Study Tip

Write each Vocabulary term on a separate card. Divide the class into two teams. Draw a vocabulary card, and have one member from each team draw diagrams or use pantomime to convey the meaning of the term to their team members. The first team to guess the term correctly wins a point. Continue until all the cards have been used.

Thinking Visually

Terms in the flowchart should be listed in the following order: *root epidermis, cortex, endodermis, xylem, spongy mesophyll, stomata.*

Chapter 23 Assessment

Reviewing Content

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

Understanding Concepts

11. The two kinds of vascular tissue in plants are xylem and phloem. Xylem consists of tracheids and vessel elements, and phloem consists of sieve tube elements and companion cells.

12. Parenchyma cells function mainly in storage and photosynthesis. Collenchyma cells help support large plants, and sclerenchyma cells make tissue tough and strong.

13. A dicot root has a vascular cylinder at its center, surrounded by a cortex of ground tissue. A dicot stem has ground tissue in the center, surrounded by a ring of vascular tissue.

14. The cell membranes of root hairs contain active transport proteins, which pump mineral ions from the soil into the plant, a process that leads to the movement of water into the plant by osmosis. Root hairs absorb most of the water taken in by plants.

Chapter 23 Study Guide

23–1 Specialized Tissues in Plants

Key Concepts

- Three of the principal organs of seed plants are roots, stems, and leaves.
- Plants consist of three tissue systems: dermal tissue, vascular tissue, and ground tissue.
- Vascular tissue contains several different cell types. Xylem consists of tracheids and vessel elements, and phloem consists of sieve tube elements and companion cells.
- Meristematic tissue is the only plant tissue that produces new cells by mitosis.

Vocabulary

epidermal cell, p. 580 • vessel element, p. 581
sieve tube element, p. 581
companion cell, p. 581 • parenchyma, p. 582
collenchyma, p. 582 • sclerenchyma, p. 582
meristem, p. 582 • meristematic tissue, p. 582
apical meristem, p. 582 • differentiation, p. 583

23–2 Roots

Key Concepts

- The two main types of roots are taproots, found mainly in dicots, and fibrous roots, found mainly in monocots.
- A mature root has an outside layer of epidermal cells and a central cylinder of vascular tissue separated by a large area of ground tissue called the cortex.
- Roots anchor a plant in the ground and absorb water and dissolved nutrients from the soil.

Vocabulary

taproot, p. 584 • fibrous root, p. 584
root hair, p. 585 • cortex, p. 585
endodermis, p. 585 • vascular cylinder, p. 585
root cap, p. 585 • Casparian strip, p. 587

23–3 Stems

Key Concepts

- Stems have three important functions: They produce leaves, branches, and flowers; they hold leaves up in the sunlight; and they transport various substances between roots and leaves.
- In monocots, vascular bundles are scattered throughout the stem. In dicots and most gymnosperms, vascular bundles are arranged in a cylinder.
- In all seed plants, primary growth of stems is produced by cell divisions in the apical meristem.
- In conifers and dicots, secondary growth takes place in lateral meristematic tissues called the vascular cambium and cork cambium.

Vocabulary

node, p. 589 • internode, p. 589
bud, p. 589 • vascular bundle, p. 590
pith, p. 590 • primary growth, p. 590
secondary growth, p. 591
vascular cambium, p. 591 • cork cambium, p. 591
heartwood, p. 592 • sapwood, p. 592 • bark, p. 593

23–4 Leaves

Key Concepts

- The structure of a leaf is optimized for absorbing light and carrying out photosynthesis.
- Plants keep their stomata open just enough to allow photosynthesis to take place but not so much that they lose an excessive amount of water.

Vocabulary

blade, p. 595 • petiole, p. 595
mesophyll, p. 596 • palisade mesophyll, p. 596
spongy mesophyll, p. 596 • stoma, p. 596
guard cell, p. 596 • transpiration, p. 596

23–5 Transport in Plants

Key Concepts

- Root pressure, capillary action, and transpiration work together to move water through the xylem tissue of even the tallest plant.
- When nutrients are pumped into or removed from the phloem system, the change in concentration causes a movement of fluid in that same direction. As a result, phloem is able to move nutrients in either direction to meet the nutritional needs of the plant.

Vocabulary

adhesion, p. 599 • capillary action, p. 599
pressure-flow hypothesis, p. 602

Thinking Visually

Make a flowchart of the tissues through which water passes, from when it enters a plant at the root until it escapes from the plant through the leaves. Use the following terms in your flowchart: *spongy mesophyll, root epidermis, stomata, cortex, endodermis, xylem.*

CHAPTER RESOURCES

Print:

- ***Teaching Resources,*** Chapter Vocabulary Review, Graphic Organizer
- ***Chapter Tests: Levels A and B,*** Chapter 23 Test

Technology:

- ***Computer Test Bank,*** Chapter 23 Test
- ***iText,*** Chapter 23 Assessment

Chapter 23 Assessment

Reviewing Content

Choose the letter that best answers the question or completes the statement.

