

Plant Diversity: **Chapt. 30 – The Evolution of Seed Plants**

Plant Origins [See Fig. 29.7]

Seed plants appeared ~360 m.y.a. with the rise of the Gymnosperms

Flowering plants (Angiosperms) – the other surviving lineage – appeared ~200 million years later

Major clades of plants [See Fig. 30.2]

Bryophytes

Gametophyte dominant; sporophyte dependent; gametophyte independent

Seedless vascular plants

Sporophyte dominant; sporophyte initially dependent; gametophyte independent

Seed plants

Sporophyte dominant; sporophyte independent; gametophyte dependent & microscopic

Gymnosperms – Gametophytes develop inside **cones**

Angiosperms – Gametophytes develop inside **flowers**

Gametophytes develop from **spores** retained within **sporangia** of the parental **sporophyte**

Heterosporous spore production [See diagram on pg. 586]

Seed plant reproduction, illustrated with a pine [See Fig. 30.3]

Layers of **integuments** envelope and protect the **megasporangium**

The whole structure – **megasporangium**, **megaspore**, and **integuments** – is called an **ovule**

A **megaspore** develops into a multicellular female **gametophyte**

Fertilization initiates the transformation of the **ovule** into a **seed**

Compared to a single-celled **spore**, a **seed** is much more resistant and complex

GYMNOSPERMS

“Naked seeds”; not enclosed by an **ovary** and develop on the surface of modified leaves that usually form **cones (strobili)**

Phylum Ginkgophyta

Ginkgo biloba is the only living species of this entire phylum

Phylum Cycadophyta (cycads, sago palms)

Thrived during the “Age of Dinosaurs”; only ~130 species alive today

Phylum Gnetophyta

3 genera:

Gnetum, *Ephedra*, *Welwitschia*

Phylum Coniferophyta

E.g., longleaf pine, giant sequoia, cypress, and ~600 other cone-bearing species

Pine Life Cycle – [See Fig. 30.6]

Megasporangia and **microsporangia** are found in separate **cones**

Meiosis produces **spores** and begins the **haploid generation**

Megasporocytes (2n) are the cells within **megasporangia** that undergo **meiosis** to produce **megaspores (n)**

Microsporocytes (2n) are the cells within **microsporangia** that undergo **meiosis** to produce **microspores (n)**

Each **megaspore** develops into a **female gametophyte**

Each **microspore** develops into a **male gametophyte** (a **pollen grain**)

A **pollen grain** gains access to a **female gametophyte** through a **micropyle**

The **female gametophyte** contains 2 or 3 **archegonia**, each with 1 **egg** cell

Two cells of the **male gametophyte** are **sperm**

Fertilization (union of 1 **egg** and 1 **sperm**) produces an **embryo**

Embryos develop within **seeds**

Seeds germinate and **embryos** become **seedlings**

ANGIOSPERMS

Flowering plants; seeds develop inside **sporophyte ovaries**

~250,000 extant species

6 main clades [See pg. 602]

Anatomy of a Flower – [See Fig. 30.7]

Sepals

Petals

Stamens = {**Anthers** + **Filaments**}

Carpels = {**Stigmas** + **Styles** + **Ovaries** + **Ovules**}

Receptacle

Complete flowers have **sepals**, **petals**, **stamens** & **carpels**

Bisexual flowers have both male (**stamens**) and female (**carpels**) reproductive structures; so **complete flowers** are also **bisexual**

Incomplete flowers lack one or more of the following: **sepals, petals, stamens** or **carpels**; *e.g.*, most grasses lack petals

Self-fertilization

Some **bisexual flowers** can **self-fertilize**

Monoecious individuals have separate male and female **unisexual flowers** on the same plant; which helps reduce **self-fertilization**, but does not eliminate it

Incomplete, staminate flowers lack **carpels**

Incomplete, carpellate flowers lack **stamens**

Dioecious species have separate male and female individuals; which eliminates the possibility of **self-fertilization**

Angiosperm Diversity – [See Fig. 30.12]

| Monocots | vs. | Eudicots |
|----------------------------------|------------|--------------------------------|
| 1 cotyledon | | 2 cotyledons |
| Parallel veins | | Netlike veins |
| Scattered vascular tissue | | Ring of vascular tissue |
| Fibrous roots | | Taproot |
| 1 opening in pollen | | 3 openings in pollen |
| Floral organs in 3s | | Floral organs in 4s or 5s |

Angiosperm Life Cycle – [See Fig. 30.10]

Anthers contain **microsporangia** that produce **microspores**

Each **microspore** forms a **pollen grain** (a **male gametophyte**)

Ovules contain **megasporangia** that produce **megaspores**

Each **megaspore** forms an **embryo sac** (a **female gametophyte**)

Pollen disperses to **stigmas**

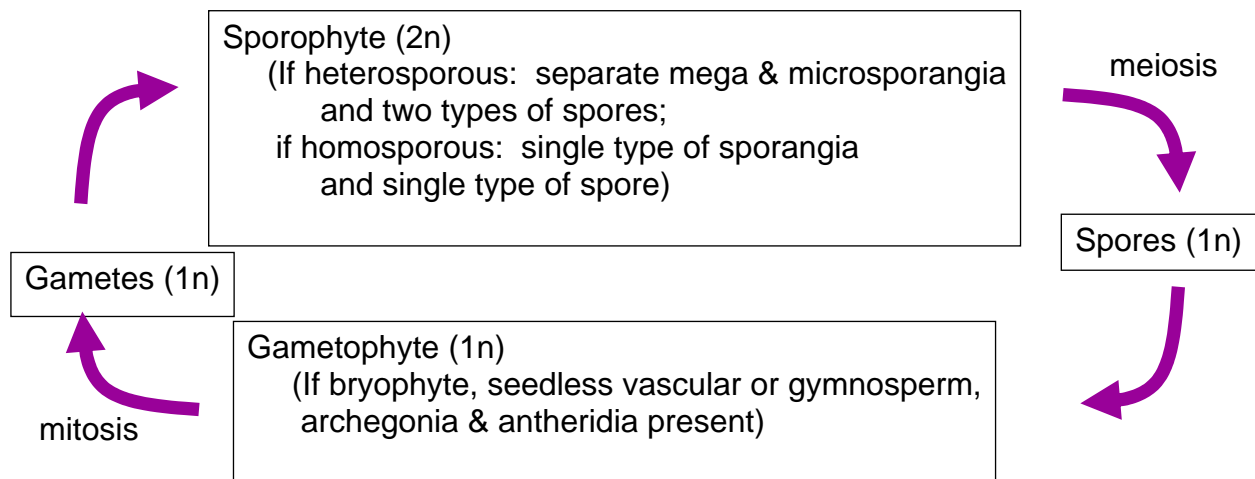
Double fertilization is unique to **angiosperms**

Sperm enter an **ovule** through a **micropyle**

From a single **pollen grain**, one **sperm** unites with the **egg** to produce a **zygote**; the second **sperm** unites with 2 **nuclei** of the **embryo sac** to produce **triploid (3n) endosperm**

Some key points to remember:

All spores and gametes are haploid
Sporophytes are diploid, and produce spores
Gametophytes are haploid, and produce gametes



Seed plants and human welfare

Humans began practicing agriculture only about 18,000 years ago
Multiple independent origins
Even so, most of our food currently comes from angiosperms

Just 6 crops – wheat, rice, maize (corn), potatoes, cassava (manioc), sweet potatoes – yield 80% of all the calories consumed by humans

It takes ~5 pounds of grain to produce 1 pound of grain-fed beef