THE **GLOBE** PROGRAM
A Worldwide Science and Education Program

Biosphere • Biometry Protocol
Land Cover Sample Site Field Guide

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Overview

This module:

- Reviews the selection of a GLOBE biometry site
- Reviews the procedure for locating your site using a GPS receiver
- Provides a step by step introduction of the protocol method

Learning Objectives

After completing this module, you will be able to:

- Define land cover and explain how these measurements
- can support understanding of satellite images
- Describe the importance of quality control steps in the the collection of accurate data
- Explain why the MUC Classification system is used to classify your study site
- Identify and document a Land Cover Sampling Site for use in GLOBE investigations
- Upload data to the GLOBE portal
- Visualize data using GLOBE's Visualization Site

Estimated Time to Complete this Module: 1.5 hours

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

The Biosphere

The Biosphere is Earth's zone of life. Every organism on Earth belongs to the biosphere. GLOBE has several ways to explore and measure components of the Biosphere through investigations in land cover and phenology. As well, the **Hydrosphere** investigations include the **macroinvertebrates** and **mosquito** larvae protocols.

Like all parts of the Earth system, the Biosphere is subject to change. We can quantify these changes by taking measurements over time, and compare what we saw in the past to what we see in the present.

You can found more information in:

Biosphere Introduction

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

What is Biometry?

Biometry is the measuring of living things. A scientist is interested not only in the characteristics of vegetation at a study site, but also how it is distributed. How dense is the forest? Does sunlight penetrate to the forest floor? Is the landscape dominated by grasses? Has there been a recent disturbance, such as a forest fire or flood? These are questions that are answered by taking biometric measurements.

In this protocol, you will be describing your land cover study site. Land cover is a general term for the differences in vegetation we see on the land. Your land cover measurements will assist you in determining the **MUC classification** of your study site.

GLOBE Biometry Measurements

Land Cover Sample Site

Canopy Cover and Ground Cover

Graminoid, Tree and Shrub Height

Tree Height on Level Ground: Simplified Clinometer Technique

Tree Height on Level Ground: Standard Clinometer Technique

Tree Height on a Slope: Stand by Tree

Tree Height on a Slope: Two-Triangle Techniques

Tree Circumference

Graminoid Biomass

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

GLOBE Land Cover Investigations

Land cover is a general term used to describe what is on the ground covering the land. Different land cover terms are used to describe the differences we see when we look at the land. Scientists classify land cover based on established criteria. This is done so that there is a consistent use of terms among people. For instance, what one person may call a forest living in the tropical Amazon may be quite different from a person living in northern Canada. Different species of trees live in these places, trees may be of different heights and the amount of ground and canopy cover may be quite different. For this reason, we need a standardized way to describe land cover.

GLOBE uses a land cover classification scheme called **Modified UNESCO Classification (MUC)**. There are many different types of classification schemes used. These are often designed for specific places or regions. MUC can be used around the world and allows people to contribute to a global data base. When you complete your biometry measurements, you will have the data you need to identify the land cover classification of your study site.

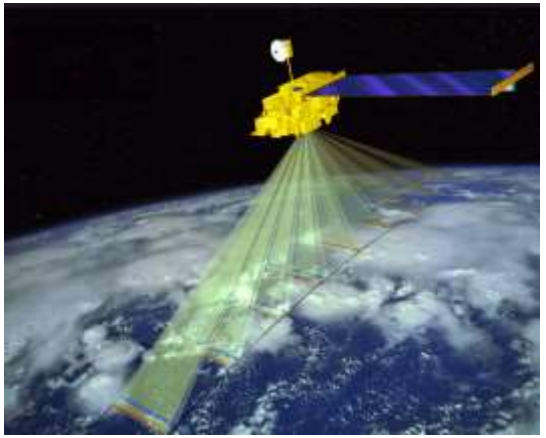
A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Mapping

An important objective of the land cover investigation to assess the accuracy of maps created by satellite images and aerial photographs.

Remote sensing simply means learning about something without making direct contact with it. We use remote sensing every day by hearing, smelling, and seeing.

With satellites and aircraft, we use machines to be our "eyes" in the sky or in orbit. Remote sensing in space has the great advantages of being able to cover very large areas quickly and to revisit the same area frequently. However, some of the detail that can be seen at ground level may not be detected by a remote sensing system. Therefore, it is beneficial to collect data at sample sites on the ground to accompany remotely sensed data about an area. GLOBE measurements allow you to be the "eyes on the ground"– and your land cover data can contribute to making better, more accurate maps.



Terra's Terra's five instruments provide measurements of plant (vegetation) composition, structure, extent, and change. Image: NASA.

