

Unit B: Plant Anatomy

Lesson 2: 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
5. Recognize the economical importance of roots.

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://en.wikipedia.org/wiki/Plant_stem
- <http://waynesword.palomar.edu/trjune99.htm>
- <http://www.enchantedlearning.com/subjects/plants/plant/>
- www.uri.edu/cels/bio/plant_anatomy/images.html

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Projector
PowerPoint Slides
Transparency Masters
PowerPoint Slides
Plant parts that we eat
Fresh stems cut from outside

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.

Have a variety of plants that we eat sitting on a table. These plants will need to be a mixture of plant roots, stems, leaves, fruits, and flowers. Have the students get into equal size groups and as a group guess which of these are stems. This should be a little bit easier now that they have covered roots.

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 try to come up with four functions of a stem. The person with the paper needs to write down the student's responses. 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.**

(PowerPoint Slide # 3 and # 4)

- I. 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.
 - 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 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 structure/part of the stem. This activity should serve as a review based on the discussion of the functions of stems. Carefully go through the information for this objective in case some students are struggling with this section.**

(PowerPoint Slide # 5)

- II. 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: B2-1 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 PowerPoint Slide #9 shows a real plant that is labeled. Show the students the location of the structures on the small branches of the plant parts that you bring to class. You could also have them try to point out the structures on the plant parts that you bring to class.**

Objective 3: Identify the internal structures of a stem.

(PowerPoint Slide # 10 and #11)

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 # 12)

- 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 # 13)

- 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: B2-2 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 # 14 will help students see a microscopic view of xylem and phloem.**

Objective 4: Distinguish between the different types of specialized stems

(PowerPoint Slide # 15)

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 # 16)

- 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. A Lilly is a bulb.

(PowerPoint Slide # 17)

- 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 # 18)

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

(PowerPoint Slide # 19)

- 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 # 20)

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

****Use TM: B2-3 to show some specialized stems. Bring in some plants which show the specialized stems.**

Objective 5: Recognize the economical importance of roots.

(PowerPoint Slide # 21)

V. There are thousands of species whose stems have economic uses.

- A. Stems provide a few major staple crops such as potato and taro.
Sugarcane stems are a major source of sugar. Maple sugar is obtained from trunks of maple trees. Vegetables from stems are asparagus, bamboo shoots, cactus pads or nopalitos, kohlrabi, and water chestnut. The spice, cinnamon is bark from a tree trunk.
Cellulose from tree trunks is a food additive in bread, grated Parmesan cheese, and other processed foods. Gum arabic is an important food additive obtained from the trunks of *Acacia senegal* trees. Chicle, the main ingredient in chewing gum, is obtained from trunks of the chicle tree.

(PowerPoint Slide # 22)

- B. Medicines found around the world that are obtained from stems include quinine from the bark of cinchona trees, camphor distilled from wood of a tree in the same genus that provides cinnamon, and the muscle relaxant curare from the bark of tropical vines.
- C. Wood is used in thousands of ways, e.g. buildings, furniture, boats, airplanes, wagons, car parts, musical instruments, sports equipment, railroad ties, utility poles, fence posts, pilings, toothpicks, matches,

plywood, coffins, shingles, barrel staves, toys, tool handles, picture frames, veneer, charcoal and firewood.

(PowerPoint Slide # 23)

1. Wood pulp is widely used to make paper, cardboard, cellulose sponges, cellophane and some important plastics and textiles, such as cellulose acetate and rayon.
2. Bamboo stems also have hundreds of uses, including paper, buildings, furniture, boats, musical instruments, fishing poles, water pipes, plant stakes, and scaffolding.
3. Trunks of palm trees and tree ferns are often used for building. Reed stems are also important building materials in some areas.

(PowerPoint Slide # 24)

4. Cork is obtained from the bark of the cork oak.
5. Rubber is obtained from the trunks of *Hevea brasiliensis*.
6. Rattan, used for furniture and baskets, is made from the stems of tropical vining palms.
7. Bast fibers for textiles and rope are obtained from stems include flax, hemp, jute and ramie.

(PowerPoint Slide # 25)

- D. Amber is fossilized sap from tree trunks; it is used for jewelry and may contain ancient animals. Resins from conifer wood are used to produce turpentine and rosin. Tree bark is often used as a mulch and in growing media for container plants.

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. PowerPoint Slide #26, #27, and #28 can be used for internal stem structure review. Some possible review questions can be found on PowerPoint Slide #29 and #30.

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.

Sample Test

Name _____

Test

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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
_____.

