

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

Lesson 3: Understanding Stem Anatomy

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

1. Describe the functions of a stem.
2. Identify the external structures of a stem.
3. Identify the internal structures of a stem.
4. Distinguish between the different types of specialized stems

Recommended Teaching Time: 1 hour

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

- A PowerPoint has also been developed with use of this lesson plan
- <http://waynesword.palomar.edu/trjune99.htm>
- <http://www.enchantedlearning.com/subjects/plants/plant/>

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Projector
PowerPoint Slides
Transparency Masters
6 to 12 inch branches of trees cut fresh from outside
PowerPoint Slides
Microscopes
Monocot stem slide if available
Dicot stem slide if available

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide #2):

- Apical meristem
- Bud scales
- Bud scale scar
- Bulb
- Cambium
- Corm
- Internode
- Lateral bud
- Leaf scar
- Lenticels
- Node
- Phloem
- Rhizome
- Stolon
- Terminal bud
- Tuber

- 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.

Begin the lesson by breaking the class up into groups. Give each group a small branch from a tree. Ask the class to closely observe the branch. What can they tell from the branch about the tree that it was growing on? Ask how many structures on the stem they can identify. Most students will be familiar with buds. If it is spring or fall, and leaves are on the stem, lead the students to observe how evenly the leaves are spread and how efficiently they collect the sunlight.

**** Use this activity to see how well the students remember the stem structures. Then lead into discussion over stem functions.**

Summary of Content and Teaching Strategies

Objective 1: Describe the functions of a stem.

**** Ask the students to stay in the same groups they are still in from the interest approach. Have one person get out a piece of paper. All of the group members need to brainstorm and come try to come up with four functions a stem possesses. The person with the paper needs to write down the student's response. They may not be able to come up with all four functions, but encourage them to work together to list as many as possible. When finished, call on each group. Have them give only one answer until all possible group answers are shared.**

II. Stems have many important jobs in a plant. Stems are responsible for the size and shape of a plant. Some stems are made of wood, some are herbaceous. The following are some functions of stems.

(PowerPoint Slide # 3 and # 4)

- A. Stems support the leaves. They hold the leaves in the most efficient position to collect sunlight. This allows the plant to produce as much food as possible.
- B. Stems move water, minerals, and manufactured food throughout the whole plant.
- C. Stems which are green in color help produce food through photosynthesis. While this is not usually the primary food production, it can be quite important in plants with no leaves or very small leaves.
- D. Stems store food which has been manufactured by the plant.

****You may bring in plants to demonstrate several of the functions of the stem. You may bring in a green stemmed plant such or a plant which stores food in its stem.**

Objective 2: Identify the external structures of a stem.

**** Ask if a student can draw a picture of a stem on the board with the appropriate parts. Then call on a student, one by one, and have them come up and label an external stem structure on the stem. This activity should serve as a review based on lesson 1 and they should remember most of the parts. Briefly go through the information for this objective in case some students are struggling with this section.**

(PowerPoint Slide # 5)

- I. There are many structures on the stem which are very useful to us in identifying plants. When you first look at stems, they all seem to look similar. After some closer observation, you will see that it is easier to identify many plants using their stems than it is using their leaves. The following are some external structures on a stem.
 - A. The growing point at the tip of the stem, called the **apical meristem** is contained inside of the bud at the end of the stem, called the **terminal bud**. The apical meristem is the same type of structure that the tip of the root has and is responsible for growth in length of the plant.

(PowerPoint Slide # 6)

- B. The leaf is attached to the stem at the **node**. The area between leaves is called an **internode**. At the node, just above where the leaf is attached there is always a side bud, called the **lateral bud**. On the outside of both terminal and lateral buds are small protective structures, called **bud scales**.

