

Vivekanand College, Kolhapur (Autonomous)

DEPARTMENT OF BOTANY

B.Sc. II

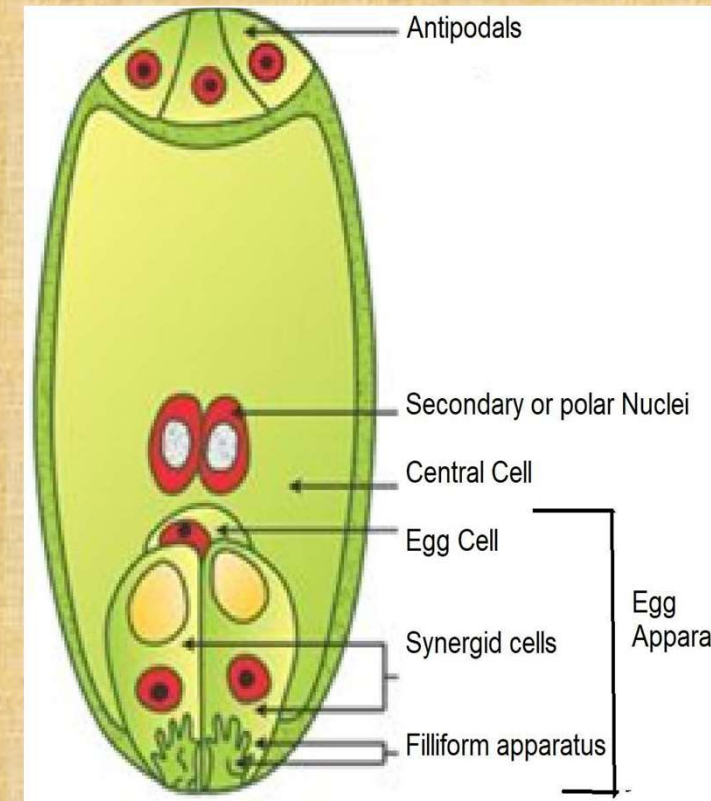
**TOPIC: TYPE OF EMBRYO SAC
(FEMALE GAMETOPHYTE)**

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EMBRYO SAC (FEMALE GAMETOPHYTE)

- Functional megaspore represents the first cell of the female gametophyte.
- Mostly chalazal and grows along the micropylar- chalazal axis.
- The nucleus undergoes three mitotic divisions and form eight nuclei.
- These nuclei are reorganised; one nucleus from each group at a pole migrates to the centre of the cell, called polar nuclei.
- The three nuclei left at the chalazal end are surrounded by walls and form antipodals.
- The three nuclei located at the micropylar end constitute the egg apparatus, one serve as egg or female gamete and the other two as synergids.
- The whole structure with two polar nuclei, three antipodals, one egg and two synergids is the mature female gametophyte or embryo sac.



TYPE OF EMBRYO SAC (FEMALE GAMETOPHYTE)

1. Monosporic embryo sac
2. Bisporic embryo sac
3. Tetrasporic embryo sac

- **Basis for classification**

- The number of megaspores taking part in the development of embryo sac
- The number of divisions occurring in the nucleus of the functional megaspore
- Organization of nuclei in the mature embryo sac

MONOSPORIC EMBRYO SAC

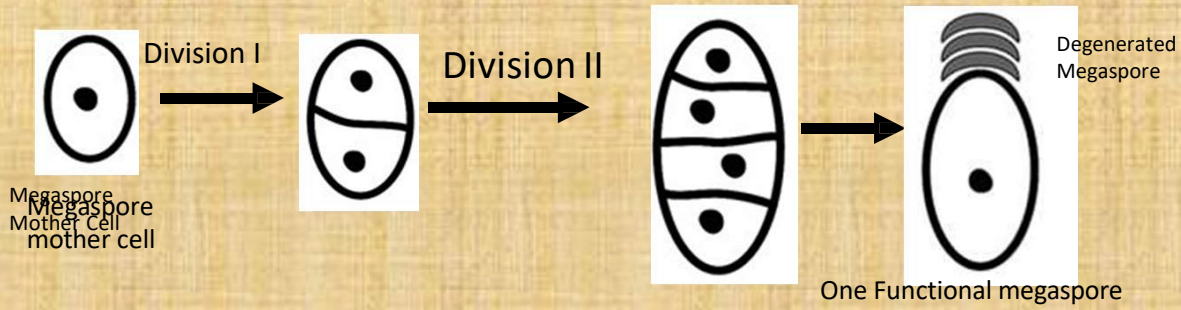
Monosporic embryo sac develops from a single megaspore and as such all the nuclei present in this type of embryo sac are genetically similar.

