Chapter 23 **Roots, Stems, and Leaves** **Name _____**

Lab Primary Roots and Internal Structure

Pre-Lab Discussion

Roots are typically underground structures and function mainly for anchorage and absorption. Typical roots have hair-like extensions of the epidermal cells. It is these hairs which absorb water by **osmosis** and **actively transport** minerals from the soil. These root hairs are located at the tips of roots only. All of the water lost by a plant during transpiration must enter through the root hairs. Roots differ from stems in that they do not have nodes nor produce leaves. They do have a special covering, the root cap, which protects the delicate growing point from injury as it pushes through the soil. All the primary tissues of a root originate from cells derived from the meristematic region of the root tip.

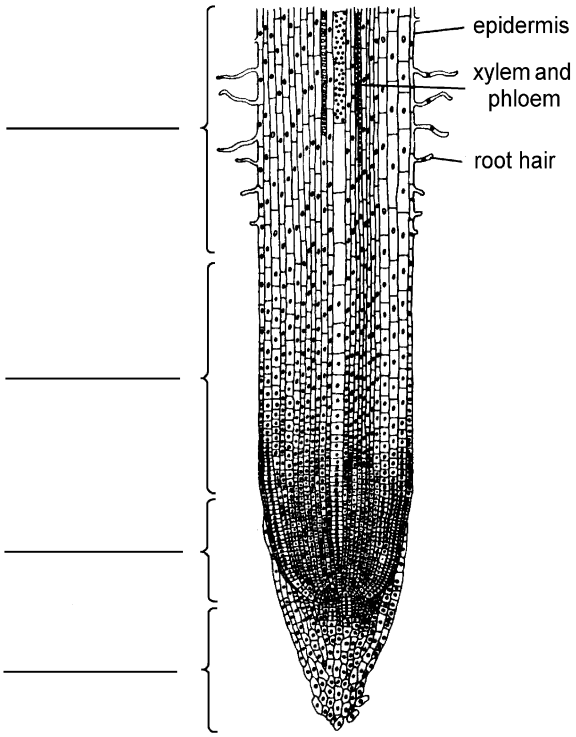
Procedure

Part 1 Primary Tissues of Roots

1. Examine Figure 1showing a longitudinal section of the young root tip. Locate the various regions of the root tip. Observe the changes in the size and shape of the cells in each region. The **root cap** will be found at the tip of the root. Its cells are large and mature. They serve to protect the growing root tip as it pushes through the soil. The much smaller cells on top of the root cap are called apical meristem cells. These small cube-like cells are the region of cell division and all of the cells of the root will come from this **meristematic region**. The cells directly above the meristematic region will begin to grow and stretch out. This is the **region of elongation**. These cells cause the push that is responsible for forcing the root tip through the air spaces in the soil. The last region which is farthest from the tip of the root is the **region of maturation.** You can tell these cell because some of the epidermal cells have differentiated and formed root hairs.

2. Label the appropriate areas in Figure1 below. Use the following terms: root cap, meristematic region, region of elongation, and region of maturation.

Figure 1 Longitudinal Section of a Young Root



Observations

1. In the space below draw a root tip like Figure 1and label the four areas. This is a review activity and is not meant for you to draw the cells in detail. Draw the relative size of one cell in each of the four areas.

Analysis and Conclusions

1. What process is involved in the absorption of water? Minerals?

2. Why would root hairs increase the rate of water absorption?

3. When a plant is pulled out of the soil, what probably happens to its root hairs? What effect would this have on the plant?

4. Explain how a root grows longer.

Match the tissue with its function. Place the correct letter from the right column in the space provided in front of each number.

5. _____ produces new root cells
6. _____ increases surface area for better absorption of water
7. _____ protects the growing root tip
8. _____ activity in this region serves to push the root tip through the soil
9. _____ region where developing root hairs are found

A) root cap
B) maturation region
C) root hairs
D) elongation region
E) meristematic region

Part 2 The Root Hairs

Background Information

The root system of a single grass-like plant called winter rye was measured and roots of all categories were carefully counted. A total of 13,815,672 roots was obtained. The combined length of all roots was 387 miles. The total surface of these roots was 2,554 square feet. Root hairs numbered over fourteen billion and had a total length of 6,603 miles. The total area of the root hair surface was 4,321 square feet. All of these roots grew in slightly less than two cubic feet of soil.

