

Seed Plants II - Angiosperms

Characteristics of Angiosperms

Eukaryotic

Multi-celled (with cell walls composed of cellulose)

Autotrophic

Do have xylem and phloem

Do produce seeds

Do produce flowers and fruits

The Groups of Angiosperms

Monocots – leaves with parallel venation; flower parts in 3s or multiples of 3

Dicots – leaves with net venation; flower parts in 4s or 5s or multiples of 4 or 5

Typical Angiosperm Life Cycle

A mature plant, which is a diploid ($2n$) sporophyte, produces flowers with stamens (male) and/or pistils (female)

Inside of anthers (microsporangia) located on the filament of the stamen, diploid ($2n$) cells divide by meiosis to produce haploid (n) microspores

Haploid (n) microspores (immature pollen grains) develop by mitosis into haploid (n) male gametophytes (mature pollen grains), which contain a tube cell and two nonmotile sperm cells

Inside of ovules (megasporangia with a surrounding cell layer called the integument) located inside the ovary of the pistil, a diploid ($2n$) cell known as a megaspore mother cell divides by meiosis to produce a haploid (n) megaspore

The haploid (n) megaspore develops by mitosis into a haploid (n) female gametophyte, which has no archegonia but is composed of seven cells including a large central cell with two polar nuclei and an egg cell with one nucleus (note: the female gametophyte develops within the megasporangium in the ovule, which remains inside the ovary of the pistil)

A pollen grain (male gametophyte) is transferred by various means (e.g., wind, water, insects, birds) from an anther to the stigma of a pistil (pollination)

The pollen grain germinates and the tube cell produces a pollen tube, which grows through the tissues of the stigma and style to the interior of the ovary to an opening at one end of an ovule

Both of the haploid (n) sperm cells migrate through the pollen tube; the nucleus of one sperm cell fuses with the nucleus of the haploid (n) egg cell (fertilization) to produce a diploid ($2n$) zygote, and the nucleus of the other sperm cell fuses with the two polar nuclei of the large central cell (a second fertilization) to produce a triploid ($3n$) endosperm cell (this process is known as double fertilization and is unique to angiosperms)

The diploid ($2n$) zygote divides by mitosis within the female gametophyte to produce a diploid ($2n$) multicellular embryo (new immature sporophyte); the triploid ($3n$) endosperm cell divides by mitosis to produce triploid ($3n$) endosperm tissue, which serves as a food reserve for the embryo

The ovule (still inside the ovary of the pistil) matures into a seed, which contains an embryo surrounded by endosperm; the ovary matures into a fruit

Eventually, the seed is released from the fruit and falls to the ground where it germinates and the diploid ($2n$) embryo develops into a diploid ($2n$) seedling, which develops into a mature diploid ($2n$) sporophyte (plant)

Typical Angiosperm Gametophytes

Angiosperm gametophytes are very small; the male gametophyte is a mature pollen grain, which contains only three cells – a tube cell and two sperm cells; the female gametophyte is multicellular, but it develops within the megasporangium in the ovule

Angiosperm gametophytes are not green; therefore, they are not autotrophic

Angiosperm gametophytes are not free-living structures; mature male gametophytes are nothing more than mature pollen grains, and mature female gametophytes are never free of the interior of the megasporangium in the ovule

Typical Angiosperm Sporophytes

After fertilization, the diploid ($2n$) zygote divides by mitosis to form a multicellular diploid ($2n$) embryo (new young sporophyte) inside the ovule

The embryo develops into a seedling and eventually into a mature sporophyte

A mature sporophyte is composed of three parts: roots, stems, and leaves

Mature leaves of angiosperm sporophytes are green because they contain photosynthetic cells; therefore, angiosperm sporophytes are autotrophic

This lecture outline was prepared partly from *Biology*, by Campbell and Reece, 2002 (6th edition), and from *Botany – An Introduction to Plant Biology*, by Mauseth, 1998 (2nd edition), and may contain phrases or entire sentences taken verbatim from those sources.