

TITLE: LAND SURVEY AND ACCESSING USGS DIGITAL MAPS

EVENT: ROAD SCHOLAR

EVENT

KEYWORDS: Geographic Grid; Latitude; Longitude; Public Land Survey System; Long Lot: Google Earth; USGS; Topographic Map; Map Scale;

BACKGROUND

Road Scholars is the oldest continuing event in the Science Olympiad catalog of events- although it has appeared under several names including Topographic Map Reading, Road Rally and the Current Road Scholars. The event has a simple premise, with students identifying features found on USGS topographic maps and using different land navigation measurements to determine their route. The event is embellished with a story line requiring students to be able to extrapolate information from technical writing.

As long as adequate supplies of cheap USGS topographic maps were available, the event was easy to run and lots of fun for students. However, in recent years, the USGS decided that it will no longer print fullsize maps and instead create and maintain a library of digital maps. In this Activity Set, you will learn the premise for map systems of location and orientation. You will also learn how to access USGS topographic maps from the USGS website and to section them according to your training and event needs.

NEXT GENERATION SCIENCE STANDARD CITED

MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine How well they meet the criteria and constraints of the problem.

Science and Engineering Practices

Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints.

GEOGRAPHY FOR LIFE STANDARD CITED

Grades 5-8 The World in Spatial Terms-A

Describe the purposes and distinguishing characteristics of selected map projections, aerial photographs and satellite produced images.

MATERIALS NEEDED

- 1. 2017 Science Olympiad Road Scholar Event Overview PowerPoint
- 2. Where's Waldo Worksheet
- 3. Pencil
- 4. Metric ruler
- 5. Internet access
- 6. MS Paint or other image-editing software

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Activity 1: Where's Waldo?

The Ancient Egyptians developed the branch of mathematics known as geometry (meaning Earth measurement) as a means of surveying land to determine property ownership. The regular flooding of the Nile River necessitated that people be able to determine the location of their property lines. Since that time, a number of land use and surveying systems have been developed to determine location, organize land use and establish ownership.

In this Activity, students will establish the need for a geographic grid to determine location and create a simple grid.

PROCEDURE

- 1. Using the Where's Waldo Worksheet (2), have students attempt to locate Waldo on the beach image shown on the worksheet. Some students may easily locate Waldo, while others may experience difficulty in doing so. Provide individual students assistance as needed.
- 2. Provide students with sufficient time to locate Waldo. After a time, ask students to describe orally or in writing where on the image Waldo is located. You will probably get a variety of answers including: Lower left side of the image; southwest corner of the image; just below the blonde lady wearing the green swimsuit; just to the upper-right of the airborne beach ball.
- 3. You can then point out that a more organized system can be created to determine geographic location. First, have students take their metric ruler (4) and place it along the right or left side of the image which should measure approximately 22 centimeters.
- 4. From the top of the image, place a dot for every measurement of 2 centimeters.
- 5. Repeat for the right or left side (where measurements were not first taken.
- 6. Draw a straight line across the image between the two sets of dots. There should be 10 horizontal lines across the image from side to side.
- 7. Have students place the metric ruler at the bottom of the image, which should measure approximately 16 centimeters.
- 8. From the right side of the image to the left, place a dot for every measurement of 2 centimeters.
- 9. Repeat for the top of the page.
- 10. Draw a straight line across the image between the two sets of dots. There should be 7 vertical lines across the image from top to bottom.
- 11. Next, have students label each of the columns that were created from right to left along the bottom of the image letters A-H.
- 12. Students should then label each of the rows created from bottom to top along the right side of the image numbers 1-11. Each of the squares created by the lines is termed a *Section*.
- 13. Ask students to determine the location of Waldo on the grid. The answer should be Section F3.
- 14. To determine a more specific location, have students divide Section F3 into four equal squares (1x1cm each). Determine Waldo's location within Section F3 as NE, SE, SW or NW. The answer should be NW.
- 15. Waldo's location can then be read as 'The Northwest corner of Section F3.'



In creating the grid, students developed a more organized and efficient means of determining location than the capricious use of approximate location relative to features. The numbered lines (rows) mimicked lines of latitude on the Earth's surface that measure north and south directions. The lettered lines (columns) mimicked lines of longitude on the earth's surface that measure east and west directions. The further sectioning of Section F3 mimicked the use of Legal Land Descriptions that are used in lot descriptions.

Activity 2: Township and Range Lines (Optional for 2016 SOSI)

One feature of the Public Land Survey System (PLSS) is the subdivision of land into townships consisting of 36 one-square mile sections (36 total square miles). Townships are determined by the intersection of Township and Range lines. The distance between each Township line is six miles and likewise between each range line. Each state that uses PLSS has a Baseline (Township) and a Prime Meridian (Range) line from which all measurements emulate.

This Activity will build upon Activity 1 in the creation of a Township and Range system.

PROCEDURE

- Return to the Where's Waldo Worksheet (2). Locate the horizontal line across the image that forms the northern border of Row 3 and the southern border of Row 4. Using a pencil or marker (3) darken this line across the page and label it as 'Township Line' in one of the margins.
- 2. Locate the vertical line that forms the western border of Column D and the eastern border of Column E. Darken this line along the page and label it as 'Range Line' in one of the margins.
- 3. Starting with the Township (Base) Line, number all rows north of the Township Line along the right side of the image 1,2,3,4,5,6, 7...all the way to 8 at the top of the page.
- 4. Number all rows south of the line 1, 2 and 3 to the bottom of the page.
- 5. Starting with the Range (Prime Meridian) Line, number all columns east of the line 1,2,3, 4 along the bottom of the page all the way to the right side of the page.
- 6. Number all columns west of the line 1, 2,3,4 all the way to the left side of the page.
- 7. Beginning with the Township Line (identified as T) determine Waldo's location on the grid and direction relative to the Township Line. It should be T.1S.
- 8. Now determine Waldo's location relative to the Range Line. It should be R.2W.
- 9. Waldo's location should therefore be identified as T.1S R.2W.

