Herbaceous Protocol Non-Standard

Purpose

Use a random sampling method to collect a sub-sample of herbaceous vegetation data in order to calculate biomass and carbon stock.

Overview

After completion of the Carbon Cycle Sample Site Set-Up students will use scientific field methods to measure the biomass and carbon stock of herbaceous vegetation. **This can be done at the same time as the tree and shrub/sapling measurement if applicable**

Student Outcomes

Students will be able to:

- Work as a team to delegate and complete field tasks
- Carry out scientific measurements using appropriate tools and their knowledge of accuracy and precision.

Questions

Content

- What is the biomass and carbon storage of the herbaceous vegetation on our sample site?

Science Concepts

Grades 9-12

Scientific Inquiry

- Design and conduct a scientific investigation
- Use mathematics in all aspects of scientific inquiry

Science in Personal and Social Perspectives

- Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models

NGSS (Black-covered directly, gray-addressed, but not directly covered)

- *Disciplinary Core Ideas*
  - Gr.6-8: LS4.A
- *Science and Engineering Practices*
  - Planning and carrying out investigations
  - Using mathematics and computational thinking
- *Crosscutting Concepts:*
  - Patterns

Time/Frequency

40 minutes (Travel time not included)

Should be completed eveyr year

Level

Secondary (Middle & High School)

Materials and Tools

- Small beanbag
- Blindfold
- Measuring tape
- Grass clippers or strong scissors
- Permanent Market
- Small brown paper bags
- *Herbaceous Field Guide*
- Balance (in classroom)
- Drying Oven (in classroom, optional)
- Pencil (in classroom)
- *Herbaceous Lab Guide* (in classroom)
- *Herbaceous Biomass Data Sheet* (in classroom)
- Google Earth image

Prerequisites

- *Develop Investigation Plan* (optional)
- A Carbon Cycle Site should already be set up.
- If this group of students did not perform the sample site set up themselves be sure to visit the site and discuss how it was set up before collecting herbaceous data, *see Discussion Points for Site Visit* (in the *Site Set-up Teacher Guide*) as a guide.

Preparation

- Divide your class into groups. [Recommended: one herbaceous group to complete measurements while other students take tree and/or shrub/sapling measurements. Or create three groups, one for each replicate – in this case you will need 3 of each tool or will need to complete the measurements at times that do not overlap]
- Review and make copies of the *Herbaceous Measurements – Student Field Guide*, *Student Lab Guide,* and *Herbaceous Biomass Data Sheet.*

What To Do and How To Do It

PREPARE TO GO OUTSIDE **Grouping:** Small Groups **Time:** 15 Minutes

- Review expected student behavior while in the field.
- Divide into Teams.
- Students gather field materials and tools.
- Students review the *Herbaceous Measurements - Student Field Guide* and ask questions.

HERBACEOUS FIELD TASKS **Grouping:** Small Groups **Time:** 40 Minutes

- Students should follow the procedures for each task in their *Field Guide*.

NOTES:

- *This can be done in conjunction with tree and/or shrub/sapling measurements. It can also be completed at the same time as the GLOBE Landcover Canopy Cover and Ground Cover protocol if also performing the biometry protocols to determine MUC.*

HERBACEOUS LAB TASKS **Grouping:** Small Groups **Time:** Varies

- After data is collected in the field, students should follow the procedures for the classroom lab tasks in their Student Instructions and use the equations on the Herbaceous Biomass Data Sheet to calculate herbaceous biomass and carbon storage. Note: the GLOBE Data Entry system will also make these calculations when data are uploaded to the GLOBE website.
- Once they have completed their data analysis, students answer *Herbaceous Analysis Questions (on Carbon Cycle webpage under 'Data Analysis' section).*

NOTE: If for any reason the herbaceous vegetation at your field site cannot be cut down and removed, your students should complete the process of selecting 3 random locations and recording the type of vegetation present in each one. Then provide them with the Carbon Lookup Tables (below), which contain carbon values for a variety of herbaceous plants/plant communities that can be used in the Herbaceous Biomass Data

Resources

- Carbon Cycle eTraining: www.globe.gov/get-trained/protocol-etraining/etraining-modules/16867717/3099387

