Exploring our planet from above

Module Overview

Students view Earth by studying aerial photographs, Space Shuttle photographs, and satellite images. They learn how remote sensing can help identify ways in which people have changed the physical environment.

***Investigation 1:* Does what you see depend on where you are?**
How does viewing an object from a distance change what the observer sees? Students compare different viewing distances on the ground, from the air, and from space.

***Investigation 2:* How can we compare maps with images from space?**
Students examine maps at different scales and make observations about the amount of detail they can see. They compare remotely sensed images with maps, and measure and map changing land use with remotely sensed images.

***Investigation 3:* What can satellites tell us about Earth?**
Students compare an aerial photo and a satellite image of the same place in order to identify basic characteristics of satellite images. They track the orbits of a satellite over the eastern United States and demonstrate how satellite signals are interpreted by simulating the creation of a satellite image. By overlapping two images, the students show how mosaics are created to show large areas. A concluding investigation matches different scientists with the kinds of remote sensing images they are likely to use in their work.

***Investigation 4:* How does color help us understand images from space?**
Students learn to interpret colors in images from space. A mapping activity helps them to recognize global vegetation patterns from the colors they see in remote sensing images. They also distinguish between true color and false color images and examine how geographers and scientists use false color images to study the surface of Earth.

Geography Standards

The World in Spatial Terms
- **Standard 1:** How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective

Places and Regions
- **Standard 4:** The physical and human characteristics of places

Physical Systems
- **Standard 8:** The characteristics and spatial distribution of ecosystems on Earth's surface

Science Standards

Unifying Concepts and Processes
- Systems, order, and organization

Science as Inquiry
- Abilities necessary to do scientific inquiry

Earth and Space Science
- Objects in the sky
- Changes in earth and sky

Science and Technology
- Understandings about science and technology

Science in Personal and Social Perspectives
- Changes in environments
- Science and technology in local challenges

Connections to the Curriculum

This module can be used in social studies classes in the study of maps and globes and as students learn about Earth's physical characteristics such as its climates, weather patterns, plants, and animal life. The investigations strengthen science and social studies skills of observation, prediction, inference, and classification. Students are given many opportunities to practice their measurement skills and to study the effects of technology on the environment. Students practice language arts skills by reading to be informed and by reading to learn to perform a task.

Time

Investigation 1: One 45-minute session
Investigation 2: Two 45-minute sessions
Investigation 3: Two 45-minute sessions
Investigation 4: Two 45-minute sessions

Mathematics Standards

Number and Operations

- Compute fluently, and make reasonable estimates

Technological Literacy Standards

Nature of Technology

- **Standard 1:** The characteristics and scope of technology
- **Standard 3:** Relationships among technologies and the connections between technology and other fields

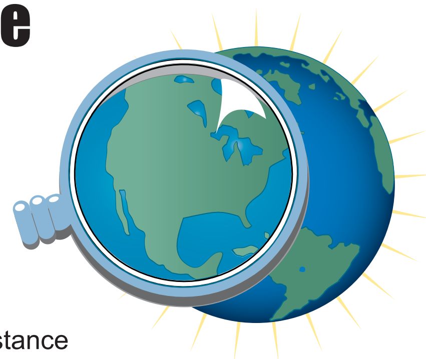
Abilities for a Technological World

- **Standard 11:** Apply design processes

The Designed World

- **Standard 17:** Information and communication

Does what you see depend on where you are?



Investigation Overview

How does viewing an object from a distance change what the observer sees? Students compare different viewing distances on the ground, from the air, and from space. This investigation has two parts. First students view simple shapes from varying distances and record their observations. Then they view NASA images and make observations about what can be seen from ground level, from an airplane, and from the Space Shuttle.

Time required: One 45-minute session

Materials/Resources

Part 1:
- Paper towel tube
- Paper or styrofoam cup
- Two lengths of string, 1 and 4 meters long
- Felt marker
- Meter stick
- Scissors
- Colored paper
- Any wall map
- A map that shows the following places in Florida: Miami, Orlando, Cape Canaveral, Lake Okeechobee (can be the same as the wall map)
- Erasable marker
- Masking tape

Part 2:
- Figure 1: Ground view of Space Shuttle on launch pad (transparency)
- Figure 2: Aerial view of Kennedy Space Center launch pad (transparency)
- Figure 3: Space Shuttle lift-off (transparency)
- Figure 4: Florida as seen by astronauts (transparency)
- Map showing major cities and lakes of Florida
- Logs 1, 2, 3, and 4 (one copy of each per student)

Content Preview

As the distance between an observer and an object increases, a larger area surrounding the object is visible. Many details, however, cannot be seen when the viewing distance increases. High altitude photographs provide viewers with the "big picture," but when detailed information is needed, regions must be observed from less distant positions or with equipment that compensates for the distance, such as a camera with a zoom lens. Measurements of land area can be made on satellite images.

Geography Standards

Standard 1: The World in Spatial Terms

How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective

- Use geographic representations, tools, and technologies to answer geographic questions.

Geography Skills

Skill Set 2: Acquiring Geographic Information

- Use aerial photographs, satellite images, or topographic maps to identify elements of the physical and human environment.

