

**TEACHING KATE
TEACHING KIDS ABOUT THE ENVIRONMENT**

HARVESTING TREES AS A CROP

Grade Level: 6

Time Required: 90 minutes

SC Science Standards

This lesson plan was correlated with only the grade level specified unless otherwise noted.

- I. A. 1. a. 2
- I. A. 1. b. 2
- I. A. 1. c. 1
- I. A. 1. d. 1
- I. A. 3. a.
- I. A. 7. c.
- I. A. 8. a.
- II. C. 1. d, e, f
- II. C. 3. b.

Purpose

Students will learn how foresters manage and maintain the forest as a continually producing crop. Students will determine approximate board feet in a log of wood.

Skills

Adding, estimating, interpreting data, measuring, multiplying, predicting, reasoning, recording data, subtracting.

Concepts

Forests have a profound impact on our daily lives. They are essential to the economic well-being and quality of life anywhere on this earth. The demand for hardwood and softwood has increased significantly and is expected to remain strong. Financially, there is a lucrative future in harvesting trees. Forest management is the manipulation of natural processes. Any science or management field requires precise measurements to obtain information for discovery and management.

Materials Needed

Biltmore Stick	chain (66 ft. length)
board feet chart	pencil/paper
measuring tape	clinometer
string	clinometer conversion chart

Definition of Terms

<u>Angle</u>	The figure formed by the divergence of two straight lines from a common point or of two or more planes from a common straight line.
<u>Approximate</u>	To come close to, as in quality, degree, or quantity.
<u>Biltmore Stick</u>	A pre-marked stick used together with a conversion chart to determine board feet in a log.
<u>Board Feet</u>	A board foot is 12" x 12" x 1" or 144 cubic inches of wood.
<u>Calculate</u>	To arrive at an answer by using arithmetical means.
<u>Circumference</u>	The distance around a circle.
<u>Clinometer</u>	An instrument used to determine angular inclination.
<u>Diameter</u>	The length of a line drawn from one point on a circle through the center to another point on the circle.
<u>Extrapolate</u>	The reading of values beyond known points.
<u>Forester</u>	A person who studies plant communities in which trees are the dominant vegetation.
<u>Interpolate</u>	The reading of values between known points.
<u>Pi</u>	A mathematical constant and is the value 3.14.
<u>Reforestation</u>	The regeneration of new trees on an area where the forest has been or will be removed; either naturally by seed fall from surrounding trees, root or stump sprouts, or artificially by planting or aerial seeding.

<u>Survey</u>	To determine accurately the area, contour or boundaries of land by measuring lines and angles according to the principles of geometry and trigonometry.
<u>Tangent</u>	The trigonometric function of an acute angle in a right triangle that is the ratio of the side opposite the angle to the length of the side adjacent to the angle.
<u>Trigonometry</u>	The branch of mathematics that deals with the relations of the sides and angles of triangles.
<u>Tree</u>	A woody plant having a well defined single stem and capable of growing more than 20 feet tall when mature.

Before the Session

Select at least six trees, located in “Outdoor Laboratory,” similar in diameter for students to work with in computing board feet. Also, mark these trees with lettered cards (A, B, C, D, etc.). Be careful to select trees that are located in an open area so that students will not have any problems in marking off a distance of 66 feet or measuring height with a homemade clinometer. Prepare materials needed for five groups of students and place in small storage boxes.

Background Information

About 100 years ago, the forest was exploited as an inexhaustible resource. Today, the forest industry plans for the future. Modern forestry includes extensive reforestation projects, research on tree diseases and creative land use strategies.

In order to ensure a continuing crop of trees for future generations, new logging practices have been adopted. In some areas, selective cutting is the harvest strategy of choice. In other areas, however, clear cutting is practiced in order to improve survival rates of seedlings by reducing competition (for space, sun, water and nutrients) from more mature trees.

It is also important to determine the expected yield of a stand of trees. To do this, forest professionals called timber cruisers are employed to survey, mark and calculate the number of board feet in a given location or in a specific tree. This lesson plan is one way timber cruisers determine the board feet in a tree.

In this lesson plan a Biltmore Stick is used along with a conversion chart to determine the approximate board feet in a log or tree. The Biltmore Stick is pre-marked for determination of the number of 16 foot logs in a tree (height) while standing at a distance of either 1 chain (66 feet) or 1.5 chains (99 feet), depending on the stick’s calibration, away from the tree. At the distance indicated by the Biltmore Stick’s scale, the stick is held vertically at shoulder height with arm

extended approximately 25 inches. The sticks are calibrated for merchantable timber, therefore, the forester then sights to the point where he/she estimates the diameter to be 8 inches (merchantable height) and notes the measurement that coincides with the sighting.

After the number of 16 foot logs has been determined, the diameter of the tree is needed. This may be obtained by using a DBH (diameter at breast height) tape or by measuring the circumference at breast height (approximately 4.5 feet above the ground) and solving for diameter. Example: Circumference (C) = 141 inches, Diameter = D.

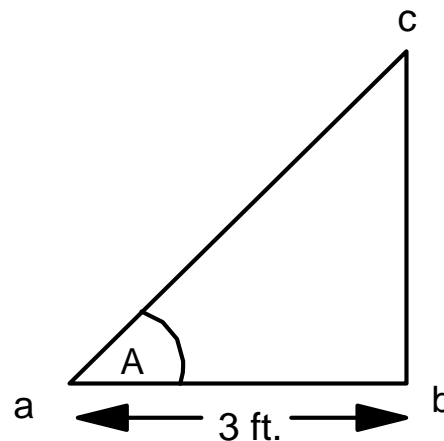
$$D = C \div \pi \qquad \pi = 3.14 \qquad 141 \div 3.14 = 44.9 \text{ or } (45 \text{ inches})$$

Another way is to use the Biltmore Stick. To determine DBH it should be held horizontally at a height of 4.5 feet with arm extended approximately 25 inches from body. The diameter is then read directly off the Biltmore Stick, following the directions thereon. Using the height and diameter measurements use the board feet conversion chart to determine the approximate number of board feet in the measured tree.

