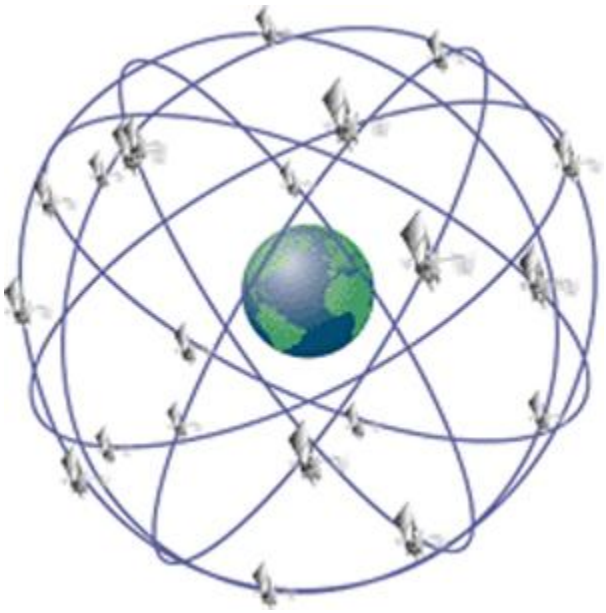
INTRODUCTION TO GPS

WHAT IS GPS?

Its full, unglamorous name is Global Positioning System. Launched by the U.S. military in 1990, GPS is a network of 24 global positioning satellites that orbit the planet, beaming radio signals back to Earth to receivers in cars, boats, planes, and hikers' hands.



HOW DOES IT WORK?

After receiving radio signals from three or more satellites, a GPS receiver can triangulate your position and display it on-screen as a set of coordinates. Once it picks up four or more satellites, you can get your position in three dimensions, including altitude. It's the world's most precise way to navigate; the typical accuracy of a hiker's unit ranges from 3 to 30 meters.

WHAT GPS CAN DO

- Provide an exact geographic fix that can be plotted precisely on a map.
- Tell you the straight-line distance and direction to your destination.
- Record the day's travel as a "track," creating a highly accurate bread crumb trail you can reverse and follow home, or transfer to computer.
- Tell your altitude within 30 feet.
- Provide detailed trip information, such as mileage, speed, and elevation gain.
- Warn of topographical roadblocks like rivers and deep canyons, as long as you've loaded topo maps onto the unit.

WHAT GPS CAN'T DO

- Provide enough map detail to plan long-distance routes or navigate through tricky terrain (pack topos or use our Adventure Planner mapping software).

- Warn of detours due to recently rerouted trails, fallen bridges, or natural disasters (call ahead or check recent trip reports on our site).
- Replace basic navigation skills (get a book or friend to teach you how to use a magnetic compass, read a topo map, and plot a route through terrain).

JARGON

Datum: Also called map datum. Every map has a "datum," which describes the survey grid used to match the coordinates and features on the ground. Most topos maps are in WGS 84 or NAD 27. Always match your GPS with your map's datum, located on the bottom of the map. Caution: If you're using a NAD 27 map and WGS 84 on your GPS unit, you could be off as much as 1/4 of a mile.

Latitude/Longitude: A traditional standard for representing your position on an east/west, north/south grid. Maps display this grid along their perimeter.

Point of Interest: see "Waypoint"

Route: A file of linked waypoints saved in your GPS unit or computer. Not as detailed as a track.

Track: Also called a tracklog. It's a series of tightly recorded waypoints automatically recorded by the GPS from a bread crumb trail of positions you've passed through since powering up. Displayed on your GPS screen, the track allows you to reverse your course of travel. It can be transferred to our Adventure Planner mapping program or other software on your computer for an exact plot on a map. Our map correspondents set their GPS units to collect a track point every 1/100th of a mile.

UTM: UTM is a reference grid that divides topographic maps into 1-kilometer squares for easy and accurate plotting. It's replacing latitude/longitude as the standard for modern land navigation.

Waypoint: Also called a Point of Interest (POI). It's an electronic pinpoint of a place.

WAAS: Wide Area Augmentation System is a network of ground stations that work with GPS satellites to enhance signal accuracy.

Using a GPS Device

To navigate and locate destinations with a GPS device, the first step is to understand and know how to find GPS coordinates. GPS uses the same coordinate system that map makers and navigators have used for centuries -- latitude and longitude.

Latitude and longitude are not difficult to understand, and a little practice will allow you to enter coordinates into your GPS and locate specific points and landmarks. If you start to find the use of coordinates interesting, you will want to learn more advanced map reading skills. Of course, with the technology now available, some GPS users never unfold a map and can find all the coordinates they need.

