

**Study Tip**

Divide the class into small groups, and ask each group to make a list of questions that would cover all the Key Concepts in the chapter. Then, have groups exchange lists and answer the questions they receive from another group.

**Thinking Visually**

Students should construct a table with column headings similar to the following: *Plant Groups, Reproduction, Tissues, Typical Size, and Habitat*. Students should list characteristics of each plant group based on the information provided in this chapter.

**Chapter 22 Assessment****Reviewing Content**

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

**Understanding Concepts**

11. The two alternating phases of a plant's life cycle: the gametophyte, or haploid phase, and the sporophyte, or diploid phase.
12. The fact that some green algae resemble small plants in color and shape. Green algae also have photosynthetic pigments, cell walls, and reproductive cycles that are similar to those in plants.
13. Botanists divide the plant kingdom into four groups based on water-conducting tissues, seeds, and flowers.
14. Because they lack vascular tissue, bryophytes draw up water by osmosis.
15. Bryophytes depend upon the presence of water to complete their life cycle, because the only way the sperm can reach the egg is to swim through standing water or dew.
16. In bryophytes, a protonema is the tangled mass of green filaments that forms the young gametophyte. It is haploid.
17. Tracheids are hollow cells with thick cell walls that make up xylem. The function of tracheids is to transport water through a plant.

**22-1 Introduction to Plants****Key Concepts**

- Plants are multicellular eukaryotes that have cell walls made of cellulose. They develop from multicellular embryos and carry out photosynthesis using the green pigments chlorophyll *a* and *b*.
- The lives of plants revolve around the need for sunlight, water and minerals, gas exchange, and the movement of water and nutrients throughout the plant body.
- The first plants evolved from an organism much like the multicellular green algae living today.

**Vocabulary**

sporophyte, p. 552  
gametophyte, p. 552

**22-2 Bryophytes****Key Concepts**

- Bryophytes have life cycles that depend on water for reproduction. Lacking vascular tissue, these plants can draw up water by osmosis only a few centimeters above the ground.
- Bryophytes include mosses, liverworts, and hornworts.
- In bryophytes, the gametophyte is the dominant, recognizable stage of the life cycle and is the stage that carries out most of the plant's photosynthesis.

**Vocabulary**

bryophyte, p. 556 • rhizoid, p. 557  
gemma, p. 557 • protonema, p. 558  
antheridium, p. 559 • archegonium, p. 559

**22-3 Seedless Vascular Plants****Key Concepts**

- Both forms of vascular tissue—xylem and phloem—can move fluids throughout the plant body, even against the force of gravity.
- Seedless vascular plants include club mosses, horsetails, and ferns.
- Ferns and other vascular plants have a life cycle in which the diploid sporophyte is the dominant stage.

**Vocabulary**

vascular tissue, p. 560 • tracheid, p. 560  
xylem, p. 560 • phloem, p. 560  
lignin, p. 560 • root, p. 561  
leaf, p. 561 • vein, p. 561 • stem, p. 561  
rhizome, p. 562 • frond, p. 562  
sporangium, p. 562 • sorus, p. 562

**22-4 Seed Plants****Key Concepts**

- Adaptations that allow seed plants to reproduce in areas without water include flowers or cones, the transfer of sperm by pollination, and the protection of embryos in seeds.
- Gymnosperms include gnetophytes, cycads, ginkgoes, and conifers.

**Vocabulary**

gymnosperm, p. 564 • angiosperm, p. 564  
cone, p. 564 • flower, p. 564  
pollen grain, p. 565 • pollination, p. 565  
seed, p. 565 • embryo, p. 565  
seed coat, p. 565

**22-5 Angiosperms—Flowering Plants****Key Concepts**

- Angiosperms develop unique reproductive organs known as flowers. Flowers contain ovaries, which surround and protect the seeds.
- Monocots and dicots are named for the number of seed leaves, or cotyledons, in the plant embryo. Monocots have one seed leaf, and dicots have two.
- There are three categories of plant life spans: annual, biennial, and perennial.

**Vocabulary**

fruit, p. 569 • monocot, p. 570 • dicot, p. 570  
cotyledon, p. 570 • annual, p. 572  
biennial, p. 572 • perennial, p. 572

**Thinking Visually**

Using the information in this chapter, make a compare-and-contrast table comparing bryophytes, ferns, gymnosperms, and angiosperms. Compare these groups of plants in terms of reproduction (seeds or seedless), tissues (vascular or nonvascular), typical size, and type of habitat.

