CHAPTER 5
FLOWERS

Plant Life Cycle: Flower.

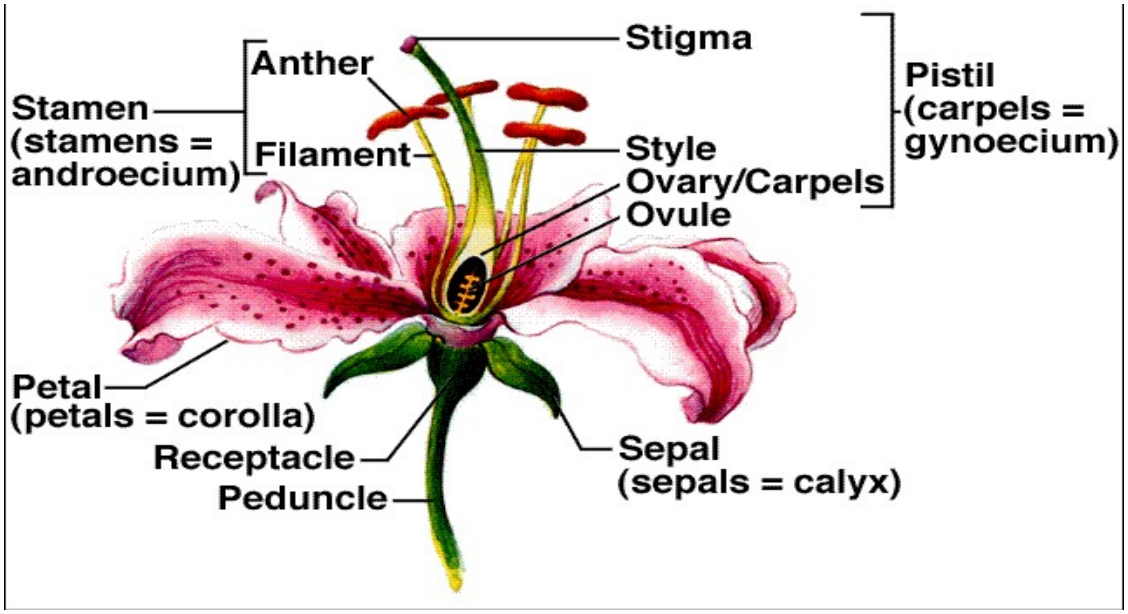


Figure 5.1 A Complete Flower showing all the 4 major parts

A flowering plant is made up of the flowers, leaves, stems and roots. The Flower consists of **sepals, petals, stamen** and **carpels**. The sepals are collectively called **calyx** and the petals are collectively called **corolla**. The calyx and the corolla together form the **Perianth**.

Classification of Flowers of Angiosperms

1. Flowers that contain all the four parts are called **Complete or Perfect flowers** (figure 5.1), while other flowers that may lack some of these parts are said to be **Incomplete or Imperfect**.

2.Some incomplete flowers may have only the **androecium** (or stamen), while others may have only the **Gynoecium** (or pistils); these flowers will be called **staminate** or **pistillate** respectively.

**** Plants that bear both pistillate and staminate flowers are said to be monoecious, an example is holly. Some plants bear only pistillate or staminate flowers, they are said to be dioecious examples include corn and squash.***

Androecium consists of **stamens,** each of which is made up of **an anther** and **a filament**. The anther carries the **pollen**. The **Gynoecium** is the female part of the flower, it is the **Carpel** also called the **Pistil**. There can be many pistils in one flower. Each carpel or pistil is made up of a **stigma, a style** and an **ovary**; an ovary consists of **ovules**.

Depending on the flower, the ovary can contain one or many ovules. Each ovule later becomes the seed.

3. Flowers can be classified based on the position of the ovary as follows:
Hypogynous, the ovary is above the flower parts); **Perigynous,** the ovary is surrounded by the flower parts, and **Epigynous**, the ovary is below the base of the flower parts).

4. Flowers can be classified based on the pattern of arrangement of the parts (symmetry).
Actinomorphic flowers have Radial symmetry (can be dissected into two equal parts, at any plane).

5. Zygomorphic flowers have irregular flowers that can only be dissected into two equal parts of mirror image in only one plane.

6. **Inflorescence** flowers occur in clusters.

