Student Sheet 1

PROBLEM SOLVING ACTIVITY: READING BETWEEN THE RINGS

One way scientists are learning about past climate is by studying tree-rings. This field of research is known as ***dendrochronology***. Scientists can use tree rings and cores to measure the age of a tree and learn more about the local climatic conditions the tree experienced during its lifetime.

In temperate areas, like most of the United States, trees only grow during the part of the year called the ***growing season***, the length of which depends on the climate in a particular location. During each growing season, the trunk of the tree grows thicker, producing a layer of new wood called a ***tree ring***. It's possible to see the boundary between one ring and the next because of differences in the color of the wood. Early in the growing season, trees grow relatively quickly and produce less-dense, paler wood. Near the end of the growing season, they produce denser, darker wood. The light-colored rings are the wood that grew in spring and early summer, while the dark rings indicate growth in late summer and fall. So, a light ring and dark ring together represent one year of growth. A ***sapling*** (young tree) grows much faster than an adult tree. A cross section of an older tree shows rings that are broad at the beginning of its life (in the center) but that become progressively smaller. An old tree produces very narrow rings and its diameter and height growth are slower.

Student Sheet 2

Trees generally grow more during wetter growing seasons with favorable temperatures, forming wider rings. Narrow rings may be caused by stressful periods such as droughts. Although tree rings only record conditions during the growing season, droughts can build up over many months or even many years, so a lack of rain or snow in the winter can lead to poor growing conditions in the spring. Because tree rings are sensitive to local climate conditions such as precipitation and temperature, they give scientists some information about an area's past local climate or "micro-climate." For example, rings generally grow wider in warm, wet years and thinner in cold, dry years. When faced with extremely stressful or unfavorable conditions, a tree might hardly grow at all.

a. Narrow rings do not only signify a lack of sun or water. A forest fire may have damaged the tree's crown and slowed its growth. Defoliation by insects or fungi can have the same effect. After several years, this tree gained strength and returned to normal growth.

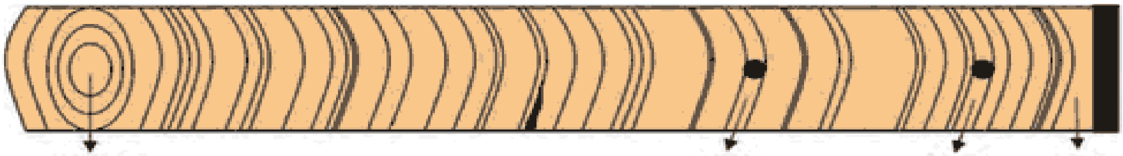
This tree had a rough time during its first ten years and grew very slowly. It probably was not receiving enough sunlight. Later on someone helped it by cutting the large trees around it to give it more light.

This tree doesn't have its heart wood in the right place. It shows off-center growth. If the tree was in a location exposed to high winds, its wood would grow faster (wider rings) on the side away from the wind than on the side facing the wind.

Student Sheet 3

This cross section probably comes from a tree that was leaning. The tree formed ***reaction wood*** (compression wood) that enabled it to straighten up. The wider rings are on the underside of the leaning trunk because growth was faster there. There are waves in the outer bark on the left side. There was probably a branch there at one time.

Another method that is used to gain information from trees about past climates is called a ***core sample***. Scientists use a tool called an ***increment borer*** to drill a small hole in the tree and extract the rings without killing it. The core can be measured and used in place of the whole cross section of a tree trunk. The actual core sample takes a small (0.200 inch diameter) straw-like sample from the ***bark*** (outermost layer) to the ***pith*** (center) of the tree. Though this hole is small, it can still introduce decay in the trunk



On the core above, are 50 years of tree-ring information. By counting the tree-rings backward from the bark (2007) to the pith it is possible to calculate the when the tree started growing. Every decade is marked with a dot. The tree rings are the white spaces between the lines. The variation in the tree-ring width was caused by climate conditions in the region where the tree grew.

By studying tree rings and core samples as well as other clues in our environment, scientists have learned that there have been times when most of the planet was covered in ice, and there have also been much warmer periods. Tree rings alone cannot tell us whether human activities are responsible, but they do help by revealing patterns that scientists can investigate further.