The PLSS and other land survey and organization systems were developed throughout history to determine geographic location, assess and assign land use and determine property ownership. These and other foundational skills needed for the Road Scholars event can be found in the U.S. Army Map Reading and Land Navigation Field Manual (1987) included in this packet.

Activity 3: Accessing USGS Digital Maps

In recent years, it has become increasing difficult for Road Scholar Event Supervisors and Science Olympiad teams to obtain full size USGS 7.5" Series Topographic Maps. With the USGS no longer printing



maps, new teams often have difficulty initially obtaining the maps, while many teams and supervisors are now left using the same maps from year to year.

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The USGS however is making digital versions of the maps available for most locations free of charge. This lesson is best executed with students using desktop or mobile computers or mobile devices on a robust network with adequate data storage available. In this Activity, you will learn how to obtain copies of USGS topographic maps via the Internet.

PROCEDURE

- 1. Access (5) the USGS website at <u>www.usgs.gov</u>
- 2. Click the *Products* Link on the Home Page. This should then bring up a sub-menu list.
- 3. Click the USGS Store link listed under the Maps submenu.
- 4. Click the link '*Map Locator and Downloader*' located in the lower right center of the page. The Map Locator and Downloader now appears. You will use it to locate the USGS map you need.
- 5. Next, key in the name of the city and state where the desired map is located in the Search bar.
- 6. The Map Locator and Downloader now shows a map of the location you selected with a red navigation marker.
- 7. Click the navigation marker to bring up a list of available maps for that location.
- 8. Select the map from the list that you wish to download. Once downloaded a Zip File should appear at the bottom left of your screen.
- 9. Click the Zip File icon to open it. You should see a PDF of the map you selected. Click the PDF file to open and display it on your screen.
- 10. If you wish to save the PDF to your hard drive (recommended), click Save As, name the file and save it to your desired location.

Activity 4: Sectioning Digital USGS Topographic Maps

Once full PDFs of the digital topographic maps have been acquired from the USGS website, it is now time to section the maps. Map sections should highlight features that you are studying such as kettle lakes, streams, PLSS, or mountain elevations. In sectioning digital maps, we crop or reduce the size of the map into that which can be fit on to an 8.5' x 11' sheet of paper, while preserving the map scale and allowing its features to be readable. You can section topo map images with MS Paint, Adobe Photoshop, Tech Smith's Snaglt or any other quality editing software.

PROCEDURE

- 1. Open the PDF of the full-size topographic map you wish to section.
- 2. If you use Adobe Acrobat, you may zoom the PDF to your desired size and then crop the image.
- 3. Scroll over to the area of the map that you want to capture. Zoom to desired size.
- 4. Hold your Alt Key down as you tap the Print Screen Key to capture the image. This puts the captured Image into the Clipboard.
- 5. Open MS Paint (6). Choose Paste. This will paste the captured image onto the screen.
- 6. Next, select the area of the image that you want to capture.



7. Once you have selected the area of the map to feature, Click Crop to delete all but the selected area of the Image. The Image that is left can be printed on 8.5' x 11' paper and questions created from it.

The sectioning of USGS maps is a useful technique for capturing those topographic features that you wish to highlight for training students or creating questions. You may use your editing software to further calibrate your images to the size(s) you need.

Activity 5: Acquiring Map Images via the Internet

The 2017 Road Scholars Event Rules also encourage the use of satellite images as well as images acquired via the Internet such as Google Maps, google earth or using available state maps, or local historical maps. The Road Scholars Online Library included with this packet has links to every state's site for obtaining digital road maps. These road maps can also be sectioned using the directions given in Activity 3.

PROCEDURE

- 1. Google Maps is a fun and easy way to help students initially learn how to acquire satellite and Internet-generated images. Begin by opening Google and clicking the Apps Icon. This will take you to a submenu that includes Google Maps.
- 2. Click the Google maps icon and you should see a large map. Note the Google Earth thumbnail in the lower left of the page.
- 3. Drag your mouse over the map to move it up or down or side to side until you reach your desired location. Note the Google Earth thumbnail in the lower left of the page has changed with the movement of the map to a different location.
- 4. Click the Google Earth icon at the bottom left of the page. This will change the screen to a satellite image.
- 5. In the search bar located in the upper left of the page, key in the desired location and then click the magnifying glass. Note the icon on the bottom left is now a map. You can change back and forth from maps to images and images to maps by clicking this icon.
- 6. After clicking the magnifying glass, your screen will show a more detailed image of the desired location.
- 7. Use the controls located on the lower right side of the page to zoom out (+), zoom out (-). The three image icons at the bottom will show you different features of this location.
- 8. Clicking the 3D Square on the right will slant the map north giving it a 3-D appearance.
- 9. Print the image if you wish or make further adjustments as desired.

At this point, you might want to discuss features of the satellite image that you are aware of and that could be used as potential questions on a Road Scholars Exam.

BIBLIOGRAPHY

U.S. Army Map Reading and Land Navigation Manual 1987 Edition

Useful for developing a variety of skills associated with the Road Scholars Event. Public domain and included with this packet.