

# Microsporangium and Megasporangium Development

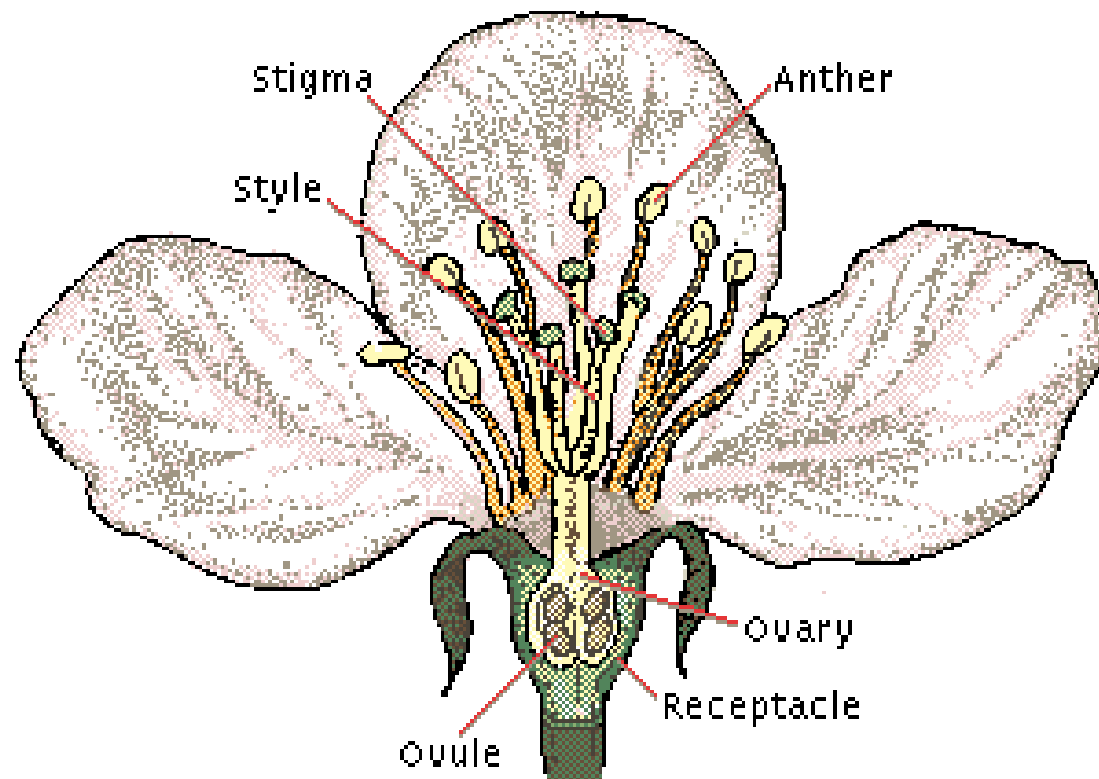
**Mr.Sagar G. Lokhande**

Developmental Botany

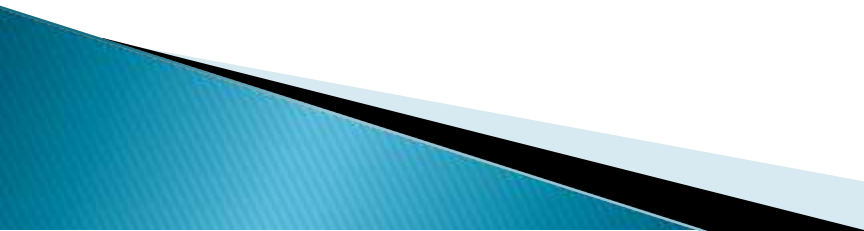
M.Sc. Botany



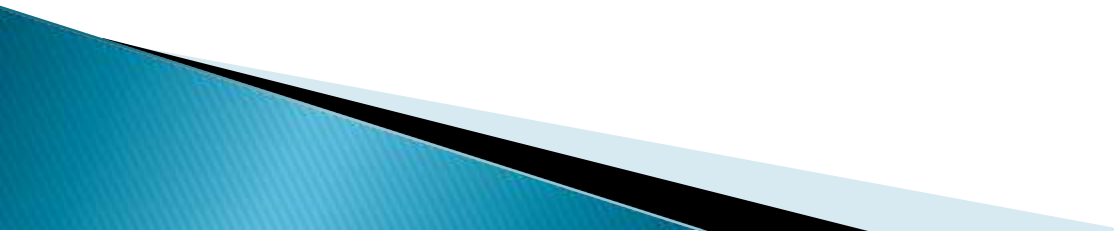
# Parts Of Flower



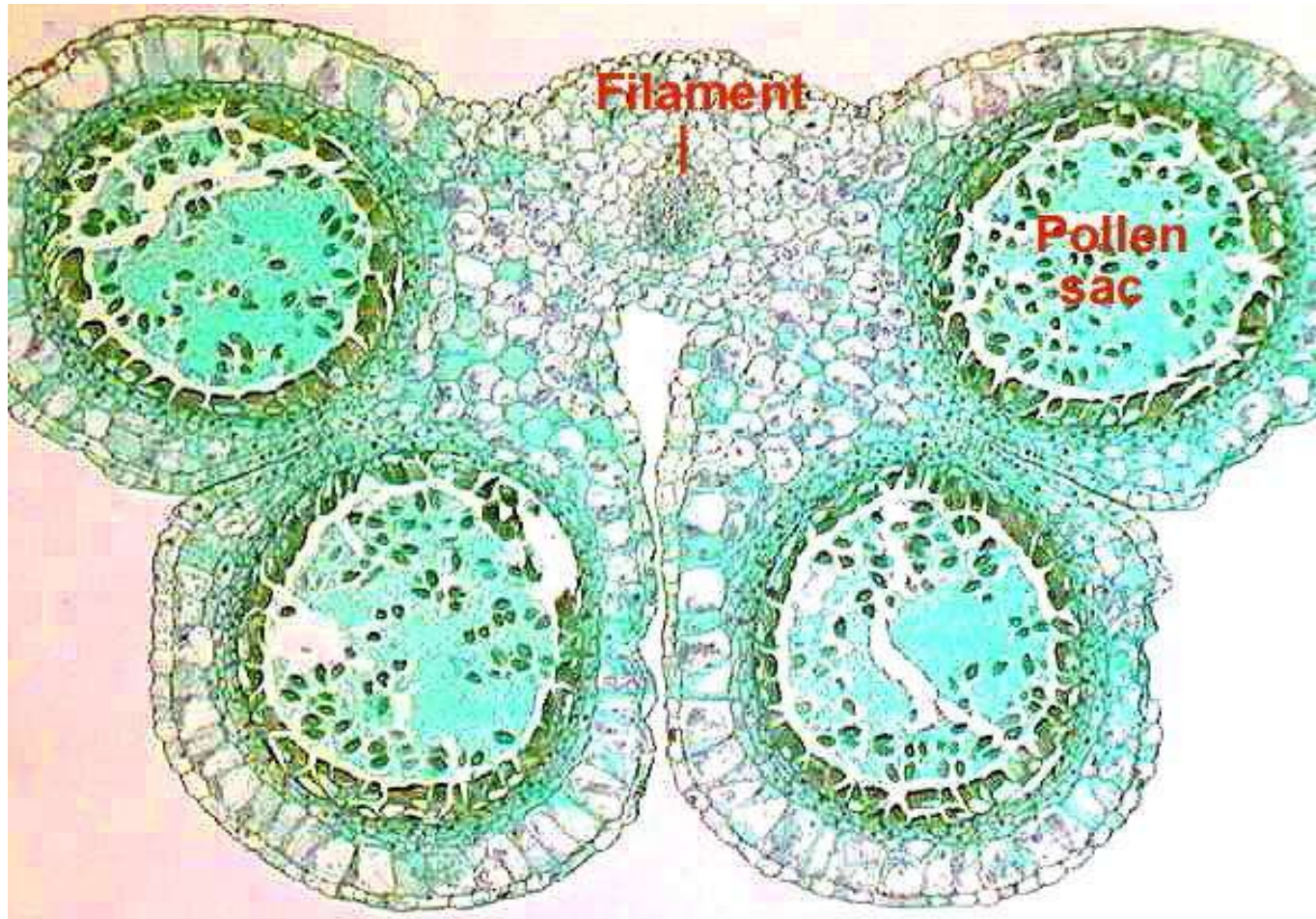
# FLOWER

- ▶ 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).
- 

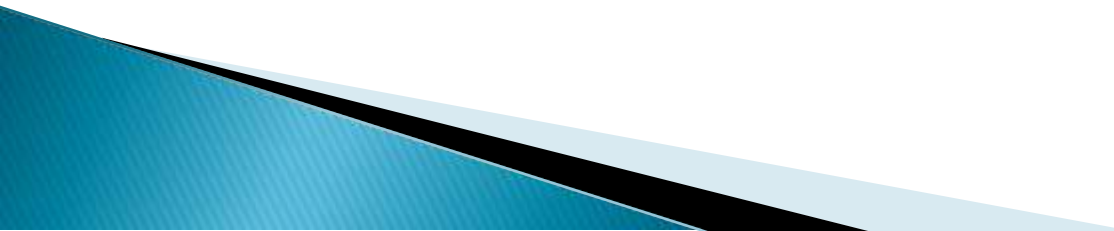
# Stamen

- ▶ Male reproductive unit.
  - ▶ Consists of two parts– **filament** and **anther**
  - ▶ Filament is attached to thalamus or petal.
- 

