# Chapter 23 Roots, Stems, and Leaves Name _____

Lab Root and Stem Structures

**Pre-Lab Discussion**

The first structures to appear on a germinating seed are the roots. The initial root to grow from a seed is the **primary** root, which is then followed by **secondary** roots that branch out from the primary root. In a **taproot** system, the primary root grows longer and thicker than the secondary roots. In a **fibrous** root system, the secondary roots continue to grow, and eventually all the roots are of equal or nearly equal size.

Roots have several functions. They **anchor** the plant in place, **absorb** water containing dissolved minerals from the environment, and act as **storage** areas for excess food. Some roots even develop into new plants. **Adventitious** roots grow from parts of the plant other than the roots. **Aerial**, or prop, roots are roots that are suspended in the air.

Plant structures that grow between the roots and the leaves are called **stems**. Although stems usually grow above the ground in vertical positions, they can also grow under the ground in horizontal positions. All stems begin growing as soft, tube-like structures. If the stem remains soft, and usually green, for the entire life of the plant, it is a herbaceous stem. A woody stem becomes hard and often turns brown.

The primary **function** of stems is to conduct water and dissolved minerals from the roots to the leaves and, at the same time, to conduct food from the leaves to the rest of the plant. Stems may also function as food storage areas, supporting structures, and places for the growth of new plants.

In this investigation, you will examine the structures of roots and stems. You will also observe the structural differences between some **monocot** and **dicot** roots and stems.

**Problem**

What are some structures of roots and stems?

**Materials (per group)**

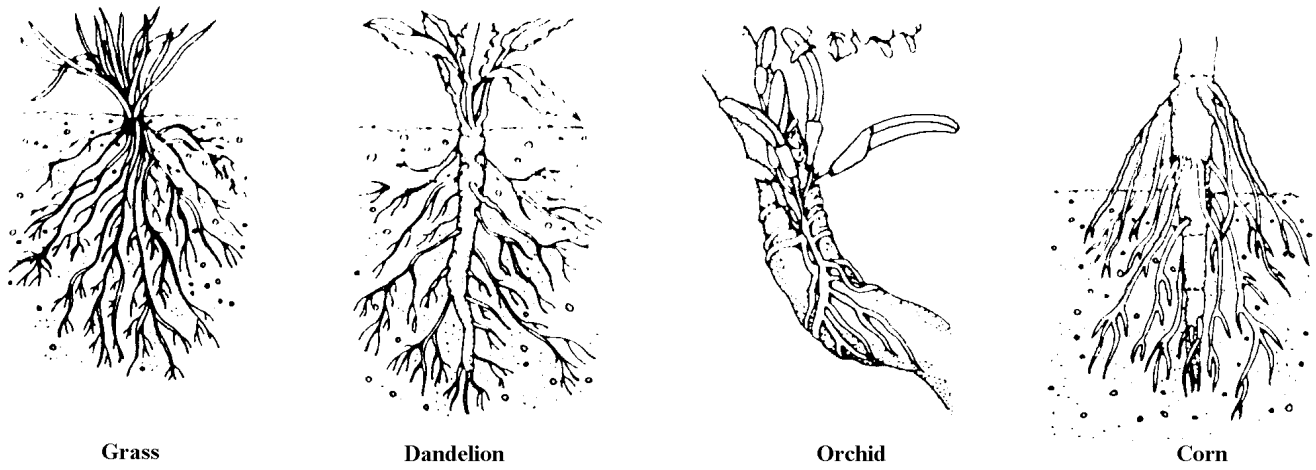
| | |
|---|---|
| 2-week - old radish seedlings | Hand lens or dissecting microscope |
| Microscope | Carrot |
| Methylene blue stain | Ethyl alcohol |
| Scalpel or single-edged razor blade | Dissecting tray |
| Forceps | Glass slide |
| 150mL beaker | Prepared slides of cross section of a sunflower root, corn root sunflower stem, corn stem |

