My NASA Data - GLOBE Connections

GLOBE Connections: Changes in Land Surface/Land Use Change

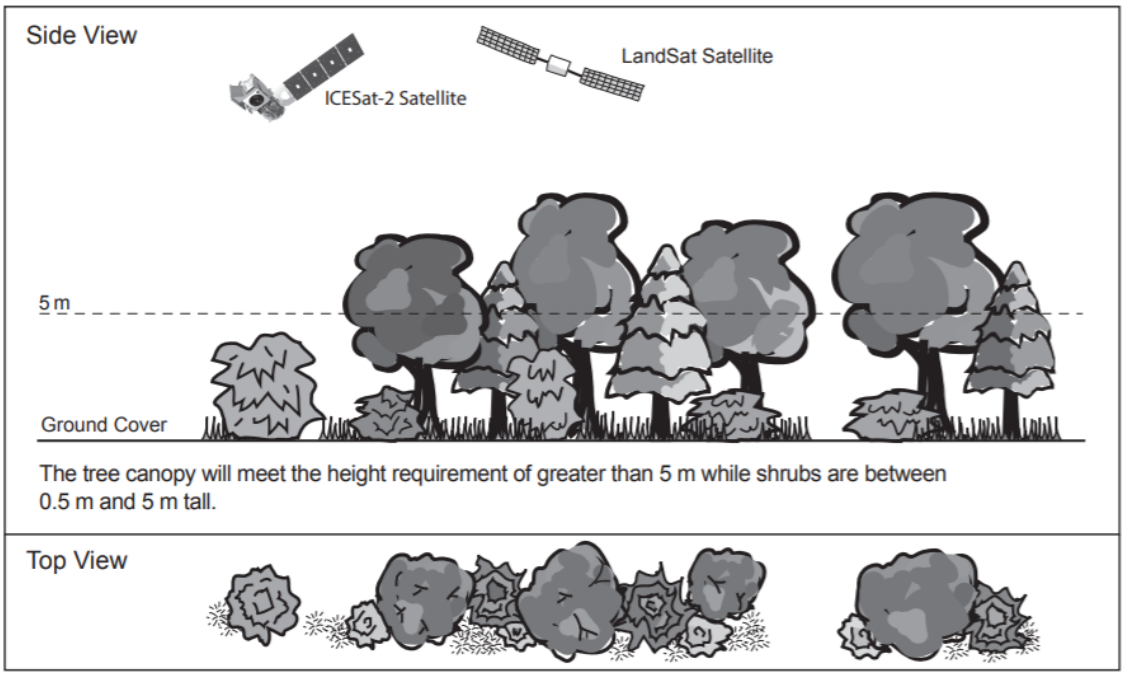
GLOBE protocols and learning activities that complement the Changes in Land Surface/Land Use Change phenomena through hands-on investigations are detailed below. Students can conduct their own investigations and see how their data related to global patterns by using GLOBE and My NASA Data together.