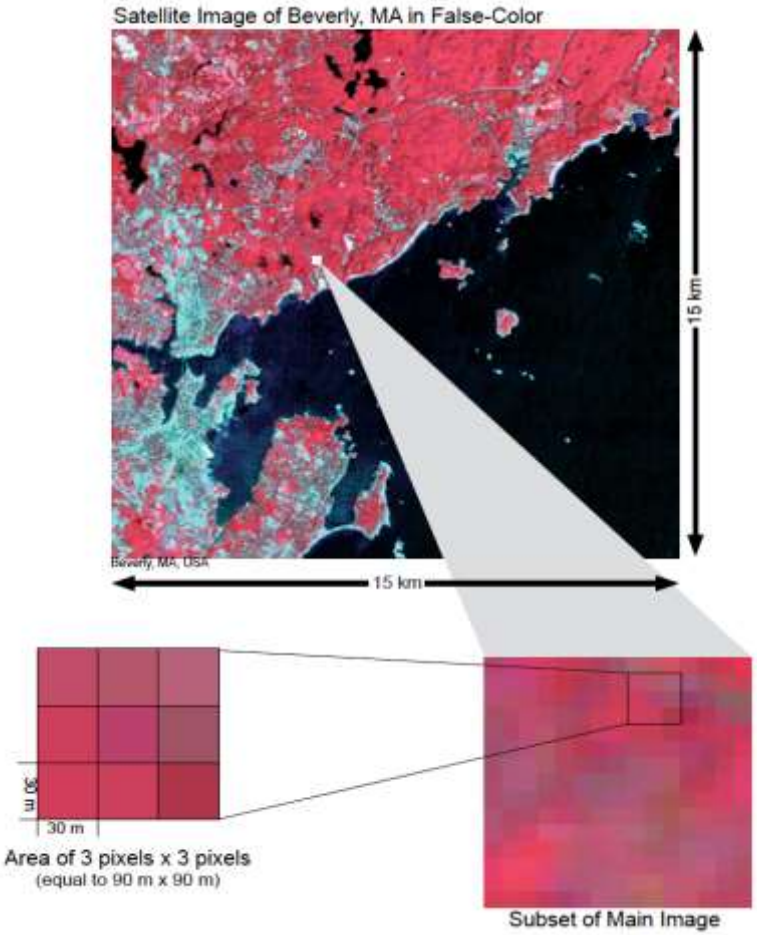
A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Scientific Importance of Land Cover

GLOBE land cover data can contribute to making better, more accurate maps.

Your land cover measurements are used to verify satellite analysis of land cover.

As you zoom in on a 15 km x 15 km satellite image, the pixels (which are 30 m x 30 m in size) become visible. You will be taking field measurements at sites that are 90 m x 90 m (equal to 3 pixels x 3 pixels on a Landsat image).



As you zoom in on a 15 km x 15 km satellite image, the pixels (which are 30 m x 30 m in size) become visible. You will be taking field measurements at sites that are 90 m x 90 m (equal to 3 pixels x 3 pixels).

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Land Cover Classification Using Satellite Data

For years scientists across the world have been mapping these changes in the landscape to prevent future disasters, monitor natural resources, and collect information on the environment. The most efficient way to map it is from space. By using such imaging satellites as Landsat and Terra, scientists have the ability to observe large tracts of the Earth's surface in a fraction of the time needed to complete aerial or ground surveys. Here are land cover types as seen from above—the perspective of an aircraft or satellite. Conifer (top), deciduous (middle), and grass (bottom.) Land cover classifications are based on the reflectance differences of varying types of plants in visible and near infrared wavelengths.

To verify their results, the scientists will often travel to the regions of interest and compare the results of the map with test sites on the ground. GLOBE data supports their work by providing ground validation data.

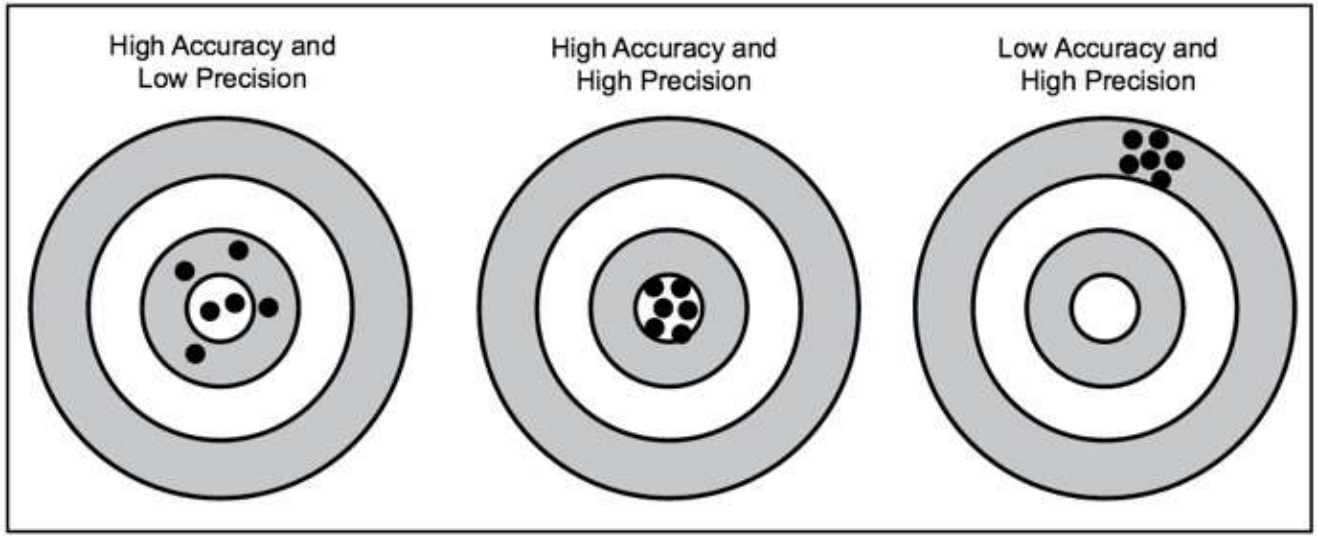
Read more about land cover classification here: NASA Earth Observatory

Text and image: NASA Earth Observatory

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Why Collect Land Cover Data?

Biometry measurements are useful for scientists who want to use your Land Cover Sample Site data. It helps to make sure that the MUC class you select is correct. Biometry measurements can help them assess how accurate and precise a land cover data set is. **Accuracy** is a measure of how well the data describe a phenomenon. **Precision** is demonstrated when repeated measurements yield the same outcome. In most GLOBE protocols, you are asked to take a measurement 3 times – allowing for you – as well as other scientists to determine the precision of your data.



