

GREENHOUSE OPERATION AND MANAGEMENT

Unit III: Plant Science Basics

Lesson 1: Plant Parts, Structures, and Functions

Competency/Objective:

Distinguish plant parts, structures, and functions.

Study Questions

1. What is a plant cell?
2. What are general differences between monocots and dicots?
3. What are the basic types of specialized plant tissues?
4. What is a seed?
5. What are the functions and types of roots?
6. What are the functions, structures, and types of stems?
7. What are the functions, structure, and types of leaves?
8. What are the functions, parts, and types of flowers?
9. What are the differences between a monoecious and a dioecious plant?

References/Supplies/Materials

1. *Greenhouse Operation and Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2002.
2. Transparency Masters
 - TM 3.1 Basic Structure of a Plant Cell
 - TM 3.2 Cross-Sections of Monocot and Dicot Seeds
 - TM 3.3 Monocot vs. Dicot Seeds
 - TM 3.4 Parts of a Plant

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- TM 3.5 Types of Roots
- TM 3.6 Specialized Stems
- TM 3.7 Cross-Section of a Leaf
- TM 3.8 Leaf Shapes
- TM 3.9 Leaf Margins
- TM 3.10 Leaf Attachments
- TM 3.11 Parts of a Complete Flower

3. Activity Sheets

- AS 3.1 Plant Parts, Structures, and Functions Work Sheet
- AS 3.2 Stem Poster
- AS 3.3 Leaf Poster
- AS 3.4 Identifying Monocot and Dicot Plants

TEACHING PROCEDURES

A. Introduction

Unit III examines plant science basics by first providing fundamental information about plant science. Parts and functions of plants and flowers are illustrated down to the cellular level. The next lesson explains plant processes and the final lesson in this unit describes how plants are classified and named.

B. Motivation

Ask students why understanding plants' structures and functions is vital to having a successful greenhouse operation. Compare a greenhouse owner to a doctor: Why does a doctor need to understand human anatomy in order to care for patients? What situations could occur in the greenhouse that would necessitate understanding plant parts and how they function?

C. Assignment of Study Questions

Be sure to have illustrations of a variety of plants displayed throughout the classroom.

AS 3.1 is a work sheet to guide students as they learn about plant parts, structures, and functions. They should answer each question as the relevant material is covered. Students may work in small groups or alone and they should consult the Student Reference and the transparency masters.

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one question at a time or have the students answer all of

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the study questions before the discussion. Another option is to have students work in a cooperative learning environment and have groups work on different study questions.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. What is a plant cell?

The elements making up the plant cell are discussed. As you cover this material, remind students to answer the appropriate questions on AS 3.1.

A. Basic structural unit of plants (TM 3.1)

B. Cell structure

1. Cell wall

- a. Primary wall (first to develop)
- b. Middle lamella (layer between walls of two cells)
- c. Secondary wall (woody part of plant that develops inside primary wall)

2. Plasma membrane (outer membrane)

- a. Surrounds the cell, just inside the cell wall
- b. Molecules of proteins, carbohydrates, phosphorous, fat
- c. Functions
 - i. Controls entrance and exit of substances from the cell
 - ii. Relays information about environmental conditions to cell nucleus

3. Cytoplasm

- a. Liquid within cell
- b. Contains organelles
- c. Site of most life processes
- d. Organelles within cytoplasm
 - i. Mitochondria
 - (a) Small, dense
 - (b) Control many chemical reactions in cell
 - (c) Provide site for respiration
 - ii. Plastids
 - (a) Contain chloroplasts (green pigment, known as chlorophyll)
 - (b) Contain chromoplasts (red, orange, and yellow pigment)
 - iii. Vacuoles
 - (a) Large, fluid filled
 - (b) Store water, dissolved minerals, and other materials
 - (c) Mature and join to form large, central vacuoles

4. Nucleus

- a. Control center of cell
- b. Location for genetic material (chromosomes)
- c. Functions
 - i. Controls physiological characteristics of plant

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- ii. Controls appearance of plant
- iii. Passes characteristics to offspring

2. What are general differences between monocots and dicots?

Plants have either one or two cotyledon (seed leaves). About 50,000 monocot plants exist; there are 200,000 dicots. Ask students why they think this occurs. TM 3.2 illustrates cross-sections of monocot and dicot seeds. TM 3.3 depicts the differences between monocot and dicot plants.

A. Monocot plants

- 1. One cotyledon
- 2. Leaves with parallel veins
- 3. Vascular bundles scattered within stem
- 4. Flower parts in multiples of three (e.g., three stamens, six petals)
- 5. Examples: corn, grass

B. Dicot plants

- 1. Two cotyledons
- 2. Leaves with branched veins
- 3. Vascular bundles in circular pattern
- 4. Flower parts in fours or fives (or multiples of fours and fives)
- 5. Examples: most flowering plants, deciduous trees

3. What are the basic types of specialized plant tissues?

The combination of cells functioning together is referred to as tissue. Two main types of plant tissue are meristem and permanent. Meristem tissue actively divides to form new growth for the plant, whereas the permanent tissue is made up of mature cells.

A. Meristem tissues (cells that actively divide to form new growth)

- 1. Apical meristem tissues (TM 3.4)
 - a. Located at tips of roots and stems
 - b. Increase plant length
- 2. Cambium meristem tissues
 - a. Located in stems
 - b. Increase plant diameter
- 3. Intercalary zone meristem tissues
 - a. Located just above nodes in monocot plants
 - b. Increase stem height

B. Permanent tissues (mature cells that do not actively divide)

- 1. Epidermis tissues (outside covering)
- 2. Vascular system tissues (path from roots to stems to leaves)

4. What is a seed?

Ask students to identify the five basic parts of a plant. If possible, have illustrations of all plant parts available to show the class. One of the basic plant parts in the earliest stage is the seed.

A. Seed

1. Contains an embryo (miniature plant)
2. Dormant until environmental conditions permit germination

B. Basic seed parts

1. Seed coat
 - a. Tough exterior surface
 - b. Protects embryo from drying out or from injury
2. Embryo
 - a. Cotyledon
 - i. Seed leaves
 - ii. Monocots - one cotyledon (protects the epicotyl)
 - iii. Dicots - two cotyledons (protect the epicotyl and provide food storage for new plants)
 - b. Epicotyl (plumule)
 - i. Growth bud of embryo located above cotyledons
 - ii. Develops into shoot that emerges from germinating seed
 - c. Hypocotyl
 - i. Stem section located below the cotyledon
 - ii. First tree stem
 - iii. Lengthens plant; cotyledons and epicotyl emerging from germinating seed
 - d. Radicle
 - i. Root tip, located at end of hypocotyl
 - ii. First root of plant
 - iii. First part to emerge from germinating seed
 - iv. Holds plant in soil, absorbing water and nutrients
3. Endosperm
 - a. Food storage tissues
 - b. Nourish the developing embryo upon germination
 - c. Only in monocots

5. What are the functions and types of roots?

Another basic part is the plant's root system. There are five types of roots, all of which absorb water and nutrients for the plant.

A. Primary functions

1. Anchor plant
2. Absorb water and nutrients

B. Specialized functions

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1. Synthesize hormones for plant growth
 2. Store carbohydrates
 3. Aerial support in some cases - climbing roots, such as ivy
- C. Root features
1. Root hairs
 - a. Single-cell, hairlike extensions
 - i. More hairs are produced under dry conditions.
 - ii. Fewer hairs are produced under moist conditions.
 - b. Located near tip of roots
 - c. Functions
 - i. Absorb water and minerals from soil
 - ii. Expand root area for greater absorption
 2. Radicle roots
 - a. Emerge from the seed
 - b. Grow into true roots or die in formation of fibrous roots
- D. Types of roots (TM 3.5)
1. Taproot (primary or true root)
 - a. Large central roots from which lateral roots grow
 - b. Excellent anchorage and food storage
 - c. Penetrates deep into soil
 - d. Common in dicots
 - e. Example: carrot
 2. Fibrous roots
 - a. No central root
 - b. Finely branched secondary roots spread shallow and wide
 - c. Excellent in absorbing water and minerals
 - d. Hold soil and prevent erosion
 - e. Common in monocots
 - f. Example: grass
 3. Aerial roots (two types)
 - a. Clinging air roots
 - i. Grow out horizontally from stem
 - ii. Fasten plant to a form of support
 - iii. Example: English ivy
 - b. Absorptive air roots
 - i. Thick outer covering of dead tissue
 - ii. Roots absorb and store water
 - iii. Example: orchids
 4. Adventitious roots
 - a. Develop in places other than nodes
 - b. Can form on cuttings and rhizomes
 - c. Example: blackberries
 5. Aquatic roots
 - a. Develop adventitious roots in shallow water from the submerged shoots
 - b. Absorb nutrients and oxygen from water
 - c. Example: water lilies

6. What are the functions, structures, and types of stems?

Ask students what stems do for plants. Have them complete AS 3.2.

A. Functions

1. Support other plant parts (e.g., branches, leaves, flowers, fruit)
2. Capture light for photosynthesis
3. Move water, minerals, and food manufactured during photosynthesis to other parts of plant
4. In some cases, store water, food, and nutrients (e.g., Irish potato, cactus)

B. Basic stem structure

1. Monocots
 - a. Vascular bundles (xylem and phloem tissues) scattered throughout the cortex
 - b. No pith (parenchyma cells) in center
2. Dicots
 - a. Vascular bundles arranged in a ring
 - b. Pith in center

C. Modified stems (not upright and vertical) (TM 3.6)

1. Corms
 - a. Underground
 - b. Thickened stems
 - c. Examples: gladiolus, crocus
2. Tubers
 - a. Underground
 - b. Swollen stems
 - c. Food storage
 - d. Examples: yam, white potato
3. Bulbs
 - a. Compressed, thickened stems
 - b. Modified leaves wrap around the stem to form the bulb
 - c. Examples: onion, tulip
4. Crowns
 - a. Similar to bulb's compressed stem
 - b. Leaf and flower buds that grow on crown, just above the ground
 - c. Examples: asparagus, fern
5. Spurs
 - a. Short stems that form on branches of woody plants
 - b. Examples: pear, apple
6. Rhizomes
 - a. Horizontal, underground
 - b. Produce roots on lower surface
 - c. Send leaves and flow shoots aboveground
 - d. Examples: iris, bamboo
7. Stolons
 - a. Horizontal, aboveground
 - b. Roots forming at nodes

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- c. Examples: Bermuda grass, strawberry

7. What are the functions, structure, and types of leaves?

Discuss the variety of shapes, margins, and arrangements. Ask students why a particular plant might have a leaf shaped in a certain way, e.g., a cactus. Have them complete AS 3.3.