Classroom Procedures

Beginning the Investigation

1. Ask the students to place the palm of one hand on the tip of their nose. Ask them to keep looking at the hand and to describe the changes they see as they move the hand away from their noses. (*At first they will see only part of the hand, then the whole hand, then part of the arm, as well as the hand*.)

    - Older students can do this activity following the directions in **Log 1**. In preparation, have students fold a sheet of paper lengthwise and mark distances of 5, 15, and 30 centimeters along the fold. Then they can hold the paper in one hand and move the other hand to each of the three distances.

2. Position a student approximately 15 centimeters from a wall map. Ask the student to describe what he or she sees. From this position the student may be able to identify a state or region. Have the student take a large step away from the map and ask what he or she sees while looking straight ahead at the map. The student should be able to describe a larger area, several states or a country. Repeat with one more large step.

    Ask the student to explain how moving away from the map changed what he or she saw. (*More area is visible but fewer details.)*

3. Discuss with students the change they see when distance between observer and object changes. (*As you move further away from an object, the boundaries of your field of vision are extended, revealing new information. Your interpretation of what you see changes because you have more information*.) Have older students express this in their own words in **Log 1**.

Developing the Investigation

4. Cut 8 to 10 circles, squares, and rectangles from colored paper. Cut the circles with a diameter approximately 2 centimeters, the squares with sides 2 centimeters in length, and the rectangles with sides of 2 and 3 centimeters.

5. Place these shapes at student eye level over a large section of a classroom wall so that only one is visible at a distance of 1 meter. They can be positioned near other objects, figures, or markings on the wall. As students move farther away from the wall, they should be able to see more of the shapes.

6. Have the students place the 4 meter string on the floor with one end touching the midpoint of the wall on which the paper shapes are mounted. Extend it away from the wall. Use small pieces of masking tape to mark 1 meter increments along its length.

7. Provide students with a small paper cup with the bottom cut out.

8. Follow the instructions in **Log 2** with groups of students lining up together to view the paper shapes. Note that each student should select his or her own *target* and stand one meter in front of it. Ask the students to view one of the shapes through the large open end of a paper cup. Older students can write their responses on **Log 2**; younger students can give verbal responses.

9. Ask the students to view the same shape after moving distances equal to two and four times the original viewing distance (2 and 4 meters) and repeat the description process using **Log 2**.

Concluding the Investigation

10. Simulate a NASA remote sensing mission with students. Tell the students that they will examine photos of a Space Shuttle launch taken at the Kennedy Space Center. Ask them to imagine what the astronauts will see as the shuttle leaves the ground. (*The launch site, the Space Center, the Florida coast, all of Florida, etc.*)

11. Display **Figures 1**, **2**, and **3** as overhead transparencies. Ask older students to write their observations on **Log 3**. Younger students can give verbal responses.

    Begin by asking students to identify the Space Shuttle in **Figures 1**, **2**, and **3**. Also point out the fuel tank and solid-fuel booster rockets that carry the shuttle into space. Ask students to outline the shuttle and the rocket with erasable markers. When showing **Figure 4**, have students mark the location of each place on the transparency.

    Figure 1: Ground view of Space Shuttle on launch pad at Kennedy Space Center, Florida
    Figure 2: Aerial view of Kennedy Space Center Launch Pad 39 from a distance of approximately 1.6 kilometers with the Space Shuttle being prepared for STS-39 mission. Image S91-32599

Figure 3: Space Shuttle lift-off
Figure 4: Picture of Florida from a distance of approximately 546 kilometers as seen by astronauts aboard the Space Shuttle in 1998.

Background

Researchers and scientists determine the distance from which to view an object based on the type of information needed. For example, scientists may use pictures taken from a satellite orbiting 35,200 kilometers from Earth to study large areas of cloud cover or weather patterns, whereas they might employ satellites orbiting 320 kilometers above Earth to study river drainage in detail.

Determining the length and width of lakes or other objects can be accomplished using satellite images. On an image, the physical dimension of a land feature can be determined by a technique known as scaling. The dimensions of Lake Okeechobee can be determined by comparing its length and width to the known width of Florida. The east-west distance across Florida through Lake Okeechobee is 224 kilometers. When scaled on the image, Lake Okeechobee is approximately one-fourth that distance, or 56 kilometers.

Evaluation

Log 1

1. 5 centimeters—palm of hand, base of fingers
   15 centimeters—whole hand
   30 centimeters—whole hand, part of arm
2. You can see more of the map but not as much detail.

****Log 2***

1, 2, and 3. What you see will vary with the placement of the paper shapes.

4. No, you would not be able to tell the shapes apart. 100 meters. You would see the wall and very large objects on it, like a bulletin board.
5. As you move farther away from something you see less detail, but you can see more of the area.

****Log 3***

Figure 1
1. Far away
2. From the ground

Figure 2
1. Yes, because the Space Shuttle looks smaller
2. From the air. You are looking down at two airplanes flying over the Space Center.

