Odyssey of the Eyes
Beginning Level

Purpose

To familiarize students with the importance of perspective and introduce students to various scales of remotely sensed data.

Overview

Students create a 3-D model of an area and develop a classification system for the landforms in their model. They use their eyes as remote sensors and view the model from a variety of heights and perspectives. Students then create maps of the objects they see. The maps can be used to answer certain questions about the environment.

Student Outcomes

Science Content

Physical Science

Symbols are alternative ways of representing data.

Science as Inquiry

Draw pictures that correctly portray at least some of the features of the thing being described.

Geography

Primary

How to describe the student's own region from different perspectives

How to display spatial information on maps and other geographic representations

The spatial concepts of location, distance, direction, and scale

Middle

Physical characteristics of places

How to make and use maps and to analyze spatial distributions and patterns

Enrichment

A map is a symbolic representation of a certain area.

Maps of the same area can be represented with different scales.

Field of view is how large an area you can perceive.

The field of view increases as the distance from the ground or object increases.

Remote sensing is collecting data about something from a distance.

Scientific Inquiry Abilities

Observe a landscape and design a model of it.

Draw a landscape from various perspectives.

Use different scales to view a group of objects.

Level

Primary

Time

Three to four class periods

Materials and Tools

Paper towel or toilet paper tubes

A variety of materials (boxes, cardboard, paper, paint, glue, tape, etc.) to make the models

Ruler

Writing materials

Odyssey of the Eyes Registration Form

Odyssey of the Eyes Observations of the Model

Odyssey of the Eyes Symbolic Map Data Sheet

Preparation

Gather all materials prior to the building of the model.

Using a common road map, review the basic components of maps and models such as map keys and symbols.

Prerequisites

None

Note: This activity presents concepts similar to those in *Relative and Absolute Directions Learning Activity* in the *GPS Investigation*.

Background

In the *Manual Interpretation* and *Unsupervised Clustering Mapping Protocols*, students create a land cover type map of the 15 km x 15 km GLOBE Study Site. The image you receive has been acquired from a satellite. Your students will classify the land cover types manually or with the use of a computer. They will also collect data, using the *Land Cover Sample Site Protocol*, to verify the accuracy of their resulting map. It is important to understand the concepts of modeling and remote sensing to have a clear understanding of where this information comes from and the significance of it.

Maps are very common models for representing the Earth's surface. When we create a map, we often use remote sensing to obtain the information needed to make the map. Satellite images are one type of *remotely sensed* information or data.

We may think of remote sensing as work that is only done by satellites, yet there are many instruments, including ourselves, that are used to remotely sense objects. Although students may not know it, they have a great deal of experience with remote sensing. Anytime they observe and learn about something (using their senses) without touching it; they are remotely sensing the object. Also, using a camera and a microscope are other forms of remote sensing. Cameras and microscopes give us information that we would not be able to access if we attempted to observe an object with our own limited senses.

Scientists who study land cover use a variety of aerial photography and satellite images depending on the purpose of their study. GLOBE scientists are interested in analyzing the satellite images to determine land cover types and land use changes over time.

Satellite images are made up of tiny squares called pixels. Look very closely at the satellite image of your GLOBE Study Site and you will be able to see this. Each square/pixel contains information about the dominant characteristics of a certain land cover area. Some images have pixels that represent a large area on the ground and others have pixels that represent smaller areas. The size of the area covered in a pixel is known as the resolution of the satellite image. The smaller the pixels' size, the better the resolution.

Resources *(Optional)*

Looking Down. Jenkins, Steve. NY: Hutton Houghton Mifflin, 1995. ISBN 0-395-72665-4

View from the Air. Lindberg, R. NY: Viking, 1995. ISBN 0-670-84660-0

Mouse Views. McMillan, B. NY: Holiday House, 1995. ISBN 0-8234-1132-x

What To Do and How To Do It

Part 1: Building and Viewing the Model

1. Students form groups and write a plan for building a model of an area, real or imagined. The schoolyard is a popular choice; however, the design of the model should be student generated. Students should list materials necessary and draw a proposed picture of their model on the *Odyssey of the Eyes Registration Form*.

