

GPS Lesson 1 INTRODUCTION TO GPS WITH GEOCACHING TEACHER INFORMATION



Lesson Summary: During this lesson students will learn how to use GPS units to perform a variety of tasks. They will become familiar with GPS and handheld GPS units and learn how to: adjust the settings of the units; enter waypoint information; find a geocache; and place a geocache.

Objectives: Students will learn how to operate a GPS unit to collect and modify waypoint information.

Estimated Time: 1 hour

Correlation to Alaska Standards:

Geography A-6 Use spatial (geographic) tools and technologies to analyze and develop explanations and solutions to geographic problems.

Technology A Operate technology-based tools.

BACKGROUND FOR THE TEACHER

The following explanation of GPS is courtesy of Garmin, one of the world's leading GPS manufacturers.

"The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 hours a day.

GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites,

the receiver can determine the user's position and display it on the unit's electronic map.

A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset time and more."

Geocaching is an entertaining treasure-hunting game for GPS users. Participating in geocaching is a good way to learn about the wonderful features and capabilities of a GPS unit. The basic idea is to set up caches of interesting items and to share the locations of these caches with others, who can then use the location coordinates and their GPS units to find them.

Some important concepts and tips for success when setting up and using GPS units:

- Check batteries before using the GPS unit. Batteries run down quickly in cold temperatures.
- GPS Units set their clocks and calendars from the satellite signal. Time settings selected in the GPS menus only affect the format that the time is displayed in.
- GPS accuracy can be affected by many things including satellite number and position, atmospheric conditions and natural barriers to the signal. Consequently, it is important for students to pay attention to the accuracy reading both when looking for and creating geocaches.

MATERIALS

- GPS units – one for each student group
- Geocaches – one for each student group
- Copies of student directions for the lesson

INSTRUCTIONAL PROCEDURES

Getting Ready

Before starting this lesson with the students, you will need to create one geocache for each group of students. Three students per group is a good number, but this activity can be done with larger or smaller groups if necessary.

If you are new to GPS or rusty, it is important to run through the lesson that follows before placing the caches so that at least one of your GPS units has the correct settings and you know how to mark a waypoint.

- For each cache, acquire a large re-sealable plastic bag (e.g., Ziploc-type) or plastic tub.
- Put objects of interest in the bag (equal to the number of students participating in the exercise). Be creative here. Objects can be educational or functional items like mini rulers or pencils, or simply fun like stickers or mini globes. For long-term caches, DO NOT use food (may attract unwanted wild geocachers). Use your judgment as a teacher. Do you really want to pass out noise-makers or yo-yos? Probably not.
- Label the bag or tub "MapTEACH" and the Cache # (1, 2, 3...).
- Without the students noticing, find a hiding place for the caches. Bring all of your GPS units with you.
- Select a hiding place that is more than 25 but less than 100 yards from where the class will start their searching. Avoid covered or heavily forested area (GPS signal will fade). Hide the cache from plain site, but don't make this too hard. In the past we have hidden caches in tall grass, or behind a tree, or in the end of a hollow log, and that has proven sufficiently challenging.
- Write down the cache # and corresponding coordinates for each geocache. Coordinates should be noted in degrees, minutes and decimal seconds (See Explore 2: Checking and adjusting the unit settings if needed).

Gear-up

- Ask students if they have ever used GPS units, or know somebody who uses one. What are they used for?
- Ask students if they know how a GPS unit works. Follow this up with a level-appropriate explanation of how GPS units use satellites to triangulate locations.
- Tell your students that they will be using GPS units to find hidden treasure! Explain geocaching.
- Assign Student groups.
- Post Student group name, assigned GPS #, geocache name, and corresponding coordinates in the classroom. Student groups will enter coordinates for their assigned geocaches into the GPS during Activity 3.

Explore

- Students navigate to geocaches

Generalize

- At the end of the activities, ask students to share their experiences working with GPS units and geocaches. What makes a good or a bad geocache? How well did the GPS units lead them to the hidden treasures? Were they able to make any connections between the number of

satellites, the accuracy of the GPS location and how well it worked to find the geocache? What does this say about the limitations of GPS units? Can they think of any other ways to navigate besides using GPS units (maps, verbal instructions, landmarks, etc.)? What are the pros and cons of each method?

That's it. There are many possible variations on this lesson. "Virtual" caches can be made in which the cache is a historical marker or a natural feature. The student must answer a question about the information in the marker or about the natural feature to get credit for the find.