(PowerPoint Slide # 7)

- C. When the leaf falls off of the stem, it leaves behind a small scar just below the lateral bud. This scar is called the **leaf scar**. When the buds sprout each spring, the bud scales fall off, leaving behind a ring of scars called the **bud scale scar**. The distance between bud scale scars represents one year's growth of the stem.
 - D. **Lenticels** are small spots on the stem that allow a stem to exchange gases with its environment.

**** Use TM: 3-1 to demonstrate where on the stem the structures are, again you may choose to draw this on the board. PowerPoint Slide # 8 also has a picture of a stem that can be used. Show the students the location of the structures on the small branches that you bring to class. You could also**

have them try to point out the structures on the branch you bring to the class.

Objective 3: Identify the internal structures of a stem.

(PowerPoint Slide # 9 and #10)

III. Inside of the stem, there are tissues that are used for transport of materials through the plants. Stem tissues are organized in one of the following ways. The important vascular tissues are either found in small bundles scattered throughout the stem, or arranged in rings or a ring of bundles. The first way, scattered bundles, is found in monocots. The second way, in rings, is found in dicots. There are three important type of tissue found inside of the stem.

(PowerPoint Slide # 11)

- A. The **xylem** is tissue that conducts the water and minerals throughout the plant. The xylem is made of tube-like cells which grow together to conduct liquids. Xylem tends to be found closer to the center of the stem.
- B. The **phloem** is tissue that conducts food that is produced in the leaf to the rest of the plant. Phloem cells also form tubes. Phloem is found generally toward the outside of the stem.

(PowerPoint Slide # 12)

- C. **Cambium** is tissue that is responsible for the production of new xylem and phloem. Cambium is responsible for growth in girth of the stem. Cambium is generally found between the xylem and the phloem.

****Use TM: 3-2 to demonstrate where on the stem the structures are. You can draw this picture on the board. Use a microscope to view the internal structure of monocot and dicot stems if slides are available. After students have viewed the slides, have them sketch what they see and label the parts. PowerPoint slide # 13 will help students see a microscopic view of xylem and phloem.**

Objective 4: Distinguish between the different types of specialized stems

(PowerPoint Slide # 14)

IV. We generally expect stems to be upright and above ground. Although we are often right, there are many stems that do not fit into this mold. Some stems are modified to store food or help the plant reproduce. Some stems grow beneath the soil instead of above it. The following are some types of specialized stems.

(PowerPoint Slide # 15)

A. A **bulb** is a very short flattened stem which has several fleshy leaves attached to it. Bulbs tend to be found beneath the soil. An onion is a bulb.

(PowerPoint Slide # 16)

B. A **corm** is a spherical structure, much like a bulb. The entire structure, however, is stem as opposed to stem and leaves.

(PowerPoint Slide # 17)

C. A **rhizome** is a thick underground stem which lies horizontally.

(PowerPoint Slide # 18)

D. A **stolon** is a horizontal stem which lies above the ground. Stolons are sometimes called runners and tend to be involved with the spreading of the plant. Strawberries spread by stolon.

(PowerPoint Slide # 19)

E. A **tuber** is a rhizome with a tip that is swollen with stored food. Potatoes are tubers.

****Use TM: 3-3 to show some specialized stems. Bring in some plants which show the specialized stems.**

Review/Summary: Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used to determine which objectives should be reviewed. Some possible review questions can be found on PowerPoint Slide #20 and #21.

Application: Students can use what they learn while working with the plant stems, using microscopes, and prepared microscope slides.

Evaluation: Set up a practical exam or quiz. Allow students to demonstrate their understanding of the objectives. Questions can also be in the form of oral testing as well. A sample written test is included below.

Answers to Sample Test:

Part One: Matching

- | | |
|------|-------|
| 1. i | 10. p |
| 2. n | 11. c |
| 3. d | 12. q |
| 4. k | 13. e |
| 5. l | 14. m |
| 6. a | 15. h |
| 7. j | 16. o |
| 8. g | 17. f |
| 9. b | |

Part Two: Completion

- rings or circles
- no order or scattered pattern

Part Three: Short Answer

- A. transportation of materials
- B. photosynthesis
- C. food storage
- D. production of new cells
- E. support of leaves and the upper portion of the plant.

