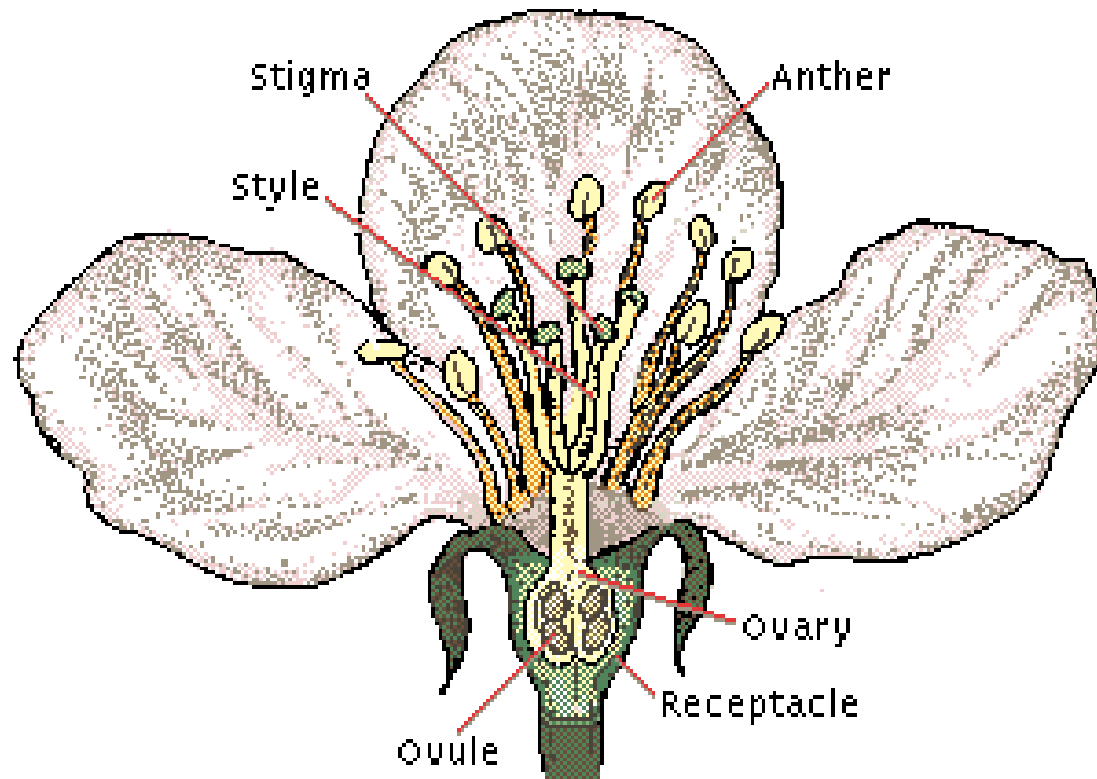


# SEXUAL REPRODUCTION IN FLOWERING PLANTS



# Parts Of Flower



# FLOWER



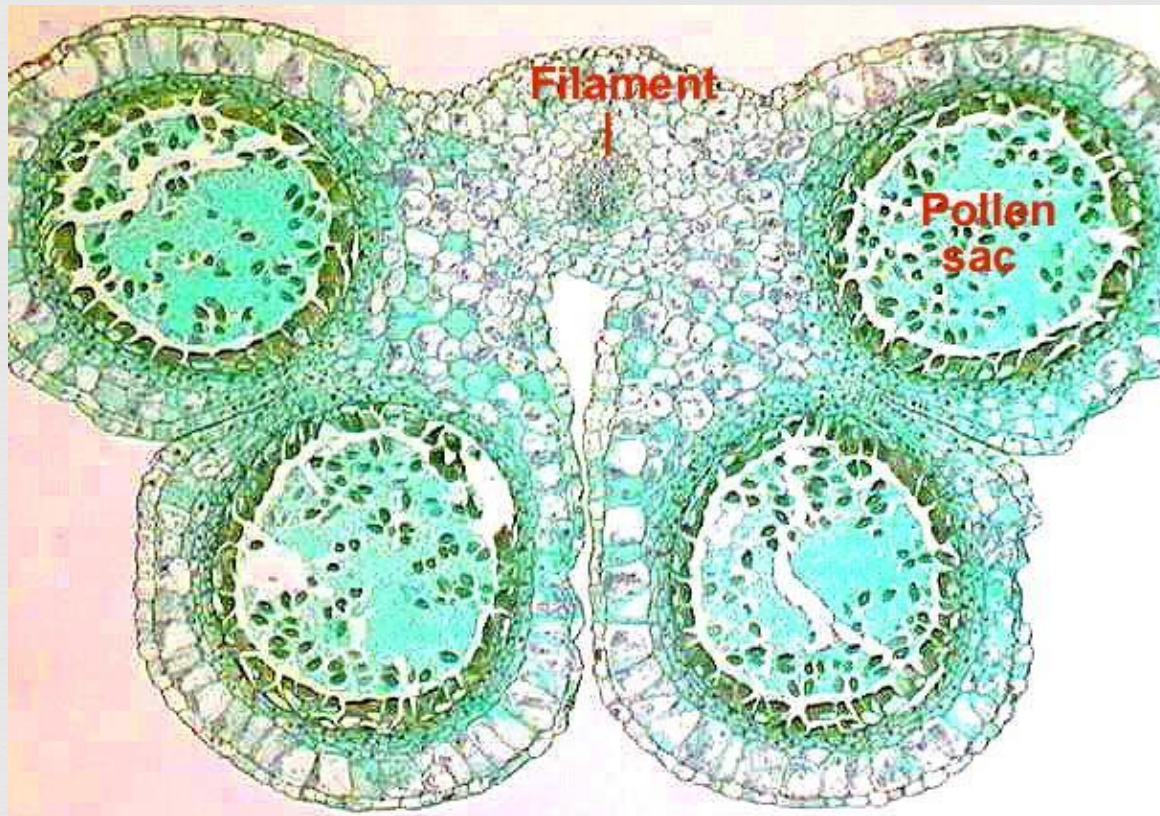
- ❧ Modified shoot
- ❧ Develops from floral primordia
- ❧ Primordia develop first into floral bud and then into a flower.
- ❧ Reproductive part of plant
- ❧ Androecium is male reproductive whorl, consists of stamens.
- ❧ Gynoecium is female reproductive part of flower, consists of carpel(S).

# Stamen



- ❧ Male reproductive unit.
- ❧ Consists of two parts- **fillament** and **anther**
- ❧ Fillament is attached to thalamus or petal.

# T.S. OF Anther



# Structure Of Anther (Microsporangium)

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- ❧ Bilobed and dithecous.
- ❧ A longitudinal groove separate the theca.
- ❧ In a cross- section anther is a tetragonal structure, consisting of 4 microsporangia, two in each lobes.
- ❧ Later two microsporangia of each lobe fuse as a pollen sac.

# Structure Of Anther



- ❧ A microsporangium is circular and surrounded by 4 layers.
- ❧ These are epidermis, endothecium, middle layers tapetum.
- ❧ Outermost layers protect the pollen and help in dehiscence of anther to release pollen.

