Sexual Reproduction in Flowering Plants

Pre-fertilisation Events

Flower

- A plant reproduces sexually with the help of flowers.
- The male reproductive structure is known as **androecium**. The individual unit is called **stamen**.
- A **stamen** consists of anther and filament.
- The anther is bilobed and dithecous in a typical angiosperm.
- The anther consists of four microsporangia, which develop to become pollen sacs.
- The female reproductive structure is known as **gynoecium**. The individual unit is called **pistil**.
- **Monocarpellary:** It contains a single pistil.
- **Multicarpellary:** It contains more than one pistil.
- A **pistil** consists of stigma, style and ovary.
- **Syncarpous** – Pistils are fused together
- **Apocarpous** – Pistils are free

Structure of microsporangium and microsporognesis

- Structure of microsporangium

1. It is surrounded by four layers.

(i) Epidemis
(ii) Endothecium } Provide protection and help in dehiscence of the anther
(iii) Middle layer
(iv) Tapetum

1. Tapetum – It is the innermost layer that provides nourishment to the developing pollen grains.
2. Sporogenous tissue is present at the centre of the microsporangium. It contains cells that give rise to the microspores through meiosis.

- **Microsporogenesis** is the process of formation of the microspore tetrad from the microspore mother cell by the process of meiosis.

Sporogenous Tissue ® Pollen Mother Cell ® Microspore Tetrad ® Pollen Grain

- A **pollen grain** represents the male gametophyte.
- A pollen grain is made up of two layers.
- The outermost layer is **exine** and is composed of sporopollenin.
- Pollen grains are well preserved as fossils due to sporopollenin. Sporopollenin cannot be degraded by enzymes.
- The innermost layer is **intine**, which is composed of pectin and cellulose.
- At maturity, a pollen grain consists of two cells:

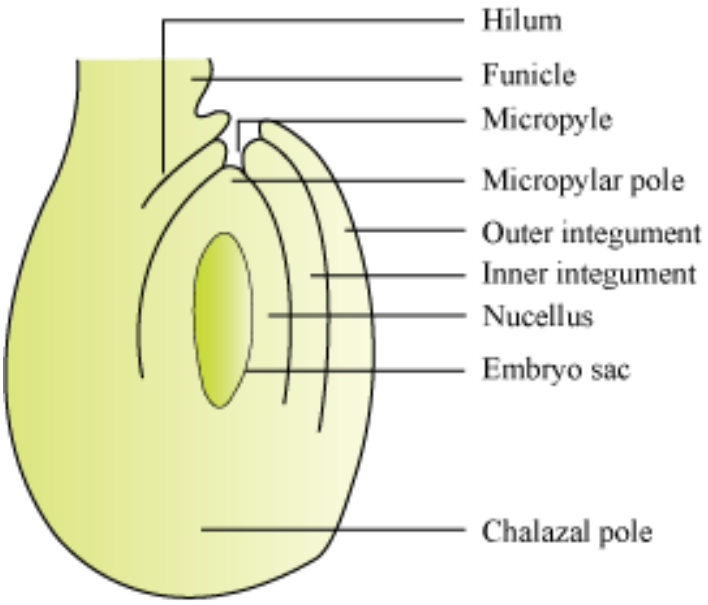
1. Vegetative cell – It is bigger in size and mainly stores food.
2. Generative cell – It is smaller and divides to form two male gametes inside the pollen tube.

Gynoecium and Formation of Female Gametophyte

- Female reproductive part of a flower is called gynoecium.
- Each pistil consists of three parts viz.
    - Stigma: receives pollen grains
    - Style: part below stigma
    - Ovary: basal part that contains placenta

