Fertilization generally describes the fusion of haploid gametes (pollen grain and ovary) to initiate the development of a new diploid organism.

1. Ovary AND EMBRYO

A. Pollination

Pollination is the act of transferring pollen grains from the male anther of a flower to the female stigma.

When the pollen are installed on the stigmate, they begin the phenomain of polinization:

1. Germination begins with an increase in pollen seed volume and the appearance of the pollen tube as a result of the absorption of nutrients secreted by the stigma.

2. The pollen tube is elongated by the vegetative cell and the reproductive cell engages the pollen tube.

3. Elongation of the tube by the phenomaine of the chemotoctime (the stigma secretes substances that attract the pollen tube).

4. Mitotic division of the reproductive cell to give two antherozoids (spermatozoids).

5. Elongation of the pollen tube is continuous and stops when the tube penetrates the ovule.

B. **Double fertilization**

This process is unique to angiosperms. It comprises of two phenomenon: Syngamy and Triple fusion

- The nucleus of one male gamete fuses with the egg nucleus and the phenomenon is called **fertilisation or syngamy**. It was first observed by Strasburger, 1884 in Monotropa.

- The second male gamete fuses with the two polar nuclei or the secondary nucleus formed by the fusion of the two central cell nuclei. The second fertilisation in most of the plants involves three nuclei, it is called triple fusion.

The two phenomena i.e., syngamy and triple fusion jointly constitute the larger phenomenon called double fertilisation. It was first explained

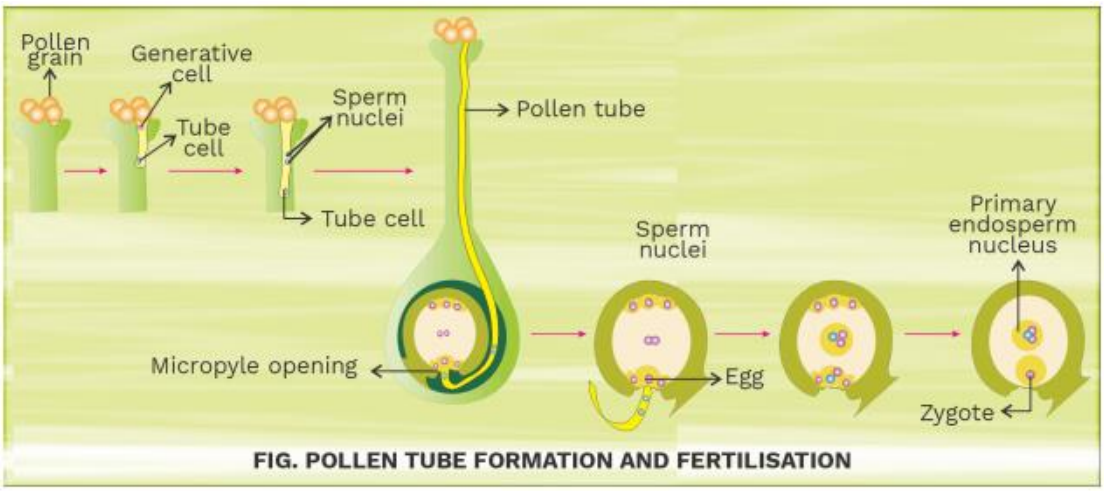


FIG. POLLEN TUBE FORMATION AND FERTILISATION

by Nawaschin, 1898.

C. POST FERTILISATION: STRUCTURE AND EVENTS

After fertilisation, the zygote divides to form the embryo and the endosperm develops further

① Endosperm

The endosperm formed is a triploid structure (n3). Its development proceeds the development of the embryo. The endosperm provides nutrition to the developing embryo. On the basis of development, the Endosperm can be of the following types

- **Nuclear Endosperm:** The division of the primary endosperm nucleus where the nuclear divisions are not accompanied by the

wall formation. This leads to the formation of a structure that has many nuclei suspended in the sap.

