

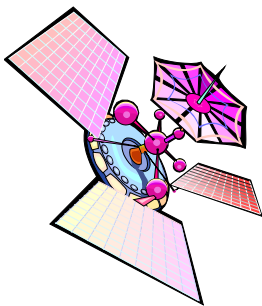
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**GPS/GEOCACHING
PROGRAM**



Global Positioning System (GPS)



**Reference & Training
for
Beginner & Intermediate Skill Levels**

With Indoor and Outdoor Activities for Building Skills with Handheld GPS Units

Steve Sewell Bio: Steve Sewell is an outdoorsmen and also professional trainer as part of his technical career. He loves to share his outdoor knowledge of GPS/Geocaching in terms and explanations that the whole audience can understand. Steve has facilitated GPS and Geocaching day programs since 2005 through area parks and recreation which exposes students to a lot of field GPS use. For these day programs he has written a about a 100 page reference/workbook for the students as a take away. Steve is also a registered Geocaching Merit Badge Counselor for the Boy Scouts, in which his GPS/Geocaching covers almost all of the requirements. In working with other youth, he has lead a GPS Special Interest Club through 4-H as well as conducting mini workshops for 4-H technology days and Girl Scouts. For his personal outdoor activities, he uses a handheld GPS for wilderness adventures, canoe day trips, geocaching, hiking, as well as road trips. **Contact Steve at SewellOutdoor@frontier.com.**

The following material is a compilation of subject matter information sourced from internet resources plus many of Steve Sewell's personal experiences. He includes many detailed explanations with additional notes and tips throughout. Review questions along with indoor and outdoor activities are also provided. Some links of original sources have been included at the start of each section in which the material came. In some cases the material was not included in its entirety, in which one will need to visit for complete details. Many of these sites have much more to offer than included in this document.

The original intended audience was for instructional use with individuals as well as non profit organization like scouts, parks & recreation, outdoor clubs, etc. in which the internet is not available in a class room or field type settings. Today with years of refinement and additional section it has become what it is today.

Information was organized and mostly written by Steve Sewell. Material written by other authors or links are provided. Section introductions, review questions, and activities are written by Steve Sewell. Insight provided and material reviewed by Jim Meizelis and former students from class Steve has facilitated.

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1) What Is A GPS Receiver Used For

Introduction Statement(s):

Basically used to figure out where you are and where you want to go

Some Uses: Wilderness travel in the BWCA, travel directions, create trail maps, share tracks, marking hot fishing spots to return, mark spots where the big buck was spotted, find your way back,

About Satellite Navigation

<http://www.magellangps.com/en/about/aboutgps/>

Global satellite navigation is an exciting technology, providing enhanced productivity and accuracy in a vast number of industries. It adds a new level of enjoyment and safety to a wide range of navigation, sports and recreational activities. A Global Navigation Satellite System (GNSS) is a network of satellites that transmits high-frequency radio signals containing time and distance data that can be picked up by a receiver, allowing the user to pinpoint their precise location anywhere around the globe.

There are two Global Navigation Satellite Systems currently in operation: the U.S. [Global Positioning System](#) (GPS) and the Russian [GLObal Navigation Satellite System](#) (GLONASS). These systems are constantly being upgraded to meet higher standards of reliability. A third GNSS named [GALILEO](#), after the Italian astronomer of the early 1600s, is currently being developed in Europe to specifically provide a higher standard of integrity and reliability, required to ensure the safety of lives during transport by air, land and sea without the use of additional augmentation systems.

History

<http://www.magellangps.com/en/about/aboutgps/gps.asp>

GPS is the U.S. [Global Navigation Satellite System](#) (GNSS). A network of 24 satellites continuously transmits high-frequency radio signals, containing time and distance data that can be picked up by any GPS receiver, allowing the user to pinpoint their position anywhere on Earth.

Originally designated NAVSTAR (NAVigation System with Timing And Ranging), development of GPS began in 1973. In 1978, the U.S. Department of Defense launched the first GPS satellite, imposing SA (Selective Availability); the intentional degradation of GPS signals to prevent military adversaries from using the highly accurate positioning data. SA limited GPS to 100-meter accuracy for non-U.S. military users. Magellan® introduced the first handheld receiver in 1989, making GPS available and practical for many new industrial and recreational applications. The network required to efficiently cover the Earth was completed with the launch of the 24th satellite in 1994. Replacement satellites continue to be launched, each having a life span of about 10 years.

In 2000, Selective Availability was turned off by presidential order, giving all GPS receivers the potential accuracy of 15 meters without the use of signal correction. The signals are available 24 hours a day in any weather condition, everywhere around the world. When used with [WAAS](#) or [EGNOS](#) receivers, GPS accuracy can be improved to 3 meters.

Putting GPS To Work

By Steve Sewell

A GPS (Global Positioning System) was originally created in the 1970's for use by the U.S. Department of Defense. The technology of GPS has matured well beyond the original military plans. Today GPS units are used by the hunter, fisherman, boater, dispatcher, surveyor, day hikers, wilderness adventures, geocachers, etc.

GPS uses expand beyond finding yourself if you happen to admit to being lost. Many basic applications can stem from the simple questions of "Where in the world.....

- am I?" (location)
- am I going?" (navigation)
- have I been?" (tracking)
- are things?" (mapping)
- is the time?" (timing)



Reference Links:

- Putting a GPS to Work: <http://www.trimble.com/gps/gpswork.shtml>

"Where in the world am I?" (a.k.a location)

A GPS unit can determine the current position or *location* of self/object in relation to other things. One of the many navigational features of a GPS is a map screen. Many units show an arrow in the middle of the screen to indicate the current location and travel direction. The same screen can show relative locations of lake coves, roads, topographic elevations, and other named coordinates to give you a good sense of where you are.

Wilderness: One time, I was on my 7th wilderness adventure in the massive Boundary Waters near Ely, Minn up by Canada. Our canoe paddling was delayed for well over 3 hours; due to numerous high white caps on the large Lake Agnes that could easily flip us into the cold Northern September water. When the water calmed enough, the race against time was on to get up the Nina Moose River and around a challenging beaver dam to the next lake to set up camp. At dusk we arrived, but we could not make out the shore line well enough to detect the eluding land marks like cliffs, lake coves, and campsites as an indicator of our relative location using a paper map. Thank goodness we had a GPS unit with map details of the area as well as campsites loaded. With the unit's backlighting on, we knew where we were in relation to the campsites and obstacles in our canoe path. We found an available campsite, set up camp, and made dinner by flashlight and head lamps.

Web Links:

- Boundary Water Canoe Area: www.bwca.com

"Where in the world am I going?" (a.k.a Navigation)

Before GPS, a map and compass was the main *navigational* means from getting from one location to an unfamiliar destination. Remember having to do math problems by hand in school. Punching in equations on a calculator is similar to what a GPS does for navigation over using a map and compass. It still pays to know the theory and to be able to do things manually in a pinch.

Canoeing: I've organized many one day canoe trips as early as my college days. Inevitable I would hear from the less experienced the words parents usually hear from the kids in the back seat: "Are we there yet!" With topographic details in my GPS, I've been able to easily answer by showing where we were pictorially on the river and the take out point we're heading too. Then based on the map scale and average speed on the GPS, I've been able to quickly estimate how much longer it will be to our take out point. I can also plan breaks for the group prior to the next set of class II rapids identified with the downloaded map details. Sometimes these rapids even have a name and are shown on the GPS screen (ex. Shot Gun Eddie, Wolf River, WI).

Re-Find Fishing Spot: I love to head up North into the upper part of the Wisconsin to fly fish on the Wolf River. The river is well known for its great echo system. The first year up there I kindly asked around where some one green with the fly rod might get some action like the experienced fly fisherman. One person said to try up river from the bridge just down the road and there are trails you can hike to get up river. He added to look for some "V" dams that create

channels of deeper water. After I headed out I wonder what “V” dams really looked like being from central Illinois. After hiking, exploring, wading, and wondering around, I finally realized that the several “sand bars” I crossed with tall grass and trees were the “V” dams. I so found a wide and deep hole that I started catching several fish nice sized fish. I used my GPS I had with me to mark the location. I now use the coordinates to navigate back to the same spot. This time with no wondering.

Road Trip: Driving on family vacations can be very enjoyable if you like to take in the view. One thing that can take the fun out of a trip is missing a turn and going an hour out of your way when you need to make a specific arrival time. On one family vacation to Saugatuck, MI, I preplanned my trip route on computer with mapping software like planning a trip on a paper state maps with a highlighter to know all the major highway turn offs. I give the major turning points names like “I55 I80” for the intersection of the highways. I also make up names for major bends in the highway. After I “connect the dots” to create a route, I then download to my GPS before set the alarm to beep 1 mile prior to a turn to give me a advanced warning. The GPS is then mounted on the windshield so that I can glance at it from time to time. We didn’t miss any of our turns, but I must warn you that you still need to pay attention to the highway signs to make sure the right ramp is taken and you’re in the correct lane. Also still bring along the paper map as a back-up.

“Where in the world have I been?” (a.k.a tracking)

Another powerful feature is the *tracking* of movement. A GPS can monitor a history of where people and objects have been. Sometimes tracking is referred to as leaving a “bread crumb trail”. That phrase comes from the old children’s story of Hansel & Gretel. Some may recall their father, a very poor wood cutter, lived on the edge of a large forest. The evil stepmother talked the father in loosing them in the woods. Hearing the discussion, Hansel leaves a trail of bread crumbs they can follow back home from deep within the forest. The one of the problems they encountered was the birds and critters ate the bread crumbs.

Returning from Trail: One of my hobbies is Geocaching for “hidden treasures.” In June of 2006, I was up in Door County, WI enjoying about an hour by myself doing some geocaching while the family took a nap. The “cache” was hidden along the trails of a significant size park. I didn’t even know these trails existed until my research on Geocaching.com. I marked on the GPS the location of where I parked the truck and proceeded to follow the general direction the GPS was pointing me. Since I did not have a trail map, every time I came to one of the numerous trail intersections or forks, I had to stop and plan with my GPS. As I got deeper and deeper into the trails and during these stops, I discovered first hand the infamous Wisconsin birds call mosquitoes. On the return trip, I wanted to get out of there fast and not take the time to ask myself, “Which way did I turn at this point?” Thankfully I had the tracking turned on and was recording my every move that I had made from the truck. I was easily able to follow the exact path shown on my GPS map screen as a dashed line. With this “bread crumb trail”, I did not have to worry about the critters eating my navigation means back. So anytime heading down an unknown trail, especially without a map and compass, be sure to turn on the GPS tracking.

Journal Enhancement: Each year I go to the Boundary Water Canoe Area (BWCA) and someone in our crew is in charge of keeping a group journal of what we did each day, what we ate, weather, pictures, and where we traveled. Lately we been using a GPS to track all the areas we’ve went and how far we traveled. The track log from the GPS is loaded into the computer and displayed on the screen over laying the relative maps and trails we traversed. We then create a PDF file for a visual map of where we’ve been that is included on CD with the other files shared with the crew. Tracks can be reused for future trip if loaded back into the GPS by anyone in the crew.

Dumb Criminal Story: There is a story of someone stealing items by breaking into many vehicles. A GPS unit was one item stolen early in the night of this individuals quest and must have been turned on during that time. When recovered by the police there was evidence of where and when the criminal had been that coincided with the different places he had been. It was also proven that the GPS unit was not his because stored in the GPS unit was a waypoint named “home” that just so happened to be the address that the GPS was stolen. All information in the GPS was submitted as evidence in court.

Keeping Tabs on Teenage Drivers: In Windsor California, a retired sheriff’s deputy installed a GPS unit in his son’s car to track where he goes and how fast he drives. With each “bread crumb” not only is the location and time recorded, but also the speed of travel at each moment. Now isn’t that a novel idea for other parents. Once the son did get a speeding ticket, but he was not in trouble with good old dad. When the track logs were loaded on the computer it was clear that son was not speeding at the point where the speed limit changed. The son and father decided to fight the ticket putting the technology of the GPS up against the accuracy of the radar gun. I myself have used the speed

calculation the GPS provides compared to the speedometer of the vehicle. It comes out exactly right on. The only time it was different is those few times the speedometer was known to be off due to tire size change.

“Where in the world are things?” (a.k.a mapping)

Traditional *mapping* or surveying the locations of objects on land and water could take several days or weeks for surveyors to accomplish. These objects can be anything like roads, rivers, topographic details, location of gold claims, location of gas/water/sewer pipes, creating accurate trail maps, etc. Now with the advent of GPS some of the same tasks can be accomplished in less than a day by just one person.

Fish Structure: Another hobby I have is fishing. My favorite local place is Evergreen Lake in McLean County, IL. A few volunteer fishermen, in the winter time while the lake was frozen, placed various types of fish structures on the surface of ice to fall through during the thaw. When placed, a GPS was used to mark their exact location as well as describe if Christmas trees, pallets, rocks, or PVC structures were used. I now take my GPS with me fishing to find the location of the type of structure I'd like to fish and can also “see” these with my depth finder.

Farming: A farmer friend of mine, Tim, hires soil sampling of his land using GPS. Soil samples will indicate the need for more or less lime or nutrients depending what was obtained within each grid section of the farm land. Each soil sample included the exact coordinates from the section obtained. The GPS is later hooked up to farm equipment to distribute the just right amounts based on the findings from each grid section. This establishes uniform yields and saves money in applying only the amount of product needed.

Create Trail Maps: I have created very detailed trail maps by setting the GPS tracks to 1/100th of a mile accuracy. I first did this when creating the geocache called “Comlara’s 5 Shot Challenge” to aid beginner geocachers by having a printed trail map. Where ever I walk a “bread crumb” will be stored in the GPS. The tracking can be turned on or off as needed, so you only record the parts of the trail you want and not any side trips off the trail. The key thing to keep in mind when you happen to leave the trails with the GPS tracking turned off, you'll want to return to the spot where you want the tracking to continue. The tracks can then be uploaded to the computer via the map software for the GPS. From the software you can view, edit, save, and print the trail tracks in relation to the other topographic details. If need be the tracks can be “cleaned up” using some mapping software to remove the tracks that happen to be recorded when you are not on the trail.

Forest Service Campsites & Portages: The United States Forest Service has all the portages and campsites for the Boundary Waters Canoe Area Wilderness (BWCAW) mapped out with coordinates in a text file. The portages (trails to get to the next lake) have comments for the length in meters and rods that can be stored in the GPS along the coordinates. Some manipulation of the text file may be needed. Copying into MS Excel can make some manipulation much easier to read and update. A text file or Excel file can be imported into most GPS map software and then downloaded to the GPS unit. Having this information preloaded in the GPS has helped me find those naturally well hidden portages and campsites.

Web Links:

- Google Maps <http://maps.google.com/>

“Where in the world is the time?” (a.k.a timing)

The use of the phrase “time is precious” has different meanings to different people depending on their perspective. For some it is mostly about lost time with family or friends. For industries and computers systems it is more about the *precise timing* of events. The GPS satellites each have highly accurate atomic clocks as an integral part of making the entire system work. Another key part of the system is the GPS receiver that has to be synchronized with the satellites. This essentially gives you the accuracy of an atomic clock right in your hand without the million dollar cost associated.

Astronomy: Some of the higher end telescopes you can buy have sophisticated computers combined with GPS to automatically locate objects in the sky. Data about time and associated sky location for planets, stars, constellations, galaxies, etc are stored in the telescope’s computer. Ever notice how throughout the night the stars and moon are in different locations at different times. Now imagine for the same exact moment you were suddenly transported to South America. Those same stars and the moon would be at a much different angle in the sky compared to being in North America. The GPS feature of some telescopes allows the computer to know the time and location. It then references

the data about an entered object and automatically points the telescope to the object with the correct angle towards the sky for the known time. It will work no matter where you are located in the world.

Photography: Ever been unsure where a photo was taken with your digital camera? You know the date and time the picture was taken but that does not help much due to the many photos taken during an afternoon in several spots. One solution is to use the tracking feature of your GPS. All that has to be done is to synchronize the digital camera date and time with that of the GPS. Before starting to take photos adjust the “bread crumb” trails on the GPS for the desired increments. Wherever you go not only is the latitude and longitude being saved with each “bread crumb” but also the time in which it was saved in the GPS. When you get home you can look at the properties of the picture file and compare the time to the tracks uploaded to the GPS mapping software. Pictures for the same time as a “bread crumb” will identify the location. The comment property of the picture files can be stored with the latitude and longitude identified along with any short descriptions. There does exist software to automatically “geotag” your photos with the location and map out your path taken.

Web Links:

- Search for “GPS” at www.telescopes.com or <http://space-astronomy.lifetip.com>
- Know exactly where you took that picture <http://www.thinkgeek.com/electronics/cameras/9f46/>

Review Questions:

1. Name some specific activities you would like to apply a GPS.

2) GPS Glossary & Features Guide

By Steve Sewell

Introduction:

Most people want to make informed decisions about purchases by having a reasonable understanding of the features they get for the money to be paid. Understanding the terms used in explaining a product's features is very wise to obtain the best value for your needs. Once purchased, the same knowledge will guide you in the application of those features.

Consider the analogy when one is in the market to buy a car. Some of the terms/features may include: 4, 6, or 8 cylinder; hybrid powered; keyless entry, power locks; M+S (mud & snow) tires; 2 vs. all wheel drive; built in DVD player; etc. People value what they pay for a car and the options they have differently. You may want fuel economy and low payments in a new car just to commute to work. Another may spend much commuting time and desire comforts or need extra room for the growing needs of a family. Yet another may need a 4 door pickup truck to get to work, get to family events, and handle outdoor special projects. Warranties offered by a manufacturer is another consideration. As with the many features balanced with price for cars, the GPS also has features to balance with price.

Questions To Keep in Mind When Shopping for a New GPS:

In purchasing a GPS, knowing what you are getting in features and matching them up to your needs and budget can be very important. The GPS you own should meet the frequent needs you have as well as those seldom used yet are still important. You may also want features you can see using in the future. Keep in mind that no GPS unit will be best suited at all navigational applications that different people need due to size and cost would be impractical.

The GPS units and related computer mapping software will vary in how user friendly is very dependant on the individual and how it will be used. For example a small compact GPS unit may have the buttons close together as part of saving space. This would be a great size for typical hikes you may take. Now take the same GPS unit snowshoeing on a cold winter day in which you need to keep your gloves on during operation. Can you operate the right buttons with gloves on? Maybe model with the spacing of the buttons farther apart would be a better choice in this application. Maybe having the same functional buttons on the sides of the unit would be preferred for outdoor use. For driving with the GPS mounted on the windshield, the buttons could be easier if on the front of the unit so you can operate with one hand.

Here's a few general things to keep in mind to make sure the GPS unit meets overall typical needs. Special needs may lead to additional questions.

- What will you use the GPS for: driving, boating, biking, skiing, snowshoeing, backpacking, camping, fishing, geocaching, hunting, simple hikes, long wilderness navigation, etc.?
- What accessories are available for purchase now or later?
- Does the GPS come with or can you obtain downloadable maps for areas of interest: N. America, Canada, Mexico, Europe, Japan, marine charts, etc.?
- Can you load into the GPS unit the amount of detailed maps of all the different areas you may need at one time?.....or does the maps at the right detail come preloaded?
- What fits into my budget now or should I wait and save up a little more?

Glossary of Terms

- **Altitude:** The elevation above sea level. A GPS can indicate travel as up or down hill. Can also gain an idea of how tall something is.
- **Bearing (BRG):** The direction from your position to a destination, measured by 0 to 360 degrees relative to North.
- **Coordinates:** A unique North and West description of the position
- **Channels:** The number of different satellite signals a GPS unit can receive. 12 to 14 is typical with new units. The more signals and signal strength increases the accuracy of readings.
- **Datum:** A datum is a global survey method of calculating and measuring used in the creation of a map. In the case of GPS, datums are different calculations for determining longitude and latitude for a given location. Currently, Geocaching uses the WGS84 datum for all caches. Many maps still use NAD27, which can cause

confusion if your GPS unit is set to NAD27. When using a GPS in conjunction with a printed map, make sure your GPS is talking the same language the map was created. Most GPS units will allow you to change the datum.

- **Heading (HDG):** The direction you are facing/traveling, measured by 0 to 360 degrees relative to North.
- **Initialization:** A means of the GPS to compute a first current position by having a rough idea of what satellites the GPS unit should be able to receive a signal. Through entering the general location (state), date, and time, the GPS can identify the satellites that should be overhead according to the satellite almanac in memory prior to obtaining a fixed position.
- **Interface:** Upload/Download coordinate/map details between a GPS unit and Computer. Usually serial or USB connection. A must for quicker and more accurate preparation for field use.
- **Latitude (Lat, N coordinate):** The angular distance North or South of the equator measured by lines encircling the earth parallel to the equator. North of the equator will be from 0 deg to +90 deg. South of the equator will be from 0 deg to -90 deg.
- **Leg:** A segment of a route that has a starting waypoint and a destination waypoint. A route may consist of one or more legs to get from point A to B, B to C, etc. Each point at which two legs meet will be an indication of a new direction of travel along a route.
- **Longitude (Long, W coordinate):** The angular distance East or West of the prime meridian (Greenwich Meridian, 0 deg) as measured by lines perpendicular to the parallels and curving to converge at the North and South poles. The degrees range from -180 degrees to 0 degree when describing West of the prime meridian. The degrees range from 0 degree to +180 degrees when describing East of the prime meridian. The U.S. will be in the negative numbers.
- **Route:** One or more legs or waypoints to a destination. Basically includes points of progress or key turns along the way to a destination.
- **Tracks:** History of where traveled. An automatic "Bread Crumb Trail" uses coordinates at set intervals. This is very good for back tracking for the return trip.
- **WAAS:** Wide Area Augmentation Systems. Makes satellite corrections to get accuracy under 3 meters. WAAS is a network of ground relay stations (constant ground position) and geostatic satellites (constant sky position). These two known constants will utilize a constant time and distance between them to correct navigation signals for atmospheric delays, incorrect satellite position, and poor geometry.
- **Waypoint (a.k.a. Landmarks, Points of Interest (POI)):** A destination identified coordinates. A stick pin on a map.
- **WGS84:** The most current geodetic datum used for GPS is the World Geodetic System of 1984 (WGS84). The significance of WGS84 is that GPS receivers rely on WGS84 and in turn Geocaching uses as a default. The standard format is HDDD MM.MM. HDDD means Hemisphere and degrees. MM.MM are minutes in decimal format

Lat/Long Riddle: A person sets up a base camp, but needs additional supplies from a couple other locations. He travels directly South 25 miles to pick up food for two weeks. Next he travels 25 miles directly East to obtain some additional building materials. He finally travels 25 miles directly North to reach his base camp with the needed supplies. Question: What color is the bear where he is traveling and why?

How much does a GPS unit cost?

GPS Units can range from under one hundred for the simplest of consumer hand held units to thousands for aviation or survey grade units. The cost depends much on the features you want and the applications you have. Finding one unit that all potential needs does not exist. Typically a good hand held unit will that will work for activities such as hiking, geocaching, boating, and driving will run \$100 \$400 plus a little extra for additional detail topographic map software specific to outdoor needs. Most of these units are designed to withstand some abuse like getting wet or dirty, being stuff tight in backpacks, impacted resistant, freezing temperatures, etc. The unit made mainly for the car travel will have a bigger size screen to easily view and operate in a car. These usually have all the detailed maps already loaded and ready to go. The models will run anywhere from \$200 to \$500. Price on all these units like other electronics seem to come down over time or the manufacture offers more features for similar prices. Also consider what accessories may come bundled with GPS models that fit your application needs.

Typical Features To Consider

Whether your main use will be outdoors or in car travel, there are some considerations to help decide which features you would like to have a GPS unit. Essentially the size and features of a GPS unit should be fairly optimized for your most typical uses. Finding balance may be a challenge for some and easy for others depending on the planned applications.

- **Accessories:** Depending on the GPS unit the following accessories may be available:
 - Vehicle Mount (stick to dashboard or suction cup to wind shield),
 - Auto-12 volt power cord (nice for charging unit or using backlighting for long night driving),
 - Screen Shield Sheets (cut to size to protect from scratches, look in the digital camera sections for the protective film you can apply to the screen the shows the picture),
 - Protective Belt Clip Case
 - Map Software (topographic, street routing, lakes)
 - battery tray (back up a unit lithium battery pack with standard battery sizes).
- **Barometric Altimeter:** Measure altitude using barometric pressure which adds accuracy to an altitude based on 4 or more satellites. This is usually found in the higher end models.
- **Batteries:** Some GPS units will take standard size batteries or special rechargeable batteries made just for the unit. It's always a good idea to have extra batteries as a backup.
 - Standard Size: AA, AAA
 - Standard Types: Alkaline, Nickel Metal-hydride (NiMH), Titanium, Lithium (see appendix for Battery Life in GPS)
 - Special Battery Pack: made specifically for a given GPS unit that is usually lithium and rechargeable.
- **Compass:**
 - **GPS Compass:** recognizes direction of heading by movement from last known position using 3 or more satellite signals. For a GPS compass to read direction it may take up to 5 strides in a straight path to register a correct heading.
 - **Electronic Compass:** works much like a regular magnetic compass and works well when standing still
- **Controls:** The controls are a means to interact with the GPS unit to perform certain navigational functions. For example there are buttons to: view different navigational screens, zoom in and out on map details, mark points of interest, and mouse like controls. Some of the newer models with larger screens have touch screen technology.
- **Connector:** If wanting to use a GPS receiver with a computer, be sure that it includes make sure it has a interface to attach a data cable. The cable usually has a serial or USB connection on the other end. Most newer models will also be NMEA (National Marine Electronics Association, www.nmea.com) compatible so your GPS can be connect to other devices via a standard communication. The connector also may provide external power to the unit and will also charge batteries made specifically for the unit. The most common use will be to connect to a computer transferring coordinate and map data to or from the GPS unit.
- **Mapping Types.**
 - **Non-Mapping:** Also known as a plotting screen and have no map details shown. These plot on the screen the relative location of stored waypoints and continually draw tracks up to the current. Knowing the relative position of your track and the waypoint can enhance the navigation experience. These are typically the older low end models and not so easily to find in newer model due the market wanting some level of mapping included.
 - **Base Maps:** Units come factory preloaded with maps of major interstates, cities, airports, lakes, & river but usually does not contain all details such as topographic and minor roads.
 - **Mapping Units:** Through an interface detailed topographic or street map data can load from a computer CD. GPS units designed specifically for road travel are typically preloaded with detailed street map data with seldom a need for a computer.
 - **Auto Routing/Re-Routing:** Select a destination and the GPS unit will provide turn by turn directions. Some will provide re-routing for when you have to detour from the planned route. Some software like found with topographic maps will only allow manual routing.
 - **On Road vs. Off Road Unit:** Basically is the unit design mainly for driving or not. The units designed for road use usually have bigger screens to make it easier to glance at while driving. No matter what the current GPS accuracy signal, the unit will show you traveling on the road. The other is more accurate and responsive to off road use. I have a friend who has demonstrated his on road unit. When trying to geocache a good distance across the field from the parking it was noticed that the GPS unit was still showing the location where he left the road. Also the on road unit don't usually come with a GPS compass and show feet to destination that is very usefully for activities like geocaching or

wilderness navigation. .Some newer more expensive units that have dual use and work well for either application.

- **Combo GPS unit & GRMS Radios:** non-mapping, base map, or mapping units that can show distance and bearing received from the coordinates sent by of others with the similar units.
- **Memory:** Based on experience, 5 megabytes hold approximately 1/3 of IL topographic details along with city, street name, waterway names. This can vary depending on the level of detail of the mapping software. Some mapping units come with a certain amount of internal memory like 16 megabytes. Some units allow the use of SD memory cards that greatly extend what can be stored. Early on SD cards would have 32 meg or even up to 256 meg. Now we see up to 16 gigabytes which will be very handy to store tons of variety of topographic and street maps of the same locations that you can change to view.
- **Screen:**
 - **Size:** The size of the screen can be measure given like 1.8"hx1.4"w found with some small hand held. Other unit's screen will be diagonally like a 5" screen. The bigger the screen the easier it is to read. The trade off is the weight to carry, size to pack away, and the power it consumes.
 - **B&W vs. Color:** Both have their advantages and disadvantages. Color is nicer to see different details more easily, but uses more power. To counter the power in color displays some setting can be made to dim after no controls being touched. B&W or monochrome grey scales provide all the details and uses less power. There is no need to dim the display for its all the same. For night use there is a backlight feature that most units have. Backlight shaves considerable time off the battery usage when on extend periods of time.
- **Track Logs:** The history of tracks can be stored in the main memory of the GPS. Many new unit allows the conversion of tracks to routes. Most units allow some form of backtracking the bread crumb trail to return the same way you came.
- **Trip Computers:** number of sets of tracks, calculate ETA, speed, distance off route, trip distance,
- **WAAS:** Most newer models have today
- **Water Resistant/Proof:** A must for outdoor and boating use. Some units have different submerge in water depth and durations.

Beginner GPS Use Tips

Below are some important tips based on my own experience and learning each new GPS unit I try:

- **Learn Your GPS:** Don't expect to know how your GPS works the first time you use it on the hiking path or traveling in your car when you are really counting on it. At least skim through the entire the instruction manual from cover to cover. Slow down when it comes to the explanation of which controls does what. Become familiar with the terminology used that may be slightly different than the general terms explained above. Don't try to memorize all the combinations of controls to use specific features. Instead, try to understand how similar the basic controls are used from one feature to another. Next be fully aware of the main features that you will be using like marking/saving waypoints, entering/saving given waypoints, using the navigation screens, and setting intervals for track logs. Next focus on other features that sound interesting and you could see using.
- **Practice Using GPS In Comfortable Surroundings:** Find a large area like a familiar local park that you don't have to worry about getting around. Plan on spending a couple of hours; maybe more that once. First try the basic features you first focused on in the manual like setting waypoints and walking of and returning. Gain trust in the GPS unit when you know where it should be pointing you. Also try following you track. View what is being shown on the different navigation screens at different moments. Once trusting the GPS in known surroundings, the easier it will be to use in unfamiliar areas.
- **Mark Important Waypoints:** One main feature of a GPS is to identify the location of different objects, but this will not work if the information is not in the database of the GPS unit. Ask yourself what are some things I will want to return or just need for reference to surroundings at any time. Some specific points of interest may be base camp, where you left you parked vehicles, trailheads, significant directional turns (like a passage around the mountain, shallow crossing of a river, a trail crossing), destinations provided before heading out, as well as other landmarks to confirm navigational paths. Without waypoints your GPS is pretty useless in a wilderness type setting. The only exception to this may be GPS unit with topographic and street details. Even then it is wise to mark the point of return that you'll eventually want to get back to or significant points along the way.
- **Know The GPS Expected Battery Life:.** No power renders a GPS unit useless. Through using the owner manual, the manufactures website, or your personal experience you need to know how long you can go before



the set of batteries will be drained. If the unit will only last 7 hours and you'll be gone for days without access to purchasing more or charging, plan on additional batteries to account for the duration need with some emergency spares. Note how long a unit will last with backlighting on in the event of some dawn, dusk, or night use. Start off a significant venture with new batteries. Wilderness trips into the backcountry when you hours/days away from civilization this becomes extremely important to plan.

- **Protect GPS From Damage:** Though GPS units are pretty durable especially handheld unit, they can still get damaged during use or just while packed away. When not in use store in a protective case or in a cushioned location in a pack of some kind. Find a safe place in a backpack or pocket to carry it. Know how the unit can manage getting wet. Some units may handle getting a little wet, but not dropped in a water or used in the rain for prolonged period of time. For those more susceptible to moisture, try using a quart size freezer bag that can be resealed. Some are very water resistant, but still have limits.
- **Backup To The GPS:** GPS units can fail for various reason like poor satellite signals or malfunction of the unit itself. Have good maps of the area travelin, a compass, and know how to use them. Follow the map from time to time compared to the GPS unit so you'll know last known locations on the map to begin map only navigation.
- **Safety First:** Be prepared for the potential weather conditions. Make sure you have enough to eat and drink for the duration traveled. Watch where you are stepping much more that focusing on the GPS screen. The GPS can get you out if you are injured and can walk. Most import to use common sense.

Check Out The Handheld Brands and Models

New models and features often come out each year by different manufactures. For a perspective on the subtle differences in features as the price tag goes up, study the following pages of low, medium, and high end hand held mapping models. The following 2006 - 2008 hand held models will provide an idea of the differences you can get when you step up from basics to a higher end unit. Today the price difference within a model series may be similar but just like computers over the years they tend to be faster and will new features. Each of these came with a base map and had street and topographic mapping software available at the time.

Note: Since about 2010 some of the higher end models starting having additional features like: digital camera, digital voice recording, built in flashlight, touch screen, text to speech (talks), voice recognition (responds to human speech), blue tooth, MP3, can utilize third party map software of greater detail, . All of these and other creative combinations may be available to compliment GPS use, yet are not all are specific to GPS. New models may also improve on these same feature concepts. The direction seems to be going the same way and the mobile phones in adding/improving features that are not specific to phone use yet are nice to have.

Magellan – eXplorist 210

With its high-speed data port and robust memory, this unit makes it easy to download and access multiple map files.

- Large 22MB of open memory for software interface, comes with 8MB basemap installed
- High-speed USB data port makes transferring files easy
- WAAS-enabled (Wide Area Augmentation System) & EGNOS Satellite-Based Augmentation Systems for TrueFix™ uses 14 parallel channels (most use 12) for precise position fixes and improved tracking
- PC-like file system for intuitive storing and finding waypoints, maps and saved data
- Keypad with joystick panning makes it easy to follow a route and scrolls though menu functions
- Geocaching software for easy downloading of cache positions you find online
- Stores up to 380 route files, each containing 500 waypoints
- Store up to 150 track log files, each with 2000 track-points, to easily find your way to your favorite spots or take that great hike again and again.
- High-contrast four-level grey LCD display is easy to read with amber glow backlight
- Rugged, highly impact-resistant, rubber-armored exterior; water-resistant to rigid IPX-7 standards
- Magellan MapSend™ compatible
- **(NOT to get confused wit the 200 model, which does not allow topo map uploads)**



Suggested Retail Price. \$149.99

Magellan – eXplorist 400



Powerful, expandable, pocket-sized mapping GPS. SD-card expandability and USB port offer unlimited map, waypoint and track log storage. Geocache Manager enables easy download and use of coordinates from Web sites. Perfect for active outdoor adventures.