A. Functions

1. Manufacture food through photosynthesis
2. Protect vegetative and floral buds
 - a. Bud scales (cataphylls)
 - i. Modified leaves
 - ii. Protect buds during winter
 - iii. Examples: juniper, mango
 - b. Floral bracts (hyposophylls)
 - i. Protect buds during development
 - ii. May be leafy (poinsettia) or fleshy (globe artichoke)
3. Store food
 - a. Cotyledons (seed leaves) store food while seed germinates.
 - b. Cotyledons store food until plant matures and begins photosynthesis.

B. Basic leaf structure (TM 3.7)

1. Epidermis (upper and lower)
 - a. Cuticle
 - i. Waxy substance covering the epidermis of stems and leaves
 - ii. Usually thicker on the top side of leaf
 - iii. Keeps water in plants
 - b. Stomata
 - i. Openings in epidermis (usually on underside of leaves)
 - ii. Allow for exchange of gases (carbon dioxide, oxygen, water vapor)
 - iii. Not present in submerged plants, such as some water lilies
 - c. Guard cells
 - i. Located on each side of stomata
 - ii. Open and close the stomata
2. Mesophyll layer
 - a. Palisade mesophyll
 - i. Elongated cells under the upper epidermis
 - ii. Contains chloroplasts
 - iii. Primary site of photosynthesis
 - b. Spongy mesophyll
 - i. Between palisade mesophyll and lower epidermis
 - ii. Mass of irregularly shaped cells
 - iii. Contains chloroplasts
 - iv. Air space between cells
 - v. Site of photosynthesis and gas exchange

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3. Vascular bundles (located in spongy mesophyll)
 - a. Phloem tissues move food from site of photosynthesis to rest of plant.
 - b. Xylem tissues move water and minerals to photosynthesizing cells in leaves and stems.
- C. Modified leaves
 1. Xeromorphic foliage
 - a. Thick-walled epidermis covered with a waxy cuticle
 - b. Protects plant in arid climates
 - c. Example: cactus
 2. Thorns
 - a. Short, hard leaves with sharp points
 - b. Protect plant
 - c. Example: honey locust
 3. Tendrils
 - a. Thin, stringy leaves
 - b. Twine to support plant
 - c. Examples: pea, grapevine
 4. Sacs
 - a. Pouchlike
 - b. Hold water and capture insects
 - c. Example: Venus flytrap
 5. Submerged foliage (hydrophytes)
 - a. Thin cell walls
 - b. Gas chambers trapping internally generated gases, enabling leaves to float
 - c. Example: water lily
 6. Prickle
 - a. Grows from epidermis
 - b. Can be easily removed
 - c. Example: rose
- D. Leaf shapes (TM 3.8)
- E. Leaf margins (TM 3.9)
- F. Leaf tips, bases, and attachments (TM 3.10)

8. What are the functions, parts, and types of flowers?

Ask students to characterize various flowers in terms of shape and function. Have illustrations of diverse flowers displayed in the classroom.

- A. Basic functions
 1. Reproductive organs of flowering plants (angiosperms)
 2. Produce seeds and fruit
- B. Basic parts of complete flower (TM 3.11)
 1. Sepals (calyx)
 - a. Vegetative part
 - b. Outer covering of flow bud
 - c. Protect stamens and pistils in bud stage

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2. Stamens - male reproductive parts (androecium)
 - a. Anther (produces pollen grains)
 - b. Filament (supports the anther)
 3. Petals (corolla)
 - a. Vegetative part
 - b. Bright color/fragrance to attract pollinating insects
 - c. Protect stamens and pistils in bud stage
 - d. Usually drop shortly after pollination
 4. Pistil - female reproductive parts (gynoecium)
 - a. Stigma receives and holds pollen grains.
 - b. Style connects stigma with ovary and supports the stigma so that it may be pollinated.
 - c. Ovary is the enlarged portion at base of pistil and is the site for fertilization. It produces ovules that develop into seeds.
- C. Basic types of flowers
1. Solitary (individual flower)
 2. Inflorescence (bunch or cluster)
 - a. Head, e.g., alstroemeria
 - b. Spike, e.g., gladiolus
 - c. Umbel, e.g., amaryllis
- D. Complete and incomplete flowers
1. Complete flowers
 - a. Contain both male and female parts
 - b. All four parts of a flower present
 - c. Usually self-pollinating
 - d. Example: rose
 2. Incomplete flowers
 - a. One or more flower parts missing
 - b. Flower either male or female
 - c. Must cross-pollinate
 - d. Example: apple

9. What are the differences between a monoecious and dioecious plant?

Classify illustrated flowers as either monoecious or dioecious.

- A. Monoecious plants
1. Both male and female flowers on different parts of the same plant
 2. Pollination occurring on same plant
 3. Examples: cucumber, corn
- B. Dioecious plants
1. Plant is either male or female.
 2. Pollination requires both a male and a female plant in proximity.
 3. Examples include holly and asparagus.

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F. Other Activity and Strategy

For a rudimentary illustration of a cell, fill a balloon with water and place it in a cardboard box just a little bit bigger than the balloon. The cardboard box is the cell wall; the balloon is the plasma membrane. It is porous and the liquid inside is the cytoplasm.

G. Conclusion

In this introduction to plant science, the five basic plant parts and functions are identified: seeds, roots, stem, leaves, and flowers.

H. Answers to Activity Sheets

AS 3.1 Plant Parts, Structures, and Functions Work Sheet

1.
 - A. Chloroplast
 - B. Plasma membrane
 - C. Cell wall
 - D. Cytoplasm
 - E. Vacuole
 - F. Mitochondrion
 - G. Nucleus
2.
 - A. Control entrance and exit of substances into and out of cell
 - B. Relays information about environmental condition to cell nucleus
3.
 - A. Mitochondria - One of the following: control many chemical reactions in cell; site of respiration
 - B. Plastids - One of the following: contain chloroplasts; contain chromoplasts
 - C. Vacuoles - One of the following: store water, dissolved minerals, and other materials; mature and join to form large, central vacuoles
4.
 - A. Controls physiological characteristics of plant
 - B. Controls appearance of plant
 - C. Passes characteristics to offspring
5.
 - A. Meristem
 - B. Permanent
6.
 - A. Meristem - actively divides to form new growth
 - B. Permanent - mature cells that do not actively divide
7.
 - A. Apical - increase plant length
 - B. Cambium - increase plant diameter
 - C. Intercalary zone - increase stem height
8.
 - A. Epidermis - outside covering
 - B. Vascular system - path from roots to stem to leaves
9.
 - A. Seed coat - protects embryo from drying out or from injury
 - B. Embryo - miniature plant
 - C. Endosperm - nourishes embryo
10. Endosperm
11.
 - A. Cotyledon

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- B. Epicotyl
- C. Hypocotyl
- D. Radicle
- 12. Cotyledon
- 13. A. Monocot
- B. Dicot
- 14. A. Synthesize hormones for plant growth
- B. Store carbohydrates
- C. Provide aerial support
- 15. A. Taproot
- B. Fibrous
- C. Aerial
- D. Adventitious
- E. Aquatic
- 16. Parenchyma cells
- 17. Floral bracts - protect buds during development
- 18. A. Phloem
- B. Xylem
- C. Cuticle
- D. Upper epidermis
- E. Chloroplast
- F. Lower epidermis
- G. Cuticle
- H. Stomata
- I. Guard cell
- J. Spongy mesophyll
- K. Palisade mesophyll
- 19. A. Manufacture food through photosynthesis
- B. Protect vegetative and floral buds
- 20. Submerged plants
- 21. Thick-walled epidermis covered with waxy cuticle
- 22. Sac
- 23. Petals - protect stamen and pistil in bud stage; attract pollinating insects
- 24. Female reproductive parts
- 25. Types of inflorescence flowers
- 26. A. Contain male and female parts
- B. All four parts of flower are present
- C. Usually self-pollinating

AS 3.2 Stem Poster

Instructor's discretion

AS 3.3 Leaf Poster

Instructor's discretion

AS 3.4 Identifying Monocot and Dicot Plants

Instructor's discretion

I. Answers to Assessment

1. C
2. C
3. B
4. A. Stamen
B. Petal
C. Pistil
D. Sepal
5. A. Epidermis
B. Mesophyll layer
C. Vascular bundles
6. A. Cell wall
B. Plasma membrane
C. Cytoplasm
D. Nucleus
7. Monoecious
8. Stores food until plant matures and begins photosynthesis
9. A. Seeds
B. Roots
C. Stems
D. Leaves
E. Flowers
10. Food storage tissue only in monocot plants
11. A. Anchor plants
B. Absorb water and nutrients
C. Synthesize hormones
D. Store carbohydrates
E. Provide aerial support

UNIT III: PLANT SCIENCE BASICS Name _____

Lesson 1: Plant Parts, Structures, and Functions Date _____

ASSESSMENT

Multiple Choice: Circle the letter of the best answer.

