2.2.2. Female reproductive organ (Pistil) = carpel = Megasporophyll

"The Pistil, Megasporangium (ovule) and Embryo sac"

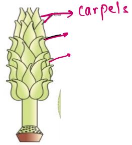
✓* Gynoecium represents the female reproductive part of flower.

* It may consist of a single pistil (carpel) = Monocarpellary ✓

—"— —"— —"— more than one Pistil = Multicarpellary ✓

** If pistils or carpels are free ✓(Apocarpus)

If fused (syncarpous)

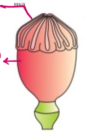


Multicarpellary, apocarpus gynoecium of Michelia **✓

↓

✓(ovaries must be free)

✓(Primitive condition)


✓ stigma
syncarpous ovary

Multicarpellary, syncarpous pistil of Papaver ← (Poppy plant)

↓

(Basal part of ✓✓ carpel must fused)

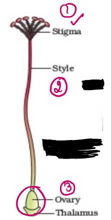
(Advanced condition ✓✓

* Free unit of gynoecium is called Pistil (carpel)

✓✓* It has three parts

✓✓(1) Stigma = landing platform for pollen grains (**terminal receptive part)

ovule
Placenta


① ✓
Stigma
Style
②
③
Ovary
Thalamus

[redacted]

[redacted]

→ Multi (Pentacarpellary)

✓(2) Style = ✓✓Elongated slender part beneath the stigma. It connects ovary with stigma.

✓ "Pollen Tube pass thr. it"

(3) ovary = Basal swollen part of a ✓✓Pistil

Inside ovary is the ovarian cavity with one or more chambers or Locule.

↳ Locule

✓ Single locule = unilocular (eg Pea) ✓ → F.

= Bilocular (Mustard) ✓ → B (Cruciferae)

= Pentalocular (chinarose) ✓

* Placenta is a parenchymatous cushion present inside the ovary where ovules (Megasporangium) are borne.

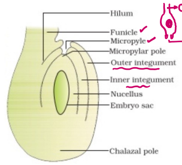
* The number of ovules in an ovary may be

✓one → eg. wheat✓, Paddy✓, Mango✓

✓many → eg. Papaya✓, watermelon✓, Orchids✓

The Megasporangium (ovule) ✓✓ :→

ovule
Hilum
Funicle


Hilum
Funicle ✓
Micropyle ✓
Micropylar pole
Outer integument
Inner integument
Nucellus
Embryo sac
Chalazal pole

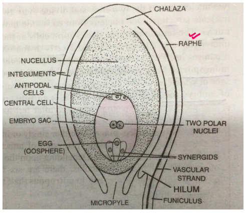
* ovule is an ✓✓integumented megasporangium found in spermatophytes which develops into seed after fertilization.

* ovule is typically an ✓✓ovoid.

* ovule is attached to placenta by means of stalk called funicle ✓✓.

** Hilum represents the junction between ovule and funicle

- Depending upon the configuration and orientation of the body of ovule in relation to funiculus, there are six type of ovules.


CHALAZA
RAPHE
NUCELLUS
INTEGUMENTS
ANTIPODAL CELLS
CENTRAL CELL
EMBRYO SAC
EGG (OOSPHERE)
TWO POLAR NUCLEI
SYNERGIDS
VASCULAR STRAND
HILUM
MICROPYLE
FUNICULUS

- In a typical anatropous ovule the funiculus is fused with body of the ovule lengthwise beyond the hilum. It gives rise to a logitudinal ridge called raphae.**

  ↓ (occur in > 80% of angiospermie families)

- funicle contain vascular strand for the supply of nourishment to ovule.

- Each ovule has one or two protective integuments.

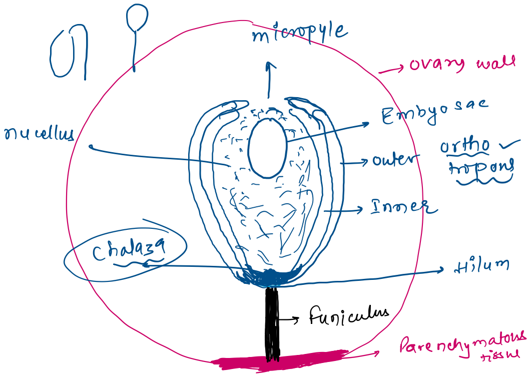
  multicellular

  ** one - unitegmic ovule eq. Higher dicots

  Two - Bitegmic ovule eq monocots & primitive dicots.

- Integuments encircle the nucellus except at the tip where a small opening called the micropyle is organised.

- opposite the micropylar end, is the chalaza, representing the basal** part of the ovule. (Place of origin of integument)

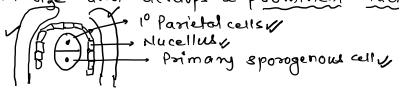

micropyle
ovary wall
Embyo sac
nucellus
outer
Inner
ortho tropous
chalaza
Hilum
funiculus
Parenchymatous tissue

- Enclosed within the integuments is a mass of cells called the "nucellus" (mass of parenchymatous cell equivalent to megasporangium)
- cells of nucellus have abundant food** reserve.
- Located in the nucellus is the embryosac or female gamutophyte.
- An ovule generally has a single embryosac formed from a megaspore.