- The Meridian Gold is intuitive, easy to use, and all the major functions are described in step-by-step instructions.
- Large screen - Large, easy-to-read screen dominates this pocket-sized powerhouse
- Easy-to-use - Navigate in seconds with simple menus, one-button shortcut to key features and joystick control
- Built-in maps - North American or European basemap shows major roads, parks, waterways and many points of interest
- SD-card expandability - Add unlimited MapSend topographic maps or turn-by-turn street routing
- Simple file system - Save, organize and access all your stored data with ease
- USB data port - Manage maps and waypoints and download coordinates from your PC
- TrueFix® technology - Reliable accuracy to within 3 meters
- Area calculation - Instantly see the distance and area between any geographic points
- Vertical profile - View graphical elevation changes for where you've been or where you're going
- Geocache Manager - PC application to download and organize coordinates from the Internet
- Track logging - Store 5 track files with 2000 points each and an unlimited number on your own SD cards
- Four navigation screens - Map, Compass, Locator and Satellite Status deliver easy-to-use information
- Rugged construction - Encased in rubber armored, impact resistant plastic
- Water resistant - Don't worry about getting it wet

Suggested Retail Price. \$199.99

Magellan – eXplorist XL



The 3.5" color display is the largest of any rugged outdoor GPS. A remarkable 30 MB available memory, SD card expandability, plus high-speed USB data port and MapSend® map compatibility make your eXplorist XL the ultimate multi-use GPS.

- Case Rubber armored impact-resistant plastic, water-resistant seal
- Base Map 16 MB Built-in basemap of North America or Europe
- Size 2.2" W x 4.7" H x 1.3" D (W 5.6 cm x H 11.9 cm x D 3.3 cm)
- Weight 5.4 oz (153 g) - w/ battery
- Display 2.25" diagonal, 4-level grayscale, high resolution (122 x 160), backlit
- Memory 16 MB user data
- Data Storage Unlimited / Secure Digital (SD) Card compatible
- Antenna Built-in multidirectional patch
- Keypad Nine direct-access keys
- Joystick Eight-way easy scrolling w/ push-in instant enter
- Receiver TrueFix™ 14 channels, WAAS/EGNOS
- Acquisition Time Hot: 20 seconds, Cold: 60 seconds, Initial: 2 minutes
- Update Rate Once per second
- Accuracy 3 to 5 meters (10 - 16 feet) - WAAS/EGNOS, < 7 meters (15 feet) - GPS only
- Source Li-Ion rechargeable battery 1300 MAH
- Battery Life Up to 17 hours continuous use

Suggested Retail Price. \$399.99

Garmin - eTrex Legend

Image and Information Courtesy of Garmin International



With the eTrex Legend, Garmin has loaded a full basemap of North and South America into one small unit. The Legend is also designed to provide precise GPS positioning using correction data obtained from the Wide Area Augmentation System (WAAS). This product will provide position accuracy to less than three meters when receiving WAAS corrections.

The basemap contains lakes, rivers, cities, interstates, national and state highways, railroads and coastlines. The eTrex Legend is also equipped with additional memory totaling eight megabytes. The added memory allows the eTrex Legend to accept downloaded map data from Garmin's entire line of MapSource® CD-ROMs, including U.S. Recreational Lakes with Fishing Hot Spots. The eTrex Legend comes in a brightly-colored translucent blue case that really makes the unit stand out. New to the product design, Garmin will include marine aids to navigation in addition to the basemap. These navigational aids will be pre-loaded into each unit from the factory.

- 8 MB GPS with PC Cable
- Database: Marine Point Database
- Basemap: Americas Highway, Atlantic Highway, or Pacific Highway
- PC interface cable
- Wrist strap
- User's guide
- Quick reference guide

Suggested Retail Price. \$160.70

Garmin – eTrex Vista

Image and Information Courtesy of Garmin International



The eTrex Vista combines a basemap of North and South America, with a barometric altimeter and electronic compass. The compass provides bearing information while you're standing still and the altimeter determines your precise altitude. The Vista is also designed to provide precise GPS positioning using correction data obtained from the Wide Area Augmentation System (WAAS). This product will provide position accuracy to less than three meters when receiving WAAS corrections.

The eTrex Vista also boasts an internal memory capacity of 24 megabytes, which allows it to accept downloaded mapping data from Garmin's MapSource® CD-ROMs, including U.S. Recreational Lakes with Fishing Hot Spots. A silver case gives this unit a high-tech look. New to the product design, Garmin will include marine aids to navigation in addition to the basemap. These navigational aids will be pre-loaded into each unit from the factory.

- 24 MB GPS with PC Cable
- Database: Marine Point Database
- Basemap: Americas Highway, Atlantic Highway, or Pacific Highway
- PC interface cable
- Wrist strap
- User's guide
- Quick reference guide

Suggested Retail Price. \$214.27

Garmin – GPSmap 60CSx

Image and Information Courtesy of Garmin International



The GPSMAP 60CSx adds several performance-enhancing features to the popular 60-series products, including a removable microSD™ card, high-sensitivity GPS receiver, barometric altimeter and electronic compass.

- Unit dimensions, WxHxD: 2.4" x 6.1" x 1.3" (6.1 x 15.5 x 3.3 cm)
- Display size, WxH: 1.5" x 2.2" (3.8 x 5.6 cm)
- Display resolution, WxH: 160 x 240 pixels
- Display type: 256 level color TFT
- Weight: 7.5 oz (213 g) with batteries
- Battery: 2 AA batteries (not included)
- Battery life: 18 hours, typical
- Waterproof: yes (IPX7)
- Floats: no
- High-sensitivity receiver: yes
- PC interface: serial and USB
- RoHS version available: yes
- Maps & Memory:
- Basemap: yes
- Ability to add maps: yes
- Built-in memory: no
- Accepts data cards: 64 MB microSD card (included)
- Waypoints: 1000
- Routes: 50
- Track log: 10,000 points, 20 saved tracks
- Features:
- Automatic routing (turn by turn routing on roads): yes
- Electronic compass: yes
- Barometric altimeter: yes

Suggested Retail Price. \$449.99

Which Brand is Preferred

The difference between the manufactures like Lowrance, Magellan, and Garmin, is similar to the personal difference between a Chrysler, Ford, and a Chevy. Each make has different model series from "low end" to "luxury". Some offer different features to compliment the unit. Each make has owners who swear by one make over the other. When it gets down to it, look at all of the features of the different brands and models to make sure what you choose one that will do all you need now, expect you may want later, and has a good value. It would be best to study the manuals found through the manufactures websites to really know all the specifics before making the final purchase choice. The kind of warranty and product support will also be a consideration.

Manufacturer Information

Lowrance GPS: <http://www.lowrance.com/>

Magellan GPS: <http://www.magellangps.com/>

Garmin. GPS: <http://www.garmin.com/garmin/cms/us>

Note : These are not the only manufactures of hand held GPS units, but they are the top three and are not listed in any particular order.

Review Questions:

2. What is a waypoint?
3. What is a route?
4. What can one follow to retrace you foots steps?
5. What should people using a GPS carry extra of?

3) How Does A GPS Work

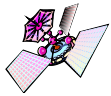
By Steve Sewell

Introduction Statement(s):

A GPS unit can not work by itself. To get the most out of a GPS unit you need to be aware of all parts of the GPS system and how it automatically does what you can manually accomplish with a compass and map. Any level of failure in any part will diminish the accuracy of positional calculations.

Three Main Components that make up the GPS System

For your GPS to be able to compute you a position, navigate to a destination, or leave a track of where you've been, a GPS must have three main components:



1. *Satellites* fairly evenly distributed around the globe to transmit data for positional calculations to be made. The data includes such things as atomic clock time to determine distance and an almanac of information about the other satellites.



2. *Ground Stations* to control proper orbit, keep satellite data up to date with the positions of the other satellites, check the atomic clock accuracy, and monitor the over all health of the system.



3. *GPS Unit* to receive satellite data and compute position.

Here's how GPS works in five logical steps:

5 Steps Courtesy of Trimble: <http://www.trimble.com/gps/whygps.shtml>

According to the Trimble* tutorial, "how a GPS works" can be summed up in 5 steps. For a very thorough explanation with animations, definitions, and other links see their online tutorial that is very well done.

1. The basis of GPS is "triangulation" from satellites.

Triangulation??? We're using the word "triangulation" very loosely here because it's a word most people can understand, but purists would not call what GPS does "triangulation" because no angles are involved. It's really "trilateration."

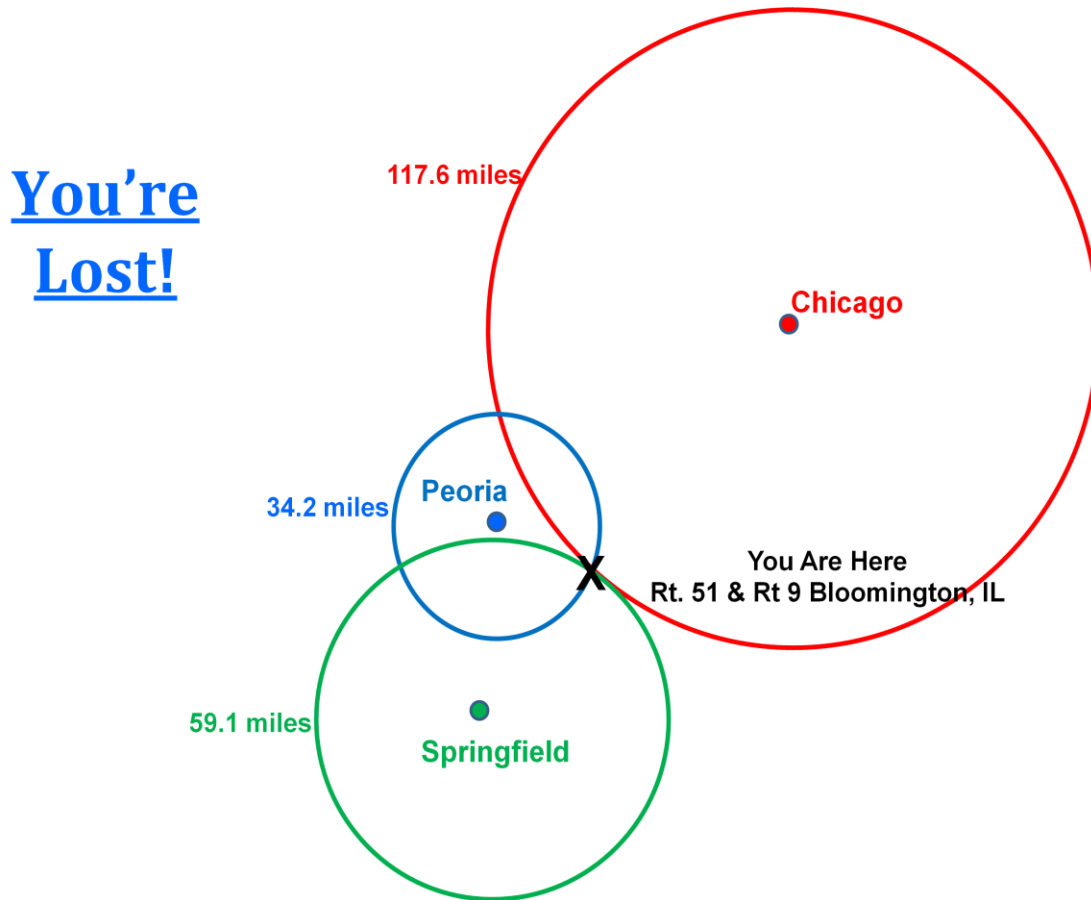
2. To "triangulate," a GPS receiver measures distance using the travel time of radio signals. (3 satellites min)
3. To measure travel time, GPS needs very accurate timing which it achieves with some tricks.
4. Along with distance, you need to know exactly where the satellites are in space. High orbits and careful monitoring are the secret.
5. Finally you must correct for any delays the signal experiences as it travels through the atmosphere.

*About Trimble: Trimble provides positioning solutions enabling professionals in engineering and construction, surveying, agriculture, fleet management and field service to be more productive by revolutionizing their work processes. For more information see www.trimble.com.

Analogy of How GPS Finds a Position

“You’re Lost!”: Let’s say you do not know where you are, but you know you’re in Illinois and you have a state map. This is all you have at the moment, but very knowledgeable people are willing to help you out:

- One person informs you that you are exactly *117.6 miles* from *Chicago IL*. Using the map legend you measure the exact length and draw a circle around Chicago using that distance as the radius. At this point your position in Illinois is somewhere on that circle.
- A second person explains they are certain you are exactly *34.2 miles* from *Peoria, IL*. You draw another circle around Peoria, in which the circles intersect at two points. Now you know your position is at one of these two points.
- You stop a third person and find out that they happen to know you are exactly *59.1 miles* from *Springfield, IL*. Now you have found yourself where Rt. 9 and Rt. 51 intersect in Bloomington, indicated by where the three circles intersect each other.



This method is similar to how a GPS works to calculate a position using the distance from three satellites as appose to three cities. The distance measured is from several thousands of miles (around 10,000 – 14,000) where the satellites orbit and reach down to where the GPS picks up the signal on earth.

Continuing with the “Your Lost!” Analogy: A GPS does not stop at just obtaining three satellite signals. Why?.... Because the three will not be very precise. When the three circles were drawn form the three cities, they will most likely not intersect at a single point due to imprecise measurement transferred from the scale and applied to the drawing of the circle. The slightly different points thereby form a small triangle in which your location is somewhere within that triangle. Let say you are a perfectionist and you want to know which corner of the intersection of Rt51 and Rt9 you are standing on in the down town of Bloomington. To accomplish this you would need another friendly person providing a distance from another city to narrow the triangle down to a general corner. More distances from cities would get you within feet of where you are standing on that corner. Similarly the more satellites above three or four, the better you can have your specific standing location down to within feet.

The GPS System “Triangulation” Perspective

3D Space: In the “Your Lost!” analogy, a two dimensional (2D) map was used to draw simple circles to find an intersecting point. In the reality of earth and the satellites above, the GPS System’s “triangulation” is based on a three dimensional (3D) perspective using intersecting spheres. The radius of a sphere is centered around each satellite, because the radio signal is broadcasted in all 3D directions at the same time. Your GPS is one point on the spheres surface which receives each of the signals. To help draw a mental picture of this, think of a basketball, softball, and volley ball. Somewhere on these outside surfaces of these balls are where you are located in this 3D space and the very center is where the satellite is located. If you could push these into each other without loosing the shape of each ball (in other words, parts of the ball is taking up the same space) to the point that each surface touches your position, a position can be calculated using the distance from the center of each ball.

Distance Measured by Time: Each signal contains an atomic clock time down to micro seconds of when a signal was sent. The GPS unit compares the precise time received from each satellite to when the satellites data said the signal was sent. The time difference is calculated. Using this time difference and formulas similar to calculating distances using the speed of light, a distance is determined from each satellite the GPS unit can receive a signal.

A Little Geometry: For some of you what I’m about to say next may bring back memories of high school geometry. You might recall that two spheres can intersect and create a plane. When a third sphere intersects that same plane, two points are identified. One of those points is where the GPS unit is located. The other point is so far out in space that it can not possibly be on earth.

For more detailed explanation and animated examples Trimble has a great section in their tutorial entitled “How it Works”: <http://www.trimble.com/gps/whygps.shtml>

Earth and Sky View of GPS System

GPS Satellites: If you ever get a chance to lay on the ground watch the clear night sky in a very dark area far away from city lights, you may see a star like reflection streaking across your view. Look for the ones without the blinking lights on the wings of planes at any altitude. It may take some minutes of watching, but it can be done with the naked eye. These are orbiting satellites of which some may be GPS satellites. Even if your eyes can’t see the GPS satellites, a GPS can still receive unless it is below the horizon or there is some obstruction blocking the signal. For a GPS to triangulate a fix on your position, it will need 3 satellites sending a good signal. A fourth will allow additional accuracy and allow the altitude to be determined. Satellites above 4 continue to add to the accuracy of a positional fix.

To summarize the number of satellites needed:

- 3 GPS Satellites for a fix on a position. (a.k.a. 2D fix)
- 4th GPS Satellites for to determine altitude and added accuracy (a.k.a. 3D fix)
- 5th plus GPS Satellites for additional accuracy (a.k.a. 3D fix)

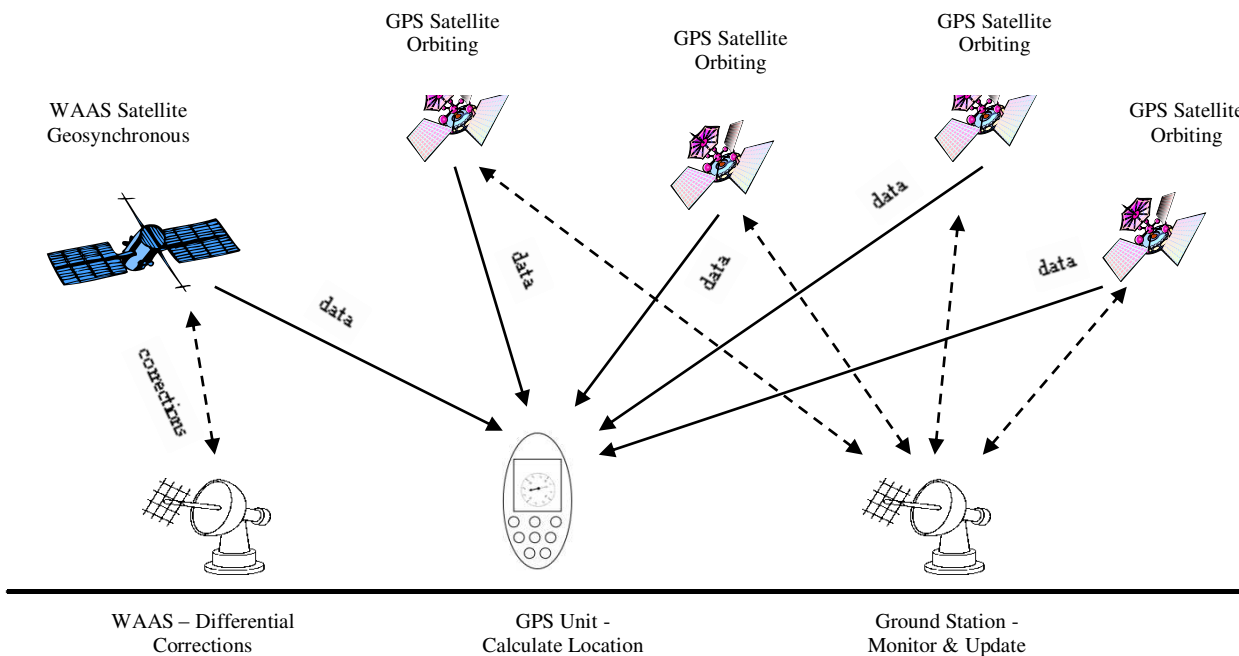
Here are some additional facts about these orbiting satellites:

- There are 24 active GPS satellites.
- They orbit the earth in different directions spread out in the sky all over the earth.
- The orbit speed take them across the sky twice a day.

Ground Stations: The ground stations have very sophisticated radar to identify the exact position in the sky each satellite is currently located and the speed of travel. If it is off the normal orbital path, instructions will be sent up to satellite to make adjustments will little thrusters. The atomic clock time is also checked and altered to be in sink with the other satellites. The potential for system failures are also monitored. The ground stations basically helps insure the quality of data sent to your GPS unit. The only draw back is that these corrections may not be instantaneous. The delay may take an hour or more. In the mean time the GPS is pick up slight erroneous information that could have you off several feet given the wrong moment. Typically the best you can expect is an accuracy of 15 meter.

WAAS: The Wide Area Augmentation System was created by the FAA (Federal Aviation Administration) to greatly aid in aviation. Basically there is WAAS ground stations placed in strategically different parts of the U.S. Other satellites are constantly monitored and corrections frequently sent to a special WAAS satellite that stays in the same position in the sky at all times. This same position is called “geosynchronous” in relation to the earth’s spin. Between a fixed WAAS ground station and relatively stationary position of one or more WAAS satellite, the accuracy in a fixed position and altitude are much more consistent and now good to within 3 meters. This level of accuracy greatly aids a pilot when there is next to zero visibility. It’s nice that all can benefit from what the FAA developed for many other applications.

Earth & Sky View Illustration:



Review Questions:

6. What are the 3 parts that make a GPS work?
7. How is distance from a satellite determined?
8. How many satellites signals does a GPS unit need to determine a position?

4) Basic GPS Keys & Features

Introduction Statement(s):

Have you had a new digital watch to replace your previous one? Do you remember a time when you used a different VCR or DVD? Did you first pull out the directions to figure out some basics operations of what you wanted to do OR just start pushing the labeled buttons to get the results you want? This may be due to having a rough idea what the buttons will do for you on the watch, VCR, or DVD. For some, operating a GPS can be very similar; if you know the results you want and can identify the basic purpose of the buttons.

There are many different makes/models of GPS that will each have a different feel. All will need to have the ability to mark a current position, enter coordinates of different locations, and indicate which way to go.

Typical GPS Keys/Buttons:

In the various GPS units I have used, I have found it best is to make sure I'm clear on what the different buttons can do and where they are located on the GPS unit. I avoid memorizing keys strokes and allow a more intuitive approach based on the goal of what I want to do and knowing the basics purpose of the keys. From there I can usually figure out the short sequence of key strokes to get the results I want. When this fails, I then get out the full manual and look it up. The manual also serves as a complete document of all the features and not just basics. While I look through the manual and sometimes stop and say to my self, "Hmm! That's neat that it can do that."

Out of the many handheld GPS units that I've worked with, all have the following abilities through the use of the keys/buttons:

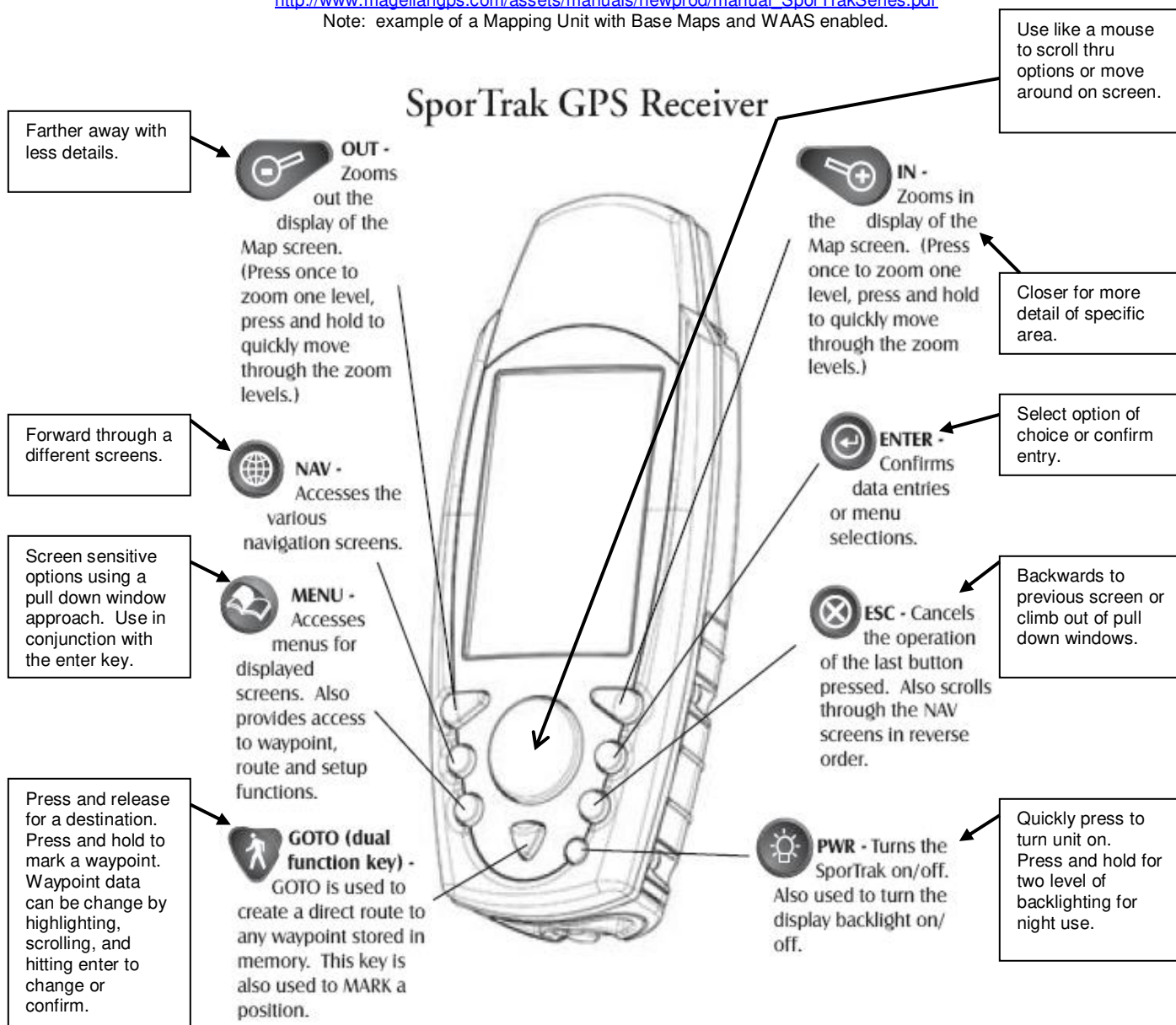
- Power on/off
- Display different navigational screens
- Goto/Mark a destination
- Name/Edit a waypoint (point of interest)
- Scroll through a menu of options and make selections
- Zoom in for more details and zoom out for the big picture on map screen

To give you an idea of how different model may vary the use of keys/buttons, study the following pages of GPS models from the different manufacturers. Each will perform similar tasks to that listed above yet they will use buttons with slightly different scope. They both have a different approach in the use of their buttons to accomplish the same tasks. No matter what GPS unit you use you'll have to understand the basic premise of each button. Most manufacturer manuals describe at a high level the purpose of each of the buttons near the very beginning. The rest of the manual will explain the details of the many functions and the sequence of keys used to accomplish a particular function.

Common Magellan GPS Keys/Buttons

http://www.magellangps.com/assets/manuals/newprod/manual_SporTrakSeries.pdf

Note: example of a Mapping Unit with Base Maps and WAAS enabled.




Note: Most Magellan GPS units have very similar key functions.

Some Common Magellan GPS Features

http://www.magellangps.com/assets/manuals/newprod/manual_SporTrakSeries.pdf

For the Magellan SporTrak Map GPS there are 7 types of navigational screens: Map, Compass, Large Data, two Position screens, Road, and Satellite Status. Other models may have similar of few screen.

* Map Screen - Position Mode



Present Position Icon
The Present Position Icon graphically displays your position on the map. While you are moving it will point in the direction you are heading.

If the SporTrak is not computing positions, this icon is replaced with an hourglass icon.

Map Scale Indicator
Provides the scale for the map. The number displayed represents approximately 1/4 of the screen's width. Scale can be changed with the IN and OUT buttons.

Track History
Dotted line on the map displays the history of where you have travelled since the last time you cleared the Track History (see Clear Memory in the Reference Chapter.)

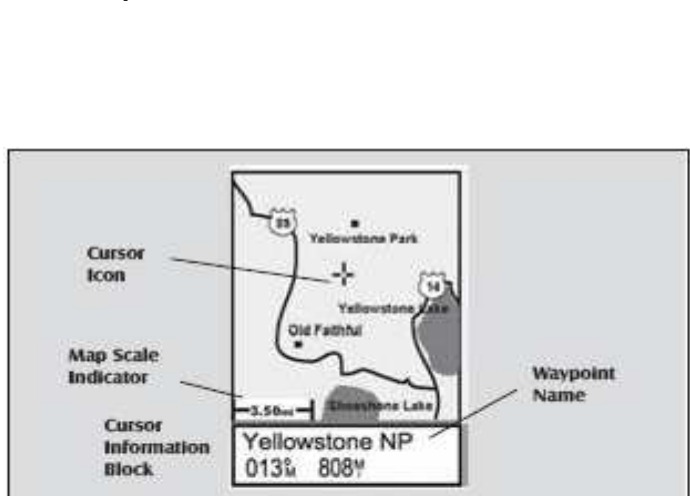
Data Fields
These fields display navigational information for viewing on the Map screen. They are both customizable with 13 data types possible.

Both of the data fields can be turned on or off allowing more viewable map area.

Both features (customize and turning the data on/off) can be accessed from the MENU button.

Position Mode

* Map Screen - Cursor Mode



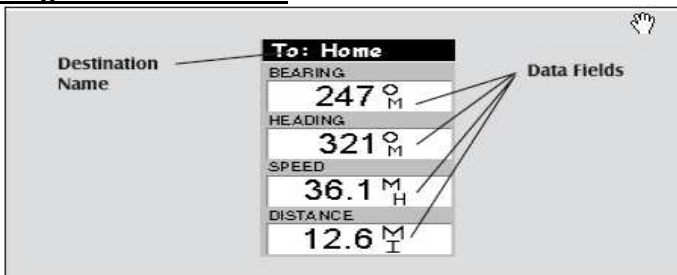
Cursor Icon
The Cursor Icon pinpoints the location you have selected by using the arrow keys.

Map Scale Indicator
Provides the scale for the map. The number displayed represents approximately 1/4 of the screen's width. Scale can be changed with the ZOOM IN and ZOOM OUT buttons.

Waypoint Name
Whenever the cursor is over a map object, the name of the map object is displayed, otherwise the word "cursor" appears. The data shown in the information block is the heading and distance from your present position to the cursor.

Cursor Mode

Large Data Screen



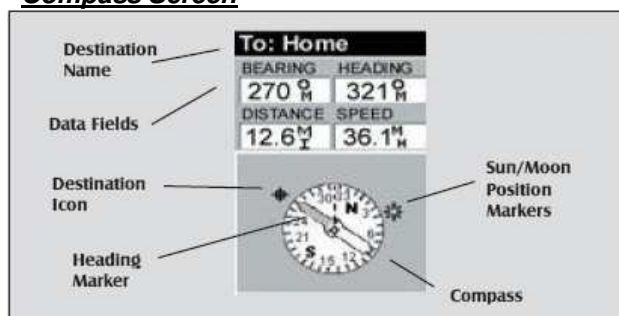
Destination Name
When you are navigating on a GOTO or multileg route, the name of the destination is placed here. For multileg routes, the name displayed is the name of the destination for the leg of the route you are presently navigating on.

Data Fields
Customizable data fields. The data displayed can be selected from 13 different options. Customizing is accessed through the MENU button. Some of the data displayed requires you to be moving to be computed, invalid data is indicated by dashes.

Two Additional Screen:

- Data
- Speed

* Compass Screen



Destination Name

When you are navigating on a GOTO or multileg route, the name of the destination is placed here. For multileg routes, the name displayed is the name of the destination for the leg of the route you are presently navigating on.

Data Fields

Customizable data fields. The data displayed can be selected from 13 different options. Customizing is accessed through the MENU button. Some of the data displayed requires you to be moving to be computed, invalid data is indicated by dashes.

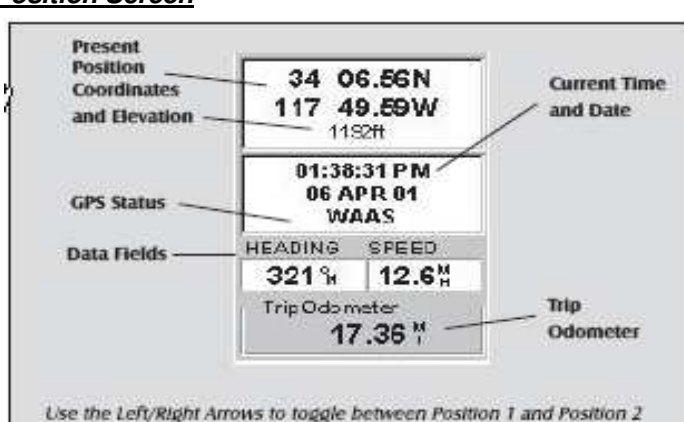
Compass/Heading Marker

When you have an active route, the heading marker will point on the compass in the direction of the destination. Note that you need to be moving for this data to be valid.

Destination Icon

When you are travelling on a route, an icon representing the destination of the leg or GOTO is displayed outside the compass. This provides you with the direction you need to head to arrive at the destination. When you are on course and heading straight for the destination, the destination icon will be lined up with the heading marker.

* Position Screen



Use the Left/Right Arrows to toggle between Position 1 and Position 2

Present Position Coordinates and Elevation

Displays your present position in the coordinate system chosen in Setup. Also displays the elevation of the present position. If the Sportrak is not computing position fixes, the last computed position is displayed.

GPS Status

Provides information on the current status of the GPS receiver portion of the Sportrak.

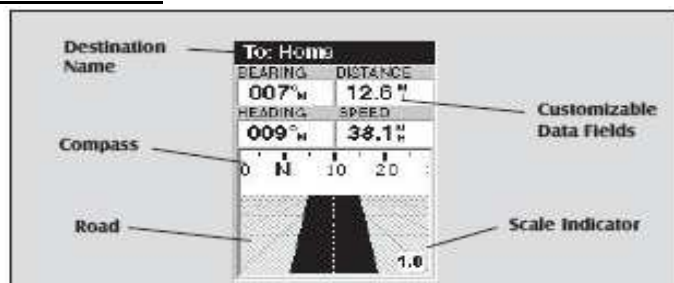
Data Fields

Customizable data fields. The data displayed can be selected from 13 different options. Customizing is accessed through the MENU button. Some of the data displayed requires you to be moving to be computed, invalid data is indicated by dashes.

Trip Odometer

The odometer performs like the odometer in your car. It can be reset through the MENU button.

Road Screen



Destination Name

When you are navigating on a GOTO or multileg route, the name of the destination is placed here. For multileg routes, the name displayed is the name of the destination for the leg of the route you are presently navigating on.

Data Fields

Customizable data fields. The data displayed can be selected from 13 different options. Customizing is accessed through the MENU button. Some of the data displayed requires you to be moving to be computed, invalid data is indicated by dashes.

Compass

Displays your heading in a familiar compass format.

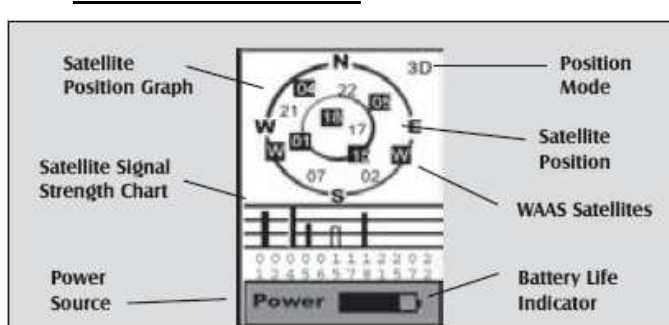
Road

This graphically displays the route (GOTO or other routes) that is active. As you move left or right of your intended track, the road will move on the display indicating which way you need to steer to get back on track. Ideally, the road would be centered on the display. Also, you will see upcoming turns in advance allowing you to make necessary preparations.

Scale Indicator

Use Zoom In/Out to change the scale.

* Satellite Status Screen



Satellite Position Graph

The two circles indicate satellite elevation as seen from your current position; the outer circle represents the horizon and the inner circle represents 45° from the horizon. The center of the circle is 90° from the horizon, or directly overhead.

Satellite Signal Strength Chart

Clear bar indicates that the Sportrak is starting to get information from the satellite. Satellites that are being used to compute your position are shown with solid bars. The height of the bar indicates the relative signal strength.

