CHAPTER 1

True Maps, False Impressions: Making, Manipulating, and Interpreting Maps

INTRODUCTION

Human geography studies the distribution of humans and their activities on the surface of the Earth and the processes that generate these distributions. People use geographic space and interact with the environment when they grow crops, build homes, drive cars, do jobs, raise children, practice religions, cast votes, and spend leisure time. Geographers help us understand the evolving character and organization of human life on the Earth 's surface.

Geographers subscribe first and foremost to the view that location matters. It is significant that 313 million persons live in the United States. More significant, however, is where these 313 million persons live. Are they urban or rural? Are they spreading out or becoming increasingly concentrated? What kinds of places are attracting people, and what kinds are losing them? These are geographic questions. Similarly, the world is capable of producing plenty of food to feed its current population of 7.0 billion. Relevant questions about world hunger are geographic ones. How are the supply of and demand for food distributed spatially? What environmental, economic, and political factors account for these distributions? How are demand and supply reconciled in the international marketplace for food?

Many of the topics that you will find in this workbook are common to other sciences. Geographers have no monopoly on the study of baseball franchises, migration, AIDS, the population explosion, civil war, and air pollution. Geographers bring to the table their unique spatial perspective and interest in human-environmental relations by asking "where?" and "why there?" questions about the same pressing human problems that engage other social and environmental scientists.

The "where" question leads to five overarching themes in human geography that run through the various chapters of this book. The first theme, **location**, refers not only to the exact coordinates of a point in space but also to where it is relative to other factors. **Place**, the second theme, involves the human and physical characteristics that uniquely define a place and impart meaning to its inhabitants. The third theme, **region**, defines areas that are bound together by common characteristics: Similar places and locations form common regions. In the fourth geographical theme, **movement** of information, goods, and people connect locations and regions to one another. The final theme is **human-environmental interactions**. Humans and their environment interact in both directions: environmental resources constrain and benefit human societies, while human activities refashion and degrade their environments.

Geography 's spatial perspective—and all five themes—lead to the heavy use of maps. In the broadest sense, a **map** is a two-dimensional graphical representation of the surface of the Earth. No map can perfectly represent reality. People tend to think of maps as unalterable facts, as if they were produced by an all-seeing overhead camera. In practice, however, mapmakers (or cartographers, as they are known in the field) exercise considerable discretion in the spatial information they display and the way they display it. You

must always keep in mind that any map you look at could have been made in countless different ways, sometimes drastically altering your perception of what you see.

Cartographers (mapmakers) make five critical decisions about map construction that greatly influence the message conveyed by the map. First, they choose a particular **map projection**, which is a systematic method of transferring the spherical surface of the Earth to a flat map. There is an old saying that "all maps lie flat, and all flat maps lie." It is utterly impossible to represent the three-dimensional world on a flat, two-dimensional piece of paper or video screen without stretching or compressing it in some way. Every projection is therefore distorted in one way or another, and this distortion influences the impression in the viewer 's mind about the size and proximity of different regions of the world (Figure 1.1).

For example, Figure 1.1 A shows the Mercator projection of the world, a map used in early navigation because all compass bearings (directions) are correct. The British Empire, based on sea power, used the Mercator projection extensively and spread it around the world. However, this projection grossly exaggerates area as you move away from the equator. For this reason, Mercator maps were a favorite of President Reagan during the Cold War because they made the Soviet Union appear much larger than it actually was, reinforcing the impression that the USSR was a dangerous threat and thereby justifying a tough anti-Soviet stance. For the same reason, Mercator projections are unpopular among equatorial countries, whose size appears diminished. A popular projection that attempts to preserve the area of map features and avoid high-latitude distortions is the Mollweide, shown in Figure 1 .1B . Many international agencies, such as the World Bank, have changed the map projections they use in an effort to more accurately depict relationships between countries, not biasing any one region. For example, Figure 1.1 C shows the van der Grinten projection, which portrays both Russia and Canada at over 200 percent larger than they actually are. The National Geographic Society used this projection for over 50 years before changing to the Robinson projection (Figure 1.1 D) in 1998. The Robinson projection better portrays the relationship between land and water areas in the world and does not distort countries at high latitudes nearly as much.
Although these four examples of map projections show the shape and size distortions that can occur, they all still adhere to certain conventions that can also be misleading. For instance, they all split the world through the Pacific Ocean, making Japan appear far from Hawaii and the United States. This false impression may have contributed to the "surprise" Japanese attack on Pearl Harbor during World War II.