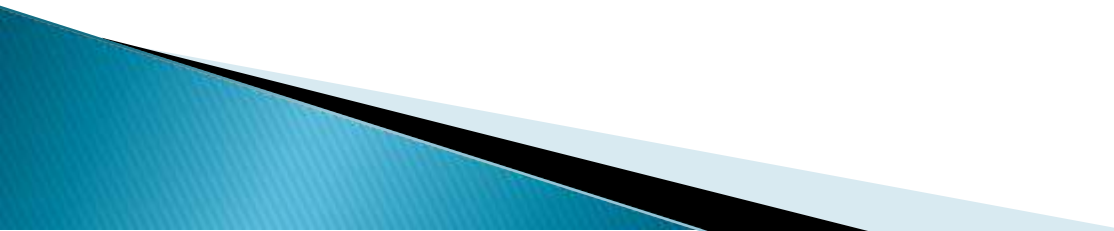
# T.S. OF Anther



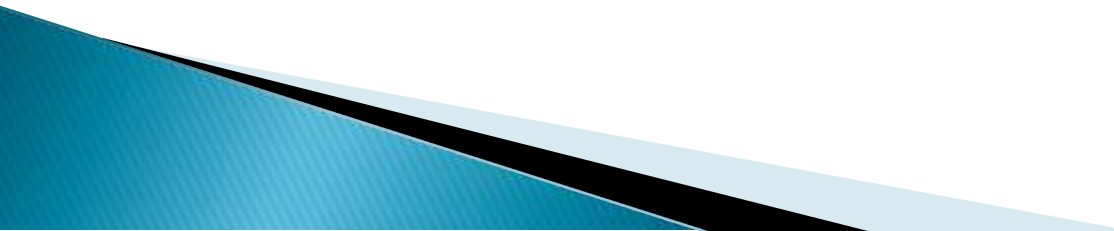
# Structure Of Anther (Microsporangium)

- ▶ 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

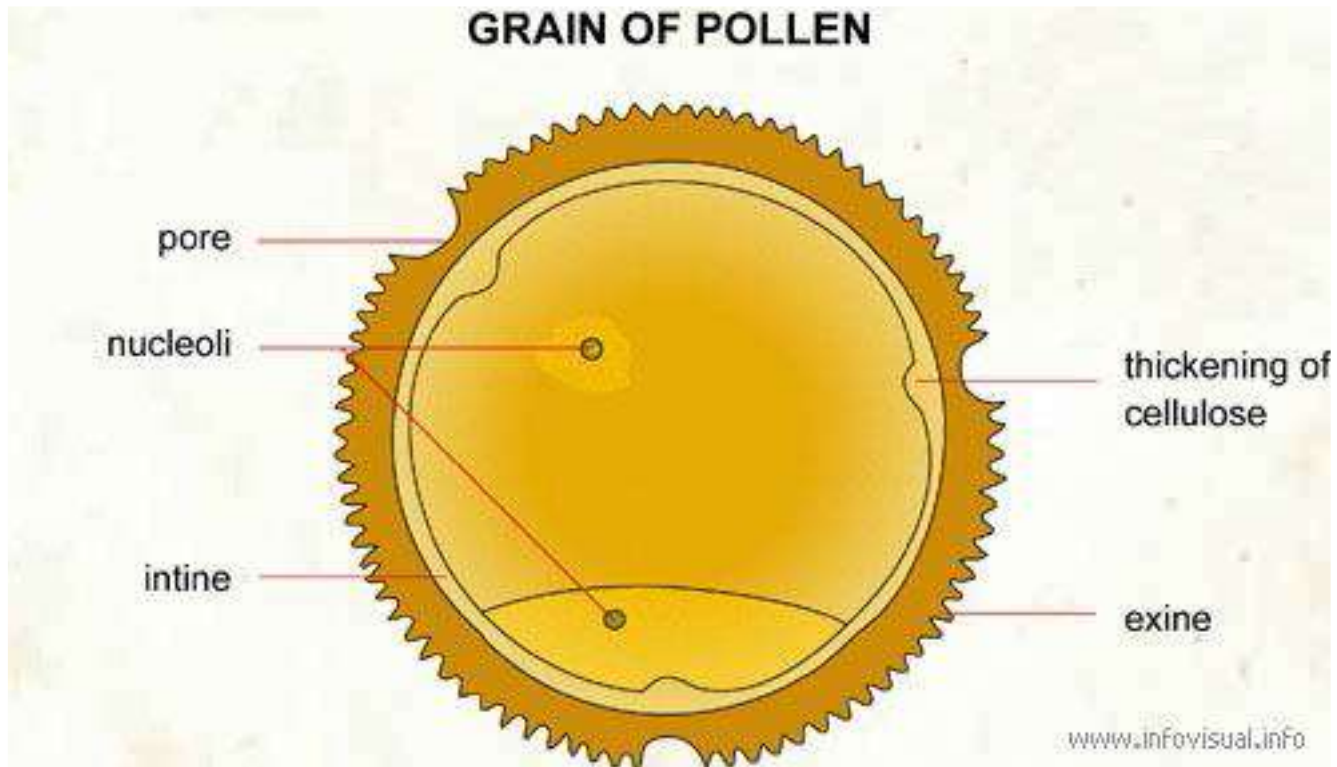
- ▶ A microsporangium is circular and surrounded by 4 layers.
  - ▶ These are epidermis, endothecium, middle layers tapetum.
  - ▶ Outermost layers protect the pollen and help in dehiscence of anther to release pollen.
- 

