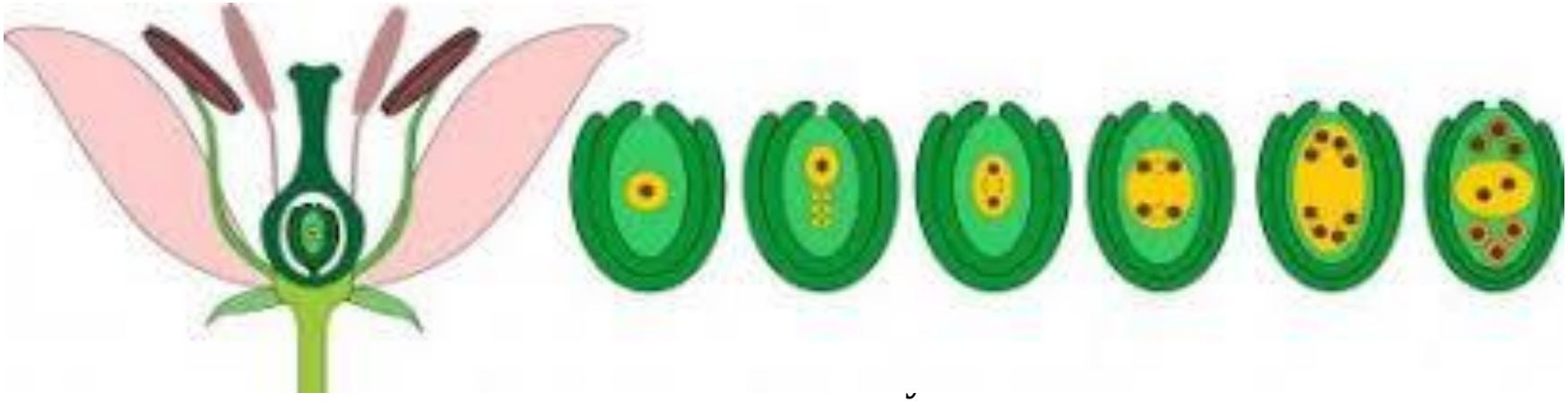
MEGASPOROGENESIS AND FEMALE GAMETOPHYTE



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For B.Sc. Part II Students

Lecture No.13

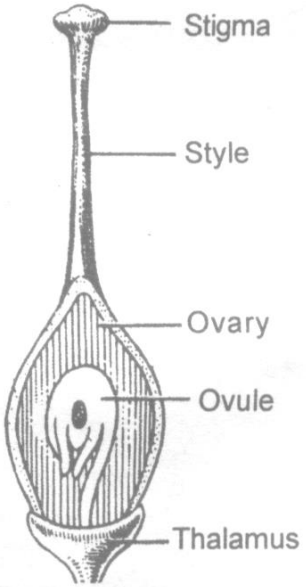
Female reproductive organ Gynoecium

➢ Gynoecium is the female reproductive organ. The free unit of gynoecium is called pistil or carpel. Carpel is also known as megesporophyll.

➢ The carpel is differentiate into three region

[i] Stigma [ii] Style [iii] Ovary

The end of the carpel receives pollen grain is called stigma. A long, narrow tubular structure is present in between the stigma and ovary called style. The basal swollen part of the carpel is called ovary.



Gynoecium /Pistil

Ovule or Megasporangium

- The ovules is also known as megasporongia which are borne on a cushion- like tissue called placenta in the ovary
- Ridge or stalk like out growth is formed from the placenta of the ovary on which body of ovules are present.
- Each ovule attached to the placenta by means of a thin stalk called funicle or funiculus /Funiculum .
- The point of attachment of the funicle with the ovule is called hilum.
- The main region of the ovule is composed by mass of parenchymatous cells called nucellus.
- Nucellus is the main part of ovule. The nucellus is covered by one or two coats called integuments
- In most of the ovule, funicle is attached to the main body of ovule for some distance (at lateral side) to form a ridge like structure known as Raphe

