

UNIT II - PLANT BIOLOGY

Lesson 1: Plant Physiology

Competency/Objective: Compare and contrast the parts and functions of monocot and dicot seeds and plants.

Study Questions:

1. Which of the major crops are monocots and dicots?
2. What are the parts and functions of a monocot seed?
3. What are the parts and functions of a dicot seed?
4. What are the parts and functions of a monocot plant?
5. What are the parts and functions of a dicot plant?

References

1. *Advanced Crop Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2000, Unit II.
2. *Plant Science* (Instructor Guide). University of Missouri-Columbia: Instructional Materials Laboratory, 1991, Lesson 5.
3. Transparency Masters
 - a) TM 1.1: Parts of a Monocot Seed (Corn)
 - b) TM 1.2: Parts of a Dicot Seed (Soybean)
 - c) TM 1.3: Parts of a Monocot Plant (Grain)
 - d) TM 1.4: Parts of a Dicot Plant (Legume)

UNIT II - PLANT BIOLOGY

Lesson 1: Plant Physiology

TEACHING PROCEDURES

A. **Introduction**

Producers need to know the differences between monocots and dicots to accurately identify the plants and know how to care for them. Differences are easier to learn by comparing the functions of the seed and plant parts of different crops.

B. **Motivation**

After discussing the first study question, make two lists (one labeled monocots and the other labeled dicots) on the board, a bulletin board, or on a large piece of poster paper. Under each list have students write crops that fall into these two classifications starting with the seven major crops produced in Missouri. Continue to add to the list while working on this unit.

C. **Assignment**

D. **Supervised Study**

E. **Discussion**

1. Monocots (monocotyledonous) are plants with one cotyledon, or seed leaf, in each seed. Dicots (dicotyledonous) have two cotyledons per seed and are more complex in structure.

Which of the major crops are monocots and dicots?

- a) Monocots
 - 1) Corn
 - 2) Grain sorghum
 - 3) Wheat and other small grains
 - 4) Grass hays
 - 5) Rice
 - b) Dicots
 - 1) Soybeans
 - 2) Cotton
 - 3) Alfalfa
 - 4) Clover
2. Discuss the major parts and functions of a monocot seed using corn as an example. (Use TM 1.1.)

What are the parts and functions of a monocot seed?

- a) Parts of a monocot seed
 - 1) Seed coat
 - 2) Embryo
 - (a) Single cotyledon
 - (b) Epicotyl
 - (c) Hypocotyl
 - (d) Radicle
 - 3) Endosperm
 - 4) Seed scar

- (a) In corn called tip cap; seed attached to cob
 - (b) In grain sorghum, wheat, grass hays, and rice the seed located in or attached to inflorescence
 - b) Functions of monocot seed parts
 - 1) Seed coat - outer covering; serves as protector
 - (a) Resists water and insects
 - (b) Maintains seed's viability
 - (c) In corn called pericarp; in wheat called bran
 - 2) Embryo - miniature plant that sprouts within the seed
 - (a) Contains all genetics, enzymes, vitamins, and minerals for new plant
 - (b) Four parts
 - (1) Cotyledon (scutellum in corn) breaks down starch from endosperm, absorbs it, and moves it to the embryo.
 - (2) Epicotyl will develop into the first shoot with leaves that emerge from the seed upon germination. It is located above the cotyledon.
 - (3) Hypocotyl is found below the cotyledon and connected to the radicle. It is the first true stem of the plant.
 - (4) Radicle develops into the primary root, absorbing water and nutrients for the seed and dying later when permanent roots are formed.
 - (c) Called germ in wheat plants
 - 3) Endosperm - energy source for germinating seed
 - (a) Found only in the monocot seedlings
 - (b) Comprises 75% of seed; 82% in corn seeds
 - (c) Used as feed for livestock; food for humans
 - (d) Provide carbohydrates, protein, iron, B-complex vitamins, and other nutrients
3. Discuss the major parts and functions of a dicot seed using the soybean as an example. (Use TM 1.2.)

What are the parts and functions of a dicot seed?

- a) Parts of a dicot seed
 - 1) Seed coat
 - 2) Embryo
 - (a) Epicotyl
 - (b) Hypocotyl
 - (c) Radicle
 - (d) Two cotyledons
 - 3) Seed scar called hilum
- b) Functions of dicot seed parts
 - 1) Seed coat is the outer covering (same as in monocots).
 - 2) Embryo serves as new growing seedling.
 - (a) Epicotyl
 - (1) The growing end of main plant stem
 - (2) Attached to hypocotyl on one end and two embryonic leaves at the other
 - (b) Hypocotyl
 - (1) Becomes the main plant stem
 - (2) Lifts cotyledons out of soil for new seed leaves to emerge
 - (c) Radicle becomes the new primary root below the surface.
 - (d) Cotyledons
 - (1) Protect the epicotyle
 - (2) Provide food for sprouting plant
 - (3) Fleshy in form
 - (4) High in protein and oil

4. All plant parts are essential because each has a specific function to aid in the growth, maintenance, or reproduction of the plant. Discuss the major parts and functions of a monocot plant using a grain as an example. (Use TM 1.3.)

What are the parts and functions of a monocot plant?

- a) Parts of a monocot plant
 - 1) Inflorescence, or head
 - 2) Leaf blade
 - 3) Node
 - 4) Internode
 - 5) Leaf sheath
 - 6) Tiller
 - 7) Roots
 - b) Functions of monocot plant parts
 - 1) Inflorescence (floral portion) - reproduction
 - 2) Leaf blade
 - (a) Manufactures food by photosynthesis
 - (b) Conducts respiration, transpiration, and food storage
 - 3) Node - attachment point of leaf to stem
 - 4) Internode - stem section between nodes
 - (a) Supports plant
 - (b) Transports and stores nutrients
 - 5) Leaf sheath - base of leaf that wraps around the stem
 - (a) Supports and stabilizes stem
 - (b) Protects leaf axil (stem attachment at base)
 - 6) Tiller - secondary stem
 - (a) New shoot from primary plant
 - (b) Grows and reproduces by itself
 - (c) Example of how monocots multiply, specifically in rice and wheat
 - 7) Roots
 - (a) Supports plant
 - (b) Stores food
 - (c) Absorbs nutrients
5. Discuss the major parts and functions of a dicot plant using a legume as an example. (Use TM 1.4.) Note: Point out the nodules on the legume plant as shown on the transparency. The importance and function of this plant part will be discussed in the next lesson under the topic of essential plant nutrients.

What are the parts and functions of a dicot plant?

- a) Parts of a dicot plant
 - 1) Terminal bud
 - 2) Leaf
 - 3) Petiole
 - 4) Node
 - 5) Internode
 - 6) Axillary bud
 - 7) Hypocotyl
 - 8) Branch, or lateral roots
 - 9) Primary, or taproot
 - 10) Root hairs
- b) Functions of a dicot plant parts
 - 1) Terminal bud
 - (a) Growth point in the plant
 - (b) Apical meristem tissues - increase length of plant

- 2) Leaf
 - (a) Manufactures food by photosynthesis
 - (b) Conducts respiration and transpiration
 - (c) Stores food (sometimes)
- 3) Petiole - stalk of the leaf
 - (a) Attaches leaves to plant stems at nodes
 - (b) Provides support to leaves
 - (c) Transports nutrients
- 4) Node - attachment point of petiole stem; supports petiole
- 5) Internode - stem sections between nodes
 - (a) Supports aboveground plant
 - (b) Transports and stores nutrients
- 6) Axillary bud
 - (a) New developing leaf sections
 - (b) Site of new node
- 7) Hypocotyl (stem between roots and first node)
 - (a) Lifts plant out of soil
 - (b) Base of the stem
- 8) Branch, or lateral roots - roots branching from taproot
 - (a) Provides support
 - (b) Absorbs nutrients
- 9) Taproot (primary root)
 - (a) Main anchor for plant
 - (b) Food storage
- 10) Root hairs
 - (a) Common on branch and taproots
 - (b) Increases plant absorption area

F. **Other Activities**

1. Teachers may want to review the germination process of a monocot and dicot seed with students. To do this, use TMs 5.3 and 5.4 from the Instructor Guide of the IML *Plant Science* curriculum.
2. Have seeds and plants available for the students to identify and label the parts.

G. **Conclusion**

Seeds and plants have different parts needed for different functions. Monocot and dicot seeds have similar parts, but functions are more complex in dicots. Every part of a plant has a use whether for reproduction, support, or absorbing nutrients. Although monocot and dicot plants are different, they share basic characteristics such as leaves, stems, and roots.

