Reproduction in Crop plants

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Reproduction

Production of a new generation of an individuals (progeny) by sexual or asexual means.

Modes of reproduction

1. Asexual

2. Sexual

Asexual reproduction

- Multiplication of plant by passing asexual process.
- It does not involve fusion of male and female gametes
- New plants may develop either from vegetative parts of plant (vegetative reproduction) or they may be arise from embryos that develop without fertilization (apomixis)

Vegetative reproduction

- Multiplication of plant by vegetative plant parts is called vegetative reproduction

- It is two types:

Natural; rhizomes, tuber, bulb, runner, sucker, stolen

Artificial; stem cutting, root cutting, grafting, layering, budding etc.

Vegetative reproduction

- Underground modified stems:

  tuber- potato (*Solanum tuberosum*) etc.

  bulb- Onion (*Allium cepa*), garlic (*Allium sativum*) etc.

  rhizome- Ginger (*Zingiber officinale*), turmeric (*Curcuma domestica*)

  corm- bunda (Colocasia antiquorum), arwi (Colocasia esculenta) etc.

- Sub aerial stem: these includes runner, stolen, sucker etc. used for propagation of mint (*Mentha sp*.), date palm (*Phonex dactilifera*) etc.

Significance of vegetative reproduction

- Desirable plant may be used directly as a variety regardless of whether it is homozygous or heterozygous
- Maintain purity of variety

Apomixis

- In apomixis, seed are formed but embryo develop without fertilization
- The resulting from them are identical in genotype to the parent plant
- Sexual reproduction is either suppressed or absent

