Lab zone Skills Activity

Calculating

In this activity, you will calculate the speed at which water moves up a celery stalk.

1. Pour about 1 cm of water into a tall plastic container. Stir in several drops of red food coloring.
2. Place the freshly cut end of a celery stalk in the water. Lean the stalk against the container's side.
3. After 20 minutes, remove the celery. Use a metric ruler to measure the height of the water in the stalk.
4. Use the measurement and the following formula to calculate how fast the water moved up the stalk.

$$\text{Speed} = \frac{\text{Height}}{\text{Time}}$$

Based on your calculation, predict how far the water would move in 2 hours. Then test your prediction.

Stems

The stem of a plant has two main functions. **The stem carries substances between the plant's roots and leaves. The stem also provides support for the plant and holds up the leaves so they are exposed to the sun.** In addition, some stems, such as those of asparagus, store food.

The Structure of a Stem Stems can be either herbaceous (hur BAY shus) or woody. Herbaceous stems contain no wood and are often soft. Coneflowers and pepper plants have herbaceous stems. In contrast, woody stems are hard and rigid. Maple trees and roses have woody stems.

Both herbaceous and woody stems consist of phloem and xylem tissue as well as many other supporting cells. Figure 6 shows the inner structure of one type of herbaceous stem.

As you can see in Figure 7, a woody stem contains several layers of tissue. The outermost layer is bark. Bark includes an outer protective layer and an inner layer of living phloem, which transports food through the stem. Next is a layer of cells called the **cambium** (KAM bee um), which divide to produce new phloem and xylem. It is xylem that makes up most of what you call "wood." Sapwood is active xylem that transports water and minerals through the stem. The older, darker, heartwood is inactive but provides support.

Reading Checkpoint **What function does the bark of a woody stem perform?**

FIGURE 6
A Herbaceous Stem
Herbaceous stems, like those on these coneflowers, are often soft. The inset shows the inner structure of one type of herbaceous stem.

Annual Rings Have you ever looked at a tree stump and seen a pattern of circles that looks something like a target? These circles are called annual rings because they represent a tree's yearly growth. Annual rings are made of xylem. Xylem cells that form in the spring are large and have thin walls because they grow rapidly. They produce a wide, light brown ring. Xylem cells that form in the summer grow slowly and, therefore, are small and have thick walls. They produce a thin, dark ring. One pair of light and dark rings represents one year's growth. You can estimate a tree's age by counting its annual rings.

The width of a tree's annual rings can provide important clues about past weather conditions, such as rainfall. In rainy years, more xylem is produced, so the tree's annual rings are wide. In dry years, rings are narrow. By examining annual rings from some trees in the southwestern United States, scientists were able to infer that severe droughts occurred in the years 840, 1067, 1379, and 1632.

FIGURE 7
A Woody Stem
Trees like these maples have woody stems. A typical woody stem is made up of many layers. The layers of xylem form annual rings that can reveal the age of the tree and the growing conditions it has experienced.
Interpreting Diagrams *Where is the cambium located?*

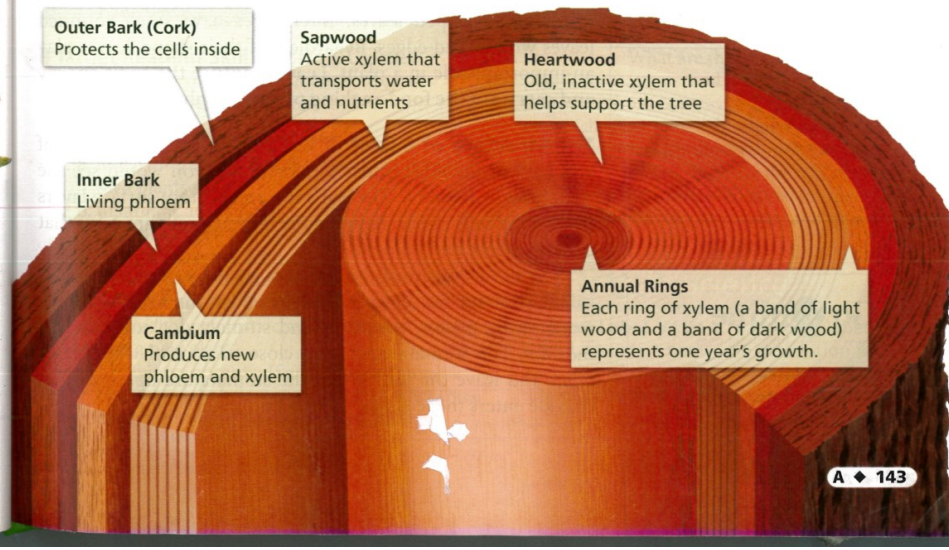
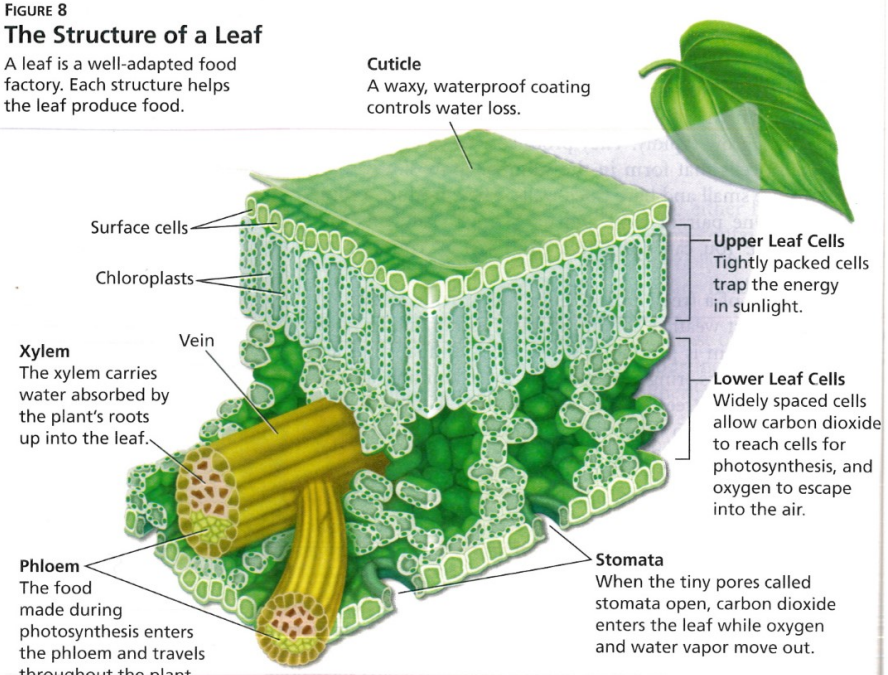


