Measuring Up Tree Size

Activity Overview
Students will identify, measure, and chronicle trees growing on the school grounds.

Objectives
Students will:

- Measure and calculate tree dimensions

- Compile and maintain tree records in a journal

Subjects Covered
Science, Math, and Social Studies

Grades
6 through 12

Activity Time
1 or 2 hours

Season
Any

Materials
Measuring tapes or d.b.h. tapes (Diameter/Logger's Tape), Compasses (optional), surveyors' flags or stakes, calculators, pencils, paper, and clipboards

State Standards
 Math:

Use reasoning abilities (A.4.1, A.8.1, A.12.1)

Communicate mathematical ideas (A.4.2), logical arguments (A.8.2, A.12.2)

Connect mathematical learning with other subjects (A.4.3)

Use vocabulary, symbols, notation (A.4.4)

Explain solutions to problems (A.4.5)

Recognize & describe measurable attributes & units (D.4.1)

Demonstrate understanding of measurement (D.4.2)

Read & interpret measuring instruments (D.4.3)

Background

Ecologists, foresters, and botanists collect and record data about trees to learn about the trees' health, growth patterns, monetary value, their influence on an ecosystem, etc. In this activity, students will use some of the same tools and calculations as these professionals to learn about the trees on their school grounds.

Students also will translate their data into a journal. A schoolyard journal about their trees provides snapshots of the schoolyard, and documents change and is useful for decision making and restoration planning. Over time students may compare, contrast, and analyze growth rates and sizes of the trees.

Measuring Tools and Techniques
A d.b.h. tape (or diameter/logger's tape) is calibrated to measure the circumference and diameter of a tree. D.b.h. stands for "diameter at breast height" and measures the tree at 4 ½ feet above ground level. If a d.b.h. tape is not available, students may measure the circumference with a flexible measuring tape and then calculate the diameter. The conversion formula is D (diameter) = C (circumference) ÷ π (3.14). In this activity, students are asked to record d.b.h. and circumference measurements. Both measurements are useful for scientific analysis and ecological study. For instance, circumference is used in a formula to rate trees by size, and d.b.h. is used to calculate dominance of a particular species.

Tree height is measured with multiple tools and methods. See Earth Partnership for Schools activity, "How Do You Measure Up? Measuring Tree Height" for instructions and choices for measuring tree height.

Canopy and crown spread are measured with measuring tapes and compasses. A tree's canopy extends from the trunk to the tip of the branches, called the drip line. Crown spread is the average spread of the canopy. Students measure the canopy first, then calculate the crown spread.

The size of a tree is ranked with a point system using the sum of circumference, tree height, and crown size. According to the American Forest System, the total point value for a tree is circumference in inches + height in feet + ¼ of crown size in feet = Total Points.

Activity Description

Select a tree on the school grounds to measure and calculate circumference, diameter, canopy, crown spread, and total size. Use the data from the Earth Partnership for Schools activity, "How Do You Measure Up? Measuring Tree Height" and use the following directions to explain how to take further measurements.

Determine measurements by using standard tools (D.4.4)

Determine measurements by using basic relationships or estimations (D.4.5)

Analyze non-routine problems (A.8.3)

Develop effective oral & written presentations (A.8.4)

Explain mathematical concepts, procedures, & ideas (A.8.5)

Identify & describe attributes in situations not directly or easily measurable (D.8.1)

Demonstrate understanding of measurement facts, principles, techniques (D.8.2)

Determine measurement directly by using standard units (D.8.3)

Determine measurement indirectly (D.8.4)

Identify, describe, & use derived attributes (D.12.1)

Science:

Discover how organisms meet their needs (F.4.1)

Investigate how organisms respond to internal/external cues (F.4.2)

Investigate structure & function of organisms (F.8.1)

Show organism's adaptations (F.8.2)

Identify how technology is used in someone's job (G.4.1)

Discover changes in technology over time (G.4.2)

Determine how science discoveries change technology (G.4.3)

Identify uses of machines (G.4.4)

Explore how machines were invented & produced (G.4.5)

Identify skills needed for a career in science or technology (G.8.1)

Explain how discoveries influence careers (G.8.2)

Illustrate impact of science & technology (G.8.3)

Design an applied science model or machine (G.8.4)

Investigate local problem & propose scientific or technological solution (G.8.5)

Directions for measuring circumference/diameter
1. Using a d.b.h. tape, measure the distance around the tree 4½ feet above the ground. Enter the diameter and circumference on the record sheet. If the tree is on a slope, measure from the ground at the mid-point of the tree base. If a branch or growth is on the trunk at the 4 ½ foot level, measure just below and record the measuring height. Measure the largest trunk with multiple-trunk trees.

