

## Overview:

Since ancient times people have used navigational methods to mark and find locations. A few of these methods include: using the stars as a navigational tool; using landmarks, such as trees and mountains; drawing maps; and using a compass. During this activity students will use instruments similar to those used by current scientists.

## Objectives:

The student will:

- identify that scientists use GPS receivers to pinpoint the location of instrument data sites;
- use a GPS receiver to mark the location of a specific site; and
- use a GPS receiver to locate a previously marked site.

## GLEs Addressed:

### *Science*

- [9] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.
- [10-11] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating.

## Materials:

- STUDENT WORKSHEET: "GPS Navigation"
- STUDENT INFORMATION SHEET: "Using a GPS"
- VIDEO: "Garmin Geko Series Personal Navigator"
- GPS receivers
- Plastic containers (one per GPS receiver)

## Activity Preparation:

1. Select an open area such as a playground or field in which to conduct the GPS portion of this activity. Because GPS units must have a clear view of the sky to receive signals from satellites, the area should not be heavily forested or closely surrounded by buildings.
2. Prepare each GPS unit for student use by installing batteries (lift the flap on the back of the unit), and setting the position format, map datum, and unit system. (See the following directions)
3. Press and hold the POWER button to turn on the GPS unit.
4. Press the PAGE button until the *Menu* page is displayed. Use the UP/DOWN buttons to highlight *Units*. Press the OK button.
5. Use the UP/DOWN buttons to highlight the *Position Format* bar. Press the OK button. Use the UP/DOWN buttons to highlight *H D °M'S.S"*. Press the OK button.
6. Use the UP/DOWN buttons to highlight the *Map Datum* bar. Press the OK button. Use the UP/DOWN buttons to highlight *WGS 84*. Press the OK button.
7. Use the UP/DOWN buttons to highlight the *Units* bar. Press the OK button. Use the UP/DOWN buttons to highlight *Statute*. Press the OK button.

8. Press and hold the POWER button to turn the GPS unit off. Repeat these steps for each GPS unit.

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**Teacher's Note:** GPS screen shots can be found at [www.garmin.com/products/geko101/screen.html](http://www.garmin.com/products/geko101/screen.html).

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### Activity Procedure:

1. Explain that scientists use Global Positioning System (GPS) receivers to determine the exact latitude and longitude of new magnetometer data sites. GPS units receive information from satellites, enabling them to pinpoint their location on Earth with an accuracy of up to 10 meters.
2. Tell students they will soon pretend to be scientists assigned to setting up data sites. Divide students into groups.
3. Distribute the STUDENT INFORMATION SHEET: "Using a GPS," and the STUDENT WORKSHEET: "GPS Navigation" to each student and review instructions. Give each group a GPS unit and a plastic container (or other object for groups to hide). Ask students to put a note in the container with the names of all the group members on it.
4. Each group will place an object near the school and use a GPS to mark its location. They will then trade GPS units with another group, and use the GPS to find the other group's hidden object.
5. Explain that a waypoint is a marked location. Demonstrate how to turn the GPS unit on and off and practice navigating to the "mark a waypoint" page on the GPS screen by holding the OK button down for two seconds. Direct students' attention to the numbers that appear at the bottom of the screen. These numbers represent the latitude and longitude of the waypoint.
6. Show students the VIDEO: "Garmin Geko Series Personal Navigator," which describes how to operate the GPS unit. Take students outside and ask them to follow the instructions on the STUDENT INFORMATION SHEET: "Using a GPS." Instruct each group to find a "data site" in which to hide their plastic containers. Ask them to mark a waypoint at this site.
7. After all group containers have been hidden, ask groups to trade GPS units. Demonstrate how to "GOTO" a waypoint using the STUDENT INFORMATION SHEET: "Using a GPS." Ask each group to use this function to find the data site of the group with which they traded GPS units.
8. Return to the classroom and ask students to finish the STUDENT WORKSHEET: "GPS Navigation."
9. Ask students to complete the worksheet, then discuss why it is important to know methods of navigation that do not require a GPS. Students should be able to identify some of the following problems: battery life failure; interference with signals; losing the unit; etc.

### Answers:

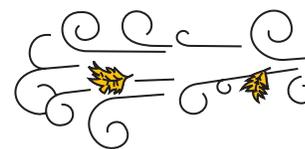
1. b) Global Positioning System (GPS) receiver
2. true
3. b) satellites orbiting Earth
4. d) in an open area such as a field

Name: \_\_\_\_\_

# GPS Navigation

## Student Worksheet

Levels V-VI



**Directions:** Follow the directions on the STUDENT INFORMATION SHEET: "Using a GPS." Record Starting Point and Data Site information in the chart below as indicated in steps 3 and 4 of the STUDENT INFORMATION SHEET. Complete questions 1-4 after returning to the classroom.

Description	Waypoint Number	Latitude	Longitude
Starting Point			
Data Site			

- Which instrument do scientists use to find the location of instrument data sites?
  - magnetometer
  - Global Positioning System (GPS) receiver
  - all-sky camera
  - thermometer
- True or False: GPS receivers are used to mark locations on Earth's surface.
- From what source do GPS units receive their information?
  - from radio towers
  - from satellites orbiting Earth
  - from a super-computing station
  - from Earth's inner core
- To ensure a clear satellite signal, where should hand-held GPS receivers be used?
  - inside buildings
  - on a crowded city street near buildings
  - in a dense, thick forest
  - in an open area, such as a field

# Using a GPS

## Student Worksheet

Levels V-VI



Scientists use Global Positioning System (GPS) receivers to determine the exact latitude and longitude of data sites. GPS units receive information from satellites, enabling them to pinpoint their location on Earth. This enables scientists to monitor glacier and sea ice movement over time.

### Instructions:

1. Press and hold the POWER button to turn on the GPS unit. Wait while the GPS locates at least four satellites. Move away from buildings and trees to get a clear satellite signal.
2. After the GPS has located at least four satellites, follow the teacher to a starting point and mark this spot as a waypoint (a marked location) on your GPS. To mark a waypoint, press and hold the OK button for two seconds. When a person holding a numbered flag appears, release the OK button.
3. Record the number on the flag, and the latitude and longitude of the waypoint on the data chart provided on the STUDENT WORKSHEET: "GPS Navigation," then press OK again to confirm the waypoint. **Note:** *the latitude and longitude are the numbers at the bottom of the waypoint screen.*
4. As a team, hide the group plastic container. This location will represent a scientific "data site." Mark a waypoint at this location and record waypoint information on the data chart provided on the STUDENT WORKSHEET: "GPS Navigation."
5. Use the following steps to return to the starting point using the GOTO function of your GPS.
6. Press the PAGE button until the *Menu* page is displayed.
7. Use the UP/DOWN buttons to highlight *Waypoints*. Press the OK button.
8. Use the UP/DOWN buttons to highlight *List All*. Press the OK button.
9. The 0-9 bar should be highlighted. Press the OK button.
10. Look at the data chart on the STUDENT WORKSHEET: "GPS Navigation," to see which waypoint number is the starting point. Use the UP/DOWN buttons to highlight *this waypoint number*. Press the OK button.
11. Use the UP/DOWN buttons to highlight *GOTO*. Press the OK button.
12. Hold the GPS receiver in front of you and walk in the direction the arrow is pointing until you arrive at your starting point.
13. Trade GPS receivers with another group and ask them which waypoint number marks the location of their "data site." Use the GOTO function to find the plastic container they hid. Return to the classroom.