Power Source

Indicates the source of power being used — POWER (Internal Battery) or POWER EXTERNAL.

Position Mode

3D - position computed is 3-dimensional (elevation is being computed).

2D - position computed is 2-dimensional (elevation is not being computed).

Blank - Sportrak is not computing a position fix.

Satellite Position

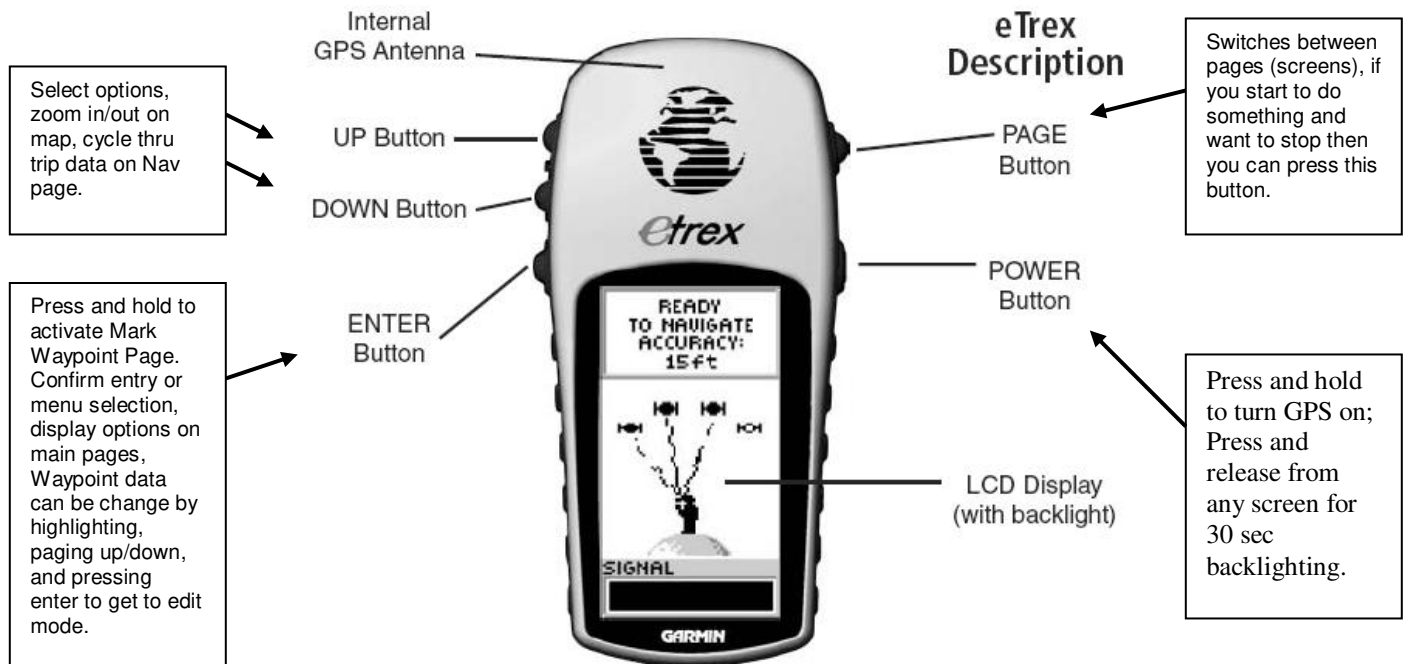
Where the satellite is located relative to your position.

Common Garmin GPS Keys/Buttons

Images and Information Courtesy of Garmin International

http://www.garmin.com/manuals/eTrex_OwnersManual.pdf

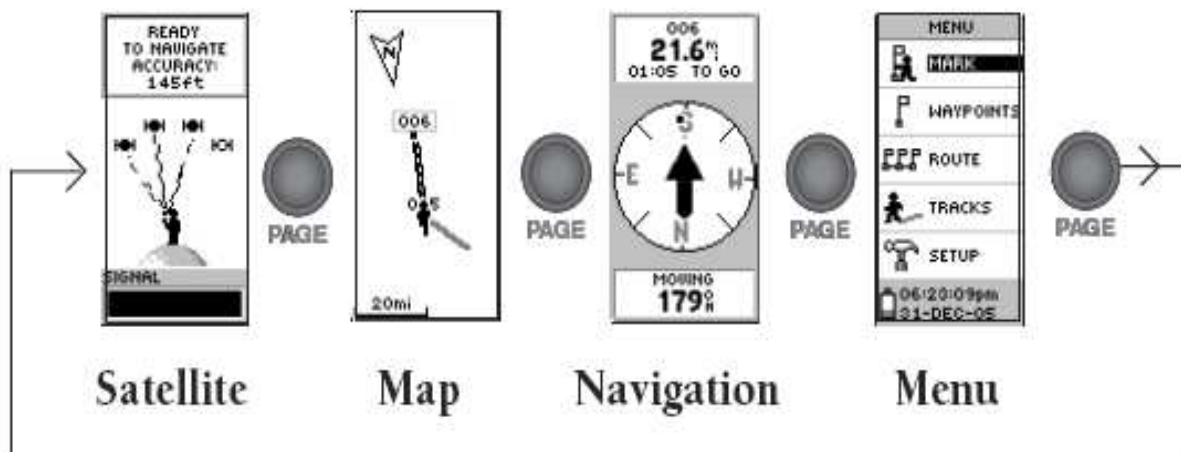
Note: example of a Non-Mapping Unit



Note: Most Garmin GPS units have very similar key functions.

Some Common Garmin eTrex GPS Features

http://www.garmin.com/manuals/eTrex_OwnersManual.pdf



Entering/Editing Points of Interest with Magellan and Garmin:

There is no easy way to cover all the different styles of interfacing with any specific GPS unit when it comes to entering and editing waypoints or points of interest. All have some type of "Mark a Location" screen in which you can move the cursor over the field in which you want to edit, hit "enter", and be able to change characters and numbers to something more meaningful or precise. Changing specific characters and numbers typically means using the control keys to move up/down and left/right. One may even need to press the enter key or OK to select the character/number. Sometimes just moving to the right will take you to the next character/number to change. A little playing with the keys to interact with these screens will unveil exactly how to accomplish different tasks. If all else fails it's always wise to actually look at the directions in the manual for the specific unit.

Here are a couple of manufacturer views of how the "Mark a Location" screen will look:

Magellan Views:

Mark

Vis	Icon	Name
<input checked="" type="checkbox"/>		CAMP

Location

34°06.583N
117°49.518W

Elevation

1640'

Message

CREATE MESSAGE?

Save **Cancel**

Cities

PASADENA

A	B	C	D	E	F	G	H
I	J	K	L	M	N	O	P
Q	R	S	T	U	V	W	X
Y	Z	1	2	3	4	5	6
7	8	9	0	-	.	'	/

<- ->

OK **CLEAR**

Garmin Views:

Images Courtesy of Garmin International

Mark Waypoint

001

Note

24-OCT-05 4:40:05PM

Location

N 38°51.393'
W 094°47.949'

Elevation

1202'

From Current Location

W 4'

Avg **Map** **OK**

Mark Waypoint

003

Note

26-OCT-05 12:27AM

Location

N 38°51.395'
W 094°47.953'

Elevation

1194'

From Current Location

W 4'

Avg **Map** **OK**

Entering Coordinates in the Right Format:

One time I went to enter in the coordinates for a new geocache on the NE side of Evergreen Lake just north of Hudson. When I looked on the map screen of the GPS it shown that the location was somewhere down by Shirley, IL. I quickly realize that I have entered in the right numbers, but I was using the decimal degrees format instead of decimal minutes for the latitude and longitude. See the respective results of entering the coordinates in each of the formats using <http://boulter.com/gps/>. Also note the different formats representing the exact same location for the entered coordinates

Decimal Degrees Entered:

GPS Coordinate Converter, Maps and Info

Enter coordinates

40.38611 -89.01835

(like 37 23.516 -122 02.625, but it's flexible)

Convert and Map

Decimal Degrees (WGS84)

Latitude

40.38611

Longitude

-89.01835

Degrees, Minutes & Seconds

Latitude

N40 23 09

Longitude

W89 01 06

GPS

Latitude

N 40 23.167

Longitude

W 89 01.101

UTM

16N

X

328683

Y

4472569



Decimal Minutes Entered:

GPS Coordinate Converter, Maps and Info

Enter coordinates

N 40 38.611 W 89 01.835

(like 37 23.516 -122 02.625, but it's flexible)

Convert and Map

Decimal Degrees (WGS84)

Latitude

40.643517

Longitude

-89.030583

Degrees, Minutes & Seconds

Latitude

N40 38 36

Longitude

W89 01 50

GPS

Latitude

N 40 38.611

Longitude

W 89 01.835

UTM

16N

X

328303

Y

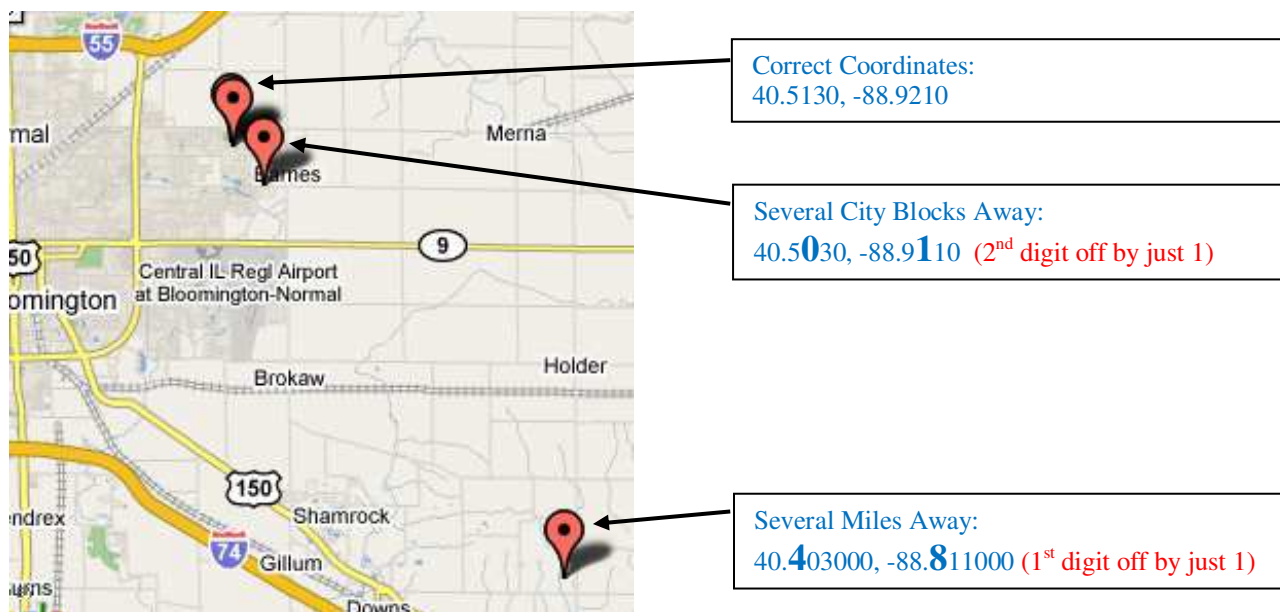
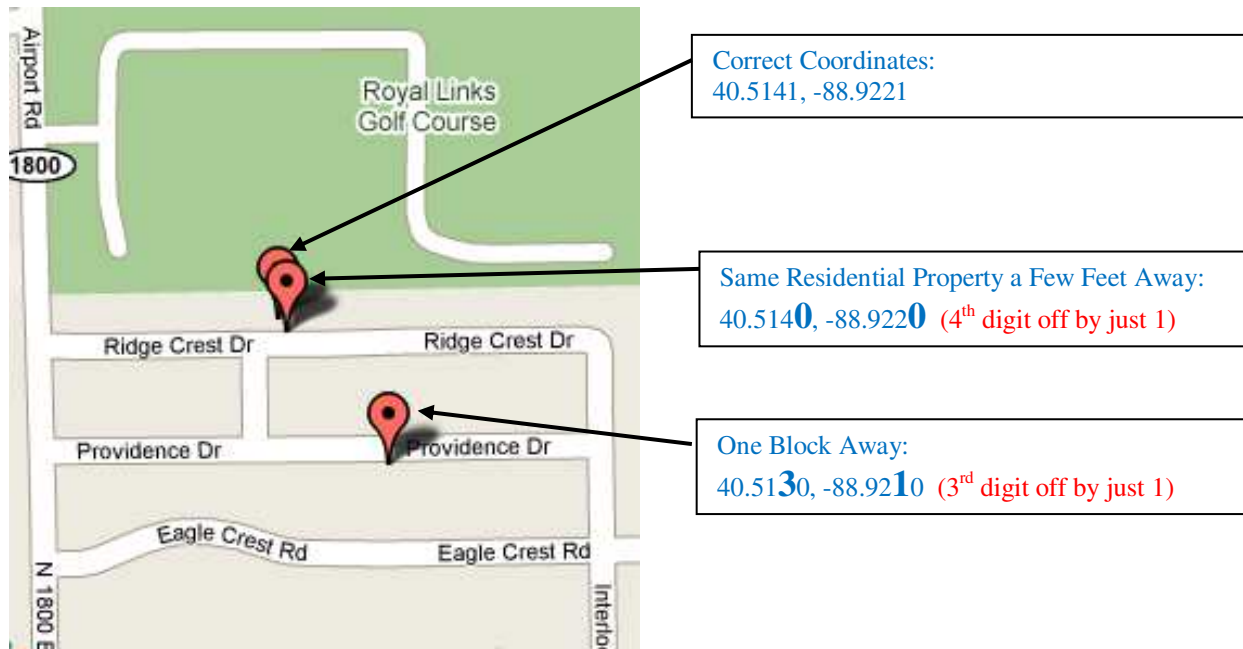
4501167



Note on Formats: There are different ways in expressing the Lat/Lon coordinate system as illustrated on the prior page. With *Degrees, Minutes & Seconds* (ex. N40 38 36) the final set of numbers for Minutes (38) & Seconds (36) are valued between 0-59 just like time is expressed. For contrast the GPS version (*Degrees & Decimal Minutes*), the minutes are value to the right of the decimal between 0-999. Mathematically valuing 0-999 can be more precise than 0-59. Field use may prove insignificant differences. The main thing is to match the format to the source like labeled in increments along a maps edge or another documented source.

Entering Coordinates with Correct Digits:

Entering in the incorrect numbers in any format can result from being off several feet to several miles. Sometimes you can enter numbers incorrectly or not have a negative number for longitude and end up not being in the United States. The range of numbers you'll find in the United State using the decimal degrees format will run from the SW part of California at 33.391933, -117.04375 to the NE part of Maine at 46.391933, -68.04375. The below images will illustrate how much just being off one of the digits to the *right* of the decimal can end up with different navigational results. It is best to double and triple check you have entered the



Activity (Indoors):

By Steve Sewell

For this activity, we are going to get comfortable with interacting with the GPS unit while sitting inside away from good satellite signals. These different parts can be a good raining or cold day activities to get very familiar with how things work.

Part #1 – Map Datum and Coordinate System:

These are typically found under the Menu and Setup. GPS units vary in how to access various settings, so it may take a little searching. Typically found under the Menu. Then look for Preferences, Setup, or Tools. Some units may have a Settings to select. Next look for something like Navigation or Coordinate System to change the formats of lat/long. The Map Datum may be on the same screen or another choice on a prior list of options.

- Set/Check the *Map Datum* to a global survey system for creating maps called **WGS 84** (most commonly used for geocaching).
- Set/Check the *Coordinate System* to be **Lat/Long**. The format should be in **Degrees/Decimal Minutes** (ex. 39° 46.321 for latitude) or the format that matches coordinates that you'll be entering in part #2.
- (optional) Find out how to clear the track and set to lowest increments (ex. .01 miles, 50 ft.). While hiking this helps to see subtle changes in the path walked in the field.

Part #2 – Enter Waypoints/Points of Interest(POI):

This will be one of the most frequently used features of a GPS. A Waypoint can be a current position or some places to navigate. To get to the view which you can enter a POI, you must use the Mark screen. From this screen you should be able to move to each field of information and hit the enter key to update the specific field needing changed.

Given a list of 2 to 5 geocaches, enter the information about each location. Be sure to double check the information is correct. It helps to work in sub groups of at least two people, so you can help each other learn and verify entries.

- From a menu find where to enter the coordinates of a waypoint.
- Enter the following
 - **Name:** Matches the unique geocache code (ex. GC11BGZ) or some abbreviation of the name that will be recognizable later.
 - **Coordinates:** Matches the latitude and longitude format and numbers provided.
 - **Description or Message (optional):** Has a close meaning to the actual name of the geocache or other brief yet meaningful information like "GPS/Geocaching Class"; "Sunk Ship 45 ft below surface", details about finding a geocache, etc. (Note: some older units may have messages limited to 25 - 45 characters)
- Don't forget to **SAVE** button or icon.
- Double Check after your save by going into the Menu and selecting either Database/Waypoints or Points of Interest, etc (depends on make or model of GPS). Find and select the POI from where saved.
- Does everything match the given information? One option would be to take turns with a partner entering and verifying the information.

You can practice entering additional waypoints based on what you find from trying the chapter entitled "Geocaching Research – Internet Methods", looking on Geoaching.com, or coordinates based on other sources.

Part #3 – Mark Position From Map Screen (optional):

Most GPS units allow you to zoom in/out and also pan to different points on the map using cross hairs. When the cross hairs are over the desired position on the map, use the mark feature of the GPS. In this situation, you do not need to enter the latitude and longitude, because where the cross hair was on the map screen are the coordinates showing. Only enter the desired name and try to change the icon. Picking an icon is so that on the map screen you have a picture of the position type that is as meaningful as possible.

Note: On some GPS units you may notice displayed the distance and bearing relative to the current location of the GPS to where the "cross hairs" are on the screen.

Part #4 – Customizing Display Fields on the Compass Screen (optional):

ONLY if instructed to do so you can customize fields on the GPS. If you have your own GPS you will want the two most popular fields to have shown on the compass screen are “*distance*” and “*bearing*”. Having these displayed will give the numeric values to assist with navigation. See if you can get these to fields to display. Future activities will utilize “distance” and “bearing” displayed as you walk around on field activities.

Review Questions:

With the GPS you will be using along with the owners manual and/or assistance:

9. Explain how to move to different screens and how you may use each screen.
10. Explain how to create a waypoint destination (a “go to”) to any given coordinates along with saving and setting up a “go to”.
11. Explain how to mark a current position.
12. Though you may need to move around obstacles the goal is for the heading and bearing degrees to measure the _____.

5) How to Use a Magnetic Compass and Map

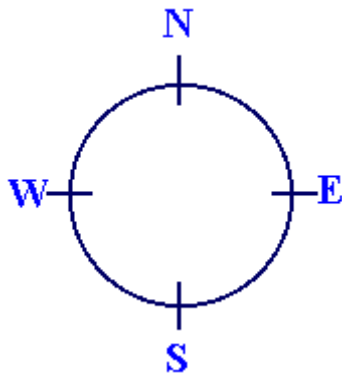
Introduction Statement(s):

The concepts used with a compass directly relate to the use of a GPS unit. One difference though is that the compass feature on the GPS is somewhat opposite that of a regular compass. On the GPS the “turnable” N, S, E, W is automatically aligned pointing North and the “needle” shows your bearing. In a compass the needle always points North. One benefit of a GPS over a compass is that it automatically keeps track of your current direction (heading) in relation to the direction to your destination (bearing).

Illustrated Guide on How to Use a Compass!

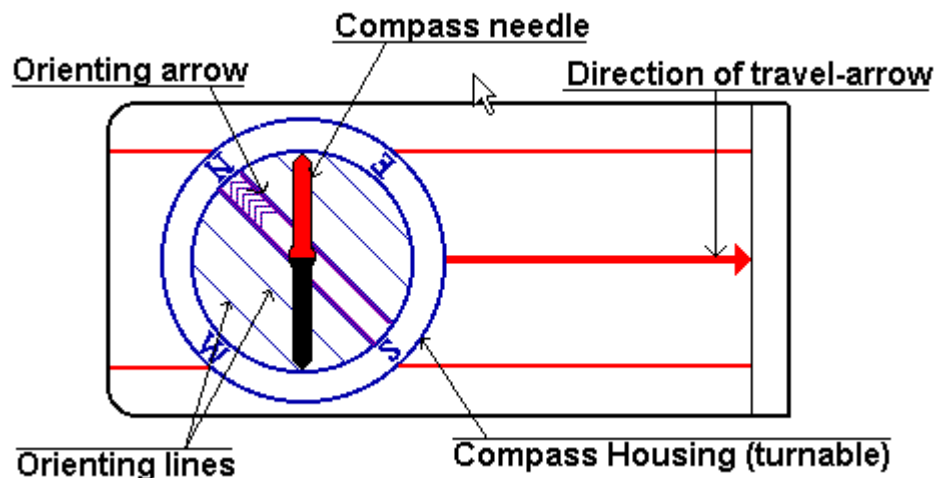
<http://www.learn-orienteeing.org/> By Kjetil Kjernsmo's

Using The Compass Alone – Lesson #1



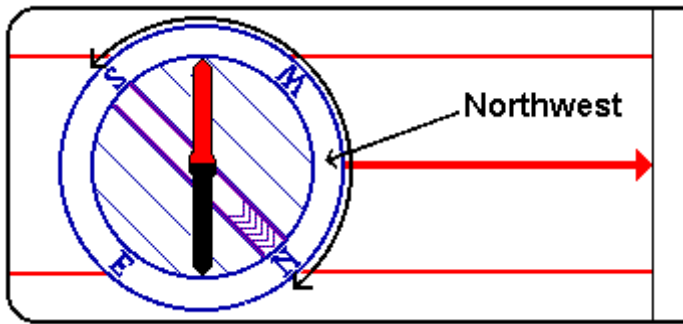
This is a very easy lesson, and I would say, not sufficient for those who would like to travel safely in unfamiliar terrain. The first thing you need to learn, are the directions: North, South, East and West. Look at the figure and learn how they are. North is the most important.

There are several kinds of compasses, one kind to attach to the map, one kind to attach to your thumb. The thumb-compass is used mostly by orienteers who just want to run fast, and this is the kind of compass I normally use. But not in this tutorial. I would recommend the third kind of compass. Let's take a look at it:

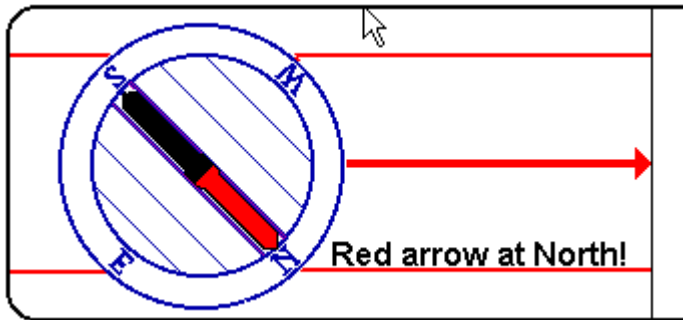


You see this red and black arrow? We call it the *compass needle*. Well, on some compasses it might be red and white for instance, but the point is, **the red part of it is always pointing towards the earth's magnetic north pole**. Got that? That's basically what you need to know. It's as simple as that.

But if you don't want to go north, but a different direction? Hang on and I'll tell you. You've got this turnable thing on your compass. We call it the *Compass housing*. On the edge of the compass housing, you will probably have a scale. From 0 to 360 or from 0 to 400. Those are the degrees or the azimuth (or you may also call it the bearing in some contexts). And you should have the **letters N, S, W and E** for North, South, West and East. If you want to go in a direction between two of these, you would combine them. If you would like to go in a direction just between North and West, you simply say: *"I would like to go Northwest"*.



Let's use that as an example: You want to go northwest. What you do is that you find out where on the compass housing is northwest is. Then you turn the compass housing so that northwest on the housing comes exactly there where the large direction of travel-arrow meets the housing.



Hold the compass in your hand. And you'll have to hold it quite flat, so that the compass needle can turn. Then turn yourself, your hand, the entire compass, just make sure the compass housing doesn't turn, and turn it until the compass needle is aligned with the lines inside the compass housing.



Now, time to **be careful!** It is extremely important that the red, north part of the compass needle points at north in the compass housing. If south points at north, you would walk off in the exact opposite direction of what you want! And it's a very common mistake among beginners. So always take a second look to make sure you did it right!



A second problem might be local magnetic attractions. If you are carrying something of iron or something like that, it might disturb the arrow. Even a staple in your map might be a problem. Make sure there is nothing of the sort around. There is a possibility for magnetic attractions in the soil as well, "*magnetic deviation*", but they are rarely seen. Might occur if you're in a mining district.

When you are sure you've got it right, walk off in the direction the direction of travel-arrow is pointing. To avoid getting off the course, make sure to look at the compass quite frequently, say every hundred meters at least. But you shouldn't stare down on the compass. Once you have the direction, aim on some point in the distance, and go there. But this gets more important when you use a map.

There is something you should look for to avoid going in the opposite direction: The Sun. At noon, the sun is roughly in South (or in the north on the southern hemisphere), so if you are heading north and have the sun in your face, it should ring a bell.

When do you need this technique? If you are out there without a map, and you don't know where you are, but you know that there is a road, trail, stream, river or something long and big you can't miss if you go in the right direction. And you know in what direction you must go to get there, at least approximately what direction. Then all you need to do, is to turn the compass housing, so that the direction you want to go in, is where the direction of travel-arrow meets the housing. And follow the above steps. But why isn't this sufficient? It is not very accurate. You are going in the right direction, and you won't go around in circles, but you're very lucky if you hit a small spot this way. And that's why I'm not talking about *declination* here. And because that is something connected with the use of maps. But if you have a mental image of the map and know what it is, do think about it. But I think you won't be able to be so accurate so the declination won't make a difference.

If you are taking a long hike in unfamiliar terrain, you should always carry a good map that covers the terrain. Especially if you are leaving the trail. It is in this interaction between the map and a compass, that the compass becomes really valuable.

Using the compass in interaction with a map – Lesson #2

This is the important lesson, and you should learn it well.

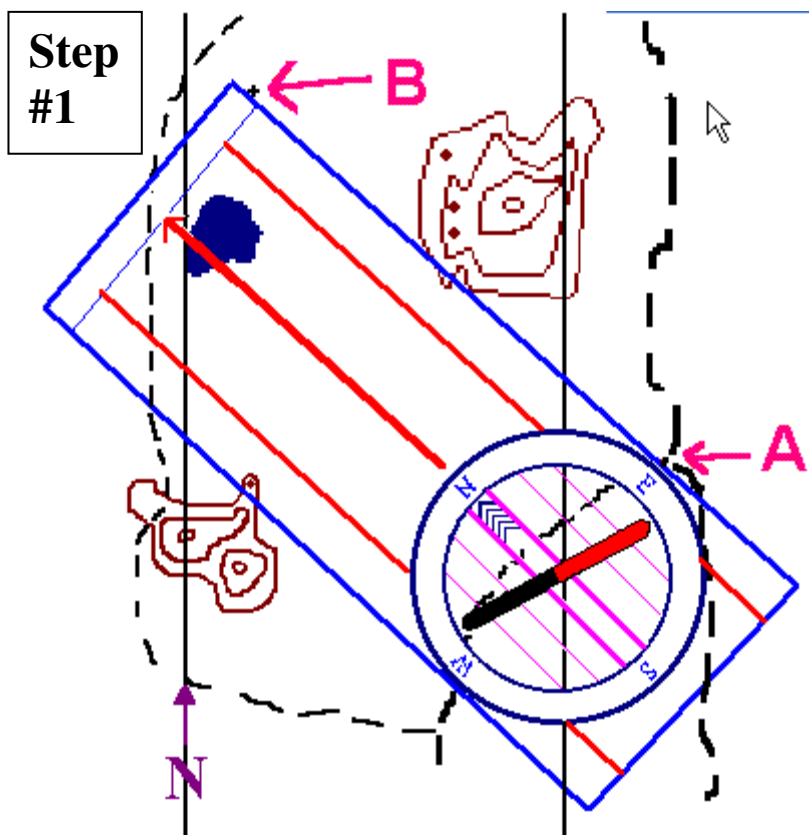
It's when you use both compass and map the compass is really good, and you will be able to navigate safely and accurately in terrain you've never been before without following trails. But it'll take some training and experience, though.

I am not covering map reading here, guess you would have to consult other sources for that, but the lesson will be useful if you have a sense of what a map says.

First, a quick summary of what you will learn in this lesson:

1. Align the edge of the compass with the starting and finishing point.
2. Rotate the compass housing until the orienting arrow and lines point N on the map.
3. Rotate the map and compass together until the red end of the compass needle points north.
4. Follow the direction of travel arrow on the compass, keeping the needle aligned with the orienting arrow on the housing.

The principles are much the same but this time, you are using the map to tell you which way is correct instead of your intuition.



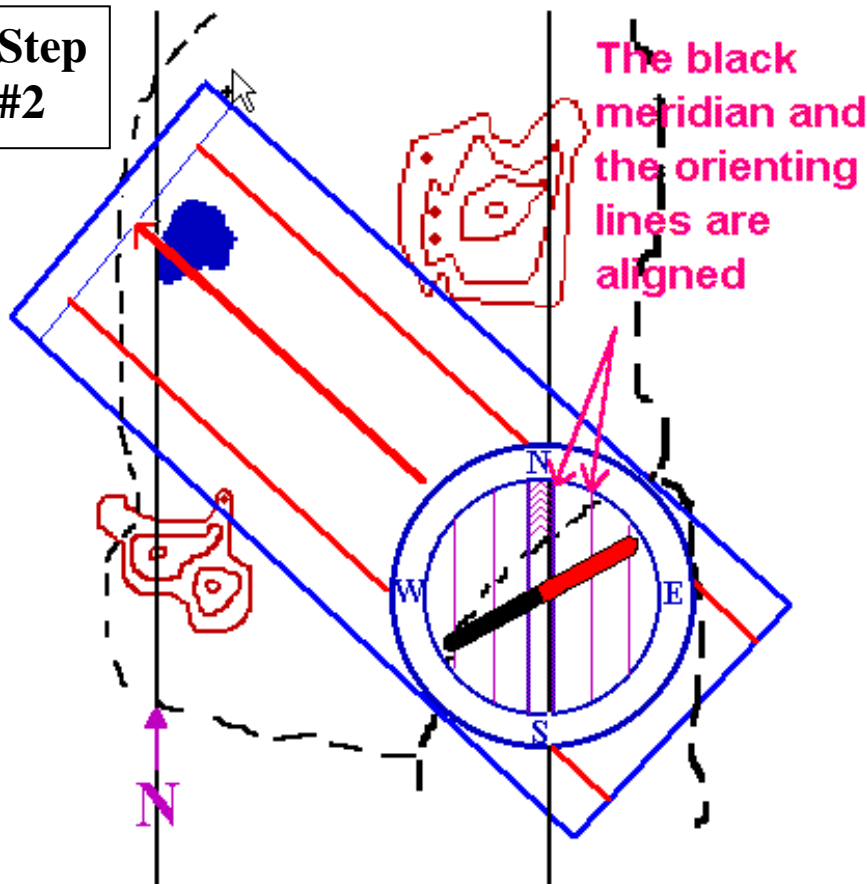
Take a map. In our first example, we look at a map made for orienteering, and it is very detailed. Well, not really. We look at a fictitious map I drew myself, but never mind. To the point. You want to go from the trail-crossing at **A**, to the rock at **B**. Of course, to use this method successfully, you'll have to know you really *are* at A. What you do, is that you put your compass on the map so that the edge of the compass is at A. The edge you must be using, is the edge that is parallel to the direction of travel arrow. And then, put B somewhere along the same edge, like it is on the drawing. Of course, you could use the direction arrow itself, or one of the parallel lines, but usually, it's more convenient to use the edge. At this point, some instructors say that you should use a pencil and draw a line along your course. I would recommend against it. First, it takes a lot of time, but offers no enhancement in accuracy of the method. Second, if you have wet weather, it may destroy your map, or if it is windy, you may lose it. You should keep your map (preferably in a sealed) transparent plastic bag, and if it is windy, tied up, so it can't blow away. But most important is that any drawings may hide important details on the map.



Time to **be careful** again! The edge of the compass, or rather the direction arrow, must point **from A to B**! And again, if you do this wrong, you'll walk off in the exact opposite direction of what you want. So take a second look. Beginners often make this mistake as well.

Keep the compass steady on the map. What you are going to do next is that you are going to align the orienting lines and the orienting arrow with the meridian lines of the map. The lines on the map going north, that is. While you have the edge of the compass carefully aligned from A to B, turn the compass housing so that the orienting lines in the compass housing are aligned with the meridian lines on the map. During this process, you don't mind what happens to the compass needle.

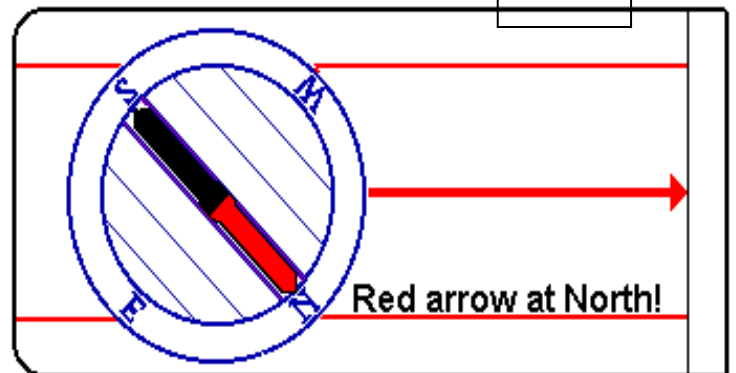
Step #2



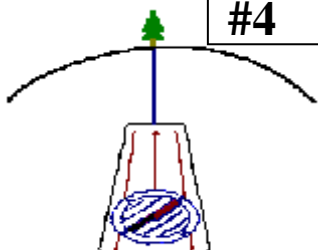
There are a number of serious mistakes that can be made here. Let's take the problem with going in the opposite direction first. **Be absolutely certain** that you know where north is on the map, and be sure that the orienting arrow is pointing towards the north on the map. Normally, north will be up on the map. The possible mistake is to let the orienting arrow point towards the south on the map. And then, keep an eye on the edge of the compass. If the edge isn't going along the line from A to B when you have finished turning the compass housing, you will have an error in your direction, and it can take you off your course.

When you are sure you have the compass housing right, you may take the compass away from the map. And now, you can in fact read the azimuth off the housing, from where the housing meets the direction arrow. **Be sure that the housing doesn't turn, before you reach your target B!** The final step is similar to what you did in lesson 1. Hold the compass in your hand. And now you'll have to hold it quite flat, so that the compass needle can turn. Then turn yourself, your hand, the entire compass, just make sure the compass housing doesn't turn, and turn it until the compass needle is aligned with the lines inside the compass housing.

