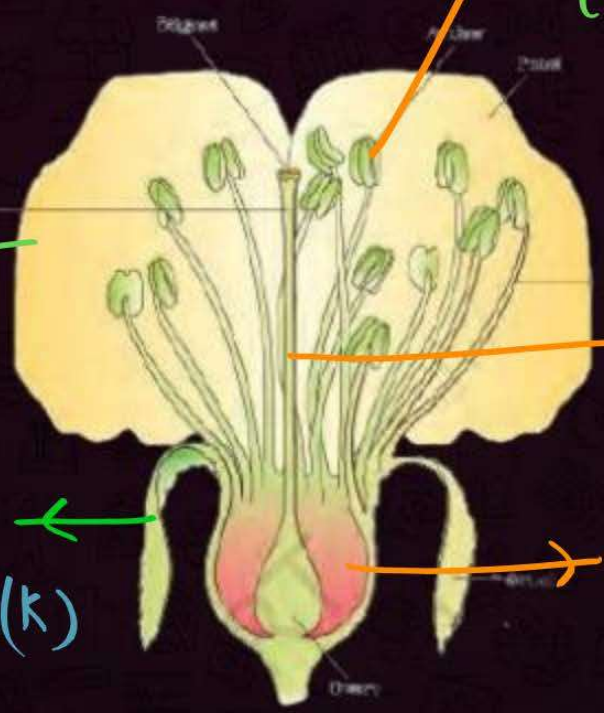
* All Ncert lines covered in notes.
* All ncert diagrams ✓
* Important questions ✓
* PYQs ✓
* अच्छा Explanation ✓ (Nice)

* Promise from your side
a) See full lecture
b) Full Concentration

FLOWER

Angiosperms



Stamens (Androecium)

Essential whorls → Participate in reproduction

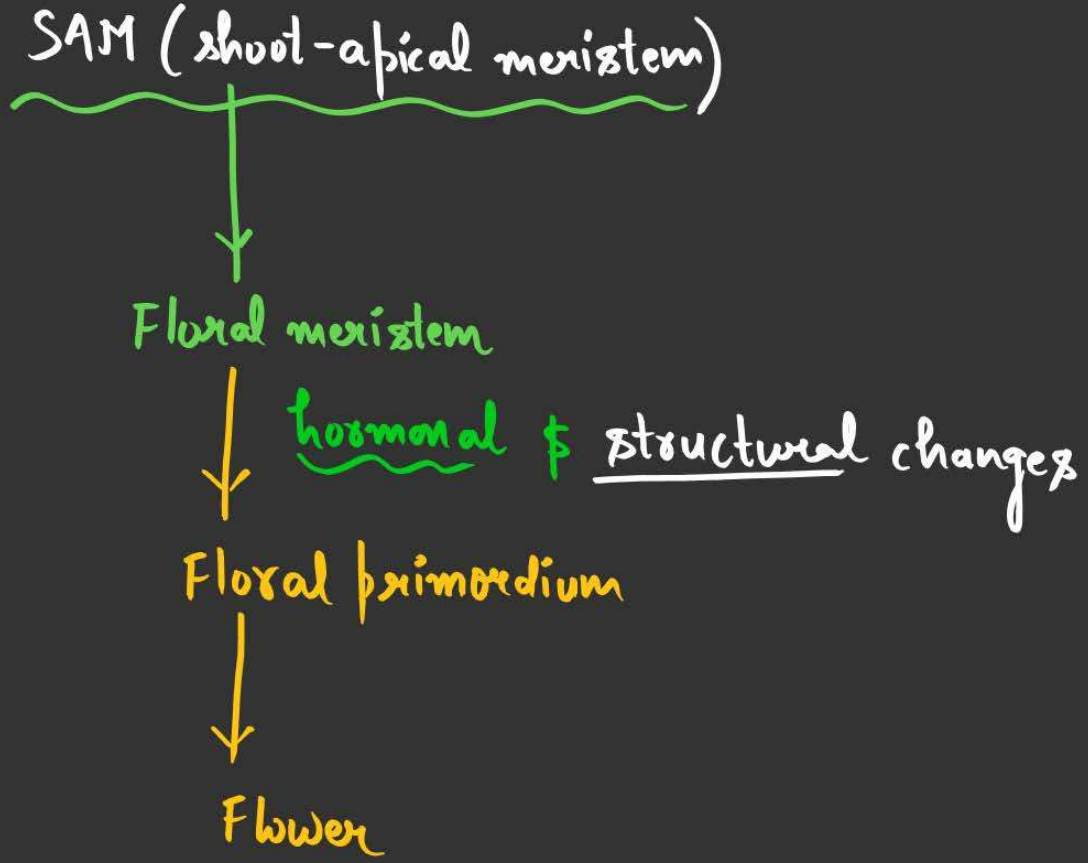
Carpel / Pistil (Gynoecium)

Thalamus / Receptacle

Non-essential whorls / Accessory whorls

Petals → Corolla (C)

Sepals → Collection: Calyx (K)


SAM (shoot-apical meristem)
Floral meristem
hormonal & structural changes
Floral primordium
Flower

Sexual Reproduction

3 Parts

Pre-fertilization event

- Pollen pistil interaction
- Microsporogenesis
- Pollengrain development
- Formation of male gametes
- Megasporogenesis
- Embryo-sac development
- Female gamate
- Pollination

Fertilisation

- Fusion

Post fertilization Events

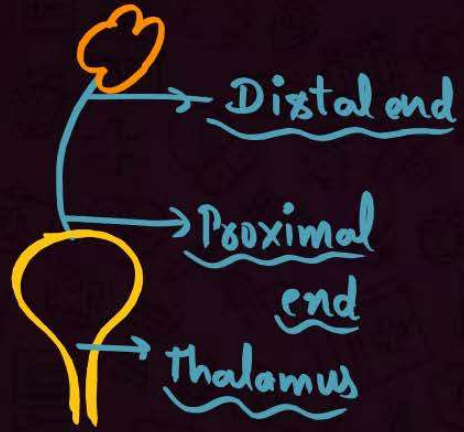
- Embryo development
- Endosperm development
- Seed formation
- Fruit formation

ANDROECIUM

→ Male reproductive Unit

→ Collection of stamens

(long slender stalk)



* Filament is attached with thalamus by Proximal end (Khela)

* Filament is attached with Anther by Distal end (Khela)

Filament can be attached with

* Thalamus (Mostly)
* Petals (Epipetalous) → Solanaceae family
* Tepals (Epiphyllous) → Liliaceae family
  (Perianth) (onion)

Filament never attached with Sepal ✗

ANDROECIUM

Anther (Mostly)

→ Bilobed

→ Dithecous

(Each lobe has ② theca)

→ Tetragonal

→ Tetrasporangiate (4 microsporangia)

Exception:

Malvaceae family

→ Cotton

→ China-rose (Hibiscus)

→ lady-finger

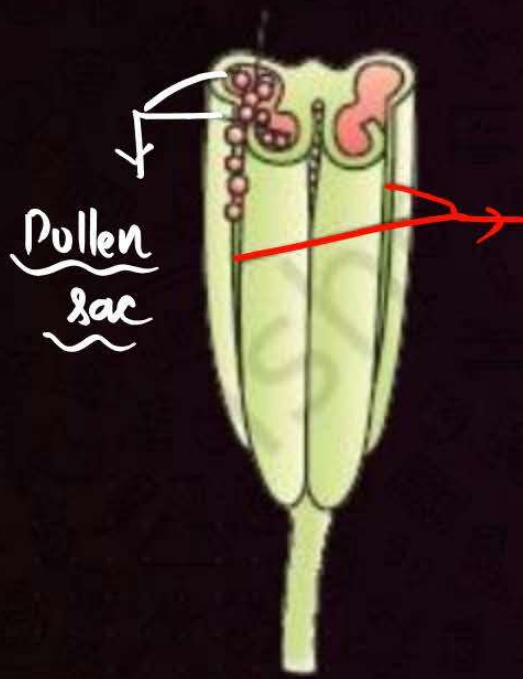
Anther

→ Unilobed

→ Monothecous

→ Bisporangiate

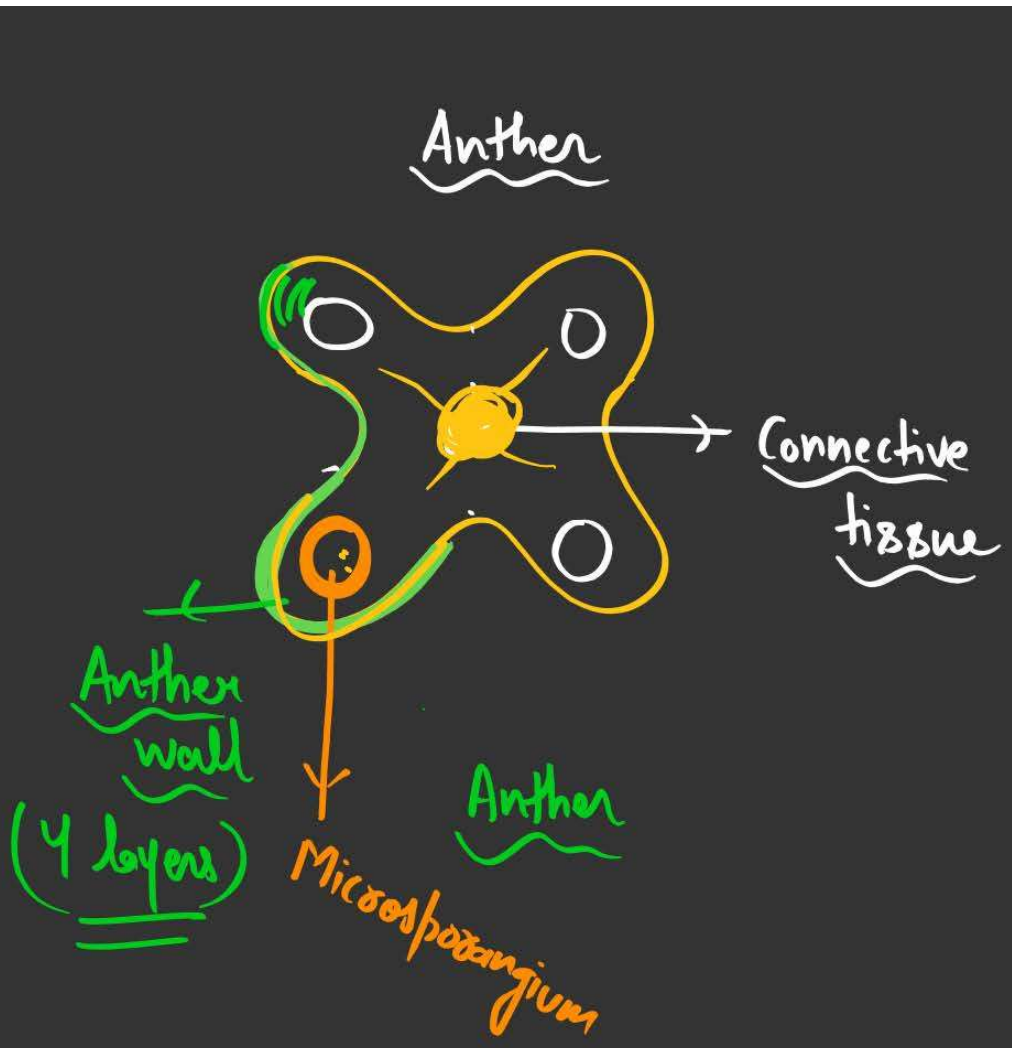
ANDROECIUM



* Longitudinal groove
  ↓
  Depression that separates the two theca and runs lengthwise