1. What grows horizontally underground and produces roots on the lower surface?
 - A. Bulbs
 - B. Corms
 - C. Rhizomes
 - D. Spurs

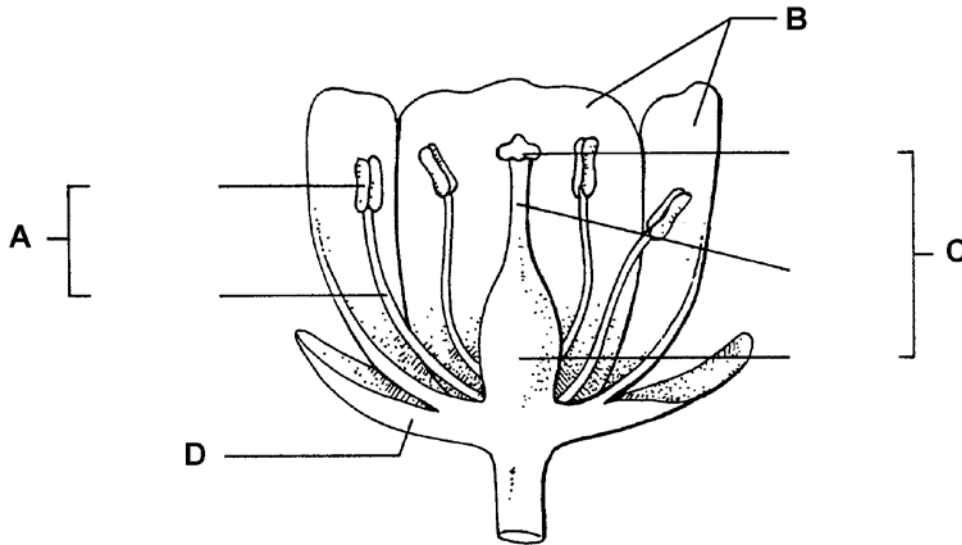
2. What does the cambium meristem tissue increase?
 - A. Stem height
 - B. Plant length
 - C. Plant diameter
 - D. Stem diameter

3. What is a modified stem with a thick, compressed stem whose leaves and flower buds grow just above the ground?
 - A. Corm
 - B. Crown
 - C. Stolon
 - D. Tuber

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4. What are the four parts of this flower?

- A.
- B.
- C.
- D.



Short-Answer Questions: Write the answers in the space provided.

5. What are the three basic structures of leaves?

- A.
- B.
- C.

6. What are the four elements of the cell structure?

- A.
- B.
- C.
- D.

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7. If male and female flowers on the same plant are in different places, what kind of plant is it?

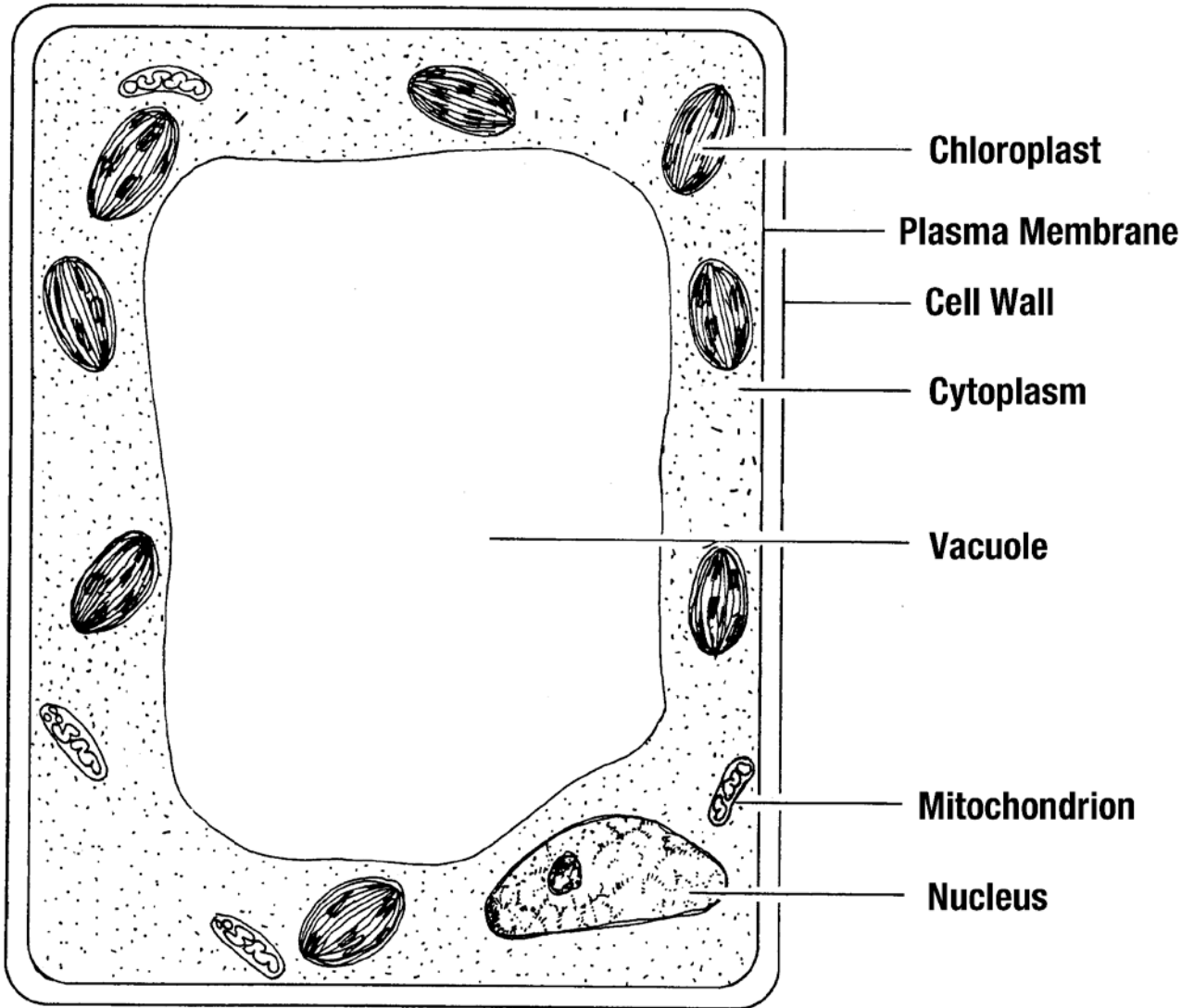
8. What is the function of the cotyledon?

9. What are the five basic parts of a plant? Draw and label each part.
 - A.
 - B.
 - C.
 - D.
 - E.

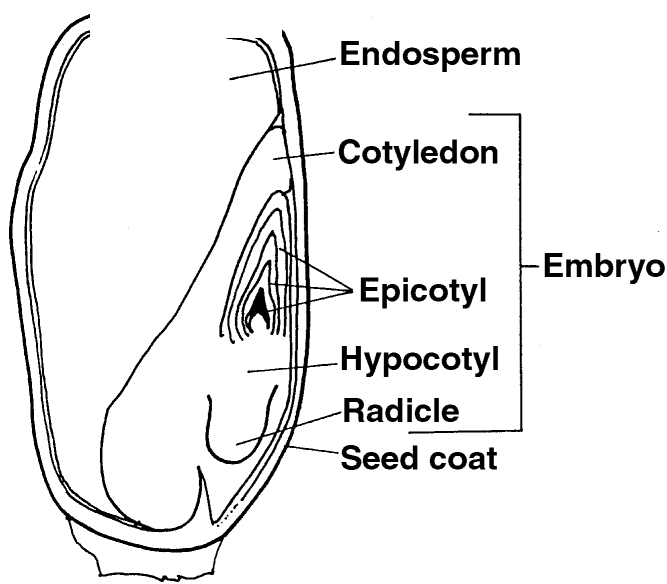
10. What is the endosperm and where is it located?

11. What are five functions of roots?
 - A.
 - B.
 - C.
 - D.
 - E.

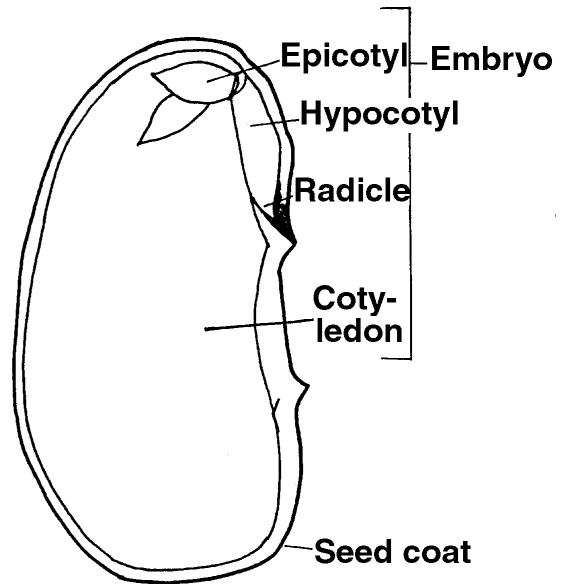
Basic Structure of a Plant Cell



Cross-Sections of Monocot and Dicot Seeds



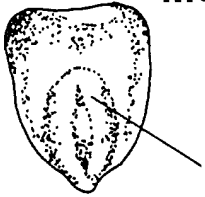
Moncot (corn)



Dicot (bean)

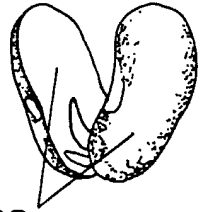
Monocot vs. Dicot

Monocot (e.g., corn)

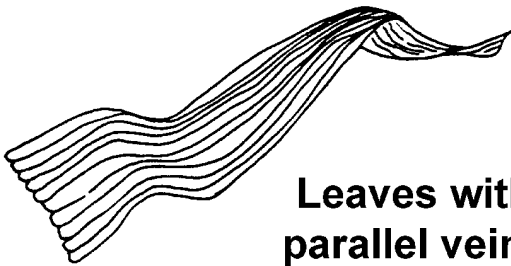


One cotyledon

Dicot (e.g., bean)

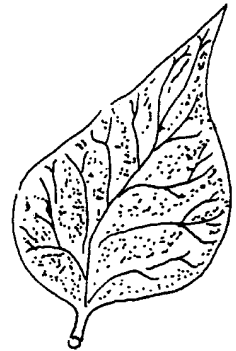


Two cotyledons



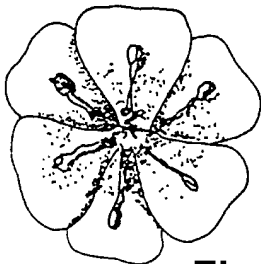
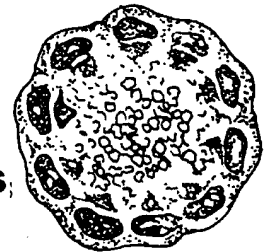
Leaves with parallel veins

