

## Spatial Thinking with GPS, Maps, and Your School District

Pose this question to your middle school or high school youth:

**“Is it possible to display details on a map from a distance in space of 12,000 miles, while traveling at speeds of roughly 7,000 miles an hour?”**

Can you image what the responses might be? This set induction question should capture student’s interest and desire to want to try it out.



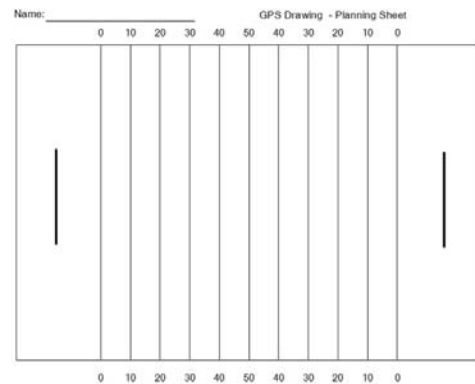
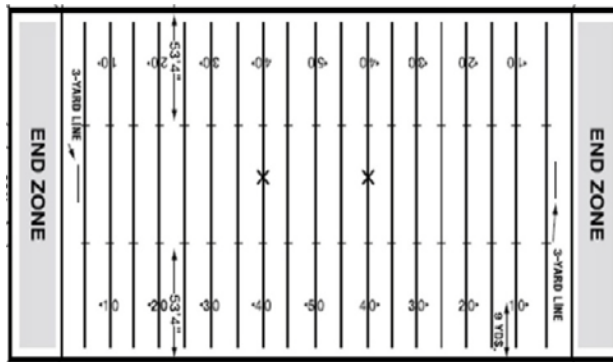
This activity lets youth use their school grounds as canvas to create and plan a drawing of their choice. The input drawing tool will be the GPS and the output will be a final printed copy using a mapping application. It would be great if youth can take home the final printed output to share with a parent or guardian. The student will explain how the artwork was created using GPS and mapping technologies. Make this an assignment and have a parent or guardian sign a sheet and provide you feedback about the activity.

Most schools have soccer, football or baseball fields that have lines that are helpful in completing the actual drawing done by youth. If you do not have any designated fields near the school create your own area. This will be your creative part. Mark the area with something that is easy for youth to see as points of reference to complete their drawings.



Spatial Thinking with GPS, Maps and Your School District: Hands-On Activity  
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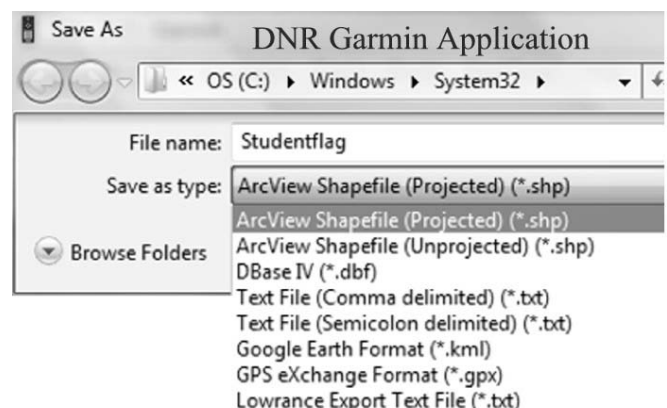
Whatever area you use for the drawing, it is important to have youth plan out their design on paper. You can have youth use graph paper, create your own planning sheet, or use drawings or images from the web. When they are in the field using the GPS they will have to make spatial relationships between their drawings and where they will be walking. A clip board can be handy in the field. (Field example from internet and teacher example - below)



From my experience, the best way for middle or high school youth to complete their drawing is to use waypoints. Every 6th step youth will mark a waypoint. Most GPS units can capture about 500 to 1000 waypoints. Many of the energetic youth will record close to 999 waypoints and others will record in the 300 to 500 range. The tracks function can also be turned to capture their tracks as they walk. Sometimes when projected in mapping applications there may be stray lines and a little more difficult to edit.