H. **Answers to Evaluation**

- | | | |
|---------------|-------------------|---------------------|
| 1. Seed coat | 13. Embryo | 25. Taproot |
| 2. Endosperm | 14. Cotyledons | 26. Branch roots |
| 3. Cotyledon | 15. Seed scar | 27. Hypocotyl |
| 4. Embryo | 16. Leaf blades | 28. Node |
| 5. Epicotyl | 17. Leaf Sheath | 29. Leaves |
| 6. Hypocotyl | 18. Tiller | 30. Terminal bud |
| 7. Radicle | 19. Roots | 31. Axillary bud |
| 8. Seed scar | 20. Internode | 32. Nodules (bonus) |
| 9. Seed coat | 21. Node | |
| 10. Epicotyl | 22. Inflorescence | |
| 11. Hypocotyl | 23. Internode | |
| 12. Radicle | 24. Petiole | |

UNIT II - PLANT BIOLOGY

Lesson 1: Plant Physiology

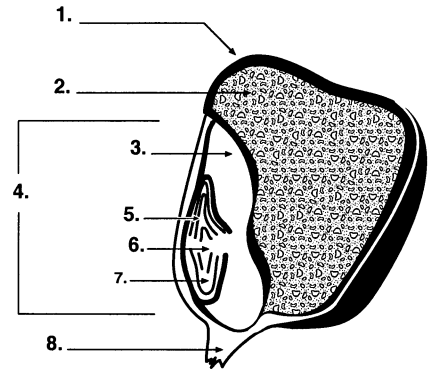
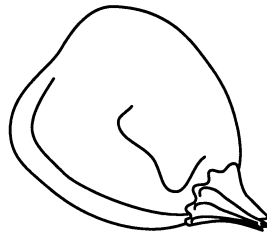
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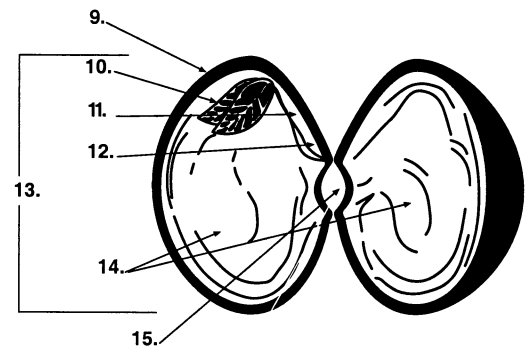
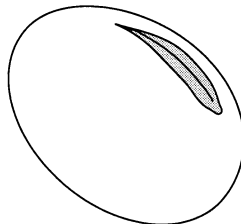
EVALUATION

Write the name of the seed or plant part in the blank with the corresponding number.

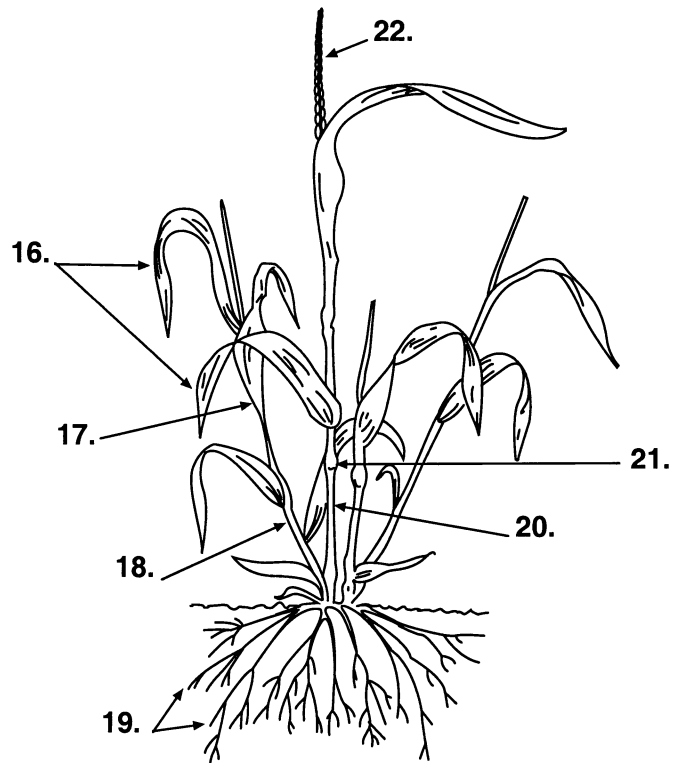
1. _____
2. _____
3. _____
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8. _____



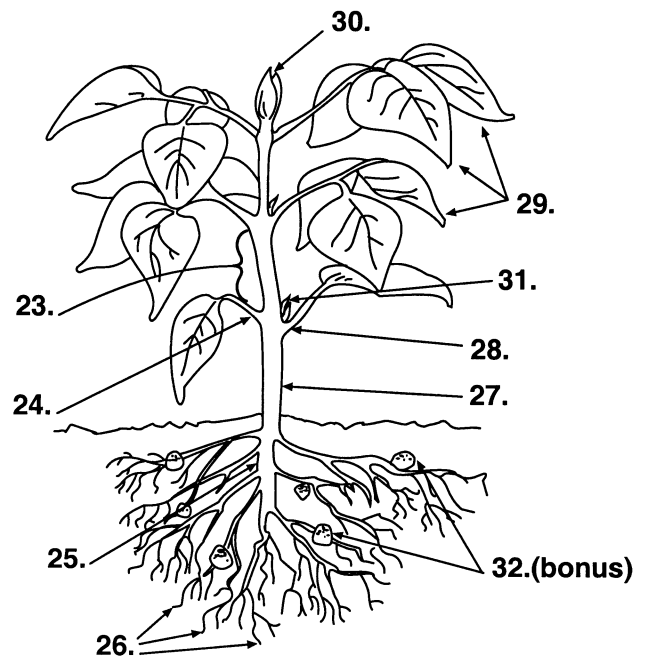
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____



15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____



23. _____
 24. _____
 25. _____
 26. _____
 27. _____
 28. _____
 29. _____
 30. _____
 31. _____
- (Bonus)
32. _____



Word Bank for Questions 1-8

Cotyledon
Embryo
Endosperm
Epicotyl
Hypocotyl
Radicl
Seed coat
Seed scar

Word Bank for Questions 9-14

Cotyledons
Embryo
Epicotyl
Hypocotyl
Radicl
Seed coat

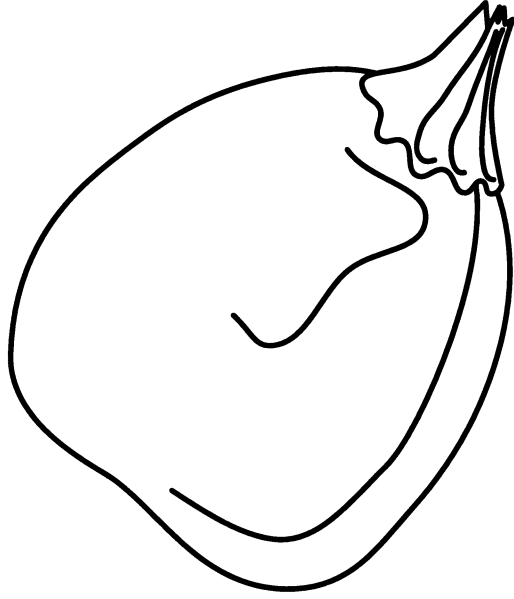
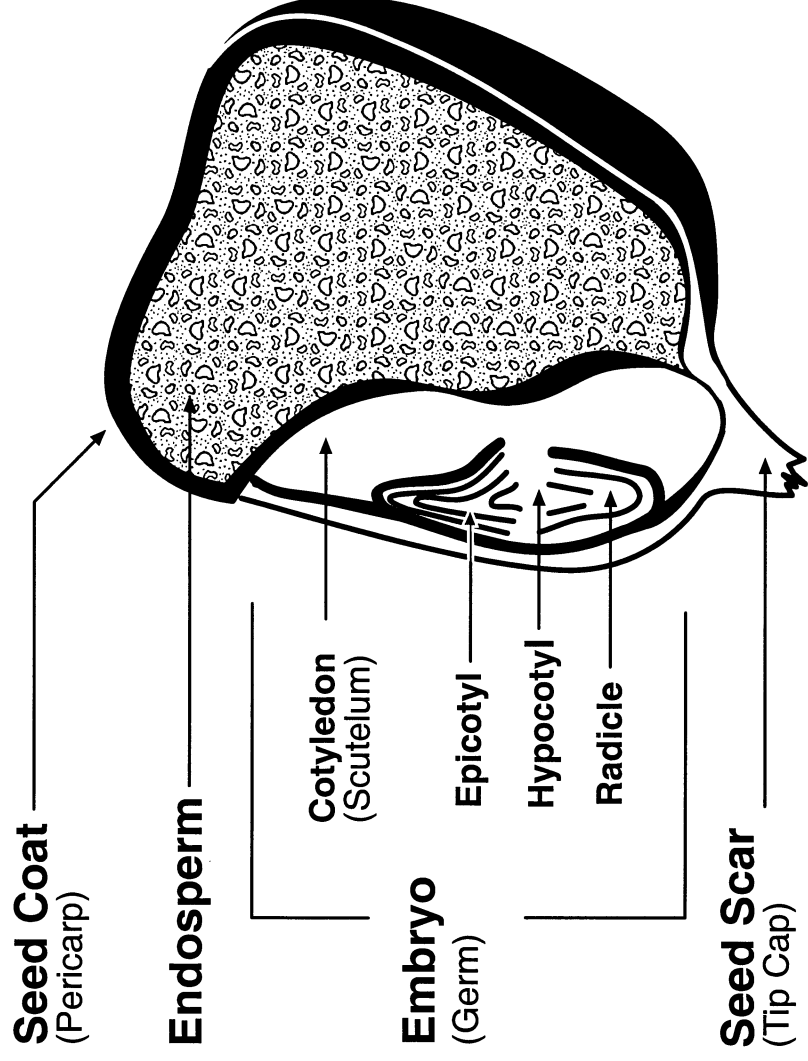
Word Bank for Questions 15-22

