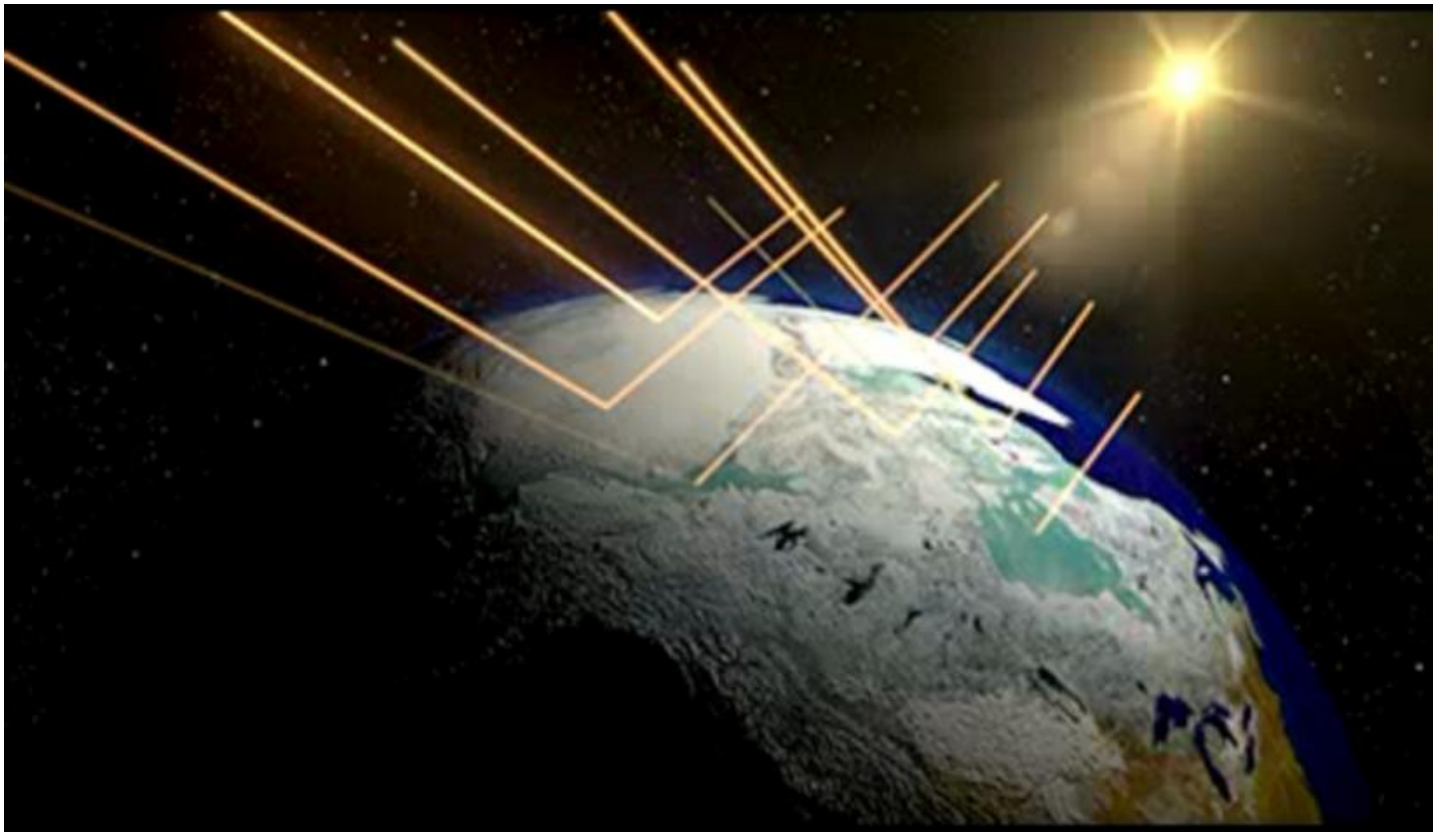
My NASA Data - GLOBE Connections

GLOBE Connections: Changing Albedo Values



GLOBE protocols and learning activities that complement the Changing Albedo Values phenomenon through hands-on investigations are detailed below. Students can conduct their own investigations and see how their data related to global patterns by using GLOBE and My NASA Data together.