Leaves with network of veins

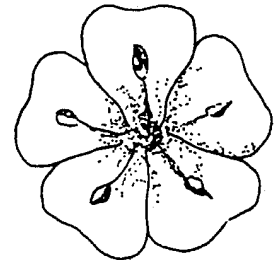


Stems with randomly scattered vascular bundles

Stems with vascular bundles in a ring

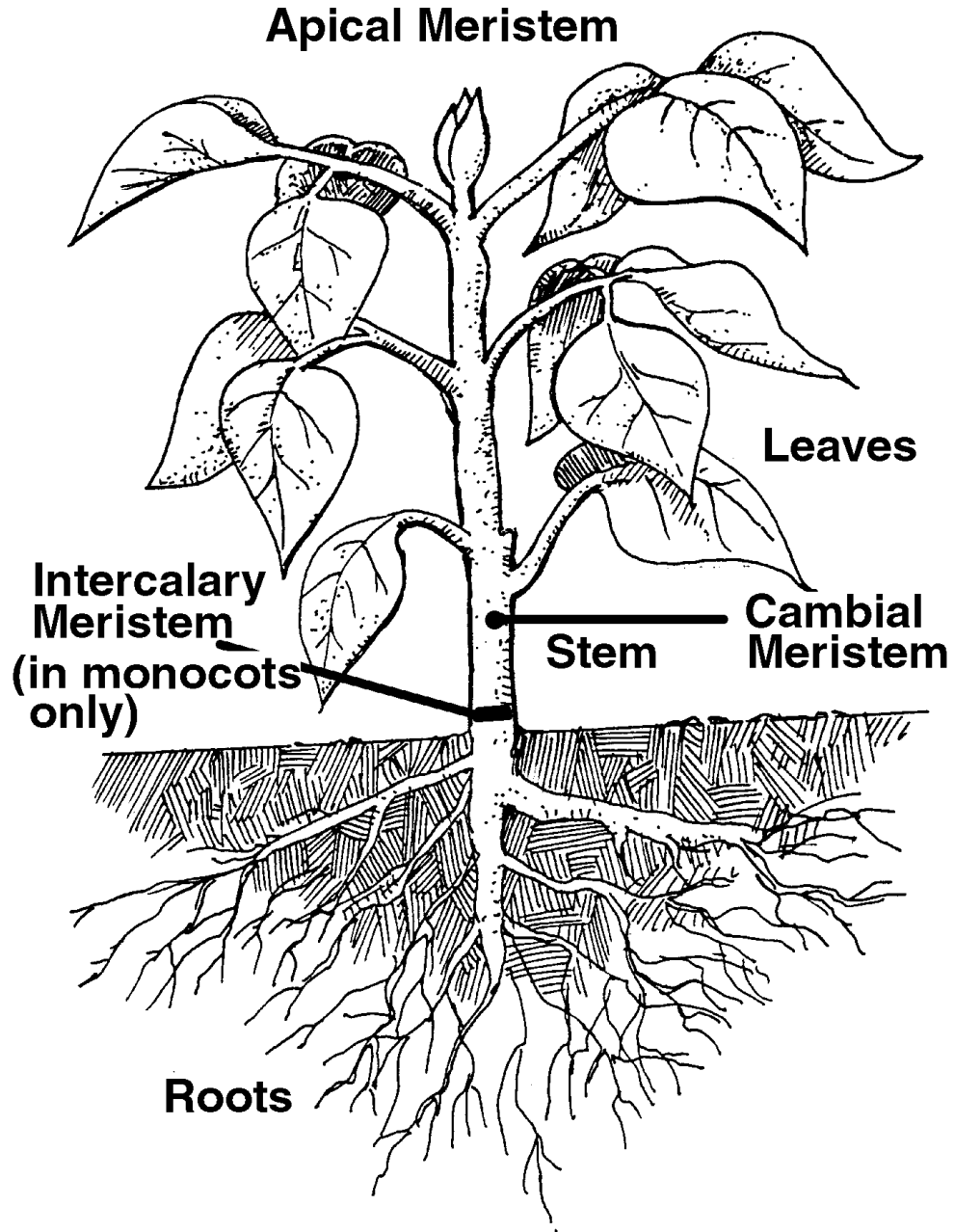


Flower parts in 3s or multiples of 3

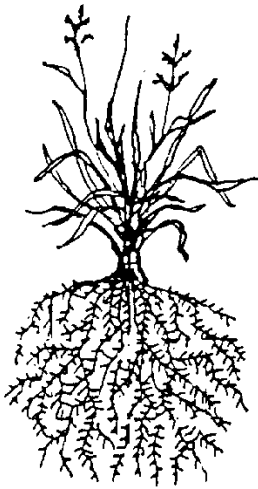


Flower parts in 4s or 5s or multiples of 4 or 5

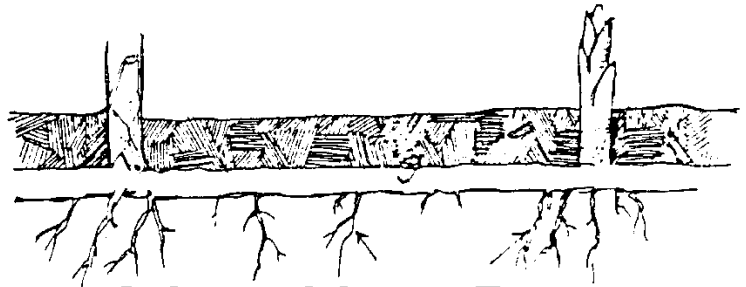
Parts of a Plant



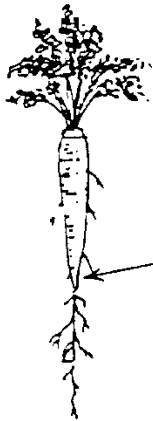
Types of Roots



Fibrous Roots

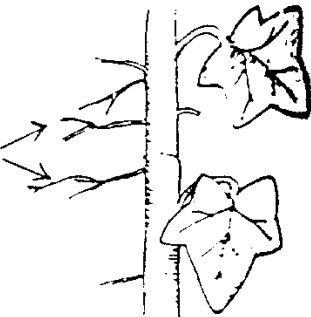


Adventitious Roots

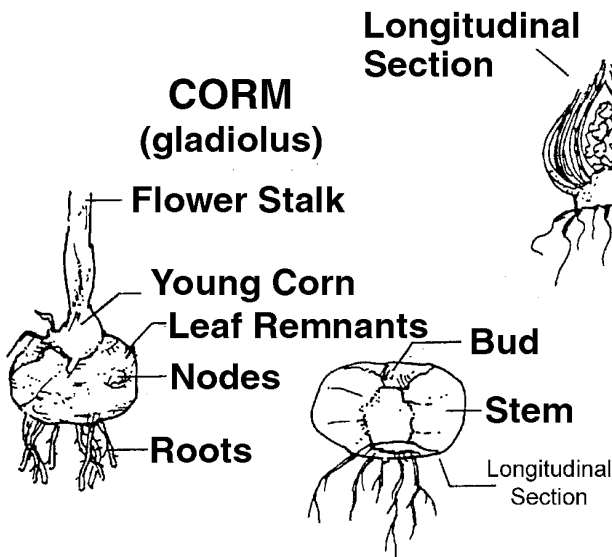
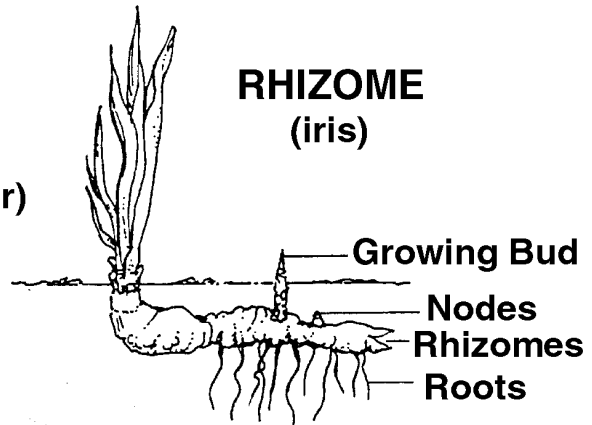
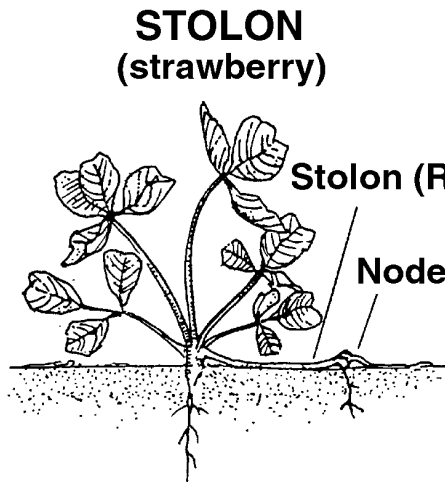