Inflorescence
Internode
Leaf blades
Leaf sheath
Node
Roots
Seed scar
Tiller

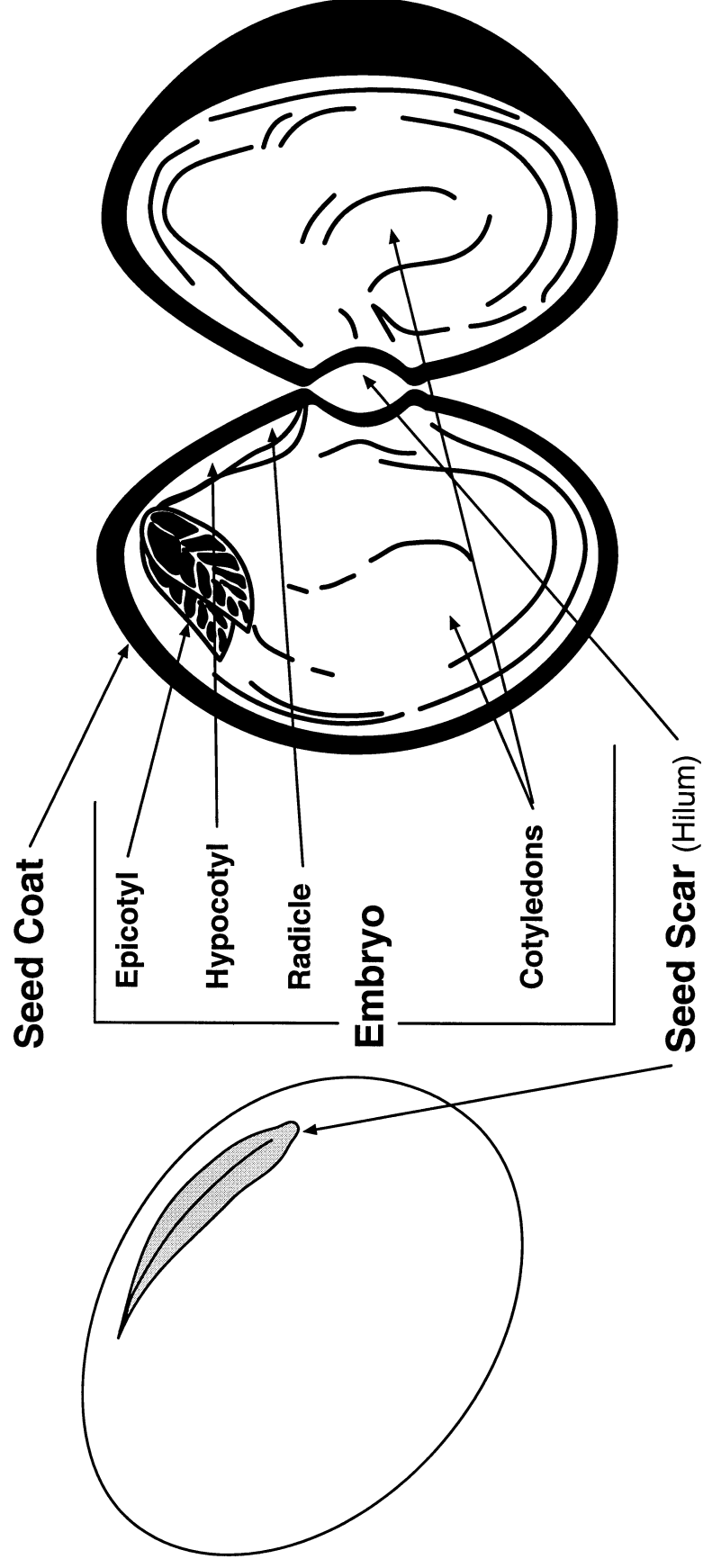
Word Bank for Questions 23-32

Axillary bud
Branch roots
Hypocotyl
Internode
Leaves
Node
Nodules
Petiole
Taproot
Terminal bud

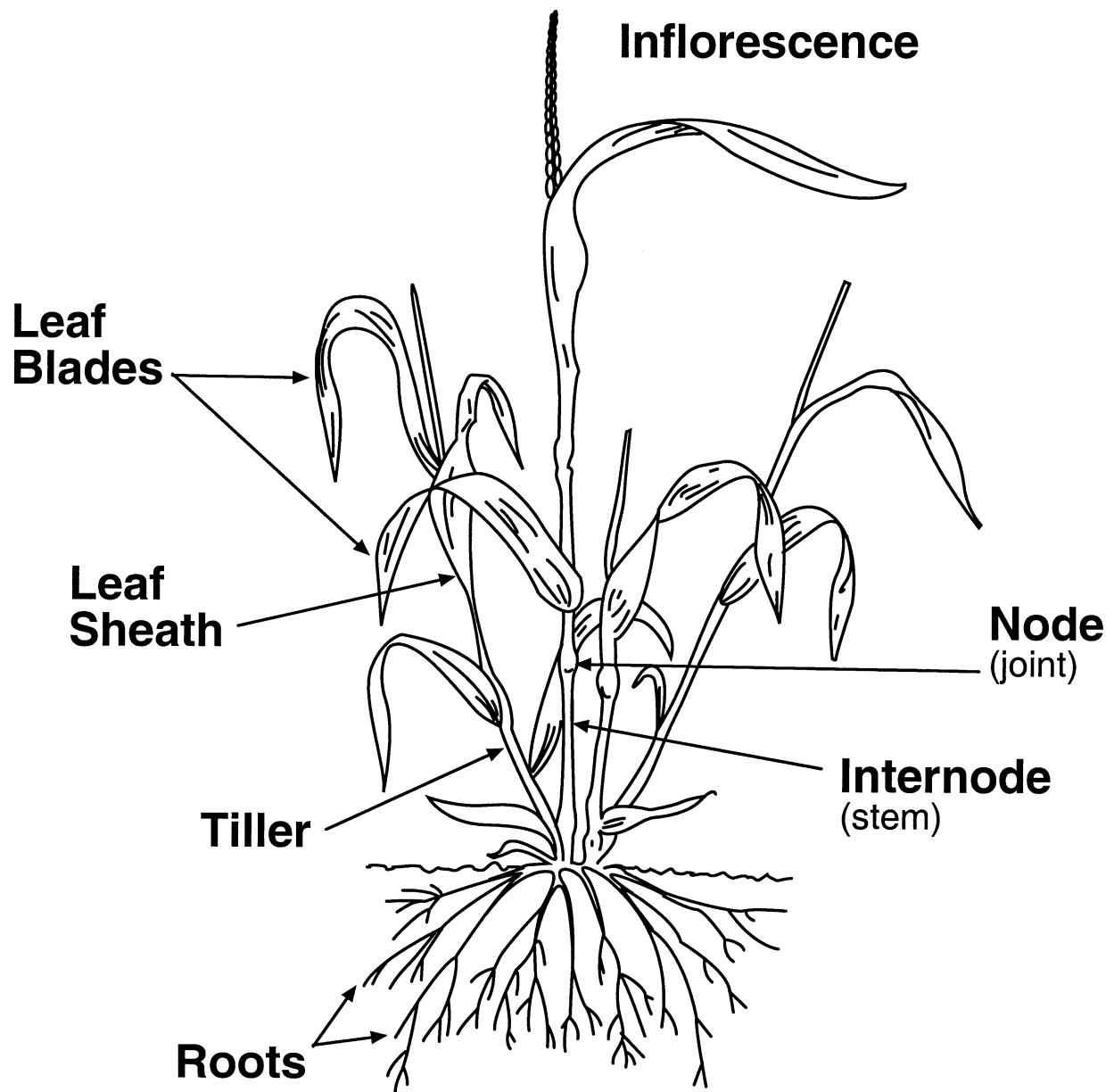
Parts of a Monocot Seed (Corn)