POLLEN-SAC

when anther matures, then microsporangia are called as "Pollen-sacs" (as they contain pollengrains)


Anther
Connective tissue
Anther wall
(4 layers)
Anther
Microsporangium

Anther

Anther Wall

has 4 layers

1. Epidermis
2. Endothecium
3. Middle layers
4. Tapetum

Microsporangium

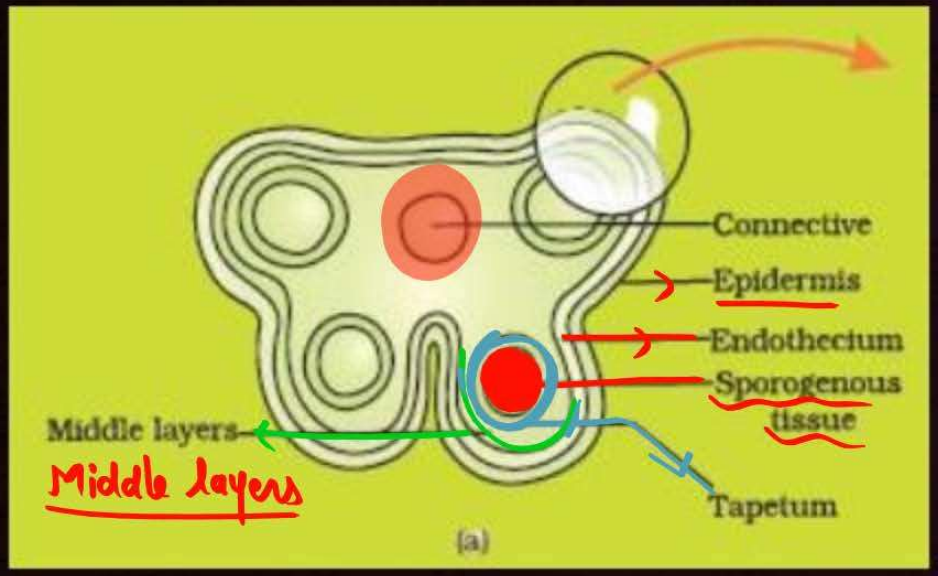
- Each microsporangium is circular structure
- In young anther Each microsporangium is filled with a mass of compactly arranged homogenous meristematic tissue called as **SPOROGENOUS TISSUE**

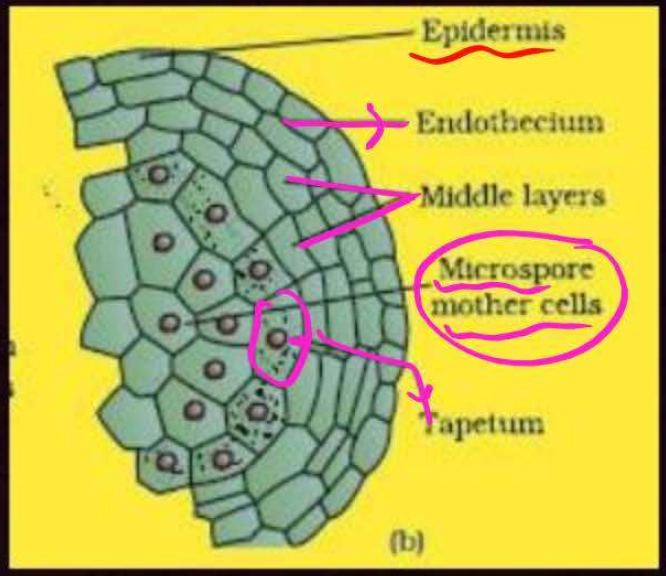
Connective Tissue

- It is vasculated sterile tissue which connects the two lobes of anther

ANTHER

Epidermis
↓
Endothecium
↓
Middle layers
↓
Tapetum





Epidermis (2n)

* Single-layered
* Outermost (Protective)

Endothecium (2n)

* Single-layered
* Function: Help in Dehiscence of anther

Middle-layers (2n)

* 2-3 layered
* Short-lived (Ephemeral)

NOTE: the outer three layers perform the function of Protection & dehiscence of anther.

Anther Wall

Tapetum — Cells have dense cytoplasm

Innermost layer of Anther wall

Polyploid

When cell arrests at Anaphase, (DNA, content and chromosomes increases)
(Endopolyploidy, Endomitosis)

has more than one nucleus

- Failure of cytokinesis
- Binucleated or multinucleated

Functions:

a. Provide nourishment to developing pollen Grains.

ANTHER

when Anther matures

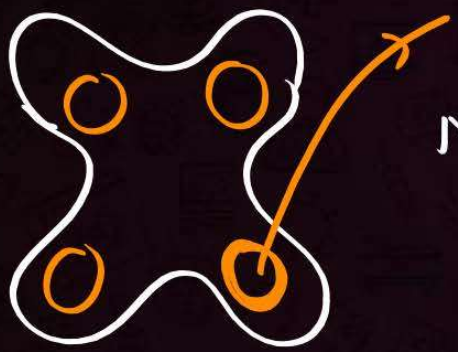
↓

* Dehydrates
* Dehisces

Pollengrains are released

Microsporogenesis

Formation of Microspores inside microsporangium



Young anther

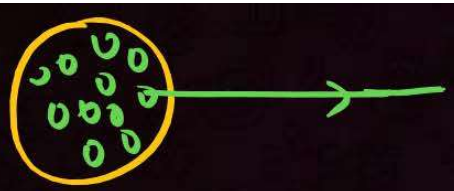
Microsporangium

→ Sporogenous tissue (Meristematic tissue)

(2n)

↓

Each cell of Sporogenous tissue act as a potential pollen-mother cell or Microspore mother cell.



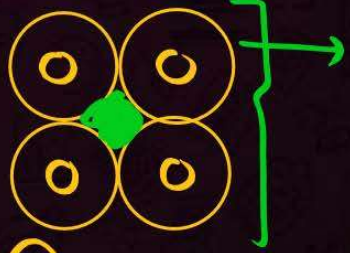
Microsporangium

Each microsporangium has thousands of (micro-spore mother cells)

Micro-spore mother cell (MMC) or Pollen mother cell (PMC)

MMC (2n)

Meiosis / Reductional division



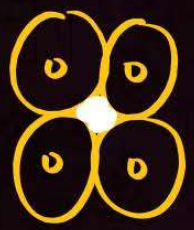
Microspore Tetrad

(4) microspores (n)

(Are attached with each other by CALLOSE)

Micropores in a tetrad are associated with each other by CALLOSE (carbohydrate)
(In cell wall of micropores)

Each microspore (n) gives rise to Pollengrain / Male gametophyte



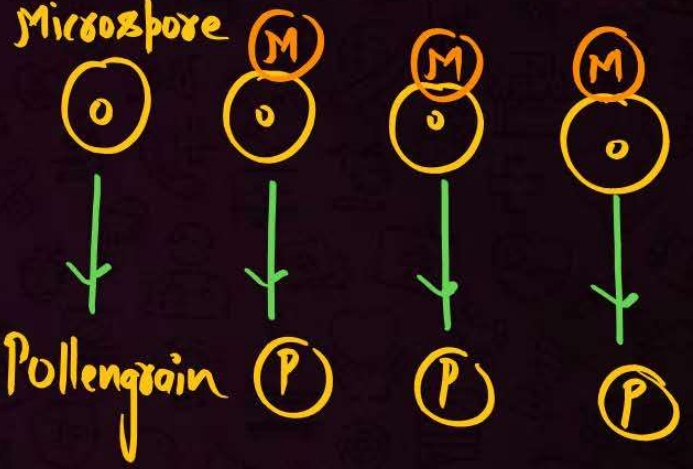
Microspore tetrad

Tetrad → separates

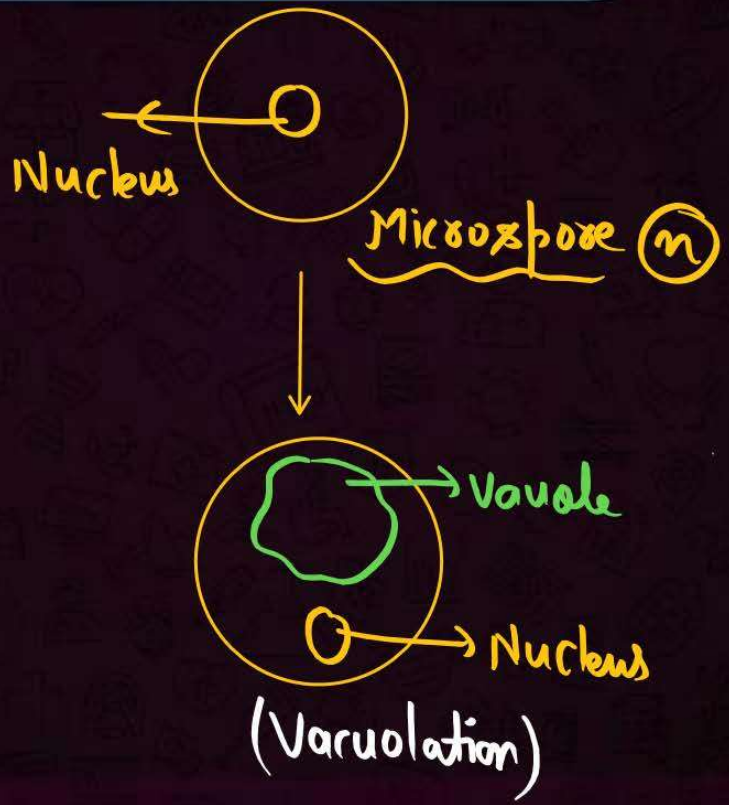
(Callase Enzyme)

