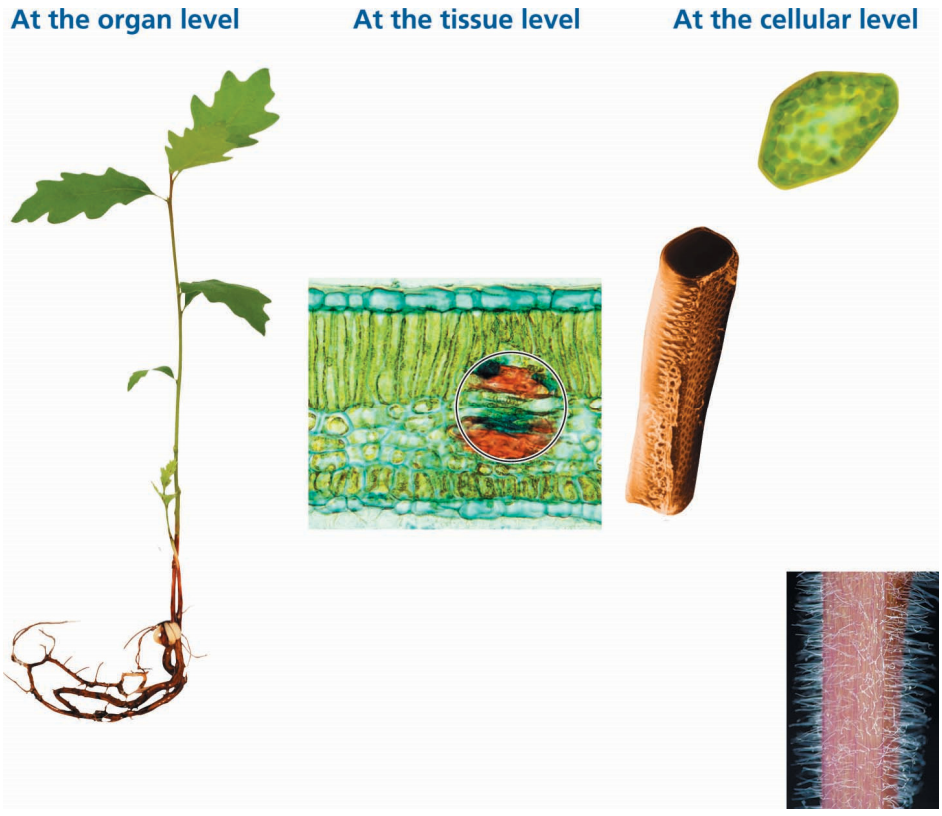
Chapter 35: Plant Structure, Growth, and Development

35.1 Describe the structure and organization of the plant body.
35.2 Explain the role of meristems in plant growth.
35.3 Describe the process of primary growth.
35.4 Describe the process of secondary growth.
35.5 Identify processes that result in the specialized parts of the plant body.

In this chapter, we have selected basic information about plant structure, growth, and development to allow you to understand how certain fundamental processes work in plants. For example, knowing the morphology of a typical root tip will help visualize the slides you look at when studying mitosis. Knowing the anatomy of the leaf puts information about photosynthesis into perspective. Mechanisms of cell signaling, gene regulation, and development are common to plants as well as animals, so continue to think about the unity and diversity of life.

Study Tip: This introductory chapter on plants is constructed hierarchically. The first organizational step begins with plant organs, then tissues, and finally cells. Label the following figure, giving the components of each organizational level and its function. This will give you a broad overview of plants under which you can hang details as they are developed.



