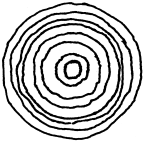


## Lesson Plan Ten: What Can We Learn from Old Trees?



Through working with tree ring samples, students will learn the kinds of information that archeologists can glean from dendrochronology, and how the information is obtained.



**Location:** classroom

**Suggested group size:** individuals, small groups, whole class

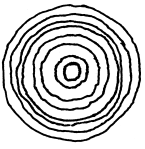
**Subject(s):** history, social studies, botany, archeology, climate

**Concepts covered:** chronology, tree rings for telling the age of the tree, when it grew, what the climate was like during that period, and how that relates to archeological dating

**Written by:** Chris Judson, Bandelier National Monument

**Last updated:** 2/2007

**Student outcomes:** At the end of this activity, students will be able to tell the age of a tree by its rings, and understand how the ring patterns can be used to determine the age of archeological sites and what the climate was like when the sites were in use.



## EDUCATIONAL STANDARDS

### NEW MEXICO STATE STANDARDS

#### ***Social Studies***

Strand: History

K-4 Benchmark I-A: Describe how contemporary and historical people and events have influenced New Mexico communities and regions

Grade 4

1. Identify important issues, events, and individuals from New Mexico pre-history to the present.

K-4 Benchmark I-D - Understand time passage and chronology.

Grade 4

1. Describe and explain how historians and archeologists provide information about people in different time periods.

K-4 Benchmark II-B: Distinguish between natural and human characteristics of place and use this knowledge to define regions, their relationships with other regions, and patterns of change.

Grade 4

1. Identify ways in which different individuals and groups of people view and relate to places and regions.

K-4 Benchmark III-E: Describe how economic, political, cultural, and social processes interact to shape patterns of human populations, and their interdependence, cooperation, and conflict.

Grade 4

1. Describe how cultures change.

4. Identify the causes of human migration.

K-4 Benchmark I-D: Acquire reading strategies

Grade 4

5. Increase vocabulary through reading, listening, and interacting



## NATIONAL STANDARDS

### **History**

Standard 2 Grades K-4: The history of students' own local community and how communities in North America varied long ago

2A: The student understands the history of his or her local community

Grade K-4: Examine local architecture and landscape to compare changes in function and appearance over time.

Standard 3 K-4: The people, events, problems, and ideas that created the history of their state

3A: The student understands the history of indigenous peoples who first lived in his or her state or region

7A: The student understands the cultures and historical developments of selected societies in such places as Africa, the Americas, Asia, and Europe

Grade 3-4: Investigate the ways historians learn about the past if there are no written records (Compare records from the past)

### **Social Studies**

II. Time, Continuity, and Change

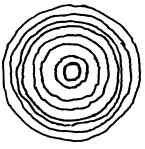
Middle Grades

b. identify and use key concepts such as chronology, causality, change, conflict, and complexity to explain, analyze, and show connections among patterns of historical change and continuity

d. identify and use processes important to reconstructing and reinterpreting the past, such as using a variety of sources, providing, validating, and weighing evidence for claims, checking credibility of sources, and searching for causality

### **English Language Arts**

7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, and people) to communicate their discoveries in ways that suit their purpose and audience.



## **MATERIALS**

Paper, writing utensils, location with good light

Tree ring drawings and diagrams (at end of this lesson)

Dendrochronology materials from Bandelier

Optional: magnifying glasses

If possible: slices of tree trunk from newly-cut tree

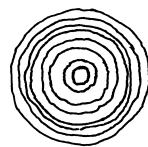
## **BACKGROUND**

Tree ring dating, or dendrochronology, is one of the most accurate methods for dating archeological sites. Many kinds of trees add one growth ring each year, usually consisting of a light-colored ring from the summer and a dark-colored ring from the winter. Counting these rings can tell how old the tree is, but the rings have more information too. For many trees, the width of the summer ring varies depending on how wet or dry the year was; the more moisture, the wider the ring. Some trees, such as cottonwoods, need a lot of water to survive, so they live near streams or other wet places where their roots have a constant water supply. These trees have annual rings which are all about the same width. Other trees, such as ponderosa and piñon pines, live in places where they must depend on rainfall for their water supply. The rings in these trees will show the pattern of the wet and dry years.