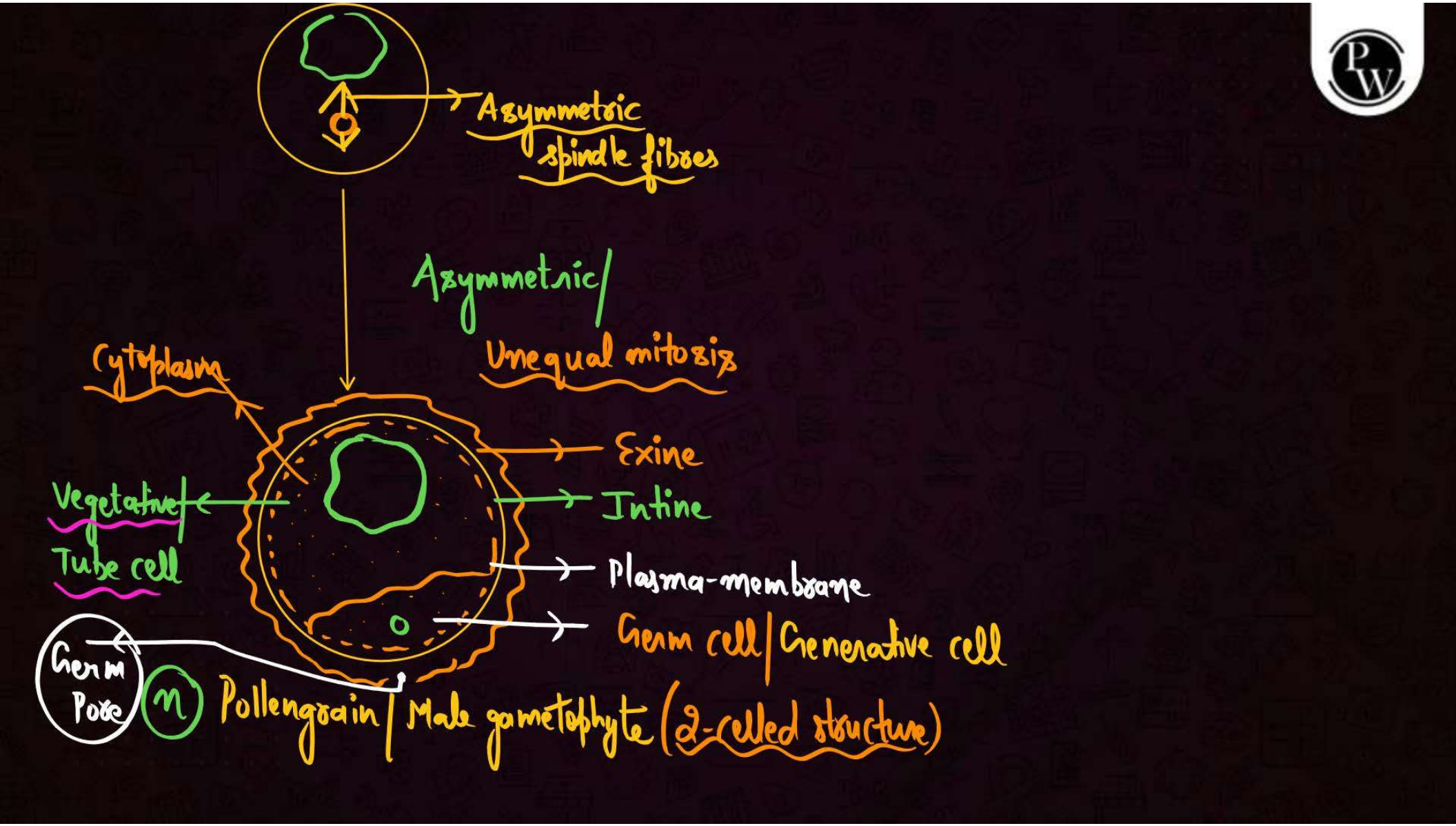
(By Tapetum)

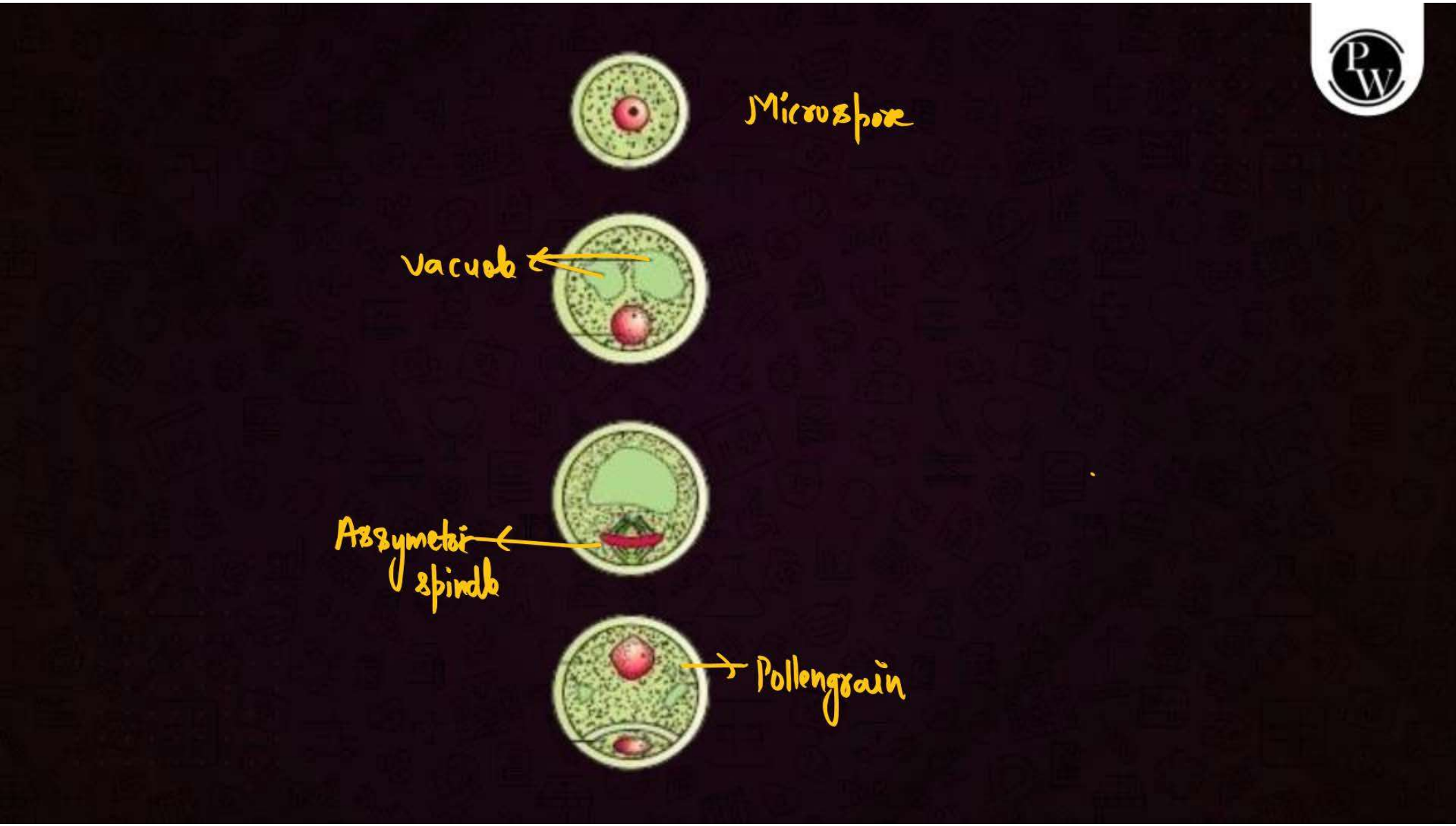
Microspore → Pollengrain



Development/formation of Male Gametophyte/Pollen Grain




Asymmetric spindle fibres
Asymmetric/ Unequal mitosis
Cytoplasm
Exine
Intine
Vegetative/ Tube cell
Plasma-membrane
Germ cell/ Generative cell
Germ Pore
n
Pollengrain/ Male gametophyte (2-celled structure)


Microspore
Vacuole
Asymetric spindle
Pollengrain

Pollen Grain / Male Gametophyte

- Haploid structure
- Spherical → shape
- Diameter 25-50 μm

Structure of pollen Grain

A. Exine → outermost covering of pollen grain.

Thick and Discontinuous (Absent at some points)

Has Germ Pore → Point where Exine Absent.

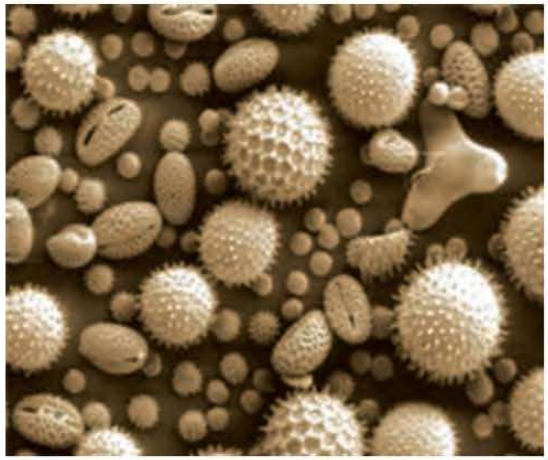
It is a point from where pollen tube comes out.

Pollen Grain / Male Gametophyte

Exine is made of Sporopollenin

SPOROPOLLENIN

- Hardest substance of Universe
- Most Resistant Substance of universe
- Nothing can degrade it
- No alkali, acid, enzyme, low or high temp.
- Due to sporopollenin, the Fossils of pollen grains are well preserved.
- Exine has taxonomic significance also it gives pollen grain different designs, ~~tacties~~ texture and pattern.



Pollen Grain / Male Gametophyte

b. Intine → Thin and continuous
made of → Cellulose and pectin (Pectucellulosic)

c. Cytoplasm → The cytoplasm of pollen grain is surrounded by "Plasma-membrane".

d. Vegetative/Tube cell

- Large cell, Haploid
- Abundant food reserve material
- **Nucleus → Irregular - shaped**
- Function: Helps in Pollen tube formation

e. Generative cell/ Germ Cell

- Haploid
- **Small and spindle-shaped**
- has less amount of cytoplasm (dense cytoplasm)
- Floats in the cytoplasm of vegetative cell
- Function → Undergoes mitosis to form two male gametes.

Shedding of Pollen Grain

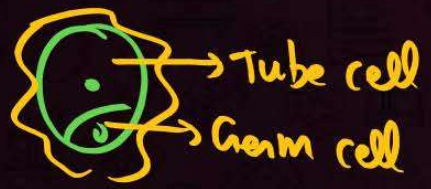
Anther dehisces, pollen grains are released.

In 60% Angiosperms

(Half development of pollen grain occurs inside anther and half on stigma)

Shedding of pollen grain, occurs at

2 celled stage

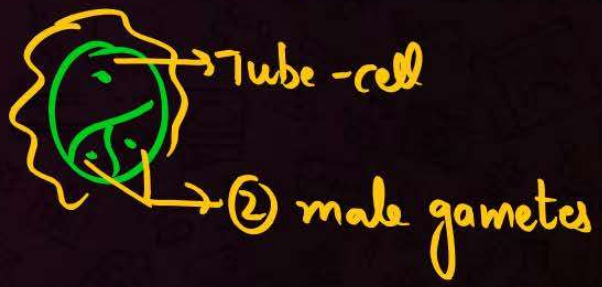


- Germ cell will divide (mitosis) to give 2 male gametes when it will reach stigma and form pollen tube.

In 40% Angiosperms

(Full development of pollen grain occurs inside anther)

Shedding occurs at **3 celled stage**



- Male gametes in pollen grain inside anther.

Pollen Allergy

Some plants → Pollen grains → contaminants cause allergy :

(1) Bronchitis

(2) Asthma

Plants:

Parthenium grass (carrot grass) (came in India as contaminant with imported wheat)

(Problematic weed)

Amaranthus

Chenopodium

Pollen Products

Pollen Products

- Pollen grains → Reserve food material (Nutrients)
- Pollen grains are taken by (1) Athletes (2) Horses
- In forms of (1) Tablets (2) Syrup

Pollen Viability

The time period up to which pollen grain remains capable of forming Pollen tube after coming out of anther is Pollen viability.

