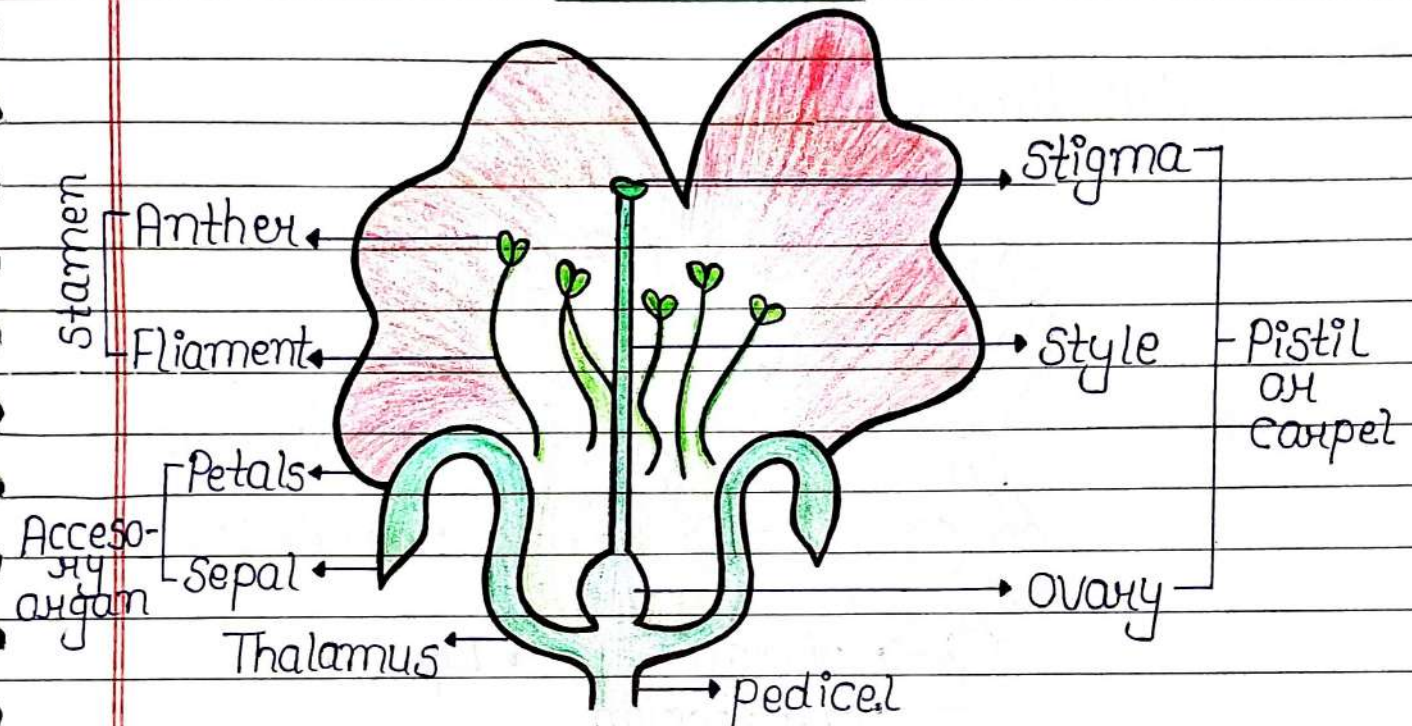


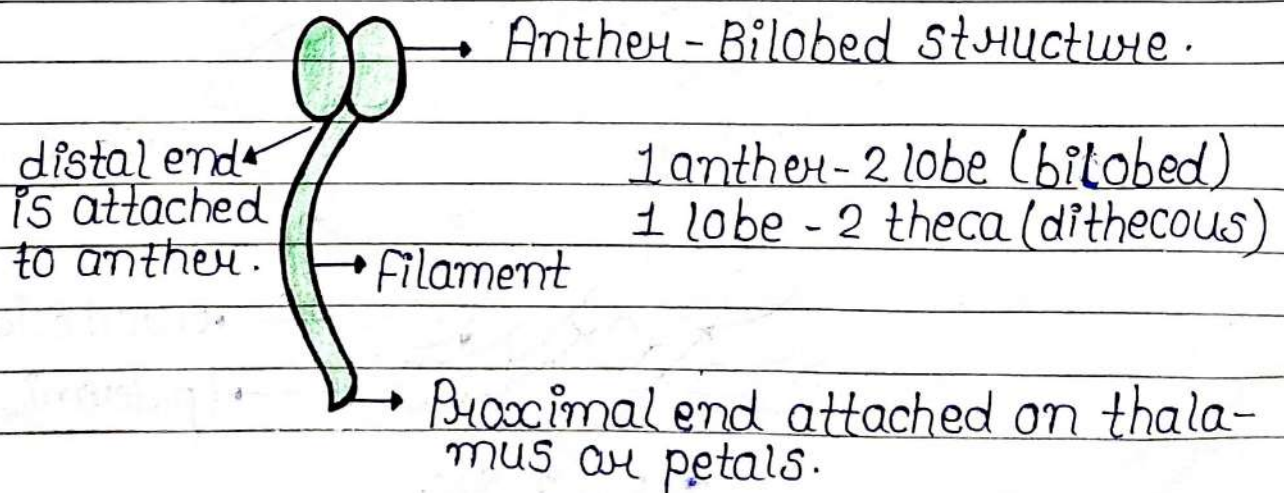
Sexual Reproduction in flowering Plants

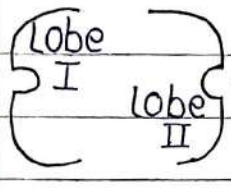


In angiosperms the main plant body is sporophyte.

