Name _____ Date _____

EXPLORATION

Roots and Stems

24–1 LAB

Plant roots and stems are living tissues that show a close relationship between their function and structure.
Plant roots absorb water and minerals from the soil and transport them upward through the stem. Roots also store food and anchor plants into the soil.
One of the major functions of stems is support. Stems also are pathways for transporting food and water. Woody stems can be used to determine the age of trees.

OBJECTIVES

- Identify and label root tissues.
- Describe the functions of root tissues.
- Identify and label the stems of one-, two-, and three-year-old trees.
- Explain the functions of stem tissues.

MATERIALS

cross section of parsnip root
single-edged razor blade
microscope slide
iodine stain
dropper
coverslip
microscope
laboratory apron

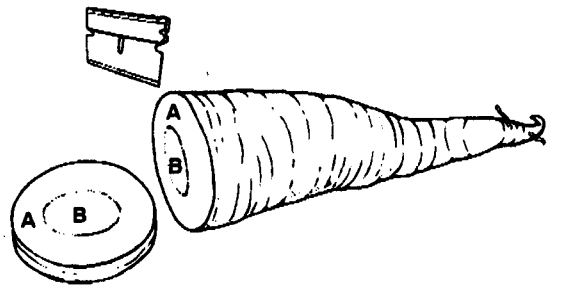
PROCEDURE

Part A. Root Anatomy

Your teacher has prepared cross sections of parsnip roots as shown in Figure 1.

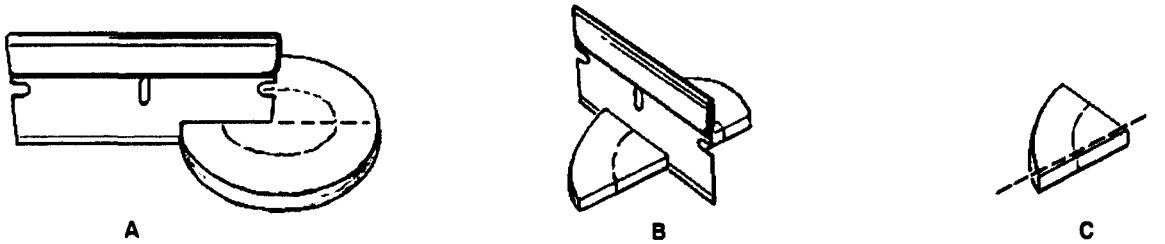
1. Examine your cross section. You can see two different regions. These regions are marked A and B in Figure 1.
2. Prepare your root tissue for microscopic viewing as shown in Figure 2 below.
   A. Cut root section in half. **CAUTION:** *The blade is sharp. Cut away from your fingers.*
   B. Cut the root section in half again in the opposite direction to form a longitudinal section as shown.

Figure 1.



C. Slice off a thin section from one edge of the remaining root section.

Figure 2.



3. Place your thin section on a microscope slide. With a dropper, add iodine stain. Then cover with a coverslip. **CAUTION:** *Iodine is a poison. If spillage occurs, immediately wash with water and call your teacher.*
4. Examine the slide under the low-power magnification of your microscope. Slowly, move the slide across the field of view so that you observe all tissues of the root section. You will observe two different kinds of cells. One kind of cell looks like a railroad track. This cell is a transporting cell. The other kind of cell is rounded or squared and is packed closely together in groups. This cell is a storage cell. Storage cells are much smaller than transporting cells. Starch grains in the storage cells will appear blue from the iodine stain.
5. Draw in Table 3 a few of the two different kinds of cells in regions A and B as seen under low power.
6. Complete Table 4 by giving the functions for the two regions. Note that the table gives the names for these regions.
7. Look at Figure 3, which shows a thin section of parsnip root seen under low power. The thin section was prepared as shown in Figure 4. This thin section is different from the first one you observed. This one is a cross section.
8. Identify and label the root structures in Figure 3 by using the descriptions in Table 1. Areas A and B (cortex and central cylinder) are labeled.