Pollen Viability

- Cereals
  - Viability → 30 minutes (½ hour)
  - Wheat
  - Maize
  - Rice
- Viability (Several months)
  - Solanaceae
  - Leguminosae
  - Rosaceae

- Pollen viability is highly variable

  Depends on :

  (a) prevailing Temperature

  (b) Humidity

Pollen Bank

Pollen Grain are stored in labs.

Cryopreservation

At −196°C in liquid Nitrogen

QUESTION

Pollen grains are well-preserved as fossils because of the presence of

A. Sporopollenin

B. Cellulose

C. Pectin

D. Carotenoids

QUESTION

Which of the following option about tapetum is correct?

A. Nutritive tissue

B. Sporogenous tissue

C. Protective and haploid tissue

D. External layer of microsporangium wall

QUESTION

The prominent pollen grain apertures called germ pores are present on

A. Vegetative cell

B. Intine

C. *Exine*

D. Generative cell

QUESTION

Pollen viability for rice and wheat plants is

A. 30 hours

B. Several months

C. ½ hour

D. 30 seconds

QUESTION

Exine of pollen grain

A. is pectocellulosic

B. exhibits of fascinating array of patterns and designs

C. has micropyle

D. is degraded enzymes

QUESTION

In flowering plants, the generative cell of pollen grain divides mitotically to give rise to the

A. 2 male gametes

B. 3 male gametes

C. 1 male gamete

D. 4 male gametes

QUESTION

The thin and continuous wall layer of pollen is

A. Exine

B. Intine

C. Germ pore

D. Endothecium

QUESTION

The two celled stage of mature pollen grain consists of

A vegetative cell, generative cell

B Vegetative cell, one male gamete

C Two male gametes

D Generative cell, one male gamete

QUESTION

contain male gametes

To form mature pollen grains how many meiosis and mitosis required?

A. 1 meiosis and 1 mitosis

B. 1 meiosis and 2 mitosis

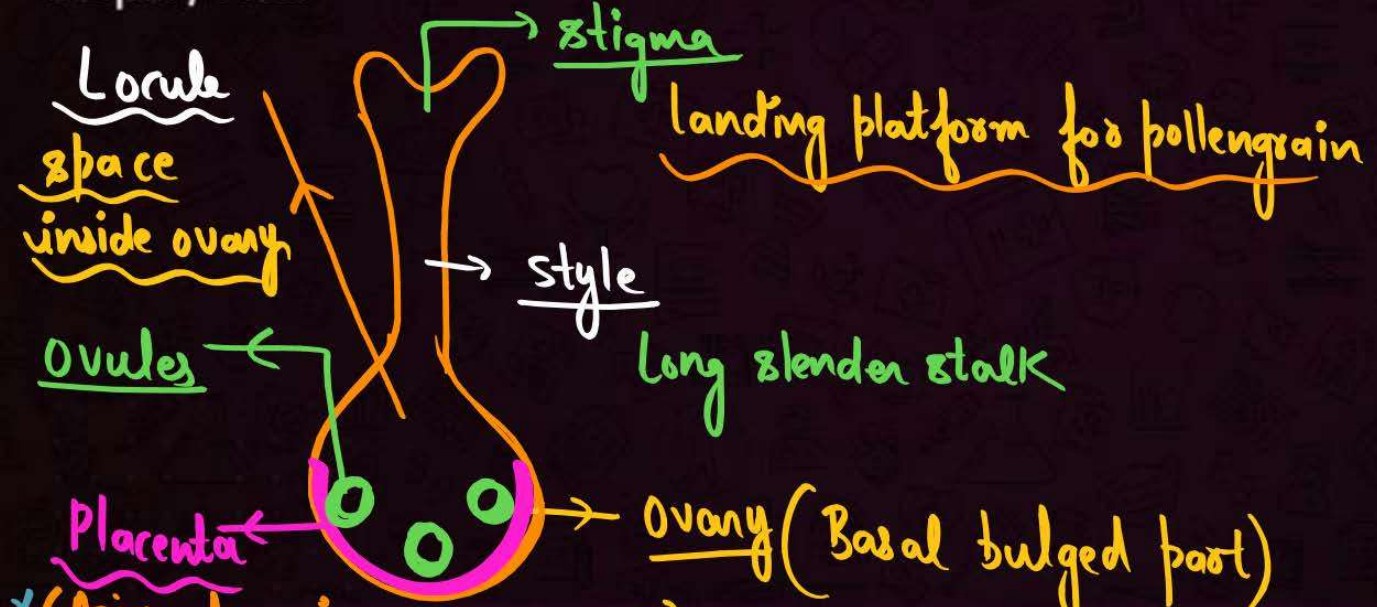
C. 2 meiosis and 1 mitosis

D. 1 meiosis and 3 mitosis

Gynoecium

Female reproductive part.

Carpel / Pistil



Number of Ovules in Ovary

Single Ovule

- Cereals (wheat, rice, Maize)
- Mango
- Coconut
- Sunflower (family)

Many

- Papaya
- Watermelon
- Cucumber
- Orchids (Thousands of ovule)

Gynoecium

Monocarpellary

Single Carpel (G_1)

- Leguminosae
- Mango
- Coconut
- Cereals

Multicarpellary (Common condition)

Many Carpels

- Michelia
- Hibiscus (China Rose)
- Papaver
- Lotus
- Rose

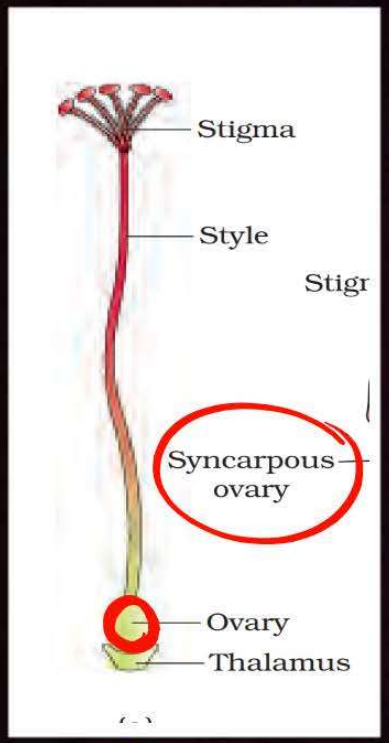
If gynoecium has more than 1 Carpels

Apocarpous

- Carpels → Free
- Lotus
- Rose
- Michelia

Syncarpous

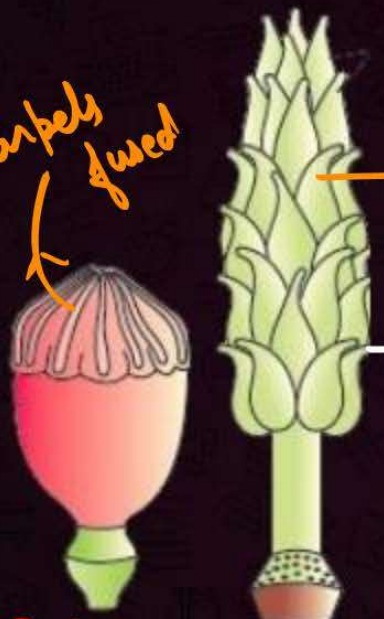
- Carpels → Fused
- Most common
- Solanaceae
- Malvaceae
- Liliaceae
- Mustard



China-rose

(M) & (8)

Carpels fused



Papaver

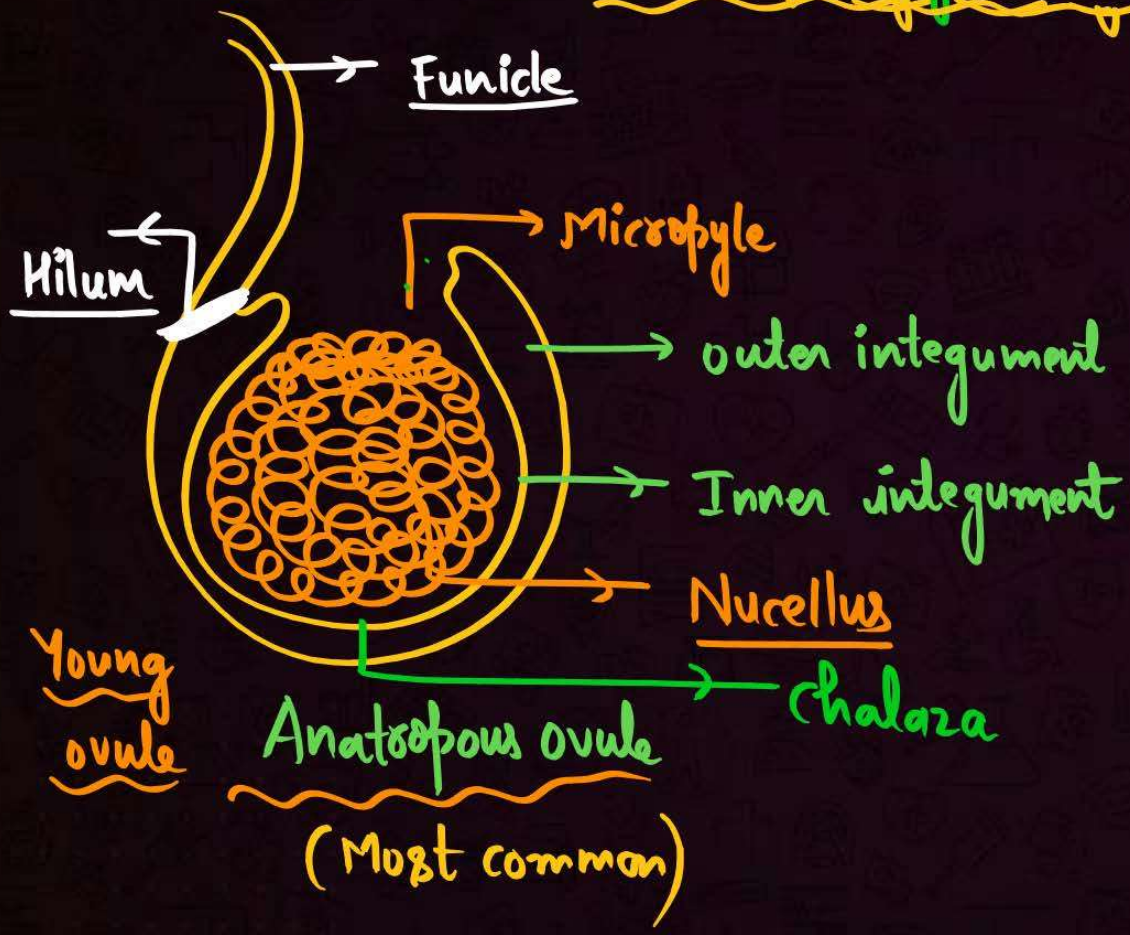
(Opium)

