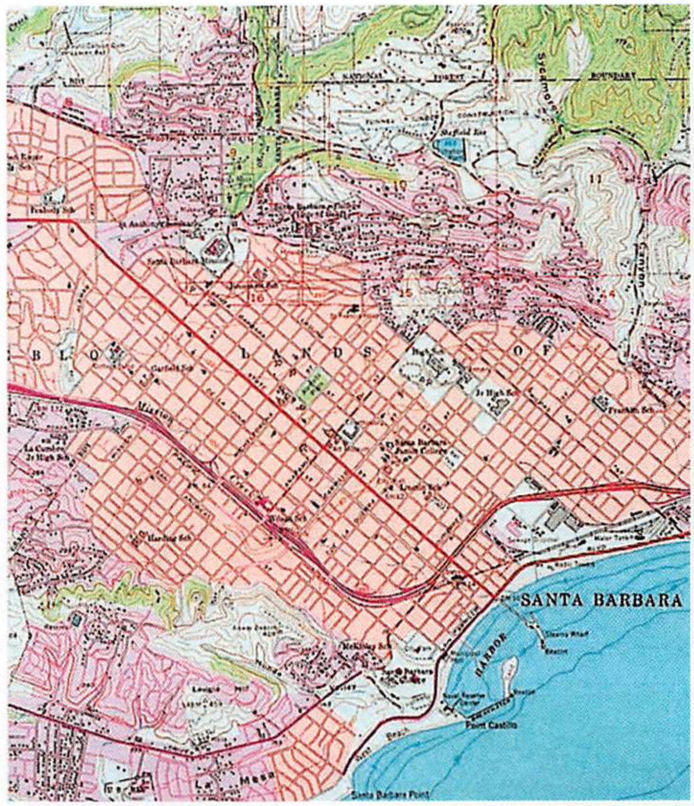



**Figure 1.23** A portion of the Santa Barbara, California, topographic quadrangle of the U.S. Geological Survey 1:24,000 series. Topographic maps portray landscape features of relatively small areas. Elevations and shapes of landforms, streams and other water bodies, vegetation, and coastal features are recorded, often with great accuracy. Because cultural items that people have added to the physical landscape, such as roads, railroads, buildings, political boundaries, and the like, are also frequently depicted on them, topographic maps are classed as general-purpose or reference maps by the International Cartographic Association. Incidentally, the scale of the original map no longer applies to this photographic reduction.

*Source: U.S. Geological Survey.*

**Graduated circle maps** use circles of different size to show the magnitude of a variable of interest in different places; the larger the circle, the greater the magnitude of the variable. They are examples of the more general class of thematic symbols called **proportional area symbols** that include shapes other than circles. On **dot maps,** a single or specified number of occurrences of the item studied is recorded by a single dot. An **isoline map** features lines that connect points registering equal values of the item mapped (*iso* means "equal"). For example, *isotherms* shown on daily weather maps connect points recording the same temperature at the same moment of time or the same average temperature during the day. Identical elevations above sea level may be shown by a form of isoline called a *contour line.*