Taproot

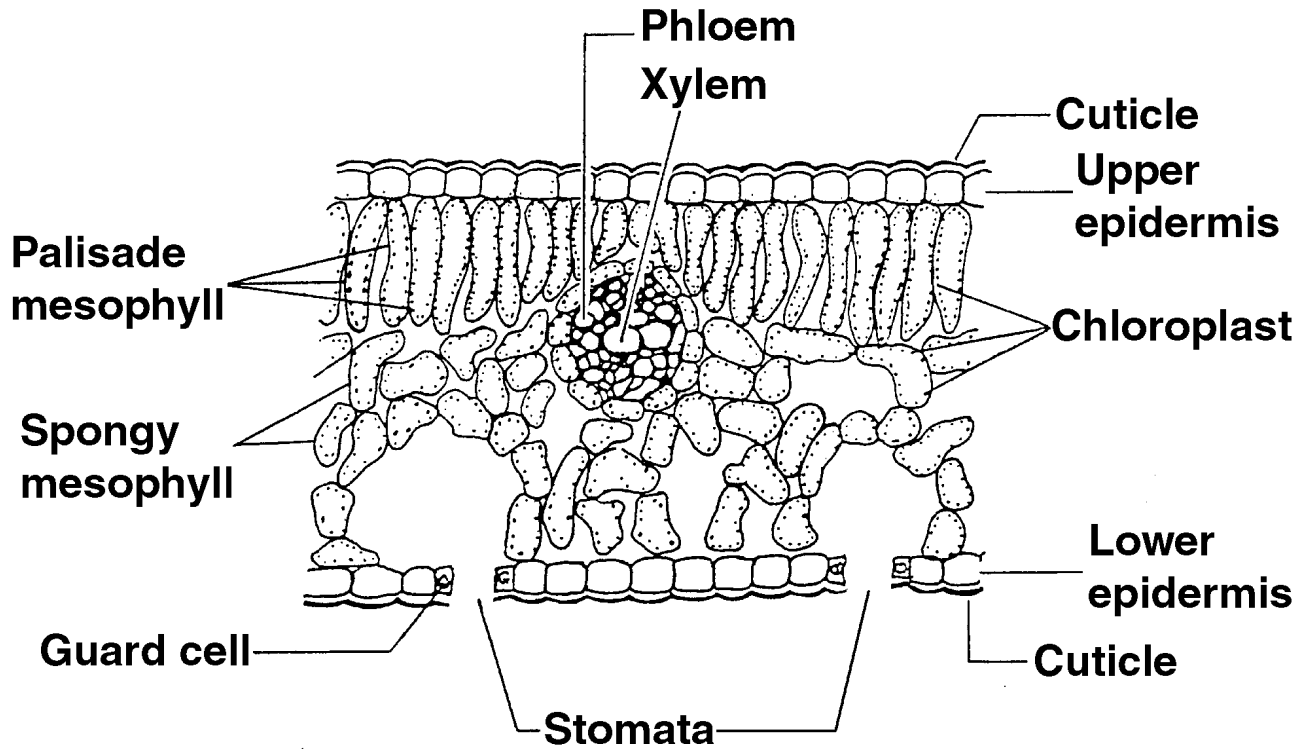
Aerial Roots



Specialized Stems



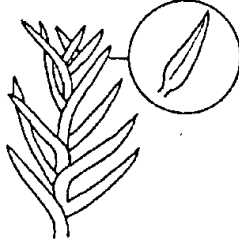
Cross-Section of a Leaf



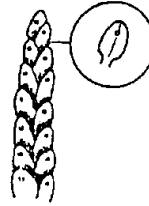
Leaf Shapes



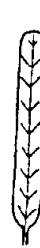
Needle-like



Awl-like



Scale-like



Oblong



Linear



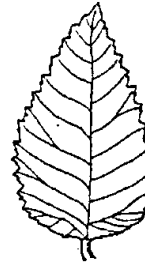
Lanceolate



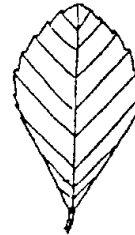
Oblanceolate



Spatulate



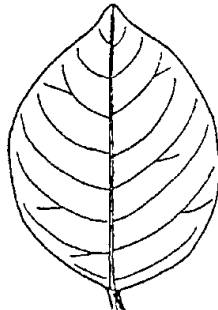
Ovate



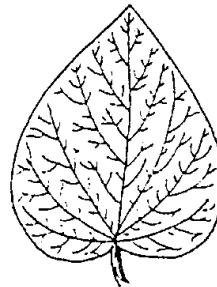
Obovate



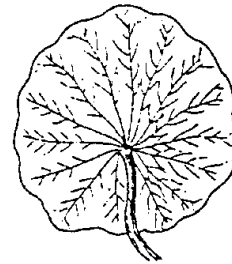
Elliptic



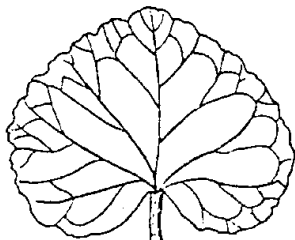
Oval



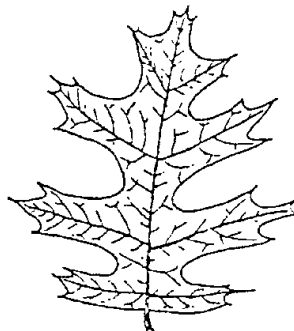
Cordate



Peltate



Reniform



Pinnately lobed

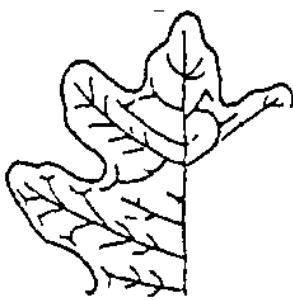


Palmately lobed

Leaf Margins



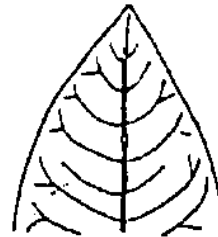
Dentate Incised Undulate



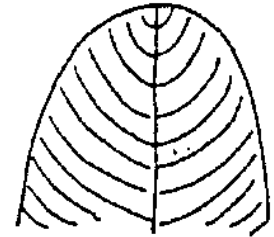
Lobed



Serrate



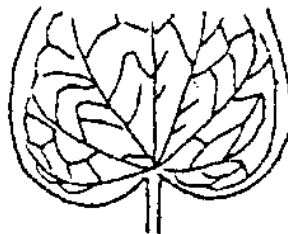
Acute



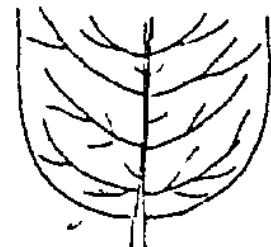
Obtuse



Truncate

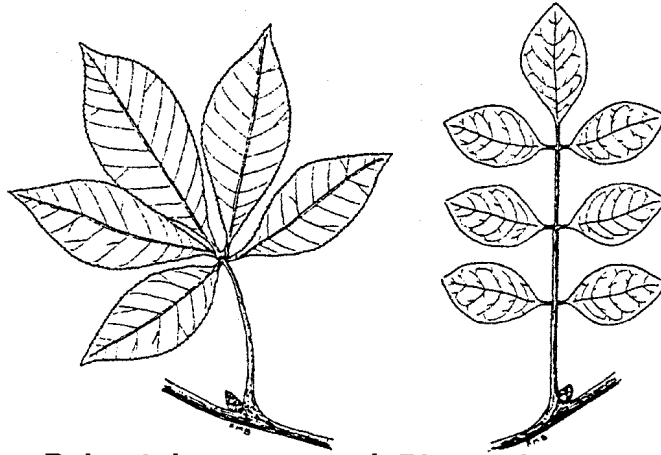


Cordate

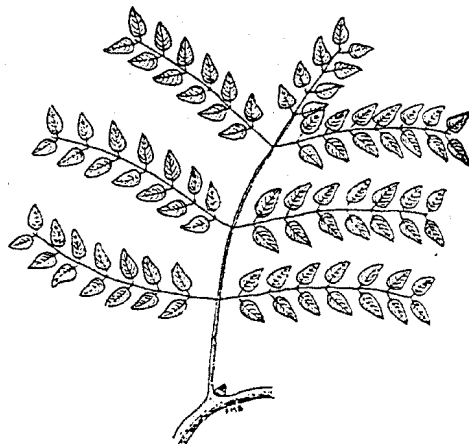


Rounded

Leaf Attachments



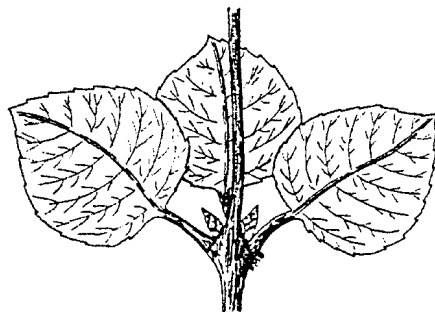
Palmately compound Pinnately compound



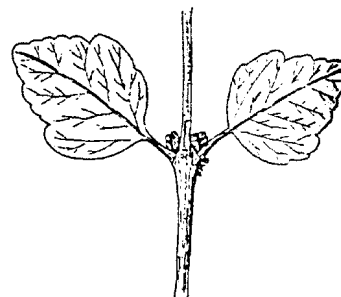
Bipinnately compound



Alternate

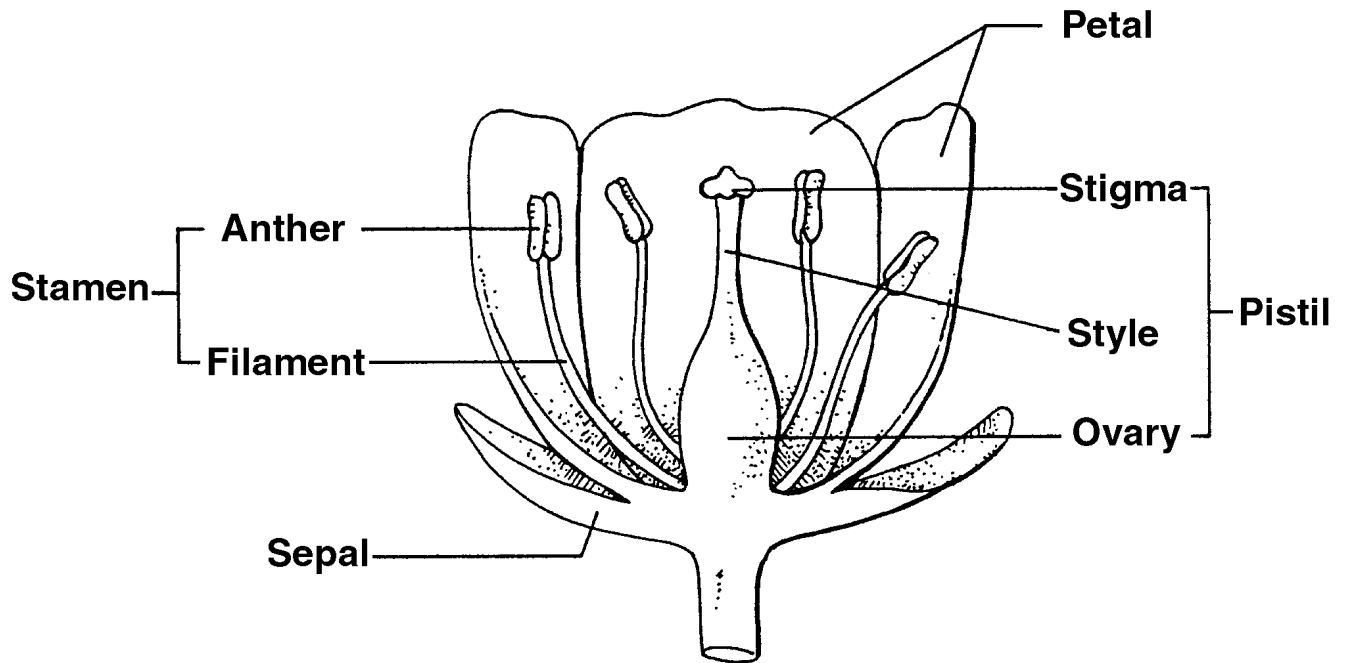


Whorled



Opposite

Parts of a Complete Flower



UNIT III: PLANT SCIENCE BASICS

AS 3.1

Lesson 1: Plant Parts, Structures, and Functions

Name _____

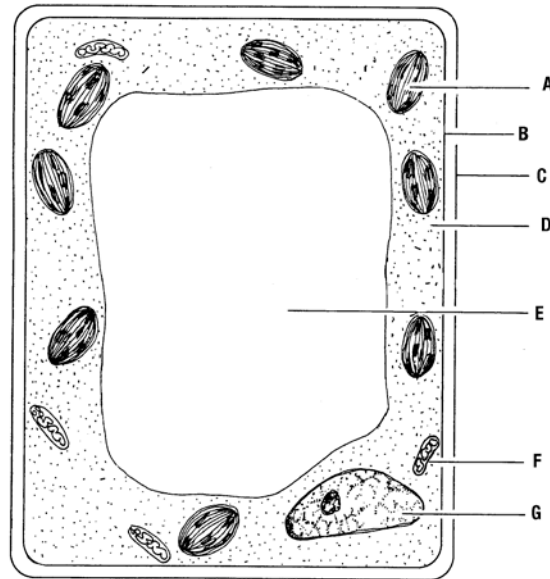
Plant Parts, Structures, and Functions WorkSheet

Objective: Identify plant parts, structures, and functions.

Directions: Answer the following questions by using the Student Reference and transparency masters. You may work individually or in small collaborative groups. Use this work sheet as a guide as you examine all of the study questions.

1. Identify the parts of a plant cell.

- A.
- B.
- C.
- D.
- E.
- F.
- G.



2. What are two functions of the plasma membrane?

- A
- B.

3. What are the three organelles in the cytoplasm? Identify one function for each organelle.

Organelle

Function

- A.
- B.
- C.

- A.
- B.
- C.

Greenhouse Operation and Management

4. What are three functions of the nucleus?

A.

B.

C.

5. What are the two basic types of plant tissue?

A.

B.

6. What are the differences between the two basic types of plant tissue?

7. What are the three types of meristems? What are their functions?

Type of Meristem

Function

A.

A.

B.

B.

C.

C.

8. What are the two types of permanent plant tissue? What are their characteristics?

Types of Permanent Plant Tissue

Characteristics

A.

A.

B.

B.

9. What are three basic parts of monocot seeds? Describe what each part does or provide a brief description of what the part is.

Seed Part

Function/Description

A.

A.

B.

B.

C.

C.

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10. Which of the three basic parts of seeds is found **only** in a monocot?

11. What are the four parts of a seed embryo?

A.

B.

C.

D.

12. What is another term for “seed leaves”?

13. A. What type of plant has one leaf?

B. What type of plant has two leaves?

14. What are three specialized functions of plant roots?

A.

B.

C.

15. What are the five types of roots?

A.

B.

C.

D.

E.

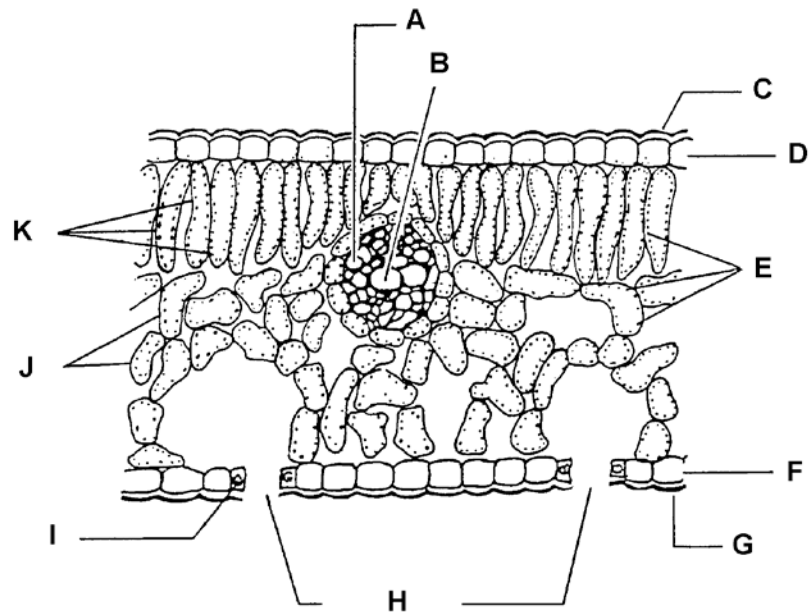
16. What is pith?

17. What is another name for hyposophylls? What does it do?

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18. Identify the interior parts of a leaf. (Hint: One interior leaf part is listed twice.)

- A.
- B.
- C.
- D.
- E.
- F.
- G.
- H.
- I.
- J.
- K.



19. What are two basic functions of leaves?

- A.
- B.

20. Which plants do **not** have stomata?

21. What are the characteristics of xeromorphic foliage?

22. What type of modified leaf does a Venus flytrap have?

23. What is the corolla? What is its function?

24. Gynoecium refers to what part of a flower?

25. What do head, spike, and umbel refer to?

26. What are three characteristics of perfect flowers?

A.

B.

C.

UNIT III: PLANT SCIENCE BASICS

AS 3.2

Lesson 1: Plant Parts, Structures, and Functions

Name _____

Stem Poster

Objective: Create a visual representation of various stems.

Directions: Bring in samples of stems from your home, school, or the community. In small groups, generate a poster or PowerPoint presentation about the stems you found. Other representations of stems may be photos or drawings. Identify each of the seven stem types and give two examples of each.

UNIT III: PLANT SCIENCE BASICS

AS 3.3

Lesson 1: Plant Parts, Structures, and Functions

Name _____

Leaf Poster

