



TREE TRAILS

3

★MODULE THREE★

★ TREE MEASUREMENT ★

Tree measurement is fundamental to the practice of forestry. Foresters count trees and measure trees. With just a few basic measurements, we can assign values to trees and compare them to each other.

Goal & Objectives

Goal: Students will measure trees and explain how measurement is used to place value on trees and forests.

Objectives: Students will

1. Apply the tree measurement process to measure a tree.
2. Explain why tree measurement is important for knowing about a tree's health and value.
3. Determine the measurements and condition of their trail tree and enter on the Tree Trails website: texasforestinfo.tamu.edu/treetrails/.
4. Explain the purposes of the Big Tree Registry.
5. Evaluate their *Tree Measurement* experience.

Content Area TEKS/STAAR

Language Arts: 5.19 (E) summarize and paraphrase texts in ways that maintain meaning and logical order within a text and across texts.

Mathematics: 5.7 (A) perpendicular, and congruent parts of two-and three-dimensional geometric figures.

5.10 (C) select and use appropriate units and formulas to measure length, perimeter, area, and volume.

Science: 5.2 (C) collect information by detailed observations and accurate measuring.

5.2 (D) analyze and interpret information to construct reasonable explanations from direct (observable) and indirect (inferred) evidence.

5.2 (E) Demonstrate that repeated investigations may increase reliability of results.

5.2 (F) communicate valid conclusions in written and verbal forms.

Social Studies: 5.24 (B) analyze information by sequencing, categorizing, identifying cause and effect relationships, comparing, contrasting, finding the main idea, summarizing, making generalizations and predictions, and drawing inferences and conclusions.

Technology Applications: b (3) (C) validate and evaluate the relevance and appropriateness of information.

b (3) (D) acquire information appropriate to specific tasks.

Materials

- Tablet(s) or computer(s) with internet access
- Projector and screen
- Whiteboard or chart paper and markers
- A variety of measuring tools: rulers, tape measures, scales, cups, spoons, yarn, etc.
- Tree measurement tools: 12" ruler, flexible tape measure
- Tree Trails Portfolio, Tree Trails Data Sheet
- Student Learning Log/Journal
- (Optional) Chart paper and markers for small groups
- (Optional) Cameras or camera phones

Time & Resources

Preparation Time: 2 hours

Instructional Time: 2-3 sessions, 45 minutes each

- Tree Measurement Guidelines handout
- Big Tree Registry
<http://tfsweb.tamu.edu/bigtreeregistry>
- Instructional Strategies
<http://schools.spsd.sk.ca/curriculum/instructionalstrategies/>

I. Engage/Excite

- A. Large Group Discussion: Exhibit a variety of measurement instruments such as rulers, yard sticks, tape measures, measuring spoons and cups, liquid containers, yarn, scales, etc. Ask students to name various professions that might use these and other measurement tools. For example, their parents, relatives, friends and/or neighbors may use these for work to build homes, design clothes, operate a restaurant, etc. List the professions and their tools.
- B. Large Group Discussion continued: Lead a discussion about standard units of measure. Point out that not all of the display measuring instruments have the same measurement standard such as rulers (standard & metric), cups and spoons (ounces, teaspoon), etc. Lead students to generalize that each measurement instrument is designed for a certain task. Generate a conversation about what it would be like if people use a non-standard tool for their work. Example: what if one house builder used a tree limb to measure his lumber needs and another builder used cardboard. Record students' responses on the list created.

Teacher Tip: You may want to share with students how people once used their bodies (hand and/or arm spans, body height) to measure such things as horse height in terms of hands. Students may have heard that horses may be measured by hand span.

- C. (Optional) Small Group Activity: In small groups of three, have students choose a profession from the list or choose another not listed. Tell them to keep their profession a secret to present later. Have the "secretary" record on a small chart or paper the Profession, Measurement Tools and Reason. Have each group act out their profession by "pretending" to use the measurement tools required by a specific profession. Have the other groups guess the profession, the measurement tools and the reason. Allow the "pretend" group to reveal their Profession, Tools and Reason chart after at least three guesses are made. Continue until all groups have presented.
- D. Large Group Activity: Begin a KWL chart and allow students to tell "What they think they Know" about measuring a tree. List their responses. Next ask why they think it is important to know how to measure trees. List their responses.
- E. (Optional) Individual Activity: Have students take the *Tree Measurement* pretest.

