2. Pioneer plants are the first plants to colonize a region. They contribute to the organic material and thereby create environmental conditions that other plants require.
3. Ferns depend on water for the transfer of sperm to the archegonia.
4. See Figure 4 on page 388.
5. (a) The sporophyte generation is the one normally seen growing in the woods.
   (b) The frond is the most noticeable feature of that generation.
6. The diploid number is restored at the end of the gametophyte generation, when fertilization occurs.
7. The prothallus is the gametophyte plant of ferns. The tiny haploid spores that have been produced by meiosis are the first cells of the gametophyte generation. As they are released, they are usually carried by the wind. If a spore lands in an environment suitable for its growth, the protective covering splits and the spore germinates. The resulting haploid plant is called a prothallus. This thin, green, heart-shaped gametophyte is about the size of the fingernail on your baby finger. A cluster of rhizoids grow from the underside of the prothallus.
8. This allows both life cycles to exist for a longer period of time. The gametophyte, a prothallus, is independent of the sporophyte.
9. Lignin increases the fern's ability to transport water and nutrients, consequently ferns can be much larger.
10. (a) Few mosses and ferns do well in sunny areas. Hot temperatures promote increased evaporation of water from the soil, which in turn reduces the success of moss and ferns.
    (b) The reduction of moss and ferns will affect plants animals that rely on them for water or shade. Both groups greatly enrich soil quality. The short-term decrease in moss and fern populations might cause a long-term decrease in the population of other plants, slowing ecological succession in the affected area.
11. This second person was not wasting her time, each of the rhizomes will give rise to individual plants.

Try This Activity (page 395)
(a)–(d) Answers will vary.

10.9 Practice (page 399)
1. The biggest group of terrestrial plants are the tracheophytes. Tracheophytes are divided into pteridophytes and spermatophytes, seedless and seed plants, respectively.
2. Most spermatophyte plant parts belong to the sporophyte generation.
3. The sporophyte generation begins with the zygote, the fertilized egg. The zygote develops into a seed, which contains the embryo and food source. In mature sporophytes, e.g., a pine tree or flowering plant, gymnosperms develop male and female cones, while angiosperms develop flower parts.
4. Gymnosperms are spermatophytes that produce naked seeds, usually inside of cones. Angiosperms are spermatophytes that produce seeds enclosed in fruit formed by the flower.
5. For gymnosperms, when pollen grains are mature, the tiny sacs of the male cones disintegrate and millions of dry pollen grains are released. The pollen grains have little flaps or wings will allow them to be carried easily by the wind. The remnants of

the male cones gradually dry up and fall off the tree. The female cones from this same year are held by the tree such that the tip is pointing upward. The scales angle downwards. When ripe, airborne pollen lands on the female cones of the same or different tree, the sticky sap and angles of the scales ensure that the pollen moves towards the ovules.

For angiosperms, pollination is usually carried out by wind or insects, but for some angiosperms, pollination is aided by birds or bats. Pollen is transferred from the anther to the stigma of either the same or a different flower. Part of the pollen makes its way down through the style tissue and the sperm eventually reaches the egg in the ovule.

6. For gymnosperms, after pollination the female cones become greenish, grow very quickly in size and reorient themselves so that the tips are pointing downwards. In some gymnosperms, fertilization may occur right away but in pines, it usually takes a year before fertilization occurs. Fertilization, the union of the microspore and megaspore, produces the diploid zygote which is the first cell of the next sporophyte generation. The zygote grows by mitosis to produce the diploid embryo which remains inside the ovule. Now that there is an embryo, the ovule becomes a seed.
   In angiosperms, the fusion of microspore and megaspore produces the diploid zygote, which is the first cell of the next sporophyte generation. The zygote grows by mitosis to form an embryo which remains inside the ovule. The ovule develops a protective seed coat and is called a seed. The ovule and possibly some surrounding tissue develops into a fruit, which provides protection for the seed and aids in seed dispersal.
7. The two classes of angiosperms are monocots, which have one cotyledon, and dicots, which have two cotyledons.