Objective: Create a visual representation of leaf shapes, margins, and arrangements.

Directions: Bring to class samples of leaves from your home, school, or the community. Individually or in small groups generate a poster or PowerPoint presentation on leaves. Other representations of leaves may be photos or drawings. Identify the type, shape, margin, and typical arrangement of each type of leaf.

UNIT III: PLANT SCIENCE BASICS

AS 3.4

Lesson 1: Plant Parts, Structures, and Functions

Name _____

Identifying Monocot and Dicot Plants

Objective: Identify parts of two plants.

Directions: Choose one monocot and one dicot plant. One of the plants may be a plant sown earlier for the Unit IV activity. Obtain a physical representation of the plants, either a photo or sketch. Answer the following questions and present the information to the class.

1. Which plant is a monocot and which plant is a dicot?
2. What type of root does each plant have? Describe the roots.
3. What type of stem does each plant have? Describe the stem.
4. What is the name of the leaf shape for both plants? Describe the leaf shape.
5. What type of leaf margin and leaf arrangement do both plants have? Describe them.
6. What type of flower does each plant have? Describe each one.
7. Does either plant require pollination?

GREENHOUSE OPERATION AND MANAGEMENT

Unit III : Plant Science Basics

Lesson 2: Plant Processes

Competency/Objective:

Identify the growth processes of a plant.

Study Questions:

1. What is photosynthesis?
2. What is respiration?
3. How do plants absorb water?
4. What is translocation?
5. What is transpiration?

References/Supplies/Materials

1. *Greenhouse Operation and Management* (Student Reference). University of Missouri-Columbia, Instructional Materials Laboratory, 2002.
2. Transparency Master
TM 3.12 Photosynthesis
3. Activity Sheet
AS 3.5 The Five Plant Processes
4. Capon, Brian. *Botany for Gardeners: An Introduction and Guide*, Portland, OR: Timber Press, 1990.

Greenhouse Operation and Management

TEACHING PROCEDURES

A. Review

Students now have a better understanding of plant parts, structures and functions. This lesson continues with the information on the five basic processes that signal plant growth.

B. Motivation

Ask students to name the major physical processes all human beings must undergo in order to stay alive. As students identify these life processes, list them on the board. During the following discussion, ask them to draw parallels between plant processes and human processes wherever possible. To be able to grow successful greenhouse crops, it is important to identify basic processes in plant development.

C. Assignment of Study Questions

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one study question at a time or have students answer all the questions before the discussion. Another option is to have students work in a cooperative learning environment and have groups work on different study questions.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. What is photosynthesis?

This is the process in which plants convert carbon dioxide and water into sugar and oxygen. Temperature, intensity of light, duration of light, and a plant's photoperiod affect photosynthesis. (TM 3.12) These environmental qualities are discussed briefly here and in more detail in Unit IV. The stage of a plant's growth and development also affects this process.

- A. Process by which plants, in the presence of light, convert carbon dioxide and water into simple sugars, releasing oxygen in the process
 - 1. Carbon dioxide is a gas that enters the plant through stomata, which are located on the leaves.
 - 2. Then water is absorbed by the plant's hair roots and enters the leaves through the xylem tissues.
 - 3. Light hits the chlorophyll.
 - 4. Light energy is absorbed and triggers a chemical reaction between carbon dioxide and water.

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5. Glucose, a simple sugar, is produced and transported by the phloem tissues to other plant parts.
 6. Oxygen is a by-product that is released through the stomata.
 7. When the stomata open, water is released.
- B. Important chemical reaction that impacts oxygen content of air
- C. Environmental factors that affect photosynthesis
1. Temperature
 2. Water availability
 3. Intensity and duration of light
 4. Amount of carbon dioxide
 5. Photoperiod
 6. Growth
- D. Expressed as a formula (CO₂ = carbon dioxide; H₂O = water; C₆H₁₂O₆ = glucose; and O₂ = oxygen)



2. What is respiration?

Once CO₂ and water are converted into sugar and oxygen, the energy must be released so that the plant can use the energy to grow. Respiration is the method by which the energy is released and used.