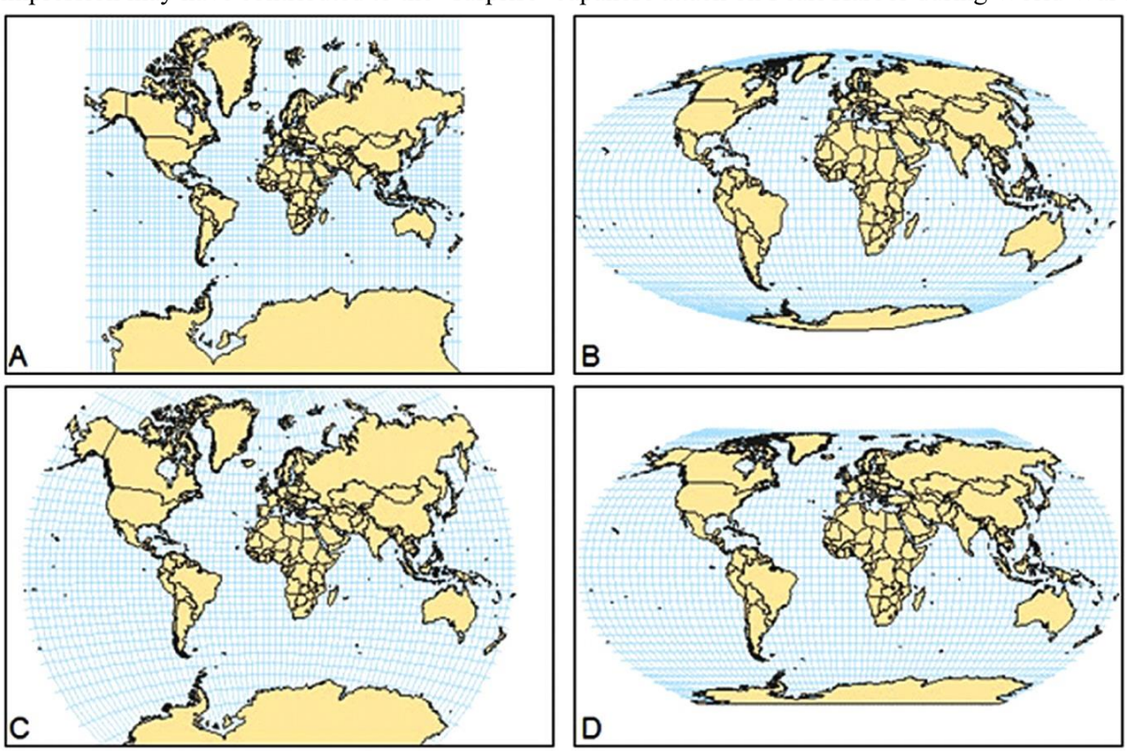


Figure 1.1 A-D The projection chosen to draw the spherical earth on flat paper affects the shape of the map and our perception of the relationships between the map features

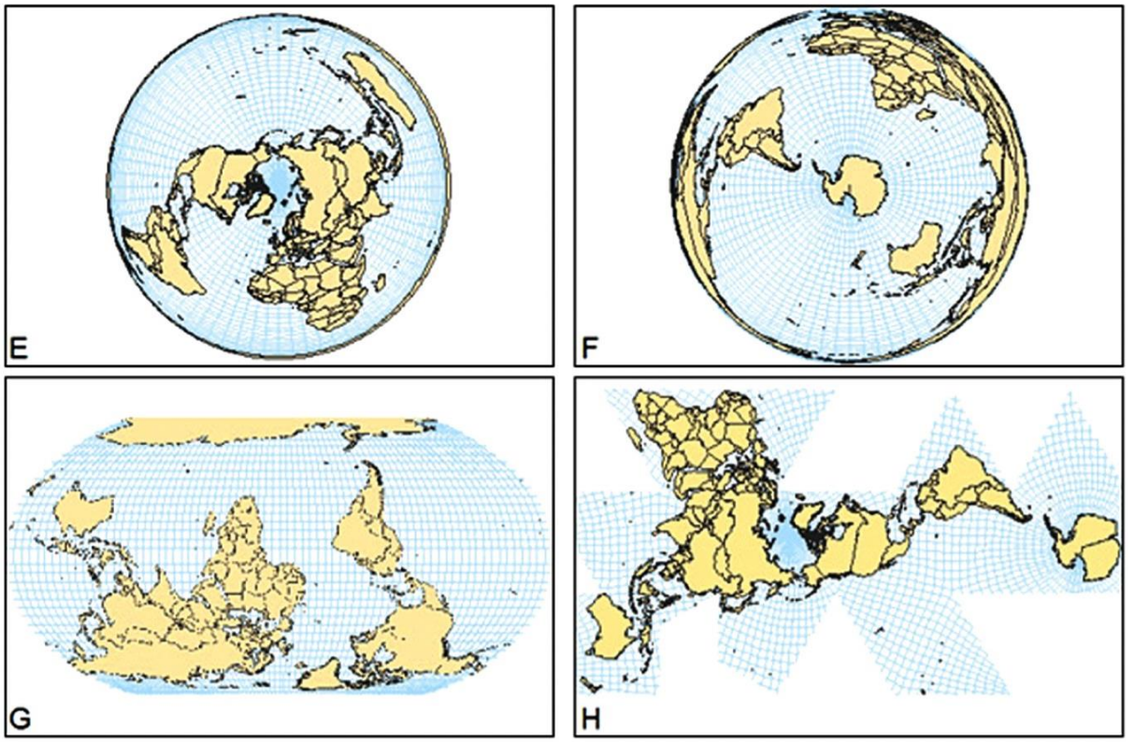


Figure 1.1 E-H The projection chosen to draw the spherical earth on flat paper affects the shape of the map and our perception of the relationships between the map features.

Polar projections centered on the North Pole in Figure 1.1 E clearly show how close the former Soviet Union and the United States are to each other over the Arctic Ocean, a relationship you cannot see in the first four projections. Looking at this projection, it becomes obvious that northern Canada and Alaska were good locations for warning stations designed to detect incoming Soviet nuclear missiles. A less common view of the polar projection focused on the South Pole and Antarctica (Figure 1.1F) makes Australia, New Zealand, Chile, and Argentina appear central to the world. In fact, there is no compelling reason for adhering to the convention of showing north at the top on a map. Europe and North America typically occupy the privileged position on a map where our eyes tend to focus, reinforcing the perception of their dominant status in the world. The Earth as seen from space could just as easily be depicted with south up (Figure 1.1 G), a radical change that calls into question global geopolitical relations.

Finally, the Dymaxion Map™ (Figure 1.1H) reveals the landmasses situated in a worldwide ocean, without visibly distorting the relative shapes and sizes and without splitting any continents. This map, designed by the Buckminster Fuller Institute, attempts to show the global connections of all humanity rather than disassociated countries and places competing against each other.

