THE GLOBE PROGRAM
A Worldwide Science and Education Program

Biosphere • Biometry Protocol

Graminoid Biomass Field Guide

Overview

- This module:
- Provides a step by step introduction of the protocol method
- Discusses the importance of obtaining graminoid (grass-like plant) data

- Learning Objectives
- After completing this module, you will be able to:

- Define graminoid biomass and give an example of how graminoid biomass can be used by scientists
- Describe the importance of quality control steps in the the collection of accurate data
- Explain the difference between accuracy and precision
- Conduct sampling procedures in the field and complete measurement procedures in the lab
- Upload data to the GLOBE portal
- Visualize data using GLOBE's Visualization Site

Estimated time to complete module: 1.5 hours

What is 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 GLOBE 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.

The Graminoid Biomass Measurements are part of GLOBE's **biometry** observations and contribute to our understanding of a sample site's land cover.

You can found more information in:

[Biosphere Introduction]

Photo Credit: Shelley E. Olds

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 measurement of land cover.

In this protocol, you will be measuring **graminoid** biomass- the total weight of **grass-like plant** material in a given volume or area. These measurements are critical for understanding energy use, storage and transfer in ecosystems.

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

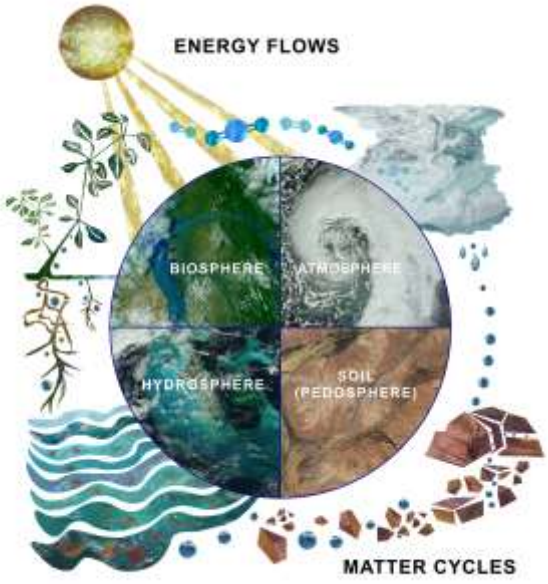
Tree Circumference

Graminoid Biomass

Why Study Land Cover?

Land cover includes both developed and natural areas. All living things depend on their habitat, or land cover, for survival. They find shelter, food, and protection there. Land cover has a direct effect on the kinds of animals that will likely inhabit an area. Therefore, land cover is of great interest to ecologists, who study how plants and animals relate to their environment.

Land cover can influence weather, soil properties, and water chemistry. Different land cover types are all distinct in their effects on the flow of energy, water and various chemicals between the air and surface soil. So, knowing what types of land cover occur is important for a variety of Earth system science investigations.



What is Biomass?

***Biomass* is organic material which has stored sunlight in the form of chemical energy.** In plants this includes both the above ground part of the plant, as well as the roots found underground. Biomass can be quantified by determining the weight or mass of plant tissue found in a given area or volume. In this protocol, we are measuring above-ground biomass of grass-like plants.

What is Graminoid Biomass?

Graminoid is another word for grasses and grass-like, narrow leafed plants.

Graminoid Biomass is a measure of the total mass of grass-like plants in a given area or volume. For this protocol, you will be measuring the above ground biomass of grasses only and not the biomass of other plants such as broad-leaf or woody plants, mosses, and lichens.

All the plants in this picture are graminoids except for the broadleaf plants indicated here by the arrows

Why Collect Graminoid Biomass Data?

Biomass measurements are useful in a variety of applications.

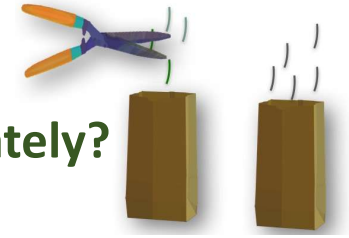
Measurement of biomass is an indicator of the amount of energy stored in vegetation. This information can be used to calculate primary productivity of an ecological site, and can also be used to calculate the amount of carbon that is sequestered (stored) in grasses and similar plants.

