Navigating:
GPS & Geocaching

Winneshiek County Conservation Equipment and Recommendations:

- **Who:** 4th grade and up
- **What:** GPS units – 13 beginner, 5 intermediate
- **Where:** Schools (outside), any park or outdoor area, or Lake Meyer Park. Call 563.534.7145 for more information.

Introduction

If you have ever been lost, your first thought might well have been "Where am I, and how do I get back?" Understanding basic mapping concepts and skills will help you find your way. Today, we can take this a step further with the Global Positioning System (GPS). GPS is now used to enhance many outdoor adventures. The technology may help you find a natural wonder, navigate an unknown stream, or get you outside searching for local Winneshiek County geocache sites.

A Brief History

The **G**lobal **P**ositioning **S**ystem 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. Since then, GPS has become a widely used aid to navigation worldwide, and a useful tool for mapmaking, land surveying, commerce, science, and recreation.

GPS works in most weather condition, almost anywhere in the world, 24 hours a day. The 24 satellites that make up the GPS space segment are orbiting the earth about 12,000 miles above us. They are constantly moving, at speeds of about 7,000 miles an hour. The first GPS satellite was launched in 1978. A full constellation of 24 satellites was achieved in 1994.

How GPS 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.

GPS Uses

GPS has been used to pinpoint ships on the ocean and to measure Mount Everest. GPS receivers have been miniaturized to just a few integrated circuits, becoming very economical. Today, GPS is finding its way into cars, boats, planes, construction equipment, farm machinery, and even laptop computers and phones.

GPS is helping to save lives and property across the nation. In 2002, it enabled rescuers to drill a shaft to free trapped miners in Somerset, PA. Many police, fire, and emergency medical-service units use GPS receivers to determine the police car, fire truck, or ambulance nearest to an emergency, enabling the quickest possible response in life-or-death situations. GPS-equipped aircraft can quickly plot the perimeter of a forest fire so fire supervisors can produce updated maps in the field and send firefighters safely to key hot spots.

GPS-equipped balloons monitor holes in the ozone layer over the polar regions as well as air quality across the nation. Buoys tracking major oil spills transmit data using GPS to guide cleanup operations. Archaeologists, biologists, and explorers are using the system to locate and track ancient ruins, migrating animal herds, and endangered species.

Geocaching

Geocaching is a high-tech treasure hunting game played throughout the world by adventure seekers equipped with GPS devices. The basic idea is to locate hidden containers, called geocaches, outdoors and then share the experience with others. Geocaching is enjoyed by people of all age groups. Used by some organizations to increase support for the environment, geocaching encourages people to get outside and exploring using location-based technology. For more information and specific outdoor programs, see the resources listed at the end of this unit.

Equipment & Supplies

- GPS Unit - an electronic unit that receives information from satellites circling the earth
- Extra batteries

Reminder - a GPS unit is not a replacement for a map or compass but should be used along with them.

Terms & Definitions

bearing – a direction based on 360 degrees; the compass direction we follow in order to get to a set destination

coordinates – a system for defining a geographical place, for example: latitude and longitude; GPS can use a number of different systems and is set using the preference screen

distance – tracks how far you have traveled and how much further you have to go
elevation contour lines – the lines on a map that connect points of equal elevation above mean sea level (MSL)
position acquired – the GPS unit has been able to read at least 3 satellites
route – a series of waypoints
track – when you enable the TRACK RECORDING feature, the GPS unit will automatically set trackpoints as you go, essentially laying a breadcrumb trail to show where you've been
triangulation – using three points to define a location
waypoint – a destination, or a point along a route leading to a destination

GPS Features

Most GPS units have the following features:

Satellite Page – shows which satellites you are connected to and the signal strength
Map Page – shows a map of where you are
Navigation Page – shows compass face and the direction of travel
Trip Odometer Page – shows distance traveled, move time, stop time, and more
Menu Page – shows marks, waypoints, tracks and set-up functions

Skills & Strategies

The 4 Basic GPS Functions

1. **Give a location:**
   A GPS unit accurately triangulates your position by receiving data transmissions from multiple orbiting satellites. Your location is given in coordinates: latitude and longitude or Universal Transverse Mercators (UTMs).
2. **Point-to-point navigation:**
   A "waypoint" is a combination of coordinates for a specific location. If you establish a starting waypoint at a trailhead, for example, and then enter coordinates for the campsite you're headed for, a GPS can give you a straight-line, point-to-point bearing and distance to your destination. Since trails rarely follow a straight line, the GPS bearing will change as you go.
   - Plotting a route with waypoints is relatively easy. Simply find the MARK function on your unit. If you're marking a waypoint where you stand, you can often do this with the single press of a button. You can also add multiple levels of detail: a name (e.g., "trailhead" or "waterfall"), the coordinates, the elevation, and even a short note. This is particularly helpful if you're marking waypoints for the trail ahead, perhaps before you leave home. NOTE: Whenever starting a hike, add a waypoint where you've started from!
3. "**Route" navigation:**
   By combining multiple waypoints on a trail, you can move point-to-point with intermediate bearing and distance guides. Once you reach the first predetermined waypoint, the GPS receiver can automatically point you to the next one or you can manually do this.
4. **Keep a "track:"**
   One of the most useful functions of a GPS unit is its ability to lay a virtual "breadcrumb trail" of where you've been, called a track. This differs from a "route," which details where you're going. You can configure a GPS to automatically drop "trackpoints" over

intervals of either time or distance. To retrace your steps, simply follow the GPS bearings in reverse through the sequence of trackpoints.

Safety

- Don't rely on GPS alone for navigation. Always carry a map and compass.
- Always carry spare batteries for your unit. When outside, don't throw out the old ones. They not only are a toxic waste, they might be able to provide enough power for one more reading when your back-up battery set dies unexpectedly.
- Because of their long life, Lithium batteries are the best choice for GPS receivers.
- Features such as auto-routing and backlighting can be turned off to conserve battery life.
- Remember that GPS units are only accurate to within 30-100 meters depending on the model.
- Practice at home before you use a GPS unit in the field.
- Avoid obstacles such as rock cliffs, tall buildings, and heavy vegetation. A GPS receiver's accuracy (and usefulness) is completely dependent on being able to receive clear transmission signals from three or more satellites.
- GPS units work best outside in clear view of the sky.

Extensions:

Science: EarthCaches (special sites people visit to learn about unique geosciences features of the Earth), natural science and exploration, physics, geography, earth sciences
Math: mapping, geometry

Resources

- National Park Service: GPS history. www.nps.gov/gis/gps/history.html
- Aerospace: GPS uses, history, and elements. http://www.aero.org/education/primers/gps/index.html
- Groundspeak: Organization dedicated to is to inspire outdoor play using location-based technology and to support parks and outdoor recreational areas. http://www.groundspeak.com
- GPS Adventures: Ideas for uses of GPS and playing outdoors. http://www.gpsmaze.com/
- Geocaching.com: Search, find, and share geocaching. http://www.geocaching.com/
- Wherigo: GPS-enabled adventures in the real world. http://www.wherigo.com/
- Earthcache.org: Sustainable alternative to geocaching where you learn new things about the planet Earth. http://www.earthcache.org/
- The Science Spot: Learning with GPS. Numerous lesson plans integrating GPS with multiple other disciplines. http://sciencespot.net/Pages/classgpslsn.html