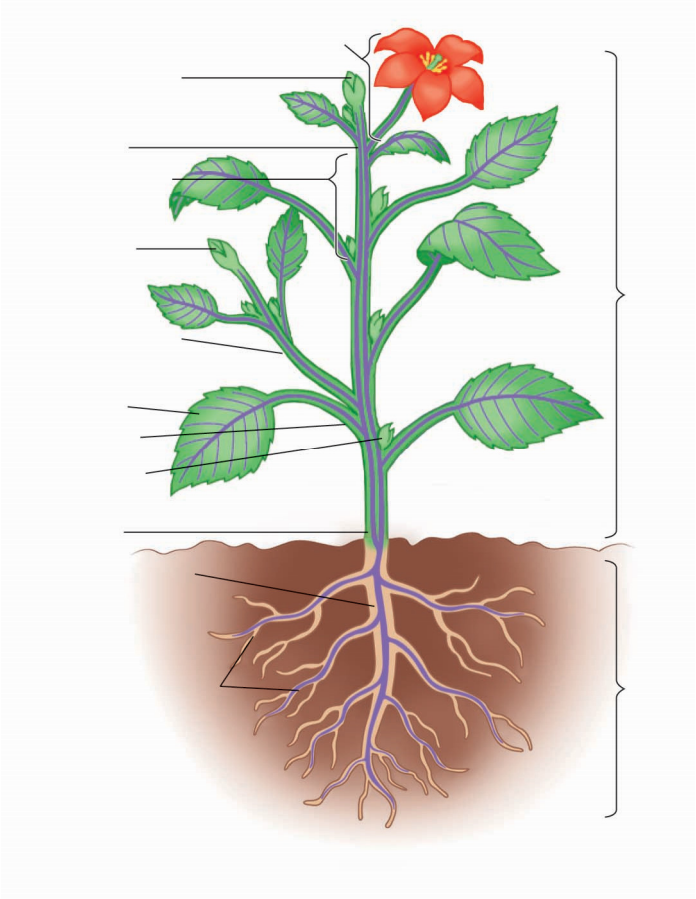
Concept 35.1 Plants have a hierarchical organization consisting of organs, tissues, and cells

LO 35.1: Describe the structure and organization of the plant body.

1. This concept is organized into three sections—plant organs, tissues, and cells. Begin by defining a *tissue* and an *organ*.

2. The three plant organs are _____, _____, and _____.

3. Completely label the following figure (Figure 35.2 in your text).



4. What are three important functions of the *root*?

5. How does a taproot system differ in function from a fibrous root system?

6. Figure 35.3 in your text shows the *root hairs* of a radish. What is the function of *root hairs*?

7. What is the chief function of stems? Note the node and internode in the figure you labeled in question 3.

8. How do the functions of *apical* and *axillary* buds differ?

9. Describe three specialized evolutionary adaptations of stems. Figure 35.5 in your text will help.

10. What is the main function of the *leaf?*

11. Study Figure 35.6 in your text to learn the difference between *simple* and *compound leaves*. What do you note is found at the base of every leaf, simple or compound?

12. What are four evolutionary adaptations leaves may exhibit beyond being specialized for photosynthesis?

13. Plants have three types of tissues. Place the name of each tissue type and its function in the following table.

Tissue Type	Function

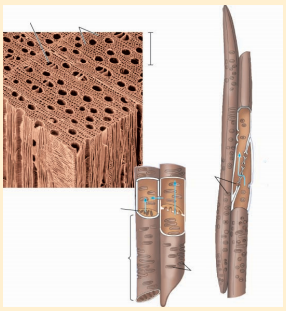
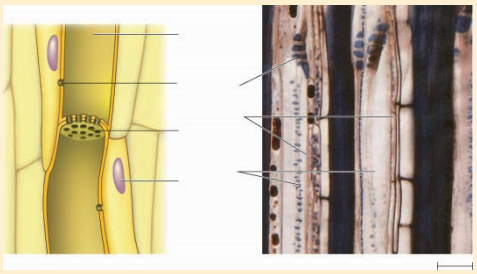
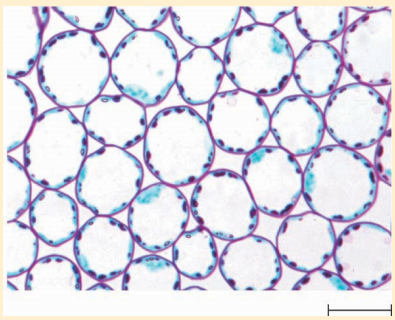
14. What is the function of the *cuticle*?

