

## Chapt. 38 – Flowering Plant Reproduction

Angiosperm alternation of generations: [See Fig. 30.10]

**Meiosis** occurs in **sporangia** of **sporophytes**

**Spores** divide by **mitosis** and develop into mature **gametophytes**

Specialized **gametophyte** cells divide by **mitosis** to form **gametes**

**Gametes** fuse during **fertilization** to produce a **zygote**

A **sporophytes'** male reproductive structures: [See Figs. 30.7, 38.2 & 38.4]

**Stamen**

**Anther**

**Filament**

Each **anther** contains multiple **pollen sacs (microsporangia)**

Each **pollen sac** contains multiple diploid **microsporocytes (microspore mother cells)**

Each **microsporocyte** divides by **meiosis** to produce 4 haploid **microspores**

Each **microspore** divides once by **mitosis** to form an immature male **gametophyte (pollen grain)**

A single **tube cell** encloses a single **generative cell**

The **pollen grain** matures into an adult male **gametophyte** when its **generative cell** divides by **mitosis** to produce two **sperm**

The adult male **gametophyte** is a fully mature, independent plant with only 3 cells

A **sporophytes'** female reproductive structures: [See Figs. 30.7, 38.2 & 38.4]

**Carpel**

**Stigma**

**Style**

**Ovary**

**Ovule**

**Receptacle**

Each **ovule** contains a **megasporangium**

Each **megasporangium** contains a **megasporocyte (megaspore mother cell)**

A **megasporocyte** divides by **meiosis** to form 4 cells

Only 1 of the 4 cells survives: the **megaspore**

The **megaspore's** nucleus divides 3 times: giving 1→2→4→8 **nuclei**

Membranes then partition the 8-nucleate immature **gametophyte** cell into 7 smaller cells (one with 2 nuclei)

The 7 cells:

1 **egg**

1 cell with 2 **polar nuclei**

5 other cells

The 7 cells comprise the mature, completely dependent female **gametophyte (embryo sac)**

**Double fertilization** of angiosperms (and independently derived in a few gymnosperms)  
[See Fig. 38.6]

A **pollen grain** disperses to a **stigma (pollination)**

The **tube cell** grows into a **pollen tube**

The 2 **sperm** cells travel down the **pollen tube** to the **embryo sac**

1 **sperm** fuses with the **egg (fertilization)**

1 **sperm** fuses with the **polar nuclei** to form the first cell of the **endosperm (triploid)**

In chapter 30 we saw some mechanisms used by plants to avoid **self-fertilization**;  
bisexual flowers also use:

Structural barriers to pollination, *e.g.*, **pin** vs. **thrum flowers** [See Fig. 38.5]

**Genetic self-incompatibility**, gauged by **S-genes**

**Development of the seed and fruit** [See Fig. 38.7]

The first **mitotic division** of the **zygote** is asymmetric

This asymmetry provides the first environmental difference experienced by the  
differentiating cells and establishes the **root-shoot axis**

The **sporophyte embryo** develops from the **zygote**

The **endosperm** develops from the **triploid endosperm nucleus**

The **ovule integuments** become the **seed coat**

Tissues of the **ovary** (and sometimes the **receptacle**) become the **fruit**

There are many types of **fruits** [See Fig. 38.9]

**Fruits aid seed dispersal**

The **ovary** wall becomes either a **dry** or **fleshy fruit**

Many **dry fruits** are **wind dispersed**

Some **dry fruits** are **animal dispersed**

Many **fleshy fruits** are **animal dispersed**

Unless the dispersers become extinct!

Some **fruits** disperse seeds **explosively**

Some **fruits** make seeds buoyant, to aid **dispersal by water**

## Development of the seed and fruit

**Eudicot embryos** develop two **cotyledons** [See Fig. 38.8]

**Monocot embryos** develop a single **cotyledon** [See Fig. 38.8]

**Cotyledons** may absorb **endosperm** throughout their functional lives (*e.g.*, castor bean)

**Cotyledons** may alternatively function as **storage organs** that absorb the **endosperm** prior to a seed's germination (*e.g.*, common bean)

The **radicle** is the first structure out of the seed coat [Fig. 38.10]

In some **eudicots** the **hypocotyl** (**embryonic axis** below **cotyledons**) pushes up through the soil

In some **eudicots** the **epicotyl** (**embryonic axis** above **cotyledons**) pushes up through the soil

In many **monocots**, the **cotyledon** remains in the seed coat, and the **coleoptile** pushes up through the soil

## **Gymnosperms** rely on wind to move **pollen** from male to female **cones**

The **ovule** exudes sap to trap pollen

Around 150 m.y.a. some insects fed on both protein-rich pollen of male cones and sugar-rich secretions of female cones...

This may have led evolutionarily to the origin of Angiosperms and animal-mediated pollination

## **Angiosperms** have formed many partnerships with animals to move their **pollen**

Some of these partnerships are the best known cases of **co-evolution**: mutual evolutionary influence

Some **flowers** provide nurseries for their **pollinators'** offspring (*e.g.*, figs and fig wasps)

Some **flowers** provide food (*e.g.*, **nectar** or **pollen**) to their **pollinators**

**Nectar** is usually presented together with attractive structures, *e.g.*, showy **petals** and **fragrances**

**Petals** sometimes exploit the sensory capabilities of **pollinators**, *e.g.*, ultraviolet reflectance

Some **flowers** trick their **pollinators** (*e.g.*, bee orchid)

### **Seed dormancy**

Most seeds become **dormant** as they mature, *i.e.*, they will not germinate without the appropriate environmental stimuli

The stimuli are species-specific, and include:

Drying, which avoids germination in the fruit

Cold, which may prevent germination in the wrong season

Disruption of the seed coat, *e.g.*, by acids or soaking in water

### **Biotechnology**

Humans have modified many food plants by **artificial selection** on reproductive structures (and other traits)

Geneticists have successfully created **transgenic** or **genetically modified (GM) organisms** through **genetic engineering**

GM organisms have and express a foreign gene

The *Bt* toxin gene from *Bacillus thuringiensis* introduced into some varieties of cotton, corn, *etc.*

For a balanced, well-reasoned discussion of GM crops, see the last sections of Chapt. 38, *e.g.*, decisions about the risks and benefits of GM crops should “be based on sound scientific information and testing rather than on reflexive fear or blind optimism”