Kingdom Plantae

Chapter 22 - Plant Diversity
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The first plants evolved from an organism much like the multicellular green algae living today. Fossils of plants suggest that the first true plants were dependent on water to complete their life cycles.

Plants are multicellular eukaryotes that have cell walls made of cellulose. They develop multicellular embryos and carry out photosynthesis using green pigments, chlorophyll *a* and *b*.

The Plant Life Cycle

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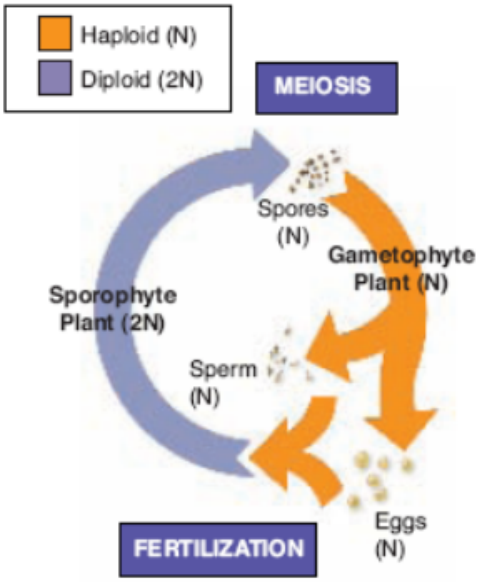
Plant life cycles have two alternating phases, a **diploid** (2N) phase and a **haploid** (N) phase, known as alternation of generations.



▲ **Figure 22–2** All plants have a life cycle with alternation of generations, in which the haploid gametophyte phase alternates with the diploid sporophyte phase.

The diploid (2N) phase is known as the sporophyte, or spore-producing plant.

The haploid (N) phase is known as the gametophyte, or gamete-producing plant.