Sections 10.7–10.9 Questions (page 402)

1. Spermatophytes are a subdivision of the tracheophytes, or vascular plants. They have roots, and stems that conduct water to leaves. Spermatophytes have reproductive structures that are not dependent on water.
2. Mosses do not have vascular tissues and rely on water for reproduction.
3. Mosses and ferns rely on water to carry male sperm cells from the antheridia to the archegonia; spermatophytes do not depend on water for fertilization.
4. Most gymnosperms have evolved thin, needle-like leaves which help the plants resist the harshness of hot, dry summers, cold winters, and moderate rainfall. The needles are covered by a hard, waxy cuticle, which helps the plant retain moisture. Gymnosperms have also evolved roots that extend over a wide surface area rather than penetrating deep into the soil. These roots anchor the tree even in locations where soil is scarce.
5. In many mosses, the sporophyte plant is often brown as indicated in Figure 4 of section 10.7. The lack of green pigment may be an indication that it is not involved in photosynthesis.
6. The fern gametophyte, the prothallus, is a small plant that withers and dies once the sporophyte plant matures. Moss gametophytes develop into larger plants as shown in Figure 4 of section 10.7.

7. A fern sporophyte is the plant you are most likely to notice in the wild. The sporangia of a fern sporophyte (called sori) are located on the fronds of mature plants. A moss sporophyte develops on the top of a gametophyte plant; for mosses, it is the gametophyte plant that you are most likely to observe in the wild. Also, moss sporophytes are not usually involved in photosynthesis, while fern sporophytes are.
8. (a) The cones shown are male. In the pine tree, male cones grow in clusters; female cones occur in groups of two or three, and are often a pinkish-purple colour.
   (b) One way to verify your answer to (a) is to observe the cones. Cones that produce pollen are male.
9. Some plants, like ferns and mosses, depend on water to carry male sperm cells to the female reproductive organs. Spermatophytes or seed plants, on the other hand, have developed means of fertilization that do not depend on water. Both gymnosperms and angiosperms rely on airborne methods to aid fertilization. These airborne means can include insects, birds, and even bats.
   Clearly the means of fertilization will be affected by environmental factors. Ferns and mosses need moist environments in order to reproduce; spermatophytes may depend on the successes of other organisms in order to ensure their own reproduction.
10. (a) Sexual reproduction provides offspring with different combinations of genes.
    (b) The diversity that results from sexual reproduction leads to more variation among the offspring, which enables the species to adapt to a changing environment.
11. If all seeds were dropped beneath the parent plant, self-fertilization would occur and genetic diversity within a given area would be reduced. If the seeds were dispersed too far from each other then the seeds may lend to the genetic diversity of their new environment provided that the seeds can germinate into plants that survive.
12. Cutting down a diverse forest ecosystem to make room for fields that will be used to raise only one crop may adversely affect plant and animal life in the surrounding areas. Planting only one species of crop might increase the danger of plant disease, alter soil conditions, and threaten the survival of animals that would normally consume other plants within the forest.
13. Coniferous (gymnosperm) forests are an important source of raw materials for a variety of commercial and industrial products. Economically, conifers are extremely important. They provide about 85% of all the wood used in building (spruce and cedar) and furniture (pine) construction. The pulp and paper industry uses millions of tonnes of conifers annually, mostly for the production of newsprint and other paper products. Conifers provide people with other useful products—varnishes, turpentine, disinfectants, fuels, and medicines such as taxol. Conifers, and forests in general, also help control flooding by absorbing rainwater through their roots and by anchoring topsoil together, preventing it from being eroded by water or wind.
14. Many possible answers. Students might use the graphical organizer at the beginning of the chapter.
15. Answers will vary.

Chapter 10 Review (pages 404-405)

