## *Teaching Activity: Tree Rings: Clues to Time and Cycles*

***Introduction:*** Tree growth depends on environmental factors including location, surrounding foliage, water and temperature. The yearly variance of these factors may be reflected in the tree's annual growth rings. Counting these growth rings gives a fairly accurate account of the tree's age. The wider the rings, the more growth; the narrower the rings the less growth due to drought or cold cycles. Because the amount of water in the environment varies from year to year, scientists use tree ring patterns to reconstruct regional patterns of drought and climate change.

This field of study known as *dendochronology* was begun in the early 1900's by an American astronomer Andrew Elliot Douglass. Douglass was investigating a possible connection between sunspot activity and droughts using pine trunk cross sections to study their annual growth rings.

To determine whether changes now occurring in climate are part of the Earth's normal pattern or are caused by human activity, scientists rely on the history of climatic changes both locally and globally. These changes are revealed from tree rings, as well as from ice cores, pollen samples, and the fossil record. Computers takes the data from these sources and try to detect possible patterns and cycles from them. Large data bases then allow the scientists to compare ring records and construct large regional maps of former climates. So far, this evidence suggests that climatic change is simply a part of life on Earth.

***Objective:***

- To analyze growth rings of trees;
- To determine what information can be determined about tree growth and environmental conditions from analyzing a cross section of a tree trunk;

***Important Terms:*** Tree trunk cross-section, environmental factors, growth rings, cambium, sapwood, pith, heartwood, capillary passages, nutrients, bark, leaves, roots, diameter, radius, circumference;

***Materials:*** Cross sections of a tree trunks, or paper copies of tree trunk cross sections, metric rulers or tapes, graph paper, paper/pencil;

***Procedure:***

1. Pass out copies of the **Tree Growth Information Sheet** and make a transparency of the cross-section on this sheet as well as the drawing of the **Parts of a Tree.**
    - Read and discuss with the class while referring to the overhead.
    - In **Part I** of the **Student Activity Sheet #1**, students should label the parts of a tree cross section using the terms from the **Tree Growth Information Sheet.**

2. Distribute tree cross-sections or paper copies of tree cross sections to groups with measuring tapes .

3. Students should measure the diameter of the slice.
   - They should then multiply the diameter by $\pi$ (3.14) to find the circumference:

**Circumference = 3.14 x Diameter**

**(NOTE: Students should measure the circumference with the tape measure to be sure they are correct.**

4. Students should check the location of the pith which can be found in the center of the cross-section.
   - Students should then count off the rings from the center out. Each ring represents a year's growth.
   - Students should count the rings out from the pith and measure the width of each ring.
   - Students should record this data on a separate sheet of paper.

5. Students should mark off each decade and then figure the percent of growth for each ten year period. This is done by dividing the measured section by the total radius and moving the decimal two places to the right:

**Example: Total radius = 40 cm  1st decade = 15 cm**

**15 cm /40 cm = .375 = 37.5 %**

**OR**

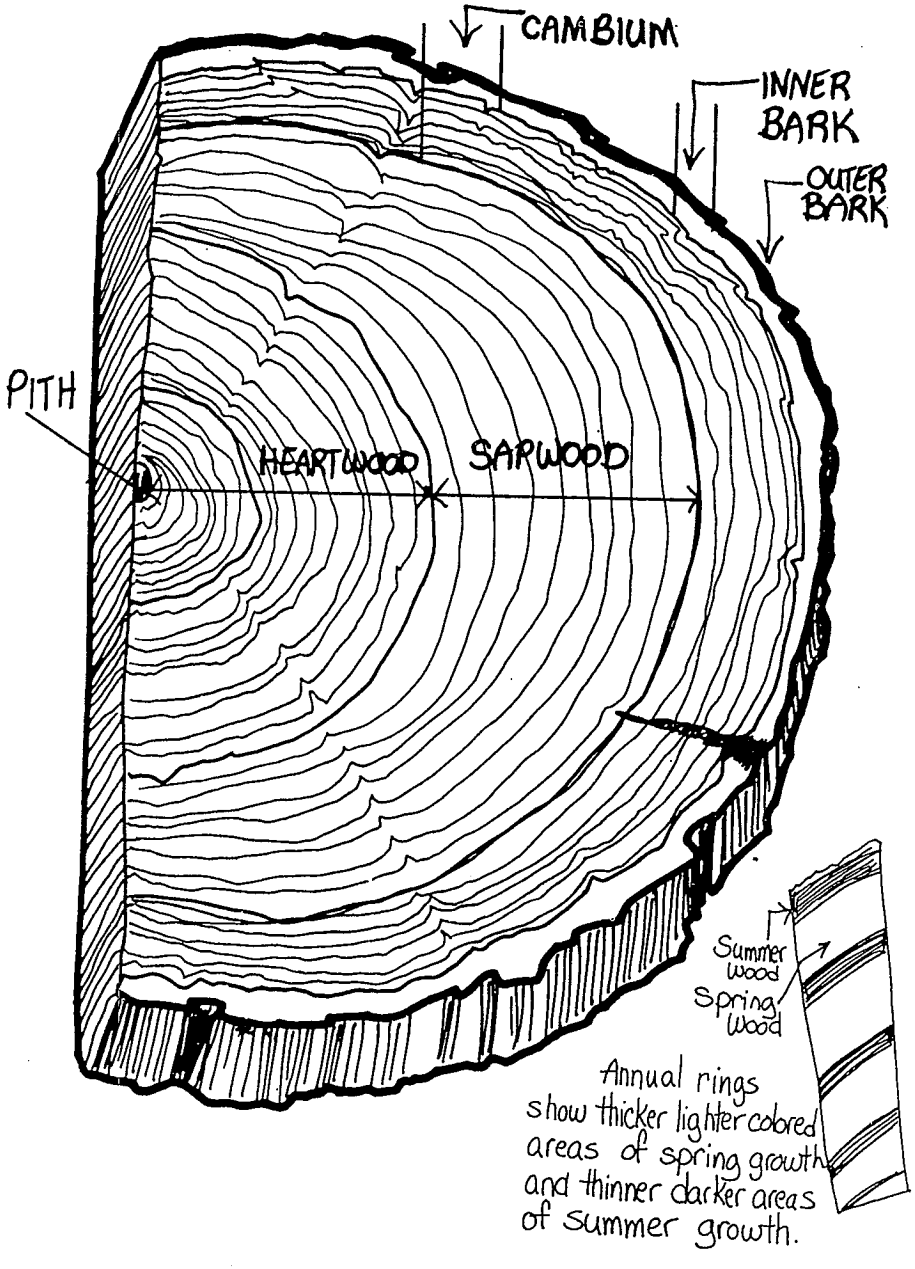
**In the first ten years of growth this tree received about 38% of its growth.**

6. In **PART II**, students should create a simple bar graph of the tree's growth over time.

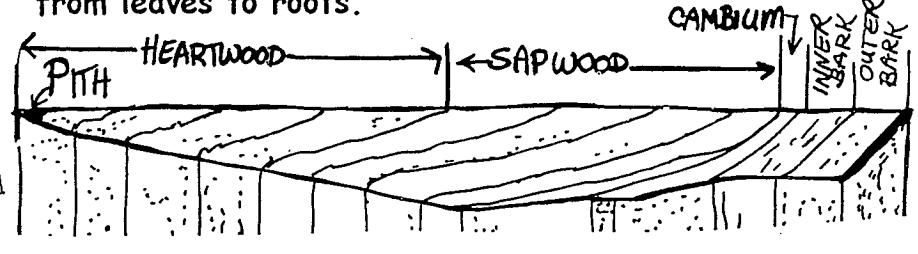
7. In **PART III**, students should create another graph showing the % of growth for the tree over time.

