Explore January: Tree Layers and Tree Rings

Explore the layers of a tree trunk and all the secrets tree rings hold.

Tree rings. Source.

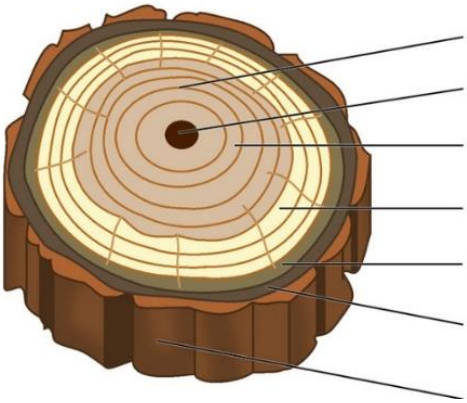
Through the observation and analysis of the cross section of a tree, much can be learned through the story of its distinctively marked layers. Generally, and under optimum conditions, growth rings occur throughout the tree's interior. Examining these unique rings can give insight on past climate history, tree age, weather patterns and more.

There are six layers of a tree trunk which include the outer and inner bark, cambium layer, sapwood, heartwood, and pith.

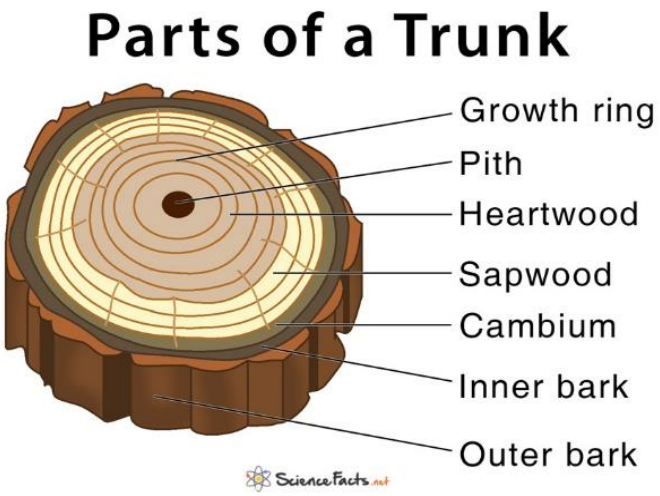
- The **outer bark** is simply the outer most layer of the tree. This layer can help to identify the species. It also helps to protect the tree by maintaining appropriate moisture levels. The outer bark protects the tree from the rain yet locks in needed moisture when they air is dry.
- The **inner bark**, also known as the phloem, is the layer that disperses nutrients throughout the tree. This layer has a short life and will eventually die and turn into part of the outer bark as the tree grows.
- The **cambium cell layer** is the section of the tree that annually grows and produces new wood.
- The **sapwood**, also known as the xylem, is new wood which is generally lighter in color. It is also the layer that distributes water throughout the tree all the way to the leaves.
- The **heartwood** is composed of old, dead wood, which is generally darker in color; this helps to identify the heartwood from the sapwood. Even though this layer is technically dead, it is very strong and will not decay as long as the rest of the tree is alive and healthy.
- The **pith** is the final layer. This section is the small, spongey, central piece of the tree.

Activity: Labeling Tree Layers

Label the parts of the tree trunk using the word bank if needed. Find answers on next page.

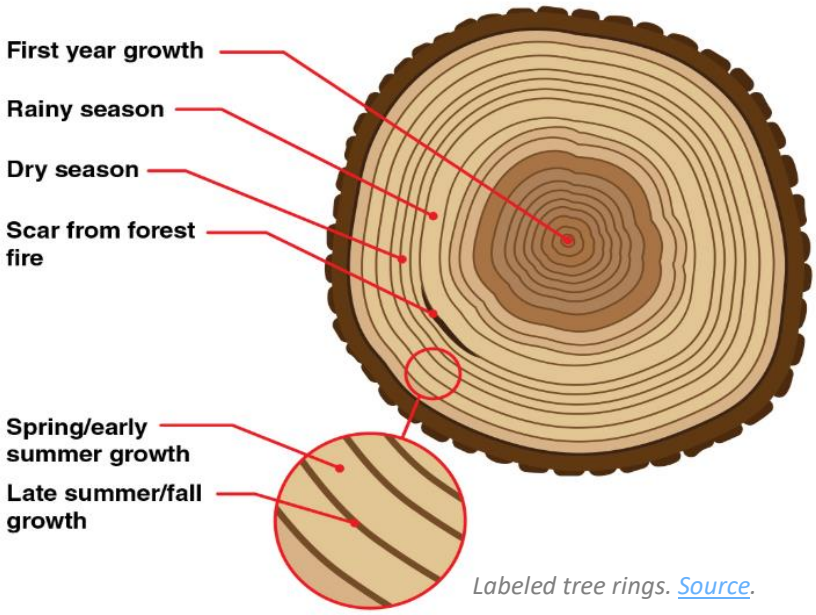


Word Bank
Pith
Outer bark
Heartwood
Inner bark
Sapwood
Cambium
Growth rings



Labeled tree trunk. Source.