The **GLOBE Cryosphere Protocols & Related ESDE Datasets** page outlines the complementary Earth System Data Explorer data available by GLOBE protocol.

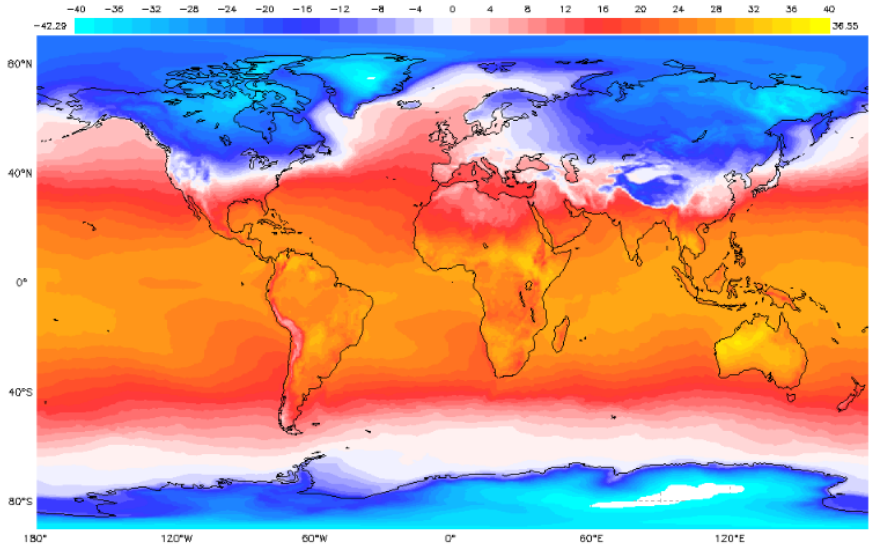
Changing Albedo Values

When sunlight reaches the Earth's surface, some of it is absorbed and some is reflected. The relative amount (ratio) of light that a surface reflects compared to the total incoming sunlight is called albedo. A surface with a high albedo will reflect more sunlight than a surface with low albedo. Surfaces with high albedos include sand, snow and ice, and some urban surfaces, such as concrete

or light-colored stone. Surfaces with low albedos include forests, the ocean, and some urban surfaces, such as asphalt.

GLOBE protocols can be used to study factors that can lead to albedo changes and the impacts of those changes.

Protocols



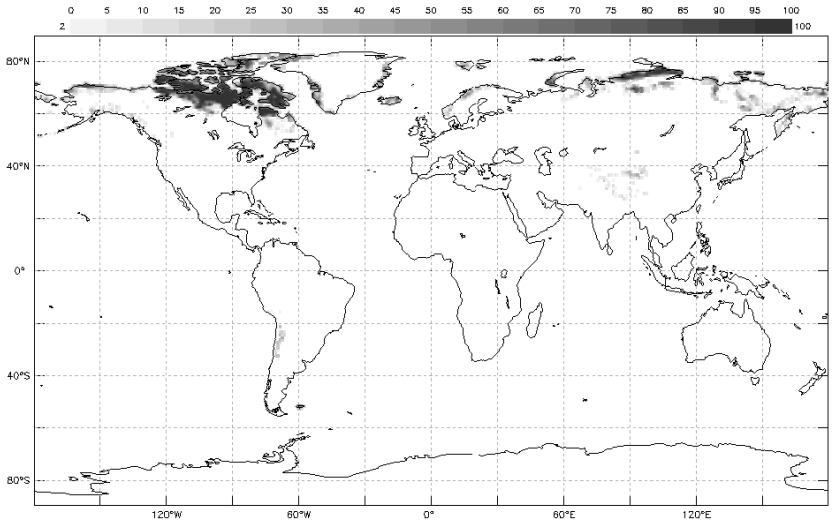
Earth System Data Explorer - Monthly Surface Air Temperature - February 2019

Air Temperature

Measure the current air temperature when an instrument shelter is not available. Current air temperature is measured using a thermometer held in the open air but in the shade for at least 3 minutes. Higher air temperatures can lead to melting snow and ice and lower albedo.

Student Outcomes:

- Weather can be described by quantitative measurements.
- Weather changes over different time and spatial scales.
- Weather changes over seasons.



