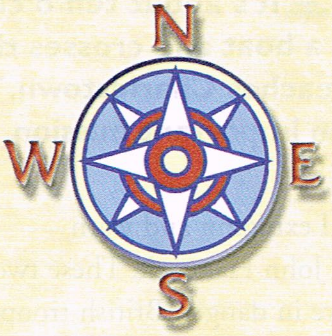
Using Maps



Contents

1 Measuring Distance on a Map

How Far Is It? Boston, Massachusetts. April, 1775. It's about ten o'clock at night. Paul Revere steps into a boat and crosses the Charles River. An hour later, he reaches Charlestown. There, he borrows a horse. He's on an important mission, and there is no time to lose.

He must get to Lexington and warn Samuel Adams and John Hancock. These two American leaders are in danger. British troops are marching to Lexington to arrest them. But the American colonies need Adams and Hancock, and Revere must get to them first.

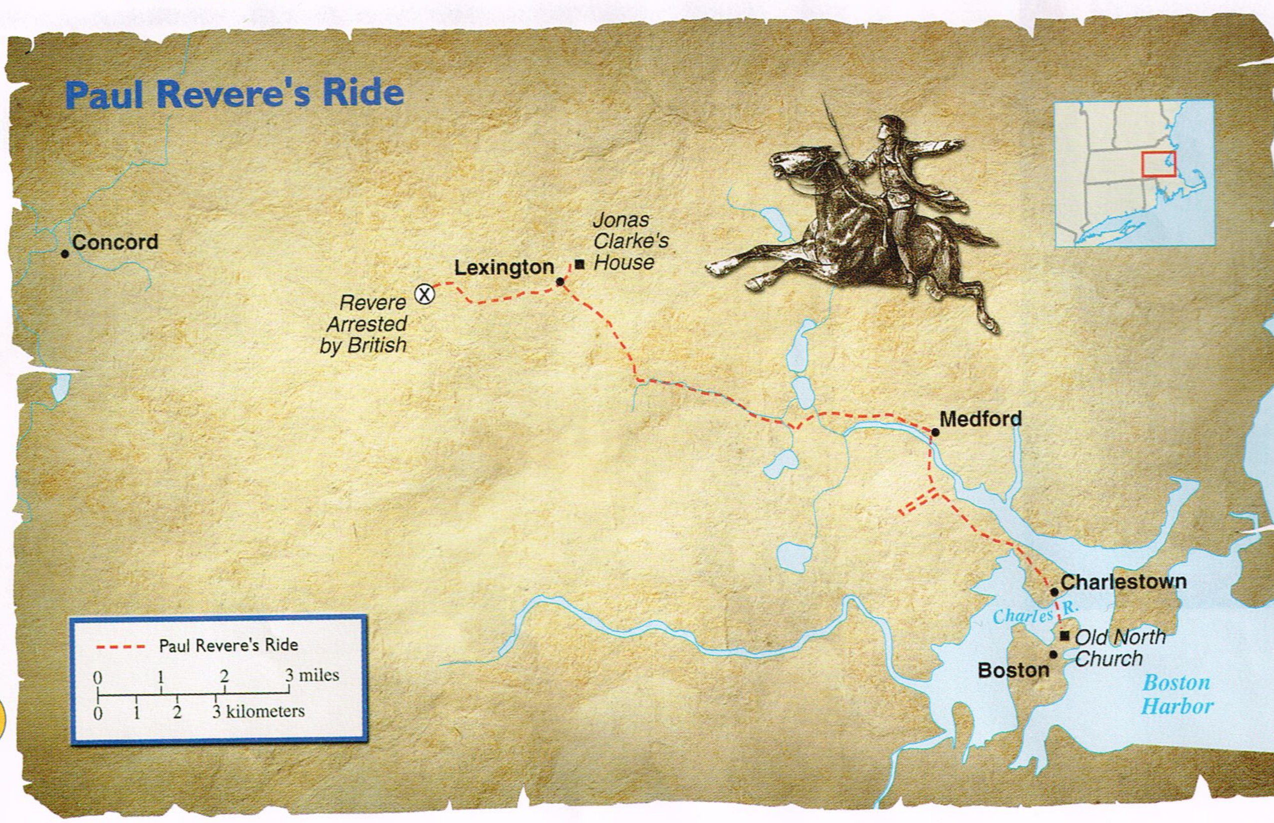
As he rides, Revere calls out, "The regulars are coming out!" He wants to let people know that English troops are marching out of Boston to Lexington. The people in the area need to be ready to defend themselves.

About 11:30, Revere reaches the town of Medford. He rides on until he gets to Jonas Clarke's house near Lexington. Adams and Hancock are there, and Revere warns them to flee.

Next, Revere heads toward Concord, but before he reaches his destination a British patrol arrests him. But Revere has done his duty. He had warned Adams and Hancock, and they had gotten away.

All this happened on April 18, 1775. The battles fought between the British and the Americans at Lexington and Concord the next day marked the beginning of the American Revolution.

This map of Paul Revere's ride on the night of April 18, 1775, can be used to measure how far he rode to warn John Adams and John Hancock that the British were coming to arrest them.



Today, you can trace the route Revere took. You'd need a good map, and you'd need to know your directions.

As you know, a map is a drawing of a real place. A symbol for a road stands for a real road. In the same way, a certain distance on a map stands for a certain distance on the ground.

Look at the map on the previous page showing Paul Revere's ride. In the bottom corner of the map, there's a small box. This is the **map key.** The map key contains information that will help you decode and understand the map. In this case, it tells you that a dotted line stands for the path of Paul Revere's ride. But the key also contains a small picture that looks like a ruler. This is picture shows the map's **scale,** in miles and kilometers. That is, it shows what distance on the map equals, or stands for, what distance on the ground. The picture is called the map scale.

vocabulary

map key a table or chart that helps you decode a map; the key is usually found in one of the corners of the map

map scale the relationship or proportion between the distance as shown on a map and the actual distance on the ground

The map scale shows that 1 inch on the map is equal to 3 miles on the ground. How do you know this? Take a ruler and place it under the map scale. Beginning at the left side of the map scale, measure 1 inch. There is a mark at this same place on the scale. The mark is labeled 3 miles.

You can use this information to figure out distances on a map. For example, what if you wanted to follow Revere's route from Medford to Lexington? How far would you have to walk? First, measure the distance with your ruler. The shortest route from Medford to Lexington measures just about 2 inches. The map scale tells you that 1 inch on the map equals 3 miles in real distance. Therefore, 2 inches on the map equals about 6 miles in real life.

Now see if you can figure out how far Revere rode in all. He began his ride in Charlestown. First he rode to Medford and then to Jonas Clarke's house. After leaving Clarke's house, he rode on toward Concord. He was captured along the way. How far did he ride in total?

Figuring out the distance for the entire ride is a little tricky. It's difficult to measure this distance on the map using a ruler. A ruler is straight, but Revere's route was not. One way to measure the distance more accurately is to use a string. Place one end of the string on Charlestown. Next place the string on the map as close as you can to the exact route Revere followed. Then measure the string. You will find that the string is about 5 inches long. Now look back at the map scale: 1 inch equals 3 miles. Multiply the 5 inches by 3 miles, and you'll find the approximate number of miles Revere rode.

Different Maps and Scales

There are many different kinds of maps. Different maps give different kinds of information. On a map of a small area, lots of smaller places can be shown. For example, the map of Paul Revere's ride even shows where some houses are located. Houses cannot be easily shown on maps of huge areas, such as a country or a continent. Entire cities appear as small dots on a map of the United States.

Travelers often use different maps when going from one place to another. That's because they need different information at different points on their trip. For instance, suppose that you and your family live in Barstow, California. You want to travel to San Diego to visit the San Diego Zoo. You might use the two maps shown on this and the next page to make your trip. The map below shows Southern California. The map on the next page shows the city of San Diego. The map of San Diego shows one small part of the map of Southern California. It has a lot of small details. It doesn't show houses, but it does show many smaller streets. Can you find the San Diego Zoo? Find the green area marked Balboa (bal BOH uh) Park. The zoo is located inside this large park. When you get to San Diego, you would use the city map to find your way to the zoo.

There's another important difference between the two maps. The scales are not the same. The map of Southern California is drawn to a scale of 1 inch to 40 miles. The map of San Diego has a scale of 1 inch to 3 miles. Both maps show distance correctly. But because the areas shown in the two maps differ in size, the scales must be different.

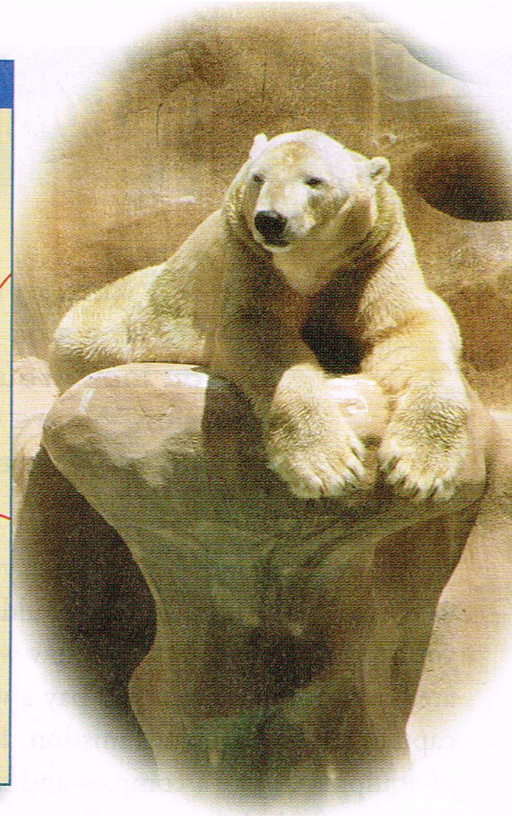
Both of these maps will be useful to you if you are traveling from Barstow to the San Diego Zoo. The Southern California map will help you get from Barstow to the San Diego area. The San Diego map will help you find the zoo once you're in San Diego.

