

# Dendrochronology



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## Overview

Students will learn about the inner layers of a tree's trunk and their function for tree life and growth. Students will learn one way that foresters can age a tree and learn more about the environmental conditions the tree grew in.

## Grade Levels

2<sup>nd</sup>, 3<sup>rd</sup> and 6<sup>th</sup> Grades

## Curriculum Correlation

2.H.1.1      3.L.2.2      6.L.1

## Duration

1 class

## Location

Outdoors or in classroom

## Materials

Cookie Counting Activity: Wood cookies, worksheets (link to PDF in Resources section), magnifiers, and educational aids

You can purchase tree cookies online or ask the school gardener or grounds keeper to cut some for you. A tree cookies can be from a small tree or limb, around 1 to 3 inches in thickness.

My Life As A Tree Activity: Paper plates and crayons

Making A Log Activity: Model Magic, Paint (tempera) or food dye for coloring the model magic, cling wrap, cheese cutter or knife

# Dendrochronology



## Learning Targets

Students will be able to name the inner layers of a tree's trunk and each layer's function for tree health and growth.



## Educators Information

Dendrochronology: The Science of Tree Dating

Den-dro-chronology is the scientific process of using tree rings (or growth rings) to understand what happened in the environment during the life cycle of a tree.

Educators Information from: **American Forest Foundation. Project Learning Tree: PreK-8 Environmental Education Activity Guide. Tree Cookies. 2009.**

By counting a tree's growth rings, you can tell the age of that part of the tree at the time it was cut. Every growth season, a tree adds a new layer of wood to its trunk and limbs. Each ring has two parts: a wide, light part (*early wood*) and a narrow, dark part (*late wood*). The early wood grows during the wet, spring growing season. During the transition from the drier summer to fall and winter, growth slows and the late wood forms. The rings provide clues about the climate, or weather, of the area over time and evidence of disturbances to and around the tree, such as fires and floods.

The shape and width of the annual rings often differ from year to year because of varying annual growth conditions. During a moist growing season, a tree in a temperate region may produce a particularly wide ring. During a drought, a colder-than-average winter, or an unseasonable frost, a tree will produce a particularly narrow ring. In a science called *dendrochronology* (which literally means "the study of tree time"), scientists have found that they can learn about past climates by studying the ring patterns of very old trees.

Many factors besides weather can affect a tree's growth. Accordingly, tree rings reflect a tree's response to such stressors as insect and disease. Sometimes a disturbance will occur after the growing season, producing a narrow or misshapen ring in the following year.

# Dendrochronology



To study a tree's growth rings without harming the trees, foresters or forest scientists use a technique called *coring*. By drilling into the center of a tree trunk with a hollow instrument called an *increment borer*, they can remove a long, narrow cylinder of wood (called a core sample). The growth rings of the tree appear as lines on the core sample.

Terms:

Outer Bark: originates from phloem cells that have worn out, died and been shed outward, acts as a suit of armor against the world by protecting the tree from insects, disease, storms and extreme temperatures. In certain species, the outer bark also protects the tree from fire.

Phloem (FLOW-uhm) (also called the inner bark): the plant tissue that transports dissolved nutrients down from the leaves to the other parts of the plant.

Cambium (KAM-bee-uhm): a thin layer of living, dividing cells just under the bark of trees. This layer gives rise to the tree's secondary growth.

Xylem (ZEYE-luhm) (also called sapwood): the younger, softer, living or active outer portion of a tree's wood that lies between the cambium and the heartwood and is more permeable, less durable, and usually lighter in color than the heartwood. The tree's water and nutrient needs are transported within the xylem or sapwood up from the roots.

Heartwood: the older, harder, nonliving central portion of wood of some trees that is usually darker, denser, less permeable, and more durable than the surrounding sapwood.



## Procedure

Cookie Counting Activity

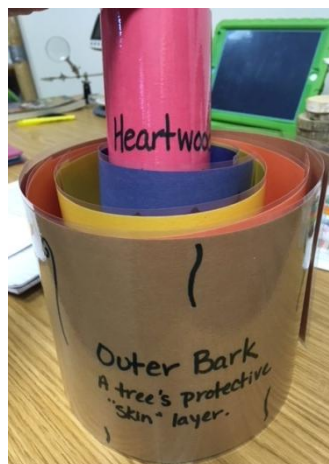
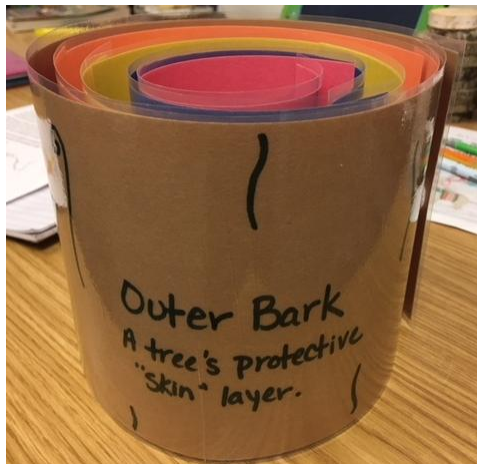
Materials: Wood cookies, worksheets (link to PDF in Resources section), magnifiers, and educational aids

