### Overview:

Scientists use Global Positioning System (GPS) receivers to map lava flows. GPS data are compiled by computer Geographic Information System (GIS) software into a digital map. Digital maps can help forecast the path of the lava flow. During this lesson, students will use GPS receivers to map the perimeter of their school grounds, then create a paper map of the grounds using the GPS data.

## Objectives:

The student will:

- understand that scientists use GPS receivers to map lava flows;
- use a GPS receiver to mark waypoints around the perimeter of an area; and
- create a paper map using GPS data.

### Materials:

- GPS receivers
- Rulers
- Student Worksheet: "Using a GPS"
- Student Worksheet: "GPS Mapping"

**Note:** Universal Transverse Mercator (UTM) is a grid mapping system based on the metric system of measurement. UTM uses Eastings and Northings in one-meter increments instead of using latitude and longitude in increments of degrees, minutes, and seconds. UTM divides Earth into rectangular zones to minimize map distortion. The Hawaiian Islands are in UTM Zones 4 Q and 5 Q. Scientists use UTM instead of latitude and longitude when mapping lava flows because it is easy to convert UTM units to distance. Each UTM unit is equal to 1 meter.

### Answers to Student Worksheets:

Using a GPS:

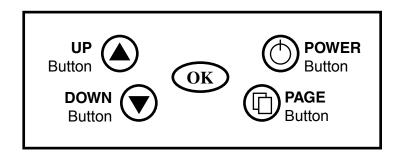
Answers on GPS Data Chart will vary.

#### **GPS Mapping:**

- 1. b) Global Positioning System (GPS) receiver
- 2. Maps will vary according to area.

## Activity Preparation:

1. Select an outside area such as a playground or football field in which to conduct this activity. The area must be less than 200 meters on each side, and should not be heavily forested or closely surrounded by buildings, because GPS units must have a clear view of the sky to receive signals from satellites. Select a



starting point for students, who will walk the perimeter of the area with a GPS unit, marking a waypoint each time they change directions.

- 2. Prepare each GPS unit for student use. This includes installing batteries by lifting the flap on the back of the unit, setting the position format, the map datum, and the unit system (see steps 3 through 12).
- 3. Press and hold the POWER button to turn the GPS unit on.
- 4. Press the PAGE button until the Menu page is displayed.
- 5. Use the UP/DOWN buttons to highlight Units. Press the OK button.
- 6. Use the UP/DOWN buttons to highlight the Position Format bar. Press the OK button.
- 7. Use the UP/DOWN buttons to highlight UTM/UPS. Press the OK button.
- 8. Use the UP/DOWN buttons to highlight the Map Datum bar. Press the OK button.
- 9. Use the UP/DOWN buttons to highlight WGS 84. Press the OK button.
- 10. Use the UP/DOWN buttons to highlight the Units bar. Press the OK button.
- 11. Use the UP/DOWN buttons to highlight Statute. Press the OK button.
- 12. Press and hold the POWER button to turn the GPS unit off. Repeat steps 3-8 for each unit.
- 13. Depending upon your students, you may wish to train a few students to serve as the "GPS Expert Crew" for the class activity.

**Extension Ideas:** 1) 3-D Topo Maps: Begin with a topographic map of your island. Help students create a 3-dimensional topographic map by cutting foam core along topo lines then gluing the layers together. 2) GPS Scavenger Hunt: Hide objects on the school grounds. Find the coordinates of the objects using a GPS receiver, then give students the coordinates and ask them to use GPS receivers to find the hidden objects.

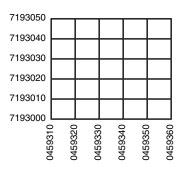
## Activity Procedure:

- 1. Explain that scientists use hand-held Global Positioning System (GPS) receivers to map lava flows. GPS data are compiled by computer Geographic Information System (GIS) software into digital maps. These maps can help forecast the path of a lava flow. During this activity, students will use GPS receivers to map a section of the school grounds.
- 2. Give each student the Student Worksheet: "Using a GPS," and review instructions, then divide students into groups and give each group a GPS unit.
- 3. Demonstrate how to turn the unit on and off and practice navigating to the "Mark a Waypoint" page by holding the OK button down for two seconds. Direct student attention to the numbers that appear at the bottom of the screen. These numbers represent the Easting and Northing of the waypoint. Students will be responsible for recording the Easting and Northing of each of their waypoints on the "GPS Data Chart" at the bottom of the Student Worksheet "Using a GPS."
- 4. Take students outside to show them the area you chose for the mapping activity. Walk with students to the starting point. Ask them to follow the instructions on the Student Worksheet "Using a GPS," to map the perimeter of the area. To create an accurate map, students must mark a waypoint each time they change directions.
- 5. After students have successfully recorded waypoints around the area, return to the classroom and explain that students will use data they gathered to create a map. Distribute the Student Worksheet: "GPS Mapping." Demonstrate how to label the x and y-axes using the Easting and Northing Data students recorded on the "GPS Data Chart." See sample below.
- 6. Compare and discuss student maps.

#### Sample GPS Data Chart

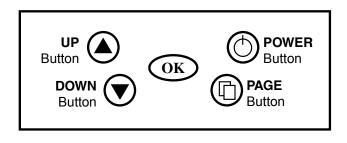
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Waypoint	Description	Easting	Northing		
001	Starting point	0459582	7193172		
002	Picnic table	0459311	7193187		
003	Basketball hoop	0459321	7193007		
004	Trash bin	0459570	7193028		

- 7. Find the lowest Easting (0459311) on the GPS Data Chart. Round this down to the nearest 10 (0459310). Write this number at the origin of the x-axis then label the x-axis in increasing increments of 10 meters.
- 8. Find the lowest Northing (7193007) on the GPS Data Chart. Round this down to the nearest 10 (7193000). Write this number at the origin of the y-axis then label the y-axis in increasing increments of 10 meters.



Name:	Student Worksheet	
	Using a GPS	

Introduction: Scientists use hand-held Global Positioning System (GPS) receivers to map lava flows. GPS data are compiled by computer Geographic Information System (GIS) software into a digital map. These maps can help forecast the path of the lava flow. In this activity, you will use a GPS receiver to map an area outside your school. Please follow the steps below to map your area.



- 1. Press and hold the POWER button to turn the GPS unit on.
- 2. Wait while your GPS receiver locates satellites. You may need to move away from structures and trees to get a good satellite signal. Your GPS unit needs to receive information from at least four satellites in order to accurately pinpoint your location. When your receiver has located four satellites continue with step 3.
- 3. Go to the starting point designated by your teacher and mark this spot as a waypoint on your GPS. A waypoint is a location on a route. 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.
- 4. Record the number on the flag, a waypoint description, and the Easting and Northing of the waypoint on the "GPS Data Chart" below, then press OK again to confirm the waypoint. Note: the Easting and Northing are the seven-digit numbers at the bottom of the waypoint screen. The Easting is above the Northing.
- 5. Walk around the perimeter (outside edge) of the area. Mark a waypoint each time you change directions. Record each waypoint number, description, Easting and Northing on the chart below.

#### **GPS Data Chart**

Waypoint #	Description	Easting	Northing
Example	Picnic table	0459582	7193172

Name:	Student Worksheet
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- 1. What hand-held instrument that receives satellite signals do scientists use to map lava flows?
  - a) Tiltmeter

- c) Seismometer
- b) Global Positioning System (GPS) receiver
- d) Correlation Spectrometer (COSPEC)
- 2. Use a ruler and the GPS Data Chart on the Student Worksheet "Using a GPS" to draw a map.

Use the GPS data you collected to create a map on the grid below. Begin by finding the lowest <u>Easting</u> you recorded (the <u>smallest number</u>) in your chart. Round this <u>down</u> to the nearest 10 meters, then write it at the origin of the x-axis. The distance between each grid line represents 10 meters, so label the x-axis in <u>increasing</u> increments of 10 meters, starting with the Easting you wrote at the origin. Find the lowest <u>Northing</u> you recorded. Round this number <u>down</u> to the nearest 10 meters and write it at the origin of the y-axis. Label the y-axis in <u>increasing</u> increments of 10 meters. Plot and label each of your waypoints, then draw a line connecting each waypoint to the previous one.