Step #3



Step #4



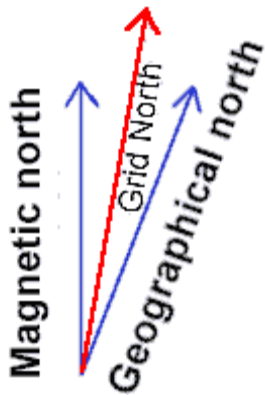
It's time to walk off. But to do that with optimal accuracy, you'll have to do that in a special way as well. Hold the compass in your hand, with the needle well aligned with the orienting arrow. Then aim, as careful as you can, in the direction the direction of travel arrow is pointing. Fix your eye on some special feature in the terrain as far as you can see in the direction. Then go there. Be sure as you go that the compass housing doesn't turn. If you're in a dense forest, you might need to aim several times. Hopefully, you will reach your target B when you do this.

At this time, you may want to go out and do some training, so you could check out some [suggested exercises](#).

Unfortunately, sometimes, for some quite often, it is even more complicated. There is something called *magnetic declination*. And then, for hiking, you wouldn't use orienteering maps. And this is the issue for [lesson 3](#).

Magnetic Declination - - Lesson #3

Unfortunately, sometimes, for some quite often, it is even more complicated. There is something called magnetic declination. You see, the compass is pointing towards the magnetic north pole, and the map is pointing towards the geographic north pole, and that is not the same place. To make things even more complicated, there is on most hiking-maps something (that is very useful) called the *UTM-grid*. This grid doesn't have a real north pole, but in most cases, the lines are not too far away from the other norths. Since this grid covers the map, it is convenient to use as meridians.

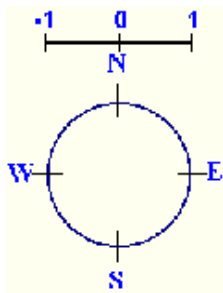


On most orienteering maps (newer than the early 70's), this is corrected, so you won't have to worry about it. But on topographic maps, this is a problem. First, you'll have to know how large the declination is, in degrees. This depends on where on the earth you are. So you will have to find out before you leave home. Or somewhere on the map, it says something about it. One thing you have to remember in some areas, the declination changes significantly, so you'll need to know what it is *this* year.

If you are using a map with a ["UTM-grid"](#), you want to know how this grid differs from the magnetic pole.



When you are taking out a course, you will do that more or less as described in [lesson 2](#), but this time, you must also look out so that you don't align the orienting lines with the grid lines pointing west or east, or south for that matter. When you have taken out a course like you've learned, you must add or subtract an angle, and that angle is the angle you found before you left home, the angle between the grid lines or meridians and the magnetic north.



The declination is given as e.g. "15 degrees east". When you look at the figure, you can pretend that plus is to the right, or east, and minus is to the left and west. Like a curved row of numbers. So when something is more than zero you'll subtract to get it back to zero. And if it is less, you'll add. So in this case you'll subtract 15 degrees to the azimuth, by turning the compass housing, according to the numbers on the housing. Now, finally, the direction of travel-arrow points in the direction you want to go. Again, be careful to aim at some distant object and off you go.

You may not need to find the declination before you leave home, actually. There is a fast and pretty good method to find the declination wherever you are. This method has also the advantage that corrects for local conditions that may be present (I am thankful towards Jim Cross who pointed this out to me). This is what you do:

1. Determine by map inspection the grid azimuth from your location to a known, visible, distant point. The further away, the more accurate it gets. This means you have to know where you are, and be pretty sure about one other feature in the terrain.
2. Sight on that distant point with the compass and note the magnetic azimuth. You do that by turning the compass housing so that it is aligned with the needle. You may now read the number from the housing where it meets the base of the direction of travel-arrow.
3. Compare the two azimuths. The difference is the declination.
4. Update as necessary. You shouldn't need to do this very often, unless you travel in a terrain with lots of mineral deposits.

There are a few riddles and rhymes to help you remember whether you should add or subtract. I don't know them. If you live in an area where you don't go far for it to change between east and west, it is so small you wouldn't need to

worry about it anyway. So it's best to just remember whether you should add or subtract. Nevertheless, I have [collected some of the rhymes people use](#).

Uncertainty

You can't always expect to hit exactly what you are looking for. In fact, you must expect to get a little off course. How much you get off course depends very often on the things around you. How dense the forest is, fog, visibility is a keyword. And of course, it depends on how accurate you are. You do make things better by being careful when you take out a course, and it is important to aim as far ahead as you can see.

In normal forest conditions we say that as a rule of thumb, the uncertainty is one tenth of the distance traveled. So if it is like in the figure, you go 200 meters on course, it is possible that you end up a little off course, 20 meters or so. If you're looking for something smaller than 20 meters across, there is a chance you'll miss. If you want to hit that rock in our example you'll need to keep the eyes open!

In the open mountain areas, things are of course a lot easier when you can see far ahead of you.

This was the last of the lessons you should know. But more lessons are upcoming. Now it is time to log out and get into the backyard, and then backcountry. Try it out! That is after all, the only way to learn this properly. **Good Luck!**

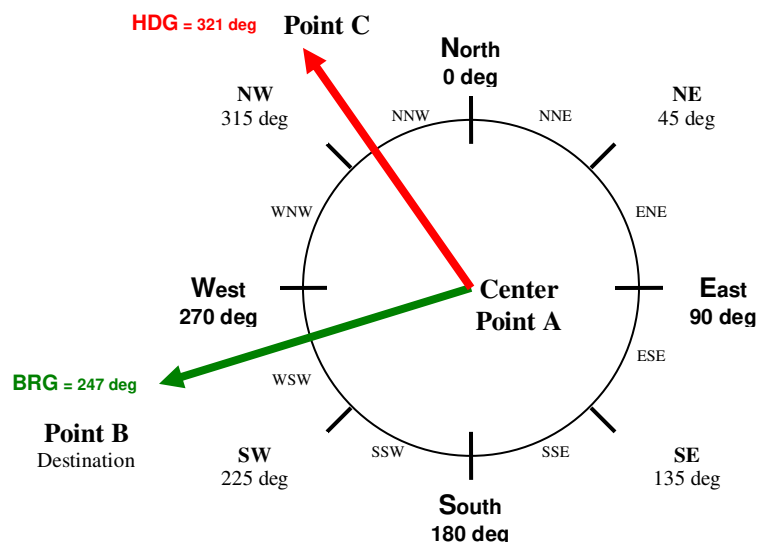
I said navigating in the mountains is easier. Well that is until the fog comes. Fog can make orienteering in the mountains and in the forest extremely difficult, and therefore, it can also be dangerous to the inexperienced. The principles of orienteering are still the same, but there are a few hints in the [next lesson](#) that will help you get trained.

Heading & Bearing:

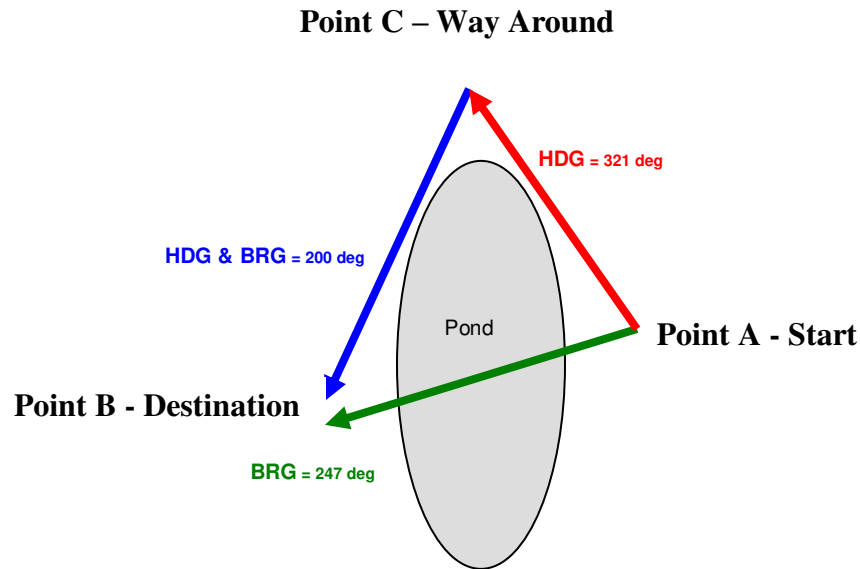
By Steve Sewell

Often there are obstacles that prevent one from going directly from point A to a point B destination. To get around these obstacles one may need to head in a slightly different direction (measured by a "heading", HDG, a.k.a. current direction of travel) by going to point C first. As one travels along a heading towards point C from A, the angle to the point B destination measured using a changing number of degrees from North (measure by a "bearing", BRG, a.k.a. direction to destination).

Example: At a given moment, you may need to take a *heading* of 321 deg to get around a lake, thick brush, or stay on the trail path. Your bearing will register as 247 deg at a start.



Note: When the heading and bearing degrees are different, the further along one travels the current heading the more the bearing will change, because the angle of reference is constantly changing with movement. In the example above, the more one travels along at a HDG of 321 degrees, the more the BRG will move towards 240 deg., 220 deg, 200 deg, etc. As soon as you are able you need to start heading back in the direction of your destination. To do this one needs to re-establish a new bearing and have the heading and bearing the same.



Note: Encountered obstacles to navigate around may include: water, forest/brush on both sides of a trail, marsh, cliff, fence, etc

Activity (Outdoors):

By Steve Sewell

Obtain a local park or trail map to practice.

Apply Lesson #2: Knowing your starting position on the map, find a straight line destination on a map with no obstacles to go around. Plot your course with a compass and then go to the same starting point. Walk towards the direction of the destination until you can confirm that it is in sight and the compass is pointing in the right direction.

Apply Heading & Bearing: Apply concepts explained in the Heading & Bearing sections by find an obstacle on the map to get around as you hike. Plot your course with the compass and then find your way in the field.

Review Questions:

13. What does one do to navigate SSW from a current location?
14. Explain the 4 steps in navigating using a compass and map?
15. If a maps declination is 5 degrees West, what should you do to correct?
16. What might one need to do to avoid an obstacle?
17. What can keep changing as you head in the same direction?

6) Basic GPS Navigation

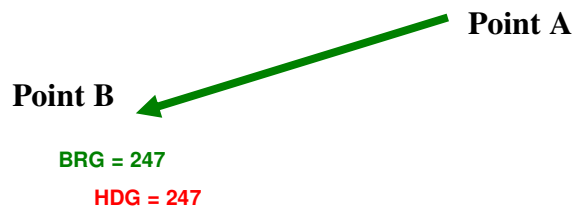
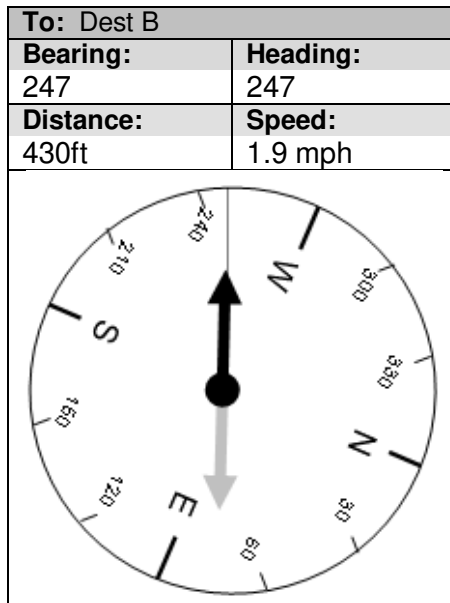
By Steve Sewell

Introduction Statement(s):

Knowing how the GPS compass will respond as you travel is essential to navigating with a GPS to a specific point. The basic navigation concepts of a magnetic compass carry over to the GPS use. The big advantage of a GPS is that it does a lot of the work quickly and much more accurately. It especially has an advantage when you can not sufficiently sight distant landmarks in your route. A GPS will constantly and automatically calculate a current direction of travel (heading) and the direction of the destination (bearing) in relation an ever changing current position.

Bearing & Heading With A GPS Unit

Remember the main opposite difference with a GPS and regular magnetic compass? The “turnable” North, South, East, West circle part of the GPS compass is automatically aligned pointing North and not the arrow. Some GPS units will show the degrees in this outer circle. The top center of the screen will be the direction of travel or “heading”. Where the circle lines up with top center, this will indicate the exact degrees of the “heading”. The arrow of the GPS compass will indicate the destination or “bearing” in degrees. Some GPS units have the ability to numerically display “heading” and “bearing” as well as other useful information.



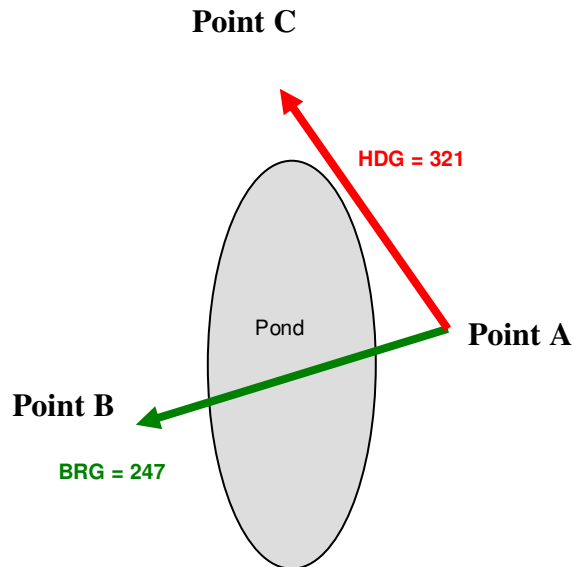
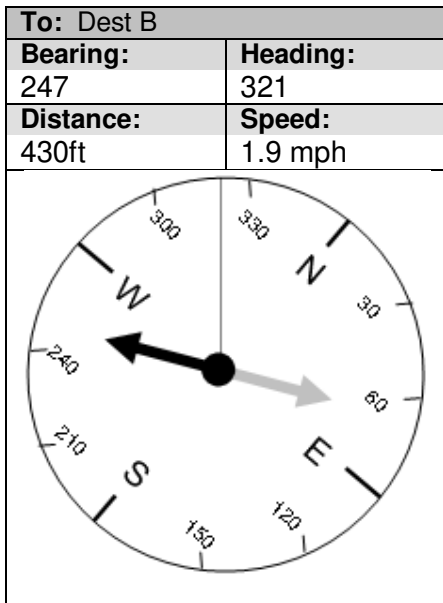
With a GPS the goal is to follow where the “arrow” or bearing is pointing you as soon as possible. If you have a clear unobstructed path from your current position to your destination, both heading and bearing would be exactly the same as you walk towards your destination. If you can’t go directly to the destination due to obstacles, then the heading will constantly change to point in the direction you want to go until you can get the heading and bearing the same.

GPS Navigation Around Obstacles

Just as with the usage of a compass and map there are often obstacles preventing one from going directly from point A to a point B destination. These obstacles can be that of water, keeping on a trail for low impact to nature, brush too thick to get through, a cliff, following a road in your car, etc.

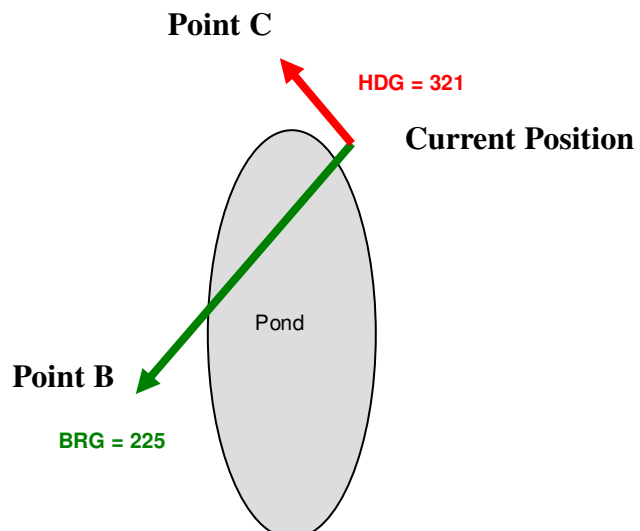
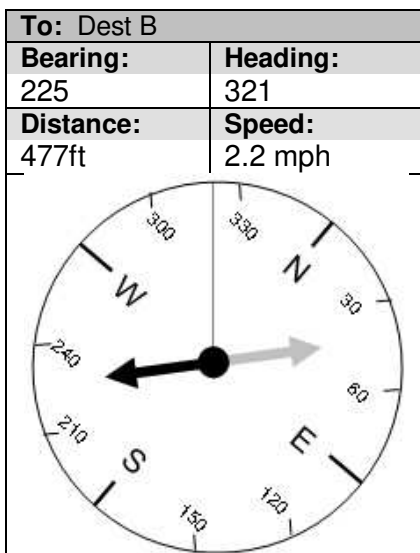
Initial GPS Readings

Let go back to our example with the pond obstacle to traverse around. Initially the bearing to point B will be 247 degrees from point A. The heading of 321 degrees is walked to point C to get a clear shot around the pond to the desired point B destination. The point in which you can get around the pond can be visually seen, so there is no need to enter point C information into the GPS (hard to do anyway if you don't know those coordinates). Using just one waypoint named "Dest B", the corresponding Bearing & Distance are given numerically on the display screen. The walking to point C along an imaginary trail will indicate on the display the heading and speed of current travel. The GPS compass image will also match the numeric bearing and heading.



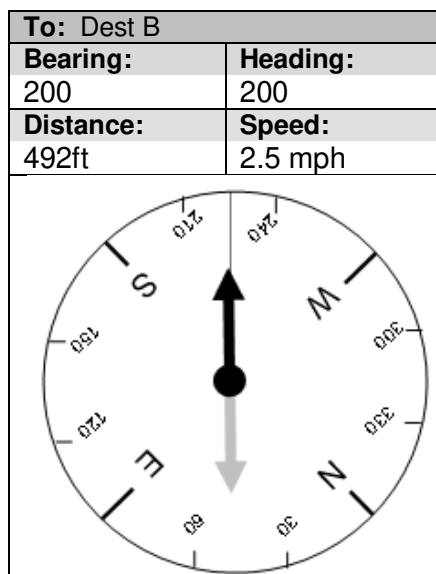
Bearing Changes As Approaching Point C

When the heading and bearing degrees are different, the further along one travels the current heading, the more the bearing will change. For this example, the more one travels along at a HDG of 321 degrees, the more the BRG will move towards 240 deg., 220 deg, 200deg, etc.. Notice how the distance increases from the current position to the final destination. The speed of travel may also vary like when you walk up or down hill; slow down to take in the scenery, etc. In other situations you may actually decrease the distance, but at a slower pace than taking the direct route as the bird would fly.

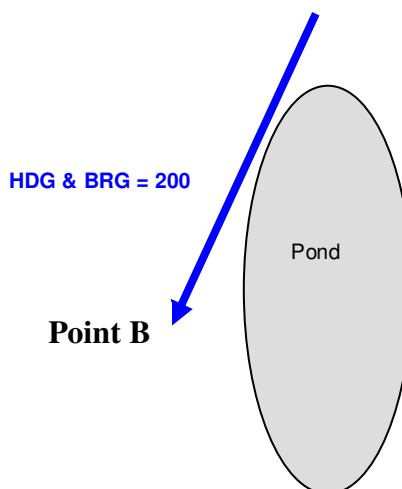


Heading Equals Bearing Once Around Obstacle

As soon as able start heading back in the direction of your destination. To accomplish, the HDG degrees needs to change to match the BRG at 200 degrees. When the heading and bearing match, the GPS compass needle will be pointing straight up on the display screen signifying your destination is straight ahead, which is the same as the heading. At this point on, the distance will decrease until near zero when you reach point B.



Point C & Current Position



GPS Navigation Tips:

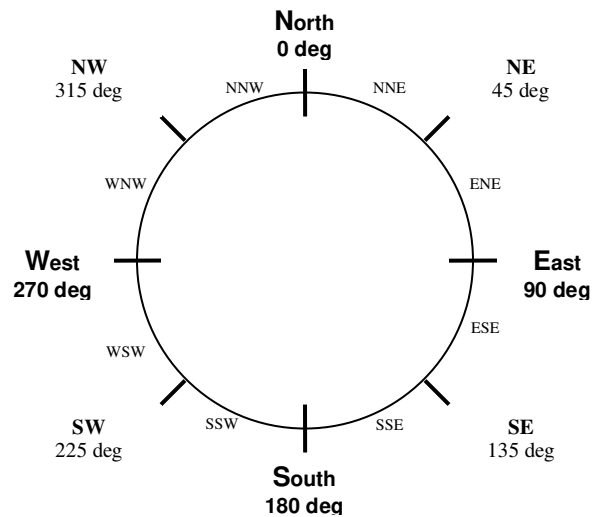
- When you can try to obtain local trail or topographic maps of the area and carry a magnetic compass. This will serve as a backup if you GPS fails. Though it will only work as a **back up** if you keep track of where you are currently on the map.
- Have you ever wanted **two opinions** on something? Having a GPS and a paper map can give you two different perspectives of the same area to confirm what you are interpreting matches to your surroundings.
- Another advantage of having both, I frequently use in the BWCA to have **two views** of the area at the same time. I always purchase a very detail topographic map (2" per mile) of the area I will be canoeing folded into a 2 gallon zip bag to be able to see a lot of the area lakes, campsites, and portages all at once. Usually all the lakes and portages I plan to get through in a day. I then have my GPS map zoom to the level to see not much more than the lake that I'm on and the campsites/portages marked on the lake. This way I can always see where I'm at on the lake relative to the contours I currently see and also compare to the big picture at the same time, while my hands stay busy using the paddle.
- Bottom line about paper maps: A GPS is a great tool and can be used by itself, BUT a printed map used in conjunction has advantages for your **enjoyment and safety**.
- **Watch your step.** Keep your eyes on where you are going much more than the GPS. You don't need to step into a hole and twist your ankle, bang your head into a tree limb, walk off a cliff, etc.
- Stay on the trails as much as possible. In other words **limit "bushwacking"**. Once I had my 6 year old son out geocaching with me. I often let him hold the GPS and he is good about following the arrow and walking in the direction of the cache. This time he wanted to take an immediate left angle turn into the thick of trees and bushes just because the arrow was pointing him in that direction. What had happened is the trail had a temporary turn to the right and the distance to the geocache was more than 500 feet away. I explained to him that he needs to stay on the trail for as long as possible. Usually you can tell that the trail(s) from the maps will be turn back the way you want to go or there is another trail you can take to get closer. As long as the distance keeps getting smaller consider staying on the trail until the distance is obviously getting further and you going in the wrong direction. We ended up finding the cache a few feet off the same trail that did take a turn back to the left.

Review Questions:

18. Which part of the GPS compass represents the direction of travel and the destination? Which is named the bearing and heading?
19. What should equal as you approach closer to your destination?

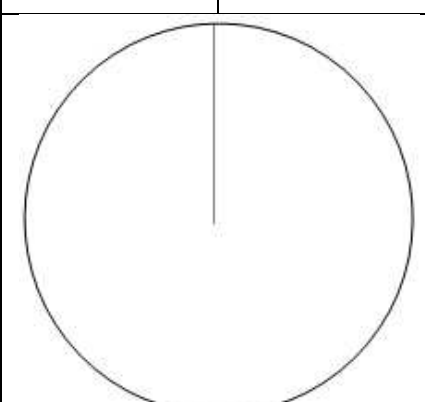
Activity #1- “Duck Blind in the Fog” (Indoors):

General Directions: Fill in the top 4 data fields of the simulated GPS compass screen below with information based scenarios part 1 & 2. For the compass circle, draw arrow from the center only the representing the **bearing** (like the dark arrow on prior simulated screen examples. For the outer part of the compass circle, label as if the known **heading** is at top of the screen. The drawing on the compass screen for these activities are similar as prior examples in this chapter. If desired you only need to out circle for **Heading** using only “N”, “S”, “E”, “W”, with small dashes intersecting the circle at those directions. It may be helpful to also label the map on the to the right to help visualize what the compass screen would be showing you at the different moments of each part of the scenario. You can assume the top of your map drawing is North. Top of the GPS compass screen is not always North. Provided below are the direction you can use relative to North.

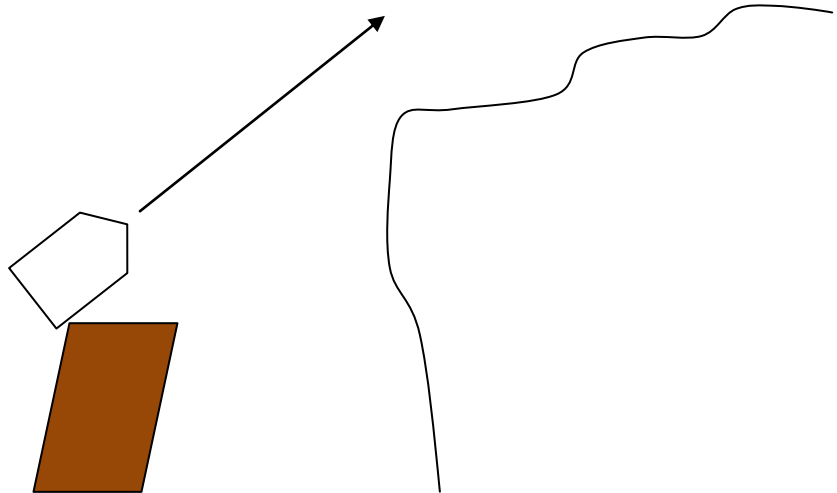


Scenario Part #1:

As a hunter you want to reach you duck blind and be ready at the optimal time. You reach your cabin on the lake minutes before dawn and notice a very thick fog all over the lake. With your GPS and other gear in hand you decide to go down to your boat and head out to your duck blind toward the other end of the lake. But it is not a straight shot out from the dock. To safely get around the lake's bend to the right in the motor boat, the first place to go is a safe waypoint out several feet to the left of a small point of land is where the lake bends. The waypoint has already been saved in the GPS from a previous trip on the lake in clear conditions for a situation just like this. The distance out to this turning point is 505 feet away. The direction is straight from the dock at a bearing of 45 degrees. You enter in a Go To for that waypoint and head in that same direction at a comfortable speed of 2mph.

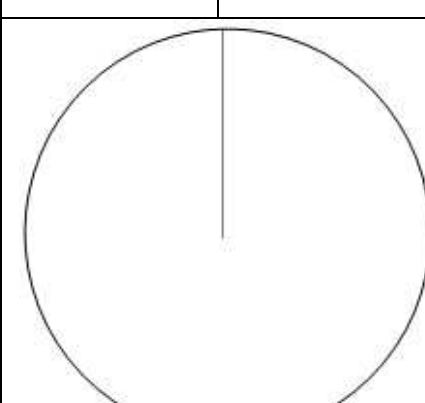
To:	
Bearing:	Heading:
Distance:	Speed:
	

Label map with bearing, heading, distance, and speed.

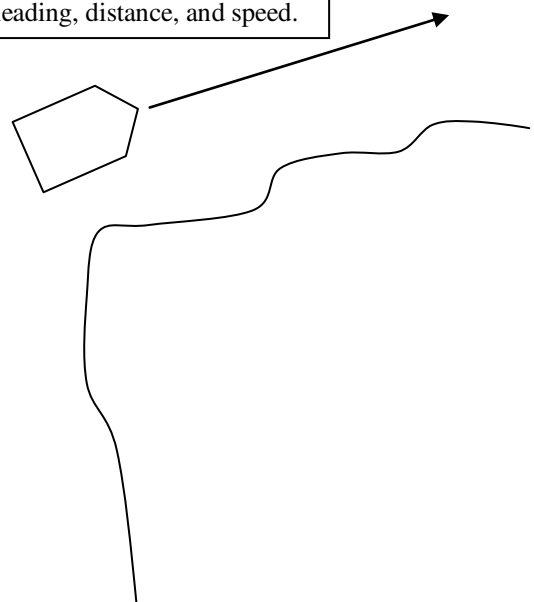


Scenario Part #2:

Your arrive at the safe waypoint out from the bend and enter in a Go To the duck blind that is also saved in the GPS. The blind is 75 degrees at a distance of .27 miles from you current position and the fog is a little thinner so you can now travel 5mph.

To:	
Bearing:	Heading:
Distance:	Speed:
	

Label map with bearing, heading, distance, and speed.



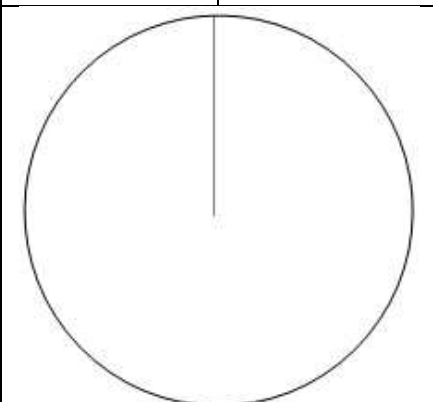
Activity #2 – “The Big Dipper Cache” (Indoors):

General Directions: (same as activity #1)

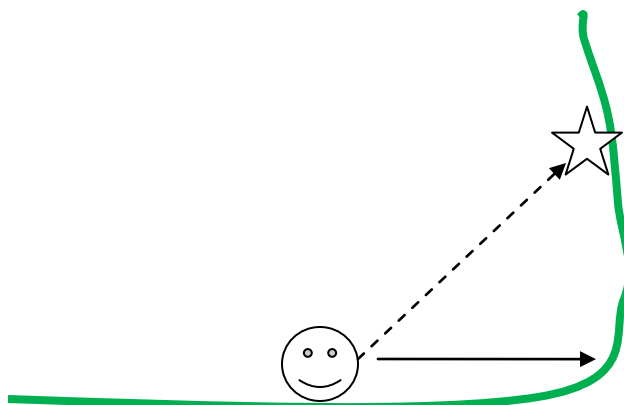
Scenario Part #1:

You’ve entered coordinates for a geocache named “The Big Dipper” that is down a trail from a trail head parking lot. As you stay on the trail you walk directly East. The cache is indicated as being North East from your current location, which is about 283 feet away. A fast pace of 3mph is desired to make a quick find.

To:	
Bearing:	Heading:
Distance:	Speed:



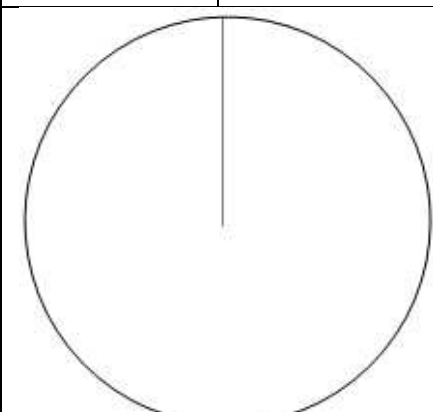
Label map with bearing, heading, distance, and speed.



Scenario Part #2:

Ahead on the trail you can see the path turns North. As you start to walk North the GPS indicates the cache is only about 197 feet away and just about 10 degrees West of North. You decide to slow down to a pace of 1mph and start thinking like the person who hid this small cache.

To:	
Bearing:	Heading:
Distance:	Speed:



Label map with bearing, heading, distance, and speed.



7) Waypoint Averaging for Accurate Navigation

Introduction Statement(s):

GPS units have a rating for their accuracy. Newer consumer units are typically rated for 3 meters or better, but even that depends on the number of satellites, a WAAS correctional signal, and signal interference. If the original waypoint was taken in poor signal conditions with no averaging of waypoint, the actual position could be off say 25 feet in one direction. Someone seeks the same location and also has poor signal at the moment through off the position 25 feet in the other direction. The distance in any one direction could be up to 50 feet in any one direction. When it comes to finding small objects like geocaches or land survey marker one would rather search within a radius less the 10 feet if at all possible. To improve on questionable signals or to verify you have a good signal it is wise to mark the original waypoint for the exact same position several times over a significant duration. The law of averages can get the actual coordinates to under one meter for the original readings. Now one only has to worry about the accuracy of the reading at the time of relocating and work with that radius.

Line of Sight

<http://www.magellangps.com/en/about/aboutgps/howworks.asp>

Satellite navigation receivers operate by line of sight with global positioning satellites. This means that at least three satellites must be in "view" of a receiver in order to calculate longitude and latitude. A fourth satellite must also be within line of sight to calculate altitude. On average, eight satellites are continuously within line of sight of every position on Earth; the more satellites in view, the more accurate the positioning.

Though the radio signals of navigation satellites will pass through clouds, glass, plastic and other lightweight materials, satellite navigation receivers will not work underground or in other enclosed spaces.

Ionosphere

<http://www.magellangps.com/en/about/aboutgps/glossary.asp#I>

The ionosphere consists of the layers of ionized air in the atmosphere extending from 70 kilometers to 700 kilometers and higher. Depending on frequency, the ionosphere can either block radio signals completely or change the propagation speed. Global navigation satellite signals are delayed as they penetrate the ionosphere. This ionosphere delay can be either predicted using models, though with relatively poor accuracy, or corrected using two frequency receivers.

Precision

<http://www.magellangps.com/en/about/aboutgps/howworks.asp>

On average, a satellite navigation receiver is accurate to within 15 meters. Thales Navigation employs several technologies to increase the accuracy of their professional and Magellan®-branded receivers. An accuracy of 3 meters or better is achieved using correction signals from [satellite navigation augmentation systems](#). In the U.S., an accuracy of 3 meters is achieved using signal corrections from a network of ground stations and fixed position satellites known as WAAS (Wide Area Augmentation System).

WAAS (Wide Area Augmentation System)

<http://www.magellangps.com/en/about/aboutgps/augmentation.asp>

In North America, WAAS provides satellite navigation correction and validation, making WAAS-enabled receivers at least five times more accurate than standard devices. WAAS relay stations have been set at known positions throughout North America.

SBAS-enabled receivers do not require any additional equipment to use WAAS correction signals and, as with satellite navigation signals, there are no setup or subscription fees. WAAS is accurate to within three meters or less. System upgrades are being developed which will soon provide accuracy to well within one meter.

In 2003, the FAA (Federal Aviation Administration) plans to certify WAAS for use in low-altitude maneuvering, instrument approach and other sensitive aviation applications.

