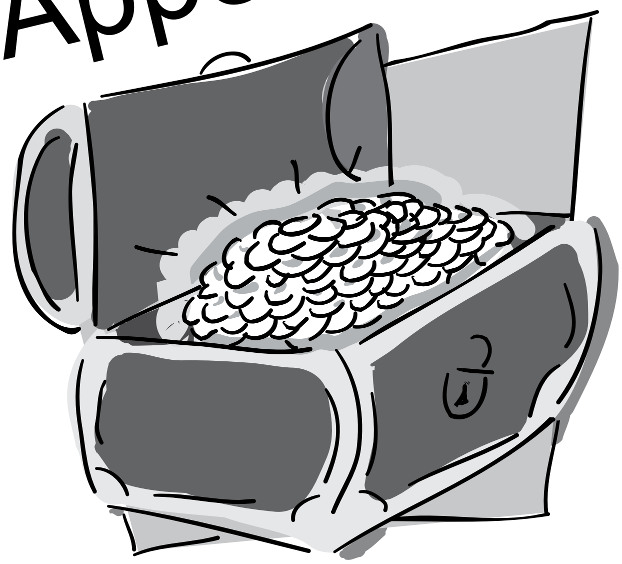
# Appendix



# GPS Investigation

## Site Location Data Sheet

You will need at least one copy of this GLOBE *GPS Data Sheet* per GLOBE site. After making your field GPS measurements and averaging the position data, record your results on one of the investigation site definition data sheets, then submit your location data to GLOBE on the Internet (**www.globe.gov**).

***Type of Site***
(Atmosphere, Biosphere, etc.)

***Site Description***
(25 characters or less)

***Averaged Latitude***
(Whole Degrees, Decimal Minutes N/S)

***Averaged Longitude***
(Whole Degrees, Decimal Minutes E/W)

***Time of 1st Observation***
Hours: Minutes: Seconds in UT

***Type of Receiver***
Magellan Trailblazer XL & UNAVCO number

or

Manufacturer model number and serial number

# GPS Investigation

Data Sheet

**Data Recorded By:** ______________________

**Date Recorded:** Year_____ Month:_____ Day:_____

**Circle Site type:** School Atmosphere Biosphere Hydrosphere Soil (Pedosphere) Other ________

Site Name: ______________________

School Name: ______________________

School Address: ______________________

Do not begin recording data until your GPS receiver has “locked in.”
Wait at least one minute between recording each observation.
Record the following data from the appropriate screens on your GPS unit.

| **Obs** | **Latitude** Decimal Degrees (N/S) | **Longitude** Decimal Degrees (E/W) | **Elevation** Meters | **Time** H:M:S UTC | **# Sats** Satellites | **Messages** Circle if Displayed |
|---|---|---|---|---|---|---|
| 1 | | | | | | 2D 3D |
| 2 | | | | | | 2D 3D |
| 3 | | | | | | 2D 3D |
| 4 | | | | | | 2D 3D |
| 5 | | | | | | 2D 3D |
| Averages | | | | | | |

GPS Reciver Information

Brand Name: ______________________

Model Number: ______________________

# Offset GPS Measurements
Data Sheet

**Data Recorded By:** ____________________

**Date Recorded:** Year_____ Month:_____ Day:_____
**Circle Site type:** School Atmosphere Biosphere
Hydrosphere Soil (Pedosphere) Other ________

**Site Name:** ____________________
**School Name:**____________________
**School Address:**____________________

***Offset GPS Measurements***

Measured Latitude: ____________________ degrees N or S (circle one)

Measured Longitude: ____________________ degrees W or E (circle one)

Direction from GLOBE site to offset location: N or S (circle one)

Distance from GLOBE site to offset location: ________ meters

***Computations***

Change in Latitude = $\dfrac{\text{Distance:\_\_\_\_\_\_\_\_\_meters}}{\text{110,000 meters/degree}}$ = ________degrees

***GLOBE Site's Latitude:***

If offset location is *further* from Equator than the study site:

GLOBE site latitude **=** ______ (Measured Latitude) **-** ______ (Change in latitude) = ______ degrees N or S (circle one)

If offset location is *closer* to the Equator than the study site:

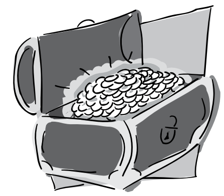
GLOBE site latitude **=** ______ (Measured Latitude) **+** ______ (Change in latitude) = ______ degrees N or S

(circle one)

**GLOBE site's longitude:** ____________ W or E (circle one)
*Same as Measured Longitude at the Offset location*

**GLOBE site's elevation:** ____________ From a local topographic map using your site's latitude and longitude

# Glossary



**Accuracy**
The difference between the indicated measurement value and the true value

**Average**
A technique for using one number to describe a group of numbers. An average (or mean) value is computed by summing a set of values and divided the sum by the number of values summed.

**Equinox**
One of the two times of year when the sun appears directly over Earth's equator occurring typically on 21 March (vernal equinox) and 23 September (autumnal equinox). On these days, the times of daylight and night will be equal.

**Geoid**
The irregular surface that follows the global mean sea level and is shaped by Earth's gravitational field

**Global Positioning System (GPS)**
The Global Positioning System is a navigation system that includes 24 satellites orbiting 20,200 kilometers above the Earth. Using time measurements of GPS satellite signals, the receivers can pinpoint our latitude, longitude, and elevation.

**Histogram**
A frequency distribution plot indicating how often a particular number appears in a group of numbers

**Latitude**
The angle measurement in degrees of a planet north and south of its equator. Beginning at the Earth's equator (0˚), latitude is measured in degrees, with the poles being 90˚ north and south.