**Procedure**

**Part A. External and Internal Structures of a Root**

1. Examine Figure 1 and identity each root as being taproot, fibrous, adventitious, or aerial.

**Figure 1 Root Types**

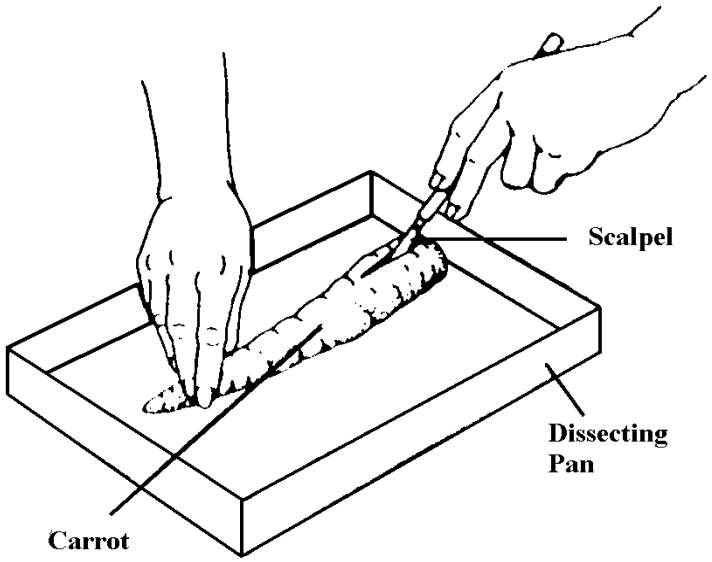



2. Examine the two week old radish seedlings. Note the basic structures of the seedling leaves, stem, and roots.

3. With a hand lens or dissecting microscope, examine the delicate root hairs extending from the root.

4. Place the carrot in the dissecting tray. As shown in Figure ,. hold the carrot steady with one hand while you cut it in half lengthwise with the scalpel or single edged razor blade. **CAUTION**: Always cut in a direction away from yourself. Because the carrot is very hard, be careful not to let the scalpel or razor blade slip and cut you.

**Figure 2**

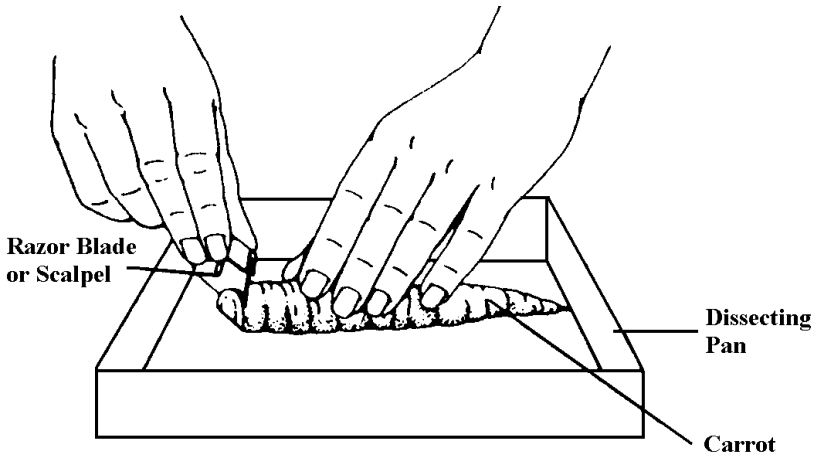



5. Examine the two halves of the carrot. Each half is a longitudinal section. Notice the **stele** in the center. The stele contains the **xylem** and the **phloem**. Surrounding the stele is the food-storing cortex. In the appropriate place in observations, sketch a longitudinal section of the carrot. Label the stele and the **cortex**.

6. To make a cross section of the carrot, place one of the longitudinal sections cut side down on the dissecting pan. About 4cm from the end of the carrot, cut straight down using the razor blade or scalpel. Discard the small piece.

7. Make another cut straight down, as close as possible to the one you just made. See Figure 3. With the forceps, carefully remove the carrot cross section from the razor blade and place it on a glass slide.

**Figure 3**




8. Place the slide over the mouth of the beaker. Then cover the carrot cross section completely with methylene blue stain. Allow the stain to set for 1 minute. **CAUTION**: Methylene blue stain is a permanent stain. Be careful not to get it on your hands or clothing.

9. After 1 minute, slowly pour alcohol over the carrot cross section until no more stain washes away.

10. Observe the cross section of the carrot with a hand lens or under a dissecting microscope. In the appropriate place in Observations, sketch the cross section of the carrot. Label the stele and the cortex.

11. Place the prepared slide of the sunflower (*Helianthus*) root cross section under the low power of the microscope. The sunflower is a **dicot**.

12. Locate the epidermal cells that form the outer edge of the root. Examine (different areas on the glass slide. Notice some root hairs, which are extensions of single epidermal cells.

13. Find the cortex, which is located within the epidermis. The cells of the cortex are large and thin walled.

14. Locate the star-shaped pattern formed by **xylem** cells at the center of the root. Switch to the high-power objective and focus on one xylem cell. Note its thick cell wall. **CAUTION**: When switching to the high-power objective, always look at the objective from the side of the microscope so that the objective does not hit or damage the slide.

15. Observe the smaller and thinner walled phloem cells within the arms of the star. This distinctive pattern of xylem and phloem is typical of dicot roots. In the appropriate place in Observations, label the xylem, phloem, cortex, epidermis, and root hair.

16. Examine the corn (*Zea*) root cross section under the low power of the microscope. Corn is a **monocot**.

17. Notice that groups of xylem cells are scattered within the central area of the root. Move the glass slide around until you find the phloem cells, which are also scattered in bunches through the central area of the root.

18. Notice that the cortex and epidermis are similar in both the sunflower root and the corn root. In the appropriate place in Observations, label the xylem, phloem, cortex, epidermis, and root hair in the corn root.