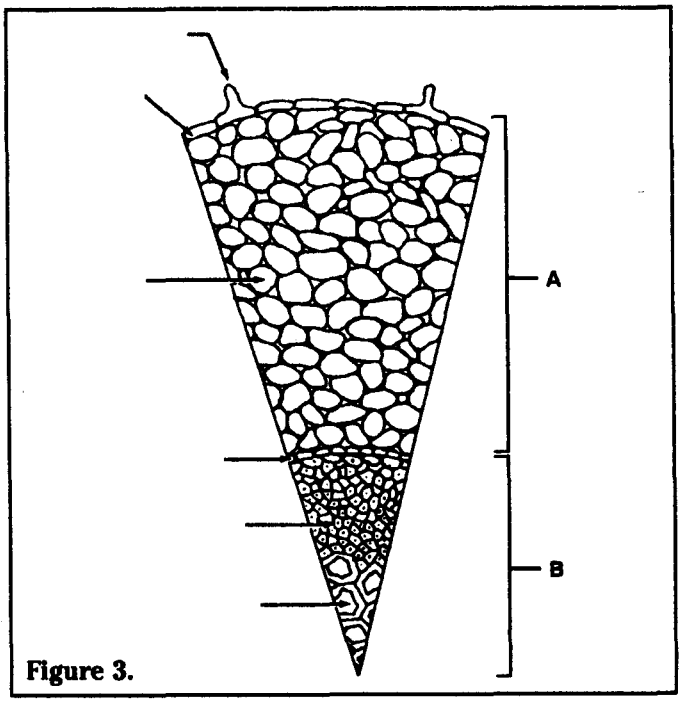


Figure 3.

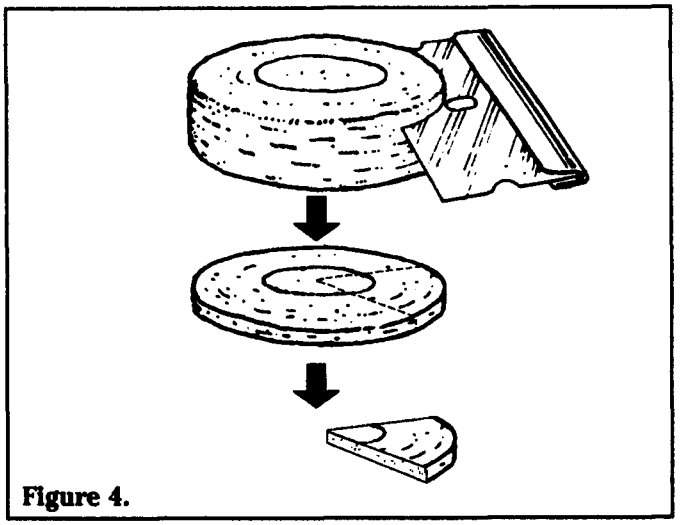


Figure 4.

Table 1.

Root Parts and Functions	
Tissue	**Description**
Xylem	Thick-walled cells in Area B at tip end of slice; part of central cylinder, transports water
Phloem	Thin-walled cells in Area B found in groups next to xylem; part of central cylinder, transports food
Epidermis	Outermost layer of root; protective covering; one cell thick
Root hairs	Fingerlike projections on some epidermal cells; increases surface area for water absorption
Endodermis	Single layer of cells, ringlike, separating Area A from Area B; protective covering
Cortex	Widest area of root; stores food; makes up most of Area A

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Part B. One-Year-Old Tree Stem

Figure 5 shows how a cross section of a tree stem is made.

1. Examine Figure 6, which shows the cross section of a one-year-old tree stem viewed through a microscope.
2. Study the descriptions of stem tissues in Table 2. Then label each kind of tissue in Figure 6.

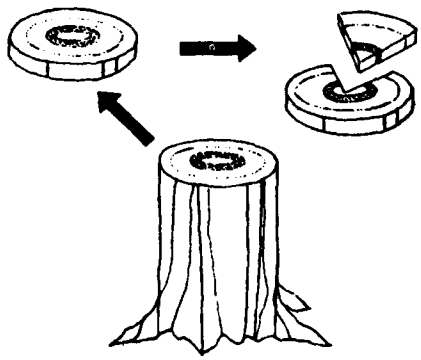

Figure 5.

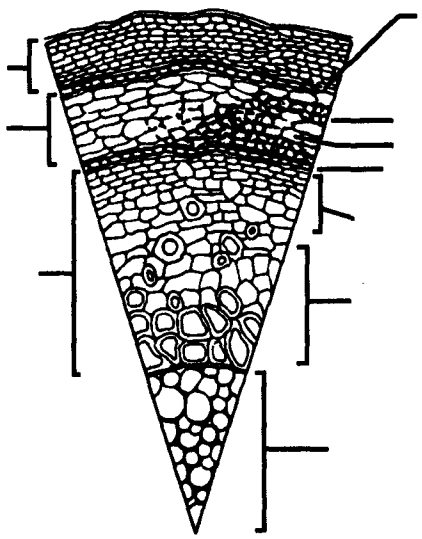

Figure 6.

