

 <b>Introduction to Climate</b>	<b>Activity 11: Time &amp; Cycles: Dendrochronology</b>	
	<b>Background Learning Goals Standards</b>	
<a href="#">Back to Activities List</a>	<a href="#">Teacher Guide</a>	<a href="#">To Student Guide</a>
<a href="#">Click on a Component Above</a>		

## Time & Cycles - Dendrochronology

Modified with permission from [Global Change: Time and Cycles](#), Department of the Interior, U.S. Geological Survey, Reston, VA, USA.

In this activity, students will use pre-marked paper strips to simulate tree-ring core samples to help them understand that data for past climate changes can be gathered from sources beyond long-term weather observations. Students will be able to recognize the direct impact of climate on annual tree growth patterns.

### Background

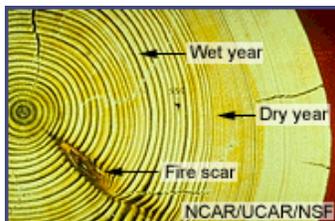
Trees contain some of nature's most accurate evidence of the past. Their growth layers, appearing as rings in the cross section of the tree trunk, record evidence of floods, droughts, insect attacks, lightning strikes, and even earthquakes.

Each year, a tree adds to its girth, the new growth being called a tree ring. Tree growth depends upon local conditions such as water availability. Because the amount of water available to the tree varies from year to year, scientists can use tree-ring patterns to reconstruct regional patterns of drought and climatic change. This field of study, known as **dendrochronology**, was begun in the early 1900s by an American astronomer named Andrew Ellicott Douglass.

A tree ring consists of two layers:

- A light colored layer grows in the spring
- A dark colored layer in late summer

During wet, cool years, most trees grow more than during hot, dry years and the rings are wider. Drought or a severe winter can cause narrower rings. If the rings are a consistent width throughout the tree, the climate was the same year after year. By counting the rings of a tree, we can pretty accurately determine the age and health of the tree and the growing season of each year.



Modern dendrochronologists seldom cut down a tree to analyze its rings. Instead, core samples are extracted using a borer that's screwed into the tree and pulled out, bringing with it a straw-size sample of wood about 4 millimeters in diameter. The hole in the tree is then sealed to prevent disease.

Computer analysis and other methods have allowed scientists to better understand certain large-scale climatic changes that have occurred in past centuries. These methods also make highly localized analyses possible. For example, archaeologists use tree rings to date timber from log cabins and Native American pueblos by matching the rings from the cut timbers of homes to rings in very old trees nearby. Matching these patterns can show the year a tree was cut, thus revealing the age of a dwelling.

To investigate the extent, speed, and effects of historical climate changes locally and globally, scientists rely on data collected from tree rings, ice cores, pollen samples, and the fossil record. Computers are used to detect possible patterns and cycles from these sources. In dendrochronology, large databases allow scientists to compare the ring records of many trees, construct maps of former regional climates, and reveal when, where, and how quickly the climates changed. These historical records are extremely valuable as we struggle to understand the extent and nature of any possible future climate change.

In this activity, students will use pre-marked paper strips to simulate tree-ring core samples. They'll work in groups to reconstruct a 50-year climatic history.

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## Learning Goals

1. Students will understand that data for past climate changes can be gathered from sources beyond long-term weather observations.
2. Students will recognize the direct impact of climate on annual tree growth patterns.

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## Alignment to National Standards

### *National Science Education Standards*

- Life Science, Structure and Function in Living Systems, Grades 5 to 8, pg. 158, Item #4: "The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as the quantity of light and water, range of temperature, and soil composition. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem."

### *Benchmarks for Science Literacy, Project 2061, AAAS*

- The Nature of Science, Scientific Inquiry, Grades 6 to 8, pg. 12, Item #1: "Scientists differ greatly in what phenomena they study and how they go about their work. Although there is no fixed set of steps that all scientists follow, scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanation to make sense of the collected evidence."
- The Nature of Science, Scientific Inquiry, Grades 6 to 8, pg. 12, Item #4: "New ideas in science sometimes spring from unexpected findings, and they usually lead to new investigations."

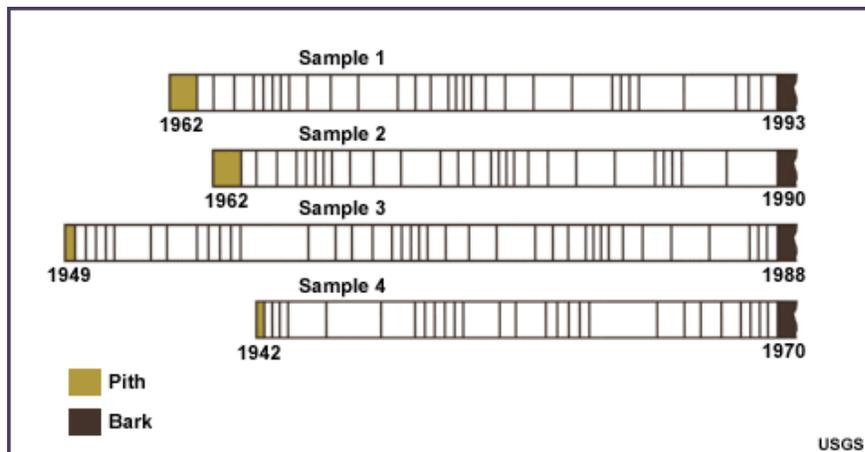
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## Grade Level/Time

