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Map Overlays

a geographic “big idea”
that can help us
understand the world.



Bright areas on this image are places where many people are using electric lights.
Can you explain why these bright areas are where they are?
Source: National Aeronautics and Space Administration.

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Big Idea – Overlaying Maps

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Interactive 1.1: World
Clickable Map



*A clickable, interactive
version of the world.*



Introduction: What do geographers “do?”

Overlaying maps is a useful geographical skill. It can help us see if things are related to each other. In this introductory chapter, we will focus on a map that shows where people live in the world. We will overlay maps that show:

- 1) locations of high mountains,
- 2) areas that are especially cold or dry, and
- 3) where large cities were located in ancient times.

Geography – “Geo” = earth, “Grafia” = study of

Geography is the study of the earth, and how people live in different places on the earth.

The subject is important because of one simple fact –

Things that are OK to do in one place might not be OK in another place.

- In kindergarten, kids learn where it is OK to yell and run around. “It’s OK on the playground. It’s not OK in church, at a concert, or in a museum.”
- High-school students learn that they should drive on the right side of the road (unless they are in England, where they should drive on the left side. A different rule there is a simple example of a fact of geography.)

- Adults decide where to build roads and malls. They decide where people can put factories, play baseball, buy cars, shoot animals, or launch missiles from a drone.

Somebody makes all these choices. They usually have reasons for their choices.

So let’s start by asking a simple question – why do you live where you do?

I know, for many students, the answer is “because that’s where my family lives.”

That’s true, but it doesn’t really answer the question. Why did your family decide to live where they do? Why do some people choose to live in crowded cities, while others live in suburbs, and still others in rural areas? (See photos.)



Rural area
Low population density
(few people per square mile)
This is called sparse population.



Suburb
Medium population density

Urban
High population density
(many people per square mile)
This is called dense population.



So . . . why do you live where you do? And why do other people live in different places?

You could ask questions like these at many different scales. A **geographic scale** is the size of area you are looking at.

Scales can range from a street to a state, country, or the whole world.

Here’s a big point: the geographic pattern of population at a state, national, or global scale is really just the result of a large number of decisions that people made at the scale of a family. A **geographic pattern** is a description of how things are arranged. Are they scattered evenly, or are they bunched together? Are they lined up? Does their arrangement on a map look like waves, rings, or some other shape?



Question: Why are we interested in geographic patterns?

Answer: Because geographic patterns can give us clues about causes and effects.

Here is a simple example of cause-and-effect logic. In police stations, officers often put pins or notecards on a map to show where things happen. They mark the locations of car crashes, burglaries, traffic stops, and so forth. They may even put the maps on computers linked by radios to the patrol cars.

Then they study the geographic patterns on the maps.

For example, what if nearly all of the stolen cars are close to an old factory?

Maybe someone is using the old building to hide and repaint stolen cars.

Or maybe the car thief lives close to that building.

In any case, the map helps the police decide where to investigate.

How do you start learning how to analyze geographic patterns?

Here is an honest answer: You can start in many different ways.

That’s one reason why this book comes with many activities.

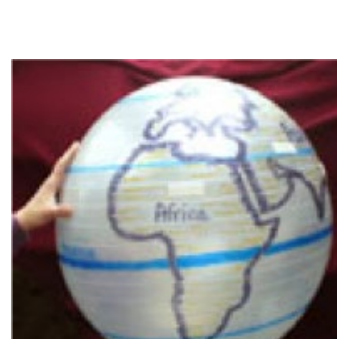
In a book like this, we have to choose where to start.

So let’s start by looking at why people live where they do.

This is a good topic for two reasons. First, it’s important.

Second, a world map of population is a good way to illustrate the skill of map overlaying. When we have mastered the skill, we can use it for many other topics.

So, here’s the plan: we will find a map of where people live, and we will analyze the map by overlaying maps that show other kinds of information.



We will look for things that have similar patterns on maps. Remember the main point:

We study geographic patterns because they might give us clues about cause-and-effect.

Here is the general question for this chapter: why do people live where they do?

Here is a more specific version of this general question:

Why do nearly all of the people live on less than one tenth of the earth?

(Does that fact mean that the earth could hold 10 times as many people?)

Let us start by making some generalizations about the earth as a whole.

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Generalizations about the Earth

Generalizations about the Earth

The earth is a big place.

