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Focus on Inquiry

Use evidence from tree cookies to determine the age of a tree and evaluate how different factors can affect the growth of the tree from year to year and what tree rings can show about the environment.

Lesson Summary

Students will be observing tree cookies to determine the age and growth patterns of trees. By looking at the rings of a tree cookie and seeing how they are somewhat different from year to year, students will recognize that the tree rings can be studied to show information about the growing conditions of the tree.

These observations and analyses of the tree cookies should eventually lead students to predict that tree rings studied from tree cookies and tree cores can be used to show indirect evidence of past climates. This is called a proxy and can be used as indirect evidence of past climates.

Lesson Content Overview

- Subject: Tree age and how it relates to tree growth.
- Duration: 2 - 55 minutes class periods
- Setting: Classroom
- Grouping: 3-5 students per group
- Grade Level: 9th-12th

Louisiana Standards (Use the Louisiana Student Standards from the [Academic Standards Library](#). Identify the code and full verbiage for the standard(s) used).

Standard	Description
HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Student Learning Objectives

Students will analyze tree rings to evaluate how different factors can affect the growth of the tree.

Prior Knowledge Needed by Students

- Knowledge of different types of trees such as coniferous and deciduous.
- Knowledge of different biomes around the world and the types of trees that grow in various biomes.

Background Information for Teachers

Some trees are temperature dependent and will have bigger (wider) tree rings if the temperature is optimal for that year and some trees are moisture dependent and will have bigger (wider) tree rings if there is a lot of precipitation that year. Some years a tree grows more than it does in other years. Other factors, such as insects or soil quality, can also affect how much the tree grows.

Tree rings studied from tree cookies and tree cores are called proxies because they can be used as indirect evidence of past climates. Other proxies include ice cores, coral patterns, and sediment cores.

Materials Needed

- Tree cookies - 1 per group
- Worksheet -Analyzing Tree Ring data (1 per student) (Appendix A)
- UCAR handout with pictures of tree rings from various trees (1 per group) (Appendix B)

Detailed Lesson

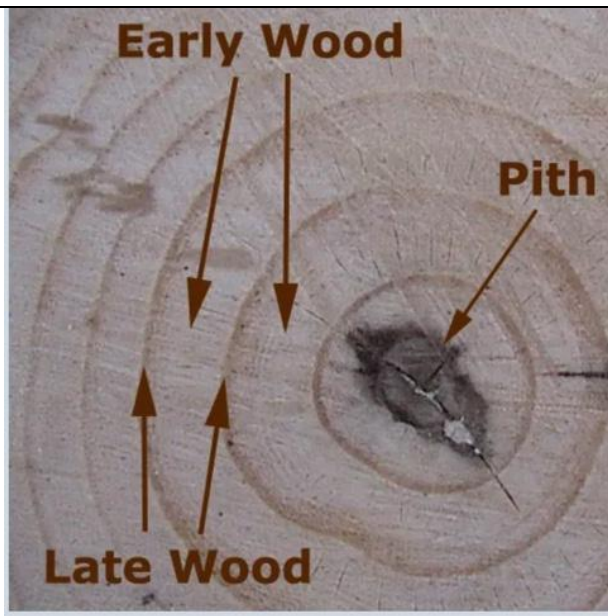
1. Engage (Time: 10 minutes)

Materials

- Tree cookies
- Worksheet
- UCAR handouts

Directions

- Put students into groups of 3 or 4 depending on number of students.
- Pass out tree cookies and worksheet -Analyzing tree ring data.
- Students complete pre-assessment questions 1-5 on worksheet (5 minutes)
- Pass out the UCAR handouts. Have students look at the UCAR handouts that show different types of trees and their rings. Discuss with students what they notice.



- Go over pre-assessment questions with students. Explain that wood made during the first part of the growing season is light in color, and wood made late in the growing season is darker. A light and a dark band together are the growth for one year. Each tree ring has two parts. In the spring and early summer each year, trees normally grow quickly, creating light-colored wood in a wide ring. This wide, light part of the ring is called "early wood." In the late summer and fall, trees normally grow more slowly, producing dark-colored wood in a narrow ring. The dark, narrow part of the ring is called "late wood". A full year's growth includes both a light, early wood ring and a dark, late wood ring.