Teacher Tip: Explain that the test is only to make sure the learning activities are appropriate and not something they already know. The pretest will help them know more about what they will be learning.

To administer the tests by paper, copy from the teacher lesson module. To administer the test electronically, recreate the test in an online survey program. Free programs allow the creator to see results from a class set.

II. Explore

- A. Large Group Discussion: Write "Why Foresters Measure Trees" on a whiteboard/chart and ask why they think foresters measure trees. List their responses. Lead the discussion to focus on how measurement is a first and very important step in determining trees size and value. Explain that foresters record a tree's measurements and its condition over time. The tree's condition and rate of growth are indicators of the tree's response to its environment, and are key factors that

II. Explore continued

foresters consider when calculating a tree's value. Foresters measure trees to plan harvesting, make management decisions and calculate timber yield. Include all the reasons on the chart and save for later. Let students know they will learn more about tree health, benefits and value in future modules.

- B. Large Group Discussion continued: Write "How Foresters Measure Trees" on a whiteboard/chart.

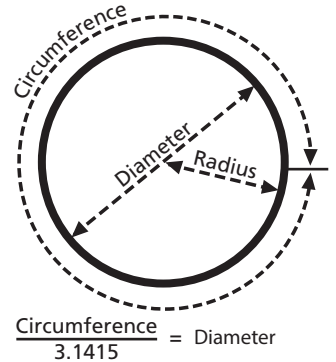
Inform students that foresters measure trees using a standard process and they will learn to measure their trail trees the way foresters do. They will measure their trail tree's circumference and convert it to diameter. They will measure its crown spread, its height, determine its condition and enter the information on the Tree Trails website. This will be the last step to complete their trail tree online.

- C. Large Group Discussion continued: Discuss the definition of circumference and demonstrate how to measure, record the circumference and convert it to diameter. Demonstrate in the class with circular objects (a column) or with student's body, head, etc.

Teacher Tip: Circumference is the linear distance around the outside of a closed curve or circular object. The circumference of a circle is the length around it.

Teacher Tip: Demonstrate the math vocabulary term, circumference using a cylindrical object. Using the same object, demonstrate the term, diameter and describe how the two measurements are related by the constant, pi.

- D. Complete the "Want to Know" section of the KWL chart.



III. Explain

- A. Large Group Discussion: Have students follow a projection of the Tree Measurement Guidelines and explain the process of how trees are measured.

Teacher Tip: You will probably want to practice measuring a tree, circumference, diameter, height and crown spread, before presenting the guidelines to students.

Teacher Tip: You may provide students with a handout of the measurement guidelines and have them watch as you also project the guidelines or you may want to have them follow with their tablets/laptops. The guidelines handout is in the resources section of the Tree Trails website.

Teacher Tip: Foresters round down in tree measurements instead of rounding up, because the tree has not yet reached the higher measurement. They keep to whole numbers because of the relative accuracy of repeatability – roughed up bark and even relative humidity can make small differences, as can having the tape measure less than perfectly perpendicular to the centerline of the trunk.



III. Explain continued

- B. Small Group Activity: After presenting the measurement guidelines, move students into their Tree Trail groups and ask students to consider which measurement technique they might use for their trail tree (general, leaning, multi-branch, etc.).
- C. Individual Activity: Have each student retrieve their Tree Trails Data Sheet from their Portfolio. Instruct them to locate the Circumference and Diameter box, Crown Spread, Height, and Condition Rating box. Inform the students that this is where they record their tree's measurements in either inches or feet and condition. Optional: use metric measurement and convert to US Standard Units.
- D. Small Group Activity: Provide each group with measurement tools. Take the students outside to locate their tree. Have each group measure their trail tree: determine where to measure the circumference (see the Tree Measurement Guidelines reference handout), then measure the circumference, measure the crown spread, it's height and determine its condition using their best judgement. Record the information on their Tree Trails Data Sheet. Have students return to the classroom.
- E. Small Group Activity continued: Have the group use the formula for diameter and calculate the diameter of their tree. Record the information on the Tree Trails Data Sheet.
- F. Small Group Activity continued: Project the Tree Trails online application and demonstrate how to enter the tree measurements. Provide the small groups with a laptop/tablet and have them follow along as each step is demonstrated. Choose Search By, choose Trail Name, then type the class trail name in the search box. Once they see the trail onscreen, find their tree according to the order of their tree in the trail and select it. Then, for each measurement box, ask another person from the group to contribute their measurement and enter it on the website. Ask another student to provide the condition, Good, Fair, or Poor, and choose it in the appropriate drop down box. Continue until all information is entered. Once these steps are completed, you can save the tree. At any time, you may go back to a tree you have saved and edit it.