1. The plant structure that is responsible for support of the plant body and for carrying nutrients between different parts of the plant is the
   a. root. **c.** leaf.
   b. stem. **d.** flower.

2. Which type of plant tissue would be found ONLY in the circled areas of the plant shown below?
   a. meristematic tissue **c.** dermal tissue
   b. vascular tissue **d.** ground tissue

3. Phloem functions primarily in
   a. transport of water.
   b. growth of the root.
   c. transport of products of photosynthesis.
   d. increasing stem diameter.

4. Tracheids and vessel elements make up
   a. phloem. **c.** xylem.
   b. trichomes. **d.** meristem.

5. The waterproof strip that surrounds cells of the endodermis is the
   a. vascular cambium. **c.** Casparian strip.
   b. vascular cylinder. **d.** cortex.

6. Increases in the thickness of stems over time result from the production of vascular tissue by the
   a. vascular cambium.
   b. cork cambium.
   c. apical meristem.
   d. ground tissue.

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7. Within a leaf, there are many air spaces between the cells of the
   a. palisade layer. **c.** meristem.
   b. spongy mesophyll. **d.** cuticle.

8. Stomata open and close in response to pressure within
   a. root cells. **c.** guard cells.
   b. cell walls. **d.** xylem.

9. The tissue that conducts the products of photosynthesis through a plant's stem is
   a. xylem.
   b. phloem.
   c. mesophyll.
   d. ground tissue.

10. The rise of water in a tall plant depends on root pressure and
    a. osmosis.
    b. evaporation.
    c. capillary action.
    d. transpiration pull.

Understanding Concepts

11. What are the two different kinds of vascular tissue in plants? Briefly describe each kind.

12. Explain the functions of these cells: parenchyma, collenchyma, and sclerenchyma.

13. If your classmate gave you a cross section of a dicot, how would you know whether the section was from a root or a stem?

14. How are root hairs important to plants?

15. What is the function of the vascular cambium in the secondary growth of stems?

16. From what type of plant tissue does bark develop?

17. What are the three main functions of leaves?

18. What is the function of the epidermis and cuticle layers in a leaf? What is the function of the pore-like openings in these layers?

19. What properties of water are important in its movement up a plant?

20. What is the function of guard cells in regulating transpiration and wilting?

21. What are the functions of phloem?

22. What are source cells and sink cells? Explain.

HOMEWORK GUIDE

Section:	Questions:
Section 23–1	1–4, 11, 12
Section 23–2	5, 14, 25
Section 23–3	6, 13, 15, 16, 23, 28, 29, 30
Section 23–4	7, 8, 17, 18, 20, 26, 27, 29, 33, 34
Section 23–5	9, 10, 19, 21, 22, 24, 31, 32

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(Continued from page 604)

15. In the secondary growth of a stem, the vascular cambium produces vascular tissue and increases the thickness of stems over time.

16. Bark develops from the cork cambium.

17. The three main functions of leaves are photosynthesis, transpiration, and gas exchange.

18. The epidermis and cuticle layers of dermal tissue that form the outer covering of a plant prevent water loss. The function of porelike openings in these layers is to allow gas exchange between the plant and the environment.

19. The properties of water that are important in its movement up a plant are cohesion, or the attraction of water molecules to one another, and adhesion, or the attraction of water molecules to the walls of a tube. As a result of this combination of forces, water is able to rise in tubes by capillary action.

20. When the guard cells are filled with water, the pressure within them increases, and they swell. This causes the stomata to open and transpiration to occur. When the guard cells lose water, the stomata close, preventing water from leaving the leaf. This in turn prevents wilting due to excessive loss of water by the leaf.

21. The function of phloem is to pump food down from the leaves into the stems and roots for storage and back again from the roots to other parts of the plant when the food is needed.

22. Source cells are located where sugars are pumped into the phloem, and sink cells are located where there is a low concentration of sugars. The pressure-flow hypothesis explains how phloem moves sugars and water from source cells to sink cells.

Critical Thinking

23. The person training the miniature tree trims off the apical meristems at the tips of shoots and roots. This keeps the tree short. However, the person does not touch the vascular cambium in the stem, so the stem continues to increase in thickness.

24. Students might choose cells from any of the three types of plant tissue: dermal tissue, vascular tissue, or ground tissue. Students should describe how the structure of the cell types is specialized to move water and minerals through the plant.

25. Without the Casparian strip, water could flow out of the xylem and back into the cortex of the root. The Casparian strip seals and waterproofs the cells of the endodermis around their edges so that water can move through them in only one direction.