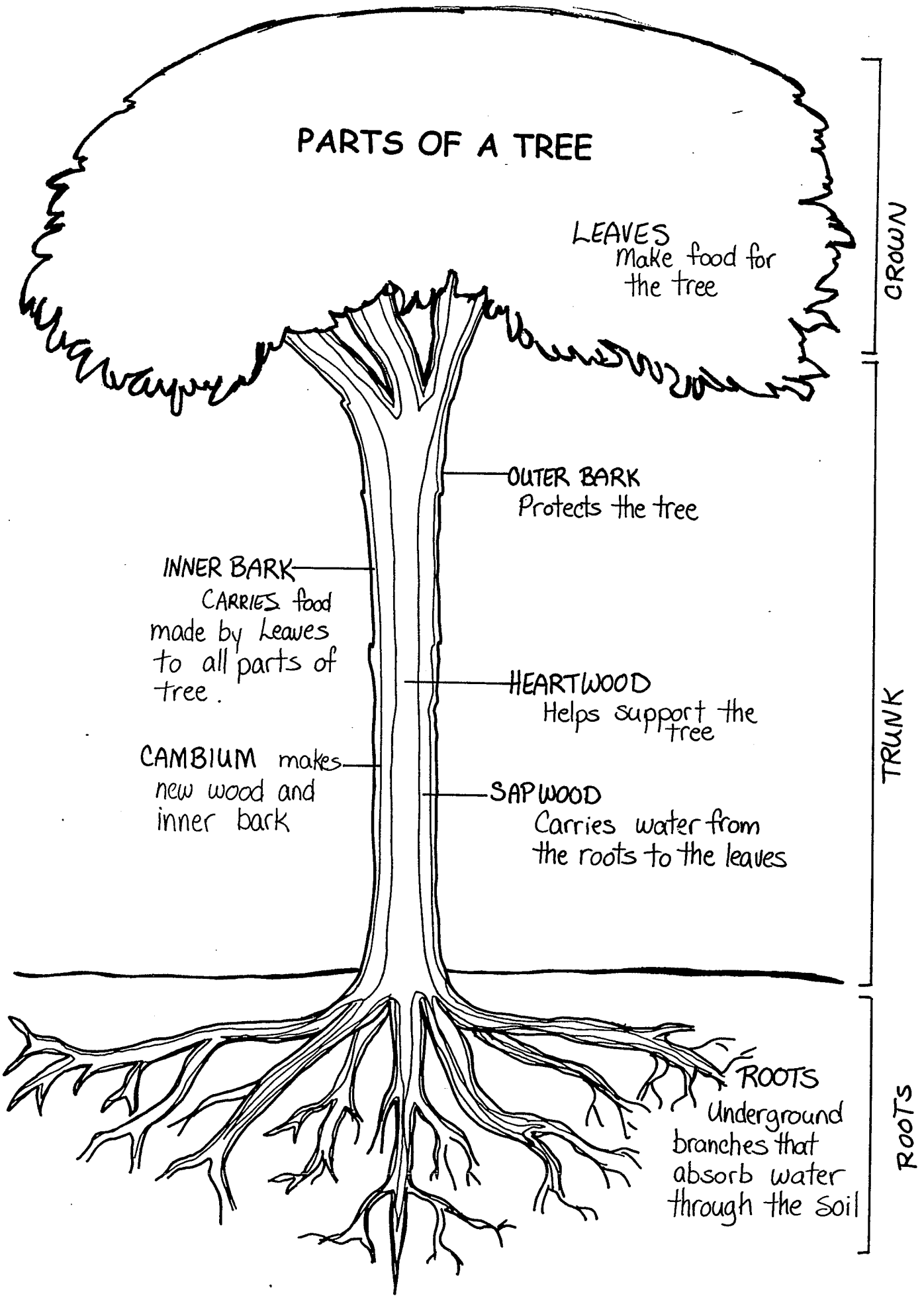
8. Students should then answer the questions in **PART IV**: **Analysis and Comprehension**.

# TREE GROWTH INFORMATION SHEET




Counting tree rings gives a fairly accurate account of a tree's age. The wider the rings, the more growth, the narrower the rings, the less growth due to drought or cold cycles. Growth occurs in a small microscopic layer of the tree called the CAMBIUM. The other parts if the tree are basically dead. The PITH is the center of the rings and its position, whether in the exact center or off to the side can indicate growth factors such as the amount of shade coming from surrounding plants. The HEARTWOOD is the darker area surrounding the pith that consists of closed up CAPILLARY PASSAGES, or tiny tubes which carry fluid from one part of the tree to the other. This former sapwood now serves as the fortification of the tree. The next layer is the SAPWOOD. It serves as the transportation system for fluids and nutrients to pass up the tree to the outer branches and leaves. The CAMBIUM layer is next. As it produces cells, the tree grows. The inner cells becomes sapwood and the outer cells become the INNER BARK. This moist layer will dry and help replace the rough exterior layer or OUTER BARK. The inner bark helps transport fluids down the tree from leaves to roots.