Figure 3
1. No, because the Space Shuttle looks larger

****Log 4***

1. 546 kilometers
2. Yes
3. See map for locations.
4. You can't see the Space Center because the photograph was taken from too far away.
5. 56 kilometers.
6. No, because it would be too small to be seen from that distance. The 56 kilometers width measures only about 1 centimeter in the photograph. A 1 kilometer wide lake would be 1/56 the size—too small to be seen.

Module 1, Investigation 1: Log 1

How does distance affect what we see?

Every day our eyes help us gather the information we need to discover and understand what is around us. In this activity, you will describe what your eyes see as you move farther away from an object.

1. Place your hand flat against the tip of your nose. Move it 5, 15, and 30 centimeters away and describe what you see at each distance in the space below. Include in your description the answer to the following questions:
    a. Can you see your whole hand or just part of it?
    b. Can you see the tips of your fingers?
    c. How much of your arm can you see?

Location	Description
Hand 5 cm from nose	
Hand 15 cm from nose	
Hand 30 cm from nose	

2. How does what you see on a wall map change as you move away from it?

____

____

____

Module 1, Investigation 1: Log 2

How does distance affect what we see?

1. Move 1 meter from a shape pasted on the wall and look at it through the large open end of a paper cup. This shape is your *target*.

   Can you see any of the other shapes near your target? How many can you identify? Name them (for example, two circles and one square).

   ____

   ____

   ____

2. Move away from the target to a distance equal to two times the original distance.
   How many meters are you from the target? ______________
   Record what you see. ____

   ____

   ____

3. Move away from the target to a distance equal to four times the original distance.
   How many meters are you from the target? ______________________________
   Record what you see from this distance. ______________________________

   ____

   ____

4. Would you be able to tell the shapes apart if you saw them from a distance equal to a hundred times the original distance? ____________________
   Your distance from the target would then be ________________ meters.
   Record what you *think* you would see at that distance.

   ____

   ____

5. Conclusions: Explain how what you see changes when you move farther away by circling the words that finish these sentences correctly.

   As you move farther and farther away from something, you see more detail or less detail.

   As you move farther away from something you see more of the area around it or less of the area around it.

Module 1, Investigation 1: Log 3
How does distance affect what we see?

Figure 1

1. The Space Shuttle looks small in the photograph, even though it is the size of a large airplane. This tells you something about the distance between the photographer and the launch site. Was the photographer close to the site or far away?

   ____

2. Was the photograph taken from the ground or from the air? ____________________
   How can you tell?

   ____

Figure 2

3. Was this photograph taken from a greater distance than the first photograph? ______
   How can you tell?

   ____

4. Was this photograph taken from the ground or from the air? ____________________
   How can you tell?

   ____

   ____

Figure 3

5. Lift-off! Was this photograph taken from a greater distance than Figure 2? ________
   How can you tell?

   ____

   ____

Module 1, Investigation 1: Log 4

How does distance affect what we see?

Figure 4

1. The Space Shuttle has circled Earth and come back over Florida. This photo was taken by the astronauts on board. How far above Florida is the shuttle?

   ___________________ kilometers

2. Compare the photograph with a map of Florida. Can the astronauts see the whole state?

   ____

3. Find Miami and Orlando on the map. Figure out where they are in the photograph.

4. Now find Cape Canaveral in the same way. This is the location of the Kennedy Space Center. Why can't you see the launch site in this photo that you saw in Figure 2?

   ____

   ____

   ____

5. Find Lake Okeechobee in the photograph. The distance across Florida through Lake Okeechobee is 224 kilometers, and the lake is about 1/4 as wide as that part of the state. Can you figure out how wide the lake is?

   ___________________ kilometers

6. Do you think that you would see the lake if it was 1 kilometer wide?_______________ Why or why not?

   ____

   ____

   ____

Module 1, Investigation 1: Figure 1
Ground view of Space Shuttle on launch pad

Lite pre-launch activities and Lite flight – KSC
NASA Langley Research Center 3/13/1995 Image # EL-1996-00059

Source: http://lisar.larc.nasa.gov/LISAR/IMAGES/SMALL/EL-1996-00059.jpg

Module 1, Investigation 1: Figure 2
Aerial view of Kennedy Space Center launch pad

This photograph provides an aerial view of Kennedy Space Center Launch Pad 39 from a distance of approximately 1.6 kilometers with the Space Shuttle being prepared for STS-39 mission.
Source: http://images.jsc.nasa.gov/images/pao/NASA_JSC/10076653.jpg

Module 1, Investigation 1: Figure 3

Space Shuttle lift-off

LDEF: Liftoff of Space Shuttle Columbia/STS–S32 for Retrieval
NASA Langley Research Center 2/6/1990 Image # EL–1994–00476

Source: http://lisar.larc.nasa.gov/LISAR/IMAGES/SMALL/EL-1994-00476.jpg

Module 1, Investigation 1: Figure 4
Florida as seen by astronauts

This photograph of Florida was taken by astronauts aboard the Space Shuttle in 1998, from a distance of approximately 546 kilometers.
Source: http://eol.jsc.nasa.gov/sseop/mrf.stm (STS-095-743-33.jpg)