In the 1920s, scientists realized that the pattern of wider and narrower rings serves as an identifying “signature” for the period the tree was alive. They realized that they could use these “signatures” to develop the method now called tree ring dating.

Since then, scientists have been using tree ring patterns from older and older trees to build charts for various areas of the country showing the patterns of wet and dry years in those areas over many centuries. Now when archeologists find a piece of wood such as firewood in an ancient firepit or a roof beam in an old building, it is a valuable clue for finding out when people were living there. They look at the pattern in the log and see where it fits on the master chart. This may allow them to know what year the tree was cut down, which may be the year that the building was built or a clue to when the fire was made.

A single tree ring date could be inaccurate, however. It wasn't unusual for the ancient people to take beams out of old buildings to make the roof of a new one. If the wood was in the fire, a number of outer rings could have burned off, or maybe the tree had been dead for years before it fell and was gathered up for firewood. So, an archeologist will use as many tree ring samples for a particular



site as possible, to have the best possible information. In addition, there are other dating methods, including pottery types, pollen analysis, Carbon 14, stratigraphy, archeomagnetism, potassium-argon, and more. An archeologist will use as many methods as possible to get the best idea of when people lived in a particular place.

## VOCABULARY

**Archeomagnetism:** a method of archeological dating based on the last date that clay in a firepit was exposed to the heat of the fire

**Carbon 14:** a method of archeological dating based on the rate at which Carbon 14 breaks down to Carbon 12

**Dendrochronology:** a method of archeological dating based on patterns of tree rings

**Pollen analysis:** a method of finding out what environment surrounded an archeological site when it was inhabited, based on what plant pollen is found. Also provides information on what crops were being grown.

**Potassium-Argon:** a method of archeological dating based on the rate at which potassium converts to argon

**Stratigraphy:** a method of archeological dating based on finding items at different levels in a site where people lived over a long period; usually the deepest things are the oldest

**Tree rings:** circular growth patterns that form inside of tree trunks every year that a tree lives; they are wider in wet years, narrower in dry ones

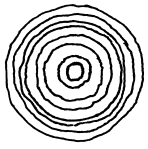
## PRE- AND POST-EVALUATION

### Pre-Evaluation:

Using a Ponderosa pine section from the Bandelier materials or another source, or a drawing or photo of a cross-section of a similar tree, ask the students to make a list of all the ways that section might be useful to a scientist trying to learn about the Ancestral Pueblo people.

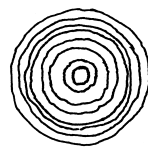
### Post-Evaluation:

Have the class review the list they made before the lesson, and see if they find they need to add to it or change it.



**PROCEDURES: ACTIVITIES TO CHOOSE FROM:**

1. If the teacher or a student has access to a tree that is being cut down and can have a slice taken from the trunk, have the class look at the rings for the years since they were born. Can anyone remember the years that show up as being wet or those that were dry? For much of the Southwest, the years between 2000 and 2003 were extremely dry, as was the winter of 2005-2006. Looking farther back, for about twenty years prior to that, there was a period that, in general, was wetter than average. See if you can see those events.
- 2A. In small groups (or as a class if you have an opaque projector) use the drawings of tree rings in this lesson plan to match their rings with the master chart to find the date the tree started growing, how long it lived, and when it was cut. See the Teacher Resource sheet at the end of the lesson for diagrams and directions.
- 2B. Examine the actual Ponderosa pine slice in the Bandelier materials, or a similar tree section. If this tree started growing in 1905, what year was it cut? How many years did it live? Could you see some very wet years and some very dry ones? Did you have difficulty counting the rings? (no answer available here since the slices differ, and probably they didn't actually begin growresouing in 1905, that's just a good number to work with.)
3. In small groups, have the students look at the samples of the other species of trees and see if they can make a drawing showing the pattern of thicker and thinner rings for the last 15 or 20 years of the tree's life. Put their charts on the board and see if it is possible to tell if all the trees lived during the same years. Were some of the samples easier to work with than others? Do some show the wet and dry years more clearly? If you were an archeologist, which kind(s) of trees would you rather work with? (In New Mexico, Ponderosa pine is often used, partly because its rings give good information, and partly because it was commonly used for making roofs, so it is often available in archeological sites. Piñon, juniper, and oak also show wet and dry years. Cottonwood, box elder, and other trees that need to live where there is abundant water give little indication of the yearly fluctuations.)
- 4A. Dry years and wet years can make a big difference in the lives of farmers like the Ancestral Pueblo people. Ask the students to look at the tree ring diagram and find:
  - What pattern would show a time when they could store lots of food for bad years? (one or more very wide rings, showing year(s) when there was plenty of rainfall)



