

INSPIRE GK12 Lesson Plan



Lesson Title	Scaling Up: Using pixel values to determine area
Length of Lesson	50 minutes
Created By	Shane A. Irvin
Subject	Geometry
Grade Level	10 th - 12 th
State Standards	2a
DOK Level	DOK 2
DOK Application	Represent data from geometric and real-world contexts with expressions, formulas, tables, charts, graphs, relations, and functions.
National Standards	Use visualization, spatial reasoning, and geometric modeling to solve problems
Graduate Research Element	Imagery analysis with focus on pixel size and distance orientation

Student Learning Goal

The students will demonstrate the ability to establish a geometric connection between aerial/satellite imagery, individual pixel size, area of objects, based off of pixel shape, and distance application with maps that do not have a specified scale. The set goal is to allow an understanding of the ratio between scales and actual distance. Providing a comparison between the two helps the student better understand applications in subjects other than math (i.e. geography, physical science). The students will identify previous interactions with distance and area. The student will be allowed to predict distances and areas on images that are handed out. The connection will provide students with a better understanding of basic geometry (shape area) and distance. The students will use the knowledge of distance and area, in particular area of irregular shapes. The usage of irregular shapes can affect the easiness of the lesson by applying harder shapes within different pieces of imagery.

The lesson can be linked to the application of shapes, area, and common activities found in everyday life such as map analysis, photography, and travel.

Materials Needed (supplies, hand-outs, resources):

Notebook paper, writing utensils, Proscope microscope (provided by EMC), rulers, four pieces of imagery (one per group of four that rotate), attached power point of images for individual practice. Computer with internet connection, mapping software (Google Earth)

A Proscope microscope will be provided as a tool to help the students count pixels that are too small to the naked eye. The microscope will be used for only one of the four images provided to prevent confusion and keep cost down. By using the microscope to



find the size of the pixel the students will guess at an interpreted distance to see how accurate they can actually get to the known distance.

Lesson Performance Task/Assessment:

A basic assessment with distinct pixel size and a formed grid will be provided to the students. The students will be requested to figure out the size, area, and distance of specific objects in the imagery. This assessment will be done for up to four objects per image with four group members per image, with up to four images total rotating around the classroom.

Lesson Relevance to Performance Task and Students:

The relevance to this lesson and real world applications will be presented through a power point by the instructor. Examples of such careers as map making and geo-spatial analysis will be introduced. In readiness for individual students who are leaning toward a military career, the presentation will supply the students with examples of applications throughout multiple career fields including the military. The incorporation of imagery analysis found in engineering will be the main career focus due to the presentation of this lesson by an NSF engineering fellow.

Anticipatory Set/Capture Interest:

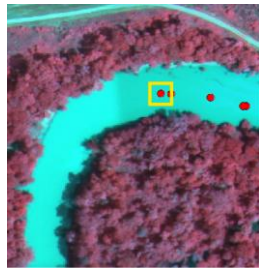
Allow the students to guess distances on a globe or a map, hiding the scale. This application will allow the students to guess and write down their answers.

Guided Practice:

The instructor will give an introduction on common scales and shapes used in imagery analysis. The instructor will then pose a question to the students, asking where they have seen the discussion of pixels in the past (TVs, cameras, computer software). The students will be asked about times that they have used maps, why they used maps, and what they learned by using maps. The students will then be asked the last time they took a picture. At this point, the instructor will show pixelated images and explain what is occurring. This will provide a connection between square pixels and terms such as megapixels and form the first connection between maps and imagery analysis.

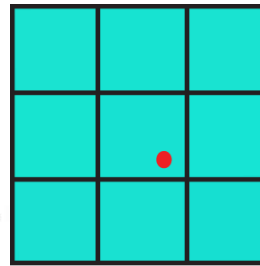
An image will be shown to the students using the Proscope microscope. The review using the microscope will allow the students to become reacquainted to the tool so that there are no questions during the independent practice. The instructor will show examples of how to use the microscope for imagery analysis by showing a way to determine the size of pixels.

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Image

(Irvin and Paz, 2010)



Pixel Value

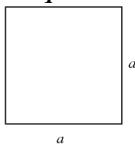
Along with pixilation the students will be shown ways to measure distance and find area from objects they can find on the map that have a known geometry, such as a car.