# Dendrochronology



Procedure:

1. Pass out real tree cookies to individuals or small groups.
2. First using the tree cookies, have students estimate how old this part of the tree was when the tree cookie was cut. Tell students whether the cookie was cut from the tree's trunk or from a limb if you know. Ask the students how they estimate the age.
3. Give students a copy of the student worksheet "Reading Tree Cookies" from PLT (PDF link in Resources section). First talk about the parts of the tree ring, listing Outer Bark, Phloem (FLOW-uhm), Cambium (KAM-bee-uhm), Xylem (ZEYE-luhm), and Heartwood. You can use a 3-D model to help explain the layers. I made a construction paper 3-D model, using different colors of construction paper to represent the different layers. I taped strips of paper into smaller and smaller rings so that they would stack within each other. I laminated the rings and attached Velcro to close the rings. See photo here.



Answers to "Reading Tree Cookies" worksheet:

Cambium

Heartwood

Xylem (or Sapwood)

Phloem

# Dendrochronology



Outer Bark

Dead branch (the black mark, beginning in year 13, is what remains of a branch that died and fell off. After a few years, the trunk grew over the scar.)

Drought or insect attack (the narrow rings signify drought, insect attack, or other growth inhibiting factors.)

Fire (the scarring shown here is due to a fire that came through when the tree was 12 years old.)

Next, flip the worksheet over “Tree Rings” from PLT and explain how to count the rings to find the age of a cross section (count only the light or only the dark rings to get the correct age).

4. Using the background information, explain the different kinds of markings that tree cookies display (scars from a forest fire or a dead branch, narrow rings from insect attacks or drought). Have students look for clues in their own real tree cookies, and guess what might have happened to the tree. Discuss their responses.

5. Optional: Distribute magnifiers to students. Have them look for small holes in the xylem and heartwood of the tree cookies. The tiny channels enable water and nutrients to travel up the trunk and branches of the tree.

## My Life as a Tree Activity

Activity from Project Learning Tree Activity Guide, <https://www.plt.org/environmental-education-curriculum/>

Materials: Paper plates and crayons

# Dendrochronology



Procedure:

1. Using white paper plates with ridges, demonstrate for students how to create a “tree cookie” using the bumpy perimeter as the bark, the smooth inside edge as the cambium, and the center circle as the heartwood.
2. Have students each use a paper plate and crayons to create a tree cookie the same age as themselves. Have them identify when important events in their lives took place, such as when they were born, when they started school, and so on.

## Making a Log Activity

Materials: Model Magic, Paint (tempera) or food dye for coloring the model magic, cling wrap, cheese cutter or knife

Log layer colors: Red for heartwood, White for early wood, Tan for late wood, Brown for bark

Procedure:

1. After learning the parts of a tree, students will build a log. Using model magic.
2. Using the red Model Magic they should roll a 1-inch diameter, 6-inch long rope, which will represent the heartwood.
3. Next they will roll out the white Model Magic. This will be the early wood and will be wrapped around the heartwood one time.
4. Then the students will roll out the tan Model Magic. This layer should be thinner than the white and it is the late wood. It is then wrapped around the springwood. The springwood and the summerwood equal one annual ring of the tree. The students will continue making annual rings, remembering to vary the thicknesses. You can set a limit based on how much model magic you have, maybe tell students to make their tree logs 2 to 4 years old.
5. After they have completed making their annual rings, they are to wrap one layer of clear wrap around the last tree ring. This is the cambium.

# Dendrochronology



6. The last part to be constructed is the bark (brown). Students may want to texture the outside of the bark using their pencils.
7. After the log is constructed, the students are to make transverse cuts on each end of the log using a cheese cutter. You may also need scissors to cut the clear wrap.
8. The students can use these to share to guess the ages of each other's log.



## Supplemental Reading

Reading the Rings of a Tree Poster: <http://www.internationalpaper.com/docs/default-source/english/sustainability/treerings.pdf?sfvrsn=2>

Tree Ring Diagram: <https://serc.carleton.edu/details/images/159482.html>

Anatomy of a Tree: <https://www.arboday.org/trees/RingsTreeNatomy.cfm>



## Extensions

Problem Solving Activity- Reading between the Rings from NOAA:

[https://www.esrl.noaa.gov/gmd/outreach/info\\_activities/pdfs/PSA\\_tree\\_rings.pdf](https://www.esrl.noaa.gov/gmd/outreach/info_activities/pdfs/PSA_tree_rings.pdf)



## Resources

Cookie Counting Worksheets from PLT: Reading Tree Cookies & Tree Rings

<https://www.plt.org/blog/activity/activity-76-tree-cookies/>

# Dendrochronology



Other worksheets:

Tree Rings Worksheet from Education.com:

<https://www.education.com/worksheet/article/tree-rings-2/>

Simple Counting Tree Rings Worksheet from Education.com:

<https://www.education.com/worksheet/article/tree-rings/>

Tree Cookie Resources from Project Learning Tree:

<https://www.plt.org/blog/activity/activity-76-tree-cookies/>