Table 2.

Stem Tissues	
Tissue	**Description**
Cork	Outermost layer, about eight cell layers thick; protects against water loss
Cork cambium	Single layer of cells just inside the cork layer; produces new cork cells
Cortex	First layer inside cork cambium, about ten cells thick; cells larger and with thinner cell walls than cork cells; stores food
Pith	Tissue at center of stem (pointed end of wedge diagram); large thin-walled cells; stores food
Xylem **(a) Spring xylem** **(b) Summer xylem**	Thick layer of cells next to pith; widest layer of cells in stem; transports water and supports stem Portion of xylem with large cells; produced in spring Portion of xylem with small cells; produced in summer
Vascular cambium	Single layer of cells at top edge of xylem; produces new xylem and phloem cells
Phloem	Groups of thin-walled cells, inside cortex; transports food
Bast fibers	Groups of thick-walled cells; no hollow center visible; surrounds phloem; supports stem

Part C. Two-Year-Old Tree Stem

1. Compare Figure 7, showing a two-year-old tree stem, with the one-year-old stem in Figure 6. How many bands or sections of xylem are present in

   a. a one-year-old tree stem? _____

   b. a two-year-old tree stem? _____

2. Note that the difference in the size of spring and summer xylem cells forms a line separating one year of xylem from the other.

   a. Which xylem has larger cells? _____

   b. Why do you suppose that cell diameter of spring and summer xylem may differ? (HINT: A lot of water results in good growth of cells. A lack of water results in slower growth.) _____

   _____

   c. A new band of xylem tissue is formed each year. This band is called an annual ring. An annual ring includes both spring and summer xylem. Which tissue forms this band?

   _____

   d. Each new band of xylem forces the older band toward the stem's center. Which stem tissue is the oldest band of xylem found closest to? _____

3. Label Figure 7, showing a two-year-old stem cross section. Use the following labels: *first year xylem* (oldest), *second year xylem* (youngest).

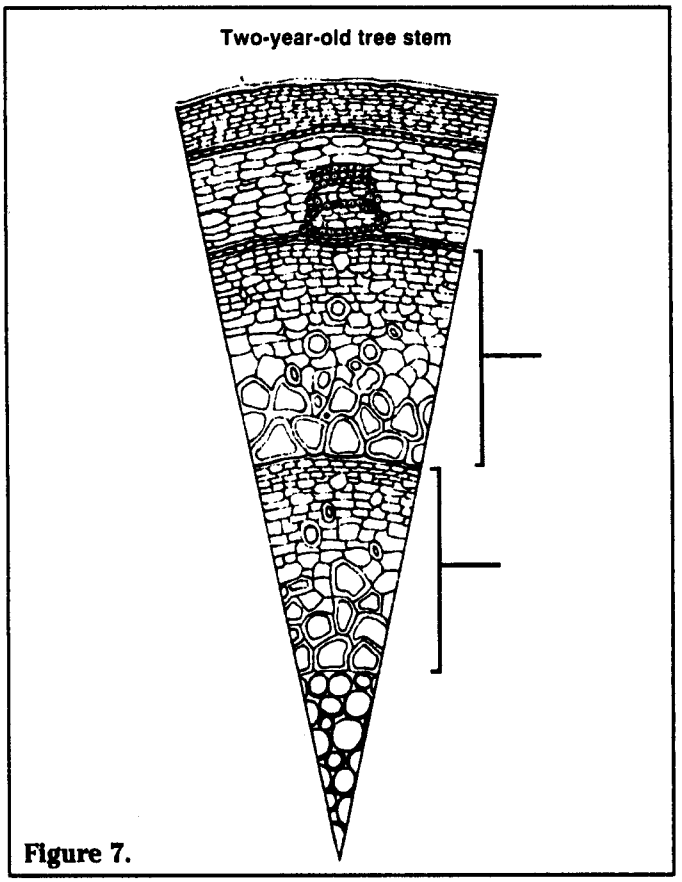

Figure 7.

Part D. Three-Year-Old Tree Stem

1. Compare Figure 8, showing a three-year-old tree stem, with the one- and two-year-old stems.
2. Label the tissues in Figure 8. Use the label lines along the right side of Figure 8 to label each band of xylem as *first year xylem* (oldest), *second year xylem,* and *third year xylem* (youngest).
3. Use the following terms to label the areas along the left side of Figure 8.
   bark—all tissue from cork through vascular cambium
   wood—all tissue from youngest xylem band through pith
   vascular ray—narrow, one-cell-thick tissue extending through the xylem.