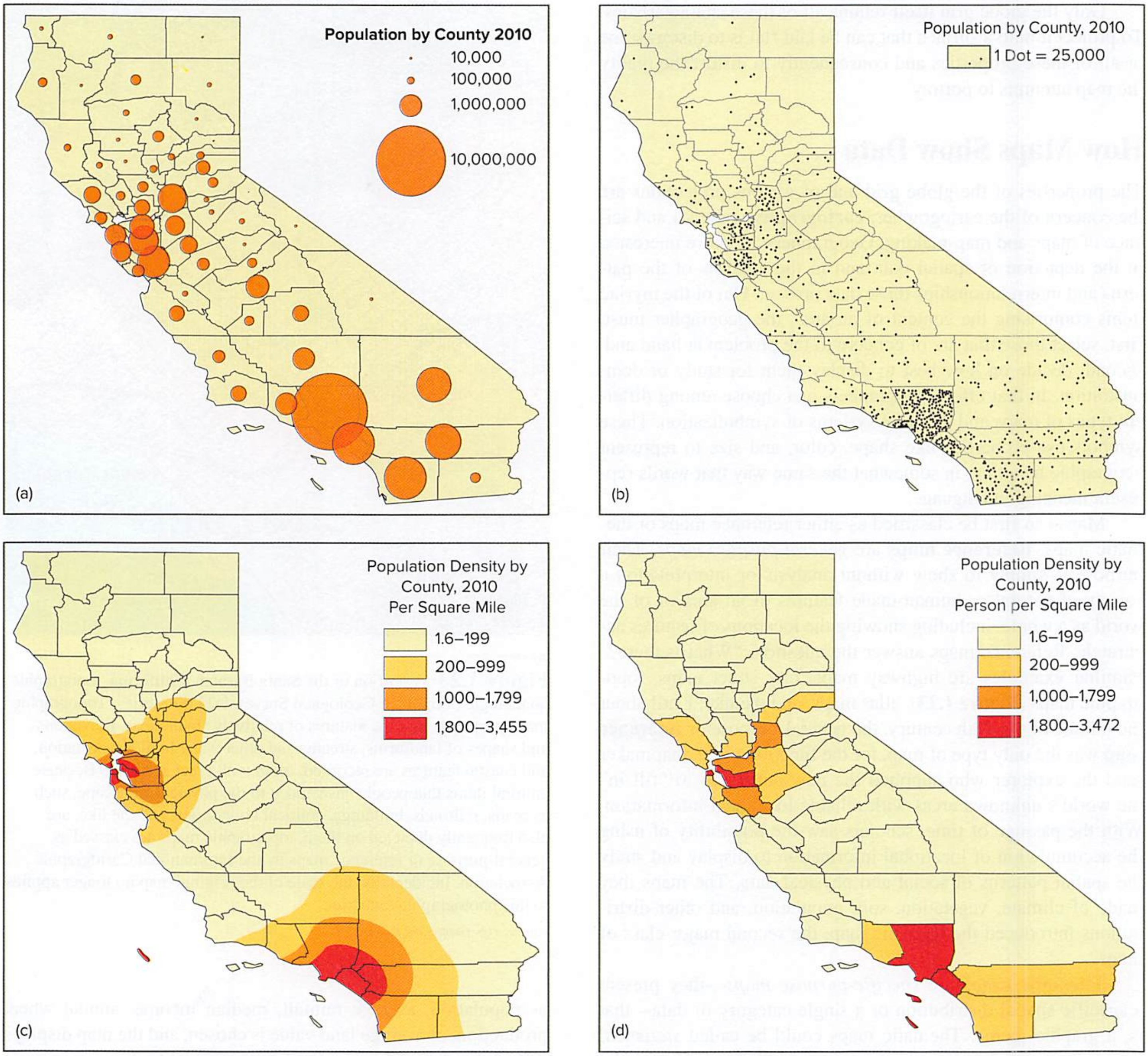



**Figure 1.24** Four thematic map types display the same data. Although population is the theme of each, these different California maps present their information in strikingly different ways. (*a*) In the graduated circle map, the area of the circle is approximately proportional to the absolute number of people within each county. (*b*) In a dot-distribution map where large numbers of items are involved, the value of each dot is identical and stated in the map legend. The placement of dots on this map does not indicate precise locations of people within the county, but simply their total number. (*c*) Population density is recorded by the isoline map, while the choropleth map (*d*) may show absolute values, as here, or, more usually, ratio values such as population per square kilometer.

A **choropleth map** presents average value of the data studied per preexisting areal unit—dwelling unit rents or assessed values by city block, for example, or (in the United States) population densities by individual townships within counties. Each unit area on the map is then shaded or colored to suggest the magnitude of the event or item found within its borders. Where the choro-pleth map is based on the absolute number of items within the unit area, as it is in Figure 1.24*d*, rather than on areal averaging (total numbers, for example, instead of numbers per square kilometer), a misleading statement about density may be conveyed. That is, if the same magnitude is shown with the same shading or color, large areal units will dominate the visual field, even though they actually represent a much less dense concentration of the feature in question.

A **statistical map** records the actual numbers or occurrences of the mapped item per established unit area or location. The actual count of each state's colleges and universities shown on an outline map of the United States or the number of traffic accidents at each street intersection within a city are examples of