2. **Explore** (10 minutes)

Materials

- Rulers
- Worksheet

Directions

- Pass out rulers. Students will answer the questions 6-10 under "Investigate" with their group.
- Go over answers to questions 6-10 with students and discuss the following:
 - Thick layers indicate a "good" growing season, and narrow rings indicate a shorter or dryer growing season.
 - Trees that depend heavily on temperature in the growing season will have narrow rings during cold periods and wider rings for warm periods. Trees that depend heavily on moisture during the growing season will have wider rings during rainy periods and narrower rings during dry periods.
- Students answer questions 11-17 under "Evaluate" with their group.

3. Explain (Time: 15 minutes)

Materials

- Worksheet
- Paper
- Pencils

Directions

- Discuss answers from questions 11-17 with class using the explanations below. Have students take notes on the explanation.

In summary, paleoclimatologists use a variety of “proxies” to interpret past climate. Proxies are preserved physical characteristics of the environment that can stand in for direct measurements. Tree rings are an example of a proxy. Historical data such as newspapers and letters are also an example of a proxy.

[Trees and their unique rings](#) also serve as proxy data. Because climate conditions influence tree growth, patterns in tree-ring widths, density, and isotopic composition reflect variations in climate. In temperate regions where there is a distinct growing season, trees generally produce one ring a year, recording the climate conditions each year. If they depend heavily on warm temperatures or lots of moisture in the growing season, their rings will be wider when those conditions are present and narrower when they aren't. Trees can also grow to be hundreds to thousands of years old and can contain annual records of climate for centuries to millennia.

Trees contain some of nature's most accurate evidence of the past. Their growth layers, appearing as rings in the cross section of the tree trunk, record evidence of floods, droughts, insect attacks, lightning strikes, and even earthquakes.

Dendrochronologists can extract samples from trees that have been dead for centuries, which they then align with patterns from old, but still living, trees. Wood can also be preserved in human construction and crafts, and samples from various wooden objects have been used to extend tree ring chronologies. Examples include beams from old buildings and wood from log cabins, planks and beams from old wooden ships, and even samples of wood from old wooden instruments such as violins. In some places, forests have been flooded when new lakes formed, or trees fell over into peat bogs, preserving the wood for many generations. Some climate chronologies created by combining tree ring records span many centuries of time.

4. Expand- Extension (Time: TBD)

Materials

- Dendrochronologists guest speaker or video

Directions

Invite a dendrochronologist to class to show students how to remove tree cores from trees as opposed to tree cookies.

5. Evaluate (Time: 50 minutes)

Materials

- Chromebook

Directions

Students create presentations about their findings.

References

Center for Science Education. *Analyzing Tree Ring Data Sequences*. UCAR.
<https://scied.ucar.edu/activity/dendrochronology-sequence>

National Centers for Environmental Information. (2016, March 11). *How Can Tree Rings Teach Us About Climate*. NOAA. <https://www.ncei.noaa.gov/news/how-can-tree-rings-teach-us-about-climate>

Appendix

Appendix A: Worksheet Analyzing Tree Ring Data

Names: _____

Observe with your group

1. What similarities or differences do you notice in the different rings?
2. Is there a pattern to the color of the rings?
3. Are the tree rings the same in thickness? Why do you think this is?
4. How old do you think your tree is?
5. Do you find anything interesting about your tree cookies? Any specific questions?

Investigate with your group.

These tree cookies come from trees that were cut down this year.

6. How old is your tree? (Start at the outer ring and count the light/dark couplets of rings for an estimate of age) What year did your tree start growing?
7. Determine the width of the smallest ring and the largest ring in millimeters.
8. Based on the size of the rings you just measured, which year was the best growing year for the tree? Which was the worst?
9. What factors could have affected the tree growth in those years causing the ring to be larger/smaller?

10. Count back to the ring of the year you were born. What does the ring thickness tell you about the tree growth for that year?

Evaluate with your group

11. If a tree lives in a tropical rain forest, do you think the tree growth would be more influenced by a slight change in temperature **or** precipitation?

12. In an arid region, what might account for variations in the tree rings from year to year, slight changes in precipitation **or** temperature?

13. Based on the two questions above, what do you think the study of tree rings can show scientists?

14. Exchange tree cookies with another group. What differences do you notice between the two tree cookies?

Why do you think there are differences?

15. Two trees living near each other in the same forest have different ring patterns in their tree cookies. What could account for this?

16. Tree cookies can only be obtained when the tree dies or is cut down. What is another way that tree scientists could determine the age of a tree that wouldn't be harmful?

17. A person who studies tree rings and patterns is called a dendrochronologist. If dendro- means tree, what do you think chronology means?

Appendix A: Tree Rings