IV. Extend/Elaborate

- A. Large Group Discussion: Tell students about a related site that uses measurement to register Big and Champion Trees. Project the Big Tree Registry website. Ask students to locate the purposes of the program and invite three students to read one of the three purposes.
- B. Small Group Activity: Move students into their Tree Trail groups and go online to the Big Tree Registry website and then open How to Measure a Big Tree. Ask each group to compare their measurement techniques with those used for Big Trees. Let each group report their findings.
- C. Small Group Activity continued: Next ask students to select the Registry of Champion Trees - Native and Naturalized species. They will notice that the trees are registered by common and scientific (Latin) names. Remind students how these names were important to identification of their tree. Now ask students to locate a Big Tree of the same species as their trail tree. Ask each group to report their findings: where the tree is located (county), what is the circumference, height, and when was it last measured.
- D. (Optional) Small Group Activity: Students might want to review some of the virtual tours with a volunteer who hunts for and measures champion trees found on the Big Tree Registry website.



V. Evaluate

- A. Individual Activity: Ask students to write: 1) List the steps they took to measure their tree, 2) Tell how they determined it's condition, 3) Tell why measurement is important to knowing about the tree's value, 4) Tell a purpose for registering Big Trees.
- B. Small Group Activity: Ask students to share their lists in Think, Pair, Share groups. After sharing, students may want to enter more information in their writing. Have them label their work as Module Three and keep their work in their Portfolios.
- C. (Optional) Individual Activity: Have students take the *Tree Measurement* posttest. Have them compare their results to self-evaluate what they learned and what they did not know.
Teacher Tip: You may use the results to determine the need for Extra Mileage/Attention.
- D. Large Group: Ask student to contribute to the KWL chart and record on whiteboard or class chart to complete with "What we *Learned*."

VI. Extra Mileage/Attention

Extra Mileage: Have students work in pairs to write a mathematical word problem related to two or three dimensions of their trail tree and give to another pair to solve. Ask student pairs to analyze how they answered the problem, what helped and what deterred them from getting the answer.

Extra Attention: Appoint peer students to accompany students while they take measurements of their trees with their hands and/or arms and let these students present their new measurements in terms of hand span and arm span measurements.

Tree Trails curriculum was developed by Texas A&M Forest Service in cooperation with Texas Urban Forestry Council and was supported by a grant from the USDA Forest Service.

Student Assessment / Pretest and Posttest

Tree Measurement

Directions: Answer the following questions by rating your response 1-5, with 5 being the highest.

Key: 1 = Not Sure 2 = Poor 3 = OK 4 = Good 5 = Great

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|----|--|---|---|---|---|---|
| 1. | I can measure my trail tree the forester's way. | 1 | 2 | 3 | 4 | 5 |
| 2. | I know how to determine which technique to use to measure my trail tree. | 1 | 2 | 3 | 4 | 5 |
| 3. | I can determine the condition of a trail tree. | 1 | 2 | 3 | 4 | 5 |
| 4. | I know how big trees are measured. | 1 | 2 | 3 | 4 | 5 |
| 5. | I can name three reasons why foresters measure trees. | 1 | 2 | 3 | 4 | 5 |
| 6. | I can locate a Champion Tree in Texas. | 1 | 2 | 3 | 4 | 5 |
| 7. | I know how tree measurement data is entered on the Tree Trail website. | 1 | 2 | 3 | 4 | 5 |
| 8. | Measuring trees is an important step in conserving our forests. | 1 | 2 | 3 | 4 | 5 |
| 9. | I am interested in knowing more about what I can do to keep my trail tree in the best condition. | 1 | 2 | 3 | 4 | 5 |

Comments:



Tree Measurement Guidelines

Getting Started

Rounding Recorded Values

All recorded measurements should be rounded down to the nearest whole number. Rounding a number for tree measurement means to remove the decimal places or fractions of a number and only record the whole number.