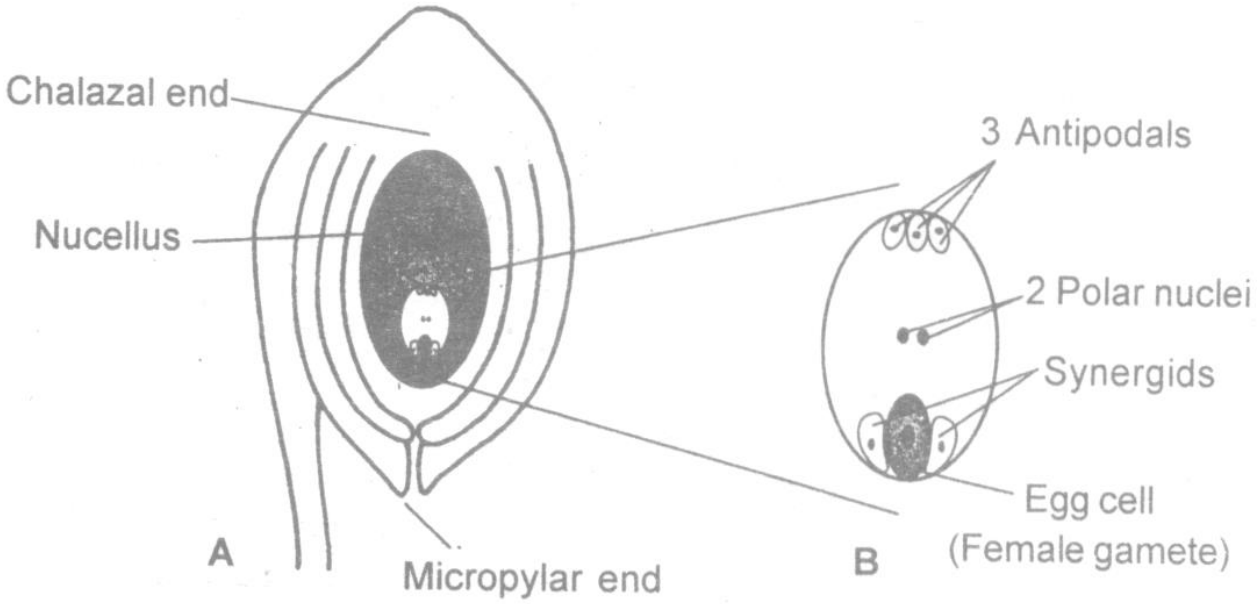


Figure: (A) Mature ovule (B) Mature embryosac

➢A place from where funicle and integuments arise is called Chalaza. Integument is absent just opposite to the chalaza, so that a narrow passage (pore) is formed which is called micropyle.

➢ In most of the Angiosperm entire part of the nucellus is utilized by developing embryo sac but in some of the angiosperm some part of the nucellus remain inside the ovules that part of the nucellus present inside the seed in the form of a thin layer known as perisperm is commonly found in family Piperaceae and Zingiberaceae

Types of ovules on the basis of integuments

Unitegmic ovule : A single integumented ovule is called unitegmic ovule –example- members of Gamopetalae and Gymnosperm**.**

Bitegmic ovule: Two integumented ovule is called bitegmic ovule . Example – In most of Angiosperm (Polypetalae and Monocots)

Types of ovules on the basis of Nucellus

On the basis of nucellus ovules are of two types

Crassinucellate :- The nucellus is massive (it is made up of many layers) and sporogenous tissue is deeply embeded in it. Such ovules ar known as Crassinucellate ovule. Example :- Polypetalae group and Monocotyledons.

Tenuinucellate – The nucellus is either less developed or present in the form of single layer around the sporogenous cell such ovule are called tenuinucellate.

Example :- Gamopetalae group

- An extreme reduction of nucellar tissue occurs in family Rubiaceae

Types of Ovules

Depending on relative position of micropyle and chalaza at maturity the following six types of ovules have been recognised.

1. Atropous or orthotropous ovules

➢The body of ovule is upright with micropyle, chalaza and funicle falling in straight line. So that this ovule is called straight or upright ovule.

Example:- Polygonaceae , Piperaceae and in Gymnosperms.

➢ It is the most primitive and most simple type of ovule of Angiosperms.