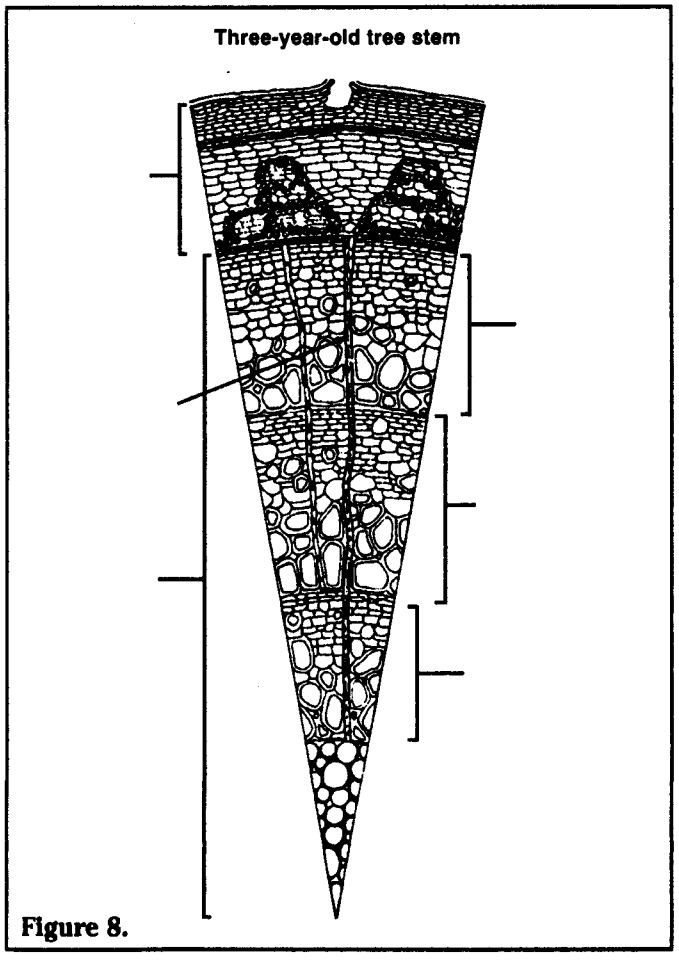

Figure 8.

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DATA AND OBSERVATIONS

Table 3.

Parsnip Root Section Under Low-Power Magnification	
Region A	**Region B**

Table 4.

Root Regions and Their Functions			
Region	**Name**	**Description**	**Function**
A	Cortex	Widest area of root	
B	Central cylinder	Center area of root	

ANALYSIS

1. How is the shape and function of the central cylinder of a root similar to a water pipe or blood vessel?

_____

_____

2. How is the structure of root cortex cells adapted for their function? _____

_____

3. Use Tables 1 and 2 to complete the following chart. Write the names of root and stem tissues that carry out each function listed.

Function	Roots	Stems
Protection		
Food storage		
Transport food or water		
Absorb water from soil		
Produce new tissue		
Support stem		

4. **a.** Name the main cell types that make up the central cylinder of a root. _____

_____

b. What does each cell type transport? _____

_____

5. Skin is called a dermis. The prefix *epi-* means outside. *Endo-* means inside.

a. What are the functions of epidermis and endodermis? _____

_____

b. Are these cell layers properly named, based upon their location and function in roots? Explain.

_____

_____

6. How is the structure of thick bast fibers adapted for their function? _____

_____

7. A thin, waxy layer is present along the outside of a tree's cork. Explain how this layer helps cork function. _____

_____

8. **a.** How many bands of xylem does a three-year-old tree stem have? _____

b. Does a new band of xylem form in a tree stem during each year of growth? _____

c. How can a tree's age be determined? _____

_____

9. Annual rings vary in thickness due to environmental factors. What kinds of environmental factors during the year might influence growth? _____

_____

FURTHER EXPLORATIONS

1. Based upon Figure 8 of a three-year-old tree stem, draw and label the cross section of a six-year-old tree stem, assuming similar environmental conditions.
2. Suppose that during a ten-year period rainfall in a region increased each spring by ten percent. During the next ten-year period, rainfall decreased each spring by ten percent in the same region. What effect do you think this weather pattern would have on the annual rings of a 20-year-old tree? Construct a graph to illustrate your answer.