MEIOSIS
Meiosis is the cell division in which the number of chromosomes is reduced by half. In animals the eggs and the sperms are produced through this cell division, while in plants the product of meoisis is the haploid spores or pollen grains. In meiosis there are two cycles of cell division, each cycle consists of 4 phases of prophase, metaphase, anaphase, and telophase.
Cycle 1
Prophase 1: The nuclear membrane degenerates, and the centrioles produce spindles. The homologous chromosomes pair-up, a process called synapsis. They form chiasmata (a bridge that connects the homologous chromosomes together) where crossing over (gene exchange) occurs.
Metaphase 1
The homologous chromosomes line-up at the center of the cell.
Anaphase 1
The homologous chromosomes separate and move to opposite poles of the cell. Cytokinesis (division of the cytoplasm) occurs, a cell plate is formed.
Telophase 1:
The cytokinesis completes. The nuclear membrane is formed and the cell divides into two daughter cells, each contains one of each pair of homologous chromosomes. Each daughter cell therefore contains half the number of chromosomes as the mother cell.
Cycle 2
Prophase 2
Each daughter cell starts a second cycle of cell division. The nuclear membrane degenerates, and the centrioles form spindles.
Metaphase 2
The chromosomes line at the center of the cell.
Anaphase 2
The sister chromatids of each chromosome separate at the centromere that holds them together. The chromatids move to opposite poles of the cell. Cytokinesis begins and a cell plate is formed.

Telophase 2

Cytokinesis is completed, each of the cells divides into two daughter cells; each daughter cell contains chromatids instead of full chromosomes. The number of chromatids in each daughter cell is the same as the number of chromosomes in each of the cells at the beginning of the second cycle before this second division. (*Note that each chromosome is made up of 2 sister chromatids).*