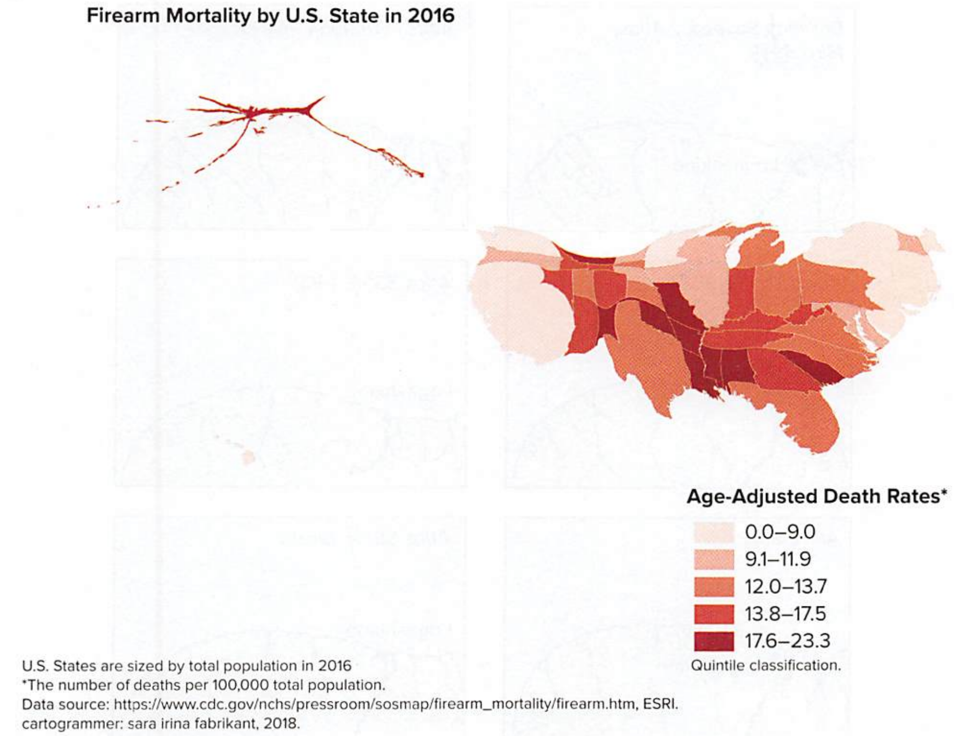



**Figure 1.25** A cartogram in which each state is sized according to its number of residents in the year 2016. The cartogram also shows firearm mortality for 2016.

statistical maps. A **cartogram** uses such statistical data to transform space so that the largest areal unit on the map is the one showing the greatest statistical value (**Figure 1.25**).

Maps communicate information but, as in all forms of communication, the message conveyed by a map reflects the intent and, perhaps, the biases of its author. Maps are persuasive because of the implied precision of their lines, scales, color and symbol placement, and information content. But maps, as communication devices, can subtly or blatantly manipulate the message they impart or contain intentionally false information (**Figure 1.26**). In fact, maps cannot help but be selective in the information they present, and they simplify this information by using cartographic symbols. Maps always show features at a different scale than they exist in reality, and the necessity to use projections to show the Earth's surface as flat always introduces some spatial distortion, as we discussed above. Maps, then, can distort and lie as readily as they can convey verifiable spatial data or scientifically valid analyses. The more that map users are aware of those possibilities, and the more understanding of map projections, symbolization, and common forms of thematic and reference mapping standards they possess, the more likely they are to reasonably question and clearly understand the messages maps communicate.

# 1.4 Contemporary Geospatial Technologies

The growth and advancement of three interrelated geospatial technologies—global positioning systems, remote sensing, and geographic information systems—has revolutionized geography and increased the geographer's ability to collect, analyze, and visually represent some forms of geographic data. **Global positioning systems (GPSs)** rely upon a system of 24 orbiting satellites, Earth-bound tracking stations that control the satellites, and portable receivers that determine exact geographic locations based on the time delay in signals received from three or more satellites (technically, they determine location from an inference based on the time required for several signals to travel from the satellite to the Earth and back). Remote sensing allows the collection of vast amounts of geographic data, while geographic information systems (GISs) can integrate GPS, remote sensing, and other forms of spatial data. Google Earth and interactive mapping and navigation web sites such as MapQuest are everyday uses of contemporary geographic research technologies.

## Remote Sensing

**Remote sensing** is a relatively new term, but the process that it describes—detecting the nature of an object and the content of an area from a distance—is more than 150 years old. Soon after the development of the camera, photographs were being taken from balloons and kites. In the early 20th century, fixed-wing aircraft provided a platform for the camera and photographer, and by the 1930s, aerial photography from planned positions and routes permitted reliable data gathering for large and small area mapping purposes. Even today, high- and low-altitude aerial photography with returned film remains a widely used remote sensing technique. Standard photographic film detects reflected energy within the visible portion of the electromagnetic spectrum.