egg sperm

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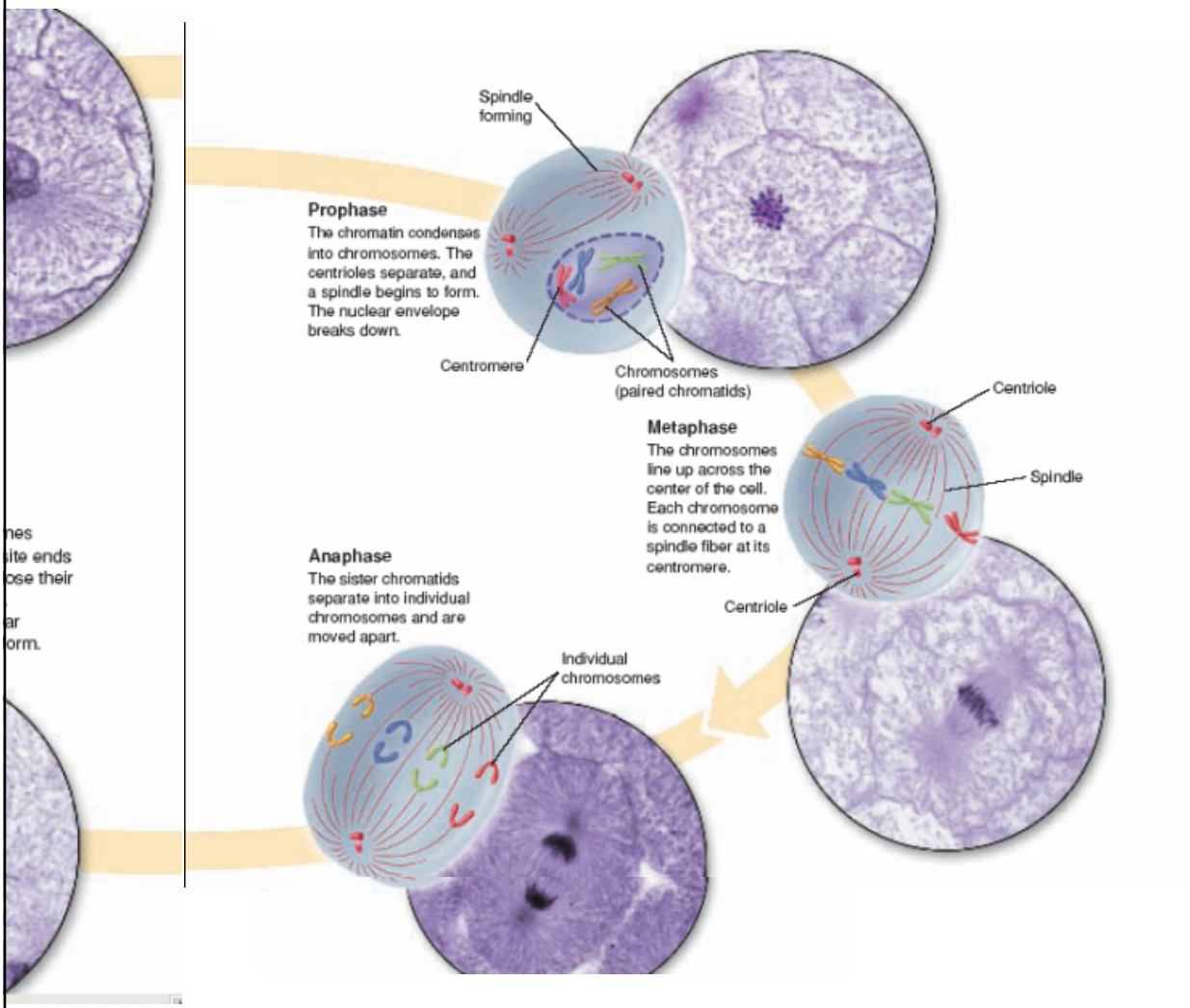
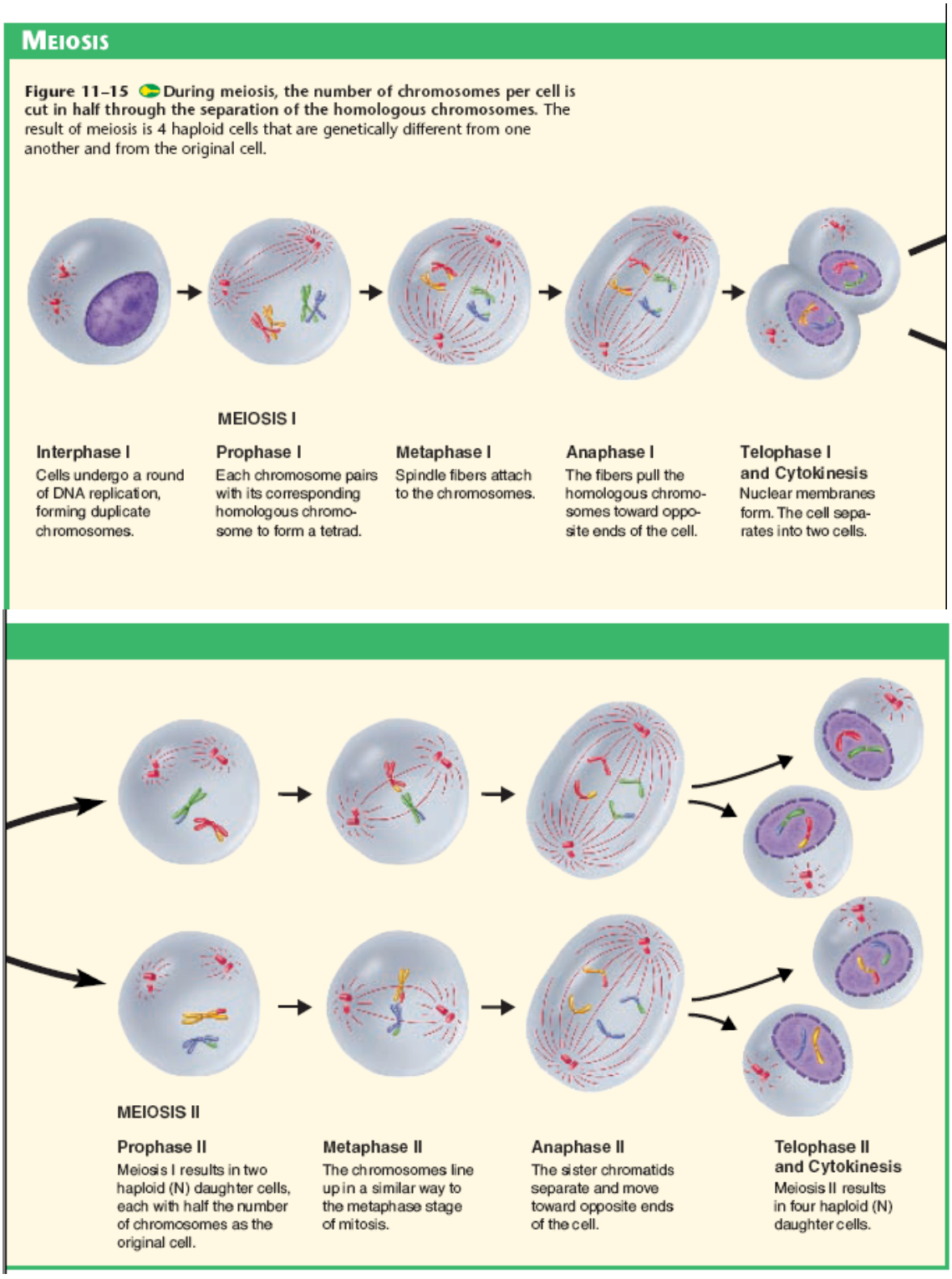
Many plants also have forms of vegetative, or asexual, reproduction.

