

Unit A: Basic Principles of Plant Science with a Focus on Field Crops

Lesson 1: Examining Plant Structures and Functions

Student Learning Objectives:

Instruction in this lesson should result in students achieving the following objectives:

1. Describe the cellular structure of plants.
2. Identify the major parts of plants and explain their functions.
3. Distinguish between plants based on seed cotyledons.
4. Explain the absorption and transport systems of plants.

Recommended Teaching Time: 3 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- http://academic.kellogg.edu/herbrandsonc/bio111/seeds_fruits_flowers.htm
- A PowerPoint has also been developed with use of this lesson plan

List of Equipment, Tools, Supplies, and Facilities:

Writing surface
Specimen plant materials
Projector
PowerPoint Slides
Transparency Masters
Chalk board
Chalk
Paper for student's booklets
Pencils for students
Copies of student lab sheets with necessary materials (listed on lab sheet)

Terms: The following terms are presented in this lesson (shown in bold italics and also on PowerPoint Slides #2, #3, and #4):

- Alternate leaf arrangement
- Bulb
- Cell
- Cell specialization
- Cladophyll
- Compound leaf
- Corm
- Cotyledon
- Dicotyledon
- Fibrous root system
- Flower
- Fruit
- Leaf
- Monocotyledon
- Multi-cellular organism
- Opposite leaf arrangement
- Organ
- Organ system
- Osmosis
- Phloem

- Reproductive parts
- Rhizome
- Root
- Seed
- Simple leaf
- Stem
- Stolon
- Taproot system
- Tendril
- Tissue
- Transpiration
- Tuber
- Vegetative parts
- Whorled leaf arrangement
- Xylem

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Bring a small field crop specimen that has been pulled up so that leaves, stems, and roots are obvious. A specimen with flowers and/or seed is preferred. Ask students to name the different parts of the specimen. As they do, have them describe the function of the part and how it is useful to humans.

****You can use this to see how much they know. Then move from the interest approach into the objectives for the lesson.**

SUMMARY OF CONTENT AND TEACHING STRATEGIES

****Have students take 3 pieces of paper and make a small book by folding these in half. On the front cover they will write Plant Structures and Functions. Then have them draw an appropriate picture to go with the lesson title. Refer back to the interest approach to reinforce the lesson topic.**

Explain to the students that you will instruct them to add information and pictures to their booklet as you go through the lesson.

The following information for Objective 1 can be used to lecture students. Continue to ask questions throughout the lecture to keep student interest and see how much information students know.

Objective 1: Describe the cellular structure of plants

(PowerPoint Slide # 5 and #6)

- I. Cells are the structural basis of all living organisms.
 - A. A **cell** is a tiny structure that forms the basic building blocks of plants.
 1. All organisms are made of one or more cells.
 2. Protoplasm in cells carries out life processes.
 - B. Plants are **multi-cellular organisms**, meaning that they have many cells.
 1. Some cells have specific functions.

(PowerPoint Slide # 7)

2. **Cell specialization** is the presence of cells that perform unique activities for a plant.
(Flowers, leaves, roots, and stems are made of specialized cells.)

(PowerPoint Slide # 8)

- C. Cells are formed into groups that work together.
1. **Tissue** is formed by groups of cells that are alike in activity and structure.
 2. An **organ** is formed by tissues that work together to perform specific functions.
 3. An **organ system** is a group of organs that works together to perform a function.

(PowerPoint Slide # 9)

- D. Cell structure is the organization of the material that forms a cell.
1. Plant cells have three major parts: wall, nucleus, and cytoplasm.
 2. The cell wall surrounds the cell and controls the movement of materials into and out of the cell.

(PowerPoint Slide # 10)

3. The nucleus is near the center of a cell and contains protoplasm, chromosomes, and other structures that control cell activity.
4. The cytoplasm is a thick solution inside the cell wall surrounding the nucleus.

(PowerPoint Slide # 11)

5. Plant cells have many additional parts, including: chloroplasts, nucleolus, vacuole, Mitochondria, and golgi body.

****Use TM: 1-1 to illustrate the major parts of a cell. Draw a picture of the cell on the board. Go through and discuss each part with students. Have them draw their own cell and label it in their booklet. When students are finishing up, ask for a volunteer to stand and share their picture and explain the cell structure. You can also call on students to help explain the cell structure as well. This will help reinforce the information you've just taught. Ask if there are any questions; discuss any information that student's are having problems with.**

Objective 2: Identify the major parts of plants and explain their functions

****Ask the students to refer back to the interest approach. Ask if they remember the main plant parts. Again we are looking for roots, stem, and leaves. When you get the answer you are looking for tell the students that they we are going to use choral response. Explain that choral response means that they, together as a**

class, will repeat key information aloud in order to help them remember it. Tell the class that when you ask, “what are the main parts of a plant”, they will respond: root, stem, leaves (in that order). “Class, what are the main parts of a plant?” (*students respond*). You may have to repeat this a couple times in order for them to catch on this first time.

****After the choral response tell the students that we are going to discuss each of the following parts in more depth.**

(PowerPoint Slide # 12)

II. Plants are comprised of vegetative and reproductive parts.

A. The major **vegetative parts** of plants are stems, leaves, and roots.

(PowerPoint Slide # 13)

1. A **stem** is the central axis that supports the leaves, connects them with the roots, and transports water and other materials between the leaves and roots.

****Use TM: 1-2 to illustrate the parts of a typical stem. Draw the stem on the board, label it. Have them draw this in their booklet as well.**

Stems vary widely in appearance based on the species of plant. Stems may be vertical or horizontal and modified for climbing and to store water and food. Several specialized kinds of stems are important:

(PowerPoint Slide # 14 and #15)

- a. Rhizome—A **rhizome** is an underground stem that grows horizontally. It may grow adventitious roots and stems to develop as a separate plant.

(PowerPoint Slide # 16 and #17)

- b. Tuber—A **tuber** is an enlarged part of a stem that grows underground. A tuber can develop into a separate plant. Examples include potatoes and yams.

(PowerPoint Slide # 18 and #19)

- c. Tendril—A **tendril** is a threadlike leafless growth on a stem that attaches itself around other stems and objects. Tendrils typically grow in a spiral shape. After attaching itself, it holds the stem in position. Vines and climbing plants often have tendrils. Examples include melons and cucumbers.

(PowerPoint Slide # 20 and #21)

d. Stolon—A **stolon** is an above ground stem that grows horizontally and propagates new plants. Strawberries are well known as examples of plants that multiply using stolons.

(PowerPoint Slide #22 and #23)

e. Bulb—A **bulb** is an underground food-storage organ consisting of flattened, fleshy stem-like leaves with roots on the lower side. Examples of bulbs are onions

(PowerPoint Slide #24 and #25)

f. Corm—A **corm** is a food storage structure at the end of a stem that grows underground. It is an enlarged or swollen stem base.