Finding Your Way

The first thing any traveler needs to know is direction. Find on the map of Southern California the symbol with four arrows pointing in different directions. That is called the **compass rose.** It shows you which way is north, south, east, and west. What general direction will you be traveling from your home in Barstow to San Diego? If you said south, you're going in the right direction!

> **vocabulary**
> **compass rose** a symbol on a map that shows directions north, south, east, and west

Use this map to find your way from Barstow, California, to San Diego, California.



Use this map to find the way to the San Diego Zoo, where the polar bear shown here lives.

It's nine o'clock in the morning when you leave Barstow. Your mother asks, "What is the best way to get to San Diego?" It's up to you!

First, find Barstow on the map of Southern California. Put your finger there. Then find San Diego and put another finger there. Next, look at the roads connecting the two. What is the shortest way to get from one city to the other?

After looking at the map, you see that Interstate 15, or I-15, goes all the way from Barstow to San Diego. You tell your mother to get on Interstate 15 and go south until she gets to San Diego. After a few hours of driving, you enter the San Diego Area. Now you put away your map of Southern California and get out your San Diego map.

Looking at the San Diego map, you see that the entire yellow area shows you the city limits. As you drive south on Interstate 15, you come to signs marking exits onto Balboa Avenue and then Aero Drive. These landmarks will help you keep track of where you are on the map.

The white squares where I-15 crosses Balboa Avenue and Aero Drive tell you that there are exits leading from the interstate to these roads. But not every road has an interstate exit. For example, you can see on the map above that there is no exit at El Cajon Boulevard for I-15.

Tell your mother to keep going south on I-15. Soon you'll see signs for Interstate 8. Ask your mom to turn west on I-8. Follow it for a few miles to State Highway 163. Then travel south on State Highway 163, which takes you to the San Diego Zoo.

As you can see from the map of Southern California, almost all of the roads from Barstow to San Diego are highways. Some are interstate highways, while others are state highways. How many different routes can you find between Barstow and San Diego?

2 Latitude and Longitude

Where in the World Are You? Water laps against the side of the ship. You can smell the salt in the air. You look around. There's nothing but water in every direction. Where in the world are you? And how does the captain know where he's going?

You've been on this ship for days. You were seasick the first day and couldn't leave your room. Now you don't know where you are. To find the answer, you pay a visit to the captain and explain your mission. He has lots of equipment, like a compass and radar, to help him find his location. But some of his most important tools are maps. He opens up a book and shows you a map of Earth. "This is everything you need to know," he says.

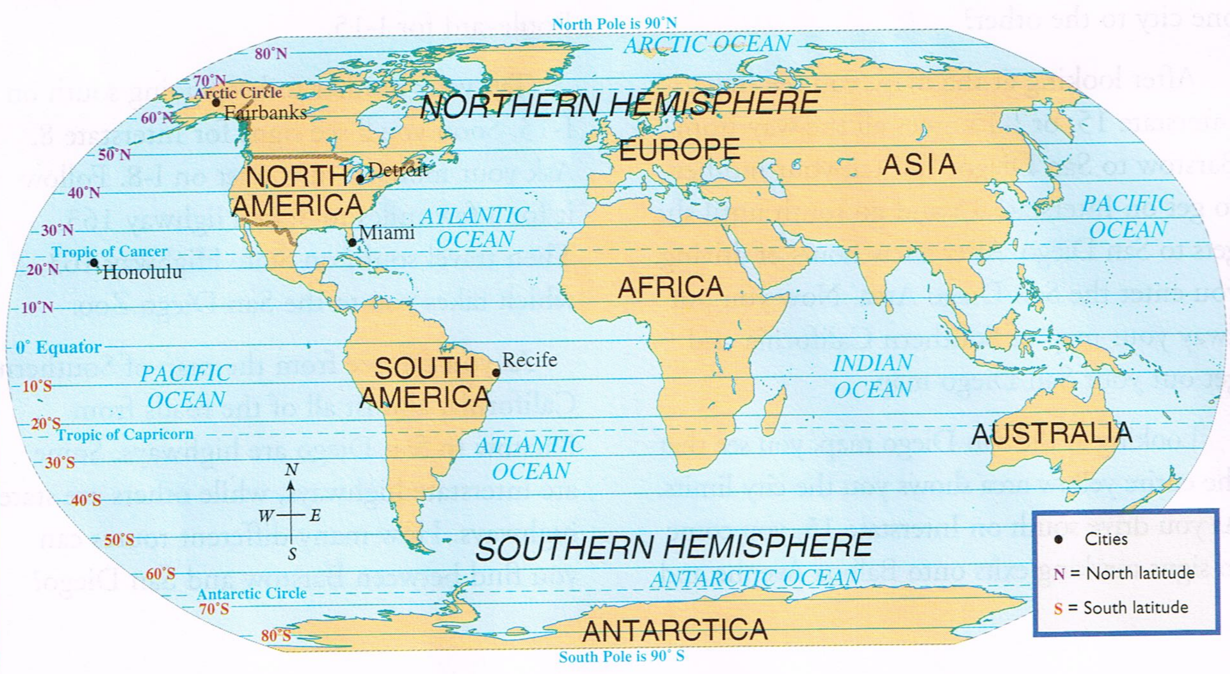
You study the map. If you could just figure it out, you'd know where you were and in which direction you are headed. Read on. By the end of the lesson you'll be able to find any place on Earth.

Making Sense of the Lines

Look at the map of Earth below. The lines running from side to side (from east to west) are lines of **latitude,** also known as **parallels.** You probably already know one of these lines of latitude. The line of latitude that runs around the middle of the earth is called the equator. The other lines of latitude circle the globe to the north and south of the equator.

Lines of latitude (parallels) show distance north and south of the equator. Use this map to find the lines of latitude closest to the cities shown on the map.

Lines of Latitude



All of these lines are called parallels because they are straight lines that never meet or cross.

On a flat map like the one shown on the previous page, these latitude lines look like straight lines that end when they reach the ends of the map, but it is important to remember that this flat map is meant to represent a round Earth. Since Earth is round, the far right side of the map actually touches the far left side, and the lines that seem to end at the right edge of the map actually continue on the left edge. In other words, those latitude lines that look so straight and flat on a map are actually circles.

> **vocabulary**
> **latitude** distance, measured in degrees north or south of the equator
> **parallel** an imaginary line that runs east-west on a globe or map but measures degrees of latitude north or south of the equator

In order to understand this better, use a globe. Place your finger on one of the lines of latitude just north of the equator and follow it all the way around the globe until you come back to the place where you started. Then choose a latitude line closer to the North Pole than the equator and follow it around. Can you see that this second circle is smaller than the circle just north of the equator? The circles get smaller and smaller as you move north or south of the equator. By the time you get to the poles themselves, these circles are so small that they are single points!

Travelers like your captain use lines of latitude to identify how far north or south they are from the equator. The lines are numbered in degrees (°) to make it easy. The equator is located at 0 degrees (0°). On the map shown, the first line north of the equator is 10°N. The line after that is 20°N, and so on. The North Pole is 90°N. The parallels south of the equator are numbered in the same way, with the South Pole at 90°S.

The spaces between the lines shown on the map also can be measured in degrees. For example, the point halfway between the equator and the line for 10°N would be 5°N.

What Latitude Tells You

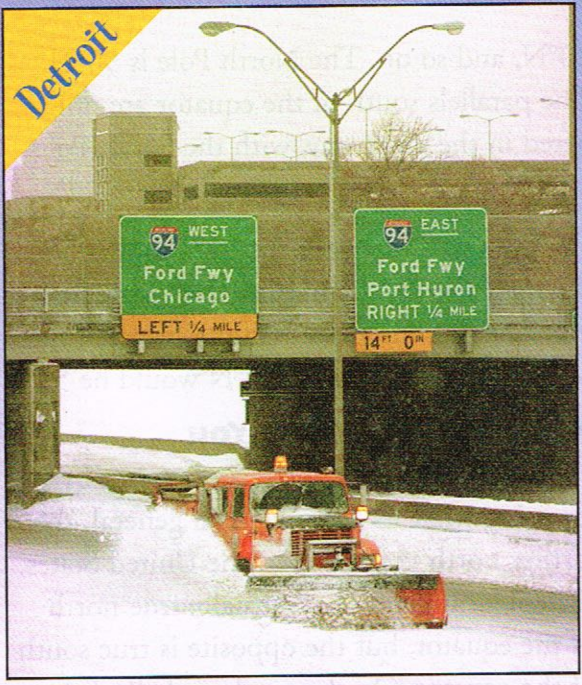
You can tell a lot about a place just by knowing what its latitude is. In general, the farther north you travel in the United States, the colder it gets. That's usually true north of the equator, but the opposite is true south of the equator. On the southern half of the planet, the farther *south* you go, the colder it is likely to be. At the equator, it's usually pretty warm most of the time. At the North and South Poles, it's cold all the time.