**Part B. Internal Structures of Stems**

1. Observe the prepared slide of a cross section of a sunflower (*Helianthus*) stem under low power of the microscope. The sunflower has an herbaceous, or nonwoody, stem. Notice that the vascular bundles are arranged in a ring within the stem. Switch to the high-power objective and focus on a single vascular bundle. Observe the thick walled xylem cells. Notice the smaller, thinner-walled phloem cells within the bundle.

2. Switch back to the low-power objective and observe the arrangement of cells within the stern cross section. The **pith** is the large area within the ring of vascular bundles. Surrounding the ring is the **cortex**. The outermost layers are epidermis. In the appropriate place in Observations, label the vascular bundle, xylem, phloem, pith, cortex, and epidermis.

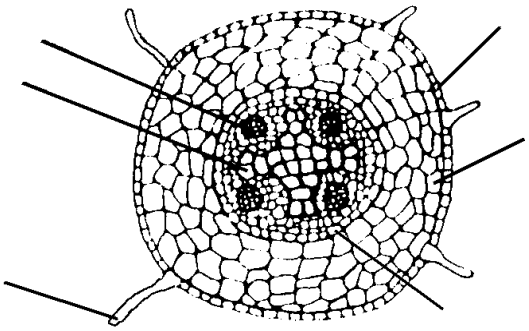
3. Observe the prepared slide of a cross section of a corn (*Zea*) stem under the low-power objective of the microscope. Note the general arrangement of the cells and the position of the xylem and phloem.

4. Examine the epidermis, cortex, and pith in the corn stern cross section. In the appropriate place in Observations, label the vascular bundle, xylem, phloem, epidermis, cortex, and pith.

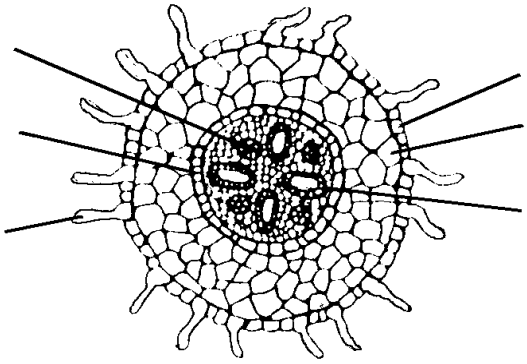
**Observations**

| **Longitudinal Section of Carrot** | **Cross Section of Carrot** |
|---|---|
| | |

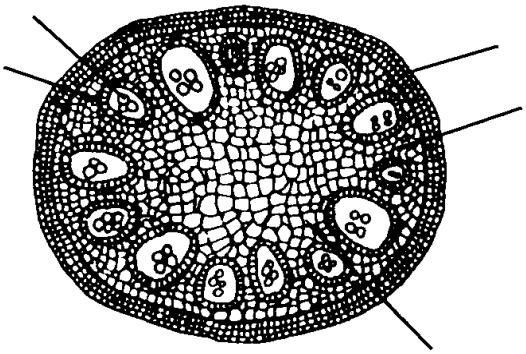
**Analysis and Conclusions**



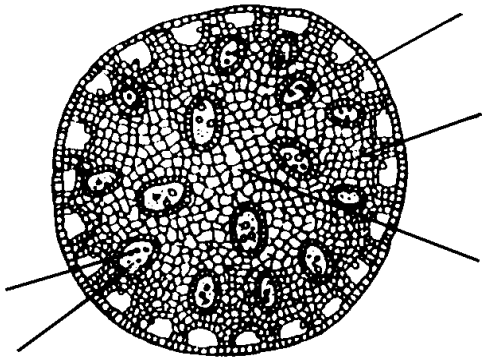
**Sunflower Root**



**Corn Root**



**Sunflower Stem**



**Corn Stem**

1. Next to the name of each plant, identify the type of root.
   a. Grass
   b. Dandelion
   c. Orchid
   d. Corn

2. Based on its root structure, is the carrot a monocot or dicot?

3. Of the fibrous and taproot, which is best adapted for food

4. Which does the shape of the root hair increase - the volume or surface area of the root?

5. How do monocot and dicot roots differ in structure?

6. Compare the pattern of xylem and phloem in dicot roots and stems.

7. Both roots and stems have a layer of epidermis that forms the outer layer of cells. How do the epidermal cells differ in function in roots and stems?

**Critical Thinking and Application**

1. Why is it advisable to prune a plant when it is transplanted?

2. Would plants with fibrous roots or taproots be more suitable for planting in a windy area?

3. What types of roots, fibrous or taproot, are most commonly found on desert plants?

4. Some giant sequoia trees that have had an automobile tunnel cut through their woody stems continue to grow. How is this possible?

5. What advantages do plants with woody stems have over plants with herbaceous, or nonwoody, stems?