mitosis - part of cell division during which the cell nucleus divides



meiosis - process by which the number of chromosomes per cell is cut in half



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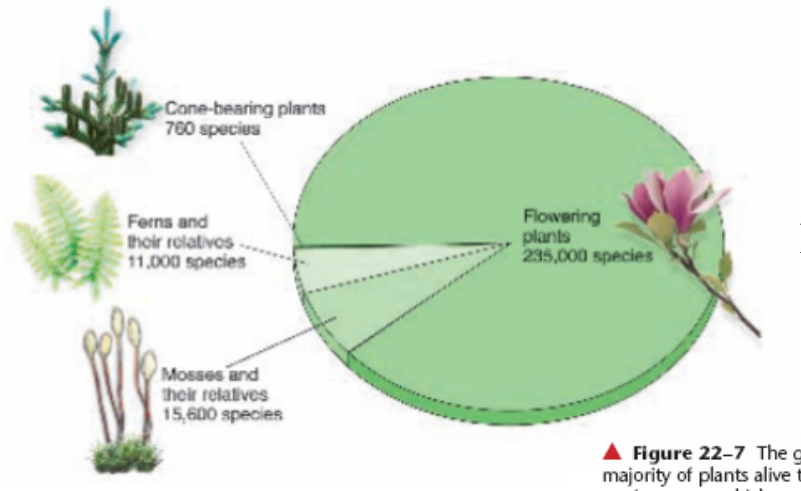
Overview of the Plant Kingdom

Botanists divide the plant kingdom into four groups:

1. mosses
2. ferns
3. gymnosperms (cone-bearing plants)
4. angiosperms (flowering plants)



▲ **Figure 22–7** The great majority of plants alive today are angiosperms, which are also known as flowering plants. **Interpreting Graphics** *What is the second largest group of plants?*

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The four groups are based on three important features:

1. water-conducting tissues
2. seeds
3. flowers

Bryophytes

Bryophytes, or nonvascular* plants, have life cycles that depend on water for reproduction. These low-growing plants can draw up water by osmosis only a few centimeters above the ground. They thrive wherever there is a regular supply of water.

* **vascular tissue** - type of plant tissue specialized to conduct water and nutrients throughout a plant and to provide support for leaves and other organs of the plant

Bryophytes include mosses, liverworts and hornworts.

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Mosses

The most common bryophytes are the mosses which belong to the phylum Bryophyta.