Types of Monosporic Embryo Sac

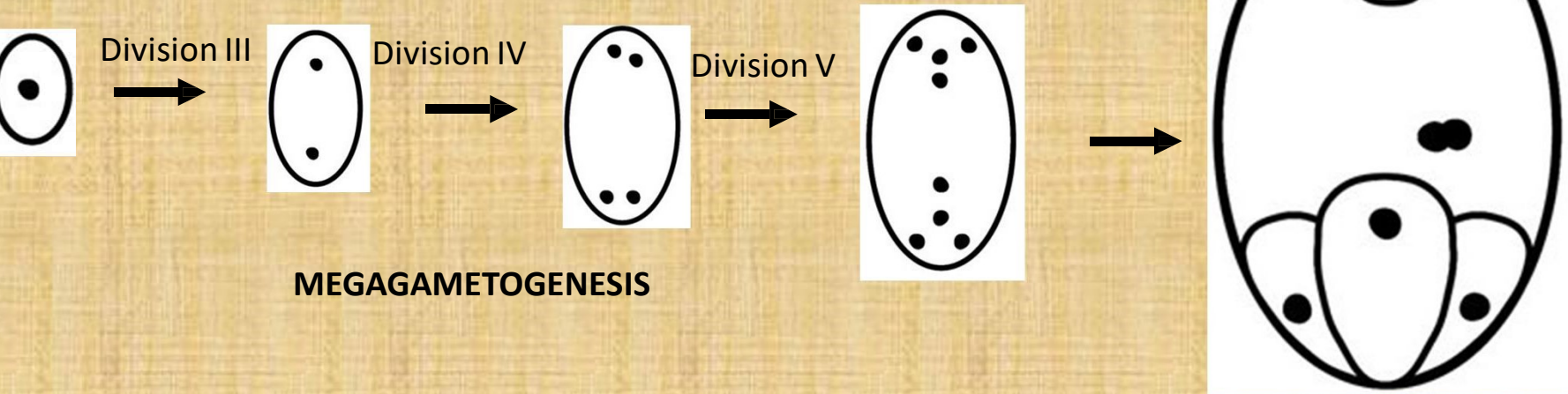
- **Polygonum type**

- 8 nucleated
- Most common type (81% families)
- First time described in *Polygonum divaricatum* by Strasburger (1879)
- Develops from the chalazal megaspore.
- The nucelus is divides thrice to form eight nuclei embryo sac