# 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.

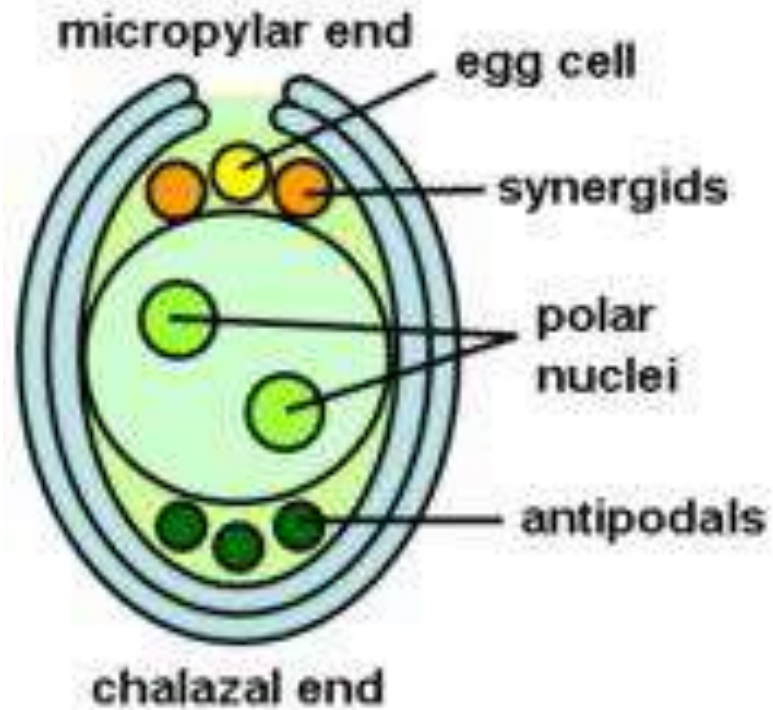
# Pollen Grain (Male Gametophyte)

- ▶ 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.

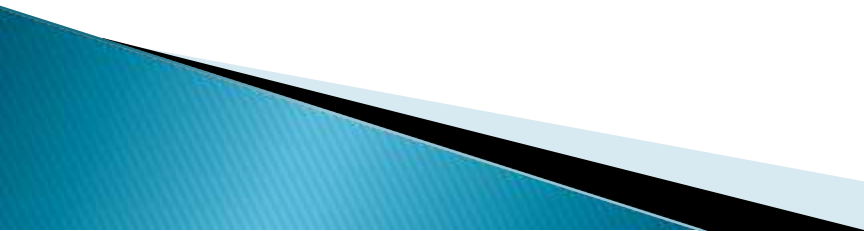
# Pollen Grain (Male Gametophyte)

- 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.

