Guidelines and Activity Plans for Camps, After-School, and other Youth Audiences - for ages 12 - 14

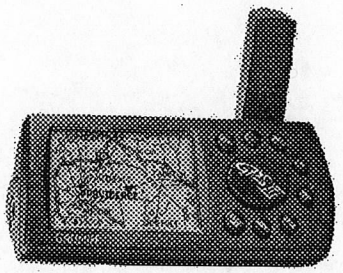
Title of Activity: "Talking" With Satellites All Around Us

Contributor: Chip Malone, Extension Educator - Genesee County

Main idea: To learn about the United States Department of Defense's global positioning communications system which is now used by private individuals and business & industry.

Objectives:

To learn the components of the GPS system. (24 satellites)
To explore a model GPS space vehicle (SV).
To understand how the GPS system works.
To learn who owns and operates the system. (It's maintained by the U.S. Department of Defense.)



Materials and other items you need:

Model GPS satellite (space vehicle); materials for children to make their own GPS space vehicles (coffee cans, dowels, cardboard); model drawing of a farm field; model tractor and implement to be placed on the field; GPS receiver; How A GPS Receiver Works fact sheet; colored images of low altitude GPS satellites (can be obtained from public domain web sites on the Internet - see **Background information**.

"Motivator" to pique young people's interest:

1. Story telling style, show what a satellite looks like and the picture of many satellites in orbit.

2. Did you know GPS satellites are considered "low altitude" space vehicles? But they are still five to seven hundred miles up in space?

Questions for young people before you start the activity:

1. If satellites can be used to tell us the exact locations of things, In what ways do you think this system of space vehicles called ***GPS*** can help people? [Hint: navigation, surveying, finding lost objects or prevent from getting lost - many more ideas will be covered in ***Creative Uses of Global Positioning Systems*** unit.
2. Has anyone ever used a GPS device? Share it with the group

Activity Steps:

1 Ask participants the questions above.
2. Using photos or printed images of GPS units, discuss how the GPS system works.

3. Have children make several model satellites out of coffee cans, dowels and cardboard.. Then place them in high locations in the classroom (or outdoors, hanging from tree branches) to imitate the concept of several satellites being in view of a receiver at any given time. Explain that GPS satellites are in "*low altitude orbit*", meaning that they are actually about 500 miles above the earth.
4. Place the model farm equipment and small scale field somewhere on the floor (ground) to help illustrate how GPS receivers on such equipment are in "view" of GPS satellites at all times.
5. Practice using GPS receiver units - Divide participants into groups of 5 of 6 and allow group leaders to rotate, taking turns using the GPS receiver(s). Allow children to see the group leader(s) use the hand held units to see how they are "booted up" and adjusted
6. Demonstrate the five types of measurement these units can indicate:
   a. Speed/velocity
   b. Location (longitude & latitude)
   c. Direction of travel (does not work like a compass)
   d. Altitude (elevation)
   e. Time

   Note: keep in mind that when several participants all gather around a GPS receiver unit, their heads are likely to block the signal coming from space. It is best to set the GPS unit in front of the demonstrator (counselor or teacher) and have the students/participants view from an over-the -shoulder angle. **Also note**: that two of the four functions (*direction of travel* and *speed*) depend on movement. Only location (latitude & longitude information),time, and altitude can be shown while sitting still.

Learning Checks:

1. How many satellites must be detected by the GPS units in order for it to work? [Hint: at least three (four in order to determine altitude)]
2. Which of the four functions is the most accurate for the GPS units to determine? [Hint: Time].

Vocabulary:

GPS - Global Positioning System - a system of 21 orbiting satellites originally set up by the US Department of Defense for determining specific points on earth or the location of objects... Now used by the general public

Low Altitude Orbit -

the distance above the earth that GPS satellites travel - only about five hundred miles compared to several thousand miles for other communications satellites

Extensions, ways to go further: Discuss ways in which GPS units could help others besides farmers.

diagram (at right). Throw two or three objects inside the square anywhere and pretend they are "lost." Have the participants identify where each lost object is by identifying their positions as coordinates (i.e. where would a pencil be located if its coordinates were N5 and W4?) Have two participants find the N coordinate by holding a long piece of string across the "N" rows and two other participants line up a string across the "W" rows. Explain that we measure points on earth in a similar manner...and it's called *Latitude* and *Longitude.*

2. Use a globe to show how coordinates are used to identify points on earth
3. Allow participants to walk around with a GPS unit in display mode to see how coordinates change. You will need to show participant(s) the display window Lat. and Long. is indicated.
4. Scavenger hunt: Either have participants find objects and write down the coordinates, or give them assigned coordinates, and have them find the object(s). Make sure hidden objects are visible within 10 to 15 meters of the actual coordinates, as there may be some precision error. **OR,**
   Have one group take an object, hide it, and record the GPS coordinates. Then have another group find the object by using the GPS unit and given coordinates.