(PowerPoint Slide #26 and #27)

g. Cladophyll—A **cladophyll** is a leaflike branch that resembles a leaf. It is also called a cladode. A cladophyll functions much like a leaf.

****Explain to them that stems don't always look the same. It depends on the plant species. Lead into discussion about the plants in your area. Use TM: 1-3 to show the kinds of specialized stems. Classify the plants in your area by using the information just presented.**

(PowerPoint Slide # 28)

2. A **root** is the part of a plant that grows in the soil or other media. Roots anchor plants, absorb water and minerals, and store food. The root system structure varies widely depending on the species of plant.

Overall, roots can be classified as two major types:

(PowerPoint Slide # 29)

a. Fibrous—A **fibrous root system** is made of many small roots and spread throughout the soil.

b. Taproot—A **taproot system** is made of one primary root with a number of small secondary roots.

****Use TM: 1-4 to illustrate the types of root systems. There is also a picture on PowerPoint Slide #30. Have them draw this in their booklet and label. Have them come up with examples of plants in the area. If you have a camera available, take pictures of plants to show the students. You could also bring the plants to class.**

(PowerPoint Slide # 31)

3. A **leaf** is typically a large, flat, green organ attached to the stem. Leaves carry out photosynthesis, transpiration, and may store food. Shape, arrangement, and other features vary widely with the species of plant.

There are two major kinds of leaves and three major types of arrangements:

(PowerPoint Slide # 32)

- a. Simple—A **simple leaf** has only one blade.

(PowerPoint Slide # 33)

- b. Compound—A **compound leaf** is divided into two or more leaflets

(PowerPoint Slide # 34)

- c. Leaf attachment also varies. This refers to the spacing and arrangement of leaves on the stem of a plant. The major kinds of attachment are:

(PowerPoint Slide # 35)

- i. Alternate—**Alternate leaf arrangement** is one leaf at each node on a stem.
- ii. Opposite—**Opposite leaf arrangement** is two leaves are attached at nodes opposite each other.
- iii. Whorled—**Whorled leaf arrangement** is three or more leaves are at each node.

(PowerPoint Slide # 36 has a picture showing the leaf arrangements)

****Use TM: 1-5 to illustrate the types of leaves. Draw leaves on the board or bring in different plant leaves to show the students. Have them tell you what type you have drawn. Ask them how they know that is the right answer? They can also draw these in their booklet.**

(PowerPoint Slide # 37)

- B. The major **reproductive parts** of plants are flowers, seeds, and fruits.
1. A **flower** is a part containing the reproductive organs. The types of flowers vary considerably. In general, flowers produce pollen and ovules. Fertilization occurs when a pollen cell unites with an ovule.
 2. **Seed** are formed by fertilized ovules and contain new plant life.
 3. **Fruit** are the ovaries which develop to protect and nourish the developing seed. The kinds and nature of fruit vary widely.

(Note: Details on flowers will be presented in another lesson.)

****As a review of this section Use TM: 1-6 to illustrate the parts and functions of plants. Draw the picture on the board. Based on the information you just taught, have the students explain each function as you point to the specific plant part. Have them draw this in their booklet.**

Objective 3: Distinguish between plants based on seed cotyledons.

(PowerPoint Slide # 38 and #39)

III. A *cotyledon* is the fleshy structure within a seed that contains food for a developing embryo.

A. Depending on the plant species, a seed may have one or two cotyledons.

(PowerPoint Slide #40 and #41)

B. A plant species producing seed with one cotyledon is a *monocotyledon*, or monocot.

1. All grasses are monocots. Corn, wheat, oats, Bermuda grass, and sugarcane are examples of monocots.
2. Monocot plants have long, narrow leaves with parallel veins. All leaves branch from the main stem.
3. Stems are non-woody and tend to have a large area of pith in the center.

(PowerPoint Slide #42 and #43)

C. A plant species producing seed with two cotyledons is a *dicotyledon*, or dicot.

1. All plants other than grasses are dicots. Soybeans, trees, lettuce, sunflowers, and petunias are examples of dicots.
2. Dicot plants have broad leaves with a net-type of veins.
3. Stems are often long and branching. They may be woody or non-woody, depending on the plant species.

****Use local plants (crops, wild flowers, and ornamentals) as specimens to illustrate differences in plants based on cotyledons.**

Use TM: 1-7 to illustrate differences in dicot and monocot seed.

Use TM: 1-8 to illustrate how a monocot plant grows.

Use TM: 1-9 to show how a dicot plant grows.

Explain to students that they will learn more about seed germination on a later date.

Objective 4: Explain absorption and transport systems of plants.

(PowerPoint Slide # 44)

IV. Water and nutrients are primarily absorbed by the roots and transported throughout the plant by various tissues in the roots, stems, and leaves.

(PowerPoint Slide # 45)

A. Roots have tiny root hairs covered with thin membranes that allow water and nutrients to enter.

1. **Osmosis** is the movement of water from greater concentration in the soil or media to lower concentration in the root.
2. Water enters until the concentration in the root is equal to the concentration outside the root.
3. The water entering roots also carries inorganic substances known as nutrients.

(PowerPoint Slide # 46)

B. After absorption by roots, water is passed from cell to cell until it reaches the xylem.

1. **Xylem** is tissue, formed as tubes, that conducts water up the stem and to the leaves.
2. The petiole of the leaf takes the water from the xylem in the stem to the leaf veins, which distribute it throughout the leaf.

(PowerPoint Slide # 47)

C. Leaves lose water by **transpiration**.

1. Transpiration occurs through tiny stomata on leaves.
2. Transpiration creates somewhat of an upward pull that assists the xylem in moving water and nutrients.

(PowerPoint Slide # 48 and #49)

D. Manufactured food is conducted from the leaves through the stems to the roots in phloem tissue.

1. **Phloem** is the tissue that conducts sugars, proteins, hormones, dissolved materials, and salts from leaves to other parts of a plant.
2. The structure is observed as elongated sieve-type cells that form tube structures in stems.

**** A cross section of a corn stalk can be used to show xylem tissue and tubes for the movement of materials. Use the roots of a plant specimen to help students see root hairs**

Use TM: 1-10 to show the arrangement of tissues in stems. Use TM: 1-11 to illustrate root structure.

Use TM: 1-12 to illustrate root structure as related to absorption. Use TM: 1-13 to illustrate stomata. All of these can be added to their booklet.

****Use LS: 1-1 for students to carry out an activity that measures the loss of water from a plant by transpiration. Materials needed for the lab are listed on the lab**

sheet. You may have to improvise with some of the materials. Have the students answer the two questions that follow the lab.