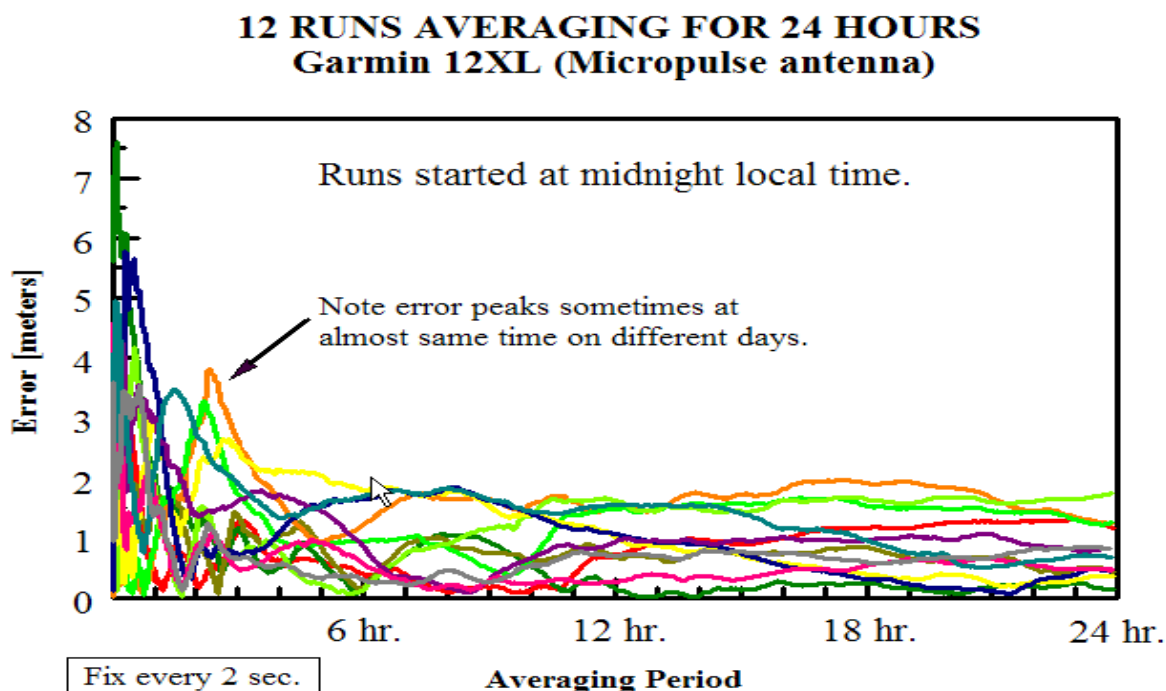
GPS ERROR WHEN AVERAGING POSITION

<http://users.erols.com/dlwilson/gpsavg.htm>

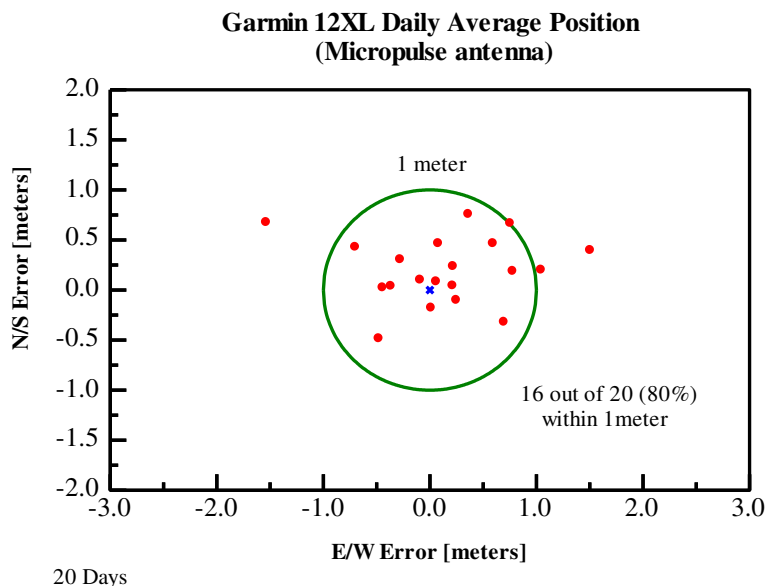
A way to improve GPS measurement of position accuracy without additional equipment is to simply average the coordinates. In this section, we consider only simple averaging (no weighting by DOP) of receiver NMEA position data. As with all pages at this site, the study is for SA off unless explicitly stated otherwise. Not only does simple averaging decrease random errors in the measurement, it also allows interpolation beyond the resolution of the measurement; thus averaging may yield accuracy better than the 0.001 seconds of latitude/longitude resolution or 1 meter of height resolution reported in the NMEA data from some GPS receivers.

As a first look at the effect of position averaging on horizontal error, consider the plot below of twelve 24-hour averaging sessions - all starting at midnight local times.

From the plot, we see that, as expected, position-averaging tends to decrease the error. However, note the occasional error peaks on about the same time on different days. This may be due to similar larger (poor) HDOP, particular satellites yielding poorer accuracy, multipath at near the same time daily, or some other reason. Clearly, if one is collecting short sessions at the same point on different days, it is best to use different times (as different as possible) on the different days. If not continuously collecting data but doing short sessions on a single day, one should separate the sessions as much as possible in times to attempt to avoid correlated errors.



The plot below shows 20 1-day (24 hour) horizontal position-averages using the Garmin 12XL (and Micropulse antenna).



For this small sample, the RMS error for 24-hour position-averaging was 0.78 m while the initial Model 2 parameters (based on 12-days) for the Garmin 12XL data predict 0.87 m -- this is fairly good agreement considering the approximation of values due to the relatively short periods of the measurements involved and that the results probably vary with time. In each of the 20 1-day averages, the error of the position-average was less than 2 meters.

In summary, different GPS receivers perform differently when position-averaging. Several days of position-averaging appear to be needed to obtain 1-meter level horizontal accuracy. High-end (survey-grade) units will do significantly better. Finally, the statistics vary somewhat and extensive measurements may be required to obtain accurate model values. For this reason, predictions should be taken only as approximations. Remember that the analysis done here were for simple position-averaging done on the NMEA data. Any "tricks" or re-configuring of the receiver algorithm for firmware position-averaging have not been analyzed.

Note by Steve Sewell: Most Newer GPS models have algorithm programming built into the GPS receiver to do continuous averaging. For example the Magellan SportTrak states on the Position Screen whether averaging is being conducted as part of the GPS Status unless a WAAS signal is found.

As the Rayleigh distribution would approximately model the horizontal position-averaging error distribution, the 95% error bound would be predicted to be approximately 1.73 times the horizontal position-averaging RMS error and other error parameters could be similarly predicted by multiplying the position-averaging RMS by the appropriate factor due to the Rayleigh distribution. The normal distribution should be used to model the height errors when position-averaging to improve vertical accuracy. Thus the 95% error bound would be predicted to be approximately 1.96 times the vertical position-averaging RMS error.

Extreme caution is recommended in applying these results here to other GPS receivers at other times and places, especially considering that there is some variation with latitude, GPS satellite constellation status and local reception of signal effects. See the section on correlation of errors for related material.

Examples of Waypoints Averaged

By Steve Sewell

In the following examples, three or more waypoints were taken. The numbers can be averaged with a calculator or by noting which number are more frequent and/or fall in the middle.

Average = N40°38.612' W89°01.774'

WPT021	N40°38.613'	W89°01.775'
WPT022	N40°38.612'	W89°01.774'
WPT023	N40°38.612'	W89°01.774'

Average = N40°38.687' W89°01.789'

WPT028	N40°38.685'	W89°01.791'
WPT029	N40°38.689'	W89°01.787'
WPT028	N40°38.687'	W89°01.788'
WPT029	N40°38.687'	W89°01.789'
WPT030	N40°38.687'	W89°01.788'
WPT034	N40°38.686'	W89°01.790'
WPT035	N40°38.686'	W89°01.789'

Averaging Waypoint Tips:

- The track logs from the GPS can also be utilized for obtaining an average. First note the GPS time. Next walk off in different directions from the target about the same distance (same number of steps) and return at least three different ways. Note if the tracks make a triangle. If so, the true coordinates are most likely in the center. Also note the GPS time when you are done. Upon return to your computer the tracks can be up load from the GPS and the coordinates for the time range noted can be averaged for a fairly solid waypoint.
- Some of the newer GPS units can just be left on in an upright position for up to 5 minutes will average itself. Even given that try averaging over different times and/or days.
- Even after averaging, it is always a good idea to verify that you can navigate to those coordinates again at different times of day than the original averaged waypoints were taken.
- With both taking of the original averaged waypoints and in searching be aware of the quality satellite signals in both strength and numbers. Know when your GPS is obtaining a WAAS signal as well. This can help you determine how much extra effort you need to do for the original waypoint and in the search pattern.

Review Questions:

20. Due to potential error of any one marked position, one must.....?

Activity – “Averaging & Navigating” (Outdoors):

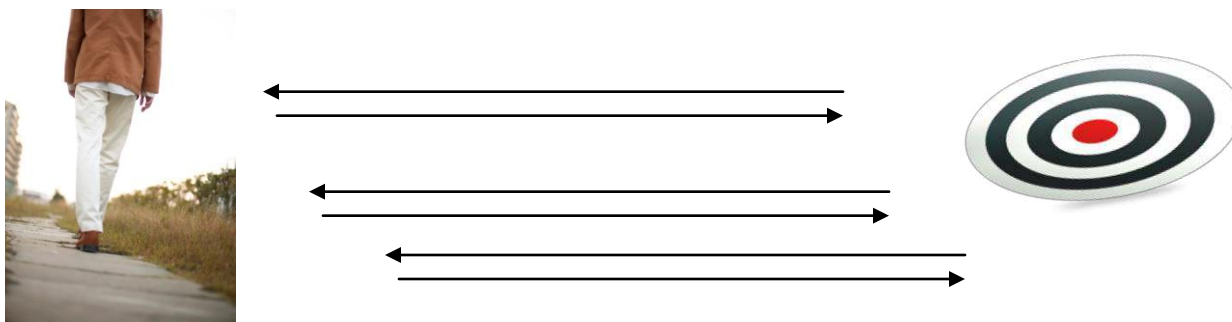
By Steve Sewell

For both of these options, make sure there are good satellite signals of 4 or more. Give the GPS unites as many as 15 minutes in a very clear view of the sky. Also if possible see if you can obtain a WAAS signal.

Option #1: Average Coordinates of an Object:

This is the typical method of averaging coordinates before determining the final coordinates to set. Write down 3 to 5 coordinate readings from a found or placed object by taking the average from a GPS unit(s) at different times and/or with multiple GPS units if you are out with friends with their own GPS. You could take reading from a screen/page showing current position and noting the coordinates being displayed in real time. You could also mark or add a waypoint and before saving write down the coordinates. Try moving away about 50 feet (15-20 strides) and back to the exact place holding the GPS right over or very close the item the coordinate are being averaged. Do this a few times walking away and coming back for the next 15 – 30 minutes. The last one or two digits will most likely vary. Average the coordinates. Share those coordinates with another person or group to enter into another GPS and see how close their GPS says they are to the object.

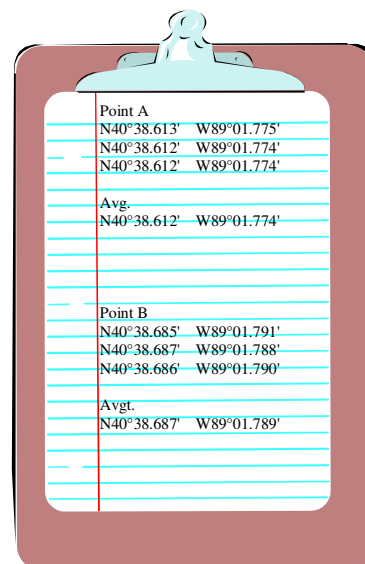
Note: This would be a common way to mark a geocache that you have just placed. Before the placement is announced on Geocaching.com, go back on a different day and different time of day to the same geocache using the average waypoints from the first day to see how on target the coordinates are. If they seem to be off average the coordinates from the second day with the first. Consider a third day if the coordinates from both days are way off. Some GPS units have a self averaging feature. I still recommend to walk away and come back a few times averaging those self averaging. This is because the satellites are constantly moving providing different GPS calculations.



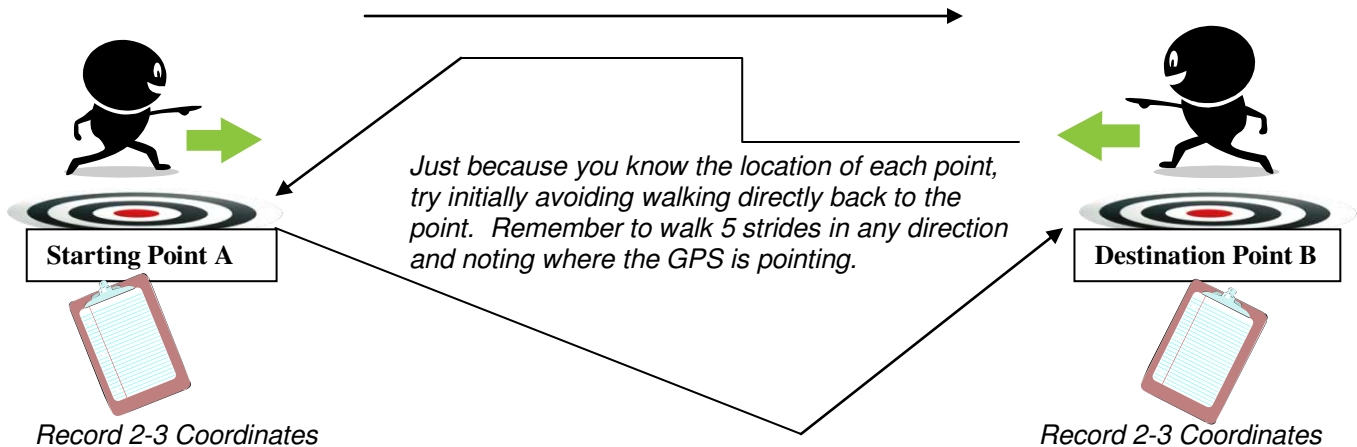
Write down obtained GPS Coordinates at the object each time you return to the object.

Option #2: Average a Starting Point & an Object Destination While Navigating Between the Two:

This option is good to not only mark and average positions, but practice using GPS navigation to a couple of destination where you can visually see the destination. This allows one to constantly see how the GPS responds in relation to the known location selected in for GPS navigation. Take a sheet of paper. Label the top half as “Point A” (Starting Point) and the bottom half as “Point B” for Destination.



When outside and after the GPS units have had a chance to obtain a strong GPS signal, you'll be walking between two points and recording the coordinate found on the GPS for each of those points. After writing down each coordinate you'll save those as a waypoint in the GPS. After each are saved you'll be using the GPS to navigate back to the prior point until you get at least 2-3 set of coordinate written down for each.



Now follow the bullet points below while saving GPS coordinates as a waypoint. Use a sports cone, stick, rock, fence post, etc. to identify each point.

- **First Loop:**

- **Starting Point:** Find an object or position to call your starting point and stand right by it.
 - Mark and name (suggested name "**A1**") your *starting point* coordinates
 - Make a mental note of object used to identify each point.
 - Write down these coordinates.
 - Save coordinates
- **Destination:** Find a *destination* within 1 minute walk (approx 100 feet) and stand right by it.
 - Mark, name (suggested name "**B1**") your *destination* coordinates
 - Make a mental note of object used to identify each point.
 - Write down these coordinates.
 - Save coordinates

- **Back to Starting Point:** Create a "Goto" to navigate back to your *starting point*.
 - Stop when the GPS unit says the starting point is within 0-5 feet.
 - Make a mental note how far off you are from the exact known *starting point*.

- **Second Loop:**

- **Starting Point:** Now start the loop all over again by moving to the exact same *starting point* if it is not already the same as currently standing.
 - Mark and name (suggested name "**A2**") your *starting point* coordinates again
 - Write down these 2nd starting coordinates on the top half of a paper under the first set.
 - Save coordinates
- **Destination:** Now Create a "Goto" back to your *destination*.
 - Stop when the GPS unit says the destination is within 0-5 feet.
 - Make a mental note how far off you are from the exact known *destination point*.
 - Move back to the exact same destination point
 - Mark, name (suggested name "**B2**") your *destination* coordinates again
 - Write these down these 2nd destination coordinates on the bottom half of a paper.
 - Save coordinates

- **Back to Starting Point:** Complete this 2nd loop back to your *starting point* until the GPS says -5 feet away..

- **Third Loop:** Make a third loop by following the second loop bullet points marking and naming the starting point and destination (suggested names "**A3**" & "**B3**")

Now average these coordinates. Average the two sets of 3 coordinated for the *starting point* and the *object*.

8) Three Leaf Clover Search Method

By Steve Sewell

Introduction Statement(s):

Sometimes the bearing and distance may jump around due to heavy tree cover or near tall buildings not providing a completely clear sky view anywhere close. So what do you do if you can't obtain stable GPS readings? One method to narrow your search is not much more than an old fashion game of "hot and cold", called the Cloverleaf. This method works very well for me in the dense woods of Spittler Woods State Park while working some geoaches that I wanted to consider using for a GPS class.

This method narrows the search area by moving in and out of the target area in different directions using the distance information provided by the GPS unit. You will cross the area a few times in which you obtain the lowest distance reading to the enter coordinates. At that lowest distance reading you will need to note the physical landmarks (i.e. leave, stick, rock, tree, etc.) of where you are standing each time. To help you know in which directions to move in and out from, your walking will basically trace out a three leaf clover and stem. Another way to think of the pattern walked would be a big windmill with four blades. Neither clover leaves nor windmill blades would have to be wide.

12 Steps To Use A Cloverleaf Search Pattern

The Clover Stem:

1. **IN:** Note your physical location in relation to different objects around at the moment you are about 50 feet away.
2. **Lowest:** Keep walking relatively in the same direction the destination coordinates until the distance reads as close to zero or starts to increase. Note the physical surroundings of this lowest distance reading. This is the top of the "stem" or center of your three leaf clover and also potential area to start a detailed search.

The Center Clover Leaf:

3. **OUT:** Continue walking the same general direction, but now away from that "top of the stem", until 50 feet distance away is reached again. This should be close to opposite from the original approaching 50 feet.
4. **IN:** Walk a small narrow loop back towards the "stem"
5. **Lowest:** Again note the specific physical surroundings where your distance reads as close to zero as possible or just starts to increase again. It should be only a few feet different from the first noted top of "stem". This basically traces the center leaf of the clover pattern.

The First Side Clover Leaf:

6. **OUT:** Now go off in a totally different direction, say to your right, around 50 feet.
7. **IN:** Walk a small narrow loop back towards the "stem"
8. **Lowest:** As the lowest distance is approached note the specific physical surroundings and the relationship to the previous two noted times. This completes one of the side clover leaves.

The Second Side Clover Leaf:

9. **OUT:** Finally walk out a distance of about 50 feet to start to create the other side leaf.
10. **IN:** Walk a small narrow loop back towards the "stem".
11. **Lowest:** As the lowest distance is approached note the specific physical surroundings and the relationship to the previous three. This completes one of the third clover leaf.

The Search Area:

12. Four times the coordinates crossed you through the search area ("top of the cloverleaf stem"). Based on all the noted specific physical surroundings, start the search the target within a related central location. Work the search out from that centered area until you find the target.

WARNING: While watching the GPS distance numbers, avoid getting hurt by watching where stepping and what you may walk into. Also respect the land and plants for low impact even if it means altering the pattern some to do so.

Activity #1 – “Draw Search Pattern” (Indoors):

Draw on paper the clover leaf search pattern described above based on walking to a geocache from the North West. Assume North is at the top of the page.

Activity #2 – “Performing the Search Pattern” (Outdoors):

Try to find a location in the thick woods to perform this activity. This same type of activity can be done in an open field, but the results may not be as profound.

Option #1: “Intersecting Trails”: If you know of or can find two trails that intersect each other among many very tall trees you can mark the very center of the intersection after holding the GPS stationary for a few minutes. Create a go to the newly saved waypoint and return up one of the trail branches about 100 feet. From here practice the search pattern explained above.

Option #2: “Geocache in the Forest”: Via satellite images explained in the Geoaching Research Methods section find a cache that is located among some thick trees. Approach the cache using any trails you may find. Practice the search method explained above even if you immediately find the cache.

Option #3: “Marking Objects with a Partner”: Find a partner. Both separately mark an object in the forest or open area using waypoint averaging. Come back together and exchange the averaged coordinates. Practice the search pattern explained above to see if you can without a doubt identify the object your partner marked.

Option #4: “Marking Trees within a Grassy Area of a Park”: Find a park that has a grassy area with several trees at minimum of 25 to feet apart. Best if the trees are more 50 feet apart. Use waypoint averaging to determine the coordinates of several trees in the immediate area. After each set of waypoints for the given trees are averaged, use the averaged coordinates to perform the “three leaf clover” search method to identify the same tree. The closer the tree the more challenging to pick one over the other that is near by.

9) Intersecting “Virtual Lines” Search Method

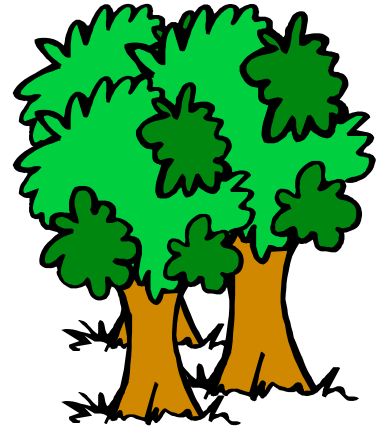
By Steve Sewell

Introduction Statement(s):

There will exist situations where your destination is within thick tree cover. The dense tree cover can alter the satellites signal's timing in a manner to cause the fix to be off. Sometimes the GPS can read a distance of 10 feet from the coordinate location of a cache. Then all of a sudden while taking two steps closer, the GPS will jump and read a destination of 20 to 50 feet to the side or behind. This can be very frustrating especially if a small geocache is hidden very well.

Three tries is not always a charm. I recall a geocache in which it took me a fourth day going back out to the location. The first three tries I kept doing the same thing of wondering around. I kept coming from different directions to see how close to 0 feet I could get. The problem was the combination of no WAAS signal, the ravine, and the thick tall tree cover was causing my GPS to jump at least 35 feet by just taking one more step. Needless to say I left a little disappointed especially the last time knowing that people had recently made the find. As I was driving home I thought to myself that I need to try a different approach. Then the thinking light bulb finally went on.

My solution was to get out of the “thick of things” to any area clear enough to get many steady satellite signals and with WAAS if at all possible. You can then draw virtual lines with your eyes through and under the canopy of trees noting the looks of the tree trunks the virtual lines passes through.



Example of Virtual Line to A Bearing

Jumpy Readings In GPS Unit: In the following example there are many ovals that represent trees from a sky view. The hidden cache is within an area of trees that is at least a 150 to 200 feet across in different directions. The tree cover is causing the GPS to be very jumpy. Cache X is a small micro cache with clues describing it as being a hard find, so you want to greatly minimize your search area.

Some Where On that Virtual Line: Go to a nearby clearing in the trees at least 50 to 100 feet away for the edge of the dense tree cover at point A. Check the number of satellites and their signal strength. Do you have WAAS? Try a few approach attempts towards Cache X until the GPS is reading both a Bearing and Heading the same degrees or within a just a couple of degrees. This may require a few attempts from the right or left from out where you tried before. As you approach you may be able to make fine adjustments in your walking to line up Bearing and Heading to the top of the GPS compass screen. When you can walk about 5 more strides in that same straight line while keeping the Bearing and Heading the same, stop without turning to either side, look straight ahead, and draw a virtual line through the different trunks of trees with your eyes noting the ones this line passes near. Cache X must be some where on or very near this virtual line. The distance to Cache X may also be estimated to the best of your guessing abilities to eliminate some of the trees to close to your current position or too far away. Note a few identifiable candidate trees as a reference point for Cache X to be located near.

Intersection of the Virtual Lines: Next do the same from one or two more points that are greater 60 degrees from previous position if at all possible. The decided approach may also be determined by the area where the candidate trees can easily be seen. The goal is to end up pointing in an area you can reference by the same one or two trees. Other landmarks like rocks or contours in elevation may work as well. Now the limited identified area will be where the eagle eyes will do the focused search for Cache X.

Using the method of virtual lines I made my find and left pretty proud of my new technique. Since that initial discovered method, I've been in similar situations to also confirm I was on the right path to find some stubborn eluding geocaches.

The following illustrates finding X using the “Virtual Lines” method from three different point and what the GPS could read from those points.

From Point A:

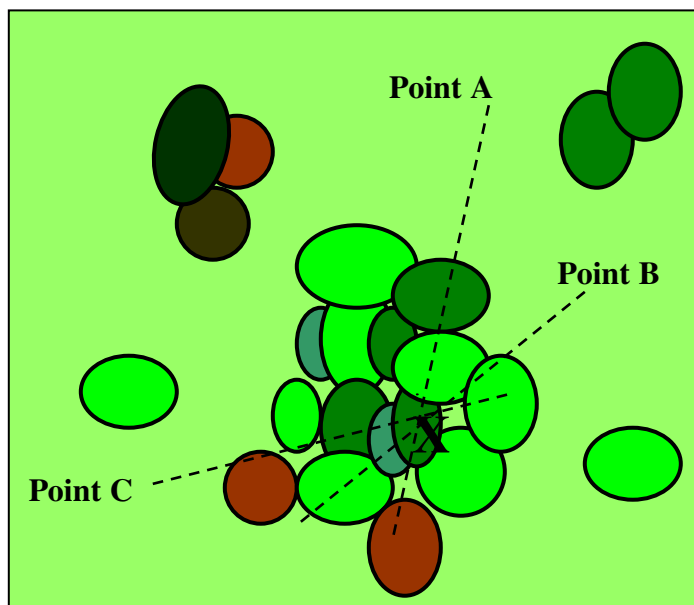
To: Cache X	
Bearing:	Heading:
195	195
Distance:	Speed:
165 ft	1.2 mph

From Point B:

To: Cache X	
Bearing:	Heading:
230	230
Distance:	Speed:
109 ft	0.8 mph

From Point C:

To: Cache X	
Bearing:	Heading:
67	67
Distance:	Speed:
97 ft	1.1 mph



Review Questions:

21. Name at least three key things to keep in mind when you need to use the method of using a virtual line to a bearing.

Activity #1 – “Open Field Virtual Lines Practice” (Outdoors):

Option #1: “50 Feet Apart”: In an large open and fairly flat area use sticks, cones, tent stakes, etc. in the ground so that they can be easily seen from 100 to 200 feet away from any direction. Place 3 in the shape of an equal side triangle about 50 feet away from each other. Obtain an averaged waypoint for each item placed. Store the averaged waypoints as V1, V2, and V3. Now by staying at a distance of at least 100 feet enter a Go To one of these waypoints and try drawing a virtual lines from three different locations from around the triangle. Does your virtual line point to the known one without being confused with the other two? Try the same with the other two.

Option #2: “25 Feet Apart”: Now do the same thing as in option #1, but this time the items are placed in a triangle only 25 feet apart.

Option #3: “Virtually Identifying Trees within a Grassy Area of a Park”: Use the same trees marked in option #4 of the “Three Leaf Clover” Search Method chapter. While staying a good distance from each tree use several “virtual lines” to identify the tree. You can then approach the tree to verify you had the correct tree instead of one near by.

Activity #2 – “Geocache Using Virtual Lines in the Woods” (Outdoors):

Through geocaching research methods, identify some areas via satellite views or the written description about the cache that may indicate the GPS unit to have some difficulties with a clear sky view. If all you can see are lots of trees with some clearings or the trail may have open view to the sky then you have your candidate. Apply the virtual line method keeping in mind the key things explained in this section. Also don't limit yourself to just one way of using the GPS unit.

10) Offset Waypoint Search Method

By Steve Sewell

Introduction Statement(s):

Sometimes the destination or target position measured by longitude and latitude is not known. This can be for different reasons. Think about a great fishing hole you can access only by a peninsula of land. The areas of water can be reached by casting out a well estimated distance. Through trial and error one small noted area continues to out produce all the other area around the peninsula. A proud stringer of fish is brought home and the fish stories start with all of your close friends. One buddy wants to hit the same fishing hole on a day in which you cannot go along. While there that glorious day of fishing you gather GPS information was gathered prior to leaving. Noted were the position on the bank, a bearing towards the fishing hot spot, and the well estimated casting distance.

Note: When geocaching, you may run into what is call an offset cache. Provide is the coordinates of where to start along with the bearing and distance to the destination. Thought some higher end GPS units can calculate the actual distance this can easily be done with the basic GPS features.

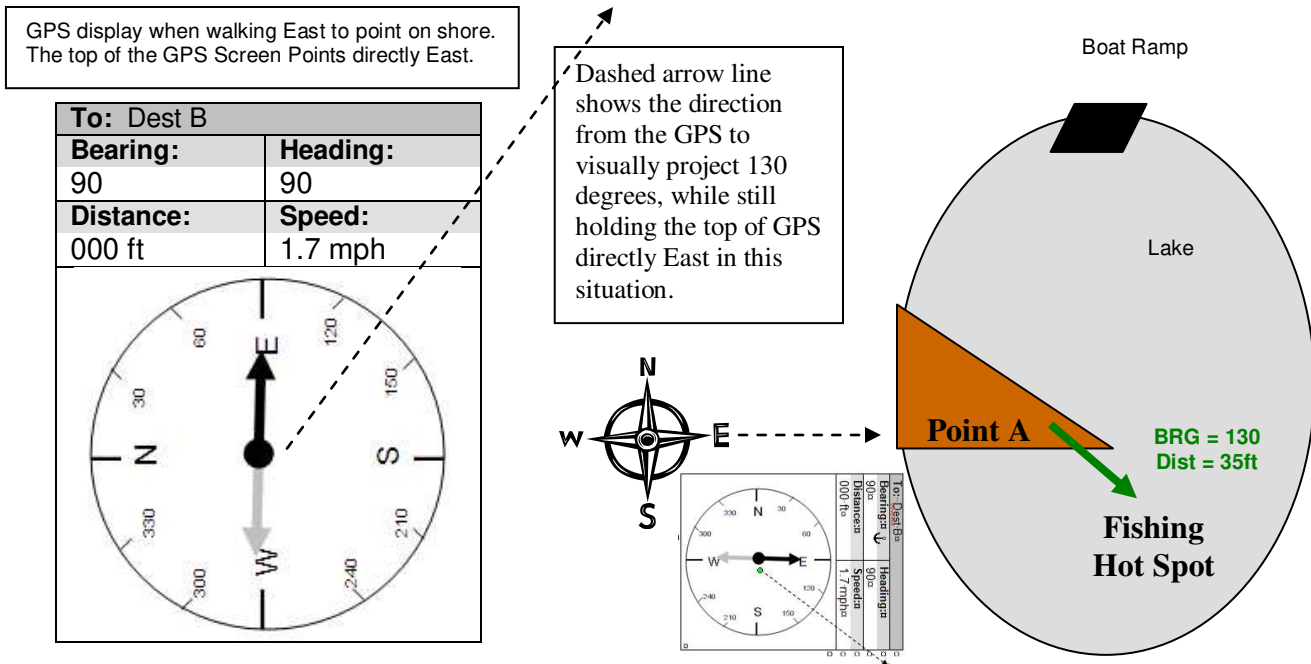
Virtually Projecting a Waypoint

The specifics given to the fishing buddy, Sam, as follows:

- Coordinates: Latitude = N40 38.625; Longitude = W089 02.255
- Bearing= 130 degrees
- Cast Distance = 35 ft
- Walk the trail directly East along the South side of the peninsula to point A

These are not the coordinates of the hot spot itself, but instead the position on shore to stand. From there Sam will have to cast out in the right direction for an estimated distance.

Sam parked his car nearby the next day and walked a heading/bearing to the coordinates until the distance was as close to zero ft as he could get. Keeping the GPS oriented in the same direction just walked, the 130 degree is noted on the GPS compass and visually projected out into the water. The relative surroundings were noted for sight reference to the destination. Now it is time to put down the GPS and pick up the fishing pole. Fishing line is casted out 35 ft in the noted direction and the next thing that happens is the infamous hard tug on the line.

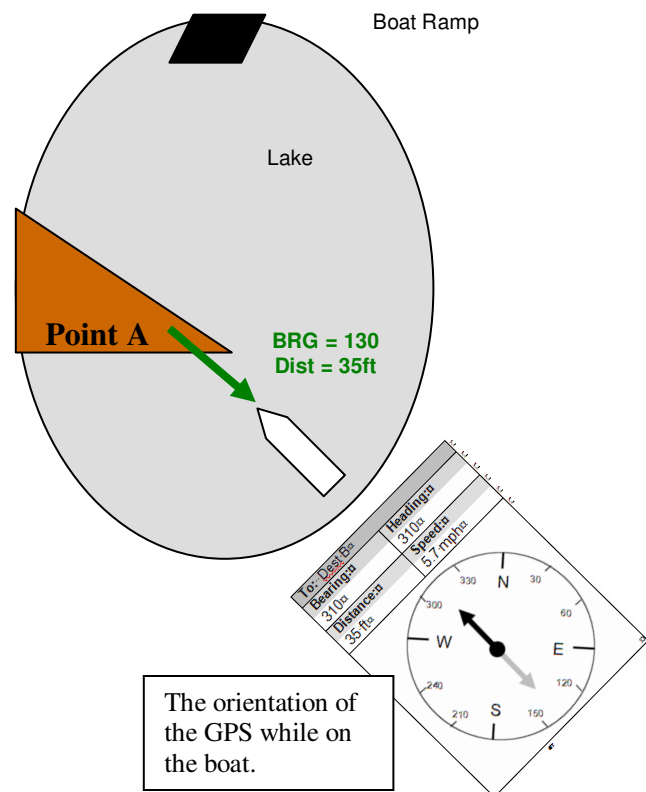
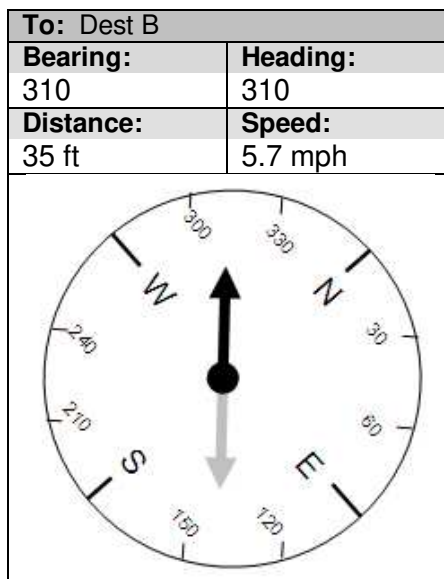


Note: When visually projecting a bearing using the GPS compass, make sure you have walked a straight line of about 5 strides beforehand. Before rotating the GPS in any manner visually project bearing across the land or water.

Going to an Offset Waypoint

Sam catches a nice stringer of fish and decides to come back the next day, but this time with his boat to sit right on top of the fishing hot spot and do some jigging for the fish. Using all the same information originally given, Sam can anchor his boat right on top of the same hot fishing spot. How?

Sam launches his boat from a North boat ramp with the same given coordinates for the land spot, point A. Due to bearing always relative to a current position, Sam realizes that his new current position will be out in the water which changes the perspective of the bearing. He determines that a bearing from the fishing hot spot to the land position, point A, will be 180 degrees different from point A to the fishing hot spot. Adding or subtracting 180 degrees against the 130 degrees will obtain 310 degrees. After getting near 35 feet from point A, Sam tries a few times to approach point A at a heading of 310. Once the heading and bearing match and he the distant out is about 35 feet he instantly drops anchor.