Polygonum type of Embryo Sac



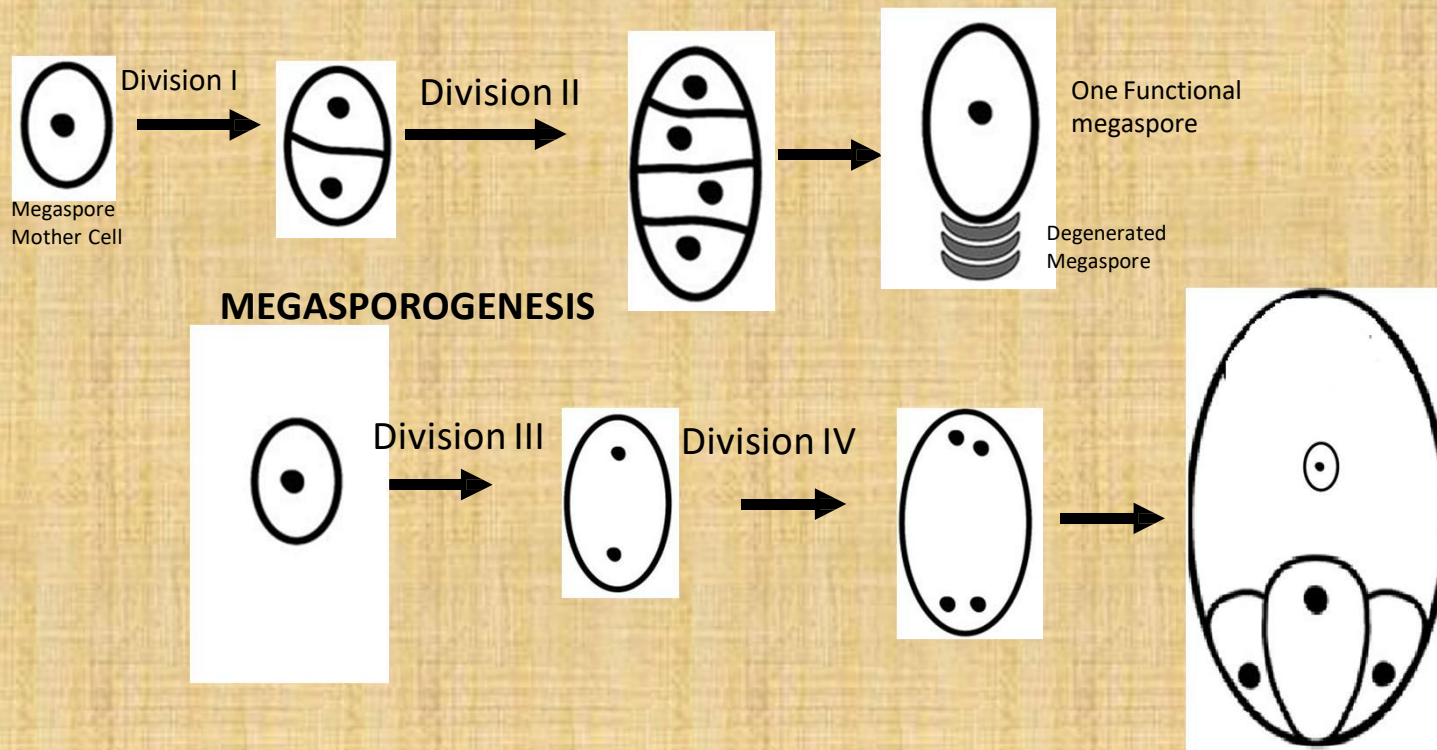
MEGASPOROGENESIS



MEGAGAMETOGENESIS

- **Oenothera type:**

- 4 nucleated embryo sac (Egg apparatus- 3 cells and Polar nucleus- single cell)
- Develops from micropylar megaspore
- Does not have antipodals
- Example – Onagraceae family



