

GPS and Geocaching

The Global Positioning System:

The **Global Positioning System (GPS)** is a constellation of artificial **satellites** that are uniformly distributed in a total of six orbits around the Earth. This ensures that at least four (and usually eight or more) satellites can be simultaneously seen at any time from almost anywhere on Earth. The GPS satellites circle the Earth at an altitude of about 13,000 miles and complete two full orbits every day. The GPS satellites are not in a geostationary orbit, but rise and set two times per day. Each satellite **broadcasts radio waves** towards Earth that contain information regarding its position and time. We can receive this information by using special receivers, called GPS receivers, which can detect and decode this information.

Each GPS device is a computer that contains a GPS receiver chip which senses signals broadcast from GPS satellites. A device needs to read signals from at least three satellites at a time to calculate its general location by a process called **trilateration**. A GPS device receives the radio signals, noting their exact time of arrival, and uses these to calculate its distance from each satellite in view.

With signals from four satellites, a GPS receiver can get an accurate fix that includes altitude and the exact time, as well as latitude and longitude. The more satellite signals the receiver reads, the more accurate the position it reports to you. By combining signals transmitted by several satellites and received simultaneously, a GPS receiver can calculate its position on the Earth (i.e., its latitude and longitude) with an accuracy of approximately 6' to 30', with the most current models having an accuracy of about 1'. There are even more sophisticated receivers that can be used to determine position with an accuracy of quarter inch.

Geocaching:

Geocaching is an outdoor recreational activity, in which the participants use a GPS device to hide and seek containers, called "geocaches" or "caches", anywhere in the world. Participants navigate to a specific set of GPS coordinates and then attempt to find the geocache hidden at that location.

A typical cache is a small waterproof container containing a logbook where the geocacher enters the date they found it and signs it with their established code name. After signing the log, the cache must be placed back exactly where the person found it. Larger containers such as plastic storage containers (Tupperware or similar) or ammunition boxes can also contain items for trading, usually toys or trinkets of little value. If you take an item, be sure to leave something else behind.



Geocaching Basics:

Geocaching starts by entering in the coordinates of a geocache into a GPS enabled device. This can be a dedicated GPS device, Smartphone, or even a GPS enabled tablet. You can find the GPS coordinates online. Smartphone apps or your GPS device's interface will let you enter the coordinates into your GPS devices. Then you can and head out to find the hidden caches!

There are several websites with searchable Geocache databases and an app on your smartphone will even let you discover caches right from your phone. If you don't have a geocaching app on your phone you can enter the coordinates right into any map app, like Google Maps, too. If you have a GPS device,

Geocaching Etiquette:

- Abide by all laws, ordinances, and regulations
- Always respect others and their property
- Heed any signs that read "No Trespassing"
- Replace the cache container as you found it (unless it is obviously exposed) and leave a cache location ready for the next Geocacher so that they will have a great experience, too
- Notify the Cache Owner if the container is in need of attention (email, Needs Maintenance log, etc)
- Beware of *Muggles* and protect the integrity of the container's hiding spot
- Avoid creating a public disturbance
- Don't sign the log over someone else's name
- If you take something, leave something (equal or better value)
- Keep trading items family friendly and safe for all ages
- Be kind to the environment
- Pick up trash as you cache
- Move trackables according to their goal or mission.
- Promptly log that you picked up a trackable from a cache so that others know it's no longer there

Geocaching Resources:

Geocaching.com – <http://www.geocaching.com/>

OpenCaching Network – <http://www.opencaching.us/>

TerraCaching – <http://www.terracing.com/>

Geocaching Terms

Geocache or Cache

A hidden container housing a log book and trinkets, logged on the website.

Geocachers or Cachers

People that look for caches.

Muggles

People who are not geocachers and know nothing about geocaching.

Travelbug or Geocoins

These are special *trackable* items. If you find one of these, or any other trackable item, be sure to log its ID code and place it in another cache as soon as possible. You can see everywhere in the world that item has been!

NaviCache – <http://navicache.com>

GPS Games – <http://gpsgames.org/>

Geocaching Phone Apps:

You don't need a dedicated GPS device to go Geocaching. Modern smartphones have a built-in GPS receiver. You can download an app that will help you discover where there are hidden geocaches in your area. They'll give you the coordinates, information about the geocache, and even let you log your visit! There are a quite a few apps available, but here are a few recommendations.

