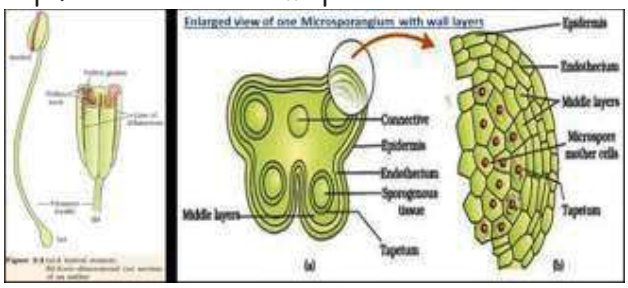
2,SEXUAL REPRODUCTION IN FLOWERING PLANTS

Stamen, Microsporangium and Pollen Grain :

- ✓ Stamen consists of long and slender stalk called filament and terminal bilobed structure called anther.
- ✓ A typical angiosperm anther is bilobed with each lobe having two theca (chamber).
- ✓ In general the anther is four-sided structure consisting of four microsporangia, two in each lobes.
- ✓ Microsporangia develop further and become pollen sacs which contain pollen grains.



Structure of Microsporangium

- ✓ Microsporangium is generally surrounded by four layered walls- the epidermis, endothecium, middle layer and tapetum.
- ✓ Innermost layer **tapetum** nourishes the developing pollen grains.
- ✓ The cells of the tapetum are multinucleated (due to endomitosis) and have dense cytoplasm.
- ✓ The outer three wall layers perform the function of protection and help in dehiscence of anther to release the pollen.
- ✓ **Sporogenous tissues-** It is compactly arranged homogenous cells which are present at centre of each microsporangium when the anther is young.
- ✓ As the anther develops, the cells of the **sporogenous tissue** undergoes meiosis to form pollen grains.

Pollen grain

- ✓ Pollen grains represent the male gametophytes.
- ✓ Pollen grains have 2 layered wall,outer exine and inner intine.

Exine

- Made up of sporopollenin- most resistant organic matter known.
- It can withstand high temperatures and strong acids and alkali.
- No enzyme can degrade sporopollenin.
- Presence of sporopollenin helps the pollen to be preserved even in fossils.

Intine.

- Thin and continuous layer made up of cellulose and pectin
- A plasma membrane surrounds cytoplasm of pollen grain.

Germ pores

- Apertures or openings on exine where sporopollenin is absent.
- After pollination pollen tube emerges through germ pore.

MATURE POLLEN

- ✓ A mature pollen consist of 2 cells with nucleus (Vegetative cell and Generative cell)

VEGETATIVE CELL

- Larger cell of the pollen grain with abundant food reserves
- Contains large irregular nucleus
- The function of the vegetative cell is to provide the medium for the movement of male gametes inside the pollen tube

GENERATIVE CELL

- Smaller cell of the pollen grain and contain minimum amount of cytoplasm
- It divides mitotically to produce two functional male gametes.

✓ In about 60% of angiosperms, pollen grains are liberated at 2-celled stage.

✓ In about 40% flowering plants, the generative cell divides mitotically to give rise to the two male gametes before pollen grains are shed at 3-celled stage

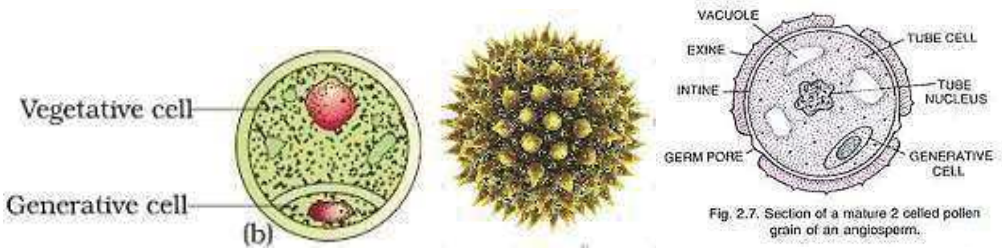


Fig. 2.7. Section of a mature 2 celled pollen grain of an angiosperm.

Megasporangium (Ovule)

✓ Ovule is a small structure attached to placenta.

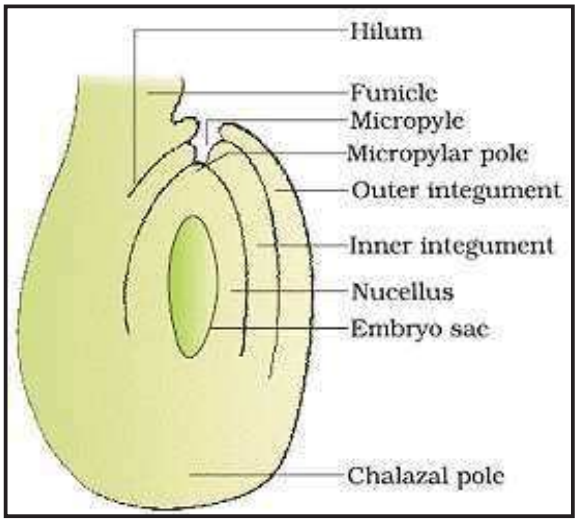
✓ Funicle – stalk by which ovule is attached to placenta

✓ The point of attachment of funicle with the body of ovule is called *hilum*.