My NASA Data Biome/Land Cover Classification - Tundra

Land Cover Classification

Students locate, photograph, and determine the MUC class for 90 m x 90 m areas of homogeneous land cover. Long term changes in snow and ice cover and albedo can lead to changes from tundra to forest land cover.

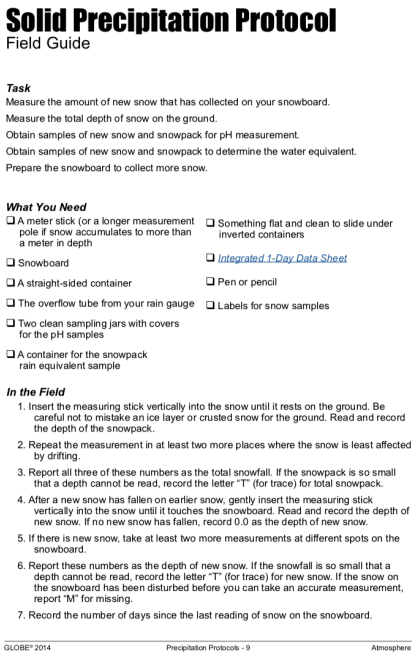
Student Outcomes:

- Students will learn how to scientifically describe and classify a Land Cover Sample Site.

Snowboard Construction: A snowboard is a thin, flat surface that rests on top of earlier layers of snow. New snow falls on top of it and can be measured with a meter stick.

Student Outcomes:

- Prepare the snowboard to collect more snow



Solid Precipitation Protocol
Field Guide

Task
Measure the amount of new snow that has collected on your snowboard.
Measure the total depth of snow on the ground.
Obtain samples of new snow and snowpack for pH measurement.
Obtain samples of new snow and snowpack to determine the water equivalent.
Prepare the snowboard to collect more snow.

What You Need
- ❑ A meter stick (or a longer measurement pole if snow accumulates to more than a meter in depth
- ❑ Snowboard
- ❑ A straight-sided container
- ❑ The overflow tube from your rain gauge
- ❑ Two clean sampling jars with covers for the pH samples
- ❑ A container for the snowpack rain equivalent sample
- ❑ Something flat and clean to slide under inverted containers
- ❑ *Integrated 1-Day Data Sheet*
- ❑ Pen or pencil
- ❑ Labels for snow samples

In the Field
1. Insert the measuring stick vertically into the snow until it rests on the ground. Be careful not to mistake an ice layer or crusted snow for the ground. Read and record the depth of the snowpack.
2. Repeat the measurement in at least two more places where the snow is least affected by drifting.
3. Report all three of these numbers as the total snowfall. If the snowpack is so small that a depth cannot be read, record the letter "T" (for trace) for total snowpack.
4. After a new snow has fallen on earlier snow, gently insert the measuring stick vertically into the snow until it touches the snowboard. Read and record the depth of new snow. If no new snow has fallen, record 0.0 as the depth of new snow.
5. If there is new snow, take at least two more measurements at different spots on the snowboard.
6. Report these numbers as the depth of new snow. If the snowfall is so small that a depth cannot be read, record the letter "T" (for trace) for new snow. If the snow on the snowboard has been disturbed before you can take an accurate measurement, report "M" for missing.
7. Record the number of days since the last reading of snow on the snowboard.

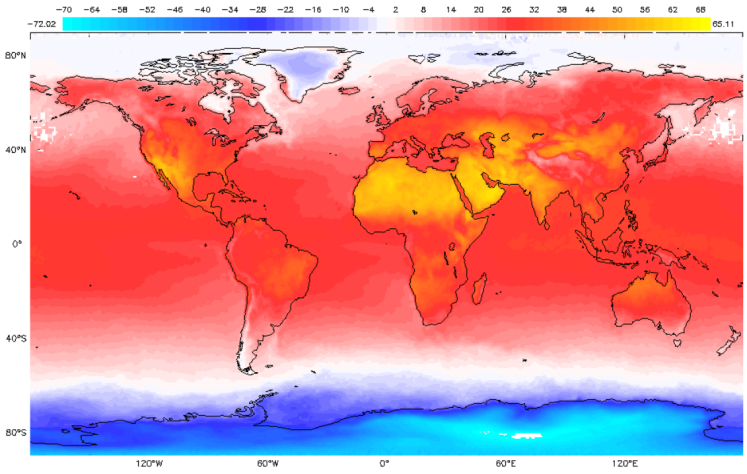
GLOBE® 2014 Precipitation Protocols - 9 Atmosphere

Solid Precipitation: Students will measure the amount of new snow

that has collected on your snowboard in comparison with the total depth of snow on the ground.

