Explore the Earth From Space!

For Grades 3-5

Math Learning Goals:

- Practice measuring in mm the lengths of objects in an image taken from space
- Practice converting units between smaller and larger units to find the real size of objects in an image
- Apply measurement and conversion skills to a real world application – using scale to find the length and area of objects in an image
- Develop and carry out a plan to find the area of their own school from a satellite image

Materials Needed:

- Exploring Washington, D.C. From Space! Worksheet
- Optional – A Satellite View of Downtown Las Vegas
- Rulers with metric units (mm)
- Google satellite image of your school or the middle or high school, somewhere relevant to the students – make sure that a football field is in view!

Introduction:

Today we will explore the earth from space! How will we do that? With real satellite photos. Ask students to describe what they know about satellites and what they are used for.

Project a satellite picture of Washington DC from space (Google Earth, for example) and ask students if they know what city it's an aerial image of. Zoom in on the White House, US Capitol, or other features to help give hints. Explain they will be exploring an image of this city taken by the International Space Station Astronauts.

Activity:

Pass out the "Exploring Washington, D.C. From Space!" handout. Read and work through the activity together as a class or break students into groups to work together.

If students need more practice, pass out "A Satellite View of Downtown Las Vegas" and have the students work on it in groups.

Time to apply! Tell the students that now they will be exploring their school from space! Pass out an image of the school from Google Earth. Tell students that their mission is to find out how big is their school. This will be a measurement of area.

Ask the students to think about how they can find out the real area of their school from the image. Is there anything in the image that you know the size of, that can be used to figure out the scale? (Hey sports fans! The football field lines are how far apart? 10 yards = ? millimeters)

Once you know the scale, how can you measure the area of the school? Have students work in groups to develop a plan and check their work. Ideally you don't provide these steps, but instead provide the scaffolding to help students figure them out.

- Break the rooftop into rectangles
- Measure the rectangles' sides in mm
- Multiply the each side times the scale to get the real lengths
- Multiply side lengths x widths to get area
- Add the area of the rectangles together

Extension – if your students are getting excited about going on to middle school, you could have them compare the size of their middle school to their elementary school, or the size of a rival school.

Tennessee Academic Standards:

<u>Grade 3</u>
Measurement and Data
Geometric measurement: understand concepts of area and relate area to multiplication and division
Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

<u>Grade 4</u>
Operations and Algebraic Thinking
- Use the four operations with whole numbers to solve problems

Number and Operations in Base 10
- Generalize place value understanding for multi-digit whole numbers
- Use place value understanding and properties of operations to perform multi-digit arithmetic

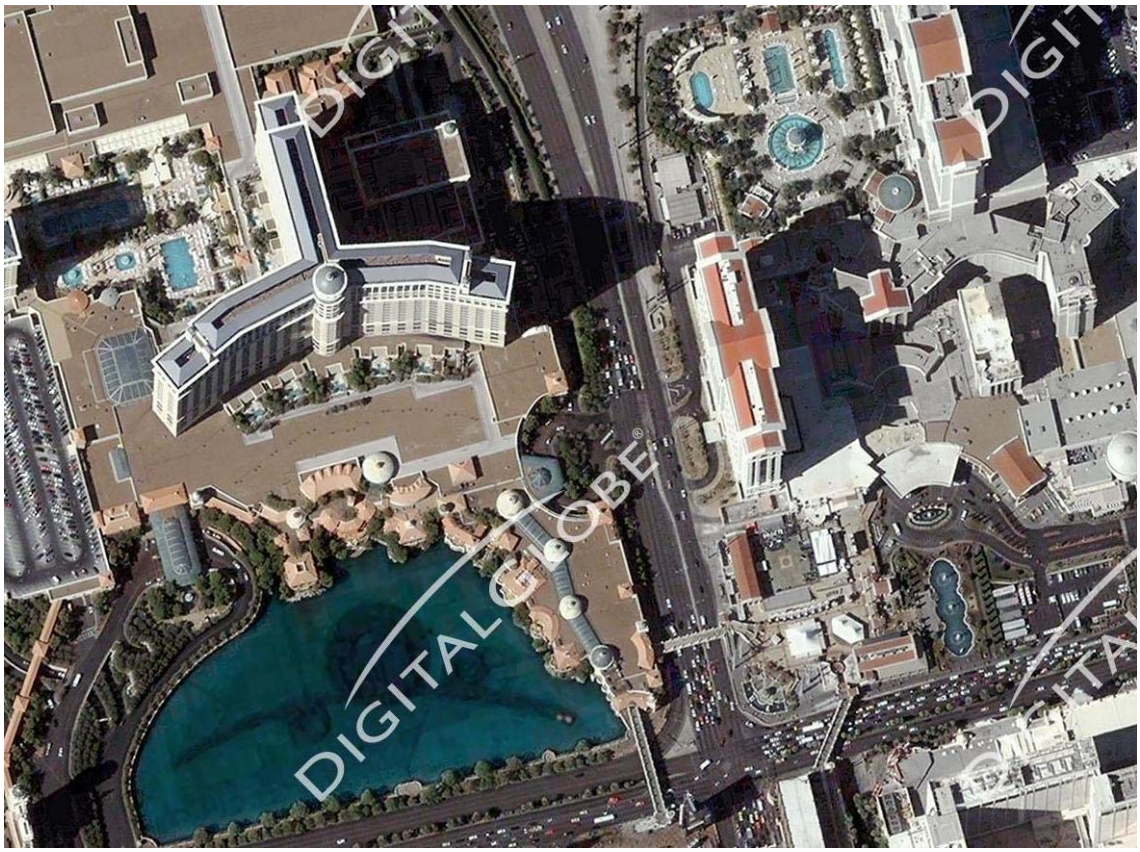
Measurement and Data
- Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit

