## My NASA Data - GLOBE Connections

## GLOBE Connections: Changes in Land Surface/Land Use Change

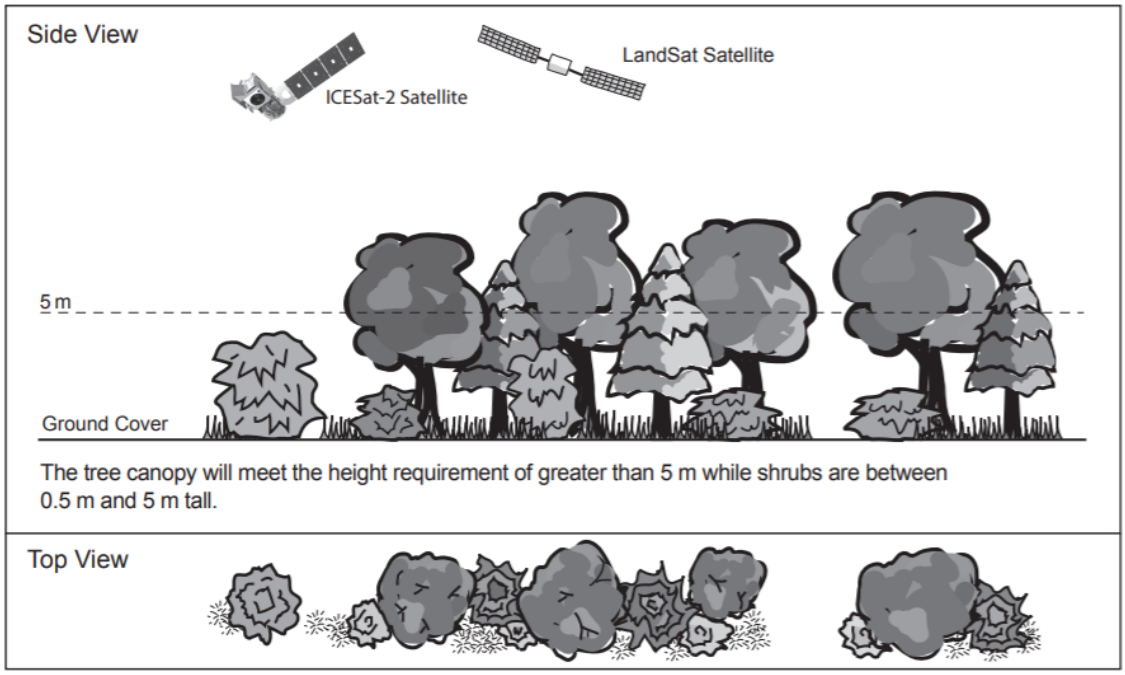

GLOBE protocols and learning activities that complement the Changes in Land Surface/Land Use Change phenomena through hands-on investigations are detailed below. Students can conduct their own investigations and see how their data related to global patterns by using GLOBE and My NASA Data together.

Visit the **GLOBE Geosphere Protocols & Related ESDE Datasets** page that outlines the datasets available in the Earth System Data Explorer.  These data complement student GLOBE investigations using the following protocols.