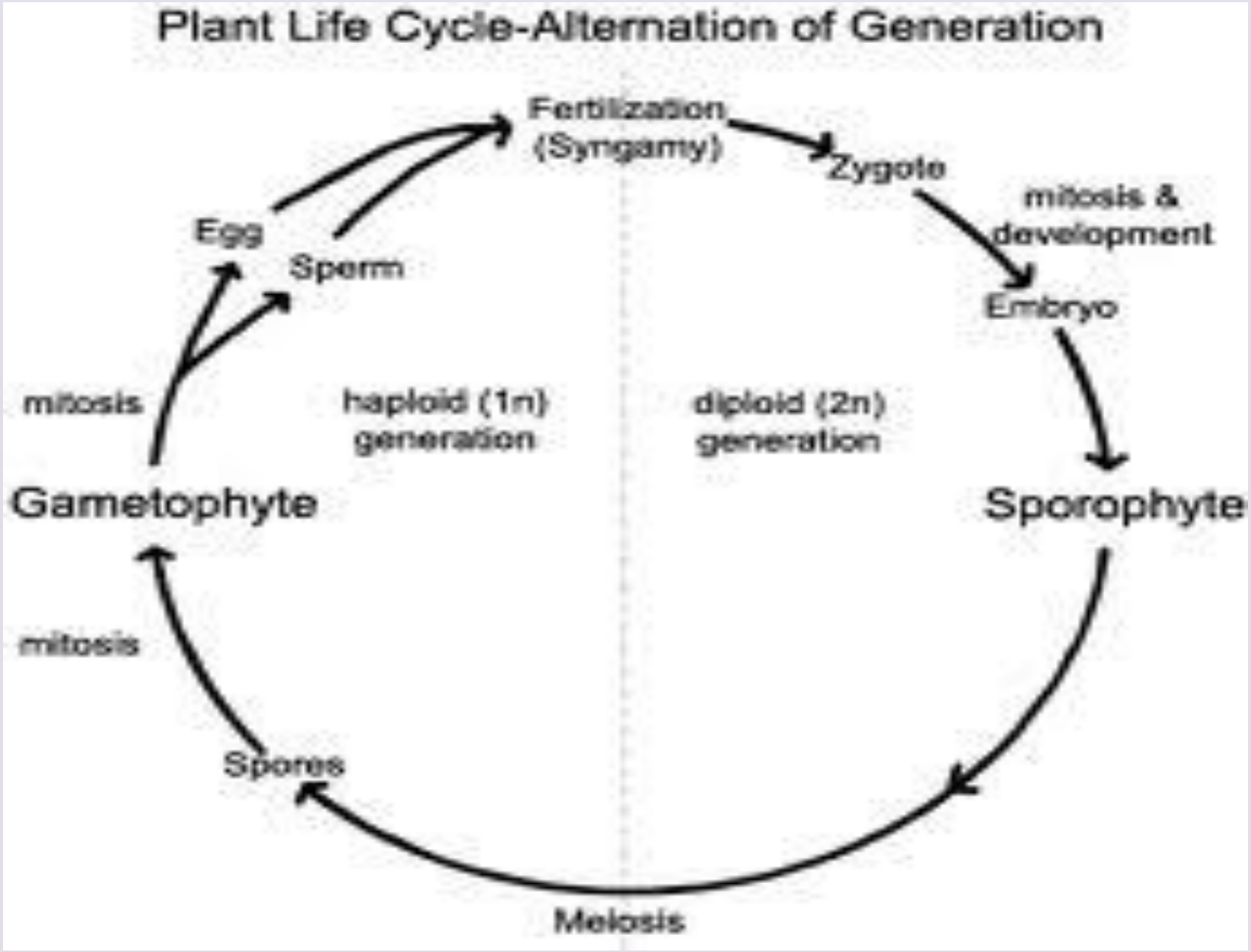
Sexual reproduction

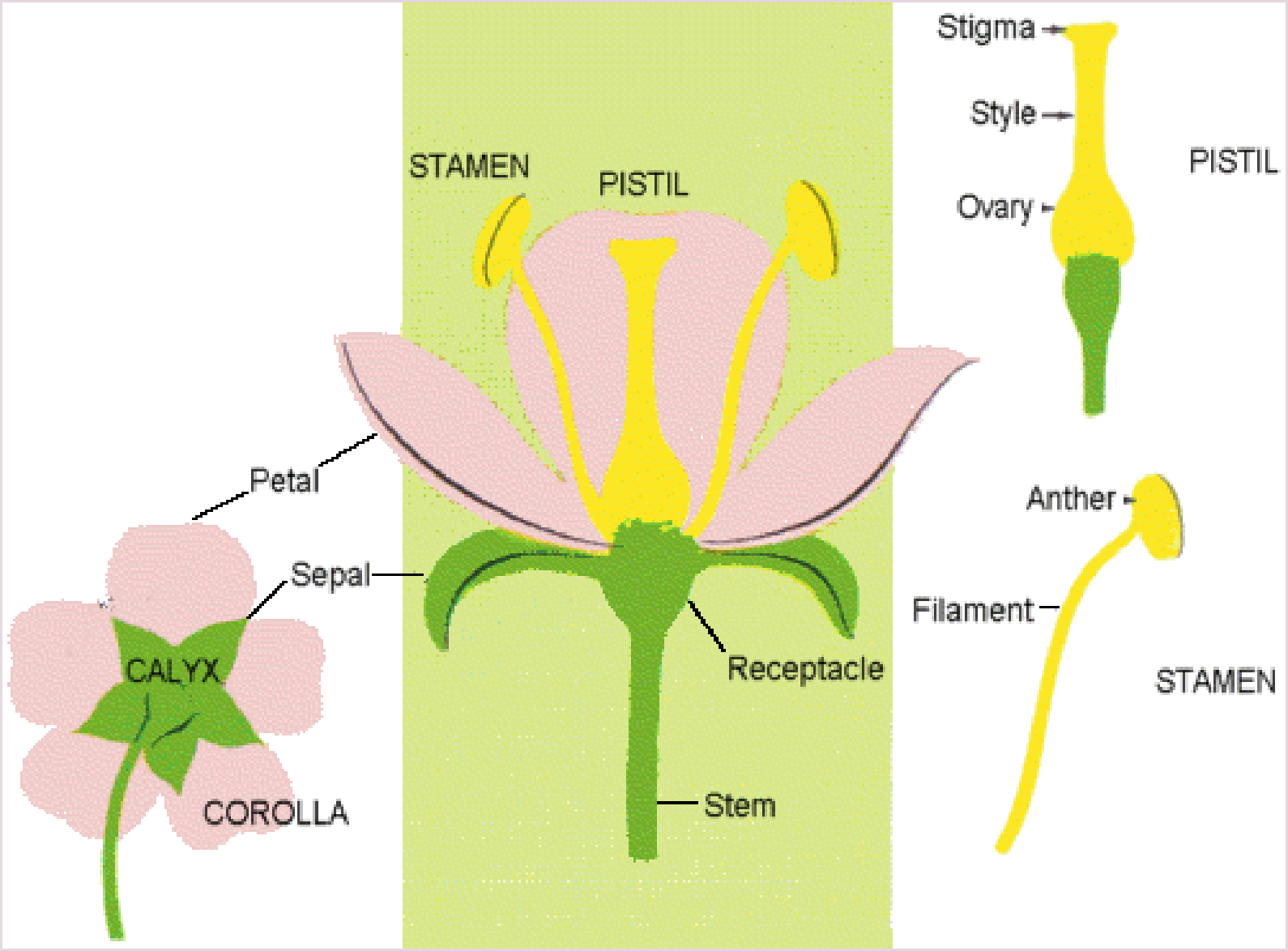
Sexual reproduction involves fusion of male and female gametes to form a zygote, which develops into an embryo.

In crop plants, male and female gametes are produced in specialized structures known as flowers.

A. **Sporogenesis:** production of microspores and megaspores

B. **Gametogenesis:** production of male and female gametes in microspores and megaspores, respectively


Plant Life Cycle-Alternation of Generation
Fertilization
(Syngamy)
Zygote
mitosis &
development
Embryo
Egg
Sperm
mitosis
haploid (1n)
generation
diploid (2n)
generation
Gametophyte
Sporophyte
mitosis
Spores
Meiosis


Stigma
Style
Ovary
PISTIL
STAMEN
PISTIL
Petal
Sepal
CALYX
COROLLA
Receptacle
Stem
Anther
Filament
STAMEN

Sporogenesis

- Microsporogenesis: Production of microspores in pollen sacs is known as microsporogenesis.

  Each anther has four pollen sacs, which content numerous pollen mother cells (PMC). Each PMC undergoes meiosis to produce four haploid cells or microspore.

- Megasporogenesis: Production of megaspores in ovule , which present inside ovary is known as megasporogenesis.

  A single cell in each ovule differentiates into a megaspore mother cell.

  The megaspore mother cell undergoes meiosis to produce four haploid megaspores.