Student Outcomes:

- Students will measure the amount of new snow that has collected on your snowboard
- Students will measure the total depth of snow on the ground
- Students will obtain samples of new snow and snowpack for pH measurement
- Students will obtain samples of new snow and snowpack to determine the water equivalent
- Prepare the snowboard to collect more snow



Earth System Data Explorer - Monthly Daytime Skin Temperature - June 2019

Surface Temperature

Students use an infrared thermometer (IRT) to measure the temperature of Earth's surface. Increasing surface temperature can lead to melting snow and ice and decrease albedo.

Student Outcomes:

- Students will learn to use an infrared thermometer, and understand how different surfaces radiate energy.

Learning Activities

Check out the three learning activities to help prepare students for collecting data and to support the integration of MND with *GLOBE* in your curriculum.

Getting to Know Your Terrestrial Biomes

Help students become familiar with the Terrestrial Biome Classifications that the Seasons and Biomes project has adopted. Changes in snow and ice extent contribute to biome classification.

Student Outcomes:

- Use appropriate sources of information
- Synthesize data from different sources to create a coherent description of the main biomes
- Identify appropriate sources of information
- Organize data into tables
- Draw conclusions by synthesizing a variety of data
- Communicate results and explanations

[How to Make a Climograph from Your Local Weather Data](#) 

Purpose: Students will assemble, analyze and graph the long-term air temperature and precipitation data for their general area, to understand the difference between weather and climate. These data can include snow and ice.

Student Outcomes:

- Weather is a day-to-day phenomenon and climate is a long-term average of weather
- The sun is the major source of energy for changes on the Earth's surface
- Organisms' functions relate to their environment
- Sunlight is the major source of energy for ecosystems
- Identify appropriate data sources
- Perform simple statistical calculations
- Organize data into tables and graphs
- Use appropriate tools and techniques
- Draw conclusions by synthesizing a variety of data
- Communicate results and explanations

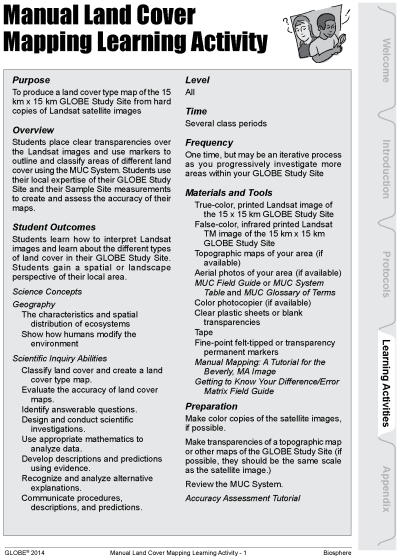
[Land Cover Change Detection](#) 

Overview: Using Multispec software, evaluate and investigate changes that have occurred in the major land cover types of your GLOBE Study Site by examining the digital files of two Landsat satellite images that were acquired a few years apart.

Student Outcomes:

- Earth has many different environments that support different combinations of organisms
- All organisms must be able to obtain and use resources while living in a constantly changing environment
- All populations living together and the physical factors with which they interact constitute an ecosystem
- Humans can change ecosystem balance
- How to use maps (real and imaginary)
- The characteristics and spatial distribution of ecosystems
- Use land cover data and appropriate tools and technology to interpret change
- Gathering spatial data and historical data to determine validity of change hypotheses

Manual Land Cover Mapping



Manual Land Cover Mapping Learning Activity

Welcome | Introduction | Protocols | Learning Activities | Appendix

Purpose
To produce a land cover type map of the 15 km x 15 km GLOBE Study Site from hard copies of Landsat satellite images

Overview
Students place clear transparencies over the Landsat images and use markers to outline and classify areas of different land cover using the MUC System. Students use their local expertise of their GLOBE Study Site and their Sample Site measurements to create and assess the accuracy of their maps.