Changes in Land Surface/Land Use Change

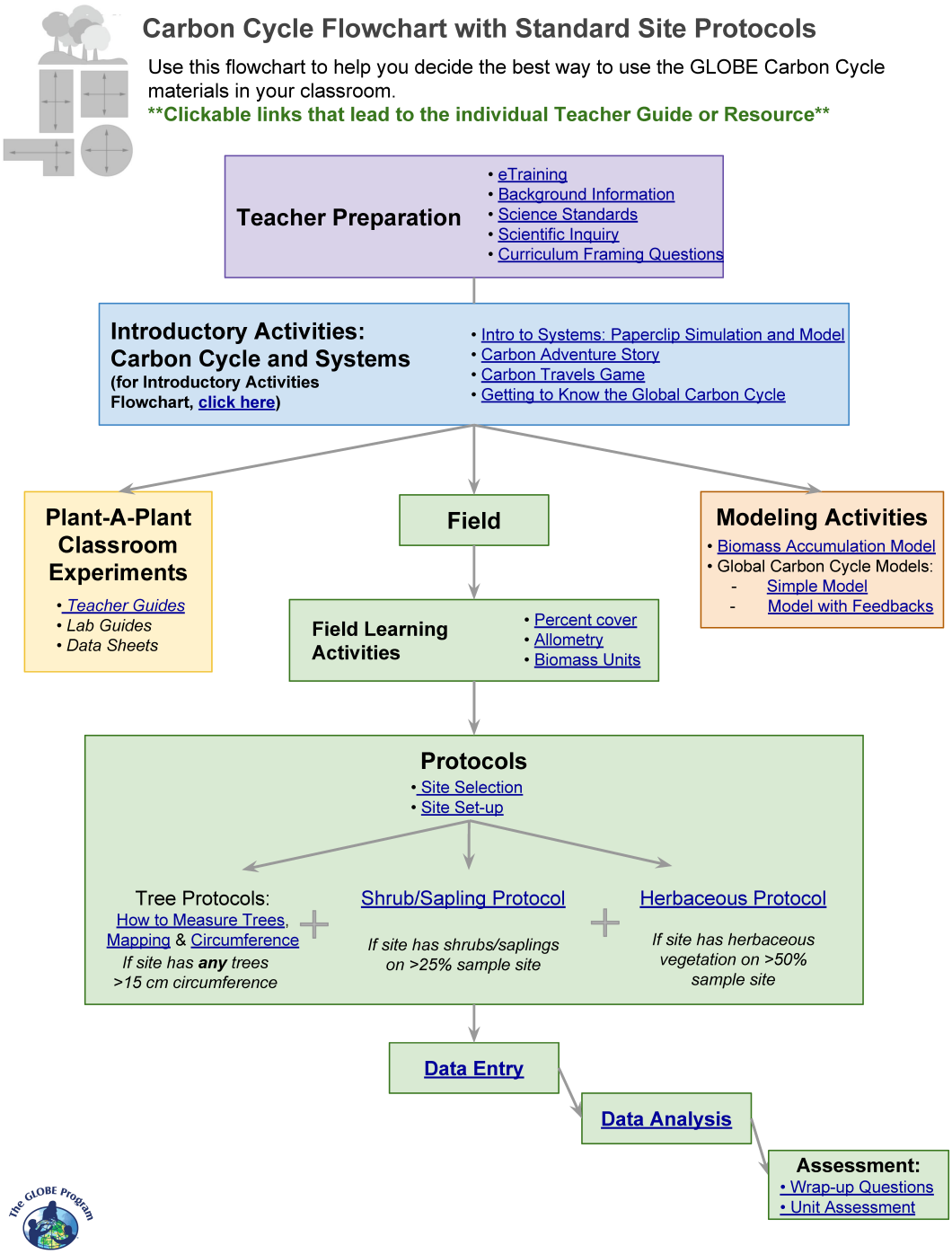
## Protocols

GLOBE protocols can be used to collect many types of data to examine land surface and use. Students can use the protocols to collect data and share their data with other GLOBE students around the world. As scientists continue their study of land surface and land-use change, they can use these data.