- **Cellular Endosperm:** The division of the primary endosperm nucleus results in the formation of multinucleate condition with regular wall formation. In coconut, the water is actually free nuclear endosperm, while, the white kernel is the cellular Endosperm.
- **Helobial Endosperm:** It is found mostly in the monocotyledons. Half the endosperm is cellular and half is free nuclear.

② EMBRYO

The zygote develops to form the embryo only after some of the endosperms are formed. The embryo develops at the micropylar end.

- **Dicotyledonous Embryo:** The zygote divides transversely to form two cells. The cell that lies towards the micropyle is known as the basal or suspensor cell. The other cell formed towards the chalazal end is known as the apical or embryonal cell. The basal cell divides transversely and form two-celled suspensor. The embryonal cell divides vertically to form two embryonal cells. The two embryonal cells further divide to form four embryonal cell and known as the quadrant stage. The two-suspensor cells divides by transverse divisions and forms a long filament like structure, called as suspensor. Suspensor pushes the developing embryo into the endosperm for nutrition. The micropylar cell of the suspensor swells up and is known as haustorial cell. The cell of suspensornear to the embryonal cells is known as hypophysis. The four cells of the quadrant divide to form an eight celled structure. The four cells of the embryo near to the hypophysis is known as hypobasal cells and four cells present towards the chalazal is termed epibasal cell. Hypobasal cells gives rise to radicle and hypocotyl and epibasal cells

gives rise to two cotyledons and plumule. All the eight cells divides to form the pro-embryo i.e. the globular embryo. y The globular embryo divides to form the heart shaped embryo which form the cotyledons and later the torpedo shaped embryo dicot embryo has an embryonal axis and two cotyledons. y Epicotyl is the embryonal axis above the level of the cotyledons that terminates into the plumule. y Hypocotyl is the portion below the level of the cotyledons that terminates into the radicle. The plumule is the future shoot while radicle is the future root.