1. (a) One reason to separate fungi and plants into two separate kingdoms is that fungi, unlike plants, do not contain chlorophyll.
   (b) One reason to keep both fungi and plants in the same kingdoms is that fungi, like plants, are often anchored in the soil, and both have cell walls.
2. (a) Mosses live in swampy regions and other moist environments.
   (b) Bryophytes rely on diffusion and osmosis to obtain and transfer water.
   (c) The major advance of the bryophytes was the development of rhizoids.
   (d) Mosses are common plants of great use to humans.
   (e) Moss sperm cells are carried to the egg cell through rainwater or dew.
3. The filamentous bodies are small in structure and often not distinguished without a microscope, and are found within the substrate.
4. Plants, such as moss, which lack a vascular system, must remain close to the ground–the source of water. Vascular systems allow plants to achieve greater heights.
5. Angiosperms are the most complex of the plant species. There are over 250 000 known species of angiosperms—more species of plants than in all the other plant divisions combined. Angiosperms reproduce asexually by a broad variety of mechanisms but they all reproduce by alternation of generations. The seeds they produce are enclosed in fruit formed by various flower parts. Angiosperms contain: a vascular system to transport water; a seed with nutrients for the developing embryo; true roots and stems for water and mineral transport; Leaves for maximum sunlight exposure for photosynthesis.
   Mosses are the least complex of the plant organisms. Mosses do not develop roots (though they have rhizoids), they do not have vascular structures, and they depend on water in their reproductive process.
6. A cuticle would not be found on non-green stems and around root tissues. The cuticle prevents water loss, water is not lost through root tissues and non-green stems.
7. Seed plants are called spermatophytes. Both angiosperms and gymnosperms are seed-bearing plants.
8. The shape, odor and colour of flowers are used to attract animals. Pollination is usually carried out by wind or insects, but for some angiosperms, pollination is aided by birds or bats. Brighter flowers and flowers that produce nectar attract insects and small birds, which may be involved in the reproductive process.
9. Seeds provide food for a plant embryo that allows the embryo to develop before being introduced into the environment. Spores will only germinate if growing conditions can be met.
10. Lichens are composed of both fungi and algae.
11. Rhizoids are hairlike structures that function like tiny roots and probably evolved before true roots, which contain vascular tissue. They are found on the lower surfaces of certain parts of mosses, ferns, and other small organisms.
    Rhizomes are the stems of ferns.
12. Mycorrhizae are symbiotic relationships between the hyphae of certain fungi and the roots of many specific plants. They are important as pioneer plants in the development of soils.
13. Fungi are used to make penicillin, an important antibiotic. Mosses are used to absorb oil spills. Ferns, such as fiddleheads, are used for food.

14. To be successful on land plants must adapt to limited water supplies. Plants have developed vascular systems which allow them to transport water, and some plants have protective cuticles and tissues to prevent water loss.
15. Water lilies, cattails, and water hyacinths are three aquatic plants.
16. Grasses, wheat, corn, beans as well as trees such as oaks, maples and cottonwoods are all flowering plants that do not have colourful (or large) flowers.
17. Perfect flowers have both male and female parts. Some species of angiosperms, such as pumpkins, have separate male and female flowers; these are called imperfect flowers.
18. The moss sporophyte plant depends on the gametophyte plant for almost all of its nutrients.
19. Diversity is important in a garden because pests or diseases that attack one species will not spread as easily to other species.
20. Plants provide nutrients when they decompose. They also provide shade, which reduces water loss. Also, plant roots help pump minerals that leech into the lower profiles of soil back to the surface.
21. Small sepals and petals would prevent pollen from getting caught in those structures.
22. (a) The true moss is green.
    (b) The other sample is probably a lichen, possibly fruticose. Fruticose is silvery-grey in colour and is often found hanging from trees.
23. (a) Disagree; the plant is too tall to be a moss.
    (b) This might be a fern; the brown spots might be sori.
24. If all of the aquatic plants in a pond suddenly disappeared, the other organisms would lose a source of oxygen and nutrients.
25. The vascular system of plants, like that of animals, is composed of a series of vessels. However, the vessels of animals branch and re-join. The vessels of plants remain largely independent. Animals also have a pumping mechanism, such as a heart, which is not present in plants.
26. The climate became colder and drier. Fern rely on water for reproduction.
27. (a) Alien plants compete for resources with native species that occupy the same habitat. This competition may alter the food chain and lead to the destruction of organisms linked with the naturally occurring species.
    (b) Alien plants might experience rapid population growth because of a lack of natural predators and competition for resources.
    (c) Northern plants often carry diseases that southern plants have not been exposed to. Northern plants grow and reproduce more rapidly in warm climates, which could alter the natural environment. The pollen count is often very high in cities like Phoenix; elevated pollen levels can trigger asthma.