2. Using a measuring tape, measure the distance around the tree at 4½ feet above the ground. Calculate the diameter by dividing the circumference by pie (3.14). Enter the diameter and circumference on the record sheet.
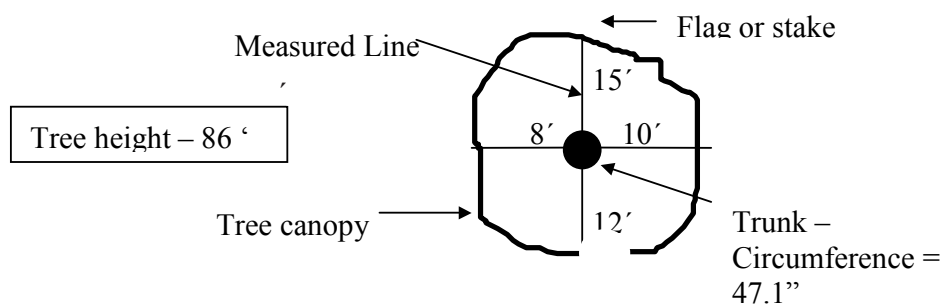
Directions for measuring canopy and crown spread
1. Pace off from the trunk to the edge of the canopy (drip line), and place a surveyor's flag or stake. Repeat three times to form two perpendicular lines. Optional: Use a compass to mark lines running N, S, E, and W.

2. Measure the distance from the trunk to the flag at each line. Enter the measurements and draw a diagram on the record sheet.

3. In the classroom, mark these distances on the base map or vegetation overlay map, and then connect the lines to draw a circle around the tree to indicate the canopy. If the tree is particularly asymmetrical you may need to take extra measurements from the trunk to the drip line.

4. To calculate the average crown spread, add the four numbers together and divide by two.

Directions for calculating tree size
Calculate the relative size of the tree based on the American Forest point system. The point value equals circumference in inches + height in feet + ¼ of crown size in feet.

Diagram looking down at the top of the tree:

Measured Line

Flag or stake

15′

Tree height – 86 '

8′   10′

Tree canopy

12′

Trunk – Circumference = 47.1"

Crown Spread = (8′ + 15′+ 10′+ 12′) ÷ 2 = 17.5′

Tree size = 47.1 + 86 + 4.4 = 137.5

Schoolyard Journal
Record the data in a schoolyard journal.

Extensions

- Construct a d.b.h. tape by relating circumference and diameter.

- Calculate the square area covered by the tree canopy.

  Square area of canopy cover = (15´ + 12´) X (8´ +10´) = 286 sq. ft.

- Rank the trees on the schoolyard from largest to smallest.

- Measure shade effects of vegetation growing under and around the tree. Measure the distance from the tree where the vegetation changes (i.e., the distance from the tree affected by shading). Use the information to answer the following questions:

  Does the effect of shading on vegetation extend beyond the tree canopy? How far beyond?

  Is the shading effect symmetric (extends the same direction in all directions from the tree)?

  Which direction does the shading extend the farthest? Does this correspond to the sun's position during the growing system?

- Make a map of the area surrounding the tree. Go outside at several different times of the day and mark shaded areas with flags. Locate the shade patterns on the map. Determine the area shaded during most of the day and the area shaded half of the day. Use the information for plant species selection.

Additional Resources

- American forests. http://www.americanforests.org/resources/bigtrees/measure.php

- Wisconsin champion trees. http://www.dnr.state.wi.us/org/land/forestry/uf/champion/

- The champion tree project. International - http://www.championtrees.org/champions/index.htm

Assessments

- Develop a rubric to assess use of measuring equipment and accuracy calculating tree size.

- Use hypothetical problems to apply the principles in other similar situations.

- Locate the five largest trees in your state or the world. Compare measuring techniques for uniformity.

Measuring Up Tree Size Field Sheet

Date: _____

Measured by: _____

_____

Common Name: _____

Scientific Name: _____

Location: _____

_____

Description of tree: _____

_____

Physical condition of tree: _____

_____

Circumference in inches: _____

d.b.h. in inches: _____

_____ inches or feet above the ground.

Tree height in feet: _____

Method of measurement: _____

_____

Canopy measurements including a sketch showing location of measuring lines:

Crown spread in feet:

(_____ + _____ + _____ + _____) ÷ 2 = _____ (A)
canopy measurements   average
                                       crown spread

Crown spread for calculating tree size:

.25 x _____ (A)   = _____ (B)
      average   ¼ crown spread
    crown spread

Tree Size:

_____ circumference + _____ tree height + _____ 1/4 crown spread (B) = _____ points

Optional Tree rank: _____