  Three of the megaspores degenerate leaving one functional megaspore per ovule

Gametogenesis

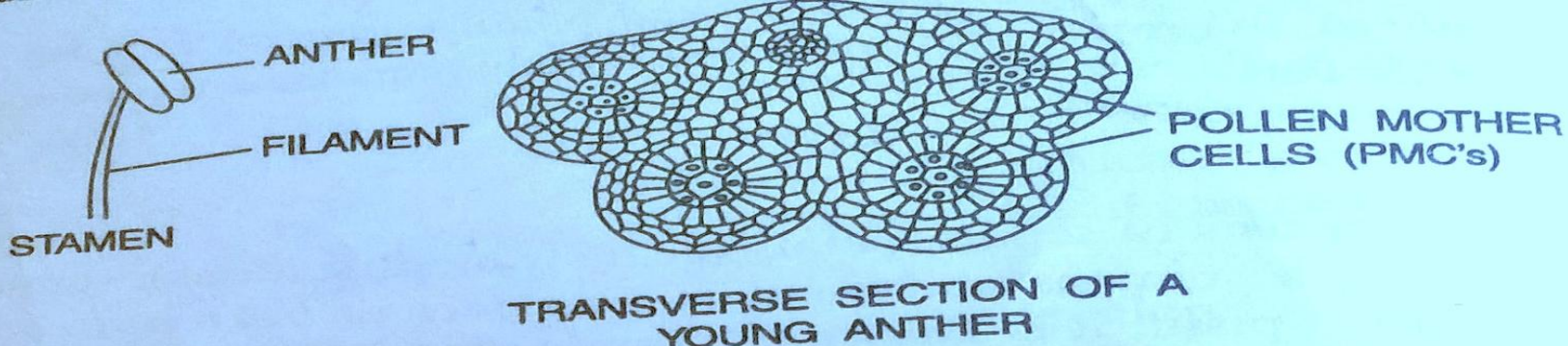
Microgametogenesis:

Production of male gamete in microspore is known as microgametogenesis.

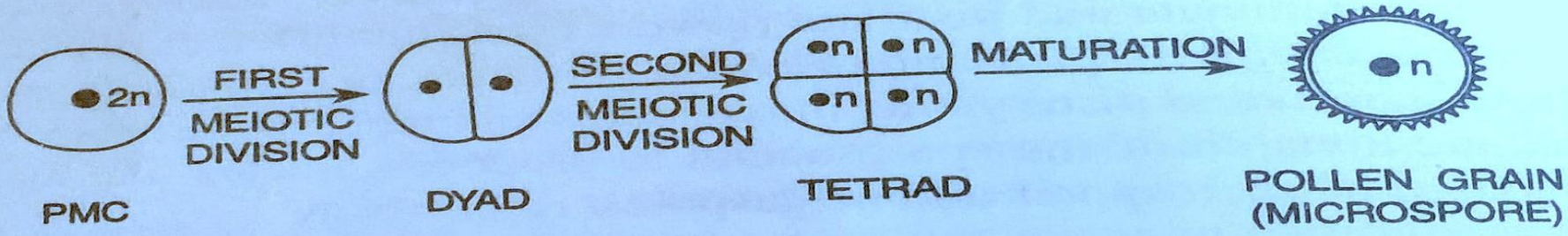
Microspore nucleus divide mitotically to produce generative and a vegetative or tube nucleus.

Pollen generally released in the binucleate stage.

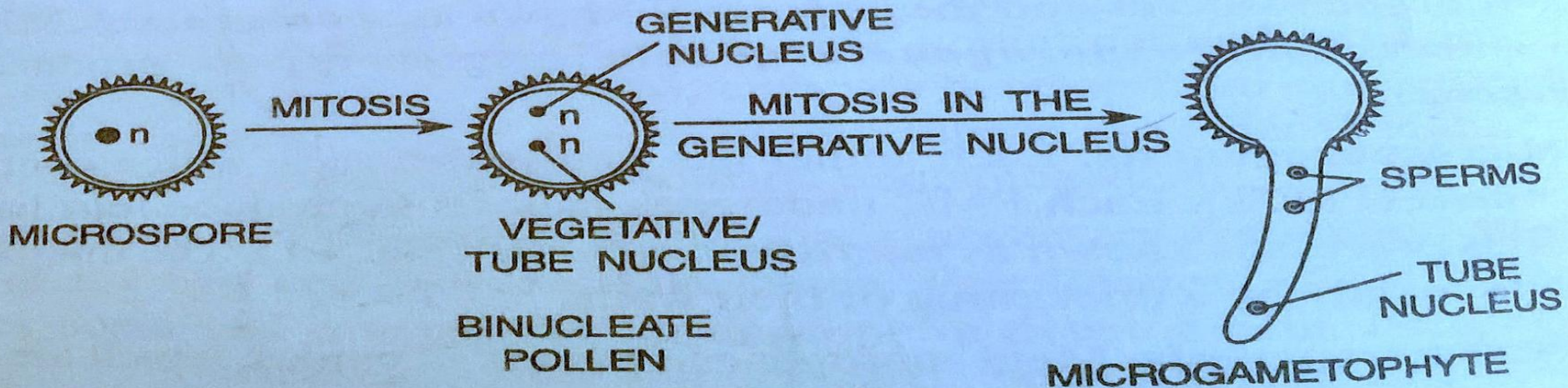
After pollination generative nucleus undergoes a mitotic division to produce two male gametes or sperms.



