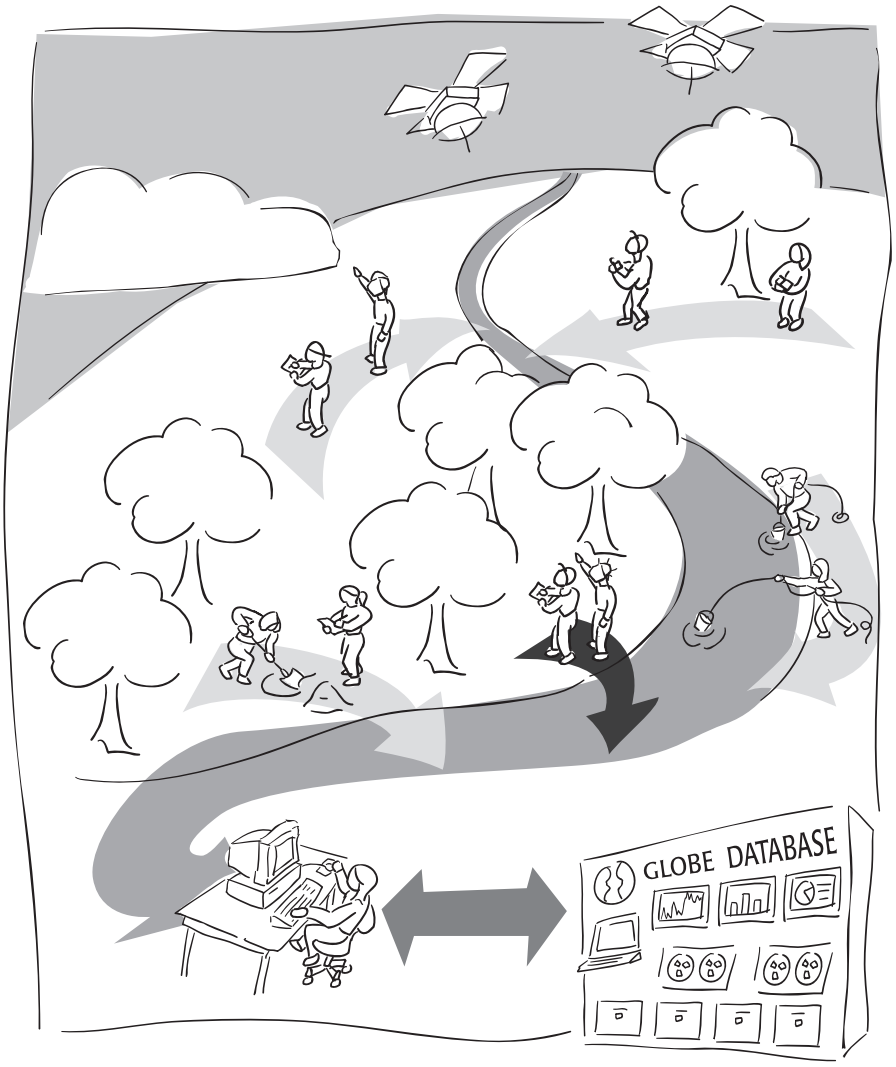
Biosphere Investigation



A GLOBE® Learning Investigation

Biosphere Investigation at a Glance

Protocols

Daily and Bi-Weekly, Seasonal Measurements

Cloned and Common Lilacs (daily, Seasonal)
Green-Up (bi-weekly, seasonal)
Green-Down (bi-weekly, seasonal)
Ruby-Throated Hummingbirds (daily or bi-weekly, seasonal)
Phenological Gardens (daily or bi-weekly, seasonal)
Arctic Bird Migration (every other day from 2 weeks prior to expected arrival)

Monthly

Seaweed Receptacle Reproductive Stages (four months in a row)

Once Per Site (or when land cover type has changed)

Land Cover Sample Site Protocol *(*Data collected once for each site: GPS location, photographs, land cover classification)

Biometry Protocol *(*Data collected once to determine land cover class of Land Cover Sample Sites or more often to study changes in biomass over time: canopy cover and ground cover, tree, shrub and/or graminoid height, tree circumference, graminoid biomass, dominant and co-dominant vegetation)

Carbon Cycle Site Selection
Carbon Cycle Standard Site Set-up
Carbon Cycle Non-Standard Site Set-up
Carbon Cycle Standard Site Tree Mapping
Carbon Cycle Non-Standard Site Tree Mapping

Yearly

Carbon Cycle Standard Site Tree Circumference
Carbon Cycle Non-Standard Site Tree Circumference
Carbon Cycle Standard Site Shrub/Sapling
Carbon Cycle Non-Standard Site Shrub/Sapling
Carbon Cycle Standard Site Herbaceous
Carbon Cycle Non-Standard Site Herbaceous

Suggested Activities

Note: Certain Learning Activities are desirable prior to implementing Protocols.
Read the Introduction to become familiar with concepts of the biosphere, land cover and phenology.