Test

Unit A Lesson 3: Understanding Stem Anatomy

Part One: Matching

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

- | | | |
|--------------------|----------------|-----------------|
| a. Apical meristem | g. Internode | m. Rhizome |
| b. Bud scale | h. Lateral Bud | n. Stolon |
| c. Bud scale scar | i. Leaf scar | o. Terminal bud |
| d. Bulb | j. Lenticel | p. Tuber |
| e. Cambium | k. Node | q. Xylem |
| f. Corm | l. Phloem | |

- _____ 1. Mark on the stem where the leaf used to be.
- _____ 2. Specialized stem which is usually laying horizontally above the soil.
- _____ 3. Specialized stem made of a short flat stem with many fleshy leaves attached.
- _____ 4. Location on the stem where leaves and buds are attached.
- _____ 5. Tube shaped cells inside of a stem which carry food down from the leaves.
- _____ 6. Actively growing tip found inside a terminal or lateral bud.
- _____ 7. Mark on the outside of a stem which allows gas to be exchanged.
- _____ 8. Area on a stem which lies between two leaves or buds.
- _____ 9. Small protective structure which can be seen on the outside of a bud.
- _____ 10. Specialized stem which has a tip that is swollen with stored food.
- _____ 11. Mark on the stem which shows where last year's bud was.
- _____ 12. Cells on the inside of a stem which carry water and minerals up from the
root.
- _____ 13. Area on the inside of a stem where new xylem and phloem are made.
- _____ 14. A specialized stem which is thick and runs horizontally underneath the soil.
- _____ 15. A bud which is found on the side of the branch in conjunction with a leaf.
- _____ 16. A bud which is found at the tip of a branch.
- _____ 17. A bulb shaped specialized stem which is made of solid stem with no leaves.

Part Two: Completion

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

1. A dicot plant has a stem whose xylem and phloem are arranged in _____.
2. A monocot plant will have vascular bundles inside its stem arranged in _____.

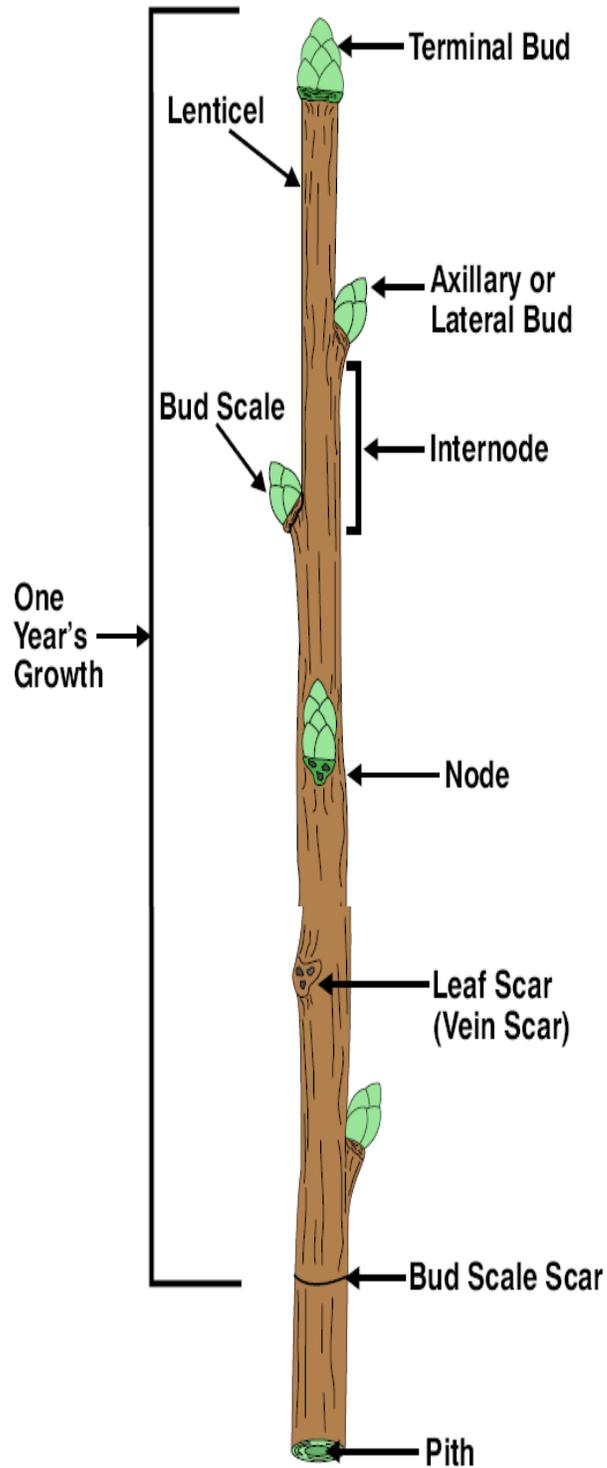
Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. Name five functions of stems.
 - a.
 - b.
 - c.
 - d.
 - e.