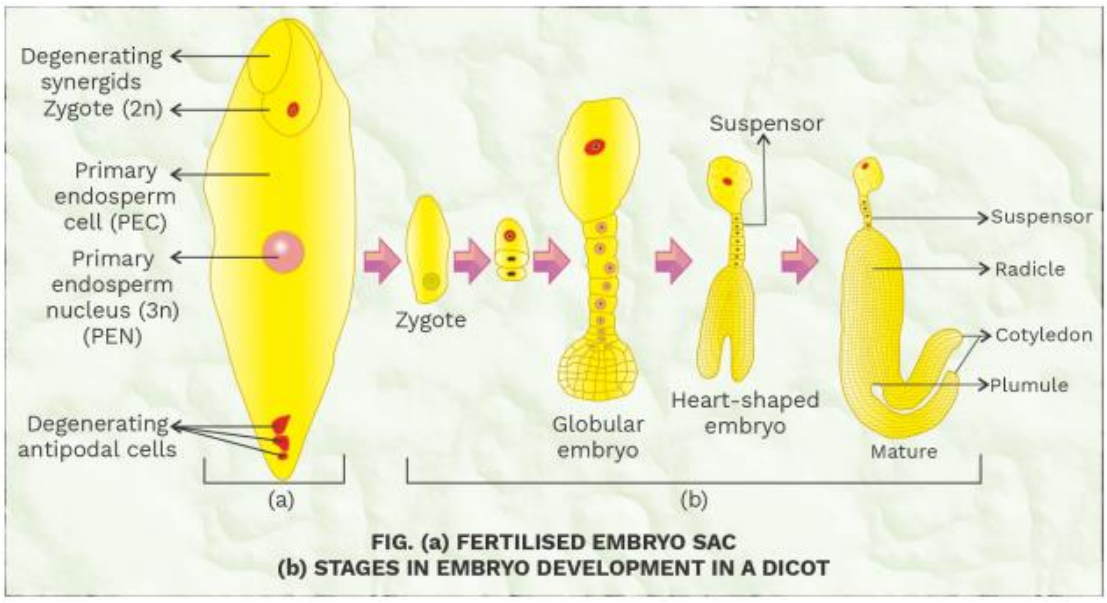


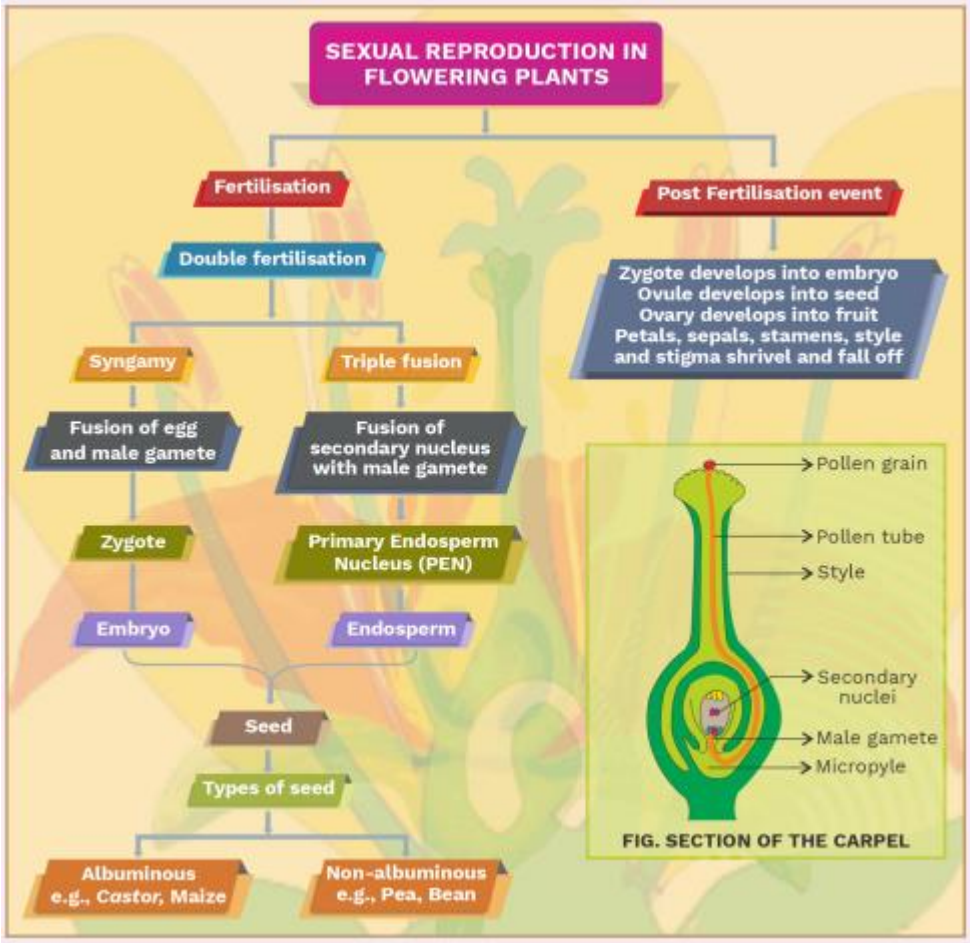
FIG. (a) FERTILISED EMBRYO SAC
(b) STAGES IN EMBRYO DEVELOPMENT IN A DICOT

- **Monocotyledonous Embryo:** The zygote divides by transverse divisipon and forms two cells. The upper cell towards the chalazal end is known as the embryonal cell while the lower cell towards the micropyle is known as the basal cell. The basal cell increases in size and forms a vesicular suspensor. The embryonal cell divides and forms a terminal cell known as cotyledons and the lower cell known as the embryonal cell. A transverse division in the embryonal axis cell gives rise to two cells. One cell gives rise to plumule initial and other gives rise to radicle initial. Plumule initial divides to form

plumule while radical initial divides to form radical. The embryo of monocots possesses only one cotyledon. In Gramineae, the cotyledon is known as scutellum that is present on the lateral side. The embryonal axis has the radicle and root cap enclosed by a sheath called Coleorrhiza. The Epicotyl has plumule which is covered by the coleoptile.