It has nearly 200 million square miles.

It has more than 7 billion people.

You can do the math.

That's about 30 people for every square mile.



How to “do the math” in geography

When we say “do the math” in this book, it does not mean “calculate some numbers as accurately as you can.”

Frankly, that is usually a waste of time, because important numbers in geography are rarely precise.

For example, one website reported that the world had 7,240,915,447 people when I wrote this sentence.

(Check it yourself at <http://www.census.gov/popclock/>).

That might have been true at one point in time, but population is always changing.

A baby is born about every 8 seconds. A person dies every 13 seconds or so.

Even simple numbers about births and deaths can change.

Here is some important advice about how to learn geographic numbers:

Ignore most of the little details,
and

make simple comparisons to help you remember numbers.

Do not try to memorize a world population of 7,240,915,447.

It is both easier and better to remember “just over 7 billion people.” That is “about 30 people for every square mile.”

“About 30 people for every square mile” is a geographic generalization.

If you try to apply a generalization to a specific place, you learn another important fact:

Generalizations are not always correct, if you apply them to specific places.

For one thing, the earth does not have 200 million square miles of good land. In fact, more than half of the earth is covered by water. It's hard for people to live in a deep ocean!

So, the earth has about 7 billion people, and most of them live on about 60 million square miles of land. Do the math - that is more than 110 people for every square mile of land . . .

BUT

That is still a generalization, because every square mile of land does not have 110 people.

Why not? Because places are different.

The earth is big. A person cannot remember facts about every square mile. Our brains just cannot keep track of that much information.

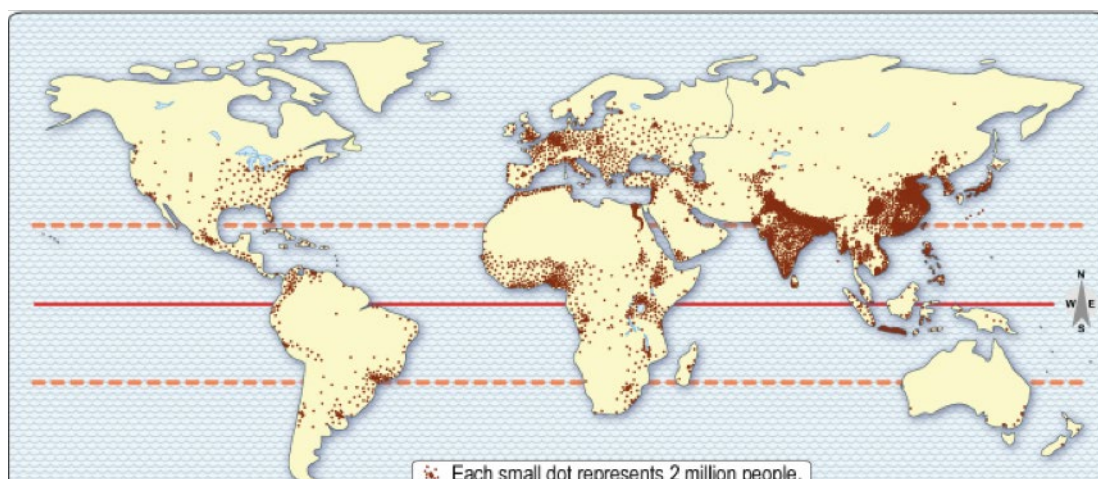
One goal in this book is to find better “ways of knowing.”

We are looking for ways that are easier and more effective than memorizing facts.

One great way is to find thematic maps that deal with the topics you are investigating. A **thematic map** uses symbols to show the geographic pattern of a specific topic or theme, like rainfall, crop yield, political party, or language (or even “weirder” topics like zombie sightings or the houses of movie stars).

In this chapter, we will investigate the geographic pattern on this thematic map.

It uses dots to show where people live.



Earlier, we made a generalization: “There are more than 110 people for each square mile of land in the world.” Do you think each square mile of land on this map has 110 people?

No – it is obvious that many people are crowded together in a few small areas.

Other fairly large areas have few people living in them.

Still other areas have scattered dots, with empty space between them.

This does not mean that two million people are living exactly where each dot is printed.

It also does not mean that no one is living in the empty spaces between the dots.

It does mean that two million people are living in the general area around each dot. These people may be scattered around. Or, they may be bunched together in small towns that are separated by less crowded areas. This map doesn't tell us. A world map can't.