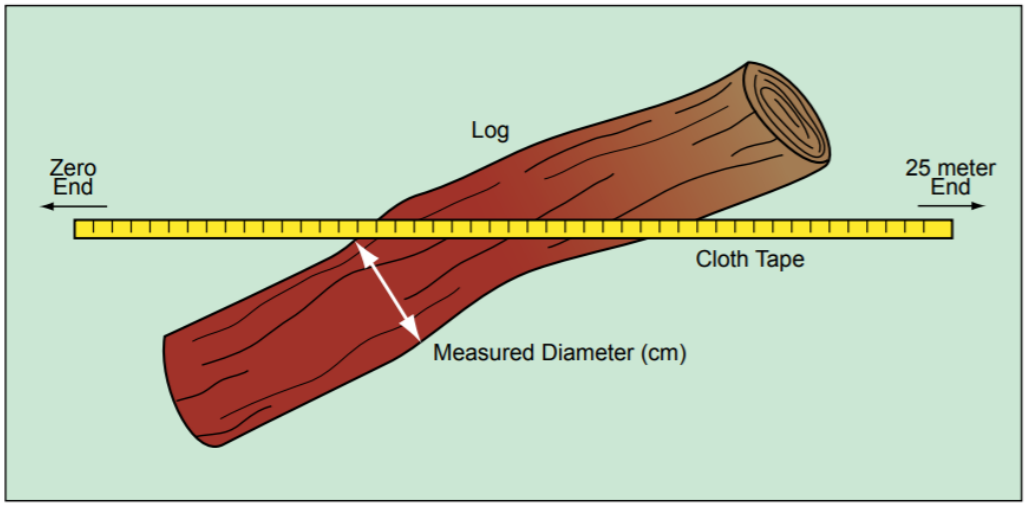

Multiple Layers of Vegetation: Tree Canopy, Shrub Canopy and Ground Cover
Source: (GLOBE Website)

**Biometry:** Measure and classify the plant life present at a Land Cover Sample Site to help determine the MUC classification.




Source: (GLOBE Website)

**Carbon Cycle:** Students learn necessary skills and work in teams to set-up a carbon cycle site. Determine which vegetation types you will measure at your site. There are decision trees available to facilitate decision making as well as a variety of carbon cycle learning activities and protocols.



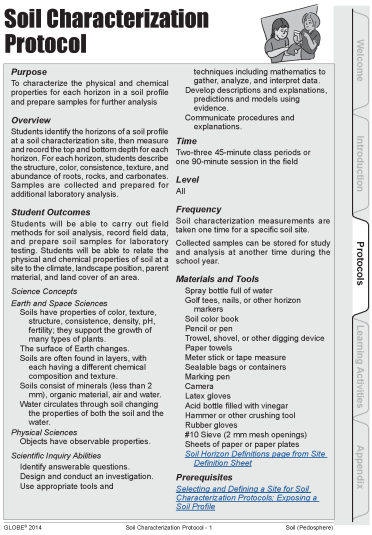

Measurement of Log Diameter Along Fuel Sampling Plane
Source: (GLOBE Website)

**Fire Fuel:** Measure the different types of fuels (i.e., dead branches, logs, live shrubs and trees for fires in land cover sample sites.



Source: (GLOBE Website)

**Land Cover Classification:** Determine the major land cover type at a Land Cover Sample Site.



**Soil Characterization Protocol**

**Purpose**
To characterize the physical and chemical properties for each horizon in a soil profile and prepare samples for further analysis

**Overview**
Students identify the horizons of a soil profile at a soil characterization site, then measure and record the top and bottom depth for each horizon. For each horizon, students describe the structure, color, consistence, texture, and abundance of roots, rocks, and carbonates. Samples are collected and prepared for additional laboratory analysis.

**Student Outcomes**
Students will be able to carry out field methods for soil analysis, record field data, and prepare soil samples for laboratory testing. Students will be able to relate the physical and chemical properties of soil at a site to the climate, landscape position, parent material, and land cover of an area.

*Science Concepts*

*Earth and Space Sciences*
- Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants.
- The surface of Earth changes.
- Soils are often found in layers, with each having a different chemical composition and texture.
- Soils consist of minerals (less than 2 mm), organic material, air and water.
- Water circulates through soil changing the properties of both the soil and the water.

*Physical Sciences*
- Objects have observable properties.

*Scientific Inquiry Abilities*
- Identify answerable questions.
- Design and conduct an investigation.
- Use appropriate tools and techniques including mathematics to gather, analyze, and interpret data.
- Develop descriptions and explanations, predictions and models using evidence.
- Communicate procedures and explanations.

**Time**
Two-three 45-minute class periods or one 90-minute session in the field

**Level**
All

**Frequency**
Soil characterization measurements are taken one time for a specific soil site.

Collected samples can be stored for study and analysis at another time during the school year.

