

Lab# 12: Tree Rings and Climate Change

Questions

What is dendrochronology? How do trees grow? Why are tree rings formed? What determines the size of the rings? How do environmental or climatic conditions affect the tree rings? Can past climatic conditions be interpreted from tree rings? Which are the oldest trees and what can be interpreted from their rings?

Overview

Trees grow from the top up and from the outside out. In this way trees add new material around the outside layer as they continue to grow. Trees that experience distinct winter and summer seasons only grow in the summer season and lie dormant in the winter. The new material that is added each growing season is the only living material in a tree that supplies water and nutrients upwards to the rest of the tree. The inside layers support the structure of the tree but do not nourish the tree. As each new growth layer/ring is added its size is determined by how much growth takes place during the growing season. The amount of growth is dependent on the amount of water the tree receives. Growth only occurs in the summer season and thus new growth ring material is not added in the winter. Longer or wetter summers produce larger growth rings on trees. The measurement of rings on a tree is an excellent means of determining the amount of growth that took place in any growing season and, from that, the length of summer and amount of precipitation (weather) can be interpreted. Any tree, then, can be used to interpret long-term weather or climate. Though some trees generally do not live to be very old (relative to the geological time record), there are trees that live to be thousands of years old and provide longer climate records. Through correlating different wood samples, scientists have been able to derive a record of climate change that is 16,000+ years long.

Different tree species are also better indicators of climate change (long term weather) because each species is adapted to specific climatic regions. As climate changes, tree species repopulate different regions. The "migration" of many trees towards the poles and higher elevations has been observed as the Earth's average temperature increases.

Note- The safest way to obtain ring samples from a tree is to use a tree boring devise. But these samples are more difficult to use for students than "tree cookies" or tree trunk slices. DO NOT cut down trees simply to get tree cookies but call your local forester and they will probably be happy to supply you with as many tree cookies as you will need. The best trees for doing dendrochronolgy are pines but virtually any tree will do.

Grade Level

4th – 9th

Objectives

In this activity students will:

1. Understand how tree rings are indicators of weather.
2. Quantify the size of tree rings and interpret weather /climate change.
3. Predict future weather conditions/climate from measured tree ring data.

National Standards

Content Standards D: Earth and Space Science:

Earth's History

Content Standards C: Life Science:

Diversity and Adaptations of Organisms

NH Standards

3c. Life Science

Students will demonstrate an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.

2b. Science, Technology, and Society

Students will demonstrate an increasing ability to use technology to observe nature.

5a. Physical Science

Students will demonstrate an increasing ability to distinguish among materials by utilizing observable properties.

6b. Unifying Themes and Concepts

Students will demonstrate their understanding of the meaning of stability and change and will be able to identify and explain change in terms of cause and effect.

Teacher Preparation

You should obtain as many "tree cookies" as possible (a variety of species is interesting to compare). Tree cookies can be obtained from your local forester or from logs cut in your own back yard (the exact year the tree was cut down is important). DO NOT cut down trees simply for this lab exercise. A professional tree boring device can be very helpful in sampling living standing trees. Tree boring devices can be very expensive but you may be able to borrow or rent one for the exercise (be very careful, they are sharp and can be difficult to use without proper instruction).

Materials

Tree cookies/tree cores

Hand lens

Paper and pencil

Metric ruler

Time Frame

1 (45 minute) class period

TEACHING SEQUENCE

Engagement and Explanation

1. Each student group should have a tree cookie, a small metric ruler, a magnifying glass/hand lens, paper and a pencil.
2. Identify any one tree ring.
3. Using your magnifying glass, observe the wood cells in a tree ring. Make observations on the changes in cell structure from the inside of each ring to the outside of each ring. Draw a diagram of the wood cells, from inside of the ring to the outside of the ring, for any one ring.
4. Starting at the center of the tree cookie, students should count the number of rings to the outside/last layer. The outside last layer on a living tree is called the cambium. It is the only part of the tree that supplies water and nutrients to the upper sections of the tree/leaves.
5. Students should identify and record the locations of the thickest and the thinnest rings.
6. Place one corner of one end of a piece of paper at the center of the tree cookie and use the long edge of the paper as a straight edge to the outside of the tree cookie. Note part of the tree you measured.
7. Mark the location of each ring on the paper.
8. Measure the thickness of each ring (between each of the marks made on the paper).
9. These measurements should be drawn as a bar graph (thickness verses distance from center).
10. Describe how the thickness of the rings has changed over time.

Elaboration

Compare the rings with archived weather data from your area. Using the weather data, students can calibrate the thickness of the rings to the average precipitation for the summer. They can then use these calibration numbers to calculate the average amount of precipitation for any rings that do not have corresponding weather data.

Also, compare the student's tree ring data with weather data sets for temperature, humidity, temperature minimal/maximum? How does the ring/precipitation graph compare with the ring/temperature graph?

Exchange

Students should compare their data on tree species with group's data.

Evaluation-questions

1. How easily can tree rings be identified?
2. How do the tree cells differ from the beginning of the growing season to the end of the growing season? Can this be used to help identify the amount of growth that has took place during each season?
3. How does the thickness of any one tree ring differ on different sides of the tree? What

environmental factors might cause this difference? What would be the best side of the tree to measure the rings and how could you identify the “good” side of a tree while the tree is growing?

4. What other factors would change the amount of moisture that one tree would receive relative to other trees?
5. Is there a discernable trend in the thickness of the tree rings (evidenced from the bar graph?) and could it represent a change in climate?
6. How old was your tree before it was cut down/sampled? What years are represented by each tree ring that you identified? You first have to know what year your tree was cut down.
7. How does average summer precipitation data for your area (research average local precipitation values from past years) compare to the ring data you measured?
8. How do the thickest and thinnest tree rings differ in terms of relative amounts of precipitation?
9. Is there evidence to support a hypothesis that a forest fire has taken place in the area that the tree grew? How do the tree rings display past forest fires?
10. How might the formation of tree rings be affected by smog and atmospheric pollution?

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Resources

<http://www.ltrr.arizona.edu/people/henri/lorim/lori.htm>

<http://www.pbs.org/audubon/wildwings/dendro.html>

Grabher, G., M. Gottfried, and H. Pauli. 1994. “Climate effects on mountain plants”. *Nature*. 369:448.

Peterson, D., R. Rochefort, R. Little, and A. Woodward. 1994. “Changes in sub-alpine tree distribution in western North America: a review of climatic and other causal factors”. *The Holocene*. 4:89-100.

Background

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Glossary

Dendrochronologist: A scientist that uses trees to interpret climate change.

Cambium: Living outside ring of trees.