The second critical decision cartographers routinely make is **simplification**. Simplification can take many forms, such as omission, straightening, exaggeration, and distortion, depending on the map' s ultimate use. Maps of Canada for educational purposes frequently omit small, uninhabited islands and straighten jagged coastlines in the Canadian Arctic, whereas maps for navigation try to show the same features with great accuracy, as well as water depth and currents. Highly simplified subway maps emphasize information that is of potential use to a subway rider and ignore features of the human and natural environment that are unimportant to navigating the subway network (Figure 1.2). Stations five or six blocks apart in the central city appear on the map as far apart as suburban stations separated by several miles, because for most subway travelers, distance is unimportant. What matters is whether they are on the right line, how many stops until they need to get off, and whether they need to change trains. To make road lines readable on the map, they are drawn thicker than if they were drawn proportional to their width in the real world. Some buildings are considered important enough to include, but most are not. No two cartographers make these ultimately subjective decisions in the same way.

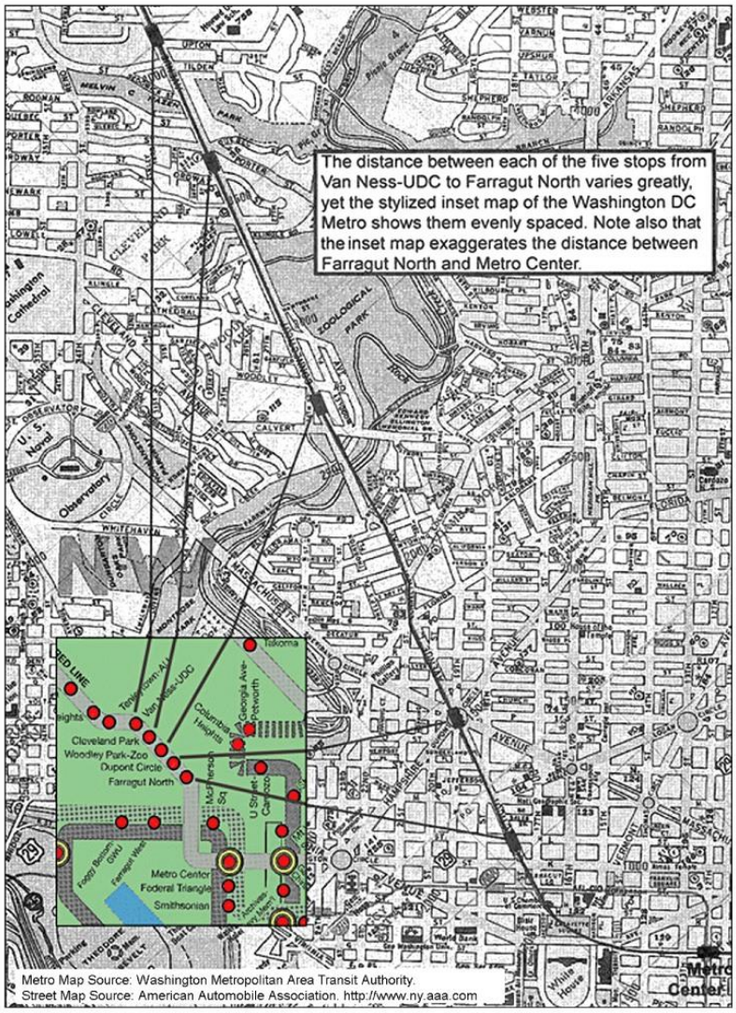


Figure 1.2 The DC Metro inset map is highly selective in that it shows only the sequential relationship between subway stops. All underlying detail is suppressed so that even distance is distorted.

A third way to manipulate the way a map looks is by choosing a different map scale. **Map scale** refers to the degree to which a map "zooms in" on an area. Map scale can be defined as the ratio of map distance (distance between two points on a map) to Earth distance (the distance between those two points on the surface of the Earth), measured in the same units. Every map has a scale, and the degree of generalization of information depends on that scale. A large-scale map depicts a small area (such as downtown Phoenix) with great detail. A small-scale map depicts a large area (such as the state of Arizona) but with less detail. You can remember this by considering the size of a particular feature on a map. For example, the larger your city or country appears on a map, the larger the map scale. Another way to remember it is by the fraction that defines the ratio of map distance to Earth distance. On a large-scale map of downtown Phoenix, the scale might be 1/10,000, which is a larger number than 1/1,000,000 for a typical small-scale map of Arizona. A large fraction means large scale; a small fraction means small scale. (*Note* : We are referring here to the entire fraction, not its denominator. The bigger the denominator, the smaller the fraction and the smaller the map scale.)

Defining the scale of analysis is important in geography. Many geographical research questions will have different answers when asked at different scales. Take, for instance, airport location. America 's airports are bursting at the seams. Departures have more than doubled since 1980, while only a single major new airport has been built. Most major airlines, with the notable exception of Southwest, operate a hub-and-spokes system, where flights converge at several times of day from all over the country, passengers debark and switch planes if necessary, and then an outgoing bank of flights take passengers to their final

destinations. If the question is whether to locate a new hub airport at a central or peripheral location, the answer is very different at the national and local scales. At the national scale, most hubs for domestic airlines are located in the *central* region of the United States to minimize detours for passengers switching planes. Major hubs are at Atlanta (Delta), Charlotte (US Air), Chicago (United, American), Cincinnati (Delta), Dallas (Delta, American), Denver (United), Detroit (Delta), Houston (United), Minneapolis (Delta), Philadelphia (US Air), Phoenix (US Air), and Salt Lake City (Delta). Cities in the peripheral corners of the United States, such as Boston, Miami, San Diego, and Seattle, are not used as domestic hubs because they would create huge detours for passengers traveling between most U.S. airport pairs. At the local scale, on the other hand, it would be nearly impossible to locate a new airport in a central location, even though centrality would maximize the airport 's accessibility to the entire metropolitan area. The cost of the land, the security risk, the number of residents and businesses it would displace, and the large populations that would be affected by noise and traffic would pose insurmountable problems for a new centrally located airport. The only major metropolitan airport built in the last two decades—Denver International Airport—is located on Denver 's eastern periphery, out on the prairie (Figure 1.3). Airport location at the local scale thus depends on an entirely different range of issues from those at the national scale.