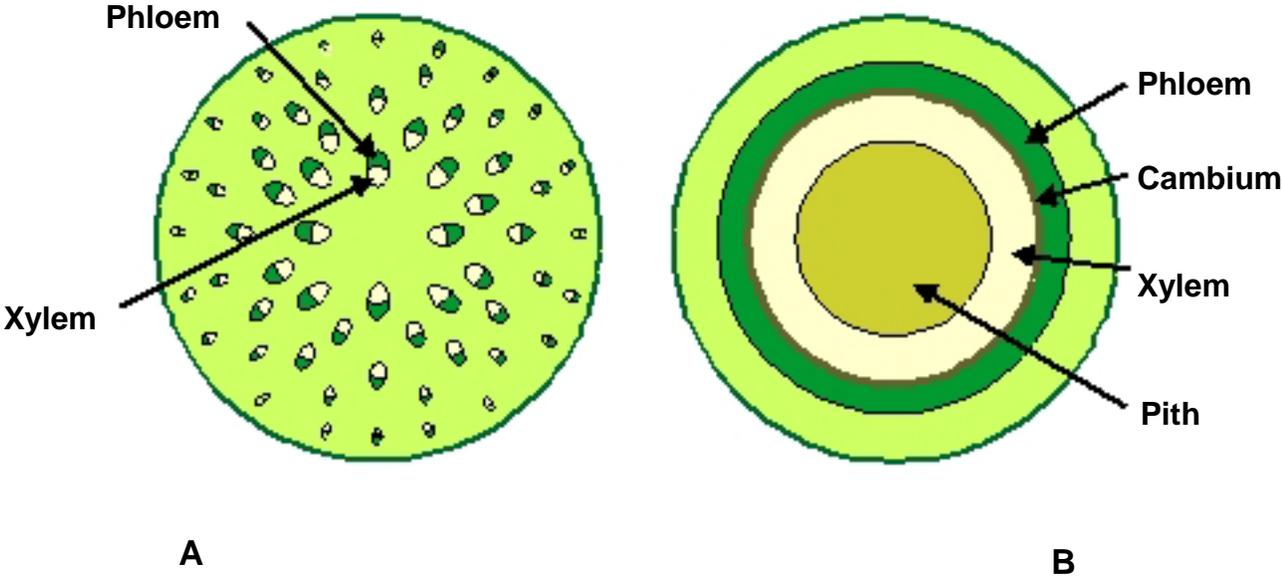
TM: 3-1

PLANT STEM STRUCTURE



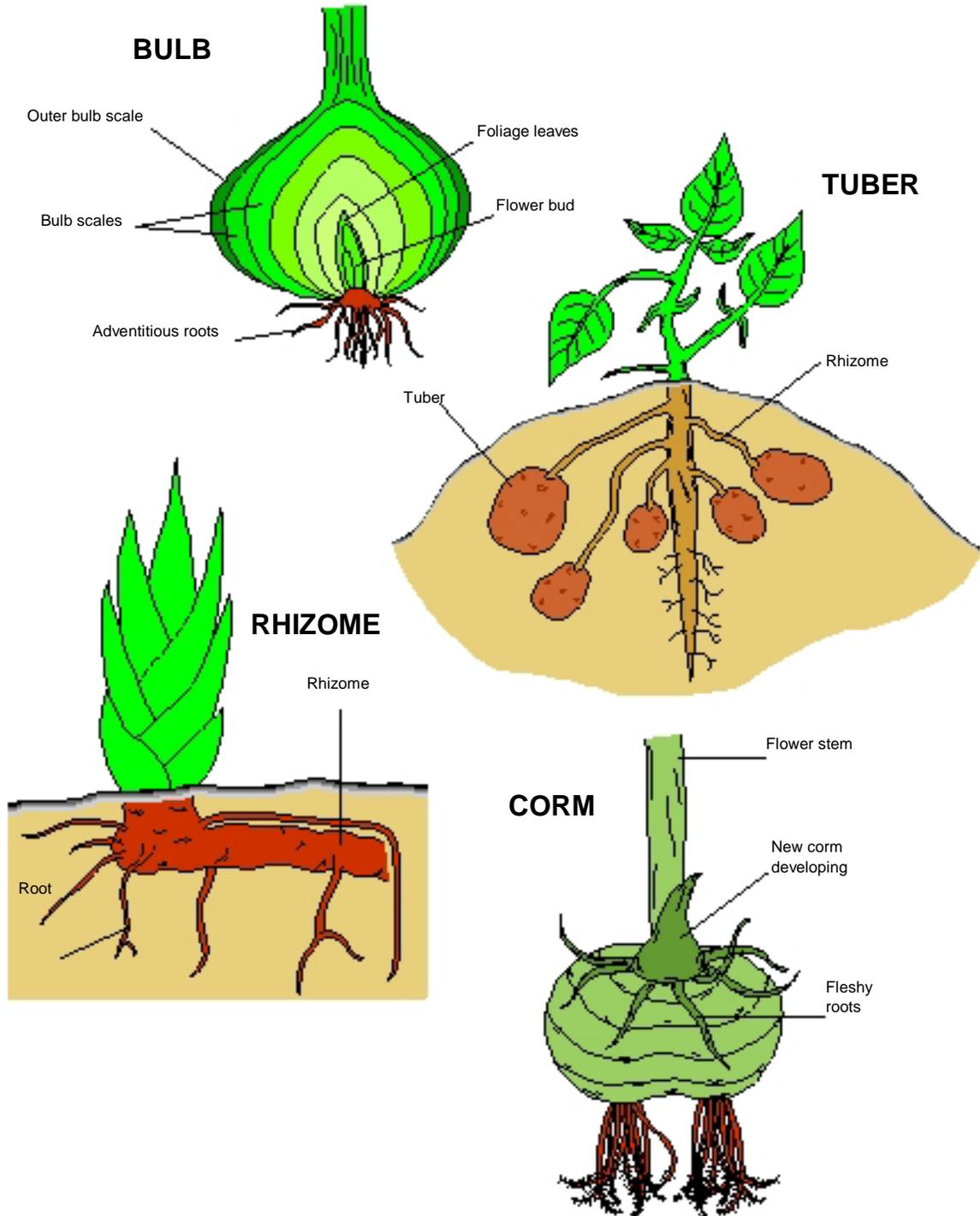
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Arrangement of Tissues in Stems



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SPECIALIZED PLANT STEMS



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