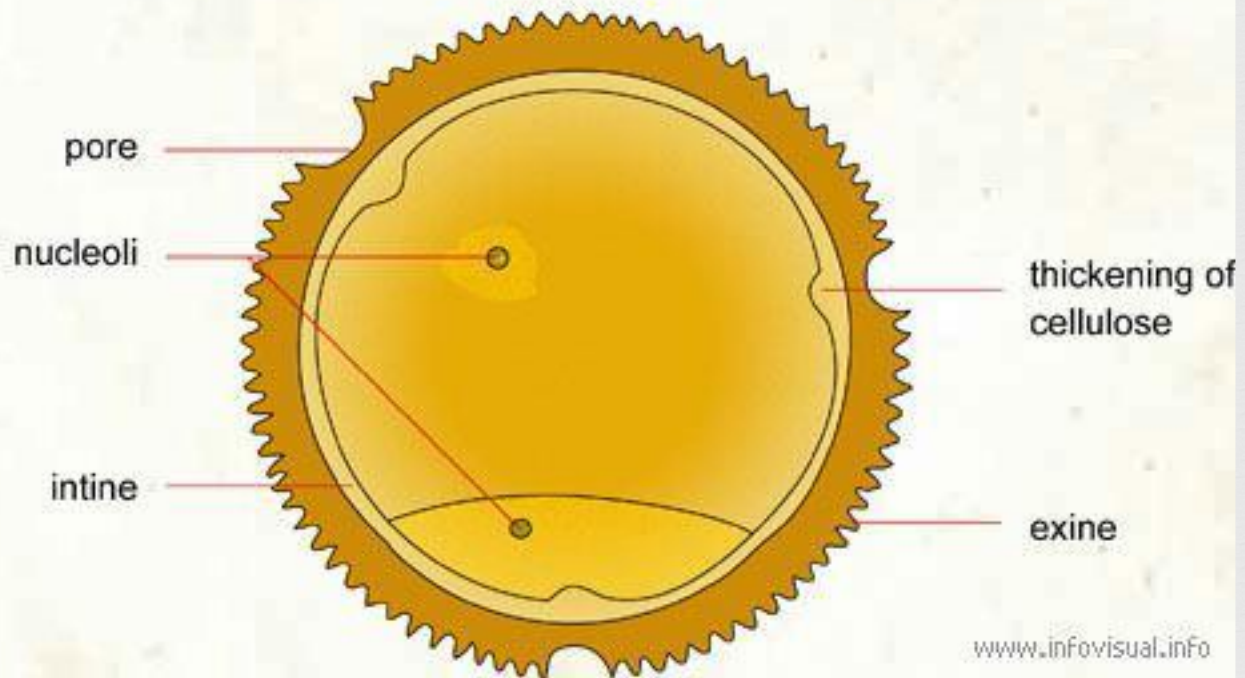
# Structure Of Anther



- ❧ Tapetum nourishes the developing pollen grains.
- ❧ When the anther is young a group of compactly arranged homogenous cells called sporogenous tissue occupies the centre of each microsporangium.



## GRAIN OF POLLEN



# Microsporogenesis

- ❧ The process of formation of microspores from a pollen mother cell through meiosis is called microsporogenesis.
- ❧ The cells of sporogenous tissue undergo meiosis to form **microspore tetrad** arranged in a cluster of 4 cells..
- ❧ As each cell of sporogenous tissue has potential to form tetrad, so each cell is a microspore mother cell (PMC).
- ❧ On maturation and dehydration of anther, the spores dissociate and develop into pollen grains.
- ❧ Pollen grains release with the dehiscence of anther.

# Pollen Grain (Male Gametophyte)

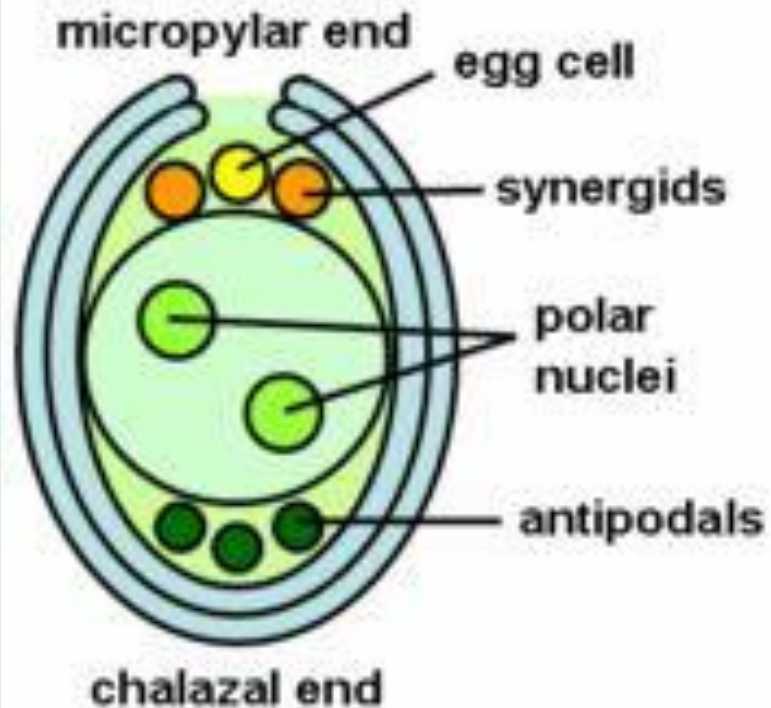
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- ❧ Spherical in shape.
- ❧ Have two layered wall- outer hard **exine** layer and inner thin **intine**.
- ❧ **Exine**- made up of sporopollenin. Resistant to organic matter, withstand high temperature, acids, alkalis and enzymes. It has prominent apertures called **germ pores**, where sporopollenin is absent.
- ❧ **Intine**- It is thin, continuous layer, made of cellulose and pectin.