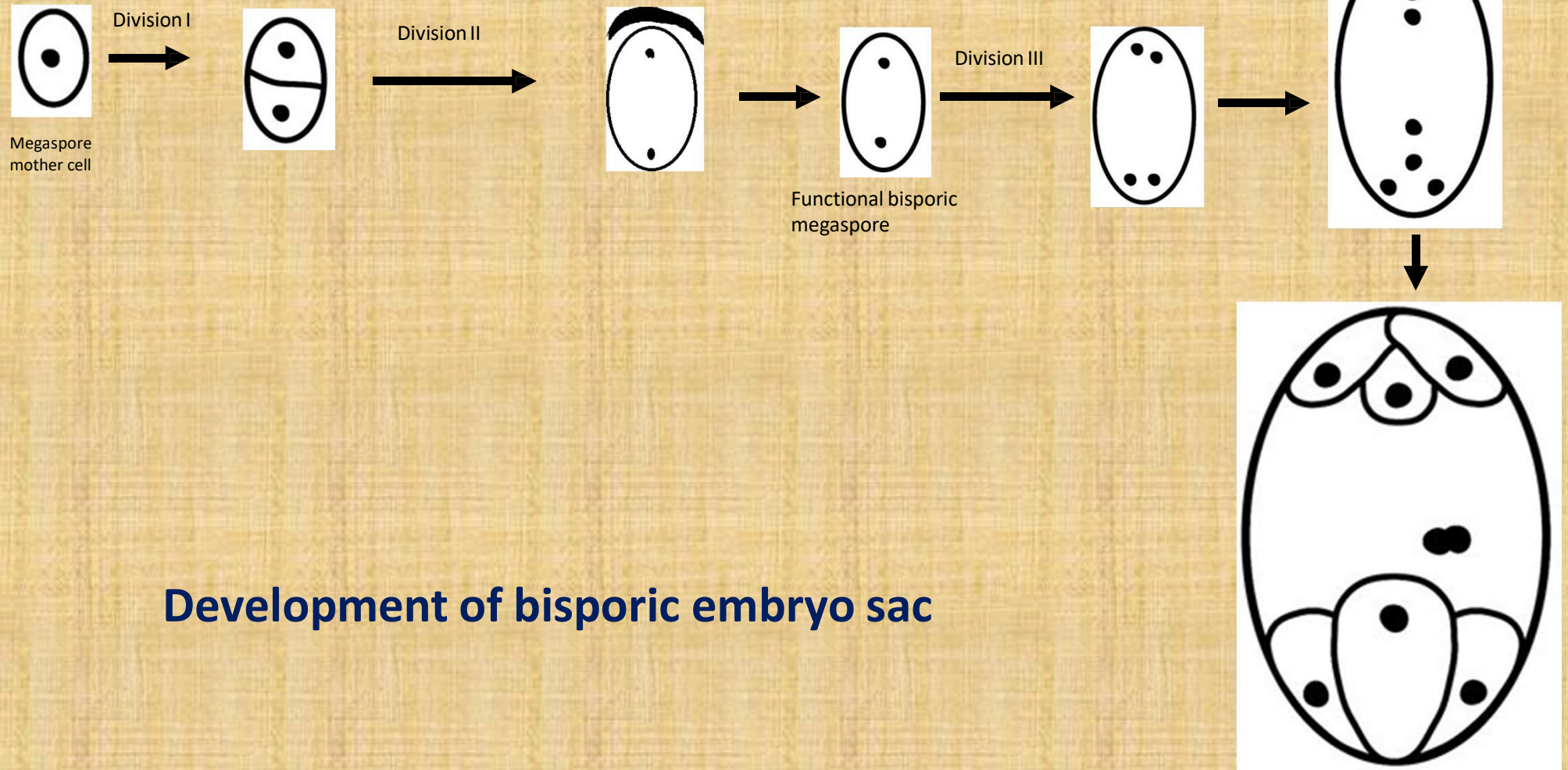
BISPORIC EMBRYO SAC

- Develops from one of the two dyads formed as a result of the first meiotic division (Meiosis I) of Megaspore Mother Cell.
- Both the nuclei of the functional dyad take part in the formation of embryo sac.
- Each nucleus undergoes two mitotic divisions and the mature embryo sac is 8 nucleated.
- The eight nuclei are organised into antipodals, egg apparatus and polar nuclei as in *Polygonum* type of embryo sac.
- The 4 nuclei derived from one megaspore nucleus are genetically different from the other four derived from the second megaspore nucleus.

On the basis of the position of functional dyad bisporic embryo sacs are of two types

ALLIUM TYPE: Develops from the chalazal dyad

ENDYMION TYPE: Develops from the micropylar dyad.