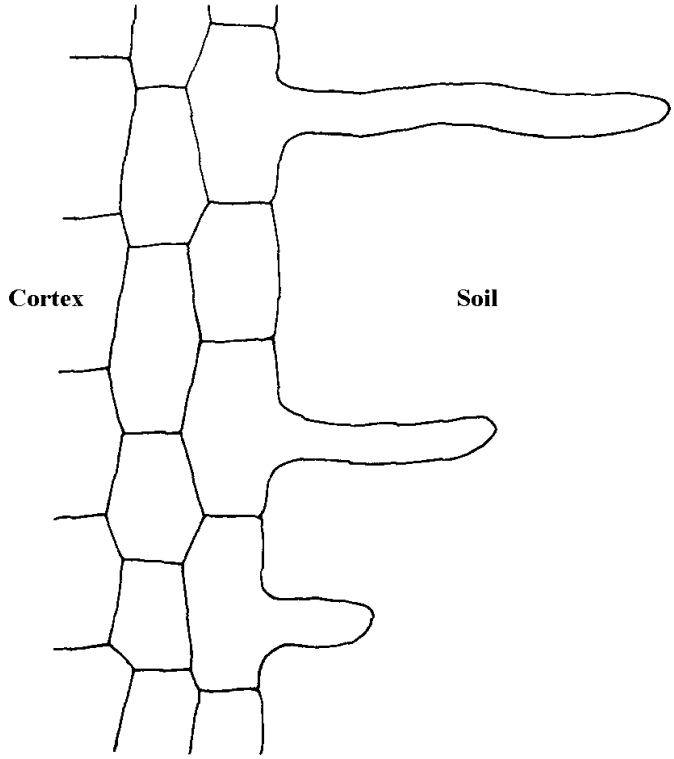
The significance of the above figures is apparent when one stops to consider the value of such roots for absorption, as soil binders in checking **erosion**, and that when such roots die and decay they help **aerate** the soil by leaving myriads of small tunnels to form a network in the soil.

The tremendous root hair surface is of vital importance because practically all the water supply taken in by the plant must pass through this surface.

Procedure

1. Use the diagram below to show the movement of water and minerals from the environment towards the cortex and eventually the xylem. Draw in the soil particles surrounding the root hairs and use arrows to show the direction of water and mineral movement. Finish the diagram by adding cells representing the cortex, endodermis, pericycle, phloem, and xylem.

Diagram of Developing Root Hairs



Analysis and Conclusions

1. What cells give rise to the root hairs?

2. How many cells are in a single root hair?

3. What is a root hair?

4. What are two functions of root hairs?

5. Stem epidermal cells are covered with a wax called cutin. Do you think there is a wax coating on the root epidermal cells? Explain your answer.

6. What was the total miles of roots calculated in one winter rye plant? A wheat plant that grows in our area would be very similar.

7. For review, list the four basic plant tissues.
   a.

   b.

   c.

   d.

8. List the three vegetative organs found in a plant.
   a.

   b.

   c.

9. Name two reproductive organs found in plants.
   a.

   b.

Pre-Lab Discussion

The primary root tissues make up the soft parts of all beginning roots. You will examine these tissues by studying a root cross section from a mature area which has formed distinct tissues.

All of the tissues have originated from the **apical meristem**. Starting from the outer surface of the root is the **epidermis**. This consists of a single layer of protective cells. The **cortex**, a thick region of thin-walled cells, lies inside the epidermis. The cortex cells function in food storage. The innermost part of the cortex is a ring of cells called the **endodermis**. These cells have thicker walls than other cortex cells and are coated along their edges with a wax called the **Casparian strip**. Inside the endodermis is the vascular, or central cylinder, called the **stele**. The outermost region of the vascular cylinder is the **pericycle**. Pericycle cells retain some meristematic ability and will give rise to the lateral roots. **Phloem** and **xylem** cells may be identified in alternating groups underlying the pericycle. Xylem cells are large and thick walled. Phloem cells are smaller with thin walls. If there is **vascular cambium** present, the cells will be very small.

Procedure

1. Examine a prepared slide of a dicot root cross section. Locate the tissues described above. In dicot roots the xylem forms several star-like arms that radiate from the center of the vascular cylinder. Phloem tissue may be found between these arms. A layer of cells known as the vascular cambium may be found separating xylem and phloem in dicot roots. Vascular cambium cells are meristematic; they divide to produce secondary phloem (**inner bark**)and secondary xylem (**wood**) tissues as the root becomes thicker and woody.