Student Outcomes
Students learn how to interpret Landsat images and learn about the different types of land cover in their GLOBE Study Site. Students gain a spatial or landscape perspective of their local area.

Science Concepts

Geography
- The characteristics and spatial distribution of ecosystems
- Show how humans modify the environment

Scientific Inquiry Abilities
- Classify land cover and create a land cover type map.
- Evaluate the accuracy of land cover maps.
- Identify answerable questions.
- Design and conduct scientific investigations.
- Use appropriate mathematics to analyze data.
- Develop descriptions and predictions using evidence.
- Recognize and analyze alternative explanations.
- Communicate procedures, descriptions, and predictions.

Level
All

Time
Several class periods

Frequency
One time, but may be an iterative process as you progressively investigate more areas within your GLOBE Study Site

Materials and Tools
- True-color, printed Landsat image of the 15 x 15 km GLOBE Study Site
- False-color, infrared printed Landsat TM image of the 15 km x 15 km GLOBE Study Site
- Topographic maps of your area (if available)
- Aerial photos of your area (if available)
- *MUC Field Guide* or *MUC System Table* and *MUC Glossary of Terms*
- Color photocopier (if available)
- Clear plastic sheets or blank transparencies
- Tape
- Fine-point felt-tipped or transparency permanent markers
- *Manual Mapping: A Tutorial for the Beverly, MA Image*
- *Getting to Know Your Difference/Error Matrix Field Guide*

Preparation
Make color copies of the satellite images, if possible.

Make transparencies of a topographic map or other maps of the GLOBE Study Site (if possible, they should be the same scale as the satellite image.)

Review the MUC System.

Accuracy Assessment Tutorial

GLOBE® 2014 Manual Land Cover Mapping Learning Activity - 1 Biosphere

Source: (GLOBE Website)

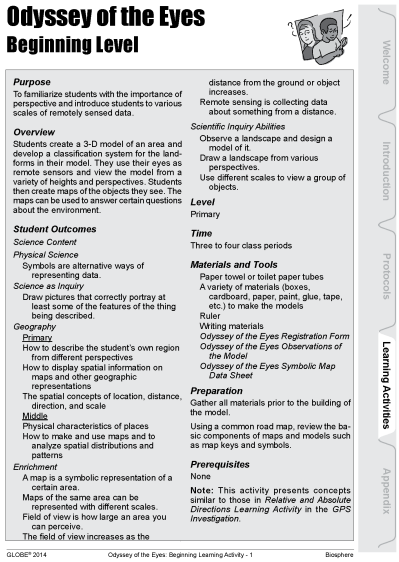
Overview: Produce a land cover type map of the 15 km x 15 km GLOBE Study Site from hard copies of Landsat satellite images

Student Outcomes:

- The characteristics and spatial distribution of ecosystems
- Show how humans modify the environment
- Classify land cover and create a land cover type map
- Evaluate the accuracy of land cover maps
- Use appropriate mathematics to analyze data
- Develop descriptions and predictions using evidence

Odyssey of the Eyes

Beginning



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*.

GLOBE® 2014 Odyssey of the Eyes: Beginning Learning Activity - 1 Biosphere

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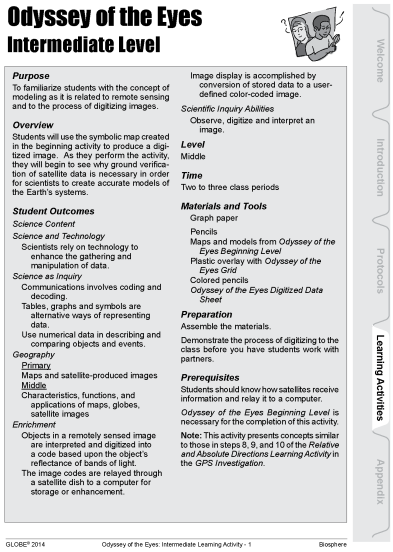
Source: (GLOBE Website)

Overview: Familiarize students with the importance of perspective and introduce students to various scales of remotely sensed data.

