



LEARNING GPS THROUGH GEOCACHING

Subject: Technology
Global Positioning Systems (GPS)

Skills: Understanding GPS and how it works, reading latitude and longitude coordinates, reading a compass, navigation and map reading.

Duration: 2 – 2.5 hours

Setting: Outdoors (The GPS receivers will not work inside.)

Volunteers: You may want to have one or more volunteers assist you with set up and monitoring participants during the activity.

Materials:

- Garmen eTrex GPS receivers (preferred hardware, other units may be used; however, instructions may have to be adjusted) One GPS unit per participant is ideal, otherwise, one unit per 2-4 participants.
- One GPS receiver instructional manual.
- 5 large plastic bags, plastic or metal containers or something that can hold prizes for participants and can be buried or hidden outside.
- 5 different treats for each participant. Treats can be small toys, candy, school supplies, anything that kids would want that can fit into the containers.
- Brown lunch bags or sacks for participants to put their prizes in once they collect them.
- Pencil or pens (enough for one per person)
- Globe with latitude and longitude lines (optional)
- Map (optional) of activity location with latitude and longitude lines for reference

OVERVIEW

Participants will learn how to use GPS, a navigational system that can be used as a land use planning and zoning tool. Participants will use GPS to find hidden treasure. This activity is known as *Geocaching* and is a popular hobby among GPS enthusiasts.

OBJECTIVES

After participating in this activity, students will be able to:

- Understand the basics of GPS;
- Understand how GPS can be used as a navigational tool;
- Successfully use GPS to navigate to a specific location;
- Understand how GPS might be used in a variety of careers including city planning and land use management.

BACKGROUND

GPS is a navigational system that can accurately locate your position anytime, anywhere, and regardless of weather on Earth. Developed by the United States Department of Defense, it uses 24 satellites orbiting the earth at altitudes of approximately 11,000 miles to transmit data. The handheld GPS receivers process data from several satellites to “triangulate” the receiver’s exact location, using latitude and longitude. Uncorrected positions determined from GPS satellite signals produce accuracies of approximately 30 meters. When using a technique called “differential correction”, users can get positions accurate to within 5 meters or less.

GPS has a number of important applications such as search and rescue missions, helping pilots avoid

collisions, and accurate application of farm fertilizers and other chemicals. In the field of planning and zoning, GPS is used to locate and map infrastructure such as water and sewer lines, traffic lights and signs, houses and commercial buildings, locations of uncapped wells and even pot holes!

GPS provides information that is used to form the basis of GIS, a type of mapping where layers of data are combined and used as a decision-making tool. GPS and GIS can be used to make important community decisions, such as: where to locate a school, mapping the fastest travel route for emergency response vehicles, locating industry where it will not threaten water quality or be a nuisance to neighbors.

PROCEDURES

The following procedures relate to using Garmen eTrex GPS receivers, but can be adapted for other brands.

- Find a location outdoors to conduct the geocaching activity. If you plan on hiding the prizes, obtain permission if you are on a campus or in a park.
- Visit the site where you will be conducting the activity and map out where you will be hiding the prizes. Consider making the last cache box close to where you started. You may want to have that box be a cooler of water, juice and snacks.
- The rest of the procedures are divided up for groups of **beginners** and **more experienced** participants. Feel free to review both sets of directions and modify the procedures to meet your and your group's needs.

Key Terms

GPS: Global Positioning Systems

Latitude: Is the distance north or south of the Equator.

Longitude: Is the distance east or west of the Prime Meridian.

Prime Meridian: The Prime Meridian is the starting point for determining longitude and is located in Greenwich, England.

Elevation: Elevation is the distance above sea level.

Accuracy : Accuracy is used to determine how much error there might be for the location a GPS unit is displaying. For example, if you have an accuracy of 10 feet then the actual exact location would fall within a circle with a radius of 10 feet from where you are standing.

Waypoint: A waypoint is a point of reference along a route.

Marking a Waypoint: Marking a waypoint is using your GPS unit to establish a point of reference for your current location.



Chuck McKeown explains how to use the GPS units to participants at the June 22, 2005 Exploration Days at MSU.



Each participant received their own GPS unit and were instructed to wear them around their necks to prevent damage. (They cost \$100 each.)



Adult volunteers helped direct participants that needed help, made sure they were following directions and rounded up late comers at the end.

