

Optional Laboratory: Measuring Tree Heights

Introduction

Foresters use tree height for many things. Tree height can give a clue as to how old a tree is. It can also reflect the quality or fertility of the site. The height of a tree can indicate a tree's dominance within the forest canopy, and is used in a very important calculation of lumber per tree.

Question

1. How is the Pythagorean theorem used to determine tree heights?

Hypothesis

Students should make their own before continuing.

Materials

Clinometer
100 foot tape
Pencil and paper

Procedure

1. Draw a large tree on your paper. Draw a person to the same relative scale as the tree. Superimpose a right triangle on the tree and person. Relate the equation $A^2 + B^2 = C^2$ to your drawing. A clinometer is based upon this equation.
2. One student should stand with the end of a 100 foot tape at the midsection of a tree to be measured. The other student should walk away from the tree on level ground, extending the tape. Mark the point 100 feet away.
3. Taking turns, students should look through the clinometer eyepiece towards the tree top and read the tree height on the right hand side of the clinometer. Record the measurement in the data table.
4. Practice on other trees.

TREE HEIGHT DATA TABLE

Tree No.	Species	Height (ft)	Crown Class	Site Observations

Background Information

Tree height is probably one of the two most important characteristics of a tree that a forester would need to know. Tree height gives clues as to how old the tree is; what kind of site the tree is growing on; the crown class of the tree; and is used in calculating the amount of wood in a tree.

Target Group

Sixth through eighth grade.

Timeline

Thirty minutes of classroom, plus 45 minutes - 1 hour field time. The information, procedure and activity should be completed within 45 minutes to an hour. Additional time may be needed for practice.

Student Learning Objectives

Students will be able to:

1. Use a clinometer correctly.
2. Locate the tree apex.
3. Develop a pacing stride for 50 or 100 feet.
4. Measure the tree height.

Materials

100 foot tape

Clinometer

Procedure

Choose a wooded area in which some large tree crowns are meshed into one another, and where there is a fairly distinct slope. Explain that a clinometer works on triangulation based on one of the sides of the triangle being 100 feet. Have a student hold the end of the 100 foot tape at the mid-section of a tree to be measured. Have another student run the tape out to 100 feet and mark the end of the tape. Make sure the second student did not go down slope or up slope from the tree. Make sure that the tree apex is discernible from the 100 foot mark. Have the student look through the clinometer eyepiece toward the tree apex. The student must keep both eyes open. One eye tracks the tree top while the other eye lines up the cross hair within the clinometer with the tree top. The student reads the measurements on the right-hand side of the clinometer. This is the tree height in feet. Groups of three to four students are recommended, so that

measurements can be compared for accuracy.

Crown Classes in Even-Aged Stands

In even-aged forests a simple classification has long been standard in this country. It involves the recognition of five crown classes based on their position in the canopy.

1. Dominant trees. The crowns of dominant trees rise somewhat above the general level of the canopy so that they enjoy full light from above and also laterally.
2. Codominant trees. These are not quite as tall as dominants. Their crowns receive overhead light but they may be hemmed to a certain degree laterally by dominants. They comprise the main canopy of the forest.
3. Intermediate trees. These crowns occupy a definitely subordinate position, but may receive some direct overhead light through holes in the canopy.
4. Suppressed trees (or overtopped). These are definitely submerged members of the forest community having little free overhead light. They exist by virtue of the sunlight that filters through the canopy or the direct light that may be received through some chance break.
5. Dead trees.

From: *Principles of Silviculture*. Baker, F.S., McGraw-Hill Book Co. New York. pgs. 72-73. 1950.

Blowouts

1. Have students pace along a 100 foot section of trail or pavement. Students should count either every other pace, or every pace; whatever they choose, they should be consistent. Have students continue pacing until they become comfortable with a fairly consistent count. This technique of having a 'built-in' pace will permit the student to measure tree heights without having to use a tape measure and still be fairly accurate. This technique also allows a student to measure the tree height alone without the aid of another student.
2. Choose a tree on a slope. Have the student pace out 100 feet across the slope to measure the tree height. Now have the student pace out 100 feet from the same tree either up or down the slope. Have the student read the tree height and compare it to the height when read across the slope. If the student paced out down the slope the reading will be higher and lower if paced up the slope. Reinforce the idea of trying to choose an 'across slope' direction when pacing out from the tree. There are conversion tables available to correct for slope when it is impossible to pace across the slope.
3. Choose a tree on a flat terrain to pace out 100 feet to measure the height. Now have the student go out 50 feet from the tree (use a tape since the student has not developed a 'built-in' 100 foot pace yet) and measure the tree height. Ask the student to compare the two measurements. The 50 foot reading should be approximately twice the 100 foot reading.

Glossary

tree apex: the tallest, uppermost part of the tree crown.

clinometer: a tool used to measure slope percentages and true heights

crown class: a classification system used to determine a trees position within a forest. Examples are **dominant** and **intermediate**.

crown: the portion of the tree which is made up of main branches, intermediate branches, twigs and leaves. The portion of the tree which rests upon the main trunk of the tree.

References

1. *Manual Of Forest Mensuration*. Beers, T. and Miller, C., T & C Enterprises, West Lafayette, Indiana. 1973.
2. *Earths Trees: Environmental Learning Series*. Earthwise. WP Press, Tucson, AZ. 1992.

example data

TREE HEIGHT DATA TABLE

Tree No.	Species	Height (ft)	Crown Class	Site Observations
1	White oak	68	co-dominant	SE facing slope - 10° slope mowed understory
2	Shagbark hickory	53	intermediate	
3	Bur Oak	75	dominant	
4	Basswood	48	intermediate	

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