Review Questions:

22. One must walk in a straight line and keep the GPS _____ to direction just walked to estimate a bearing from particular standing coordinates.
23. It is desired to reach an offset destination from coordinates that are given. The bearing is 340 degrees from those coordinates to the offset destination. For what ever reason you can not start at the given coordinates. What math should be performed be on top of the offset destination? What angle of approach should be taken?.
24. Can you think of other applications for an offset cache?

11) The Sport of Geocaching

Introduction Statement(s):

Geocaching is an individual, group, or family sport that includes hiking in nature and/or seeing sites of interest utilizing a GPS. Geocaching incorporates the fun of a treasure hunt combined with the challenges of a little adventure and sometimes detective work. These may lead to new places of discovery.

What is Geocaching?

<http://www.geocaching.com/about/>

&

<http://www.geocaching.com/faq/>

You pronounce it Geo-cashing, like cashing a check. Geocaching is an entertaining adventure game for gps users. Participating in a cache hunt is a good way to take advantage of the wonderful features and capability of a gps unit. The basic idea is to have individuals and organizations set up caches all over the world and share the locations of these caches on the internet. GPS users can then use the location coordinates to find the caches. Once found, a cache may provide the visitor with a wide variety of rewards. All the visitor is asked to do is if they get something they should try to leave something for the cache.



Statistics Courtesy of Geocaching.com

As of Date	Active Caches	# of Countries	# Logs Written for Last 7 Days	# Account Holders Logging for Last 7 Days
11/8/2005	213,235	218	125,692	22,274
9/30/2006	317,512	222	201,233	32,891
4/11/2008	555,293	worldwide	431,799	57,472
3/15/2009	747,866	Around the world	N/a	n/a

Note by Steve Sewell: About 3/4 million hidden treasures worldwide. People in general are now each averaging over 8 caches finds per a week.. These are not necessarily all the same people every week. One person can find typically 4-5 in a couple of hours depending on how close the caches are to each other and the combination of the level of difficulty and terrain.

Brief History

<http://www.geocaching.com/about/history.aspx>



Information Courtesy of Geocaching.com

On May 2, 2000, at approximately midnight, eastern savings time, the great blue switch* controlling [selective availability](#) was pressed. Twenty-four satellites around the globe processed their new orders, and instantly the accuracy of GPS technology improved tenfold.

On May 3, one such enthusiast, Dave Ulmer, a computer consultant, wanted to test the accuracy by hiding a navigational target in the woods. He called the idea the "Great American GPS Stash Hunt" and posted it in an internet GPS users' group. The idea was simple: Hide a container out in the woods and note the coordinates with a GPS unit. Within three days, two different readers read about his stash on the Internet, used their own GPS receivers to find the container, and shared their experiences online.

Due to growing publicity, in late 2000, Jeremy Irish partnered with Elias Alvord and Bryan Roth, two coworkers at Sunrise Identity, to start a new company called [Groundspeak Inc.](#)

Several Variations of Geocache Types

http://www.geocaching.com/about/cache_types.aspx

Information Courtesy of Geocaching.com



Geocache Types



Traditional Cache: This is the original cache type consisting, at a bare minimum, a container and a log book. Normally you'll find a tupperware container, ammo box, or bucket filled with goodies, or smaller container ("micro cache") too small to contain items except for a log book. The coordinates listed on the traditional cache page are the exact location for the cache.

The general rule of thumb is, "If you take an item, leave an item, and write in the logbook." Some caches are themed, so make sure to read the description before going on a hunt.



Multi-Cache (Offset Cache): A multi-cache ("multiple") involves two or more locations, the final location being a physical container. There are many variations, but most multi-caches have a hint to find the second cache, and the second cache has hints to the third, and so on. An offset cache (where you go to a location and get hints to the actual cache) is considered a multi-cache.



Project A.P.E. Cache: In 2001, twelve geocaches were placed in conjunction with 20th Century Fox to support the movie *Planet of the Apes*. Each cache represented a fictional story in which scientists revealed an Alternative Primate Evolution. These caches were made using specially marked ammo containers. Each cache had an original prop from the movie. Only a few Project A.P.E. caches exist today.



Mystery or Puzzle Caches: The "catch-all" of cache types, this form of cache can involve complicated puzzles you will first need to solve to determine the coordinates. Examples include sending the cache owner a verification codeword found inside the logbook, performing some task at the cache location and taking a photograph, or writing the online log in a format or with content that satisfies the cache requirements. Due to the increasing creativity of geocaching this becomes the staging ground for new and unique challenges.



Letterbox Hybrid: A letterbox is another form of treasure hunting using clues instead of coordinates. In some cases, however, a letterbox has coordinates, and the owner has made it a letterbox and a geocache. To read more about letterboxing, visit the [Letterboxing North America](#) web site.



Wherigo™ Cache: Wherigo is a toolset for creating and playing GPS-enabled adventures in the real world. By integrating a Wherigo experience, called a cartridge, with finding a cache, the geocaching hunt can be an even richer experience. Among other uses, Wherigo allows geocachers to interact with physical and virtual elements such as objects or characters while still finding a physical geocache container. A Wherigo-enabled GPS device is required to play a cartridge. Learn more at Wherigo.com.



Event Cache: Occasionally, local geocachers and geocaching organizations designate a time and location to meet and discuss geocaching. After the event the caches are archived.



Mega-Event Cache: A Mega-Event cache is similar to an Event Cache but it is much larger. In order to qualify as a Mega Event, the event cache must be attended by 500+ people. Typically, Mega Events are annual events and attract geocachers from all over the world.



Cache In Trash Out Event: [Cache In Trash Out](#) is an activity intimately tied to geocaching. While out there on a cache hunt, we collect litter along the trails and properly dispose of it. Cache In Trash Out Events are much larger clean-up events that involve and benefit the larger community.



EarthCache: An EarthCache is a special place that people can visit to learn about a unique geoscience feature or aspect of our Earth. EarthCaches include a set of educational notes and the details about where to find the location (latitude and longitude). Visitors to EarthCaches can see how our planet has been shaped by geological processes, how we manage the resources and how scientists gather evidence to learn about the Earth. For more information about EarthCaches, visit <http://www.earthcache.org/>.



GPS Adventures Maze Exhibit: An event exhibit cache represents geocaching participation at the GPS Adventures Maze Exhibit. The GPS Adventures Maze is a traveling educational exhibit designed to teach people of all ages about navigation, GPS technology and geocaching.

Grandfathered Cache Types

These are cache types that are no longer available for creation on geocaching.com. Visit [the Waymarking web site](#) for other GPS hunting activities.

Virtual Cache: A virtual cache is a cache that exists in a form of a location. Depending on the cache "hider," a virtual cache could be to answer a question about a location, an interesting spot, a task, etc. The reward for these caches is the location itself and sharing information about your visit.



Because of the nature of these geocaches, you must actually visit the location and acquire the coordinates there before you can post. In addition, although many locations are interesting, a virtual cache should be out of the ordinary enough to warrant logging a visit.

Virtualls are now considered [waymarks on Waymarking.com](#).



Webcam Cache: These are caches that use existing web cameras placed by individuals or agencies that monitor various areas like parks or road conditions. The idea is to get yourself in front of the camera to log your visit. The challenging part, however, is that you need to call a friend to look up the web site that displays the camera shot. You will need to have them to save the picture to log the cache. If you're a tech-head you could use your wireless modem and save the image yourself on your laptop.

Webcam caches are now in the [Web Camera category on Waymarking.com](#).



Locationless (Reverse) Cache: Locationless caches could be considered the opposite of a traditional cache. Instead of finding a hidden container, you are given a task to locate a specific object and log its coordinates. A scavenger hunt of sorts, it involves collecting waypoints of various objects around the world.

Locationless caches have evolved into [Waymarking](#). Waymark categories are similar to how locationless caches were listed on geocaching.com, but you can now search for the locations in each category.

Tips: Your First Few Geocache Finds

By Steve Sewell

- Choose a cache with a easy rating on difficulty to find and terrain.
- Choose a regular cache size instead of small or micro size.
- Consider borrowing a GPS from a friend before buying.
- Have a friend or better yet a friend experienced at geocaching go with you on your first set of geocaches.
- Bring a print out of the geocach details including the title, details, hints, and a few of the log entries. All may prove to be beneficial clues to a successful find.

Tips: Steps to Geocaching

By Steve Sewell

The steps to geocaching can be broken down in four basic parts that are all essential to a successful geocaching experience:

- Researching
- Preparing
- Hunting
- Finding

Researching

Identify geocaches that are desired to be found. The typical way is to use the Geocaching.com's link entitled: "Hide & Seek a Cache". From here you have several options to search for geocaches:

- Address
- Zip
- State/Country
- User Names
- Coordinates
- Keyword

In you research you should be able to answer the following questions:

- Does it look like an interesting area?
- Can you identify that there is an area you can safely park a vehicle near the access?
- What is the rating level on the difficulty to find and the terrain to be traveled?
- Can you estimate distance and time to reach the geocache location?
- Will there be much elevation changes?
- Are there rivers, creeks, fences, wall, etc. that may be in the way of your planned route? If so consider a different approach.
- Is there the potential for thick tree cover that may hinder good GPS readings and in turn slow down your search?

Preparing

- Gather you researched information to take along.
- Bring a map(s) of the area traveled.
- Find trail maps that may be available
- Be able to identify Poison Ivy, Poison Oak, etc
- Learn basic First Aid
- Bring and drink plenty of water. Typically 2 liters per person
- Bring extra batteries for the GPS unit.
- Let someone know where you are going and when you will be returning.
- If going for non-urban caches consider packing a day pack. Consider the following:
 - Pen or pencil to sign logs
 - Good Magnetic Compass
 - Drinking water

- Trade goodies
- Extra pencils or pens
- Ziplocks
- Bug repellent
- SunScreen
- Hat
- Duct tape
- Spare log sheets
- Flashlights
- Spare batteries
- First Aid Kit
- Pocket knife with screw driver
- Wipes
- Tweezer type tool
- Pen or pencil to sign logs
- Basic first aid kit
- Camera

Hunting

- “Mark Your Park” – Be sure to mark where you left the vehicle. You’ll want to get back to that spot by the end of your geocaching adventure.
- Keep your awareness of your surroundings. You don’t need to trip over a stick, step into a hole, walk off a cliff, etc. Watch where you are walking a lot more than the GPS.
- Consider marking different significant points along trails for reference. Give the marked waypoint meaningful names that you’ll be able to see on the map screen.
- While hiking set your track mode to a lower setting if the GPS is capable. A setting of “.1” or “.01” might be desired as the hiking trails wind around much.
- Be aware of your GPS satellite signal strength and the related accuracy. Do you have a WAAS signal?
- When you get down to the last 50 feet, slow down your pace and start thinking like the person who hid the cache.
- Stay on the hiking path for as long as possible. The trail may end up taking you closer to the cache that may be initially apparent.

Finding

- Note the exact way the geocache is hidden so when you place the container back it will be in the original setting intended by the owner.
- When trading items take something of equal or lesser value.
- Note any maintenance that you can communicate back to the owner.
- (Optional): Perform any maintenance that you desire to handle that may be needed.
- Make any notes about the find like date, time, weather, experience that you may want to share.
- Upon return log the caches you found on Geocaching.com

Finding your first Geocache According to Geocaching.com

<http://www.geocaching.com/about/finding.aspx>

Step 1 – Researching the Cache

Keep in mind that distances can be deceiving. When you're using your GPS unit to find a cache, the unit only knows how close the site is as the crow flies (a direct line). You may be a mile from the cache, but there may be a river in the way, or a near-vertical climb involving 3 miles of switchbacks, or a mountain – you get the picture.

1. Buy a map of the area from your local camping store for those caches that are off a trail or too remote to drive close to. Topographical maps (which show features of the land like hills) are best, so you can get a good idea of the terrain you'll be crossing. You'll also know whether to bring your Honda Civic or rent a Land Rover.
2. For car geocaches (ones you can drive to and walk a short distance), use MapBlast. Geocaching.com provides you with a link to MapBlast so you can get directions to that location. Make sure to zoom in on the location to make sure it's near a road. MapBlast can only get you so far!
3. If you have a good idea of the area, you can navigate via the GPS unit only. This is best when the park is small. This is also the most challenging, and is not recommended for your first hunt.

You'll most likely need to do all three things to prepare and reach the geocache, though our experience has shown different combinations for each cache. I'd always start with one of the online map sites first to get an idea of the area, then decide on whether you need to buy a map or use what you have.

Since this is your first time, it's also ok to read the stash notes, look at a picture of the cache, or read other people's experiences finding the cache. Some may be visible from 20 feet away, while others in more trafficked areas may be buried under some rocks (or in one case, in a World War II bunker!). Getting within a mile or two of the site isn't usually too difficult – it's the last mile that'll get you every time.

Step 2 – Preparation

Preparation is key in any kind of outdoor activity, but you can never stress enough the importance of preparation and safety. Keep these tips in mind when searching for a cache:

1. Have a buddy with you! Never go off into the woods or remote locations without a partner, especially when Geocaching. We don't want you focusing on your GPS unit and walking off a cliff. It's great fun, so think about planning a camping trip around the stash hunt with your family or friends.
2. Many of the caches are off-trail, so make sure to be aware of your surroundings. If you're concentrating on your GPS unit, look around you occasionally for holes, bears, etc.
3. Bring and drink plenty of water, and don't drink directly from a stream! For some of the more difficult trips, bring a water filtration system. You can get them at most camping stores.
4. Let someone know where you're going and when you're coming back.

Step 3 – The Hunt

Now you're ready for the hunt.

1. It should be pretty straightforward to get within a mile or so from the cache (unless it's deep off-trail). If you've done your research, follow the map more than the GPS unit (although we keep ours on the whole time). It's inevitable that you'll lose signal from overhanging trees, mountains, etc.
2. If you're using USFS roads (US Forestry service), the signs for each road can be pretty small in size. Instead of street signs, they're brown signs that have white writing running vertically. Usually they're close to the ground. Sometimes you may have to backtrack on the road to locate them.
3. It's always good to have a compass on hand if your GPS unit doesn't have one.

4. When you leave your car, mark its location as a waypoint! Sounds silly, but once you get deep into the cache hunt, it's easy to get disoriented. We've learned this from experience!
5. When you get close to the Geocache (within 300 feet, which is the length of a football field), make sure to check your GPS unit signal. Sometimes the signal will have an error between 25-200 feet. Don't concentrate as much on the arrow as the distance decreasing, as you get closer to the site.
6. For the last 30 feet, use a compass or direct your buddy in the direction of the cache. In some cases we've had good luck circling the site with the GPS unit to get a good area to search.)
7. The final 30-100 feet is the hardest. It helps to think like the person who hid the cache. If there are stumps around, investigate around the base. Check for a pile of rocks. Some stashes, especially in people-trafficked areas, are pretty ingeniously hidden, so it helps to know the container they used.

Additional Suggestion By Steve Sewell: Check to see if a WAAS signal has been identified by the GPS unit. If not see if you can get to higher ground or a clearing in which one can be identified. From the clearing start walking towards the direction of the cache about 10 feet, stop, determine if there still is a WAAS signal, if so draw a virtual line through the area noting objects the virtual line is running through. Note any objects along the virtual line that is about the distance noted when you were last getting a "clear sky" GPS reading.

Step 4 – The Find

Huzzah! You found the cache! Congratulations! Now what?

- Usually you take an item and leave an item, and enter your name and experience you had into the log book. Some people prefer to just enter their name into the log book. It's an accomplishment enough to locate the cache.
- Make sure to seal the cache and place it back where you found it. If it had some rocks covering it, please replace them. It's pretty straightforward.
- Remember that waypoint we suggested you create where your car/trail was located? Use that now to get back! You'll be glad you had it.
- When you get home, email the person who hid the cache and let them know you found it! They're always happy to know the condition of their cache and it's nice to know that people are looking for them. You can also log your find for that specific cache.

Guide to Creating and Hiding a Cache

<http://www.geocaching.com/about/hiding.aspx>

Step 1 - Research a cache location

Geocaching is just like real estate - location, location, location! When thinking about where to place a cache, keep these things in mind:

- **Will it be easy to get to?** - If it is only a couple hundred feet from the highway, there's a strong chance someone may plunder it. Try to find a place that will take a bit of time to get to, preferably on foot.
- **Will it be easy to find?** - If it is too visible, or too close to busy roads, trails, etc. there's a good chance someone may stumble upon it. Several of the original caches were discovered this way, but the people who found it were nice enough to leave them there (or participate). But don't make it too difficult! If you hide it well, give hints on geocaching.com as to the location.
- **Will it be on private or public land?** - If you place it on private land, please ask permission before putting it there! If you place the cache on public lands you need to contact the managing agency to find out about their rules. You will be in violation of federal regulation by placing a cache in any area administered by the National Park Service (US). The National Park regulations are intended to protect the fragile environment, and historical and cultural areas found in the parks.

- **Does it meet requirements to be listed on the site?** - Make sure to [review the guidelines](#) for listing a geocache on this web site during your research.

You are ultimately responsible for the cache so make sure you know the rules for the area where your cache is being placed.

Ultimately you'll want to place a cache in a place that is unique in some way. The big reward for geocachers, other than finding the cache itself, is the location. A prime camping spot, great viewpoint, unusual location, etc. are all good places to hide a cache.

Note: Please be respectful of the areas you are thinking about placing the cache. For example, if it's the location of the spotted owl, or off-trail with delicate ground cover, keep in mind that others will be walking in these areas.

(Added 5/28/02) **Please do not place caches on archaeological or historical sites.** In most cases these areas are highly sensitive to the extra traffic that would be caused by vehicles and humans. If you find a cache in one of these areas please remove it and replace it a safe enough distance from the site to ensure that the site will not be impacted by people searching for the cache and unknowingly traveling over or through a site.

Step 2 - Preparing Your Cache

First, you need a container. Anything water resistant, snow resistant, etc (depending on your climate), will do, but geocachers have had good success with plastic buckets, tupperware (or Rubbermaid) containers, ammo boxes, or unused sewer pipes (really!). You'll also want to invest in some zip-loc baggies to put the items into in case your container leaks.

Whatever the container, **make sure to mark your cache** so that someone who doesn't play can figure out what it is. Most folks mark the container with Geocaching.com, the name of the cache, and any contact information they feel is necessary. More info is better than less.

Next, you'll need a logbook and a pen. A small spiral notebook does the trick. Make sure to put a pen in the cache as well! The author always forgets to bring one when searching for a cache.

(11/20 note: If you are in an area where the temperature dips below freezing, make sure to bring a soft lead pencil to place in the cache. Pens tend to freeze and are rendered useless :)

It's also recommended to have a note to welcome the cache finder and let them know what it is all about (if they accidentally found the cache). We have a letter you can use in both [Microsoft Word format](#) and [Text format](#).

Lastly, you can put goodies in the cache. It's recommended, but not necessary! Some ideas of items to give as gifts:

- Disposable camera - Put one in and ask everyone to take a picture of themselves and put it back in the cache. Later you can develop the photos and place them online.
- Cheap toys - play-doh, silly putty, action figures, etc.
- CDs, VGA Cards, gift certificates, dollar bills, gold bars, etc.

It's up to you what you want to put in your cache, budget permitting. If you are a Dot com millionaire, I would hope you would pony up a bit of cache (err cash), but most of us can spend less than \$10 to place a decent cache.

Do not put food in a cache! Critters have better noses than we do, and will bite, nibble or swallow your cache in an attempt to get to the goodies. Bottled water is a good alternative (and refreshing to geocachers).

Please! No alcohol, tobacco, firearms, prescription or illicit drugs. Let's keep this safe and legal.

Step 3 - Placing Your Cache

When you reach the location to place your cache, the hardest part (depending on the model of your GPS unit, the terrain, etc), is getting exact coordinates from your GPS unit. It all depends on how visible your cache is, but you'll need to get the coordinates as close as possible to the cache.

Some GPS units have the ability to do averaging, but if yours can't, the best suggestion is to take a waypoint, walk away from the location, then return and take another waypoint. Do this around 7-10 times, then pick the best waypoint (I've done this with a Garmin eTrex on a cache)

Once you have your waypoint, write it in permanent marker on the container, the log book, and make sure you have a copy to bring back with you. Write a few notes in the log book if you like, place it in a zip-loc baggie, and place it in the container. Make sure to secure the container with a rock, etc, to decrease the chance of it blowing, floating, or being carried away.

Please do not bury the container unless you have express permission of the landowner or manager. If the cache is far enough away from trafficked areas, your cache should be fine. An exception would be covering the cache with dead branches, bark, etc. to conceal the container.

Step 4 - Report the Cache

Either [fill out the online form](#), or Send e-mail to report@geocaching.com. The form is a much faster way to get your cache report published.

If you use email, please provide the coordinates in WGS84 format and let us know a) the difficulty (1-5, 5 being the hardest) and terrain rating (1-5, 5 using climbing gear), b) a nickname for the cache, and c) your contact info. If you're creating a web site for the cache, let us know and we'll add it to the page.

If you're a member of the geocaching mailing list, feel free to send it there as well. Most (if not all) of the geocaching sites read the list.

Step 5 - Maintain the cache

Once you place the cache, it is your responsibility to maintain the cache and the area around it. You'll need to return as often as you can to ensure that your cache is not impacting the area, and ensure that the cache is in good repair. Once people have visited the cache, inquire about the cache and their opinion of the location. Does the area look disturbed? Are visitors disrupting the landscape in any way? If you have concerns about the location, feel free to move or remove it from the area.

Review Questions:

25. Name two ways to identify the details of the surrounding area of a cache one would like to find?
26. Some of the things mentioned in finding a cache could be considered safety issues. When looking for a cache, list at least 4 things that can be safety considerations in preparation for heading out to the cache?
27. When you take an item from a cache, you should?
28. Leave the cache exactly where?

12) Starting Your Geocaching.com Account

Introduction Statement(s):

You can view very little of the geocache data from geocaching.com without setting up an account. If you want to see maps and the cache coordinates you will need at least set up a free basic account. Logging on to an account will allow keeping track of your own finds and put "watches" on certain caches of interest. The account will also be the only way to report to others of official geocaches that personally hidden. Other features are available with premium membership to make the geocaching experience quicker and easier. Well worth looking into.

Membership Registration

Basic Membership....It's free! and also easy to set up. The hardest part will be to come up with a username that represents you and is unique from others on the system. A name could be an alias already known to you, a license plate number, combination of two or three words that describes you geocaching skills, you and your partners nick name, etc. The simple steps are:

- Click on <http://www.geocaching.com/>
- Click on Getting Started
- Click on Free Account
- Decide if Basic Membership or Premium Membership
- Fill In the Form (see most of form below)
- Click on Create My Account



Image Courtesy of Geocaching.com

Membership Registration

To create your membership, please provide your account details in the form below. All fields are required. As per our privacy policy we will not sell your information to third parties. We only use this information for statistical purposes, and to ensure that the listings and logs that are submitted are valid.

User Name*:

This is the name that will represent you throughout all Groundspeak websites. Note that occasionally, a username turns out to be unsuitable for a variety of reasons. Should this happen, we will ask you to choose a new username; we also reserve the right to change usernames ourselves when necessary.

(Between 2 and 20 Characters)

Password*:

(Between 2 and 20 Characters)

Re-Enter Password*:

Primary E-Mail Address*:

After you create your account, a validation e-mail will be sent to this address.

Re-Enter E-Mail Address*:

Your First Name*:

Your Last Name*:

I want to receive the Groundspeak weekly newsletter:

☒ Yes ☐ No

E-Mail Format:

☒ HTML ☐ Plain Text

Update Home Coordinates

<http://www.geocaching.com/my/home.aspx>

Your home coordinates will be used for quick searches, weekly cache notifications, and pocket queries. It's not a requirement to use your home coordinates, but it can greatly enhance the functionality of the web site. You can access "Update My Home Coordinates" from "My Account" after you log in.

Image Courtesy of Geocaching.com



Mark my Home Coordinates

Entering your "home coordinates" improves the functionality of the web site significantly. For example, this data enriches your quick searches and enhances pocket queries. Also, the weekly cache notifications are made more relevant to you: new caches nearest you are listed, and events are ordered based on how near you are.

Entering your home coordinates also facilitates the review process when you decide to submit a cache. It saves you and the reviewer time. You can choose to use the actual coordinates of your home or a location within 2 or 3 miles (3 or 4 km) of it.

Degrees and minutes (MinDec) ▾

N ▾	40	°	30.795	'
W ▾	088	°	55.166	'

Show map for these coordinates



View/Edit Account Details

<http://www.geocaching.com/account/default.aspx>

When you need to update your email address or change other information, then access the "View My Account Details" from "My Account" when you log in. Changing your email address will send verification email to the given email account. Some of the other items that can be changed as desired are:

- Name
- Mailing Address
- Password
- Location
- Time Zone
- Display Units

Sample Weekly Notification:

When you have an account, Geocaching.com keeps you informed of new event and caches in order by how close they are to your home coordinates. This can be one starting point for researching in to a cache you may want to try to find. Below is a sampling of portions of one of those weekly updates.

From: Groundspeak [<mailto:noreply@geocaching.com>]

Sent: Thursday, March 19, 2009 8:23 PM

Subject: [GSP] Groundspeak Weekly Notification

This is an automated message from Groundspeak

Hello from Groundspeak! This is your weekly geocaching.com update from Groundspeak for 3/12/2009 to 3/19/2009

In This Issue

- I. 2nd Annual West Bend \$1000 Cache Ba\$h™ - August 14-16
II. Geocaching in the News (6 Articles)
III. Upcoming "Mega" Events (9 Events)
IV. Upcoming Events (36 Events)
V. Recently Published Geocaches (64 Caches)

II. Geocaching in the News (6 Articles)

1. Wiggins treasure hunt teaches skills

Publication: The Fort Morgan Times (Fort Morgan, CO)

Posted: Friday, March 13, 2009

<http://www.fortmorgantimes.com/news/2009/mar/13/wiggins-treasure-hunt-teaches-skills/>

III. Upcoming "Mega" Events (9 Events)

1. MOGA 2009 (Mega-Event Cache) (GC1DRV3)

Location: Missouri, United States (167.9mi SW (270.3km SW))

Date: 3/28/2009 by MOGA

<http://coord.info/GC1DRV3>

IV. Upcoming Events (36 Events)

1. 3.141592653 (Event Cache) (GC1NC5V)

Location: Indiana, United States (107.5mi SE (173km SE))

Date: 3/20/2009 by sataraid1

<http://coord.info/GC1NC5V>

V. Recently Published Geocaches (64 Caches)

1. RT 66: IL-Stroll Down The Mother Road: END (Traditional Cache) (GC1NNTW)

Location: Illinois, United States (18mi NE (28.9km NE))

Date: 3/14/2009 by Boo 2

<http://coord.info/GC1NNTW>

2. RT 66: IL- Pool Park (Traditional Cache) (GC1NNWY)

Location: Illinois, United States (19.1mi NE (30.7km NE))

Date: 3/14/2009 by Boo 2

<http://coord.info/GC1NNWY>

Review Questions:

29. Think of a user name to start your Geocaching.com account? Have a few additional ideas in case the first is taken.

13) Geocaching Research – Internet Methods

Introduction Statement(s):

Geocaching is at an optimum when you do a little research to areas one would like to visit or explore in addition to finding some caches. One could start with a state or local map. For example there is the constitution trail in Bloomington/Normal IL (<http://www.normal.org/gov/ParksAndRec/Facilities/ConstitutionTrail.asp>). Let's say a trip on the newer West side trail is desired, a little research of for caches on or near the trail would add to the fun of a hike or bike trip.

Starting With Geocaching.com & Known GPS Coordinates


Step 1 – Obtain GPS Coordinates

Obtain a GPS “fix” by personally going to the area with your GPS, obtaining from a friend, online sources, etc. For example a GPS Fix on a West side trail: Latitude= N 40 29.337 Longitude=W 89 03.278

Step 2 – Enter GPS Coordinates @ Geocaching.com

<http://www.geocaching.com/seek/>

After logging on to Geocaching.com, click with the mouse on “Hide and Seek a Cache” and enter GPS coordinate in the area of the search criteria for Latitude Longitude Search. Make sure to use the right format. Double check the entry to make sure it matches the right coordinates and click on the search button. .

Image Courtesy of Geocaching.com 

Latitude Longitude Search:			
WGS84 Datum:			
Latitude: (N/S HDDD MM.MM)	N ▼	40	29.337
Longitude: (W/E HDDD MM.MM)	W ▼	89	03.278
<input type="text" value="5"/> Mile(s) Radius			<input type="button" value="Search"/>

Step 3 – Study the List of Caches

A list of caches starting with the one closest to the search coordinates will be displayed. Examine the different columns of information:

- Distance & Direction from given coordinates
- Click on Icons for description of cache types; also get the name of the icon cache type by hovering the cursor over the icon
- The “D/T” is for rating difficulty and terrain on a scale of 1 to 5 with 5 being the most challenging (remember that if your new to start with easier cache rating like listed below)
- Originally Placed is so you have an idea how well it has stood the test of time
- Description showing the full cache name, cache owner, cache name starting with “GC”, and the state the cache is located
- Last Found helps give you an idea if it might still be their if it was found recent to a personal geocaching adventure.

Image Courtesy of Geocaching.com

Icons	(D/T)	Placed	Description	Last Found
SW 0.3mi ✓	(1/1)	25 Nov 03	Walking to Mulberry Lane by ken1945 (GCH971) Illinois	Yesterday* 22 Jul 06
W 0.5mi	(2/1.5)	1 Jan 07	MusiCache BLM4 by rkers10 (GC104P4) Illinois	Yesterday*
E 1mi	(2/1.5)	6 Nov 07	"Flash Cache" TakhomaCache on Wylie by MutherAndSun (GC17812) Illinois	21 Feb 09
SE 1.5mi ✓	(2/1)	19 Apr 03	Bridge over Some Street by GAAK (GCFD42) Illinois	08 Mar 09 22 Jul 06

Now here is an interesting side note about the URL. Notice how the coordinates searched is imbedded within web link/address shown at the top of the web browser.

http://www.geocaching.com/seek/nearest.aspx?lat_ns=1&lat_h=40&lat_mmss=29.337&long_ew=-1&long_h=89&long_mmss=03.278&dist=5&submit8=Search

Step 4 – Read Details of Caches


http://www.geocaching.com/seek/cache_details.aspx?guid=bdf4dfb4-9919-4476-ad45-19a4518b1d2e


After clicking on one of the full cache names from the previous step you will be able to review all the details of that particular geocache. Read the details and click on some of the links for view maps, etc. Sometimes the details have direct and subtle hints about the cache location. These hints may be found in the name of the cache to how things are worded in the explaining of the cache. The following example ended up that the cache was by some mulberry trees.


Image Courtesy of Geocaching.com 



[Geocaching Home](#) > [Seek](#) > View Cache Details

Walking to Mulberry Lane

A cache by [ken1945](#) Hidden: 11/25/2003
Size:  (Regular) Difficulty: ★★★★★ Terrain: ★★★★★ (1 is easiest, 5 is hardest)


 Greyed out links are only available to [Premium Members](#).

N 40° 29.141 W 089° 03.575 [\[Other Conversions\]](#)
UTM: 16T E 325440 N 4483703
 W 7.6mi from your home coordinates
In Illinois, United States [\[View Map\]](#)

Print:
 Simple [\[No Logs\]](#) [\[5 Logs\]](#) [\[10 Logs\]](#) |  [Driving Directions](#) **NEW!**

Download: [\[Read About Waypoint Downloads\]](#)

[LOC Waypoint File](#) | [GPX eXchange File](#) | [Send to GPS](#) | [Send to Phone](#)

 **Please note:** To use the services of geocaching.com, you must agree to the terms and conditions [in our disclaimer](#).






This is a small container with Camo tape on it. The cache is on a well-paved trail. Parking is at the trailhead to the west. It is reasonably handicapped accessible. You will have to leave the trail to get actual location, however.


Sorry about the previous inattention, I have updated the cache 11/11/05.

Enjoy the hike.

GCH971

Navigation

-  [log your visit](#)
-  [view gallery](#)
-  [watch listing](#)
-  [ignore listing](#)
-  [bookmark listing](#)



1 user(s) watching this cache.