Development of bisporic embryo sac

TETRASPORIC EMBRYO SAC

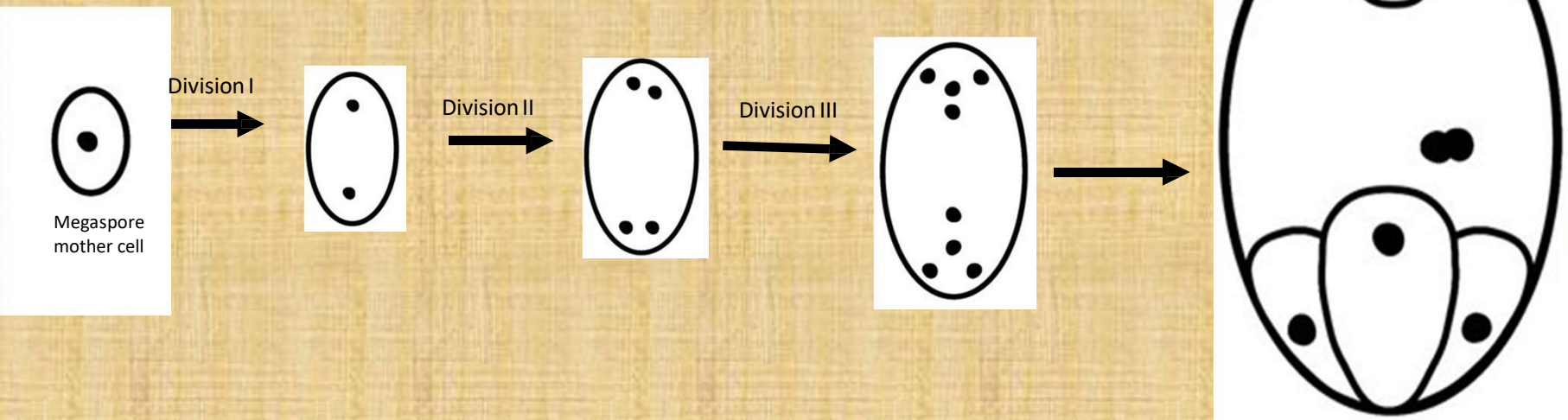
- Meiotic division of the megaspore mother cell is not accompanied by cytokinesis and hence all the four haploid nuclei lie in a single cell called **Coeno-megaspore**.
- All four nuclei of coeno-megaspore participate in the formation of embryo sac
- Genetically more heterogeneous than bisporic type of embryo sac.
- The tetrasporic embryo sacs are further divided on the basis of following criteria-
 - The position of haploid nuclei in the coeno-megaspore
 - The number of times these nuclei divide
 - Organization of nuclei in the mature embryo sac

TYPE OF TETRASPORIC EMBRYO SAC

- **No nuclear fusion occurs**
 - Adoxa Type
 - Plumbago Type
 - Penaea Type
 - Pepromia Type
 - Drusa Type
- **After the second meiotic division three megaspore nuclei fuse to form triploid nucleus at the chalazal end of the coenomegaspore, The fourth nucleus at micropylar end remains haploid**
 - Fritillaria Type
 - Plumbagella Type

