Science & Technology of GPS
(Instructor Info)
Since Earliest Times, We’ve Been Trying To Figure Out Where We Are And Where We’re Going
Early Navigation Techniques

• Marked Trails-Landmarks (Local)
• Celestial Navigation (Night & Accuracy)
• Sextant
• LORAN & DECCA (Radio based system limited to coastal & large lake areas)
• Sat-Nav (Uses low orbit satellites)
X Marks the Spot

• You and a partner stand back to back each holding a balloon.

• Student with the X on their balloon describes location of the X

• Student without X listens till they feel they know where X is located then uses marker to mark X on their balloon
X Marks the Spot

- What could we mark on the balloon to help us find a specific location easier and more accurately?
  - North (90 N) & South (90 S) Poles
  - Equator & Prime Meridian (Intl. Date)
  - 30 N, 30 S, 60 N, 60 S
  - Locate Australia (S 25 E 135)
  - Locate Ames, Iowa (N 42 W 93)
What is GPS?
Global Positioning System

A network of satellites that continuously transmit coded information, which makes it possible to precisely identify locations on earth by measuring distance from the satellites.

**THE GPS SATELLITE CONSTELLATION**

From *GPS Land Navigation* by Michael Ferguson
GPS Facts

- Developed by Department of Defense as a military navigational tool.
- Systems birth was in the early 1970’s
- 24 Satellites orbiting at high altitudes (11,000 miles) First Satellite launched in 1978
- Became fully operational in April 1995
- Useful night & day – rain or shine
- Use of radio waves
- Accuracy depends on unit, some are accurate to a centimeter.
27 Satellites
6 orbits
Min. 4 per orbit
Min. 5 visible at any one time.
Orbit the earth every 12 hours.
Orbit 10,900 Nautical Miles above earth surface.

Launch History
www.navcen.uscg.gov

Satview
tycho.usno.navy.mil
How GPS Works!
Trilateration Activity

This activity will demonstrate how GPS Receivers can be so accurate!

Materials needed:

• Map of River Country
• Geometric Compass
• Pencil
Trilateration Activity

Locating a position on a map!
(Scale is 1 cm = 20 km)

• 60 km from Smithville
• 200 km from Fullerville
• 220 km from Blueville
First GPS Model - Rockwell
HOW TO USE THE GARMIN eTrex
eTrex Description

- Internal GPS Antenna
- UP Button
- DOWN Button
- ENTER Button
- PAGE Button
- POWER Button
- LCD Display (with backlight)
Selecting a Page

All of the information needed to operate the eTrex is found on four main "pages" (or display screens). These pages are the Satellite, Map, Pointer, and Menu. Once power is applied, press the **PAGE** Button to switch between pages.
What Information Does a GPS Provide?
BASIC NAVIGATION INFORMATION PROVIDED BY GPS UNITS . . .

YOUR CURRENT POSITION
- COORDINATES (LATITUDE & LONGITUDE, UTM, MGRS, ETC.)
- ELEVATION (0R BETWEEN WAYPOINTS)

• DIRECTION TO SPECIFIED WAYPOINTS

• DISTANCE TO SPECIFIED WAYPOINTS
  - (0R BETWEEN WAYPOINTS)

• YOUR SPEED OF TRAVEL

• YOUR DIRECTION OF TRAVEL
AND OFTEN MUCH MORE

- SUNRISE & SUNSET TIME
- TIME OF DAY
- HEADING & BEARING
- TRIP ODOMETER & TRIP TIME
- MAXIMUM & AVERAGE SPEED
- COORDINATES OF CITIES & TOWNS
- MANY OTHERS
Using Easy GPS

- Free download from web
- Fast and easy way to create, edit, and transfer waypoints and routes between your computer and your GPS
- EasyGPS connects your GPS to mapping and information sites on the Internet, giving you one-click access to street and topo maps, aerial photos, weather forecasts, and nearby attractions

http://www.easygps.com/
Let’s go outside and have some Fun!
GPS Applications!
SOME GPS APPLICATIONS

COMMERCIAL & GOVERNMENT
• Agriculture
• Military
• Maritime
• Automotive
• Surveying
• Aviation
• Forestry
• Environmental
• Public Safety
• Mapping Software

RECREATIONAL
• Hiking
• Hunting
• Nature Study
• Fishing
• Boating
• Biking
• Skiing
• Snowmobiling
• Geocaching
• Golf ! ETC.
• GIS

SKIP to “Using Easy GPS”
Contour Guidance
Flag
Straight Guidance
Stop Guidance
A-B Line
Excluded Area

Back to GPS Applications
Military Uses

- **PLGR GPS Receiver**
  The Manpack was replaced in 1993 by the hand-held Precision Lightweight GPS Receiver (PLGR), popularly known as the "Plugger." These units are similar to civilian receivers, but they can use higher-precision GPS signals.

- Image courtesy Rockwell Collins.

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Transportation Related Business

This technology tracks where your vehicles are on a detailed map, where they have been, where they are going, what speed they are traveling, as well as ignition on/off. In the right hands, this data can become very useful information when managing your business.
GPS Navigation in the Air

Pilots Use of GPS

Pilots on long distance flights without GPS rely on navigational beacons located across the country. Using GPS, aircraft can fly the most direct routes between airports. Pilots often rely on GPS to navigate to their destinations. A GPS receiver in the cockpit provides the pilot with accurate position data and helps him or her keep the airplane on course.

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Mapping the Earth with GPS

• Surveyors and map makers use GPS for precision positioning. GPS is often used to map the location of such facilities as telephone poles, sewer lines, and fire hydrants. Surveyors use GPS to map construction sites and property lines. Forestry, mineral exploration, and wildlife habitat management all use GPS to precisely define positions of important assets and to identify changes.