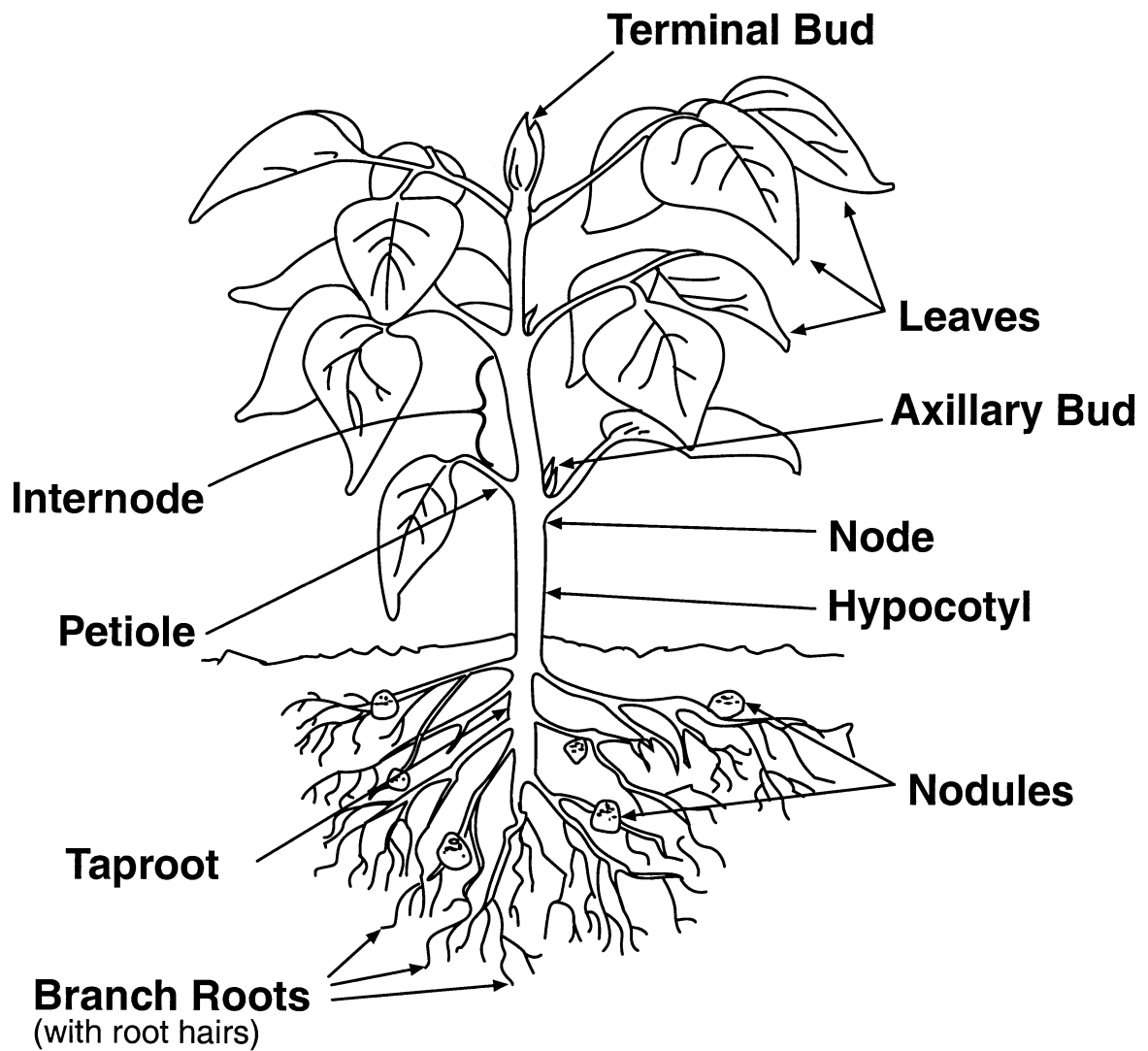
Parts of a Dicot Seed (Soybean)



Parts of a Monocot Plant (Grain)



Parts of a Dicot Plant (Legume)



UNIT II - PLANT BIOLOGY

Lesson 2: Plant Growth and Nutrient Needs

Competency/Objective: Describe how growth stages affect crop management practices.

Study Questions

1. **What are the plant growth stages?**
2. **What is the life cycle of a plant?**
3. **What are the essential plant nutrients?**
4. **What management practices are associated with key plant growth stages?**

References

1. *Advanced Crop Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2000, Unit II.
2. Transparency Masters
 - a) TM 2.1: The Growth Stages of Corn
 - b) TM 2.2: The Growth Stages of Soybeans
 - c) TM 2.3: Feekes' Scale of Wheat Development
 - d) TM 2.4: The Growth Stages of Grain Sorghum
 - e) TM 2.5: The Growth Stages of Alfalfa
 - f) TM 2.6: The Growth Stages of Cotton
 - g) TM 2.7: The Growth Stages of Rice
3. Activity Sheet
 - a) AS 2.1: Remembering Nutrients

UNIT II - PLANT BIOLOGY

Lesson 2: Plant Growth and Nutrient Needs

TEACHING PROCEDURES

A. **Review**

Although plants have similar growth stages, it is important for producers to understand the differences among individual crops so they can implement the best management practices. Understanding plant life cycles and growth stages is key to successful crop production.

B. **Motivation**

Present various crop specimens in different growth stages. Question students about the growth stages of the plant. Ask about the longevity of each specimen.

C. **Assignment**

D. **Supervised Study**

E. **Discussion**

1. Discuss the four main growth stages of crops. Using the transparencies provided for each major crop, highlight the differences in the names of stages or the number of stages. Discuss with the students the growth stage differences between Missouri's most important crops.

What are the plant growth stages?

- a) Germination: embryo in the seed develops into a new plant.
 - b) Vegetative: plant grows by extending the stem and adding leaves.
 - c) Reproductive: flowers are produced and new seeds are formed.
 - d) Maturity: plants ripen, lose green pigment, and dry down.
2. A plant's life cycle is classified by the length of time required for the plant to complete its growth stages. Discuss the three major life cycles of plants. Give examples of different crops classified in each life cycle.

What is the life cycle of a plant?

- a) Annuals - crops planted or harvested during a 1-year period or less
 - 1) Summer annuals - crops planted in spring or summer and harvested in the fall of the same year
 - (a) Corn
 - (b) Grain sorghum
 - (c) Soybeans
 - (d) Rice
 - 2) Winter annuals - crops planted in the fall and harvested the following summer
 - (a) Winter wheat
 - (b) Winter oats
 - (c) Winter barley
 - (d) Winter rye
- b) Biennials - crops completing their life cycle in the second year after planting
 - 1) Include very few field crops
 - 2) Sweet clover
 - 3) Common in vegetable crop seed production

- c) Perennials - crops or plants remain alive 3 or more years after planting
 - 1) Maintained by crop's ability to reseed or spread by vegetative reproduction
 - 2) Life expectancy limited by weed pressure, disease, grazing intensity, and competitive species
 - 3) Forage crops such as fescue, alfalfa, and lespedeza
- 3. There are 17 elements considered essential for plant growth and development. Nine are referred to as macronutrients; eight are considered micronutrients. Explain the importance of understanding the elements needed for plant growth to correct nutrient imbalances with soil additives.