# Pollen Grain (Male Gametophyte)

- ❧ Pollen grain cytoplasm is surrounded by plasma membrane.
- ❧ Mature pollen grain has 2 cells- (i) vegetative cell (ii) generative cell.
- ❧ Vegetative cell- bigger, abundant food reserve, large irregular nucleus.
- ❧ Generative cell- small, spindle shaped with dense cytoplasm and a nucleus, floats in vegetative cell cytoplasm.
- ❧ In 60% species pollen grains are shed in 2 celled stage where as 40% species shed in 3 celled stage in which generative cell divides mitotically into 2 male gametes.

## Embryo sac



# Female Reproductive Unit- Pistil



- ❧ Pistil- female reproductive part of flower.
- ❧ It may be mono or bi or tri or polycarpellary, syncarpous or apocarpous.
- ❧ Each pistil consists of ovary, style and stigma.
- ❧ The ovary has one or more cavities called **locules**.
- ❧ Placenta in locules bears ovules.
- ❧ Number of ovules may be one or more.

# Ovule



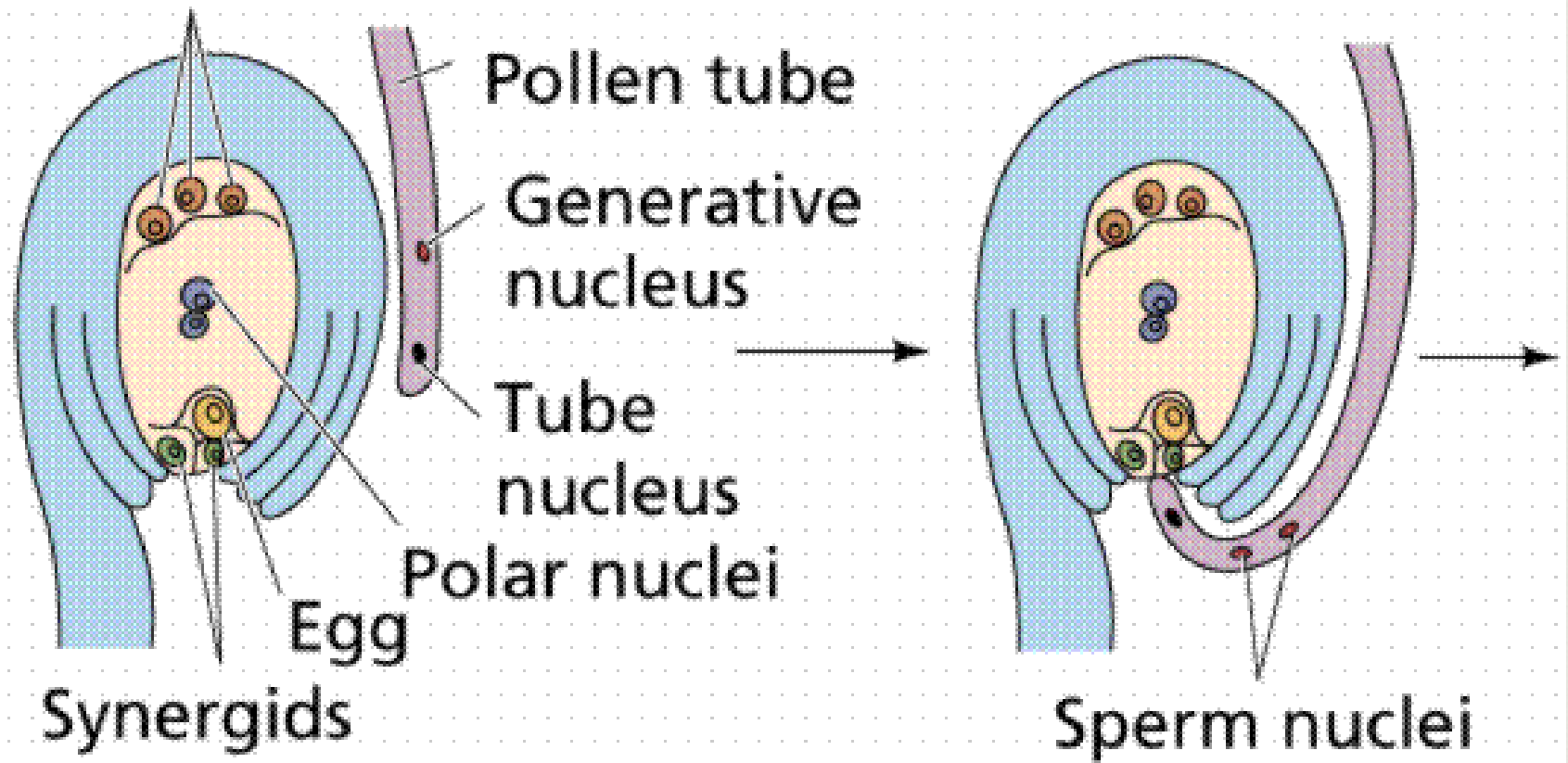
- ❧ Arises as primordium on placenta.
- ❧ The short stalk which attach ovule with placenta is **funicle**.
- ❧ The primordium grows into a mass of cells forming **nucellus**, the body of ovule.
- ❧ The two protective covering of nucellus is **integuments**, except at the tip leaving a small opening called **Micropyle**.