2. Students will need two to three class periods to build their models.

3. Students will now use their eyes to view the model through a paper towel tube from four different views. This will give students an opportunity to view a change in *resolution* and a change in *field of view*. Have students record their observations on the *Odyssey of the Eyes Observations of the Model Work Sheet*.

   a. **Mouse View** — Observe the model from the side. Draw a map of the model and label it.

   b. **Bee's View** — Observe from 10 cm above the model. Draw a map of the model and label it.

   c. **Bird's Eye View** — With the model on the floor, observe from desk level. Draw a map of the model and label it.

   d. **Satellite View** — Observe from a second story window or stairwell. Draw a map of the model and label it.

Discussion Questions

1. Are there any visual differences between the Bee's View and the Mouse's View? What are they?

   Note: Young elementary school children often have more difficulty with the concept of "top view." Some extra time may be needed here. See resource list for suggested resources.

2. Compare your four drawings. Which view would be the most useful if you were:

   a. An eagle looking for a mouse?

   b. Deciding where to build a mall?

   c. Looking for animal tracks?

   d. Studying the extent of deforestation or reforestation?

   e. Finding a lost child in the woods?

   f. Seeing how much of the forest in your area has been damaged by pollution?

   g. Looking for a lost pin?

3. What are the advantages of using satellites to view the Earth? Are there any disadvantages?

Part 2: Making a Symbolic Map of the Model

1. Have students pick a symbol to represent each land cover type in their model (roads, rocks, playground equipment, pond, river, grass, houses, etc.). List the land cover items and symbols in the *Odyssey of the Eyes Symbolic Map Data Sheet.*

2. Use the symbols to create a map of the area on another sheet of paper.

3. Have student groups exchange symbolic maps, decipher the maps, and write a fictional story about an event that could occur within the depicted environment.

Note: If you plan on doing *Odyssey of the Eyes Intermediate Level,* please save the maps and models for comparison.

Discussion

1. If you were asked to make a map of your neighborhood, would you prefer to draw a true to life map or a map using symbols? Why?

2. Which distance (mouse, bee, bird, or satellite) would give you the best field of view for observing the area in your GLOBE Study Site? Why?
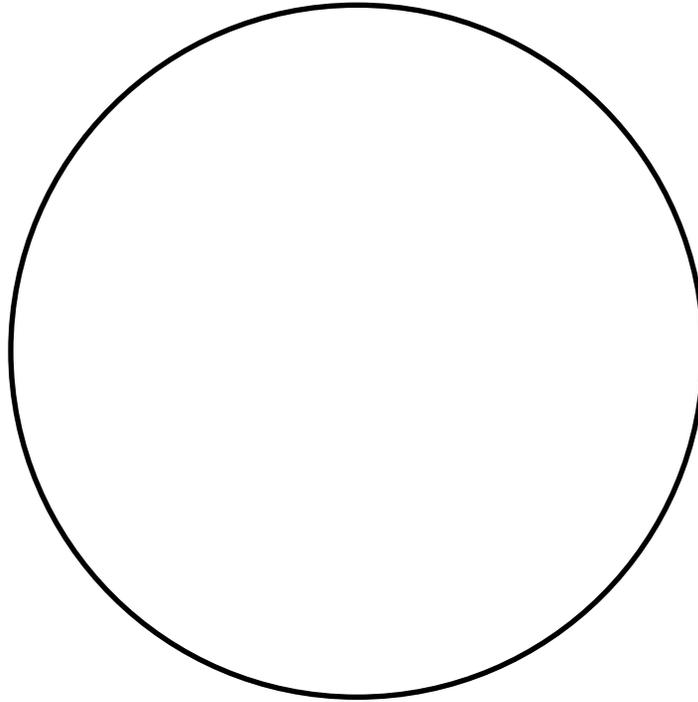
Extension