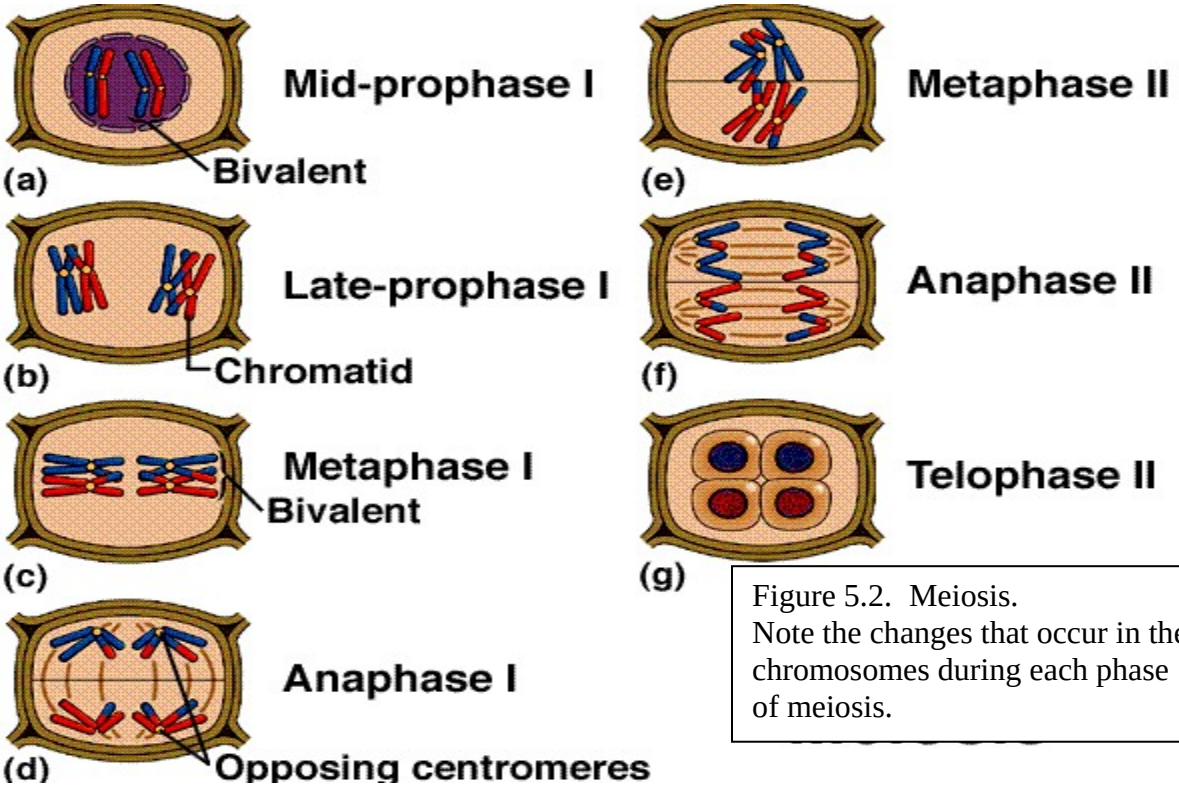


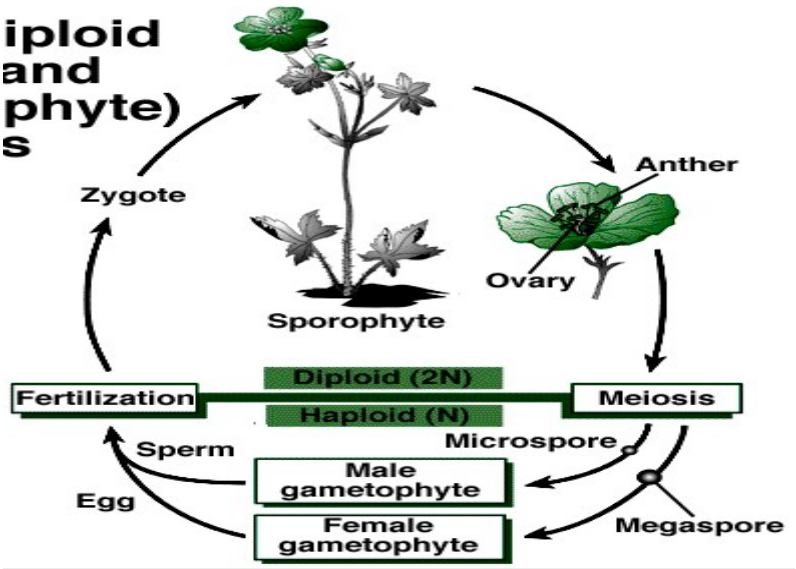
Figure 5.2. Meiosis.
Note the changes that occur in the chromosomes during each phase of meiosis.

One plant cell with 2N number of chromosomes (total number of chromosomes in a plant cell is always referred to as 2N or diploid; cells with 2N number of chromosomes are sporophytes) ends up producing N number of chromosomes (cells with N number of chromosomes are referred to as haploid cells or gametophytes) during the Cycle 1 of meiotic cell division and N number of chromatids in the cycle 2 of meiotic cell division. The chromatids will ultimately become full chromosomes during the interphase of cell division.

Alternation of Generation In The Life Cycle of Plants

During reproduction, the male part of the plant (anther) undergoes meiosis to produce haploid cells, called microspores (pollen grains). The ovary also undergoes meiosis to form haploid cells known as megaspores. The microspore produces a male gametophyte, while the megaspore produces the female gametophyte. This is considered the haploid phase of the plant's life cycle.

Figure 5.3.
The figure shows a flowering plant with 2 generations: the haploid or gametophytic generation, and the diploid or sporophytic generation



Later both the male and the female gametophytes unite, a process called **fertilization** to produce a zygote (a two-cell organism). The zygote develops into a sporophyte, which is a complete plant. This is the diploid phase in the life cycle of a plant.

The plant life cycle is therefore considered to have two phases; the first is the haploid phase, followed by a diploid phase; in one life cycle of an angiosperm, there is an alternation of these two generations: haploid and diploid generations.

Pollination

The transfer of pollen grains from the anthers to the stigma is known as pollination. Pollination could be self (within the same plant) or cross (occurs between two plants). Agents of pollination include the wind, water, birds, humans and insects.

Animals and insects are attracted to flowers because of the colors and smell. Apart from the color and the smell, most pollinators are attracted to flowers for their nectar (sugary liquid in the base of the floral organ of a plant). Some animals adapt themselves to pollinate particular flowers only, this is known as **co-evolution**.

Wind pollinated flowers usually arranged in inflorescent. Grasses are examples of wind pollinated flowers. These plants have long stamens with anthers hanging out for the pollen to be easily released.