Mark Leibowitz/Masterfile

Figure 1.3 Denver International Airport, built in 1995, is located 20 miles east of the city center.

Related to map scale is the fourth cartographic issue, data **aggregation** . The level of data aggregation influences the spatial patterns we see. By level of aggregation, we are referring to the size of the geographic units under investigation (i.e., cities, counties, states, regions, countries, or groupings of countries, such as Central America, Western Europe, or Eastern Africa). A particular pattern that is revealed at one level of aggregation does not necessarily appear at another. For example, the spatial pattern of college graduates depends on whether you consider counties or states as your unit of analysis. If asked by a high-tech employer: "Where are the highest percentages of people with a college degree?" a good geographer would answer that it depends on the level of geographic resolution you have in mind. At the state level of aggregation, Massachusetts has the highest percentage of people with a bachelor 's degree or higher at 38.2 percent, and West Virginia has the lowest at 17.3 percent (Figure 1.4). Maps at the county level, however, show that some urban counties and counties with universities in West Virginia have higher percentages of college graduates than do some rural counties in Massachusetts (Figure 1.5).

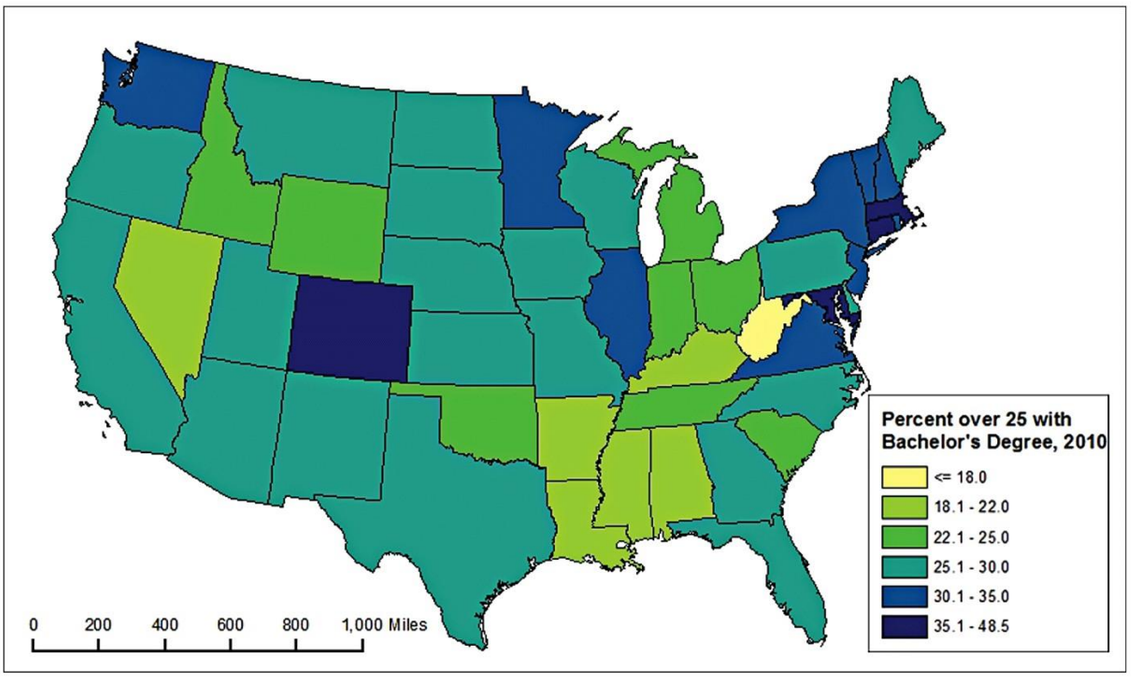


Figure 1.4 Percent of the population over 25 years old with a bachelor's degree, 2010. Source : U.S. Census Bureau.

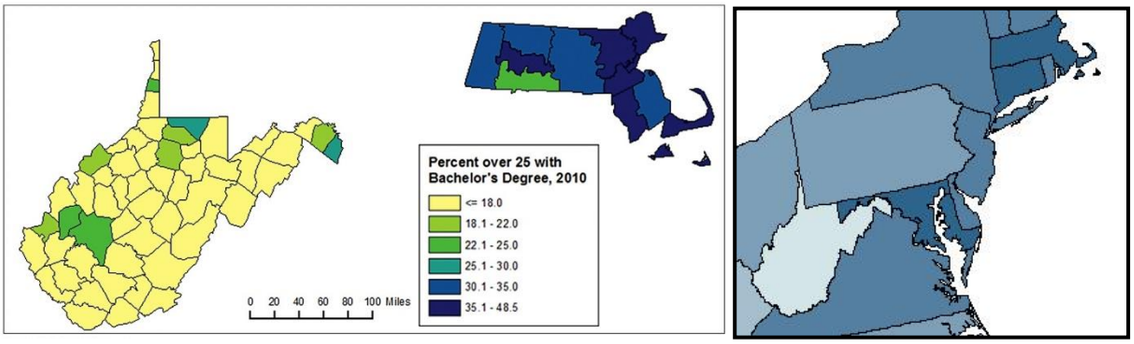


Figure 1.5 Percent over 25 with a bachelor's degree for WV and MA counties, 2010. Source : U.S. Census Bureau.

Finally, the fifth way to influence the way a map looks is through the type of map you choose. General-purpose maps with a variety of common features such as cities, boundaries, mountains, and roads are known as **reference maps**. Maps that highlight a particular feature or a single variable such as temperature, city size, or acreage in potatoes are called **thematic maps**.