Collect a few different types of maps or ask students to research different types of maps. Discuss the purpose of each map. Explore the maps' different scales and fields of view in the discussion.
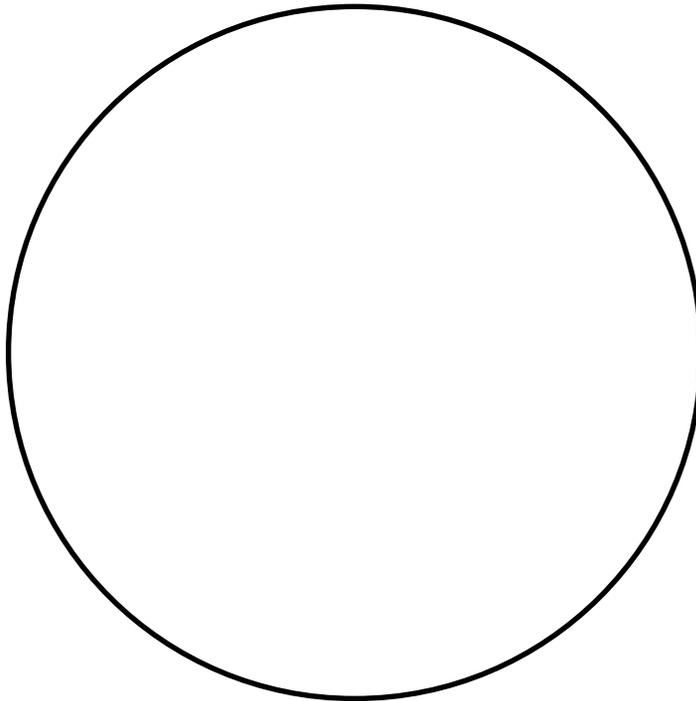
Odyssey of the Eyes
Registration Form

Name: _____ Date: _____

Write a short description of the model you are going to create in the space below.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Materials Needed:	Provided By:

On the back of this page, draw a diagram of the model you are going to create.