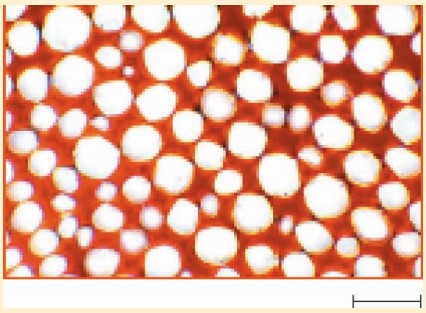
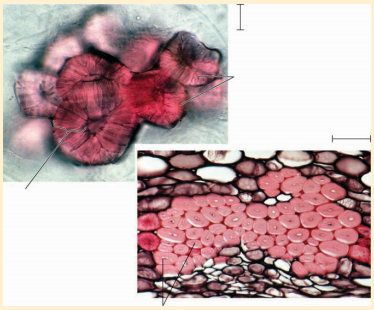
15. Name the two vascular tissues and give the function of each.

16. Xylem transport tends to be in one direction, but *phloem* transport is more complicated. Explain the pattern of sugar flow in phloem tissue.

17. The two major tissues of the *ground tissue system* are *pith* and *cortex*. Where is each found in the plant?

18. Plants have five major types of cells. In the following chart you will find a picture of each cell type. Label as indicated and give the major function of each cell type.

Plant Cells	Function
	Label **vessel elements, tracheids**, and **pits.**
	Label **companion cell, sieve tube element**, **plasmodesma**, and **sieve plate.**
	

	Label and describe the function of these cells.
	Label and describe the function of these cells.

19. Compare the following structures:

    a. **tracheids** and **vessel elements**

    b. **sieve tube elements** and **companion cells**

20. As you finish this first extensive concept, do not lose sight of the big picture. Complete the following summary charts.

    The three plant organs are

    The three basic plant tissues are

    The five basic plant cell types are

Concept 35.2 Different meristems generate new cells for primary and secondary growth

LO 35.2: Explain the role of meristems in plant growth.

21. What is the difference between *indeterminate growth* and *determinate growth*?

22. Although plants generally show indeterminate growth, what are three examples of plant parts that show determinate growth?

23. What are *meristems* and how do they contribute to plant growth?

24. Explain the following relationships.

    apical meristems and **primary growth**

    lateral meristems and **secondary growth**

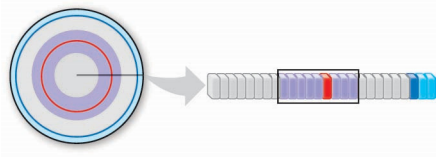
    primary growth and **secondary growth**

Study Tip

Only plant meristem cells are capable of division! If you attached a basketball goal 10 feet off the ground on a tree, the goal would always remain at that height. The plant is growing upward *only* from the terminal meristems.

25. Read carefully the explanation for primary growth from Figure 35.11 in your text. (The animation in Mastering Biology is also helpful.) Then draw and label a simple outline of a root as directed in question 1 of the figure text.

26. Continuing with Figure 35.11 in your text, carefully read the explanation for secondary growth. The figure below comes from question 2. Label the red vascular cambium layer on the diagram. Then label five xylem cells from oldest (X1) to youngest (X5) and three phloem cells (P1 to P3 in the proper order).



27. Based on the length of their life cycle, plants are categorized into three groups. Explain what each category means below and provide an example.

annuals

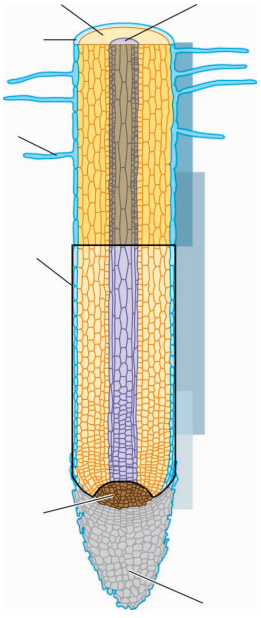
biennials

perennials

Concept 35.3 Primary growth lengthens roots and shoots

LO 35.3: Describe the process of primary growth.