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

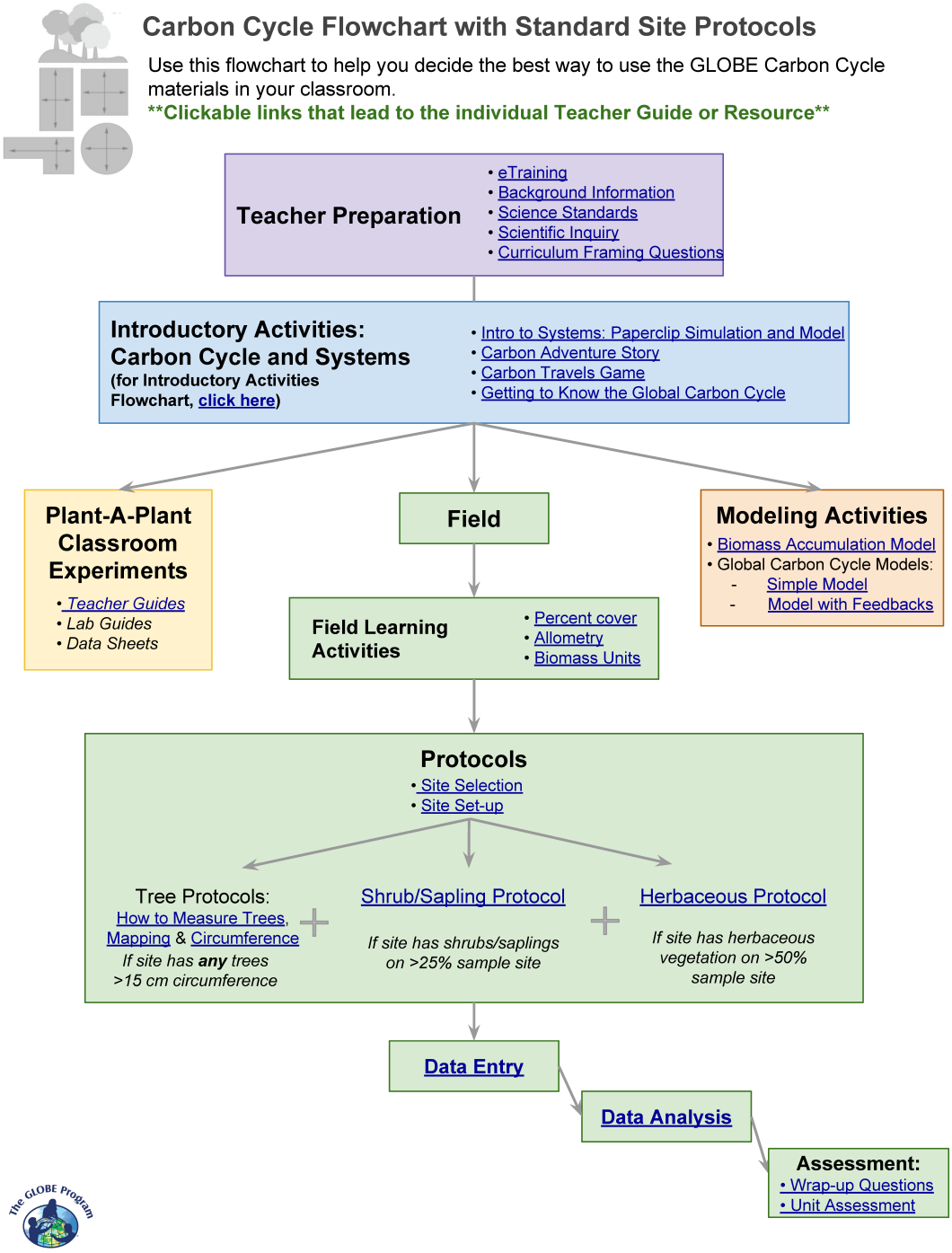
GLOBE protocols can be used to collect many types of data to examine land surface and use. Students can use the protocols to collect data and share their data with other GLOBE students around the world. As scientists continue their study of land surface and land-use change, they can use these data.



Multiple Layers of Vegetation: Tree Canopy, Shrub Canopy and Ground Cover

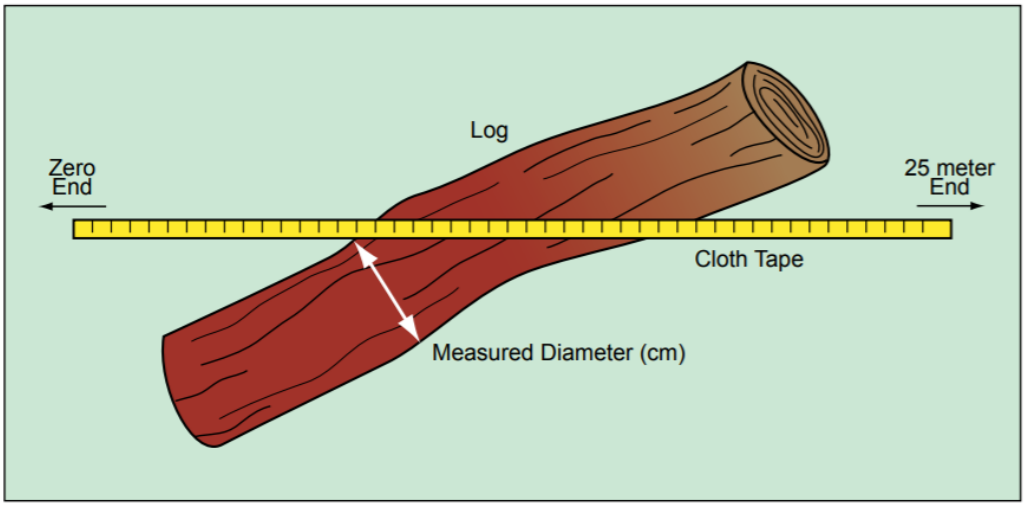
Source: (GLOBE Website)

