FOREST INVENTORY

OSU EXTENSION
4-H YOUTH DEVELOPMENT

Objectives

- Learn to measure standing trees to estimate volume of forest products
- Learn to use a Biltmore Stick
- Learn to use Doyle Log Rule

Materials:

- **Identification key for trees**
- **Biltmore Stick or a Tree and log scale stick.**
- **Pencil**

Life Skill:

- **Keeping Records**
- **Critical Thinking**
- **Problem Solving**
- **Decision Making**
- **Learning to Learn**

Background

A wise timberland owner or manager keeps an accurate inventory of their timber resources. They know approximately how many board feet (a piece of lumber that is 1 foot wide, 1 foot long and 1 inch thick) of lumber can be cut from trees of various sizes and from the stand as a whole. Better management decisions can be made when there is good information available on the volume per acre, total volume, and volume of the various products which might be harvested.

The **species** of each numbered tree should be listed using the common names.

The **DBH** (diameter at breast height) should be measured (at 4 1/2 ft. above ground level) and recorded in **2 inch** diameter classes.

The **number of 16' logs** or height should be measured to the nearest half-log and recorded.

The **volume** in board feet of each tree should be determined, from the DBH and number of logs information, and using the Doyle Log Rule (Form Class 78) table provided.

Crown Class refers to the tree's position within the total canopy of the forest stand. The crown class of each tree should be determined and recorded.

Crown Class

Dominant: trees have crowns that extend above the average of the surrounding tree crowns. They receive light from directly above and some from the sides.

Co-Dominant: trees have crowns that form the general level of the canopy. They receive sunlight from the top, but very little from the sides.

Intermediate: trees are shorter than the preceding crown classes, but have some branches that extend into the general crown cover. They receive little light from above and none from the sides.

Suppressed: trees have their crown entirely below the general crown level and receive no direct sunlight from above or below.

The following **tree measurement** information should be studied carefully. It is included here to aid in preparation for the tree measurements and volume determination segments of this activity

Tree Measurement

Participants will learn to measure standing trees in order to estimate the volume of forest products that may be obtained from the trees. They will identify five trees and estimate their diameters, merchantable heights, and volumes. Since most timber is bought and sold on a volume basis (usually by board foot volume), it is a good idea to have some estimate of total tree volume, volume per acre and volume by product before selling timber.

Products

Any type of forest product can be measured accurately, but the same unit of measure does not apply equally well to all products. For this activity, only board foot measurements will be used.

Tools

There are a number of different tools which can be used to make tree measurements including a caliper, diameter tape, hypsometer, or clinometer. Some are more accurate, thus more expensive, than others.

For this activity a very inexpensive tool will be used to estimate both height and DBH measurements. This instrument is called a **tree scale stick** and should be calibrated with the **Doyle Log Rule**.

Diameter

The trunk of a tree is shaped somewhat like a cylinder so it is possible to estimate the volume by measuring both the diameter and the height. The **diameter** is **always** measured at 4.5 feet above the ground on the uphill side of the tree. This measurement is universally referred to as DBH or 'diameter at breast-height.'

In order to measure the diameter of a tree, use the side of the scale stick (*a.k.a.:* Biltmore Stick) which reads "Diameter of Tree (in inches)". The tree scale stick must be held level, against the tree, at a distance of 25 inches from the eye and at a height of 4.5 feet above the ground (see **Figure 1**).