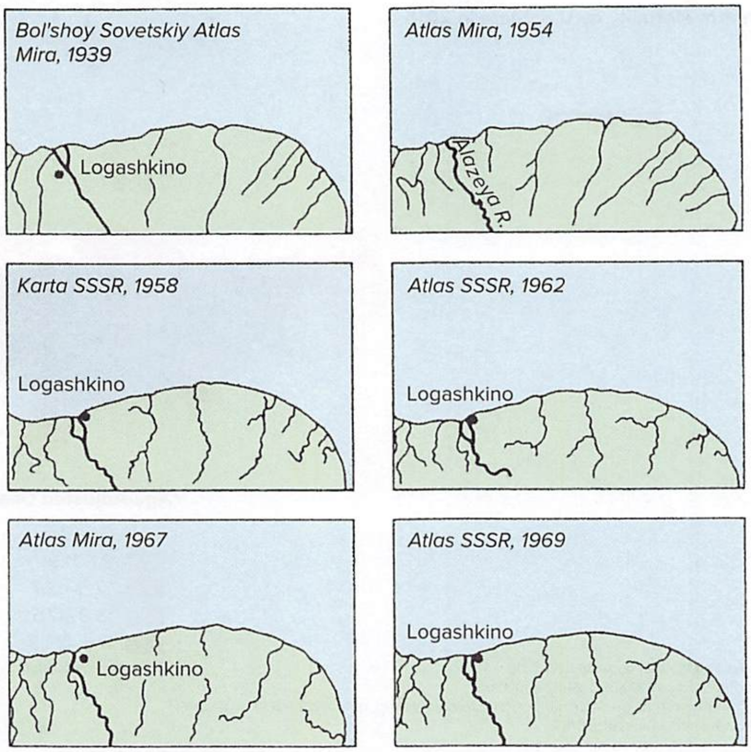



**Figure 1.26** The wandering town of Logashkino, as traced in various Soviet atlases by Mark Monmonier. Deliberate, extensive cartographic "disinformation" and locational falsification, he reports, became a Cold War tactic of the Soviet Union. We usually use—and trust—maps to tell us exactly where things are located. On the maps shown, however, Logashkino migrates from west of the river away from the coast to east of the river on the coast, while the river itself gains and loses a distributary and, in 1954, the town itself disappears. The changing misinformation, Monmonier suggests, was intended to obscure from potential enemies the precise location of possible military targets.

*Source: Mark Monmonier,* How to Lie with Maps, *2nd Ed. University of Chicago Press, 1996.*

It can be supplemented by special sensitized infrared film that has proved particularly useful for the recording of vegetation and hydrographic features and by nonphotographic imaging techniques, including thermal scanning (widely used for studying various aspects of water features such as ocean currents and water pollution and, because it can be employed during nighttime hours, for military surveillance and energy budget observations) and radar mapping (also operative night and day and useful for penetrating clouds and haze).

For more than 30 years, spacecraft (with or without crews) have supplemented the airplane as the vehicle for imaging Earth features. Among the advantages of satellites are the speed of coverage and the fact that views of large regions can be obtained. In addition, they are equipped to record and report back to Earth digitized information from multiple parts of the electromagnetic spectrum, including some that are outside the range of human eyesight. Satellites enable us to map the invisible, including atmospheric and weather conditions, in addition to providing images with applications in agriculture and forest inventory, land-use classification, identification of geologic structures and mineral deposits, and more. The different sensors of the American Landsat satellites, first launched in 1972 (Landsat 8 was put aloft in 2013), are capable of resolving objects between 15 and 60 meters (50 and 200 ft) in size. Even sharper images are yielded by the French SPOT satellite (SPOT 7 was launched in 2014); its sensors can show objects that are as small as 2 meters (6 1/2 ft). Satellite imagery is relayed by electronic signals to receiving stations, where computers convert them into photolike images for use in scientific research and in mapping programs.

# Geographic Information Systems (GISs)

Increasingly, digital computers, mapping software, and computer-based display units and printers are employed in the design and production of maps and in the development of databases used in map production. In computer-assisted cartography, the content of standard maps—reference and thematic—is digitized and stored in computers. The use of computers and printers in map production permits increases in the speed, flexibility, and accuracy of many steps in the mapmaking process but in no way reduces the obligation of the mapmaker to employ sound judgment in the design of the map or the communication of its content.

**Geographic information systems (GISs)** extend the use of digitized data and computer manipulation to investigate and display spatial information of all types. A GIS is both an integrated software package for handling, processing, and analyzing geographical data and a computer database in which every item of information is tied to a precise geographic location. In the section above that introduced geographic features, we discussed the fact that some features are better conceived of as objects and others as fields. As we mentioned there, this has implications for how we represent geographic information in the GIS. In the **vector approach,** reminiscent of object conceptualization, the precise location of each object—point, line, or area—in a distribution is described. In the **raster approach,** reminiscent of the field conceptualization, the study area is divided into a set of small (usually) square cells, with the content of each cell described or quantified (the rasters are analogous to pixels on a computer screen). The vector approach is more often suitable for human or cultural data, such as roads or cities, whereas the raster approach is more often suitable for natural geographic data, like elevations or rainfall. In either approach, a vast amount of different spatial information can be stored, accessed, compared, processed, analyzed, and displayed.