**CHAPTER RESOURCES****Print:**

- Teaching Resources**, Chapter Vocabulary Review, Graphic Organizer
- Chapter Tests: Levels A and B**, Chapter 22 Test

**Technology:**

- Computer Test Bank**, Chapter 22 Test
- iText**, Chapter 22 Assessment

## Chapter 22 Assessment

### Reviewing Content

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

- Which of the following is NOT a characteristic of plants?
  - eukaryotic
  - cell walls contain chitin
  - multicellular
  - contain chlorophyll
- The first plants evolved from
  - brown algae.
  - green algae.
  - red algae.
  - golden algae.
- The most recognizable stage of a moss is the
  - sporophyte.
  - protonema.
  - archegonium.
  - gametophyte.
- The small, multicellular structures by which liverworts reproduce asexually are
  - protonemas.
  - rhizoids.
  - gemmae.
  - archegonia.
- Water is carried upward from the roots to every part of a plant by
  - cell walls.
  - phloem.
  - cuticle.
  - xylem.
- The leaves of ferns are called
  - sori.
  - fronds.
  - rhizomes.
  - spores.
- To which group does this plant belong?
  - bryophytes
  - ferns
  - gymnosperms
  - angiosperms



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- The reproductive structures of cycads are called
  - flowers.
  - sporangia.
  - sori.
  - cones.
- In angiosperms, the mature seed is surrounded by a
  - cone.
  - flower.
  - fruit.
  - cotyledon.
- A plant that has a life cycle that lasts two years is a
  - dicot.
  - monocot.
  - biennial.
  - perennial.

### Understanding Concepts

- What is alternation of generations?
- What evidence supports the theory that plants evolved from multicellular green algae?
- Describe the three important features used by botanists to divide the plant kingdom into four groups.
- By what process does water move through the body of a bryophyte?
- During the life cycle of a moss, what environmental conditions are necessary for fertilization to occur?
- What is a protonema? Is it haploid or diploid?
- What are tracheids? What is their function in a vascular plant?
- How was the ability to produce lignin significant to the evolution of plants?
- Describe the dominant stage in the life cycle of a fern.
- Compare the structure and function of rhizomes, rhizoids, and roots.
- Describe the male gametophyte of a seed plant.
- What adaptations allow conifers to live in dry habitats?
- Which group of plants contains the most species?
- How do fruits aid in the dispersal of angiosperms?
- How does the pattern of veins differ in a monocot and a dicot leaf? Draw an example of each.



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### (Continued from page 574)

18. The evolution of lignin made the cell walls of plants rigid. This enabled plants to grow upright and reach great heights.

19. The dominant stage in the life cycle of a fern is the diploid sporophyte, which when mature consists of roots, underground stems called rhizomes, and fronds, which are large leaves. On the undersides of the fronds grow small containers called sporangia, which grow in clusters called sori that release spores.

20. Rhizoids are long, thin cells that anchor bryophytes in the ground and absorb water and minerals. The water moves from cell to cell through the rhizoids to the rest of the plant. Rhizomes are creeping or underground stems that live through the winter and produce new leaves in spring. Roots are underground organs that absorb water and minerals from the soil.

21. In seed plants, the male gametophyte is contained in pollen grains.

22. Features of conifers that suggest they evolved to live in dry habitats include long, thin needles to reduce the surface area of their leaves; the leaves' waxy outer covering; and the placement of leaf openings in cavities in the surface of the leaves to reduce water loss by evaporation.

23. Angiosperms contain the most living species.

24. Fruits attract and are eaten by animals that spread the seeds enclosed in the fruits widely, increasing the ranges that the angiosperms inhabit.

25. Drawings should show that monocots have leaves with parallel veins. Dicots have leaves with branched veins.



### HOMEWORK GUIDE

Section:	Questions:
Section 22-1	1, 2, 11-13, 26, 30
Section 22-2	3, 4, 7, 14-16, 28, 31
Section 22-3	5, 6, 17-20, 27, 33, 36
Section 22-4	8, 21, 22, 34
Section 22-5	9, 10, 23-25, 29, 32, 35