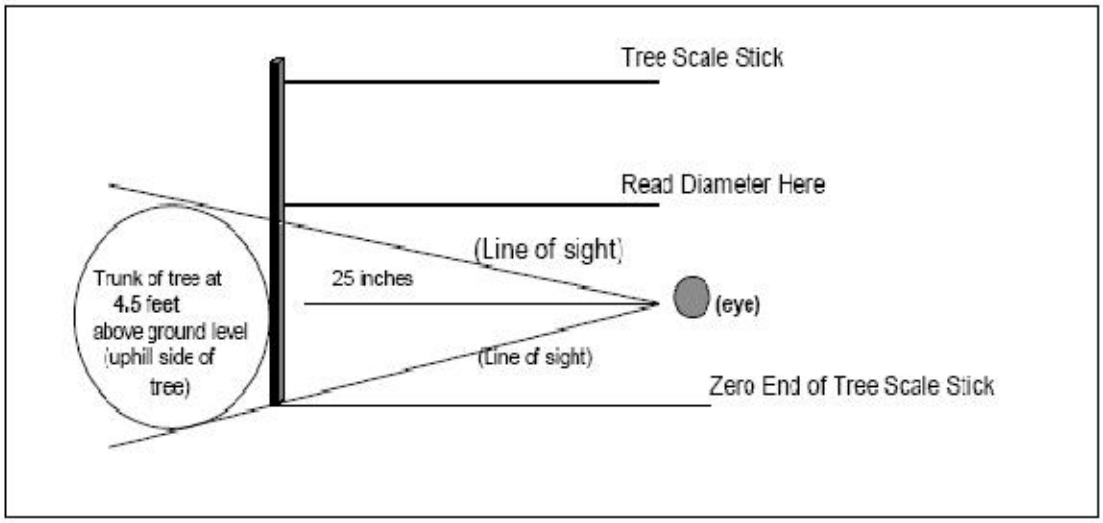
With the stick held level and flat against the tree, the following steps should be followed.

- Close one eye while looking straight ahead at the center of the tree
- Roll eye to the left, keeping head still, and move the stick so that the "zero" end of the stick and outside bark of the tree line up
- Roll eye to the right, without moving the head, and read the number which lines up with the right side of the tree trunk. This is the diameter.
- **Record diameter to the nearest two inch diameter class.**

2" class = 1.1 - 3.0"
4" class = 3.1 - 5.0"
6" class = 5.1 - 7.0"
8" class = 7.1 - 9.0"
10" class = 9.1 - 11.0"
12" class = 11.1 - 13.0"

Any deviations in the above distances will result in inaccurate readings. Only considerable practice will prepare you in obtaining accurate measurements.

Figure 1: Measuring Diameter



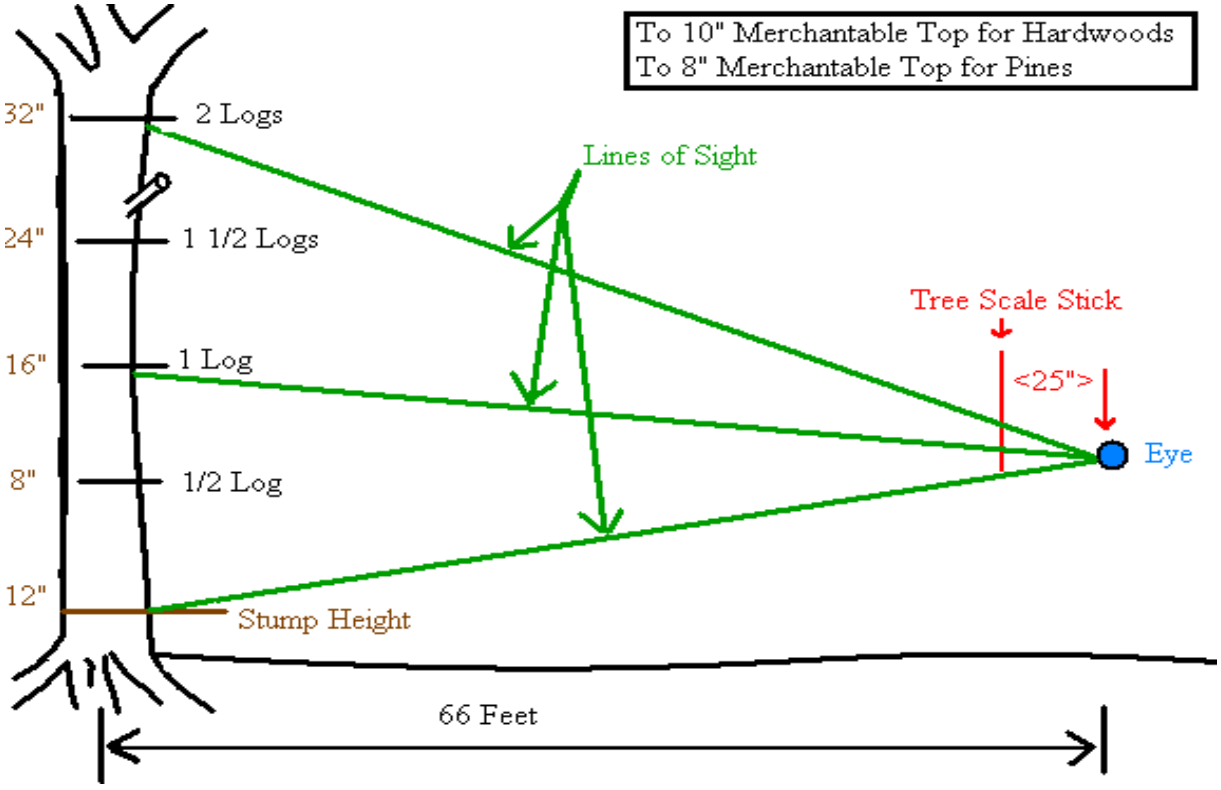
Height may be measured as either **total height** (from ground line to tree top) or as **merchantable height** (the length of the trunk that can produce the commercial product for which the tree may be harvested).

