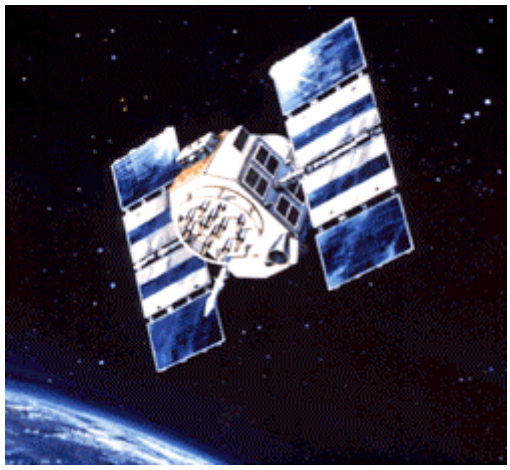
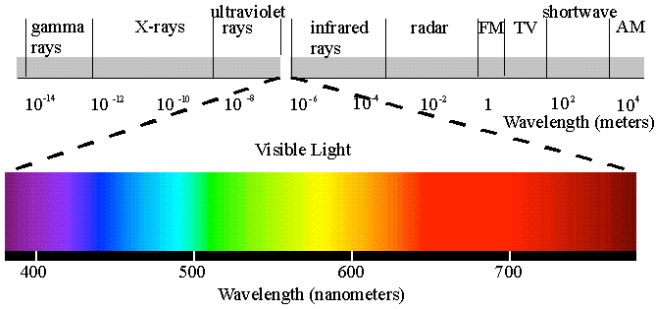
Skill Building: How Use GPS in Field Ecology

History tells us that Columbus was never really sure how far west he had sailed, since his ability to determine longitude was limited by the lack of a good clock. That's not a problem today. With the help of today's satellites and common instruments, we can constantly determine exactly where we are on Earth's surface and our altitude.



Global positioning systems (GPS) must be in contact with at least three satellites in order to tell us where we are; a fourth satellite must be in range to tell us our altitude. The signals are radio waves (electromagnetic waves that pass through lightweight materials like wood or plastic). Note that radio waves have wavelengths of from a meter to a thousand meters or more.

GPS began with national defense satellites. In the United States we use the NAVSTAR system (below) supplemented by the Wide Area Augmentation System. Measurements are usually accurate to about 15 meters and can be as accurate as 3 m.



Images above courtesy of NASA.

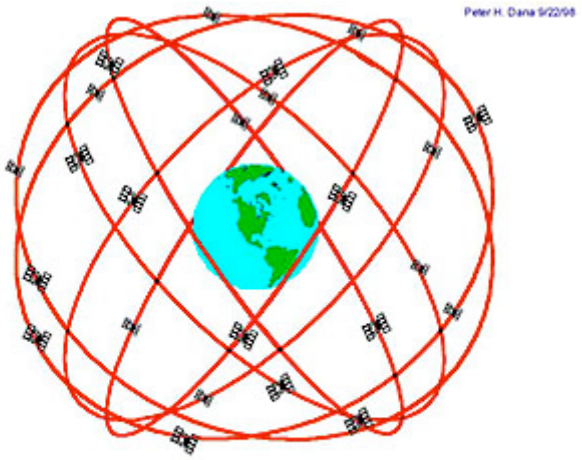
To use GPS you not only need contact with those satellites, but also software (which you normally need to buy as part of a receiver) and map data (provided by local agencies.) That's why your GPS sometimes tells you that you are on a road that looks like a cow path, or shows you in a field when you are really on a newly-built road. It's not the satellite's call, but the decision of the local agency that provides the maps.

How to Use GPS in the Field

Each GPS receiver will have a different operating system. Here's a sample of how you miht use a common receiver (Garmin Nüvi™) in the field.

1. Begin by turning the instrument on (slide power lever).
2. The instrument (made for drivers) asks you to recognize that drivers shouldn't be manipulating it while on the road. You must "accept" that warning.

3. Hit the menu button, then "Tools"
4. Hit "Where Am I?" You should see:
    a. Latitude
    b. Longitude
    c. Elevation
5. Walk slowly down a trail or along a road. Watch as the location changes. You might measure how far you have walked by regular paces, or use a tape. (See a sample of a student activity drawing a map with GPS at http://www.gpsdrawing.com/workshops/schools/corby.htm)



GPS Nominal Constellation
24 Satellites in 6 Orbital Planes
4 Satellites in each Plane
20,200 km Altitudes, 55 Degree Inclination

6. Each degree of latitude is about 69 miles and each minute about a mile, so students should be able to see the seconds on the latitude scale change as they walk as little as 0.1 mile. (The Earth is a bit ellipsoidal so that's not exact.) Longitude varies from ~69 miles at the equator to 0 at the poles. For most of the United States (near 40^{o} longitude) a degree represents 53 miles.

Applications

One valuable application of GPS is to follow the route of a stream, looking at the drop per (0.1) mile. Explorers can easily record coordinates and elevation as they follow a stream route, and then record their observations on the relationship between changes in elevation and stream flow.

The coordinates obtained by GPS are also invaluable in generating satellite photos (GoogleEarth.com™) and maps (www.Nationalatlas.org) to correspond with field observations.

Read More

How GPS Works: http://www.nasm.si.edu/gps/work.html

Map Tools to Measure Stream Flow:
http://nationalatlas.gov/articles/water/a_streamflow.html

Free GPS Software: http://www.maps-gps-info.com/fgpfw.html

Samples of Mapping Worksheets and other Classroom Activities:
http://sciencespot.net/Pages/classgpslsn.html