Scenes of the Earth
Lesson Plan

Overview

- Students learn that changes in perspective can change the way that they can observe objects. In particular, students explore the relationship between a scene's area and its detail.
- Students look at the ground through cardboard tubes from various heights. At each height the students calculate the area that is visible, and describe what they see in as much detail as possible.
- Students learn that satellite and aerial images vary in size, scope, and detail. Students then see this effect in actual images from satellites.
- By the end of the lesson, students should have an appreciation for how the earth can be viewed and recorded in different ways.

Suggested Lesson Sequence	Please see the Global Visions module descriptions.
Lesson Level	Intermediate
Mathematics Connections	· Students will explore the notion of **area**. · Students will practice finding areas of enclosed regions by using **"tiling" strategies** to **tessellate** the area of a circle with squares. · Students will develop strategies to **estimate** the **approximate areas** of circles. · Students will explore the relationship between **area** and **perimeter** of differently shaped figures.
Science Connections	· Students will view objects from different **perspectives**, and find that changing perspective affects the amount and type of information that can be recorded. · Students will identify some of the **plants, insects, dirt, stones**, and other items that are included in their school playground **environments**. · Students practice the important skills of **observation, description**, and **recording** of **data**.

Technology Connections	· Students investigate how satellites **record image data** from orbit above the earth at varying levels of detail. · Students will explore the notion of a satellite image **scene** by viewing images on a computer. · Students will explore how changes in scene ***size*** may affect the amount of ***detail*** they can observe within the scene.
Lesson Assessment Tools	· Assessment and Standards Table (Word) · Assessment Activity Description · Authentic Assessments

Materials

- This lesson requires Powerpoint Reader (Windows / Mac), Quicktime Player, and Adobe Reader.
- Pixel the Satellite Scenes of the Earth Animation (Quicktime)
- Scenes of the Earth Activity Sheet (PDF)
- Grid tiles sheets (PDF) that should be printed and cut to make 16 grid tiles
- Scenes of the Earth Slide Show Assessment Activity (Powerpoint)
- Cardboard tubes
- 2 colors of yarn or string
- Scissors
- Sheet of lined paper

Vocabulary Words

- Ground Field of View – the total ground area that can be viewed by looking through a device such as a camera lens or a cardboard tube at a particular height
- Scene - an image acquired by a satellite orbiting the earth
- Detail – how finely the features within a ground field of view can be observed in an image or with the naked eye
- Area - the amount of ground space that can be seen in a particular ground field of view
- Tiling - putting objects of known area side by side within a larger unknown area, in order to determine the total larger area
- Image - a paper or digital picture
- Square decimeter - a unit of area measurement that is equal to 100 square centimeters. The top area of a CD case is slightly larger than one square decimeter.

Procedure

1. To help introduce this lesson, a one-minute Pixel the Satellite "Scenes of the Earth" Animation is available for your use in the classroom. You may wish to play this animation on a large screen before distributing any paper materials to the students. This animation has been designed to help inform and excite students about the lesson, as well as to set the stage for the lesson context. The transcript of this Pixel the Satellite Animation is as follows (this and all other Pixel the Satellite Animation transcripts can be printed for students with hearing impairment):

   SCENES OF THE EARTH ANIMATION TRANSCRIPT:

   "1. Did you know that I'm not alone up here orbiting the earth? 2. That's right, I've got lots of satellite friends who take pictures of the earth just like I do! 3. But, just like people on earth, we satellites are all a little bit different from each other. 4. Some of us look at big, huge areas while we orbit the earth – so big that we can take pictures of the whole earth in one day! 5. Other satellite friends of mine, though, look at the earth in smaller portions – and it takes them about 2 whole weeks to take pictures of the entire planet. 5. Do you think a large area can be studied in more detail or in less detail than a small area? 6. This next lesson gives you a chance to think about these things with your teacher. 7. As for now, I'm off to fly over the yellow sands of the Sahara Desert! 8. See you soo-oon!!!"

After viewing this animation, tell students that they are now going to pretend that they are satellites themselves and will look down upon the earth to record their own observations through a satellite "viewing tube". This will be an excellent time to have a short discussion about what the children think they would be able to see if they were riding on a satellite orbiting the earth. You may also wish to introduce the lesson vocabulary words at this time.

2. A location on the playground (or nearby park) should be chosen for the next activity. Students will be recording detailed observations of small plots of the ground while looking through a cardboard tube, so the lesson would be most effective if the location were a natural surface-- grass, gravel, sand, etc. While outside, but before engaging in the activity, ask children to think about and discuss what they think they will see as they look through the tubes from various heights. Reflect back to the discussion in the classroom (from the previous step) and have students think about how their answers are different from when they thought about themselves riding on an orbiting satellite.

3. Hand out the Scenes of the Earth Activity Sheet. Students should work as partners and be given two pieces of different colored yarn. One color should be about 2 meters in length and the other about 1 meter in length. In preparation for measuring area, the teacher (or students) should cut out 16 square decimeter (dm^2) tiles, using the Grid Tiles as a template. A square decimeter is 10 cm x 10 cm (100 cm^2), or approximately 16 square inches (4 x 4 inches).

4. Time to be a "little satellite"! Children should look through their tube and describe, in as

much detail as possible, the ground they see. Students will complete this task both standing and kneeling to explore how the detail and size of their "fields of view", or "scenes", change with respect to how far away from the ground the tube is. Students should write their observations of the two "scenes" on their activity sheet (e.g. colors, plants, insects, pebbles, etc.). Be sure that both partners are able to look through the tube at both heights to gain a perspective of the different "ground fields of view".