TEACHER RESOURCES

The deviation or variance from true-north to magnetic north is significant at higher latitudes (such as Alaska) and changes every year. GPS units will correct for this if you set them to use "true" north (Explore 2, Step 3e). If you want to discuss the difference between magnetic north and true north and its effect on traditional magnetic compasses, the following website and its associated links provide a good explanation:

http://gsc.nrcan.gc.ca/geomag/field/magdec_e.php

You can use this website to determine the correct current adjustment for your location (to manually enter in the settings with "user" and then "mag"):

<http://www.ngdc.noaa.gov/geomagmodels/Declination.jsp>

Converting between Decimal Degrees and Degrees/Min/Sec can be done online here:

<http://www.fcc.gov/mb/audio/bickel/DDMMSS-decimal.html>

If you want the students to learn to make the conversion using their own math skills, a simple how-to is here:

<http://www.mass.gov/mgis/llcoord.htm>

Learn more about how GPS units work at: <http://www8.garmin.com/aboutGPS/>

Official "Geocaching" is a global hobby with a well established website and set of rules. You can read about it here: <http://www.geocaching.com/>

Group Name: _____ Group GIS Number: _____

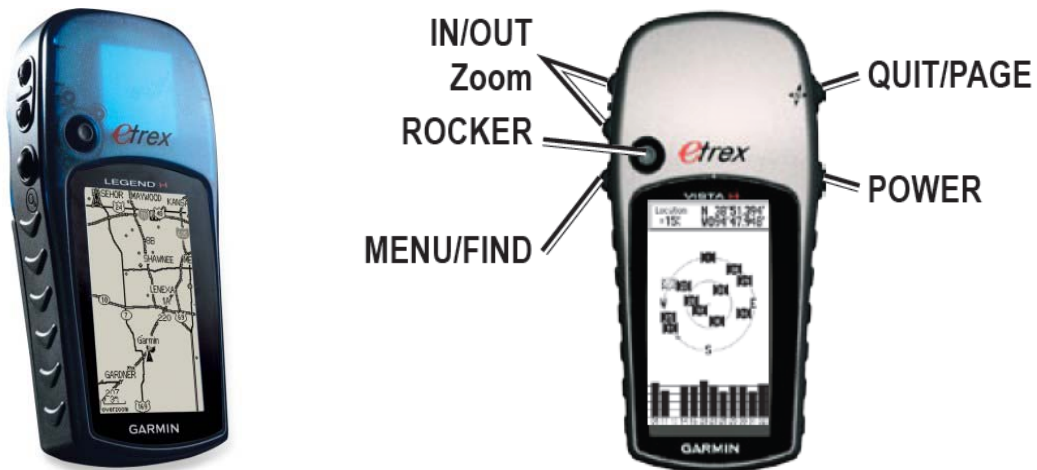
Group Members _____

**GPS Lesson 1
INTRODUCTION TO GPS WITH GEOCACHING
STUDENT EXERCISE**

Goal: Find hidden treasure with the use of a GPS unit and a set of latitude and longitude coordinates.

Explore 1: Familiarize Yourself with the GPS Unit (don't turn it on yet!)

1. Note the location and basic function of each of the buttons.



2. **Some things to know about these units:**

- Basic handheld units like this are passive GPS receivers.
- They receive signals from satellites but do not transmit any signals of their own.
- The device receives information from satellites that makes it possible for the user to determine their position on the surface of the earth.
- Locations and paths of travel can be programmed into or recorded by the GPS unit for “wayfinding” or “tracking.”
- ****Note the “Rocker” serves as a scrolling tool as well as the “enter” button, press down on the “Rocker” to “enter”.**

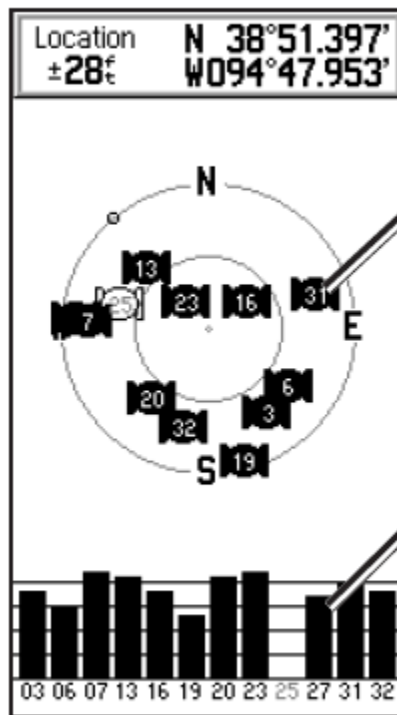
3. Some things to know about GPS:



- The system consists of more than 24 satellites orbiting the Earth about 12,500 miles above.
- The arrangement of the satellites is called the **constellation** and it is constantly changing.
- The satellites must continue to move to stay in orbit.
- The spacing of the satellites gives global coverage 24/7.