✓ The main body of the ovule is covered with one or two envelopes called integuments. These leave an opening at the top of the ovule called micropyle.

✓ The body of the ovule shows two ends: the basal end, often called the chalazal end and the upper end is called micropylar end.

✓ Parenchymatous tissue enclosed inside the integument is called nucellus



Megasporogenesis

✓ The process of formation of megaspore from megaspore mother cell by meiotic division is known as megasporogenesis. This process takes place in ovule

✓ Ovule differentiates a single megaspore mother cell (MMC) in the micropylar region of nucellus.

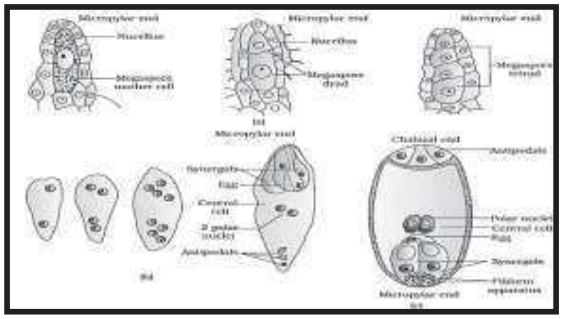
✓ MMC undergoes meiotic division that results into the production of four megaspores.

✓ In most of the flowering plants three megaspores degenerate and remaining single megaspore develops into female gametophyte (embryo sac).

✓ The nucleus of functional megaspore divides mitotically to form two nuclei which move to opposite poles to form 2-nucleate embryo sac.

✓ Two more sequential mitotic division results into 8-nucleate embryo sac.

- ✓ One nucleus from each pole then moves towards the middle of the large central cell and forms a pair of polar nuclei.
- ✓ The three nuclei of the micropylar end form the egg appa•ratus (one central egg and two lateral synergids) and the rest three at the chalazal end are called antipodal cells.
- ✓ At maturity ,embryosac is **8-nucleated and 7 celled.**



POLLINATION

- ✓ Transfer of pollen grains from anther to stigma.

Autogamy–

- o Transfer of pollen grains from anther to stigma of same flower.
- o It requires synchronous maturation of anther and stigma.
- o **Cleistogamous Flower** –
- o flower which do not open.
- o cleistogamous flowers are autogamous as there is no chance of transfer of foreign pollen to the stigma.
- o Cleistogamous flowers ensure the development of seeds even in the absence of pollinators. e.g Viola (common pansy), Oxalis, and Commelina.
- o **Chasmogamous** Open flowers with exposed anther and stigma.

Geitonogamy

- o Transfer of pollen grains from anther of a flower to stigma of another flower of same plant.
- o Geitonogamy is functionally a type of cross-pollination involving a pollinating agent.
- o Genetically it is similar to autogamy since the pollen grains coming from the same plant
- o **Xenogamy–**
- o Transfer of pollen grain from anther to the stigma of a different plant of the same species.

Agents of pollination

- ✓ Pollinating agents includes abiotic (water, wind) and biotic (insects, butterfly, honey bee etc.)
- ✓ Large number of pollen grains are produced by plants using abiotic mode of pollination to compensate the loss of pollen grains during transfer.

Adaptations in flowers for Pollination

WIND POLLINATION

- ✓ Pollen grains light weighted and non- sticky.
- ✓ Have well-exposed stamens (so that the pollens are easily dispersed into *wind* currents)
- ✓ Large and feathery stigma helps to receive pollen grains moving in the air.
- ✓ In wind pollinating plants numerous flowers are packed into an inflorescence.
- ✓ Eg. : Corncob,Rice,Maize,Papaya ,Date palm

WATER POLLINATION

- ✓ Pollen grains protected by mucilaginous covering.
- ✓ Large and ribbon shaped pollen grains in some species.
- ✓ They do not produce nectar/honey
- ✓ Eg : Fresh water plants- *Vallisneria, Hydrilla* Marine Plants - *Zostera*
- ✓ All aquatic plants are not pollinated by water,(Eichornia and water lilly are insect pollinating hydrophytes)

INSECT POLLINATION

- ✓ The flowers pollinated by insects are bright-coloured and produce nectar.
- ✓ The fragrance of the flowers attracts the insects.
- ✓ The pollen grains are sticky, large, and rough so that stick to the body of the insects.
- ✓ The stigmas are also sticky so that the pollens depositing are not dispersed.
- ✓ Eg.Cucumber,Sunflower,Aster

Artificial Hybridization

- ✓ It is one of the innovative methods of the crop improvement program.
- ✓ In artificial hybridization,only desired pollen grains are *are used forpollination and fertilization.*

Emasculation :

- ✓ Removal of anther from a bisexual flower before it releases pollen grain.
- ✓ In the case of unisexual flowers, this step is not necessary.