- What pattern would show a time when they would have to depend on the food they had stored? (one or more very narrow rings, showing year(s) when there was little rain)
  - What pattern would indicate a time when they might have to consider moving away? Do you see a pattern like that in this sample? (many narrow rings in a row, indicating a lengthy drought, one long enough that their storerooms might become empty. Some Pueblo people today say that the tradition was to have at least 5-7 years of food stored away if possible)
  - If you know that this was a roof beam in a house, and you know what year the tree started growing, how would you know what year the house was built? (it was probably built soon after the tree was cut, so by counting from the year the tree began growing, to the outside ring, you have a good idea when the house was built)
- 4B. Have the students choose a set of rings showing a period of 8 or 10 years and write a story about what life would have been like for someone who lived through that period. Or, let them draw their own tree ring pattern to set the stage for a story of the life of an Ancestral Pueblo person.

### EXTENSION IDEAS

1. Take the tree slice that shows its rings most clearly and xerox the rings at 200% or more (if this is not feasible, use one of the tree ring drawings). Pretend it was cut this year. As a whole class, count back from the outermost ring and mark off various dates that are important to members of the class, such as the years most students were born, what year the school was founded, the year people walked on the moon, etc, depending on how old the tree was. Have the students write labels with captions, and post it in the room or in a public space in the school or elsewhere.
2. Have a forester visit the class and show the use of an increment borer to see the rings in a tree without cutting it down, or an archeologist to tell how tree rings have been used to learn more about an archeological site near your school. You might link this with other lessons in this curriculum that suggest a visit by an archeologist, including “What Can Pot Sherds Tell Us About the Past” Activity 4, and “Making Pueblo Pottery” Extension Activity 3



## RESOURCES

### Books:

Lister, Robert and Lister, Florence, *Those Who Came Before—Southwestern Archeology in the National Park System*, Western National Parks Association, Tucson, AZ 1993 (ISBN 1-877856-38-X)\*\*\*

Panchyk, Richard, *Archeology for Kids, Uncovering the Mysteries of Our Past*, Chicago Review Press, 2001 (ISBN 1-55652-395-5) \*\*\*

U.S. Department of the Interior, *Intrigue of the Past, Discovering Archeology in New Mexico, manual of Project Archeology*; for information on workshops, contact the Heritage Education Team, Bureau of Land Management, Anasazi Heritage Center, PO Box 758, Dolores, Colorado, 81323, (303) 882-4811

Dendrochronology kit available for loan from Bandelier; 505-672-3861 x 517

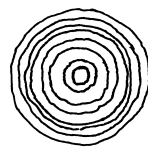
Teacher resource sheet, with tree ring drawings and dating diagram, at the end of this lesson plan

### Web Resources:

Bandelier website: [www.nps.gov/band](http://www.nps.gov/band)

Bandelier museum collection website: [www.cr.nps.gov/museum/exhibits/band](http://www.cr.nps.gov/museum/exhibits/band)  
(or go to the Bandelier website and click on the collections icon)





## READING TREE-RING DIAGRAMS

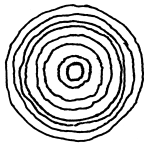
The tree-ring drawings in this activity are from imaginary trees, to make it easier to work with them. The kit available from Bandelier contains slices from various kinds of trees, if you and your class wish to go on to making your own diagrams after working with the fictional ones. These directions apply to use of the drawings.