Developement of ovule :→

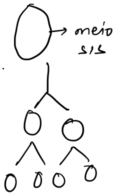
- ovule develops as primordium and then mound of nucellus over placenta
- The initials of integuments develop from its base.
- They grow and come to surround the nucellus on all sides except at the tip or micropylar region.

- In the hypodermal region of nucellus towards the micropylar end develops a Primary archesporial cell.
- It grow in size and develops a prominent nucleus.


1° Parietal cells
Nucellus
Primary sporogenous cell

- The primary sporogenous cells commonly functions directly as diploid megaspore mother cell or megasporocyte.

- Ovule generally differentiati a single megaspore mother cells (MMC) in micropylar region of nucellus.



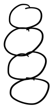
- MMC is large cell containing dense cytoplasm and a prominent nucleus.

Megasporogenesis :→

- The Process of formation of megaspore from the MMC is called megasporogenesis.

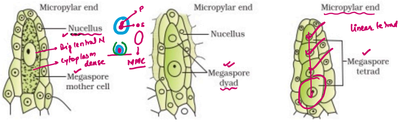
- The megaspore mother cells undergoes meiosis and form a linear tetrad of ④ haploid megaspore.

- The process of meiosis leads to formation of haploid megaspores



- Commonly the chalazal megaspore remains functional while other ③ degenerate.

MMC → m
(2n) (n)


Micropylar end
Nucellus
Big central N
cytoplasm dense
Megaspore mother cell
P
os
MMC
Micropylar end
Nucellus
Megaspore dyad
Micropylar end
linear tetrad
Megaspore tetrad

Parts of the Ovule showing a large megaspore mother cell, a dyad and a tetrad of Megaspore

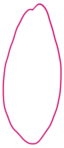
Female Gametophyte :→

Megagametogenesis (Developement of female gametophyte)

- In majority of flowering plants, one of the megaspore is functional while the other three degenerates.

- Functional megaspore is first cell of female gametophyte. The cell enlarges and undergoes three free nuclear mitotic divisions. (strictly)

- The nucleus of functional megaspore divides mitotically to form two nuclei which move to opposite poles, forming the 2-nucleate embryo sac.



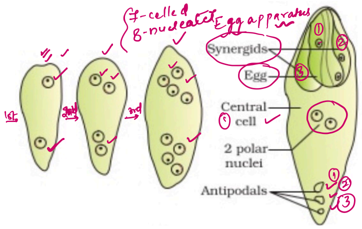
- Two more sequential mitotic nuclear divisions results in the formation of the 4-nucleated and later the 8-nucleated stages of the embryo sac.

- Nuclear divisions are not followed immediately by cell wall formation.

- one nucleus from each side moves to middle, they are called Polar nuclei. are situated below the egg apparatus in the large central cell. **

- six of eight nuclei are surrounded by cell walls and organised into cells. **

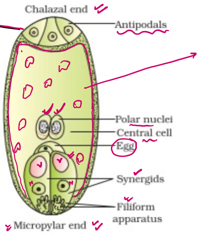
- Embryo Sac formation from a single megaspore is termed Monosporic developement


1st
2nd
3rd
7-celled
8-nucleated
Egg apparatus
Synergids
Egg
Central cell
2 polar nuclei
Antipodals
①
②
③
①
②
③

2, 4 and 8-nucleate stages of embryosac and a mature

Embryo sac **

Three cells are at the chalazal ends and are called the Antipodals


Chalazal end
Antipodals
Polar nuclei
Central cell
Egg
Synergids
Filiform apparatus
Micropylar end

The central cell is the largest cell of embryo sac. It has highly vacoulated cytoplasm which is rich in reserve food.

In the middle, the cell contain two polar nuclei.

The polar nuclei often fuse to form a single diploid secondary or fusion or definitive nucleus.

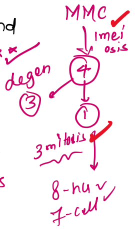
A Diagrammatic representation of mature embryo sac

** Thus all cells of the embryo sac are haploid except the central cell which is first binucleate and then becomes diploid due to fusion of Polar nuclei.

Structure of Embryo sac (female gametophyte) :-

- It is an oval multicellular haploid structure which is embedded in the nucellus towards micropylar half of the ovule
- Typical most common type of embryo sac, found in 80% flowering plant is Polygonum type. **
- ** It is 8-nucleate and 7-celled. (3 micropylar, 3 chalazal and one central)

↳ It is formed by one meiosis (formation of 4 megaspores from one MMC) and three mitosis (inside functional megaspore)


MMC
1meiosis
4
degen
3
1
3 mitosis
8-nu
7-cell

- There is a characteristic distribution of cells with in the embryo sac.

Three cells are grouped together at the micropylar end and constituti egg apparatus (equivalent to one archegonium)

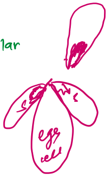
↓

consists of

(help cells) Two synergids and one egg cell. (oospheres) **

Two synergids ↓ they have special cellular thickenings at the micropylar tip called filliform apparatus. ← finger like projection of the walls.

one egg cell ↓ (larger cell)



(It contain chalazal Vacoule and a central nucleus)

- It play an important role in guiding the pollen tube into the synergids