In other words, every map is a generalization. It has to leave some details out.

To read a map correctly, you have to understand how it was made. This is another purpose of this book – to illustrate the skills you need to read maps well. These skills can also warn you when someone makes a map that could mislead you.

(That's enough about that for now. We can't do everything in the first chapter. Map skills will be a part of every chapter.)

Interactive 1.2: World Population Graph



This interactive chart shows population trends over time.

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Reasons for the geographic pattern of human population

Our goal in this chapter is to learn how map overlays can help us answer two key questions:

Where do most people live? Why do they choose to live there?

We can start by making guesses. Do you think statement 1, 2, or 3 is most likely to be true?

1. Most people live near mines where they can dig for gold and other valuable minerals.
2. Most people live in areas that have enough rain and sunshine to grow food crops.
3. Most people live in places where they make things like shoes, cars, phones, or skateboards.

These statements are hypotheses – cause-and-effect statements that we think might be true. A **hypothesis** is a carefully worded statement about cause-and-effect. We test hypotheses in order to see if they are true.

How can we test these hypotheses?

- We could interview a million people and ask them why they live where they do.
- We could look at census records to see if people live near mines, cropland, or factories.
- We could ask factory owners a simple either-or question.
 - Did they build their factories near places that already had a lot of people?
 - Or did they build them in empty places and then ask people to move there to work?

These investigations are all possible, but they would take a lot of time. Comparing maps is easier. To do that, we try to find maps that show the locations of things like good farmland. Then we compare these maps with our map of population.

Map comparison is easier if we use maps that are the same size and projection. A **map projection** is a way showing a large round earth on a small flat screen or piece of paper. All map projections involve some stretching and/or cutting. As a result, they can be misleading.

We will say more about different kinds of projections later.

If two maps are the same size and projection, we can overlay them. This means we can put one map right on top of the other. With a computer, we can turn different kinds of information on or off separately. With the right software, we can even make one map partly transparent. Then we can “look through” it to see how things on it line up with things on the other map.

These are the skills we will use to investigate the conditions that might influence where people choose to live.

Note: We will provide a different “clickable” computer map for each chapter in this book. These maps are designed to help you study the specific topics in each chapter.

For example, the clickable map for the chapter about Africa has 30 different layers of information related to the idea of latitude (distance from the equator). You can turn these maps on or off in any combination. This will let you compare the geographic patterns of things like rain, wildfires, lions, ancient capitals, slave traders, and diseases like malaria. Comparing maps can make it easier to identify possible cause-and-effect relationships.

(This, in turn, might help in your science and history classes!)

Interactive 1.3: Map Projections



Click here to take a look at many different map projections.

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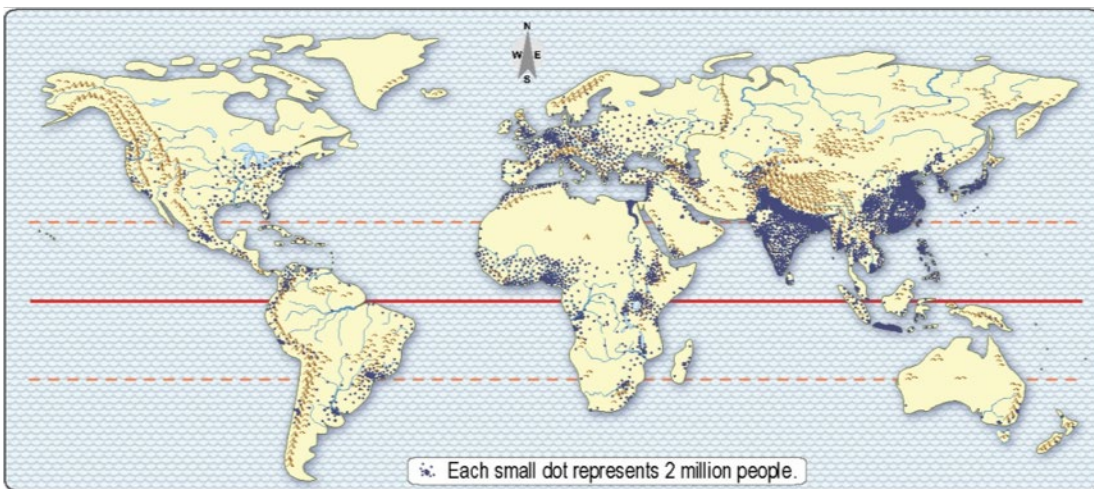


Hypothesis #1: It is hard for people to live in rugged mountains.