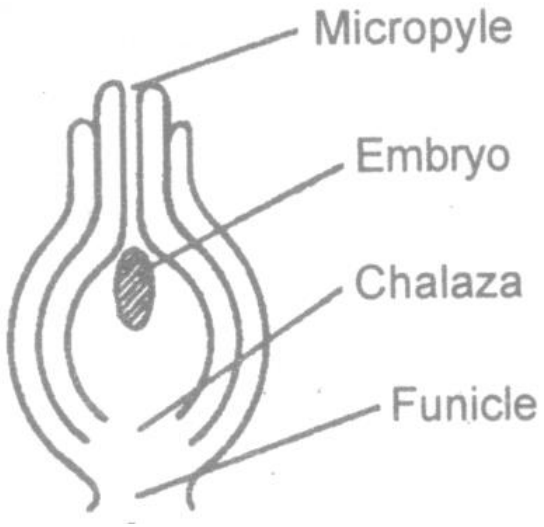


Figure: Atropous or orthotropous ovules

2. Anatropous ovules

➢Due to unilateral growth of funicle the whole body of ovule is inverted to 180º. As aresult micropyle come close to the base of funiculus. Due to unilateral growth of funiculus so it is also called **inverted ovule**. The nucellus remain straight i.e. micropyle and chalaza lie in one line and funicle lie parllel to it.

➢ It is most common type of ovule and occurs in several families of both dicotyledons and monocotyledons.

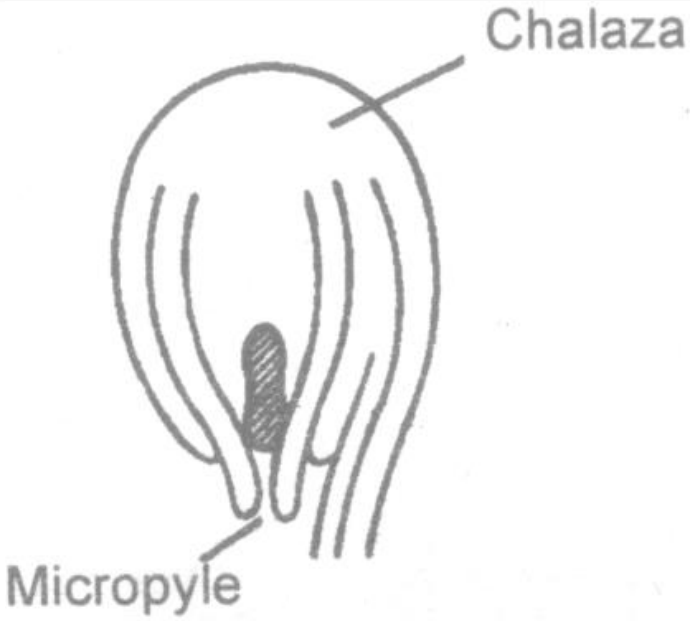


Figure: Anatropous ovules

3. Hemitropous or Hemi-anatropous ovule

In this ovule, the body of the ovule bent on funicle at 90º angle, i.e., body of ovule present at right angle to the funiculus.

- This is intermediate type between ortho and anatropous ovules.
- This ovules also called horizontal ovule because body of ovules present in horizontal position on the funiculus micropyle and chalaza are present in the same line but micropyle is situated away from hilum. Example:- Family Ranuculaceae and Primulaceae

Figure: Hemitropous or Hemi-anatropous ovule

4. Campylotropus ovule

➢In this ovule, the body of ovule curved in this way so micropyle and chalaza do not present in straight line.

