Determining the Age and Benefits of a Tree

Grades: 9-12

Illinois State Standards:
- 11.A.4a and 11.A.5a Formulate hypotheses referencing prior research and knowledge.
- 11.A.4c Collect, organize and analyze data accurately and precisely
- 13.B.3e Identify advantages and disadvantages of natural resource conservation and management programs.

Overview:
- It is possible to determine an estimated age of a tree without looking at tree rings. During this activity, students will determine the approximate age of a tree. They will then investigate the benefits of the tree based on the tree species and size.

Time:
- One 45-minute class period
- Further discussion questions add an additional 45-minute class period

Supplies:
- Tree to measure
- Measuring Tape
- Estimated Age of Urban Trees chart
- Access to the internet

Instructions:
1. Select your tree.
   - Have the students hypothesize about the age of the tree based on its size. This hypothesis can be determined by the whole class or by individual students. Write down your predictions so you can compare these to the estimated age you determine for your tree after you complete your measuring.
2. Identify your tree.
   - Tree species grow at different rates. An American elm with a diameter of 15 inches is about 38 years old but a Red oak with the same diameter would be 75 years old – knowing the species is very important to this activity.
   - Ask the students why they think trees grow at different rates. There can be many answers... but some trees, like the Downy hawthorn (*Crataegus mollis*) have a mature height of 20 – 30 feet; the biggest tree on record for this

Check out the Tree Identification activity on our teacher resources page... It is a great addition to this lesson plan!
species is 35 feet tall. While other trees, such as the Giant Sequoia (*Sequoiadendron giganteum*) have been measured as tall as 311 feet. Our state tree, the White Oak (*Quercus alba*) has been measured at 86 feet tall!

3. Measure 4 ½ feet from the base of the tree.
   - Discussion point: how would measuring incorrectly affect your findings? Discuss how measuring the circumference of the tree too high or too low would affect the results.
   - The proper way to measure a tree trunk is at 4 ½ feet from the base of the tree. This is known as DBH or diameter at breast height. However, if your tree trunk is split or a branch is coming out of the trunk at 4 ½ feet from the base of the tree, measuring is a bit more complicated.
     - If your tree is on a hill, measure the circumference 4 ½ feet from the mid-point of the tree base.
     - If your tree has a branch or obstruction at 4 ½ feet, measure the circumference from just below the obstruction and note the actual height at which you are measuring.
     - If your tree trunk splits into multiple trunks below 4 ½ feet, measure the circumference of the largest trunk at 4 ½ feet.
     - If your tree trunk splits into multiple trunks at 4 ½ feet, measure the smallest circumference on the trunk below the 4 ½ feet and note the height at which you are measuring.
   - Have one student hold the measuring tape at the base of the tree.
   - Have a second student hold the measuring tape vertically in a straight line up the tree.
   - Have a third student put their finger—and hold it very still—marking 4 ½ feet up from the base of the tree.

4. Measure the circumference of the tree.
   - Have the third student continue to keep his/her finger on the tree.
   - Have a fourth student wrap the measuring tape around the tree.
   - Several other students can assist in making sure that the measuring tape is flat and straight.
   - The fourth student (wrapping the measuring tape around the tree) should determine the diameter of the tree in inches. You will need to round to the closest inch.

5. Determine the diameter based on your circumference measurement.
   - Diameter can be determined by using the equation:
     \[
     \text{Diameter (d)} = \frac{\text{circumference (c)}}{\pi} \text{ where } \pi = 3.14 \quad \text{or} \quad d = \frac{c}{3.14}
     \]
   - For example, if your circumference is 31.5 inches, your equation would be:
     \[
     d = \frac{31.5}{3.14} \quad \text{which means} \quad d = 10.03''
     \]
   - Round your number to the closest inch, which means your DBH is rounded to 10 inches.
6. Determine the age of your tree.
   - Determine the age of your tree by using the Estimated Age of Urban Trees by Species and Diameter at Breast Height chart (attached below). For example, if you have a white pine with a 10” diameter, your tree is estimated at 26 years old.

7. Calculate the benefit of your tree.
   - Go to the following website: http://www.treebenefits.com/calculator/
   - Enter your zip code and click the “submit” button.
   - Double check that the zip code and city are correct. Enter your tree information in the boxes on the left side of the screen.
   - Read and discuss the information provided for your tree. Clicking the tabs at the top of the page will describe the benefits of your tree in more detail.

8. Repeat steps 1, 2 and 6 for several different species of trees. Compare and contrast the information found on the website. Specifically discuss the features listed under Storm Water, Energy, Air Quality and CO2 to see how different tree species affect the urban environment in different ways.

9. Take this lesson one step further and spend some time exploring the Questions for Further Discussion on the following page.

**White Oak Images from The Morton Arboretum:**

![White Oak - Tree](image1)

![White Oak - Leaf](image2)

![White Oak - Fruit](image3)

![White Oak - Bark](image4)

For a great follow up homework assignment, have students complete this activity with a tree in their neighborhood and calculate its benefits.
Questions for Further Discussion

- Why is this providing only an ESTIMATE of the age of the tree? In other words, what factors could change/alter the size of the tree from the estimate found on the Estimated Age of Urban Trees by Species chart? Potential answers: in a rainy year the tree may grow more, in a drought year the tree will grow less, an urban tree could have been deprived other nutrients that may affect its' size due to things such as construction or sidewalks.

- Knowing that this is only an estimate, why would we bother determining the age of the tree? Potential answers: Coring a tree (cutting out a core sample to more accurately determine the age of a tree) is tricky, complicated, and requires precise scientific equipment. Although this is not possible in every circumstance, determining the estimated age can help us determine the approximate benefit of an individual tree. When deciding what tree to plant in our yard at home, our school or our park, many factors should be considered.

- Why is planting a diverse population of trees in an urban area important? If we know that American Elms grow faster than red oaks, why would we not just plant all American elms? Potential answers: biodiversity is important for a variety of reasons. If we have all American elms we have the problem of all the trees dying with Dutch Elm Disease; currently we have a pest called the emerald ash borer, which is a non-native beetle, killing ash trees across the United States. Having species diversity means that if some species are susceptible to a disease or a pest, others may be resistant. Also, having a diverse population of trees enables us to also have a diverse population of insects (good pollinators) or birds, or mammals, or any other species which may rely on a variety of tree species for their survival. For further information about the emerald ash borer, check out this website: http://www.na.fs.fed.us/fhp/eab/.

- Dendrology is the study of trees. The chart you read to determine the estimated age of a tree was created by a dendrologist. What careers might you go into which involve dendrology? Potential answers: forestry, scientific research, natural resource management, and many more! For more information on some scientists and their careers, check out The Morton Arboretum’s website at http://www.mortonarbor.org/meet-our-scientists.html.
### Estimated Age of Urban Trees by Species and Diameter (DBH)

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Citations for the Table “Estimate age of urban trees by species and diameter

1 Estimates are approximate given the significant variation in the growth rates of individual urban trees.

(#) = source of information for the species. See accompanying page of citations.