2. Draw and Label a cross section of a young dicot root. The cross section should be drawn so as to show the distribution of all tissues. You need only to draw an outline image of each area of the basic dicot root. Use the following terms to label your outline drawing. Make the perimeter of the circle the epidermis and draw rings for the following areas: cortex, endodermis, pericycle, phloem, and xylem.

3. After you have finished drawing and labeling the dicot root, you may label the detailed drawing on the next page.

Outline Drawing of a Dicot Root

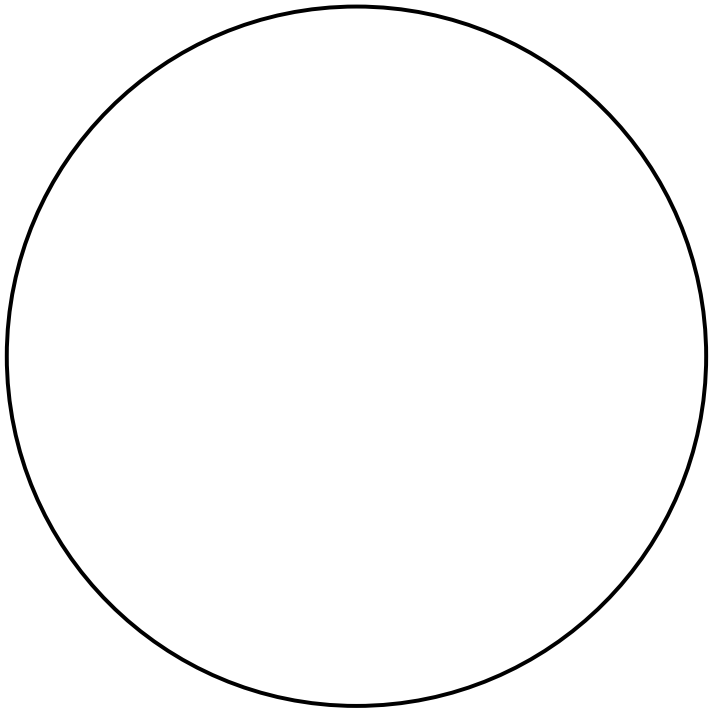
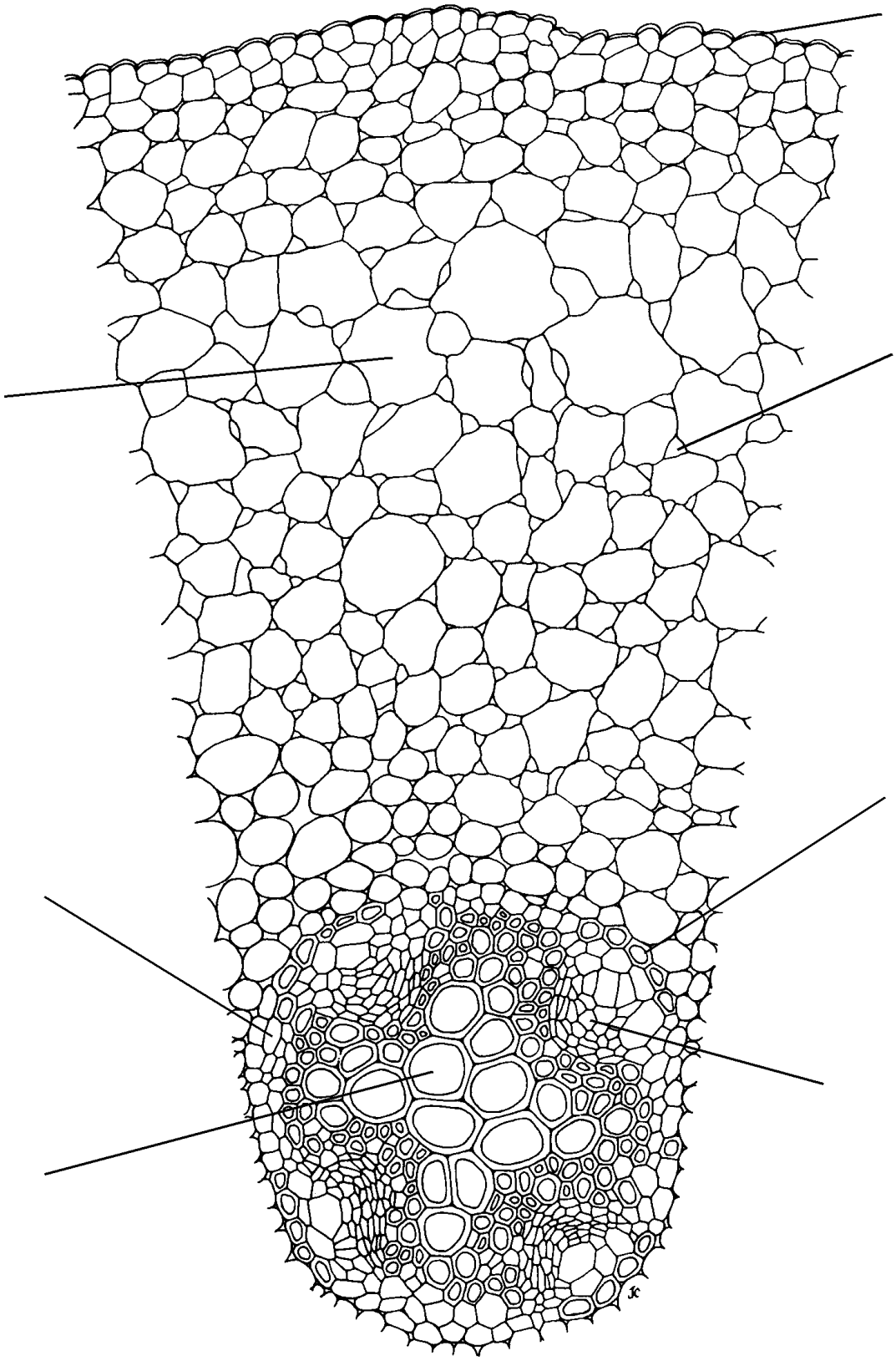