Examples: 48.9 feet is recorded as 48 feet, 132 $\frac{3}{4}$ inches is recorded as 132 inches



Foresters round down in tree measurements instead of rounding up, because the tree *has not yet* reached the higher measurement. They keep to whole numbers because of the relative accuracy of repeatability – roughed up bark and even relative humidity can make small differences, as can having the tape measure less than perfectly perpendicular to the centerline of the trunk.

Is It One Tree or Two (or More?)

Determine whether a tree has a single trunk or whether it represents two or more stems growing very close to one another. Trunks that have clear separation or include bark at or near the ground line should be considered separate trees; trunks of different species should also be considered separate trees, no matter how close together. When following the circumference rules below, if the point below the lowest fork places the measurement at the ground line, the stems should be considered separate.

Circumference

General Rule

Diameter at Breast Height (DBH) point is 4.5 feet up from the ground. (Example A)

First, find the DBH point. Then, find the smallest trunk circumference between the DBH point and the ground.

Measure and record, in inches, that smallest trunk circumference. If the tree forks, measure below the lowest fork. (Example B)

Also record the height above the ground, in inches, where the measurement was taken for your records.

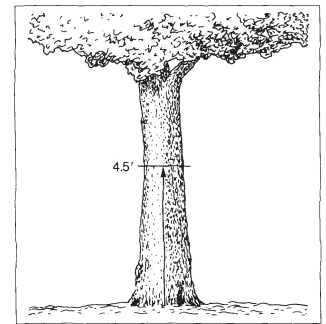
Considerations for Determining DBH Point

Tree on Slope: Measure up 4.5 feet along the axis of the trunk on high and low sides; DBH point is midway between these two planes. (Example C)

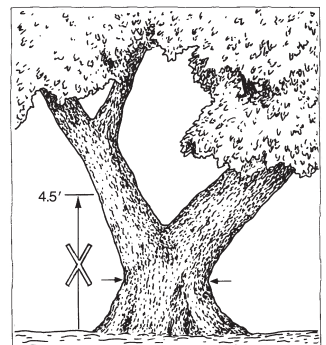
Leaning Tree: Measure 4.5 feet along both the top and undersides of the trunk; DBH point is midway between these two planes. (Example D)

Low Branches: When determining where on the trunk to measure circumference, ignore portions that do not form part of the tree's crown, such as dead branches or forks, and epicormic sprouts, which are ones that grow from the trunk or branches.

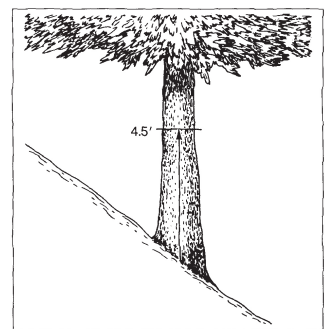
Obstruction at DBH: If there is a bump, burl, branch, or other obstruction at the DBH point, measure the circumference above and below the obstruction and record the smaller value. A buttress that forms between the trunk and root system as a natural feature of the species (e.g. baldcypress, water tupelo) should not be considered an obstruction.



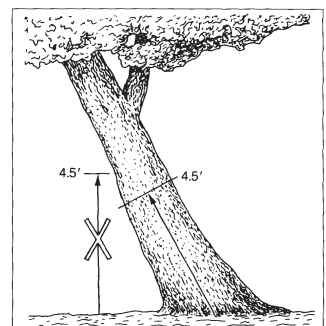
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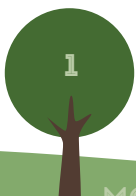
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C



D



Tree Measurement Guidelines

Height

General Rule

Find the vertical distance between the ground line and the tallest part of the live crown. Record the measurement in feet. Also record the method used to determine this value.

Choices include: direct measurement [telescoping pole, climbing], clinometer, hypsometer, relascope, laser rangefinder [w/ or w/o internal clinometer], stick method, pencil method, comparison, or wild guess.