Suggested Procedures for Working with Participants That Have Experience with GPS

1. When working with a more experienced group, we suggest putting the instructions for each cache box inside the previous cache box. This is more typical of true geocaching. When selecting the location of each cache box, write down the coordinates (latitude and longitude) of each location as it appears on the screen. Use the “Page” button to get to the correct screen where you can view your coordinates at the bottom of the screen. It is a good idea to have maybe 5 or so GPS units with the locations of each cache box “Marked.” The purpose for this is two-fold: 1) so you can easily find the cache boxes to collect them after the activity is completed, and 2) in case you have some participants who aren’t as familiar with GPS as others, you can give them units that already have the locations “Marked” so they don’t wander around all day. To mark a location of a cache box, stand in the location where the box will be placed, then use the “Page” button on the side of the unit to get to the screen that says “Mark” at the top of the table. Hit the “Enter” button to activate the mark function and then “Enter” again to mark that location. Do the same thing for all the locations of the cache boxes.
2. The Role Play handouts for this activity were designed so that they could be used to give participants the latitude and longitude for the next cache box by writing them in the blank. You won’t want to bother making handouts in the field, rather just write down on one piece of paper the coordinates of each of your cache boxes. You won’t want to leave your cache boxes until you prepare all the handouts and place them in the box. Remember, you will need one handout and prize per participant in each cache box.
3. Prepare the Role Play handouts. You can either use the Role Play handouts that are included or can make your own. The handouts describe several different careers related to land use and planning that may use GPS. When putting instructions inside the cache boxes, we suggest only using one type of handout (for example: City Planner) and writing the coordinates for each of the cache boxes in the space provided. If you use more than one type of handout, this may confuse participants. Be sure to plan on giving the participants the coordinates to the first cache box, this first cache box will have the handout listing the coordinates for the next cache box and so on.
4. Another thing to think about when preparing the handouts is whether you want all of the participants to be going to the same cache box all at one time. To mix it up, and make it slightly more difficult/interesting, you may want to consider mixing up the order of the coordinates on the handouts. Before you place the handouts in the cache boxes, write down different coordinates in the space provided on each handout, that way different people will get different instructions. You will want to give all participants the same coordinates for their last cache box so they all end up at the same location.
4. Make sure the batteries of all the units are charged the day before you conduct the activity. It is a good idea to bring extras along the day of the activity.
5. At the site before participants arrive, hide the cache boxes if you haven’t done so already. Make sure you have enough prizes for every participant in each cache box as well as the correct handouts and instructions.
6. You may also want to turn all the GPS units on before participants arrive to make sure they are all “Ready.” (It can take 5-10 minutes to lock in all the satellites.) If you have one or more units that are not working, use the manual, which is also available on-line, to troubleshoot. You may also want to check the batteries on the side of the unit.

Suggested Procedures for Working with Participants That Have Experience with GPS

7. When participants arrive, hand out the GPS units to each participant or if you don't have enough, divide the participants into teams of 2-4 participants. Hopefully, you would have enough so that each team is no larger than 4 participants. Try and spread those who have the most familiarity with GPS out among the teams. Wait to hand out the units if you think the participants won't listen to instructions.
8. When all participants have arrived, give everyone an overview of the history of GPS. Some key points to highlight are: 1) GPS was created by the United States Department of Defense for use by the military, 2) All GPS satellites are owned by the USA and are shared by everyone in the world, 3) GPS is used to identify the latitude and longitude of any point on Earth, 4) Review what latitude and longitude are by using a globe or a map, 5) Explain that many different types of careers use GPS, which they will learn more about when doing the geocaching activity.
9. Give participants a brief overview of how to use the GPS unit. Show them how to use the "Page" button to get to the different screens.
10. You will then want to hand out the GPS units, if you already haven't done so, the coordinates to the first cache box and the bag to put their prizes in (optional). You will need to give them instructions on how to use the handouts hidden in the cache boxes. Explain that they will get the directions for the next cache box inside the cache boxes (and tell them if not all of the handouts or coordinates are the same).
11. Tell participants once they reach a cache box they will pick up a prize and a handout with the latitude and longitude of the location of their next cache box written on it. They will need to use their GPS unit to read the latitude and longitude points to walk to the coordinates of the next cache box. They need to walk in the direction that gets them closer to the coordinates. Note that the GPS units do not point North.
12. If you think the students need a map with latitude and longitude points for reference (professionals would also use maps), contact Chuck McKeown with MSU at mckeownc@msu.edu and he will be able to send you a map of any location in Michigan. However, you need to contact him approximately two weeks in advance of the activity to give him time to make the map and mail it to you. When contacting him, you should give him the basic latitude and longitude, county and township or city where you will be holding the activity. You would need to make enough copies of the map for all your participants.
13. Giving a bonus prize to those who found all cache boxes can be a good motivator to stay on task. If you are doing this, be sure to explain this in advance.
14. Tell participants that they should all end up at the same point and if they get lost, find a leader or another participant. (It is a good idea to have one or more adult volunteers in the area to keep an eye on participants. You may want to have one person stay at the starting point in case people need help.) Feel free to give those who may be struggling one of the GPS units that has the cache box locations already marked. Since they have some experience with GPS, they should know how to locate a marked point.
15. Tell participants what time they should be at the last point so they can keep track. Be sure to have a list of all participants' names before they leave so you can call them off to make sure everyone has returned. Remind them to look where they are going, and not just at the GPS unit, while walking. Then tell them to begin.

Suggested Procedures for Working with Participants That Have Experience with GPS

16. After everyone has finished. Take attendance to make sure everyone made it back. If some are still working, send an adult volunteer to round them up.
17. Go around and see who made it to all the cache boxes by checking to see if they have all the prizes. Award prizes to those who made it to all the boxes (optional). Collect the GPS units.
18. Debrief by asking individuals to tell stories about their experience. Then ask the group questions about their particular career from the Role Play handout. Ask them how their role play career uses GPS. (This will make them read the handouts.)
19. You may also want to ask them technical questions like: point on the globe which lines are latitude. Point on the globe which lines are longitude. Ask them to identify degrees, minutes and seconds when listing a coordinate. Ask them which one is written first latitude or longitude. (The answer is latitude.) You could also ask them questions about the Equator and Prime Meridian as well as the history of GPS. You may want to prepare a handout of these questions or write them on a flip chart or poster board.
20. End the activity by congratulating their expert use of GPS. Then distribute the handout with the web sites related to geocaching and GPS activities online that they can do at home or the library.
21. Remember to collect your cache boxes (and the GPS units) before leaving!