A GIS database, then, can be envisioned as a set of discrete informational overlays linked by reference to a basic locational grid of latitude and longitude (**Figure 1.27**) or some other coordinate system. The system then permits the separate display of the spatial information contained in the database. It allows the user to overlay maps of different themes, analyze the relations revealed, and compute spatial relationships. It shows aspects of spatial associations otherwise difficult to display on conventional maps, such as flows, interactions, and three-dimensional characteristics. In short, a GIS database, as a structured set of spatial information, has become a powerful tool for performing geographical analysis and synthesis.

A GIS data set may contain a great amount of place-specific information collected and published by the U.S. Census Bureau,


**Figure 1.27** A model of a GIS. A GIS incorporates three primary components: data storage capability, computer graphics programs, and statistical packages. In this example, the different layers of information are to be used in different combinations for city planning purposes. Different data sets, all selected for applicability to the questions asked, may be developed and used in urban geography, economic geography, transportation planning, industrial location work, and similar applications.

*Source: Shaoli Huang.*

including population distribution, race, ethnicity, income, housing, employment, industry, farming, and so on. It may also hold environmental information downloaded from satellite imagery or taken from Geological Survey maps and other governmental and private sources. In human geography, the vast and growing array of spatial data has encouraged the use of GIS to explore models of regional economic and social structure; to examine transportation systems and urban growth patterns; and to study patterns of voting behavior, disease incidence, accessibility of public services, and a vast array of other topics. GISs are essential tools in the process of voter redistricting. For physical geographers, the analytic and modeling capabilities of GIS are fundamental to the understanding of processes and interrelations in the natural environment.

Because of the growing importance of GIS in all manner of public and private spatial inquiries, demand in the job market is high and growing for those skilled in its techniques. Most university courses in GIS are taught in Geography departments, and "GIS/remote sensing" is a primary occupational specialty for which many geography undergraduate and graduate majors seek preparation.

## Mental Maps

Maps that shape our understanding of distributions and locations or influence our perception of the world around us are not always drawn on paper. We carry with us *mental maps* that in some ways are more accurate in reflecting our view of spatial reality than the formal maps created by geographers or cartographers. **Mental maps (cognitive maps)** are internal models or representations of an area or an environment developed by an individual on the basis of information or impressions received, interpreted, and stored. Sometimes, they leave out what are believed to be unnecessary details, and only important elements are incorporated. We use this information—this mental map—in organizing our daily activities: selecting our destinations and the sequence in which they will be visited, deciding on our routes of travel, recognizing where we are in relation to where we wish to be. A mental route map may also include reference points to be encountered on the chosen path of connection or on alternate lines of travel.

Such mental maps are every bit as real to their creators (and we all have them) as are the street or highway maps commercially available, and they are a great deal more immediate in their impact on our spatial decisions. We may choose routes or avoid neighborhoods not on objective grounds but on emotional or perceptual ones. In those choices, characteristics of people such as age or gender play an important role. For instance, the mental maps of women may contain danger zones where fear of sexual assault, harassment, or threatening persons?

To parallel the other two items is a determinant in routes chosen or times of journey. Whole sections of a community may be voids on our mental maps, as unknown as the interiors of Africa and South America were to Western Europeans two centuries ago. Our areas of awareness generally increase with the increasing mobility that comes with age, affluence, and education and may be enlarged or restricted for different social groups within the city (**Figure 1.28**).

# 1.5 Systems, Maps, and Models

The contents of areas are interrelated and constitute a **spatial system** that, in common with all systems, functions as a unit because its component parts are interdependent. Only rarely do individual elements of area operate in isolation, and to treat them as if they do is to lose touch with spatial reality. The systems of geographic concern are those in which the functionally important variables are spatial: location, distance, direction, density, connectivity, and the other basic concepts that we have reviewed. The systems that they define are not the same as regions, though spatial systems may be the basis for regional identification.

Systems have components, and the analysis of the role of components helps reveal the operation of the system as a whole. To conduct that analysis, individual system elements must be isolated for separate identification and, perhaps, manipulated to see their function within the structure of the system or subsystem. Maps and models are devices that geographers use to achieve that isolation and separate study.

Maps, as we have seen, are effective to the degree that they can segregate at an appropriate level of generalization those system elements selected for examination. By compressing, simplifying, and abstracting reality, maps record in manageable dimension the real-world conditions of interest. A model is a simplified abstraction of reality, designed to clarify relationships among its elements. Maps are a type of **model,** representing reality in an idealized form to make certain aspects more clear.

The complexities of spatial systems analysis—and the opportunities for quantitative analysis of systems made possible by computers and sophisticated statistical techniques—have led geographers to use other kinds of models in their work. An important example is the computational model that represents reality as a set of mathematical or computer programming statements. Model building is the technique scientists use to simplify complex situations, to eliminate (as does the map) unimportant details, and to isolate for special study and analysis the role of one or more interacting elements in a total system. Models also allow geographers to conduct experiments on a simulation of a portion of reality instead of the reality itself, which is often very difficult, unethical, or impossible to do.