TRANSVERSE SECTION OF A YOUNG ANTHER



MICROSPOROGENESIS



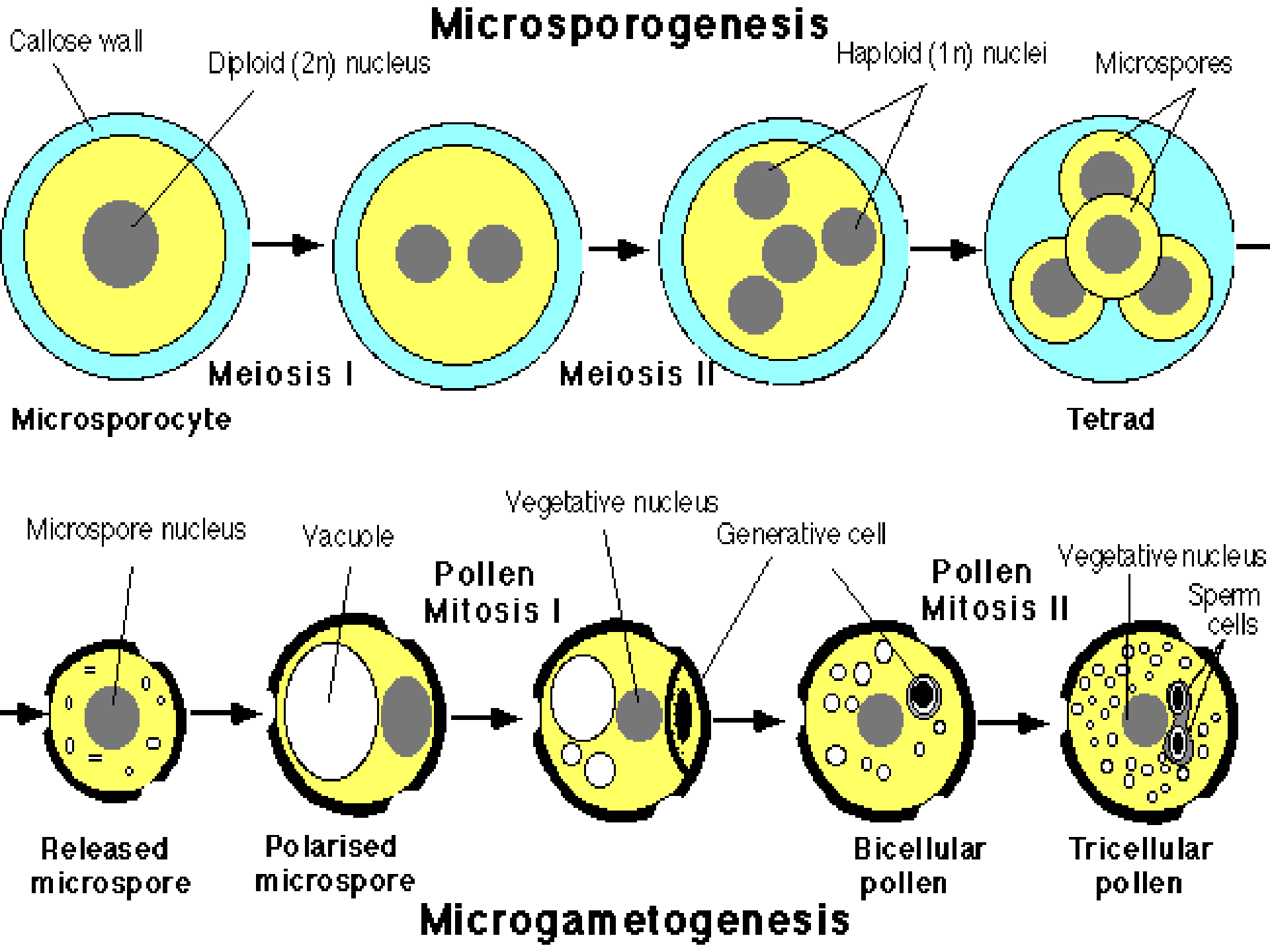
MICROGAMETOGENESIS

Development of male gamete

On maturation of the pollen, the microspore nucleus divides mitotically to produce a generative and a vegetative or tube nucleus.

The pollen is generally released in this binucleate stage.

The transfer of pollen grain from anther (male part) to stigma (female part) of flower is called pollination.


Microsporogenesis
Callose wall
Diploid (2n) nucleus
Haploid (1n) nuclei
Microspores
Meiosis I
Meiosis II
Microsporocyte
Tetrad
Microspore nucleus
Vacuole
Vegetative nucleus
Generative cell
Pollen Mitosis I
Pollen Mitosis II
Vegetative nucleus
Sperm cells
Released microspore
Polarised microspore
Bicellular pollen
Tricellular pollen
Microgametogenesis

Continue….

After the pollination, the pollen germinates.

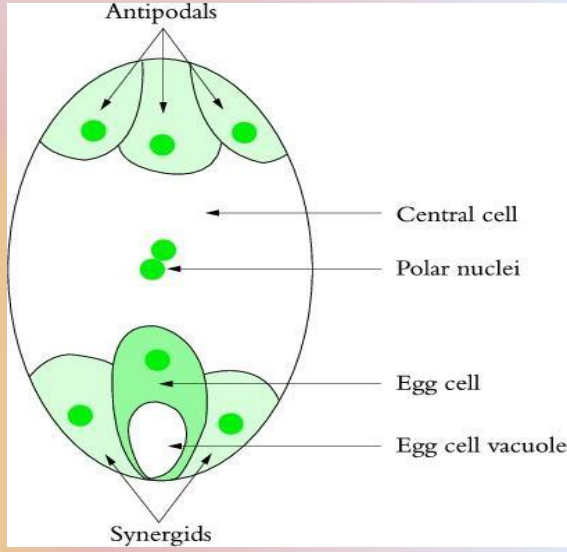
The pollen tube enters the stigma and travels down the style.

The generative nucleus at this phase undergoes another mitotic division to produce two male gametes or sperm nuclei.

The pollen along with the pollen tube possessing a pair of sperm nuclei is called microgametophyte.

The pollen tube enters the embryo sac through micropyle and discharges the two sperm nuclei.