➢The embryo sac and nucellus both are present in curved position Micropyle comes close to the hilum. Example:- Leguminosae, Capparidaceae, Cruciferae family

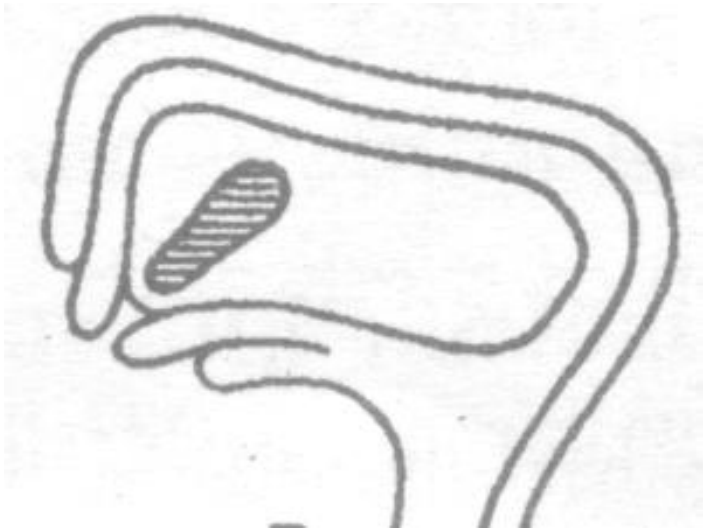


Figure: Campylotropus ovule

5. Amphitropus ovule

➢In this type of ovule, curvature is more pronounced or effective in the nucellus and due to this effect of nucellus embryo sac becomes **horse shoe shaped**.

➢Micropyle comes close to the hilum. It is also called as transverse ovule. e.g. Mirabilis , Lemna and Poppy, Alisma , Butomaceae family.