The drawings portray cross-sections of three different trees of the same species (Ponderosa pine). Accompanying the cross-sections is a “master” diagram showing the widths of the rings formed over a series of years, with the years labeled.

To use the diagram, see the sketches of the steps involved. First, fold the drawing of a cross-section in quarters, with both folds going through the center of the circles. Notice that where the rings cross each folded edge, they look very much like the diagram. Lay either folded edge on the diagram, and slide it back and forth until the spaces between the rings line up with matching spaces on the diagram. Now, because you know what years are shown on the diagram, you can figure out what years each tree lived. Don’t be surprised if the rings on some drawings don’t exactly match the ones on the diagram. The overall pattern of numbers of thin and thick rings, as well as how thick or thin each one appears, should make it possible to determine which ones match. The answers are shown on the teacher’s resource version but not on the student version.

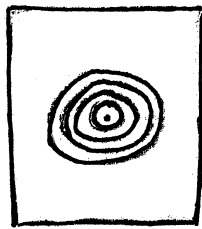
### Answers:

- A. Lived from 1398 – 1410
- B. Lived from 1374 – 1392
- C. Lived from 1381 - 1406



# Teacher Resource Sheet Tree-Ring Dating

## Using a Tree-Ring Diagram to Date a Sample



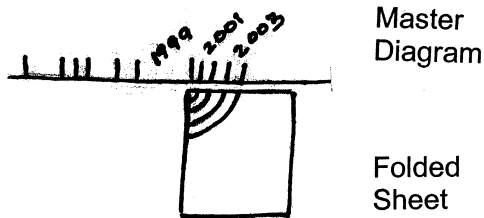
Step 1



Step 2

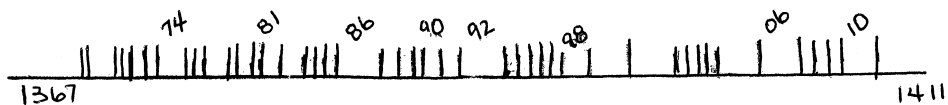


Step 3



Result: years shown are  
2000 – 2004

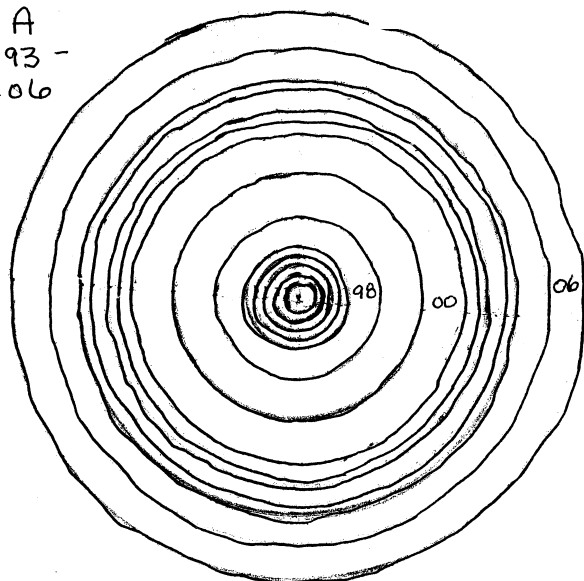
## Tree-Ring Master Diagram



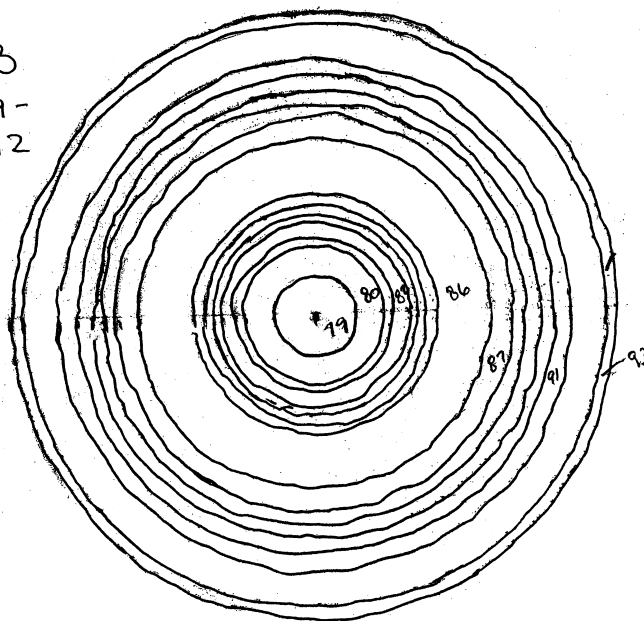


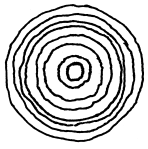
# Teacher Resource Sheet Tree-Ring Dating (Continued)