- A. Reverse of photosynthesis
- B. The controlled breaking down of glucose, releasing energy for plant growth, absorption, translocation, and other metabolic processes
- C. A basic life process
 1. Enables plant cells to release energy that is then used in many energy-requiring chemical reactions within cells
 2. Releases water and CO₂ into the atmosphere

3. How do plants absorb water?

Ask students how they think this process occurs, drawing upon their knowledge of plant parts and functions from the previous lesson.

- A. Hair roots take up water and dissolved minerals from the soil through the process of osmosis.
- B. Water moves from the roots and through the plant via the xylem vessels.

Greenhouse Operation and Management

4. What is translocation?

The vascular system of a plant is a conduit for water and food. Ask the students which tissues move food and which move water.

- A. Movement of water and nutrients within plant
- B. Occurs within vascular system
 - a. Xylem tissues pull water upward.
 - b. Phloem tissues move food from leaves to the rest of the plant.

5. What is transpiration?

Encourage the students to discuss why environmental factors may affect the rate of transpiration. After all of the plant processes are discussed, have students complete AS 3.5.

- A. Loss of water from plant
 - 1. Primarily from evaporation
 - 2. Primarily through leaf surfaces (some from stems and petals)
- B. Occurs when stomata open to take in CO₂
- C. Regulated by guard cells
- D. Reduces pressure in plant cells
- E. Environmental factors that affect transpiration rate
 - 1. Light
 - 2. Temperature
 - 3. Humidity
 - 4. Wind

F. Other Activities and Strategies

1. To track the path of the vascular system, place several drops of food coloring in a quarter cup of warm water and put a white carnation in the mixture. Make sure the stem is freshly cut and allow the plant to translocate the liquid. Once the color of the flower has changed, remove the flower from the liquid and bisect the stem and flower. Ask students to characterize what has occurred.
2. Show the class the following video, available from CATER (Career & Technical Education Resources), 2 London Hall, University of Missouri-Columbia: *Photosynthesis and Respiration* (AG V113).

G. Conclusion

Photosynthesis, respiration, absorption, translocation, and transpiration are the five plant processes necessary in the development of healthy plants. It is important to know about these plant processes and how they can be encouraged and manipulated in the greenhouse to produce better plants.

H. Answers to Activity Sheet

Instructor's discretion

I. Answers to Assessment

1. B
2. E
3. D
4. A
5. C
6. Any four of the following:
 - A. Temperature
 - B. Light intensity or duration
 - C. Amount of carbon dioxide
 - D. Plant's photoperiod
 - E. Water availability
 - F. Plant's growth cycle affect photosynthesis
7. Light, temperature, humidity and wind.
8. $6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \xrightarrow[\text{light energy}]{\text{chlorophyll}} \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2$
9.
 - A. Carbon dioxide is a gas that enters the plant through stomata, which are located on the leaves.
 - B. Then water is absorbed by the plant's hair roots and enters the leaves through the xylem tissues.
 - C. Light hits the chlorophyll.
 - D. Light energy is absorbed and triggers a chemical reaction between carbon dioxide and water.
 - E. Glucose, a simple sugar, is produced and transported by the phloem tissues to other plant parts.
 - F. Oxygen is a by-product that is released through the stomata.
 - G. When the stomata open, water is released.

UNIT III : PLANT SCIENCE BASICS

Name _____

Lesson 2: Plant Processes

Date _____

ASSESSMENT

Match the statement on the left with the plant process on the right. Write the letter in the space provided.

- | | |
|--|-------------------|
| _____ 1. Evaporation through leaf surfaces | A. Translocation |
| _____ 2. Break down and release of glucose | B. Transpiration |
| _____ 3. Taking up of water and dissolved minerals | C. Photosynthesis |
| _____ 4. Movement of water and dissolved minerals | D. Absorption |
| _____ 5. Creation of glucose | E. Respiration |

Short-Answer Questions: Write the answers in the space provided.

6. What are four environmental factors that affect photosynthesis?
- A.
 - B.
 - C.
 - D.
7. What are four environmental factors that affect transpiration?
- A.
 - B.
 - C.
 - D.
8. What is the formula for photosynthesis?

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9. What seven steps occur during photosynthesis?

A.

B.

C.

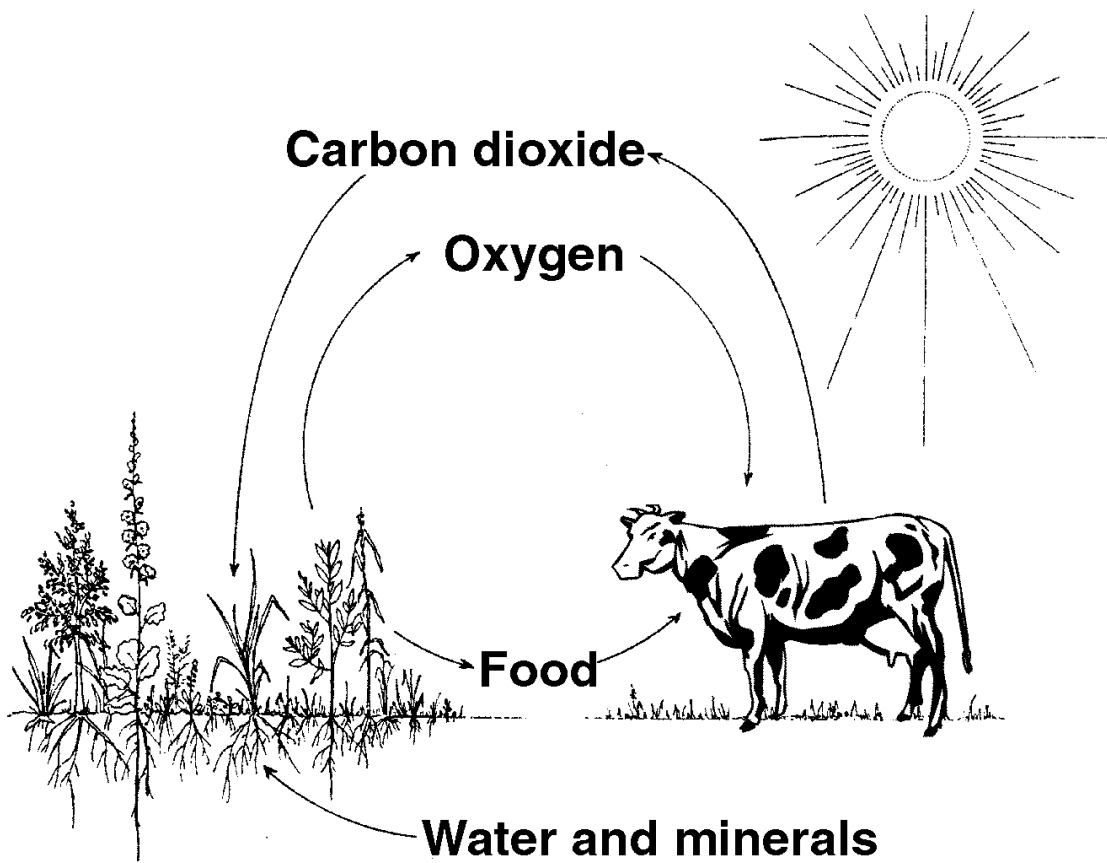
D.

E.

F.

G.

Photosynthesis



Adapted from Capon, Brian. *Botany for Gardeners: An Introduction and Guide*, Portland, OR: Timber Press, 1992.

UNIT III : PLANT SCIENCE BASICS

AS 3.5

Lesson 2: Plant Processes

Name _____

The Five Plant Processes

Objective: Relate the five plant processes to the greenhouse environment and design.

Directions: Drawing on your knowledge of plant processes, greenhouse environment, and greenhouse design, answer the following questions for **each** of the five plant processes. First, list the five plant processes. When answering the two questions below, follow the same A-E sequence as listed below.

A.

B

C.

D.

E.

1. How could a greenhouse owner encourage each of the following plant processes?

A.

B.

C.

D.

E.

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2. How could a greenhouse owner discourage each of the following plant processes?
- A.
 - B.
 - C.
 - D.
 - E.

GREENHOUSE OPERATION AND MANAGEMENT

Unit III : Plant Science Basics

Lesson 3: Plant Classification and Nomenclature

Competency/Objective:

Distinguish plants by characteristics and purpose.

Study Questions

1. How are plants classified?
2. What is the scientific system of classification and naming?

References/Supplies/Materials

1. *Greenhouse Operation and Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2002.
2. Transparency Masters

TM 3.13 Stem Growth
TM 3.14 Major Classification Categories
3. Activity Sheets

AS 3.6 Plant Pictionary: Part I
AS 3.7 Plant Pictionary: Part II
4. Magazines with pictures of plants, glue, scissors, and paper to use in the activities

TEACHING PROCEDURES

A. Review

Plants are categorized in terms of physical characteristics and purpose. This lesson applies information students learned earlier in this unit to the classification of plants.

B. Motivation

Ask students if there is an advantage to having a systematic means of classifying and naming plants. What might occur without such a system? By knowing how plants are classified and named, students can begin to identify the physical characteristics of plants when given the

Greenhouse Operation and Management

scientific names. Ask students to infer how a greenhouse owner would use this information to select suitable specific plants.

C. Assignment of Study Questions

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one study question at a time or have students answer all the questions before the discussion. Another option is to have students work in cooperative learning environment and have groups work on different study questions.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. How are plants classified?

Plants are grouped by characteristics or function. Activity 3.6 allows students to practice what they are learning.