Understanding Latitude and Longitude

The latitude and longitude lines cover the planet, this planet - Earth, in a grid that can be used to pinpoint any location with a set of coordinates.

Latitude lines are a set of lines that run horizontally around the globe parallel to the equator. A location's latitude coordinate is measured in degrees north or south of the equator. The maximum value for latitude is 90 degrees, which would put you on the north or south pole. Longitude lines run through the poles north to south. They provide a measurement in degrees as you move east or west. The zero latitude line runs north and south through Greenwich, England. Latitudes then increase in degrees east and west out from Greenwich for 180 degrees to the other side of the planet.

A location's coordinates are designated by latitude and longitude annotated in degrees, minutes and seconds. For example, the town of Spring Valley, Minnesota has coordinates of 43 degrees, 40 minutes, 34 seconds north latitude and 92 degrees, 36 minutes, 7 seconds north longitude. Using more common punctuation, the coordinates can be written N 43° 40' 34", W 92° 36' 07". Other ways of writing coordinates uses decimals for the minutes and seconds.

GPS Coordinates

Unless you are just using your GPS to find the nearest McDonalds or ATM you will need to learn a little about map coordinates. A GPS coordinate converter will convert different formats of coordinates into the format you want to use or are most comfortable with. GPS devices use signals from the GPS satellites to compute locations or coordinates in the form of latitude and longitude.

Latitude is a measurement in degrees away from the equator towards one of the poles. Longitude is the number of degrees a position is east or west of the prime meridian which passes from pole to pole through the Royal Observatory in Greenwich, United Kingdom.

Coordinate Formats

Latitude and longitude coordinates can be formatted several different ways. Your GPS can switch between the different formats, but you will be probably most comfortable with one format. Here are the different formats and how they look using the coordinates for the famous Palacio Salvo in Montevideo, Uruguay:

Degrees, Minutes, Seconds: *S34° 54' 24", W56° 11; 54"* This is the classic method of showing coordinates. There are 60 minutes, indicated by the apostrophe, in a degree and 60 seconds -- quote mark -- in a minute.

Decimal Degrees: *-34.906725, -56.198308* Minutes and seconds are converted to decimal places and south latitude and west longitude are given minus signs. This format is easy to type into navigations systems with a numeric keypad.

GPS Coordinates: *S34 54.404, W 56 11.898* This format converts just the seconds to decimal places on the minutes. The format is useful when plotting coordinates on a map. Maps of 100,000 or 250,000 to 1 will have tick marks for the minutes on a grid. Having the minutes in decimal form makes it easy to estimate between the minute ticks on a map.

- A side note: One minute of longitude is one nautical mile. For planes and ships measuring speed in knots, this is a handy map reading hint. The fighter pilot flying low level at 480 knots knows that he will cover 8 ticks of longitude every minute.

UTM Coordinates: *21S 573238 6137007* UTM is a grid system used primarily by the military that divides the land mass of the planet into one kilometer squares. Once it is understood, UTM is a very accurate way to pinpoint locations -- and targets! The system is popular in northern Canada where the narrowing longitude lines makes accurately plotting latitudes more difficult.

Format Conversions

Here is a sample conversion from degrees, minutes, seconds to decimal degrees:

- In a given coordinate of 118 degrees 8 minutes 26.2353 seconds West, let's do a conversion from degrees, minutes and seconds to decimal degrees.
- 118 degrees 8 minutes 26.2353 seconds West = -118.1406209154
- 118 + 8/60 + 26.2353/3600 = 118.1406209154
- Units are negated to indicate direction (West latitude or South longitude)

To give another coordinate format, consider 25.124167 as a given coordinate, which basically is just degrees, a pure decimal number. Again, don't ignore the fraction.

- Take it and multiply it by the number of minutes in a degree (0.124167x60=7.450 minutes). This gives you a coordinate of 25 degrees and 7.450 minutes.
- With actual numbers, a given latitude of N 25 07.450 is the same as N 25° 07' 27", or simply 25.124167. If you are calculating distances using coordinates, never ignore the decimal points as they represent a fraction of minutes. Observe:
- N 25 07.450 is the same as 25 degrees and 7.450 minutes North of the Equator
- To calculate for the fraction portion of the minutes, multiply the decimal portion to the number of seconds in a minute (.450 x 60 = 27). Hence, 7.450 minutes is equivalent this coordinate: 7 minutes and 27 seconds (7' 27").

Now, refer to your map, find the location indicated by the given coordinates. Use the degrees-minutes-seconds format and find out where they intersect to establish GPS location. Some GPS devices have conversion features to make it easier for you to spot map locations.