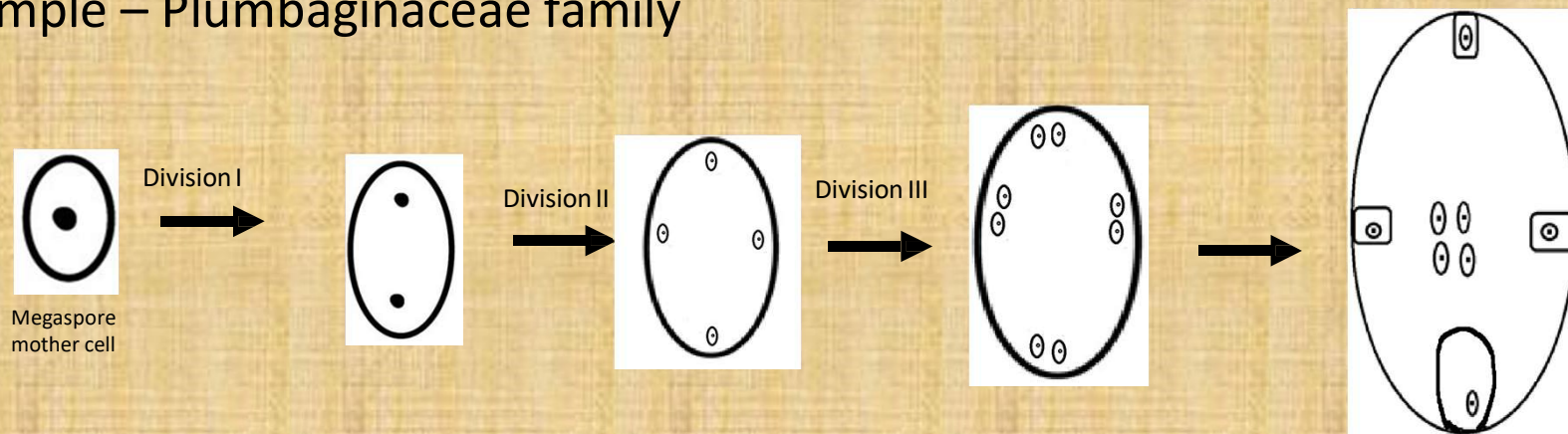
ADOXA TYPE

- It has 8 nuclei which are formed by the mitotic division of the four haploid nuclei of the coeno-megaspore.
- The arrangement of the 8 nuclei in the embryo sac is the same as in Polygonum type.
- Example – *Adoxa*, *Sambucus*, *Ulmus*, *Tulipa*, *Erythronium* etc.



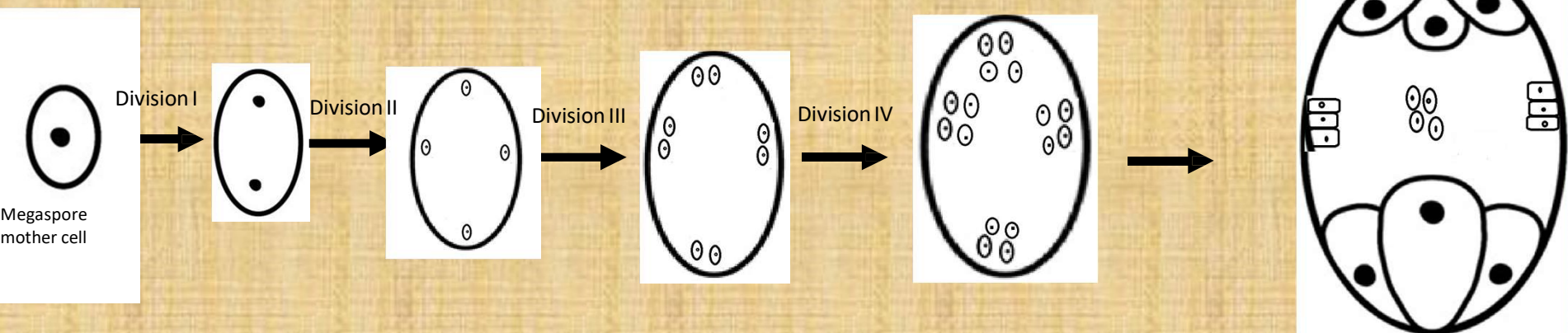
PLUMBAGO TYPE

- This type of embryo sac is characterized by the absence of synergids and antipodals.
- Out of four haploid coeno-megaspore one migrates to the micropylar end, one at chalazal end and two at the lateral sides.
- Each nuclei divides again and formed four groups of two nuclei.
- One of the nucleus from each group moves to the center of the cell and form four polar nuclei.
- The remaining nucleus at the micropylar is cut off by a membrane and form the egg. There are no synergids.
- The other three nuclei usually disappear but occasionally they too may be cut off by membranes and appear as accessory egg cells.
- Example – Plumbaginaceae family



