Shrub and Sapling Protocol Non-Standard

Purpose

Use diagonal transects to collect a sub-sample of shrub/sapling data, height and # of hits (to estimate % cover) in order to calculate biomass and carbon stock using allometric equations.

Overview

After completion of the Carbon Cycle Site Set-Up students will use scientific field methods to measure the height and percent cover of shrubs and saplings. **This can be done at the same time as the tree and herbaceous 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

- How are height and percent cover used to calculate carbon storage of shrubs and saplings?

Science Concepts

Grades 9-12

Scientific Inquiry

- Design and conduct a scientific investigation
- Use appropriate tools and techniques to gather, analyze, and interpret data
- Use mathematics in all aspects of scientific inquiry

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 (dependent on shrub abundance, travel time not included)

Should be completed every year

Level

Secondary (Middle & High School)

Materials and Tools

- Compass (1)
- 2-3 m stick marked by centimeter (1)
- Clinometer (optional see "*Biosphere Investigation Instruments- Clinometer*" for construction and use)
- Pencil (1)
- *Shrub/Sapling Data Sheet*

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 shrub group to complete measurements while other students take tree and/or herbaceous measurements. Or create four groups, one for each quadrant transect – in this case you will need 4 of each tool or will need to complete the transects at times that do not overlap]
- Review and make copies of the *Shrub/Sapling Measurements – Student Field Guide and Shrub/Sapling 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 *Standard Shrub/Sapling Measurements - Student Field Guide* and *Shrub/Sapling Data Sheet* and ask questions.

SHRUB/SAPLING 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 herbaceous 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.*

CALCULATE VARIABLES (optional) **Grouping:** Small Groups **Time:** 20 Minutes

- The GLOBE Data Entry form will perform all necessary calculations. However, if you would like your students to get more practice using equations and making calculations, have them calculate deciduous %cover, evergreen %cover, deciduous average height, and evergreen average height (the variables needed for the allometric equations) using the equations on the *Shrub/Sapling Calculations Sheet* at the end of this Teacher Guide.

Resources

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

Shrub/Sapling Measurements - Non-Standard - Student Field Guide

Shrub/Sapling Team - 2-3 people

Task

Collect data on the height and crown area (to estimate % cover) of all shrubs/sapling in the sample site in order to calculate biomass and carbon stock using allometric equations.

Definitions

- *Shrub* = a woody plant with multiple stems
- *Sapling* = a tree < 15 cm CBH

Materials

- ❑ 2-3 m stick marked by centimeter
- ❑ Clinometer (optional)
- ❑ Pencil
- ❑ Calculator (optional)
- ❑ *Shrub/Sapling Data Sheet*

Procedure

1. Start at one edge of the non-standard sample site, methodically measure each shrub on the entire site, and enter data in the Non-Standard Shrub/Sapling Data Sheet below.
2. Approach the first shrub or sapling and record whether it is deciduous or evergreen in the first column of the data sheet.
3. Then use a meter stick or measuring tape to measure the length in meters of the longest side of the shrub/sapling crown. Record.
4. Repeat this method for the length of the shortest side of the shrub/sapling crown. Record.
5. For each shrub or sapling use the measuring stick to measure the **height** if it is less than 2-3m tall. Otherwise estimate the height or use a clinometer. *Note this should be a representative height of the whole shrub, so do not simply measure the highest branch.
6. Repeat steps 2-5 for all shrubs and saplings on your sample site.
7. If your teacher directs you to, use the *Shrub/Sapling Calculations Sheet and* enter your data on the GLOBE website. The number of hits of deciduous and evergreen shrubs will be converted to percent cover. Percent cover and average shrub height will be used in allometric equations to determine biomass and carbon stock of shrubs/saplings on your sample site.

What do I do if…

…the shrub or sapling is taller than the height of the meter stick?

Option 1. Set the meter stick next to the shrub as a reference, and estimate the height.

Option 2. Use a clinometer following the instructions given to you by your teacher.

GLOBE Carbon Cycle - Non-Standard Shrub/Sapling Data Sheet

School: Date:

Site Name:

Recorded By:

Sample #	Type (E = evergreen, D= deciduous)	Length of Longest Side (m)	Length of Shortest Side (m)	Estimated Representative Height (m)	Notes
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
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28					

Shrub/Sapling Calculations

Use the data from the *Shrub/Sapling Data Sheet* in the equations below:

1. Calculate the variables needed for the equations:

Total number of observations = _____

Total number 'D' hits = _____

Total number 'E' hits = _____

Sum of the Estimated Representative Heights of 'D' hits only = _____

Sum of the Estimated Representative Heights of 'E' hits only = _____

2. Use the variables above in the equations below:

$$\text{Deciduous \% cover} = \frac{\text{Total number 'D' hits}}{\text{Total number observations}} \times 100$$

$$\text{Deciduous average height (m)} = \frac{\text{Sum of heights of 'D' hits}}{\text{Total number 'D' hits}}$$

$$\text{Evergreen \% cover} = \frac{\text{Total number 'E' hits}}{\text{Total number observations}} \times 100$$

$$\text{Evergreen average height (m)} = \frac{\text{Sum of heights of 'E' hits}}{\text{Total number 'E' hits}}$$