<u>Grade 5</u>
Number and Operations in Base 10
- Perform operations with multi-digit whole numbers and with decimals to hundredths.

Measurement and Data
- Convert like measurement units within a given measurement system

Adapted by Kelly Sturner, Virginia Parkman, and Suzanne Lenhart

A Satellite View of Downtown Las Vegas



This QuickBird Satellite image was taken of downtown Las Vegas Nevada from an altitude of 450 kilometers. Private companies such as Digital Globe (http://www.digitalglobe.com) provide images such as this to many different customers around the world. The large building shaped like an upside-down 'Y' is the Bellaggio Hotel at the corner of Las Vegas Boulevard and Flamingo Road. The width of the image is 700 meters.

The scale of an image is found by measuring with a ruler the distance between two points on the image whose separation in physical units you know. In this case, we are told the field of view of the image is 700 meters wide.

Step 1: Measure the width of the image with a metric ruler. How many millimeters long is the image?

Step 2: Use clues in the image description to determine a physical distance or length. Convert this to meters.

Step 3: Divide your answer to Step 2 by your answer to Step 1 to get the image scale in meters per millimeter. Report your answer to two significant figures.

Once you know the image scale, you can measure the size of any feature in the image in units of millimeters. Then multiply it by the image scale from Step 3 to get the actual size of the feature in meters to two significant figures.

Question 1: How long is each of the three wings of the Bellaggio Hotel in meters?
Question 2: What is the length of a car on the street in meters?
Question 3: How wide are the streets entering the main intersection?
Question 4: What is the smallest feature you can see, in meters?
Question 5: What kinds of familiar objects can you identify in this image?

Answer Key:

This QuickBird Satellite image was taken of downtown Las Vegas Nevada on October 14, 2005 from an altitude of 450 kilometers. Private companies such as Digital Globe (http://www.digitalglobe.com) provide images such as this to many different customers around the world. The large building shaped like an upside-down 'Y' is the Bellaggio Hotel at the corner of Las Vegas Boulevard and Flamingo Road. The width of the image is 700 meters.

The scale of an image is found by measuring with a ruler the distance between two points on the image whose separation in physical units you know. In this case, we are told the field of view of the image is 700 meters wide.

Step 1: Measure the width of the image with a metric ruler. How many millimeters long is the image?
Answer: 150 millimeters.

Step 2: Use clues in the image description to determine a physical distance or length. Convert this to meters.
Answer: The information in the introduction says that the image is 700 meters long.

Step 3: Divide your answer to Step 2 by your answer to Step 1 to get the image scale in meters per millimeter.
Answer: 700 meters / 150 millimeters = 4.66 meters / millimeter. To two sig.fig this becomes 4.7 meters/mm

Once you know the image scale, you can measure the size of any feature in the image in units of millimeters. Then multiply it by the image scale from Step 3 to get the actual size of the feature in meters to two significant figures.