- **FRUIT:** The ovary matures into a fruit after fertilisation. There are two types of fruits formed:
  - **True fruit:** It develops from the ovary only and no other part of the flower takes part in the formation of the fruit. Example: Mango, Tomato.
  - **False fruit:** It is a fruit in which other parts of the flower also take part in the formation of the fruit along with the ovary. Example: Strawberry, Apple, Cashew.
- **SEED**

  The ovules in the ovary develop into the seeds. The seeds are basically of two types:
  - **Albuminous or Endospermic:** These seeds that have a large amount of endosperm. Example: Wheat, Maize, Onion
  - **Non-Albuminous or Non–Endospermic**: These are the seeds in which the endosperm is used up during the course of development. They store food in their cotyledons.



2. NOTION OF DEVELOPMENT CYCLE

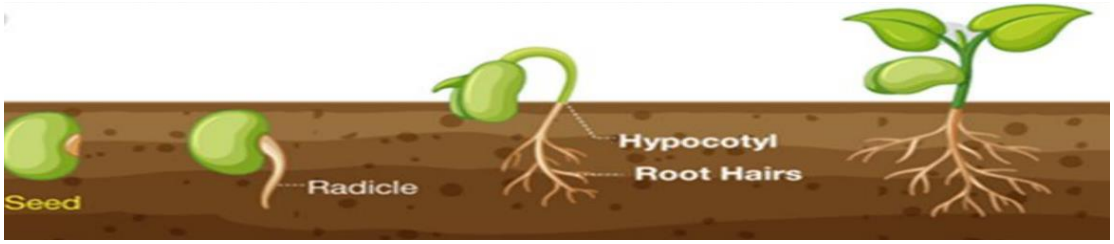
Like humans and other animals, plants have life cycles. The life cycle of a plant is like a story that describes the stages a plant goes through from the beginning of its life until the end and how that process starts all over again.

The main stage of the life of a flawring plant are:

A. Germination

Germination is a process by which the embryo in the seed becomes activated and begins to grow into a new seedling. Germination begins with the seed's absorption of water (When conditions are right, water is absorbed very rapidly through the micropyle). As the cells hydrate, they swell and become turgid or rigid. The moisture triggers an increase in cellular respiration (Oxygen must be present for cellular respiration),

Metabolic activity surges, Proteins are synthesized and Gibberellins stimulate the production of enzymes. The enzyme protease breaks down stored proteins into amino acids. The sugars and amino acids are directed towards cell division, growth, and differentiation sites at the root and shoot meristems or tips. Metabolic processes increase. The swelling of cells causes the seed coat to rupture. The primary root or radicle emerges downward, and the stem grows upwards. The shoot begins manufacturing food through photosynthesis and the roots absorb water and nutrients.



B. GRAWING AND FLAWRING

The seedling grows into an adult plant with roots, stems, and leaves. The roots draw water and nutrients from the soil and are carried through the stem to the leaves. The leaves create food and energy through photosynthesis. When a plant is fully mature, it will produce flowers. The flower is the part of the plant that is needed for reproduction. Flowers have many different parts for reproduction. Usually, the flower petals are bright, colorful, and sweet smelling to attract insects to help with pollination.

C. POLLINATION

This process moves pollen from the flower's stamen (the pollen-producing reproductive organ) to the pistil (the reproductive organ that receives pollen and produce seeds or fruit). Pollination can occur with the help of insects, birds, bats, and even the wind. After a plant has been successfully pollinated, it will develop a new seed and the whole process begins again.

D. DISPERSION

Plants release new seeds, which are dispersed (spread over a wide area) in different ways. Some seeds are spread by the wind, travelling far from the parent plant and increasing the range where the plant can grow. Some seeds float on water, and others are carried by insects. Seeds can also be spread by sticking to animal fur and later falling off. Some animals eat seeds and spread them around when they defecate (poop) in other areas. Humans spread seeds when they plant gardens. Some plants disperse seeds without any help. They have exploding seed pods that fling the seeds into the air! Once a seed reaches a new destination with suitable conditions, the life cycle begins again.