COLLEGE OF SCIENCE
Laboratory of Tree-Ring Research

Rings of Time: Innovating K-12 Education with Dendrochronology Project

Lesson Title: Tree Rings and Their Influences

Grade Level: Third Grade
Lesson Length: 50 minutes

AZ Science Standard:	3.L1U1.6 Plan and carry out investigations to demonstrate ways plants and animals react to stimuli.
Learning Objective:	Students should be able to explain the difference between sensitive and complacent growth. Students will be able to understand the structure of cross sections and tree rings.

Vocabulary	Materials

• Dendrochronology
• Cambium
• Sapwood
• Heartwood
• Early wood
• Late wood
	• Presentation
	• Activity Sheets
	  ○ What Tree is Best for Dendro?
	  ○ ^Answer Key
	  ○ Looking at Cross Sections
	  ○ ^Answer Key
	  ○ Looking at Tree Rings and Cores
	  ○ ^Answer Key
	  ○ Front and Back Version
	  ○ Measuring Tree Cores
	  ○ ^Answer Key
	• Rulers (*class set*)
	• Coloring utensil (*class set*)

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Guiding Questions:

What is the difference between sensitive and complacent growth?

How do cross sections differ from tree rings?

Why is the information studied in the field of dendrochronology important?

Engagement/Introductory Activity

Topic Addressed - What Character Traits are Best for Dendrochronology?

Teachers will pass out the "What Tree is Best for Dendrochronology?" worksheet.
Students will attempt to fill in what blanks they can in ~ 5 minutes.

Notes: Teachers can choose to go over the worksheet simultaneously with students or can wait until after they attempt the worksheet alone. Teachers can use the answer key as a quick reference to what the answers should be similar to.

Engagement/Introductory Explanation

Topic Addressed - What Character Traits are Best for Dendrochronology?

Teachers can now review the information below as students follow along on their worksheet.
Use slides 3 to 12.

Define Dendrochronology: the science of dating events, environmental change, and archaeological artifacts by using the characteristics of annual tree rings
Adapted from the Oxford Languages definition

Characteristics that make a tree the most ideal to study:

1. Has Rings - not all trees have rings because some, like the palm tree, are grasses!
    a. *Image citation*
2. Distinct Ring Boundaries - this means you can see each ring clearly like in the picture.
3. Rings are Annual - it grows 1 ring per year.
4. Sensitive Growth
    a. Response to "What is sensitive growth?" on **slide 7** - *these are trees that grow in environmental conditions that cause changes to their resource use very frequently. Tree growth is in response to its external conditions and is recorded in its rings. Sensitive growth creates rings that look different from one another every year. The picture labeled complacent on your worksheet shows a tree with little variability from year to year.*
    b. Ask students: **Which tree has sensitive growth? Complacent growth?**

   c. Answer: **Sensitive = B ; Complacent = A**
   d. Ask students: **Why do you think it's better to have a tree with sensitive growth?**
   e. Answer: **Because the more variability in ring width, means that more changes in the tree's environment occurred. We can then study those rings to find out what caused the variability in their width.**
5. Circular Shape
   a. Ask students: **Why do you think it's better to study the circle cross section?**
   b. Answer: **Because you can see the full ring all the way around the tree meaning it had uniform growth over its lifespan. It did not have any events that caused it to start regrowing making it harder to tell how old it is.**
   c. *If students ask why the distorted tree is that way…**because it was in many fires. Each time the tree is burned in a fire, it has to start regrowing so it distorts the circular shape of the tree.***
   d. *Image citation*
6. Long Ring Record - this means the more rings it has the older the tree is so the further back in time we can count and study.

Exploratory Activity

Topic Addressed - Understanding Cross Sections, Tree Cores and Tree Rings

Teachers can pass out the "Looking at Cross Sections" and "Looking at Trees Rings and Cores" worksheets.
Give students about 10 minutes to fill in what they can.

Explain

Topic Addressed - Understanding Cross Sections, Tree Cores and Tree Rings

Teachers can now explain the below concepts:

Slide 14: A cross section comes from the trunk of a tree. It is a sample of the tree that dendrochronologists - these are the scientists who study dendrochronology - use to gather their information from. They are sections cut from the entire trunk of a dead or fallen down tree.

