

Lesson Plan: Carbon Sequestration in Trees

<Header Image: <https://elements.envato.com/look-up-along-the-big-tree-trunk-MGCW9Gg> >

Overview

As a **high school** or introductory **undergraduate** Ecology or **Biological Sciences** or **Environmental Sciences** or **Earth Sciences** teacher, you can use this lesson plan to explain carbon content of trees, **carbon sequestration**, and their direct and indirect impact on **climate mitigation and adaptation**.

In this lesson plan, students will be introduced to the various methodologies used to calculate **tree carbon density (TCD)**, **biomass density**, **growing-stock volume density (GSVD)**, **diameter at breast height (DBH)**, and **tree height**. The students will also learn indirect approaches to estimate biomass sampling using **allometry** and **trigonometry**.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in the Biological Sciences or Environmental Sciences or Earth Sciences.

Learning Outcomes

The tools in this lesson plan will enable students to:

- Learn to measure and determine a tree's diameter and height.
- Learn to calculate a tree's biomass and a tree's carbon content.
- Learn about **Biomass Expansion Factor (BEF)**, Above ground Biomass density (AGBD), and Below-ground Biomass density (BGBD)

Discuss carbon sequestration in trees and sequestration as a climate mitigation and adaptation strategy

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Want to know more about how to contribute? Contact us.

About

Grade Level	High School, Undergraduate
Discipline	Environmental Sciences, Biological Sciences, Earth Sciences, Chemistry
Topic(s) in Discipline	Carbon Sequestration, Carbon Cycle, Biogeochemical Cycles, Ecology, Botany, Biosphere, Biomass expansion
Climate Topic	Climate and the Biosphere
Location	Global, Asia, India

Access	Online
Language(s)	English
Approximate Time Required	120-180 min
Mapped Sustainable Development Goal(s), apart from 4 and 13	15: Life on Land

Step-by-step User Guide

Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

1	<p>Introduce the topic through a reading</p> <p>Reading (10 mins)</p>	<p>This introductory reading titled, “carbon sequestration” by Selin, N. Eckley (2023), Encyclopedia Britannica. From the reading, emphasize what is carbon sequestration to your students as the long-term carbon storage in plants, soils, geologic formations, and the ocean. Draw your students’ attention to the possibility of changes in the rate of carbon sequestration linked to the changes in land use and forestry.</p> <p>This can be accessed here.</p>
2	<p>Assess the net change in carbon stock in trees</p> <p>Classroom/Laboratory Activity (20 mins)</p>	<p>Use the reading titled, “Assessment of Tree Carbon Stocks of Forests: A Case Study of the Sarwari Khad Watershed, Western Himalaya, India” by Ghoshal, S. and Samant, S. S. (2015), Society for Environment and Development, to conduct a classroom/laboratory activity on how to assess the carbon stock of forests. In this case study of the Western Himalaya, India, the authors calculate biomass change through the use of the following methodology:</p> <p>Calculate Above Ground Biomass Density (AGBD) with the following equation</p> $\text{AGBD (t/ha)} = \text{GSVD (m}^3\text{/ha)} * \text{Biomass Extension Factor (BEF) (t/m)}$ $\text{Growing stock Volume density (GSVD)} = \text{BEF} * \text{B} * \text{H}$ <p>BEF of Indian Himalayan Species = 0.42</p> $\text{BGBD} = \exp \{-1.059 + 0.884 \times \ln(\text{AGBD}) + 0.284\}$ <p>Add the values of AGBD and BGBD to get the total biomass density (TBD). Calculate the total tree carbon density (TCD) using the following formula:</p> $\text{TCD (Mg ha}^{-1}\text{)} = \text{B (Mg ha}^{-1}\text{)} \times \text{Carbon fraction}$ <p>Where, Carbon fraction = Carbon percentage/100</p> <p>Compare your results with the data of the past year and more. The net change in the carbon stock is assessed as carbon sequestration in the tree.</p>

		This can be accessed here .
3	<p>Field Activity (Optional)</p> <p>Classroom/Laboratory Activity (Measure tree diameter and height) (30-40 min)</p>	<p>Use the video titled, “Trunk Diameter: Learn To Measure” where Ellyn Shea of Urban Forest Map describes how to measure the trunk diameter of any tree. In this video she describes methods to measure the diameter of trees with single or multiple trunks and trees with vines around the trunk. The video also describes Diameter at Breast Height (DBH) and Circumference at Breast Height (CBH).</p> <p>This can be accessed here.</p> <p>Use the video titled “How to measure the height of a tree” by Arthur Temple College of Forestry and Agriculture where Dr. Dean Coble and Jason Grogan describe how to measure the height of a tree using a yardstick. It uses trigonometry to measure the height of any tall object, like a tree.</p> <p>This can be accessed here.</p> <p>Activity:</p> <p>After watching the reference videos, plan your field trip with your students and select a minimum of 10 tree species for your study. Measure CBH and Height as per instruction in the video.</p> <p>Then, calculate Basal Area (B) occupied from DBH, above-ground biomass density (AGBD), below-ground biomass density (BGBD), and total tree carbon density (TCD).</p> <p>Compare the data of the previous year with that of the current year. The net change in the carbon stock will show carbon sequestration in the tree.</p> <p>Further calculate your Biomass Expansion Factor (BEF) by measuring carbon density in small tree bole.</p>

Questions

Use this Lesson Plan to help the students to understand and find answers to:

1. Explain the role of trees in Carbon Sequestration.
2. How to measure Diameter at Breast Height (DBH)?
3. How to measure tree height from a distance?
4. Discuss how to calculate a tree's Biomass Expansion Factor (BEF) and its carbon content.

Additional Resources

(Optional)

Credits

1.	Reading “carbon sequestration”	by Selin, N. Eckley (2019), Encyclopedia Britannica .
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2.	Reading “Assessment of Tree Carbon Stocks of Forests: A Case Study of the Sarwari Khad Watershed, Western Himalaya, India”	by Ghoshal, S. and Samant, S. S. (2015), Society for Environment and Development .
3.	Video “Trunk Diameter: Learn to measure”	by Kiran Goldman, Vimeo .
4.	Video “How to measure the height of a tree”	by Arthur Temple College of Forestry and Agriculture .