28. The Figure 35.13 shows an image similar to a slide many students study in a mitosis lab and is labeled for this lesson as the "Primary growth of a eudicot root." Label the following structures shown in the figure: *vascular cylinder*, *epidermis*, *apical meristem*, *root cap*, *root hair*, *zone of differentiation*, *zone of elongation*, and *zone of cell division*.



29. Describe what happens in each of the following zones:

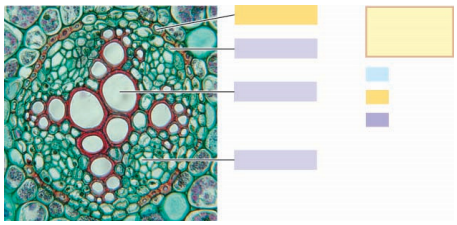
zone of cell division

zone of elongation

zone of differentiation

30. When looking for the stages of mitosis, what is the only area that will show cell division?

31. Although monocot and eudicots roots are arranged differently, the tissues have the same functions. As an example, use the figure to label the solid cylinder of vascular tissue taken from the center of a eudicot root. Label the xylem, phloem, endodermis, and pericycle. Define the two new terms as indicated.



endodermis

pericycle

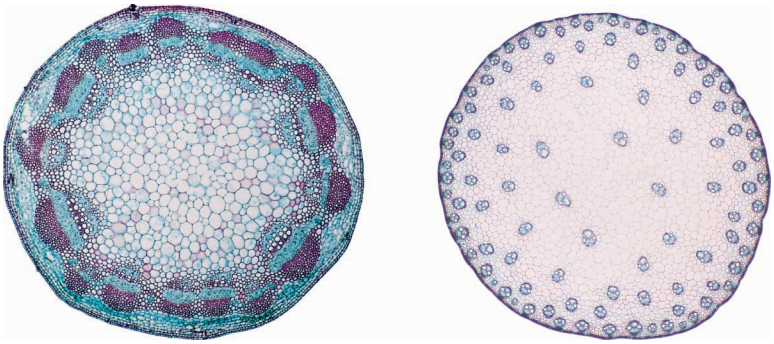
32. Why must new roots formed by the pericycle originate in the center of the root?

33. Using Figure 35.16 on p. 769 in your text, locate and label the shoot apical meristem, leaf primordia, young leaf, developing vascular strand (procambium), and axillary bud meristems.

34. What structure in Figure 35.16 is responsible for primary growth?

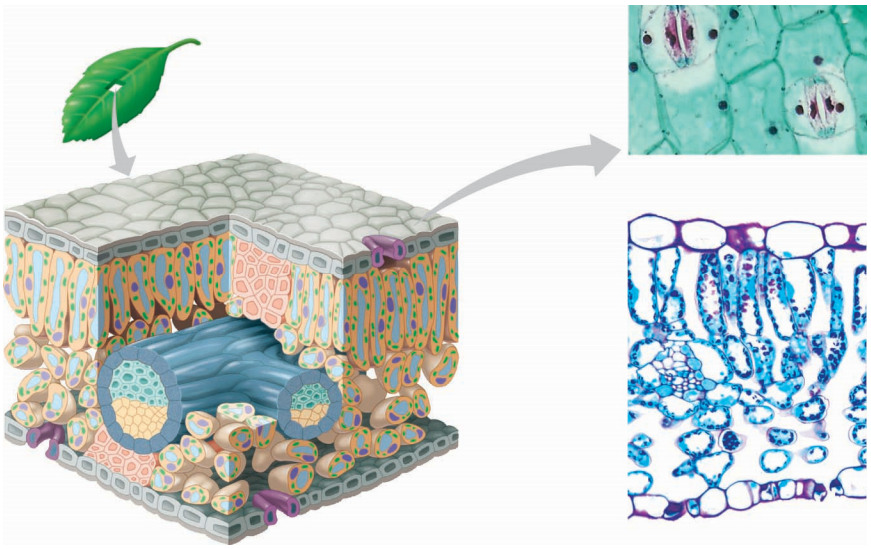
35. What is *apical dominance*? Explain the role of apical dominance in plant growth.