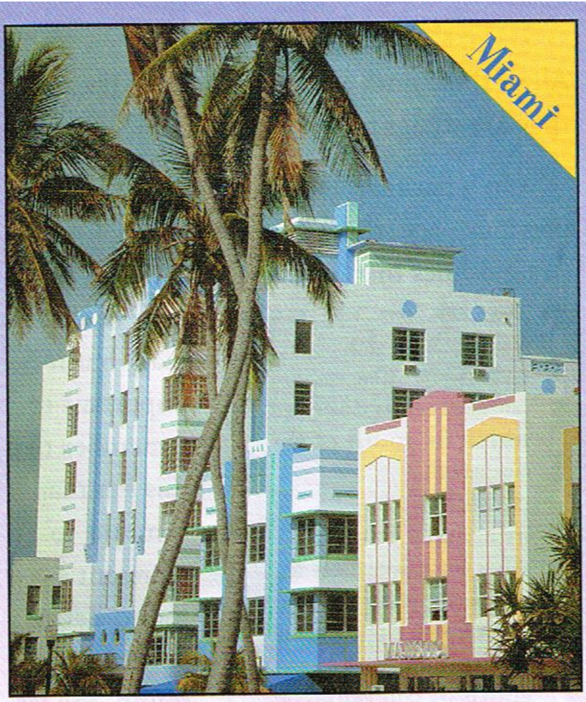
Most of the United States lies between 25°N and 47°N. Miami, Florida, is located at about 25°N. The weather in Miami is usually warm. Even in winter the normal temperature is above 70°F. Detroit, Michigan, is located at about 42°N. What do you think the normal winter temperature in Detroit is?

Winters in Detroit are cold. The average high temperature during the winter is about 32°F. That's the temperature at which water freezes. Detroit gets lots of snow and several months of cold weather.

Fairbanks, Alaska, is located at 64°N. Honolulu, Hawaii, is located at 21°N. How do you think the January temperature in Fairbanks will compare to the January temperature in Honolulu?

Now look south of the equator. The tip of South America reaches to about 55°S. It's almost as far south as Alaska is north. The climate there is cold all year long. Farther





In general, the higher the latitude a place has, the colder it is. These pictures of Detroit (left) and Miami were both taken in winter, but Detroit is at a much higher latitude than Miami.

north in South America, the weather becomes warmer. The city of Recife, Brazil, is located at about 8°S. The temperature there will be warm all year long. Recife is warmer than Miami because it is so much closer to the equator.

Just now, the captain stops by to tell you the ship is at 40°N latitude. It's winter, and there's a strong breeze. What would you be wearing?

Lines of latitude also help us name parts of the globe. The equator divides earth into two **hemispheres** (HEM uh sfeerz). A hemisphere is half of a sphere. The hemisphere north of the equator is called the Northern Hemisphere. The hemisphere south of the equator is called the Southern Hemisphere.

Lines of Longitude

Now imagine that you and 359 of your closest friends are spread out along the equator, each of you 69 miles apart, so that all of you make a dotted line all around the world. All 360 of you begin walking directly north, heading for the North Pole. For most of your journey, you can't see your friends. But as long as everyone walks straight toward the North Pole, you will gradually get closer and closer together. By the time you reach the pole, all 360 of you will be together, pushing and shoving to stand in the same place.

If you could look back down the way you came and see your footprints, you would see lines of **longitude,** or **meridians.** These are imaginary lines that run from the North Pole to the South Pole. These meridians are equal distance apart at the equator, but they come together at each pole.

Like lines of latitude, lines of longitude are measured in degrees. There are 360 degrees of longitude. The map of the world

vocabulary

hemisphere half a sphere

longitude distance, measured in degrees east or west of the prime meridian

meridian an imaginary line that runs north-south on a globe or map but measures degrees of longitude east or west of the prime meridian below shows lines that are 15° apart. In between each of these are 14 other lines that are not shown. At the equator, each meridian of longitude is 69 miles apart. At the poles, all the meridians meet at a single point. You can see this if you look at a globe.

You might think that the lines of longitude would be numbered from 1 to 360. Wrong! They are numbered from 1 to 180 as you go east and then again from 1 to 180 as you go west. The first line of longitude is numbered 0°. It is a special line that runs through Greenwich (GREN itch), England. This is a small part of London. There was once an important observatory in Greenwich. An observatory is a place where scientists study the stars. In the 1800s, it was decided that this place would mark 0° longitude. It is called the **prime meridian.**

> **vocabulary**
> **prime meridian**
> **0° longitude; the longitude line that runs through Greenwich, England**

The lines of longitude east of the prime meridian are numbered 1°E, 2°E, and so on all the way to 179°E. The lines of longitude west of the prime meridian are numbered from 1°W to 179°W.

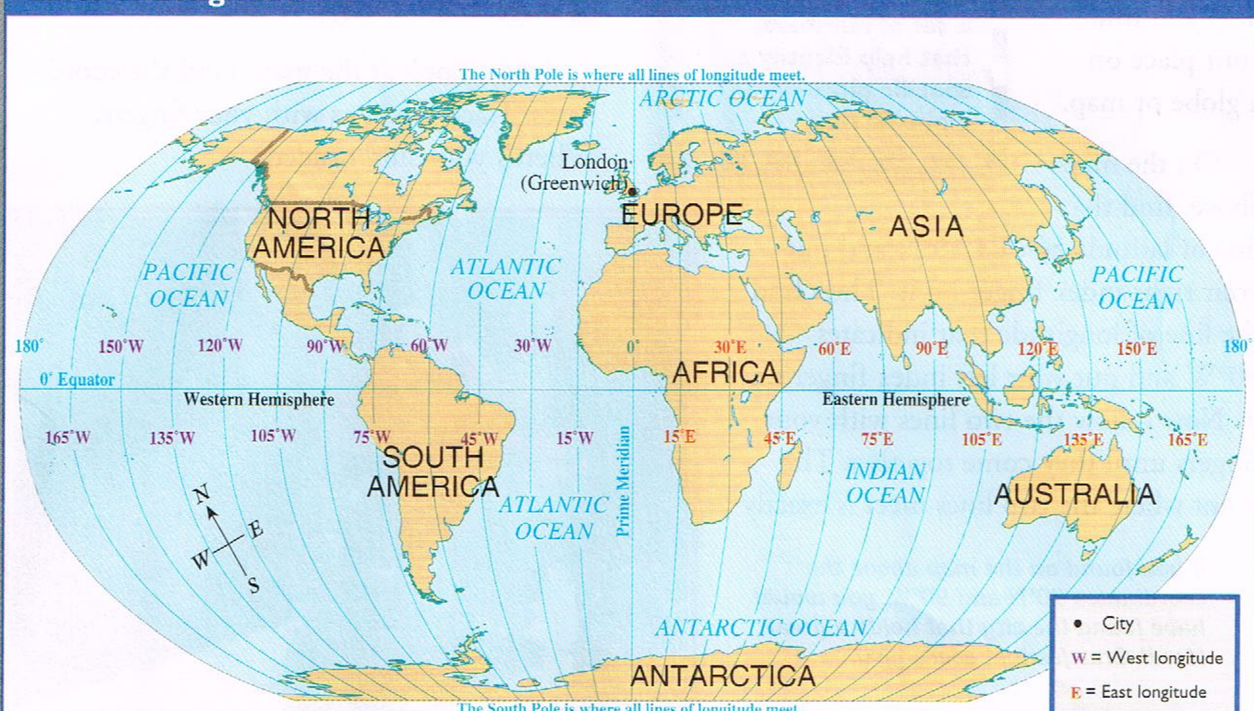
Halfway around the world from the prime meridian is another important longitude line. This is the 180° line of longitude. It is not west or east longitude because the lines of east longitude and west longitude meet there. The 180° line is known as the international date line; you'll learn more about it later in this unit.

The Coordinate System

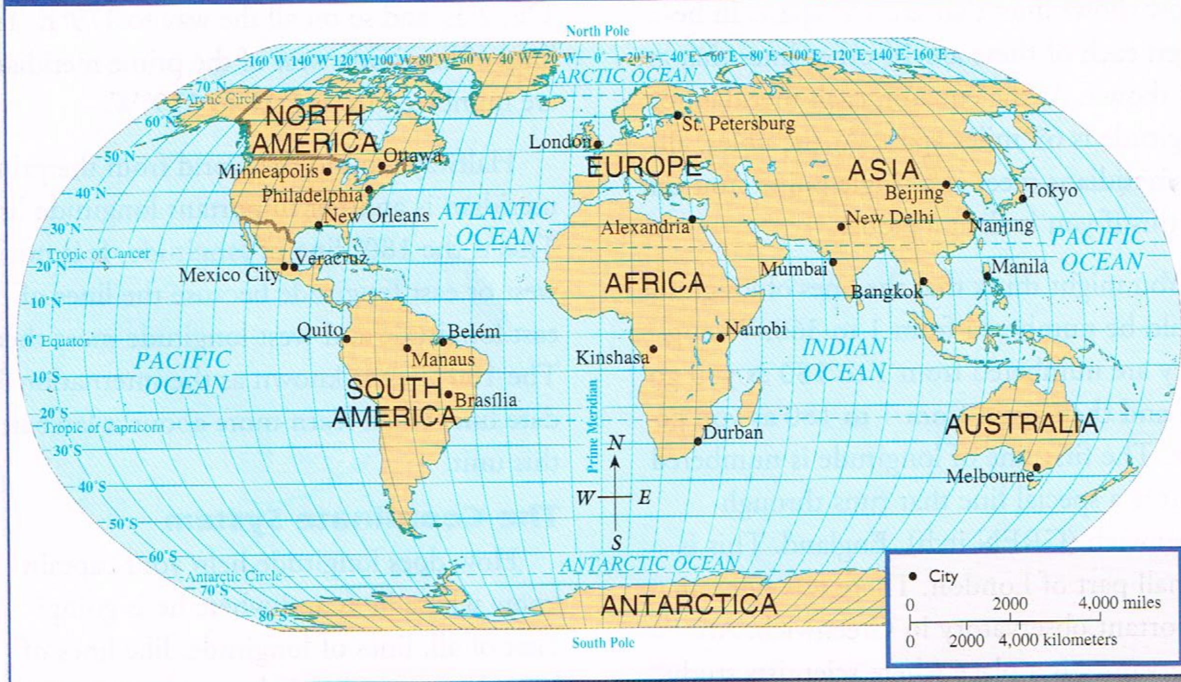
How does longitude help your captain know where he is and where he is going? First of all, lines of longitude, like lines of latitude, are used to help us name parts of the globe. The prime meridian and the 180° longitude line divide Earth into two hemispheres. The hemisphere east of the prime meridian is called the Eastern Hemisphere. The hemisphere west of the prime meridian is called the Western Hemisphere.