Odyssey of the Eyes

Observations of the Model-1

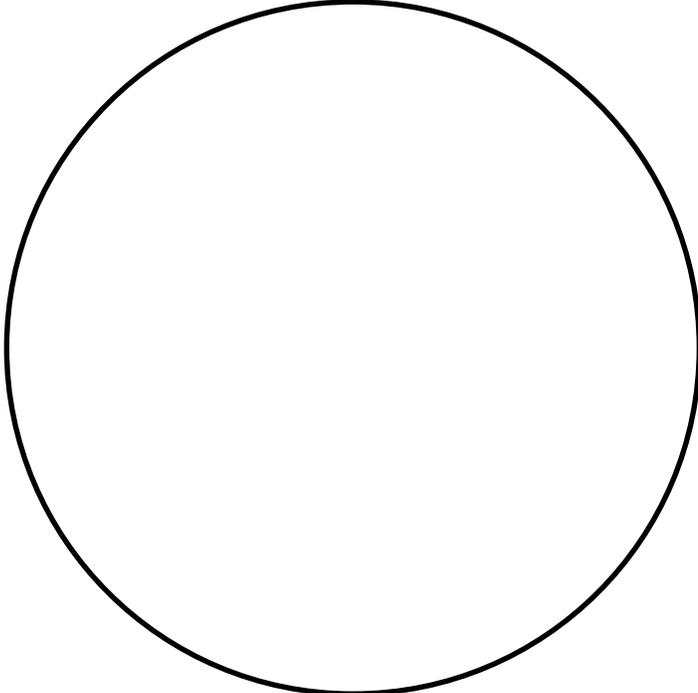Name: _____ Date: _____

Mouse View
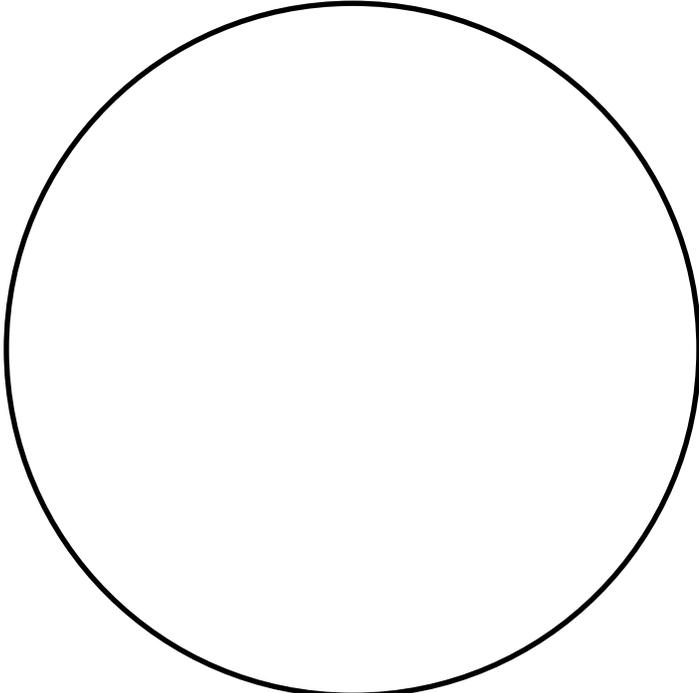
Bee's View

Odyssey of the Eyes

Observations of the Model-2

Name: _____ Date: _____

Bird's Eye View

Satellite View

Odyssey of the Eyes

Symbolic Map Data Sheet

Name: _____ Date: _____

Land Cover Key

	Land Cover Type	Symbol
	Example: *Road*	══════
	Example: *Tree*	▲
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Use the back of this paper to draw your symbolic map. Include the dimensions of the map in centimeters (length and width).

Odyssey of the Eyes
Intermediate Level

Purpose

To familiarize students with the concept of modeling as it is related to remote sensing and to the process of digitizing images.

Overview

Students will use the symbolic map created in the beginning activity to produce a digitized image. As they perform the activity, they will begin to see why ground verification of satellite data is necessary in order for scientists to create accurate models of the Earth's systems.

Student Outcomes

Science Content

Science and Technology

Scientists rely on technology to enhance the gathering and manipulation of data.

Science as Inquiry

Communications involves coding and decoding.

Tables, graphs and symbols are alternative ways of representing data.

Use numerical data in describing and comparing objects and events.

Geography

Primary

Maps and satellite-produced images

Middle

Characteristics, functions, and applications of maps, globes, satellite images

Enrichment

Objects in a remotely sensed image are interpreted and digitized into a code based upon the object's reflectance of bands of light.

The image codes are relayed through a satellite dish to a computer for storage or enhancement.

Image display is accomplished by conversion of stored data to a user-defined color-coded image.

Scientific Inquiry Abilities

Observe, digitize and interpret an image.

Level

Middle

Time

Two to three class periods

Materials and Tools

Graph paper

Pencils

Maps and models from *Odyssey of the Eyes Beginning Level*

Plastic overlay with *Odyssey of the Eyes Grid*

Colored pencils

Odyssey of the Eyes Digitized Data Sheet

Preparation

Assemble the materials.

Demonstrate the process of digitizing to the class before you have students work with partners.

Prerequisites

Students should know how satellites receive information and relay it to a computer.

Odyssey of the Eyes Beginning Level is necessary for the completion of this activity.

Note: This activity presents concepts similar to those in steps 8, 9, and 10 of the *Relative and Absolute Directions Learning Activity* in the *GPS Investigation*.

Background

The sun emits energy in the form of light. This light energy reaches the earth. The light is composed of many bands of light, including visible light. Visible light is made up of red, orange, yellow, green, blue, indigo, and violet. Each object on earth reflects visible light differently. Some objects reflect all visible light (objects that appear white to us), others absorb all visible light (objects that appear black to us), and some reflect different amounts for each band of visible light. Satellites record the amount of light reflected from objects on the ground. They store this information as data or code. These codes or data are visualized on a computer and called satellite images.

What To Do and How To Do It

Part 1: How Digitized Images Are Made

Students will learn how satellites and computers communicate with each other. One student will serve as the satellite and the other will represent the computer. Using a black and white picture, the student "satellite" will scan a picture, translating it into a digitized code. The student "computer" will translate the numeric code, reproducing the image.