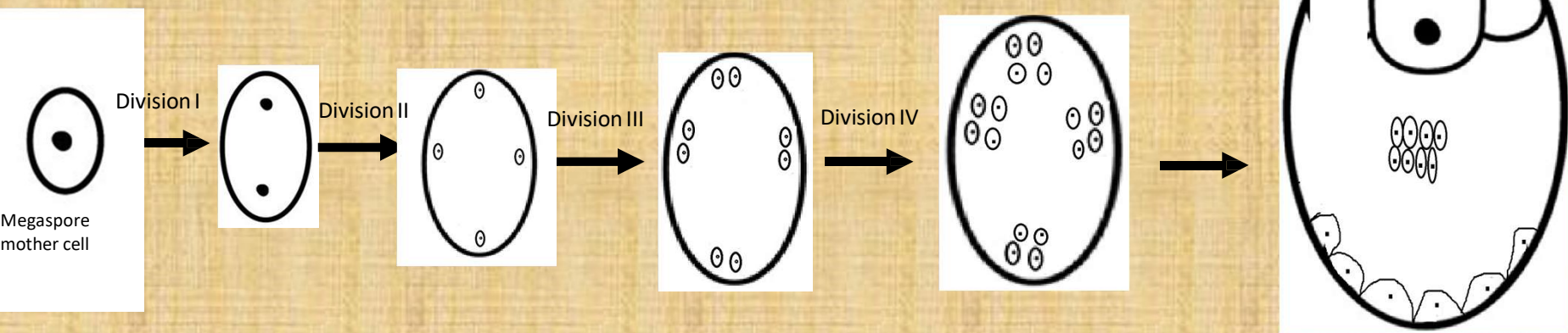
PENAEA TYPE

- The four haploid nuclei of the coeno-megaspore undergo two successive mitotic divisions forming 16 nuclei.
- These nuclei arrange themselves in four groups of four each, one at the micropylar end, one at chalazal end and one each on the two lateral sides.
- Now one nucleus from each groups migrates to the centre, and these four nuclei in the centre form polar nuclei.
- The three nuclei at the micropylar end are cut off by membranes and form the egg apparatus.
- The remaining three groups of nuclei (one chalazal and two lateral) degenerate at maturity.
- Highly polyploid (5x) primary endosperm nucleus is formed after double fertilization.
- Example – Family Penaeaceae, Malpighiaceae and Euphorbiaceae.



PEPEROMIA TYPE

- The egg apparatus of Peperomia type is characterized by a single synergid.
- The four haploid nuclei of coeno-megaspore undergo two successive mitotic divisions forming 16 nuclei.
- Two nuclei at the micropylar end form egg and a synergid, eight fuse in the centre of the cell to form a polar nucleus and the remaining six at the chalazal end formed antipodals.
- Example- Peperomia and Gunnera