To test this hypothesis, we can overlay the map of population on a map of mountains.

When we do that, we see that mountainous areas generally have few people living in them.

(Note that we made the population dots dark blue, so they are easier to compare with the brown upside-down Vs that represent mountains.)



Mountains make life difficult in many ways. People can fall off steep cliffs. Landslides can damage houses. It's hard to drive tractors and other farm machines on steep land. Even goats do not like to graze on really steep slopes. Just getting around is not easy, because it is hard to build roads or railroads on steep land.

Mountains also influence climate. High places are colder than surrounding lowlands. They usually get more rain and snow. Really high mountains stay cold, and the snow never melts.

On the other hand, mountains can protect people from attack. It is hard for tanks and soldiers to move on steep slopes. Terrorists often hide in mountains, because it is hard to attack them.

In the chapters on South America, Russia, and Europe, we will explore other effects of the processes that build mountains. Here, we just compared world maps and made a conclusion:

Very few people live in areas with high mountains.

Now . . . what hypothesis should we consider next?



A road in the Andes Mountains of South America.

Obviously, it would be hard to build factories or houses next to this road. You probably couldn't even build a gas station here! As a result, there are few people living here, and very few dots in this area on the world map above.

(Photo provided by Connie Weil)

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Hypothesis #2: Most people do not want to live in really cold places.

To test this hypothesis, we can overlay a map of cold places on our map of population.

First, we need to make a decision, because there are different ways to define “cold place.”

- We could make a map that shows the lowest temperature measured at different places.
- We could show the average temperature of the year, or just the coldest month.
- We could look at the effect of temperature on food plants like corn or wheat.

(Corn needs about 90 frost-free days to get started, grow, and make corn.)

It turns out that the last definition of “cold” is the best for a geographic inquiry.

On this map, our overlay is a blue color over the general areas where the summer season

is not long enough or hot enough to grow grain crops like corn or wheat.



You can clearly see that very few people live in places where it is too cold to grow grain.

We could investigate each dot in the blue areas, to see if there is a reasonable explanation.

For example, many people in Norway make a living by fishing. They don’t try to grow corn!

In recent years, they also discovered oil in the shallow water near Norway. Some people now work as oil-well drillers. Others transport oil. Still others build equipment for use in oil wells.

Other parts of the world have different stories. For example, some people live near large metal mines in Siberia. In South America, many people live on a flat area high in the mountains.

(This area is called the Altiplano, which means “high flat area” in the local language.)

This high area is cooler and more comfortable than the hot rainforest near sea level.

We will look at Russian miners and South American mountain people in other chapters. Here, our focus is on the global scale. The map on this page helps us see why few people live in large parts of Canada, Russia, and other northern countries.

But the “empty areas” on the map are not all shaded blue. In other words, a map of growing season can help us explain part of the pattern of population, but not the whole pattern.

When we do a geographic analysis, we should remember that the geographic patterns of most things are the result of many influences. This is an important principle:

Very few geographic patterns are so simple that they have only one cause.

You should remember that fact whenever someone tries to tell you that there is a single cause for something like business success, crime, poverty, or terrorism.