A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Protocol at a Glance

When	Anytime. Determining some of the biometry measurements are best done during the growing season
Where	Homogeneous 90 m x 90 m vegetation patch
Time Needed	1-2 hours for initial description, plus subsequent visits to conduct the biometry measurements
Prerequisites	None
Key Instruments	50 m measuring tape, GPS receiver, compass

Needed Documents:

- Land Cover Sample Site protocol Field Guide (pdf)
- Land Cover Sample Site Data Sheet
- GPS Field Guide and GPS Data Sheet
- MUC Field Guide or MUC System Table and MUC Glossary of Terms

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Timing and Frequency of Data Collection

- To lay out your MUC, you only need to visit the site once.
- Time required for initial set up and description: estimated 1-2 hours.

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Describe your Land Cover Sampling Site

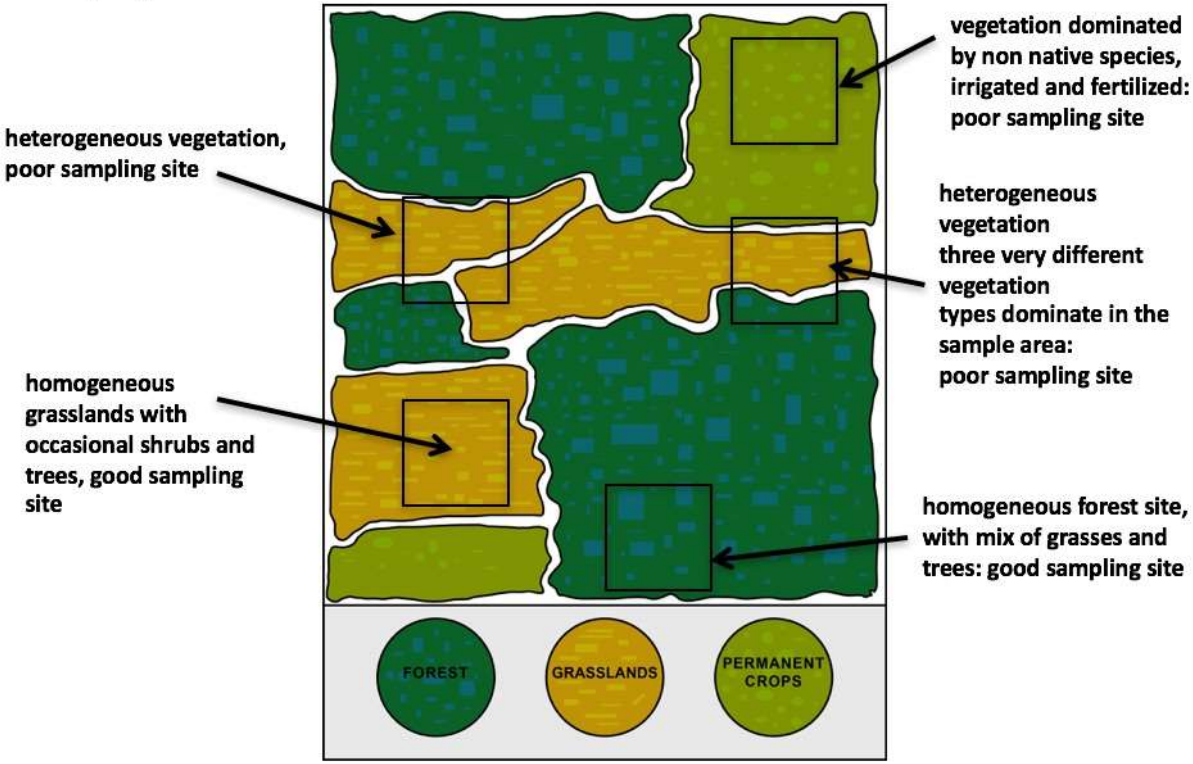
Needed Equipment:

- GPS Receiver
- Compass
- Clipboard
- Pen or Pencil
- Camera
- Permanent tree markers (optional, if you plan to return to the site)
- 50 m tape measure
- Local vegetation field guides

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Homogeneous vs. Heterogeneous Sampling Site Diagram