DRUSA TYPE

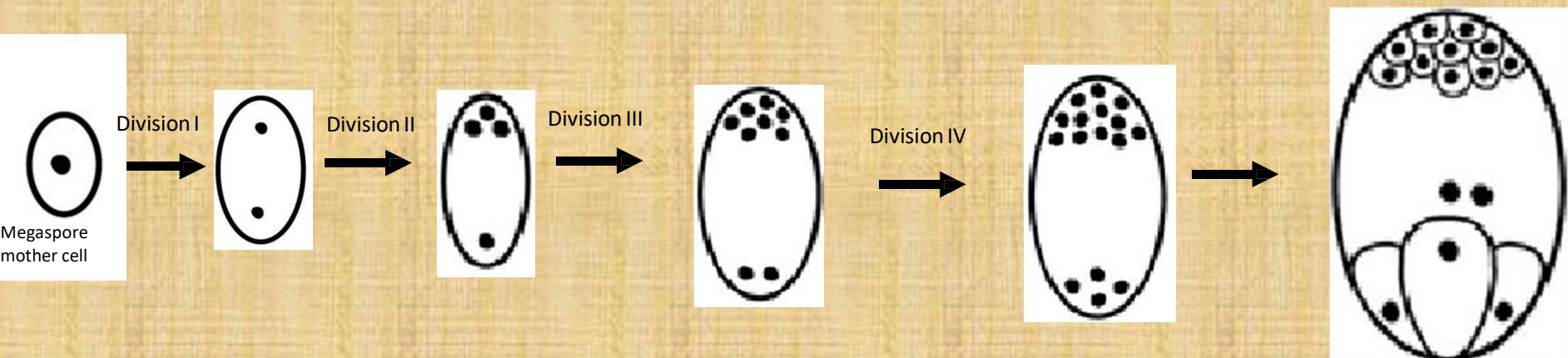
16 nucleate embryo sac

This type of embryo sac is characterised by large number of antipodals

In the mature embryo sac three nuclei form egg apparatus. Two act as polar nuclei and the remaining 11 nuclei are cut off by membrane and form antipodal cells.

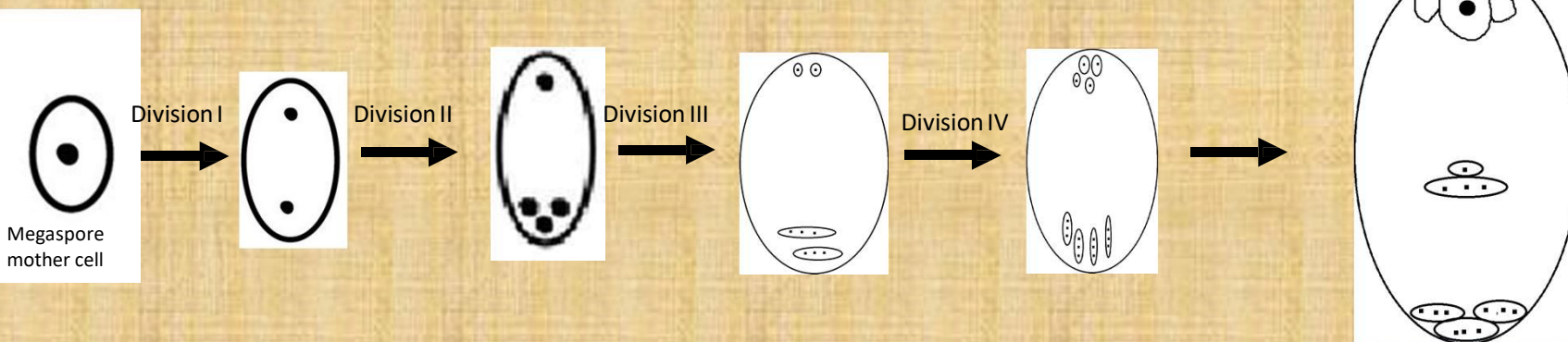
The number and organization of nuclei may vary due to irregularity in the divisions.

Example – *Drusa*, *Rubia*, *Chrysanthemum*, *Ulmus* etc.



FRITILLARIA TYPE

- The four haploid nuclei of the coeno-megaspore arrange themselves in two groups – three at the chalazal end in the form of a triploid nucleus and one haploid at the micropylar end.
- The triploid chalazal as well as the haploid micropylar nucleus undergo two mitotic divisions and as a result four triploid nuclei are formed at the chalazal end and four haploid at the micropylar end.
- In mature embryo sac three haploid nuclei organize into egg apparatus, three triploid into antipodal and remaining one haploid and one triploid nuclei move to the centre where they fuse to form a tetraploid polar nucleus.
- Example – *Fritillaria*, *Lilium*, *Piper* and *Gaillardia*



PLUMBAGELLA TYPE

- The initial development is similar to Fritillaria type and a triploid nucleus is formed at the chalazal end and a haploid at the micropylar end.
- Each of these nuclei undergoes a single mitotic division and form two groups of two nuclei each.
- One triploid nuclei from chalazal end and one haploid nucleus from the micropylar end fuse at the centre and form tetraploid polar nucleus.
- One haploid nucleus at the micropylar end forms the egg and one triploid nucleus at the chalazal end the single antipodal.
- There is no synergids.



Thank You