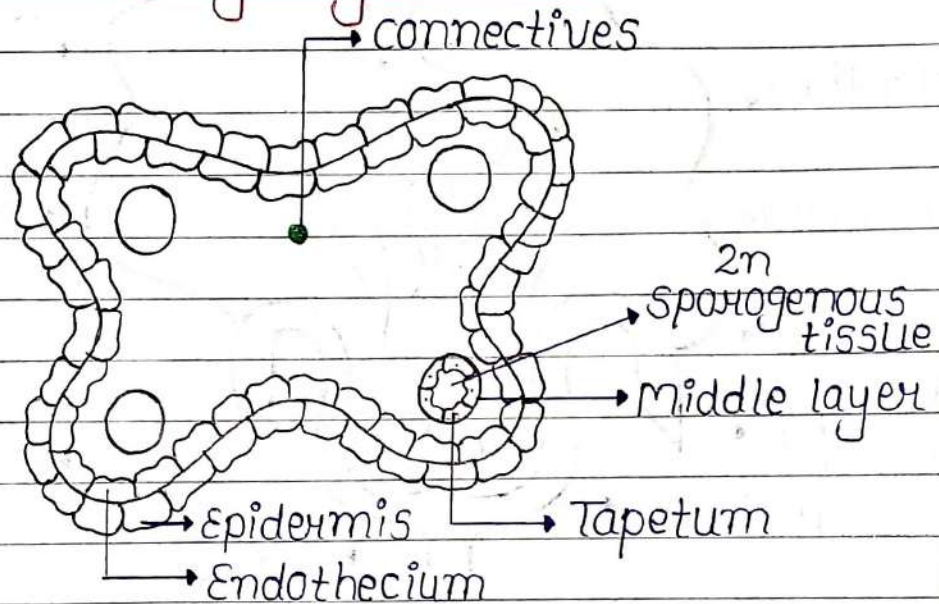
Structure of stamen :-

Stamen is consist of - the long and slender filament and bilobed Anther.



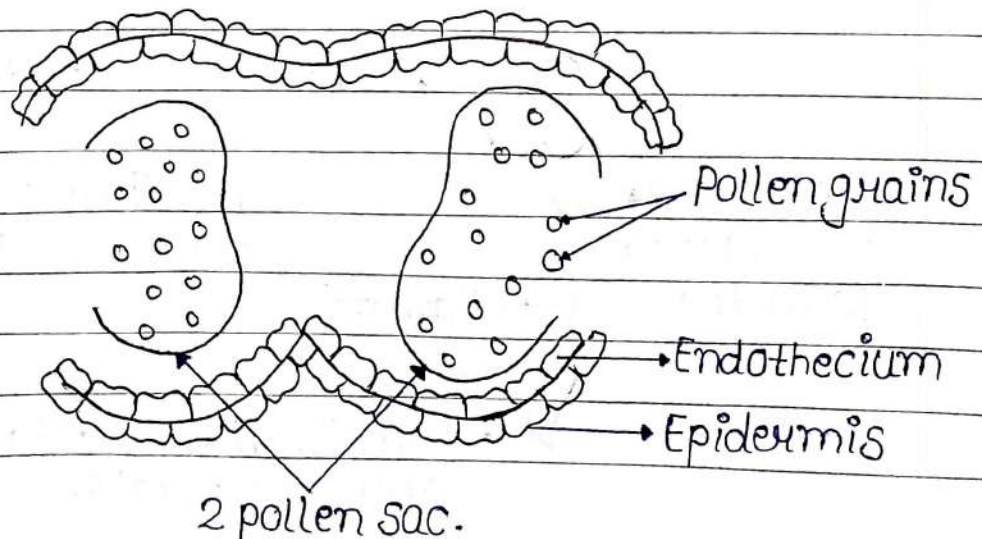

 ← longitudinal groove - separate two theca.

Structure of young Anther.



Young Anther have microsporangia at each 4 corner.
 → [Tetraspangiate]

Mature Anther



▶ Epidermis, Endothecium and middle layer provide protection, dehiscence to release pollen grains.

▶ Tapetum is binucleated (multinucleated) and have dense cytoplasm.

→ Provide nourishment to developing pollen.

→ Produce Exine.

→ Produce Pollen kit.

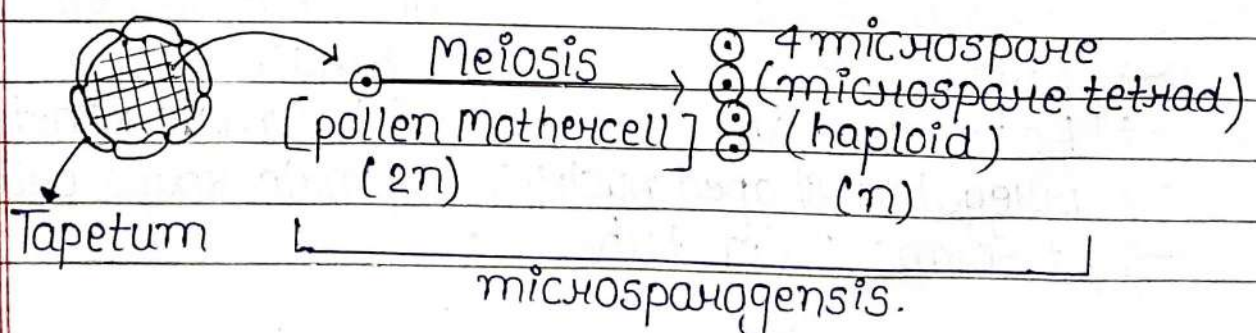
▶ Endothecium have main role in dehiscence:

Microsporogenesis :-

▶ The whole sac of a microsporangium is filled with sporogenous tissue, also known microsporangocytes.