1. Students work in pairs. One serves as the satellite and the other represents the computer. The satellite places the plastic overlay with the *Odyssey of the Eyes Grid* over the black and white picture of the *Odyssey of the Eyes Satellite.* The satellite scans the picture, one box at a time, starting at the left-hand corner of the picture. The satellite calls out a number code for each box on the grid to his or her computer (partner). The computer writes the number code on their grid.

2. The satellite will interpret each square according to the following guidelines:
   - The satellite indicates the beginning and end of each scan line with a "0."
   - **If a box is white**: the satellite interprets the message as a "1."
   - **If a box is gray**: the satellite interprets the message as a "2."
   - **If a box is black**: the satellite interprets the message as a "3."
   - **If a box is not all black, all gray or all white:** the satellite must make a decision as to the best possible choice, "1", "2" or "3." The "satellite" should make his decision based on whether the square is mostly black, gray, or white.

3. Using a pencil, the student representing the computer translates the digital code onto the graph paper, creating a satellite image. They begin or end a line when they read a "0," leave a box blank when they read a "1," and shade in the square lightly if they read a "2" or shade in the square black, if they read a "3."

Example:
If the boxes in the first row are white, white, black, mostly black, and gray and the second row is white, gray, black, mostly white, and gray; the "satellite" would translates this to [01133200123120]. The computer writes down this code and then colors in the grid of the first row with white, white, black, black, gray and the second row with white, gray, black, white, gray.

Note: For additional practice, use student generated color pictures and different size grids.

Part 2: Making a Digitized Image Using Data From a Map Model

1. Supply each group with a plastic grid overlay (made from the *Odyssey of the Eyes Grid*). Have the students place this grid over the symbolic map from *Odyssey of the Eyes Beginning Level.*

2. Ask students to create a color and number code (key or legend) for the land cover items on their map. Assign each landform on the symbolic map a color and a number. Record this on the *Odyssey of the Eyes Digitized Data Sheet.*

3. Ask students to create the digitized code for their map:
   - Begin and end each scan line with a "0."
   - Scan each line of the symbolic map, "coding" each square with a number determined by the *Odyssey of the Eyes*

Digitized Data Sheet.
- Record the numbers on the data chart.
- Review the guidelines in *Part One* of this activity for further assistance.

4. Finally, using the digitized code, ask students to select the matching colors and reproduce the map as a digitized image on a piece of graph paper.

Discussion and Assessment

1. Look at your symbolic map.
   a. What is different about the digitized map or image?
   b. What is the same?
   c. Do you think that the image and model both represent the same amount of each land cover type or landform?

2. Look at your original model.
   a. What is different about the digitized map or image?
   b. What is the same?
   c. Do you think that the image and model both represent the same amount of each land cover types or landform?
   d. Look at the symbolic map. Look for differences and similarities between the symbolic map and original model. Can you name two of each?

3. Compare and contrast maps produced by other groups:
   a. How do you know the maps are accurate?
   b. What happens to land cover types that are a small size when you draw a symbolic map or digitize an image?
   c. What happens to land cover types that have irregular shapes?
   d. How do these changes affect what type and amount of land cover you see?