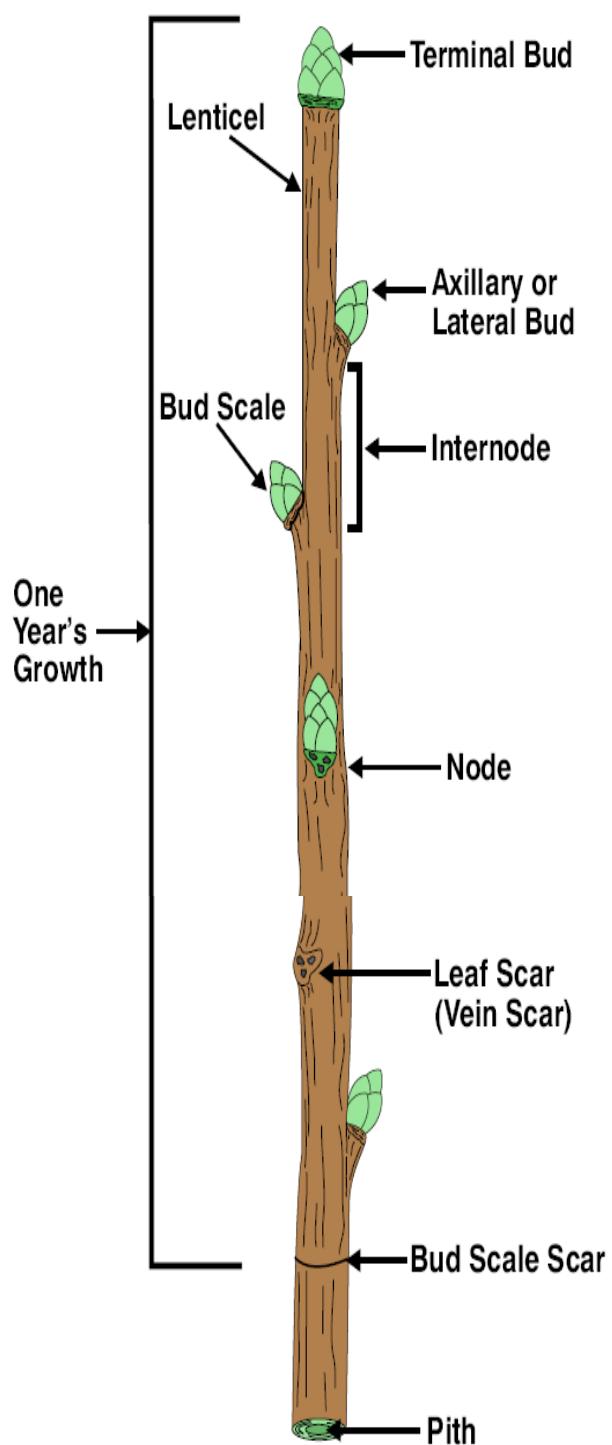
Part Three: Short Answer

Instructions. Provide information to answer the following questions.