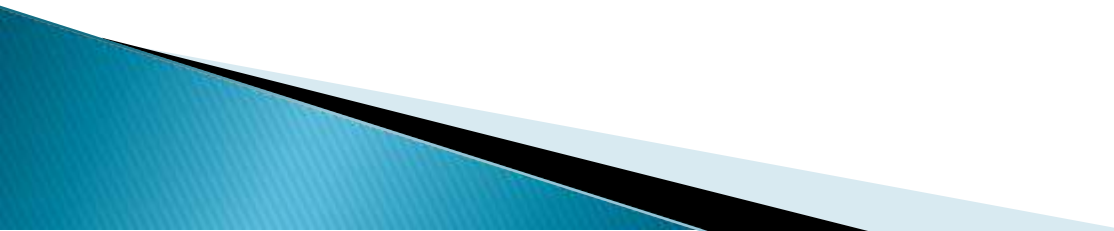
# Embryo sac



# 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

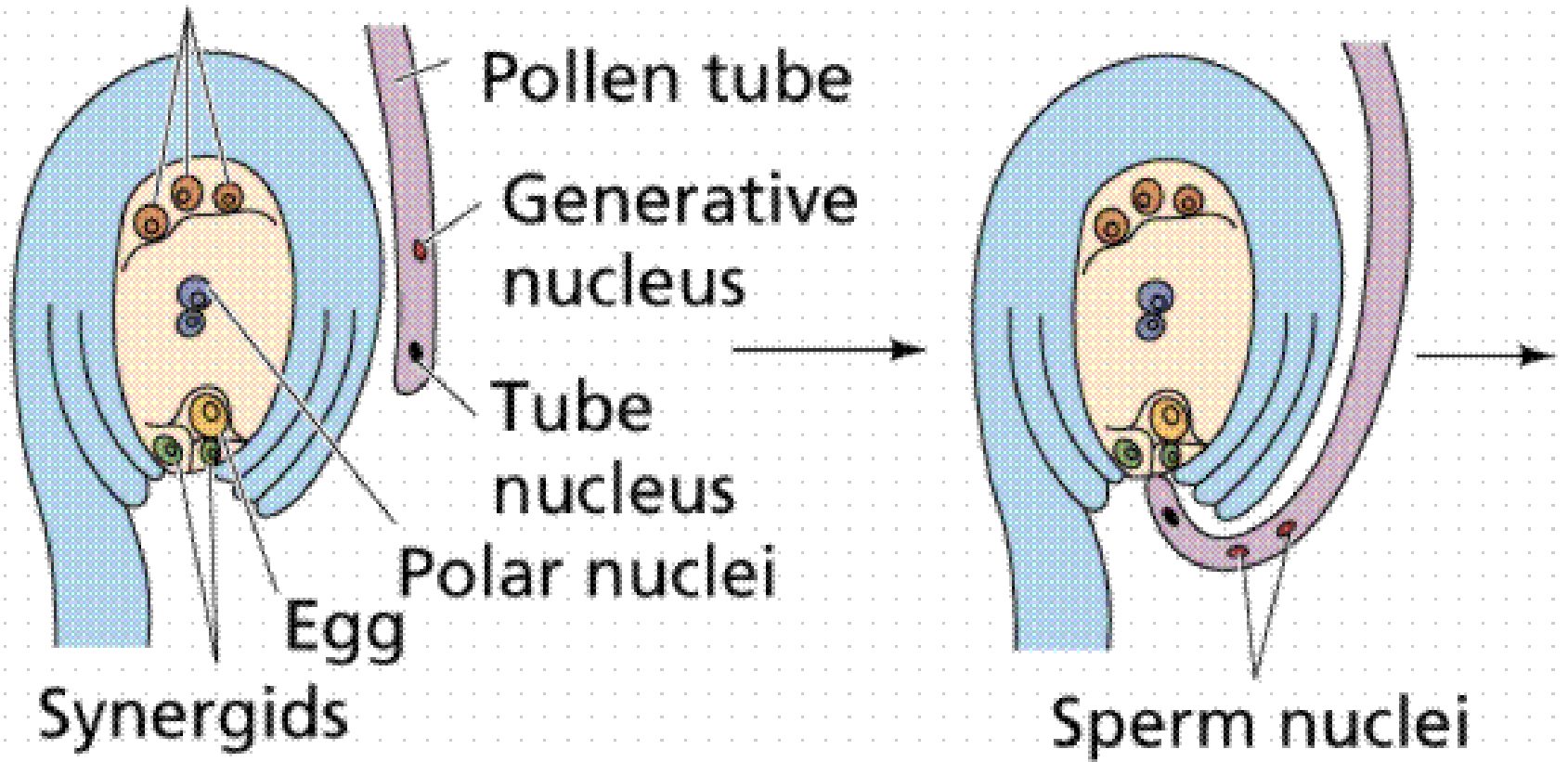
- ▶ Arises as primordium on placenta.
  - ▶ The short stalk which attach ovule with placenta is **funicle**.
  - ▶ The primordium grows into a mass of cells forming **nucellus**, the body of ovule.
  - ▶ The two protective covering of nucellus is **integuments**, except at the tip leaving a small opening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

