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It's the Great Circle, Columbus!



When explorers began sailing across the oceans in search of new lands, the need for a completely new science emerged. **Cartography,** or the science of designing maps, became extremely important to explorers and sailors who were seeking new lands. It's still important today because maps allow scientists to track changes to our planet's surface and allow people everywhere to locate specific places on Earth.

Since Earth is a sphere, scientists use the Earth's axis of rotation to determine reference points for directions. The geographic North and South Poles are the points where the Earth's axis of rotation intersects the surface of our planet. As you know, the equator lies halfway between the poles. This **parallel** separates our planet into the Northern and Southern Hemispheres. Parallels are the many circles that run east and west around the Earth (well at least on maps and globes). They are referred to as parallels because they are parallel to the equator. Parallels are labeled *N* for north of the equator and *S* for south of the equator. Cartographers measure the distance between these parallels in degrees of **latitude.**

Latitude is the distance north or south of the equator. The equator is 0 degrees latitude. Latitude is also referred to as an angular measurement. Since the distance from the equator to each of the poles is 1/4 of a circle (circle is 360 degrees), the latitude of each pole is 90 degrees. One degree of latitude equals 1/360th of the Earth's circumference. That is equal to 111 kilometers. For every degree of latitude, there are sixty minutes ('). Every minute of latitude equals 1.85 kilometers. Each minute of latitude is equal to sixty seconds ("). If we were to locate the city of Washington, D.C., its latitude would be 39 degrees N. If we wanted a more precise measurement, then Washington, D.C., is located at 38 degrees 53' 23" N latitude.

Another measurement cartographers use is **longitude.** Longitude shows the location of a specific place east or west of the **Prime Meridian. Meridians** are imaginary semi-circles that run north and south around the Earth through the poles. The Prime Meridian, 0 degrees, runs through Greenwich, England. Just like latitude, longitude is an angular measurement. However, the distance between each degree of longitude changes with the location of the longitude. All of the meridians meet at the poles. As you move away from the equator where one degree of longitude equals 111 kilometers, the distances decrease. In fact, at 80 degrees N latitude, one degree of longitude equals about 20 kilometers. All meridians west of the Prime Meridian are 0 degrees to 180 degrees W (west), and all meridians east of the Prime Meridian are 0 degrees to 180 degrees E (east). If we looked at Washington, D.C., again, its more precise measurement would be 38 degrees 53'23" N, 77 degrees 00'33"W. Now we move on to the **great circle.**

Great circles are very important in navigation. Pilots who fly long-distance aircraft use great circles to find the most direct route between two locations. Great circles are any circles that divide our planet in half or mark the

circumference of the globe. Simply put, two meridians that are across the Earth from each other form a great circle. The equator is the only line latitude that is a great circle. On a sphere, the shortest distance between two points is the route along a great circle. Airplanes and ocean-going vessels usually navigate using great circles.

Cartographers have found ways to use the Earth's magnetic force to help determine direction. Our planet has two **geomagnetic poles**- the Geomagnetic North Pole and the Geomagnetic South Pole. The geomagnetic poles and the geographic poles are located in two different places. The geomagnetic poles are along a line through the center of our planet. This line is at an angle to the Earth's axis of rotation. Since these poles exist, we can use magnetic compasses to find directions (north, south, east, and west) on Earth. The needles on magnetic compasses always point to our Geomagnetic North Pole. The horizontal angle between the true Geographic North Pole and the Geomagnetic North Pole is called **magnetic declination.** Since our planet's magnetic field constantly changes, maps that show the magnetic declinations of the Earth are updated regularly.

One final way that people find direction on Earth is by using **global positioning systems (GPS).** GPS was once only used by the military. However, now systems are readily available for consumer use. This system uses a global network of satellites. These satellites transmit radio waves to the Earth's surface. The first GPS system was NAVSTAR, which was started in 1978. Receivers on the Earth's surface pick up signals from three satellites in order to determine position. These satellites calculate the latitude, longitude, and altitude of the receiver and are accurate within several meters of the actual location.

All of these methods used by cartographers help us to find our way around our vast planet.

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Questions

_____ 1. Lines of longitude run _____.

A. North and south of the equator
B. East and west of the equator
C. East and west of the prime meridian
D. North and south of the prime meridian

2. Compare parallels with meridians.

_____

_____

_____ 3. Airline pilots and ocean-vessel pilots use _____ to travel the shortest distance between two points.

A. Great circles
B. Semi-circles
C. Compasses
D. None of the above

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4. Why is the distance between meridians not constant, but the distance between parallels is constant?

_____

_____

5. What is wrong with the following location: 125 degrees N, 195 degrees E?

_____

_____

_____ 6. The distance covered by a degree of latitude is _____.

A. 1/360th of the Earth's circumference
B. 1/180th of the Earth's circumference
C. 1/270th of the Earth's circumference
D. 1/90th of the Earth's circumference

7. How does GPS help people to find their location on Earth?

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How many of these can you write about? Think! Write! Check all the ones you answered.

- ☐ Write a title down paragraph to explain lines of parallel or lines of meridian. Use the letters in the word "latitude" or the word "longitude" to begin each sentence.
- ☐ Use the internet and other library resources to research the history of compasses on Earth. Have they changed the technology of compasses during the past few years? Make sure your essay discusses how compasses have evolved since they were first invented.