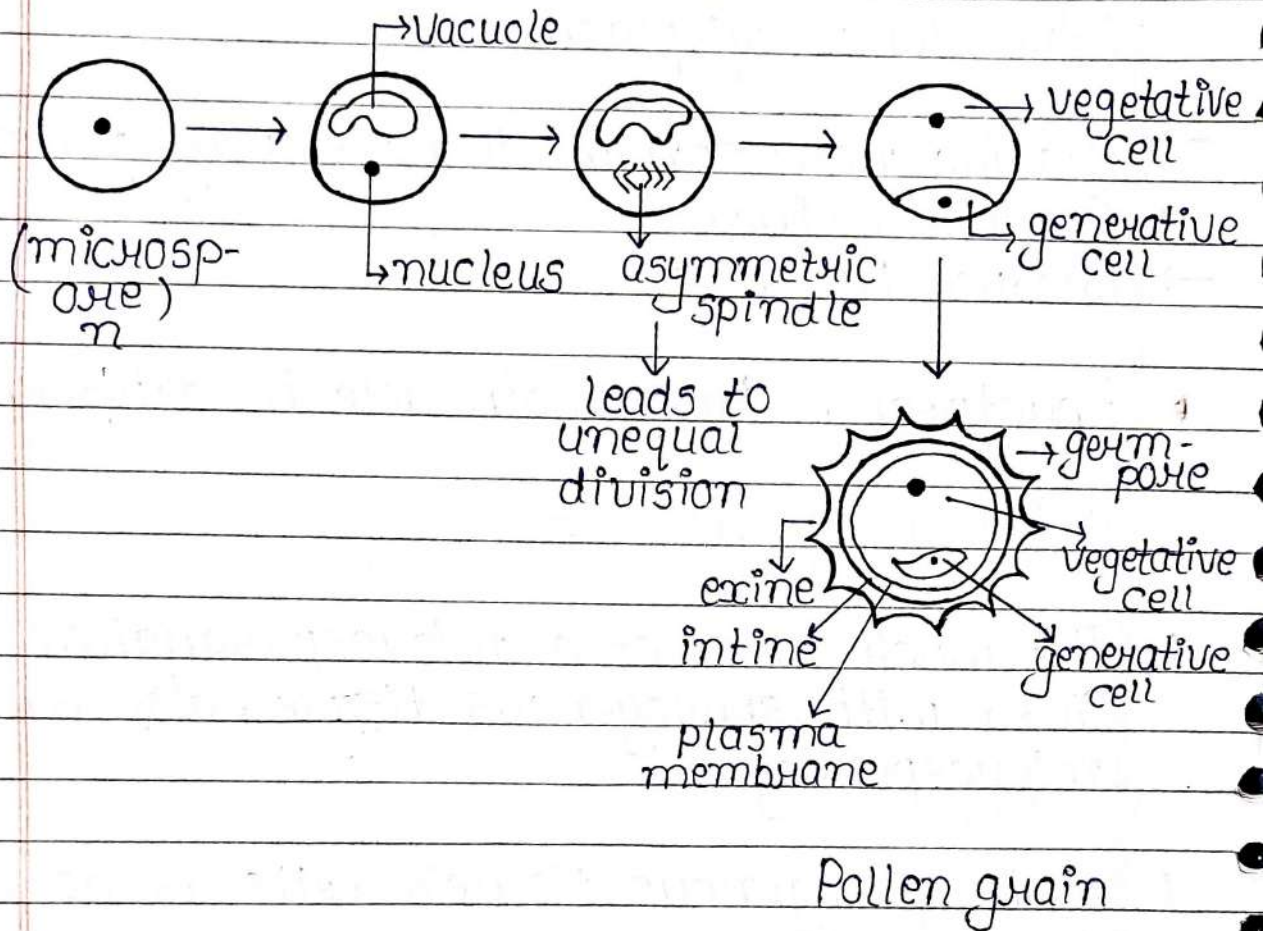
▶ Each sporogenous tissue's cells is act as pollen Mother cell.

▶ Pollen Mother cell undergo Meiosis and produce 4 microspore which is microspore tetrad (haploid).



This whole process is microsporogenesis.

After that, Each microspore can divide by Mitosis to give rise to pollen grain.



▷ Pollengrain is Malegametophyte.

▷ Part in which exine is absent called as germ pore.

<u>Vegetative cell</u>	<u>Generative cell</u>
→ large size	→ small size
→ Food reserve	→ Give malegamete
→ irregular shaped nucleus.	→ spindle shape cell
→ It forms Pollen tube.	→

Exine

Discontinuous layer
Made up of sporopollenin which is highly resistive.
Protection - provide.
Have sculpture.

Intine

Continuous layer.
Made up of pectine and cellulose help in pollen tube development.

- ▷ In 60% plant pollination occur in two cell stage. (1 vegetative cell + 1 generative cell).
- ▷ In 40% plant pollination occur in 3 cell stage. (1 vegetative cell + 2 male gamete).

Pollen allergy :-

- Allergy cause by pollen grain when inhaled.
- Pollen grains of many species cause, severe allergies and bronchitis, asthma. i.e. parthenium.

Pollen as food supplement :-

- Pollen grains are rich in nutrient.
- Taken in the form of tablet and syrup.
- It increase the efficiency of Athlete and horses.

Pollen Bank :-

- Pollen is genome (n).

- It is stored at -196°C in liquid Nitrogen.
- Latex used as breeding in plants.

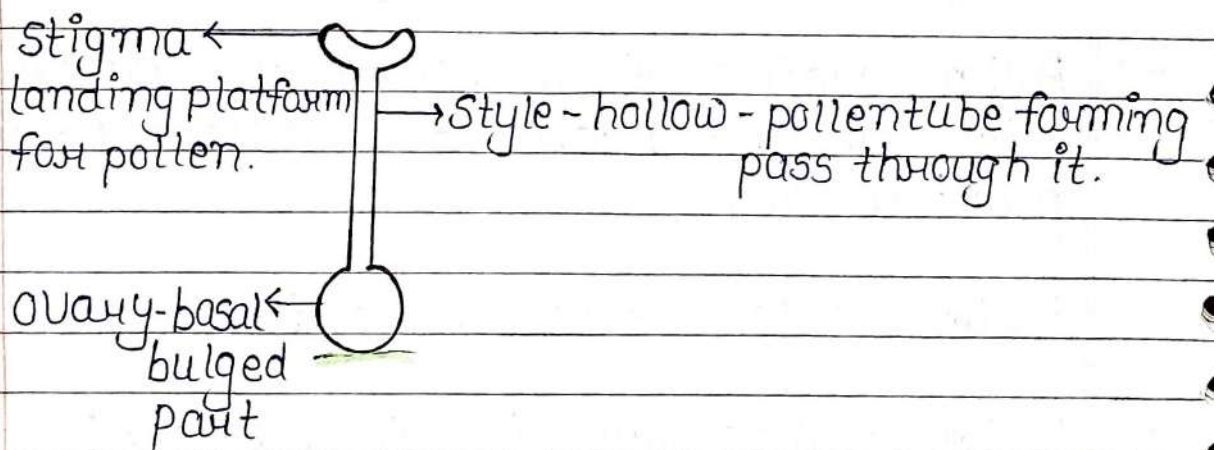
Viability of pollen :-

It is the maximum time upto which pollen can germinate to form pollen tube.