# Ovule

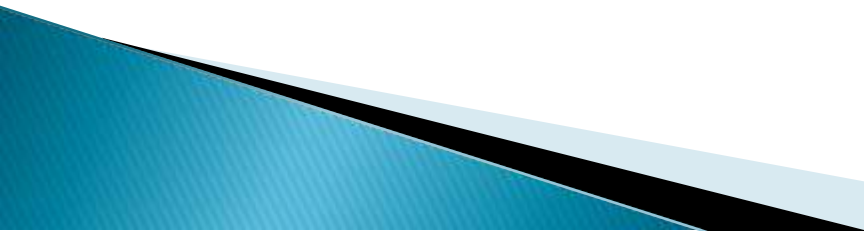
- ▶ Basal part of ovule is called **chalaza** that lie opposite to micropyle.
- ▶ Cells of nucellus are rich in reserve food.
- ▶ A single **embryo sac** or **female gametophyte** located in the nucellus, which is developed from megaspore.



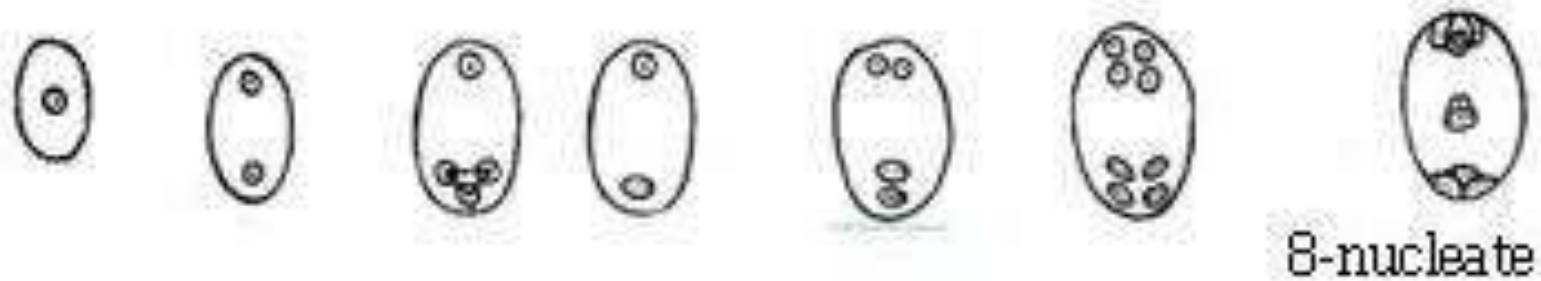
# Three antipodal cells



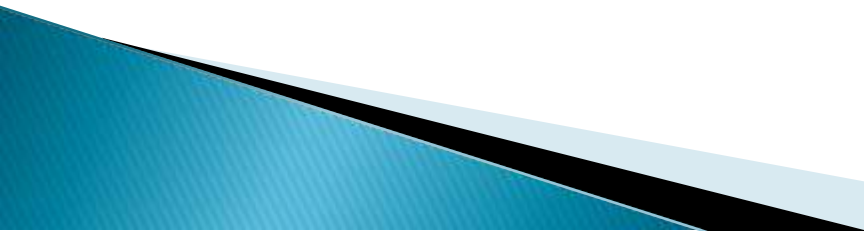
# Megasporogenesis And Development Of Female Gametophyte

- ▶ 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.
- 

# Stages of female gametophyte



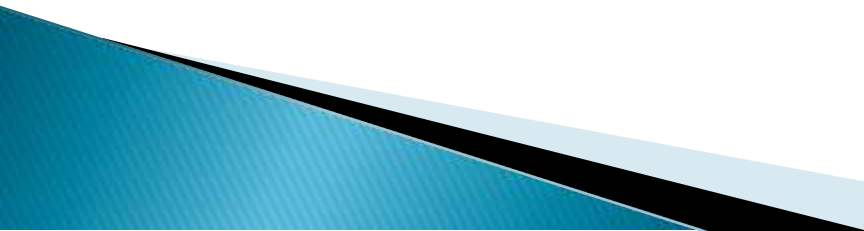
# Megasporogenesis And Development Of Female Gametophyte