The Biltmore Stick is based upon simple trigonometric functions. This principle is also used when heights are measured using a clinometer or the old Indian method. Briefly explained, if you know the distance ab and the angle A you can determine the length of side bc (or X).

*Tangent is determined from a tangent chart.

Formula: $ab \times \text{Tangent } A = X$



Example: If $ab = 36$ feet

$$A = 35^\circ$$

$$*\text{Tan } A = 0.7002$$

$$36 \text{ feet} \times 0.7002 = X$$

$$X = 25.2072 \text{ feet} \quad *\text{The height is approximately 25 feet.}$$

Suggested Lesson Plan

1. After a brief background introduction, divide the class into groups of five and designate one of the pre-marked trees for each group to work with in computing the board feet.
2. Pass out a storage box containing the equipment needed for each group to complete their activity.
3. Pass out directions for students to follow as they work on their assignment.
 - a. Students measure the diameter of their assigned tree. (See procedure in Background Information.)
 - b. Using chain, students mark a distance of one chain (66 feet) from their tree.
 - c. Students hold the Biltmore stick vertically at shoulder height and extended 25 inches away from one eye.
 - d. Sight the tree, along the stick, to where the diameter is estimated to be 8 inches (merchantable height). Students should note the measurement for height, where their eye sight passes through the stick, and record.
 - e. Using the diameter and the Biltmore height, students calculate the number of board feet in a tree. (See explanation and example in Background Information.)

Application

Students may want to pursue research in the area of forest productivity. Research in tree physiology, nutrition, vegetation control, environmental impacts and management techniques will prove valuable to our knowledge and proficiency in producing quality crops in less time than it took in the past. Biometrics, the application of mathematics and statistics to the study of biology, will be a guiding tool in helping tree farmers be more selective in planting and cultivating crops of trees on a consistent basis. Organizations such as Westvaco Forest Research Corporation are committed to helping develop trees for superior fiber production and increased fiber yield. By adopting good tree management practices, landowners can increase tree size and quality and thereby, increase their timber profits.

Extension

Once the amount of board feet is calculated, students may wish to extrapolate this information into how many houses could be built out of one tree or how many trees it would take to build a house.

Note: A 2000 square foot home framed would contain approximately 20,000 board feet of lumber (including all wood products-boards, plywood, etc). Including kitchen cabinets would add approximately 3000 board feet to the estimate.

Resources Available

Boller, L. J., Sr. 1995. Clemson University, Department of Forest Resources, Clemson, S.C. 29634.

Kessler, G. 1995. Clemson University, Department of Forest Resources, Clemson, S.C. 29634.

Project Learning Tree. 1993. American Forest Foundation, 1111 19th St. NW, Washington, D.C.

Shealy, H. 1995. University of South Carolina- Aiken, Department of Biology/Geology, Aiken, S.C.

South Carolina Forestry Commission. Columbia, S. C.

Teaching KATE. 1995. Coalition for Natural Resource Education.

Trees as a Crop, AIMS Activities. 1987. Aims Education Foundation.

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HARVESTING TREES AS A CROP

WORKSHEET

Name: _____

HOW MANY BOARD FEET ARE IN A TREE

- I. At breast height (4.5 feet), measure the circumference of a tree in inches.

$$\frac{\text{_____ in.}}{\text{(Circumference)}} \div 3.14 (\pi) = \frac{\text{_____ in.}}{\text{(Diameter)}}$$

- II. Measure one chain (66 feet) from the base of the tree. Extend you arm straight at shoulder height holding the Biltmore Stick 25 inches from one eye. Sight the area on the tree where you estimate the diameter is 8 inches (merchantable height). Record the number of logs closest to your line of sight. The number is equal to the number of 16 foot logs the tree has.

of 16 ft. logs = _____

- III. Use the Biltmore Chart to find board feet in the tree. Show calculations.

Biltmore Board Feet Conversion Chart

Diameter in Inches	Number of 16 Foot Logs					
	3	4	5	6	7	8
16"	190	230	300			
18"	230	330	430			
20"	270	390	510	660		
22"	320	450	640	800	940	1080
24"	370	530	750	920	1100	1280
26"	420	630	870	1100	1310	1510
28"	500	750	1020	1240	1550	1810
30"	610	900	1210	1210	1840	2150

Number of Board Feet in Tree. _____

HARVESTING TREES AS A CROP

WORKSHEET - CONTINUED

Name: _____

Use this space for calculations of Number of Board Feet in Tree.

How Many Trees to Build a House?

- I. It requires 20,000 board feet to build a 2000 square foot house including framing, plywood and other wood products. An additional 3000 board feet is needed for kitchen cabinets. Calculate how many trees are needed to frame and build a 2000 square foot house. Show calculations.

House Structure + Cabinets = Total Board Feet Needed

_____ + _____ = _____

Total Trees Needed = $\frac{\text{Total Board Feet Needed}}{\text{Total Board Feet in Tree}}$

Total Trees Needed = _____

Use this space to show calculations for Total Trees Needed.