An interaction model discussed in Chapter 3, for instance, suggests that the amount of exchange expected between two places depends on the distance separating them and on their population size. The model indicates that the larger the places and the closer their distance, the greater is the amount of interaction. Such a model helps us to isolate the important components of the spatial system, to manipulate them separately, and to reach conclusions concerning their relative importance. When a model satisfactorily predicts the volume of intercity interaction in the majority of cases, the lack of agreement in a particular case leads to an examination of the circumstances contributing to the disparity. The quality of connecting roads, political barriers, or other variables may affect the specific places examined, and these causative elements may be isolated for further study.

Indeed, the steady pursuit of more refined and definitive analysis of human geographic questions—the "further study" that continues to add to our understanding of how people occupy and utilize the Earth, interact with one another, and organize and alter Earth

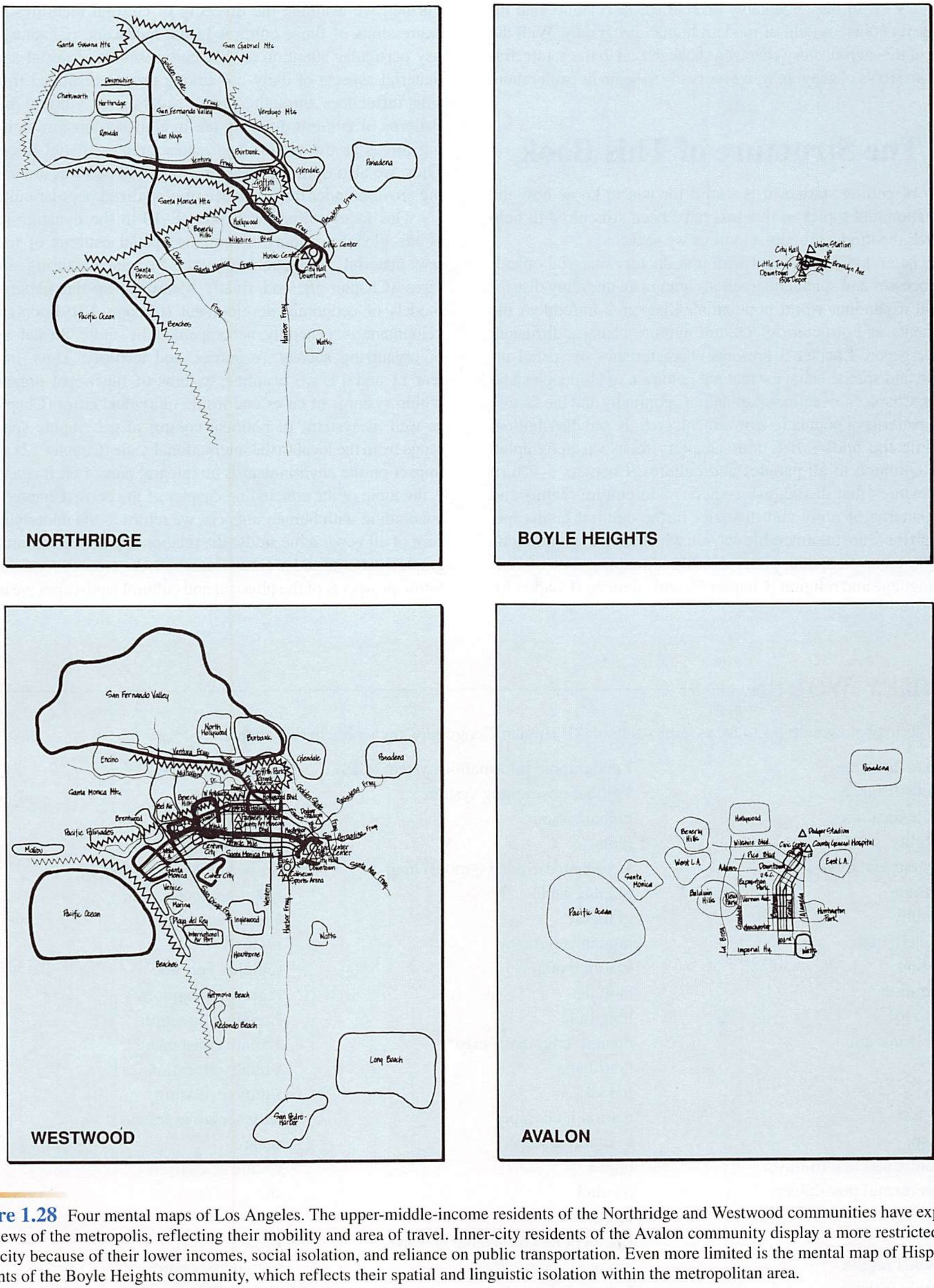



**Figure 1.28** Four mental maps of Los Angeles. The upper-middle-income residents of the Northridge and Westwood communities have expansive views of the metropolis, reflecting their mobility and area of travel. Inner-city residents of the Avalon community display a more restricted view of the city because of their lower incomes, social isolation, and reliance on public transportation. Even more limited is the mental map of Hispanic residents of the Boyle Heights community, which reflects their spatial and linguistic isolation within the metropolitan area.

*Source: From Department of City Planning, City of Los Angeles,* The Visual Environment of Los Angeles, *1971.*

space—has led to the remarkably diversified, fascinating, and interesting yet coherent field of modern human geography. With the content of this introductory chapter as background to the nature, traditions, and tools of geography, we are ready to begin its exploration.

## 1.6 The Structure of This Book

By way of getting started, it is useful for you to know how the organization and topics of this text have been structured to help you reach the kinds of understandings we seek.

We begin in Chapters 2–4 with introductory material on cultural processes and spatial interactions among an unevenly distributed and expanding world population. Chapter 2 introduces the components and structure of culture, culture change, diffusion, and divergence. Chapter 3 presents characteristics of spatial interaction and spatial behavior that are common to all peoples and cultures. Chapter 4 examines population geography and the factors driving patterns of population movement, growth, and distribution.

While the book's first four chapters focus on geographic themes common to all peoples and cultures, Chapters 5–7 turn to the features that distinguish societies and culture realms and create patterns of unity and diversity in the cultural landscape. Although there are innumerable ways in which human populations differ, we focus on spatial patterns of three major points of contrast: language and religion (Chapter 5), and ethnicity (Chapter 6). Further, we examine the diversity of cultural identities and the expressions of those cultures in the landscape (Chapter 7). We pay particular attention to folk cultures—the material and nonmaterial aspects of daily life among groups insulated from outside influences through spatial isolation or cultural barriers. Patterns of cultural diversity are in constant tension with unifying forces as the world experiences greater spatial interaction. Thus, we also examine ways in which folk cultures are undergoing erosion under the influence of globalized popular cultures.