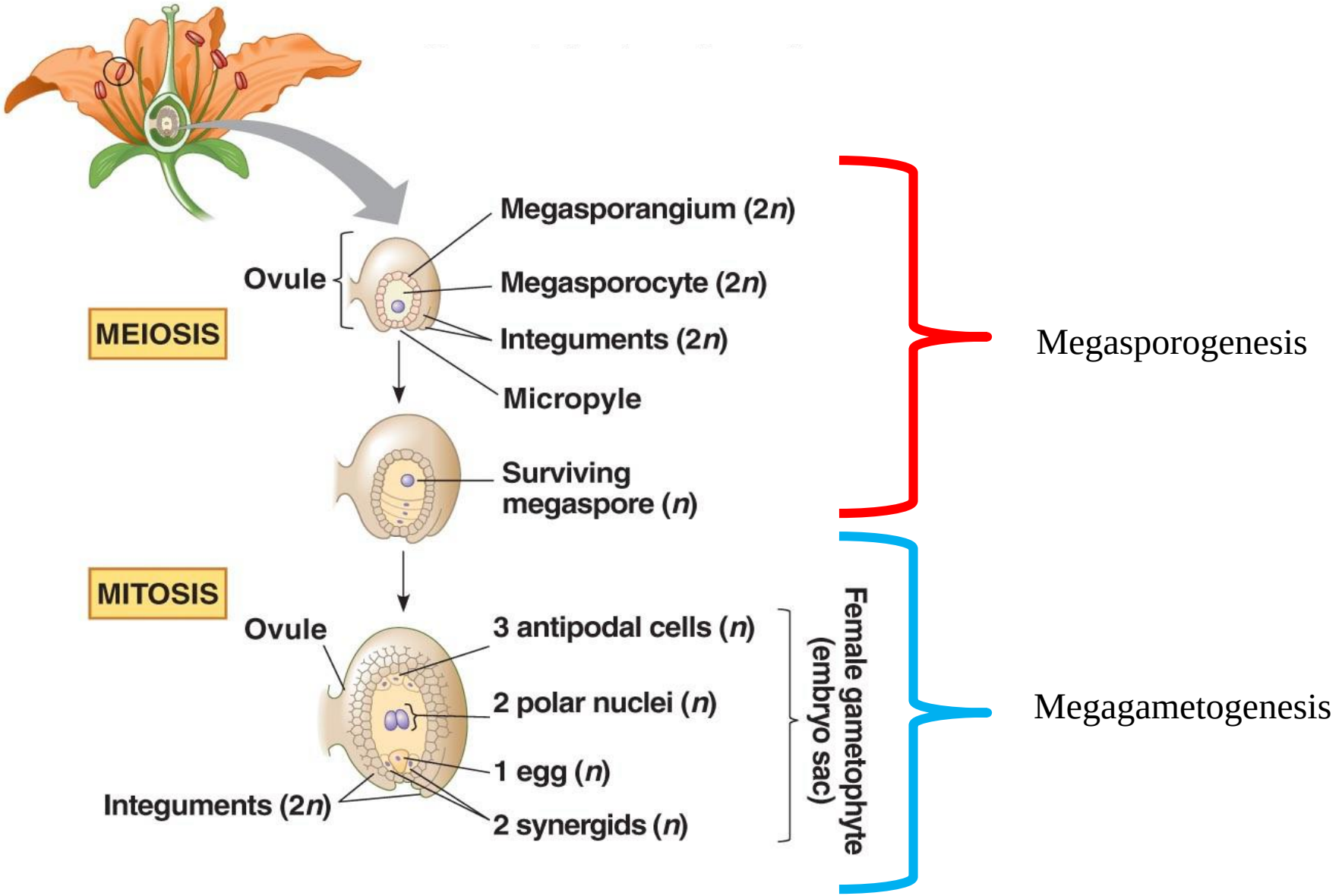
Figure: Amphitropus ovule

6. Circinotropous ovule

➢This type of ovule , first of all body of ovule inverted once and again turned into straight position due to the growth of funiculus so that body of ovule present on funicle at 360º.

➢The entire body of **ovule is surrounded by funiculus**. It is also known as coiled ovule. Micropyle is situated away from hilum .Example: Cactaceae family Opuntia