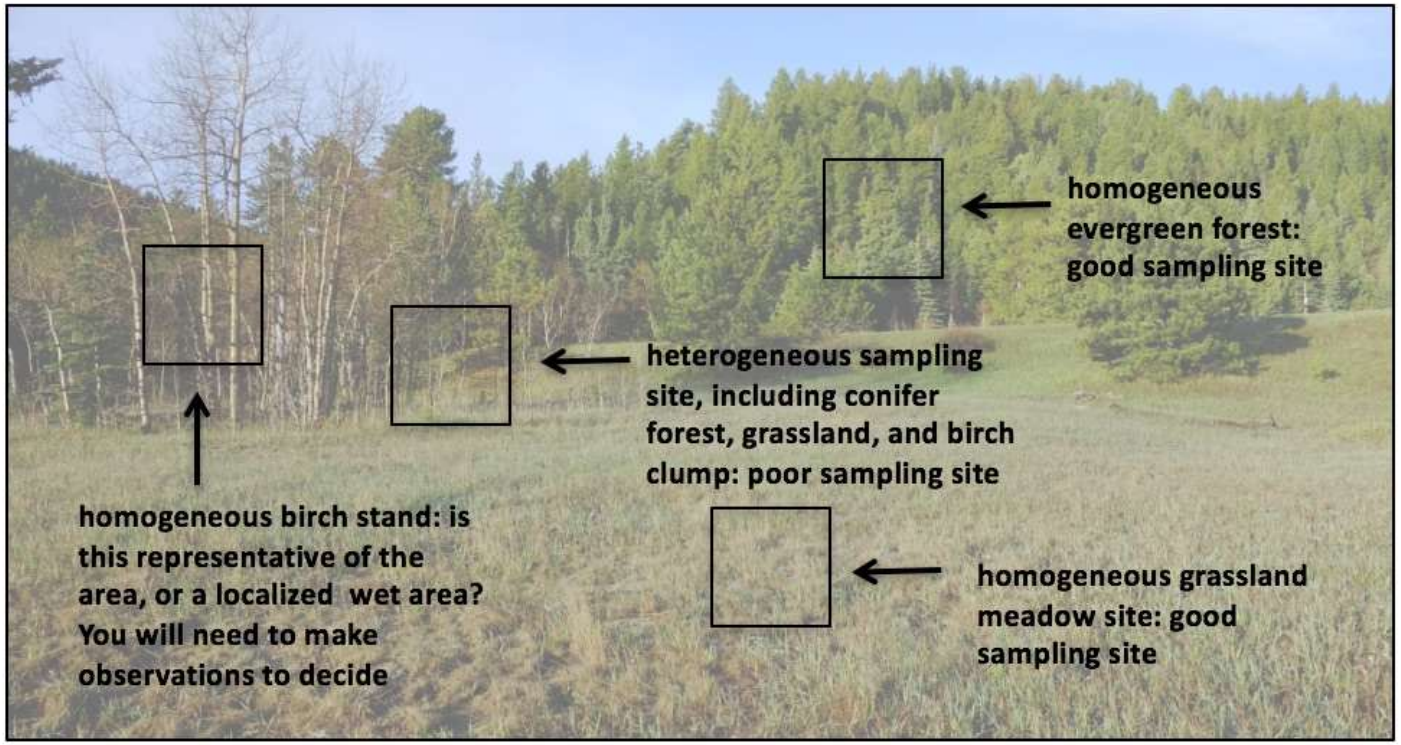
A homogenous site can contain many different species and growth forms (trees, grasses, and shrubs) but the sampling site should exhibit the same species and density of plants over the whole sampling area:



A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

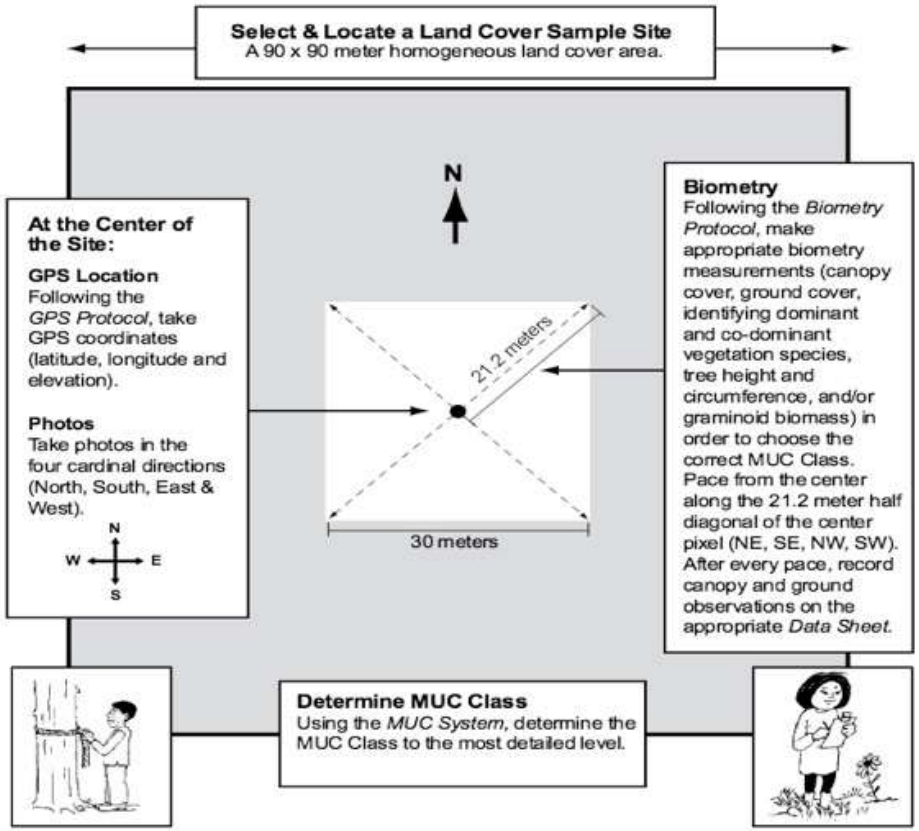
Site Selection in the Field:

- Locate the approximate center of the **90 m x 90 m** homogeneous site.
- Note: The site can be much larger than 90 m x 90 m as long as it is homogeneous.