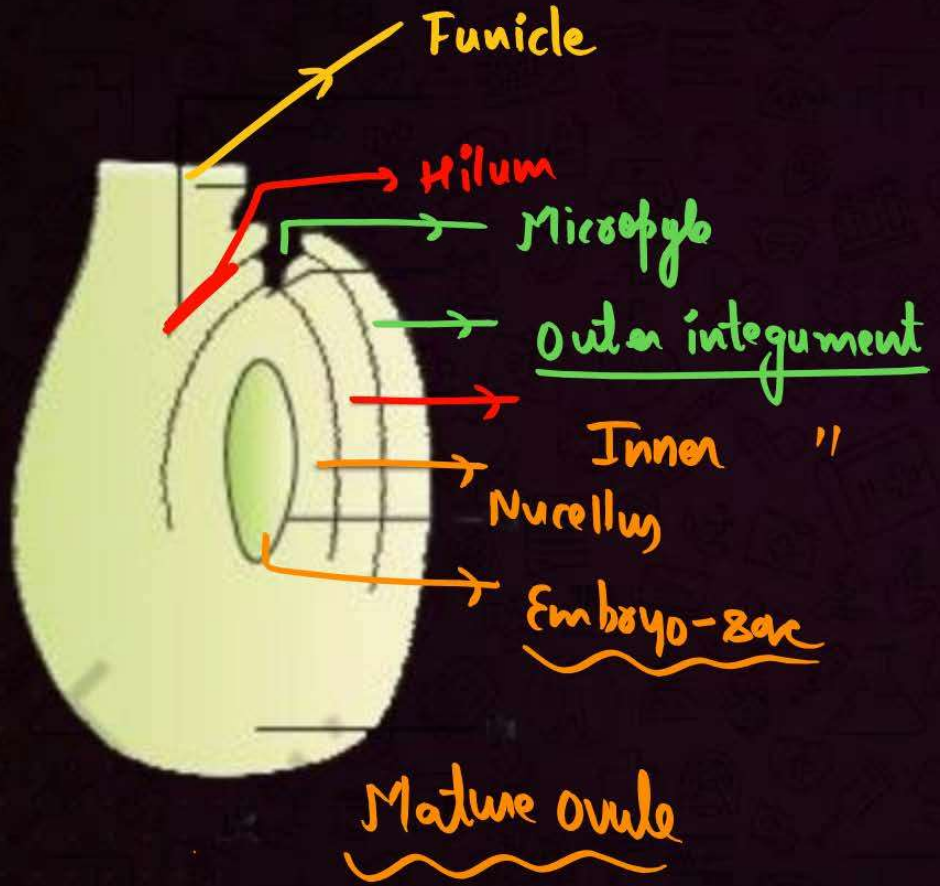
Michelia → Multicarpellary & Apocarpous

Carpels free

↳ Multicarpellary & syncarpous

Ovule | Integumented megasporangium




Funicle
Hilum
Micropyle
Outer integument
Inner "
Nucellus
Embryo-sac
Mature ovule

Ovule/Megasporangium

(a) Funicle (2n) → Stalk which connects ovule with ovary wall or placenta.

(b) Hilum → Point of attachment of funicle with ovule.

(c) Micropyle → Opening of ovule.

(d) Chalaza → Base of ovule (opposite to micropyle)

(e) Nucellus → (Diploid) Mass of parenchymatous cells.

(f) Integuments (Diploid) (2)
(Protective envelops)
(2 in number)

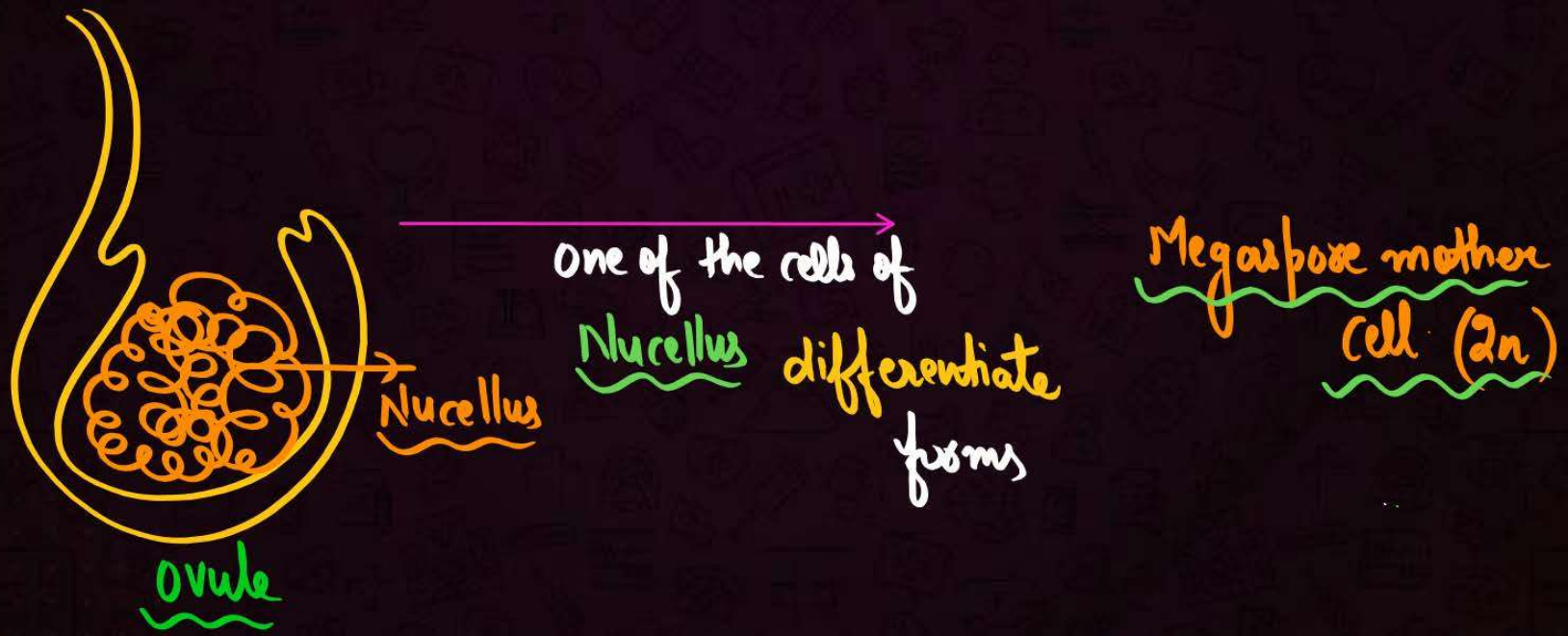
- Bitegmic → Mostly two (2)
- Unitegmic → There may be (1) integuments in few angiosperms

- Outer integument
- Inner integument

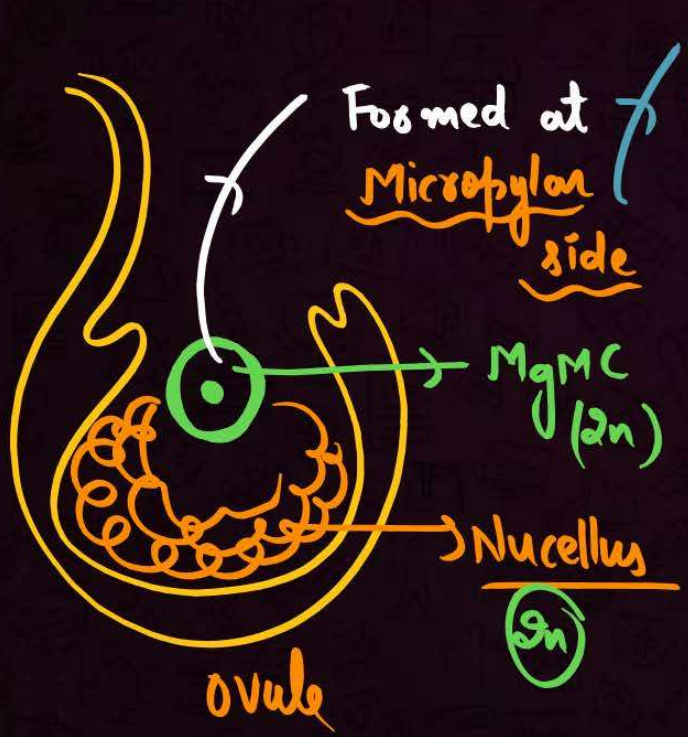
(g) Embryo-sac → Haploid
Female-gametophyte
Present in mature ovule

Megasporogenesis

Formation of megaspore (Haploid) inside megasporangium (ovule)



Megasporogenesis



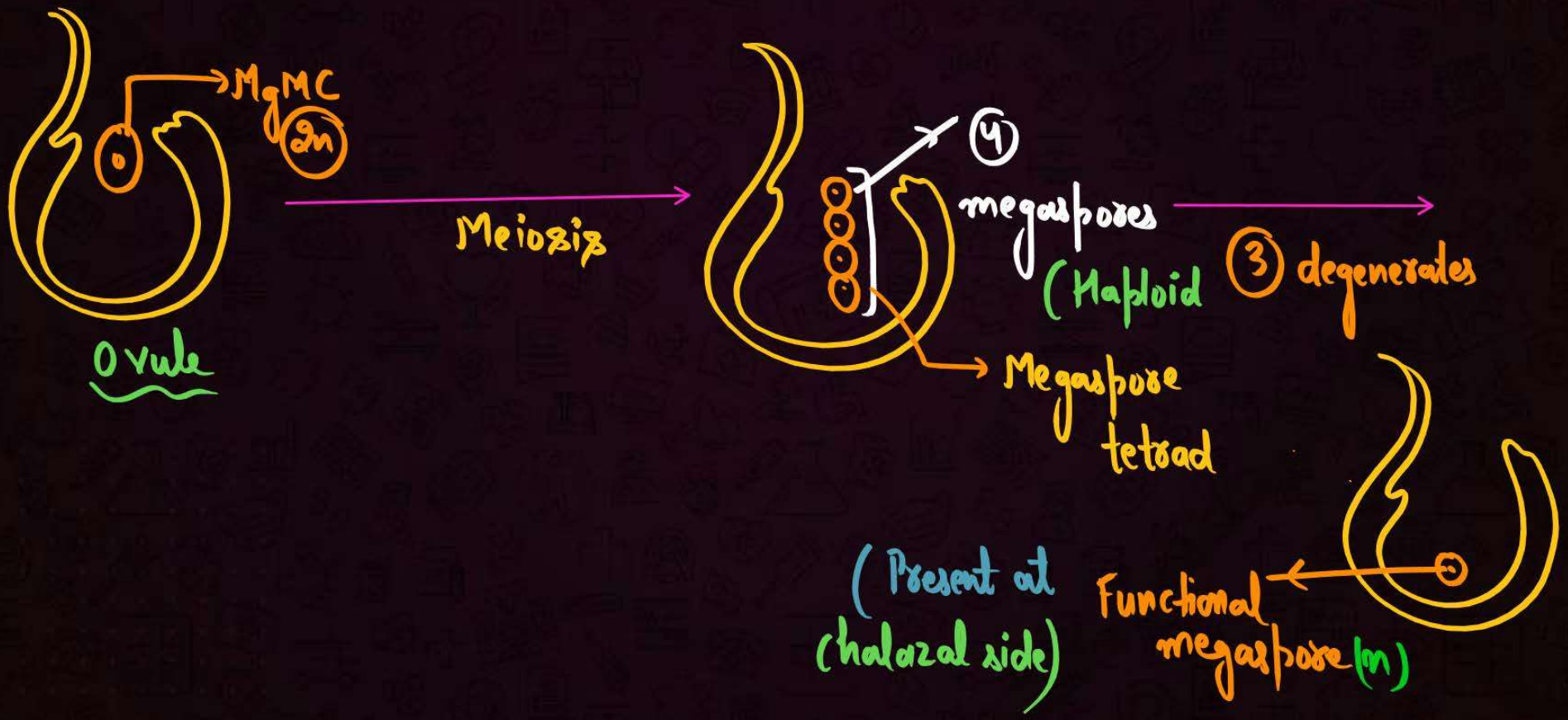
Megaspore-mother cell (MgMC)