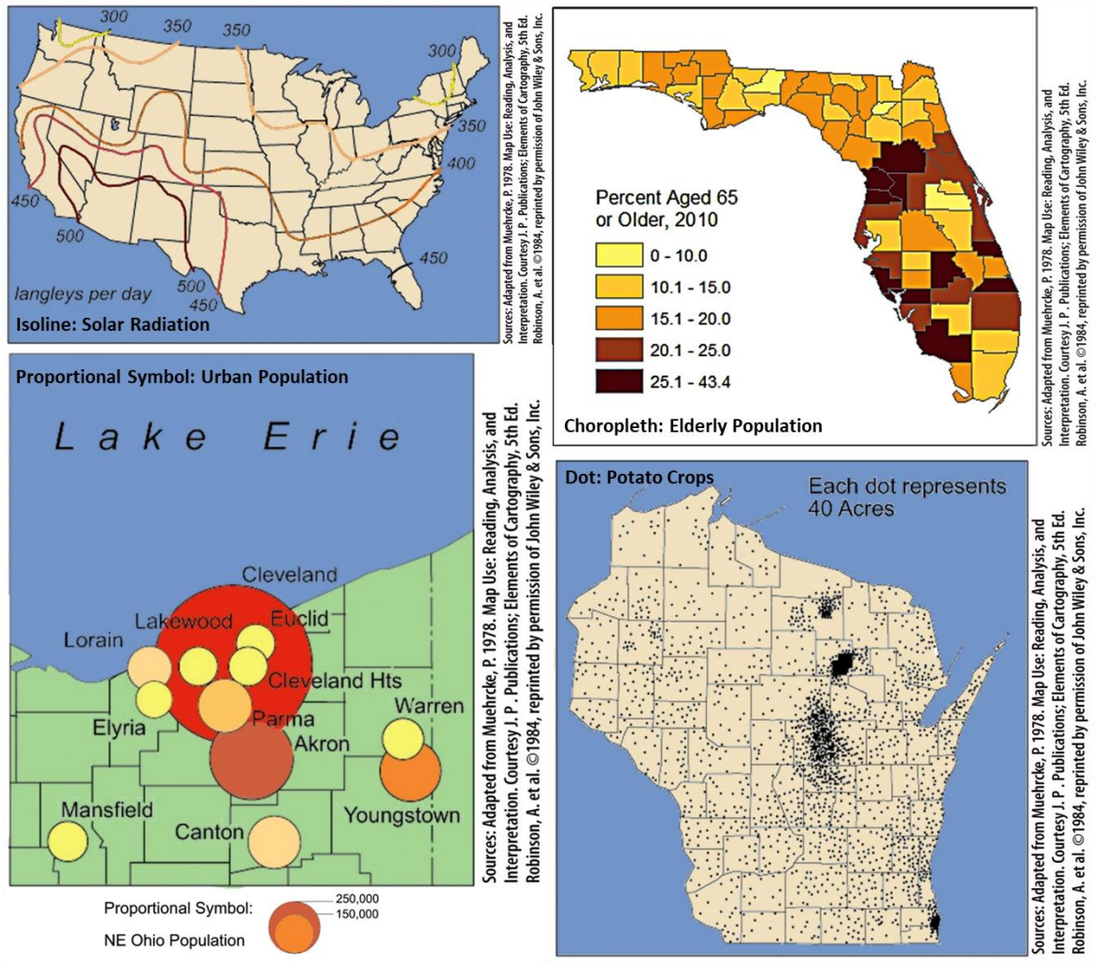
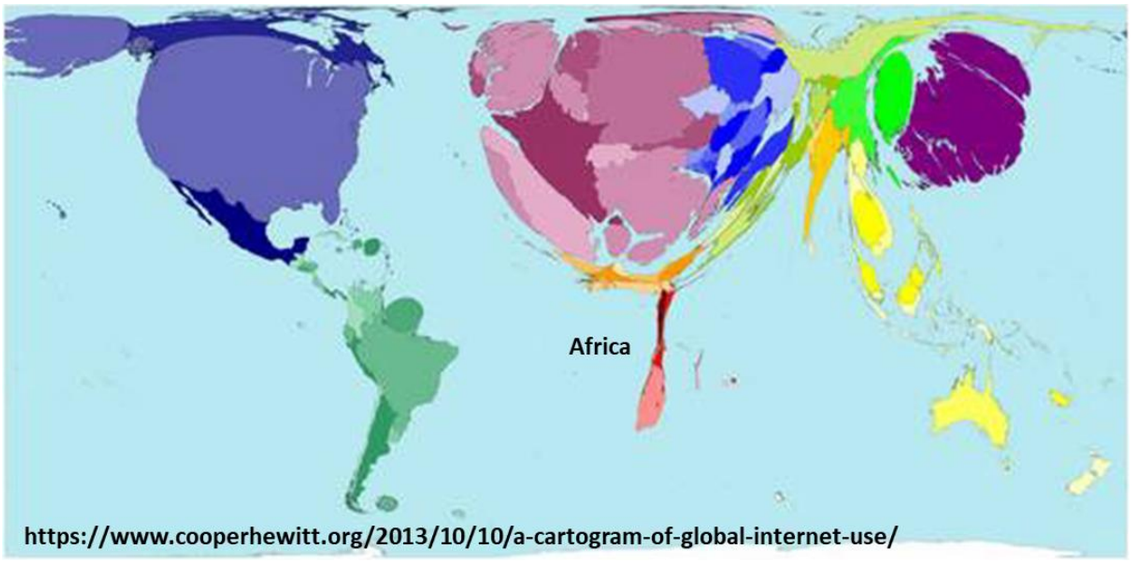
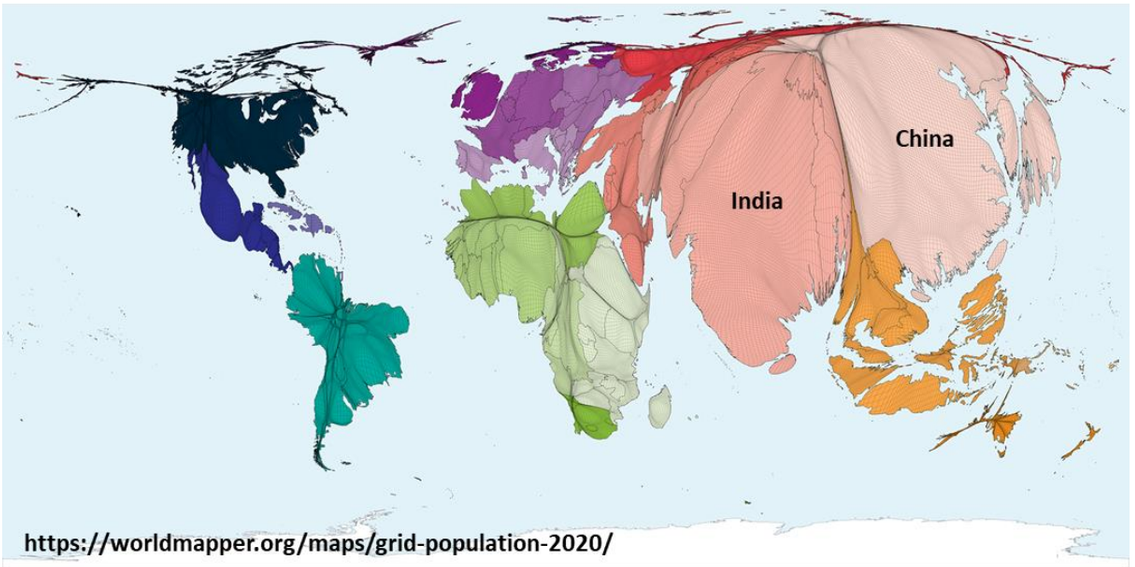