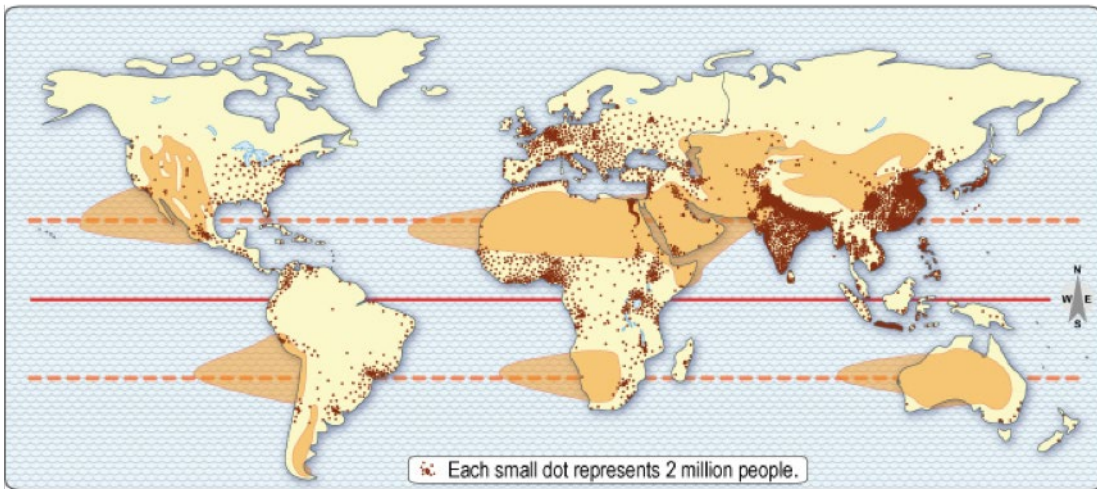
Now . . . what hypothesis should we consider next?

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Hypothesis #3: Few people live in places where there is not enough rain to grow food.

To test this hypothesis, we can find a map of dry areas and overlay it on the population map. The tan color on this map shows deserts – areas that get very little rain or snow.



In general, people do seem to avoid dry areas. There are not many dots inside large deserts.

If you look closely at the map, however, you can see that a few dry places have a lot of dots.

Look at Southern California, for example. Millions of people are living in places that are too dry to grow crops without irrigation. The reason is hidden in the phrase “without irrigation.” People in California pay a lot of money to bring water from distant mountains or rivers.

You might also have seen a video or read a book about Egypt. It’s where ancient people built pyramids. On this map, Egypt is a curving line of dots near the Nile River in northeast Africa.

Other chapters in this book have more about water. The topic is important because control of water is a major cause of conflict. TV announcers often blame wars on crazy leaders. Many wars, however, actually start as arguments over resources like water or oil.



This “artificial river” is part of the California Aqueduct system. The system uses dams to block rivers in high mountains. These dams make reservoirs (man-made lakes) to store water from melting snow. Then artificial rivers (like this one) and huge pipes bring the water to the fields and cities of California.



Practical Rule: If you don’t understand the causes, you are less likely to win a war!

Wars and terrorist attacks are like population in one important way. To understand where they occur in the world, you usually have to look at several causes, not just one.

So . . . what’s next?

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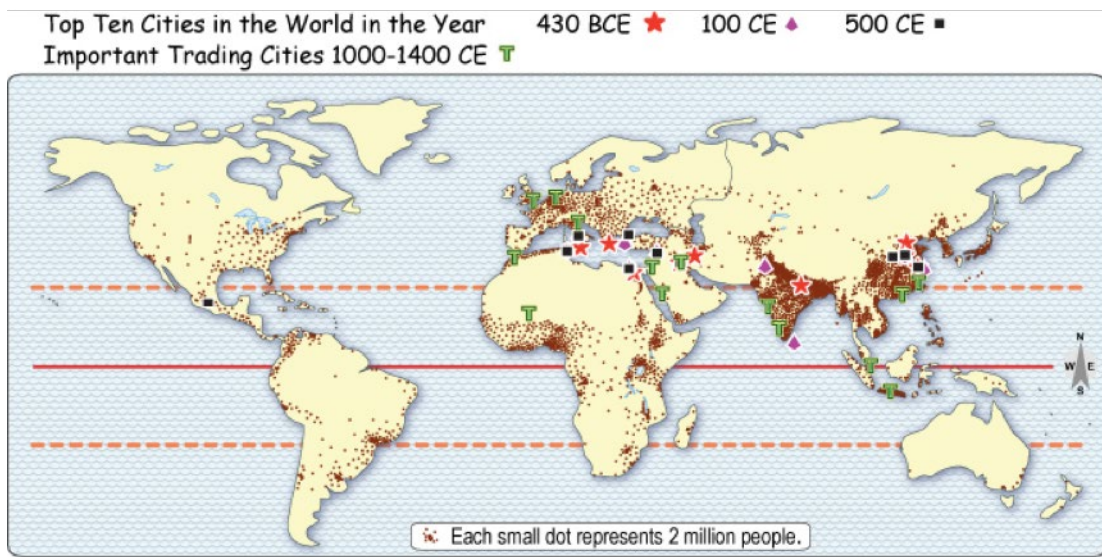


Hypothesis #4: If an area had a large population in the past, it probably still does.