Megagametogenesis:

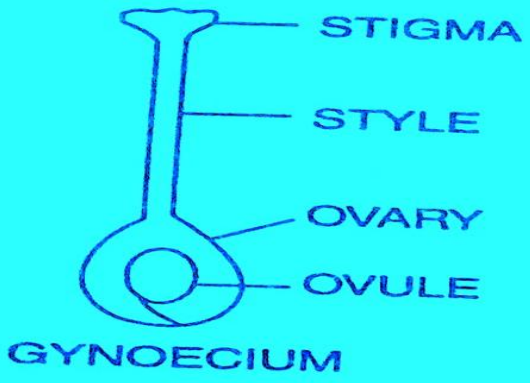


The development of embryo sac from a megaspore is known as megagametogenesis.

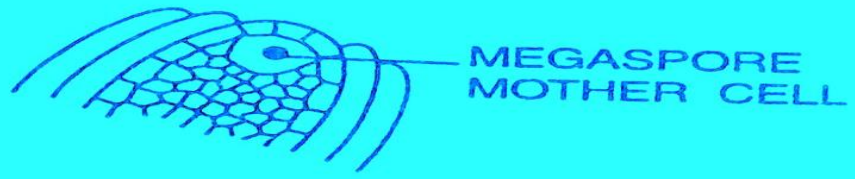
Functional megaspore nucleus divide mitotically to produce four or more nuclei.

In most of the crop plants megaspore nucleus undergoes three mitotic division and produce eight nuclei.

These eight nuclei arranged themselves as three antipodal, two nuclei at centre, which later fuse and form secondary nucleus, and at opposite pole one central egg cell and two synergid cells.

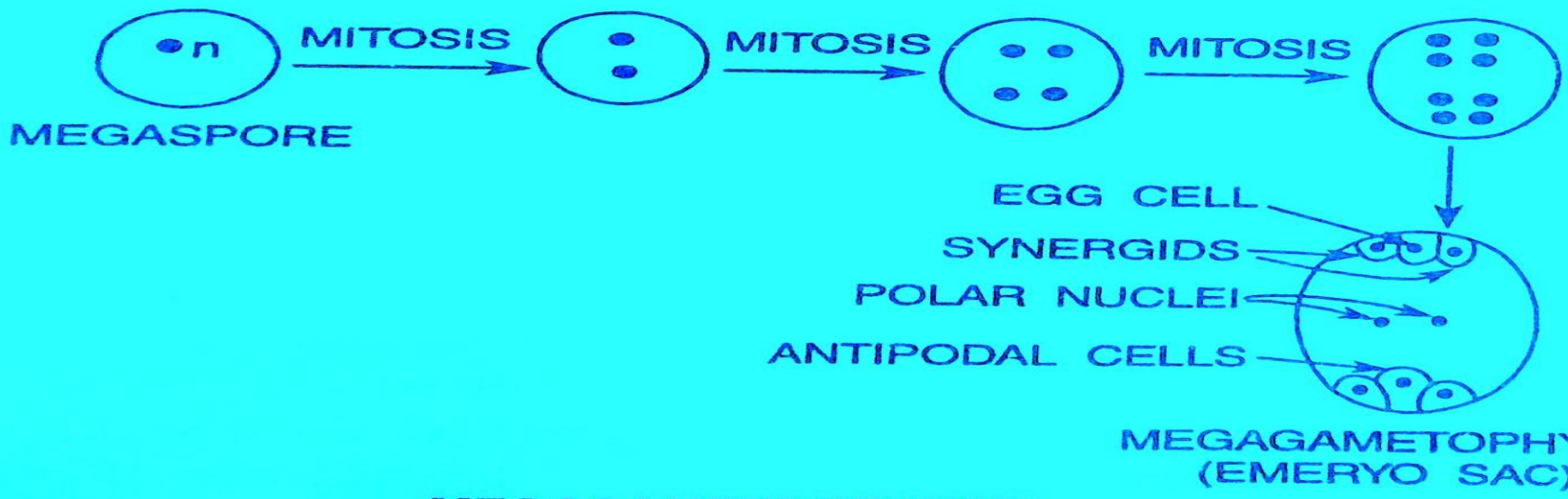


GYNOECIUM



LONGITUDINAL
SECTION OF OVULE

MEGASPOROGENESIS



MEGAGAMETOGENESIS

Development of female gamete

The nucleus of the functional megaspore undergoes three mitotic divisions to produce eight or more nuclei.

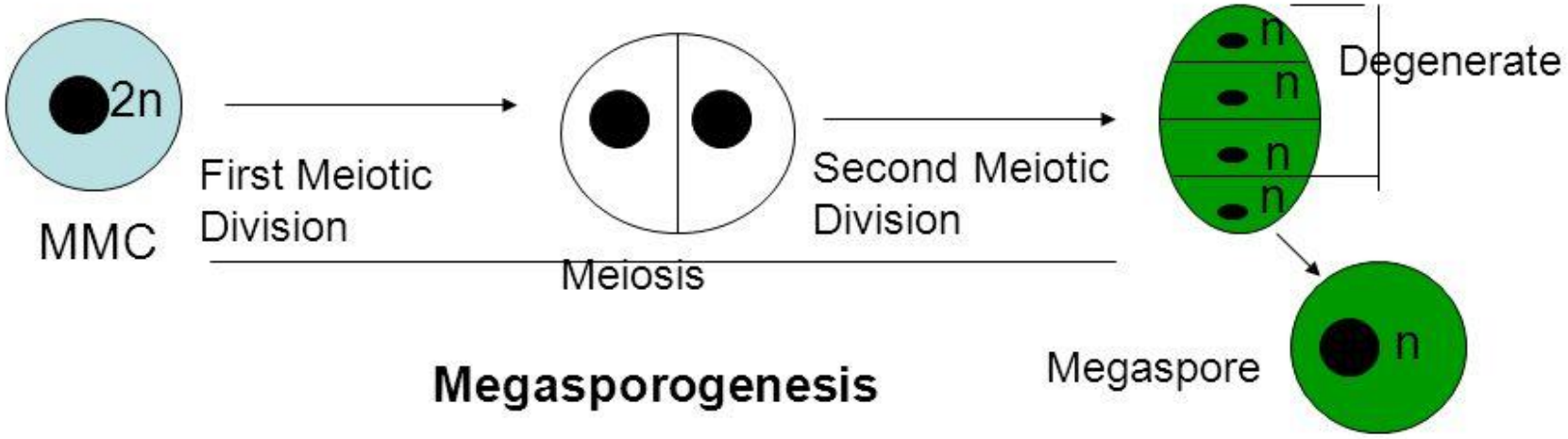
The exact number of nuclei and their arrangement varies from one species to another.