**Longitude**
The angle measurement in degrees east and west around a planet's spin axis. On Earth, the Prime Meridian is the north-south line through the town of Greenwich, England. This is 0˚ longitude, and the International Date Line is 180˚ from the Prime Meridian.

**Magnetic Compass**
A hand-held instrument displaying the angular orientation of a pivoting lightweight magnet. Because Earth behaves like a giant magnet, the magnet in the compass will point toward Earth's magnetic poles which generally indicates north and south.

**Magnetic Variation**
Also called Magnetic Declination, this is the angle between the magnetic and geographic (spin axis) poles specific to a locality. It is expressed in degrees east or west to indicate the direction to true north from magnetic north. Earth's magnetic north pole is slowly moving and presently located in Canada's North West Territories about 11 degrees away from our North Pole. Additionally, magnetic properties of Earth's composition vary slightly between locations contributing a unique distortion to Earth's magnetic field at any given site. Values may be found on navigation charts.

**Meridian**
This is a circumference around the Earth's surface which passes through both poles and the equator. These form curves of constant longitude between any two poles.

**Navigation**
The science and technology of determining course, position, and distance traveled.

**Offset Site**
This is a site directly north or south of a site where we are able to make a successful GPS measurement.

**Positions (or Locations)**
Absolute
Measured from an agreed upon *fixed* location.
Relative
Measured from some arbitrary point such as your location.

**Plumb bob**
A vertical line formed by a string supporting a weight. The weights used to be made of lead and a former and Latin derived chemical name for lead was "plumbum" from which comes the English word "plumber".

**Precision**

The measure of the repeatability of an observation, that is if a measurement is repeated multiple times, how much will the individual measured values vary from the average of all the measurements.

**Reference Ellipsoid**

A smooth surface that approximates mean sea level. It is used by GPS receivers as the reference surface in their elevation measurements.

**Resolution**

The smallest change which can be *displayed* by an instrument

**Satellite**

Any celestial body that orbits another larger body

**Solstice**

One of the two times of the year when the overhead sun appears furthest from Earth's equator occurring typically on 21 June and 22 December. These will be the longest and shortest days of the year if your location is respectively closer to or further from the overhead sun.

**Sun angle**

This is the angle between horizontal (the ground) and our sun. Sometimes this angle is called an elevation or altitude angle.

**Trigonometry**

The mathematical study of triangles, trigonometric functions, and their applications. Trigonometric techniques allow us to relate angle values to the lengths of various sides of a triangle.

**Zenith angle**

For our sun angle measurement, this is the angle between vertical (straight up) and our sun. In navigation, this is sometimes called a zenith distance. On the days of the spring or fall equinoxes, this angle will be our latitude. The zenith is the point directly overhead wherever we are. The sum of the sun angle and the zenith angle is 90˚.

## *Circular Units, Distances, and Relationships*

**Degree (˚)**

A circle may be divided into 360˚ (or 400 Grads or about two times Pi (∏ Radians). Small fractions of a degree may be indicated either as decimal fractions (25.2525˚) or using whole degrees, minutes, and seconds 25˚ 15' 9").

**Minute (arc minute, ')**

One degree may be divided into 60 minutes. Therefore, there are 360 x 60 = 21,600 arc minutes (21.600') in a circle.

**Second (arc second, ")**

One minute may be divided into 60 seconds. Therefore, there are 60 x 60 = 3600 arc seconds in one degree or 1,296,000 arc seconds (1,296,000") in a circle.

**Radian**

An angle measurement unit equal to the angle subtended at the center of a circle by an arc equal in length to the radius of the circle. A full circle contains two times Pi radians or 360˚. One radian is about 57.3˚. For example: 25˚. 15' 9" = 25.2525˚ = about 0.4407 radians. Pi is an irrational number (cannot be described as a ratio of two whole numbers and thus requires an infinite number of decimal digits) with a value of about 3.141592653590. Pi has been computed to millions of digits but the accuracy of the value listed here would induce errors of less than a meter when working with distances the size of our solar system.

### *Time Reference Frames*

**Local Solar Noon**

The time-of-day when the sun angle is greatest at your location. This time is specific to your location and varies by about a half-hour throughout the year.

**Mean Time**

Formerly called Civil Time, this is the time-of-day value typically displayed on our clocks. It is defined to cause the yearly *average* location of the sun to be the same and near overhead at noon in your time zone. Each time zone is different by one hour from adjacent time zones and is defined to be 15˚ of longitude with a few minor exceptions determined by governments to suit local needs or geography. Your mean may be related to Universal Time by determining your distance from Earth's 0˚ longitude either in 15˚ increments or numbers of time zones. Universal and Mean Time may be contrasted to Sidereal Time (used by astronomers and sometimes called star time) which is defined to bring distant celestial bodies to the same point in the sky after exactly one Earth rotation around its sun. A sidereal day is about 4 minutes shorter than a day as indicated using mean time.

**Universal Time**

Also known as UT, Zulu, or GMT (Greenwich Mean Time), this is the time-of-day for a 24 hour day defined to cause the yearly *average* location of the sun to be overhead at noon when observed at Earth's zero degree longitude.

### *Consequences of the 23.5˚ tilt of Earth's spin axis from the plane of Earth's solar orbit*

**Arctic and Antarctic Circles**

Also called North and South Polar Circles, these are the extremes in latitude (66.5˚ North and South) from Earth's poles where total darkness or sunlight may be experienced in local respective winters or summers.

**Tropics of Cancer and Capricorn**

These are the extremes in latitude (23.5˚ North and South respectively) from Earth's equator between which the sun may be directly overhead at some time during the year.