A. Classified by plant characteristics

1. Stem type
 - a. Single main trunk (trees)
 - b. No main trunk (shrubs)
 - i. Herbaceous (soft, nonwoody)
 - ii. Woody
2. Stem growth (TM 3.13)
 - a. Climbing (creeping)
 - b. Erect
 - c. Decumbent
3. Type of fruit
 - a. Dry
 - b. Fleshy
4. Life cycle
 - a. Annual (completes life cycle in 1 year)
 - b. Biennial (completes life cycle in 2 years)
 - c. Perennial (continues to grow from year to year)
5. Foliage
 - a. Deciduous (loses leaves in winter)
 - b. Evergreen (keeps leaves all year)
6. Hardiness
 - a. Hardy (withstands temperature extremes)
 - b. Tender (sensitive to temperature extremes)

- B. Classified by plant purpose
 - 1. Edible
 - 2. Ornamental

2. What is the scientific system of classification and naming?

Taxonomy is the science of identifying, naming, and classifying organisms. Botanist Carolus Linnaeus created the system of binomial nomenclature to give each plant a unique name that would be understood universally. AS 3.7 provides an opportunity for students to apply binomial nomenclature when given plant characteristics.

A. Binomial nomenclature (two-word name)

- 1. Gives each plant a unique scientific name
 - a. Latin
 - b. Used throughout the world to identify a specific plant
- 2. Avoids confusion caused by the wide variety of common names given to a single plant

B. Structure of the scientific name (TM 3.14)

- 1. Genus
 - a. First part of name
 - i. First letter capitalized
 - ii. In italics
 - b. Identifies plant group that shares similar characteristics
- 2. Species
 - a. Second part of name
 - i. All lowercase letters
 - ii. In italics
 - b. Provides additional information such as geographic location, origin, and physical characteristics
- 3. Cultivar (variety) - from the words “cultivation” and “variety”
 - a. Occasionally added to the binomial; enclosed in single quotes or preceded by the abbreviation cv
 - b. Identifies variations of the species
 - c. Developed by botanists and agronomists (does not occur in the wild)
 - d. Hybridization among cultivars of same species

F. Other Activities and Strategies

- 1. Select two different plants and classify their characteristics.
- 2. Select two different plants and write their complete taxonomy.

Greenhouse Operation and Management

G. Conclusion

By understanding how plants are categorized, the greenhouse operator can make better choices regarding greenhouse crops. Binomial nomenclature is a universal way of identifying plants and promotes clearer communication between greenhouse owners and horticulturalists.

H. Answers to Activity Sheet

Instructor's discretion

I. Answers to Assessment

1. C
2. C
3. B
4. A
5. D
6. B

UNIT III : PLANT SCIENCE BASICS

Name _____

Lesson 3: Plant Classification and Nomenclature

Date _____

ASSESSMENT

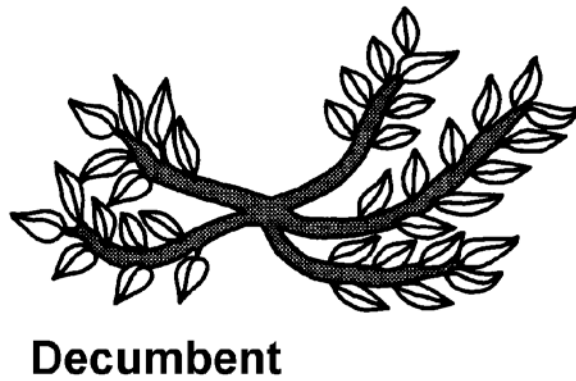
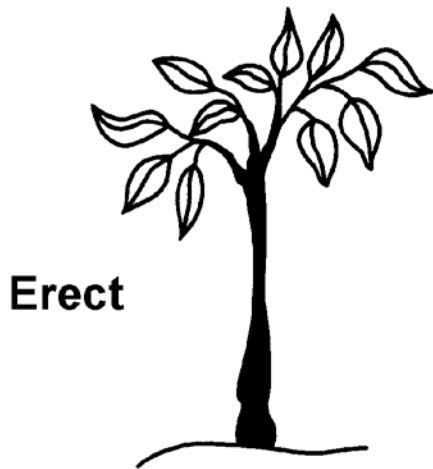
Multiple Choice: Circle the letter of the best answer.

1. What elements are in a binomial nomenclature of a plant?
 - A. Family and genus
 - B. Phylum and species
 - C. Genus and species
 - D. Phylum and cultivar
2. What are three plant characteristics used to classify plants?
 - A. Edible, ornamental, type of fruit
 - B. Stem growth, leaf type, and cultivar
 - C. Life cycle, foliage, and stem type
 - D. Foliage, hardiness, and variety
3. What identifies a plant group that shares similar characteristics?
 - A. Cultivar
 - B. Genus
 - C. Species
 - D. Variety
4. What identifies variations of the species?
 - A. Cultivar
 - B. Genus
 - C. Species
 - D. Subphylum
5. What identifies the origin, geographical location, and physical characteristics of a plant?
 - A. Cultivar
 - B. Genus
 - C. Phylum
 - D. Species

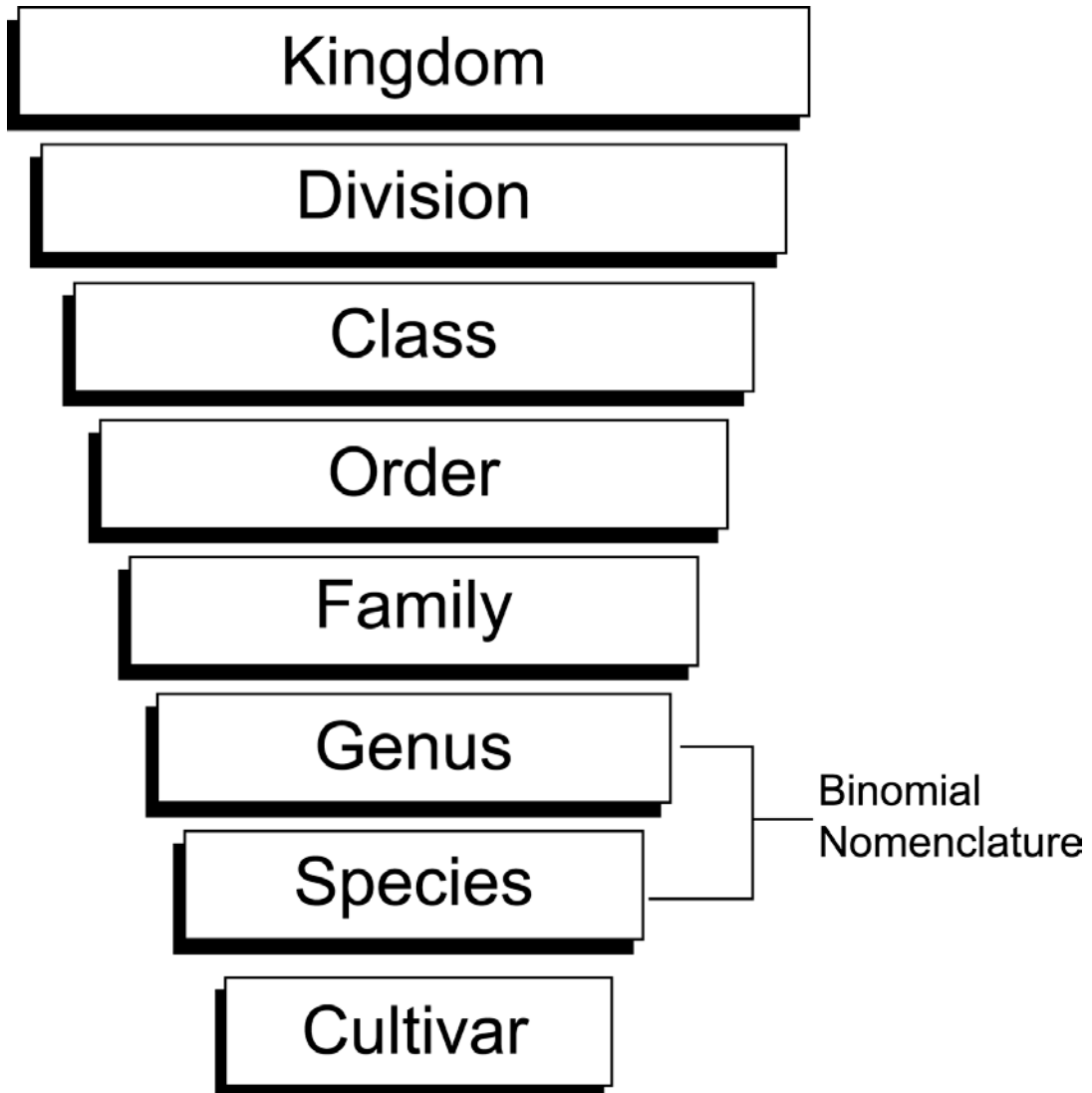
Greenhouse Operation and Management

6. What characteristics are used to classify plant function?
- A. Perennial and biennial
 - B. Edible and ornamental
 - C. Species and foliage
 - D. Cultivar and hardiness

Stem Growth



Major Classification Categories



UNIT III: PLANT SCIENCE BASICS

AS 3.6

Lesson 3: Plant Classification and Nomenclature Name _____

Plant Pictionary: Part I

Objective: Identify and gather representations of plant characteristics used for classification.

Directions: Divide the class into two groups. Depending on class size, each group either works on half of the characteristics used to classify plants or on all of them. Each group should find at least two examples of each characteristic. Use magazines, seed catalogs, the Internet, or any other available resources.

Groups can create large flashcards or PowerPoint presentations. If flashcards are used, write on the back of the photo or sketch the characteristic (e.g., stem type, woody, or single trunk) and the common name of the plant (e.g., cedar). If the group is collecting examples on the computer, compose a key at the end with the same information.

Group 1 show its flashcards or presentation to Group 2. Group 2 identifies the characteristics used for classification. Do the same with Group 2's presentation.

UNIT III: PLANT SCIENCE BASICS

AS 3.7

Lesson 3: Plant Classification and Nomenclature Name _____

Plant Pictionary: Part II

Objective: Use plant characteristics to identify plants' binomial nomenclature.

Directions Using the flashcards or presentations from AS 3.2 Leaf Poster, find the scientific name of the plants. Horticulture textbooks, encyclopedia, seed catalogs, and the Internet may be helpful.

Bonus Question: What is the binomial nomenclature for the seed you planted in Unit I?