PARTS OF A TREE
LEAVES
Make food for the tree
CROWN
OUTER BARK
Protects the tree
INNER BARK
CARRIES food made by Leaves to all parts of tree.
HEARTWOOD
Helps support the tree
CAMBIUM makes new wood and inner bark
SAPWOOD
Carries water from the roots to the leaves
TRUNK
ROOTS
Underground branches that absorb water through the soil
ROOTS

## *Student Activity Sheet: Tree Rings: Clues to Time and Cycles*

***Introduction:*** Tree growth depends on environmental factors including location, surrounding foliage, water and temperature. The yearly variance of these factors may be reflected in the tree's annual growth rings. Counting these growth rings gives a fairly accurate account of the tree's age. The wider the rings, the more growth; the narrower the rings the less growth due to drought or cold cycles. Because the amount of water in the environment varies from year to year, scientists use tree ring patterns to reconstruct regional patterns of drought and climate change.

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***Objective:***

- To analyze growth rings of trees;
- To determine what information can be determined about tree growth and environmental conditions from analyzing a cross section of a tree trunk;

***Procedure:***

1. Read and discuss the **Tree Growth Information Sheet** with your teacher, as well as the drawing of the **Parts of a Tree** sheet.
   - Label the parts of a tree cross-section **( PART I )** using the terms from the **Information Sheet**.

2. Measure the diameter of the tree slice that is assigned to your group with a measuring tape.
   - Find the circumference using the formula below:
     **Circumference = 3.14 x Diameter**

   ** **Measure the circumference with the tape measure when you are done to be sure the computation is correct.**
   - Record your answer on a separate sheet of paper.

3. Find the pith at the center of your cross-section.
   - Count the rings out from the pith and measure the width of each.
   - Record this data on a separate sheet of paper.

4. Count off the rings from the center out and figure the percent of growth for each ten year period.
   - This is done by dividing the measured section by the total radius and moving the decimal point two places to the right.

     **Example: Total radius = 40 cm 1st decade = 15 cm**

     **15 cm/ 40 cm = .375 = 37.5%**

     **This means that in the first ten years of growth this tree received about 38 percent of its growth.**

   - Record this data on a separate sheet of paper.

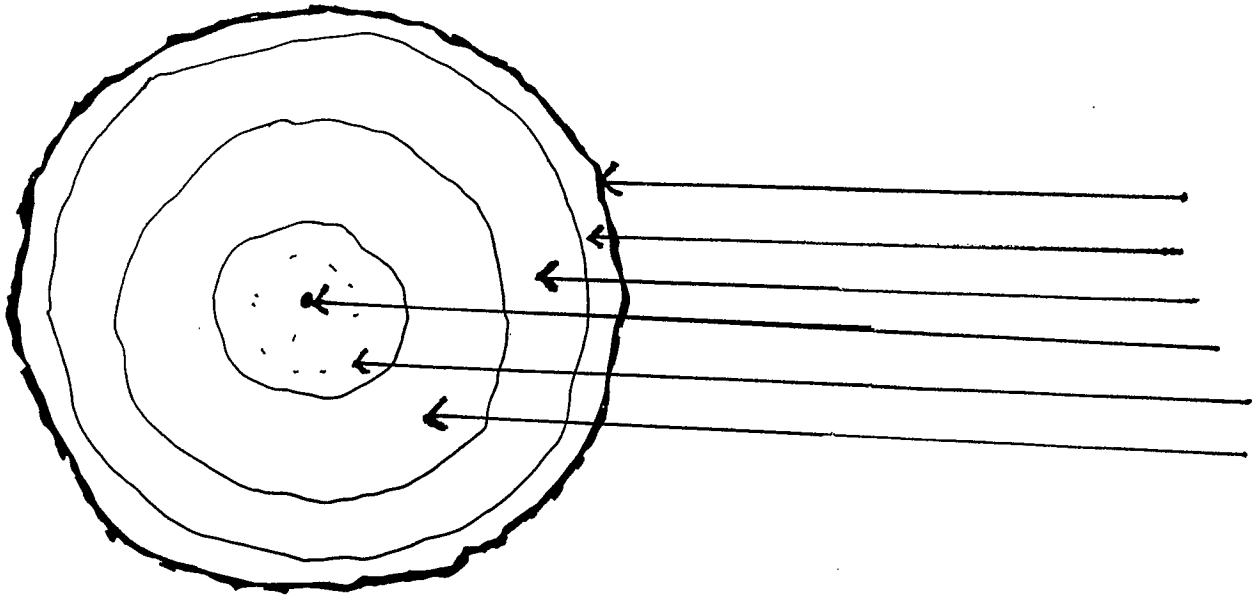
5. Create a simple bar graph in **PART II** of the tree's growth over time using the data you recorded.
   - Use a different color for each piece of information.