- **Grade level:** 6 to 8
- **Time:**
  - Preparing the paper strip samples: 15 minutes
  - Lesson background: 20 minutes
  - Student activity: 45 minutes
  - Class discussion: 20 minutes

## Materials for Each Group of Four Students

- A set of paper strips pre-marked with ring patterns. Use the graphic below, either printing it out from this page or [linking to another page](#) where the graphic is larger and by itself. Make a copy for each group. Then cut the paper strips apart and (if you want to make them sturdier) glue them onto light cardboard or sturdy paper (file folders would work well too). For a more realistic sample 'core' you may want to consider using straws or wood dowels. Be aware that the preparation time will be much longer and more tedious.

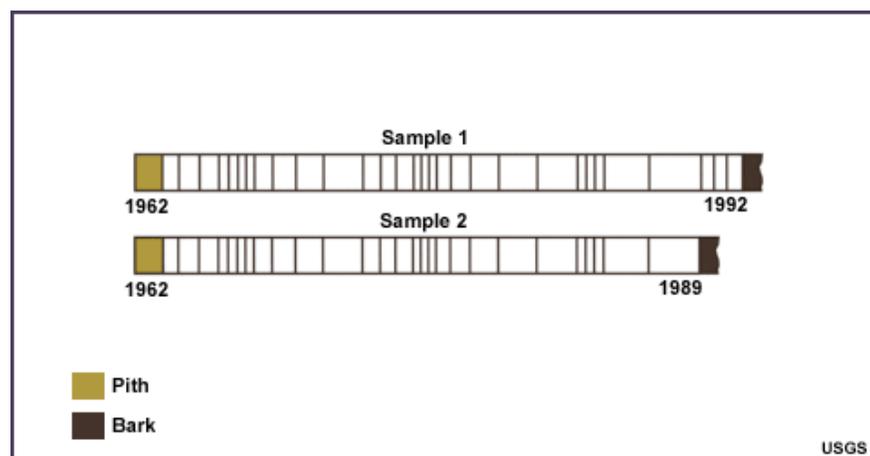


- Transparent tape
- A worksheet

## Procedure

### Overview

The graphic below shows how the Sample 1 and Sample 2 strips can be aligned.



The students will align all four samples so that the patterns match. Then they'll determine the year when each tree was cut and when it began to grow. They'll count all of the rings from the oldest samples as they are aligned with the younger samples to determine the total amount of time represented by the rings. They should count aligned rings that appear on several samples only once.

You may want to tell the students that the pith (central layer) and bark are not counted in determining the age of a

sample. The youngest ring is closest to the bark and the oldest ring is closest to the pith.

### Activity

1. Group students in teams of four and distribute the paper strips and student guides.
2. Either write the following information on the blackboard or copy it and hand it out. This information is also included in the student guide.

Imagine you have core samples from 4 trees:

- Sample 1: From a living tree from the Pinetown Forest, July 1993
  - Sample 2: From a tree from the Pinetown Christmas Tree Farm
  - Sample 3: From a log found near the main trail in Pinetown Forest
  - Sample 4: From a barn beam removed from Pinetown Hollow
3. Ask the students to determine the age of each tree (how many years it had been growing) by counting the rings. Then have them record their answers on the worksheet. The answers are provided below.

Sample	Age of Tree	Year Cut or Cored	Year Growth Began
1	31 years	1993	1962
2	28 years	1990	1962
3	39 years	1988	1949
4	28 years	1970	1942

4. Ask them to look for patterns in the rings. Once they have discovered a ring pattern, they should line up all the samples. Note that although the patterns in this exercise match well, actual ring patterns vary among tree species.
5. Knowing that Sample 1 was cut in 1993, the students can match the patterns of the other samples and determine when the other trees were cut or cored and when they began to grow. Students should record this information in their notebook or fill in the chart.

### Observations and Questions *(also in the student guide)*

1. Which tree ring represents your birth year?
2. What kind of growing season (good or bad) existed that year in Pinetown? How can you tell?
3. If poor tree growth around Pinetown was mainly caused by drought, which years were probably drought years? How can you tell?
4. Did Pinetown have more years of drought or plentiful rainfall?

### Answers

The answers to some of the questions will depend upon the class, for example, when the students were born.

In looking at the climate record as revealed in the tree rings, notice that there is a significant period of poor growing conditions in each of the four decades covered by the tree samples. This pattern, which can be graphed, is the type of

pattern scientists might look for when studying climate change.

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### **Assessment Ideas**

Ask students the following:

- Why might a climatologist be interested in the tree-ring data from Pinetown?
  - Is it likely to be more important to sample trees in the area that are quite old or ones that are fairly young? Why?
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### **Modifications for Alternative Learners**

- Visually impaired students should be partnered with sighted students.

**When you're finished with the activity, click on [To Student Guide](#) or [Back to Activities List](#) at the top of the page.**

