

March 6, 2009 - UCET Conference

GEOCACHING & GPS IN THE CLASSROOM

Geocaching Fact:

Worldwide, there are currently 750,000 active caches & 65,000 active geocachers.



Geocaching can be educational in so many ways...

HOW CAN I USE GPS/GEOCACHING IN S MY CLASSES???

data collection, discovery learning, self-guided tours, travel bugs, earth caches, area/perimeter calculation, historical tours, asynchronous story creation, calculate slope, team building, puzzle solving, map creation...

GPS technology can be an amazing tool for education. There are so many different applications and ways to implement this into your classroom instruction, no matter what you teach. I have been compiling a list of ways to use this tool in teaching, and so far I have 54 different ways to use GPS in instruction. The list is by no means complete. I will continue to add to it as ideas come along. For the most up-to-date list of ideas, please visit this website:

<http://edublog.sedck12.org/gps.php>

Math:

- Calculate the perimeter or area of your school or other large area - you could even use the area calculation to estimate the volume of water that hits that area during a 1" rainstorm!
- Calculate the slope of a hill, using the trip information page. It will show you how far you have walked, and you can note the change in elevation. After that,



Creative Cache Containers

This is a photo of the most creative "container" I have ever seen. Container creation could be a great art or shop project!

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let the power of the Pythagorean Theorem guide you!

- Magic of Nine (GCGJPT) Geocache (http://www.geocaching.com/seek/cache_details.aspx?wp=GCGJPT).

Through some mathematical trick, the procedure outlined in the cache description will give correct coordinates, even though the input numbers could be different. Can anyone explain to me *how this one works*?

- Create a path, and at each turn, tell your partner the angle to measure to make the next turn. Could each member of the team retrace the correct path?
- Create a multi-cache, and require students to do different math functions or problems to come up with the correct numbers for the next location.
- Have students walk and plot on the map the endpoints of a given shape (triangle, rhombus, parallelogram, circle, etc.) and see their results. (My addition - using Google Earth, plot the coordinates and enter them into the GPS units. Have students go from point to point and see how the shape that they walked compares to the shape that they plotted.)
- Calculate the distance between 2 points, then calculate the legs using Pythagoreans Theorem
- Calculate the height of an object
- Calculate or find the elevations of different points and graph those elevations.
- Area: Have students go outside and step off an area, graph it, and find the area. Use the GPS to walk the same

area to see how close you were with the first estimate.

- (Elementary) Use the units to practice or learn cardinal directions of N, S, E, & W.
- Practice adding and subtracting 3 digit numbers to come up with GPS coordinates to travel from one cache or location to another.
- Use a Sudoku puzzle to give cache coordinates - replace the first needed digit in the puzzle with an A, second number with a B, and so on until the full coordinates are given.

Social Studies/Geography:

- Get to know your Presidents. See President's Day (GC10QA0)! (http://www.geocaching.com/seek/cache_details.aspx?wp=GC10QA0) Use the presidential election order to give the coordinates of a geocache in a code.
- Develop an historical tour of your town that takes people to different monuments, statues, or markers of historical events, and develop a narrative for each location
- Come up with a "Travel Bug" on Geocaching.com that will go from place to place and end up in an historical location that pertains to the class, or give your travel bug a specific route to follow, such as the Old Spanish Trail or the route Lewis & Clark took - whatever you are studying!



See places you've never seen!

- Send a travel bug along the route that the pioneers took, or to go to the locations of different Civil War battles.
- Hide flags for various countries and have a group/pair of students each find one and look on the Internet (CultureGrams) for more information of that country.
- Find elevation change & relief when learning to use topographic maps.
- Take a GPS on field trips and either use the Geocaching.com website or have each class leave a cache for the next class.
- Geocache Time Capsule: Create a cache and leave some news items or top issues of the class year and place them in a cache near your school. Leave similar items each year and over time it can give some perspective on past events.
- Use the GPS to show students that there is more than one way to find different locations or objects - compare it with a compass, stars, or other ways of navigating.

