



The Laboratory of Tree-Ring Research
The University of Arizona
 1215 E. Lowell Street
 Tucson, AZ 85721
<http://ltrr.arizona.edu/>

Lesson 2 Title: Observing the Past

Using the tree-ring record to reconstruct past events

Area: *This section related to ADE standards is to be completed by the K-12 educator. The study of tree-rings fits in to every strand/concept and can be connected to any subject area from Art History to Zoology! Need materials? Contact us at outreach@ltrr.arizona.edu

ACADEMIC STANDARDS:			
Unit (ADE Standard):	R__	M__	SC__
INDICATORS:			
Lesson Title (ADE Measurement Strand/Concept Criteria):	S_C_	S_C_	S_C_
Objectives:	PO:	PO:	PO:
1. List ecological events that may impact tree-growth 2. List anthropogenic (human) activities that may impact tree-growth 3. Identify tree adaptations 4. Describe several techniques used to analyze tree-growth			

Need: Students will learn about adaptation, events that impact tree growth and the utility that the tree-ring record provides to researchers studying complex interactions. Students will analyze paper tree cores and plot tree ring data in this lesson.

Time: 50 min.

Online Resources:

<https://www.youtube.com/watch?v=GvuLjhdEBoo>

Rex Adams talks about dendroclimatology in this great video!

<http://video.pbs.org/video/2330301577/>

Ron Towner talks about recording tree ring data

<http://www.12news.com/story/weather/talking-weather/2015/11/15/treering-time-travel/75837144/>

ABC News Phoenix talks about the tree-ring lab in Tucson

Realia (Tools, Equipment, and Supplies):

- Observing the Past Lesson Presentation
- Tree-ring cross sections or copies of tree-ring image laminates
- Paper cookies 1 and 2 handouts
- Crayons or colored pencils
- Core sample from your kit
- Sampling Presentation (optional)
- Cross-Matching Tree Core Sets
- Simplified Skeleton Plotting Handouts
- Connection to the internet to show a video/connect to a link (optional)
- Skeleton Plotting Worksheets and Answer Key
- Graph Paper and Scratch Paper to create your own tree rings to plot (optional)

Key Terms: (This is a comprehensive list of the vocabulary that may be helpful to review or introduce for this lesson and you may choose the terms that make sense for your grade level and classroom needs from this list for this lesson.) adapt, adaptation, analysis, analyze, anthropogenic, branches, canopy, chronology, climate, complacent, core, cross-dating, cross-section, Dendrochronologist, Douglas Fir tree, ecological, ecology, geography, geology, leaf structure, master chronology, Mesquite tree, natural variability, sensitive, skeleton plotting, standardization, standardizing, topography, tree species, trunk.

Bellwork Option 1: Ask students to answer the question of “What factors influence tree growth?”. (Note: A bellwork handout has been made for you and is included with this lesson plan in your Lesson 2 folder on your memory drive).

Bellwork Option 2: Ask students to answer the question of “What types of events might a tree experience?”. (Note: A bellwork handout has been made for you and is included with this lesson plan in your Lesson 2 folder on your memory drive).

Interest Approach:

State: We previously made observations and drew conclusions about tree growth and drew conclusion about events that impact tree growth and annual ring patterns.

Ask: What else did we talk about that is related to tree growth?

Ask: Does anyone remember what types of information is recorded in the tree-ring record?

State: Let’s make a list of the factors that impact tree growth. Great!

Ask: Is it correct to state that what we are really talking about is geography, topography, geology and even climate right?

Ask: So how does a tree adjust and react to these factors? Adaptation

Adaptation! Yes!

Ask: What does the term adaptation mean?

Ask: How does a tree adapt? Bark, leaf structure, canopy structure, branch structure etc.,.

State: From our discussion we see that trees adapt to their environment, and we describe trees as “sensitive” if they record many changes year to year in ring width and “complacent” if they have similar rings each year.

State: Let’s look as examples of sensitive and complacent trees.

Ask: Do you see the difference in the rings? Fantastic!

State: Lets look at another image.

Ask: Which of the two trees above is more likely to have **sensitive** growth? Why?

State: Noow you all get to be the Dendrochronologists – scientists who analyze tree-rings!

Ask: Do you each have two paper cookies? Which one do you feel is sensitive? Cookie 2.

Ask: Why? The dramatic series of narrow rings.

State: Take a moment to color the narrowest rings on both of your paper tree-cookies and label cookie 1 as complacent and cookie 2 as sensitive do that you can refer to it later.

State: As Dendrochronologists, ideal samples for you to study are sensitive because they yield more interesting information. Helpful clues for Dendrochronologists are characteristics of annual rings with distinct boundaries and lots of variability (sensitivity).

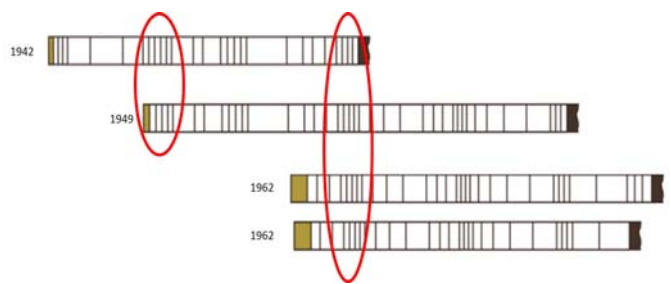
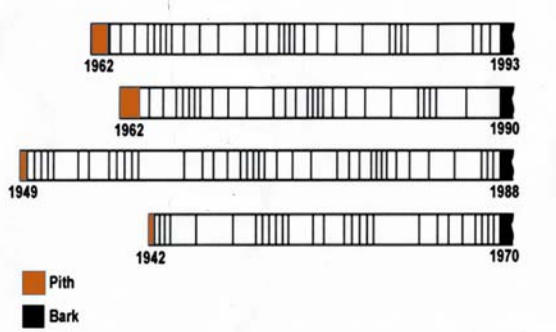
Check for understanding: 2 minute challenge: Ask students to: Write down 2 interesting items/concepts you have learned about dendrochronology.