- Estimates of biomass are also useful because vegetation cover plays a role in the hydrological properties of a site, such as infiltration, runoff and erosion.
- Controlled burning is used by managers to promote growth of grasses that can be foraged by livestock.
- Many ecologists find plant biomass a good indicator of a species' role in the ecosystem, because the measurement reflects the nutrients, water and sunlight that is procured by that species.

Flood erosion: Slope is Intact where there is grass. Where there was a path, the slope was subject to mass wasting and erosion during the 2013 flood in Boulder, Colorado USA.

Why Collect Green and Brown Biomass?

You will be collecting both standing green above ground biomass and standing brown biomass. Grasses regenerate at the beginning of the growing season from below ground tissue. There is ongoing turnover from green to brown leaves during the growing season, and when growth ceases at the end of the growing season, the standing biomass rapidly turns from green to brown.



Why weigh green and brown graminoid biomass separately?

- Green and brown (living and dead) tissue enter different food webs and their contribution to various parts of the carbon cycle can be modeled.
- Knowing the green/brown composition of a grassland is also important information when determining fire risk.
- An accurate estimate of above-ground dry weight biomass is necessary for grassland and prairie management. Biomass measurements can inform us about available forage for animals and determine the risk of erosion related to loss of grass cover. Knowing the amount of green vs. brown biomass can be important in modeling seasonal dynamics when the grass is grazed by animals.

Biomass Burning

Scientists use satellite data to monitor fires and smoke associated with wildfires, prescribed burns, deforestation and other agricultural applications, collectively referred to as biomass burning. Biomass burning plays a major role in the global carbon cycle impacting both regional and global climate change. Biomass burning releases significant amounts of CO2, trace gases and particulates into the atmosphere. Knowing the amount of biomass in an area can assist in preparing for wildfires.

Detailed measurements from **Tropospheric Emission Spectrometer** on the Aura satellite of the global tropospheric distributions of co-located O3, CO, water vapor, and nitrogen oxides are being used to investigate the impacts of biomass burning on air quality and climate. Image: NASA.

Let's do a quick review before moving onto data collection! Question 1

What is a "graminoid?"

A. A grass-like plant, with thin leaves, such as rushes, sedges and grasses

B. A broad-leaf plant, like an oak tree or a rose.

What is your answer?

Let's do a quick review before moving onto data collection! Answer to Question 1

What is a "graminoid?"

A. A grass-like plant, with thin leaves, such as rushes, sedges and grasses- ☺ Correct!

B. A broad-leaf plant, like an oak tree or a rose.

Were you correct?

Let's do a quick review before moving onto data collection! Question 2

Of what scientific use is graminoid biomass data?

A. We can use to understand energy use, storage and transfer in ecosystems

B. It can be used to calculate the amount of carbon stored in grass-like plants

C. It can be used to estimate risk of erosion related to loss of grass cover

D. It can be used to determine the available food for livestock

E. All of the above

F. A and B only

What is the answer?

Let's do a quick review before moving onto data collection! Answer to Question 2

Of what scientific use is graminoid biomass data?

A. We can use to understand energy use, storage and transfer in ecosystems

B. It can be used to calculate the amount of carbon stored in grass-like plants

C. It can be used to estimate risk of erosion related to loss of grass cover

D. It can be used to determine the available food for livestock

E. All of the above ☺ Correct

F. A and B only

Were you correct? Let's move on to the data collection procedure.