Lines of longitude (meridians) get closer together as they go north or south from the equator toward the poles.

Lines of Longitude



Using Lines of Latitude and Longitude



You can find any place on Earth by using the coordinate system created on a map by lines of latitude and longitude. What city lies at 30°N and 90°W?

Longitude gives you east-west information. Latitude gives you north-south information. When you put them together, you can know exactly where you are. For example, your captain knows that the ship is at 40°N and 60°W. These two numbers are called **coordinates** (coh OR dih nihts). These are any set of numbers that help you find your place on a globe or map.

vocabulary
coordinates
a set of numbers that help identify a specific place on a globe or map

On the map above, find the line of latitude labeled 40°N and put your right index finger on it. Then find the line of longitude that indicates 60°W and put your left index finger on it. Now follow the two lines with your fingers until they come together. The point where the two lines meet is exactly where your ship is. You are sailing across the Atlantic Ocean.

Now you know you're in the Atlantic Ocean. But do you know where you're headed? At that moment, the captain passes by. You ask him, "Do you know where we are going?"

He nods and says, "Sure. We're headed for a lovely city located at 30°N and 90°W. We'll be there in a few days."

Okay. Look at the map. Find the coordinates. Trace the lines with your fingers. Where's your ship headed?

If you found on the map above the coordinates 30°N and 90°W, you would have found the city that holds a great Mardi Gras festival every year.

Finding a Place on a Map 3

Crossing the United States **Back in the 1860s, building the Transcontinental Railroad was back-breaking work. The workers didn't have any modern equipment. They used hammers and shovels and carried each heavy steel rail by hand.**

The rail was placed on wooden ties, and then the workers hammered steel spikes into place to hold the rail. Then the workers moved on, placing more ties, hauling another rail, driving in more spikes.

There were two crews of laborers. One started from Omaha, Nebraska, and built the railway west. The other crew started in Sacramento, California, and built the railway east.

It seemed like an impossible job, but two armies of workers laid mile after mile of track. Finally, on May 10, 1869, the two railroads met. The place was Promontory Point, Utah.

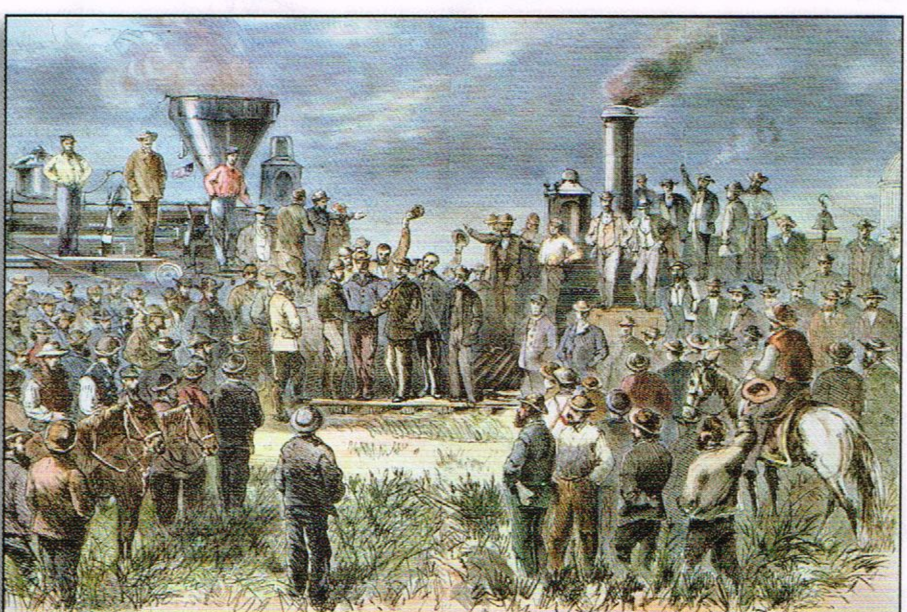
Dividing the Lines

Where on Earth is Promontory Point? Well, it is exactly at 41°38′N, 112°30′W.

You've studied latitude and longitude. You know about degrees. What are the extra numbers in the coordinates? They are called *minutes*.

The first coordinate for Promontory Point is 41°38′N. That is short for 41 degrees, 38 minutes north. Long ago, mapmakers realized that a degree is a very great distance. Sometimes, mapmakers want to measure smaller distances. So they have divided degrees into smaller units. There are 60 minutes in 1 degree. When writing the coordinates, they use the symbol (′) to stand for minutes. So 38′ is read as 38 minutes.

But remember, minutes of latitude and longitude are not units of *time,* they are units of *space.* Don't be confused by the use of the same word. You can't assume that because two points are 2 minutes apart in latitude that it would take you 2 minutes to get from one to another. It might take longer if you walked, or less time if you traveled by railroad!



This scene shows the day the Transcontinental Railroad was completed at Promontory Point, Utah, on May 10, 1869.

The set of coordinates for Promontory Point is 41°38′N, 112°30′W. You can use these coordinates to find the location of Promontory Point on a map. You know that latitude measures distances north and south of the equator. So the coordinate that ends with *N* for *north* or *S* for *south* is the latitude. That would be 41°38′N. Longitude indicates locations east and west of the prime meridian. So 112°30′W is the longitude.

Where the Lines Cross

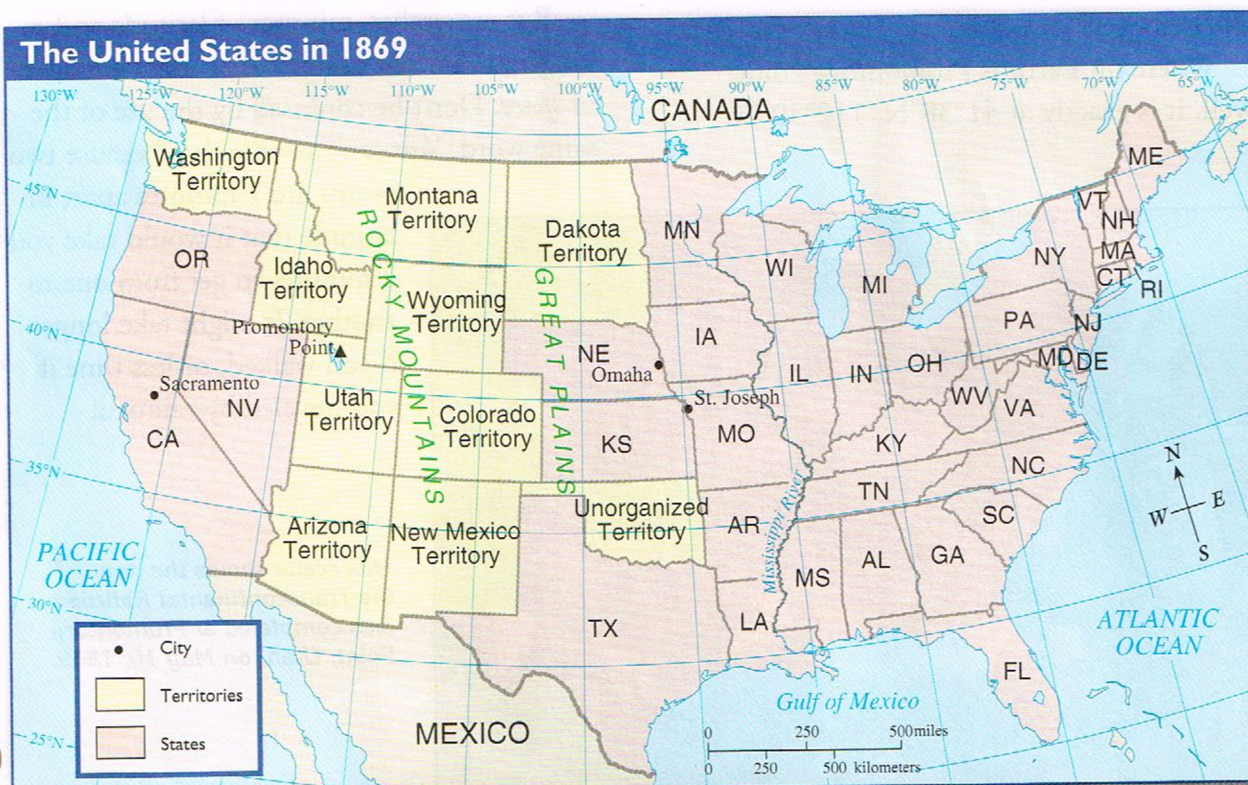
The map on this page shows what the United States looked like in 1869. You'll recognize most of the states. Many of those west of the Mississippi River had not yet been formed. They were called territories. Somewhere out in the territories is Promontory Point. Can you find it?

