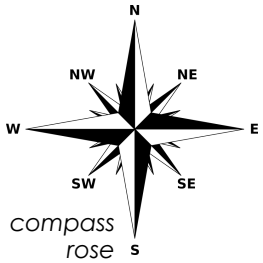
Map Master

Before the days of GPS and Google maps, people had to rely on real maps – as in paper copies! Maps were not made by computers back then like they are today. Instead, they were made by hand. **Cartography** is the study and practice of making maps. A **cartographer** is a person who measures, analyzes, and uses geographic information to create maps. As explorers were attempting to chart the New World, cartography was especially important. Let's explore the ingredients that made up the maps that explorers had to rely so heavily on!

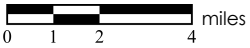
WHAT IS IT? A **map** is a diagram of an area of land. It gives a lot of information about the area, which is useful to anyone exploring, traveling, or just wanting to learn more about the area. There are different types of maps that can tell you different things. Some maps show roads, others show state lines, and others show landforms (like bodies of water or mountains). Some maps show large areas of land, while others show small areas of land.

WHICH WAY? Maps may just look like pictures to you, but there is actually a special way to read maps. One of the first things you should know about in order to read a map is how to read direction. Maps tell you what direction different places are in. Almost all maps include a **compass rose**, or a circle that shows directions. The compass rose is there to remind you that the top of the map is north, the bottom is south, the right is east, and the left is west.



compass rose

FAST FACT: Look out ahead of you. Even though north is always at the top of the map, what you see in front of you is not always north. To figure out which direction you are facing in real life, you can use a **compass**. A compass is a tool that has a magnetic needle that always points north because the earth is one big magnet that makes it point that way!

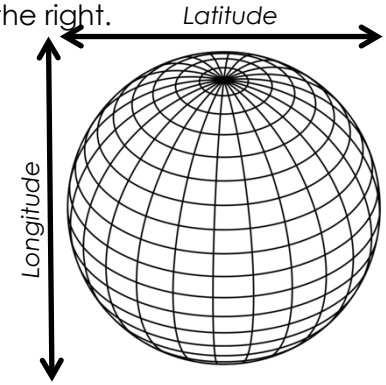


The scale above is 1 inch long. So, one inch represents 4 miles on this map.

HOW FAR? Once you know which direction you're going in, you'll need to know how far you're going or what distance you'll travel. Near the compass rose at the bottom of most maps, you'll find a scale. A **scale** is a bar that shows you how much space on the map represents a certain distance in real life. For example, one inch on a map could represent one mile in real life.

FAST FACT: If you're trying to use the scale of a map to measure distance, there is a quick trick that can help you. Grab a sticky note and line up the top edge of the sticky with the bottom of the scale on the map. Line up the left side of the sticky note with the left side of the scale. Use a pencil to draw a small dash at the top of the sticky where the scale ends. Now, you can move the sticky all over the map to help you figure out distance.

LINES ALL OVER! Most maps include imaginary lines to give readers even more information. These lines are called longitude and latitude lines. **Latitude** lines run horizontally from left to right, wrapping around the map like belts. Latitude lines tell how far something is located away from the equator. The **equator** is another imaginary line that runs through the center of the earth, dividing the earth exactly in half. **Longitude** lines run vertically from top to bottom. Longitude lines tell how far something is located to the left or to the right.



Longitude and latitude lines are both measured in degrees. The most important latitude line is the equator, and it is labeled 0°. Move north of the equator and you'll reach 1° N (meaning 1 degree north of the equator). Move south of the equator and you'll reach 1° S. Longitude lines are also measured in degrees, but they're not labeled north and south. They're labeled east and west. In the same way that the equator separates north and south latitude lines, the **Greenwich meridian** separates east and west longitude lines. This line runs through England, a country in Europe. The Greenwich meridian is labeled 0°. Move west of the equator and you'll reach 1° W (meaning 1 degree west of the meridian). Move east of the meridian and you'll reach 1° E.

The Making of a Map

Directions: You are embarking on a mapmaking adventure similar to what the cartographers experienced during the Age of Exploration. Without having traveled the world yourself or having access to satellite images like mapmakers do today, you have to rely on reports given to you by explorers. You will use the information given from a set of explorer reports and your knowledge of maps to create a map of a New World.