4. What function does the satellite perform when mapping?

5 What function does the computer perform when mapping?

6. Why are maps from one group of students different than maps from another group?

7. Do the colors chosen to represent each type of land cover have to reflect what you see on the ground?

8. How would digitizing your model be different if the model were illuminated under blue light?

Note: Ground verification is what you are doing in some of the *Land Cover/Biology Protocols*. In the *Land Cover Sample Site Protocol,* students verify what is actually on the ground compared to what is interpreted by a satellite image or a model.
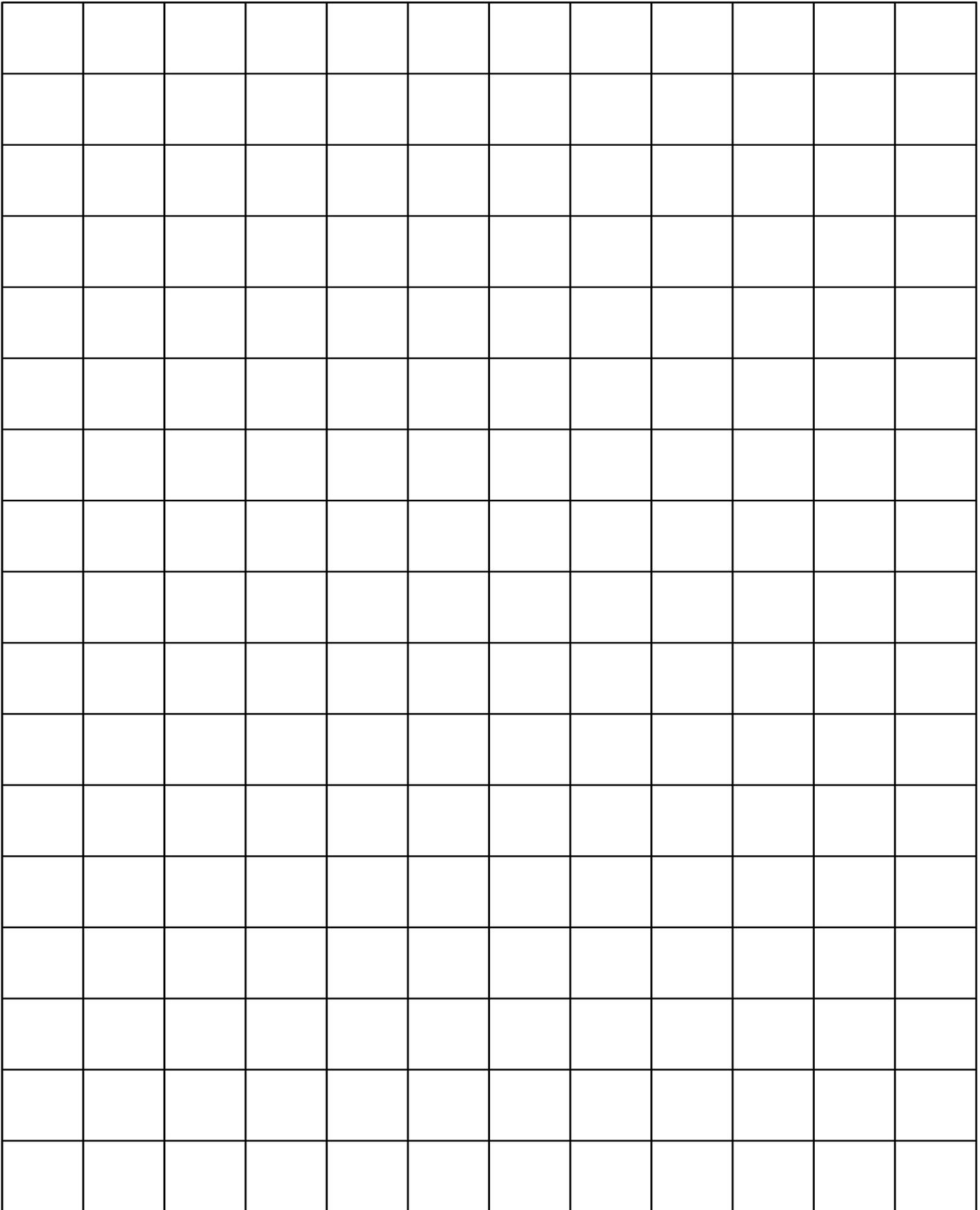
Extension

