

# TREE MEASUREMENTS

THE URBAN FOREST Grades: K-8

## Overview:

Roughly 80% of Americans live in urban areas like Dallas or Sacramento. The trees you see in parks, along roadways, and in our yards make the city a happier and healthier place to live. Urban foresters have the job of planting, caring for, and protecting these trees. When an urban forester completes a tree inventory on a parcel of land, they collect a variety of measurements and data for each tree and plot that information in a software program, allowing them to track the trees in that area. Some of this information includes calculating the DBH (diameter at breast height), the height of the tree, the condition or health of the tree, and the approximate age. Collecting this data allows urban foresters to plan where future tree plantings should take place and what tree species they should use. In this exercise, students will act as the urban foresters for a day, learning how to measure DBH, height, age, and identify the condition of trees.

## Measuring DBH:

Because “breast height” is different for everyone, in the US, it is typically measured at 4.5 feet (1.4 meters above the ground). For today’s exercise we simply suggest having students reach their arms out horizontally and using that as their means to measure DBH. (students can link arms to ‘hug’ the tree to measure or use a string/ measuring tape)

## Method:

### 1. Measuring Circumference:

Select a Tree and Measure the Circumference:

Have your students pick which tree they would like to collect data on. Using the measuring tape or a piece of string, students will wrap the string around the tree’s trunk at their breast height, measuring the distance. This measurement is the circumference of the tree. (Students can also link arms around the tree. A typical “wingspan” of a person is the same as their height. Use this to determine the approximate circumference.)

### 2. Calculate the Diameter:

To calculate the diameter of the tree, follow the formula:

Diameter = circumference  $\div$   $\pi$  (be sure to input the measurement in inches).

For example: if your tree’s circumference was 10 inches, you would divide that by 3.14, giving you an approximate diameter of 3.18 (or 3.2) inches. This means that the DBH (diameter at breast height) is 3.2 inches.

## At a glance

### Skills:

Critical Thinking  
Discussion  
Urban Forestry

### Lesson Delivery:

(Best/Suggested method in bold)

- Whole group
- **Small group**
- **Independent work**

### Location:

(Best/Suggested location in bold)

- **Outdoor**
- Indoors

### Materials:

Necessary

- String
- Measuring Tape or Ruler
- Paper
- Pencil/Pen



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| Modifications & Extensions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| K-2*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 3-5*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 6-8*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p> <b>Modification: Tree Detective Cards</b></p> <p>Instead of full calculations, have students draw or take notes on one tree:</p> <ul style="list-style-type: none"> <li>• What does it look like?</li> <li>• How big is it (can you hug it or not)?</li> <li>• What animals or insects might live there?</li> <li>• What do you think this tree needs to stay healthy?</li> </ul> <p>Skip the diameter/age calculation—focus on observation, vocabulary, and tree appreciation.</p> | <p> <b>Modification: Simplified Data Sheet</b></p> <p>Provide a worksheet with these prompts:</p> <ul style="list-style-type: none"> <li>• Tree name (or sketch if unknown)</li> <li>• Circumference (in inches)</li> <li>• DBH (diameter = circumference ÷ 3.14)</li> <li>• Height (using pencil method)</li> <li>• Growth factor (use species list)</li> <li>• Approximate age (DBH × growth factor)</li> </ul> <p>Pair students up to practice measuring and recording.</p> | <p> <b>Modification: Full Urban Forester Data Log</b></p> <p>Provide students with a data collection sheet that includes:</p> <ul style="list-style-type: none"> <li>• Tree species</li> <li>• Circumference (measured)</li> <li>• DBH (calculated)</li> <li>• Estimated height (measured with pencil or geometry)</li> <li>• Tree condition (healthy, damaged, leaning, pest-infected, etc.)</li> <li>• Approximate age (with formula)</li> <li>• Notes on habitat and any wildlife observed</li> </ul> <p>Encourage accuracy and real-world data collection skills.</p> |
| <p> <b>Extension: Tree Hug-O-Meter</b></p> <p>Have students link arms to see how many classmates it takes to "hug" a tree. Use this as a fun, visual way to compare tree sizes around campus. Students can also use a piece of string to guess measurements and have a competition to see who had the closest guess.</p>                                                                                                                                                              | <p> <b>Extension: Tallest Tree Challenge</b></p> <p>Make it a friendly competition: Which group can find and measure the tallest or oldest tree on campus?</p>                                                                                                                                                                                                                                                                                                               | <p> <b>Extension: Urban Forestry Recommendations</b></p> <p>After analyzing tree data, have students write a short recommendation to the school:</p> <ul style="list-style-type: none"> <li>• Should we plant more trees?</li> <li>• What kinds?</li> <li>• Where would they grow best?</li> </ul> <p>Optional: Create digital maps or posters to present findings like real urban foresters.</p>                                                                                                                                                                       |



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## Measuring Height:

To measure the height of the tree, use the measuring tape or piece of string and find the distance from the very top of the tree down to the flare of the tree (where the trunk goes into the ground). If the crown of the tree is too high to reach, you can use the “pencil” method to determine the approximate height (see below).