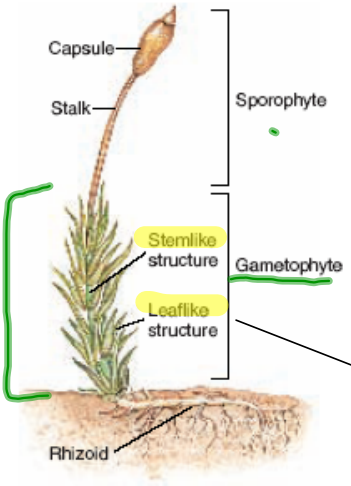

Figure 22–9 This illustration shows the structure of a typical moss plant. The green photosynthetic portion is the gametophyte. The brown structure on the tip of the gametophyte is the sporophyte. **Applying Concepts** *Which stage of the moss plant provides nutrients for the other stage?*

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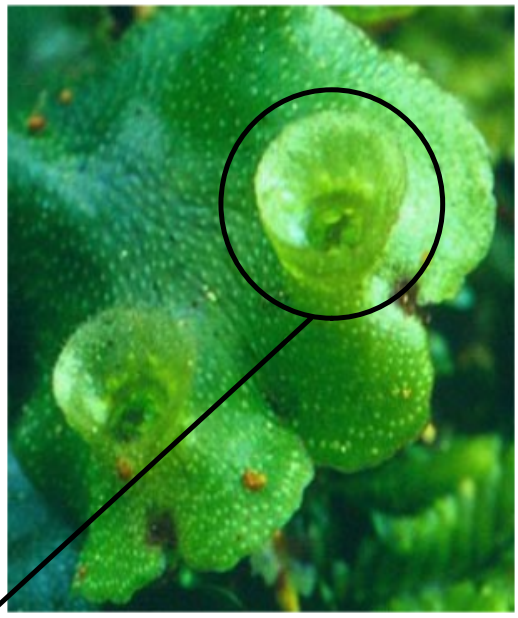
- "leaves" are one cell thick
- plants lose water quickly if the surrounding air is dry

Rhizoids are long, thin cells that anchor mosses in the ground and absorb water and minerals from the surrounding soil. Water moves from cell to cell through rhizoids and into the rest of the plant.

"umbrellas" produce gametes



Liverworts

gemma cup -> produce gemmae
(small multicellular reproductive structures)

Hornworts

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Life Cycle of Bryophytes
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In bryophytes, the gametophyte generation is the dominant, recognizable stage of the life cycle and is the stage that carries out most of the plant's photosynthesis.

For fertilization to occur, the sperm of a bryophyte must swim to an egg.