**Materials and Tools**
- Spray bottle full of water
- Golf tees, nails, or other horizon markers
- Soil color book
- Pencil or pen
- Trowel, shovel, or other digging device
- Paper towels
- Meter stick or tape measure
- Sealable bags or containers
- Marking pen
- Camera
- Latex gloves
- Acid bottle filled with vinegar
- Hammer or other crushing tool
- Rubber gloves
- #10 Sieve (2 mm mesh openings)
- Sheets of paper or paper plates
- *Soil Horizon Definitions page from Site Definition Sheet*

**Prerequisites**
*Selecting and Defining a Site for Soil Characterization Protocols: Exposing a Soil Profile*

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GLOBE® 2014 Soil Characterization Protocol - 1 Soil (Pedosphere)

Source: GLOBE Website

**Soil Characterization:** Students will identify horizons in a soil profile, observe the structure, color, consistency, texture, and the presence of rocks, roots, and carbonates of each horizon, and take samples for use in laboratory characterization protocols.

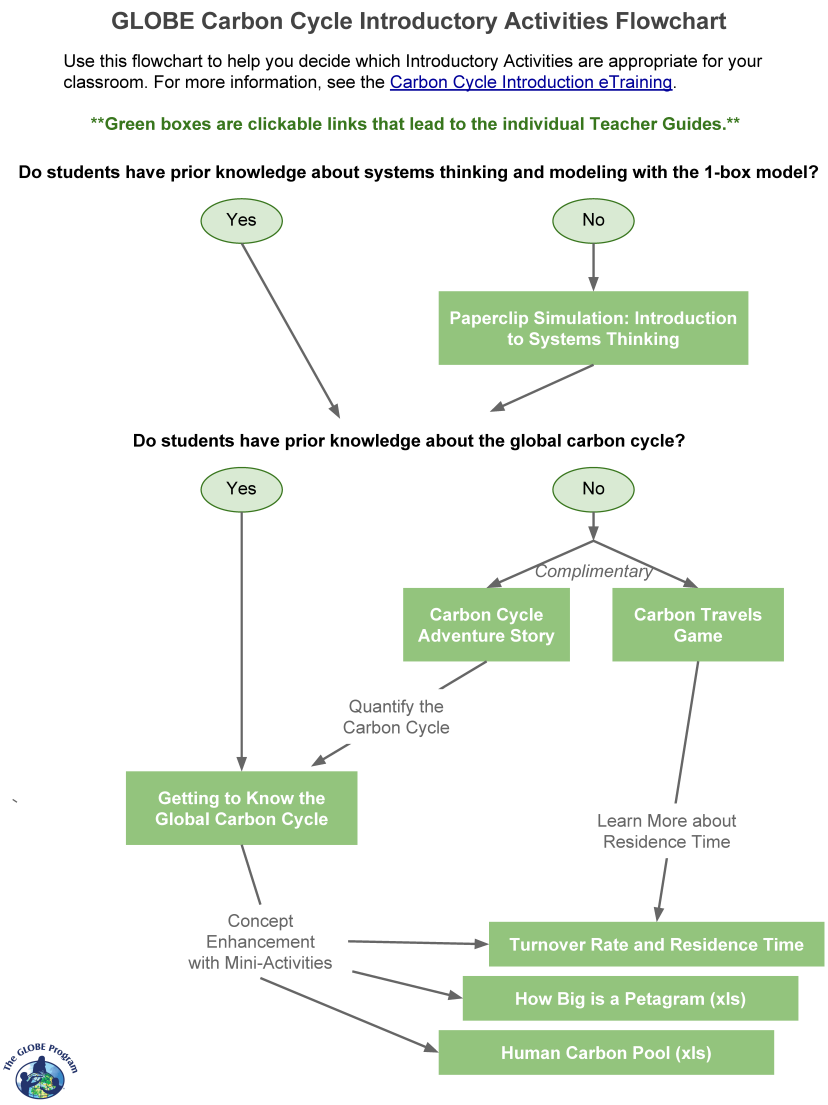
## Protocol Bundle

The urban protocol bundle can be used with Changes in Land Surface/Land Use Change.

**Urban Protocol Bundle** - The purpose of the Urban Bundle is to suggest a group of GLOBE protocols that can provide students and teachers with integrated knowledge of the environment in urban areas, including various processes and their interactions. Given the many small-scale variations caused by the built environment, such citizen science contributions are particularly needed to adequately characterize the urban environment.

