

# **DENDROCHRONOLOGY FOR GIFTED AND TALENTED MIDDLE SCHOOL STUDENTS: DETERMINING THE AGE AND PAST ENVIRONMENTS OF THE BLACK FOREST REGION, COLORADO, USA**

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## **Abstract**

At the El Paso County Fox Run Regional Park there has been an attempt to lessen the threat of wildfires. Nearly seventy percent of the younger trees have been cut down as well as about fifty percent of older trees. There are two species of trees present; Ponderosa Pine and Douglas Fir. The numerous stumps are available for dendrochronology investigations. Students from Colorado Springs, District 11 visit the site during a six-week field course. Students develop answers to the following questions by investigating a minimum of 25 tree stumps: 1) How old was the tree when it was cut down? 2) How many years of growth are there per inch of tree radius? 3) What evidence is available to determine the relative amount of precipitation? and 4) Was there any evidence of insect damage or wildfires? In

addition, the students develop tables and illustrations which show the changing environments during the life of the trees. They also compare the topographic location versus the type of the tree and try to develop a short paper about what they believe is the reason for the relationships observed.

Several trees are cored with an increment borer and that data is compared to the data determined from the stump study. Using computer spreadsheets helps the students to better visualize the differences between the stumps and the cores. Old newspaper stories and data from government Internet sites help in developing an overall understanding of the past history of the forest. This information is used to relate the differing climatic events and the last 350 years of human history in the region.

Not only does the field investigation develop an understanding of time, but assists in writing capability, mathematics, and the need for careful development of scientific studies. By comparing the field data to human history the students gain a further understanding of the passage of time.

# Introduction to the Fox Run Park Tree-ring Field Investigation

The present is the key to the past and conversely the opposite may often be true. In addition, both the present and the past may help predict the future. These statements do not mean that the conditions throughout time are exactly the same but that similar types of influences affect similar types of processes. Dendrochronology is a technique that can be used to verify the statements above.

## “What is Dendrochronology?”

Dendrochronology is the dating and study of annual rings in trees. The word comes from these roots:

ology= the study of  
chronos=time; more specifically, events and processes  
in the past  
dendros=using trees; more specifically, the growth  
rings of trees”

<http://www.ltrr.arizona.edu/dendrochronology.html>



# Information about Tree-rings

The growth of tree-rings and their subsequent investigation can help us gain a considerable amount of information about the events at a specific location:

- Type of climate
- Variability of climate
- Wildfire events
- Insect infestations
- Past human events such as logging and development
- Help understand environmental conditions and processes
- Place the present happenings into the historical context
- Develop an understanding of future events

A annual tree-ring develops due to a variety of factors:

- Climatic differences such as solar radiation, wind, temperature, moisture
- Other climatic differences that occur within and throughout the forest
- Geomorphic differences such as slope orientation and gradient, soil properties
- Physiology of the tree
- The age related growth trend due to normal physiological aging processes.
- The occurrence of factors from *outside* the forest stand

The more a tree's rate of growth has been limited by the above environmental factors, the more variation in ring to ring growth will be present. This variation is referred to as *sensitivity* and the lack of ring variability is called *complacency*. You will determine the amount of sensitivity and complacency of the forest from your collected data. In addition, a number of tree samples must be examined and cross dated from any given site to avoid the possibility of all the collected data showing a missing or extra ring.

## **General Field Assignment**

You will complete a statistical analysis of the data you collected at Fox Run Park by following the directions listed and explained in your field assignment sheet below. Notice all the stumps throughout the forest. The stumps are what you will use to complete this field assignment.



An illustration of the many stumps that is available for data collection.

To determine what type of tree the stumps are look at the standing trees and observe the differences in the bark.

## Field Assignment

Use the following table and the formulas included with the assignment to determine the age of trees by their diameter at Fox Run Park. Compare the results from tree to tree and develop an understanding of the wet versus dry periods during the past 100 years. Are there any long term droughts or wet periods evident?

Develop a technique to show your results.



Students investigating Fox Run Park

### Procedure:

1. Find as many cut trees as you can with the time you are given. You will also be able to use tree cores collected by your instructors. A photograph of such a core is shown in the next photograph.



2. Identify the type of tree. There are Douglas firs and Ponderosa pines.
3. Count the tree rings. There are two rings per year; a light and dark ring.