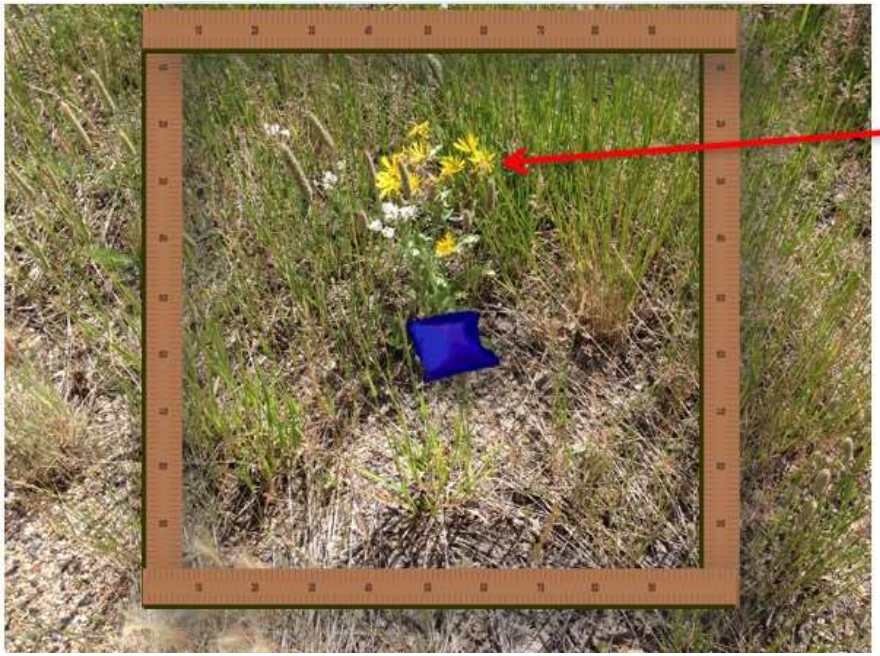
Protocol at a Glance

Where	Biosphere Study site
When	Variable, depending on your research goals
Frequency	As necessary to determine MUC at most sites, or, frequently as an enrichment study
Skill Level	All
Equipment	For Field: Bean bag, blindfold, grass clippers, small brown paper bags, balance, pen or pencil. For Lab: balance and drying oven.
Necessary Documents	Graminoid Biomass Field and Lab Guide Graminoid Biomass Data Sheet

How to Collect Your Data

Blindfold your partner and have him or her throw a beanbag somewhere in the site.

a. Mark a one-meter square around the beanbag to take a random sample.



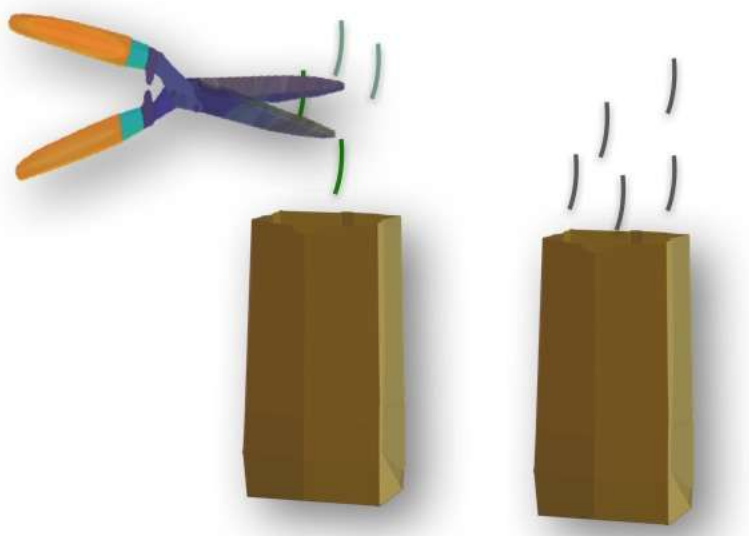
Don't include broadleaf plants (herbs and forbs) or mosses in your sample. Sample only grasses and grass-like plants (sedges, for example).

Collect your graminoid samples

b. Using the garden clippers, clip all the vegetation close to the ground within the square (m2). Do not collect any unattached leaves or litter.

c. Sort the clippings into green and brown portions. Any clipping with even a little green is considered green.

d. Place the green and brown portions into separate brown paper bags. Label the bags.