In solanaceae, Rosaceae, Leguminosae - long viability & wheat, paddy - short viability (30 minute).

Viability depends on prevailing temperature, species and Humidity.

Structure of Pistil -



Gynoecium may consist of -

1. Single carpel - Monocarpellary.

2. Two carpel - Bicarpellary —
 → Syncarpus (fused carpel)
 → Apocarpus (free carpel)

3. Multicarpellary.

→ Apocarpus eg. → *Michelia*

→ Syncarpus eg. → *Papaver*.

▷ Chamber in ovary known as → Locule.

▷ The number of ovule in ovary may be one-
eg. wheat, Paddy, Mango.

▷ The number of ovule in ovary may be many-
eg. Papaya, watermelon, orchids.

Structure of ovule.

★ Ovule is also known as Megasporangium.

Stalk connect ovule
↑ to placenta

funicle

Hilum

↓
Point of
attachment of
funicle on
ovule.

→ Micropyle.

→ Outer integument

→ inner integument

→ Nucellus

→ Embryo sac.

→ Chalazā.

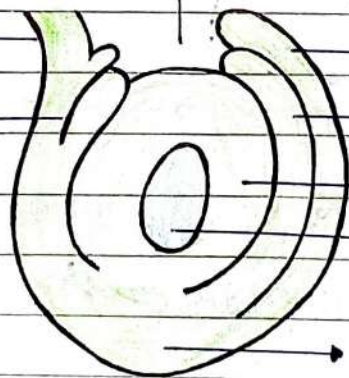
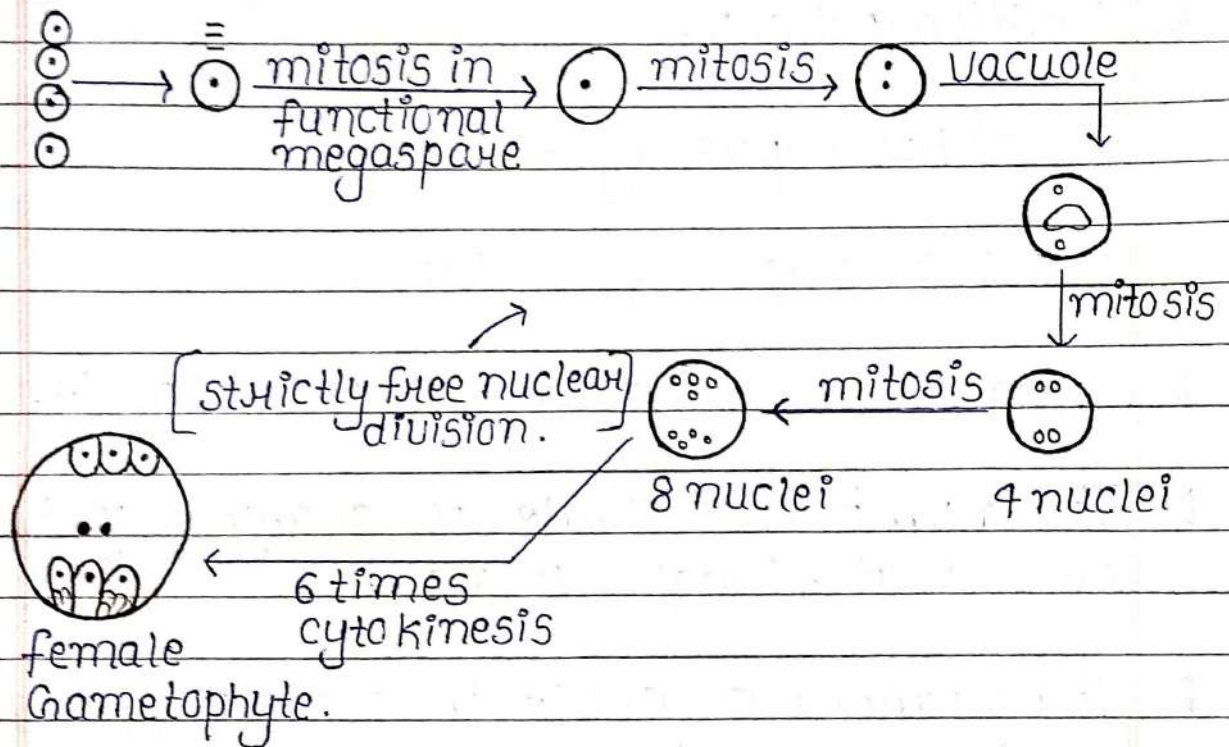


Fig :- Structure of Anatropous ovule.

→ One cell of nucellus acts as megaspore Mother cell.



→ On synergid cellular thickening occurs and called as filiform Apparatus which guide the entry of pollen tube.

