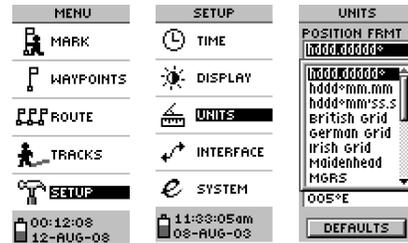


## Finding Lines of Latitude and Longitude on the ground.

You may have noticed but on many maps there are lines and borders on them that you can't see or find when you are at these locations on the ground. While true in the visible sense, if you were to go to court in a legal case to find the border of someone's property or you wanted to find the prime meridian, there are tools to help you find these invisible lines. You can use your GPS to find one of the more used lines that exist on maps but aren't seen on the ground. These are the lines of latitude and longitude. These lines will be particularly evident if you have several people each with their own GPS unit.

Once you have locked on to the satellites and are ready to navigate, make sure that your receiver is showing Latitude and Longitude in decimal degrees\*<sup>1</sup>



Have your group spread out into a circle around the leader and use the page button to all be looking at the compass page. Use the toggle buttons on the upper left side of the unit to change the information window under the compass to read: Location.

Ask several group members to read the last 3 digits of their latitude. Add about 30 to this number and round it to the closest 10s group. So if you have a latitude of 45.81420° have everyone walk until the reading becomes 45.81450°. Remind the group that they are not all trying to all get to the same spot but to just stop once the last 3 decimal places of latitude read **480**. (Focusing on the last 3 numbers is easier when walking and the other numbers won't change at this scale.) Of course if you want to remind your group to walk in a north-south direction (point out which way is North), you will save some time for them finding it.

Once everyone has found this latitude, take a look at the shape that students are standing in. You can tell your group they are roughly standing on a line of longitude. (Not a whole number line but some decimal line.) Errors in the signal may make it less than a perfect straight line but students should get the idea.

Now, ask several people in your group to look at their longitude and read their values. Looking only at the last 3 decimal places, add or subtract roughly thirty from one of the numbers called out. If you are at -88.04894° then ask your group to find the latitude of -88.04860°. Again confirm the shape of the group once they reach their destination as a line. How does this new line relate to the orientation of the previous line they made?

Finally ask them to find the place where these lines of latitude and longitude cross. I.e.  $45.81450^\circ$  and  $-88.04860^\circ$ . Your group may remember the general shape of the two lines and extrapolate where they will cross but incase they aren't thinking this way, you can remind them that the point is somewhere along the line on which they are all currently standing. So follow the line one way or the other until they reach the point you have read to them. (You may want to simplify this last task to read just the last two digits for them to find. In our example this would be  $.xxx50^\circ$  N and  $.xxx60^\circ$  W.

Look at the area your group covers. This will give you an idea how accurately the GPS can measure a point. Typically this will be an area about 10m x 10m.



Figure a. This satellite picture of boulder shows the road known as Baseline running along the  $40^\circ$  N latitude line. You will determine some fraction of a latitude and longitude line that runs near your school or base of operation.

### Special note for younger participants:

\*1 Younger groups may find it easier to use the UTM projection mode in the GPS as it measures how many meters north – or south - of the equator you are and how many meters you are from a reference line of longitude. While they are large numbers, they are always positive whole numbers which may be easier than the decimals dealt with above. The choice to use Lat Lon in degrees was followed because most schools are teaching this system and it is certainly simpler than using or explaining degrees with minutes. Eventually if you like to geocache, it is most common to use the degrees and minutes representation but for now it is easier with degrees or UTM.