Question 1: How long is each of the three wings of the Bellaggio Hotel in meters?
Answer: About 25 millimeters on the image or 25 mm x (4.7 meters/mm) = 120 meters.

Question 2: What is the length of a car on the street in meters?
Answer: About 1 millimeter on the image or 1 mm x 4.7 meters/mm = 4.7 meters.

Question 3: How wide are the streets entering the main intersection?
Answer: About 8 millimeters on the image or 8 mm x 4.7 meters/mm = 37 meters.

Question 4: What is the smallest feature you can see, in meters?
Answer: Some of the small dots on the roof tops are about 0.2 millimeters across which equals 1 meter.

Question 5: What kinds of familiar objects can you identify in this image?
Answer: Will vary depending on student.

1. Cars, busses
2. Swimming pools and reflecting ponds
3. Trees
4. Lane dividers
5. Shadows of people walking across the plaza to the Hotel.

Note: Ask the students to use image clues to determine the time of day (morning, afternoon, noon); Whether it is rush-hour or not; Time of year, etc.

This is a picture taken by International Space Station astronauts of Washington, DC, and can be found among many other pictures at http://eol.jsc.nasa.gov/Coll/EarthObservatory/PostedSort.htm. The bridge at the bottom-center of the image is the George Mason Bridge (1) and it is 0.75 kilometers from end to end across the main part of the Potomac River (2).

The scale of an image is found by measuring with a ruler the distance between two points on the image whose separation in physical units you know. It is the most important number to determine because without it, you don't know how big the objects in the image are!

Step 1: Measure the length of the George Mason Bridge with a metric ruler. How many millimeters long is the image of the bridge?

Step 2: The information in the introduction says that the bridge is actually 0.75 kilometers long. Convert this number into meters.

Step 3: Divide your answer to Step 2 by your answer to Step 1 to get the image scale in meters per millimeter to two significant figures.

Once you know the image scale, you can measure the size of any feature in the image in units of millimeters. Then multiply it by the image scale from Step 3 to get the actual size of the feature in meters to two significant figures.

Question 1: About what is the distance between the US Capitol Building (3) and the Washington Monument (4)?
Question 2: About how wide are the major boulevards and roadways?
Question 3: About how wide is the Potomac River?
Question 4: How big is the smallest feature you can measure, and what do you think it is?
Question 5: How big is the area covered by this image in kilometers rounded to the nearest tenth?
Question 6: What other features can you recognize in this image?

You can use GOOGLE-Earth to help find other interesting landmarks in the image!

Answer Key:

The scale of an image is found by measuring with a ruler the distance between two points on the image whose separation in physical units you know. It is the most important number to determine because without it, you don't know how big the objects in the image are!

It is highly recommended that students use GOOGLE-Earth and dial-in 'Washington DC' to zoom-in on this area in higher resolution. They can use the various tools to bring up the labels for roads, buildings and geographic features.

Step 1: Measure the length of the Mason Bridge with a metric ruler. How many millimeters long is the image of the bridge? Answer: 15 millimeters

Step 2: The information in the introduction says that the bridge is actually 0.75 kilometers long. Convert this number into meters. Answer: 750 meters

Step 3: Divide your answer to Step 2 by your answer to Step 1 to get the image scale in meters per millimeter to two significant figures.
Answer: The image scale is 50 meters/mm

Once you know the image scale, you can measure the size of any feature in the image in units of millimeters. Then multiply it by the image scale from Step 3 to get the actual size of the feature in meters to two significant figures.

Question 1: About what is the distance between the US Capitol Building and the Washington Monument?
Answer: 72 millimeters on the image x 50 meters/mm = 3,600 meters or 3.6 kilometers.

Question 2: About how wide are the major boulevards and roadways?
Answer: The thick black lines are about 1.0 millimeter wide or 1.0mm x 50 meters/mm = 50 meters.