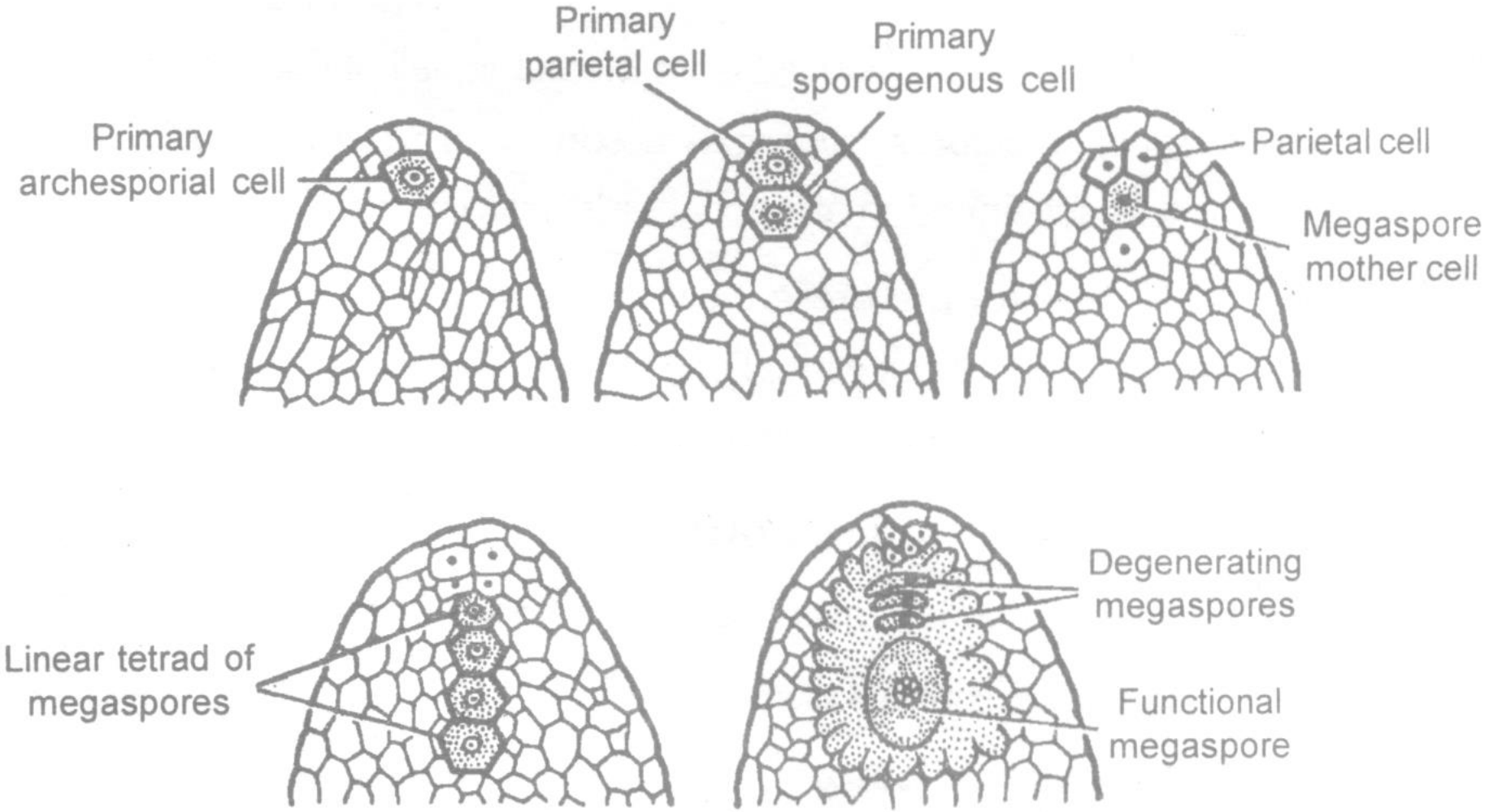
Figure: Circinotropous ovule


Megasporangium (2n)
Ovule
Megasporocyte (2n)
MEIOSIS
Integuments (2n)
Micropyle
Surviving megaspore (n)
MITOSIS
Ovule
3 antipodal cells (n)
2 polar nuclei (n)
1 egg (n)
Integuments (2n)
2 synergids (n)
Female gametophyte (embryo sac)
Megasporogenesis
Megagametogenesis

Megasporogenesis

Formation of megaspore (n) from megaspore mother cell (2n) inside the megasporangium (ovule) is called megasporogenesis.

- A single hypodermal cell in nucellus is differentiated from rest of cellsby its dense cytoplasm , larger size and larger nucleus , which is called primary archesporial cell or archesporial initials
- Archesporium divides periclinally to form an outer primary parietal cell and inner Primary Sporogenous cell. Activity of Primary Parietal cell depends on type of plants.
- If plant belongs to Gamopetalae then it forms Tenuinucellate type ovule and if plant belongs to Polypetalae then if form Crassinucellate type of ovule.
- The primary sporogenous cell directly act as a megaspore mother cell. It divides meiotically to form, four haploid megaspores.
- The four haploid megaspores generally arranged in linear tetrad . Generally the lower most or chalazal megaspore remains functional out of tetrad of megaspores and the other three lie towards the micropyle degenerate


Primary archesporial cell
Primary parietal cell
Primary sporogenous cell
Parietal cell
Megaspore mother cell
Linear tetrad of megaspores
Degenerating megaspores
Functional megaspore

- The functional megaspore produces female gametophyte.
- In most of Angiosperms Chalazal megaspore remains functional.

