Forestry Suppliers Lesson Plan

Using GPS

Forestry Suppliers' GPS F.I.E.L.D. Kit™
Fundamental Investigation of the Environment Leading to Discovery™
Study Kit Correlated to National Science Education Content Standards

If you're interested in spatial studies for classroom activities, consider the Forestry Suppliers' GPSF.I.E.L.D. Kit. Use the kit for the exercises outlined in this Lesson Plan, as well as other related activities (see "Further Studies" section for a few ideas).

This F.I.E.L.D. Kit is available exclusively from Forestry Suppliers and includes some of the items used in this lesson plan. All kit items may also be purchased individually. Call our Sales Department at 1-800-647-5368 or visit us on the web at www.forestry-suppliers.com.

Fields of Study:
- Areas–Geography
- Earth Science
- Mathematics

National Science Education Content Standards Correlation

Grades	A	B	C	D	E	F	G
K-4	✓			✓	✓	✓	
5-8	✓			✓	✓	✓	
9-12	✓			✓	✓	✓	

GPS/GIS Kit Contents Stock Number 36843		Required For This Lesson Plan			
Qty.	Description	K-4	5-8	9-12	Stock Number
3	GPS Receiver, Garmin eTrex 10		✓	✓	39470
1	Training DVD for Garmin eTrex 10, 20, 30 Series		✓	✓	39767
1	Reference: Going Places with GPS		✓	✓	60005

Grades 5-8

Background

If you have ever been lost, your first thoughts might well have been "Exactly where am I, and what is the easiest way back?"

Understanding basic mapping concepts and skills will help you find your way. This includes the use of a compass.

When used properly, a compass can help to point you in the right direction. Today, we can take this a step further with the Global Positioning System (GPS).

The Global Positioning System 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 was opened to civilian use in the 1980s. GPS works in any weather condition, anywhere in the world, 24 hours a day.

The GPS Satellite System

The 24 satellites that make up the GPS space segment are orbiting the earth about 12,000 miles above us. They are constantly moving, making two complete orbits in less than 24 hours. These satellites are travelling at speeds of roughly 7,000 miles an hour.

The first GPS satellite was launched in 1978. A full constellation of 24 satellites was achieved in 1994.

Each satellite is built to last about 10 years. Replacements are constantly being built and launched into orbit. A GPS satellite weighs approximately 2,000 pounds and is about 17 feet across with the solar panels extended.

How It Works

Twice daily, GPS satellites circle the earth in a very precise orbit and transmit signal information to earth. GPS receivers use this information to calculate a user's exact location. The GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. This time difference tells the GPS receiver how far away the satellite is. By comparing distance measurements from multiple satellites, the receiver can calculate 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 (two-dimensional) position–latitude and longitude–and track movement. By tracking four or more satellites, the receiver can also determine the user's altitude for a 3D (three-dimensional) position. 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.

Sources of GPS Signal Errors

While highly accurate for most applications, there are certain factors that can degrade the GPS signal, such as:

Atmospheric Delays — The satellite signal slows as it passes through the atmosphere. The GPS system uses a built-in model that calculates an average amount of delay to partially correct for this type of error.

Signal Multipath — This occurs when the GPS signal is reflected off objects such as tall buildings or large rock surfaces before it reaches the receiver. This increases the travel time of the signal, thereby causing errors.

Receiver Clock Errors — A receiver's built-in clock is not as accurate as the atomic clocks onboard the GPS satellites. Therefore, it may have very slight timing errors.

Orbital Errors — Inaccuracies of the satellite's reported location.

Number of Satellites Visible — The more satellites a GPS receiver can "see", the better the accuracy. Buildings, rugged terrain, electronic interference or sometimes even dense foliage can interfere with signal reception, causing position errors or possibly no position reading at all. GPS receivers typically will not work indoors, underwater or underground.

Satellite Geometry/Shading — This refers to the relative position of the satellites at any given time. Ideal satellite geometry exists when the satellites are located at wide angles relative to each other. Poor geometry results when the satellites are located in a line or in a tight grouping.

Purpose

- To give students a conceptual understanding and basic use proficiency of a GPS unit
- Provide a basic introduction of GPS use and GIS application

Pre-Activity Assessment

Instructors should make assessment of the students' background knowledge of:

- Basic compass function and use
- Basic mapping skills
- GPS terminology
- GPS function and use

For more information about GPS, we suggest the following web links that will provide strong, basic information and enhance proficiency in mapping knowledge skills, GPS function/use and GIS concepts.

- www.esri.com
- www.garmin.com

Prerequisite

Students should have a basic working knowledge of the GPS unit that they will be using. A user's guide can usually be found on the manufacturers' web site.

Procedure

Students engaging in this exercise should have a basic knowledge of GPS and the related terminology. This activity must be conducted outdoors.

Prior to the activity, the instructor should establish points or markers, each with a unique number or letter to identify it. The points/markers should be spaced at least 100 feet apart so the students will have a line-of-sight to navigate to each location. Larger distances between points is most desirable. The point/markers can be pieces of cut cardboard placed on the ground or orienteering markers (Forestry Suppliers #37214). Refrain from using permanent landmarks, (telephone poles, playground equipment, fencing, etc.), during this activity if possible. These objects are better used as a separate geographical data entry when creating a total GIS "picture" of a specific area.

1. Students should be divided into groups of no more than 5 students.
2. Each group will be assigned a specific set of markers/points to find and record the coordinates. A waypoint should then be created.
3. The waypoint should be named or recorded as the same number that appears on the marker/point. (Example: Team 1 is assigned markers 3, 5, and 8. Team 1 then proceeds to the markers, stopping only at 3, 5, or 8 to record each one's coordinate or waypoint.
4. When Team #1 finds marker number 3, the waypoint is recorded as number 3. The same procedure will be completed for the other two.
5. After Team #1 completes this task, they will return to the instructor and wait for the other teams to complete the recording of their designated markers.
6. Once all the teams have recorded their waypoint of their markers, all GPS units will be turned in to the instructor.
7. The instructor will then give each team a GPS unit used by a different team in the previous activity.
8. Now using another teams' original GPS unit, each team will navigate a new course to new markers/points.

Assessment

- What is the meaning of the acronym GPS?
- List common uses of a GPS unit.
- What are the 3 segments of GPS?
- What are common sources of error when using GPS receivers?
- What is WAAS?

Content Standards Covered

A Science as inquiry
- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

D Earth and Space Science
- Structure of the earth system

E Science and Technology
- Abilities of technological design
- Understandng about science and technology

F Science in Personal and Social Perspectives
- Science and technology in society
- Science and technology in local, national and global challenges

G History and Nature of Science
- Science as a human endeavo

Rubric

After completing the suggested pre-activity assessment and the procedure, students should be able to:

1. Understand basic GPS terms and skills.
2. Understand the concept and use of a GPS unit.
3. Show basic proficiency in GPS unit use
4. Understand the need and application of GPS/GIS in various areas of work and recreation.

Grades 9-12

Background

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