Figure 1.6 Four types of thematic maps.

There are several types of **thematic maps** (Figure 1.6). **Isoline maps** show lines that connect points of equal value (*iso* means "equal" in Greek). A topographic map, for instance, shows lines of equal elevation above sea level. Crossing an isoline amounts to going up or down that surface (increasing or decreasing the value of the variable being mapped). A **choropleth map** shows the level of some variable within predefined regions, such as counties, states, or countries. It categorizes a variable into classes and depicts each class with different shading patterns or colors. A **proportional symbol map** uses a symbol such as a circle to show intensity or frequency; the size of the symbol varies with the frequency or size of the variable being mapped. Finally, **dot maps** use a dot to represent the occurrence of some phenomenon in order to depict variation in density in a given area.





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There is also a fifth type of thematic map which was not commonly used until relatively recently (see figures above), the cartogram. Cartograms take some time to figure out as they are deliberately distorted. A cartogram is a thematic map in which the geographic size of the features (nations, states/provinces, counties…) is altered to be directly proportional to the characteristic selected for data visualization. Because the values shown are relative to each other, the information is shown according to largest to smallest – and thus the area allotted to each feature (in both maps above, nations) is larger if that characteristic is measurably larger, or smaller as that characteristic is less.

The top map here looks at the usage of the internet by country. Note how prominent the US and Europe are, and the – perhaps surprisingly – less usage there is in the world's two most populous countries, India and China. But the telling measure here is how little internet usage there is in Africa.

The bottom map is of country population. Note the size of India and China – both have more than 1 billion people. The United States is the world's third largest country (as of 2020), and has barely 1/4th the population of India or China.

Cartograms are also called value-area maps or an anamorphic maps.

The project you will work on in this chapter asks you to use **spatial data**, which have a geographic or locational component. You can place them on the surface of the Earth, and therefore you can map them. Many users will be familiar with simple forms of spatial data through common Web-mapping tools such as Google Maps, Bing Maps, or MapQuest. These programs allow users to add locations on a map and link them to photos, descriptions, or other information. Geographers commonly use two types of geographic data: primary and secondary. **Primary data** are measured or obtained directly by researchers or their equipment without any intermediary. For instance, survey research involves asking people about their shopping behavior, travel patterns, or migration history. Traffic counts can be measured by video cameras, sensor plates or wires, or human observers. Geographers obtain **secondary data** from another source that has previously collected, processed, and catalogued the data. Agencies of international, national, state, and local governments collect and disseminate a veritable treasure trove of geographic information. Examples are agencies of the United Nations (www.un.org), the U.S. Census Bureau (www .census.gov), the National Oceanographic and Atmospheric Administration (www .nesdis.noaa.gov), state governments, and local planning agencies. Using secondary data can be efficient (imagine conducting your own census!) and can enable you to greatly extend the scope of your research by including a wide array of factors.

One of the most important recent trends in geography is the development of **geographic information systems (GIS)**. A GIS is, in short, a spatial database linked to a graphic display. Geographers and scientists in related fields use a GIS to store, access, analyze, and display geographic information in electronic form with user-friendly software. Addresses and locations can be given *x,y* Earth coordinates (geocoded) within a GIS, enabling the user to pinpoint and interrelate a variety of phenomena in geographic space. The volume and variety of geographic data that can be linked using space as the reference grid literally have no limit. Different geographic information is stored in different layers that can be viewed in any combination, and their relations to each other can be analyzed.

A GIS has many useful applications in planning, environmental management, market research, and demographic analysis.

TRUE MAPS, FALSE IMPRESSIONS

► *CASE STUDY (continued)*

CASE STUDY: The African-American Population in the U.S.

GOAL

To interpret and critically evaluate maps, to understand how **scale** influences data representation on maps, and to recognize three types of map scale: representative fraction, verbal, and graphic. You will also learn how to represent data with different types of **thematic maps** —the **dot map** , the **isoline map** , the **choropleth map**, and the **proportional symbol map** —and see that your choice of map type profoundly influences the resulting spatial pattern.