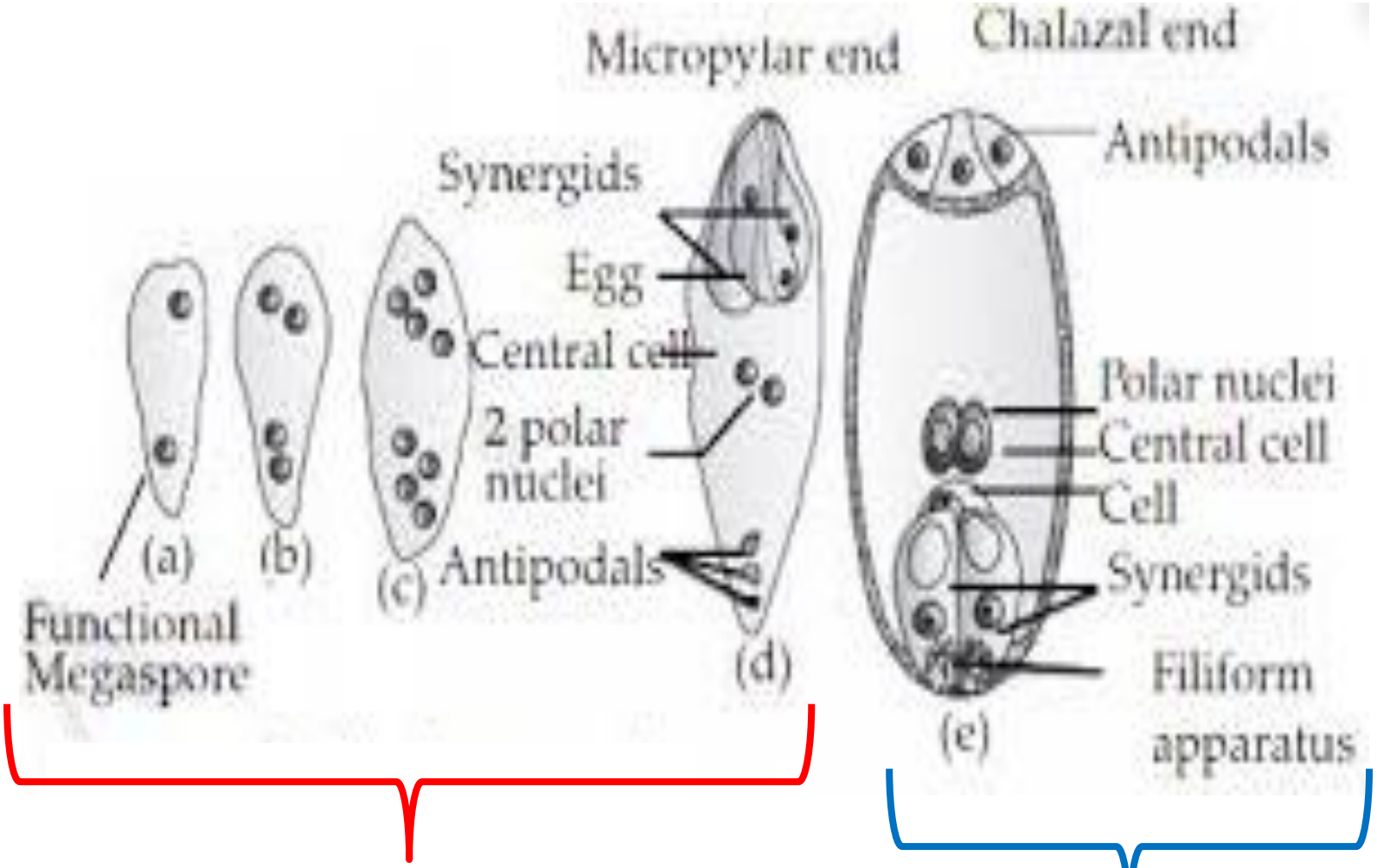
Development of female gametophyte or embryosac: Megagametogenesis

- Megaspore is the first cell of the female gametophyte. This megaspore grows in size and obtains nutrition from the nucellus.
- The nucleus of megaspore divides mitotically to form a two nuclei. Each nucleus moves towards the opposite pole and reached at their respective poles.
- Both the nuclei lie at poles divide twice mitotically. Resulting, four-four nuclei are formed at each (Total 8-nuclei).
- Out of the four, one-one nucleus migrates from the both poles (one nucleus from chalazal side and one nucleus from micropylar side) towards the centre. They are known as polar nuclei. Both polar nuclei are present in the centre.
- Remaining three-three nuclei at each pole surrounded by cytoplasm to form cells as a result of cytokinesis Three cells are formed towards the micropyle in which one cell is large and more distinct out of three cells.

- This is called egg cell and remaining two smaller cells are known as synergids.
- These three micropylar cells collectively known as **egg-apparatus.**

(1Egg cell + 2 Synergids)