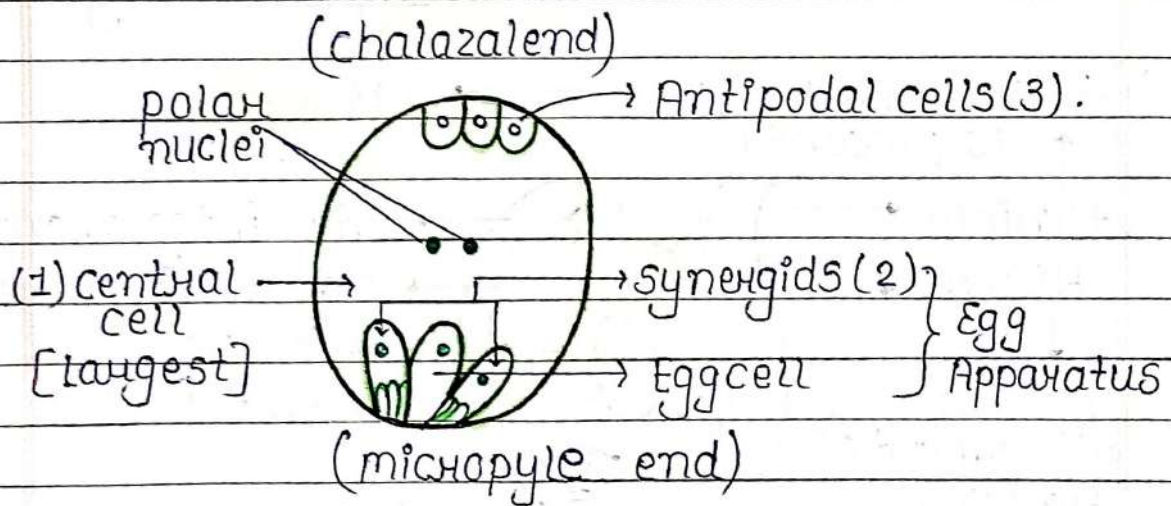


Fig. Embryo Sac.

- Embryo sac is also known as Female Gametophyte.
- It is 7-celled and 8-nucleated structure.

- 6-times cytokinesis occurred.
- All cells in embryo sac is haploid (genetically same).

Pollination :-

Transfer of pollen grains from anther to stigma.

On the basis of source of pollen.

Types of Pollination

Self pollination

- Autogamy
- Geitonogamy

Cross pollination

- Xenogamy

(possible)

- Autogamy, Geitonogamy
- Xenogamy

Bisexual flower Plant → Sweet Potato.

unisexual flower but bisexual plant → coconut, castor, maize, cucurbits.

- ↓
- Geitonogamy
- Xenogamy

Unisexual Plant → Date palm, Papaya

- ↓
- Xenogamy possible

1. Autogamy :-

When pollen grains are transferred from anthers of a flower to stigma of same flower is called Autogamy.
eg:- Pea.

Condition for autogamy -

- ▷ Bisexual flower
- ▷ Synchrony (anther maturity and stigma receptivity same time).
- ▷ Open and close flower.

Cleistogamous and chasmogamous flower.



- | | |
|---|---|
| ▷ Close flower. | ▷ Open flower. |
| ▷ NO pollinator require. | ▷ Pollinator required. |
| ▷ Seed set assure. | ▷ Autogamy, Geitonogamy and Xenogamy occur. |
| ▷ only Autogamy occur and has to be bisexual. | |

Example : underground flower. } Both cleistogamous and chasmogamous.
Commelina
Oxalic
Viola

Geitonogamy :-

The transfer of pollen grain from anther to stigma of another flower on same plant is Geitonogamy.

Condition for Geitonogamy —

- Plant Bisexual eg. Maize
- ▷ Pollinator required
- ▷ It is functionally xenogamy but genetically autogamy.

Xenogamy :-

Transfer of pollen grains from anther to stigma of a different plant is called Xenogamy.

Conditions for xenogamy :-

- ▷ Species same but different plant.
- ▷ Pollinator require. eg. Papaya
- ▷ Maximum variation.

Pollinating Agent :-

↓
Abiotic

↓
Biotic

1. Wind (Anemophily)
2. Water (Hydrophily).

1. Bird (Ornithophily).
2. Bat (Chiropterophily).
3. Insect
4. Animals
5. Ants
6. Snail.

- Biotic do more pollination than abiotic (Biotic > Abiotic).
- Among abiotic - wind ↑
- Among biotic - honey bee do maximum pollination.

Wind Pollination Feature :-

- ▷ Flower should be colourless, odourless and present in (small) cluster.
- ▷ Pollen - small, non-sticky and light.
- ▷ Stigma - feathery and exserted, also sticky.
- ▷ Style - long exserted.
- ▷ Monoovular ovary.

Eg. Maize and Date palm.

Water Pollination :-

- ▷ Algae, Bryophyte and Pteridophyte (pollination by water).
- ▷ In monocot 30 genera show water pollination.
- ▷ In some, plants are aquatic but pollination is by wind and Insect.

Example : water lily and water Hyacinth.

Water Pollination in Aquatic Plant —

↓
On Surface water
(Epihydrophily)

↓
Underwater
(Hypohydrophily)

eg. Vallisneria & Hydrilla

eg. Zostera (sea grass)

- ▷ Male pollen float on surface and fall inside female flower.

- ▷ Pollination under water.

- ▷ Ribbon shaped pollen
- ▷ mucilaginous covering.

Biotic Agent :-

1. Insects :-

- ▷ Colourful, odour and nectarful flower.
- ▷ Sticky and heavy pollen.
- ▷ Flies & Beetle - foul odour.
- ▷ Bee do maximum pollination.
- ▷ Other involved insects are butterflies, beetle, moth, wasp, ant etc.

eg. sunflower, Rose, Hibiscus.

2. Bat (chiropterophily) :-

- ▷ large size flower.
- ▷ strong odour.
- ▷ dull in colour.
- ▷ Nectarful.

eg. Mango, Agave, Guava, Banana.

3. Birds :-

- ▷ large size flower
- ▷ Bright colour → Humming bird and sun bird are nectar hobbler.
- ▷ Odour absent
- ▷ Nectarful

eg. Bombax.

Other agents are Lizard, Gecko lizard, garden lizard, Lemur.

Rewards for Pollinator :-

To ensure regular visit of insect some rewards —

- (i) Edible nectar and pollen (in some).
- (ii) Space for egg laying.
eg. *Amorhophallus*
Yucca plant
(to moth).

↓
larva of moth come out before
fruit develop.

Outbreeding Devices :-

- ▷ Outbreeding devices refers to the process or mechanism that plants used to avoid self-pollination or Autogamy.

- ▶ Autogamy increases homozygosity which leads to expression of recessive and Homozygous trait (Harmful trait).

The following are the mechanism to avoid autogamy :-

1. Different time of maturity of Anther and stigma.
2. Different position of anther and stigma so that pollen cannot come in contact with stigma.
3. Unisexual flower (Dioecy)
eg. Castor and maize → avoid autogamy but not geitonogamy.

eg. Papaya (unisexual plant) → avoid both autogamy and Geitonogamy.