Checking for what the youth learned:

What information do you need to know to precisely identify a point on the earth? [hint: latitude and longitude]

What is the term used to define where these two lines intersect? [Hint: a coordinate]

How many places on the Earth have the coordinates: N 47.003°, W 64.980°? [Hint: one]

If a place you want to go to has the coordinates S° 20 , E 135° , point to the part of the globe where that place is. [Hint: Australia]

If you had been at N40°, W 120° and were now at N40°, W 75°, which direction would you go to get back to where you started? [Hint: West]

What tools can you use to determine the coordinates of a location? (maps, GPS, compass, globes)

Vocabulary:

Coordinates - The latitude and longitude values that identify points on earth.

Latitude - East-west lines parallel to the equator, tell how far north or south of the equator.

Longitude - North-south lines from the North Pole to the South Pole, tell how far east or west of the Prime Meridian to the other side of the globe (the International Date Line)

GPS unit - hand-held electronic device that receives signals from satellites which can calculate the latitude and longitude coordinates of a location at a given point in time

Background information:

Latitude and ***Longitude*** are used to define the coordinates for identifying positions on earth.

The ***Global Positioning System (GPS)*** is a collection of 24 earth-orbiting satellites. These satellites allow any person who uses a GPS receiver to determine his or her precise longitude, latitude and altitude anywhere on the planet. With built-in computer capabilities they can provide much more information on *velocity*, *direction of travel*, and *trip planning*.

Extensions, ways to go further: Look in an atlas to see how coordinates are used in maps.

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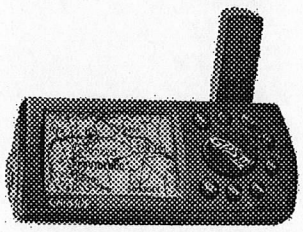
Title of Activity: Just Exactly Where Are We? Pinpointing Positions on Planet Earth



Contributor: Chip Malone, Extension Educator - Genesee County

Main idea: Positions on earth are located and defined using coordinates. This activity is a hands-on approach to understanding the basic concepts used in locating points on earth with Global Positioning Systems (GPS).

Objective:

To introduce participants to latitude and longitude.
To use everyday objects to help participants understand coordinates.

Materials and other items you need:

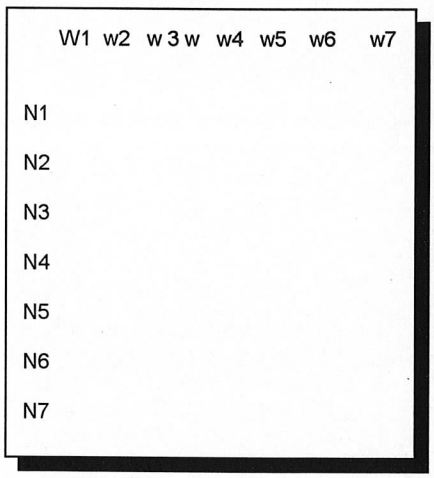
(2) 30 foot strings or cords
Markers labeled N1....through N9 and W1...through W9
globe or large ball with latitude and longitude lines,
bingo cards, Battleship game board, GPS receiver units

"Motivator" to pique young people's interest:

Show how everyday objects (Bingo card, Battleship game) use *"coordinates"* to locate points. Then ask...

Questions for young people before you start the activity:

What types of coordinates do we use to locate points on earth? [Hint Longitude and Latitude]



Activity Steps:

1. Make a large square by placing (7) markers labeled W1 - W7 across the top (approximately 2' apart) and (7) more labeled N1 - N7 (same distance apart) down one side. Place duplicate markers directly across from each row, forming as perfect a square as possible. See

Background information: Read the ***How a GPS Receiver Works*** ***by Marshall Brain*** fact sheet to become familiar with how the GPS system works. Use the supplied poster... or other images taken from the Internet to display what a GPS satellite looks like and to gain information on how they work. An excellent source to get back ground information presented by Aero Space Corporation's public domain: http://www.aero.org/publications/GPSPRIMER/index.htm

Guidelines and Activity Plans for Camps, After-School, and other Youth Audiences - for ages 12 - 14

Title of Activity:

The Space & Farm Connection

Contributor: Chip Malone, Extension Educator - Genesee County

Main idea: Agriculture uses space-age global positioning technologies to do "precision farming."