Review/Summary: Focus the review and summary of the lesson on the student learning objectives. Have students explain the content associated with each objective. Use specimens of plant materials for students to use in demonstrating their knowledge of the objectives. Also have them turn to a partner and explain their drawings. Encourage them to share their work with family. This will help them in remembering what they learned. Use student responses as the basis for reteaching if needed.

Application: Application can involve one or more of the following student activities that was mentioned above: Measuring Water Loss from a Plant by Transpiration—Lab Sheet LS: 1-1

Evaluation: Evaluation should focus on student achievement of the objectives for the lesson. Questions could be in the form of oral testing or drawing selected items from the booklet the students made. They would then be in charge of labeling the items. A sample written test is included below.

Answers to Sample Test:

Part One: Matching

1=j, 2=c, 3=a, 4=i, 5=h, 6=g, 7=d, 8=e, 9=b, 10=f

Part Two: Completion

1=Osmosis

2=Transpiration

3=dicot

4=xylem

Part Three: Illustration

1. Use TM 1-1 as a guide for scoring this sketch.
2. Use TM 1-6 as a guide for scoring this sketch.

Test

Unit A Lesson 1: Examining Plant Structures and Functions

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term next to the definition.

- | | |
|-------------------|------------|
| a. cells | f. stems |
| b. multi-cellular | g. leaves |
| c. tissue | h. roots |
| d. organ | i. flower |
| e. organ system | j. monocot |

- _____ 1. Plant with seed having one cotyledon.
- _____ 2. Formed by a group of cells similar in activity and structure.
- _____ 3. Tiny structures that are the basic building blocks of plants.
- _____ 4. The part of a plant containing reproductive organs.
- _____ 5. Anchor plants in the soil.
- _____ 6. Large, flat plant structures attached to stems.
- _____ 7. A collection of tissues.
- _____ 8. A collection of organs.
- _____ 9. Organisms containing more than one cell.
- _____ 10. Connect leaves and roots.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

- 1. _____ is the movement of water from greater concentration in the soil to lower concentration in the roots of plants.
- 2. _____ is the loss of water by leaves.
- 3. A _____ is a plant from a seed with two cotyledons.
- 4. The tissue forming tubes in plants that conducts water and nutrients from the roots is _____.

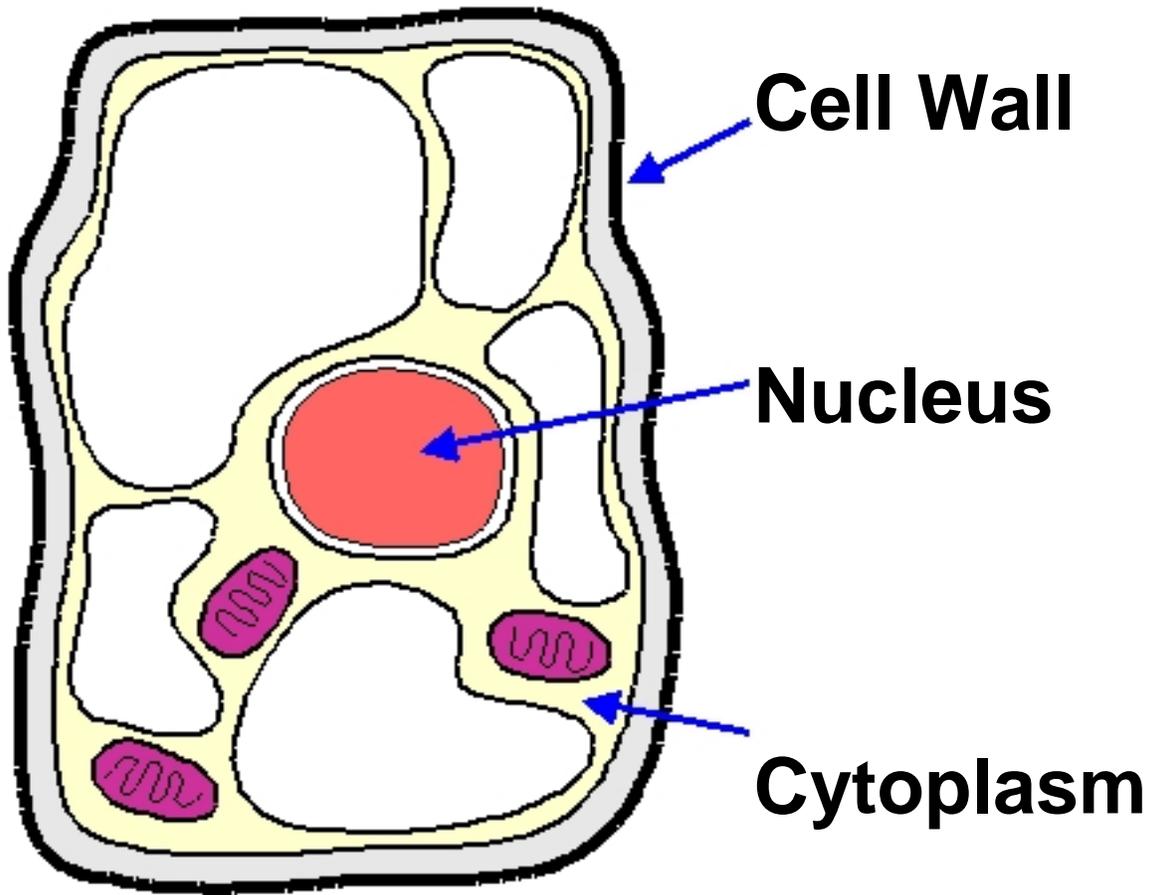
Part Three: Short Answer

Instructions. Complete the following:

1. Draw and label the major parts of a plant cell.

2. Draw and label the major parts of a plant.

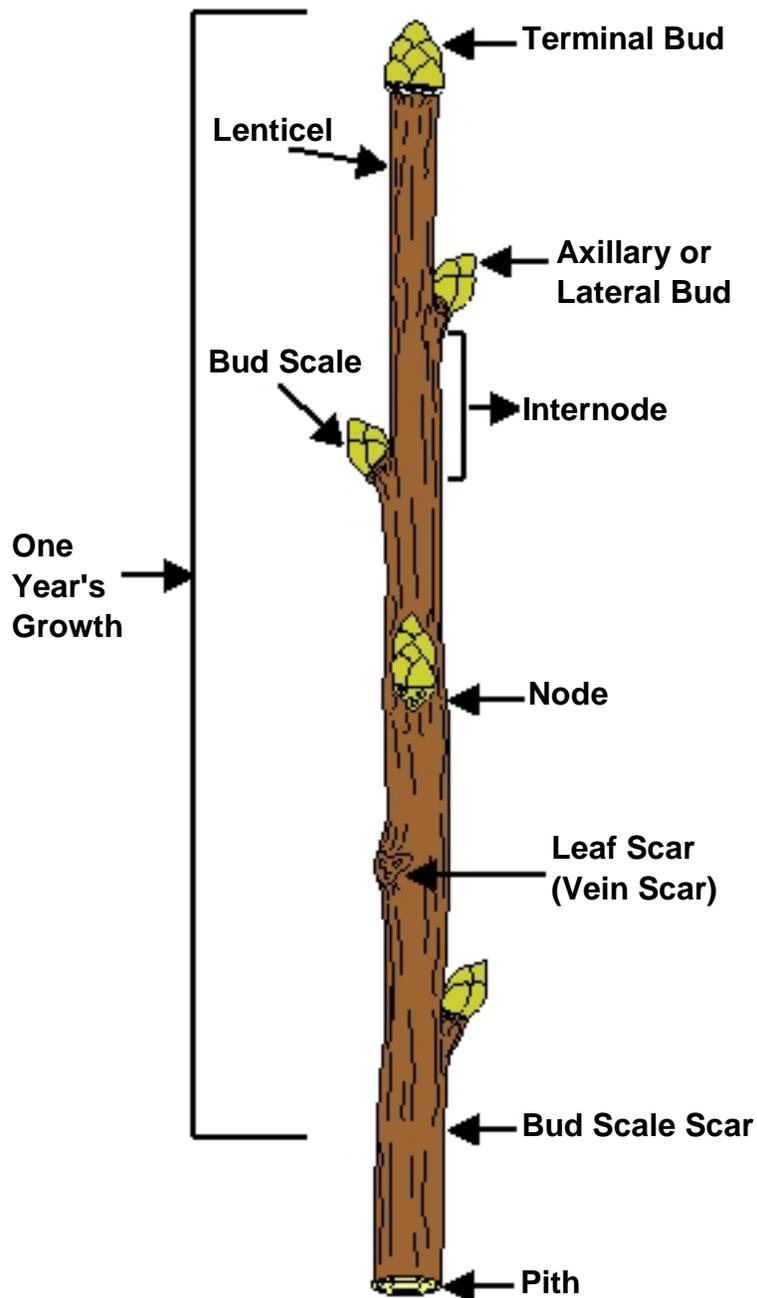
Major Parts of a Plant Cell



Plant Cell

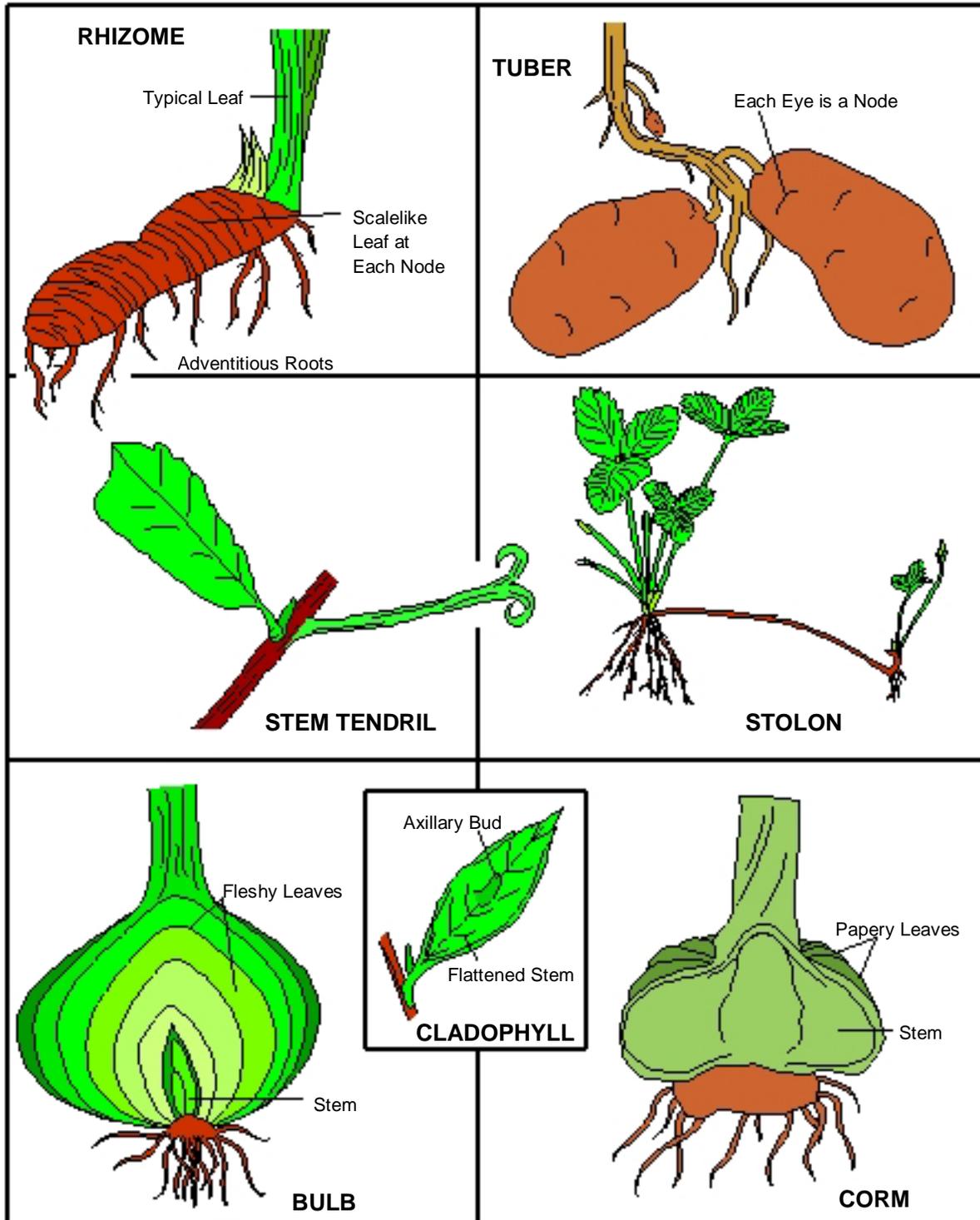
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Parts of a Typical Stem