# Ovule



- ❧ Basal part of ovule is called **chalaza** that lie opposite to micropyle.
- ❧ Cells of nucellus are rich in reserve food.
- ❧ A single **embryo sac** or **female gametophyte** located in the nucellus, which is developed from megaspore.

## Three antipodal cells



# Megasporogenesis And Development

## Of Female Gametophyte

- ❧ One of the nucellar cell in the micropylar region is differentiated into megaspore mother cell.
- ❧ The cell is larger, contains dense cytoplasm and a prominent nucleus.
- ❧ It undergoes meiosis forming 4 haploid cells called megaspore tetrad.
- ❧ 3 megaspores degenerate and only one megaspore become functional.



8-nucleate

# Megasporogenesis And Development

## Of Female Gametophyte

- ❧ Functional megaspore is the first cell of female gametophyte.
- ❧ Its nucleus undergoes mitosis and the two nuclei move to opposite poles and form 2 nucleate embryo sac.
- ❧ Two successive mitotic division in each of these 2 nuclei form an 8 nucleate embryo sac.

# Devices For Autogamy



- ❧ Simultaneous maturation of anther and pistil.
- ❧ Anther and stigma lie close to each other.
- ❧ Cleistogamous flower (oxalis, commelina, viola)

# Devices For Xenogamy



- ❧ Unisexual flower and dioecious plants.
- ❧ Pollen release and stigma receptivity are not
- ❧ synchronised.
- ❧ Different orientation of anther and stigma of
- ❧ flower.
- ❧ Self incompatibility.

# Adaptation Of Wind Pollinated Flowers

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- ❧ Pollen grains are light, nonsticky/ dry, sometimes winged.
- ❧ Well exposed anther.
- ❧ Large feathery stigma.
- ❧ Flowers arranged as inflorescence.
- ❧ Single ovules.

# Adaptation Of Water Pollinated Flowers

- ❧ Seen in submerged flowers like *Vallisneria* and *Hydrilla* and *Zostera*.
- ❧ In *Vallisneria* male flowers released on water surface and female flowers reaches the surface for pollination.
- ❧ In sea grasses, pollen grains are long ribbon like and carried passively to submerged female flowers.
- ❧ Mucilage coated pollen grains.