State: Another way we can look at the events that occur in tree-growth is through a chronology, or a record of events over time. We are going to look at tree cores as they show the same information as we see in cross-sections or tree cookies.

Pass around the core sample from your kit. Note that the core mounted in the wooden frame is flat but when it is taken from a tree, it is sticky and round from sap. When researchers collect the cores, they are set to dry and then placed in wooden mounts and the top is cut or sanded to view more ring detail. (Note: Coring images and info is also in your folder in Lesson 2 on your memory drive. You can also sign up to bring your class to a field session and we can teach your class about coring and bring in more samples and instrumentation!)

Activity: Cross Matching Paper Cores

Have students color in narrow rings, then have them orient the core sets with the bark on the right and the pith on the left, Next have students order the cores with the earliest year on top. Now they can match the rings and hypothesize based on narrow and wide rings what events may have occurred over time and around which years.



Ask: Did the tree ring widths and patterns match?

Ask: What was the total length in years of your chronology? 1942 to 1993 (51 years)

Ask: What did you notice?

Ask: What did you wonder?

State: One reason for the patterns is that each tree species experiences an event differently. We call that natural variability as the tree rings vary from year to year. To standardize the patterns in a way that researchers can globally share tree-ring data we use a technique called skeleton plotting to illustrate variability.

State: Here is a video about skeleton plotting: <http://www.12news.com/story/weather/talking-weather/2015/11/15/treering-time-travel/75837144/>

State: Lets look at skeleton plotting together using an image of a core, a cross section or cookie, and an image of graph paper. Note that the graph paper has numbers on the top to show years in decades or 10 years in a section. Now let's examine our core and cross section, and count the rings and label year 1 and so on.

State: Next let us identify the narrowest and widest rings. Notice that here are also numbers on the bottom that indicate year 1 through the last year the tree was alive.

Ask: Does everyone see the number 1 here? That is the first year of growth.

State: Once the narrowest and widest rings are identified we can mark marks on each year of life to show if the rings were wide or narrow. Narrow rings are the longest lines, widest rings are the shortest lines.

Ask: Does everyone see where wide, average and narrow are indicated here? Great!

Walk students through marking the narrowest rings and the widest rings.

Have students watch you label or demo the skeleton plotting. (Note that there is Skeleton Plotting worksheet in your Lesson 2 folder on your memory drive.)

State: once the narrow and wide rings are indicated by year on the graph paper we get a chronology and we can match those events to a master chronology that reflects previous research and collections of data from a series of trees in a certain location.

State: That tree ring chronology goes back 8-10,000 years in some cases! Here we can visit a link that shows where this type of information is shared:

Visit the International Tree-Ring Data Bank here:

<https://www.ncdc.noaa.gov/data-access/paleoclimatology-data/datasets/tree-ring>

State: We can also use a process called cross-dating where we look at different sources of wood and match the events or activities that impacted the growth or use of the tree. Here is an image of the types of information that we can use to learn more about samples collected. In some cases we can

go back to the exact year, in other cases we have to use clues such as the tools used to harvest the wood, to understand how old the tree may be and perhaps we can match it to an era. Dendrochronologists also examine charcoal (fire wood) as you can see rings in some samples and petrified wood!


Summary (Teacher): The teacher will ask questions to help the students summarize the lesson and then has the option to show this video from ABC News:

<http://www.12news.com/story/weather/talking-weather/2015/11/15/treering-time-travel/75837144/>
ABC News Phoenix talks about the tree-ring lab in Tucson

Conclusion (Student):


 **Crayon Moment :** This moment inspires learners to draw images to support concepts and create visual connections to the lesson.

Students will be asked to draw one example of an event that impacts tree growth, or b) list and draw 2 natural events, and 1 human activity that impact tree growth as their ticket out. (Note: A Ticket Out handout has been made for you and is included with this lesson plan in your Lesson 2 folder on your memory drive).

 **Go With The Flow Moment:** This moment encourages learners create flow charts to organize information or concepts.

You may also ask the students to label their drawings or create a flow chart with arrows on their drawings to demonstrate events or factors that influence or impact tree growth. (Note: A Ticket Out handout has been made for you and is included with this lesson plan in your Lesson 2 folder on your memory drive).

Application: Students can explore the many ways that the tree ring record is applicable. (Note that in your “readings” folder in your memory drive there are multiple samples for learners to read including the Bear Essential News Article on DendroClimate that connect tree rings to every-day items. You also have a suggested reading list within your workshop presentation on your memory drive).

 **Extended Classroom Activity:** Students can research the average age of a specific tree species that is found on school property and then examine precipitation and temperature records as well as any information on when the tree may have been planted by interviewing school staff about the tree.

Eyewitness Moment: Interviewing school staff about what they know about the tree on the school grounds is a great way for learners to formulate questions for an interview and report on an event and then fact check using precipitation and temperature data related to trees in that area. Perhaps the tree was planted before or after the school was built and that gives you an estimate of how old the tree may be! Who knows what memories everyone has of the trees right in their own yard or on school grounds!

 **Almanac and Encyclopedia Moment:** moments when learners use resource materials such as websites. Students may also visit the Laboratory of Tree-Ring Research

Facebook Page and research what activities we have been doing right here in Tucson!

LTRR Facebook Page <http://goo.gl/2qRGqS>

Evaluation: Students will be evaluated by short activities, periodic quizzes or exams based on grade level and classroom needs.