4. **Turn the unit on and learn how to use it.** This is best done outside with a clear view of the sky, or next to a window if you are inside.

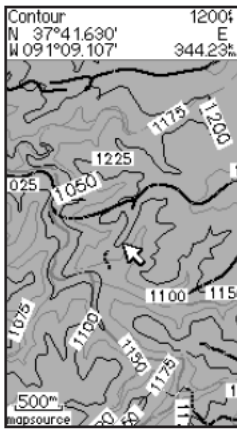
The screen should look like this first...



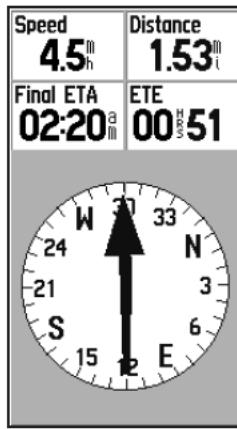
The number of each overhead satellite is shown.

The strength of each satellite signal is shown.

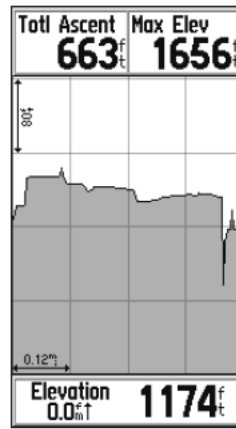
- a) If you have a clear view of the sky, the **GPS unit will start to recognize the signals from several satellites**. They will be represented by their **satellite ID number**. If you are indoors or under thick trees, your unit will not receive satellite signals well (if at all).
- b) Using the **"Page"** button on the upper right side of the unit, you can page through the main screens of the unit. Try it. (**Remember you need >3 satellite signals to calculate altitude.***)



Map Page



Compass Page



Altimeter Page



Main Menu

- c) Show your teacher that can page through all of the screens.

Teacher sign-off: _____

Explore 2: Check and Adjust the Unit's Settings (Inside Activity)

We will check and adjust the following: Time, Units, System

1. Using the "page" button, page to the "Main Menu" screen. Now Select "Setup." Use the "ROCKER" to scroll to and highlight "Setup" and then press down the "ROCKER" to enter.

Setup Menu (Time)	Units Setup (Units)	Setup Menu (System)
Time Format	Position Format	GPS
12hour	hddd.ddddd ^o	GPS on
Time Zone	Map Datum	WAAS/EGNOS
US - Alaska	WGS84	Enabled
UTC Offset	Distance/Speed	Battery Type
-09hrs 00min	Statute	Alkaline
Daylight Saving Time	Elevation (vert. speed)	Text Language
Auto	Feet (ft/min)	English
	Depth	External Power
	Feet	Lost turn off

2. Time

- a) Select "Time." Use the "ROCKER" button to highlight "Time" and press down the "Rocker" to enter.
- b) Set "Time Format" to "12 HOUR."
- c) Set "Time Zone" to "US-Alaska."
- d) Leave UTC Offset alone (it will be -09:00 for Alaska).
- e) Set "Daylight Saving Time" to "Auto."
- f) Use the "Page" button to return to the Setup screen.

3. Units

- a) Select "Units." Use the "ROCKER" button to highlight "Units" and press down the "Rocker" to enter.
- b) Set "Position Format" to hddd.ddddd^o
- c) Set "Map Datum" to "WGS 84."
- d) Set "Distance/Speed" to "STATUTE."
- e) Set "Elevation" to "Feet (ft/min)."
- f) Set "Depth" to "Feet."
- g) Use the "Page" button to return to the Setup screen.

4. System

- a) Set "WAAS/EGNOS" to "Enabled" (allow the unit more accuracy).
- b) Have an instructor check your settings and sign below.