## Measuring height using pencil method:

There are different techniques to measure the height of a tree. Students can use geometry (see the videos on teacher resource page) or they can use the pencil method to get a rough estimate.

1. Divide students into pairs
2. Have student 1 stand far enough back so that they can see the top of the tree.
3. Have student 2 stand next to the base of a tree.
4. Have student 1 hold a pencil next to the student 2. Place a mark on the pencil at their height.
5. Measure how many lengths of the pencil it takes to reach the top of the tree.
6. Multiply to determine the height of the tree based on the picture (right).

(Bonus- create a class competition to see who can find the tallest tree on campus!)

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## Calculating Approximate Age:

The most accurate way to find the age of a tree is by obtaining a core sample or cutting a cross-section. There is, however, a less invasive way to find the approximate age of a tree by utilizing the tree species' growth factor formula. There are other factors that contribute to a tree's growth rate, like being planted in very fertile soil vs. poor soil, growing in a dense space with competition vs. being the only tree in a field. For this activity, the growth rates below will provide you with an estimate on how old your tree is.

1. Students will need to identify what kind of tree they are collecting data for. If they are unsure, they can look up their tree on the Texas Trees Foundation Tree Plotter Map (<https://pg-cloud.com/TexasTrees/>), refer to a tree field guide, or use the iNaturalist app.

2. Multiply the tree species' growth factor (see below) by the tree's DBH. Remember to keep the DBH in inches. This will calculate the tree's age in years.

## Growth Factors by Tree Species:

- American Elm - 4.0 Growth Factor X Diameter
- Black Walnut - 4.5 Growth Factor X Diameter
- Buckeye - 5.0 Growth Factor X Diameter
- Bur Oak - 5.0 Growth Factor X Diameter
- Cherry Laurel - 5.0 Growth Factor X Diameter
- Dogwood - 7.0 Growth Factor X Diameter
- Green Ash - 4.0 Growth Factor X Diameter
- Northern Red Oak - 4.0 Growth Factor X Diameter
- Redbud - 7.0 Growth Factor X Diameter
- Red Maple - 4.5 Growth Factor X Diameter
- Shumard Oak - 3.0 Growth Factor X Diameter
- Sweetgum - 4.0 Growth Factor X Diameter
- Sycamore - 4.0 Growth Factor X Diameter

## Bonus activity: String Measurement Contest

Create a class competition to see who can guess the correct circumference of a tree using pieces of string.

1. Have students take turns walking around or wrapping their arms around a tree to guess the circumference.
2. Students will then cut a piece of string to match their guess.
3. Teacher measures the correct diameter of the tree.
4. Students take turns comparing their string to the correct measurement. The closest measurement wins!



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## Tree Condition:

When urban foresters are collecting information on the trees that they are taking inventory of, they are also assessing the condition the tree is in. First, foresters give the tree a status: is it alive or dead? Sometimes this can be a tricky question to answer as deciduous trees lose their leaves and go dormant in winter.

There are two tests a student can perform to find out if their tree is dormant or dead. First, is the bend test. A small dormant branch should be flexible when gently bent. A dead branch will easily snap and break off when bent. The scratch test is another way to identify whether a tree is dormant or dead. Using your fingernail, scratch a small portion of the outer bark off the branch and see what color exists underneath. A green color tells you that the tree is alive, while a brown color likely means the tree is dead. Both of these tests should be executed with caution as we do not want to harm the dormant tree.

After the urban forester assigns the tree a status, they check on factors that would lead to recommended maintenance, such as strangled roots from irrigation, dead or broken branches, and disease. Allow your students to carefully assess the condition of their trees as they complete this activity.





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Before stepping outside to collect data on the trees at your campus, practice finding DBH and age using the measurements provided below. Then, use the rest of the chart to collect information on the trees at your campus.

| Tree Type | DBH                 | Height    | Age | Condition      |
|-----------|---------------------|-----------|-----|----------------|
| Redbud    | Diameter = 5 inches | 89 inches | 35  | Alive; healthy |
|           |                     |           |     |                |
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After gathering data on you school's trees, answer the following questions.

1. Do some tree species grow faster than others? Why do you think that is?
2. What conditions might prevent a tree from growing as fast as its expected growth rate?
3. What steps can be taken to provide the best growing conditions for the trees on your campus?
4. Provide an assessment of the trees on the trees at your campus, considering their size, age, and overall condition. Are there areas that would benefit from future plantings? Explain.