Populations tend to grow unless something really bad happens.

Wars, diseases, and famines can kill a lot of people. So can natural disasters like earthquakes, floods, droughts, or volcanos. These events, however, rarely reduce the population of an area for long. As a result, places that had large populations in the past, for whatever reason, are still likely to have a lot of people today.

We can test this hypothesis by looking at maps of ancient cities. A clickable world map could let you show each group of cities separately. Here, we will combine several map layers to save space and printing cost. These layers show the top ten cities for three time periods. The map also shows some important trading centers in the Middle Ages.



Question: What does this map show us?

Answer: Most of the areas that had cities a long time ago still have a lot of people.

Conditions that helped populations grow in ancient times – good soil, flat land, good trade connections, and so forth – have not changed. In Egypt, 80 million people now live in the Nile Valley. This is the same area where people built pyramids, thousands of years ago.

In modern China and India, hundreds of millions of people are now living on the same fertile plains that supported many cities in ancient times.

The modern world, however, also has large numbers of people living in some places that did not have big cities in ancient times. For example, you can see groups of dots on each coast of North America. One group is near New York. Another group is around Los Angeles. There are areas of large population near cities like Lagos and Johannesburg in Africa. There are clusters of dots around cities like Bogota, Sao Paulo, and Buenos Aires in South America.

Don't worry if you do not know where all of these cities are right now. We will look at them again in other chapters. There, you will explore why people live where they do on other continents. We do not want to clutter the main point of this chapter by going into details now.

On this page, we just want to emphasize how a map of ancient cities is like the maps of mountains, short growing season, and dry areas. Each of these different maps can help us understand some of the modern map of population, but no single map can explain all of it.

Interactive 1.4:
Ancient and Modern Cities



A clickable, interactive world map that shows where ancient and modern populations are located.

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Hypothesis #5: People can move to places where they think they will do better.

Here is another fact that can affect the map of population: people can move.

Suppose someone makes a new discovery or invention. When that happens, people often move to take advantage of it.

Here is a simple example.

Some people found gold in California in 1849. Many people decided to move there to look for gold. (That's what they called "the Gold Rush!")

Here is a more complicated but much more important example.

People invented tractors and other farm machinery. With these machines, a few people could do jobs that required hundreds of workers using old tools. Many people lost jobs as farm workers. These people often moved to cities in order to look for new jobs.

This process of rural-to-urban migration can help us understand the history of American cities like Detroit, Chicago, or Los Angeles. Today, it is still going on in China, India, Africa, and South America. **Rural-to-urban migration** is the movement of people from farms and small towns to large cities and their suburbs.

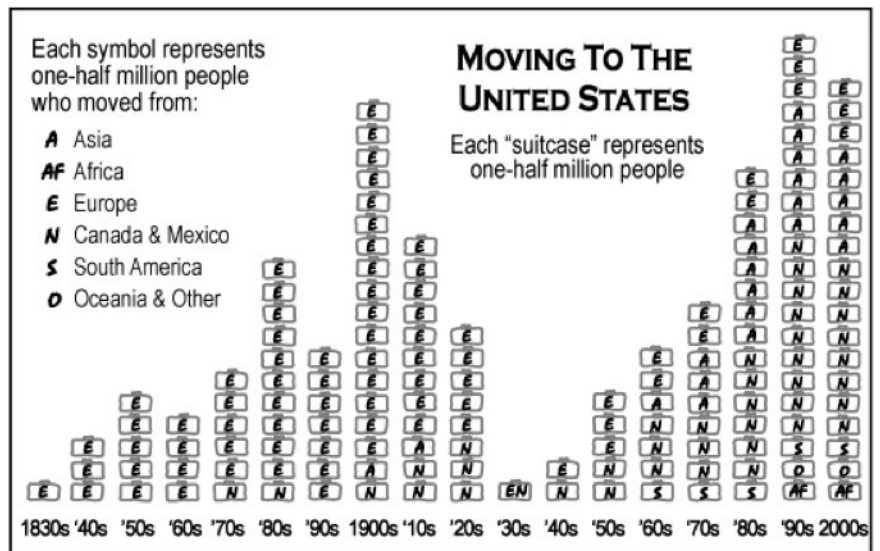
Another important change was the invention of air conditioning. This made hot places more comfortable. In the United States, people moved to cities like Atlanta, Houston, Phoenix, and Los Angeles. Air conditioning also helped other hot places around the world.