6. Create another graph in **PART III** showing the percent of growth by the tree over time.

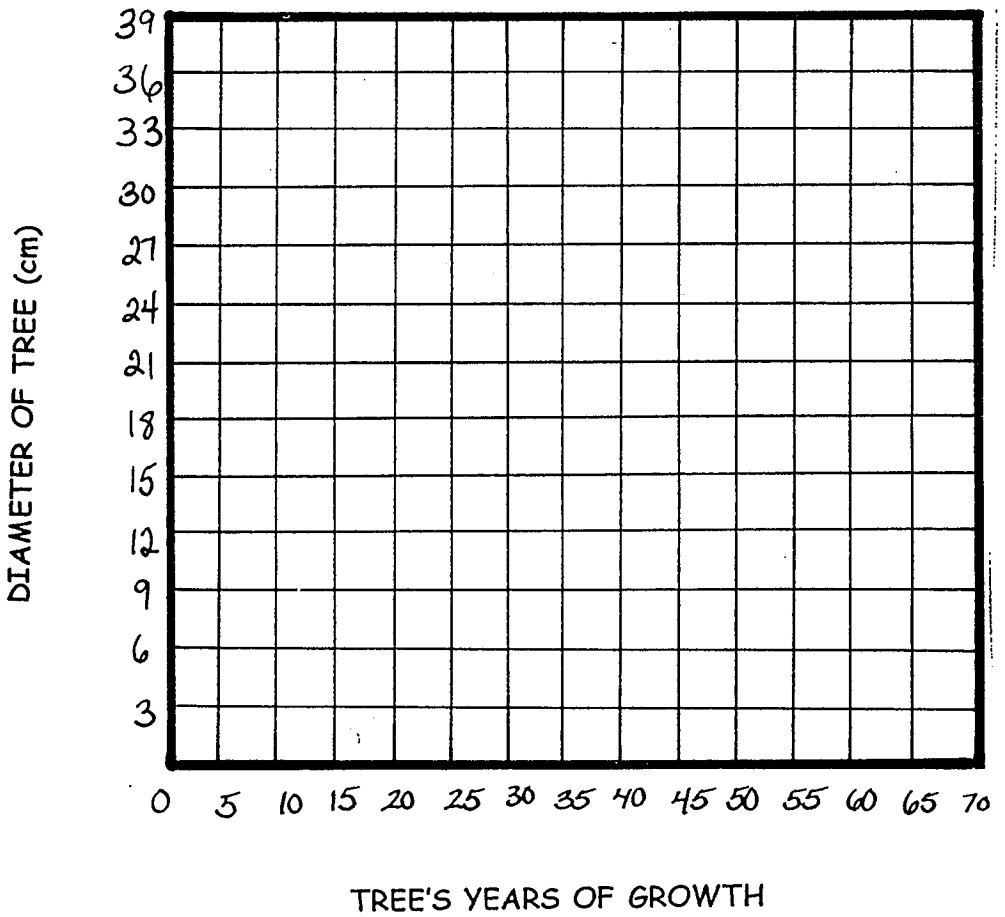
7. Answer the questions in **PART IV: ANALYSIS AND COMPREHENSION.**