FIGURE 8
The Structure of a Leaf
A leaf is a well-adapted food factory. Each structure helps the leaf produce food.



Leaves

Leaves vary greatly in size and shape. Pine trees, for example, have needle-shaped leaves. Birch trees have small rounded leaves with jagged edges. Regardless of their shape, leaves play an important role in a plant. **Leaves capture the sun's energy and carry out the food-making process of photosynthesis.**

The Structure of a Leaf If you were to cut through a leaf and look at the edge under a microscope, you would see the structures in Figure 8. The leaf's top and bottom surface layers protect the cells inside. Between the layers of cells are veins that contain xylem and phloem.

The surface layers of the leaf have small openings, or pores, called **stomata** (STOH muh tuh) (singular *stoma*). The Greek word *stoma* means "mouth"—and stomata do look like tiny mouths. The stomata open and close to control when gases enter and leave the leaf. When the stomata are open, carbon dioxide enters the leaf, and oxygen and water vapor exit.

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The Leaf and Photosynthesis The structure of a leaf is ideal for carrying out photosynthesis. The cells that contain the most chloroplasts are located near the leaf's upper surface, where they get the most light. The chlorophyll in the chloroplasts traps the sun's energy.

Carbon dioxide enters the leaf through open stomata. Water, which is absorbed by the plant's roots, travels up the stem to the leaf through the xylem. During photosynthesis, sugar and oxygen are produced from the carbon dioxide and water. Oxygen passes out of the leaf through the open stomata. The sugar enters the phloem and then travels throughout the plant.

Controlling Water Loss Because such a large area of a leaf is exposed to the air, water can quickly evaporate, or be lost, from a leaf into the air. The process by which water evaporates from a plant's leaves is called **transpiration.** A plant can lose a lot of water through transpiration. A corn plant, for example, can lose almost 4 liters of water on a hot summer day. Without a way to slow down the process of transpiration, a plant would shrivel up and die.

Fortunately, plants have ways to slow down transpiration. One way that plants retain water is by closing the stomata. The stomata often close when leaves start to dry out.

Reading Checkpoint **How does water get into a leaf?**

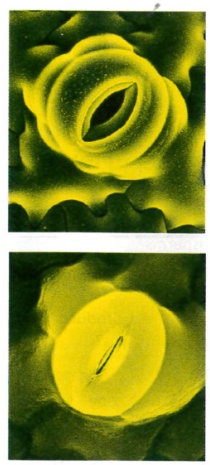

FIGURE 9
Stomata
Stomata open (top) and close (bottom) to control when gases enter and exit the leaf.
Relating Cause and Effect *What gases enter and exit when the stomata open?*

Section 1 Assessment

Target Reading Skill **Outlining** Use the information in your outline about seed plants to help you answer the questions below.

Reviewing Key Concepts

1. a. **Reviewing** What two characteristics do all seed plants share?
   b. **Relating Cause and Effect** What characteristics enable seed plants to live in a wide variety of environments? Explain.
2. a. **Listing** Name the three main parts of a seed.
   b. **Sequencing** List the steps in the sequence in which they must occur for a seed to grow into a new plant.
   c. **Applying Concepts** If a cherry seed were to take root right below its parent tree, what three challenges might the cherry seedling face?
3. a. **Identifying** What are the main functions of a plant's roots, stems, and leaves?
   b. **Comparing and Contrasting** Compare the path on which water moves through a plant to the path on which sugar moves through a plant.
   c. **Applying Concepts** How are the structures of a tree's roots and leaves well-suited for their roles in supplying the tree with water and sugar?

Writing in Science

Product Label Write a "packaging label" for a seed. Include a name and description for each part of the seed. Be sure to describe the role of each part in producing a new plant.