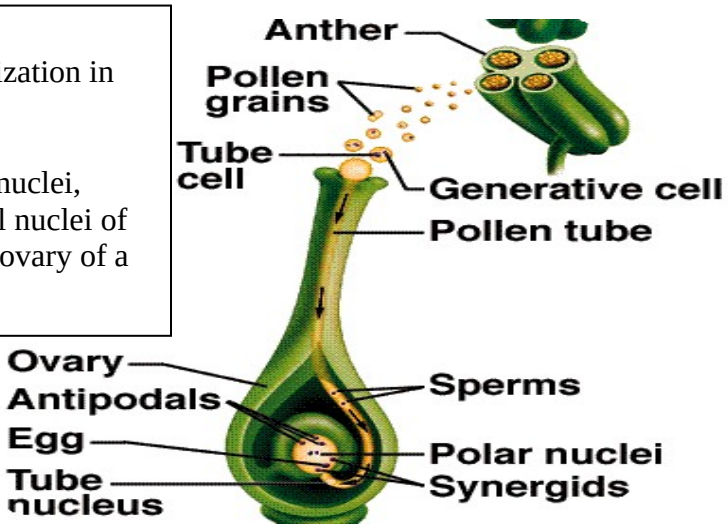
Fertilization is the union between the two gametes (male and female) to produce a zygote that develops into an embryo during sexual reproduction. Some plants can reproduce asexually; in this case the offsprings are clones (identical cells) of the parents.

Meoisis allows the genes from homologous chromosomes (similar chromosomes carrying the same traits) to mix such that the offsprings produced from the union of these gametes are genetically different from their parents.

Double Fertilization occurs in flowering plants (angiosperms). After pollination when pollen grains have been deposited on the stigma, the pollen grain germinates producing a pollen tube. The pollen tube grows down the style toward the ovary. The nucleus in the pollen tube divides to produce two sperms nuclei. The tube penetrates an ovule that has divided to produce 8 nuclcei (one is the egg nucleus, two synergid nuclei, two polar nuclei and three antipolar nuclei). One of the sperm nuclei fertilizes the egg nucleus, while the other one fuses with the polar nucleus in the ovule to form a primary endosperm nucleus that later develops into an endosperm. Endosperms in plants now serve as a source of food for humans. After fertilization, the sepals, petals and stamen wither away, as the ovary develops to form a fruit. The fertilized ovule becomes the seed.

Figure 5.4.
Pollination / Fertilization in an angiosperm.

Note the synergid nuclei, polar and antipodal nuclei of an ovule inside an ovary of a flower



Parthenocarpy

In some plants, parthenocarpy can occur; this is a process that fruits can be formed without fertilization occurring, this yields seedless fruits. Examples of such fruits are bananas, grapes, and some oranges, however some plants can be induced to yield such seedless fruits through the use of hormones.

Key Points

1. A flower consists of sepals (calyx), petals (corolla), stamen (anther and flament) and carpels (ovary, style, stigma, also called pistil). The sepals and petals are collectively called PERIANTH.
2. A flower with all the 4 parts is complete (perfect), the one that does not have all the 4 parts is incomplete (imperfect).
3. The female part (carpel or pistol) is called the gynoecium while the male part (stamen) is called the androecium when a flower hasboth parts it is said to be monoecious while if it has only one part (either male or female it is said to be dioecious).
4. An ovary contains one or many ovules. In flowers the ovary forms the fruits while the ovules form the seeds. The location of the ovary in a flower can be used to reclassify a flower: hypogynous (ovary above flower parts); perigynous (ovary surrounded by flower parts); epigynous (ovary below flower parts).

5. Flowers can be classified based as the symmetry of parts: actinomorphic (radial); zygomorphic (irregular) and influorescence (clusters of flowers together).

Study Questions

1. Describe the following parts of a flower: Perianth, Corolla, Calyx

2. What do you understand by Perfect (complete) and Imperfect (incomplete) flower?

3. Which part of a flower is known as androecium; and which is gynoecium?

4. Explain the following terms?
Hypogynous, perigynous, epigynous, actinomorphic, zygomorphic, and inflorescence

5. Describe the events that occur during each phase of meiosis (prophase I and II, metaphase I and II, anaphase I and II, and telophase I and II).

6. What is the major difference between a sporophyte and a gametophyte in a flowering plant?

7. Explain the term "Alternation of Generation" in a flowering plant.

8. What is pollination? State 3 ways by which pollination can occur in a flowering plant.

9. What do you understand by fertilization?

10. What is the significance of meiosis in fertilization?

11. Explain ‘double fertilization’ in flowering plants and explain Parthenocarpy?