Slide 15: This is what a most ideal cross section looks like. Earlier (**go back to slide 10 or 11**) we saw one that was distorted from fires. Those can still be studied but it is harder to get more information from them.

Slide 16 to 17: On your "Looking at Cross Sections" worksheet…

- Bark: this is the outermost part of the tree protecting it from most external conditions. This is also the youngest part of the tree.
- *Vocabulary word - Cambium: this layer is the growing part of the tree and is technically the only*

living part of the tree. It sits right below the bark.

- *Vocabulary word - Sapwood: this part of the tree moves water from the roots to the leaves of the tree. It is also called "new wood" because as the sapwood develops, older layers die and turn into heartwood.*
- *Vocabulary word - Heartwood: this is the supporting section of a tree. This wood is darker because it is dead wood that does not decay or lose strength.*
- Pith: this is the innermost part or center of the tree. It is also the oldest.
    - *Definitions taken from the Forest Service*

The structure of a tree is important to understand because it helps scientists, and us, understand characteristics about a tree and the environment it lived in.

Slide 18 to 20: Tree cores, like at the bottom of your "Looking at Tree Rings" worksheet are like a small slice of a cross section although we get core samples from a living tree so we do not have to cut it down. Scientists use a sharp metal tube to drill into the tree and pull out a straw size sample of the tree to then study the rings inside the tree. The rings tell us about the age of a tree and the conditions in which a tree lived through.

- Annual Ring: A tree grows one layer per year. Or one ring per year. One ring is the early wood plus the late wood in one layer of the tree's growth.
- *Vocabulary word - Early wood: the lighter part of a tree ring. This grows during the first part of the growing season and is the sapwood for this layer of the tree.*
- *Vocabulary word - Late wood: the darker part of the tree ring. This is the heartwood for that layer of the tree. It's darker because it's the dying sapwood in the later part of the year.*

These structures are important to understand because scientists use tree rings to date, or find the age of, trees. When a lot of trees are dated, then dendrochronologists can build timelines with information about climate in our history.

Extension Activity/Questions

Topic Addressed - Becoming A Dendrochronologist

Teachers will pass out the "Measuring Tree Cores" worksheet, a ruler to each student/pair of students, and give each student two colors: one for the narrow rings and one for the wide rings.

Instruct students to take their rulers and measure the width of each ring for Tree Core A and B, color their cores, and answer as many questions as they can. Give them about 10 minutes to complete their worksheets.

Once students finish, teachers can explain the concepts related to the worksheet:

Remember the resources that trees need are water, sunlight, nutrients from the soil, and carbon dioxide from the air to grow.

The most impactful environmental conditions to trees are temperature and moisture of the environment. Climates that are generally more hot and wet result in the most tree growth compared to

environments that are more dry and cold.

***Tree growth therefore is in response to its external conditions**. That information is recorded in its rings. Wide rings show years where the climate and resources a tree needs to grow were abundant. Narrow rings show years where the climate or resources a tree needs to grow were less prevalent. Cross sections with a mix of wide and narrow rings, reflect the variability of the years that tree lived.*

Dendrochronologists study these differences in ring width to create a chronology (or timeline) of the earth's climate history.

So why is understanding this important? Understanding changes in the trees' environment that we can see recorded by their rings helps us map how climate, conditions, and topography has changed over time. When we compare climate from the past to historical events and conditions of life, we can then see how humans and the world impacted one another over time. This is important in understanding how we can move forward into the future with the earth without causing too many bad changes.

Evaluation Activity

Slide 23: Kahoot Time

OR

Slide 24 - 25: Story Time

Students should take the remaining time in class to write a short story about the life their tree has lived. Make sure they include…

1. 2 vocabulary words from the lesson
2. If their tree has had complacent growth or sensitive growth
3. *If extension activity and content was completed…*
    a. Include if their tree has more wide rings or narrow rings
    b. Make sure they connect that wide rings reflect warm and wet years while narrow rings reflect cold and dry years in the trees climate

Note: Delete the slides for whichever activity the teacher chooses not to do.