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.

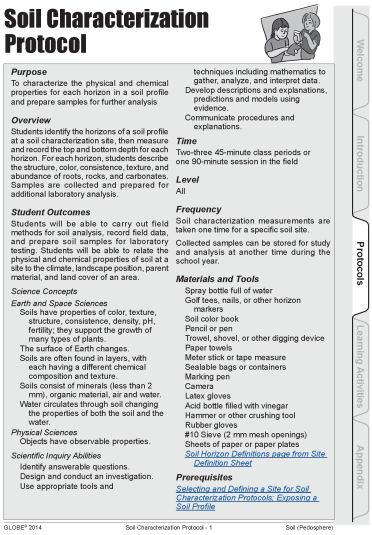


Measurement of Log Diameter Along Fuel Sampling Plane
Source: (GLOBE Website)

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

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

Welcome | Introduction | Protocols | Learning Activities | Appendix

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.

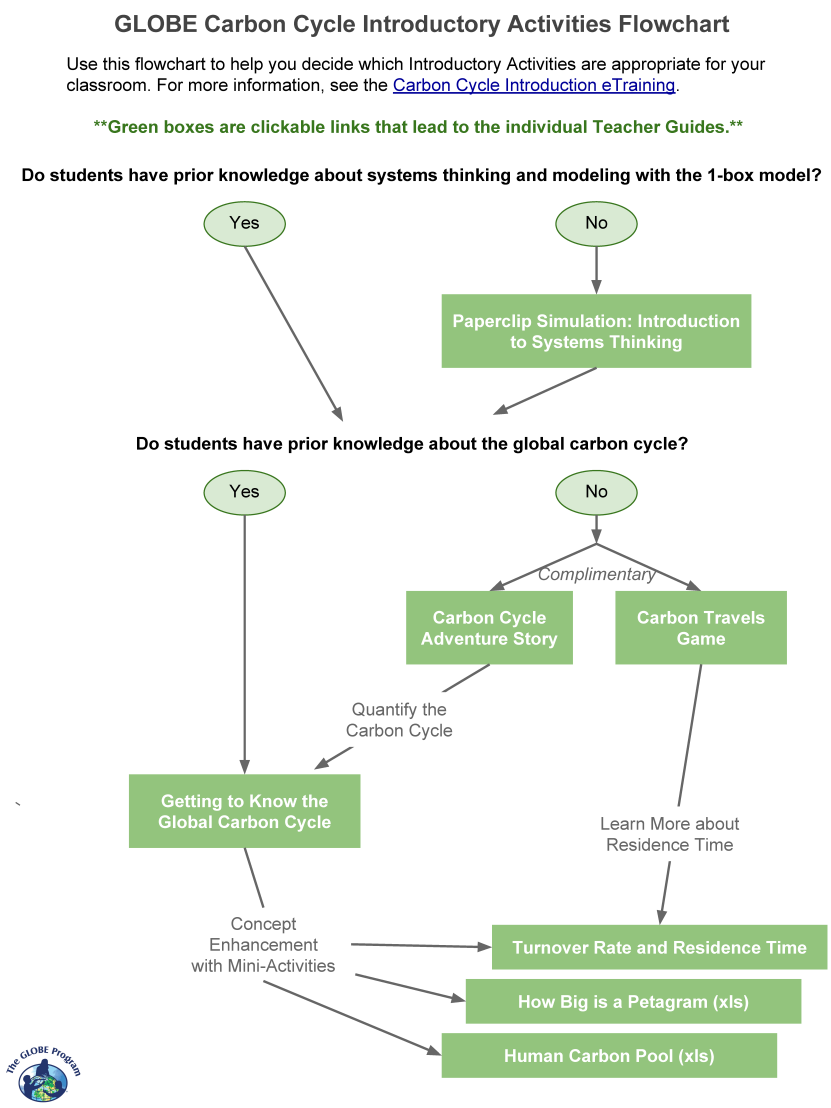
Protocol Bundle

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

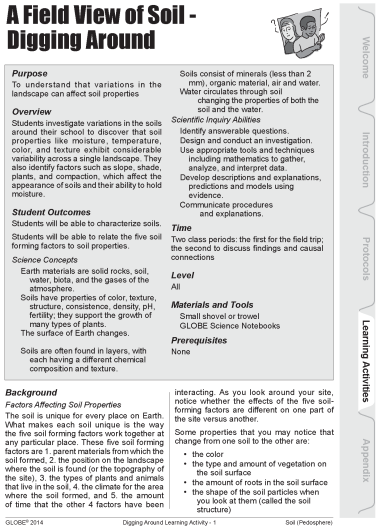
Check out these learning activities to help prepare students for collecting data and to support the integration of MND with *GLOBE* in your curriculum.