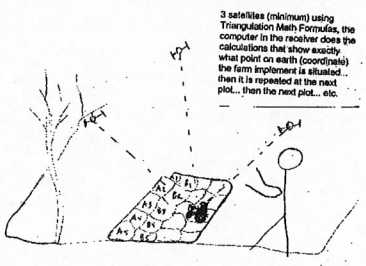
Objective: Participants will learn about the uses of modern technology such as satellites and Global Positioning Systems (GPS) in agriculture. Participants will gain a basic understanding of precision farming

Materials and other items you need:

Farm equipment brochures using GPS

Supplies for field application demo: disposable cups, marker, water and container, 1/4 cup measuring device, coloring (optional), model field grid, toy farm equipment.

"Motivator" to stimulate young people's interest:



Did you know that some farmers use satellites and computers to help them decide everything from how many seeds to plant in a row to how much fertilizer to apply to a part of a field?

Global positioning satellites help farmers to make these decisions using very precise information about fields divided into very small plots (a few hundred square yards). From way out in space, satellites can send signals to devices, called ***GPS receivers***. When three or more satellites are sending signals the computers within the ***GPS receivers*** can calculate exact locations called ***coordinates***. And finally, all this information can be stored in computers on farm equipment. Computer programs that use this stored information about where each plot in the field is located are called ***GIS*** (Geographic Information Systems).

Background information: GPS is used for "precision farming" to increase efficiency of use of field inputs (such as seed, fertilizer and pesticides) and for economic and environmental reasons. It can also be used to map crop yields and other information. Many other agricultural uses of GPS technology may be developed in the future.

Questions for young people before you start the activity:

Precision farming:

1. What happens if plants get too much or too little fertilizer or pesticides?
[hint - very costly; possibly destructive to the environment; could be harmful to the crop]

2. Where do the excess materials go? [Hint: into the ground water; they can pollute streams, rivers, lakes and wells.]
3. What happens if plants are too close together or too far apart? [Hint: plants wont grow as well due to competition with other plants; poor yield]
4. What if you get everything just right? [Hint: Good crop yields; low impact on the environment; farmers get better profit]

GPS in animal agriculture and wildlife:

1. When would it be important to keep track of an animal's location? [Hint: Wildlife research; finding cattle located on large ranges]
2. How could GPS help? [Hint: put GPS receivers on certain animals to keep track of them]

Activity Steps:

1. Show farm equipment brochures.

Precision farming demo:

2. Mark a set of 9 or more small cups with a line about equally high (about halfway up inside each cup).
3. Arrange the cups in a grid - or place them on an imitation farmer's field made of cardboard. Each cup represents a part of a field. The line represents the optimum level of input (fertilizer, etc.).
4. Fill the cups with varying amounts of water to represent the current conditions in the field indicated by the grid (some to below the line, some above, some right to the line).
   This represents that before fertilizing, different parts of the field have different nutrient needs. Some places have too few nutrients, some to many, and some just the right amount.
5. Ask a child to "Drive" the farm implement (model tractor or imaginary) through the "field,"dispensing an equal amount of water (somewhat less than half a cup) to each cup. Remind everyone that this is the conventional way of applying materials to a farm field - an even application over the entire field.
6. Results: Let the group observe and be ready to share what results they find. *(HINT: Some cups will overflow - Runoff Explain environmental concerns. Some cups will be filled to a level between the line and the top of the cup - More than optimum, inefficient* Explain farmer's economic concerns. *Some may be right at the line optimum. Some may be filled to a level below the line. less than optimum, yield concerns)*

Checking for what the youth learned & creative application:

Why wouldn't a farmer want the same amount of inputs to all parts of the field? [Hints: Due to variations in the land (or environment) there may be different needs for fertilizer use or pesticides in different parts of the field]

How could a farmer learn about the crop or soil needs in each part of the field? [Hint: Divide the field into small, manageable plots and sample each plot. Then keep track of those plots with the use of the GPS system.]

Vocabulary and definitions?

Precision farming: farming practices which use very specific information on very specific plots to reduce waste and maximize efficiency.
efficiency: maximum amount of benefit with the least overall cost or input
runoff: when inputs (like fertilizer and pesticides) are applied in excess and some of it flows off the field into streams.
input: refers to the resources like fertilizers, herbicides, insecticides, and even the labor time that are applied to a field in order to grow a crop.

Extensions - possible ways to take the lesson further:
Discuss how could GPS systems be used in animal agriculture, or wildlife tracking?

Guidelines and Activity Plans for Camps, After-School, and other Youth Audiences - for ages 12 - 14

Title of Activity: Creative Uses of Global Positioning Systems

Contributor: Chip Malone, Extension Educator - Genesee County

Main idea: To brainstorm ideas of how GPS Science can become even more valuable to society

Objective:

1. Participants will brainstorm practical uses and other ideas for GPS
2. Participants will work cooperatively as young scientists in "think tank" groups to develop lists of ways GPS science can be used to improve daily lives (business, security, recreation, etc.)