LEARNING OUTCOMES

After completing the chapter, you will be able to:

- Convert map scale to real-world distances.
- Recognize choropleth, proportional symbol, isoline, and dot maps.
- Recognize that changing the scale and type of a map changes its message.
- Understand the difference between changing scale and changing level of aggregation.
- Use GIS to change the class limits on a choropleth map.
- Describe the geographic distribution of African-Americans in the United States.

BACKGROUND

Africans were first brought to what is now the United States between 1619 and 1808 as slaves to work on tobacco, rice, sugar, and cotton plantations, mostly in the South. Although the practice of bringing slaves into the country was banned beginning on January 1, 1808, some smuggling of slaves continued further into the nineteenth century. Importation was replaced by programs of slave breeding and trade within the South. Although most slaves were concentrated in the South, a small number of slaves escaped to the North and other parts of the country, where they were represented across many walks of life. A free black man living in Baltimore was commissioned by Thomas Jefferson to survey the District of Columbia. Black cowboys, based in Texas, were well known on cattle drives throughout the West.

Many people are surprised to learn that African-Americans represented a sizable share of the U.S. population during the seventeenth and eighteenth centuries. At the time of the first census in 1790, one of every five residents of the new country was African-American. Concentrations were highest in southern states: 54 percent of South Carolina's population was African-American, 40 percent of Virginia's, 37 percent of Georgia's, 34 percent of North Carolina's, and 33 percent of Maryland's.

After emancipation in 1863, most African-Americans remained in the South, working as sharecroppers or tenants on white-owned cotton farms, barely getting by. Although there were compelling reasons to leave the South, including crushing poverty, antiblack terrorism, and lack of civil rights, few actually left the region. Many black farmers were illiterate and therefore unaware of economic opportunities in other parts of the country. White landowners, desperate to preserve their favored way of life sustained by cheap black labor, promulgated an economic system that put sharecroppers in a position of permanent indebtedness, making departure illegal. In the late nineteenth century, northern labor unions lobbied against the importation of African-Americans from the South, fearing it would depress their wages. They preferred European immigrants to meet the demand for new industrial workers in America's burgeoning manufacturing sector.

All of that changed after the end of World War I, beginning one of the most dramatic migration streams in U.S. history. At the turn of the twentieth century, 90 percent of the nation's African-American population lived in the South, mostly in the rural South. By 1970, barely 50 percent lived in the South (Figure 1.7), millions having sought a better life in northern cities. The reasons for leaving were many and complicated. The supply of cheap immigrant labor was cut off by World War I, and recruiters went south, bringing literally trainloads of African-American workers to the steel mills, automobile factories, and meatpacking plants of Pittsburgh, Detroit, Chicago, and other northern cities (Figure 1.8). Once these connections had been established, thousands of migrants followed and established themselves in predominantly black neighborhoods such as Harlem in northern Manhattan (Figure 1.9) and the South Side of Chicago. The Great Depression of the 1930s and the mechanization of cotton harvesting after 1945 further spurred the African-American exodus from the South. The mechanical cotton picker rendered sharecroppers obsolete by drastically reducing the need for their labor. Early models of the cotton picker reduced the costs of picking cotton from $40 to $5 per bale. Each machine did the work of 50 pickers. As the mainstay for southern African-American

employment evaporated, many left the rural South in search of northern jobs. A second wave of black migration headed to California from 1940 to 1970, lured by both industrial and agricultural jobs.

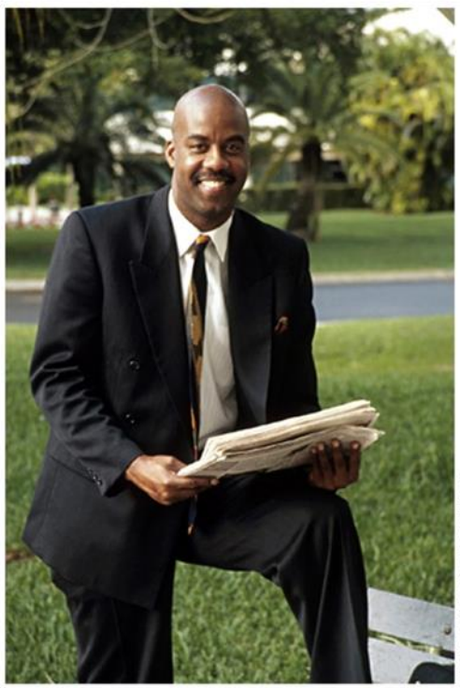
The story does not end here, for migration flows between the South and North were reversed after 1970. Fewer African-Americans now left the South, and many more moved from the North to the South. Race riots and deteriorating economic conditions in northern cities served as push factors, and the favorable economic opportunities and improved social conditions of the "New South" attracted migrants from the North.

Figure 1.7 Farmer near Hattiesburg, Mississippi, plows his field. His products are marketed through a cooperative of African-American family farmers.

Figure 1.8 Many African-Americans flourished in their neighborhoods in northern cities. Many, such as his construction worker at Newark Airport, continue to work in blue-collar industries.

Figure 1.9 African-American culture, featuring jazz and blues music, played for renowned people such as Olympian great Jesse Owens (dancing here with his wife at the opening of the Cotton Club in Harlem, September 25, 1936).

Whereas the earlier migration streams connected the *rural* South to the *urban* North, today' s streams primarily link the *urban* North with the *urban* South. California, after several decades as a magnet for black migrants, lost more than it gained in the late 1990s. Many blacks returned to the South, and others "spilled over" into nearby Arizona, Nevada, and Washington. College-educated African-Americans are migrating to the South at higher rates than are those with a high school education or less (Figure 1 .10).