The megaspore nucleus divides thrice to produce eight nuclei.

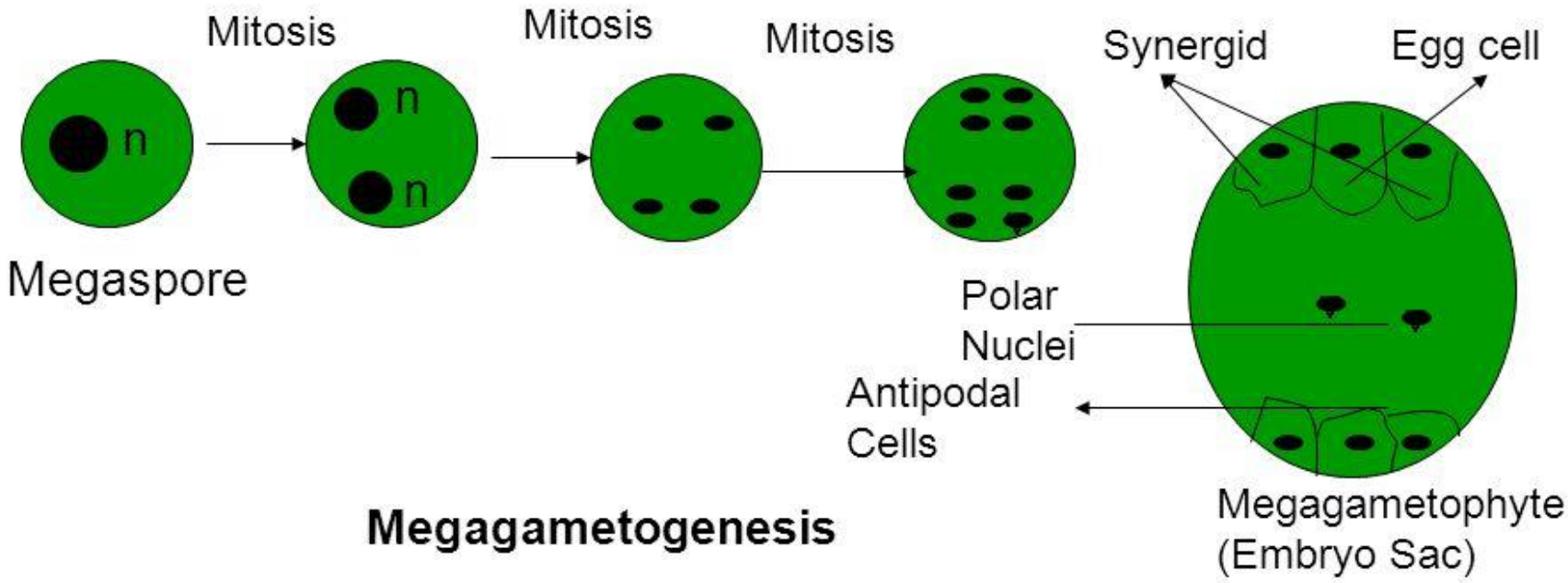
Three of these nuclei move to one pole and produce a central egg cell and two synergid cells on either side.

Another three nuclei migrate to the opposite pole to develop into three antipodal cells.

Female gametogenesis



Megasporogenesis



Megagametogenesis

Continue….