4. Self-incompatibility → Pollen from same anther is rejected. It is a genetic mechanism which do not allow autogamy and geitonogamy.

Artificial Hybridisation :-

It is the process in which only desired pollen grains are used for pollination and fertilisation.

Hybridisation Proceeds in two steps :-

1. Emasculation
2. Bagging

1. Emasculation :

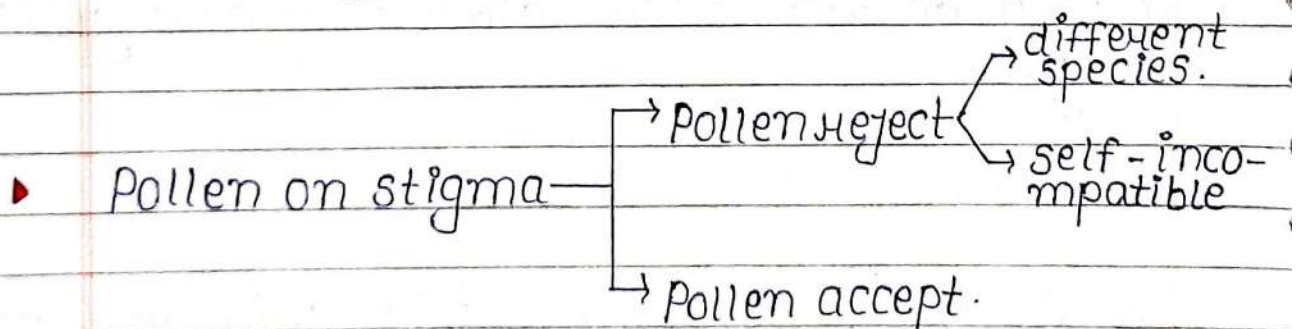
In this, the anther is removed from a bisexual flower before they release pollen grain. This process of removal of anther using forceps is emasculation.

2. Bagging :

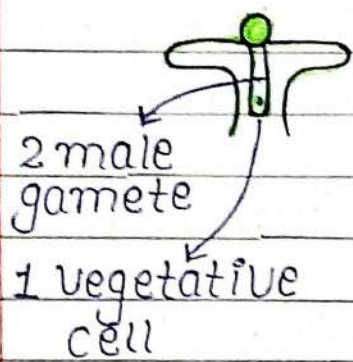
Flower is masked by a bag. In this stigma is covered before and after fertilisation. In unisexual flower bagging is done before flower open.

Pollen - Pistil interaction :-

It involve all event, after pollination till entry of pollen tube in ovule.

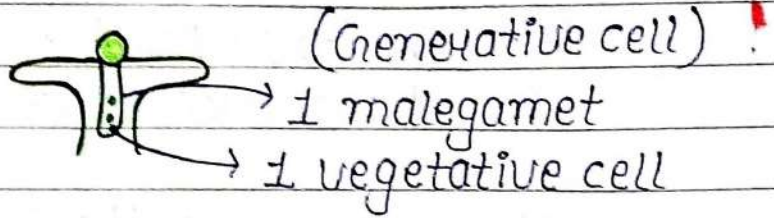


- Pollen tube come out from germ pore and develop from intine.



1 vegetative cell

3-celled stage
Pollination.



* Nucleus of generative cell divide in stigma.

2-celled stage pollination

- ▶ Growth of pollen tube is in style.
Style can be hollow or solid.
- * In solid style transmission tissue is present.
This is chemotropic movement.
- ▶ Pollen tube Entry
In this the pollen tube enter into one of the Synergids and release both male gamete.
Vegetative nucleus degenerate after that.

Fertilisation :-

Fusion of male and female gamete is known as fertilisation.

- One male gamete fuse with nucleus of egg cell is termed as SYNGAMY.
- Another male gamete fuse with two nuclei of central cell which results in Triple fusion.

Syngamy and triple fusion together known as Double fertilisation, which is characteristic of Angiosperm.

- Syngamy results in the formation of zygote.
- Triple fusion results in formation of Primary Endosperm Nucleus (PEN).
- Synergids and Antipodal degenerate.

Post Fertilisation Events :-

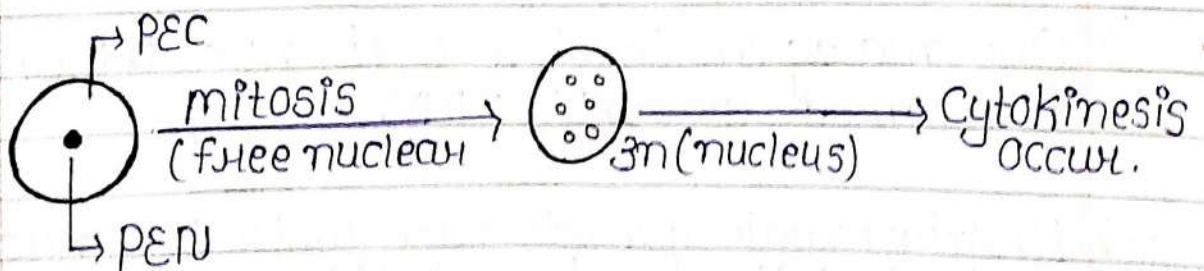
Events of endosperm and embryo development, maturation of ovule into seed and ovary into fruit, are known as post-fertilisation events.

Endosperm Development :-

Endosperm development precedes embryo development.

P.E. cell divides repeatedly and form triploid endosperm tissue.

Nutritive tissue which provide food to developing embryo.