Diagram of a Dicot Root (x-s)



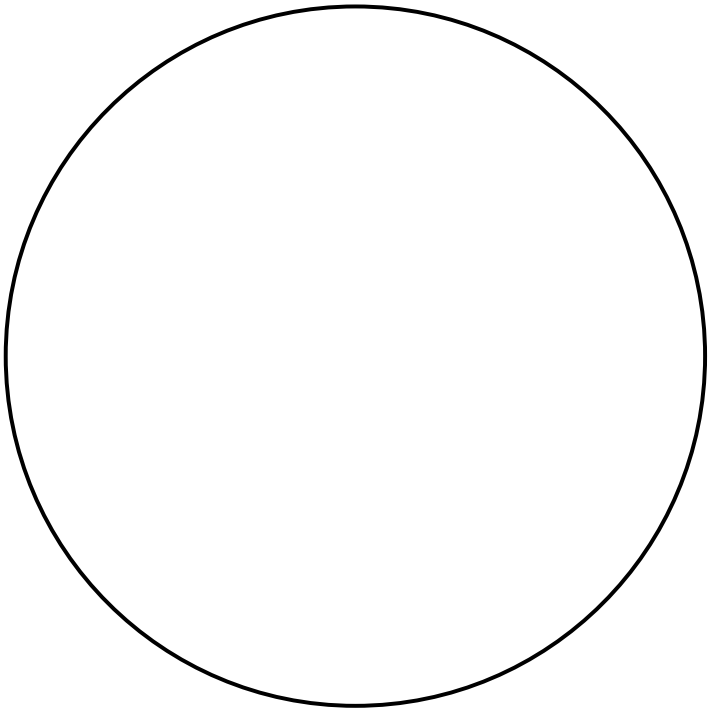
Dicot Root (Buttercup)

4. Examine a prepared slide of a monocot root cross section. Locate the tissues described earlier. In monocot roots the xylem forms a ring arrangement of the xylem and phloem cells. There is no vascular cambium. The appearance of the vascular tissues is of radiating spokes on a wagon wheel. In the center the cells are thin walled and used for storage. This center storage area is often called the pith.

5. Draw and Label a cross section of a young monocot root. The cross section should be drawn so as to show the distribution of all tissues. You need only to draw an outline image of each area of the basic dicot root. Use the following terms to label your outline drawing. Make the perimeter of the circle the epidermis and draw rings for the following areas: cortex, endodermis, pericycle, phloem, xylem, and pith.

6. After you have finished drawing and labeling the monocot root cross section, label the monocot root diagram in Figure 2.