This map shows lines of latitude and longitude every 5 degrees. See if you can locate the coordinates for Promontory Point. First look along the left side of the map. You won't find 41°38′N, so locate the line of latitude closest to it. That is the 40°N line. The place you're looking for will be 1°38′ north of this line. Think about it this way. There are 5 degrees between each line shown on the map. So 1 degree is less than half of the distance between the lines. Estimate, or carefully guess, where that place is. Put your left index finger there.

Now look along the top of the map and locate the line of longitude closest to 112°30′W. Once again, this exact line is not shown. But 112°30′W will be exactly halfway between the 110° and 115° lines. Put your right index finger on this line of longitude. Follow the lines with your fingers until the two lines meet. The place where the lines cross is Promontory Point.

Now look at the map and find Omaha, Nebraska. Omaha is located at 41°18′N and 95°57′W. By comparing these coordinates with the coordinates for Promontory Point (41°38′N, 112°30′W), you can see that the

This map shows the United States around the time the Transcontinental Railroad was being built. You can use this map to locate Promontory Point.



railroad went a long way west and just a tiny bit (20′) north.

Finding an Exact Location

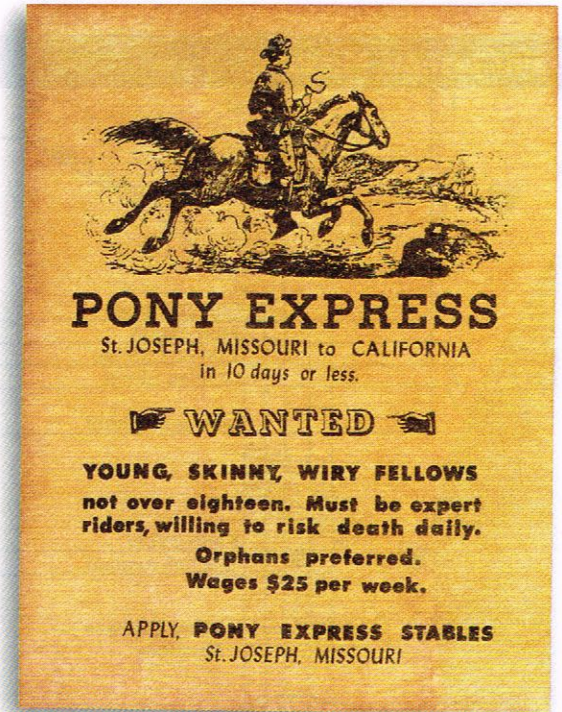
The Transcontinental Railroad linked the eastern United States with the West Coast. Even earlier, the Pony Express accomplished the same thing. The Pony Express was the way mail was sent across the "Wild West." Men on horseback carried the mail along the Pony Express route. They changed horses about every 10 miles. After every 100 miles, a rider handed the mail to another rider, who carried it for another 100 miles. The route ran from St. Joseph, Missouri, to Sacramento, California. It was almost 2,000 miles long. Mail took about 10 days to get from one end to the other.

Today, there is a Pony Express museum in St. Joseph. You can learn all about the Pony Express. You can see pictures of the riders and learn about the dangers they faced.

Let's imagine that your parents or relatives have agreed to take you to the museum. But first you have to find out just where St. Joseph, Missouri, is located.

Start with a book of maps called an **atlas.** An atlas has an index. Look at the sample atlas index below. You can see that the index shows coordinates for St. Joseph and the page where you will find the correct map in that atlas.

Place	Page	Lat.	Long.
St. George, Utah	119	37°10′N	113°58′W
St. James, Missouri	111	37°99′N	91°61′W
St. Johnsbury, Vermont	109	44°42′N	72°02′W
St. Joseph, Missouri	121	39°77′N	94°85′W
St. Louis, Missouri	117	38°63′N	90°20′W
St. Paul, Minnesota	118	44°94′N	93°09′W



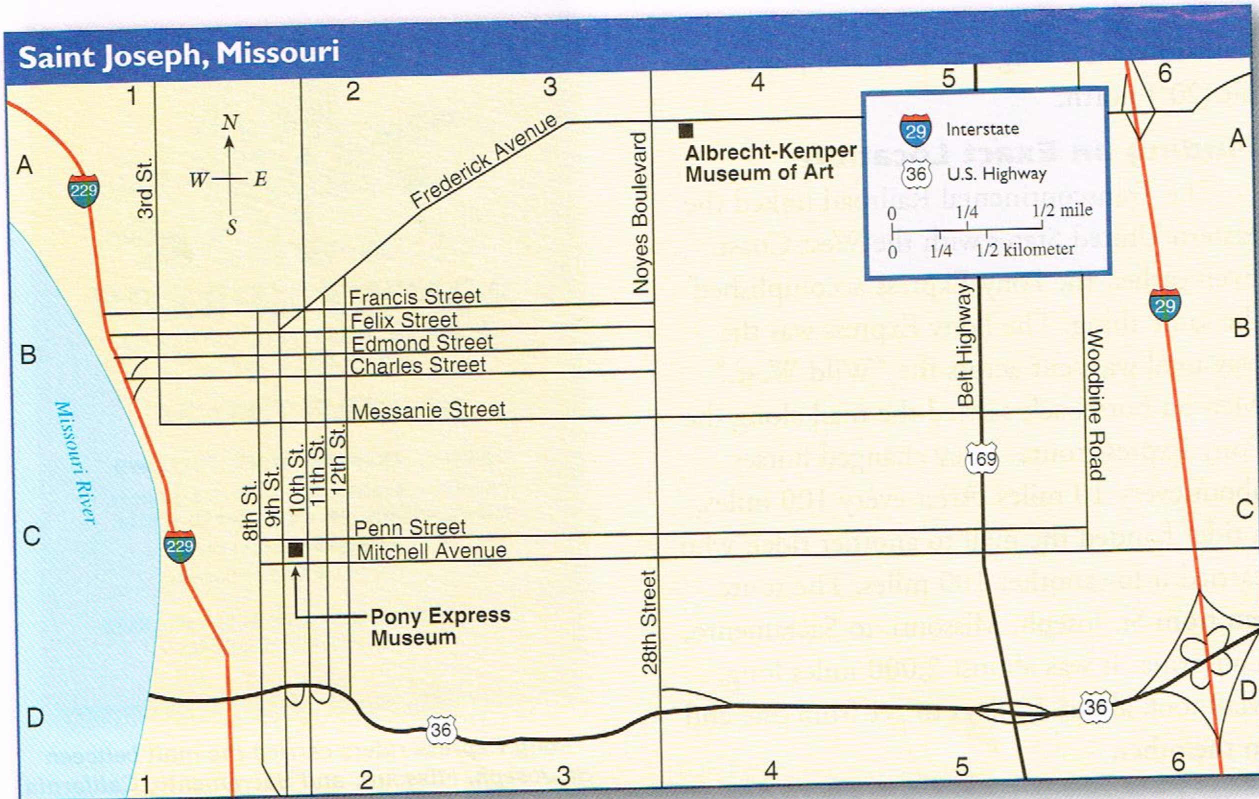
Pony Express riders carried the mail between St. Joseph, Missouri, and Sacramento, California in about ten days.

Using Road Map Coordinates

Let's take a closer look at St. Joseph, Missouri, to learn about different types of coordinates that are used on road maps. Imagine that you are on a sightseeing trip with your family. Since you are such a map expert, you have been given the map. Your task is to find the Pony Express Museum on a map of St. Joseph. Instead of looking all over the map, start with the road map index. This is like the index in a book. It lists all the places shown on the map and gives their coordinates. The index gives you these coordinates: C-2. You're puzzled. These certainly are different coordinates from those for latitude and longitude.

vocabulary
atlas a book of maps

Many local highway maps give coordinates as letters and numbers. They are simpler to use on maps of small areas.



Instead of using a coordinate system of latitude and longitude, some maps use a system of letters (A, B, C, etc.) and numbers (1, 2, 3, etc.) to create a grid system.

Look at the map of St. Joseph shown above. Notice that the letters run down the sides of the map and the numbers run along the top and bottom. You are looking for the coordinates C-2. But don't look for a line marked C and follow it to where it crosses a line marked 2. Instead, put your finger on the space marked C. Put another finger on the space marked 2. Follow the spaces until they meet. Somewhere close to where your fingers meet is the Pony Express Museum.

You have a great time at the Pony Express Museum. Your mother decides she wants to see the Albrecht-Kemper Museum of Art, but she can't find it on the map. Can you? The map index will tell you that the coordinates are A-4. But how will you get there? And about how far is it from the Pony Express Museum?

The Albrecht-Kemper Museum of Art

A Puzzle About Time **A family is traveling by cruise ship from China east toward Los Angeles, California. The mother is about to have twin babies. At 1:00 A.M. on Monday, January 1, 2001, the ship nears 180° longitude. The woman has a baby girl.**

The ship crosses the 180° line of longitude. An hour later, the woman gives birth to a second girl. She has had twins!

The first child gets a birth certificate saying she was born at 1:00 A.M. on Monday, January 1, 2001. The second child gets a birth certificate saying she was born at 2:00 A.M. on Sunday, December 31, 2000.

The baby's father believes there has been an error on the birth certificates. After all, how could the baby born first be given a later birth date than the second baby?

The International Date Line

The puzzle about the two children is easily explained. You see, geographers have drawn an imaginary line from the North Pole to the South Pole. Along that line one day changes to another. If it is Monday on the east side of the line, it is Tuesday on the west side. There is a difference in time of 24 hours. This line is called the **international date line**.

The international date line is the same as the 180° meridian in most places. In some places, it curves around areas of land. If the line ran through countries, people on one side of a street might always be a day behind the people who lived on the other side of the street. Just think how confusing that could be! To solve that problem, the international date line is placed over oceans.