Student Sheet 4

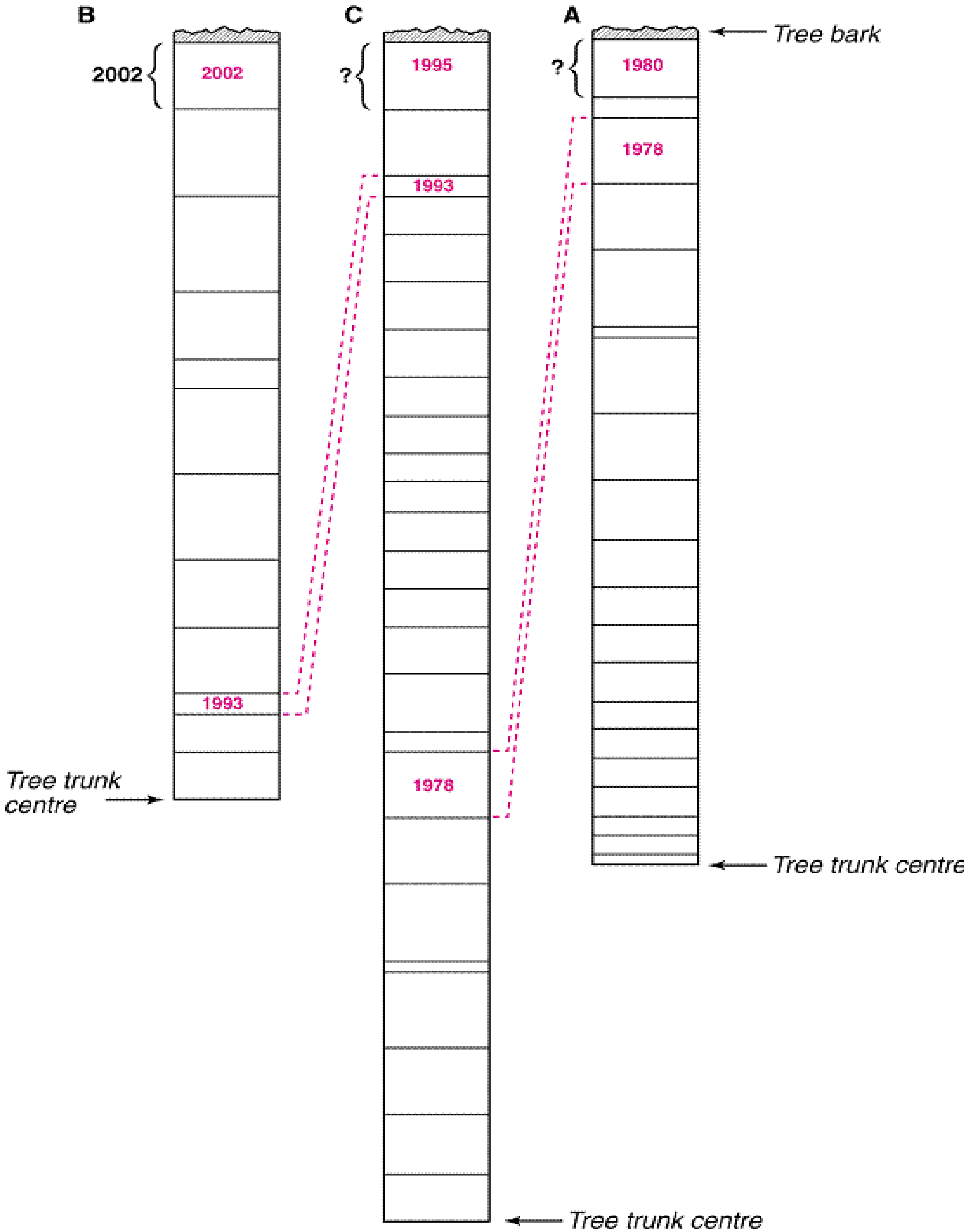
DATA TABLE 1:

NO. OF CORE SAMPLE	AGE OF TREE	YEAR TREE WAS CUT	YEAR GROWTH BEGAN

GRAPH 1: TREE RING WIDTH

Student Sheet 5

FIGURE 1



Student Sheet 6

ANALYSIS:

1. Which core sample is the oldest?
2. How old was Tree A when it was cut?
3. How many years ago did Tree B start growing?
4. How old was Tree C when it was cut?
5. List the years that indicate drought conditions.
6. How many dry cycles were there? (2 or more years)
7. Is there a pattern to the droughts?
8. How many wet cycles were there? (2 or more years)
9. Compare the ring for the year you were born with the ring for 2002. How do they compare? Note down any similarities or differences. What might have caused these?
10. What does your graph of tree-ring width against time represent?
11. Give a brief and general description of how the climate changed during the period that your tree samples represent.
12. How could we obtain climatic information further back in time than tree rings provide?
13. If carbon dioxide levels are rising and global warming continues, what differences would you expect to see in the tree rings between the modern ones and those laid down in 100 years time?