## Critical Thinking

26. Student answers should be consistent with the information in the chapter.
27. Vascular tissue supports a tall plant and carries water and nutrients from the soil to its upper regions. Thus, ferns, which have vascular tissue, grow tall, whereas moss plants cannot grow tall, because they lack vascular tissue. Plants require a method to transport water and nutrients throughout the plant body in order to survive.
28. She needs to provide constant moisture for the mosses and liverworts and protection from too much sun.
29. Student answers should reflect the concept that angiosperms have protected seeds and many ways in which the seeds can be dispersed, which increase the chances of survival.
30. The rootlike structures, similar to rhizoids, might have been used for transport of water and minerals. The branched stalks have capsulelike structures on the ends that might have been used for reproduction.
31. *Cooksonia* resembles mosses living today. Both have simple structures and grow close to the ground. They have similar rootlike structures and reproductive structures. Mosses today have more complex leaflike structures absent in *Cooksonia*.
32. Essays should include the major characteristics of plants: multicellular eukaryotes with cell walls made of cellulose; multicellular embryos; photosynthetic pigments, chlorophyll *a* and *b*. Students should also describe the characteristics of bryophytes, seedless vascular plants, gymnosperms, and angiosperms that are used to classify these plant groups. Last, students should explain how similarities in DNA sequences are used to show which plant species are more closely related.
33. Concept maps should show *vascular tissue* as the main system with *xylem* and *phloem* branching off it as subsystems. *Tracheids* should branch off *xylem* as cells that carry water. Branching off *phloem* should be cells that transport dissolved nutrients.

## Critical Thinking

26. **Comparing and Contrasting** Select four major groups of plants, and describe their methods of reproduction and development. Include information about the size of the mature plants.
27. **Comparing and Contrasting** Moss plants are small. Ferns can grow as tall as a small tree. Explain why this is so. How does your answer illustrate a major characteristic of the plant kingdom?
28. **Predicting** A friend of yours lives in a desert area of New Mexico. She wants to grow a garden of mosses and liverworts. What environmental conditions would she need to provide in her garden for it to be successful?
29. **Formulating Hypotheses** Propose a hypothesis to explain why angiosperms have become the dominant type of plant on Earth.
30. **Interpreting Graphics** The plant below is called *Cooksonia*. Identify the structures that are shown in this drawing. Which structures might have been used for transport of water and minerals? Which structures might have been for reproduction?



31. **Applying Concepts** Identify fossil evidence of a change in a plant species. Using *Cooksonia* as your example, which present-day species resembles this organism? Explain how the modern plant compares to *Cooksonia*.
32. **Classifying** Recently, taxonomists have added several kingdoms to the classification system of living things. Mostly, these additions have come about as scientists try to organize different types of unicellular organisms. Write an essay explaining the classification system for the plant kingdom. Be sure to include (a) four groups of plants, (b) the important features used to organize these groups, and (c) the role of DNA in classification.
33. **Comparing and Contrasting** Develop a concept map illustrating systems and subsystems in plant vascular tissue.

34. **Comparing and Contrasting** Compare the size and function of the gametophyte in bryophytes, ferns, and seed plants. Then, describe a general trend in the size of the gametophyte in plant evolution.
35. **Classifying** Study the photograph of the orchid below. Is this plant a monocot or dicot? Explain your answer.



36. **Connecting Concepts** Use what you know about natural selection to explain how the first nonvascular land plants might have evolved into vascular plants. Refer to Chapter 15 for help in answering this question.

## Writing in Science

Choose a particular group of seedless vascular plants and a particular group of seed plants. Then, write a paragraph that compares reproduction in the groups of plants that you have chosen. (Hint: Use the Key Concepts and the Study Guide to help you organize your ideas.)

## Performance-Based Assessment

**Making a Time Line** Make a time line to show the major milestones in the evolution of plants. Include a representative plant to show major evolutionary changes in the development of plants. Use the geologic time scale and other information in Chapter 17 for help in drawing your time line.

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34. The function of the gametophyte is the same, but there is an evolutionary trend toward smaller gametophytes. In bryophytes, the gametophyte is the dominant stage. In ferns, the gametophyte is much smaller than the sporophyte and lives independently. In seed plants, the gametophytes are further reduced to tissues that develop inside cones or flowers.
35. The plant is a monocot, since monocots can have floral parts in multiples of three.

36. Accept all reasonable hypotheses. Answers should include the idea that vascular tissue evolved as a result of variations in plant structure due to mutations. The evolution of vascular tissue improved the transport of water and nutrients within the plant and the absorption of water and minerals from the soil. This development, along with the evolution of lignin, also allowed plants to grow taller. Thus, vascular plants were able to colonize drier habitats and compete for sunlight by raising leaves above surrounding plants.