Most people do not notice the international date line. It doesn't have much to do with local events or local time. The people most affected by the international date line are those traveling between Asia or Australia and the United States. People flying from Japan may arrive in the United States hours before they leave. People flying from the United States will arrive in Japan a day later.

vocabulary
international date line an imaginary line that marks the place on Earth where each new day begins

Of course, time is not really lost or gained by crossing the international date line. It takes roughly the same time to fly in both directions. The international date line causes an imaginary loss or gain in time. It was created to solve problems with the calendar for world travelers.

Ferdinand Magellan

Ferdinand Magellan was an explorer in the 1500s. He led the first trip around the world. Magellan and his crew were the first to experience the problem that occurs when travelers go all the way around a planet that is itself rotating.

Magellan and his crew sailed from Spain to the Americas and kept traveling west until they had gone all the way around the world. Actually, Magellan himself did not make the complete trip around the world. He died during the journey, but his crew made the complete voyage. They kept careful records of their journey. When they reached Spain again, they found that the journey had taken one more day than their records showed.

A similar thing happened to people traveling east around the world. They would arrive home a day earlier than they expected.

In order to solve this problem, the international date line was created. It's not a perfect solution, however. Odd things can happen, as in the case of the twins born in "reverse order."

Time Zones

The international date line is easier to understand if you first understand time zones. You may know that other parts of the United States have different times than where you live. Perhaps you've seen it on TV. A program that begins at 8:00 in New York will begin at 7:00 in the Midwest, 6:00 in the Rocky Mountains, and 5:00 on the West Coast.

The United States, including Hawaii and Alaska, is covered by six time zones. Most of the states are in one of four time zones.

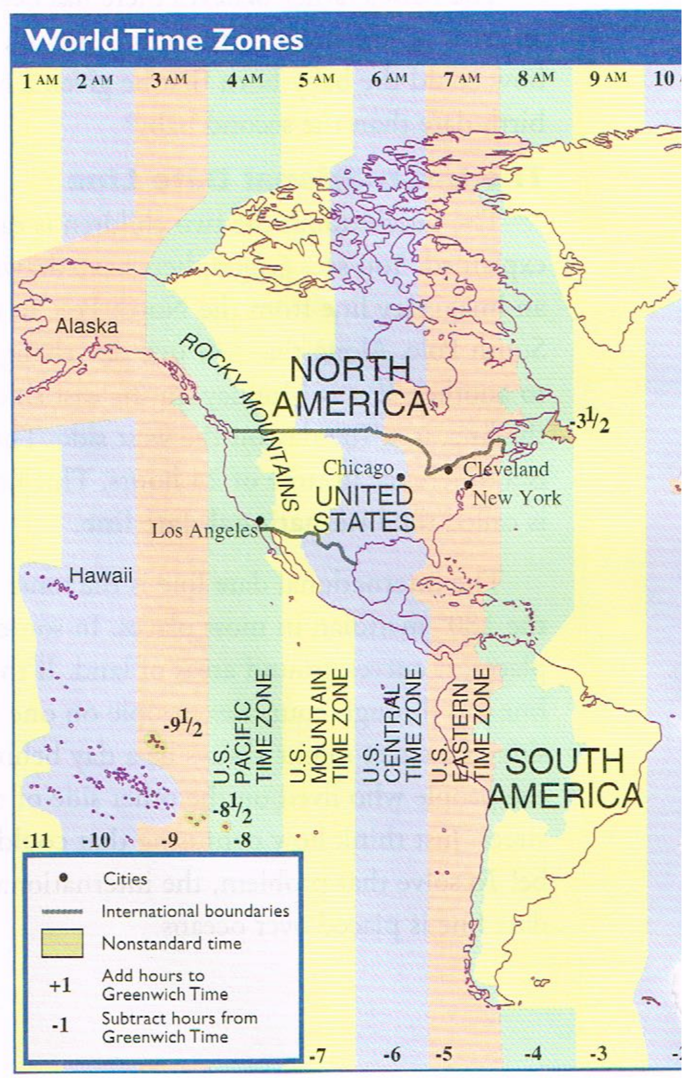
When people travel through the time zones, they gain or lose time. For example, suppose you board an airplane in Cleveland. This city is in the eastern time zone. The plane flies to Chicago, which is in the central time zone. The flight lasts about one hour. If you leave at 1:00 P.M., you will arrive in Chicago at 1:00 P.M.

This happens because places in the central time zone are one hour earlier than places in the eastern time zone. So even though you spent an hour flying, you gain the hour back by entering the new time zone.

When you fly back from Chicago to Cleveland, you will "lose" time. If you leave at 8:00 A.M., you will arrive in Cleveland at 10:00 A.M. You fly for one hour. You lose another hour because you changed time zones.

The same change in time occurs every time you travel between time zones. If you travel into the next time zone to the east, you lose an hour. If you travel into the next time zone to the west, you gain an hour.

Look at the map of World Time Zones. What time zone do you live in? What time is it right now? What time is it in Los Angeles? What time is it in New York?



International Time Zones

The time zones in the United States are part of a worldwide system of time zones. There are 24 time zones. Think of the time zones as making up a continuous circle that goes around the world from east to west. Each is 1 hour apart. Each time zone to the east is 1 hour later than the neighboring time zone. Each time zone to the west is 1 hour earlier than the neighboring time zone to the east.

The international date line is in the middle of a time zone. The time on the east side of the time zone is one day earlier than the time on the west side of the time zone. Look at the map. Just to the east of the international date line, it is midnight on Sunday. Just to the west of the international date line, it is midnight on Monday.

Now use what you have learned. If it is Tuesday morning in Los Angeles, California, on the west coast of the United States, what day is it in Australia? This continent is across the international date line from Alaska. Therefore, Australia is one day ahead of California. It's Wednesday there.

Now let's consider time. For example, let's say it is 10:00 A.M. on Friday in Los Angeles. What time is it on the east coast of Australia? Locate Los Angeles on the map. Then count westward through the time zones: 10:00, 9:00, 8:00, and so on. It will be Friday at 6:00 A.M. on the *east* side of the international date line.

Immediately across the date line it will be Saturday at 6:00 A.M. The next time zone will be 5:00 A.M. The east coast of Australia is in the next time zone. It will be 4:00 A.M. on Saturday there.

Now try some time changes on your own. It's 8:00 P.M. on a Tuesday in Japan. What time and day is it in Hawaii?

The world is divided into 24 time zones. If it is 9 A.M. where you live, what time would it be in Chicago?

Why Have Time Zones?

You may wonder why people felt the need to set up such a complicated system of time zones. Here's a clue. Earth is divided into 24 time zones. What else is divided into 24 parts?

Did you say a day is divided into 24 hours? If so, you were on the right track. The 24 time zones on Earth and the 24 hours in a day are closely connected. You see, Earth rotates, or turns around, on its **axis** once every 24 hours. This means that different parts of Earth are facing the sun at different times. When the United States and its time belts are facing the sun and experiencing daytime, China and its time belts are facing away from the sun and experiencing nighttime. Time zones were invented because of this rotation. If Earth didn't rotate on its axis, we wouldn't need time zones. But then it would always be daylight in certain parts of the world and always nighttime in others!

Time zones were invented because of the rotation of Earth on its axis.

But what about the international date line? Why did people feel the need to set that up? This is one of those cases where one thing led to another. Once the time zones were set up, and the time zone in which Greenwich, England, is located had been designated as the time zone on which all of the others depended, the need for a date line arose.

vocabulary
axis an imaginary straight line that runs through a turning object

You can understand this by glancing back at the map of World Time Zones. First, find the prime meridian, the 0° longitude line that runs through Greenwich, England.

Imagine that it is 3:00 A.M. on Saturday, June 10, in the Greenwich time zone. What time will it be in the next time zone to the east? 4:00 A.M., of course. Now count over 11 more time zones to the east, adjusting the time as you go. You should end up in a time zone (shaded green) that includes eastern Russia and New Zealand, and, if you have counted correctly, you will say that the time in this zone must be 3:00 P.M. on June 10.

You may say, "That was easy!" But there's just one small problem. If you count your way to this same time zone but go west from Greenwich instead of east, you will get a different answer. Try it and see.

Go back to Greenwich and count 12 times zones to the west, adjusting the time as you go. If it is 3:00 A.M. on Saturday, June 10, in Greenwich, it will be 2:00 A.M. in the next time zone to the west, then 1:00 A.M., then midnight, and then 11:00 P.M. *on the previous day*—June 9. Keep counting until you have ticked off 12 time zones. You should end up in the same time zone you were in before—the green one containing Russia and New Zealand. But what are the date and time? According to this count, it's 3:00 P.M., just as it was before, but it's Friday, June 9, instead of Saturday, June 10!

So which day is it in this time zone—June 9 or June 10? Geographers figured that the only way to solve this problem was to divide this contested time zone into two parts. In the eastern half of this time zone it would be the earlier date, and in the western half it would be the later date. And that's how the international date line came to be!

Physical Maps Show the Easy Route Learning how to read a map makes the job of locating places a lot easier. But once you locate a place on a map, how would you find the best route to get there?