STUDENT ACTIVITY SHEET #1:TREE RINGS:CLUES TO TIME AND CYCLES

PART I: PARTS OF A TREE CROSS SECTION

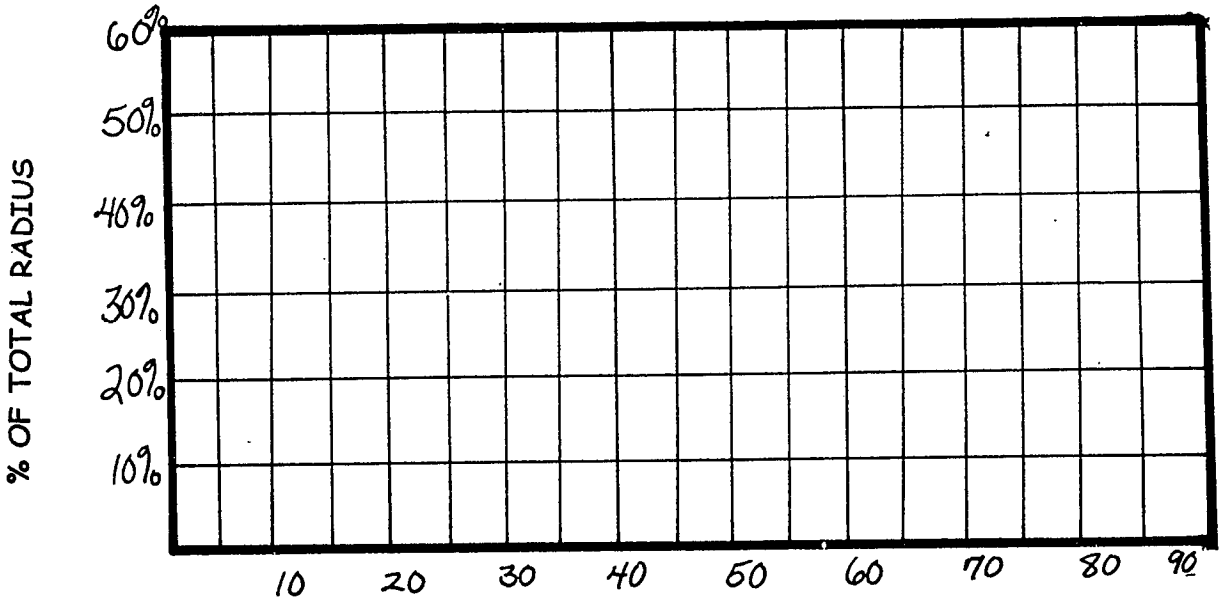


PART II: TREE'S GROWTH OVER TIME



STUDENT ACTIVITY SHEET #1:TREE RINGS:CLUES TO TIME AND CYCLES

PART III: % OF GROWTH OVER TIME




PART IV: ANALYSIS AND COMPREHENSION

1. Of what value are tree cross-sections to climatologists and others interested in Earth's past climate conditions? Why?_____

_____

_____

_____

2. What kind of information does the width of the growth rings give scientists?

_____

_____

_____

3. In which layer does the growth of a tree occur? _____

**Student Activity Sheet # 1**

4. Is this area considered alive or dead? _____

5. Does any growth occur in the other layers? Why? _____
_____

6. What is the PITH ? _____

7.What factors might affect the location of the PITH? _____
_____

8. How can you tell the difference between the HEARTWOOD and the SAPWOOD? The INNER BARK and the OUTER BARK? _____
_____
_____
_____
_____

9. What is the constant when you divide the circumference by the diameter? What is the relationship between the diameter and the radius? _____
_____
_____
_____

10. When does a tree have its greatest percent of growth? _____
_____

11. Are the tree rings all the same size? What might account for the different widths in the rings? _____
_____
_____
_____
_____

12. Do you think there will be a relationship between trees within a certain area? Why?_____
_____
_____

13. What was the circumference of your tree cross section? _____