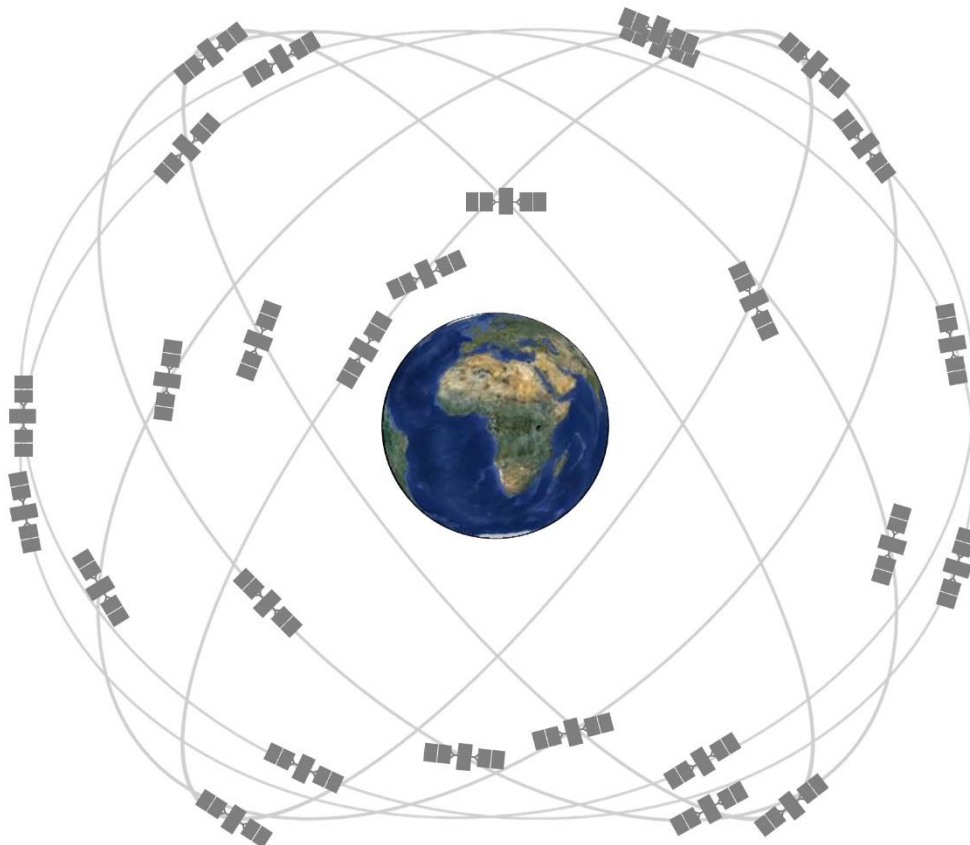
Geocaching – Geocaching.com has a dedicated app for both Android and iOS that syncs directly with the website. The app is free, but limits the caches you can get information about. There is a premium subscription available. Search for “Geocaching” on Google Play or the App Store.

c:geo – c:geo is a free, open source geocaching app for Android that syncs with multiple geocaching platforms, including Geocaching.com, Opencaching, Extremcaching, and more. Search for c:geo on Google Play or go to <http://cgeo.org>

Cachly – Cachly is an iOS app that has a one-time fee, but has a bunch of features. Search for Cachly on the App Store or visit <http://cach.ly>

GeoCaches – GeoCaches is a very simple iOS app for finding Geocaches. It lacks a lot of the features of the other apps, but is free. Search for GeoCaches on the App Store.

There are plenty of other geocaching apps, too. Some are free and some have a fee. They all offer a variety of features and support for the different platforms. You'll want to have an account on Geocaching.com or another geocaching platform to use these apps. Also, if you don't have a premium subscription to Geocaching.com you may be limited to how many caches you can get full details on per day (things like other geocachers' notes, hints, etc.).



GPS Satellites orbit Earth, sending signals that GPS receivers can use to determine their location.

Other Uses for GPS:

Other GPS games, similar to Geocaching include Benchmarking (finding USGS survey markers), Shutterpotting (finding the exact location that a photograph has been taken), Geodashing (a race using GPS waypoints to designate the path), Geohashing (<http://wiki.xkcd.com/geohashing/>), Wherigo (interactive, real-world adventures using a GPS device), Waymarking (using a GPS to find interesting locations), and more! And even within Geocaching there are a bunch of different types of caches to find and games to be played.