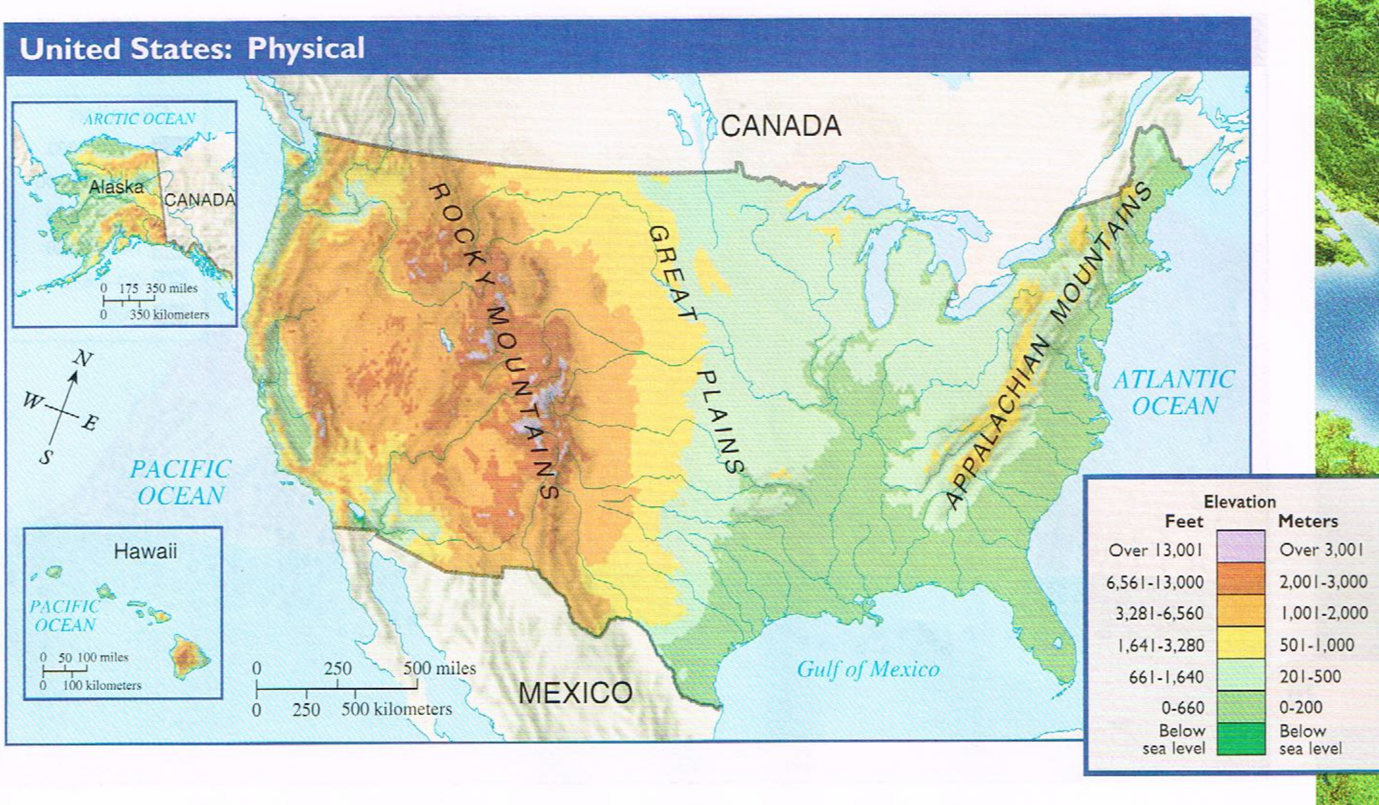
One way to find the best and easiest route to take is by looking at a special kind of map. So far, you've been looking at maps that show roads, towns, cities, and state and national boundaries. These maps tell you where places are located. They also help you figure out how far one place is from another place.

However, these maps do not show you what the land itself looks like. You might want to know about routes that cross mountains and valleys. What you need is a **physical map,** a special type of map that shows the features of the land, such as hills, mountains, and valleys.

All physical maps give information about the **elevation,** or height, of the land. However, there are different kinds of maps that show elevation. Some use lines to show elevation. Others, including the map below, use colors to show elevation.

> **vocabulary**
>
> **physical map** a type of map that shows hills, mountains, valleys, and other features of the land
>
> **elevation** the height of something; on maps elevation is shown as the number of feet above or below sea level

This physical map shows elevation in different areas of the United States.



Look at the physical map of the United States on the previous page. From the map you can see that there are two main areas of mountains in the United States. One long range of mountains is in the East. These are the Appalachian Mountains. They run from Maine all the way south to Alabama. The other area of mountains is in the West. There are several ranges of mountains in the West. The biggest is the Rocky Mountains, which run from Canada southward through the American Southwest. You can see that mountains cover much of the western U.S.

These mountains are shown in different colors on the map. In fact, all land areas of the U.S. are shown in color. Places where the land is low are shown in green. Yellow shows land that is higher. Light orange and dark orange mean that the land is very high. Mountain tops—the very highest land—are colored light purple.

Understanding a Physical Map

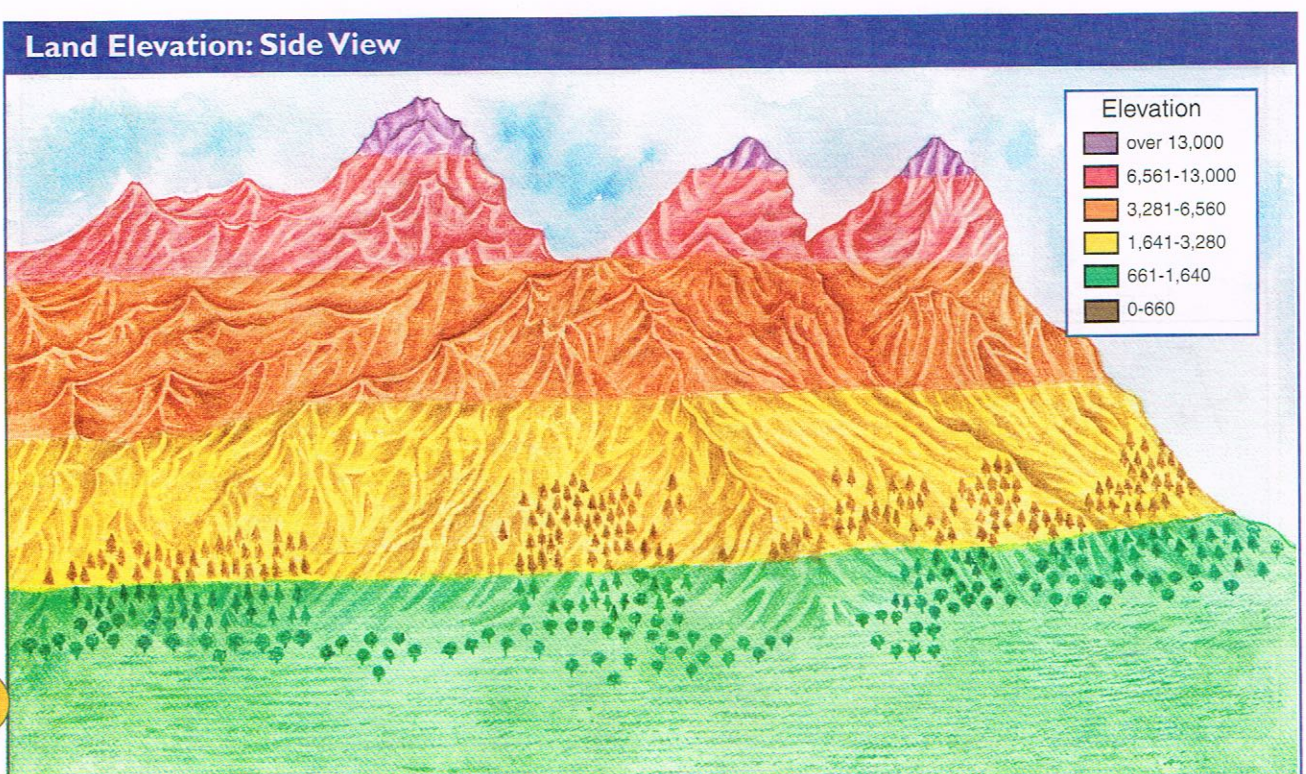
It is easier to understand what the colors on a physical map mean if you think of how mountains look from the side. Look at the drawing of the mountain scene below. The lowest part of the scene is a valley. The valley is colored green. Look at the elevation key on the drawing below. The green color shows elevations from 661 to 1,640 feet. That means that the valley is between 661 feet and 1,640 feet in elevation. How high is the part of the mountains that is colored orange?

Now imagine that you are a bird. You're flying, looking directly down on the mountains from above. The picture on the next page shows a bird's-eye view. It shows areas of higher and lower elevation using color.

Notice the part of the mountain that is yellow. This color shows the same part of the mountains as the yellow on the first picture. It shows the part of the mountains that are 1,641 to 3,280 feet high. Now look at the part of the mountain that is colored pink. How high is this part of the mountain?

You can learn useful information by looking at an elevation map. For example, suppose you want to get the best view of the surrounding land. Where would you go?

This view of mountains and valleys uses different colors to show elevation.



You would climb one of the peaks, of course. These peaks are shown as the three purple areas on the map below. What if you wanted to build a railroad through this area? Where would you put it? You would not put it across the purple areas. That land is steep and high. Instead, you'd build it through the green area. This color indicates that the elevation is low.

So you can see how colors can be used to show the elevation of the land. And you can learn a lot about the land by studying an elevation map. However, this kind of map has limitations. For example, look at the bird's-eye map below. Notice that all three mountain peaks are purple. The purple means the peaks are over 13,000 feet high. But look back at the land elevation map on the previous page. One peak is higher than the others. One peak may be just 13,050 feet high. The other may be 13,500 feet high. You cannot tell the difference on the map below.