Land Cover
Read the *Measurement Logistics* and *Suggested Methodology in the Introduction*.
Perform *Getting to Know Your Satellite Imagery* and *GLOBE Study Site Learning Activity*.
Make a densiometer and clinometer (*see Investigation Instruments*).
Review how to pace and use a compass, densiometer, clinometer and tape measure (*see Investigation Instruments*).
Practice the *GPS Protocol* (see GPS Chapter) and the Biometry Protocol.
Choose appropriate Land Cover Sample Sites within your Study Site (review *Sample Site Selection and Set-up*).
Perform the *Site Seeing Learning Activity (Beginner, or Intermediate)* - introduces systems concepts.
Perform the *Leaf Classification Learning Activity* - introduces the concepts of classification.
Practice using the MUC System to classify land cover.
Perform Land Cover Sample Site Protocol at each Sample Site.
Perform the *Odyssey of the Eyes Learning Activity (Beginning, Intermediate, or Advaced)* - introduces remote sensing.
Perform the either the *Manual Mapping: A Tutorial for the Beverly, MA Image* (from the Appendix) if you will be doing a manual map or the Unsupervised Clustering Tutorial if you will be doing a computer-aided map.
Perform either *Manual* or *Computer-aided Land Cover Mapping Learning Activity* using a Landsat satellite image.
Perform the *Bird Beak Accuracy Assessment Learning Activity* to introduce accuracy assessment.
Perform the *Accuracy Assessment Tutorial* from the Appendix to analyze the accuracy of your land cover type map.
Perform the *Land Cover Change Detection Learning Activity*.
Perform the *Discovery Area Learning Activity* - uses the satellite images and maps students create.
Using GLOBE Data to Analyze Land Cover Learning Activity - relates land cover data to other GLOBE investigation measurements

Phenology

If you intend on doing the Phenological Gardens Protocol, the best time to plant your garden is in the spring or autumn. Also, you must wait a year before collecting data.

Green-Up Cards, *A Sneak Preview to Budburst*, and a *First Look at Phenology* learning activities set the stage for taking plant phenology measurements.

Choose one of the Phenology Protocols to start (Green Down or Hummingbirds in the fall; Green Up, or Hummingbirds in the spring); Phenological Gardens throughout the year).

A Beginning Look at Photosynthesis and *Investigating Leaf Pigments* learning activities help students better understand the process of photosynthesis.

Global Patterns in Green-Up and Green-Down and *Limiting Factors in Ecosystems* help students to explore global trends in green-up and green-down and to explore why these patterns occur in different ecosystems.

Carbon Cycle

Read the *Introduction to the Global Carbon Cycle*.

Perform Carbon Cycle Learning Activities to gain understanding in systems thinking, carbon and the global carbon cycle. Use the *Flowchart for Carbon Cycle and Systems Introductory Materials* to choose the appropriate activities for your students.

Determine if your site is Standard or Non-Standard with the *Site Selection Protocol*.

Perform *Biomass Units* activity to learn the concept of biomass.

Standard Sites Only: practice estimating percent cover with the *Percent Cover* activity.

Perform the *Allometry* activity to understand how circumference of trees can be used to estimate biomass.

Practice pacing and using a compass with the guides in the *Standard Site Set-up Protocol* or *Non-Standard Site Set-up Protocol*.

For sites with trees: learn and practice the correct way to measure tree circumference with the *How to Measure Trees Supporting Protocol*.

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Carbon Cycle Non-Standard Site Tree Circumference

Carbon Cycle Standard Site Shrub/Sapling

Carbon Cycle Non-Standard Site Shrub/Sapling

Carbon Cycle Standard Site Herbaceous

Carbon Cycle Non-Standard Site Herbaceous

Learning Activities

Land Cover

Getting to Know Your Satellite Imagery and GLOBE Study Site

Site Seeing (Beginner, and Intermediate verisons)

Leaf Classification

Odyssey of the Eyes (Beginning, Intermediate, and Advanced versions)

Bird Beak Accuracy Assessment

Discovery Area

Using GLOBE Data to Analyze Land Cover

Manual Land Cover Mapping

Manual Mapping: A Tutorial for the Beverly, MA, Image

Computer-aided Land Cover Mapping

Accuracy Assessment Tutorial

Land Cover Change Detection

Change Detection Tutorial

Do You Know Your MUC?

Phenology

Green-up Cards

A Sneak Preview of Budburst

A First Look at Phenology

A Beginning Look at Photosynthesis

Investigating Leaf Pigments

Carbon Cycle

Flowchart for Carbon Cycle and Systems Introductory Materials

Paperclip Simulation and Model-Introduction to Systems Thinking

Carbon Cycle Adventure Story

Carbon Travels Game

Getting to Know the Global Carbon Cycle

Biomass Units

Percent Cover

Allometry

Biomass Accumulation Model

Appendix