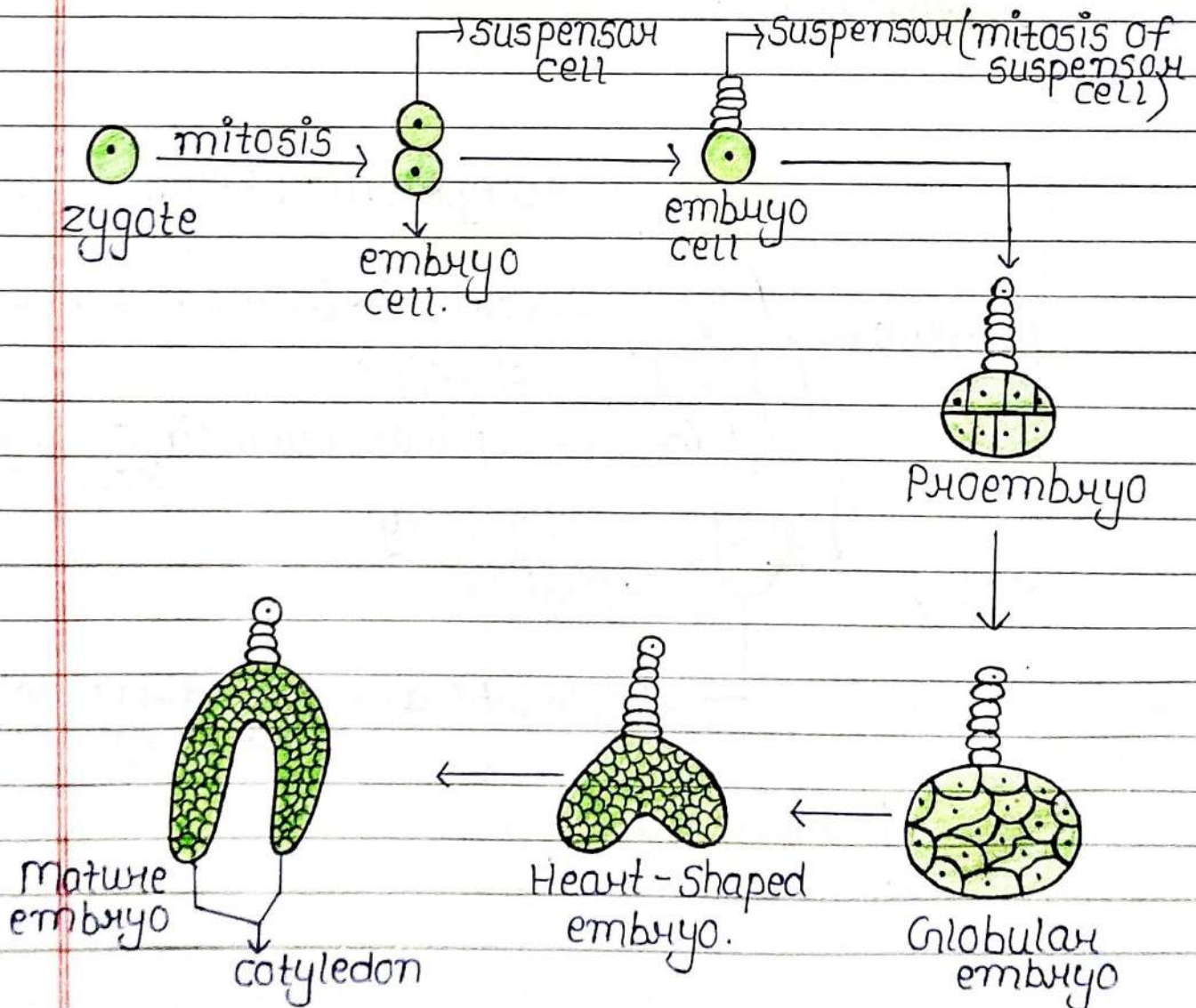
→ Coconut water - free nuclear endosperm
white edible part - cellular endosperm.

Embryogeny :-

Embryo development is embryogeny.

The zygote give rise to proembryo and subsequently to the globular, heart-shaped and mature embryo.

Embryo develops at the micropylar end of the embryo where the zygote is situated.



Note: Initial development is similar in monocot and dicot.