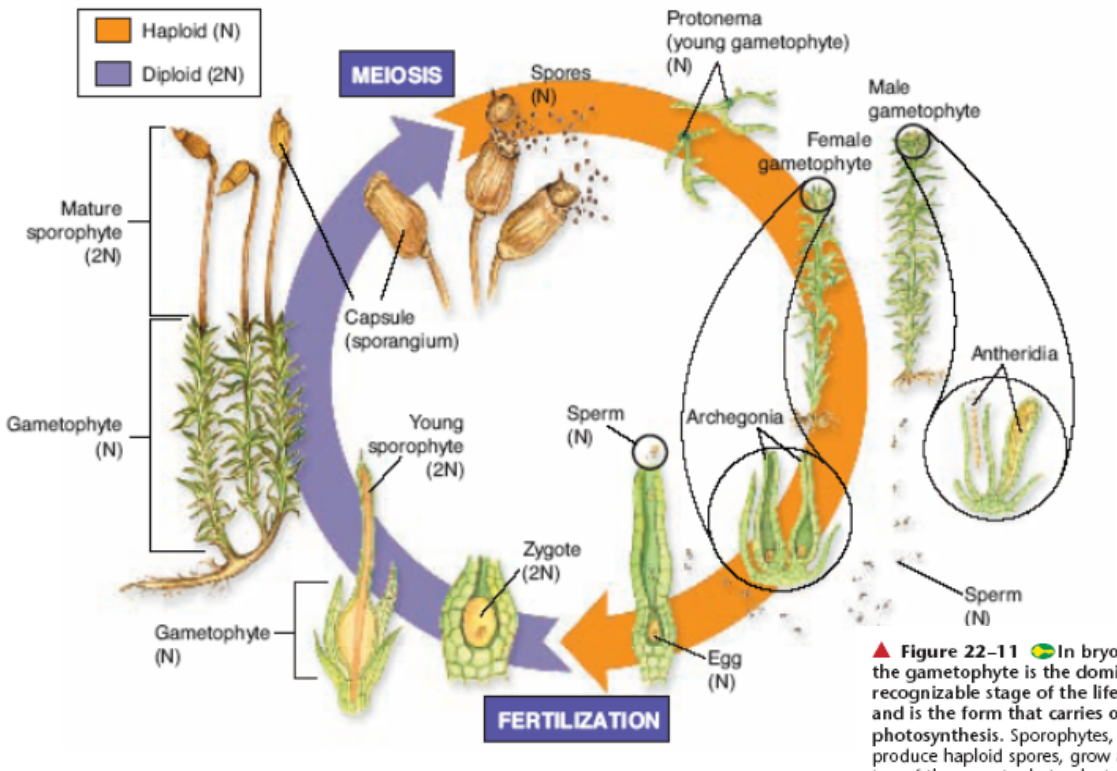


Figure 22–11 In bryophytes, **the gametophyte is the dominant, recognizable stage of the life cycle and is the form that carries out photosynthesis.** Sporophytes, which produce haploid spores, grow at the top of the gametophyte plant. When the spores are ripe, they are shed from the capsule like pepper from a shaker. In some species, gametes (sperm and eggs) are produced on separate male and female gametophyte plants.

protonema - a young gametophyte
- a mass of tangled green filaments

antheridia - structures that produce sperm with whip-like tails (antheridium)

archegonia - structures that produce egg cells (archegonium)

Zygote – fusion of an egg and sperm.

Vascular Plants

(Page 560)

The first vascular plants had a new type of cell that was specialized to conduct water.

Tracheids are hollow cells with thick cell walls that resist pressure. They are connected end to end like a series of drinking straws. They allow water to move through a plant more efficiently than by diffusion alone.

Tracheids are the key cells in xylem, a type of vascular tissue that conducts water. Xylem moves water from roots to leaves.

Vascular tissue called phloem transports solutions of nutrients and carbohydrates produced by photosynthesis from leaves to roots.

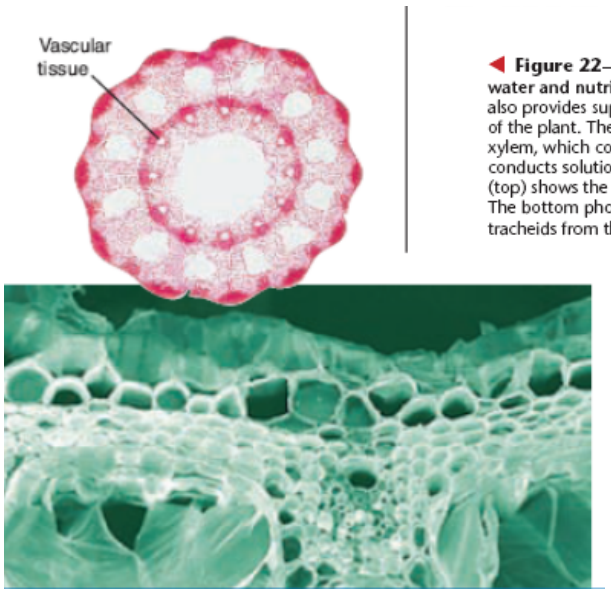
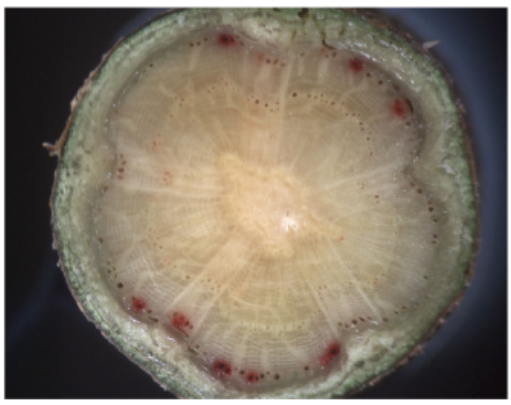


Figure 22–13 Vascular tissue conducts water and nutrients throughout the plant body. It also provides support for the leaves and other organs of the plant. The two types of vascular tissue are xylem, which conducts water, and phloem, which conducts solutions of nutrients. The cross section (top) shows the vascular tissue of the horsetail stem. The bottom photo shows a much-magnified view of tracheids from the xylem of the horsetail.