GPS Units Sale
Wide GPS Selection & Reviews.
New Markdowns On Top Quality Gear.
[www.REI.com](#)

Garmin GPS on Sale
All Models and Styles Available
Find your Garmin GPS Here!
[Become.com/GarminGPS](#)



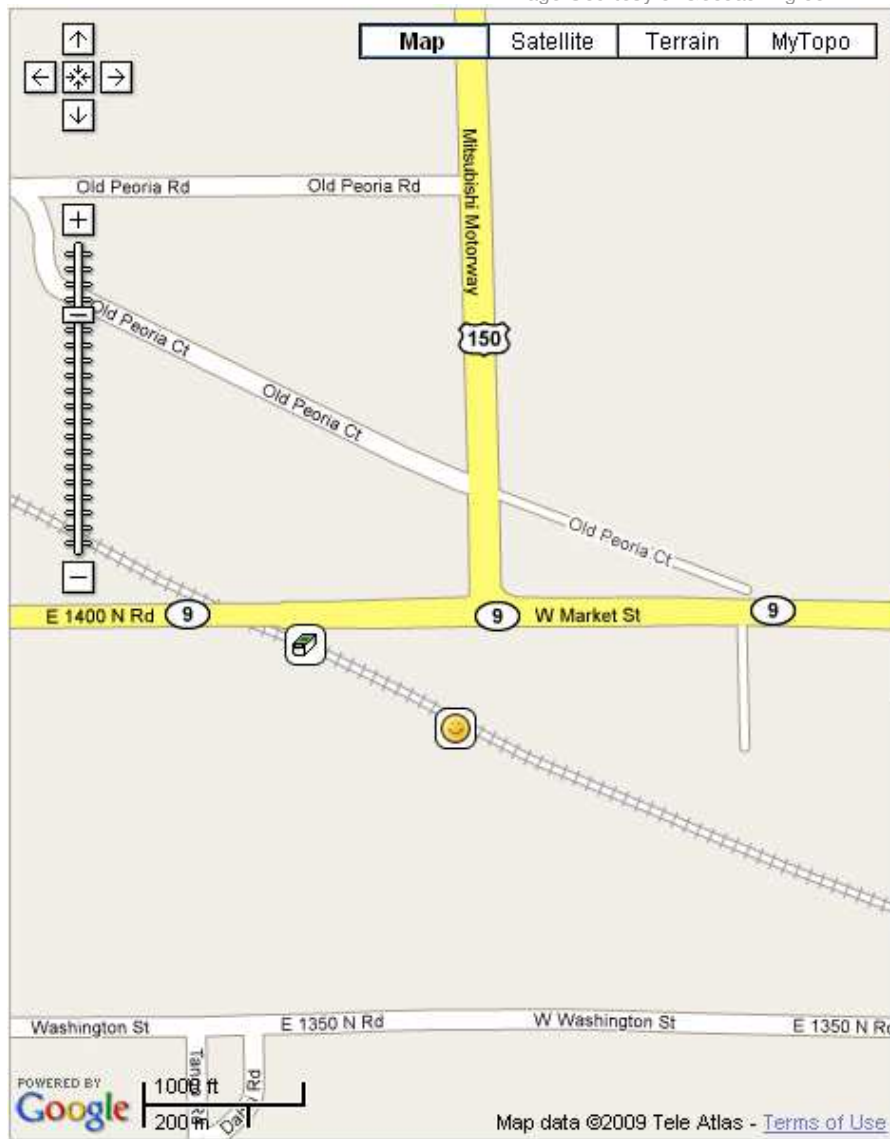
 

Image Courtesy of Geocaching.com



Zoom To Address:

Premium Member Filters: ([upgrade](#))



☐ Hide My Finds ☐ Hide My Caches

[Create Pocket Query](#)

Search Results:

2 caches displayed

[Refresh Map](#)

☐ Show Numbers on Map

Cache Name	GC Code
Walking to Mulberry Lane	GCH971
MusiCache BLM4	GC104P4

Map data ©2009 Tele Atlas - [Terms of Use](#)

Starting With Google Maps To Obtain GPS Coordinates

Step 1 – Search For Location on Google Maps

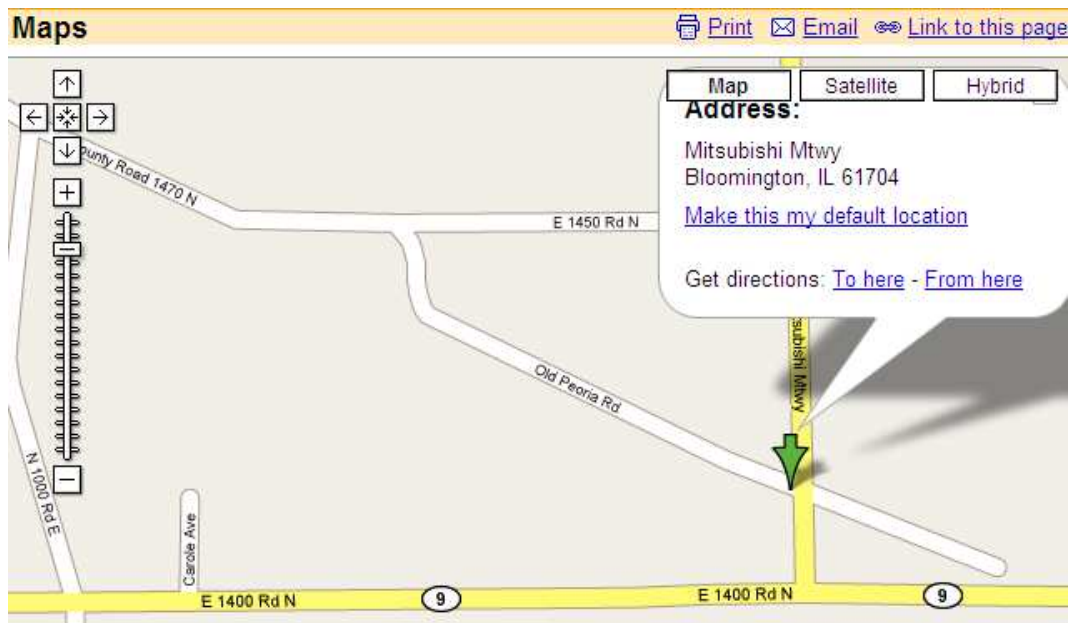
<http://maps.google.com/>

After determining location desired to conduct some geocaching, enter an address or a street on Google Maps. Include the city and state. For example use “Mitsubishi Mtwy, Bloomington, IL” from the Blooming/Normal Constitution Trail map.



Step 2 – Examine the Google Maps Results

Using the zoom and panning features find the desired location on the map. Zoom in and center your location on the map.



Step 3 – Zoom In & Center Desired Location

Zoom in and center your location on the map as best as possible. This will allow a more specific area that the map being viewed is based on. There are coordinates behind the scenes that this view is based on. So basically the coordinates will be closer to the specific spot desired.

Step 4 – Obtain Coordinates from Link

<http://www.google.com/maps?f=q&hl=en&q=Mitsubishi+Mtwy,+Bloomington,+IL&ie=UTF8&om=1&ll=40.487546,-89.059038&spsn=0.003974,0.007113>

Click on the [Link to this page](#) and note the decimal format of the coordinates in the displayed link. This not a latitude and longitude format of the coordinates. For example see the bolded coordinates in the link above (“**40.487546,-89.059038**”).

Step 5 (Option #1) – Enter Decimal Coordinates @ Geocaching.com

<http://www.geocaching.com/seek/>

Enter the decimal coordinates contained within the link identified in step #4 above. In to the “Hide & Seek A Cache” web page from Geocaching.com. Use the “....format in decimal” entries and submit. Then follow steps 3 & 4 from the section named **Starting With Geocaching.com & Known GPS Coordinates**

Or search by latitude/longitude format in decimal:

Latitude:	Longitude:	
<input type="text" value="40.487546"/>	<input type="text" value="-89.05903"/>	<input type="button" value="Submit"/>

example: latitude: 33.5111 longitude: -112.125
(W and S are negative)

Step 5 (Option #2): See Different Formats of Coordinates

<http://boulter.com/gps/>

GPS Coordinate Converter: Go to Boulter.com and copy/paste the decimal coordinates (ex. “40.487546,-89.05903”) straight out of the web address/link into the “Enter Coordinates” field and click on the “Convert & Map” button.

GPS Coordinate Converter, Maps and Info

Enter coordinates

(like 37 23.516 -122 02.625, but it's flexible)

Decimal Degrees (WGS84)

<u>Latitude</u>	<u>Longitude</u>
40.487546	-89.05903

Degrees, Minutes & Seconds

<u>Latitude</u>	<u>Longitude</u>
N40 29 15	W89 03 32

GPS

<u>Latitude</u>	<u>Longitude</u>
N 40 29.253	W 89 03.542

UTM

	<u>X</u>	<u>Y</u>
16N	325492	4483909

☐ Open links in a new window



Clicked At:

DETAILED MAPS AT:

- [MapPoint](#)
- [Yahoo! Maps](#)
- [MapQuest](#)
- [Geocaching.com](#)
- [MultiMap](#)
- [Tiger](#)
- [MapTech](#)
- [Google Maps](#)
- [Rand McNally](#)
- [ACME Mapper](#)
- [TopoZone](#)
- [TerraServer USA](#)
- [TerraServer](#)
- [Terracaching](#)

Geocaching.com Direct Access: Click on Geocaching.com from this page and get a quick idea of geocaches near the cross hairs (“+” sign in the center of the screen). Also note the link has the coordinates too.

<http://www.geocaching.com/map/getmap.aspx?lat=40.487546&lon=-89.05903>

[View results in Google Maps \(beta\)](#)



As a Premium Member you can zoom in, zoom out, and pan maps. Caches you have found are also marked. Visit the [Premium Membership](#) page for more information on subscriber features.

Identify Area Caches: Shows the closest 20 caches from your mouse click, if available in the given map area. Each listing has a number which corresponds to the list below. To obtain the list of caches, click the radio button entitled “Identify”, then click anyway within the map area. From the links in the descriptions, the details of the caches can be found.

[View results in Google Maps \(beta\)](#)



	Icons	(D/T)	Description	Placed	Last Found
1		(1/1)	Walking to Mulberry Lane by ken1945 (GCH971) Illinois	25 Nov 03	Yesterday* 22 Jul 06
2		(1.5/1)	The Walton Homestead - The West 40 by AlacritY (GCQRG2) Illinois	1 Oct 05	2 days ago* 22 Jul 06

Examine The Terrain For Cache By Satellite: Sometime google.maps can reveal additional roads, parking lots, trails, open verse wood area, building, landmarks, etc Click on “[View results in Google Maps \(beta\)](#)” followed by the “Sat” for Satellite, and one zoom out, then get a detailed map. Note the other number caches that show up.

Address, City, State, Postal Code

WEB SERVICES BY

[Click on Cache to view Details...](#)

Drag map to display additional items... [Create Permalink](#) ☐ Show Reference Marker

Bookmarks

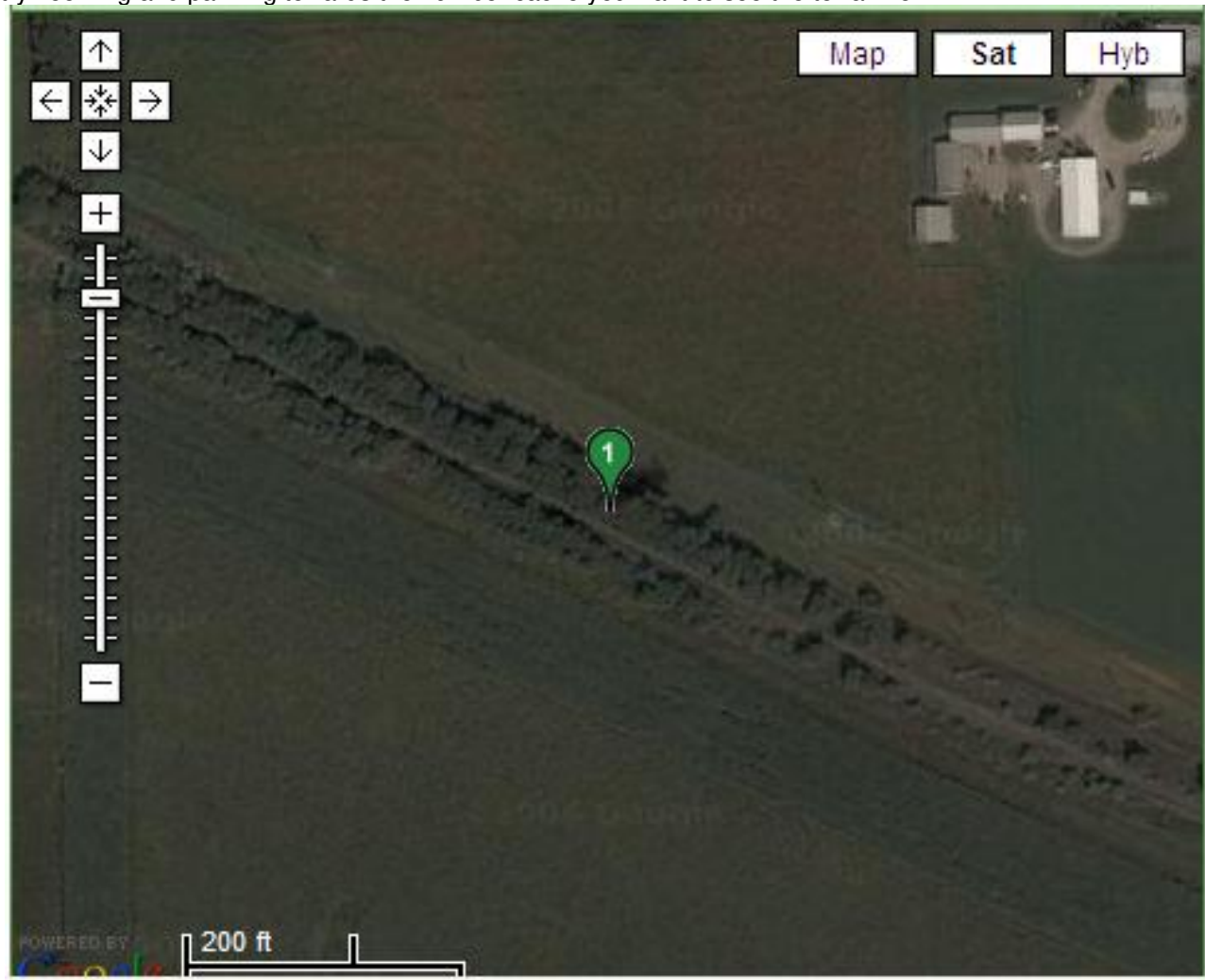
[Select Bookmark List]

4 Geocaches Found in search area*...

	Cache Name
1.	Walking to Mulberry Lane
2.	The Walton Homestead - The West 40
3.	Bridge over Some Street
4.	Off Your Rocker - Fishin' A Barrel

Showing 4 Cache(s).

Now try zooming and panning towards the number cache you want to see the terrain for. :



Note #1: Try the “Search by Address” at the top of the webpage for jumping to a new location and keep the caches in the new area shown.

Note #2: Actual caches have been found to be off as much as 100 feet from relative location shown in Google Maps. Trust the GPS coordinates over what is shown in Google Maps. Also satellite images are not always very current.

Review Questions:

30. Name and briefly explain the purpose of the steps to search caches when you know the coordinates.
31. Name and briefly explain the purpose of the steps to search caches starting with an address.

14) GPS Map Software

Introduction Statement(s):

Using software for a GPS allows you to: update with map details, more easily mark waypoints, create routes, share data files with others, etc. We'll show a few of the many features.

Magellan Map Send Topo?

http://www.magellangps.com/assets/manuals/newprod/manual_MapSendTopo.pdf

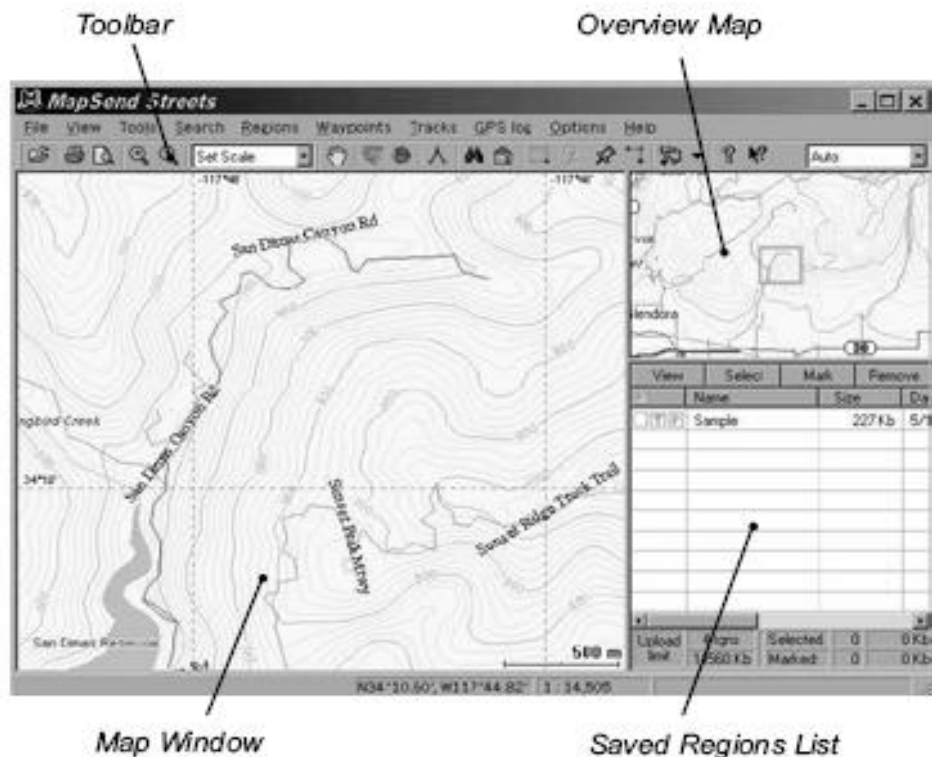
Upload/Download to Computer

MapSend™ Series Software Quick Reference Guide

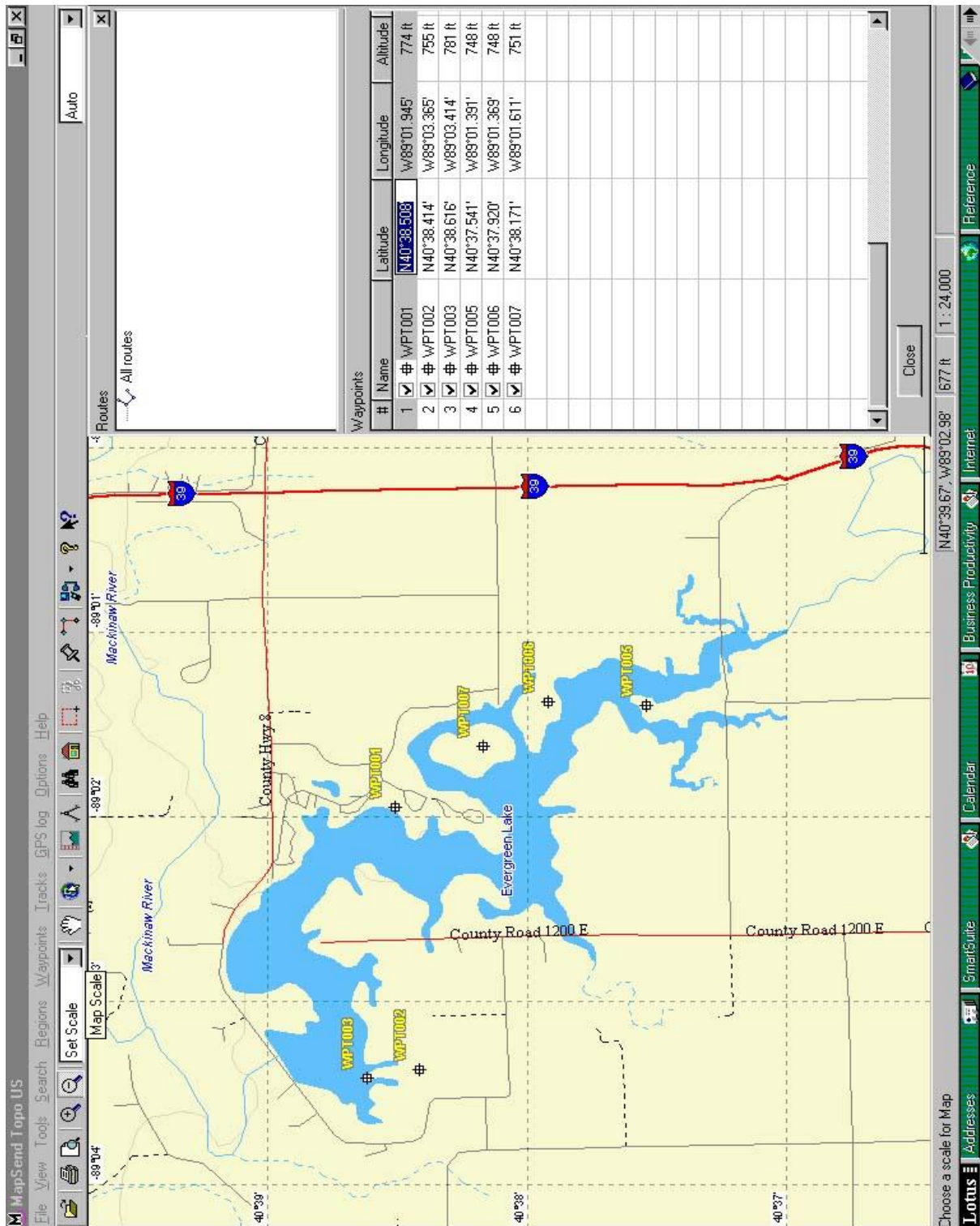
Introduction:

Magellan's MapSend™ Streets Gold and MapSend™ Topo of the United States CD-ROM enhances the utility of Magellan map-capable receivers with even greater mapping detail and useful information management capabilities. MapSend will upload data to the GPS receiver to view fully detailed street maps for any region in the United States. MapSend will also locate street addresses on a map. You can also find any USA city and airport, along with many parks, lakes, streams, rivers, and dams. MapSend contains a wide assortment of built-in POIs that you can use for route management. You can upload any category of POIs to your GPS receiver to be used the same as any waypoint you have in your receiver. The software's waypoint and route management features allow users to upload, download and customize data for specific navigation needs. For route planning purposes, MapSend Streets automatically measures the distance of each leg and the total distance to the destination. MapSend Topo of the United States also includes topographic maps and a vertical profile utility. Both versions of MapSend are designed for use with Windows 95, 98 or NT.

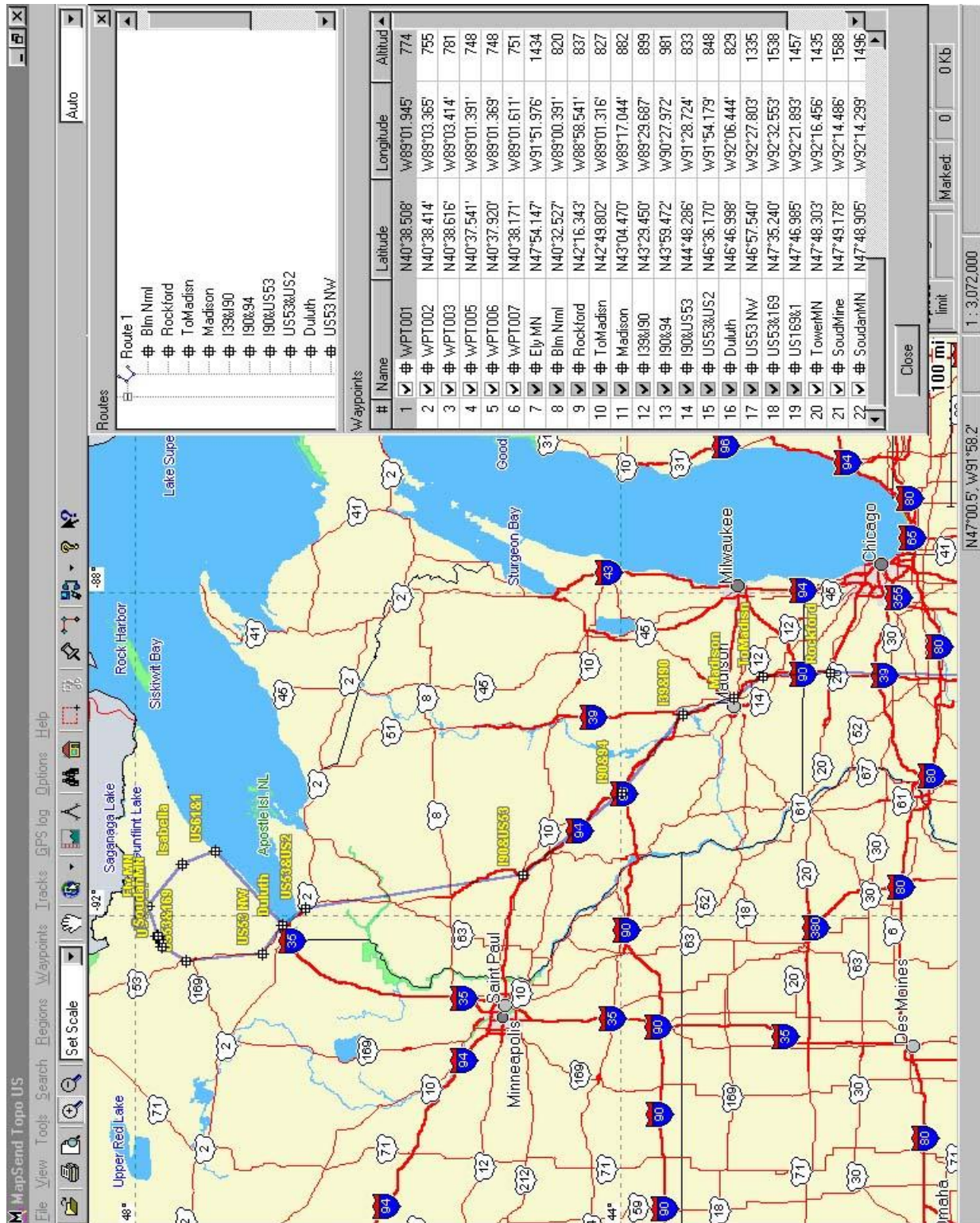
This Quick Reference Guide is a supplement to the User Manual that is available to you from within the MapSend software. While using MapSend, you can refer to the User Manual and get detailed answers to your questions about this software.



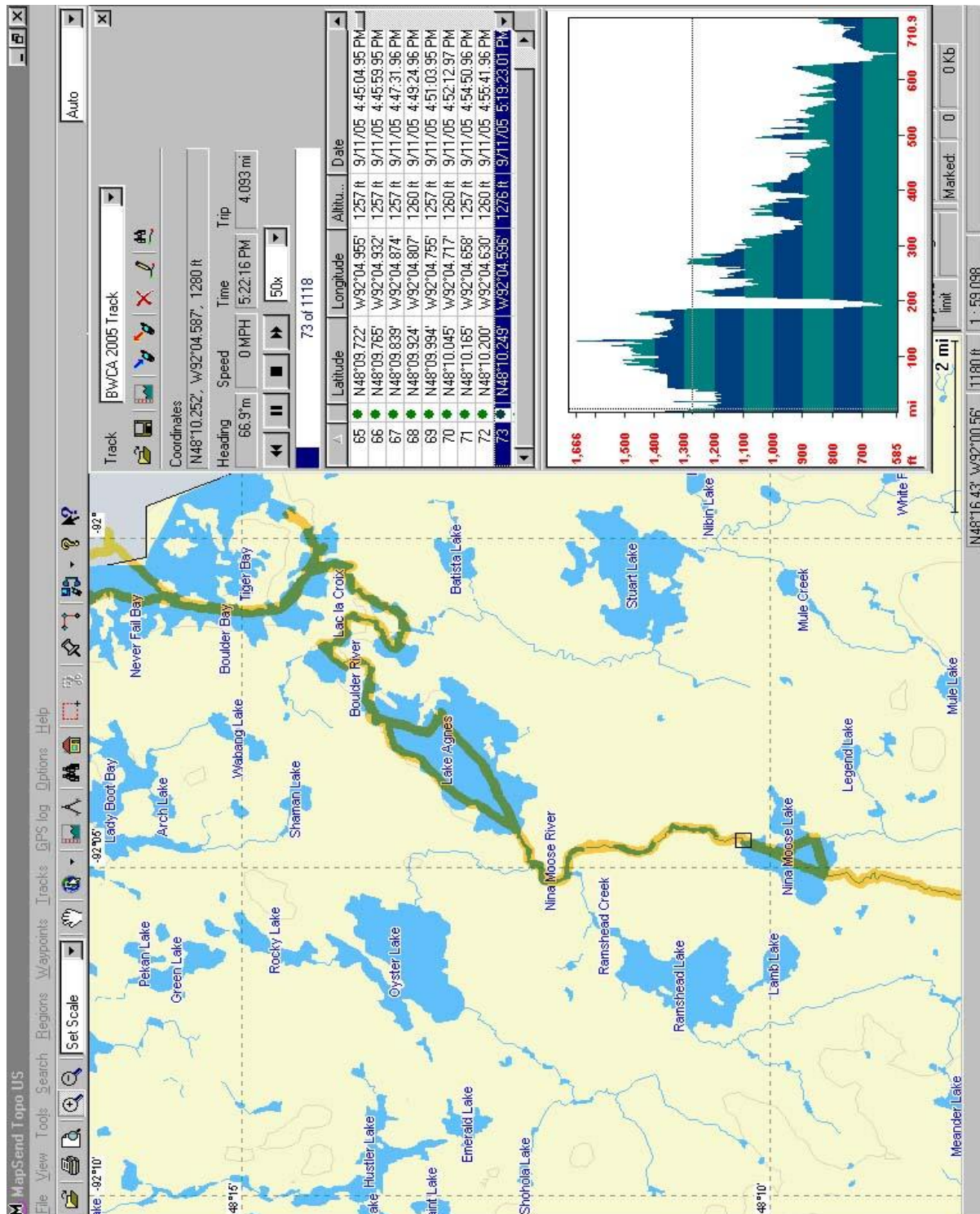
Placing Waypoints On Map: Researching and marking places of interest is more efficient using the computer's larger screen along with the keyboard and mouse. These waypoints can be downloaded to the GPS or upload to the computer and saved for future use. The saved waypoint files can be shared with others using similar software.



Mapping A Route: Identify roads or paths to travel and create a route that will get you to a destination. Routes can be downloaded to the GPS to indicate where to turn next and provide additional navigation information like ETA. These routes can be uploaded to the computer and saved for future use. The saved route files can be shared with others.



Recorded Tracks: Similar to a route, tracks (“bread crumb trails”) can be uploaded to the computer to study or save for future reference. Later the tracks can be downloaded back to the GPS and used as a route. These tracks can be shared with others



Review Questions:

32. What are some benefits of using software for your GPS.

Appendix – “A” Miscellaneous

Resource Information:

- GPS Information: <http://www.gpsinformation.net/>
- The Earth according to WGS 84: http://home.online.no/%7Esigurdhu/Grid_1deg.htm
- Satellite Image: <http://www.terraserver.com/>
- GPS Coordinate Converter, Maps and Info: <http://boulter.com/gps/>
- NOAA's National Weather Service Weather Forecast Office – Central IL: <http://www.crh.noaa.gov/ilx/>
- Energizer Batteries Technical Information: <http://data.energizer.com/>
- Orienteering: <http://www.learn-orienteering.org/old/exercise1.html>
- Beta version of Google Earth (version #4): <http://earth.google.com/download-earth.html>



- Central Illinois Geocachers Association : <http://www.cigacache.org/>
- IDNR Geocaching Rules. <http://www.dnr.state.il.us/lands/Landmgt/Programs/DayUse/Ch30Geocaching.htm>

Additional Glossary of Terms:

<http://www.geocaching.com/about/glossary.aspx#spoiler> & Steve Sewell

- **CITO:** Cache In Trash Out - When out geocaching, take a bag with you and pick up trash along the way! More info can be found [on the Cache In Trash Out page](#) .
- **Geomuggle:** A non-geocacher. Based on "Muggle" from the Harry Potter series, which is a nonmagical person. Usually this term is used after a non geocacher looks puzzled at a geocacher making circles with their GPS receiver, or when a non-geocacher accidentally finds a cache. Geomuggles are mostly harmless.
- **Hitchhiker:** A hitchhiker is an item that is placed in a cache, and has instructions to travel to other caches. Sometimes they have logbooks attached so you can log their travels. A [Travel Bug](#) is an example of a hitchhiker.
- **Maps:**
 - **Title:** Indicates what the map is supposed to illustrate.
 - **Scale:** Ratio of map distance to ground distance.
 - **Legend:** The symbol key of what items on the map.
 - **Direction:** A direction arrow or compass rose to indicate which direction is North. Normally North is at the top of the map.
 - **Date:** When was the map made.
- **watch list:** A watch list is a list of users that are watching a specific travel bug or cache. On some cache pages there is a number of users watching the cache. There is no current functionality to see who those people are.

Battery Life In GPS

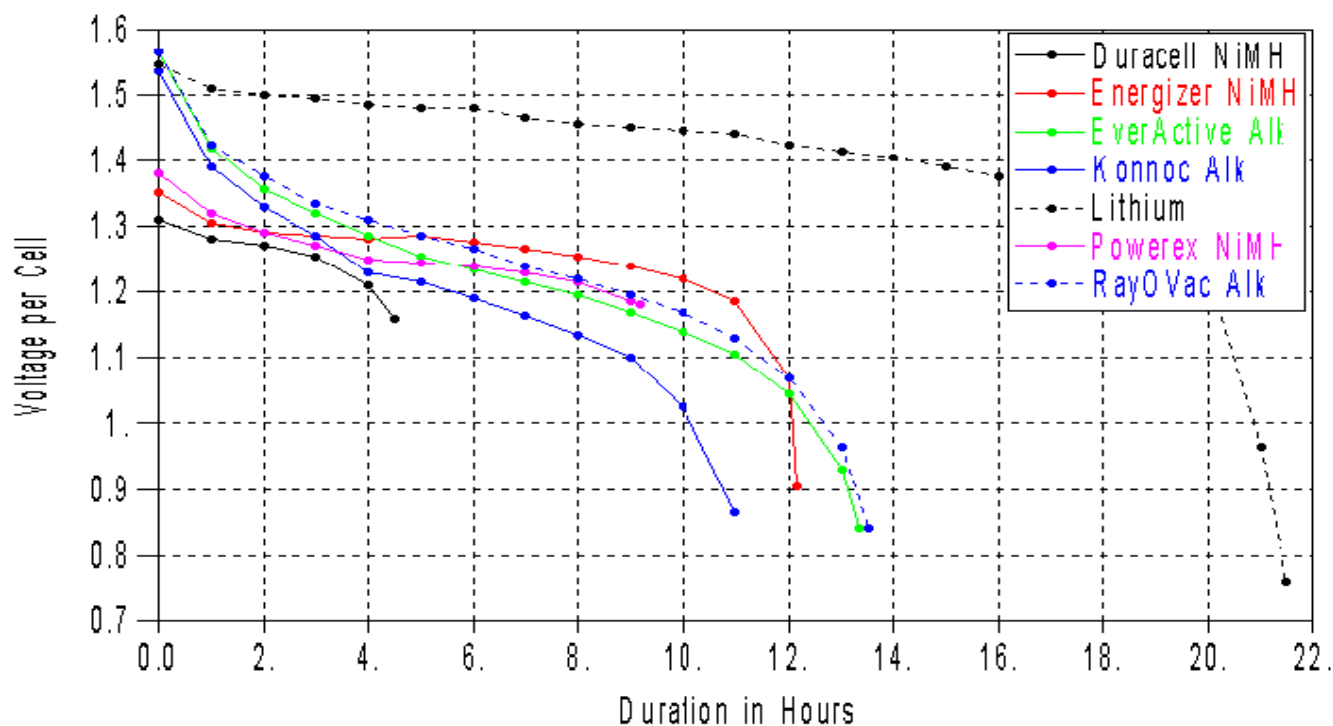
Since your GPS unit works off of batteries while in the field, it is important to have an idea of approximately how long the batteries chosen will last. One might consider using different batteries for different situations or determine the number of extra batteries needed for extended use.

GPS Battery Operational Durations for AA Cells

http://www.krabach.info/battery_tests/AA_battery_tests.html

In an effort to determine the run time of a **Magellan Sportrack Color GPS**, several different AA batteries were tested on a recording DVM, printing to a thermal printer. The voltmeter system used was a classic, HP-41 programmable calculator and HP thermal printer, attached to a Corvallis Micro Technology, Inc. CMT-300 Programmable Measurement System to measure battery voltage while the GPS was continually on with the backlighting off. *The tests were done at room temperature and may not be relevant at freezing to subzero temperatures.*

The AA alkaline and Lithium batteries were fresh from Wal-Mart and the NiMH batteries were freshly charged in a quality charger. The prices listed are approximate, depending on where you can buy them. This tests were done as the result of questioning some NiMH (commercial Duracell batteries obtained at a flea market several years ago) lasting only 4 hours, while the advertised duration was supposed to be 14 hours with alkaline batteries. The following table shows that the Lithium AA cells give the longest time with over 21 hours power, but at a severe cost of about \$4.75 per run. (The Magellan GPS requires two AA batteries for power.) The alkaline batteries, at about \$1 per run, last about the same as the Magellan 14 hour advertised life, except for the Konnoc (China) batteries (\$0.50/run) obtained in a local Job Lot store. There was no appreciable difference between the RayOVac and the Wal-Mart 'EverActive' house brand. The NiMH rechargeables were the obvious choice for long term use. The 2000 mAh lasted around 9 hours and the 2300 mAh lasted 12 hours, the latter about the same as the alkaline batteries.