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1st Ever GPS BUG Race

- two travel bugs
- earn mileage points for when you travel bug is found and taken to another location
- if your travel bug is found, but its finders are not able to relocate it, you will get mileage points for that
- Each group can hide up to 5 traditional caches and receive mileage points when discovered by geocachers
- Bonus mileage for camera bugs. (24 exp disposable camera that has 10 pictures of different finders)
- And finally, mileage points for caches found by your GPS Team.

I Back to GPS Applications
The sensor array, which exploits global positioning system (GPS) satellites to detect minute ground movements.

Nature Mapping in Iowa
Marine Navigation

- GPS provides reliable, accurate and consistent navigation data that has significantly increased marine safety. Systems that combine GPS and wireless communications deliver precise position information over wireless satellite links for emergency reports, navigation and tracking.

- The Coast Guard uses DGPS systems to place and maintain buoys, lights, and day markers that direct traffic in harbours, and on coastlines, rivers and lakes. Sailors rely on GPS to enhance competitiveness, set courses and track performance. In competitive racing for example, DGPS systems are used aboard competitors and committee boats, and provide precision placement for race course marks.
GPS For Hunters

GPS navigation can be the difference between successful hunting and wandering aimlessly around in the woods. Mark the location of your deer blind, or find your way back to that great duck-hunting spot.

GPS as a planning and analysis tool
Use your GPS with topographical maps to make your scouting time more efficient. If you look on a map and notice possible deer funnel areas where ridges come together or a creek or river abuts a bluff you can mark the latitude and longitude as a waypoint and so you can find the spot quickly. Build a database with a GPS receiver by making a waypoint for each, and naming them with a code you can understand.

Safety
GPS is useful too because it allows you to safely and easily navigate your way back even if you get caught in bad weather and visibility is compromised.
Easily navigate back to base camp if you get separated from the rest of the group.
If you get in serious trouble, you can use a GPS unit to communicate your exact position to rescue teams.

Back to GPS Applications
As a forester, Sawchuck finds that GPS and GIS technologies enable him to more rapidly collect and geocode data and then present it in numerous formats ranging from text-based tables to detailed color maps. But the most valuable asset that the GPS/GIS combination brings to this forester’s job is its analytical power. "A lot of people view GIS as a great mapmaking tool," Sawchuck notes. "It does that really well, but the real power behind GIS is the ability to do analysis of your information."
Satellite navigation is fast becoming an industry standard for location information used by emergency and other specialty fleets. Location and status information provided to public safety systems offers managers a quantum leap forward in efficient operation of their emergency response teams. The ability to effectively identify and view the location of police, fire, rescue, and individual vehicles or boats means a whole new way of doing business.
Hiking

• Download Hiking & Biking waypoints to use while traveling. Mark points of interest as you go or mark prior to trip by finding on the web.

• Click for next page!
Back to GPS Applications
Biking

- Download Hiking & Biking waypoints to use while traveling. Mark points of interest as you go or mark prior to trip by finding on the web.

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Snowmobiling

Using Easy GPS to create or copy routes already created and available on the web!
Skiing and GPS

• Download free GPS Map with waypoints of popular ski locations.

• Some adventurers have even created geocache where skis are needed.

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In Hands Off mode the *GolfPS*™ Personal GPS System provides instant and continuously updated distance to the green. In addition, the *GolfPS*™ Personal GPS Golf System provides distances to any feature on the course, such as bunkers, water hazards and pin placements. With each shot, you receive accurate and consistent yardage for your favorite courses.
The Benefits of GPS for Fishing

GPS technology make your fishing expeditions much more rewarding. More accurate than "line of sight" or other navigation methods, a GPS unit tells you where you are and where you're going to within a few meters. Once considered a luxury, GPS is now an essential item in the fisher's arsenal.

A GPS is very handy and a good depth finder is useful too. Finding these places still requires some traveling time but good preplanning with a map and GPS means less wasted time. It is especially useful if you fish huge backcountry and featureless waterways.

Combine the benefits of mapping with GPS by getting digital charts or scan in paper maps with GPS mapping software and then enter way points along your planed route. A GPS unit can mark these fishing hot spots so that you can find it again easily.

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Canoeing, Kayaking & Boating

GPS provides mariners with navigational and positioning accuracy up to within 3 meters. There is no easier or safer way to navigate on the open waters.

**Canoeing & Kayaking**
Record your journey by saving points of particular interest and beauty or patches of soft shore where you can easily return on future trips. Marking hazardous areas to avoid when canoeing or kayaking at a rapid pace can be boat-saver and lifesaver.

GPS allows you to easily communicate coordinates to others or to find your way back to...
The use of GPS is becoming common amongst farmers & custom applicators. It is being used for development of combine yields, control of variable rate application of fertilizers or herbicides and helping the guidance of equipment during field use.
Geographic Information System, GIS

Simply put, a GIS combines layers of information about a place to give you a better understanding of that place. What layers of information you combine depends on your purpose—finding the best location for a new store, analyzing environmental damage, viewing similar crimes in a city to detect a pattern, and so on.
Geographic Information System, GIS

- GPS Units allow you to identify a specific geographic location
- Data can then be linked to the geographic location data

http://www.gis.com/whatissgis/whatissgis.pdf

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Mapping Software
1. Name two methods of early navigation?

2. What does GPS stand for?

3. Who developed GPS Navigation?

4. How many GPS Satellites are there in orbit?

5. At what altitude are these satellites?
6. What type of signal does a GPS receive?

7. What are some applications of GPS in our lives?

8. How many satellites must a GPS receive information from in order to navigate in 3 dimensions?

9. How long has GPS Technology been available?

10. Will a GPS work in your classroom?

11. How accurate were our eTrex receivers?
(Presenter Contact Info)