Dicot Embryo :-

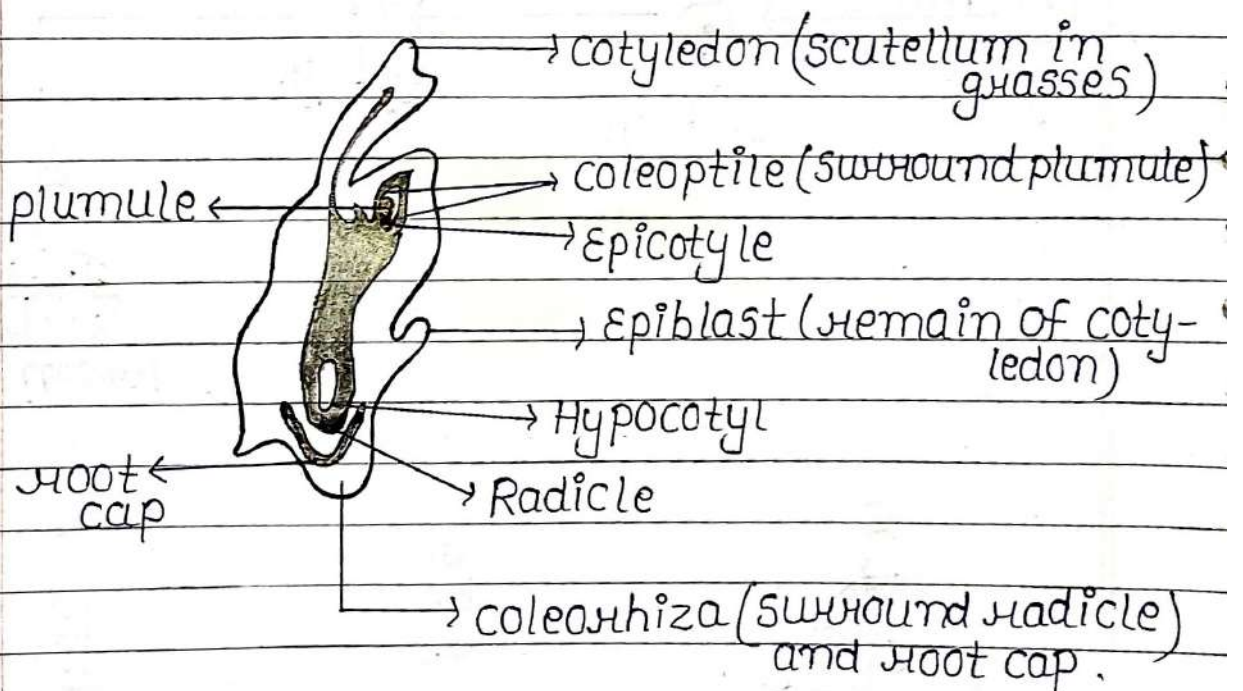
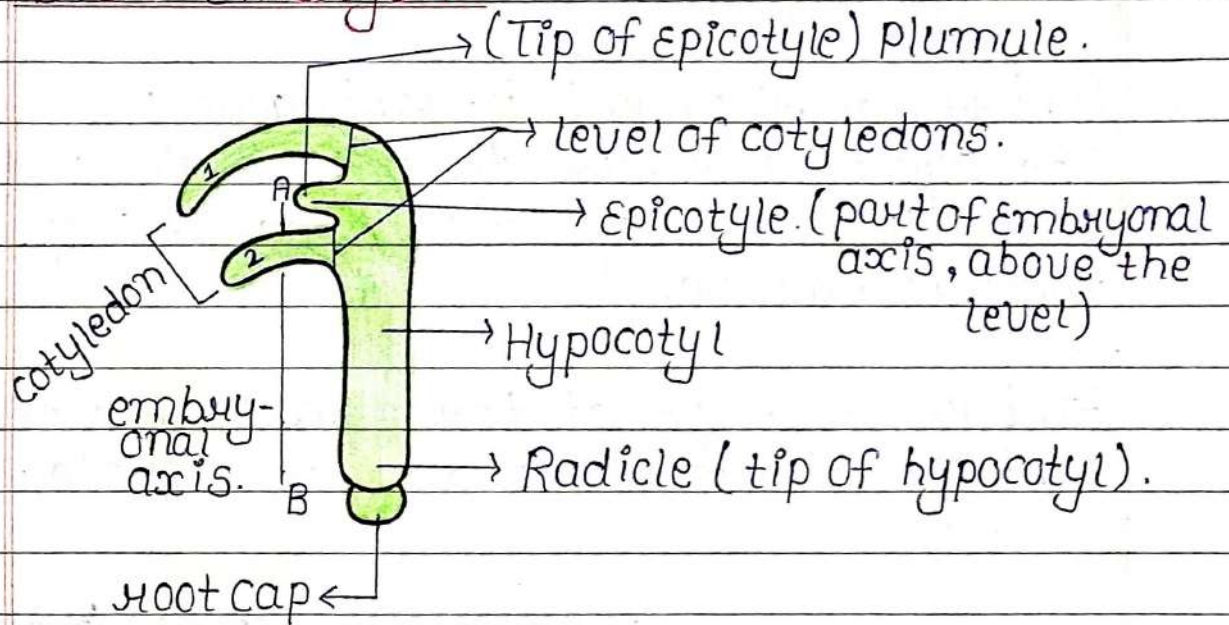


Fig: Monocot Embryo.

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Seed $\div$ (Fertilised ovule)

A typical seed consist of —

1. Seed coat (develop from integument)

Testa (outer)

Tegmen (inner)
2. Embryo

embryonal axis

cotyledon
3. Endosperm

Non-Albuminous

Albuminous
4. Perisperm (nucellus persistent).
eg. Black Pepper
Sugar beet.

► Albuminous seed $\div$

Endosperm is not consumed completely during embryo development.

eg. Monocot (wheat, maize, barley) and castor.

► Non-albuminous seed $\div$

Endosperm is consumed completely during embryo development.

eg. Dicot (Pea, groundnut).

Advantages of Seed :

- ▷ Seed protect the embryo from harsh condition.
- ▷ Provide nourishment to developing embryo.
- ▷ Seed gives variation.
- ▷ Dormancy due to which seed can be stored.

Viability of Seed :-

The ability of seed to germinate after dormancy period.

- (i) *Phoenix dactylifera* (2000 years)
↳ found in dead sea.

- (ii) *Lupinus arcticus* (10,000 years)
↳ found in Arctic Tundra.

In some plant fruit contain very large number of seed such as —

- ▷ *Striga*] parasite
- ▷ *Amobanche*]
- ▷ *Orchid*
- ▷ *Ficus* (Peepal). * Fruit wall — pericarp.

Fruit :- (Mipened ovary)

Types of fruit :-

True fruit

develop from ovary only

example :
Mango

False fruit

Thalamus involved

Examples :
Apple
Strawberry
Cashew

Parthenocarpic fruit

Fruit develop without fertilisation.

Example :
Banana.
→ Such fruit are seedless.

Type Of fruit :-

1. Simple fruit :- Develop from multicarpellary syncarpus ovary.

(a) Dry fruit (b) fleshy fruit

2. Aggregate fruit :- Develop from multicarpellary Apocarpus ovary.

example :-
Strawberry
custard Apple

3. Composite fruit :- floral axis gets converted in to fruit.

example :-
Jack fruit, Pineapple
Mulberry.

1.(a) Dry fruit — Pericarp not divisible into layer.

Such as - Mustard, Pea, ground nut.

(b) Fleshy fruit — Pericarp divisible into layer and edible.

Such as - Mango, guava, orange.

↓
Mesocarp
edible.

APOMIXIS :-

→ Seed develop without fertilisation.

→ In apomixis some diploid cell of nucellus divide mitotically to form embryo.

→ and ovule develop into seed.

Example :

Some grasses

Asteraceae

Mango

Citrus

nucellus cell apomixis

Apomixis is a form of asexual reproduction that mimics sexual reproduction.

POLYEMBRYONY :-

When two or more embryo develop from a single fertilised egg. The condition is known as polyembryo.

In human case it result in forming twins.

Example: [Orange seed]

zygote → Embryo
nucellus → embryo

HYBRID SEED :-

- The hybrid seeds formed by apomixis is called apomictic seeds which are clone of mother plant.
- It reduces the cost of hybrid production.
- No meiosis so, offspring similar to parents.
i.e clone.
- conserve useful character.

Note :- Apomixis is the formation of seed without fertilisation.

But Parthenocarpy is the formation of fruit without fertilisation. Both are modes of asexual reproduction.