Back in the classroom, the software of choice (and also free) is DNR Garmin but there are other applications that can be used. Youth will download their data by hooking the GPS to either a serial port or USB port depending on the computer used. The DNR Garmin application can recognize either connection. Youth will download their waypoints and save them to a location they can access later.

The easiest to use will be Google Earth Format (\*.kml) which can be used with Google Earth. If you have Arc Map software or want to use ArcGIS Explorer Online save waypoints as ArcView Shape (Projected) (\*.shp). Make sure youth name and save to a location that they can retrieve the waypoints later. The file name should be the student's last name and project name with no spaces.



Have youth input their waypoints into a mapping application. Hopefully during this stage you will hear a buzz like, "Wow, I created this cool drawing with multimillion dollars satellites 12,000

miles high in the atmosphere, while traveling at speeds of roughly 7,000 miles an hour for free!” For the final step, youth will need to symbolize the waypoints with color, size, text and other information you require.

A final copy of the map can be created by the keyboard function Print Screen and then pasting into a software program like Word, Photoshop or PhotoDraw.

## Evaluation

- Planning of drawing to be used on the football field - final drawing attached
- GPS drawing - waypoints resemble what you planned
- Using GIS mapping software provide proper layout and print a final copy for evaluation
- Parent or Guardian signature

## Standards - NYS

Standards related to these activities that were used to support technology education curriculum.

- Students will explore how subsystems and system elements inputs, processes, outputs interact within systems.
- Students will demonstrate engineering design to locate and utilize a range of printed, electronic, and human information resources to obtain ideas.
- Students will demonstrate the proper use a computer system to connect to and access needed information from various Internet sites and use appropriate GIS software.

## Standards - (ISTE) International Society for Technology in Education

- Creativity and Innovation - Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology
- Critical Thinking, Problem Solving, and Decision Making - Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
- Technology Operations and Concepts - Students demonstrate a sound understanding of technology concepts, systems, and operations.

## Extensions

- Let youth take a GPS home and try using the GPS around their home. Then have them duplicate the process again at school and bring the printed copy back home to parents.
- Have youth brainstorm possible projects or other activities they could do on school grounds or in their community that would use GPS and mapping technology.
- Research how local farms use GPS and mapping technology in their fields for planting, harvesting and fertilization.
- Have youth use a mapping application to calculate the school roof area. Then pose a question. If the roof was covered with solar cells could it help provide electricity to the school? If so how much would it produce? Would it be cost effective?
- Have student walk or run the one hundred yard dash and use the GPS to calculate the time and their maximum speed.
- Ideas for using a mapping application and GPS for projects around you school district
  - Create a map labeling the building with North, South, East, and West. If possible report to the principal to see if the building could be labeled inside and outside.
  - Create a map showing the location of trash containers on school grounds and see if there are other locations that might need them.
  - Create a map that shows fire exits and fire drill meeting locations.
  - Design a map that displays any school trails.
  - Create a map to identify the local trees, shrubs and flowers on school grounds.
  - Interview the school bus supervisor and inquire if youth could map their bus routes for the district.
  - Identify the signage on school grounds and propose possible additional signage where needed.
  - Label and identify all key features of buildings, community entrances, community parking, playgrounds, and trails for the community to refer to.
  - Identify school drainage features and note any problem areas.
  - Identify any hazards on the school campus.
  - Develop a scale model of school grounds with contour lines.
  - Use Google Sketch up to display 3D models of your school buildings in Google Earth.
  - Research the history of the land where the school is built.

## References

### ***Going places with GPS - Easy GPS Activities for Clubs, Classrooms and Beyond***

Roger Palmer and Anita Palmer - 2009 Manufactured by: GISetc

Easy GPS Activities for Clubs, Classroom and beyond is the first GPS book with fun and exciting lessons and activities that you can do with your GPS. This book eases the beginning user into using a GPS with straight forward, simple exercises and then gradually adds to the level of difficulty.