Table 1. Carbon Storage Look-up Table for Agricultural Crops. From Li et al. 1992 and Changshen Li, pers comm. 2012)				
Crop Name	Carbon Storage (g C/m2)		Crop Name	Carbon Storage (g C/m2)
Alfalfa	561.4		Oats	1043.5
Artichoke	688.2		Onion	960
Banana	800		Papaya	2000
Barley	832		Peanut	375.7
Beans	293.3		Potato	857.1
Beet	1152		Radish	408.1
Berries	320		Rapeseeds	563.4
Broccoli	400		Rice, Deepwater	342.9
Cabbage	280		Rice, Paddy	823.8
Cassava	923.1		Rice, Rainfed	933.3
Cattail	1400		Rice, Upland	444.4
Celery	400		Rye	304.8
Corn	1030.9		Safflower	650
Corn, Silage	900		Sedge	2000
Cotton	450		Sedge, Boreal	148
Cover Crop	400		Sorghum	685.7
Flax	150		Soybean	351.2
Flowers	182.7		Strawberry	730.9
Grape	70		Sugarcane	1776
Grass, Annual	444.4		Sunflower	240.1
Grass, Perennial	933.3		Tobacco	192
Green Onion	400		Tomato	461.3
Hay	1100		Tule	1080
Lettuce	142.8		Wheat, Spring	780
Millet	212.9		Wheat, Winter	761
Mustard	440			

Table 2. Carbon Storage Look-up Table for Residential and Native Grasses		
Grass Type	Carbon Storage (g C/ m2)	Source
Residential Lawn	82	Jo and McPherson 1995
Tall Grass Prairie	212	Derner et al. 2011

Herbaceous Vegetation Measurements - Student Field Guide

Herbaceous Sampling Team - 2-3 people

Task

Collect samples of herbaceous vegetation from the Carbon Cycle site.

Materials

- ❑ Small beanbag
- ❑ Blindfold
- ❑ Measuring tape
- ❑ Grass clippers or strong scissors
- ❑ Small brown paper bags
- ❑ Pen or marker

Procedure

1. Blindfold one member of your group and have him or her throw a beanbag somewhere in the site.

   a) IF your site is too large (i.e. a whole city block), use a random sampling method such as number generator or random number table to select 3 measurement locations within the sample site. This is best done using a Google Earth image and GPS coordinates.

2. Mark a one-meter square around the beanbag to take a random sample.
3. Using the grass clippers, clip all the vegetation close to the ground within that square. Do not collect any leaves or litter that are already unattached from the ground.
4. Place clippings into a (or several) brown paper bag(s). All “standing” plants, both green and brown can be bagged together.
5. Label the bag(s) with the **site name, date, and sample number** (e.g., Field Site, Herb Sample #1, Bag1 of 2).
6. Repeat steps 1-5 two more times.

Herbaceous Vegetation - Lab Protocol and Data Sheet

Herbaceous Measurement Team - 2 people

Task

Measure herbaceous biomass from the Carbon Cycle Sample site.

Materials

- ❑ Balance
- ❑ Pen or marker

Procedure

1. Set up the herbaceous samples to dry.

   a) Drying Oven: Check the temperature of the drying oven, it should read between 50 and 70 degrees Celsius. Put the labeled bags in the drying oven.

   b) Air Drying: Select a dry secluded area large enough for all of your sample bags. Open the tops of the paper bags for maximum airflow.

2. Use a balance to mass (g) each bag once a day after day 1 if using oven, and once a day after day 5 if air drying. When the mass is the same two days in a row, the samples are completely dry. Design your own data sheet to keep track.

3. Record the mass of each bag and its contents on the *Herbaceous Biomass Data Sheet*, following the sample below.

4. Shake out the contents of each bag and weigh the empty bag. Record the mass, being careful to keep the bags containing the same samples grouped together (i.e. Sample #1, Bag 1 of 2 and Bag 2 of 2). Repeat this step for each bag and sample.

5. Use the *Herbaceous Biomass Data Sheet* and provided equations to calculate the site's average herbaceous biomass (g/m^2) and carbon stock (gC/m^2).

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

Herbaceous Biomass Measurements (SAMPLE DATA TABLE)

Sample Number	Mass of Sample and Bag (g)	Mass of Empty Bag (g)	Herbaceous Biomass (g/m^2)
Field, Herb #1	Bag 1 of 2 1000g	200g	800g
Field, Herb #1	Bag 2 of 2 300g	198g	102g
Field, Herb #1			902g
Field, Herb #2	Bag 1 of 1 1100g	201g	899g
Field, Herb #3	Bag 1 of 1 1064g	200g	864g

GLOBE Carbon Cycle - Herbacous Biomass Data Sheet			
School:			Date:
Site Name:			
Recorded By:			
Herbaceous Biomass = Mass of Sample and Bag – Mass of Empty Bag			
Herbaceous Biomass Measurements			
Sample Number	Mass of Sample and Bag (g)	Mass of Empty Bag (g)	Herbaceous Biomass (g/m^2)
Herbaceous Biomass g/m^2 (sum of herbaceous biomass samples)			
Average Herbaceous Biomass g/m^2 (sum of samples/3)			
Herbaceous Carbon Stock g C/m^2 (herbaceous biomass * 0.50)			