TREE RING KIT
STUDY GUIDE

INTRODUCTION

The **stem** of a plant has two primary functions: 1) to manufacture, support and display leaves where photosynthesis occurs, and 2) to transport materials to and from the leaves. The stem has a cylindrical or columnar shape, which gives maximum strength with a minimum surface area. This allows the plant to support its leaves but minimize its water loss.

The stem can grow in length, which is called **primary growth**, and in width, which is called **secondary growth**. Plants that have primary and extensive secondary growth are **woody** and we call them **trees** and **shrubs**. Contrasted to the woody plants are **herbaceous** plants, which do not have secondary growth.

In a woody plant, most of the food produced by photosynthesis in the leaves is used to build a permanent woody framework of stems supporting a canopy of leaves. Woody stems also bear leaves, but not after they are one year old. Older, larger stems are called **branches** and the main stem of the woody plant is called the **trunk**.

A cross-section of a trunk of a woody plant reveals much about the plant's form and function and its life history and age. The three main areas of the cross-section are 1) the **bark**; 2) the **wood**; and 3) the **pith**. These areas each have their own unique structure and function.

The following activities examine a section of a woody stem to determine the age and growth pattern of the tree and to understand the structure and function of the major tissue types. Scientific skills that will be reinforced in these activities are observing, classifying and quantifying.

ASSEMBLY AND MATERIALS

1. This kit includes a cross-sectional ring from a tree. No assembly is required.
2. A magnifying lens is also included to help your observations.
3. If you have a compound microscope, you might also want to purchase a slide of a cross-section of a woody stem to view the plant cells in more detail. Item number MS-BASSWD is available from Home Science Tools.

WOODY PLANT STRUCTURE

With good lighting, use the magnifying lens to identify the major features of the stem described below. Use the diagram to help locate these structures on your tree ring. The pith, bark and wood will be easily seen but some of the individual structures of these layers may not be visible.

1. Locate the **pith** in the center of the tree ring. This area is usually darker and may be softer. It is made up of large, thin-walled cells. The pith cells in young woody plants store water.
2. The outer perimeter of the tree ring is where you'll find the **bark**. Bark in mature trees is composed primarily of three layers: **cork, phloem** and **cork cambium**.
    a. First, look at the dark outer **cork** layer. The outer layer in very young stems is only one cell thick and called the epidermis. In older plants, such as yours, a thicker layer of cork replaces the epidermis. The cork layer is very thick and rough on some trees, but thin and much smoother on other trees. Think about what possible functions the cork layer provides (examples include protection from water loss, from weather and from insects).
    b. Find the lighter inner layer of the bark, called **phloem**. Cells in this layer carry dissolved food (sap) down to the roots.
    c. The thin layer between the cork and phloem is the **cork cambium**. It produces the cork cells as they wear off the stem over the life of the plant. This layer is usually so thin that you can't see it without magnification.
3. Locate the **wood** between the pith and the bark. The wood is made up of **xylem** tissue. Young xylem tissue, closest to the bark, is lighter colored and called **sapwood**. Sapwood carries water and dissolved minerals through the tree. Older xylem tissue, closest to the pith, is darker and called **heartwood**. Heartwood functions only to support the tree. Xylem tissue in younger trees is all sapwood.
4. A thin layer of cells called the **vascular cambium** separates the phloem from the xylem tissue. This layer produces new xylem and phloem cells. This layer is usually too thin to see without magnification.
5. Your tree ring may also have **pith rays** that extend from the pith through the xylem and into the phloem. These are also called **medullary rays** and function to transfer food and water horizontally through the stem.

ANNUAL RINGS

1. The wood of the stem is secondary xylem that has been laid down by the vascular cambium in

concentric **annual rings**. Most wood is laid down in the spring when the greatest growth occurs. These xylem cells are larger, producing the lighter part of the annual ring called **springwood**. In summer, growth is slower and the xylem cells are smaller. This produces the darker and denser part of the annual ring called **summerwood**. This light and dark alternation gives a distinctive ring pattern. Each year, the tree grows in width as another layer of this secondary xylem is added, thus the term "annual rings."

2. Count the number of annual rings in your tree cross-section. How old was this tree? Why would this method of dating only work for the trunk (primary stem) of the tree?
3. Look at the width of each individual ring. In years with plenty of rain, tree rings will tend to be wider. In years of drought the rings will be narrower. Why do you think this is so? Do you see any differences in size of the annual rings? What could you determine about the climate or growing conditions for the years prior to when this tree was cut down?
4. You may notice that the rings are wider on one side of the tree trunk. What factors may account for this type of growth pattern?

TEACHING TIPS FOR YOUNG CHILDREN

If you are doing these activities in the fall, get a large garbage bag full of dead leaves. Ask your child to hold the bag and feel how heavy it is. Explain that much of the water left these leaves before they fell and when they were still on the tree they were even heavier. Ask the child how strong a tree must be to hold up leaves that would fill many of these sacks plus quite a bit of water.

Each year, the tree gains another ring, making it stronger to hold more leaves. Show the tree ring and measure how big around the plant was its first few years of life. Could it hold many leaves then? Look at large trees and ask your child if they can guess how old they are. If you have access to a large, dead tree stump or a large log, count the rings to determine the age of the tree before it was chopped down.

FURTHER STUDY

If you have access to tree logs, your students can compare growth patterns and tissue types for different types of trees, including hardwoods and softwoods, angiosperms and gymnosperms. A tree identification guide will be helpful, which defines the various classes of woody plants and gives distinguishing characteristics of the stem sections.

Use pictures from a biology textbook or plant identification guide to compare the cross-section of a woody dicot with that of a woody monocot, such as a palm tree. Also, compare your tree ring to a one-year old woody dicot stem and an herbaceous dicot stem. Compare the structures mentioned above. Are the structures present? Are they equal in size?