Merchantable height will be the measurement used for this activity. Therefore, the top diameter (upper limit of height measurement) will be 8" for pine (softwood) trees and 10" for hardwood trees (deciduous).

To measure the merchantable height of a tree, the participant should measure or pace 66 feet out from the base of the tree to a point where the entire tree can be seen. It is a good idea to stay on the same contour as the tree rather than up or down hill from it. Being uphill or downhill

from the tree may result in unreliable readings. Next, the participant should hold the tree scale stick so that the edge reading **NUMBER OF 16 FOOT LOGS** is facing him/her. This instrument on the edge of the tree scale stick is called a Merritt Hypsometer. Hold the stick in a vertical position with the **zero end** pointing toward the ground and look straight forward at the tree. Adjust the stick upward or downward so that the line of sight bisects the bottom of the stick at a point 12 inches above the ground or **stump height**. **DO NOT MOVE YOUR HEAD OR STICK, MOVE THE EYES ONLY!!**

The individual should then look up the stick to a point where the top of the last merchantable cut would be made in the tree. This would be the point at which the **diameter** of the trunk tapers to 8 inches for pine and 10 inches for hardwoods, or where the first major fork or other major defect in the tree occurs. The measurement should be read to the **nearest ½ log**. If the merchantable height is slightly more than 2 ½ logs, record it as 2 ½ logs. However, if the merchantable height is slightly less than 2 ½ logs, the reading must be recorded as 2 logs.



Volumes

A volume table is a table which estimates, on the average, the volume of wood contained in trees of various sizes. This volume is determined by applying the measured DBH (diameter at breast height) and the merchantable height to the table. A sample Volume Table is shown below.

For example, to find the average volume of a tree that had been measured to be 16" DBH with a merchantable height of 1 ½ logs, simply follow the column headed **"DBH in Inches"** to 16. Next, under the columns marked **"Volume (in board feet) by Number of Merchantable 16 foot Logs"**, find the column marked **1 ½logs**.

The point where 16 inches in diameter and 1 ½ logs bisect is the reading to be recorded in the **Volume (bd. feet)** area on the scorecard. In this instance, the correct volume is **94 board feet.**

Tree #	Tree Species	DBH	# of 16 Foot Logs	Volume in Board Feet	Tree Crown Class

Volume Table

Doyle Log Rule (Form Class 78)

Volume (in board feet) by Number of Merchantable 16-foot Logs

DBH (in)	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5
10	14	17	20	21	22				
12	29	36	43	48	53	54	56		
14	48	62	75	84	93	98	103		
16	72	94	116	132	149	160	170		
18	100	132	164	190	215	232	248		
20	135	180	225	261	297	322	346	364	383
22	174	234	295	344	392	427	462	492	521
24	216	293	370	433	496	539	582	625	668
26	266	362	459	539	619	678	737	793	849
28	317	434	551	650	750	820	890	961	1032
30	376	517	658	778	898	984	1069	1160	1251

Instructors Guidelines
For
Forest Inventory Activity

For this activity

1. Identify five (5) trees.
2. Determine their Diameter at Breast Height (DBH).
3. Determine the number of 16 foot logs/tree.
4. Using Doyle Log Rule, determine the volume (in board feet) of the logs for each tree.
5. Identify crown class for each tree.
6. Record all of the above information on the form below.