# Adaptation In Insect Pollinated Flowers

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- ❧ Large
- ❧ Brightly coloured and showy.
- ❧ If flowers are small, grouped into inflorescence.
- ❧ Highly fragrant
- ❧ Produce nectar
- ❧ Sticky pollen and stigmatic surface
- ❧ Provide rewards to animal pollinator such as nectar, food (pollen) or provide safe place for laying eggs.

# Pollen-pistil Interaction



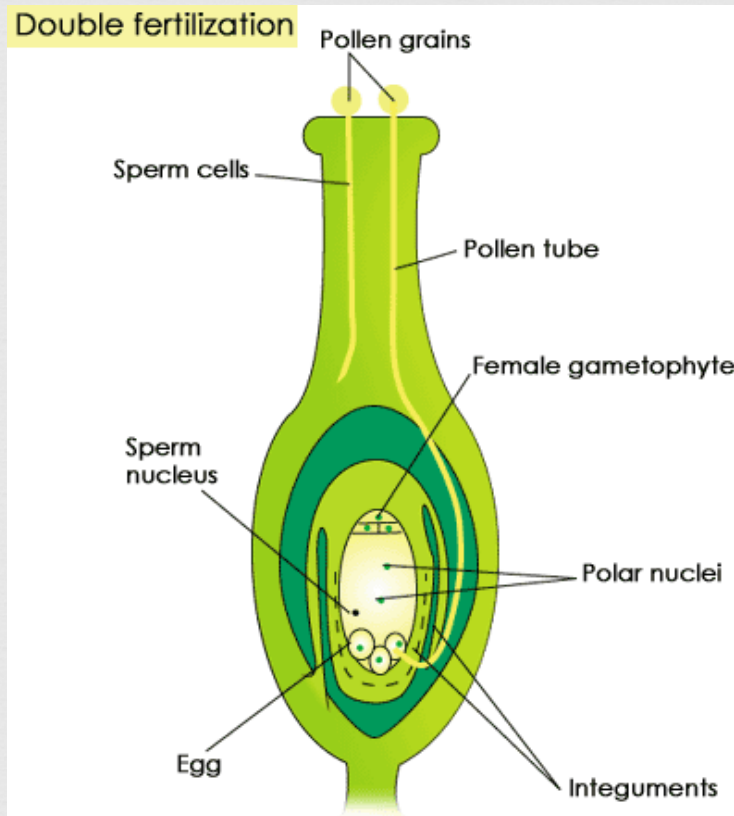
- ❧ **Recognition of compatible pollen-**It is the interaction between chemical components of pollen and those of stigma.
- ❧ **Germination of pollen and development of male gametophyte-**
  - ❧ (a) compatible pollen starts its germination, stimulated by certain secretion of stigma.
  - ❧ (b) intine grows out through one of germ pore.
  - ❧ (c) content of pollen moves into the tube i.e. vegetative and generative / 2 male gametes.

# Pollen-pistil Interaction



- ❧ (d) pollen tube grows through the tissues of stigma and style by secreting enzymes to digest them and enters ovule through micropyle.
- ❧ (e) It enters the embryo sac through filiform apparatus of one synergids to liberate male gametes.
- ❧ (f) germinated pollen grain with pollen tube carrying vegetative nucleus and 2 male gametes is the fully developed female gametophyte.

# Double Fertilisation



# Double Fertilisation



- ❧ Release of 2 male gametes from pollen tube into cytoplasm of synergids.
- ❧ Fusion of one male gamete with egg cell called **Syngamy** and form zygote( $2n$ ) which develops into embryo.
- ❧ Fusion of 2nd male gamete with polar nuclei of central
- ❧ cell to form PEN( $3n$ ).
- ❧ As syngamy and triple fusion occur in an embryo sac, the phenomenon is known as double fertilisation.
- ❧ Central cell with PEN is called PEC which develops into endosperm.