Pencil Method to Measure Height

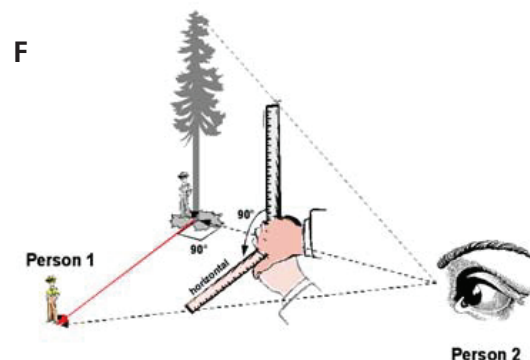
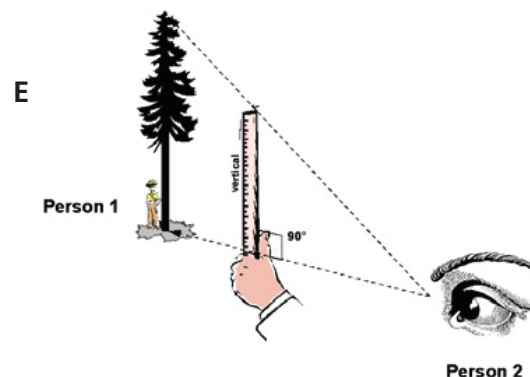
One person stands near the trunk of the tree and the second person stands at a distance where both Person 1 and the top of the tree are visible.

Person 2 holds a ruler (or pencil) upright at arm's length and (carefully!) walks forward or backward until the entire length of their ruler covers the tree from base to top. (Example E)

Still holding the ruler at arm's length, Person 2 turns their wrist right or left so that the ruler is now horizontal, with one end even with the base of the tree.

Now Person 2 instructs Person 1 to move away from the trunk in the direction the ruler is pointed (at a 90 degree angle) until they are standing where the end of the ruler points. (Example F)

Person 1 is now standing roughly the same distance from the trunk as the tree is tall. Use a tape measure to record this distance, in feet.



Crown Spread

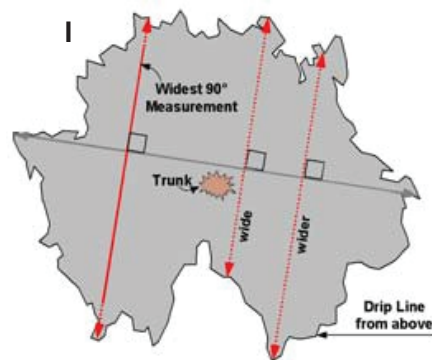
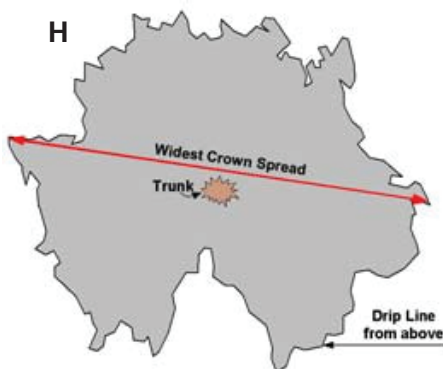
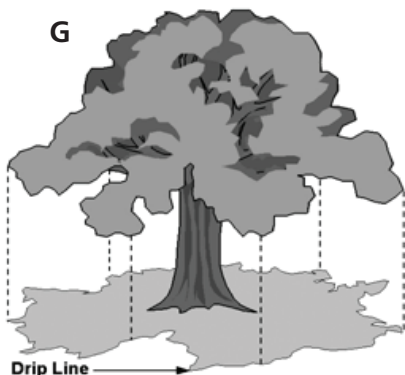
General Rule

Along the drip line of the tree, take two measurements of the crown width, in feet, at right angles, or perpendicular, to one another. Then, average the two perpendicular crown spread measurements.

Drip Line (Example G): the outline on the ground of the outermost leaves of the crown. Include only live portions of the crown.

Measurement 1 (Example H): find the widest crown spread, which is the greatest distance between any two points along the drip line and measure the length, in feet.

Measurement 2 (Example I): turn the measurement line 90 degrees, or perpendicular, from Measurement 1's line, find the widest crown spread along this plane and measure the length, in feet.



Illustrations by
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