What are the essential plant nutrients?

- a) Macronutrients
 - 1) Supplied by water and air
 - (a) Carbon (C)
 - (b) Hydrogen (H)
 - (c) Oxygen (O)
 - 2) Available in the soil
 - (a) Primary
 - (1) Nitrogen (N)
 - (2) Phosphorus (P)
 - (3) Potassium (K)
 - (b) Secondary
 - (1) Calcium (Ca)
 - (2) Magnesium (Mg)
 - (3) Sulfur (S)
- b) Micronutrients - found in soil solids and chemicals
 - 1) Iron
 - 2) Zinc
 - 3) Chlorine
 - 4) Molybdenum
 - 5) Manganese
 - 6) Copper
 - 7) Boron
 - 8) Cobalt
- 4. Discuss the importance of knowing growth stages of crops. The application of fertilizers, herbicides, and other crop-improving management practices requires timed sequencing along with specific growth stages, for example, postemergence vs. preemergence herbicides.

What management practices are associated with key plant growth stages?

- a) Nutrient management
 - 1) Test soil to determine nutrient content.
 - 2) Apply nutrients prior to planting, as necessary.
 - 3) Starter fertilizers and seed are placed in the ground and supply some nutrients.
 - 4) Some fertilizers are applied after emergence.
 - (a) Applied by side dressing on soil surface
 - (b) Applied by foliar fertilization through the plant's foliage
 - (1) Supplemental method of feeding plant through root system
 - (2) Not a practical method for large amount of nutrients
 - 1) Expensive to apply
 - 2) Severe burning of crop
 - 5) Amount applied and nutrients needed will vary.
 - (a) Depending on the specific crop
 - (b) Available nutrients in soil

- (c) Soil moisture
 - (d) Method of application
- b) Replanting
 - 1) Do not make a hasty decision regarding replanting.
 - 2) Determine the cause first.
 - 3) Consider the following.
 - (a) Original planting date and desired plant stand
 - (b) Earliest possible replanting date that may be used
 - (c) Economic cost of seed and pest control measures
- c) Moisture management through irrigation
 - 1) Ability to irrigate determined by topography of land
 - 2) Water source availability
 - 3) Capital required
- d) Pest management
 - 1) Weed management
 - (a) Mechanical methods - hand pulling, hoeing, burning, mowing, smothering with plastic mulch
 - (b) Cultural methods - crop rotation, crop competition, weed-free crop seed
 - (c) Biological control - natural enemies for weeds
 - (d) Chemical control - herbicides
 - 2) Disease management
 - (a) Affected at any stage of growth
 - (1) Biotic (living) agents - fungi, bacteria, viruses, nematodes, parasitic plants
 - (2) Abiotic (nonliving) agents - weather, water or temperature stress, combination of factors
 - (b) Attack at seed level with inoculants
 - (c) Early growth stages - chemical, cultural, or biological control
 - 3) Insect management
 - (a) Physical control - direct removal by controlling light, temperature, or traps
 - (b) Cultural control - crop rotations, soil tilling, resistant varieties, removal of host vegetation
 - (c) Biological control - use of other insects or pathogens
 - (d) Chemical control - use of liquids, gases, powders, or granules

F. **Other Activity**

Visit a greenhouse or botanical garden to observe various stages of plant growth.

G. **Conclusion**

Nutrients assist in the production of healthy crops. Without the 17 essential nutrients, crops would be unable to grow and produce properly. Whenever possible, producers should take advantage of the various advances available in pesticides and fertilizers.

H. **Answers to Evaluation**

- 1. c
- 2. d
- 3. b
- 4. a
- 5. a
- 6. a
- 7. c
- 8. a
- 9. a
- 10. b

11. a
12. c
13. c
14. a
15. Carbon, hydrogen, oxygen
16. Calcium, magnesium, sulfur
17. Nitrogen, phosphorus, potassium
18. Boron, chlorine, cobalt, copper, iron, manganese, molybdenum, zinc
19. Nutrient management, repopulation or replanting, moisture management with irrigation, and pest management
20. Original planting date and desired plant stand; earliest possible replanting date that may be used; cost of seed and pest control measures economically justified

UNIT II - PLANT BIOLOGY

Name _____

Lesson 2: Plant Growth and Nutrient Needs

Date _____

EVALUATION

Match the definition on the left to the term on the right.

- | | |
|---|-----------------|
| 1. _____ Embryo develops into a new plant. | a. Vegetative |
| 2. _____ Stems lose green pigment and turn brown. | b. Reproductive |
| 3. _____ Seed formation occurs | c. Germination |
| 4. _____ Stem extends and leaves multiply. | d. Ripening |

Match the crop in the left column to the plant cycle in the right column.

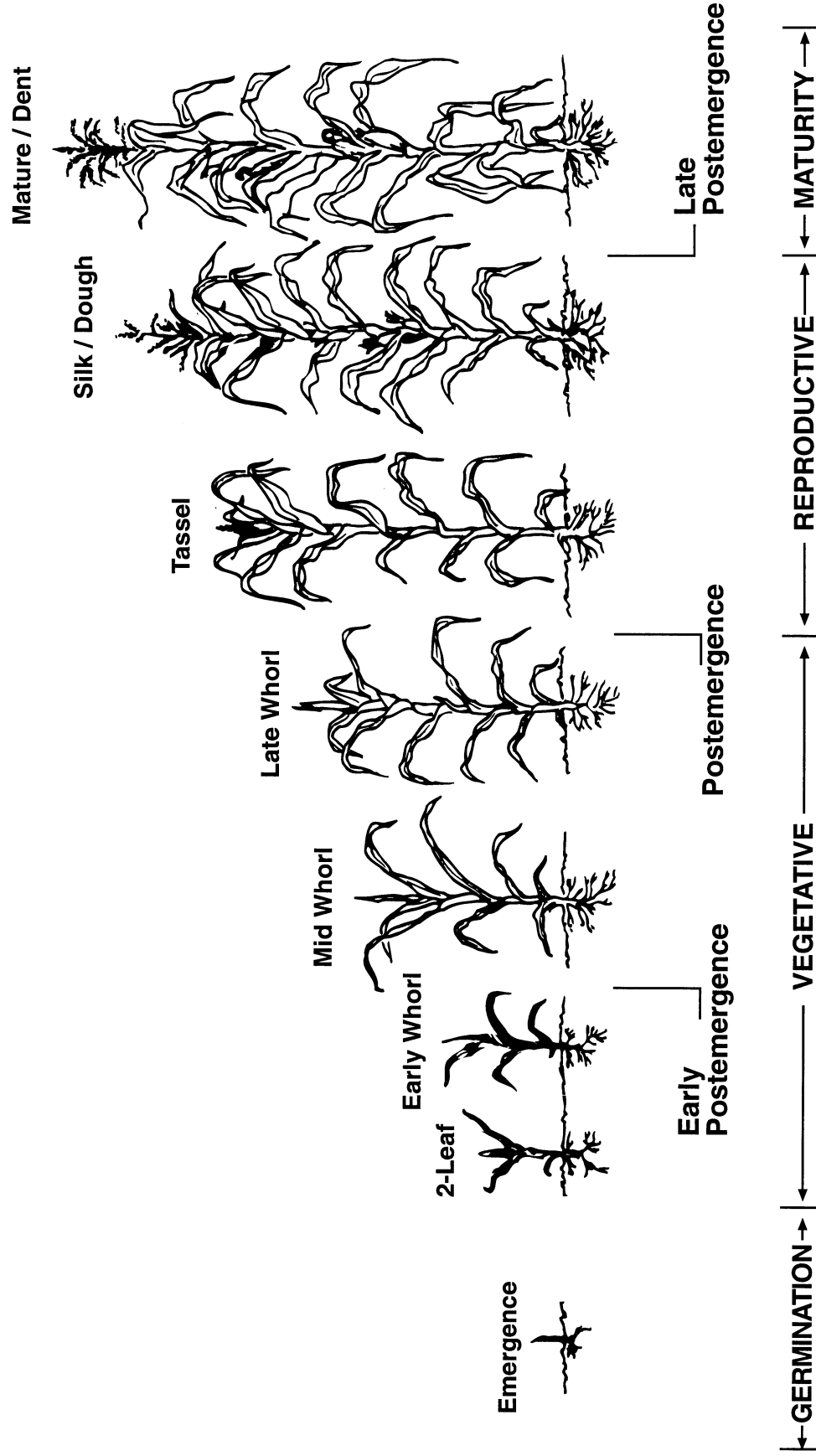
- | | |
|------------------------|--------------|
| 5. _____ Corn | a. Annual |
| 6. _____ Soybeans | b. Biennial |
| 7. _____ Fescue | c. Perennial |
| 8. _____ Wheat | |
| 9. _____ Grain sorghum | |
| 10. _____ Sweet clover | |
| 11. _____ Rice | |
| 12. _____ Grass | |
| 13. _____ Alfalfa | |
| 14. _____ Cotton | |

Complete the following short answer questions.