# Post Fertilisation Events



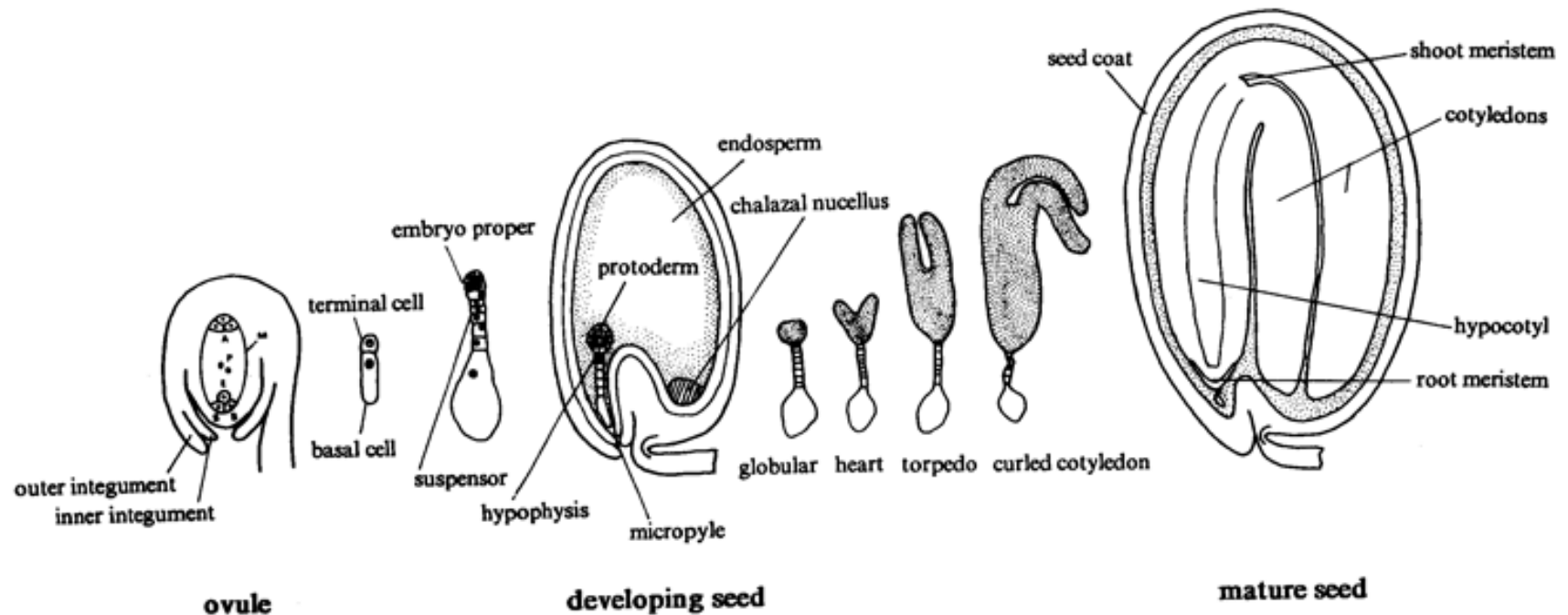
- ❧ Development of endosperm
- ❧ Development of embryo
- ❧ Maturation of ovule into seed
- ❧ Maturation of ovary into fruit.

# Endosperm



- ❧ Its development precedes embryo development.
- ❧ There are 3 methods of embryo development : nuclear, cellular, helobial.
- ❧ In nuclear type PEN divides mitotically without cytokinesis and endosperm is free nuclear, then cell wall formation starts from periphery and endosperm become nuclear.
- ❧ It provides food to developing embryo.
- ❧ If endosperm is completely utilised by embryo, seed is non-albuminous, if present ,seed is albuminous.

# Embryo Development



# Embryo



- ❧ It starts after certain embryo formation.
- ❧ Zygote divides mitotically and form proembryo.
- ❧ Then it develops into globular and heart shaped embryo and then horse shoe shaped mature embryo with one or two cotyledon.

# Special Reproduction (Apomixis / Agamospory)

- ❧ Seeds are formed without fertilisation.
- ❧ It may develop if a diploid egg cell develops into embryo without fertilisation.
- ❧ If cells of nucellus may develop into embryo and pushed into the embryo.

# Special Reproduction (Polyembryony)

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- ❧ If more than one egg may form in embryo sac.
- ❧ If more than one embryo sac formed in an ovule.
- ❧ Other cells like synergids or nucellus develop into embryo.
- ❧ E.g. orange, lemon, mango, onion, groundnut etc.