### ***Fun with GPS***

Donald Cooke 2005

For the millions of GPS owners who love their GPS units but don't know all they can do with them, this fun guide shows that a GPS can do a lot more than just calculate a location. Dozens of illustrated examples show how a GPS can be attached to a multitude of devices, including dogsleds, race cars, hot-air balloons, windsurfers, pet animals, ski racers, hockey players, and sailboats. Each example includes maps and photographs to inspire hobbyists, airline passengers, athletes, animal lovers, drivers, teachers, and youth to track and map their activities. How to incorporate GPS mapping technology in the classroom in order to reinforce science, math, and geography curricula, provide the groundwork for project-based learning, and show youth that their schoolwork is important and relevant is discussed.

### ***Integrating GIS and Global Positioning Systems***

Karen Steede-Terry – 2000

The coupling of the Global Positioning System (GPS) with Geographic Information System (GIS) is an information revolution that will give unprecedented accuracy in measurement and completeness of coverage to anyone who works with geographic data of any kind. This comprehensive reference answers the myriad questions involved in combining these two systems for maximum benefit. It provides information about how GPS works, the pros and cons of implementing GPS use, what is the best GPS system for specific applications, and how to integrate the technology and equipment needed to use GPS with existing GIS systems.

## **DNRGarmin GPS Application –**

<http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html>

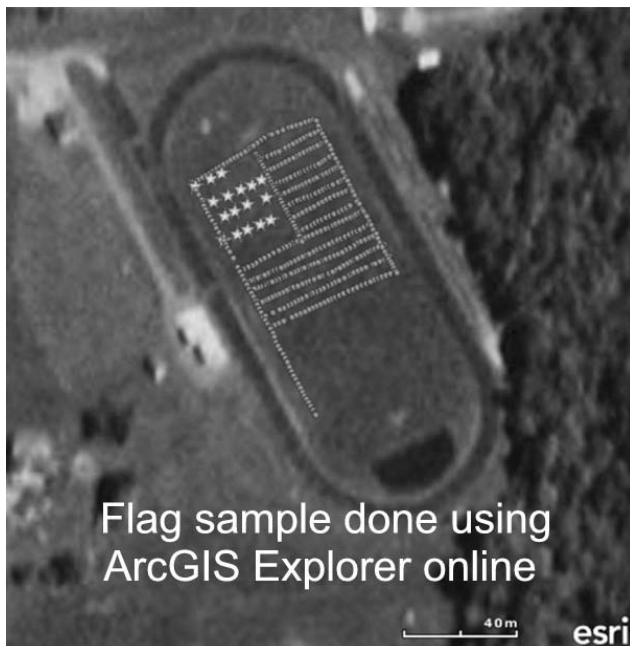
Software can be downloaded for free

This extension was built to provide users the ability to directly transfer data between Garmin GPS handheld receivers and various GIS software packages. Using this program a user can use point features (graphics or shapefile) and upload them to the GPS as Waypoints. Line and Polygon Graphics or shapes can be uploaded to the GPS as Track Logs or Routes. Conversely, Waypoints, Track Logs, and Routes collected using the GPS can be transferred directly to ArcView/ArcMap/Google Earth/Landview and saved as Graphics or Shapefiles.

**GeoMentor Program** - <http://edcommunity.esri.com/geomentor/index.cfm>

A GeoMentor "adopts" a school, class, or club and supports the educator/s in working with youth. Using tools of geography (such as maps and globes, atlases, charts, imagery, and field work), the GeoMentor helps the educator and youth develop skills in geographic thinking.