- ▶ 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.
- 

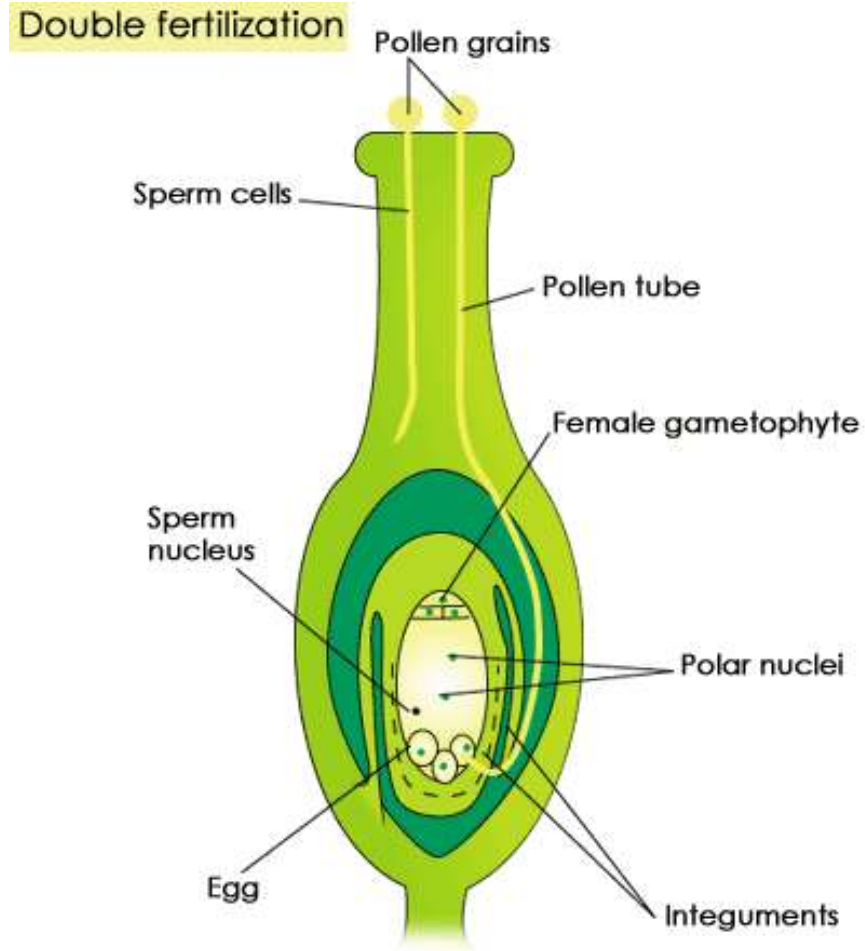
# Pollen–pistil Interaction

- ▶ **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.