Student Outcomes:

- Symbols are alternative ways of representing data
- Draw pictures that correctly portray at least some of the features of the thing being described
- 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
- Physical characteristics of places
- How to make and use maps and to analyze spatial distributions and patterns



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*.

GLOBE® 2014 Odyssey of the Eyes: Intermediate Learning Activity - 1 Biosphere

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Source: (GLOBE Website)

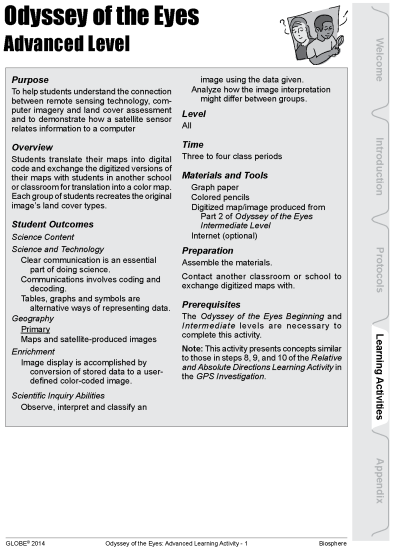
Intermediate

Overview: Familiarize students with the concept of modeling as it is related to remote sensing and to the process of digitizing images.

Student Outcomes:

- Scientists rely on technology to enhance the gathering and manipulation of data
- Tables, graphs and symbols are alternative ways of representing data
- Use numerical data in describing and comparing objects and events
- Maps and satellite-produced images
- Characteristics, functions, and applications of maps, globes, satellite images

Advanced



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 *Intermediate* 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*.

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GLOBE® 2014 Odyssey of the Eyes: Advanced Learning Activity - 1 Biosphere

Source: (GLOBE Website)

Overview: 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

Student Outcomes:

- Clear communication is an essential part of doing science
- Communications involves coding and decoding
- Tables, graphs and symbols are alternative ways of representing data
- Maps and satellite-produced images
- Observe, interpret and classify an image using the data given
- Analyze how the image interpretation might differ between groups

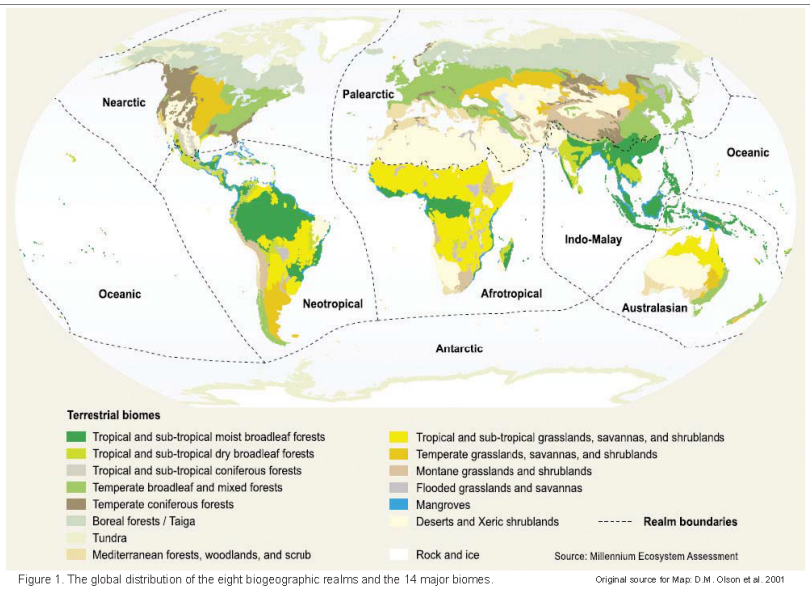

Figure 1. The global distribution of the eight biogeographic realms and the 14 major biomes. Original source for Map: D.M. Olson et al. 2001

Source: [GLOBE Getting to Know Your Terrestrial Biomes]

[What are Some Factors that Affect Seasonal Patterns?]

Purpose: Students use GLOBE data and graphing tools to compare the influence of latitude, elevation, and geography on seasonal patterns.

Student Outcomes:

- Weather changes from day to day and over the seasons.
- Seasons result from variations in solar insolation resulting from the tilt of the Earth's rotation axis.
- The sun is the major source of energy at Earth's surface.
- Solar insolation drives atmospheric and ocean circulation.

Sources:

[GLOBE Website]