Can you think of other inventions that may have persuaded people to move to new places?

Here again, we will not go into a lot of detail in this first chapter. We will simply note that the process of migration is important. It can help us understand the map of human population.

Your history book can give you more details about people migrating to the United States.

Personal note: You might not have to read about migration, however. Your own parents or grandparents might be able to tell you about the time when your family migrated. If you are sitting in a school in the United States, someone in your family probably moved from some other part of the world!



This "symbol graph" shows the number of people that moved to the United States from each continent during each decade from 1830 to 2010. You can make this graph easier to read by coloring the boxes for each continent a different color.

Adapted from Teaching Geography (Guilford Press)

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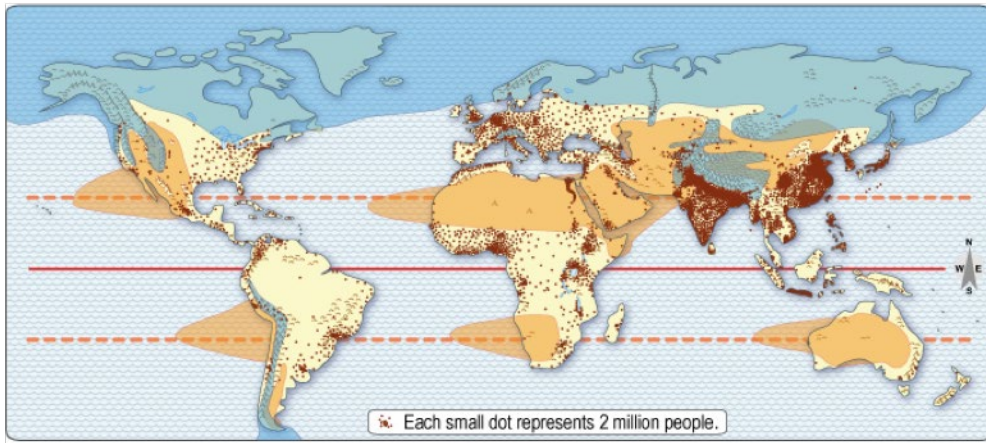
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Hypothesis #6: Overlaying several maps can help us understand a map pattern better.

To test this hypothesis, we can overlay several of the maps that we have used so far. When we do that, we see that few people live in areas that are cold, dry, or steep. In other words, several conditions can explain the pattern of population better than any one condition.



If you look closely, however, you can still see several areas that have very few dots but are not cold, dry, or steep. There must be more reasons why people decide not to live in certain places. In other words, we need to think of even more hypotheses to test.

We will not keep doing this investigation right now. It would take a long time, because the world pattern of population is a complicated topic. This is not surprising, for two reasons:

- 1) The world has a lot of people. (It has more than 7 billion, remember?)
- 2) People have many different reasons for living where they do.

With just a few maps, however, we have been able to identify large areas that seem to be too cold, too dry, or too steep. These areas add up to nearly half of the earth's land area.

These limits are not necessarily permanent. Someone could invent something that could really change things. For example, what would happen if someone discovered a kind of corn that can grow in places with only one warm month? What about building cities under heated domes? What if they find a way to make ocean water drinkable?

If someone did any of these things, large numbers of people could live in areas that are nearly empty today. In other words, the world pattern of population depends on the tools and skills that people have. This leads to another important rule:



Rule: If technology changes, maps of things like population and wealth might also change.

Jobs in Geography: This is one of the most important “uses” of geography. People study geography in order to predict where people might get richer when conditions change. Trained geographers often work as advisors for business leaders or government officials. These are high-pay jobs!

Like any tool, map overlaying is good for some kinds of investigation, but it also has weaknesses. It is important to remember that we cannot always come to a conclusion after looking at just a few maps. But we can get a really good start. Map overlaying can help us rule out some obviously wrong answers.

These are useful skills for businesspeople, politicians, and voters!

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Summary: How can the big idea of map overlaying help us understand the world?



Background: People make choices. They choose where to live and what jobs to do. They choose what kind of house to build, where to buy things, where to travel, and so forth. The success of those choices, however, often depends on where they are. A good choice in one place might turn out to be really bad in another place.