GPS many more practical applications besides Geocaching and games, too. The most common use is navigation purposes in vehicles like cars, but there are many other applications of GPS technology as well. Some additional applications of GPS technology include:

Farming – GPS sensors can be attached to tractors. These sensors can help with navigation at night and during periods of poor visibility. In addition, soil sensors and other monitors can also help pinpoint locations where changes in watering, fertilization or weed control are necessary in the farmers' fields.

Lost Pets – Several companies sell collars for the family pet that can track an animal's whereabouts and even monitor its heart rate and temperature to make sure it is safe.

Robotics – Self-navigating, autonomous robots can use GPS sensors to calculate latitude, longitude, time, speed, and heading.

Navigation – GPS Navigation is not only used in cars, but also by airplanes, boats, and trucks. GPS can also be used to track the exact location of trains and other vehicles.

Astronomy – GPS can be used to help astronomers calculate exactly where their telescopes are located and what they are looking at.

Surveying – Surveyors use absolute locations to make maps and determine property boundaries.

Tectonics – GPS enables scientists to measure how the earth moves along fault lines during earthquakes.

Biology – Scientists can use GPS for tracking animals during migration.

Exercising – GPS enabled watches can track a jogger or biker's path. It can also be used to calculate information like distance and average speed. When used with other tools, like heart-rate monitors they can be used to calculate calories burned and other health information.

Public Safety – GPS devices can be embedded in cell phones, automobile safety systems (like OnStar), and other tools to help with public safety. In the event of an emergency the devices can help police and rescuers find people that are hurt or in danger.

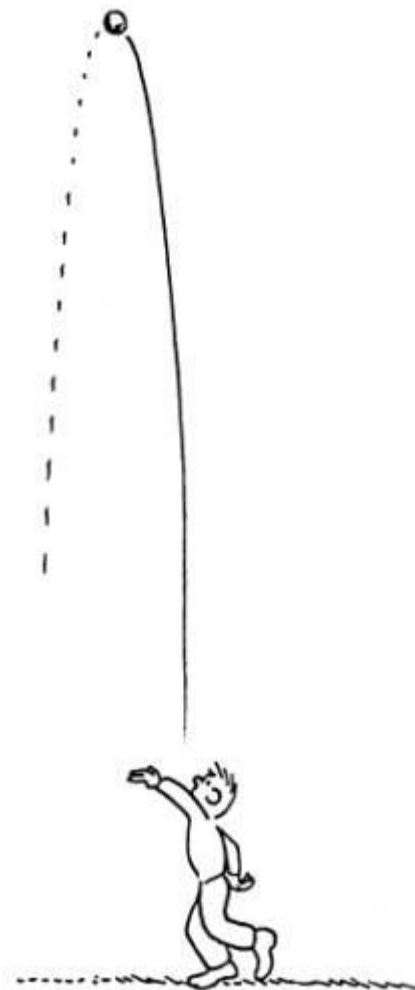
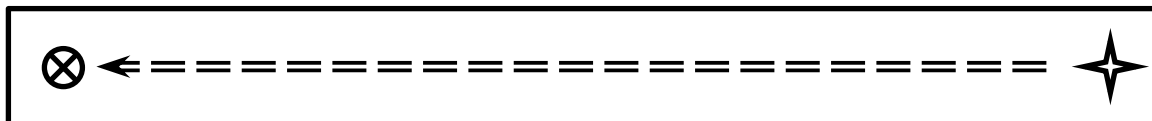
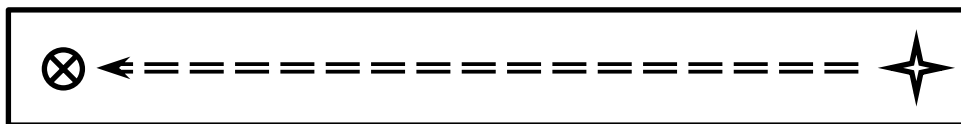
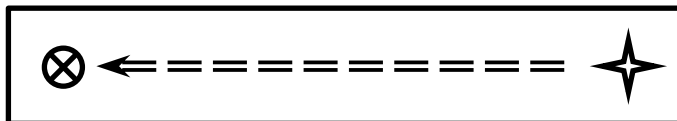
For more information about real-world applications for GPS technology, other than Geocaching, visit <http://www.gps.gov/applications/>

Demonstration:

You can throw a ball in the air to demonstrate how the GPS can determine how long it takes to receive the satellite's time-stamped message increases. As the distance increases, the time the ball is in the air increases. Similarly, the longer it takes for your GPS receiver to receive the signal from the satellites, the further away those satellites are. Your GPS device uses that calculated distance to determine its precise location.