2. Repeat step 1 two more times.

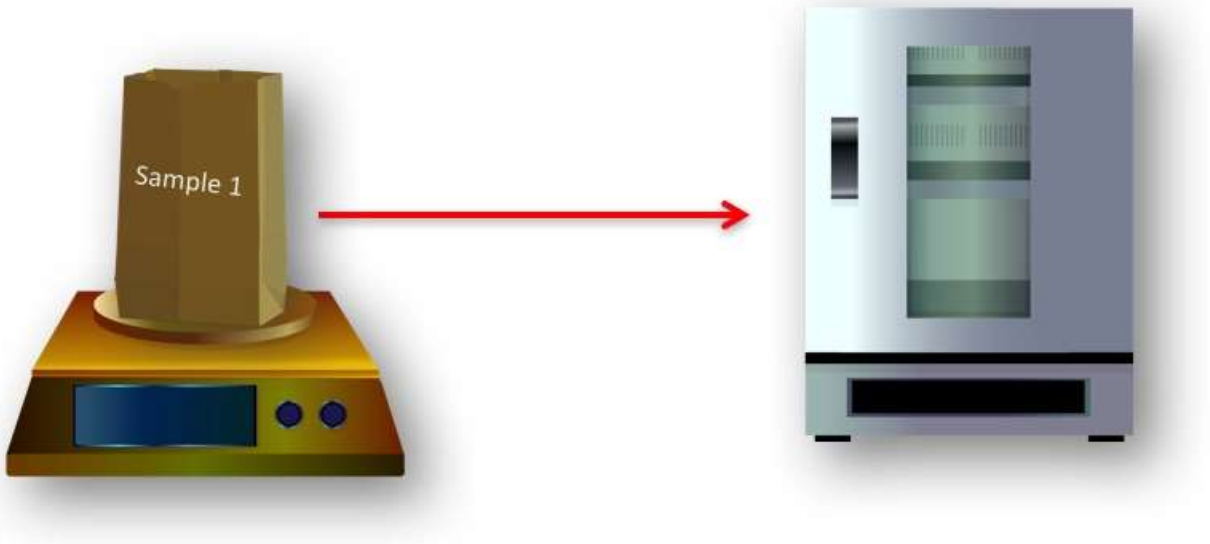
The next steps take place in your laboratory space

Calculating Graminoid Biomass:

a. Check the temperature of the drying oven, it should read between 50 and 70 degrees Celsius.

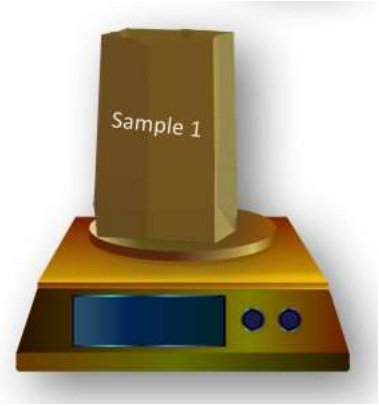
b. Put the labeled bags in the drying oven.

c. Use a balance to measure the mass (g) of each bag once a day.



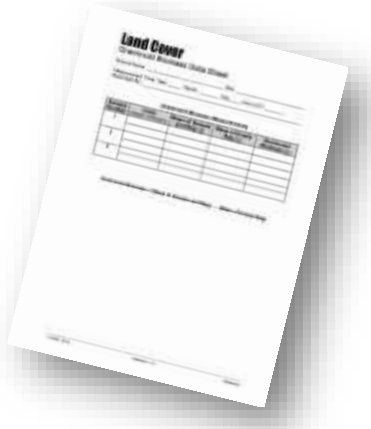
Measure your dry weight

- d. When the mass is the same two days in a row, the samples are completely dry.
- e. Record the mass of each bag and its contents on the Graminoid Biomass Data Sheet
- f. Shake out the contents of one bag and weigh the empty bag. Record this mass. Repeat this step for each bag.
- g. Calculate the mass of the graminoid vegetation (graminoid biomass) using the following formula:



Graminoid Biomass = Mass of Sample and Bag – Mass of Empty Bag

- h. Record the graminoid biomass of each sample on the Graminoid Biomass Data Sheet.



Helpful Hints

- Do not use a conventional oven to dry the graminoid vegetation. This is dangerous because the oven may have to be left on continuously for several days!
- Make sure to use several small brown drying bags for proper drying of graminoid samples
- In warm, dry climates, graminoid biomass samples can be dried in mesh bags outside.