A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Diagram of Sample Site Considerations



A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

In the Field

2. Fill in the top portion of the data sheet

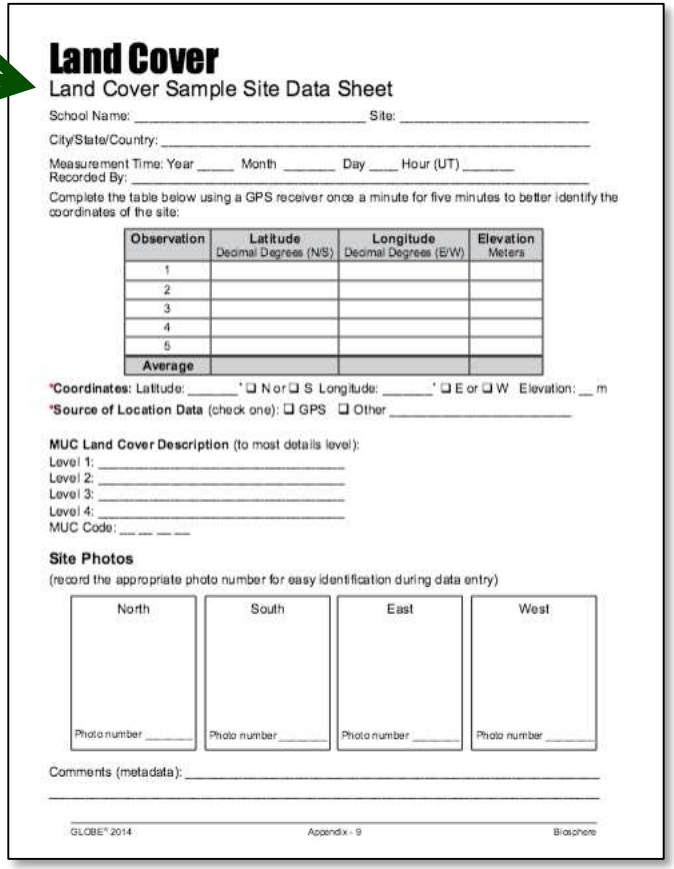
Follow GPS Protocol, reproduced here:

3. Collect positional data using a GPS receiver.

Identify the latitude, longitude and elevation of the center following instructions from the GPS field guide, below:

Turn on the receiver, making sure that you are holding it vertical and you are not blocking the antenna's view of the sky. In most receivers the antenna is internal and is located at the top of the receiver.

After an introduction message, the receiver will start to search for satellites. Some receivers may display the previous latitude, longitude, and elevation values while it is locking onto satellite signals.



Land Cover

Land Cover Sample Site Data Sheet

School Name: _____ Site: _____

City/State/Country: _____

Measurement Time: Year _____ Month _____ Day ____ Hour (UT) _____
Recorded By: _____

Complete the table below using a GPS receiver once a minute for five minutes to better identify the coordinates of the site:

Observation	Latitude Decimal Degrees (N/S)	Longitude Decimal Degrees (E/W)	Elevation Meters
1			
2			
3			
4			
5			
Average			

*Coordinates: Latitude: _____ ❑ N or ❑ S Longitude: _____ ❑ E or ❑ W Elevation: __ m

*Source of Location Data (check one): ❑ GPS ❑ Other _____

MUC Land Cover Description (to most details level):
Level 1: _____
Level 2: _____
Level 3: _____
Level 4: _____
MUC Code: __ __ __ __

Site Photos
(record the appropriate photo number for easy identification during data entry)

North	South	East	West
Photo number _____	Photo number _____	Photo number _____	Photo number _____

Comments (metadata): _____

GLOBE® 2014 Appendix - 9 Biosphere

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Using a GPS Receiver

- Wait for the receiver to indicate that at least four satellites have been acquired and that a good measurement is available. In most receivers, this is indicated by the appearance of a "3-D" message.
- At one minute intervals and without moving the receiver more than one meter, make five recordings on a copy of the GPS Investigation Data Sheet
- of all digits and symbols for the following displayed values:
- **a. Latitude**
- **b. Longitude**
- **c. Elevation**
- **d. Time**
- **e. Number of satellites**
- **f. "2-D' or "3-D" status icons**

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

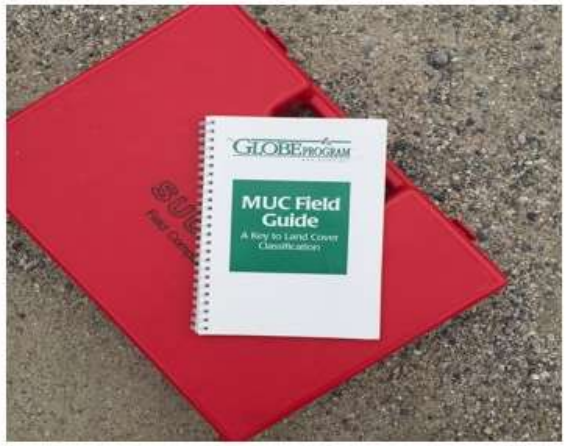
Calculate your average reading and verify.

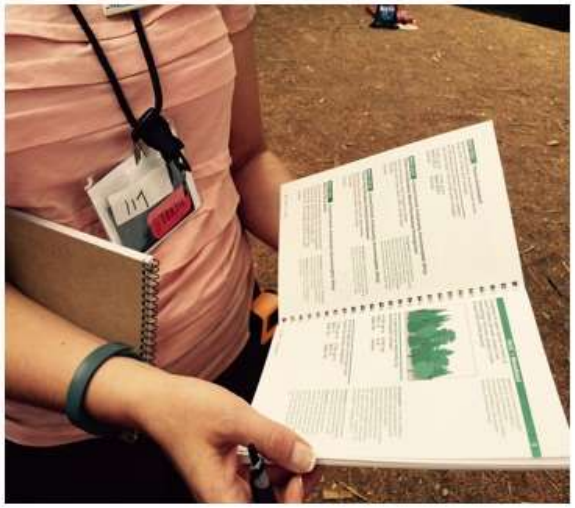
- Turn off the receiver.
- Average all five latitudes, longitudes, and elevations.
- Confirm for yourself that your results make sense.
- You should be able to get a rough estimate of your latitude and longitude by looking at a globe or local map.
- Copy and submit all GPS readings as your site location to the GLOBE data portal.