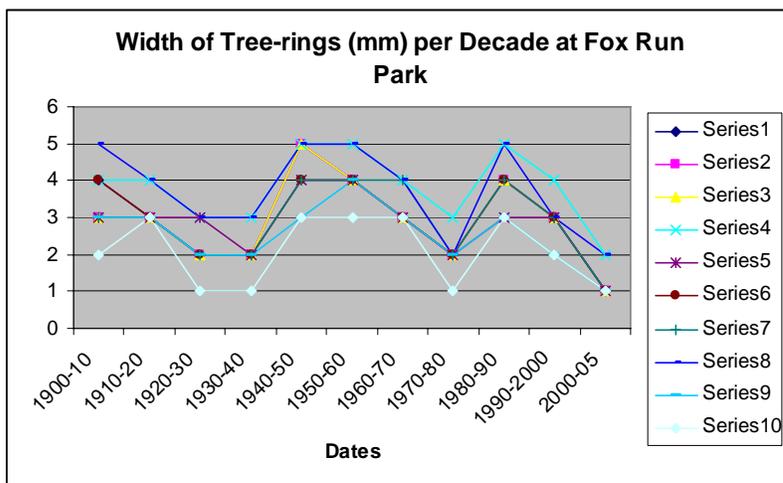




Not just tree-rings were available for study. Evidence of animals were also present.



The following chart and data set is an example of the data collected by one of the GT students.



| Years   | 1900-10 | 1910-20 | 1920-30 | 1930-40 | 1940-50 | 1950-60 | 1960-70 | 1970-80 | 1980-90 | 1990-2000 | 2000-05 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----------|---------|
| Tree 1  | 4       | 3       | 2       | 2       | 5       | 4       | 3       | 2       | 4       | 3         | 1       |
| Tree 2  | 3       | 3       | 2       | 2       | 5       | 4       | 3       | 2       | 4       | 3         | 1       |
| Tree 3  | 3       | 3       | 2       | 2       | 5       | 4       | 3       | 2       | 4       | 3         | 1       |
| Tree 4  | 4       | 4       | 3       | 3       | 5       | 5       | 4       | 3       | 5       | 4         | 2       |
| Tree 5  | 3       | 3       | 3       | 2       | 4       | 4       | 3       | 2       | 3       | 3         | 1       |
| Tree 6  | 4       | 3       | 2       | 2       | 4       | 4       | 3       | 2       | 4       | 3         | 1       |
| Tree 7  | 3       | 3       | 2       | 2       | 4       | 4       | 4       | 2       | 4       | 3         | 1       |
| Tree 8  | 5       | 4       | 3       | 3       | 5       | 5       | 4       | 2       | 5       | 3         | 2       |
| Tree 9  | 3       | 3       | 2       | 2       | 3       | 4       | 3       | 2       | 3       | 2         | 1       |
| Tree 10 | 2       | 3       | 1       | 1       | 3       | 3       | 3       | 1       | 3       | 2         | 1       |

Average width of tree-rings in millimeters per decade

The data shows a cycle of wet and dry periods. Trees 9 and 10 were on a ridge. Trees 4 and 8 were in a valley. The trees location may explain why there are some difference from the other trees. All of the trees were Ponderosa pines. As the present drought continues it will be interesting to see what the tree-rings will be like after the next five years.

## Useful Definitions

The following definitions will assist you in understanding and completing your investigation:

### dendroarchaeology

The science that uses tree rings to date the age of trees used in the construction of human habitations and when the tree was cut.

### dendrochronology

The science that uses tree rings dated to their exact year of formation to analyze temporal and spatial patterns of processes in the physical and cultural sciences.

dendroclimatology

The science that uses tree rings to study present climate and reconstructed past climate.

dendroecology

The science that uses tree rings to study factors that affect the earth's ecosystem.

dendroentochronology

The science that uses tree rings to date and study the past dynamics of insect populations.

dendrogeomorphology

The science that uses tree rings to date earth surface processes that created, altered, or shaped the landscape.

dendroglaciology

The science that uses tree rings to date and study past and present changes in glaciers.

dendrohydrology

The science that uses tree rings to study changes in river flow, surface runoff, and lake levels.

dendropyrochronology

The science that uses tree rings to date and study past and present changes in wildfires.

increment borer

An auger-like instrument with a hollow shaft that is screwed into the trunk of a tree, and from which an increment core is extracted using an extractor.



tree ring

A layer of wood cells produced by a tree or shrub in one year, usually consisting of thin-walled cells formed early in the growing season and thicker-walled cells produced later in the growing season. Both seasons wood form one annual ring, which usually extends around the entire circumference of the tree.

## **Internet Sites to Visit**

[www.dendrochronology.com](http://www.dendrochronology.com)  
Dendrochronology Laboratory

Oxford

[www.ltrr.arizona.edu/dendrochronology.html](http://www.ltrr.arizona.edu/dendrochronology.html)     The  
Laboratory of Tree-Ring Research

[www.ltrr.arizona.edu/exercises.html](http://www.ltrr.arizona.edu/exercises.html)     Instructional cross-  
dating exercises - **Exercises**

[www.ltrr.arizona.edu/skeletonplot/introcrossdate.htm](http://www.ltrr.arizona.edu/skeletonplot/introcrossdate.htm)  
Cross-dating tree rings using skeleton plotting –  
**Exercises**

[www.plantbio.ohiou.edu/dendro](http://www.plantbio.ohiou.edu/dendro)     Introduction to  
dendrochronology

[web.utk.edu/~grissino](http://web.utk.edu/~grissino)     Ultimate tree-ring web pages