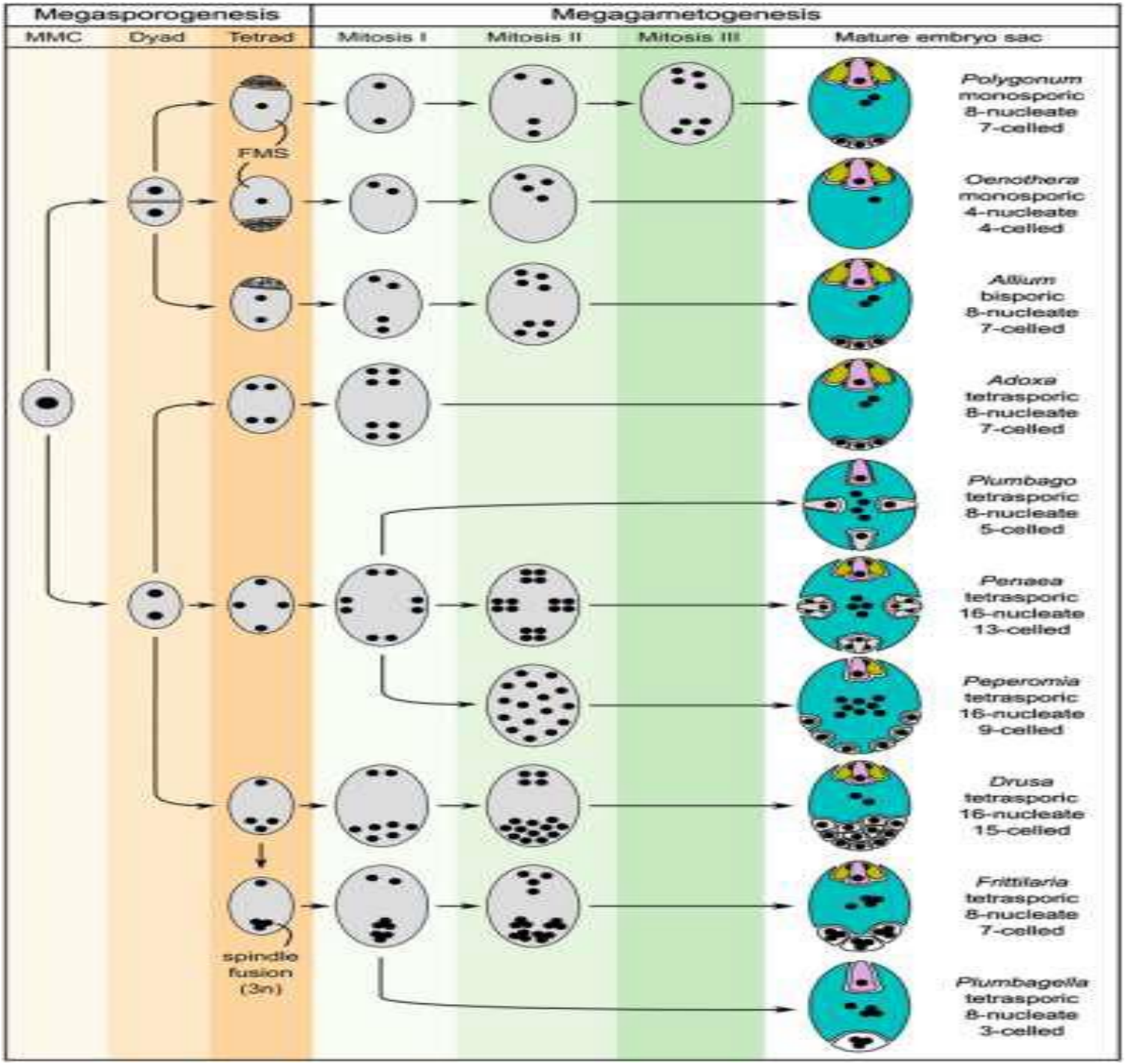
- The three cells are formed toward the Chalaza are called antipodal cells.
- Both the polar nuclei present in the central cell.
- But just before the process of fertilization they unite or fuse together in the centre to form secondary nucleus. It is diploid in nature (2n) and one in number.
- Therefore , seven cells and eight nucleated structure is formed . This eight nucleated and seven celled structure is called female gametophyte or embryosac of Angiosperms.
- This type of embryosac is known as “polygonum type”
- Fingers like processes are produced from the outer wall of the synergids are known as filiform apparatus. With the help of these structures, synergids absorb food from the nucellus and transfer to the embryosac. Filiform apparatus is less developed in antipodal cells. Filiform also secrete chemicals which attracts the pollen tube.



Stages in development of embryosac from megaspore

A mature embryosac

Types of Embryosac



Thank You !!