36. It is possible to tell a young eudicot from a monocot by the microscopic anatomy of the stem. In the following figure, label which stem is a monocot and which is a eudicot, then label the vascular bundles and the epidermis.



37. How is the arrangement of vascular bundles different in monocot and dicot stems?

38. To understand the process of photosynthesis, you will need to know leaf structure in detail. Use Figure 35.18 in your text to label each structure just as shown in the text.



39. What gas critical to photosynthesis enters the leaf through stomata?

    What gas is lost through stomata in transpiration?

40. How is the function of *palisade mesophyll* different from *spongy mesophyll*?

Concept 35.4 Secondary growth increases the diameter of stems and roots in woody plants

LO 35.4: Describe the process of secondary growth.

41. Primary growth arises from apical meristems and results in _____ of roots, stems, and leaves. Secondary growth arises from *lateral meristems* and consists of the tissues produced by the _____and _____, which results in increased _____ of roots and stems.

42. Explain what is produced by these structures:

    vascular cambium

    cork cambium

43. Read the text that accompanies Figure 35.19 and then answer these questions:

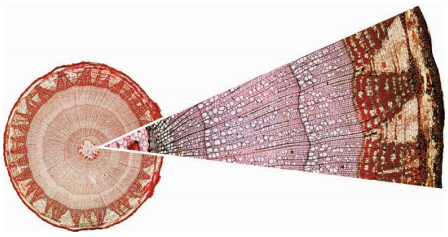
    a. What results in primary growth of the stem?

    b. What cells are formed to the inside and outside of the vascular cambium?

    c. What is the difference in the formation of primary xylem and phloem versus secondary xylem and phloem?

44. What meristematic tissue forms the *bark*, and what is the function of the *bark*?

45. On this figure, add these labels: *cork cambium*, *cork*, *bark*, *growth ring*, *secondary xylem*, *secondary phloem*, and *vascular cambium*.



46. *Dendrochronology* is the science of analyzing growth rings and is used extensively to study climate change. Explain how *growth rings* are formed.

47. Much of the Eastern deciduous forest was cleared by early settlers by girdling the trees. Girdling is the total removal of a section of bark around the entire circumference of the trunk of a tree. Using Figure 35.22 in your text as a guide, explain how this killed the tree.

48. Look at the stem in Figure 35.19 in your text and find the horizontal slits in the bark, known as *lenticels*. You may have noticed lenticels on the young twigs of trees or shrubs. What is the function of *lenticels*?

Concept 35.5 Growth, morphogenesis, and cell differentiation produce the plant body

LO 35.5: Identify processes that result in the specialized parts of the plant body.

49. Explain *developmental plasticity*, including why it may be more common in plants than animals.

50. The three overlapping processes involved in the development of a multicellular organism (plant or animal) are _____, _____, and _____.

51. Define each fill-in-the-blank answer from the previous question.

52. List five reasons why *Arabidopsis* is an attractive model organism for plant research.

53. Cell growth depends on cell _____ and cell _____. What does asymmetrical cell division generate in the two uneven cells (see Figure 35.27)?

54. Does cell division or cell expansion contribute the most to cell growth? Explain.

55. What is *pattern formation*?

56. We should call to your attention that gene expression and cell differentiation in plants mirror what you already have learned concerning animals. Read the section on this topic, p. 778, carefully. Complete the following to emphasize this commonality:

    Cell differentiation depends on the control of _____ _____, the regulation of _____ and _____, resulting in the production of specific proteins.

57. How are indeterminate vegetative meristems converted to determinate floral meristems?

58. Study the ABC hypothesis and Figure 35.33 in your text concerning flower formation, then complete the missing cells in the following chart.

Active Genes	Flower Structure Produced
A and B genes	
	Stamens
A genes only	
	Carpels

Test Your Understanding, p. 782

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____

7. _____ 8. _____9. _____ 10. _____