## Learning Activities

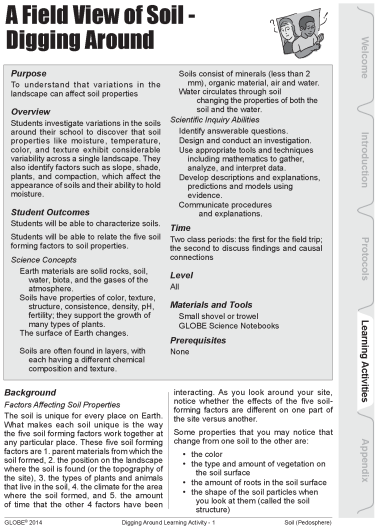
Check out the three learning activities to help prepare students for collecting data and to support the integration of MND with *GLOBE* in your curriculum.




Source: GLOBE Website

## Carbon Cycle Introductory Activities Flowchart

Use this flowchart to help you decide which Introductory Activities are appropriate for your classroom. For more information, see the Carbon Cycle Introduction eTraining.



A Field View of Soil - Digging Around

Purpose
To understand that variations in the landscape can affect soil properties

Overview
Students investigate variations in the soils around their school to discover that soil properties like moisture, temperature, color, and texture exhibit considerable variability across a single landscape. They also identify factors such as slope, shade, plants, and compaction, which affect the appearance of soils and their ability to hold moisture.

Student Outcomes
Students will be able to characterize soils.
Students will be able to relate the five soil forming factors to soil properties.

Science Concepts
Earth materials are solid rocks, soil, water, biota, and the gases of the atmosphere.
Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants.
The surface of Earth changes.
Soils are often found in layers, with each having a different chemical composition and texture.
Soils consist of minerals (less than 2 mm), organic material, air and water.
Water circulates through soil changing the properties of both the soil and the water.

Scientific Inquiry Abilities
Identify answerable questions.
Design and conduct an investigation.
Use appropriate tools and techniques including mathematics to gather, analyze, and interpret data.
Develop descriptions and explanations, predictions and models using evidence.
Communicate procedures and explanations.

Time
Two class periods: the first for the field trip; the second to discuss findings and causal connections

Level
All

Materials and Tools
Small shovel or trowel
GLOBE Science Notebooks

Prerequisites
None

Background
Factors Affecting Soil Properties
The soil is unique for every place on Earth. What makes each soil unique is the way the five soil forming factors work together at any particular place. These five soil forming factors are 1. parent materials from which the soil formed, 2. the position on the landscape where the soil is found (or the topography of the site), 3. the types of plants and animals that live in the soil, 4. the climate for the area where the soil formed, and 5. the amount of time that the other 4 factors have been interacting. As you look around your site, notice whether the effects of the five soil-forming factors are different on one part of the site versus another.

Some properties that you may notice that change from one soil to the other are:
- the color
- the type and amount of vegetation on the soil surface
- the amount of roots in the soil surface
- the shape of the soil particles when you look at them (called the soil structure)

GLOBE® 2014 Digging Around Learning Activity - 1 Soil (Pedosphere)

Welcome Introduction Protocols Learning Activities Appendix

Source: GLOBE Website

## A Field View of Soil - Digging Around

**Overview:** Students investigate variations in the soils around their school to discover that soil properties like moisture, temperature, color, and texture exhibit considerable variability across a single landscape. They also identify factors such as slope, shade, plants, and compaction, which affect the appearance of soils and their ability to hold moisture.