Our focus shifts in Chapters 8–10 to the dynamic patterns of the global economy, examining spatial patterns of food and raw material production (Chapter 8), manufacturing and services (Chapter 9), and finally measures, spatial patterns, and models of economic development (Chapter 10). Economic development is generally accompanied by more formal systems of organizing society, resources, and territory. Thus, in Chapters 11 and 12, we examine systems of functional organization within systems of cities and inside individual cities (Chapter 11), as well as systems of political control of geographic space that range from the local to the international scale (Chapter 12). Human impact on the environment is an integral part of each chapter and is the topic of the concluding chapter of the book (Chapter 13). In concluding with human impacts, we return to the underlying concern of all geographic study: the relationship between human geographic patterns and processes and both the present conditions and future prospects of the physical and cultural landscapes we inhabit.

## AP KEY WORDS

Use the terms below with a ▌ to focus your study of AP Human Geography key words in this chapter.

▌ absolute direction
▌ absolute distance
▌ absolute location
accessibility
administrative region
▌ cartogram
cartography
▌ choropleth map
▌ clustering
concentration
connectivity
cultural landscape
density
develop
▌ dispersion
▌ dot map
▌ environmental determinism
▌ environmental possibilism
equator
field
▌ functional region
geographic feature
▌ geographic information system (GIS)
▌ global positioning system
globalization
globe
▌ graduated circle (symbol) map
graphic scale
graticule
human geography
▌ isoline map
latitude
longitude
mental (cognitive) map
meridian
model
natural landscape
▌ natural resource
object
parallel
▌ pattern
▌ perceptual (vernacular) region
physical geography
▌ place
place stereotype
placelessness
prime meridian
▌ (map) projection
proportional area symbol
raster approach
▌ reference map
region
regional concept
regional geography
▌ relative direction
▌ relative distance
▌ relative location
▌ remote sensing
representative fraction
scale
▌ scale of analysis
site
situation
▌ space
spatial association
spatial diffusion

spatial distribution
spatial interaction
spatial system
statistical map
systematic geography
thematic map
thematic (formal) region
vector approach

## AP TEST PRACTICE

### Multiple Choice Questions

1. **The importance of analyzing landscapes such as the one in the Figure 1.1 on page 3 is that it**
   (A) provides a context for understanding human-environment relationships.
   (B) allows geographers to make assumptions about the impact of climate change.
   (C) has an impact on government policy about the environment.
   (D) explains why people spend large amounts of money on leisure activities.
   (E) shows how leisure activities in developing countries compare to those in developed areas.