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)

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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

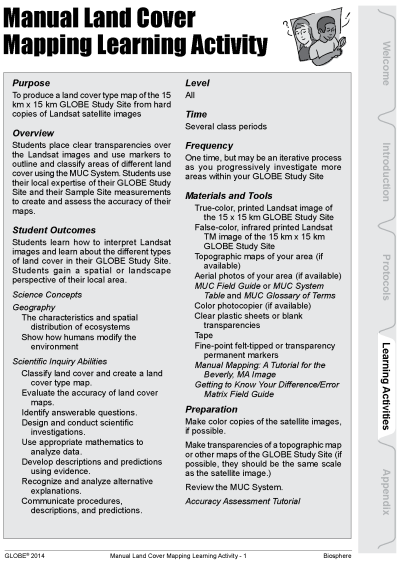
Image Credit: NASA

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

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

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Source: GLOBE Website

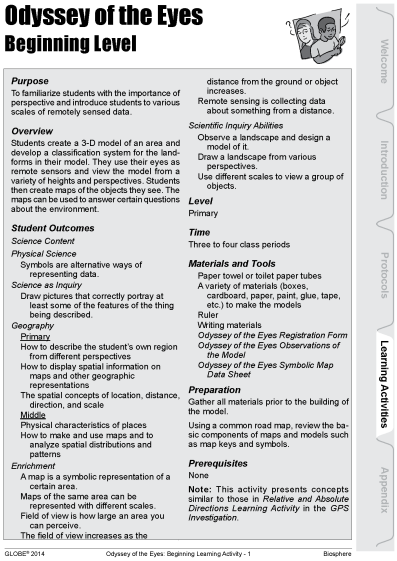
Manual Land Cover Mapping

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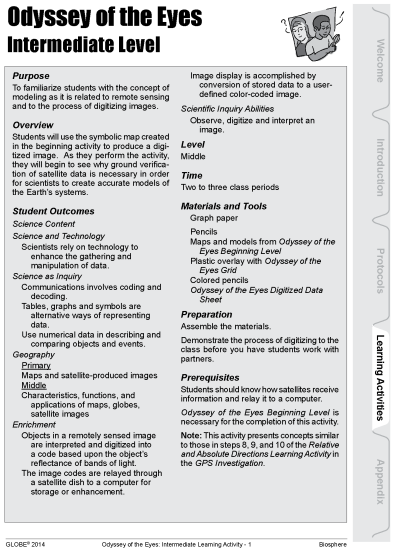
GLOBE® 2014 Odyssey of the Eyes: Beginning Learning Activity - 1 Biosphere