A  
1393 -  
1406



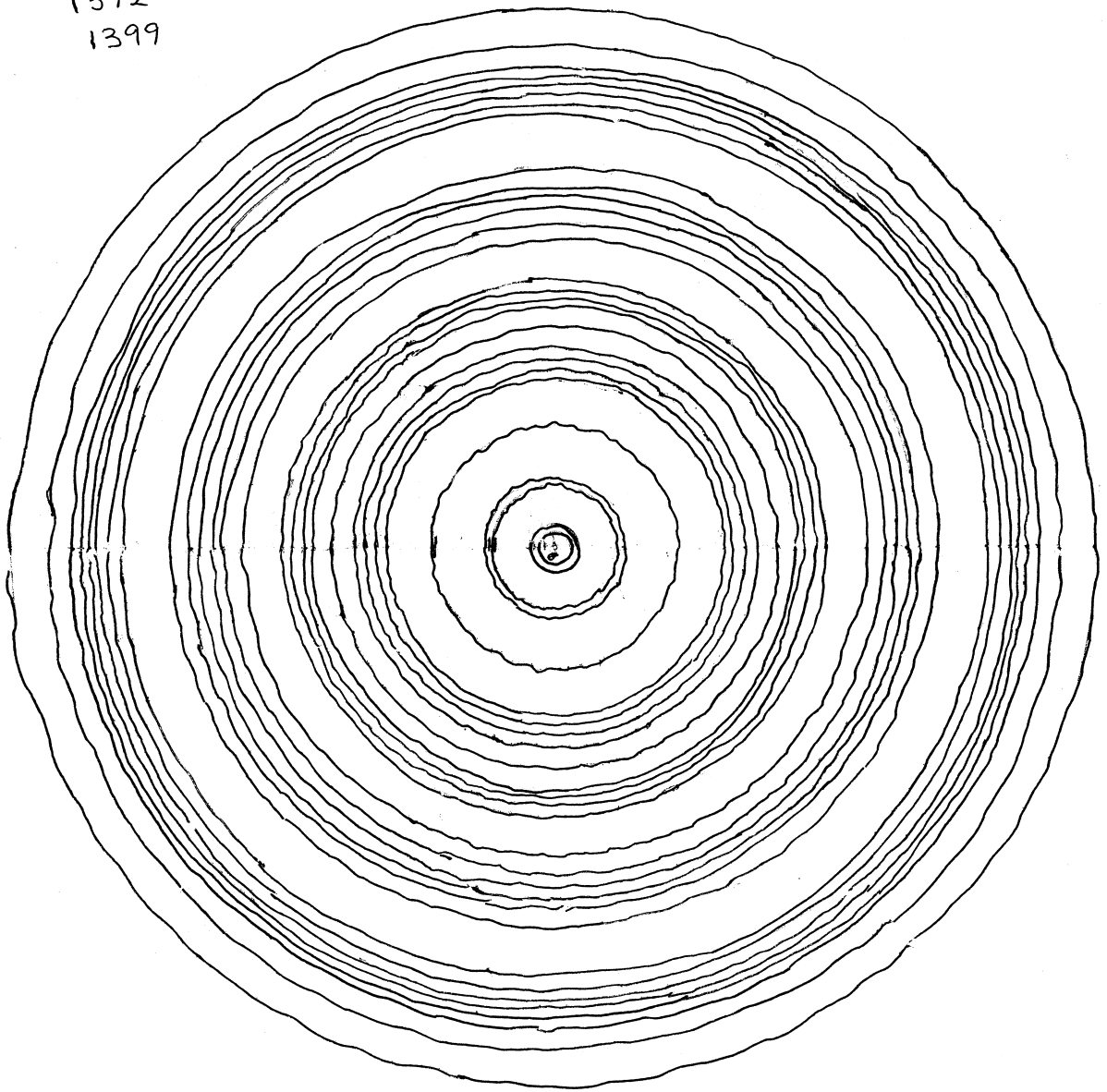
B  
1379 -  
1392

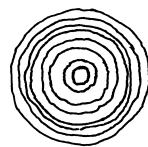




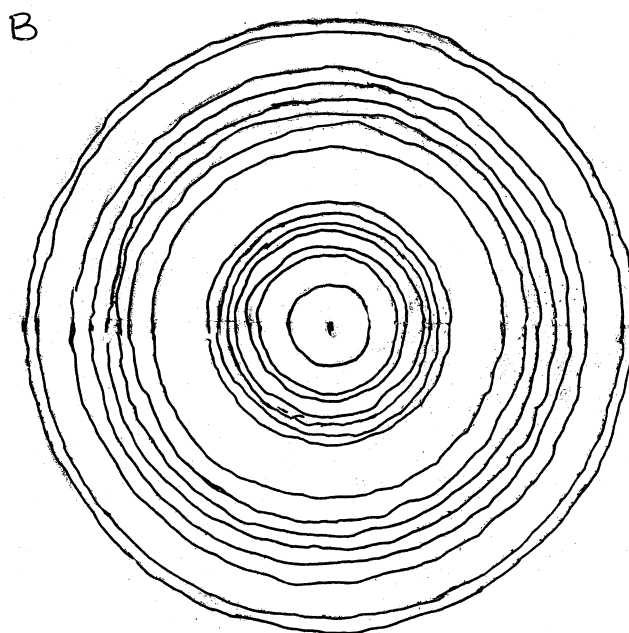
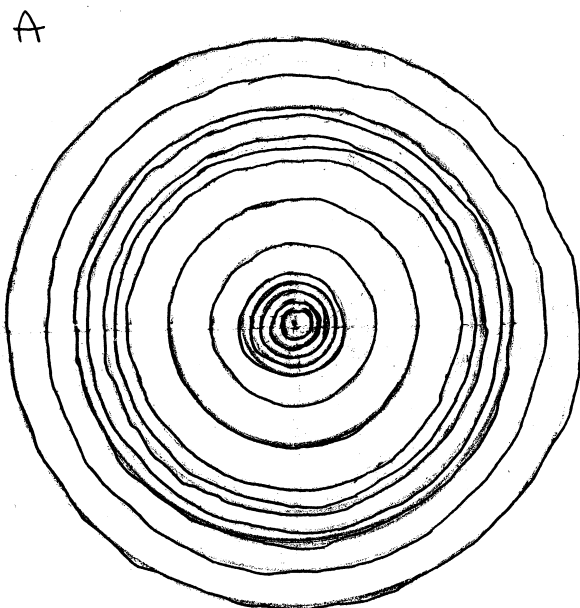
**Teacher Resource Sheet  
Tree-Ring Dating  
(Continued)**

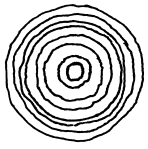
C  
1372 -  
1399





# Student Resource Sheet Tree-Ring Dating





**Student Resource Sheet  
Tree-Ring Dating  
(Continued)**