Seedless Vascular Plants

Ferns and Their Relatives

Seedless vascular plants include club mosses, horsetails and ferns.

Ferns and their relatives have true roots, leaves and stems.

Roots are underground organs that absorb water and minerals. Water-conducting tissues are located in the center of the root.

Leaves are photosynthetic organs that contain one or more bundles of vascular tissue. This vascular tissue is gathered into veins made of xylem and phloem.

Stems are supporting structures that connect roots and leaves, carrying water and nutrients between them.

Figure 22–14 Club mosses and horsetails are seedless vascular plants. The club moss *Lycopodium* (left) looks like a tiny pine tree growing on the forest floor. The only living genus of Arthrophyta is *Equisetum*, or horsetail (above).

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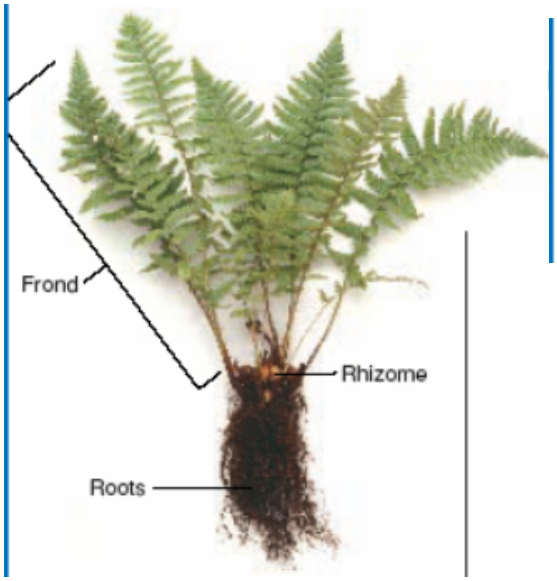
Horsetail, or scouring rush, usually grows about 1 m high and contains crystals of abrasive silica.

Ferns

Ferns belong to the phylum Pterophyta. They have true vascular tissues, strong roots, creeping or underground stems called rhizomes, and large leaves called fronds.



▲ **Figure 22–15** Ferns are easily recognized because of their delicate leaves, which are called fronds. Fronds grow from a rhizome, which grows horizontally through the soil. **Applying Concepts** *Is the plant shown a sporophyte or a gametophyte?*

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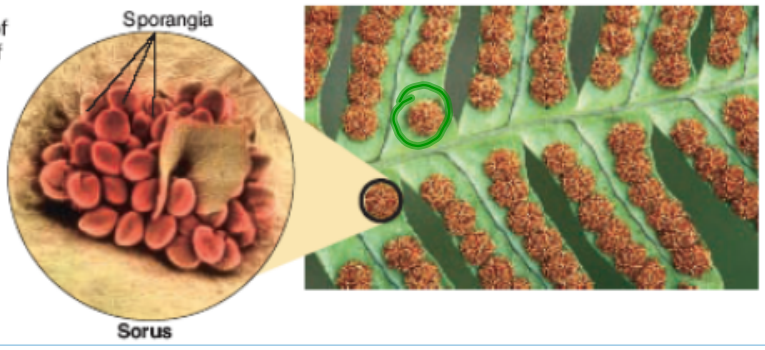
Ferns can thrive in areas with little light. They are most abundant in wet or at least seasonally wet habitats around the world.