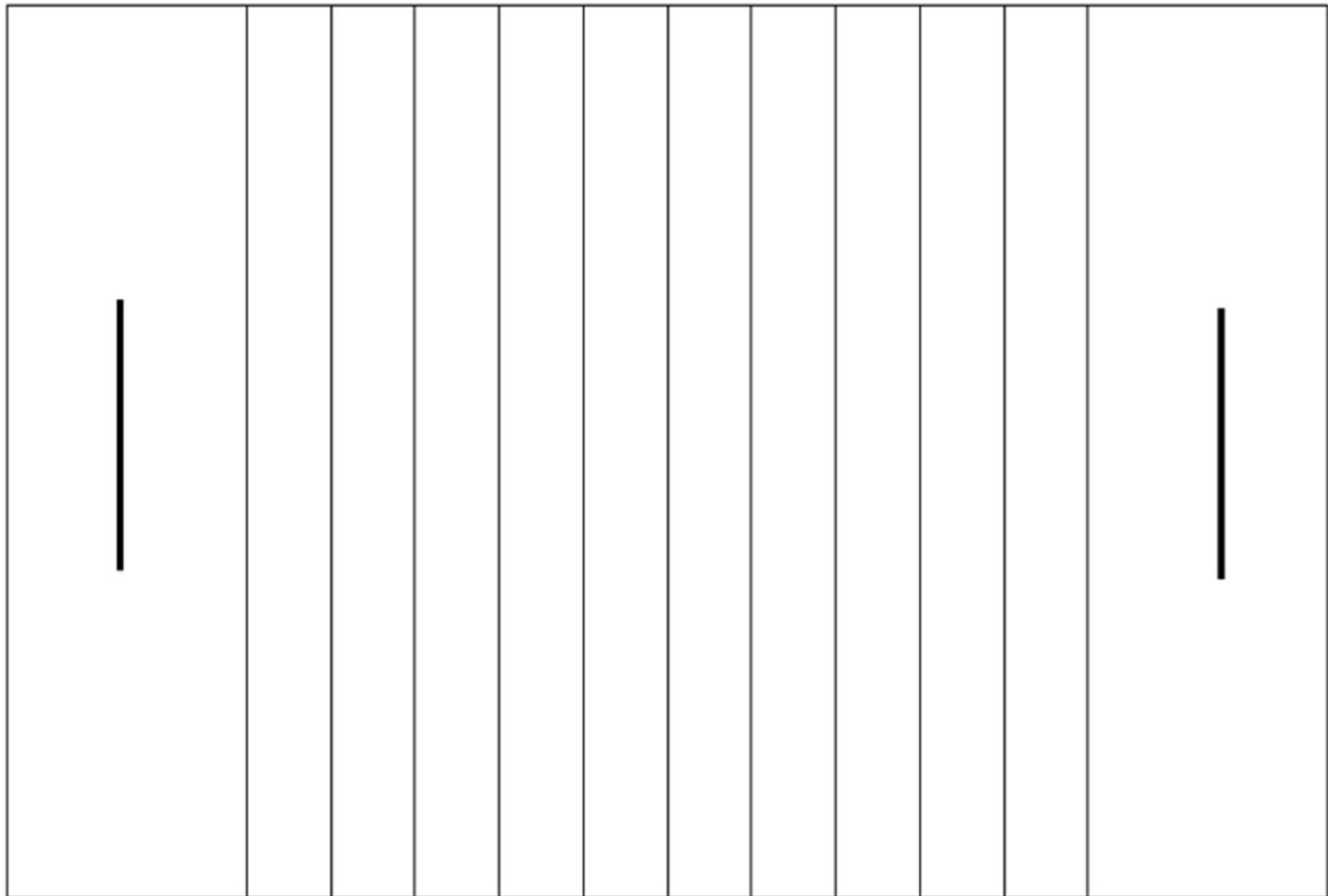
## **Examples - online imagery and waypoints**



Name: \_\_\_\_\_

### GPS Drawing - Planning Sheet

0 10 20 30 40 50 40 30 20 10 0



0 10 20 30 40 50 40 30 20 10 0