5. Students can measure the area of the "ground field of view" or scene from the standing and kneeling positions. As one person looks through the satellite tube standing up, the partner should outline a circle on the ground (with yarn or string) that captures the entire visible area. The yarn should be cut with scissors at the correct length necessary to make the circle. This process should be repeated in the kneeling position.

6. Return to the classroom with the two pieces of yarn of different lengths to measure the two areas. Placing the yarn on a flat surface, the students should make two circles with their yarn. Using the Grid Tiles previously cut out, students may find the area of the ground from the two "fields of view" by placing as many cut out tiles as they can in each circle. Students will estimate the area of each circle by counting the number of square decimeters (dm^2) that fit inside. The teacher may need to help students estimate the total area if partial tiles are used.

7. After estimating the area of the "fields of view" from the two heights, the teacher might then wish to compile a list of the observations that students recorded on the blackboard. Questions for discussion might include: How do the lists of what was observed differ as the circles got smaller? How are they similar? What did you gain as your "satellite" was positioned closer to the ground? What did you lose as the "satellite" was positioned closer to the ground? Do you think that satellites have this ability to fly closer to (or farther from) the ground as a helicopter might do? (Although satellites do not operate in such a fashion because they have one fixed altitude for their orbit, balloons and airplanes can more easily take photographs of the same region of the earth from various altitudes. In these situations, greater detail (at the expense of breadth) is usually gained as cameras get closer to the ground. The way individual satellites can accomplish recording different areas and amounts of detail is done with special viewing lenses, or *optics*, which is a concept that is developed in the Satellite Eyes lesson.)

8. A discussion of these ideas should lead to the notion of "surface area"-- the size of the region captured within the string circles (i.e., the "ground field of view", or, for the purposes of this activity, the "scene"). You should ask students to think about how the surface area or ground field of view changed at the two different heights.

9. In this activity, students used the concept of tiling to "tessellate" the areas of a circle with squares. Tessellation is a term that means using the same congruent figures to "tile" a surface. Other size tiles could be used to measure the area. The smaller the square, the more accurate the estimations of surface area will become. Throughout the process, take the opportunity to

lead a discussion about how the students handled tiles or squares that were situated on the borders -- only partially within the circles.

10. Questions for Class Discussion

How does scene size (i.e., the ground you could see within your yarn circle) relate to the amount of detail that could be observed through the tube?

If the scene size is smaller, more detail is visible. In larger scenes, the less detail is observable but the ground field of view (area) is larger.

In what way did your list of observations change as you moved closer to the ground?

Answers will vary, although students should describe objects in more detail as they moved closer.

What are some ways to compute surface area?

In this activity, surface area was computed by counting the number of tiles that fit into the circle.

When tiling, how do you decide how to count tiles that are only partially contained within the circular region?

Teachers should help students to see how their strategy may be under- or overestimating the area of the circular region.

How might the playground activity relate to how airplanes and satellites take imagery of the earth?

Satellites and airplanes are able to take images of the earth at different levels of detail due to their different heights. The areas of these scenes also differ. The following slide show assessment activity as well as other ESC lessons such as Satellite Eyes will help students connect this activity to the actual functioning of a satellite.

11. Slide Show Assessment Activity

- Have students take out a piece of lined paper and a pencil. Load the Scenes of the Earth Slide Show Assessment Activity on a computer, preferably so that all students can see the same image at the same time. Students will see actual satellite imagery of the Epcot Center in Orlando, Florida. Students will have this opportunity to make the link between their playground activity and the satellite images. Several questions are listed below each image in the presentation. Encourage students to discuss these questions in class. The last slide in the activity lists several questions that students should answer on their own by writing on their piece of paper. These questions include:
    - What is detail? *(answers should relate to how "detail" is described in the*

activities of this lesson. Detail should be explained in terms of image sharpness and distance from the ground when observing the earth's surface.)

- What is area? *(answers should relate to how "area" is described in the activities of this lesson. Area should be explained in terms of the amount of space contained within a ground target or a satellite image. Students may also describe area in that it may be quantified by tiling known smaller areas.)*
- How are detail and area related when looking at ground scenes? *(Typically, the larger the area viewed, the lower the level of detail that can be seen.)*
- How might you be able to find the area shown in the last scene? *(Students may make the connection that perhaps a large tile could be placed on the ground and moved about the United States to tessellate the ground in that scene. Another approach would be to print out the image and use a tile of a given area to tessellate the image. The second approach would provide a size for the image, rather than for the ground, unless a scaling factor was taken into account.)*

Lesson Extensions for Authentic Assessment

- Students can explore the relationship of area and perimeter with their differently colored strings. The teacher should pose the question: Can the same amount of string make shapes whose figures cover different amounts of a region? Students can use their string and tiles to explore this question. Teachers could also challenge students to find the figure with the greatest or least area using their string. (Greatest – circle, Least – a very thin rectangle)
- To explore more areas by zooming in and out with satellite imagery, you may wish to visit the NASA Scientific Visualization Studio (http://svs.gsfc.nasa.gov) on the Internet with your students. Many additional exciting satellite image "zooms" are available on that site that helps to develop the relationship between detail and area of an image.

Acknowledgement

- The images shown in this slide show were acquired by the IKONOS (high detail), Landsat 7 (medium detail), and MODIS (low detail) satellite sensors. Image sequence courtesy of the NASA Goddard Space Flight Center Scientific Visualization Studio.