A refresher on distance and area will then be discussed, hitting on points of irregular shapes as well as traditional shapes. The instructor will inform the students of ways to find irregular shapes, such as applying different shapes with known areas inside the irregular shape.

Shapes:

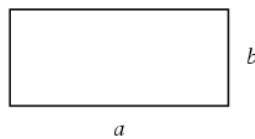
Square



$$\text{Area} = a^2$$

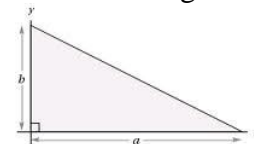
(Wolfram, 2010)

Rectangle



$$\text{Area} = a \times b$$

Triangle



$$\text{Area} = 1/2 \times b \times h$$



Distance will be discussed along with the ratios that occur on a map. The lesson will then evolve into showing examples of the applications of distance and area identification on maps. The instructor will then show imagery and show the students how to determine area of the irregular as well as traditional shapes. Scrolling through about five to ten images, the instructor will then ask for student participation by letting them guess what certain areas would be. Once the students seem to have an understanding of pixelated imagery and how to scale the image via pixels per inch, the instructor will move to independent practice.

After the lesson is complete the scale will be revealed to see how different the students' answers were before learning about distance and area measurements using geometry. The Proscope microscope will also provide a captured interest, providing the student their second or third interaction with the piece of equipment. While the student will not be using it for its life sciences and high level microscopy, the microscope will still be used to aid the students in seeing pixels on a map too small for the naked eye.

Before moving to independent practice, the instructor will then pose the following questions:

1. How can you use this application in everyday activities? Could a map be analyzed strictly based off of pixel information?
2. Can the pixel value be found from a map with a given scale?
3. Why does low resolution imagery cause greater inaccuracies in distance and area?
4. What other math can be applied to imagery?

Independent Practice:

Students will be placed into groups of four. Once in the groups an image will be passed out to each group. Each image will be an aerial or satellite image of a different location. Once the students have the passed out images and the instructor will ask for each student to take a rough guess to a scale of the un-scaled imagery.

The student will then begin to analyze the imagery using the geometry and methods learned during the guided practice including analysis with the Proscope microscope (one group at a time to prevent excessive handling and abuse). The students will determine the area of specified objects on each of the images supplied. The images will have different shapes requiring students to use different geometric shapes learned above to determine specific area.

Once the students have a basic idea of the pixel size the instructor will come and see if the students are close enough in accuracy. If not the instructor can see if the students are fully understanding what they are practicing (observation assessment).



The students will then compare their answers to provided answers by the instructor. Once the students have tried and have been provided the answers the instructor will move into assessment.

Remediation and/or Enrichment:

Remediation:

In situations that remediation is needed the student can see the instructor for one on one tutoring. The student can also be paired with a high performing student with full understanding of the lesson.

Enrichment/Extension:

In situations where there is full understanding, the lesson can be extended by incorporating more information about the imagery, including, determining how tall a building may be by analyzing the statue it places on the ground using geometry. The students could also analyze additional maps available in the classroom to try and determine pixel value of the imagery. Individual IEP's will be supported.

Check(s) for Understanding:

The instructor will provide a written quiz that the students will discuss basic geometry covered throughout this lesson as well answer question based on inquiry questions asked throughout the lesson.

The instructor will then pose the following questions:

1. How can you use this application in everyday activities? Could a map be analyzed strictly based off of pixel information?
2. Can the pixel value be found from a map with a given scale?
3. Why does low resolution imagery cause greater inaccuracies in distance and area?
4. What other math can be applied to imagery?

Closure:

Discuss how this application of geometry is used in society and its importance throughout everyday life. Discuss how this same tool of map analysis through geometry can be used for applications outside the provided parameters. This discussion allows a solid approach to basic mathematic principles while incorporating so many applications helping the students see firsthand inquiry.



Possible Alternate Subject Integrations:

Physical Science, Geography, Physics

Teacher Notes:

www.wolfram.com (Shape images)

www.thelescope.com (microscope tool)

Imagery is supplied by graduate student research:

Irvin, Shane A. and Joel O. Paz (2010). Using aerial imagery analysis to assess water quality parameters in Tibbee Creek, Mississippi. Abstract.