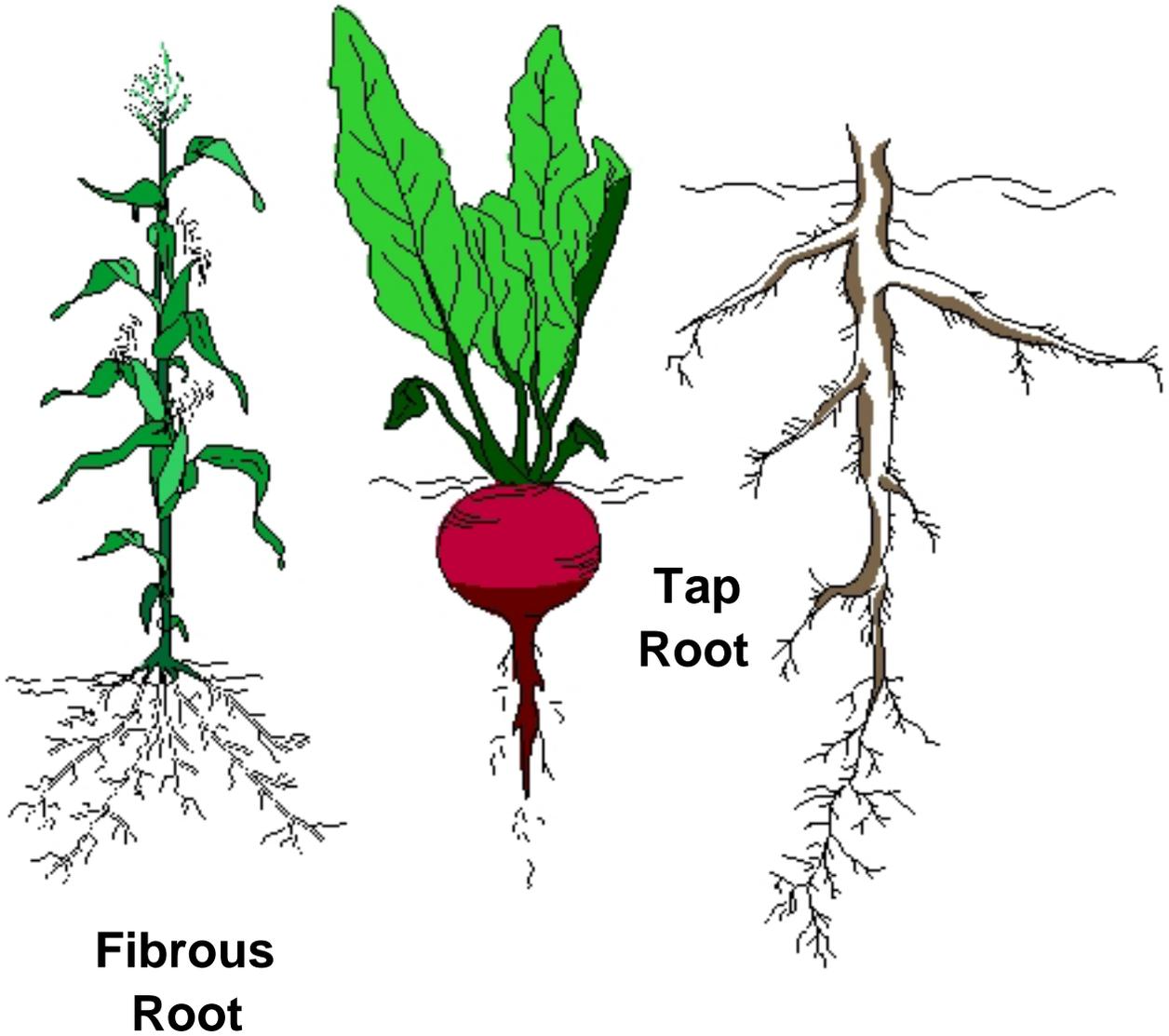


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Specialized Stems

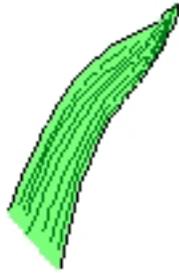


Kinds of Roots



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Leaf Venation Patterns



Parallel Venation



Pinnate Venation



Palmate Venation

Leaf Types



Palmately Compound

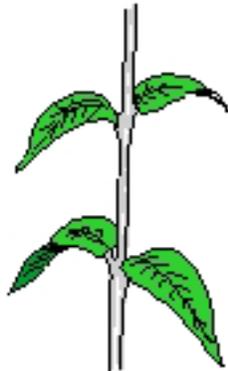


Odd Pinnate

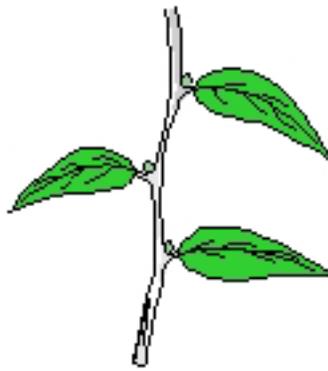


Even Pinnate

Leaf Arrangements



Opposite



Alternate



Whorled

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Functions of Leaves, Stems, Roots, and Flowers

Female Flower Functions:

- Reproduction
- Anchor plant
- Store food in seeds and fruits

Male Flower Function:

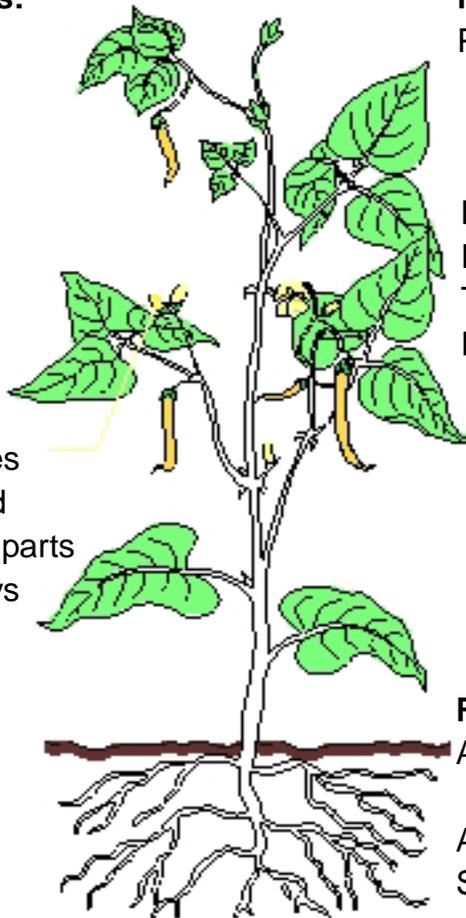
- Pollination

Leaf Functions:

- Photosynthesis
- Transpiration
- Food storage in some crops—lettuce, cabbage, etc.

Stem Functions:

- Conducts water and minerals from soil to leaves
- Conducts manufactured food from leaves to other plant parts
- Produces leaves and displays them to light
- Supports leaves, flowers and fruit
- Stores food reserves in some plants—potato, asparagus, cabbage hearts, etc.