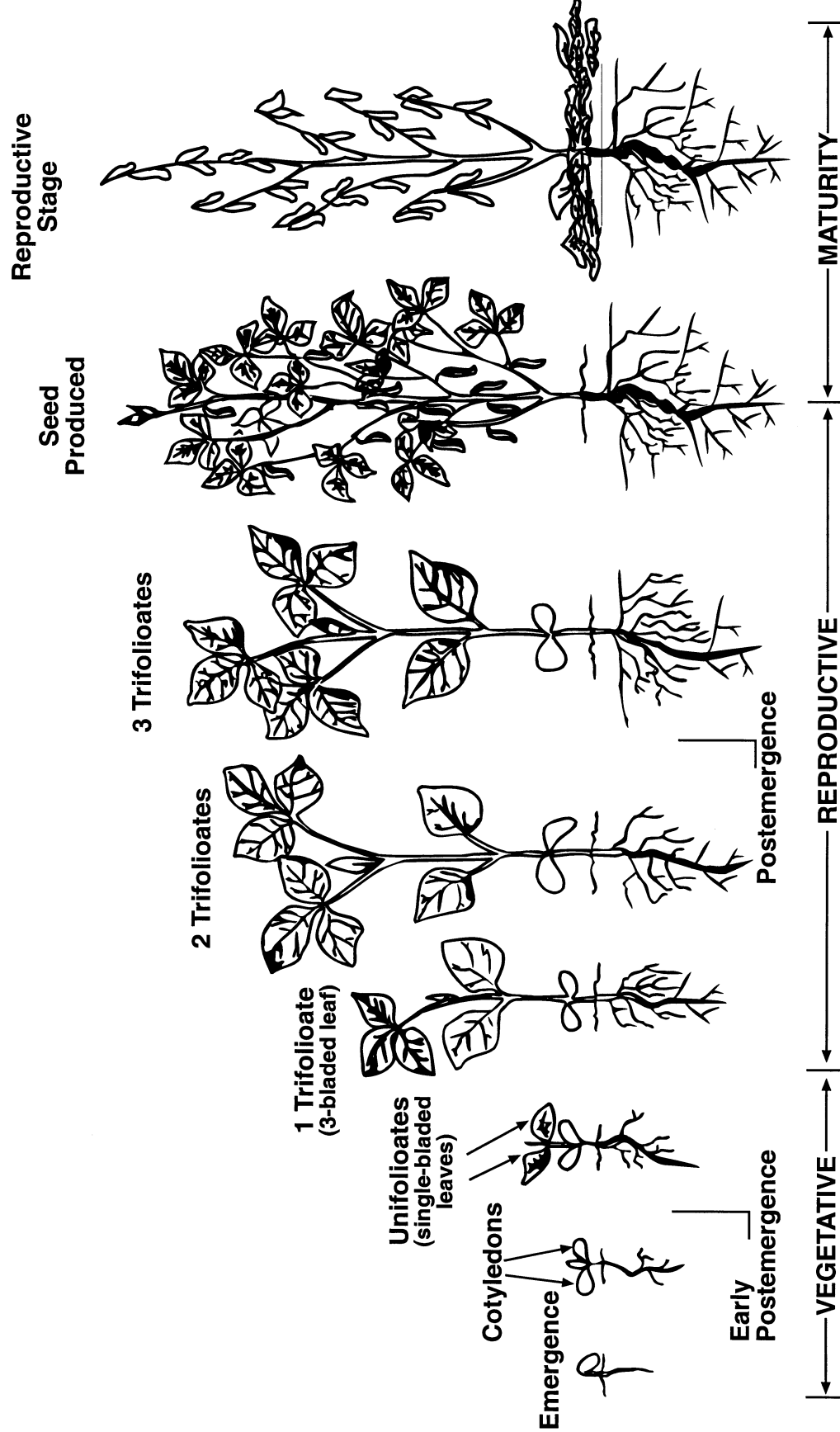
15. What are the three most basic mineral elements found in all life-forms?
- a.
 - b.
 - c.

16. List three secondary macronutrients.
 - a.
 - b.
 - c.
17. What are the three primary macronutrients needed by plants?
 - a.
 - b.
 - c.
18. List the eight micronutrients.
 - a.
 - b.
 - c.
 - d.
 - e.
 - f.
 - g.
 - h.
19. List the four management practices that need to be considered during the growth of the plant.
 - a.
 - b.
 - c.
 - d.
20. List three concerns of growers when deciding whether to replant a crop.
 - a.
 - b.
 - c.