Structure of Megasporangium and Megasporogenesis

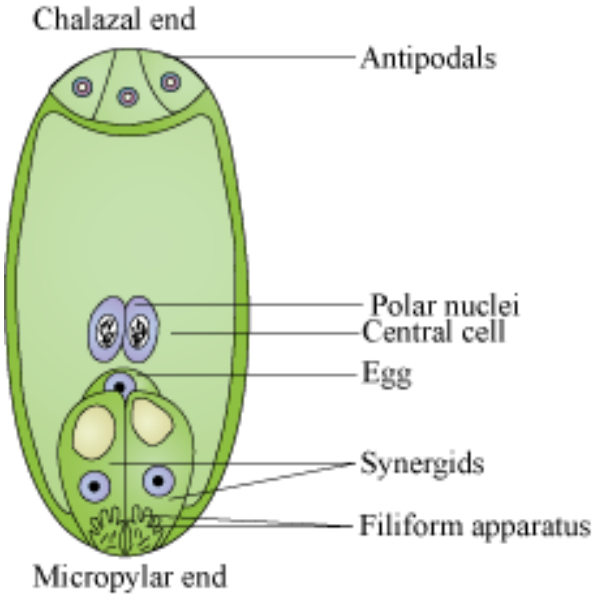
- **Megasporangium**
    - It is commonly known as ovule.
    - Structure of a typical megasporangium



A typical anatropous ovule

- Nucellus is a nutritive tissue; micropyle is the opening of the ovule from where the pollen tube enters
- **Embryo sac** is located inside the nucellus. It is also known as the female gametophyte.

- **Megasporogenesis** is the process of formation of the megaspore from the megaspore mother cell by the process of meiosis.
- After megasporogenesis, four haploid megaspores are formed. Out of the four megaspores, one functional megaspore develops into the female gametophyte or embryo sac.
- A typical megaspore embryo sac is a 7-celled and an 8-nucleate structure, as shown below:



Pollination

- It is the process of transfer of pollen grains from the anther to the stigma of the pistil.
- Pollination is divided into three types:
    - **Autogamy:** Pollination that occurs within the same flower
    - **Geitonogamy:** Pollination that occurs between two flowers of the same plant
    - **Xenogamy:** Pollination that occurs between the flowers of different plants. Xenogamy brings genetic variation.
- **Self pollination**
- Homogamy and cleistogamy are two contrivances for self pollination.
- **Cleistogamy–** Flowers are closed; therefore, the stigma and the anther are not exposed to be pollinated by pollens from different flower.
- **Homogamy-** Anther and stigma of the bisexual flower mature at same time
- Self pollination is necessary to ensure the continuity of the race and to preserve parental characteristics. But repeated self pollination leads to loss of vigour in plants.

- **Fertilisation**
- The fertilisation in an angiosperm is called **double fertilisation** as it involves two steps.
    - **Syngamy:** Fusion of one male gamete with an egg cell to form a zygote
    - **Triple fusion:** Fusion of another male gamete with two polar nuclei located inside the central cell of the embryo sac to form a triploid primary endosperm nucleus

Post-fertilisation events

- Zygote develops into embryo.
- Triploid endosperm nucleus becomes endosperm.
- Floral parts such as sepals, petals and stamen fall off.
- Ovary develops into fruit.
- **Embryogenesis** is the process of development of the embryo from the diploid zygote
- On the basis of the embryo present, seeds are of two types –
    - **Dicotyledonous embryo**
        - Dicotyledonous embryo comprises embryonal axis and two cotyledons.
        - The portion of the embryonal axis which lies above the cotyledon is epicotyl while the one that lies below the cotyledon is hypocotyl.
        - Epicotyl terminates with plumule; gives rise to the future stem of the plant

        - Hypocotyl terminates with radicle; gives rise to the future root of the plant

    - **Monocotyledonous embryo**

        - Monocotyledonous embryo comprises one cotyledon, which is known as scutellum.

        - Coleorrhiza encloses the radicle; white coleoptile encloses the plumule

- Ovule develops into seed inside the ovary (fruit).

- **Artificial hybridisation** involves the inter-breeding of two different varieties of plants (or animals) to produce hybrids with desired characteristics.

- **It is achieved by –**

    - **Emasculation:** Process of removing the anther from a bisexual flower without affecting the pistil

    - **Bagging:** Process where the emasculated flower is wrapped in a bag to prevent pollination by unwanted pollinators

- **Apomixis:** Production of seeds without fertilisation. It is an asexual method of reproduction. For example, grass
- **Polyembryony:** It is the process of producing more than one embryo in a seed. For example, *citrus,* mango