The Landsat satellite collects the data for your GLOBE Study Site. Label the parts of the Landsat satellite and describe what each part does. For diagrams and information about Landsat, see the Land Cover/ Biology GLOBE Web site at http://www.globe.unh.edu
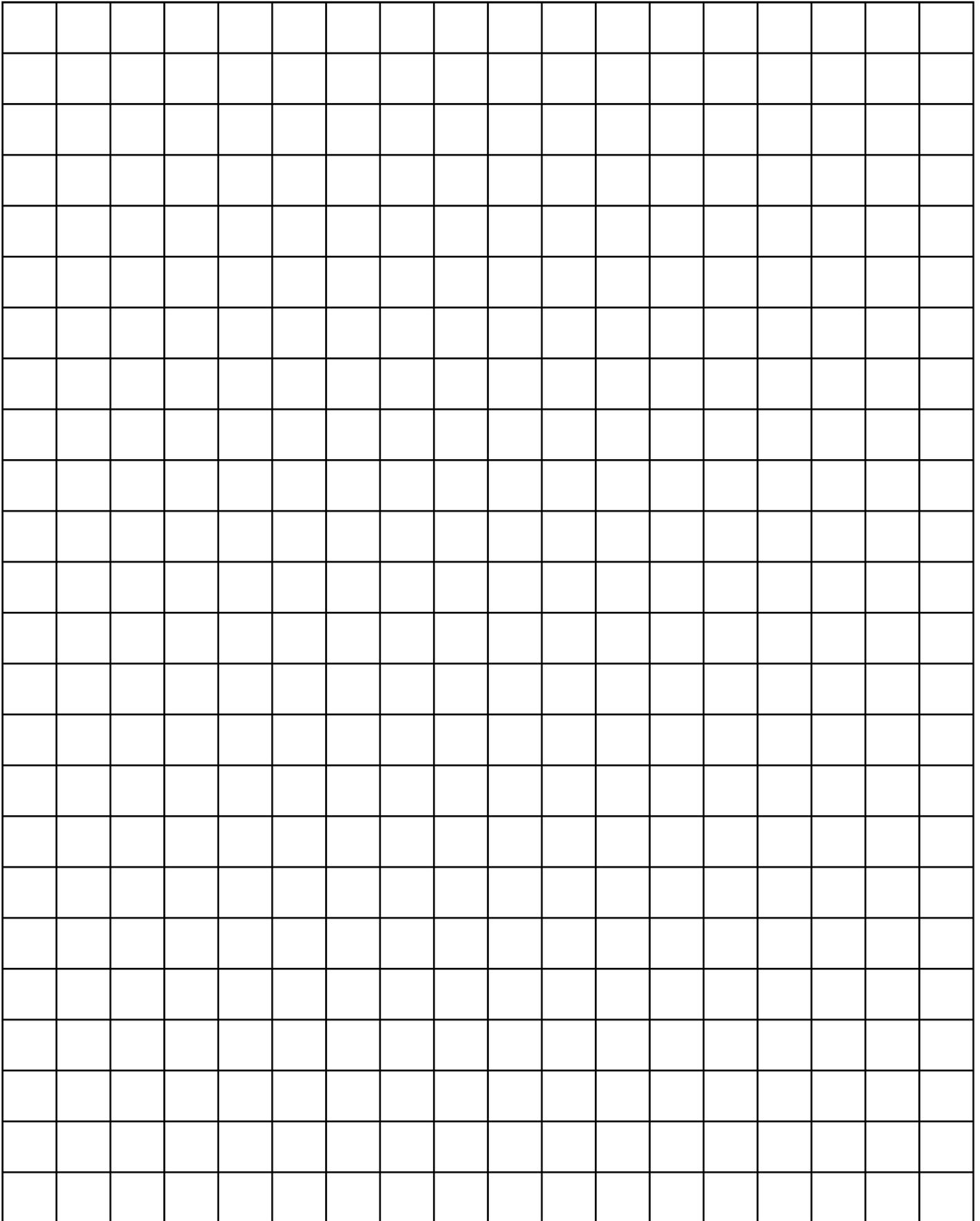or the Landsat NASA Web site at http://geo.arc.nasa.gov/sge/landsat/landsat.html

Acknowledgment
Satellite art by Sherri Wormstead

Odyssey of the Eyes Large Grid

Odyssey of the Eyes Small Grid

Odyssey of the Eyes: Intermediate Learning Activity - 5

Odyssey of the Eyes
Digitized Data Sheet

Name: _____ Date: _____

Land Cover Type	Symbol	Number	Digitizing Color
Example: *Road*	═══════	1	Black
Example: *Tree*	▲	2	Green

Digitized Code

Use a 0 to indicate the beginning and ending of each scan line.