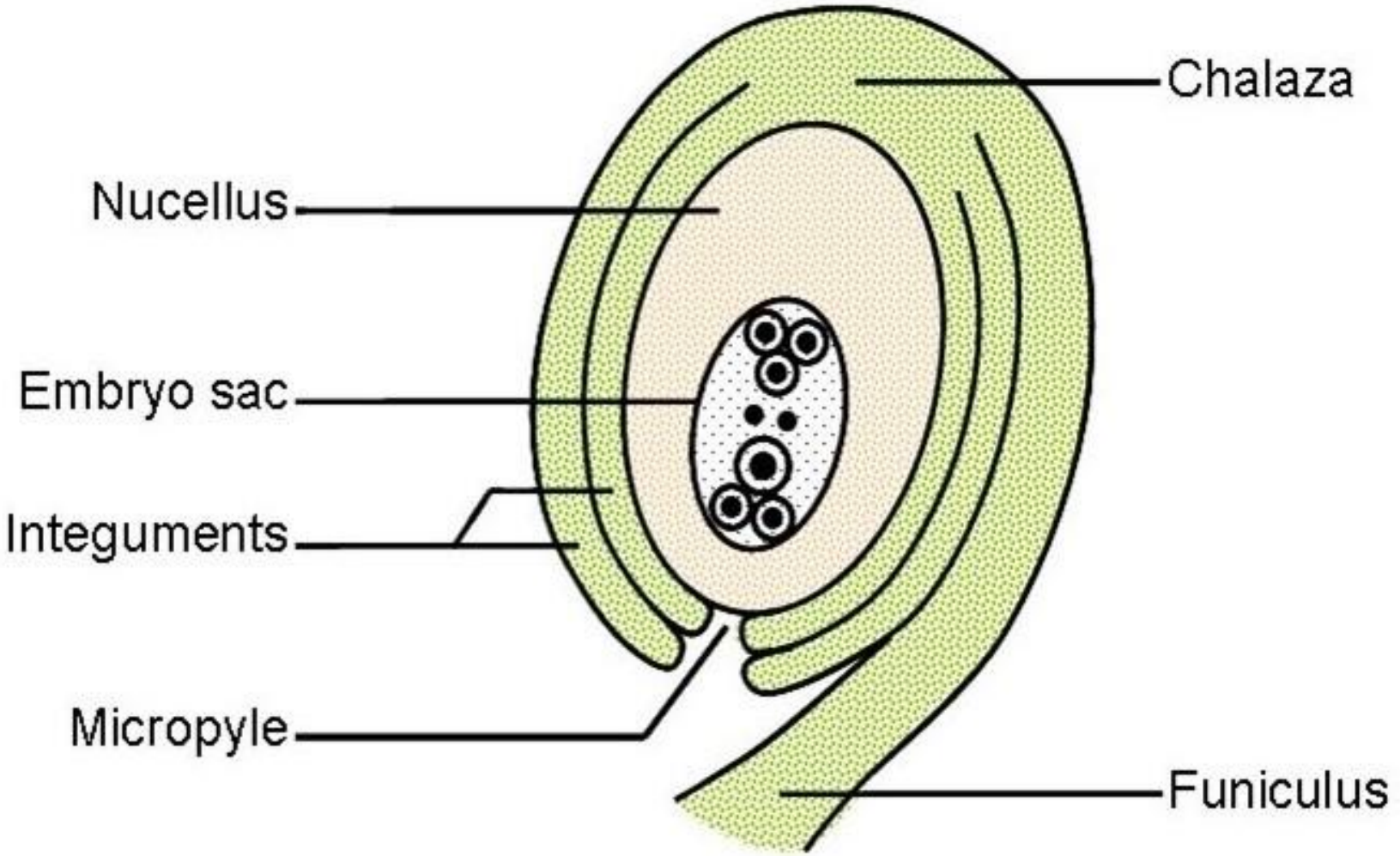
The two nuclei remaining in the center, the polar nuclei, fuse to form the secondary nucleus.

The megaspore thus develops into a mature female gametophyte called megagametophyte or embryo sac.

The development of embryo sac from a megaspore is known as megagametogeneis.

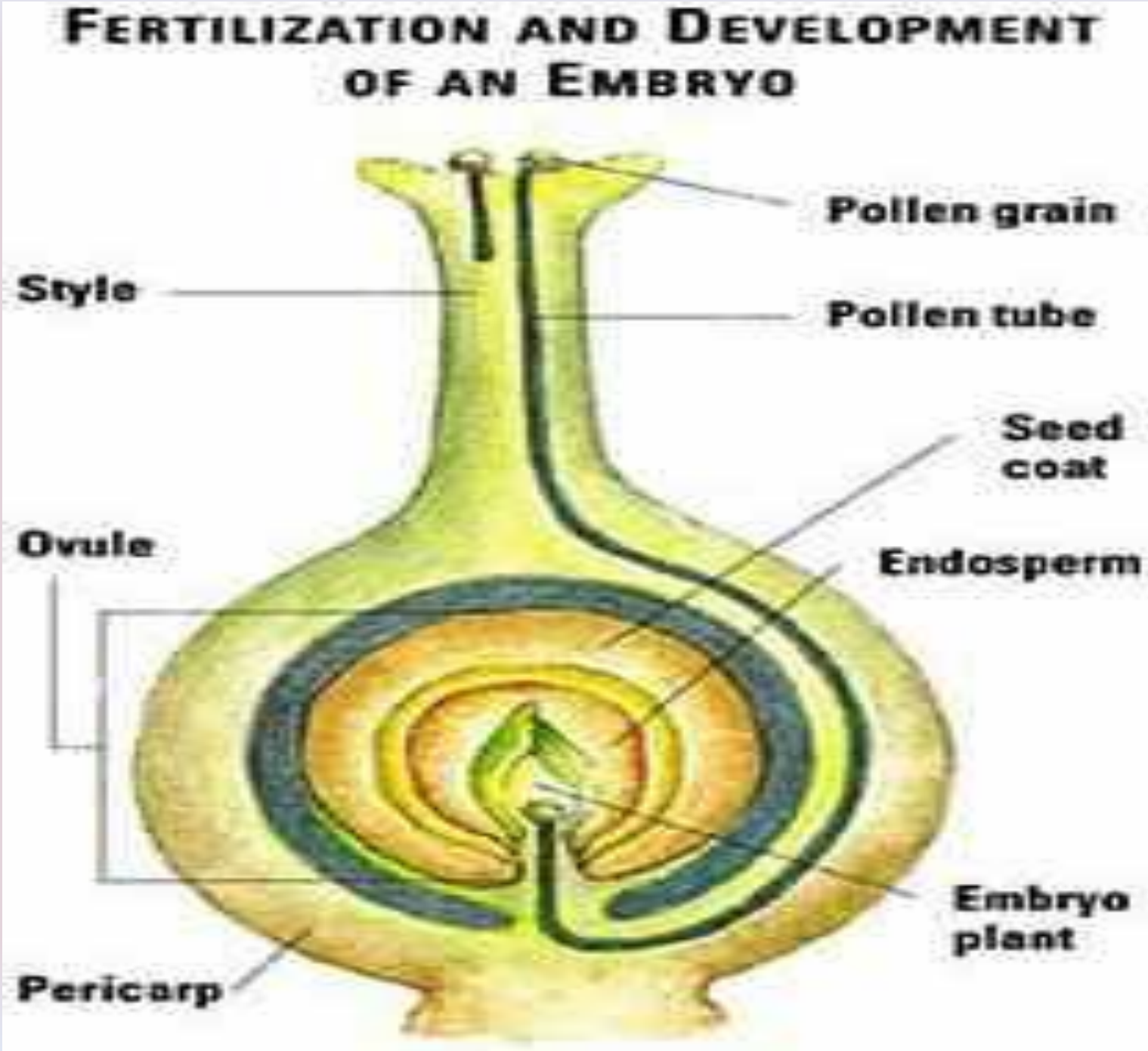
The embryo sac generally contains one egg cell, two synergids with the apparent function of guiding the sperm nucleus towards the egg cell and three antipodals which forms the prothalamus cells and one diploid secondary nucleus.