The **tree rings** extend throughout the sapwood and heartwood and can be counted to determine the age of the tree. When examining tree rings, you will notice alternating light and dark rings. The width of the rings varies because they relate to the wet a dry seasons that the tree has lived through. Try out this tree ring simulator for hands on learning about tree rings, temperature, and moisture. The lighter rings are normally wider because they reflect the rainy season which result in more growth from the tree, and the darker rings reflect the dry season which result in less growth. This means that each single ring does not reflect a year of growth, you must count one light and one dark ring, which would equal one year of growth, or you can count just the dark rings. Another important thing to note is that when counting tree rings, you do not count the pith, which is the central dark spot on the tree.

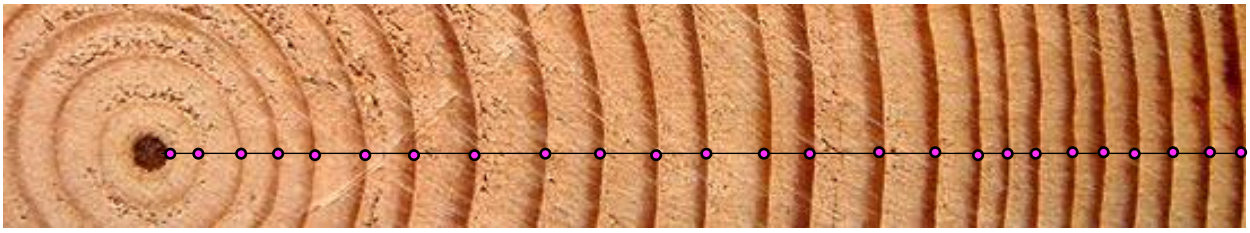


Labeled tree rings. Source.

Look at the photo of the tree rings below and test your tree ring counting skills.

How old is this tree?
Stop counting at the last dark ring.

Source



Source

Each dot on the line represents one year of growth, this includes a wet season and a dry season growth ring. This tree is 25 years old.

Dendrochronology
There is a field of study dedicated to reading tree rings called dendrochronology. A scientist who studies tree rings to answer questions about past events and climate is called a dendrochronologist. Many stories can be told by examining tree rings including effects of climate change including annual increase or decrease in rainfall, hot and cold years, years where there was an early frost. Scientists can also help us trace back when forest fires occurred. Watch this video to hear more from a dendrochronologist.

What information can you tell from the tree shown above? Are all the rings the same distance apart? What other features are notable?

_____

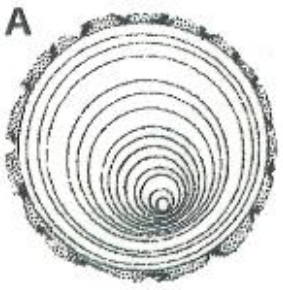
_____

_____

_____

Here are more examples:

What do you notice in example A?



_____

_____

_____

_____

Why do you think that is?

_____

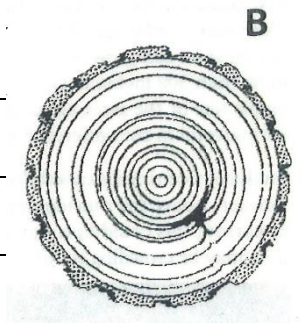
_____

_____

_____

Instead of the pith starting directly in the center of the tree it is much lower, and the growth rings are very narrow on one side and much wider on the other side. This can be because this particular tree was competing for resources with other trees and tall plants or if tree is growing on a slope, if another tree has fallen in this tree as it continues to grow, or if the tree is exposed to consistently high winds.

What do you notice in example B?



_____

_____

_____

_____

Why do you think that is?

_____

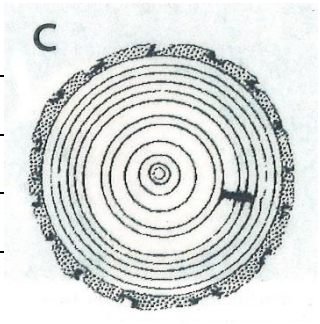
_____

_____

_____

There is an irregular scar on the bottom of the tree cookie. You can see that some of the tree rings have merge together. This can indicate damage from insects, fires, or machines like cars or lawn mowers.

What do you notice in example C?



_____

_____

_____

_____

Why do you think that is?

_____

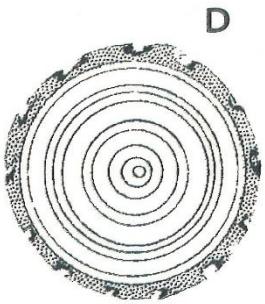
_____

_____

_____

The more uniform scar on the right-hand side of the tree cookie can be from a tree limb that has died and fallen off. You can see that the tree has continued to grow around the scar.