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

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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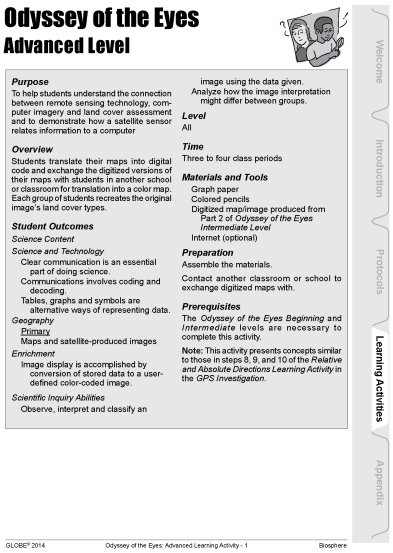
Source: GLOBE Website

Odyssey of the Eyes - 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

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

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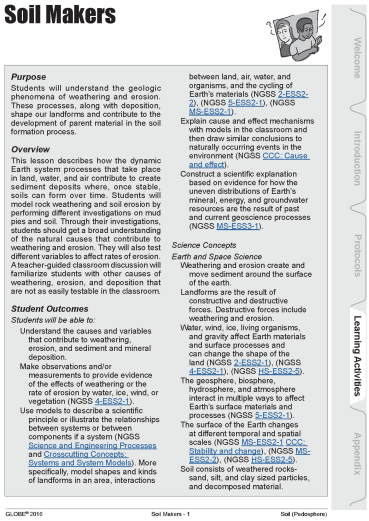
Source: GLOBE Website

Odyssey of the Eyes - 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



Soil Makers

Purpose

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.

Overview

This lesson describes how the dynamic Earth system processes that take place in land, water, and air contribute to create sediment deposits where, once stable, soils can form over time. Students will model rock weathering and soil erosion by performing different investigations on mud pies and soil. Through their investigations, students should get a broad understanding of the natural causes that contribute to weathering and erosion. They will also test different variables to affect rates of erosion. A teacher-guided classroom discussion will familiarize students with other causes of weathering, erosion, and deposition that are not as easily testable in the classroom.

Student Outcomes

Students will be able to:

- 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 (NGSS 4-ESS2-1).
- Use models to describe a scientific principle or illustrate the relationships between systems or between components if a system (NGSS Science and Engineering Processes and Crosscutting Concepts: Systems and System Models). 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 (NGSS 2-ESS2-2), (NGSS 5-ESS2-1), (NGSS MS-ESS2-1).
- Explain cause and effect mechanisms with models in the classroom and then draw similar conclusions to naturally occurring events in the environment (NGSS CCC: Cause and effect).
- 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 (NGSS MS-ESS3-1).

Science Concepts

Earth and Space Science

- Weathering and erosion create and move sediment around the surface of the earth.
- Landforms are the result of constructive and destructive forces. Destructive forces include weathering and erosion.
- Water, wind, ice, living organisms, and gravity affect Earth materials and surface processes and can change the shape of the land (NGSS 2-ESS2-1), (NGSS 4-ESS2-1), (NGSS HS-ESS2-5).
- The geosphere, biosphere, hydrosphere, and atmosphere interact in multiple ways to affect Earth's surface materials and processes (NGSS 5-ESS2-1).
- The surface of the Earth changes at different temporal and spatial scales (NGSS MS-ESS2-1 CCC: Stability and change), (NGSS MS-ESS2-2), (NGSS HS-ESS2-5).
- Soil consists of weathered rocks-sand, silt, and clay sized particles, and decomposed material.

GLOBE® 2016 Soil Makers - 1 Soil (Pedosphere)

Welcome Introduction Protocols Learning Activities Appendix

Source: GLOBE Website

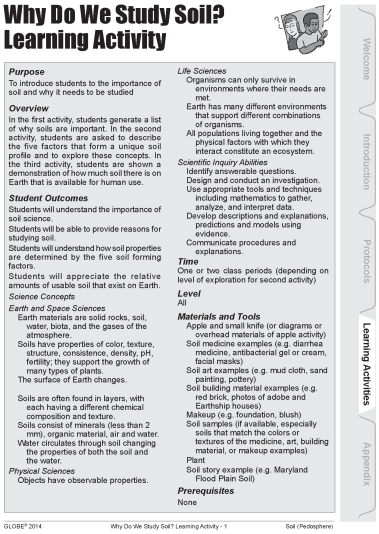
Soil Makers

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 interpret 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

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

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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