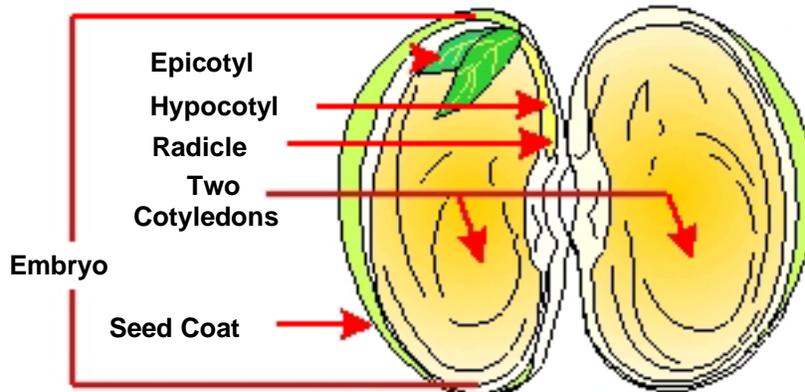


Root Functions:

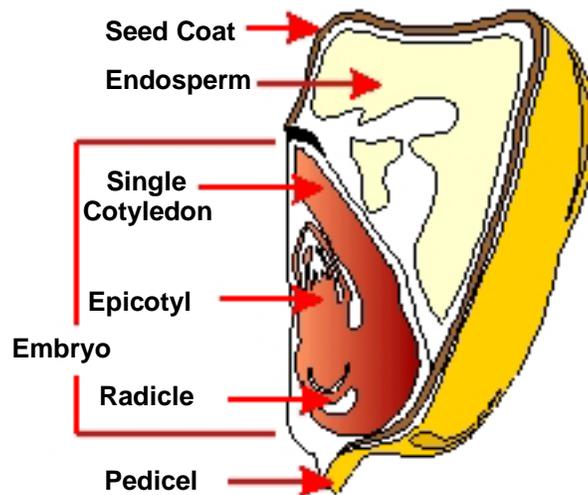
- Absorb water and minerals
- Anchor plant
- Store food reserves in some crops—carrots, beets, etc.

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Comparison of Monocot and Dicot Seed



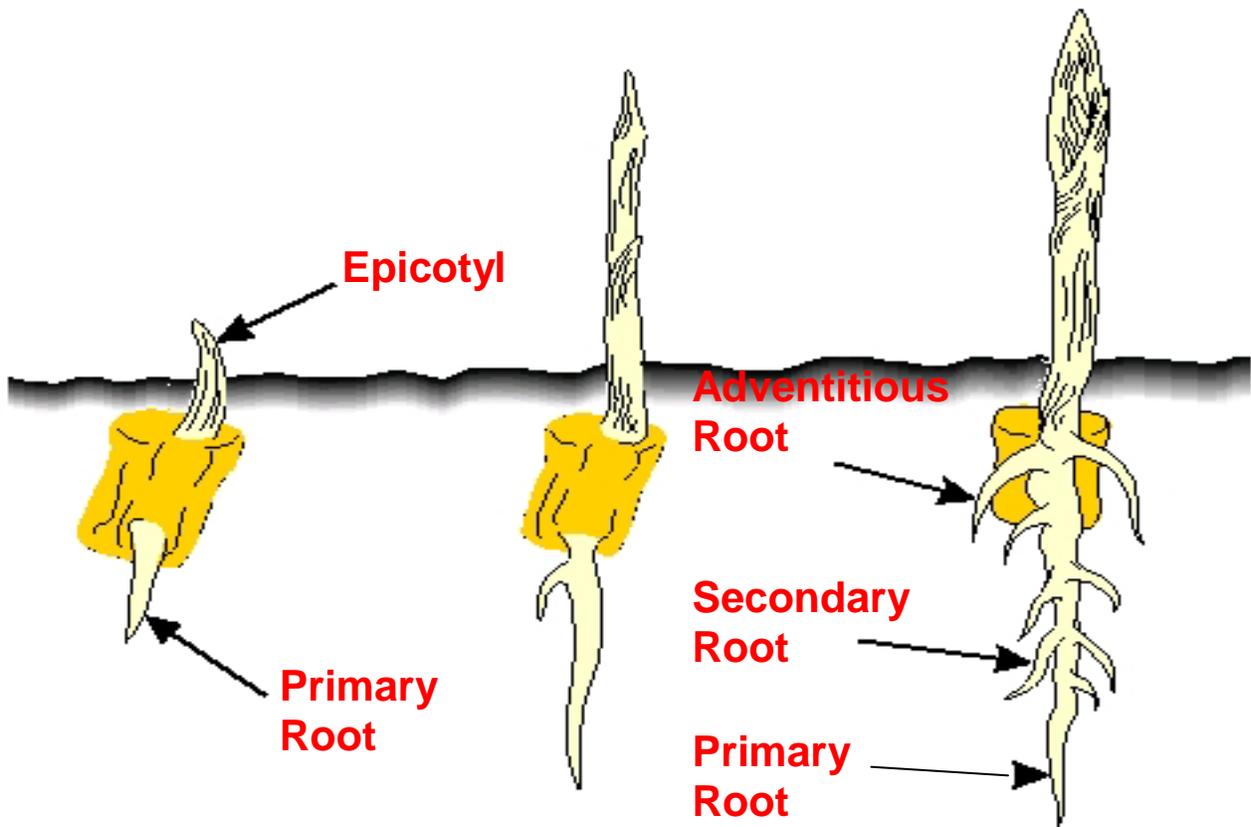
BEAN SEED



CORN SEED

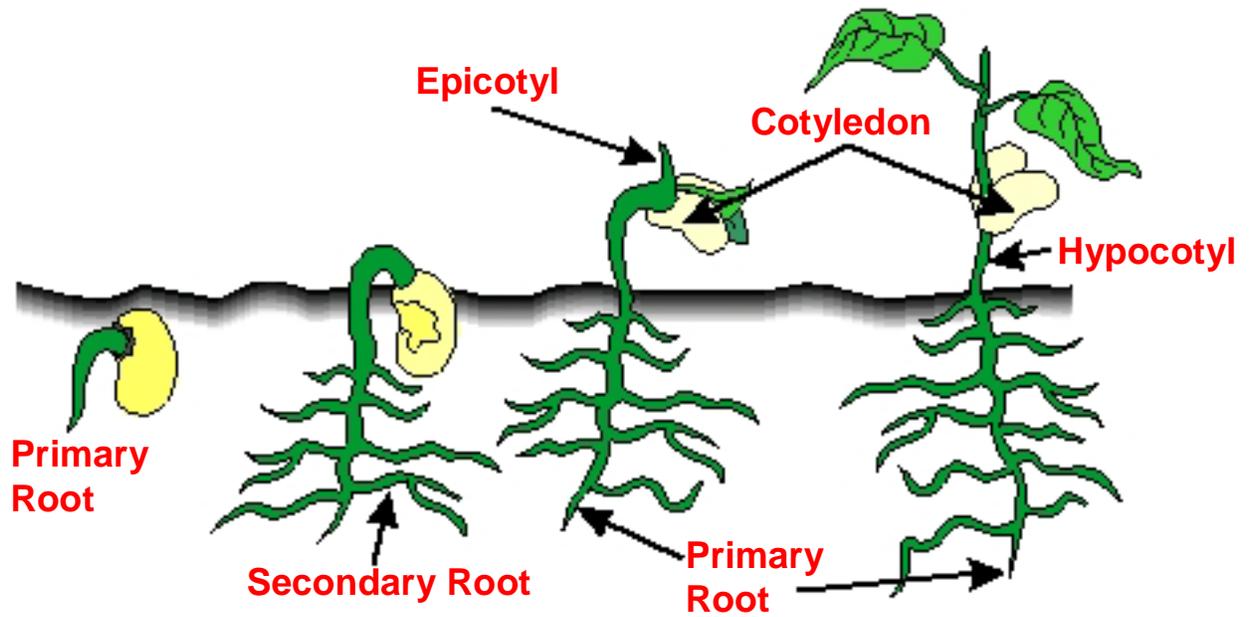
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Corn