Assign one group member to read aloud the following descriptions to your group. As the descriptions are read aloud, each group member should pause and update his or her map. *Each map should be kept secret and hidden from the other group members until the end of the activity.*

Explorer #	Details and Observations
1	"I am sure that we found Asia! We traveled for several months and successfully found an island! We first hit land at 20° N and 61° W. Then, we sailed around the coast of it. The island stretched west 30 miles. It stretched south around 15 miles." Plot this information first using pencil, and then trace and shade this explorer's discovery with a red colored pencil.
2	"Our crew set sail west from England. We headed much more north than Explorer #1 did. We hoped to find Japan. I think we found islands outside of Japan. We first found land at 47° N and 47° W. The land stretched west to 53° W. The island was shaped like a triangle. Its northernmost point was 53° N and 50° W." Plot this information first using pencil, and then trace and shade this explorer's discovery with a blue colored pencil.
3	"The ships headed southwest from Spain. We found land at 5° N and 41° W, much further south than Explorer #1. We continued along the land, checking out the coast and stopped at 10° N and 55° W. Again, we stopped along the coast at 13° N and 63° W. The coast then dipped down to 10° N and 65° W. We decided to stop following the coast. We then traveled back about 60 miles northeast and ended up near where Explorer #1 first explored. We passed through 20° N and 65° W. It was then that I was certain – we were not in Asia. We were exploring a whole new continent of land!" Plot this information first using pencil, and then trace and shade this explorer's path with a green colored pencil.
4	"We were amazed at how far the New World stretched. We know this land is not Asia now, so we explored as much of the eastern coast as we could. Here are a few of the stops we made along the coast: 35° N and 67° W, 40° N and 65° W, 43° N and 63° W, 45° N and 55° W, and 47° N and 47° W. We traveled northeast further and further. I believe the last spot we hit was first discovered by Explorer #2." Plot this information first using pencil, and then trace and shade this explorer's path with a purple colored pencil.

5. Now, using what you know about the shape and outline of North and South America, use a pencil to finish drawing the outline of the two continents. Be sure to use the information you plotted from the explorers to help guide your outline.

Navigational Technology

What comes to mind when you think about technology? You probably think of iPads, video games, and cell phones. Technology is the new ideas or inventions that are created to make life easier. Today's technology looks very different from the technology that existed during the Age of Exploration. However, technology has made new things possible both now and back then. In the 1400s and 1500s, new technology and the desire to explore led to the Age of Exploration. During this time, there was a lot about the world that people didn't know. People liked the mystery of unknown places and thought there might be riches in new lands. This made many people want to explore. Many new technologies made exploration possible.

Why did sailors read stars?

One of the new ideas that explorers used was celestial navigation. Celestial navigation means to use the sun, moon, and stars as guides. Many sailors including Columbus used celestial navigation. For example, Columbus used the North Star as his guide by measuring the angle from his boat to the North Star. He made sure his boat was always at the same angle with the star so he didn't sail in circles.

Celestial navigation is still used by sailors today.

What is a caravel?

Over 400 years ago, one of the fastest ways to travel was by caravel ship. This type of ship was a fishing boat at first, but around the year 1500 the Portuguese made changes and improvements to caravels. They wanted the ships to be able to be used to travel to Africa. After it was improved, it became the favorite ship of many explorers like Christopher Columbus. The new ship design made caravels quick and easy to steer. The bottom of the new ship only went beneath the water a tiny bit, which is what made it more agile. Historians think that La Pinta and La Niña from Columbus' fleet were caravels.

What is an astrolabe?

Do you ever wonder which star you're seeing when you look up in the sky at night? If you lived 400 years ago, you would have used an astrolabe, which means "star-catching" in Greek. It was a small tool that was used to take measurements of things in outer space. For example, astrolabes could be used to find out how high the sun is above the horizon. However, the astrolabe required a lot of focus and its users needed to be able to read charts to use the measurements given.

Who invented the compass?

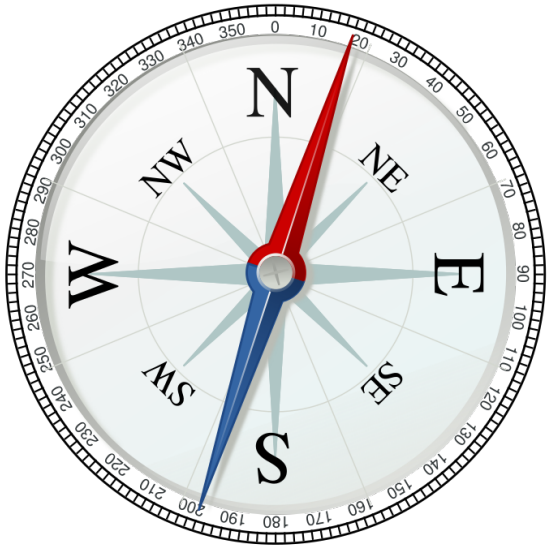
Thousands of years ago, the Chinese discovered that magnets could stop, spin, and turn. They found that magnets would always move to point to the same direction: north. And so, the compass was born! Before the compass, travelers had to use landmarks or things in outer space to guide them. But, how could travelers use landmarks when they were out on the open sea? Or how could they see stars on a cloudy or foggy night? The compass finally gave explorers a reliable way to guide their direction. Compasses always showed them how to find north.