Project:

Trace and cut out the shapes below, or use string, pipe cleaners, or sticks of these lengths. They will represent the signals coming from different satellites. On the picture of Earth and the satellites on the next page you can see how a GPS device that knows its distance from different satellites can determine its location on the Earth. Try placing the strips on the picture so that the \star symbols are each on a different satellite and the \otimes symbols overlap somewhere on the Earth (the location of the GPS device).





Using signals sent from satellites, GPS devices can pinpoint their location on the Earth.

This worksheet was prepared with information gathered from Geocaching.com, Wikipedia, GPS.gov, and other places on the internet.

Our Geocache Locations:

For this project we've hidden 6 Geocaches for you to find. These caches are all hidden along the DeKalb Nature Trail, including the branch that heads off toward the NIU East Lagoon. If you find all 6 Geocaches you'll hike about 1.25 miles. The Geocaches are near the trails and you won't have to walk far off the path, however be aware of these potential hazards:

- Poison Ivy – we were careful to place caches in clear areas, but there is some poison ivy along the trails in some spots, so be aware. Leaves of three, let them be!
- Burs – there are some burdock plants in the area. These are harmless, but do contain burs that can easily get caught in clothing and hair and are somewhat difficult to remove.
- Thorns – there are several plants in the area that have thorns, including wild roses, wild raspberries, hawthorn, buckthorn, and others.
- Animals – most wild animals that you'll encounter will be harmless if left alone, but if an animal looks sick or distressed, give it extra space and stay cautious.
- Litter – there is sometimes litter along these trails that may include broken glass, sharp metal, or other hazardous materials. Please be cautious.

These are not publicly listed Geocaches, so you cannot find them on Geocaching.com. They are private, just for this event. Therefore, you must enter these coordinates manually into your GPS unit or phone. The easiest way to do this on a phone is to just enter the coordinates in Google Maps, or use the links or QR Codes to go directly to the cache coordinates. When entering coordinates, do not include any symbols (degrees or minutes), so for the first coordinates, search for *N 41 55.751 W 088 45.880*.

DeKalb has a bunch of fun things to find. Keep your eye out for these and more while you're searching for geocaches!



Geocache 1

N 41° 55.674' W 088° 45.841'

<https://goo.gl/maps/iSW9xufcpGbApY3M7>

Found:



Frisbee golf is popular in Prairie Park. You may see some golfers throwing their discs!



Geocache 2

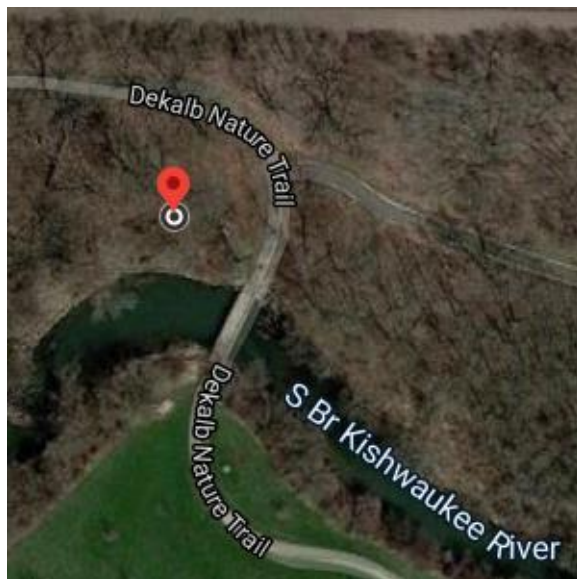
N 41° 55.751' W 088° 45.880'

<https://goo.gl/maps/Mqwf4Qjw6m7tYp3cA>

Found:



This cache is just past the bench overlooking bridge that crosses the South Branch of the Kishwaukee River. Look at the big shagbark hickory tree across the trail!



Geocache 3

N 41° 55.744' W 088° 45.830'

<https://goo.gl/maps/7YjHPiHcRXCoikTr6>

Found:



There are a lot of large trees in the area that provide homes to many different birds, squirrels, chipmunks, and other animals.



Geocache 4

N 41° 55.765' W 088° 45.618'

<https://goo.gl/maps/3C3Kj9i33sDkH77SA>

Found:



The trail crosses under the train tracks here. Do you see a strange face looking at you from the shield that protects the trail from debris that may fall from the tracks?