2. **A major difference between relative space and absolute space is that**
   (A) relative space is the area where group or family members live while absolute space is not inhabited by a person's relations.
   (B) relative space is made up of the places a person goes to on a day-to-day basis.
   (C) relative space is comparative and varies with context, while absolute space is based on mathematical coordinates.
   (D) absolute space is more often used by geographers to show relationships between places.
   (E) absolute space is less accurate than relative space for showing location.

3. **Looking at maps at different scales such as the population density maps in Figure 1.9 on page 11 is important for a geographer because**
   (A) density changes within an area as the scale is made smaller or larger.
   (B) information that is true at a larger scale may not be true of all areas at a smaller scale.
   (C) small-scale maps are often less accurate than large scale maps.
   (D) large-scale maps allow information to be tailored to the county or city level.
   (E) conclusions from large-scale studies can be assumed to be true at smaller scales as well.

4. **A local TV or radio station's broadcast area, a pizza shop's delivery area, and a neighborhood church are all examples of functional (or nodal) regions because**
   (A) they have a specific function in the neighborhood.
   (B) they are all regulated by local government laws.
   (C) they have relationships with areas outside their own locality.
   (D) they are small scale businesses.
   (E) they have a central location and are only available within a specific area.

5. **In order to make a series of map overlays to show the interaction of terrain with city infrastructure, a geographer would use**
   (A) a GPS system.
   (B) a cartogram.
   (C) a polar projection.
   (D) a GIS system.
   (E) an urban model.

6. **A problem with studying geography by region is**
   (A) regions may overlap and often have transitional boundaries.
   (B) regions are so different from one another that comparisons are impossible.
   (C) functional regions are no longer a valid concept in human geography.
   (D) some regions are more developed than others.
   (E) climate regions play a very important role in agricultural practices.

7. **All of the following are ways that mapping spatial data is used to analyze the human organization of space EXCEPT:**
   (A) Dot matrix maps use a dot to represent a specific amount of data on a map.
   (B) Thematic maps can show the distribution of specific phenomena or the spatial characteristic of numerical data.
   (C) Topographical maps show the elevation of an area along with the landscape features added by humans.
   (D) Choropleth maps use gradations of color to show a spatial characteristic of specific data.
   (E) Cartograms show the number of instances of a specific phenomenon by graphing it on an X and Y axis.

8. **When describing the location of a place on the earth, geographers use**
   (A) site to explain the physical characteristics of a place and situation to explain the place's relationship to other places.
   (B) latitude and longitude to note the relative location of the place on the globe.
   (C) place names and other toponyms to describe the place.
   (D) absolute and relative distance to describe location based on where other nearby places are located.
   (E) cultural landscape studies to compare that place's location to other places on the earth.

9. **The two photographs of Miami, Florida, in Figure 1.12 on page 14 illustrate the idea that**
   (A) the physical landscape of an area never changes.
   (B) human impact has had a major impact on the physical landscape in the past but what people do today has had little impact.
   (C) rising population has very little impact on the physical landscape.
   (D) the characteristics of a place today are a result of the impact humans have had on their physical landscape in the past.
   (E) geography is only useful for studying the physical landscape of the past.

10. **Field experiences for human geographers are**
   (A) a way that data was gathered before the advent of GIS and GPS systems.
   (B) a way that organizations and individuals can gather useful data for economic, environmental, and social decision making.
   (C) studies that focus on rural areas and agricultural data collection.
   (D) made by doing controlled experiments in laboratories.
   (E) only used to study developing countries through interviews, photographs, informal observations, and surveys.

## Free Response Questions

1. **Answer Parts A, B, and C below.**
   (A) Define the term cognitive or perceptual region (also called a vernacular region) and give an example of one.
   (B) Define the term mental map and explain how one might be used.
   (C) In what ways are mental maps similar to perceptual regions?

2. **Study at the map in Figure 1.5 on page 9.**
   (A) Name the type of projection shown and explain why this projection might be used by a geographer.
   (B) Name another type of projection. Explain what this type of projection could be used for and what the drawbacks of using it could be.
   (C) Name a third type of projection, what it could be used for and what the drawbacks of using it could be.

3. **Answer Parts A, B, and C below.**
   (A) Define the terms *spatial distribution* and *spatial association*.
   (B) Explain the difference between arithmetic density and physiological density. How does density affect the spatial distribution of a phenomenon?
   (C) How do dispersion (or concentration) and pattern affect the spatial distribution of a phenomenon?