26. a. How the rates of water intake and transpiration vary with the time of day **b.** Between about 12:30 and 3:30 PM **c.** About 35 grams of water **d.** As transpiration increases or decreases, water intake also increases or decreases.

27. Cactus: spinelike leaves reduce water loss; pine: waxy epidermis and sunken stomata reduce water loss.

28. Students' experimental designs should include reasonable hypotheses and controls.

29. Students' definitions should reflect an understanding of how leaf structures catch light and take in carbon dioxide and water for photosynthesis, as well as how they move the products of photosynthesis to the rest of the plant.

30. Grasses have monocot stems, which grow only by primary growth at the apical meristems. Conifers grow by both primary growth at the apical meristems and secondary growth at the vascular cambium.

31. Sample answers: Like a skyscraper, a tree has structures that transport materials from its lowest level to its highest. Unlike a skyscraper, a tree is an organism that functions without human intervention.

32. In early spring, the daily rise and fall of temperature causes the sap to start flowing up from the maple trees' roots. During the summer and autumn, the flow would be in the opposite direction and the sap would not be as concentrated.

Chapter 23 Assessment

Critical Thinking

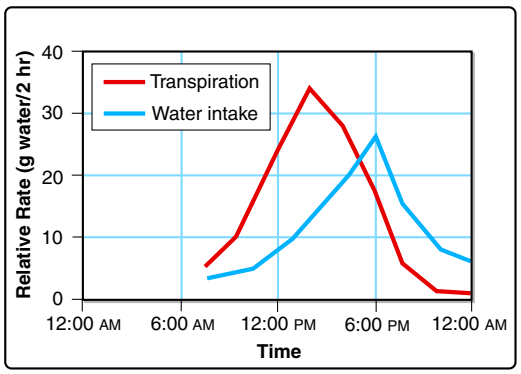
23. Inferring In Japan, the art of growing miniature trees is highly valued. By cutting the roots and tips of the branches, gardeners can keep the tree small. The trunk of the tree, however, continues to increase in diameter. How do you explain the ever-increasing growth of the diameter of the trunk?

24. Comparing and Contrasting Choose a group of cells in the root, in the stem, and in the leaf. Explain how these cells are specialized for transport of water and minerals.

25. Predicting How would the function of a plant root be affected if the endodermis cells did not have Casparian strips? Explain.

26. Using Tables and Graphs During transpiration, water evaporates from the leaves of plants into the air. Examine the graph that follows and answer the following questions.

- **a.** What does the graph show?
- **b.** During which span of time is the greatest amount of water lost through transpiration?
- **c.** About how many grams of water are lost every 2 hours when the transpiration curve is at its highest peak?
- **d.** What can you conclude about the relationship between transpiration and water intake?



27. Comparing and Contrasting Choose a plant from a desert and a plant from a coniferous forest, and compare the ways in which their leaves are adapted to their biomes.

28. Designing Experiments What relationship would you expect between a plant's lifespan and its ability to undergo secondary growth? What data could you collect to test your hypothesis? Describe an experiment to collect the data.

29. Forming Operational Definitions Review the structure and functions of a leaf and use this information to write an operational definition that explains in your own words what a leaf is.

30. Comparing and Contrasting Identify and compare the methods of stem growth in grasses and conifers. Use the terms *primary growth* and *secondary growth* in your answer.

31. Using Analogies Someone has said, "A tree is like a skyscraper." In what ways would you agree or disagree with this statement? In your answer, refer to the processes responsible for the transport of water and nutrients in trees and other plants.

32. Applying Concepts Why are maple trees tapped for their sugar in the early spring rather than in the summer or autumn?

33. Comparing and Contrasting Compare epidermal cells in the root and the leaf. How are they specialized for structure and function?

34. Connecting Concepts Recall from Chapter 22 four things that plants need to survive. Describe how roots, stems, and leaves each contribute to meeting at least two of those needs.

Writing in Science

Consider the vascular tissue in a root, a stem, and a leaf. Write a paragraph showing how the cells in this tissue are specialized for transport of water and minerals. (*Hint:* Create an outline to organize your ideas.)

Performance-Based Assessment

Making Models Make a three-dimensional model of one of the following: the layers in a plant leaf, the structure of a plant root, or the structure of a woody stem with secondary growth. Label the major structures in your model. On a separate sheet of paper, describe the function of each structure.

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33. Root epidermal cells protect tissues and absorb water. Tiny cellular projections, called root hairs, increase the surface area for absorption. Leaf epidermal cells are tough, irregularly shaped cells that form a waterproof barrier that protects tissues and limits water loss through evaporation.

34. Students' answers should discuss how roots, stems, and leaves contribute to meeting a plant's needs for two of the following: sunlight, water, gas exchange, and the movement of water and nutrients.