Listed in Order by Duration in Hours

Amp Usage Voltage Using Backlighting

04.5 hrs -	Duracell NiMH (flea market \$1/cell)		Voltage (approx)	1.5 vdc	1.1 vdc
09.0 hrs -	Maha Powerex NiMH 2000 mAh (\$2.25/cell)		No backlighting	130 ma	160 ma
11.0 hrs -	Konnoc Alk (Ocean State Job Lot) (\$0.26/cell)		½ backlighting	180 ma	200 ma
12.0 hrs -	Energizer NiMH 2300 mAh (\$2.34/cell)	Now 2500mAh	Full backlighting	220 ma	240 ma
13.4 hrs -	EverActive Alk (Walmart) (\$0.51/cell)				
13.6 hrs -	RayOVac Alk (\$0.64/cell)				
21.5 hrs -	Energizer Lithium (\$2.34/cell)				

While these tests were run on a Magellan Sportrack Color GPS, I assume that the relative differences in run time would apply to any other handheld GPS brand.

Considerations By Steve Sewell: There are two perspectives I would think about: 1) Always try to get the most value over time, which would lead me towards high quality rechargeable NiMh, since I don't mind taking the time to recharge for normal usage like geocaching or short travels, 2) If I need to backpack extremely light for very long periods of time, I'd focus on the longest duration I could find like the Lithium. If I thought the duration was good and packing less extra batteries would outweigh the cost, then I consider paying the extra money. Another consideration is Lithium battery performance is not impacted by cold weather like other batteries, so you can trust them more.

Battery Price/Performance Comparisons for AA Batteries By Steve Sewell:

- RayOVac **Alkaline**; 8pk = \$4.67; duration = 1x; economical, hold charge over long period of time
- Energizer **Titanium**; 8pk = \$8.17; duration = 1.5x; last a little longer during use, holds charge over time
- Energizer **NiMh**; 4pk = \$11.39; duration = 1x; most economical; when stored does keep full charge, charge within a week of use,
- Energizer **Lithium**; 8pk = \$18.49; duration = 2.5x; most expensive, light wt, longest lasting, good for cold

Appendix – “B” Review and Activity Answers

1) What Is A GPS Receiver Used For

Review Questions:

1. Name some specific activities you would like to apply a GPS. *(students can share a few of their ideas like fishing, hunting, traveling on vacation, and keeping from getting lost, geocaching, determine insurance rating territories, tracking UPS deliveries (where in route), etc.*

2) GPS Glossary & Features Guide

Lat/Long Riddle: A person sets up a base camp, but needs additional supplies from a couple other locations. He travel's directly South 25 miles to pick up food for two weeks. Next he travels 25 miles directly East to obtain some additional building materials. He finally travels 25 miles directly North to reach his base camp with the needed supplies. Question: What color is the bear where he is traveling and why?

The color of the bear is white for a polar bear. There is only one spot on earth, the North Pole, that you can travel in essentially a triangle and arrive at the same spot. Only the North Pole can you always start of heading South and go in a total of three different directions and end up back at the North Pole where Polar Bears live. Other places you would have to travel in a 4 different rectangular directions to end up at the same spot.

Review Questions:

2. What is a waypoint? *A point (coordinates) of a location of interest*
3. What is a route? *A connection of waypoints for a path of travel.*
4. What can one follow to retrace you foots steps? *Use tracks or “electronic bread crumbs”*
5. What should people using a GPS carry extra of? *Batteries*

3) How Does A GPS Work

Review Questions:

6. What are the 3 parts that make a GPS work? *GPS unit, Satellites, Ground Stations*
7. How is distance from a satellite determined? *Travel time of radio signals.*
8. How many satellites signals does a GPS unit need to determine a position? *3 satellites for a position (x & y coordinates), 4 satellites for position and altitude (x, y & z), additional satellites for more accuracy*

4) Basic GPS Keys & Features

Review Questions:

With the GPS you will be using along with the owners manual and/or assistance:

9. Explain how to move to different screens and how you may use each screen. *Magellan: Nav (globe) key & X (escape) button. Garmin: Page button*
10. Explain how to create a waypoint destination (a “go to”) to any given coordinates along with saving and setting up a “go to”. *Magellan: press & release the little man (Go To) button, scroll through option, select using “Enter”. Garmin: Page to menu screen, select waypoint, press enter. For both unit, highlight the coordinates, hit enter, move left or right for each digit and up and down for each digit. The coordinates will then need to be saved.*
11. Explain how to mark a current position. *Magellan: press & hold the little man (Go To) button, cursor to and edit desired info, cursor to and save using “Enter”. Garmin: Press and hold the “Enter”, edit desired data, save*
12. Though you may need to move around obstacles the goal is for the heading and bearing degrees to measure the _____. *As soon as you get around any obstacles get the heading and bearing the same.*

5) How to Use a Magnetic Compass and Map

Review Questions:

13. What does one do to navigate SSW from a current location? Line up SSW (203 deg) with the red arrow. Then keeping the North needle lined up with the North orienting arrow, walk in the direction the red arrow is pointing?
14. Explain the 4 steps in navigating using a compass and map?
 - Align compass edge with point A & B in the same direction or the red arrow
 - Line up the compass housing lines to the North,
 - Rotate map and compass exactly together to line up the red North needle point North.
 - Follow the red arrow
15. If a maps declination is 5 degrees West, what should you do to correct? Plus 5 deg to compass reading
16. What might one need to do to avoid an obstacle? Take a heading(s) to point(s) around the obstacle and reestablish a new bearing to point B
17. What can keep changing as you head in the same direction? Your bearing to you destination if the heading and bearing are not the same

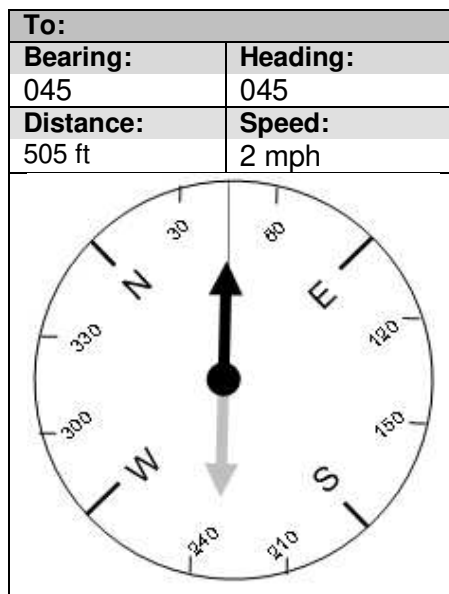
6) Basic GPS Navigation

Review Questions:

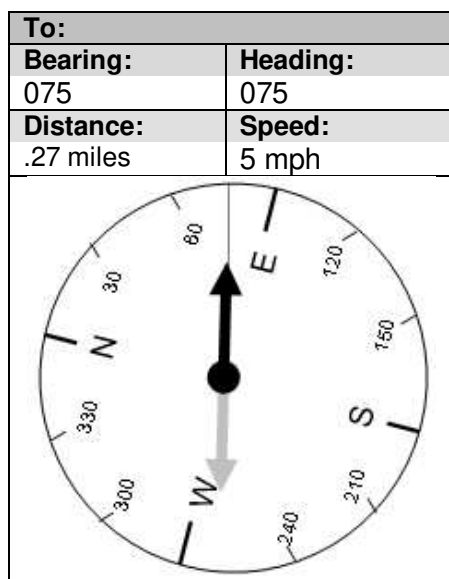
18. Which part of the GPS compass represents the direction of travel and the destination? Which is named the bearing and heading? The outer circle represents the degrees of heading. The needle represents the degrees of bearing.
19. What should equal as you approach closer to your destination? Bearing & heading

Activity #1- “Duck Blind in the Fog” (Indoors):

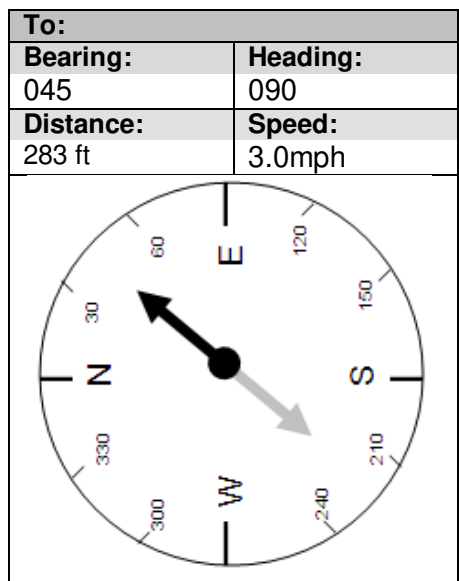
Scenario Part #1:



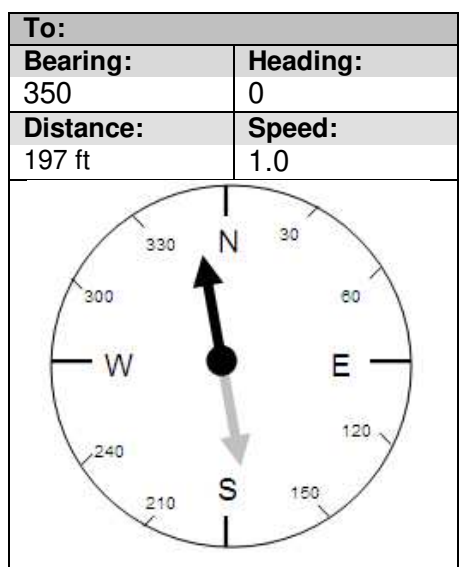
Scenario Part #2:



Activity #2 – “The Big Dipper Cache” (Indoors):
Scenario Part #1:



Scenario Part #2:



7) Waypoint Averaging for Accurate Navigation

Review Questions:

20. Due to potential error of any one marked position, one must.....? [Average at least a few way points at different times or days.](#)

8) Three Leaf Clover Search Method

Review Questions:

9) Intersecting “Virtual Lines” Search Method

Review Questions:

21. Name at least three key things to keep in mind when you need to use the method of using a virtual line to a bearing. [First get into a clearing with good satellite signal at least 50 feet away, try a walking a few approaches until heading and bearing equal, draw a virtual line along the same heading noting objects that could be candidates at about the right distance, do the same 1 or 2 more time at angles greater the 60 degrees if at all possible.](#)

10) Offset Waypoint Search Method

Review Questions:

22. One must walk in a straight line and keep the GPS _____ to direction just walked to estimate a bearing from particular standing coordinates. [“oriented” \(the only exception would be if the GPS has an electronic compass that reacts like a magnetic compass\)](#)
23. It is desired to reach an offset destination from coordinates that are given. The bearing is 340 degrees from those coordinates to the offset destination. For what ever reason you can not start at the given coordinates. What math should be performed be on top of the offset destination? What angle of approach should be taken. [Subtract 180 degrees. 160 degree angle of approach.](#)
24. Can you think of other applications for an offset cache? [Military when it's unsafe to get coordinates of target, Direction of pipe or wire underground from a clear marker,](#)

11) The Sport of Geocaching

Review Questions:

25. Name two ways to identify the details of the surrounding area of a cache one would like to find? [Buy a map of area OR look online through geocaching.com or Google maps.](#)
26. Some of the things mentioned in finding a cache could be considered safety issues. When looking for a cache, list at least 4 things that can be safety considerations in preparation for heading out to the cache? [Go with a buddy, Keep aware of surrounding, Take/drink water, Let someone know where you will be, Take a map, Take a compass, Mark location of your car for the return,](#)
27. When you take an item from a cache, you should? [Leave an item \(exchange items\)](#)
28. Leave the cache exactly where? [it was found, exactly](#)

12) Starting Your Geocaching.com Account

Review Questions:

29. Think of a user name to start your Geocaching.com account? Have a few additional ideas in case the first is taken. [\(self answered\)](#)

13) Geocaching Research – Internet Methods

Review Questions:

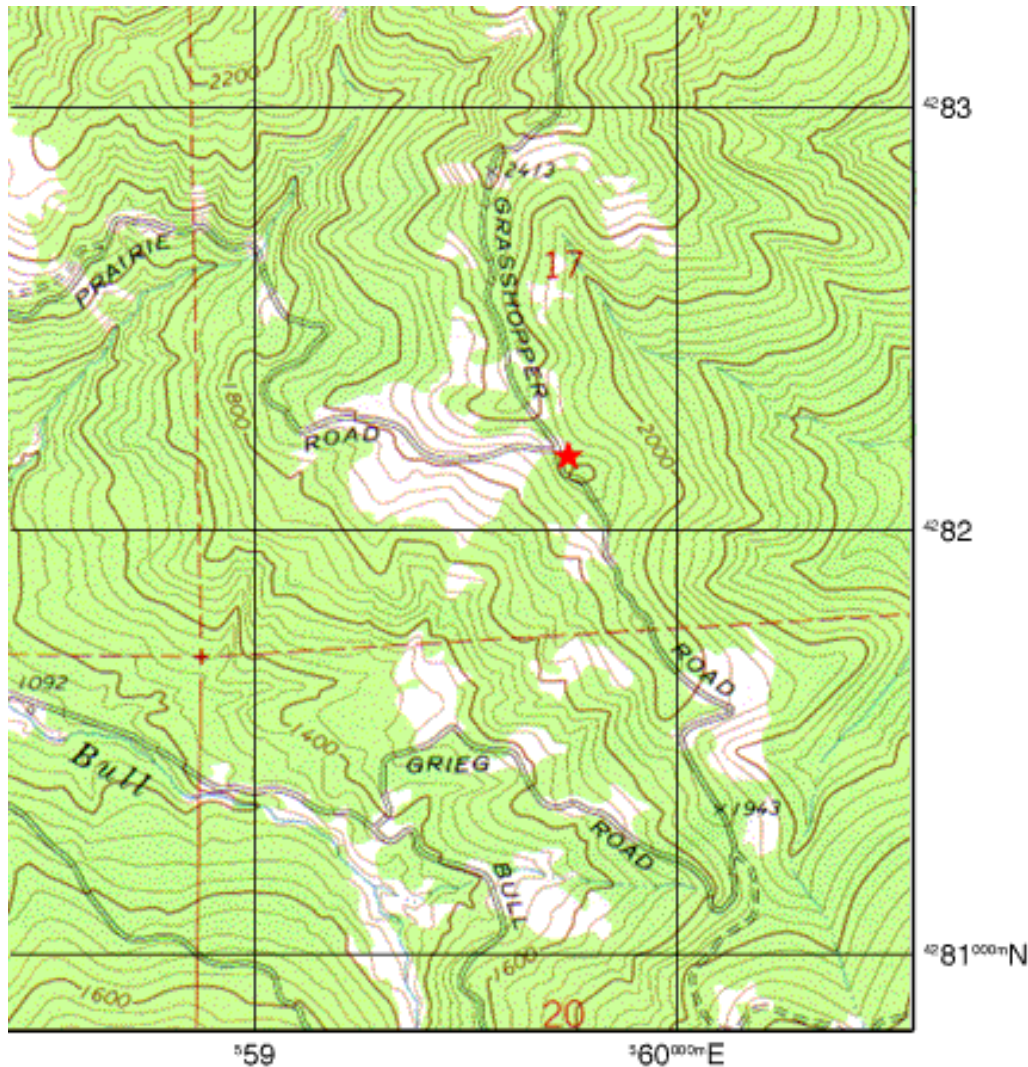
30. Name and briefly explain the purpose of the steps to search caches when you know the coordinates.
- Step 1 – Obtain GPS Coordinates** - need coordinates of where to base geocaching
 - Step 2 – Enter GPS Coordinates @ Geocaching.com** – entered coordinates for search
 - Step 3 – Study the List of Caches** – how far way, how challenging, which direction, when last found
 - Step 4 – Read Details of Caches** – study details to make quicker finds
31. Name and briefly explain the purpose of the steps to search caches starting with an address. ???
- Step 1 – Search For Location on Google Maps** – when you don't have coordinate
 - Step 2 – Examine the Google Maps Results** – study the map to identify areas of interest
 - Step 3 – Zoom In & Center Desired Location** – narrow the map area that coordinates will be based on
 - Step 4 – Obtain Coordinates from Link** – actual decimal coordinates can be obtained from “link to this page”
 - Step 5 (Option #1) – Enter Decimal Coordinates @ Geocaching.com** – use Geocaching.com directly to avoid other sites OR
 - Step 5 (Option #2): See Different Formats of Coordinates** – be able to copy paste into the converter to see all versions of coordinates, confirm map area, and link directly into Geocaching.com for the same coordinates without reentry.

14) GPS Map Software

Review Questions:

32. What are some benefits of using software for your GPS. Copy paste coordinates from website into software, plan the route for a trip, identify where you've been on a hike to save for a later time, the screen is bigger and easier to see and study, share files with friends,

Appendix – “C” Universal Tranverse Mercator (UTM)



A Quick Guide to Using UTM Coordinates
[\(http://www.maptools.com/UsingUTM/\)](http://www.maptools.com/UsingUTM/)

Standing at the road junction marked with the star on the topographic map pictured above, a GPS unit set to display position in UTM coordinates, would report a location of:

**10 S 0559741
4282182**

The **10 S** represents the zone you are in. The zone is necessary to make the coordinates unique over the entire globe.

The top set of numbers, **0559741**, represent a measurement of East-West position, within the zone, in meters. It's called an Easting.

The bottom set of numbers, **4282182**, represent a measurement of North-South

position, within the zone, in meters. It's called a northing.

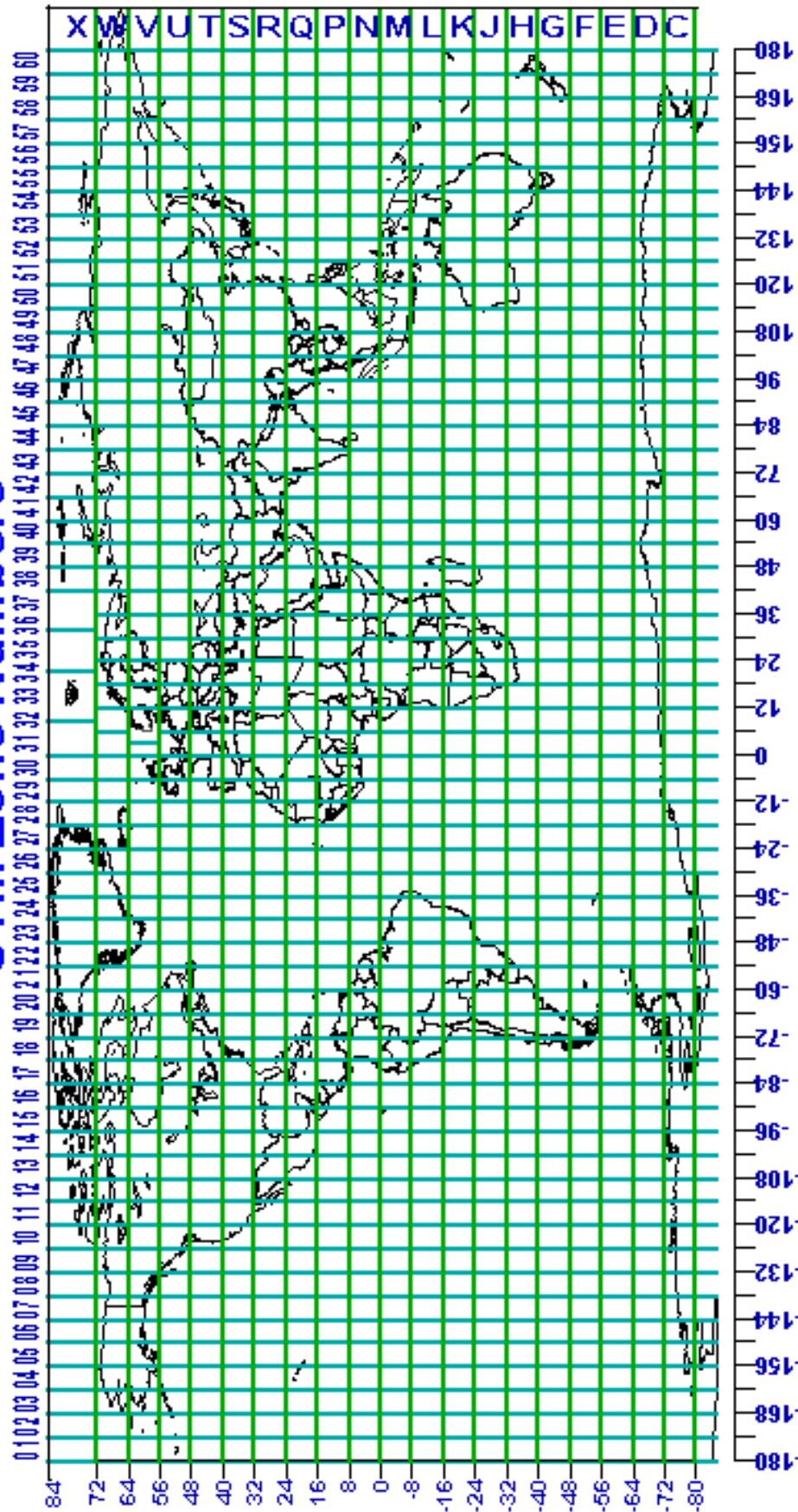
The map has Universal Transverse Mercator (UTM) grid lines spaced every kilometer or 1000 meters. The vertical grid lines determine East-West position and the horizontal grid lines determine North-South position.

Look along the bottom edge of the map at the labels for the vertical grid lines.... 559 and 560000 mE.

The label, 560000 mE., reads "five hundred and sixty thousand meters East." The label, 559, is an abbreviation for, 559000 mE. The two grid lines are 1000 meters apart. The horizontal grid lines are labeled in a similar manner.

UTM Zone Designators

UTM Zone Numbers



Universal Transverse Mercator (UTM) System

Peter H. Dana 9/7/94

Why Use UTM Coordinates

The UTM coordinate system offers the following benefits:

A square grid

UTM Provides a constant distance relationship anywhere on the map. In angular coordinate systems like latitude and longitude, the distance covered by a degree of longitude differs as you move towards the poles and only equals the distance covered by a degree of latitude at the equator. Since land navigation is done in a very small part of the world at any one time using large scale maps. The UTM system allows the coordinate numbering system to be tied directly to a distance measuring system.

No negative numbers or East-West designators

Grid values increase from left to right and bottom to top

This is just like the X Y Cartesian coordinate system you learned high school math class. Simple Cartesian coordinate mathematics can be used. No spherical trigonometry is required!

Coordinates are decimal based

Ones, tens, hundreds and so on. No more minutes and seconds to convert.

Coordinates are measured in metric units

All UTM coordinates are measured in meters. Most of the world has already adopted the metric system. Now you won't need to remember how many feet are in a mile. And what's that in yards?

Shorthand for UTM Coordinates

Most land navigation activities focus on a very small portion of the globe at any one time. Typically the area of interest to an outdoorsman is less than 20 miles on a side. This focus on a small area allows us to abbreviate UTM coordinates.

The zone information and the digits representing 1,000,000m, and 100,000m are dropped. The 1m, 10m and 100m digits are used only to the extent of accuracy desired.

A GPS unit might read

**10 S 0559741
4282182**

Using a notation similar to the one found on a USGS topographic map, this would be written as:

Zone 10 S 559741 mE. 4282182 mN.

An abbreviated format for the same coordinates would look like:

The 100m abbreviated format, **597 821**, and the 10m abbreviated format, **5974 8218**, are the most commonly used.

59 82	Describes a 1000m by 1000m square.
597 821	Describes a 100m by 100m square.
5974 8218	Describes a 10m by 10m square.
59741 82182	Describes a 1m by 1m square.

Notice that the easting is reported first, followed by the northing. Remember the phrase "read right up" to help you remember to read the easting from left to right, followed by the northing from the bottom up.

Also notice that when you abbreviate coordinates you should not do any rounding. **0559651** becomes **596** not **597**. This ensures that your position is still within the reported square. As accuracy decreases, the square gets bigger.

Using a UTM Corner Ruler

A UTM Corner Ruler consists of two scales at right angles to each other. UTM Corner Rulers will typically provide an additional digit of precision beyond a UTM Grid Overlay. On a 1:24,000 scale map you will be able to determine a position to within a 10m square. The trade off is that the Corner Ruler is somewhat harder to use.

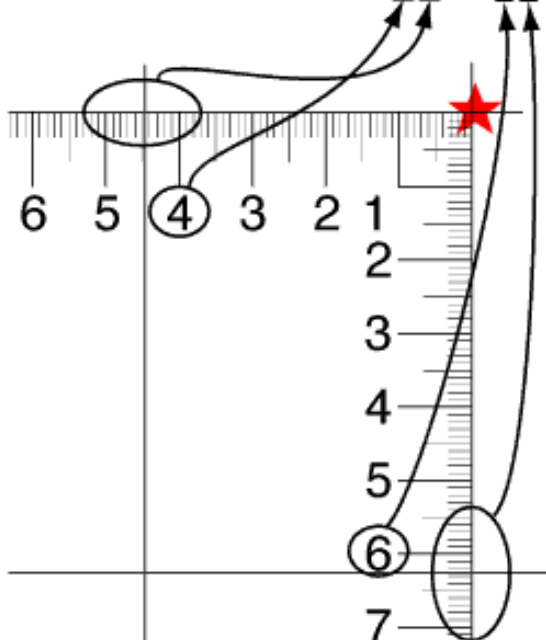
Start by placing the top right corner of the Corner Ruler on the SW corner of the UTM grid that contains the feature. The ruler edges should extend to the West and South. To find the UTM coordinates of a feature marked on your map slide the rulers North and East until the corner is on top of the feature to be measured. Read the UTM coordinate values from the starting grid lines. To locate a UTM coordinate on the map slide the ruler North and East until the desired distances are indicated at the grid lines.

If the grid square you are using is on the edge of your map, you may need to start from a corner other than the southwestern one. You can still use the corner ruler, remember that UTM coordinate values increase from West to East and from South to North.



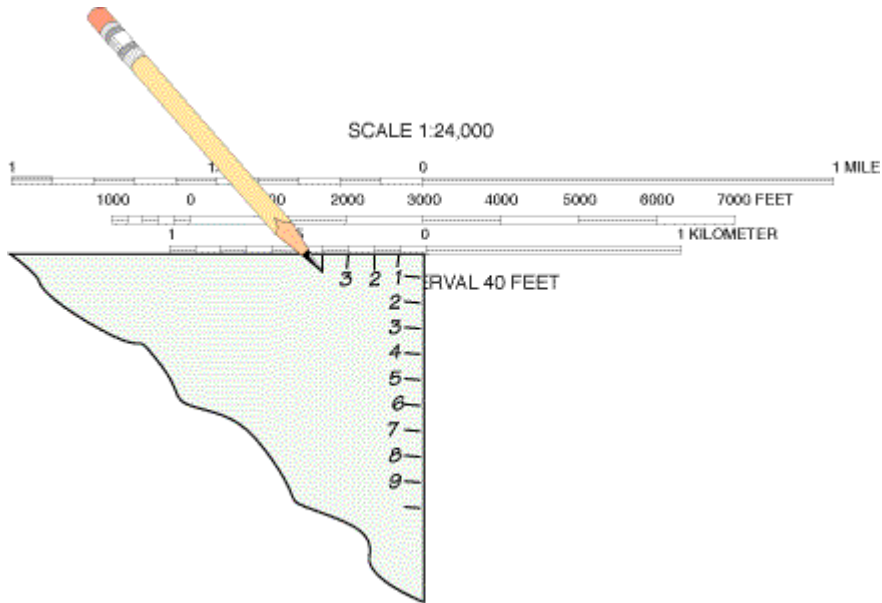
You should return to the [exercise](#) and try it using a 1:24,000 scale UTM Corner Ruler.

The ★ is located at **5945 8163**



If you are using an odd scaled map or if you left your UTM tools behind, you can quickly make a simple corner ruler using the scale bars on the map.

Start with the corner of a scrap of paper. Mark off a one kilometer distance and the 100m subdivisions using the metric scale bar. Repeat this process along the other edge. Number both rules starting from the corner which would be zero.



Overlays containing UTM corner rulers for several different map scales are available from [MapTools](#).

Practice Map

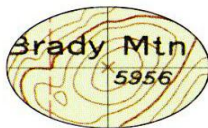
8

Using the map on the following pages, answer these questions. Try using the grid tool in the back, an improvised ruler made using the scale bar, and any other 1:24,000 scale tools you have. Answers follow the map.

Determine coordinates for the following locations:

What map features are located at the following coordinates?

#1



Brady Mtn

#9 707.39km E 4358.03km N

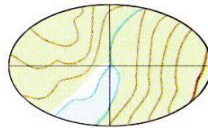
#2



Grouse Ridge
x7181

#10 708883m E 4358712m N

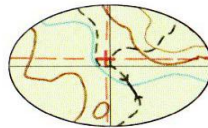
#3



North end of
Lake Spaulding

#12 10S 0708032
UTM 4359711

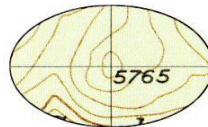
#4



Trail junction of
Grouse Ridge and
Beyers Lake trails

#13 707.78km E 4358.77km N

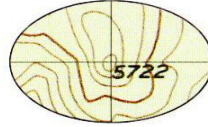
#5



Knoll marked
x5765

#14 706.30km E 4360.59km N

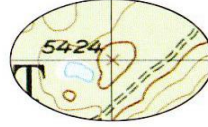
#6



Knoll marked
x5722

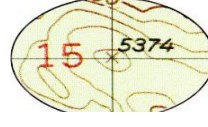
#15 704.69km E 4357.82km N

#7



Knoll marked
x5424

#8



Knoll marked
x5374

1:24,000



Answers to the Map Problem

Determine coordinates for the following locations:

#1 706.59km E 4358.62km N
or
706590m E 4358620m N

#2 704.88km E 4360.38km N

#3 705.32km E 4358.34km N

#4 708.03km E 4359.34km N

#5 708.82km E 4359.87km N

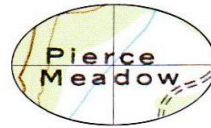
#6 708.40km E 4358.05km N

#7 709.20km E 4357.28km N

#8 705.82km E 4356.89km N

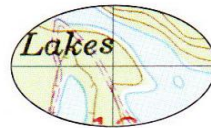
What map features are located at the following coordinates?

#9



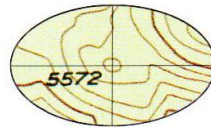
Pierce Meadow

#10



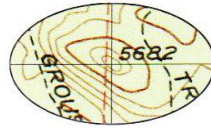
Eagle Lakes

#11



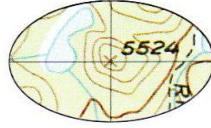
Knoll marked
x5572

#12



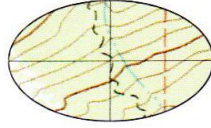
Knoll marked
x5682

#13



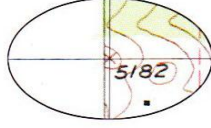
Knoll marked
x5524

#14



Grouse Ridge Trail
switchbacks

#15



Knoll marked
x5182

Answers are shown with 10m precision, for the benefit of folks using a tool marked with a 10m interval. The grid tool in the back of this book, and hand made rulers are only marked at 100m intervals. In this case you can estimate the 10m digit, or just leave it off. The answer to #1 would become 706.5km E 4358.6km N or 706500m E 4358600m N. You may also have decided the easting should be 706.6km, it is, after all, right on the line.

Appendix – “D” Scouting Geocaching Merit Badge Requirements

Geocaching merit badge requirements

<http://meritbadge.org/wiki/index.php/Geocaching>

1. Do the following:
 - a. Explain to your counselor the most likely hazards you may encounter while participating in geocaching activities and what you should do to anticipate, help prevent, mitigate, and respond to these hazards.
 - b. Discuss first aid and prevention for the types of injuries or illnesses that could occur while participating in geocaching activities, including cuts, scrapes, snakebite, insect stings, tick bites, exposure to poisonous plants, heat and cold reactions (sunburn, heatstroke, heat exhaustion, hypothermia), and dehydration.
 - c. Discuss how to properly plan an activity that uses GPS, including using the buddy system, sharing your plan with others, and considering the weather, route, and proper attire.
2. Discuss the following with your counselor:
 - a. Why you should never bury a cache.
 - b. How to use proper geocaching etiquette when hiding or seeking a cache, and how to properly hide, post, maintain, and dismantle a geocache.
 - c. The principles of Leave No Trace as they apply to geocaching.
3. Explain the following terms used in geocaching: waypoint, log, cache, accuracy, difficulty and terrain ratings, attributes, trackable. Choose five additional terms to explain to your counselor.
4. Explain how the Global Positioning System (GPS) works. Then, using Scouting’s Teaching EDGE, demonstrate the use of a GPS unit to your counselor. Include marking and editing a waypoint, changing field functions, and changing the coordinate system in the unit.
5. Do the following:
 - a. Show you know how to use a map and compass and explain why this is important for geocaching.
 - b. Explain the similarities and differences between GPS navigation and standard map reading skills and describe the benefits of each.
 - c. Explain the UTM (Universal Transverse Mercator) system and how it differs from the latitude/longitude system used for public geocaches.
 - d. Show how to plot a UTM waypoint on a map. Compare the accuracy to that found with a GPS unit.
6. Describe the four steps to finding your first cache to your counselor. Then mark and edit a waypoint.
7. With your parent’s permission*, go to www.Geocaching.com. Type in your zip code to locate public geocaches in your area. Share the posted information about three of those geocaches with your counselor. Then, pick one of the three and find the cache.

* To fulfill this requirement, you will need to set up a free user account with www.Geocaching.com. Ask your parent for permission and help before you do so.

8. Do ONE of the following:

- a. If a Cache to Eagle® series exists in your council, visit at least three of the 12 locations in the series. Describe the projects that each cache you visit highlights, and explain how the Cache to Eagle® program helps share our Scouting service with the public.
- b. Create a Scouting-related Travel Bug® that promotes one of the values of Scouting. "Release" your Travel Bug into a public geocache and, with your parent's permission, monitor its progress at www.geocaching.com for 30 days. Keep a log, and share this with your counselor at the end of the 30-day period.
- c. Set up and hide a public geocache, following the guidelines in the Geocaching merit badge pamphlet. Before doing so, share with your counselor a six-month maintenance plan for the geocache where you are personally responsible for the first three months. After setting up the geocache, with your parent's permission, follow the logs online for 30 days and share them with your counselor.
- d. Explain what Cache In Trash Out (CITO) means, and describe how you have practiced CITO at public geocaches or at a CITO event. Then, either create CITO containers to leave at public caches, or host a CITO event for your unit or for the public.

9. Plan a geohunt for a youth group such as your troop or a neighboring pack, at school, or your place of worship. Choose a theme, set up a course with at least four waypoints, teach the players how to use a GPS unit, and play the game. Tell your counselor about your experience, and share the materials you used and developed for this event.