

The Evolution of Seed Plants

- **Seed plants** are vascular plants that produce seeds.
- Contributing to the success of seed plants as terrestrial organisms are three important reproductive adaptations:
 - continued reduction of the gametophyte
 - the advent of the seed
 - the evolution of pollen

Reduction of the gametophyte continued with the evolution of seed plants

- An important distinction between mosses and other bryophytes and ferns and other seedless vascular plants is *a gametophyte-dominated life cycle for bryophytes and a sporophyte-dominant life cycle for seedless vascular plants.*
- Continuing that trend, the gametophytes of seed plants are even **more reduced** than those of seedless vascular plants such as ferns.
- In seed plants, the delicate female gametophyte and young embryos are protected from many environmental stresses because they are retained within the moist sporangia of the parental sporophyte.
- The gametophytes of seed plants obtain nutrients from their parents, while those of seedless vascular plants are free-living and fend for themselves.
- For the gametophyte to exist within the sporophyte has required extreme miniaturization of the gametophyte of seed plants.
- The gametophytes of seedless vascular plants are small but visible to the unaided eye, while those of seed plants are **microscopic**.
- Why has the gametophyte generation not been completely eliminated from the plant life cycle?
 - The haploid generation may provide a mechanism for “screening” new alleles, including mutations.
 - Gametophytes with harmful mutations affecting metabolism or cell division will not survive to produce gametes that could combine to start new sporophytes.

Seeds became an important means of dispersing offspring

- In bryophytes and seedless vascular plants, spores from the sporophyte are the resistant stage in the life cycle.
- Spores were the main way that plants spread over Earth for the first 200 millions years of life on land.
- The seed represents a different solution to resisting harsh environments and dispersing offspring.
 - In contrast to a single-celled spore, a multicellular seed is a more complex, resistant structure.
- A **seed** consists of a sporophyte embryo packaged along with a food supply within a protective coat.
- All seed plants are heterosporous, producing two different types of sporangia that produce two types of spores.
 - Megasporeangia produce megaspores, which give rise to female (egg-containing) gametophytes.
 - Microsporeangia produce microspores, which give rise to male (sperm-containing) gametophytes.

- An **ovule** consists of integuments, megaspore, and megasporangium.
 - A female gametophyte develops inside a megaspore and produces one or more egg cells.
 - A fertilized egg develops into a sporophyte embryo.
 - The whole ovule develops into a seed.
- A seed's protective coat is derived from the integuments of the ovule.
- Within this seed coat, a seed may remain dormant for days, months, or even years until favorable conditions trigger germination.
- When the seed is eventually released from the parent plant, it may be close to the parent, or be carried off by wind or animals.

Pollen eliminated the liquid-water requirement for fertilization

- The microspores, released from the microsporangium, develop into pollen grains.
- These are covered with a tough coat containing sporopollenin.
- They are carried away by wind or animals until **pollination** occurs when they land in the vicinity of an ovule.
 - The pollen grain will elongate a tube into the ovule and deliver one or two sperm into the female gametophyte.
- While some primitive gymnosperms have flagellated sperm cells, the sperm in most gymnosperms and all angiosperms lack flagella.
- In seed plants, the use of resistant, far-traveling, airborne pollen to bring gametes together is a terrestrial adaptation.
 - In bryophytes and pteridophytes, flagellated sperm must swim through a film of water to reach eggs cells in archegonia.
- The evolution of pollen in seed plants led to even greater success and diversity of plants on land.