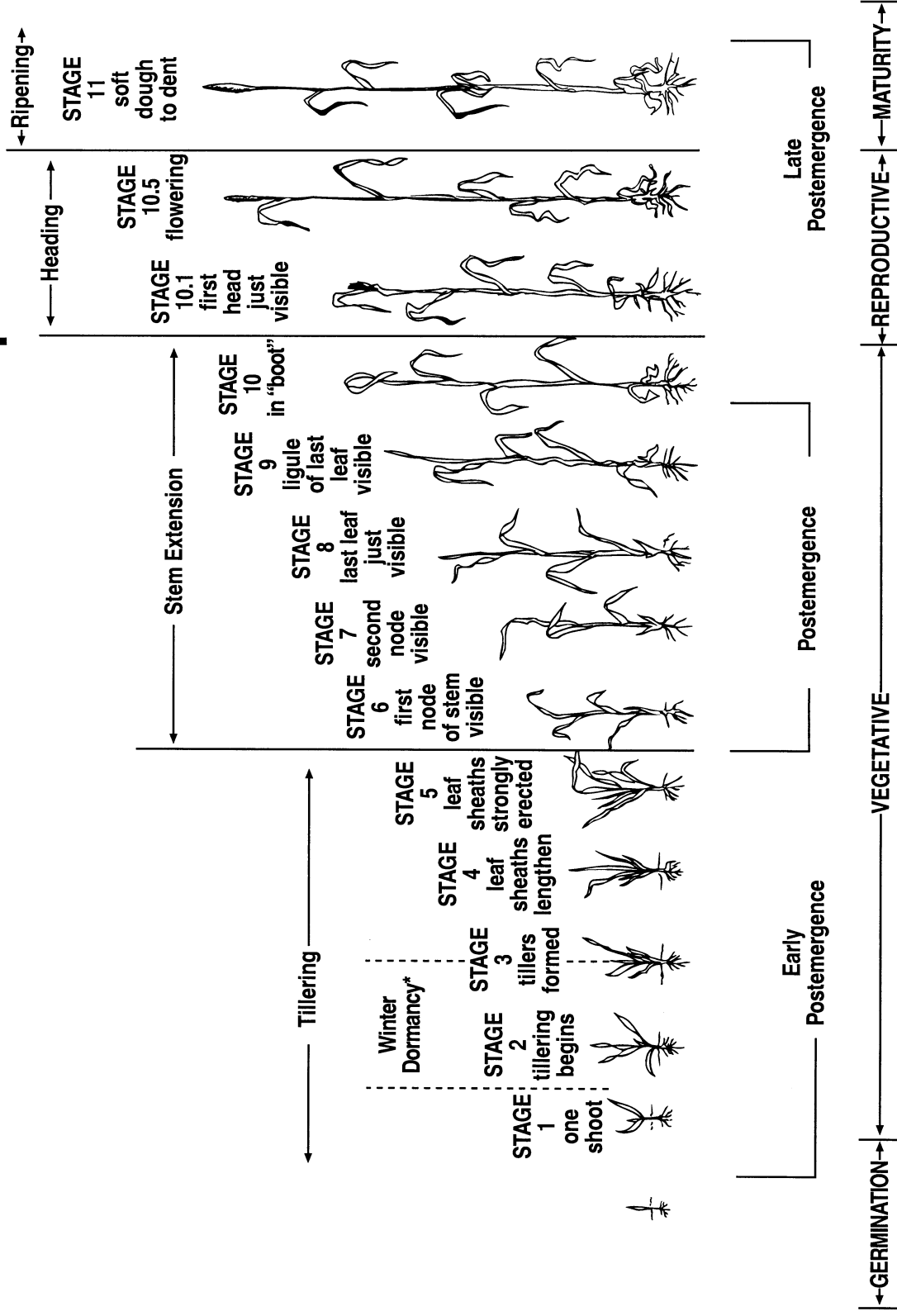
Growth Stages of Corn



Growth Stages of Soybeans



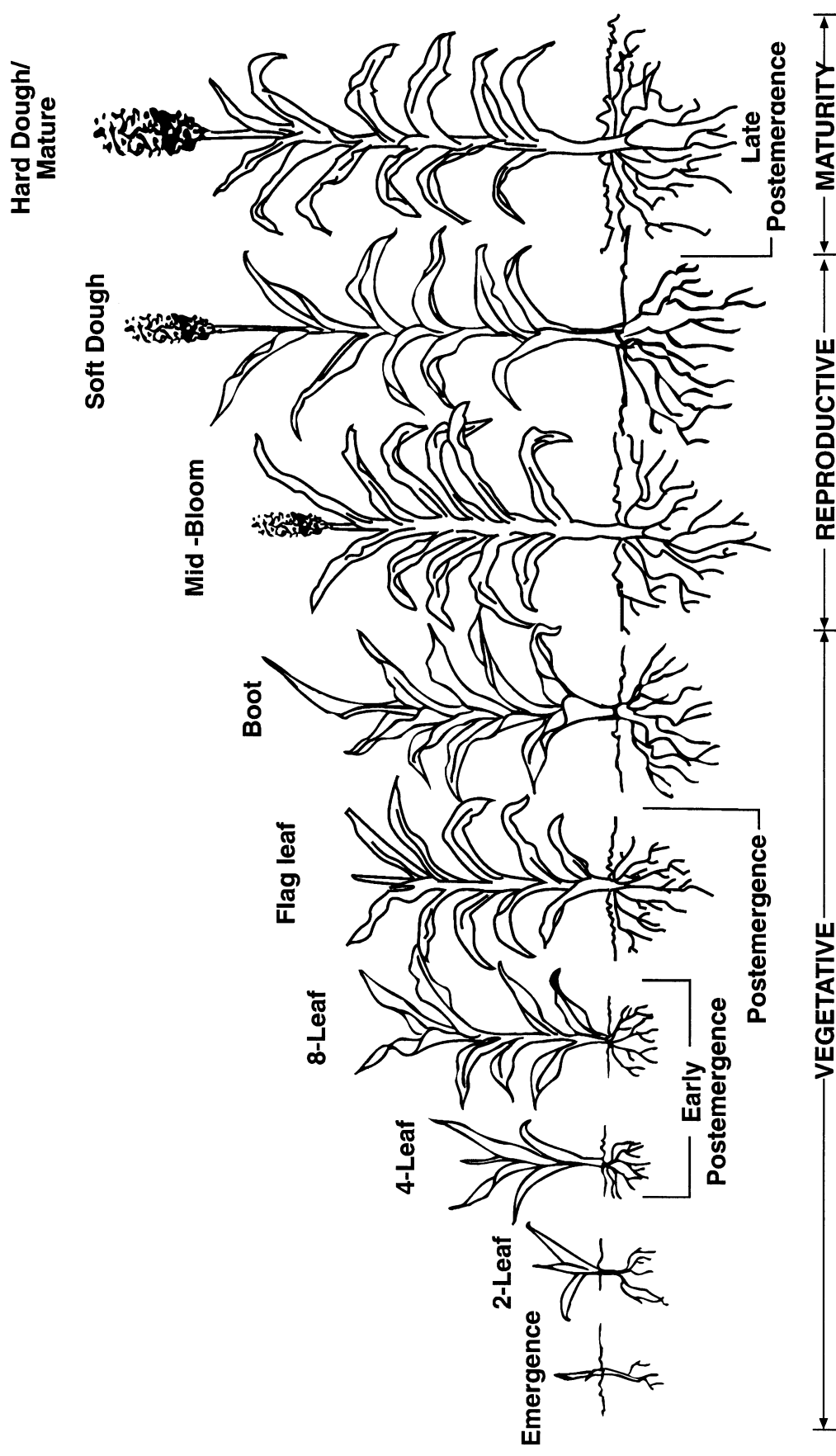
Feekes' Scale of Wheat Development



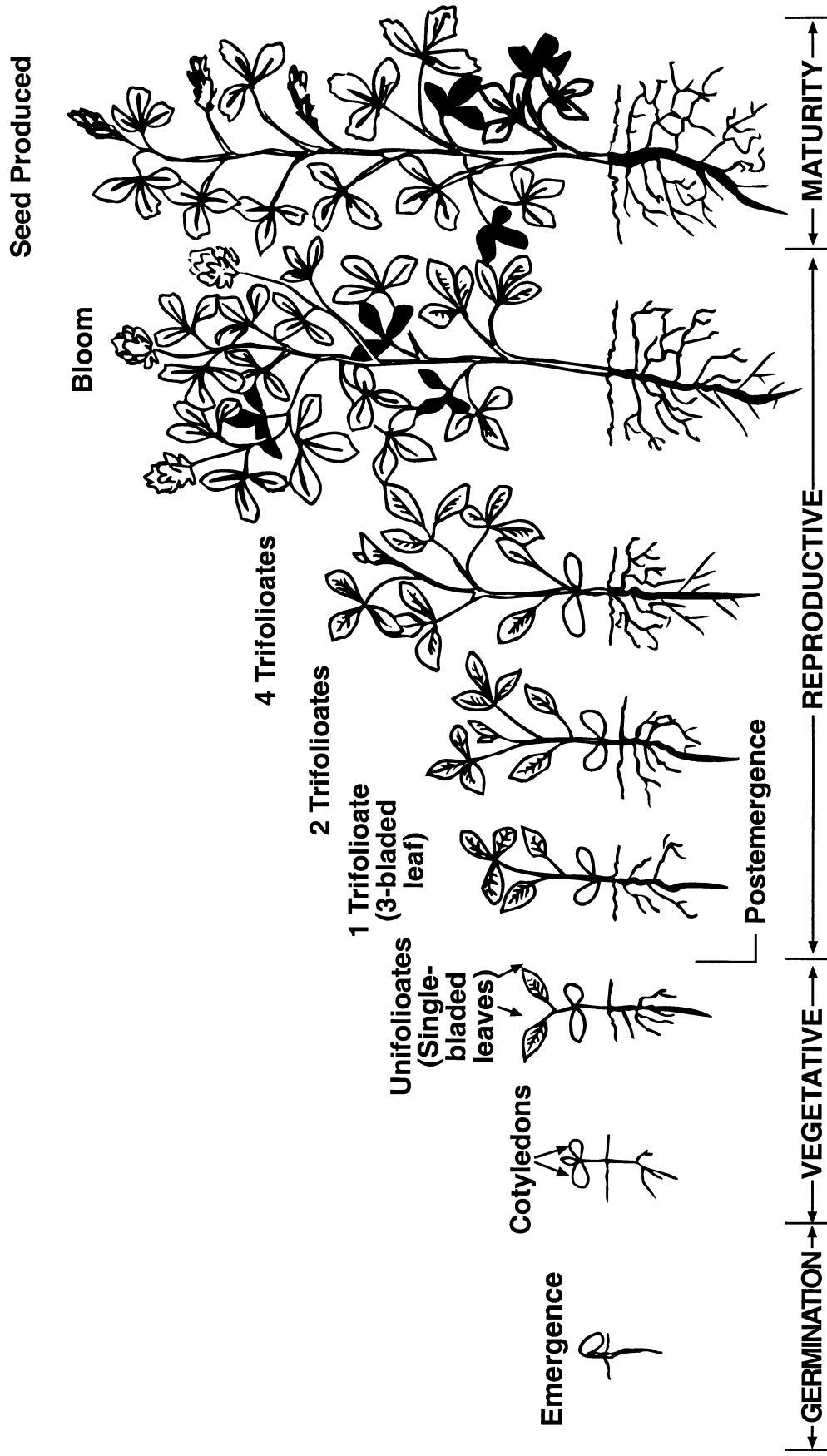
* Usual dormancy occurrence within this range, depending on weather.