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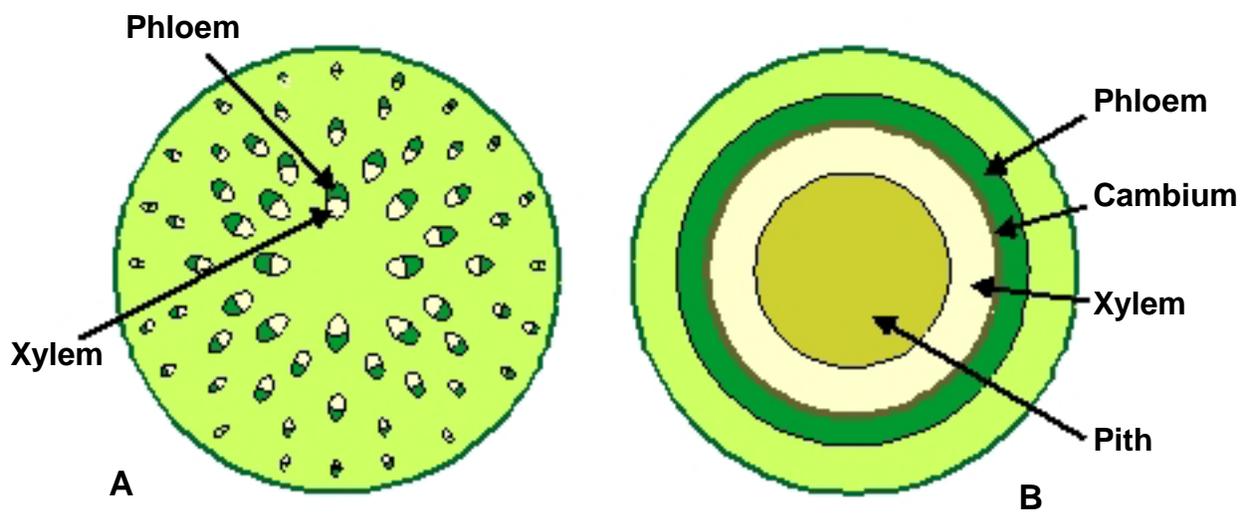
Bean



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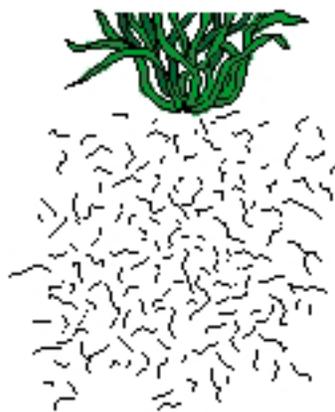
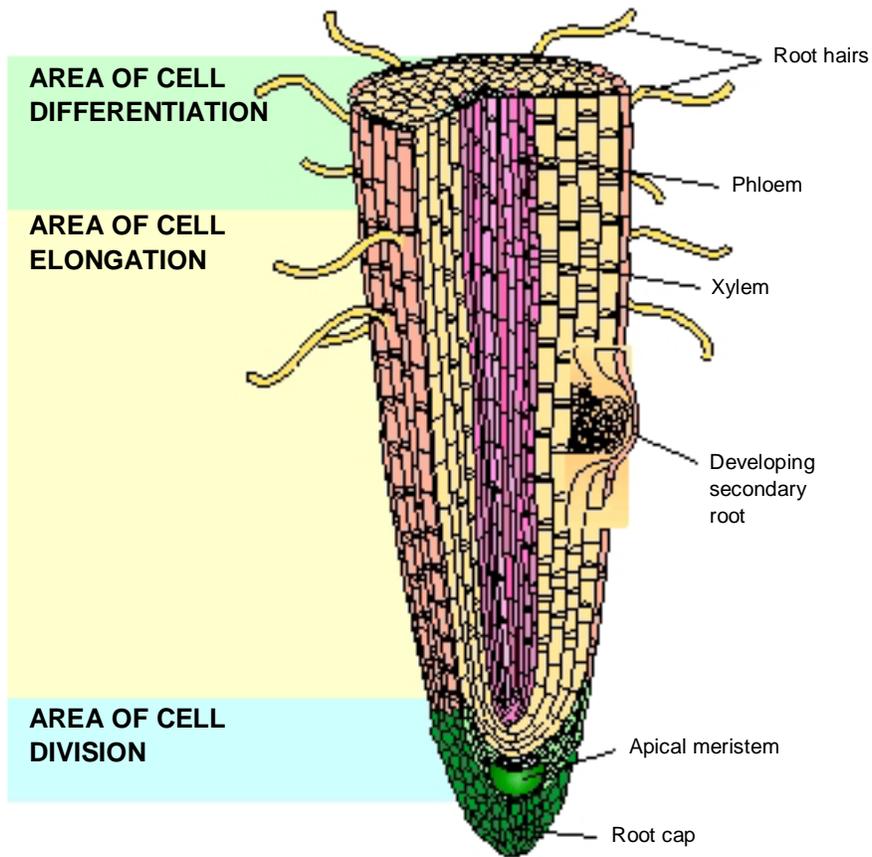
TM: 1-10