For the large-sized grid squares, use the following lines as an example of how to set-up your paper.

0 ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ 0

0 ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ 0

For the small-sized grid squares, use the following lines as an example of how to set-up your paper.

0 ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ 0

0 ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ 0

Odyssey of the Eyes
Advanced Level

Purpose

To help students understand the connection between remote sensing technology, computer imagery and land cover assessment and to demonstrate how a satellite sensor relates information to a computer

Overview

Students translate their maps into digital code and exchange the digitized versions of their maps with students in another school or classroom for translation into a color map. Each group of students recreates the original image's land cover types.

Student Outcomes

Science Content

Science and Technology

Clear communication is an essential part of doing science.

Communications involves coding and decoding.

Tables, graphs and symbols are alternative ways of representing data.

Geography

Primary

Maps and satellite-produced images

Enrichment

Image display is accomplished by conversion of stored data to a user-defined color-coded image.

Scientific Inquiry Abilities

Observe, interpret and classify an image using the data given.

Analyze how the image interpretation might differ between groups.

Level

All

Time

Three to four class periods

Materials and Tools

Graph paper

Colored pencils

Digitized map/image produced from Part 2 of *Odyssey of the Eyes Intermediate Level*

Internet (optional)

Preparation

Assemble the materials.

Contact another classroom or school to exchange digitized maps with.

Prerequisites

The *Odyssey of the Eyes Beginning* and I*ntermediate Levels* are necessary to complete this activity.

Note: This activity presents concepts similar to those in steps 8, 9, and 10 of the *Relative and Absolute Directions Learning Activity* in the *GPS Investigation.*

What To Do and How To Do It

1. In the previous activity, *Odyssey of the Eyes Intermediate Level*, students translated their map models into a digitized code. Type this digitized code into a word processor. Use "0" to begin and end each line of the map. Allow the numbers to "word wrap" on the screen so that the map pattern is not visible in the message.

Example:
01111220011111330024643400246444002556550044444440011111220011111330011111330011111220011111330011111330024643400246444002556550044444440011112200111133002464340024644400255655002464340024644400255655004444444001111220025565500444444400111112200111113300111133001111220011111330011111330024643400246444002556550044444440011112200

2. Include the key (from the *Odyssey of the Eyes Digitized Data Sheet)* to translate the codes to colors.

    Example:
    1 violet
    2 indigo
    3 green
    4 yellow
    5 orange
    6 red

3. Exchange keys and digitized codes with students in another class or school. This exchange can be done on the Internet, by exchanging disks between schools or classes, or just by exchanging hard copies of the information.
4. Once your students receive the code from the other school or class, translate it into a color map using the key. Your students will produce a false color image.
5. Return the completed maps to the sending school for verification.

Discussion

1. What are the dominant land cover types on your false-color image?
2. Can you recreate a sketch of a map or a model of the area from the false-color image?
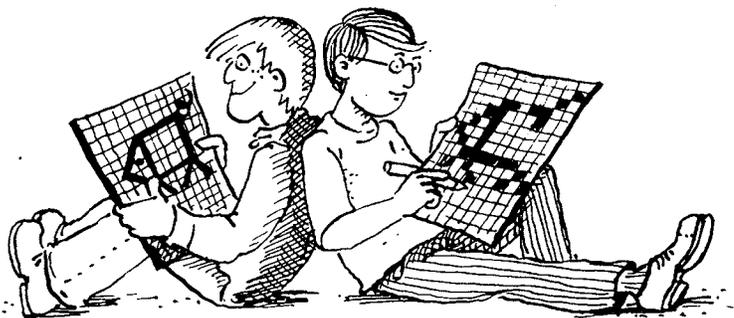
Source: Jan Smolik, 1996, TEREZA, Association for Environmental Education, Czech Republic