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Determine MUC Class of Sample Site

- 4. Determine MUC class to the most detailed level using either the MUC Field Guide. You will likely need to make measurements following the **Biometry Protocol Field Guides** to help determine the class.
- Note: This step may take several visits as you collect necessary biometry data.
- For most sites, it will be necessary to measure **Canopy Cover and Ground Cover** and **Graminoid, Tree and Shrub Height** before you can complete your Land Cover Sample Site Description.





A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

MUC Guide has a dichotomous key structure

When classifying land cover using the MUC System, always begin with the most general classes (Level 1) and proceed sequentially to the more detailed (higher level) classes. For example, the Level 2 classes within Closed Forest are Mainly Evergreen, Mainly Deciduous, and Extremely Xeromorphic (Dry). These Level 2 classes contain more detail than the Level 1 class, Closed Forest, and they may all be collapsed into the Closed Forest class. In other words, any member of one of these three Level 2 classes is always a member of the Closed Forest Level 1 class. See table below. This is a condensed version of MUC, showing only the Level 1 and Level 2 classes, and how your biometry measurements are needed to determine the appropriate MUC class. Conduct the appropriate biometry protocols to determine the MUC class of your sample site. You will likely be able to determine Level 3 or Level 4 classes once you have collected sufficient data.

MUC Code	MUC Level 1 Classes	Coverage Required
0	Closed Forest	>40% trees, at least 5 meters tall, crowns interlocking
1	Woodland	>40% trees, at least 5 meters tall, crowns not interlocking
2	Shrubland or Thicket	>40% shrubs or thickets, 0.5 to 5 meters tall
3	Dwarf-Shrubland or Dwarf-Thicket	>40% shrubs or thickets, under 0.5 meters tall
4	Herbaceous Vegetation	>60% herbaceous plants, grasses, and forbs (broad-leaved)
5	Barren	<40% vegetative cover
6	Wetland	>40% vegetative cover, includes marshes, swamps, bogs
7	Open Water	>60% open water
8	Cultivated Land	>60% cultivated species
9	Urban	>40% urban land cover (buildings, paved surfaces)

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

5. Note any unusual or helpful metadata. Record this in the appropriate place on your Land Cover Sample Site Data Sheet.

6. Using the camera, take a photo in each cardinal direction – north, south, east and west. Use your compass to determine the directions. Record each photo number in the correct arrow on Your Data Sheet.

You are done!

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

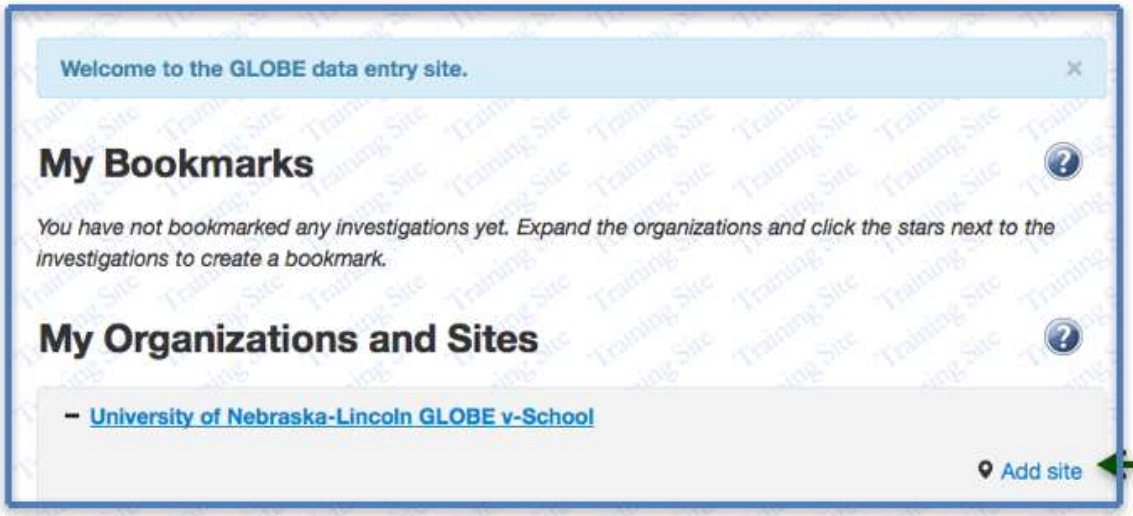
Report Data to the GLOBE Database

- **Live Data Entry:** Upload your data to the official
- GLOBE science database
- Email Data Entry: Send data in the body of your email (not as an attachment) to **DATA@GLOBE.GOV**

- Mobile Data App: Download the GLOBE Science Data Entry app to your mobile device and select the right option.
- **For Android** via **Google Play**
- **For IOS** via the **App Store**

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Entering your Data via Live Data Entry or Data Entry Mobile App- Step 1