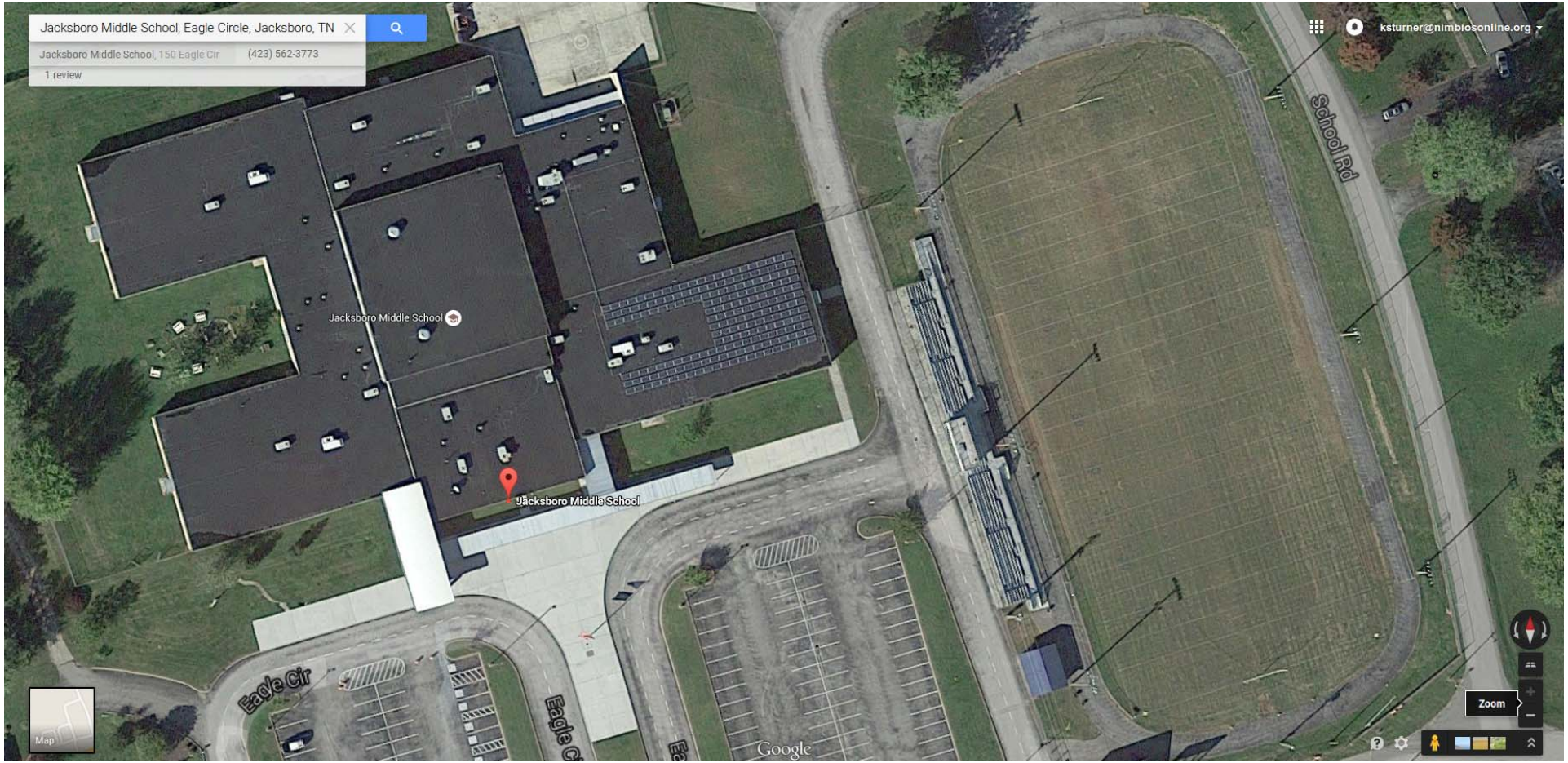
Question 3: About how wide is the Potomac River?
Answer: The river banks are about 12 millimeters apart along most of the river, so their true width is 12 mm x 50 meters/mm = 600 meters or 0.6 kilometers.

Question 4: How big is the smallest feature you can measure…and what do you think it is?
Answer: Students should be able to find many buildings that look like white spots with barely a square shape. These would be about 1 millimeter wide or 50 meters in true physical size.

Question 5: How big is the area covered by this image in kilometers rounded to the nearest tenth?
Answer; The field is 169 millimeters by 97 millimeters which is 8.5 kilometers x 4.9 kilometers in true size.

Question 6: What other features can you recognize in this image?
Answer: Students should be able to figure out the following features without using GOOGLE:

1. Rivers and waterways
2. Large and small buildings
3. Major boulevards
4. Minor streets
5. Bridges
6. Areas with trees and plant life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