Structure of Embryo sac



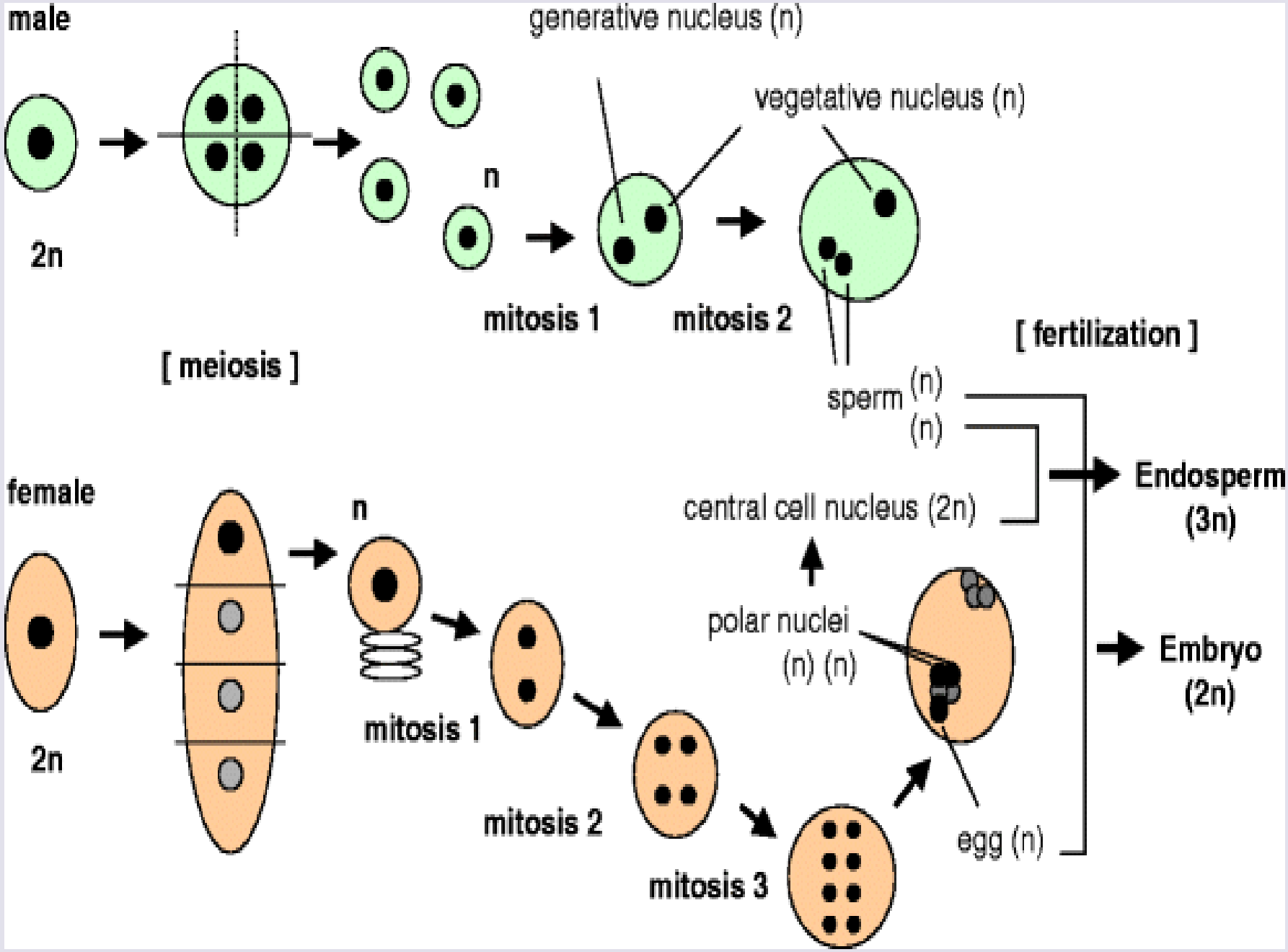
Cross-section through Ovule

Fertilization and Development of an Embryo



Fertilization

- The fusion of one of the two male gamete or sperms with egg cell and production of diploid zygote, is known as fertilization.
- Fusion of remaining male gamete with the secondary nucleus, leading to formation of a triploid primary endosperm nucleus is known as triple fusion
- This process is known as double fertilization



Double Fertilization and Triple Fusion

Signification of Sexual Reproduction

- Makes possible to combine genes from two or more parents
- Recombination among these genes produce a large number of different genotypes
- It create variations

THANKS