Arrangement of Tissues in Stems

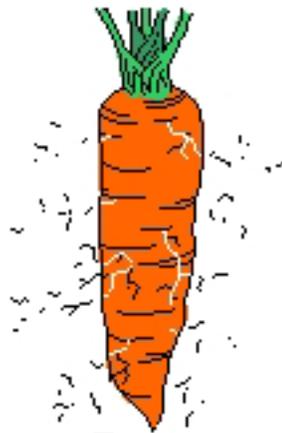


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Roots



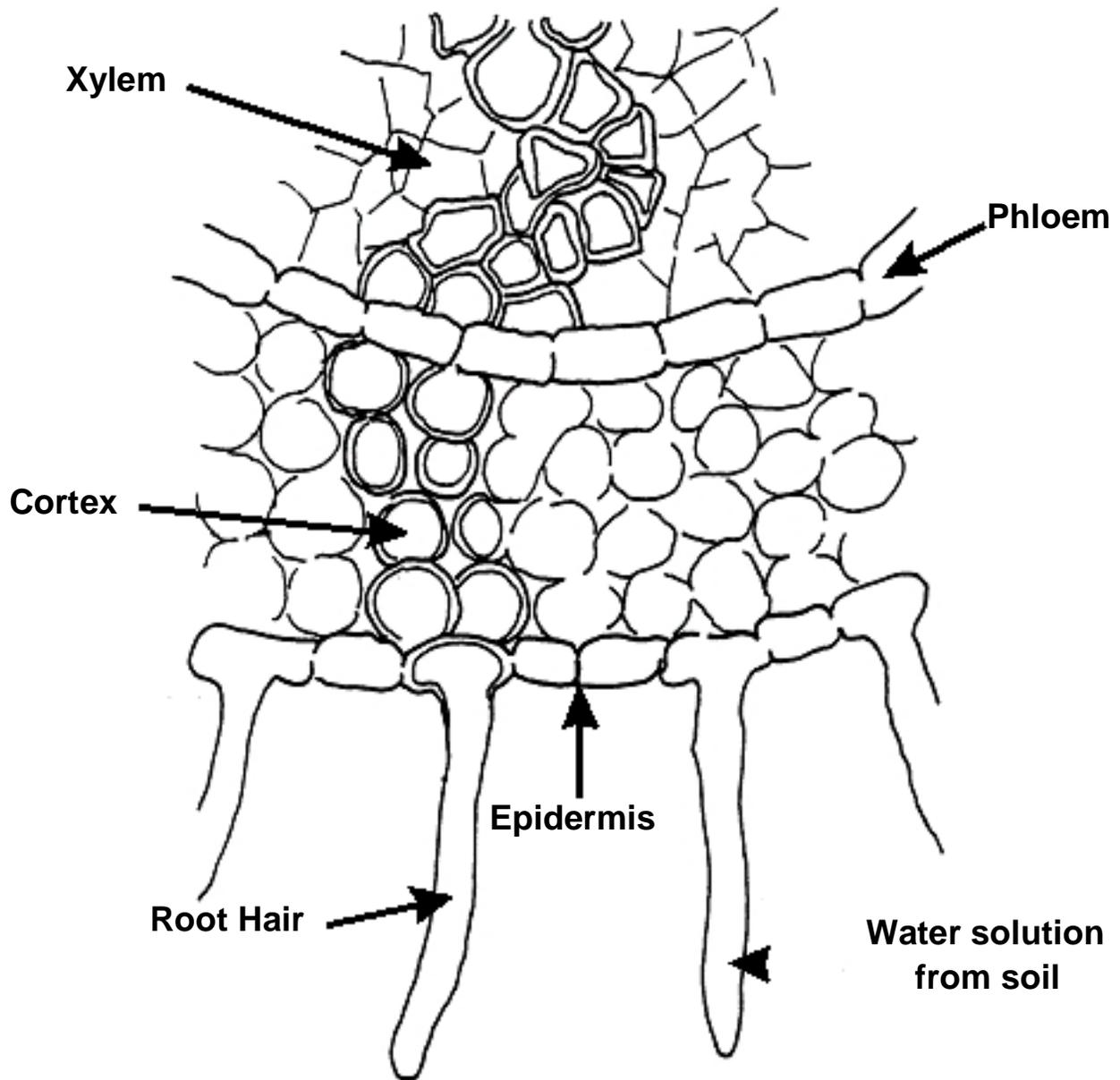
**Fibrous Root
(turfgrass)**



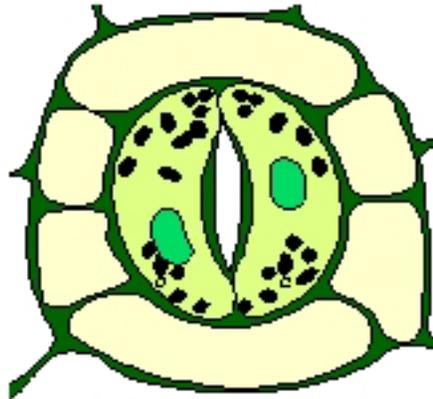
**Taproot
(carrot)**

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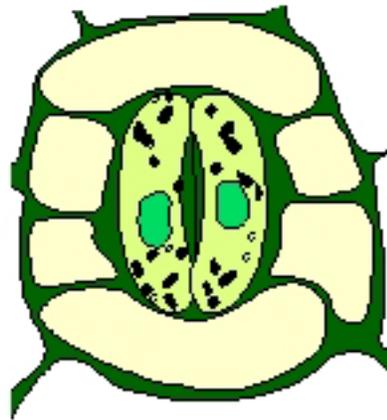
Absorption



Stomata



Stoma Open



Stoma Closed

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Lab Sheet

Measuring Water Loss from Transpiration

Purpose:

The purpose of this activity is to discover the amount of water a plant loses by transpiration. (This activity can be carried out by groups of 2-4 students working together.)

Objectives:

1. To use a technique to collect water that is transpired by plants.
2. To measure the amount of water that is transpired.

Materials: (These are the materials needed for each group of students.)

1. A rapidly growing plant in a pot, bucket, or other container, or a plant growing in a convenient location.
2. Plastic bag or sheet of clear plastic that will cover the plant or a branch of the plant containing 10-12 leaves.
3. String, rubber bands, or other suitable tie materials to hold the plastic in place over the plant.
4. Stake to support the weight of the plastic.
5. Plastic straw or other suitable tubing for a drain.
6. Graduated beaker or measuring cup.

Procedure:

1. Be sure the plant is well watered.
2. Cover the entire vegetative portion of the plant with plastic material.
3. Locate tubing at bottom of plastic covering to serve as a drain.
4. Place plant in sunny location for an entire day to promote transpiration.
5. Collect and measure the water that is transpired during daylight hours; record the measurement; and empty the beaker.
6. Collect and measure the water that is transpired during dark hours (night); record the measurement, and empty the beaker.
7. Compare differences in the amount of transpired water that is collected.

Questions:

1. Which period (day or night) produced the most water in the container? Why?

2. Does temperature have an effect on transpiration? Does light? Does air humidity?