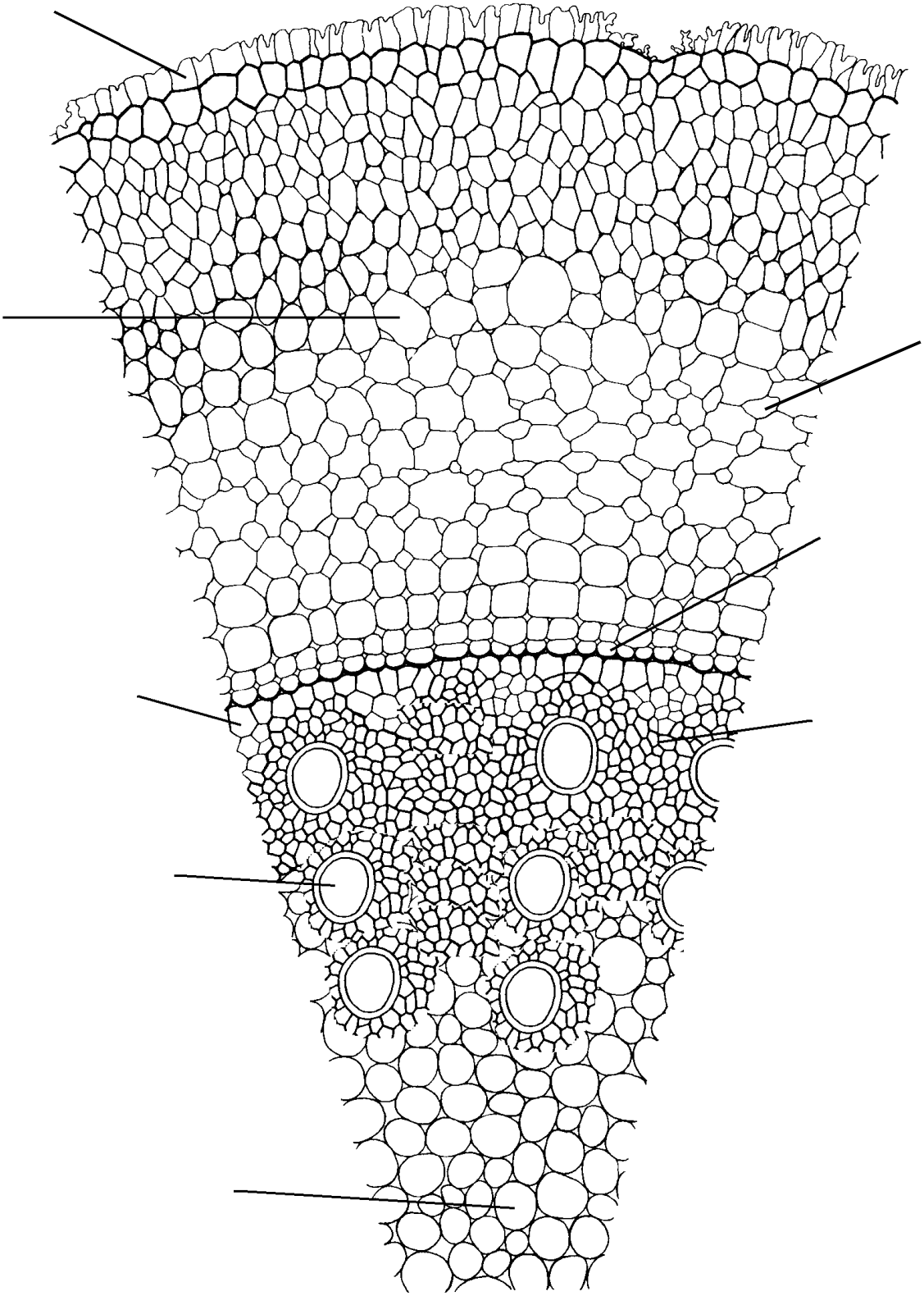
Outline Drawing of a Monocot Root.



Analysis and Conclusions

1. The outer layer of the root is the _____ .
2. The tip of the root is protected by the _____ .
3. Beneath the epidermis is the _____, which serves for the storage of _____ .
4. The innermost part of the monocot root is called the _____ .
5. The differentiation of meristem cells takes place within the region of _____ .
6. Lateral roots grow from the meristematic tissue called _____ .
7. The tissue that forms a star-like pattern in the center of dicot root is _____ .
8. Vascular cambium cells increase root diameter when they produce _____ and _____ .
9. The surface area for absorption is tremendously affected by the presence of _____ .

Diagram of a Monocot Root (x-s)



Monocot Root (Corn)