Geocache 5

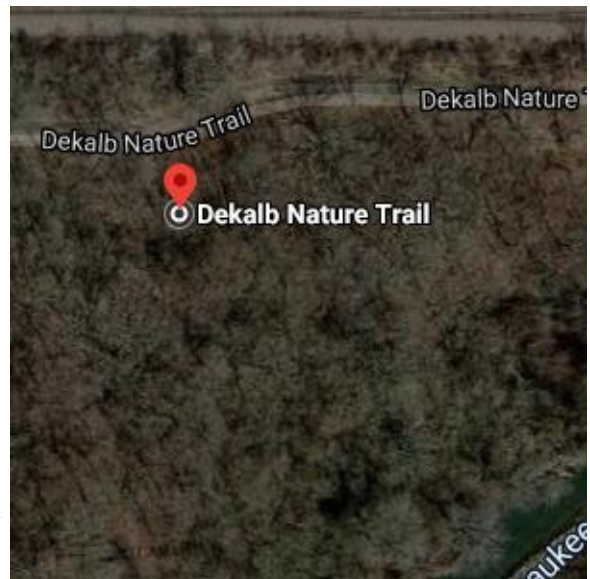
N 41° 55.754' W 088° 45.992'

<https://goo.gl/maps/1x9m2YPwuU7LbTiV7>

Found:



Look for a path that leads south off the main trail. There are many trails that criss cross these woods if you'd like to explore.



Geocache 6

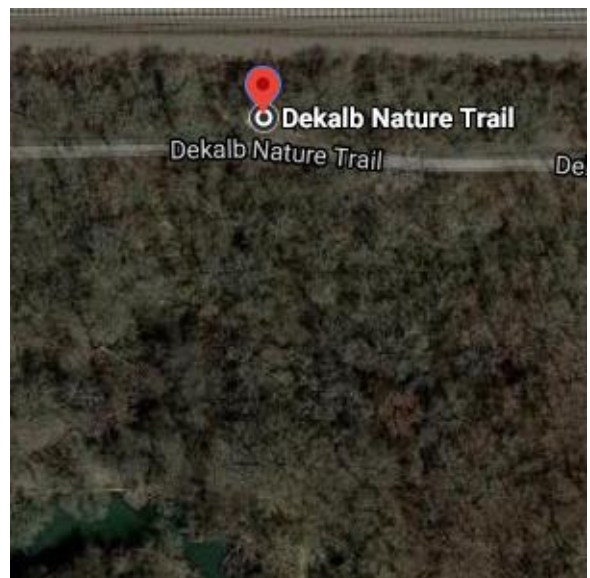
N 41° 55.769' W 088° 46.064'

<https://goo.gl/maps/djiCbYzMgnodQwxf9>

Found:



Look for the Treebeard wizards carved in the trees nearby!



Hints:

These hints will help you find the Geocaches if you need a little assistance. **Only read these if you need help!**

Geocache 1: In the roots of this tree is a perfect little hiding spot.

Geocache 2: Look for the rotten log. You may need to move some pieces of rotten wood!

Geocache 3: Look inside the V of the tree. An adult may need to help.

Geocache 4: Look for a pile of branches near some old railroad ties.

Geocache 5: A short way off the main trail on a smaller side trail you'll find a tangle of branches with the cache hidden within.

Geocache 6: Behind a larger tree with an interesting hole, you'll find the cache!



Geocache 1



Geocache 2



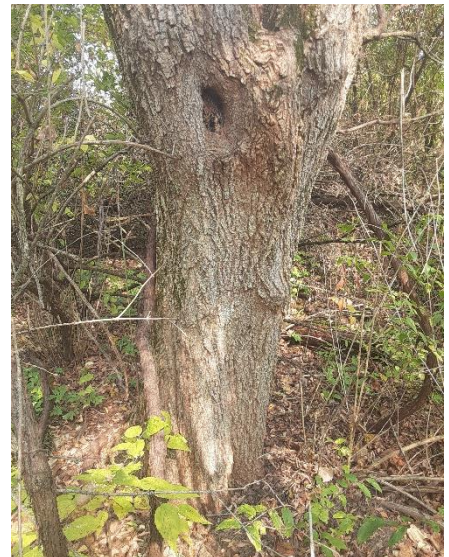
Geocache 3



Geocache 4



Geocache 5



Geocache 6