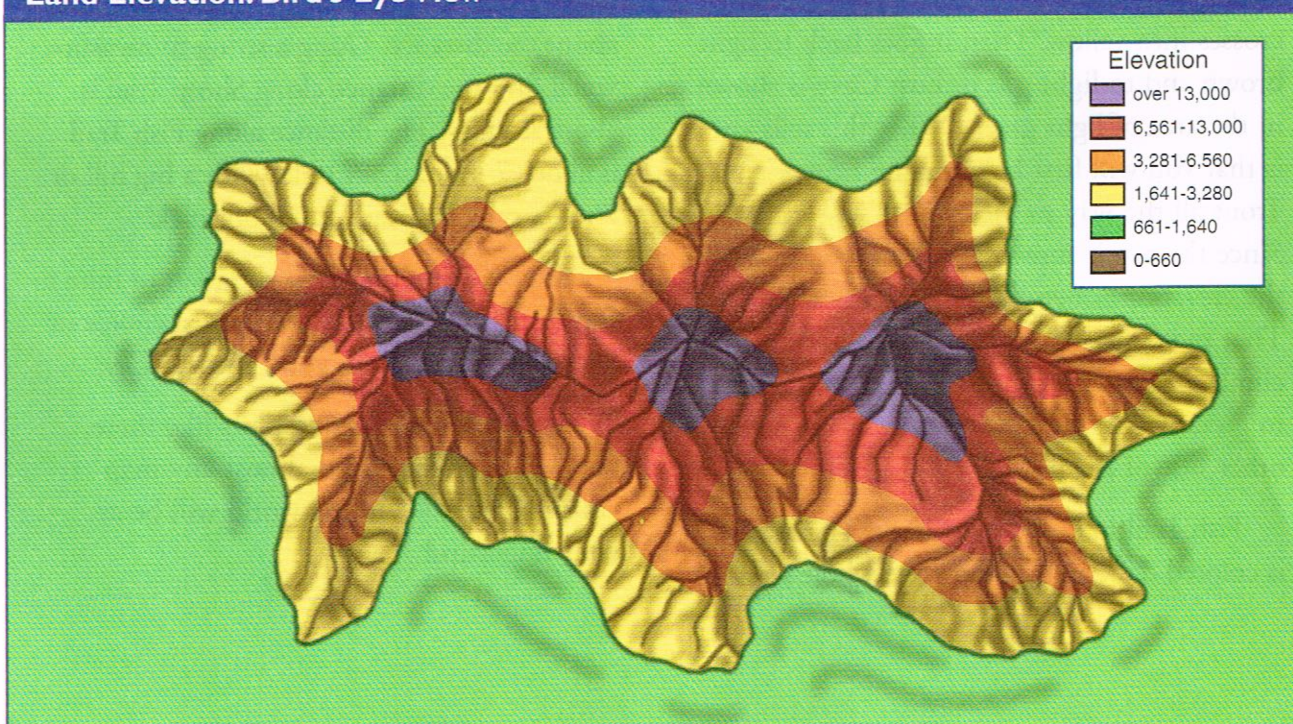
Now look back at the physical map of the United States. The elevation key tells you how high the land is. How high are the Great Plains? Most of this area is shaded light green. Therefore, the elevation is between 661 and 1,640 feet high. Which mountains are higher, the Rocky Mountains or the Appalachian Mountains? The Rocky Mountains are higher. They are shaded dark orange and purple. That means much of the land is more than 6,561 feet above sea level, and some of it is more than 13,000 feet above sea level. The Appalachians, on the other hand, are shaded yellow and light orange. They measure between 1,641 and 6,560 feet high.

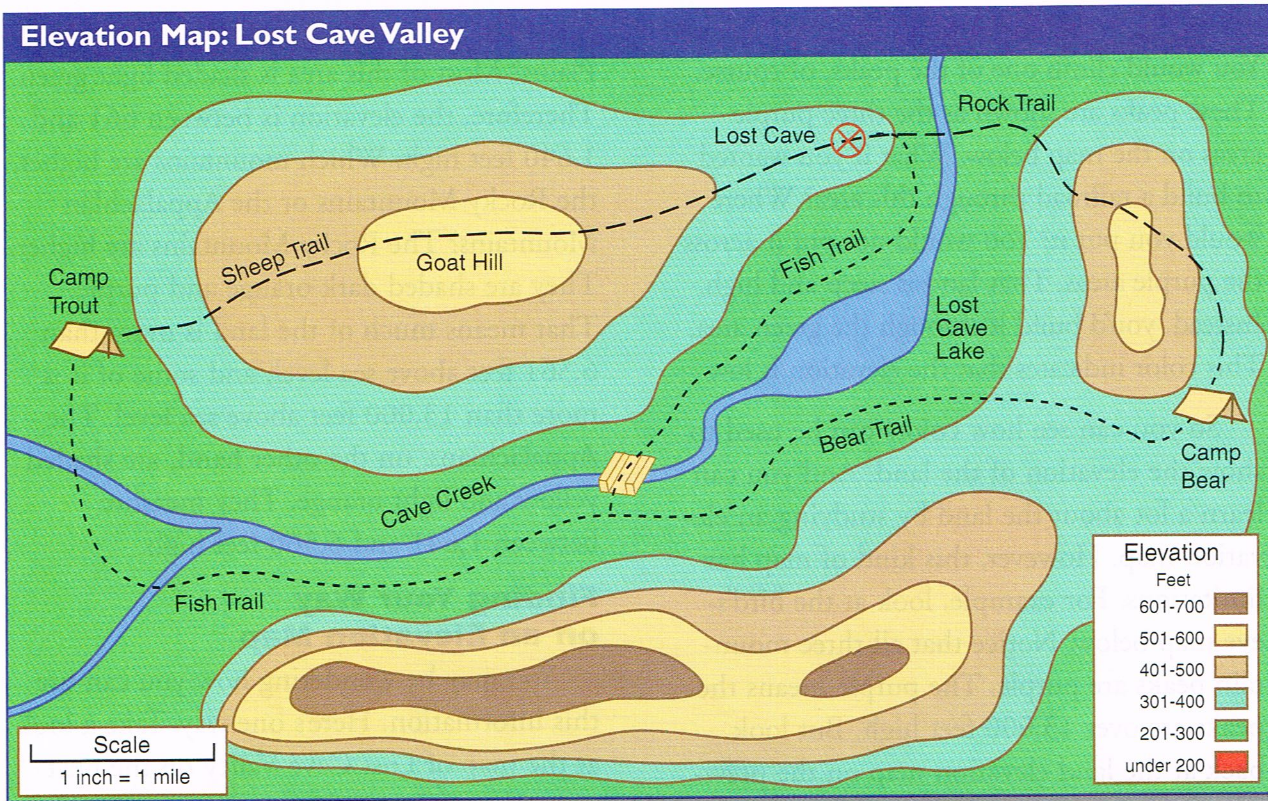
Finding Your Way on an Elevation Map

You may be wondering how you can use this information. Here's one way. Take a look at the map of Lost Cave Valley on the next page. You and your friends are spending the day exploring the valley and hills. You start at Camp Trout. It's on the west side of the map near the stream. Your goal is Lost Cave. As you can see, there are two trails to Lost Cave. You could take Sheep Trail or Fish Trail. You and your friends can't decide which one to choose.

This is a "bird's-eye" view of the same scene shown in the illustration on the previous page. How do the two illustrations differ?

Land Elevation: Bird's-Eye View





By using this elevation map of Lost Cave Valley, you could find the easiest and quickest routes to visit the places you want to see.

Look at your map. What does it tell you about the trails?

On the map, the area around Camp Trout is shown in dark green. Look at the elevation key. Dark green is land that is between 201 and 300 feet high. Sheep Trail goes up Goat Hill. It climbs from the dark green, to the light green, and then to light brown. Next it crosses into yellow. Then it goes back to light brown and to light green. Lost Cave is shown in the area of light green. What this tells you is that you will first be climbing from Camp Trout all the way to the top of Goat Hill. Since the top is shown as yellow, you know the elevation is between 501 and 600 feet. That means that you'll have about a 300-foot climb to the top of the hill. Then you'll have to go down another 200 feet or so on the other side of the hill.

Fish Trail follows Cave Creek. The map is colored dark green almost the whole way. Only near the cave will you travel into an area that's colored light green. This means your trail will be nearly level most of the way. You may climb about 100 feet up to the cave.

Do you want to climb up the hill and then hike down the hill again to get to the cave? Or do you want to walk along a nearly level trail to get there? Of course, you might also think about the distance. Using a string to measure, you'll find the distance along Sheep Trail is about 4 miles. The distance along Fish Trail is about 7 miles. Four miles with a big hill or 7 miles on a flat trail: Take your pick!

After visiting the cave, you plan to hike to Big Bear Camp. Again, you have a choice of two trails. Which will you choose? Why?

If you can answer questions like these, you will be able to read almost any map you're handed—and the world will be at your fingertips!

atlas a book of maps

axis an imaginary straight line that runs through a turning object

compass rose a symbol on a map that shows directions north, south, east, and west

coordinates a set of numbers that help identify a specific place on a globe or map

elevation the height of something; on maps elevation is shown as the number of feet above or below sea level

hemisphere half a sphere

international date line the imaginary line that marks the place on Earth where each new day begins

latitude distance, measured in degrees north or south of the equator

longitude distance, measured in degrees east or west of the Prime Meridian

map key a table or chart that helps you decode a map; the key is usually found in one of the corners of the map

map scale the relationship or proportion between the distance as shown on a map and the actual distance on the ground

meridian an imaginary line that runs north-south on a globe or map but measures degrees of longitude east or west of the prime meridian

parallel an imaginary line that runs east-west on a globe or map but measures degrees of latitude north or south of the equator

physical map a type of map that shows hills, mountains, valleys, and other features of the land

prime meridian 0° longitude; the longitude line that runs through Greenwich, England