Tree #	Tree Species	DBH	# of 16 Foot Logs	Volume in Board Feet	Tree Crown Class

Volume Table

Doyle Log Rule (Form Class 78)

Volume (in board feet) by Number of Merchantable 16-foot Logs

DBH (in)	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5
10	14	17	20	21	22				
12	29	36	43	48	53	54	56		
14	48	62	75	84	93	98	103		
16	72	94	116	132	149	160	170		
18	100	132	164	190	215	232	248		
20	135	180	225	261	297	322	346	364	383
22	174	234	295	344	392	427	462	492	521
24	216	293	370	433	496	539	582	625	668
26	266	362	459	539	619	678	737	793	849
28	317	434	551	650	750	820	890	961	1032
30	376	517	658	778	898	984	1069	1160	1251

Activity Sheet

For this activity

1. Identify five (5) trees.
2. Determine their Diameter at Breast Height (DBH).
3. Determine the number of 16 foot logs/tree.
4. Using Doyle Log Rule, determine the volume (in board feet) of the logs for each tree.
5. Identify crown class for each tree.

Tree #	Tree Species	DBH	# of 16 Foot Logs	Volume in Board Feet	Tree Crown Class

Volume Table

Doyle Log Rule (Form Class 78)

Volume (in board feet) by Number of Merchantable 16-foot Logs

DBH (in)	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5
10	14	17	20	21	22				
12	29	36	43	48	53	54	56		
14	48	62	75	84	93	98	103		
16	72	94	116	132	149	160	170		
18	100	132	164	190	215	232	248		
20	135	180	225	261	297	322	346	364	383
22	174	234	295	344	392	427	462	492	521
24	216	293	370	433	496	539	582	625	668
26	266	362	459	539	619	678	737	793	849
28	317	434	551	650	750	820	890	961	1032
30	376	517	658	778	898	984	1069	1160	1251

Contributing Authors

Kevin Allen, Ph.D.
State Extension Specialist — 4-H Environmental and Natural Resources
Department of Natural Resource Ecology and Management

Craig McKinley, Ph.D.
State Extension Specialist — Forestry
Department of Natural Resource Ecology and Management

Suggested Oklahoma Guides

A recommended study guide for Tree Identification is the 2002 revision of: ***Forest Trees of Oklahoma*** by Elbert L. Little, Jr.

Tree Scale Sticks

Tree scale sticks may be purchased from the following companies:

Forestry Suppliers, Inc., P.O. Box 8397, Jackson, MS 39204 (18006475368)
Ben Meadows Co., P.O. Box 80549, Atlanta, GA 30366 (18002416401)

Additional Resources

Oklahoma 4-H at http://oklahoma4h.okstate.edu/index.htm

Oklahoma 4-H Forestry Judging website at http://nrem.okstate.edu/Extension/judging.html
Oklahoma 4-H Forestry Judging Manual. 2007 revision.
4-H Forestry Program—Unit A: Trees
4-H Forestry program—Unit B: Forests

Oklahoma Forestry and Wildlife Camp website at http://whatisforestry.org/youth-camp.php

Oklahoma Cooperative Extension Forestry at http://nrem.okstate.edu/Extension/pubs.html

On-line Tree Identification Sites

http://www.arborday.org/trees/treeID.cfm
http://www.dnr.state.wi.us/org/caer/ce/eek/veg/treekey/index.htm
http://www.uwsp.edu/cnr/leaf/Treekey/tkframe.htm
http://www.extension.iastate.edu/Pages/tree/key.html
http://www.cnr.vt.edu/DENDRO/DENDROLOGY/idit.htm
http://forestry.about.com/library/treekey/bltree_key_id_start.htm
http://www.cas.vanderbilt.edu/bioimages/tree-key/simple-leaf-trees.htm
http://forestry.msu.edu/extension/extdocs/Identkey/opening.htm
http://oregonstate.edu/trees/dk/start.html

References Cited

Oklahoma 4-H Forestry Judging Manual. 2007 revision.