Big idea: Overlaying thematic maps can help us see what conditions may be important influences on the choices people make.

Overlaying maps can help us test hypotheses about why people live where they do:

Hypothesis #1: Steep slope

It is hard for people to live in rugged mountainous areas.

Hypothesis #2: Low temperature

Most people do not want to live in really cold places.

Hypothesis #3: Shortage of water

Few people want to live in places that do not get enough rain to grow food.

Hypothesis #4: Past history

If an area had a large population in the past, it may still have many people.

Hypothesis #5: Present migration

People can move to places where they think they will do better.

Hypothesis #6: Multiple causes

Putting several maps together can help us understand a map pattern better.



General summary: This chapter used a skill called map overlaying to test these hypotheses. Map overlaying is an example of a “big idea” in geography. The goal in this book is to find a small handful of big ideas that can help us understand a large number of things in the world around us. The last page in this chapter has a list of the big geographic ideas in this book.

These big ideas can help you interpret news stories about issues in other parts of the world. For example, if you remember the maps in this chapter, you have a good idea of what parts of the world seem to be too cold, dry, or steep for people to live there easily.

Understanding the big ideas of geography can also help you make personal decisions. For example, the big ideas of geography can help you to decide what kinds of clothes to pack when you travel. They can help you decide about where to live, work, or go on vacation.

They can even help business people decide how to make money in specific places.



Review: make a mental snapshot of the maps in this chapter. Then look at the map of bright lights on the first page. How much of the pattern of lights now seems to make sense to you?

Technical footnote about the importance of map scale and map projection

World maps are easier to compare if they have the same scale and projection. **A map projection** is a way of stretching and/or cutting an image of the earth so that a large round earth can be shown on a flat piece of paper or a computer screen.

Different map projections have different kinds of distortion. That's another way of saying that no flat map can show the curved earth surface

Twelve Big Ideas in Geography

In this book, we will look at twelve big ideas in geography. Each of these concepts can help us understand a surprisingly large number of different facts about places all around the world. Here are the twelve ideas:

Map comparison – Overlaying maps can help us test hypotheses about causes.

Region – Putting places that have similar conditions into groups can help us understand places better.

Elevation – The air gets colder as you go up from sea level.

Distance – It costs money and time to move things, people, or ideas.

Latitude – Solar energy, temperature, rainfall, and many other environmental conditions depend on distance from the equator.

Area – Large areas are likely to have more resources, but they can also pose problems for transportation, communication, and government.

Resources – Natural resources can support jobs and make people wealthy, but they must be used wisely to avoid problems.

Population density – The number of people per square mile in an area can have many influences on life there.

Culture – Different groups of people can have different ideas about how to live, even in areas that have similar conditions.

Complexity – Complex arrangements of coastlines, mountains, rivers, and other resources can offer people many different ways of living.

Legacies – Choices people made in the past can limit the options we have today.

Systems – The continents and oceans are linked together by complex movements of energy, water, and chemical elements like calcium, carbon, and nitrogen.

Each big idea can help us explain even more details in the world map of population. They can also help us understand many other important facts about the world.

This understanding, in turn, can help us figure out the geographic conditions that may be influencing the news today. These “headline events” include:

- **economic facts**, like the rise of China and India as industrial and military powers,
- **social facts**, like the movement of people to cities, especially near the Equator,
- **technological facts**, like the impact of inventions like cell phones or electric cars,
- and even **military facts**, like the locations of terrorist attacks around the world.

Geography is not just about headlines, however. Understanding the big ideas of geography can also help you make personal decisions about where to live, work, or go on vacation. It can even help you decide how to make money in specific places, or what kinds of clothes to pack when you travel!

Keep this basic idea in mind while reading this book:

The goal of this short book is to explain and illustrate a small handful of big ideas that can help us understand a large number of things in the world around us.

Geographic Scale

the size of area you are looking at.

BACK

Geographic Pattern

a description of how things
are arranged

BACK

Thematic Map

a map that uses symbols to show the geographic pattern of a specific topic or theme, like rainfall, crop yield, political party, or language

BACK

Hypothesis

a carefully worded statement about cause-and-effect.

BACK

Map Projection

a way showing a large round earth on a small flat screen or piece of paper

BACK

Rural to Urban Migration

the movement of people from farms and small towns to large cities and their suburbs.

BACK