Materials and other items you need: flip chart, markers

"Motivator" to pique young people's interest:

1. Present the questions below but do not allow participants to answer them. Tell the group there is a game to play which will help to answer the questions.
2. *Did you know* pizza companies were the first groups to research private uses of GPS?

Questions for young people before you start the activity:

1. What other technologies could be combined with GPS to invent creative new uses? [Hint: Think about some situations where it would be helpful to use the GPS system to indicate: location, speed, direction of travel.]

2. Why do you suppose that pizza companies were one of the first organizations to put research and development money into GPS technologies? [Hint: to develop efficient delivery systems for their pizza orders]

Activity Steps:

1. **Leonardo da Vinci GPS Think Tank game**: Have groups of participants brainstorm to come up with ideas of how GPS technology could be used to help people in other ways. The group with the most ideas wins.

Alternative method of scoring - pre-enlist a panel of *"Official" Science Judges.* Ask the judges to determine the "winner" conclusions thought up by the participant groups - and explain why. This select group of *"officials"* may also be able to expound on some of the brainstorming ideas the children developed. This is an excellent way to involve older youth (i.e. upper grade students, camp counselors, teen leaders)

2. Another version of the same activity might be to pre-assign four or five categories for participants to brainstorm ideas. Print the topics on blank charts and give each group 10 minutes to brainstorm. Consider the following think tank topics:

    a.) GPS inventions for the *Agriculture Industry*
    b.) GPS Inventions for the *Sales & Service Industry*
    c.) GPS Inventions for *Transportation & Tourism*
    d.) GPS Inventions for the *Military & Public Security*
    e.) GPS Inventions for *Schools*

Learning Checks: Review lists. Have discussions about how some of the inventions might work.

Vocabulary: None

Background: None

Guidelines and Activity Plans for Camps, After School, and other Youth Audiences - for ages 12 - 14

Title of Activity: Track & Field Days Using GPS

Contributor: Chip Malone, Extension Educator - Genesee County

Main idea: Activities to exercise creativity using GPS.

Objective: Participants will use GPS science to measure the results in field day relay events.

Materials and other items you need:
GPS units, score sheets, race markers for the course, GPS holder for racers, pencil, clip boards, prizes & awards

"Motivator" to pique young people's interest:
Tell children to get excited about today's GPS Track & Field Event!!!

Questions for young people before you start the activity:
What are the basic functions of GPS- what information can a GPS unit give you?

Activity Steps:

GPS field days- relay race:

Event 1: Set up a course (be sure it is in the open, to receive good satellite signals) about two or three hundred yards. Mark it well (with lime, flour, or small bright cones) so that racers can follow it in a relay race. Pick teams and have each member on a relay team hold the GPS receiver like a marathon baton. Record the time it took to complete the race, the distance covered, the average speed, and the maximum speed. Keep track of the results on the team score chart

> **Note**: GPS units are a little expensive. Units are more likely to be dropped in fast pace events. You may want to chose a contest with slower events (such as rapid walking, hands and knees, etc.) This will make the race last longer and reduce the chances of a child falling with the GPS "baton" in his/her hand. You could place a GPS holder safely on a wheel barrow and have children push it around the track.

Event 2: Place a hidden object (such as a cone or flag) in a location approximately 200 yards away. Give the contestant (individual or team) the

coordinates of where it is located. Time them on how long it takes to find the object using the GPS receiver.

Event 3: *Treasure Hunt* - A non-competitive event - team activity. Place some fun time treat (such as a snack or treasure chest of prizes) in a hidden location and record the coordinates. Place a marker so that it can be seen only when participants get within 20 to 30 feet from it. Tell them to bring the "treasure" back to the starting point. This can be a great way to end the field days... with every enjoying the "treasure" they located using GPS.

Checking for what the youth learned:

Review race results; have participants discuss other ways GPS could be used in field & track events.

Extensions, ways to go further:

Watch for news articles describing recent or new developments in the use of GPS. [Like the rent-a-car company who just charged a customer $400 for exceeding 79mph and even produced a map showing where he did it? See: http://www.zdnet.com/zdnn/stories/news/0,4586,2778752,00.html]

Thinking about other current uses of GPS:

Why would it be helpful to use GPS with:

Cell phones? (911 locating emergency calls)

Emergency vehicles? (find accident sites)

Criminals? (prevent escaping trial or leaving probation areas)

Here's a good one - How might it be valuable for retail stores to use GPS with their customers?

Write a story or create a play about GPS being used in the 2003 Winter Olympics

Vocabulary: ***invention***: creating something new

applied science: when the purpose of scientific research and development is intended to help people or society.

Background information:

Since GPS receivers can calculate location coordinates, direction of travel, speed, time and record travel routes, they have great potential for recording sports events. As GPS units become more accurate and precise, and as their cost lowers, and as more research and development is put into recreational use, we are likely to see this technology used on a regular basis for many sports events.