Navigational Technology

How did cartography skills develop? What is the importance of the Portuguese School of Navigation?

Cartography is a fancy word that means map-making. Have you ever thought about how hard it would be to make a perfect map of a place you have only been to once? The ancient Greeks made the oldest maps. The Greeks made them by hand. Map-making became easier when the printing press was invented in the 1400s. The printing press made it easy to make and share maps with many people. Later, mapmakers started adding special details to maps. For example, they added geographic features like rivers and islands.

In 1418, Portuguese Prince Henry started the first school for navigating the ocean. He called it the Portuguese School of Navigation. In his school, people were trained to make maps and navigate the ocean. Prince Henry wanted to be able to send lots of explorers sailing down the west coast of Africa.



TOOL: MAGNETIC COMPASS
PURPOSE: Direction
When traveling on the open sea, navigators did not have any landmarks to tell them the direction they were headed in.

HOW IT WORKS:
A compass is a small magnet and the earth is a large magnet. The compass needle is attracted to the earth's magnetic north pole, so it always points north.

HOW IT HELPS:
Navigators used compasses to determine which direction they were traveling in.

PROBLEM: The magnetic north pole and the actual north pole of earth are slightly different.

TOOL: ASTROLABE
PURPOSE: Latitude
Navigators needed to know *latitude*, or how far above or below the equator they were.

HOW IT WORKS:
An astrolabe is a metal wheel with a moving arm in the middle and a ring on top. The user holds the tool up by the ring on top. The user measures the angle of the sun by getting the sun to shine through the holes in the wheel.

HOW IT HELPS:
By measuring the sun's angle above the horizon, a navigator could determine latitude.

PROBLEM: It was hard to keep the tool steady while traveling on the rolling ocean water.

TOOL: CROSS-STAFF
PURPOSE: Latitude
Navigators needed to know *latitude*, or how far above or below the equator they were.

HOW IT WORKS:
A cross-staff is very simple. It has two arms. The user should point one at the horizon and one at a star or the sun. The angle between the two arms gave the altitude of the sun or star.

HOW IT HELPS:
By measuring a star's angle above the horizon or the height of the sun at noon, a navigator could determine latitude.

PROBLEM: Navigators had to move both arms of the cross-staff, so they often made errors.

TOOL: SEXTANT
PURPOSE: Latitude
Navigators needed to know *latitude*, or how far above or below the equator they were.

HOW IT WORKS:
A sextant measures the angle between two objects. Light is reflected between two mirrors and the angle between the light reflected is measured.

HOW IT HELPS:
By measuring the sun's angle above the horizon, a navigator could determine latitude.

PROBLEM: It wasn't invented until the 1700s, so most early explorers didn't have access to a sextant.

TOOL: HOURGLASS
PURPOSE: Time for Longitude

During the Age of Exploration, there was no way to find *longitude* – how far a ship traveled east to west. So, navigators needed to know the time and speed traveled to find the distance traveled.

HOW IT WORKS:
An hourglass is a tube with two glass bulbs – one on each end. It is filled with sand. It takes an hour for the sand to pass from one bulb to the other.

HOW IT HELPS:
Navigators found longitude by measuring the ship's speed and the time spent traveling. Speed multiplied by time equals distance traveled.

PROBLEM: The user had to pay close attention to the tool to be sure to turn it when the sand runs out.

TOOL: CHIP LOG
PURPOSE: Speed for Longitude

During the Age of Exploration, there was no way to find *longitude* – how far a ship traveled east to west. So, navigators needed to know the time and speed traveled to find the distance traveled.

HOW IT WORKS:
Knots were tied along a rope. The rope would be thrown down and would drag through the water for a set amount of time. Users counted how many knots were let out into the water to determine speed.

HOW IT HELPS:
Navigators found longitude by measuring the ship's speed and the time spent traveling. Speed multiplied by time equals distance traveled.

PROBLEM: The user had to pay close attention to count the knots so they didn't miss any.

SHIP: CARAVEL
PURPOSE: Long-Distance Travel

Navigators needed a replacement for the large, slow-moving cargo ships that carried goods and only traveled short distances.

HOW IT WORKS:
Caravels had a rounded bottom so they moved faster through the water. Later versions were able to use two different types of sails depending on the type of travel that was needed.

HOW IT HELPS:
This ship could move fast and was very maneuverable, meaning it was easy to turn and direct.

TOOL: LEAD LINE
PURPOSE: Water Depth

Navigators needed to know how deep the water was that they traveled in.

HOW IT WORKS:
A lead line was a long rope with a heavy weight on the end. It would be dropped into the ocean and let down until it hit the bottom. Then, it would be pulled back in, and the length of wet rope would be measured to determine how far down it dropped.

HOW IT HELPS:
Navigators knew very little about the ocean at this time, so this gave them more understanding.