Science:

- EarthCaching. There are many caches that people have come up with

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to point out or direct you to locations that are geologically interesting. These are called earthcaches. Plug in the coordinates into a GPS and let your students direct the class to places where you could talk about rock types, faults, or any other topic in Geology. There are nearly 2,000 of these locations already, and you could add your own!

- **Weather.** "In our fifth grade caches, we will have a log book, thermometer/hygrometer, cloud chart, and directions. We will ask people to log the date and time, as well as a general description of the weather conditions, a comment on clouds overhead (if any), and the temperature and humidity." The cache finders will log this information and collect the data for you!
- **Earth Science.** "In the sixth grade caches, which will be placed along creeks/rivers, we will have water testing strips. We will ask finders to log the date, time, and results of a quick water test at the site."

- "Our students will help us collect and graph the data. They will also be involved in making and hiding the cache containers. We're going to request that people fill in the log book and also take away a note sheet with the same data to include in their online log of their find. That way, we can collect data from the cache pages in real time without having to visit the hide locations frequently."
- **Make a botanical tour of your campus or a park** marking the locations of different plants and include a tour guide that gives each plant its scientific name and characteristics.
- **Types of Rock Scavenger Hunt.** Give your students the locations of different types of rocks. Their job is to determine as a group what type or kind of rock it is, give 3 reasons why they think this, and bring back a sample of the rock.
- **Create a map or tour of different rock formations** with a description of each layer visited.
- **Create a map of different micro-ecosystems** around the campus.
- **Locate & record coordinates of 3 major geologic features** near your home (i.e. faults, landslides, highly eroded areas, geologic formations, etc.).

- **Create a virtual outdoor classroom** by marking the locations of different habitats to visit as examples.
- **Use the units in the study of moon phases** - the Calendar on the GPS units give the current phase of the moon.

Language Arts:

- **Hide different parts of a sequential story** in different caches around your campus. Students will find each part and as a group, decide the proper sequence.
- **Send your students to a coordinate** and have students write a description of the object they find there or a description of what they see there facing a certain direction.
- **Hide topics for essays & have groups find a cache** and do a group project on that topic.
- **Cut apart a story** and have student find the pieces and put them back together using retention skills.
- **Have several student writings** at each point, each with different numbers. The student chooses the story they like based on interest and goes to the group by interest, then continue on with like groups.
- **Class reads story or book.** Hide props for the characters, setting, problem/solution etc. and have the students locate these props with the GPS. Meet back together to do a retelling or make up a new ending.

Other Content Areas & Electives:

- **Art:** Send your students on a Photo Safari, where they mark the locations and take digital photos of different sculptures or monuments around your town. They can report back with a slide show and a map describing what they saw, who created it, and why it is significant.
- **Physical Education:** Have your students map out a mile long course

Travel Bugs can take your students places you can't!



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around your school to follow for walking or running.

• Home Ec./Family & Consumer Science/Health:

- Create an historical homes tour around your town.
- Give students a recipe and the coordinates of the ingredients (i.e. store, garden, restaurant, etc.) and have them retrieve the ingredients, come back to the school, and cook the dish.
- Place ingredients & pieces of a recipe in different locations. Each group must find their goal in order to complete the recipe accurately & with all ingredients.
- Go and find different foods from each food group.