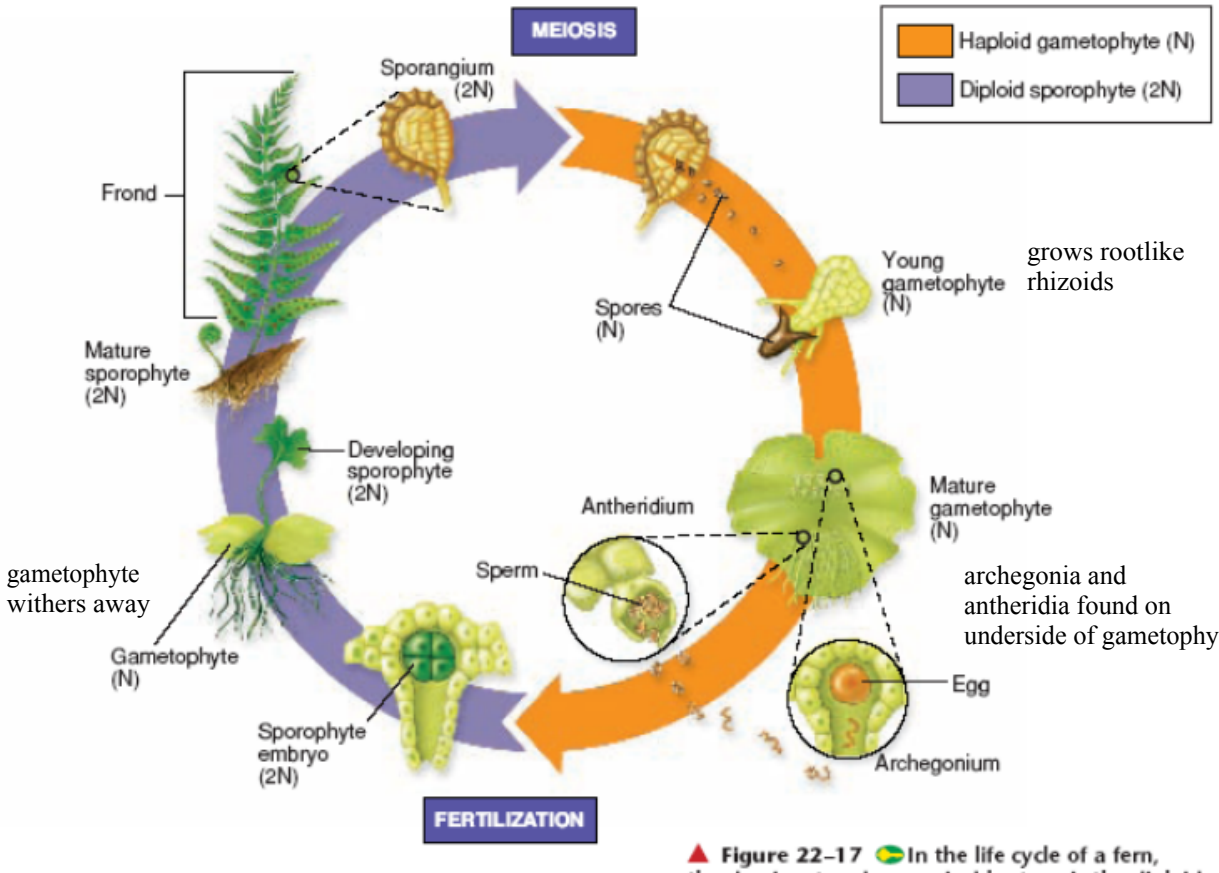
Life Cycle of Ferns (Page 562)

Ferns and other vascular plants have a life cycle in which the diploid sporophyte is the dominant stage.

Fern sporophytes develop haploid spores on the underside of their fronds in tiny containers called sporangia (singular: sporangium). Sporangia are grouped into clusters called sori (singular: sorus).

Figure 22–16 Many clusters of sporangia form on the underside of fern leaves—each cluster is called a sorus. In each sporangium, cells undergo meiosis to produce spores. **Inferring** *Are these spores haploid or diploid?*





▲ **Figure 22–17** In the life cycle of a fern, **the dominant and recognizable stage is the diploid sporophyte.** The tiny, heart-shaped gametophyte grows close to the ground and relies on dampness for the sperm it produces to fertilize an egg. The young sporophyte grows from the gametophyte.

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A Fiddlehead is a fern so young and new that it hasn't yet "unfurled" and opened its leaves. The end is still curled in a tight spiral, ready to unroll as the sun warms it and it gathers strength and size. This spiral shape reminds many people of the end of a violin, hence the name "Fiddlehead."

Ostrich Fern Fiddlehead

Matteuccia struthiopteris

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