

GLOBAL POSITIONING SYSTEM (GPS)



To the LORD belong the heavens, even the highest heavens, the [earth] and everything in it.

Deuteronomy 10:14

God is the owner of the heavens and the earth, and everything that is in them. He's a good owner, too. He never loses anything. He knows where everyone on earth is. Remember Jonah? He couldn't hide from God, and neither can we.

And just as God always knows where we are, now He has provided us with the means to find out, too. Through the technology of the Global Positioning System (GPS), God has let us discover where on earth we are ... and how to get from one place to another.

Where on earth are we? In order to understand how GPS works, we must first learn to find out exactly where we are on the earth.

Latitude/Longitude Symbols

° = degrees
' = minutes
" = seconds

1. On a globe of the world, find the lines that run north and south through the equator.

a. As the lines go north or south from the equator, do they get farther apart or closer together?

At what two points on a globe do all these lines meet? _____

These lines are called _____

b. What two continents does the zero longitude line run through?

c. Look on the other side of the globe directly opposite zero longitude. What longitude is this? _____

It passes through this continent: _____

d. The zero longitude line separates east from west. What continent(s) is(are) entirely in the western hemisphere? _____

e. Locate 90° west longitude. Which five countries in North America does it pass through?

f. Which four countries does 135° east longitude pass through?

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2. Now that we understand what longitude lines mean, let's study the other major lines on a globe.

a. The equator passes around the globe at the center and runs east and west. This line is also called _____ latitude. Notice the other lines that circle the globe parallel to this line. The lines above the equator are called _____ latitudes. The lines below the equator are called the _____ latitudes.

b. The _____ is 90° north latitude and the _____ is 90° south latitude. If 0° latitude is the equator and 90° is the North Pole, the latitude that is exactly half way between the equator and the North Pole is _____. Which countries in the western hemisphere does 45° north latitude pass through? _____

c. What ocean would you be in if you were at 0° longitude and 0° latitude?

Is there any other point on earth that has exactly the same latitude and longitude? _____

- d. Find Denver, Colorado, on a globe or map. Which major latitude and longitude lines run through or near it?

- _____ latitude
- _____ longitude

Anywhere on earth can be expressed by the degrees of the _____ and _____

In North America, your position can be described as "X" degrees _____ longitude and "X" degrees _____ latitude.

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3. To understand how the Global Positioning System knows where we are, do the following:

- a. Open a map and place it on a piece of one inch thick Styrofoam that is at least as large as your map. Using a pencil with an eraser, pierce the point of the pencil anywhere on the map, going through the map into the Styrofoam. Use a tack to attach a string to the eraser of the pencil. The pencil eraser represents a satellite above the earth and the string represents the signal from the satellite. The end of the string can be put anywhere on the map in a circle around the pencil. Attach a tack, which represents your GPS receiver, at the loose end of the string. The "eraser" satellite knows how far (the length of the string) the "tack" GPS receiver is from the satellite, but not the direction from the satellite. Now, using the tack on the loose end of the string pierce the map, making sure the string is tight.

- b. Repeat the process with another pencil by placing this pencil with string attached in another location, but attach the other end of the string to the same tack on the map. What does this pencil and string represent?

- Pencil _____
- String _____

With two satellite signals, is it now possible to know exactly where you are on earth?

- c. Repeat with a third pencil. Now with three strings representing the distance from the three satellites and converging, can we be at more than one spot? _____

- d. Suppose we want to know how far we are above the earth, will three satellites be sufficient?

- e. Very carefully, take the tack with three strings attached and lift it above the map. In what occupation would a person want to know how far they are above sea level?

In what dangerous activity might a person want to know how far they are above sea level?

- f. To know how high we are above the earth, take another shorter pencil, representing how high we are above the earth, and repeat step 3b. Now notice that this satellite determines our position above the earth.

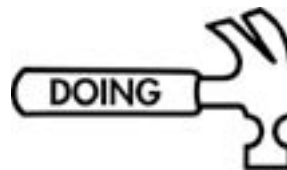
- g. Since we can only be at one spot on the earth, we can determine the following positions exactly:

- _____
- _____
- _____

- h. If we move only a few feet from our present location, what happens to the distance from the satellite? _____

This is how the GPS works.

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Since receivers don't all operate the same, we will give only general directions.

1. Turn your GPS receiver on. When it first comes on, it will tell you not to rely on the receiver until it does what? _____

The signals do not always penetrate buildings well, so you may have to be in an open area.

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2. When you are tracking four satellites, the GPS receiver will give your location in three readings. List them here.

- Your latitude is _____
- Your longitude is _____
- Your distance is _____ feet above sea level.

Example: Latitude: N 42° 59.169'
Longitude: W 86° 12.379'
661 feet above sea level

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3. Take a walk with your GPS receiver turned on. Notice if you walk due north or south, your _____ changes; if you walk east or west, your _____ changes; and if you are also climbing a hill, the _____ also changes.

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4. **Navigating with your GPS receiver:** By establishing waypoints with your GPS receiver, you can plan a route or find the same point back whether it is dark or light, cloudy or sunny. There are two ways to establish waypoints in the GPS. Do one of the following:

- a. Suppose you are fishing on a lake and find a place where the fish always bite. Follow the directions from your GPS receiver and enter this point in your GPS receiver. You can establish a name, number, and usually a symbol for that point. Every time you go to that lake, you can locate the exact spot on the lake. To illustrate, do the following on your map. Locate a lake on the map and put a pin in the lake on the map. Next put a pin in your hometown and a string between them, which represents the closest route. What information can you receive about your waypoint, no matter where you are?

- _____
- _____
- _____
- _____
- _____

- b. The second way to establish a waypoint is to know the exact location of where you want to go. If your buddy has a GPS receiver and notes a point where he always catches fish and is willing to share this information, what information would you need?

- _____
- _____

After you enter this information as a waypoint, you can add what other information? (Hint: reread 4a.)

- _____
- _____
- _____

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5. **Planning a route:** Demonstrate to your counselor how to use the GPS receiver by doing one of the following:

- a. Choose a favorite place and plan a route to it from your home using your GPS. Follow the instructions below. To illustrate this, use the map again. You should have two pins in the map. Where should each be?

- _____
- _____

Now, using several pins, mark the highways you would use to get to the waypoint. At each intersection where you would make a turn, put a pin and string. Save this information, by using the route feature of your GPS receiver. To do this, establish a waypoint at each intersection. Continue until you come to the final waypoint. Using the route system, we can find our way to any waypoint. At each intersection, put in the following information:

- _____
- _____
- _____

When arriving at the final waypoint, the GPS receiver will tell us we have arrived. To return to the starting waypoint, just reverse the route.

- b. Establish a route on your GPS receiver by going on a hike or ride with your counselor or parent.

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MERIT BADGE APPROVED BY _____

MERIT BADGE COMPLETED ON _____