One of the cells of Nucellus differentiates and form Megaspore mother cell at micropylar end

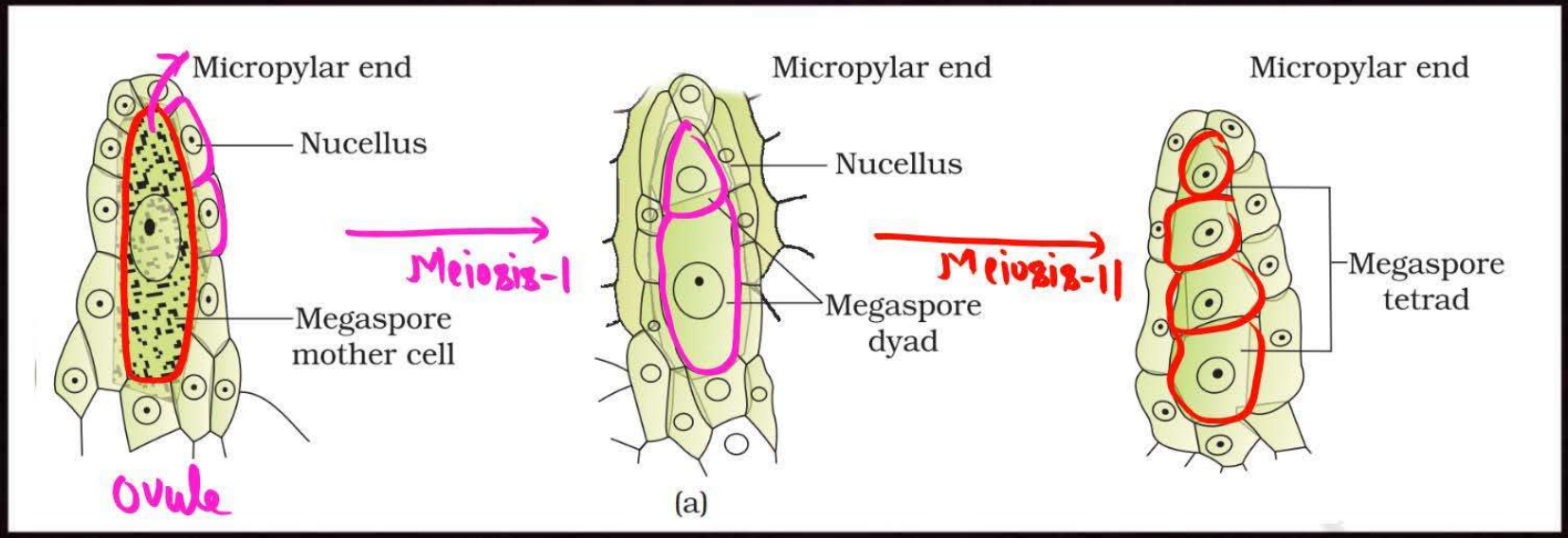
MgMC

- Diploid cell → has dense cytoplasm
- Large cell → prominent nucleus

Megasporogenesis



Megasporogenesis



Development of Female gametophyte / Embryo-sac

Functional megaspore(n)

Functional megaspore(n)

1st Free-nuclear division (Mitosis) (Immediately cytokinesis will not occur)

2-nucleated stage

2-nuclei move towards opposite poles.

2nd (free-nuclear division) (mitosis)

4-nucleated stage

3rd (free nuclear division) (mitosis)

Polarisation

8-nucleated stage

Ultimately → Cytokinesis

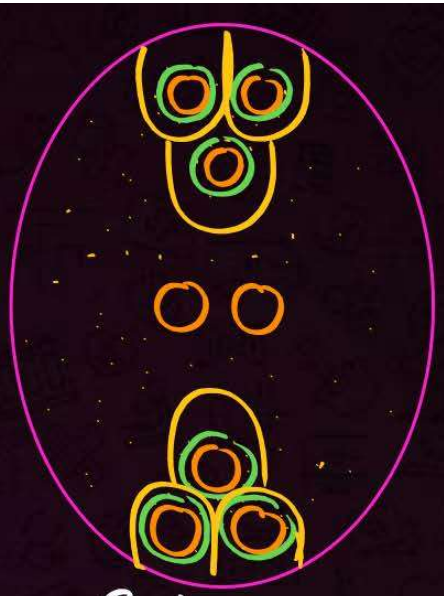
"Cell Wall Development"

Out of the 8 nuclei

Only 6 nuclei

undergoes cell wall development

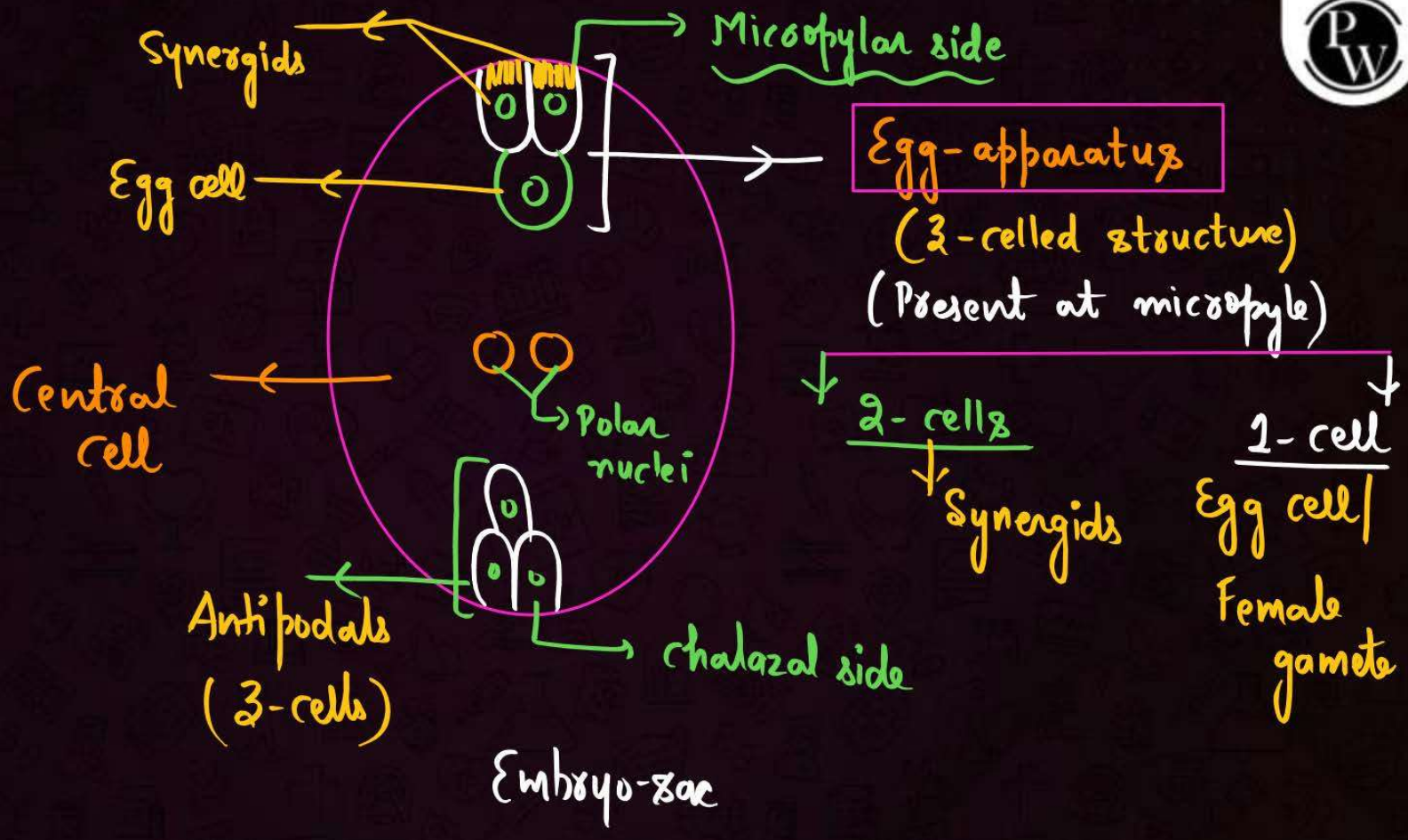
Polar nuclei does not undergo cell wall development



Embryo-sac

Now called as
Female Gametophyte
or
Embryo-sac

Embryo-sac


Synergids
Egg cell
Micropylar side
Egg-apparatus
(3-celled structure)
(Present at micropyle)
2-cells
Synergids
1-cell
Egg cell
Female gamete
Central cell
Polar nuclei
Antipodals
(3-cells)
Chalazal side
Embryo-sac

Embryo-sac

- 7 celled and 8 nucleated structure. ← Most Silly mistake
- Polygonum (Angiosperm) type of embryo-sac.
- Embryo-sac is Monosporic (Most angiosperms)
- Embryo-sac develops from 'single megaspore.

Synergids

Haploid

- Helper cells / Cooperative Cells
- Has Filliform apparatus Cellulosic thickening or microfibrils, they release Chemotropic substance (chemical) which guide pollen tube to take entry inside ---- Synergids → Embryo-sac → Ovule

Egg Cell

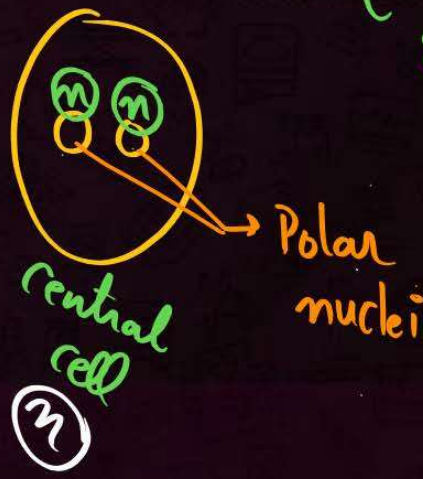
Haploid

- After fertilization forms Zygote (2n)

Central Cell

Haploid Cell → (Twist)

- Binucleated (2) nuclei
- Central cell after fertilization forms PEC (Primary Endosperm Cell)



QUESTION

The point of attachment of funiculus to the body of ovule is

A. Placenta

B. Micropyle

C. Integument

D. Hilum

QUESTION

Ovule found in 82% of angiosperm families is

A. Anatropous

B. Orthotropous

C. Amphitropous

D. Circinotropous

QUESTION

A multicarpellary, syncarpous gynoecium is found in

A. *Papaver*

B. *Michelia* (Apocarpous)

C. *Hibiscus*

D. More than one option is correct

QUESTION

Mark the odd one (w.r.t. ploidy level).