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

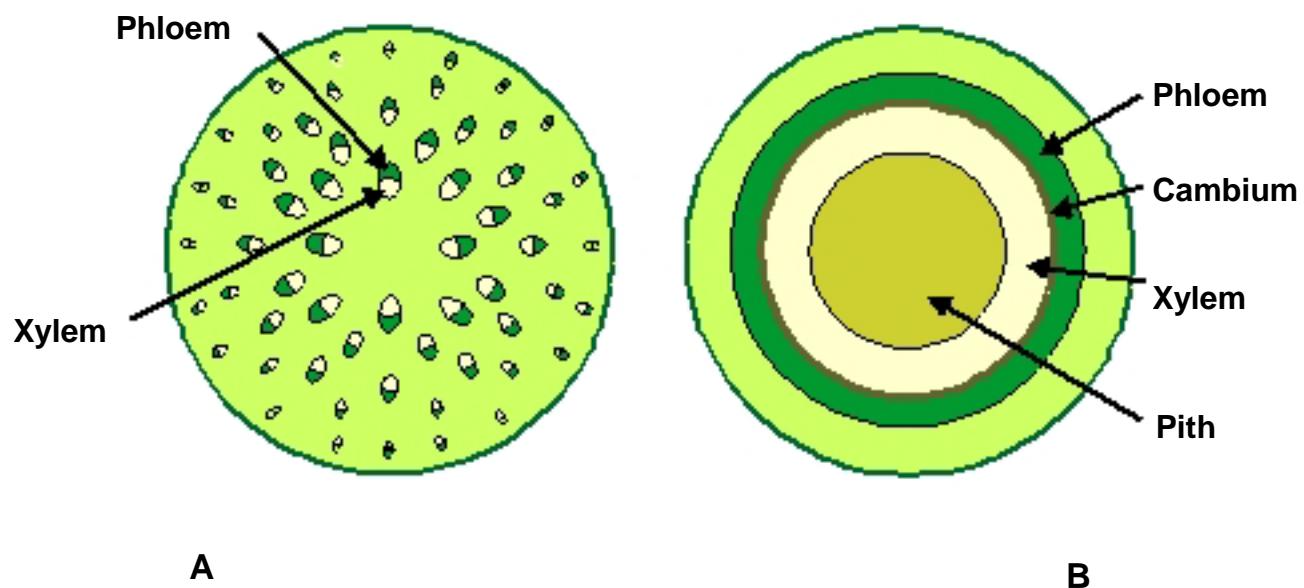
TM: B2-1

PLANT STEM STRUCTURE



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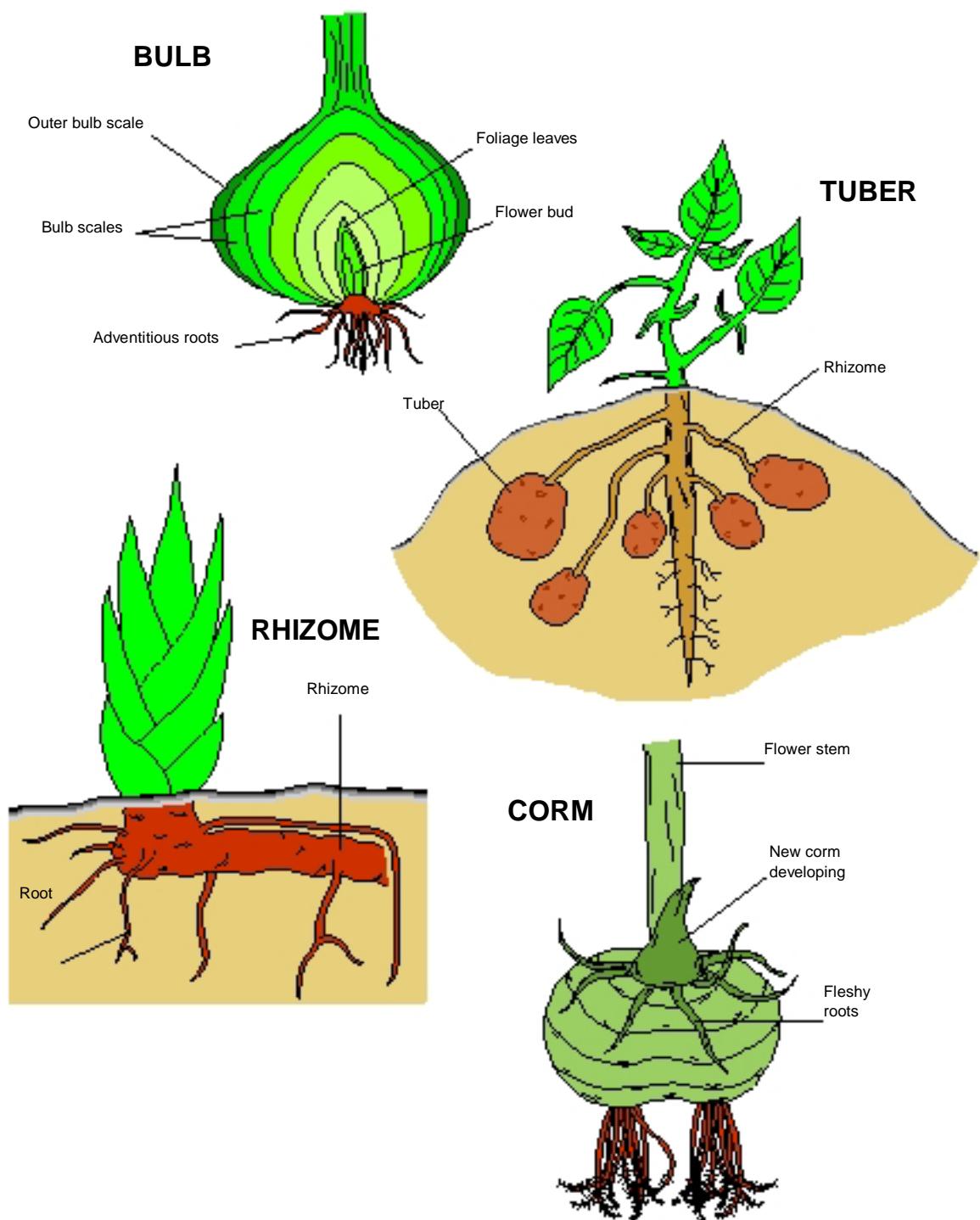
Arrangement of Tissues in Stems



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TM: B2-3

SPECIALIZED PLANT STEMS



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