Willie L. Hill, Jr./The Image Works

Figure 1.10 Recent data show a black "brain drain" from New York, Pennsylvania, and Ohio and a "brain gain" in Georgia, Maryland, Texas, and North Carolina, where the existence of a large black middle class in cities such as Atlanta and Dallas exerts a strong attraction.

In 2008, perhaps the ultimate race barrier was broken when Barack Obama was elected president of the United States (Fig. 1.11). Although of mixed race (his mother was white), he self-identifies as African-American, and his wife, Michelle, is descended from slaves in South Carolina. Obama 's election was an emotional milestone for the many people who fought for equality during the long civil rights struggles, and it also sent a powerful message to the entire world that past injustices are at last being resolved and that the United States truly is a land of opportunity. Young people of the post–civil rights era were some of Obama' s most enthusiastic supporters, indicating that racial divisiveness is less prevalent in new generations than in past ones. Racism has not disappeared, but the election of an African-American president provides great hope that hatred and discrimination based purely on skin color might finally be eliminated.

Figure 1.11 Barack Obama, with wife Michelle at his side, was sworn in as 44th President of the United States on January 20, 2009.

This exercise, involving mapping the distribution of African-Americans, relies heavily on information about race from the U.S. Census. Census race data are used to enforce antidiscrimination laws on voting rights, equal job and housing opportunity, and access to credit, as well as in studies of migration, residential segregation, health, education, and poverty. Until recently, the U.S. Census Bureau had established five racial categories— American Indian or Alaskan Native, Asian or Pacific Islander, Black, White, and "Some Other Race"—and asked respondents to self-identify as one of the five groups. Beginning with the 2000 Census and continuing in the 2010 Census, Americans were allowed to select more than one racial category, reflecting the growing rates of racial intermarriage and the increasing racial and ethnic diversity of the nation's population. In addition, the number of racial categories was increased to six, renamed as "American Indian and Alaska Native," "Asian," "Black or African-American," "Native Hawaiian or Other Pacific Islander," or "Some Other Race." Also, the census category "Hispanic or "White," and Latino" is independent of these racial categories; Hispanics can be of any race.

The United States is about to pass through a new demographic change that some refer to as the post-racial age— groups currently categorized as racial minorities will account for the majority of the population by 2042 (and by as soon as 2023 for Americans under the age of 18). The white population will be the minority when compared to all others. But more important is the increasing complexity of racial categorizations and identities. "Race" is in fact a social construct; there are no biological determinants that define one race as clearly distinguishable from another. Definitions have changed throughout history, so that at one time the Irish were not considered "white," and neither were Italians, Lebanese, or Jews. Because more and more Americans are of mixed race or self-identify with one racial category with increasingly fuzzy barriers, race as a classification scheme may outlive its usefulness. Some claim that the very categories themselves serve a political purpose: to privilege the dominant white class above those of color. Racial politics continue to be an important part of the country, but whiteness is no longer a precondition for entry into the highest levels of public office or private-sector leadership. Racial strife and misunderstandings will certainly continue, but the demographic shifts that we are seeing will likely reduce the power of racial hierarchies in society so that all U.S. citizens are treated as individuals rather than as members of a caste or identity group. While the 2010 Census recognized greater racial diversity and intermixing, with 63 possible racial combinations, questions of what race means in our society and why we continue to collect data by race remain important social and political issues

DEFINITIONS OF KEY TERMS

Aggregation The level of detail for dividing a thematic map into geographic units, ranging from a coarse division (e.g., countries) to a fine division (e.g., zip codes).

Cartogram A thematic map in which the geographic size of the features (nations, states/provinces, counties…) is altered to be directly proportional to the characteristic selected.

Choropleth Map A thematic map in which ranked classes of some variable are depicted with shading patterns or colors for predefined zones.

Dot Map A thematic map in which a dot represents some frequency of the mapped variable.

Geographic Information Systems A computer hardware and software system that handles geographically referenced data. A GIS uses and produces maps and has the ability to perform many types of spatial analysis.

Human-Environmental Interactions The ways in which human society and the natural environment affect each other (the fifth theme of geography).

Human Geography The study of the distribution of humans and their activities on the surface of the Earth and of the processes that generate these distributions.

Isoline Map A thematic map with lines that connect points of equal value.

Legend Explanatory list of symbols in a map. Usually appears in a box in a lower corner.

Location The absolute position of something on the surface of the Earth and its relative proximity to other related things (the first theme of geography).

Map A two-dimensional graphical representation of the surface of the Earth (or of events that occur on the Earth).

Map Projection A systematic method of transferring a spherical surface to a flat map.

Map Scale The ratio of map distance to Earth distance, measured in the same units.

Movement The flow of people, goods, money, ideas, or materials between locations near or far (the fourth theme of geography).

Place The local human and physical characteristics that uniquely define a place and give it meaning to its inhabitants (the second theme of geography).

Primary Data Information collected directly by the researchers or their equipment without any intermediary. This can include surveys, interviews, observations, or measurements obtained in the field.

Proportional Symbol Map A thematic map in which the size of a symbol varies in proportion to the frequency or intensity of the mapped variable.

Reference Maps A general-purpose map that shows recognizable landmarks, roads, and political units.

Region An area characterized by similarity or by cohesiveness that sets it apart from other areas (the third theme of geography).

Secondary Data Information obtained indirectly from another source that was previously collected, processed, and made available to a larger audience.

Simplification Elimination of unimportant detail on maps and retention and possibly exaggeration and distortion of important information, depending on the purpose of the map.

Spatial Data Information that has a geographical or locational component.

Thematic Maps A map that demonstrates a particular feature or a single variable. Four types of thematic maps are (1) **dot maps**, (2) **choropleth maps**, (3) **proportional symbol maps**, and (4) **isoline maps.** See also: **cartogram**.