Teacher sign-off: _____

Explore 3: Enter a Waypoint (*the geocache location*)

Assigned coordinates:

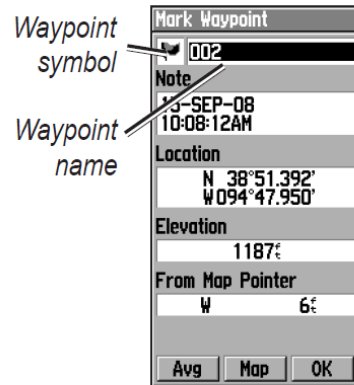
Waypoint name: _____

Latitude: N _____

Longitude: W _____

1. Navigate to the “ **Main Menu**” page and select “**Mark**” with the “**Rocker/Enter**” button.

2. Use the “**Rocker**” button to highlight the “**Lat/Lon**” field and press to “**enter.**” The **waypoint screen** will appear.



Mark Waypoint Page

3. **Use the “Rocker” to edit the existing coordinates.** Once you have your assigned coordinates displayed, select “**OK**” from the numerical keypad and press the “**Rocker/enter**” button.
4. Use the “**Rocker**” to highlight the “**Waypoint Name**” field (default Name is 001, 002, etc.) and press “**enter.**” When you do this the **Edit Waypoint Name screen** appears.
5. **Use the “Rocker”** to edit the waypoint name. Once you have entered your assigned **waypoint name**, select “**OK**” from the alphabetic key pad with the “**enter**” button.
6. **See if you can Change the Symbol** for the waypoint by using the “**Rocker**”.
7. When you are finished editing items in “**Mark Waypoint**” page, **save the location** by using the “**Rocker**” to **navigate** to “**OK**” at the bottom right of the window and **select “OK**” with the “**enter**” button.

Teacher sign-off: _____

Explore 4: Finding a Geocache (Outside Activity)

1. Getting Started

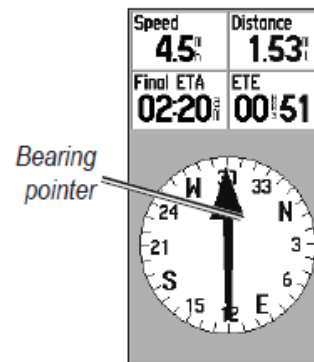
- On the teacher's instructions, go outside and **turn on the GPS unit**.
- Make sure you have a **clear view of the sky**.
- Wait for the GPS** unit to acquire enough satellite signals (3-4) to establish a location. On the **"Satellite"** page, the unit will first note **"Acquiring Satellites"** and then change to the map window indication you are ready to navigate (**this may take a few minutes**).

2. Start navigating

- Page to the **"Main Menu"** page and select **"Waypoints"**
- Select the waypoint that represents the **geocache** for your group (e.g. Cache1, Cache5, etc.) and the waypoint screen will appear.

Waypoint		
•	Geocache 1	
Note		
02-May-12 9:46:56 AM		
Location		
N 58.12889° W 135.46185°		
Elevation		
23'		
From Current Location		
SE 618.57'		
Delete	Map	GoTo

- Select **"GOTO"** from the **"Waypoint"** screen and the digital compass screen will appear. If the compass screen does not appear, use the **Page** button to scroll to it.



Compass Page

- Follow the Arrow** to the location of the geocache. As you **get very close**, the **GPS will not help you** any more because it is usually only accurate to about 10-15 feet. You have to use your eyes!
- Return** to the Teacher with your treasure.

Teacher sign-off: _____

Explore 5: (Optional) Make a Geocache

Using your new GPS skills, plan and hide a geocache of your own!

1. **Name the geocache** (6 characters maximum)
Geocache Name: _____
2. **Choose items to hide**
3. **Put items and an identifying label in the container** (include the name of the cache)
4. **Choose a place to hide the cache**
 - a) don't make it too hard or it takes too long to find
 - b) a portion of the container must be visible
 - c) the cache cannot be buried
5. **Mark the location of the geocache and enter the geocache name in the GPS**
6. **Go to the classroom**
7. **Give the GPS unit to the teacher**

Teacher sign-off: _____
(make sure there is a valid waypoint for the geocache)

8. The instructor will give your group a GPS unit prepared by another group of students and the name of the Geocache that you will look for.

Geocache Name: _____

9. Using the skills you learned during Activity 4, **see if your group can find the geocache.**

Take your "treasure" to the classroom.

10. **Return the GPS to the instructor.**

Teacher sign-off: _____