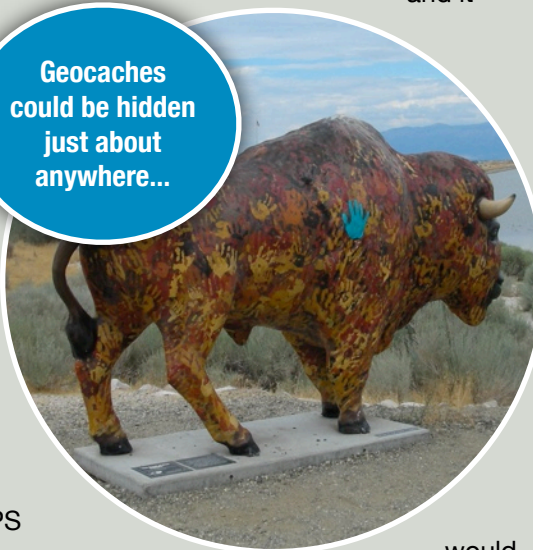
Counseling/TLC:

- Create a problem or activity to promote a teamwork teaching moment.
- Have students come up with different careers that could use a GPS and describe how they would use it.
- (Elementary) Use the GPS to introduce students to the school by using it to find classes (or find the Gingerbread Man at Panguitch Elementary).
- **Computers:** Create a new geocache and list it on Geocaching.com. Create a travel bug to make it more interesting.
- **Music:** Go to different sites to find music clues or rhythms and try to duplicate them with rhythm sticks.

My favorite educational geocache:

The name is "What If..." and asks the question, what if the Sun were the size of a community water tank? The placer has scaled the Solar System based on the size of the tank as the size of the Sun. I have completed all of the stages, and the scale is amazing. Saturn, the last cache that you can see the tank from is 8.5 miles away! Pluto is the last cache in the series, and it

Geocaches could be hidden just about anywhere...



would be less than an inch in diameter and 32 miles away. It is an amazing way to help students visualize the sheer dimensions and emptiness of the solar system.

If you are in Cedar City, the work has already been done for you, but there are a multitude of ways to incorporate this into your instruction in many different classes. You could...

- ...use this in Science to teach the planets in the Solar System. At each planet location, you could tell how large the planet would be at this distance from your "Sun" and then talk

about the orbit, diameter, mass, etc. of each planet as you went. The [Nine Planets](#) website has images and all of the information that you will need! If you need a little help with converting the sizes of the planets and the distances to scale, let me know and I will pass along a file called [Planetary Conversions in Excel](#) that will do the work for you.

- ...use this in Math to teach conversions, ratios, fractions, etc. Find a suitable "Sun" and measure its dimensions. Then use this and the information at [Nine Planets](#) to convert each planet size and distance from the sun to your scale. Feel free to use the Excel file linked above for help.

- ...use this in Geography to help teach mapping skills. Find a suitable "Sun" to figure out the relative sizes and distances and have your students locate and map spots where each planet could be and how big it would be at that distance.

- ...extend this in Science by assigning moons from the planets to your students. Based on your scale, they would have to calculate how big the moon would be and how far away it should be from it's planet. Extra credit could be given for making a model of their moon.

Of course, the real power of these activities is not to just do the math or project, but to actually go out and let your students experience the scale and the distances involved for themselves. Be careful, the larger your Sun is, the further you will have to travel to Pluto!

OK, HOW DO WE DO SERIOUS MATH?

Find perimeter & area of a large space, discover the slope of a hill, calculate volume of rain fall.

Make it REAL for your students

Many times students just don't understand a concept until they DO or EXPERIENCE it first hand. The steps below will show you how to let the students walk in and interact with real math in their world.

Find Perimeter & Area

The Garmin eTrex Legend GPSr's have a built in program to do this. You can do this same thing with other GPS units, but it will take a bit more manual recording of data to do so.

First, on the Garmin eTrex, power it on, get your satellite fix and head to a large open space like the football field or the edge of campus. Once the unit says **Ready To Navigate**, hit the **Page** button until you see the **Trip Computer** screen. We need to zero out any data to view how far we have walked and to see an empty Map. Move the **Click Stick** left followed by a click to select the page options menu. Click **Reset...** and then **Select All**. Now click **Apply** and then **OK** to confirm the reset of all data.