Growth Stages of Grain Sorghum

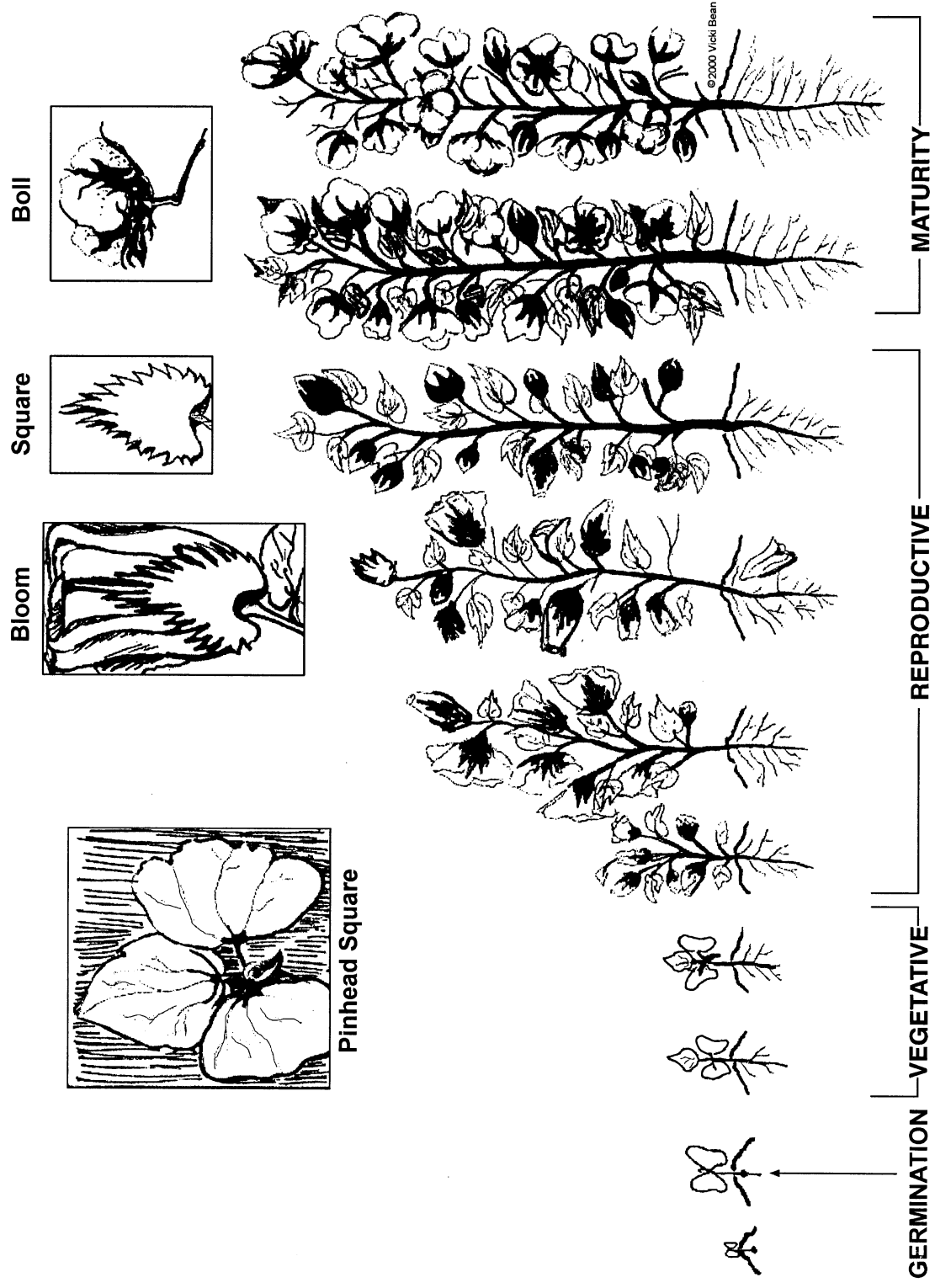
TM 2.4



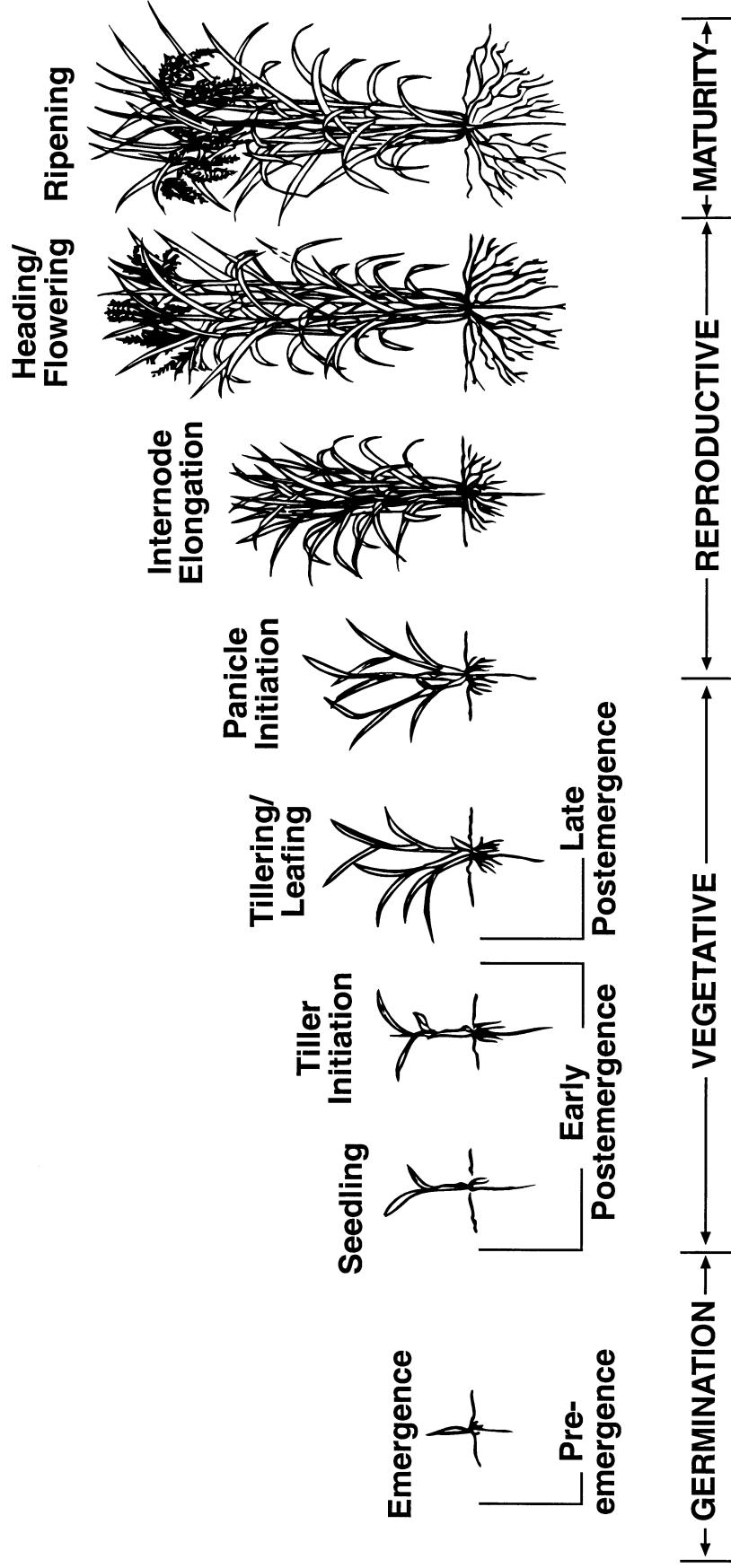
Growth Stages of Alfalfa



Growth Stages of Cotton



Growth Stages of Rice



Lesson 2: Plant Growth and Nutrient Needs

Name _____

Remembering Nutrients

Objective: To develop a method of remembering the names of the macronutrients and micronutrients that are important in plant growth.

Directions: List the macronutrients and micronutrients below and make a sentence with words using the first letter of each nutrient to help you remember the nutrient names. The list of nutrients can be in any order to help compose your sentence.

Word Sentences

- Macronutrients:
1. _____
 2. _____
 3. _____
 4. _____
 5. _____
 6. _____
 7. _____
 8. _____
 9. _____

- Micronutrients:
1. _____
 2. _____
 3. _____
 4. _____
 5. _____
 6. _____
 7. _____
 8. _____

Write each sentence below.