Let's do a quick review before moving onto data entry! Question 3

In this protocol, how do you determine the random sample where you will take clippings for analysis in the lab?

A. Lay out a grid and sample at intervals

B. Throw a bean bag

What is the answer?

Let's do a quick review before moving onto data entry! Answer to Question 3

In this protocol, how do you determine the random sample where you will take clippings for analysis in the lab?

A. Lay out a grid and sample at intervals

B. Throw a bean bag ☺ correct!

Were you correct?

Let's do a quick review before moving onto data entry! Question 4

If the clipping is almost all brown with just a little bit of green on one end, you would put the clipping in the:

A. Green sampling bag

B. Brown sampling bag

C. Mixed brown and green sampling bag

What is your answer?

Let's do a quick review before moving onto data entry! Answer to Question 4

If the clipping is almost all brown with just a little bit of green on one end, you would put the clipping in the:

A. Green sampling bag- ☺ Correct!

B. Brown sampling bag

C. Mixed brown and green sampling bag

Were you correct?

Let's do a quick review before moving onto data entry! Question 5

When the oven-dried mass of the sample is the same for at least ___ in a row, it is considered completely dry.

A. 24 hours

B. Two days

C. Three days

D. One week

What is your answer?

Let's do a quick review before moving onto data entry! Answer to Question 5

When the oven-dried mass of the sample is the same for *at least* ___ in a row, it is considered completely dry.

A. 24 hours

B. Two days ☺ Correct!

C. Three days

D. One week

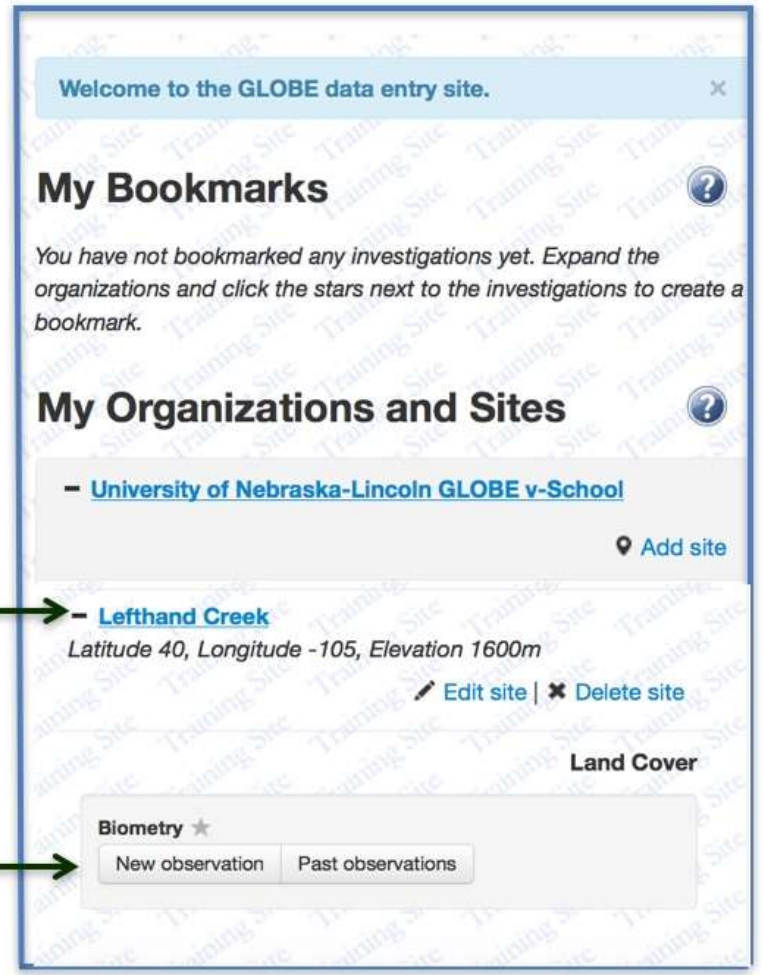
Were you correct? Let's move on to GLOBE data entry and visualization!