A. Nucellus (2n)

B. ~~Michelis~~ Integument (2n)

C. Funicle (2n)

D. Embryo sac (n)

QUESTION

To form mature embryo-sac/ female gametophyte

A. 1 meiosis and 2 mitosis

B. 1 meiosis and 1 mitosis

C. 1 meiosis and 3 mitosis

D. 1 meiosis and 4 mitosis

Break

↓

15 minutes

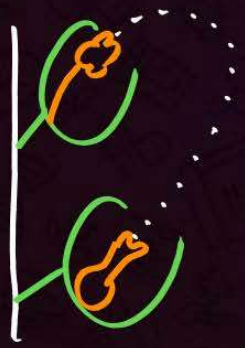
POLLINATION

Transfer of pollen grain from anther to Stigma.

Autogamy/ Self Pollination

Pollination between same plant and same flower

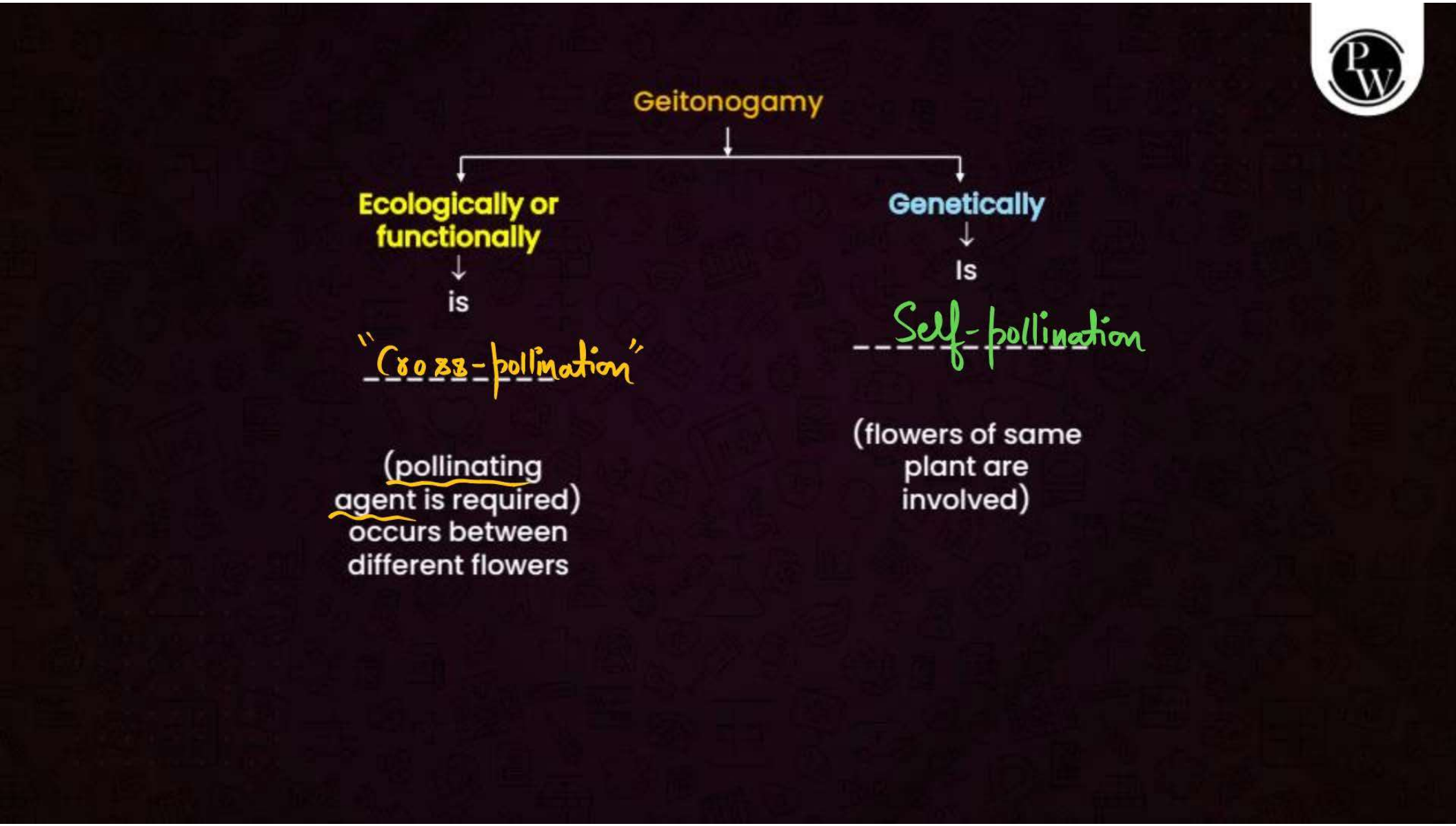
Geitonogamy



Pollination between different flowers of same plant

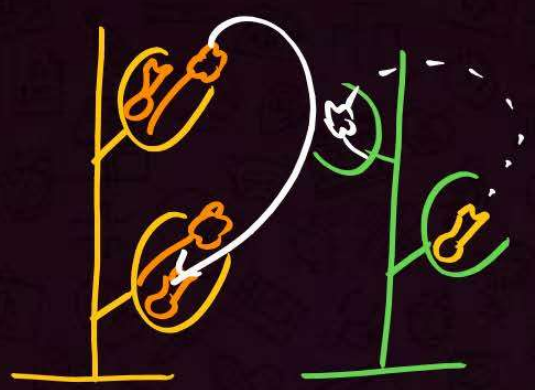
Xenogamy/ Allogamy/ Cross Pollination

Pollination between different flowers and different plants


Geitonogamy
Ecologically or functionally
is
"Cross-pollination"
(pollinating agent is required) occurs between different flowers
Genetically
is
Self-pollination
(flowers of same plant are involved)

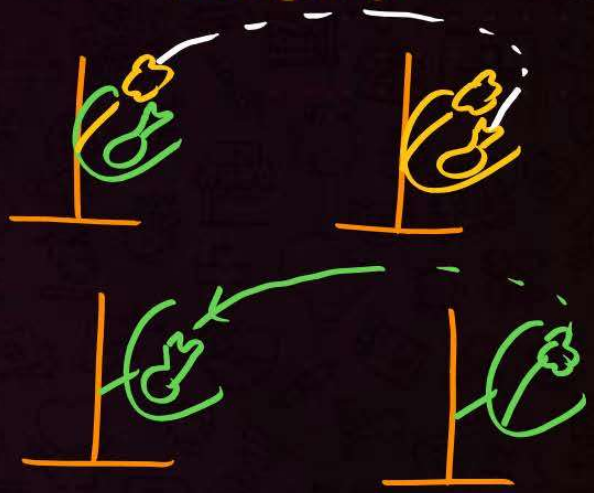
Self pollination can occur in plant having bisexual flowers.

Geitonogamy

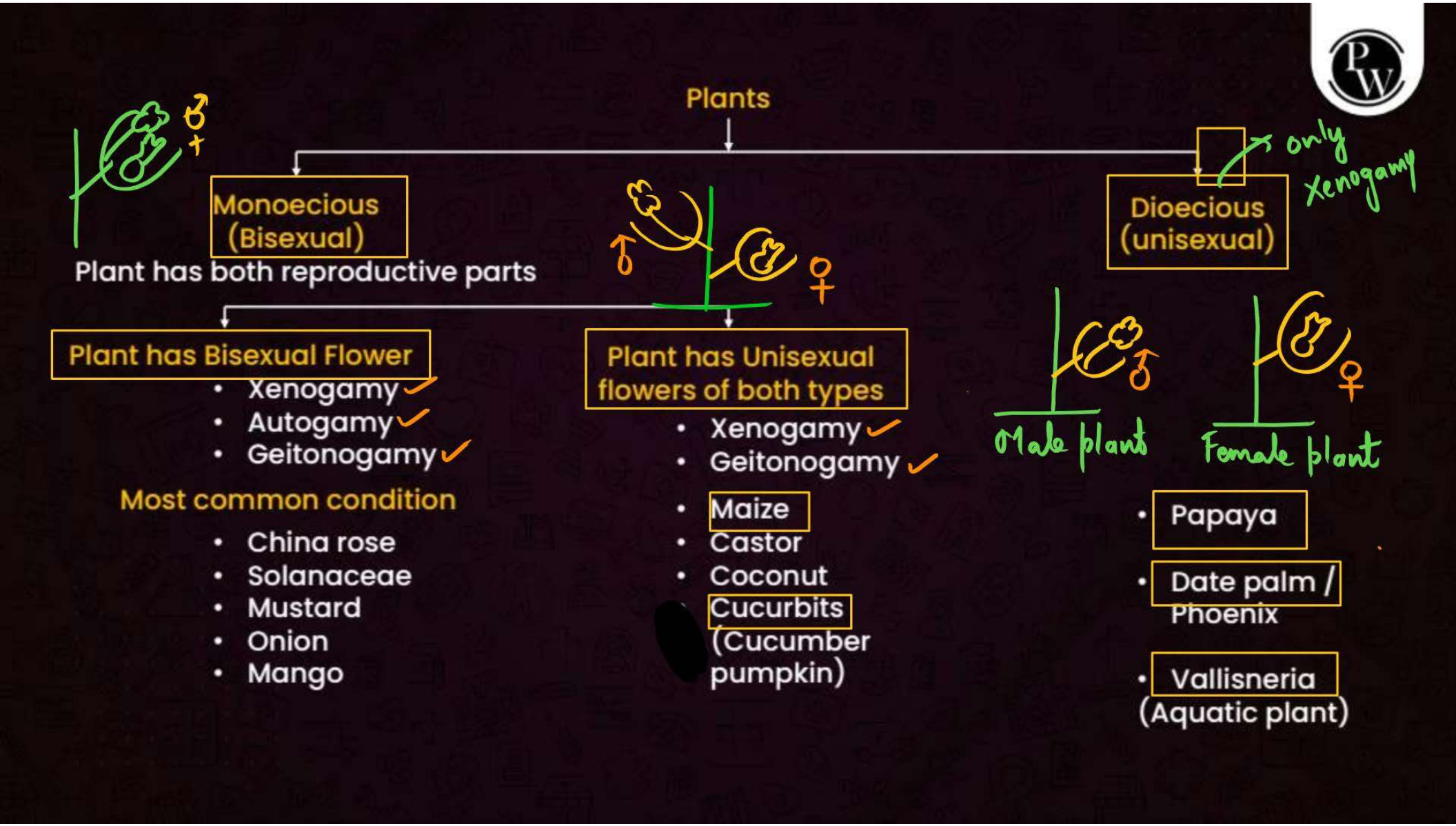


- Can occurs between bisexual flowers or unisexual flowers of same plant

Xenogamy



- Xenogamy may occur between bisexual flowers or unisexual flowers of different plants


Plants
Monoecious (Bisexual)
Plant has both reproductive parts
Dioecious (unisexual)
only Xenogamy
Plant has Bisexual Flower
Xenogamy
Autogamy
Geitonogamy
Most common condition
China rose
Solanaceae
Mustard
Onion
Mango
Plant has Unisexual flowers of both types
Xenogamy
Geitonogamy
Maize
Castor
Coconut
Cucurbits (Cucumber pumpkin)
Male plant
Female plant
Papaya
Date palm / Phoenix
Vallisneria (Aquatic plant)

QUESTION

In papaya male and female flowers are present on different plants. It permits

A. Autogamy

B. Geitonogamy

C. Both autogamy and geitonogamy

D. Xenogamy

QUESTION

Dioecious condition prevents

A Autogamy

B Geitonogamy

C Xenogamy

D Both (1) and (2)