**Student Outcomes:**

- Students will be able to characterize soils
- Students will be able to relate the five soil forming factors to soil properties
- Earth materials are solid rocks, soil, water, biota, and the gases of the atmosphere
- Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants
- The surface of Earth changes
- Soils are often found in layers, with each having a different chemical composition and texture
- Soils consist of minerals (less than 2 mm), organic material, air and water

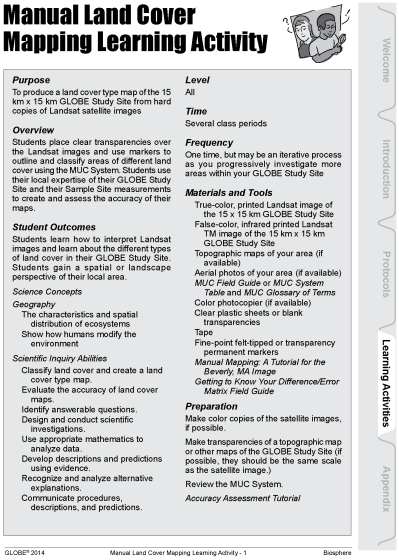
GLOBE Observer Land Cover
Image Credit: NASA

## 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 Learning Activity**

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***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

## Manual Land Cover Mapping

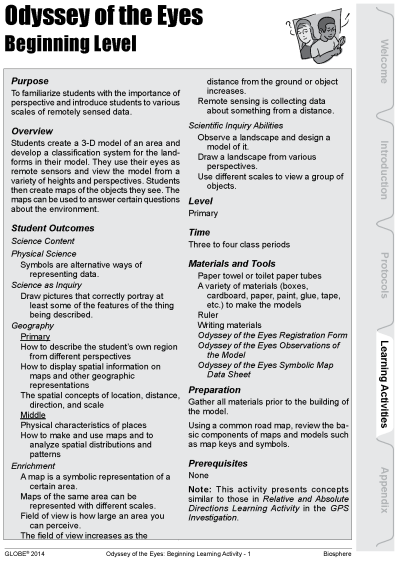
**Overview:** Produce a land cover type map of the 15 km x 15 km GLOBE Study Site from hard copies of Landsat satellite images

**Student Outcomes:**

- Describe 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*.

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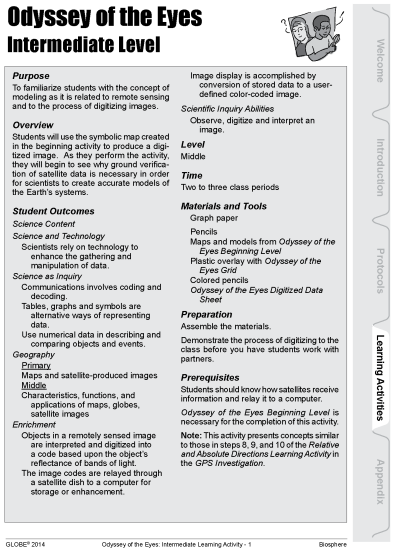
GLOBE® 2014 Odyssey of the Eyes Beginning Learning Activity - 1 Biosphere

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**

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***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

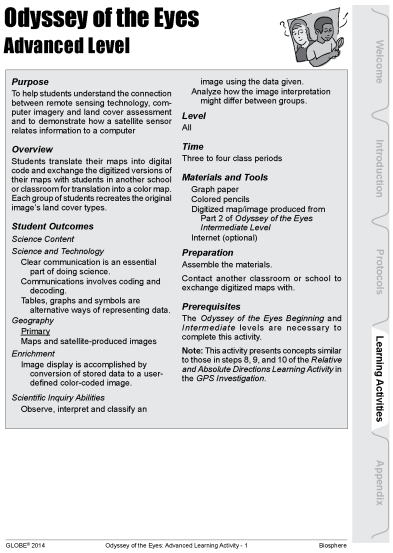
Source: GLOBE Website

## 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



**Odyssey of the Eyes**
**Advanced Level**

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***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*.