A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

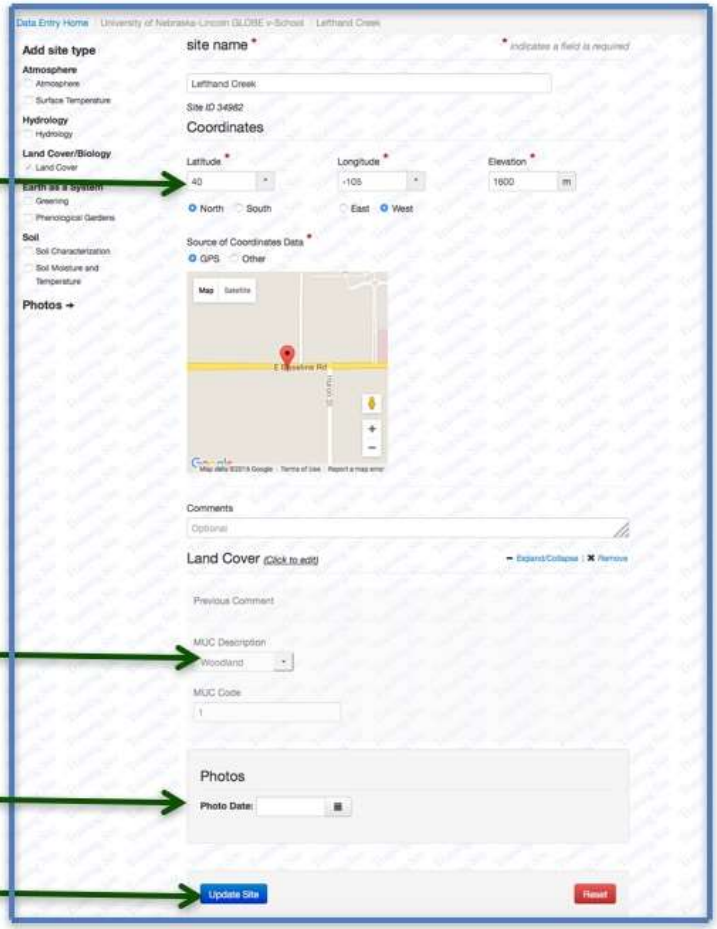
Entering your Data via Live Data Entry or Data Entry Mobile App- Step 2

Add locational data

You will determine the MUC code from your land cover measurements

Upload photos

Submit data



You are done! Want to check who else has submitted land cover data using the GLOBE Visualization System?

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Visualize and Retrieve Data- Step 1

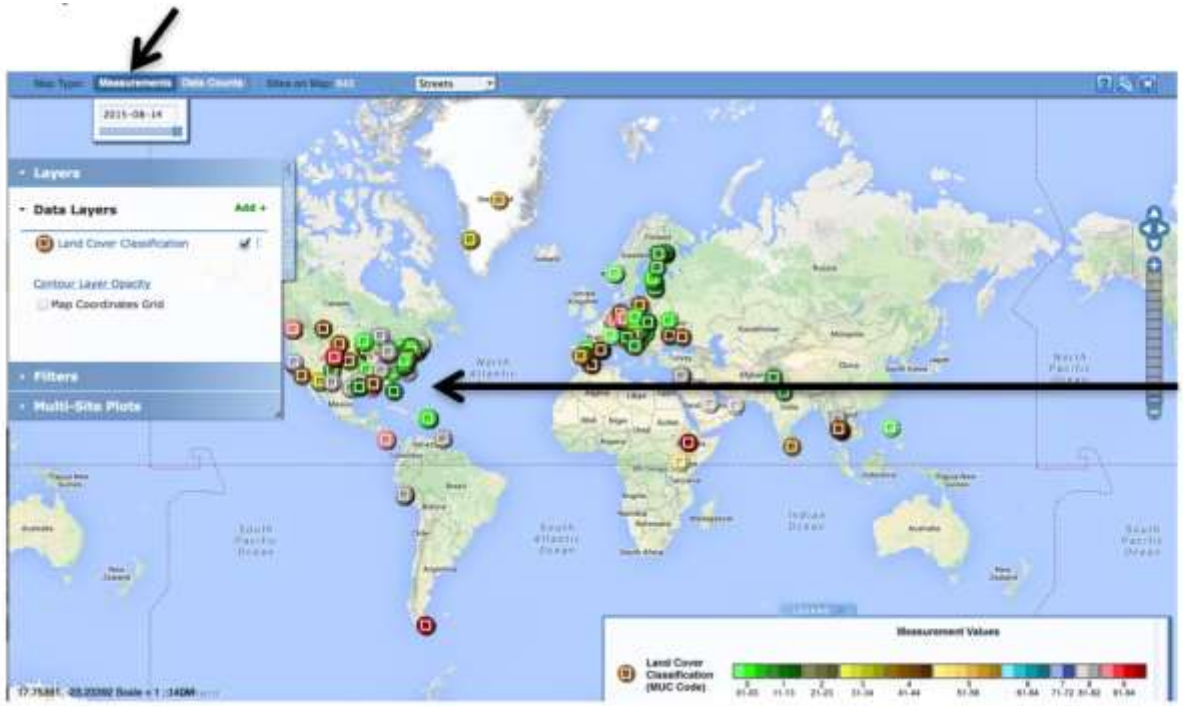
Your tree circumference data will be used to determine your site's Land Cover Classification. GLOBE provides the ability to view and interact with data measured across the world. Select our visualization tool to map, graph, filter and export Land Cover Classification data that have been measured across GLOBE protocols since 1995.

Link to step-by-step tutorials on Using the Visualization System will assist you in finding and analyzing GLOBE data: PDF verson PowerPoint version

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Visualize and Retrieve Data- Step 2

Select the date for which you need Land Cover Classification data, add layer and you can see where data is available.