Bagging :

- ✓ Bagging is the protection of emasculated flower from contamination by undesirable pollen grains
- ✓ Here the flower is covered by a bag, until the flower attains receptivity.
- ✓ In unisexual flowers, bagging is done before the flowers are open.
- ✓ Once the flower attains stigma receptivity, the desired pollens are dusted on the stigma.

Double Fertilisation

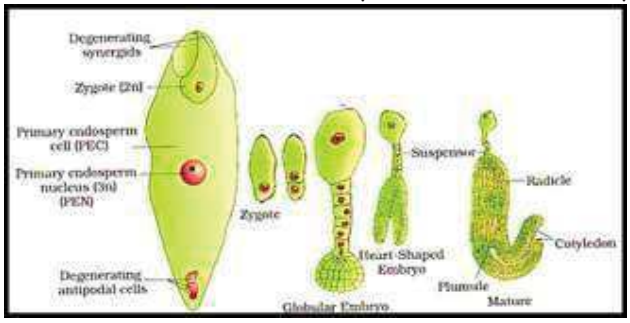
- ✓ After entering into one of the synergids,the pollen tube releases two male gametes in the cytoplasm of the synergid.
- ✓ One male gamete (n) fuses with egg(n) and form a zygote .It is called **Syngamy**.
- ✓ Other male gamete fuses with two polar nuclei to produce a triploid **primary endosperm nucleus (PEN)**.
- ✓ Since two types of fusion takes place in an embryo sac the phenomenon is called **double fertilisation.**
- ✓ The PEN develops into the endosperm and zygote develops into embryo.

Embryo

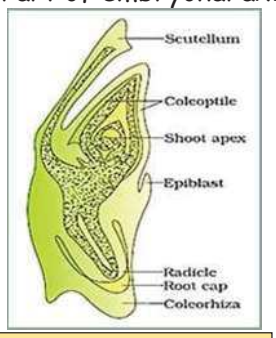
- ✓ Embryo develops at the micropylar end of the embryo sac where the zygote is located.
- ✓ Development of zygote to embryo starts only after endosperm formation has started.
- ✓ This is because endosperm provides nutrition needed for the embryo to develop.

Embryogeny

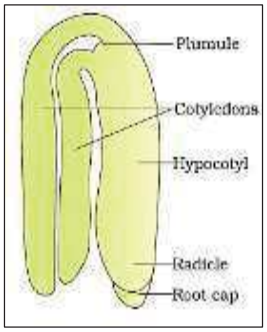
- ✓ Stages of embryo development are same in both monocot & dicot plants
- ✓ The zygote gives rise to the proembryo and subsequently to the globular, heart-shaped and mature embryo.



- ✓ **Dicotyledonous embryo has the following parts**
- ✓ 1. Embryonal axis - Main axis of the embryo which divides into different regions
- ✓ 2.Cotyledons/embryonic leaves provide nourishment to the developing radicle & plumule
- ✓ 3.Plumule(upper end of the embryonal axis)and radicle(lower end of the embryonal axis)
- ✓ 4. Epicotyle - Part of embryonal axis above the cotyledons which terminates at plumule
- ✓ 5 Hypocotyle - Part of embryonal axis below the cotyledons which terminates at radicle



MONOCOT EMBRYO

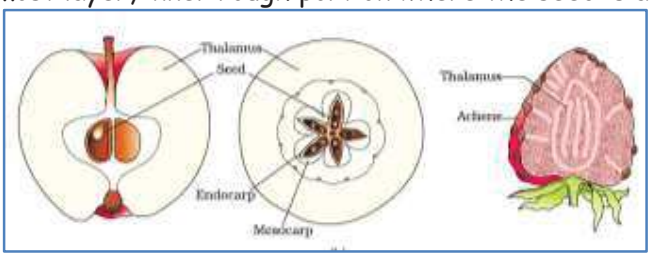


DICOT EMBRYO

- ✓ **Monocotyledonous embryo has the following parts**
- ✓ 1. Embryonal axis - Main axis of the embryo which divides into different regions
- ✓ 2.Single cotyledon called **scutellum** located at one side of the axis.
- ✓ 3.Plumule(upper end of the embryonal axis)and radicle(lower end of the embryonal axis)
- ✓ 4.Coleorrhiza: undifferentiated sheath covering radical & root cap
- ✓ 5.Coleoptile: sheath covering plumule

Fruits

- ✓ Fertilized and mature ovaries are called fruits
- ✓ The wall of ovary develops into wall of fruit called **pericarp.**
- ✓ In some fruits the pericarp is further differentiated into three layers, namely:
- ✓ Epicarp: Outermost layer, forms the peel.
- ✓ Mesocarp: Middle layer, fleshy, edible portion of the fruits
- ✓ Endocarp: Innermost layer, inner rough portion where the seed is accommodated.



- ✓ In true fruits only ovary contributes in fruit formation but in false fruit thalamus also contributes in fruit formation(Eg. Apple,Strawberry,Cashew
- ✓ Fruits formed without pollination and fertilization are called **Parthenocarpic fruits**.Eg.Banana
- ✓ Parthenocarpic fruits are generally seedless in nature.