Now, hit the **Page** button until you see the **Main Menu** screen. Select **Accessories** with the Click Stick, and then select **Area Calc.** on the screen that follows.

This little program on the GPSr shows you the map screen and your tracks - virtual bread crumbs that the GPS drops as you move. Using the **Click Stick**, click **Start** and then slowly walk around the area that you want to calculate.

Square shapes are nice, but it might be fun to have students walk out in a big block letter their first initial. Using the **Zoom In** button (middle button on the left side of the unit) until the tracks and your turns are clearly visible.

Once the area or shape has been traversed, click **Stop** and the area will be calculated. You can move the **Click Stick** down

to highlight the area units and then click to change the measurement units - any standard or metric square unit you would like!

Saving the value is not that important - just have students record their data on paper.

Discover the Slope of a Hill

This one can be done just by using the information on the **Trip Computer** screen. We need to find the rise and run for slope - the **Rise** will be our **change in elevation** and the **Run** will be the distance that we have traveled. We can use this distance because the GPS records the distance we travel from space, and not the actual steps that we take.

First, if the unit is off power it on, get your satellite fix and head to the base of the hill

to be calculated. Once the unit says

Ready To Navigate, hit the **Page** button until you see the **Trip**

Computer screen. We need to zero out any data from this position for accurate

measurements. Move the **Click Stick** left followed by a click to select the page options menu.

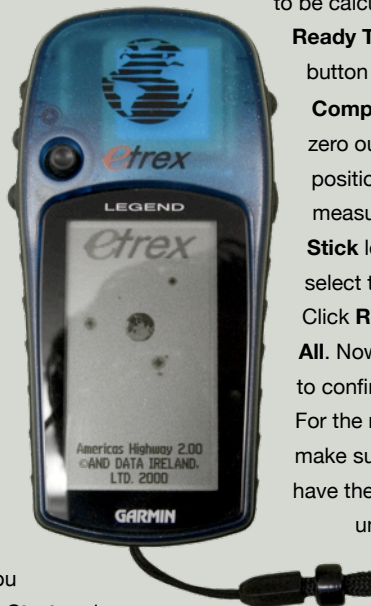
Click **Reset...** and then **Select All**. Now click **Apply** and then **OK** to confirm the reset of all data.

For the most accurate tracking, make sure that students do not have their heads hunched over the unit - their noggin will block the GPS signal!

Record the starting **Elevation** before

beginning the walk up the hill.

Once your base elevation is written down, simply walk the walk up the hill. When you get to the summit, record both the **Elevation & Odometer**. Some conversion calculations will need to be made to get your distance from miles to feet (1 Mile = 5280 ft) but then the slope can be easily calculated by dividing the **change in elevation / distance traveled**.



Caches are hiding where you least expect them

A good exercise to check the math would be to estimate the slope of the hill in another way - **Google Earth** could even be used to measure the distance using the **Ruler** and the **Elevation Information** that it provides!

Calculate the Volume of Rain Fall

You can take **Area Calculation** to the next level by having your students estimate the **total area of your campus** using the methods that I have described and then posing the following question to them, "How many gallons of water would hit the campus during a 1" rainstorm?"

This is a simple calculation using this formula: **Volume = Base X Height** where the base is the campus area and height is the 1" of water. Students will need to convert the water depth to the same distance unit used for area (feet for ft², meters for m², etc.), but that is a good exercise in itself.

You can make this exercise even more intriguing by examining water shed issues - how much of this water will be run-off and how much will actually soak in and replenish the water table? This can be found by determining how much of your campus is hard surfaces (building, parking lot, sidewalks, etc.) and what percent is soft (fields, playgrounds, landscaped areas, etc.). Again, Google Earth may be the best tool to find these values, but using the GPS is an excellent introduction for this activity.

You and your students will be AMAZED by how much total water falls and how much of it goes down the gutter. I have done this activity at a VERY small school in Escalante, and I was astounded by the results.