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**

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



Identify your Sampling site

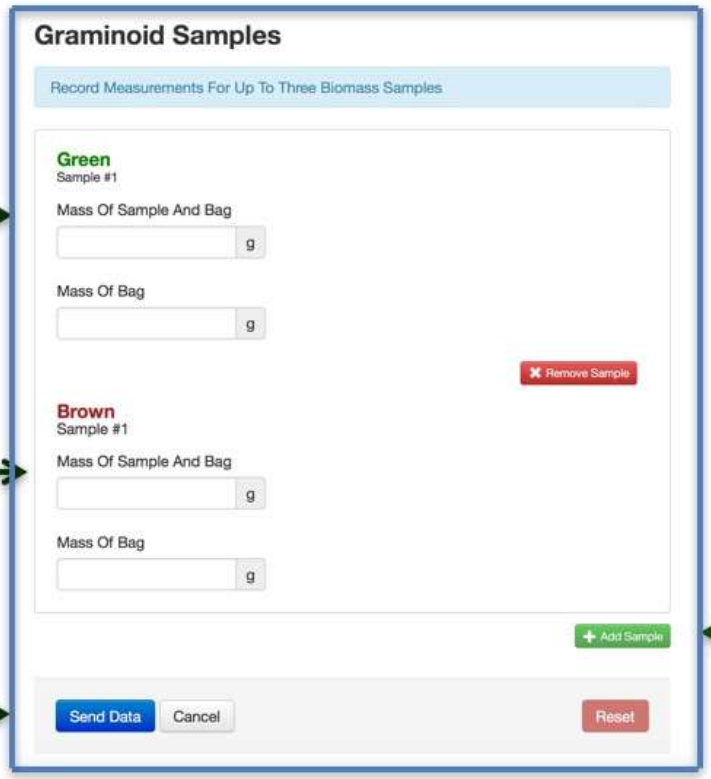
Select *"New observation"*

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

1. Enter Mass in g of green samples and bag. Enter mass of empty bag.

2. Enter Mass in g of brown samples and bag. Enter mass of empty bag.

4. Click to submit



3. Add up to three samples of each category

You are done!

Next Steps

You have now completed the slide stack. If you are ready to take the quiz, sign on and take the quiz corresponding to **Graminoid Biomass Protocol.**

You can also review the slide stack, post questions on the discussion board, or look at the FAQs on the next page.

When you pass the quiz, you are ready to take **Graminoid Biomass Protocol** measurements!

Review questions to help you prepare to do the Graminoid Biomass measurements associated with the GLOBE Biometry Protocol

1. **Graminoid biomass measurements are part of what GLOBE Protocol area or Earth system sphere?**
2. **Graminoid biomass measurements are part of specific protocol?**
3. **What environmental factors influence the amount and kind of graminoid biomass landscape?**
4. **What is another term for graminoid?**
5. **Are mosses, lichens, forbs and small showy flowering plants considered graminoids?**
6. **Name three reasons why a region's graminoid biomass is important for scientists and land managers to know.**
7. **How does graminoid biomass data help us to quantify changes in atmospheric gases and CO2?**
8. **When is the best time during the year to measure graminoid biomass?**
9. **Why is it not allowed to use a home oven to dry your graminoid biomass samples?**
10. **How do you know when your samples are completely dry?**

Frequently Asked Questions

What if we can't get to our site during peak vegetation (full leaf-on) conditions?

If you cannot get to your site during peak growth (leaf-on), measure your site during the leaf-off period and try your best to get the peak growth (leaf-on) data, when you can.

When I am measuring grass biomass, what do I do with mosses or lichens?

Moss and lichens are considered "Other Green" and have their own designation on the Canopy and Ground Cover Data Sheet. Do not include mosses or lichens in your dried samples. Record in metadata if these species comprise a large part of your green ground cover.

My school does not have a drying oven. Can we dry the grass another way?

First, check to see if you can use a drying oven at a community college, university, government agency or some other business or organization in your community. In warm, dry climates, graminoid biomass samples can be dried in mesh bags outside. Do not use a conventional oven to dry the graminoid vegetation. This is dangerous!

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 content of the module? Contact GLOBE eTraining: rlow@ucar.edu

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