What do you notice in example D?



_____

_____

_____

_____

Why do you think that is?

Source: All About Minnesota's Forests and Trees, pg. 48

_____

_____

_____

_____

Various wide and narrow wet season growth lines can give insight on years of drought or other disturbances.

Current Dendrology Projects

What's in NOAA's Tree Ring Database?

NOAA National Centers for Environmental Information (NCEI) houses the International Tree-Ring Data Bank (ITRDB), which contains ring width data from forests worldwide, plus ring width data from old buildings, and even from rare Stradivari violins. The ITRDB contains ring width data from trees at over 4,600 locations on six continents, providing tree growth histories from around the world. New additions from field scientists are added regularly.

The ring patterns of more than 6,000 trees (green triangles on the map on the following page) have been archived in NOAA's International Tree-Ring Data Bank. Climate scientists compare the tree growth records to local weather records. For locations where a good statistical match exists between tree growth and temperature or precipitation during the period of overlap, the ring widths can be used to estimate past temperature or precipitation over the lifetime of the tree.

Locations where tree ring data has been collected for NOAA's International Tree-Ring Data Bank

Cornell University – Cornell Tree-Ring Laboratory

The Laboratory for Aegean and Near Eastern Dendrochronology

Aegean Dendrochronology Project

Our key long-range goal is to build long multi-millennial scale tree-ring chronologies in the Aegean and Near East that will extend from the present to the early Holocene to cover, broadly speaking, the last 10,000 years of human and environmental history. Our raison d'être is to provide a dating method for the study of history and prehistory in the Aegean that is accurate to the year. This kind of precision has, up to now, been lacking in ancient studies of this area. Indeed, few archaeological problems stimulate as much rancor as chronology, especially that of the Eastern Mediterranean. The work of the Aegean and Near Eastern Dendrochronology Project aims to help to bring some kind of rational and neutral order to Aegean and Near Eastern chronology from the Neolithic to the present.

We also aim to provide a fundamental climate and environmental studies resource for a region which was the cradle of a number of civilizations central to human history from the origins of agriculture through to the Classical period, the Medieval period, and beyond.

Southern Levant Dendrochronology Project

The Southern Levant Dendrochronology Project (SLDP) began as a laboratory sub-project from lab member Brita Lorentzen's PhD dissertation with the aim of building up the database of dendrochronologically dated timbers from sites in the southern Levant (i.e., southern Lebanon, Israel, Jordan, and Egypt); provenancing timbers important to the region; and building long-term chronologies for species native to the southern Levant. This project has now expanded to encompass several veins of research.

Coring pines at Rosh HaNigra

Institutional Sexism in Scientific Research - Reflection

Participants should learn about the first woman to be promoted to full professor at University of Arizona's internationally-respected Laboratory of Tree-Ring Research, Valerie Trouet. In this video from UofA, she opens up about her academic journey, how institutional sexism impacts women in STEM, her hope for the future, and the joy of her most recent and greatest career accomplishment to date.

"Since 1937, there haven't been any female full-time professors, and that's not from lack of good women scientists."

Using Trees to Study Climate Change Conducted by the University of Cambridge

Scientists are studying tree rings to learn about changes in climate over hundreds of years. In this video, BBC News reports on how the width of the rings can give clues to rainfall, temperature and even tsunamis. Trees are gathered from underwater sources.

Additional Resources

- NASA, Global Climate Change, Vital Signs of the Planet
- NASA, Climate Kids, What Can Trees Tell Us About Climate Change?
- The Arbor Day Foundation, What Tree Rings Tell Us About the Life of a Tree

A student learns how to take a tree core sample with an increment borer in the Manti-LaSal National Forest in Utah.

To learn more about another important way scientists study Earth's climate history, see About Ice Cores.

Extensions

Student's Personal Journey via Tree Rings

Students draw a tree cross section and add tree rings to demonstrate their age. When considering how far apart to place the rings, allow them to create a timeline from birth until how old they are.

If they had some great things happen during certain years, maybe their rings would be placed farther apart creating a wider span. One student during this exercise indicated a wide growth ring span because she had received a rescue dog, and another showed when he started dance class. Students can mark their rings with notable events if they feel comfortable doing so. For example, a student may want to make a mark on a tree ring during a year that they fell off a bike and broke an arm perhaps, or something else happened that they would like to share. But students should never feel that they must share personal events.

Curriculum connections can easily be made to topics such as: archeology, technology, scientific research, botany – trees, Language Arts, social studies, geography, meteorology, climate change and of course, environmental science.

For more ideas, contact Kate Reilly, Manager of Education at Duke Farms at kreilly@dukefarms.org.