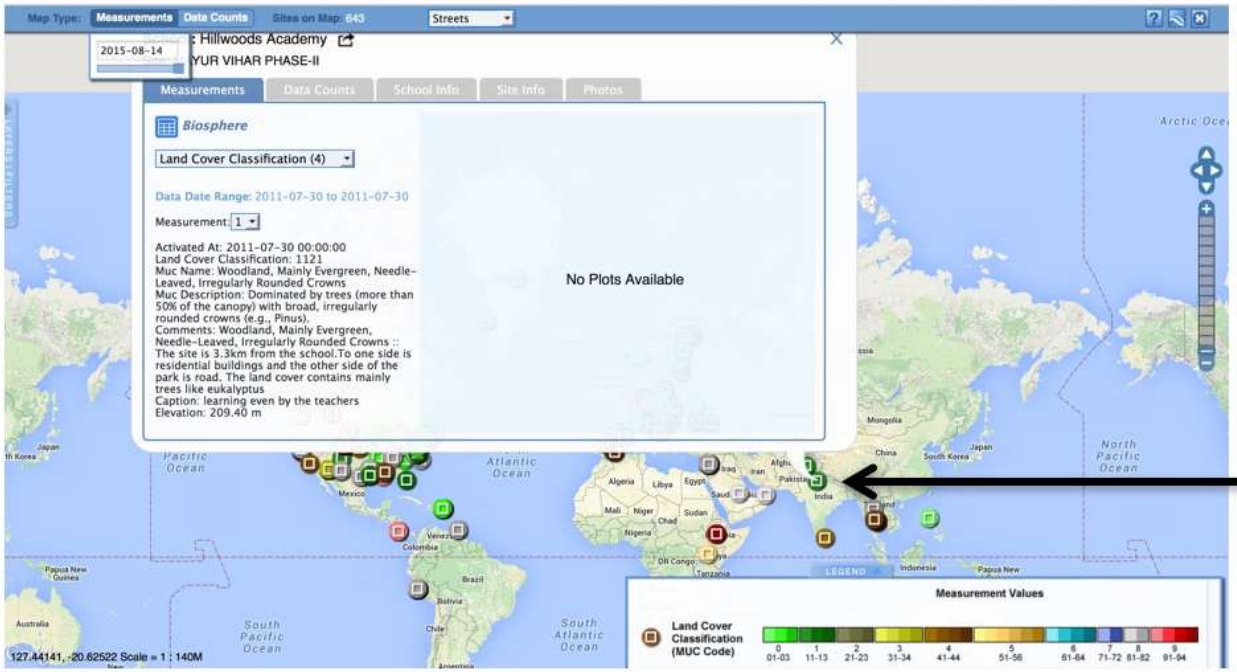


Locations where Land Cover Classification data is available for the week you selected

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Visualize and Retrieve Data- Step 3

Select the sampling site for which you need Land Cover Classification Data, and a box will open with a data summary for that site. You can visualize data as graph or table, and export data as .csv files for analysis using spreadsheet applications .



Clicking on a location will open to a map note providing Land Cover Classification data for that location and time. Follow instructions in the tutorial to download data as a .csv file for analysis.

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Review questions to help you prepare to do the Land Cover Sampling Site Description associated with the GLOBE Biometry Protocol

1. **Land Cover measurements are part of what GLOBE Protocol area or Earth system sphere?**
2. **What GLOBE protocols require you to establish your Land Cover Sampling Site?**
3. **What is the difference between homogenous and heterogeneous sampling sites?**
4. **Can a sampling site be classified as homogenous if it has evenly dispersed trees, grasses and shrubs in the same vegetation?**
5. **How big should your sampling site be, at minimum, in meters?**
6. **What instrument do you use to determine the latitude and longitude of your sampling site?**
7. **What vegetation classification scheme is used by GLOBE to ensure that land cover data is comparable from one site to another?**
8. **What protocols will you need to do in order to determine the MUC class of your land cover sampling site?**
9. **How can land cover day you collect be useful to scientists and land managers?**
10. **Define these terms: *accuracy* and *precision*. Why do GLOBE protocols usually specify that measurements be taken at least 3 times?**

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Are you ready to take the quiz?

- You have now completed the slide stack. If you are ready to take the quiz, sign on and take the quiz corresponding to **Land Cover Sample Site Description Field Guide Protocol.**

- When you pass the quiz, you are ready to establish your **Land Cover Sample Site**!

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Some Questions for Future Research using your Land Cover Data:

- What natural changes could alter the MUC class of these sites?
- Is this MUC class typical for its latitude, longitude and elevation?
- If someone only had photos of your site, what MUC class would he/she think this site is?
- What other MUC classes are most similar to your site?
- How will the land cover of your site affect local climate?
- How will the land cover at your site affect your local watershed?
- If you compared a Landsat image from ten years ago to one from today how do you think they would differ?
- Does the nearest water body affect the vegetation of this site?
- What types of animals do you think live here?
- How are the land cover and soil characteristics of this site related?

A. What Is a Land Cover Sample Site?
B. Why Collect Land Cover Sample Site Data?
C. How Your Measurements Can Help.
D. How to Collect Your Data
E. Entering Data on GLOBE Website
F. Understand the Data
G. Quiz Yourself
H. Additional Information

Please provide us with feedback about this module. This is a community project and we welcome your comments, suggestions and edits! Comment here: eTraining Feedback
Questions about the content of this module? Contact GLOBE eTraining: rlow@ucar.edu

Slides:

Russanne Low, Ph.D., University of Nebraska-Lincoln, USA

Rebecca Boger, Ph.D., Brooklyn College, NYC, USA

Cover Art:

Jenn Glaser, *ScribeArts*

More Information:

The GLOBE Program

NASA Wavelength Digital Library of Earth and Space Science Education Resources

NASA Global Climate Change: Vital Signs of the Planet

The GLOBE Program is sponsored by these organizations:

Version 12/1/16. If you edit and modify this slide set for use for educational purposes, please note "modified by (and your name and date) " on this page. Thank you.