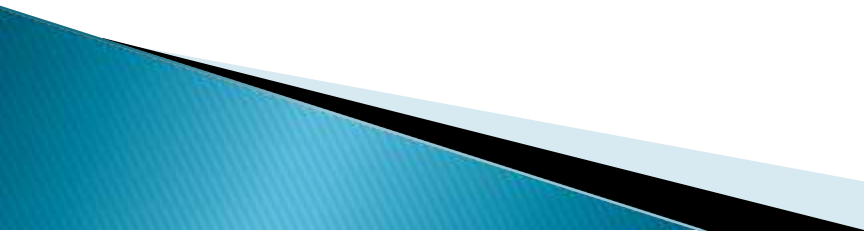
# Pollen–pistil Interaction

- (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

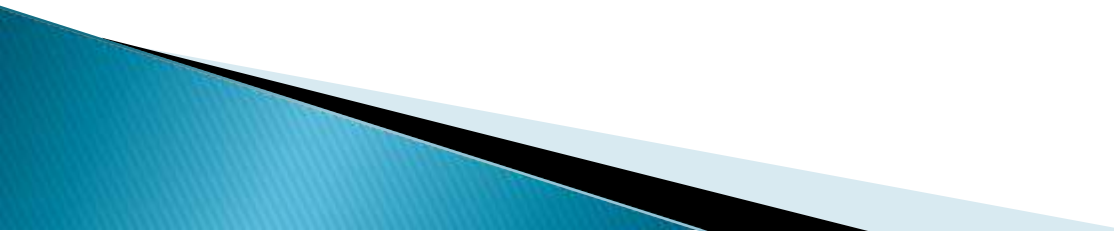


# Double Fertilisation


- 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.
- 



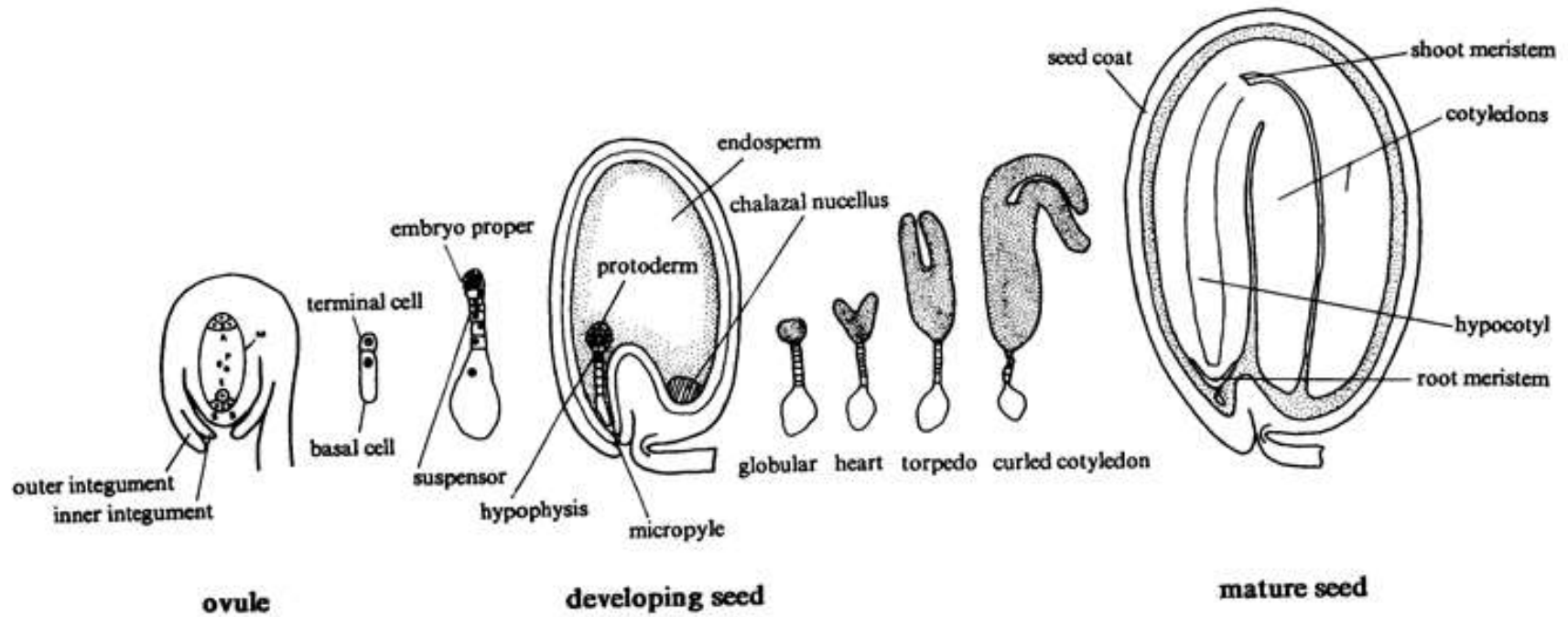
# Post Fertilisation Events

- ▶ 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.
- 

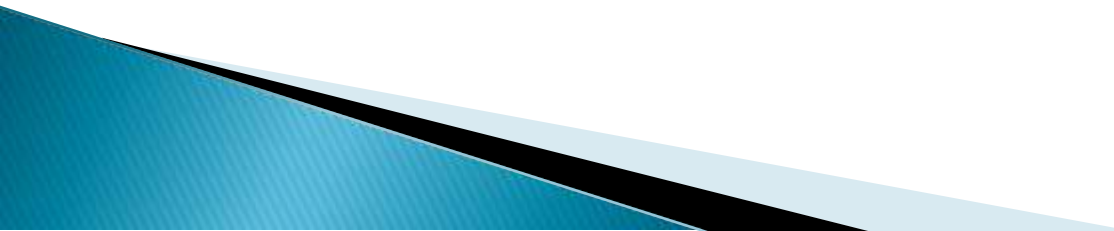
# Embryo Development



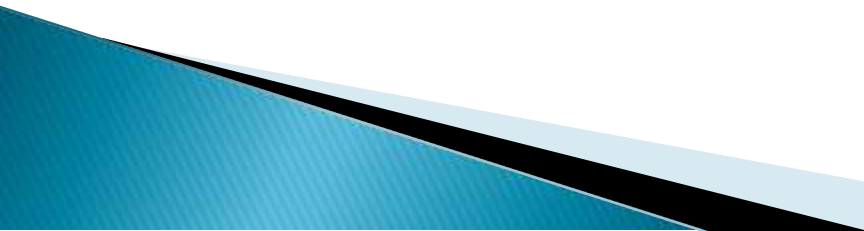
# Embryo

- ▶ 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)

- ▶ 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.
- 

Thank you