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

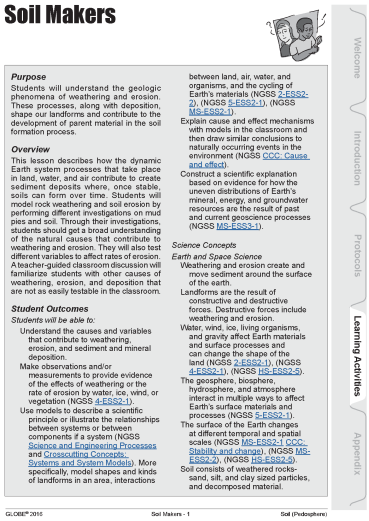
Source: GLOBE Website

## Advanced

**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




Source: GLOBE Website

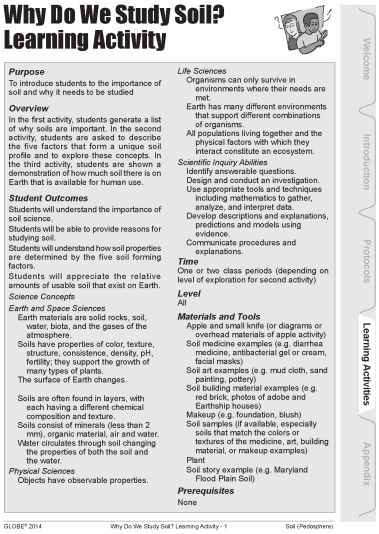
## Soil Makers

**Overview:** Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

**Student Outcomes:**

- Understand the causes and variables that contribute to weathering, erosion, and sediment and mineral deposition
- Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation
- Use models to describe a scientific principle or illustrate the relationships between systems or between components of a system (More specifically, model shapes and kinds of landforms in an area, interactions between land, air, water, and organisms, and the cycling of Earth's materials)
- Explain cause and effect mechanisms with models in the classroom and then draw similar conclusions to naturally occurring events in the environment (
- Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current

geoscience processes



Why Do We Study Soil?
Learning Activity

**Purpose**
To introduce students to the importance of soil and why it needs to be studied

**Overview**
In the first activity, students generate a list of why soils are important. In the second activity, students are asked to describe the five factors that form a unique soil profile and to explore these concepts. In the third activity, students are shown a demonstration of how much soil there is on Earth that is available for human use.

**Student Outcomes**
Students will understand the importance of soil science.
Students will be able to provide reasons for studying soil.
Students will understand how soil properties are determined by the five soil forming factors.
Students will appreciate the relative amounts of usable soil that exist on Earth.

*Science Concepts*
*Earth and Space Sciences*
- Earth materials are solid rocks, soil, water, biota, and the gases of the atmosphere.
- Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants.
- The surface of Earth changes.

- Soils are often found in layers, with each having a different chemical composition and texture.
- Soils consist of minerals (less than 2 mm), organic material, air and water.
- Water circulates through soil changing the properties of both the soil and the water.

*Physical Sciences*
- Objects have observable properties.

*Life Sciences*
- Organisms can only survive in environments where their needs are met.
- Earth has many different environments that support different combinations of organisms.
- All populations living together and the physical factors with which they interact constitute an ecosystem.

*Scientific Inquiry Abilities*
- Identify answerable questions.
- Design and conduct an investigation.
- Use appropriate tools and techniques including mathematics to gather, analyze, and intergret data.
- Develop descriptions and explanations, predictions and models using evidence.
- Communicate procedures and explanations.

**Time**
One or two class periods (depending on level of exploration for second activity)

**Level**
All

**Materials and Tools**
- Apple and small knife (or diagrams or overhead materials of apple activity)
- Soil medicine examples (e.g. diarrhea medicine, antibacterial gel or cream, facial masks)
- Soil art examples (e.g. mud cloth, sand painting, pottery)
- Soil building material examples (e.g. red brick, photos of adobe and Earthship houses)
- Makeup (e.g. foundation, blush)
- Soil samples (if available, especially soils that match the colors or textures of the medicine, art, building material, or makeup examples)
- Plant
- Soil story example (e.g. Maryland Flood Plain Soil)

**Prerequisites**
None

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GLOBE® 2014 Why Do We Study Soil? Learning Activity - 1 Soil (Pedosphere)

Source: GLOBE Website

## Why do We Study Soil

**Overview:** Introduce students to the importance of soil and why it needs to be studied.

**Student Outcomes:**

- Understand the importance of soil science
- Be able to provide reasons for studying soil
- Understand how soil properties are determined by the five soil forming factors
- Appreciate the relative amounts of usable soil that exist on Earth
- Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants
- The surface of Earth changes