QUESTION

In monoecious plant like castor and maize

A. Autogamy and allogamy are not prevented

B. Geitonogamy is prevented

C. Autogamy is not prevented

D. Geitonogamy is not prevented

Contrivances/ conditions for self pollination / Inbreeding Devices

a. **Bisexual flowers**
(Monoclinous flowers)

b. HOMOGAMY

- Anther and Carpel matures at same time.
- Synchrony in
Pollengrain release &
Stigma receptivity.

c. **CLEISTOGAMY** → Anthesis → flowers opening absent
↓
Only self pollination

d. Bud pollination
Anther and Carpel matures in bud-state and pollination occurs
Exam:
- Pea
- Rice

Cleistogamy

Plants

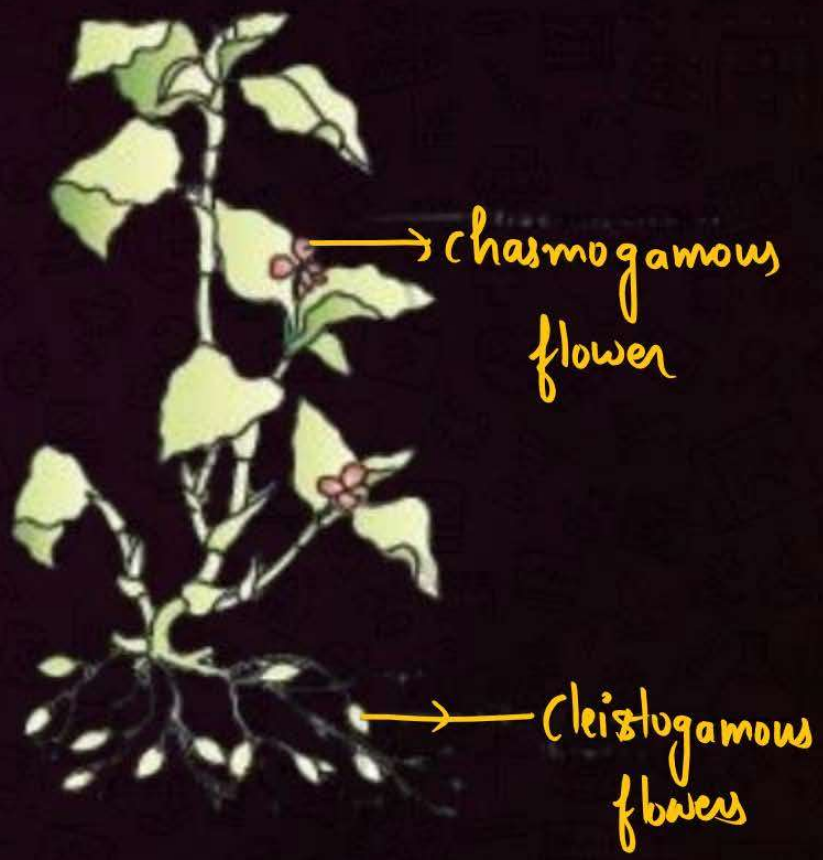
Examples:

a. Viola (common pansy)

b) Commelina

c) Oxalis

Both Chasmogamous and cleitogamous flowers



Advantages of Cleistogamy

a. Seed-set is assured even in the absence of pollination

b. No pressure on plant as it is cheap to plant because no nectar or any other floral reward to be given.

Disadvantages of Cleistogamy

Only self pollination

- Can be inbreeding depression
- Genetic diversity/variations is reduced

Contrivances/Condition for Cross pollination/OUTBREEDING DEVICES

a. Unisexual flower

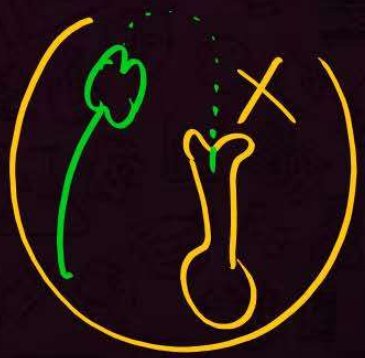
b. Dichogamy/Heterogamy

Anther and carpel do not mature at same time

- Protogyny — Carpel matures first
- Protoandry — Anther matures first

c. Chasmogamous flowers → Flower opening present

d. Self/sterility/Self incompatibility



Pollen grains are not identified by stigma of same flowers Genetically controlled

Contrivances/Condition for Cross pollination/OUTBREEDING DEVICES

e. **Heterostyly**

Large difference between length of stamen and carpel

f. **Herkogamy**

- Presence of physical barrier between Carpel and stamen
- Calotropis

QUESTION

Mark the odd option (w.r.t. contrivances of autogamy)

A. Homogamy

B. Cleistogamy

C. Dicliny (Unisexual flower)

D. Bud pollination

QUESTION

The types of flowers which always produce seeds even in the absence of pollinators

A. Chasmogamous flowers

B. Cleistogamous flowers

C. Bisexual flowers

D. Unisexual flowers

Pollinating Agents

Most common
Entomophilly

Abiotic (Nonliving)

- Wind (Anemo philly)
- Water (Hydrophyilly)

Wind pollination is more Common than water pollination

Biotic agents (living)

a) Entomophilly → By Insects (Bees, Beetles, Wasps, butterflies, moth)
Most common are Bees

b) Primates (Lemur)
c) Reptiles (Gecko lizard, Garden lizard)
d) Rodents (Arboreal Rodents (Tree dwelling)

e) Elephants
f) BirdS
g) Snake
h) Snails
i) Bats

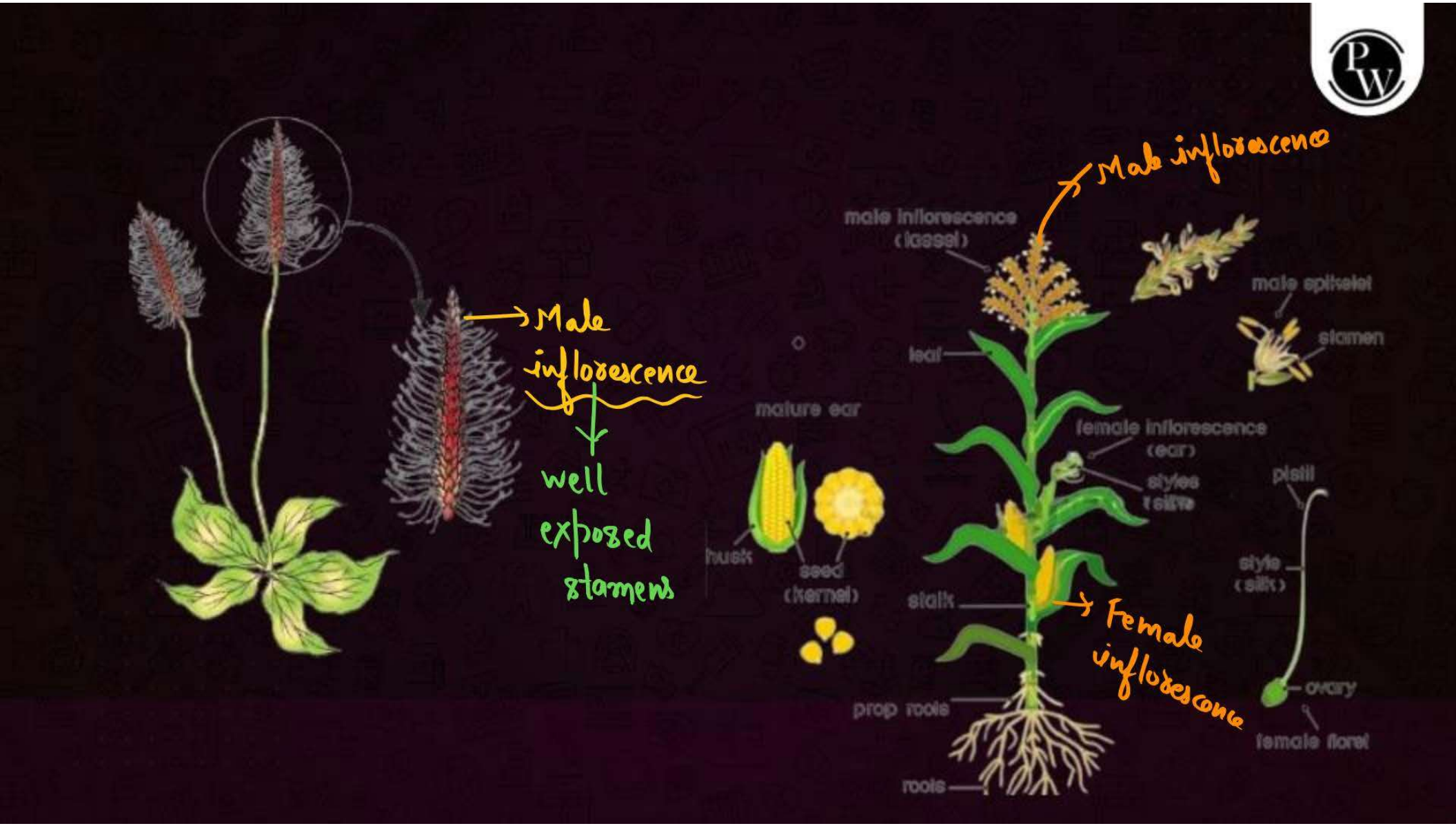
Anemophily / Wind Pollination

Property of Flower

- Odourless → No smell
- Nectarless
- Mostly colorless
- Small sized
- Flowers are often Packed into Inflorescence
- Ovary has Single ovule (Imp)
- Stamens → well-exposed
- Pollen grains → Non-sticky and light weight
- Stigma (1) Large
  (2) Feathery

- Examples → Cereals (Monocot) (poaceae)
  - Wheat
  - Maize
  - Rice

Maize


Male inflorescence
well exposed stamens
mature ear
husk
seed (kernel)
male inflorescence (tassel)
Male inflorescence
male spikelet
stamen
leaf
female inflorescence (ear)
styles (silks)
pistil
style (silk)
ovary
female floret
stalk
Female inflorescence
prop roots
roots

Tassles

Style

Stigma

Corn Cob

Hydrophilly / Water Pollination

- Rare in Angiosperms
- Restricted to only in 30 genera (out of them most are Monocots)

Hydrophytes (Aquatic Angiosperms)

Hydrophilly
- Vallisneria
- Hydrilla } Fresh H_2O
- Zoostera } Marine H_2O

In most of the hydrophytes Insect pollination or wind pollination is seen.

Reason : In most hydrophytes Flower is present above water surface.

Hydrophytes

- Water hyacinth (Eicchornia)
- Water lily (Nymphea)
- Lotus
- Pistia

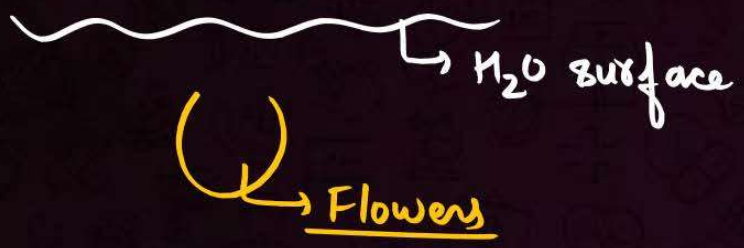
} Insect Pollination

Hydrophilly

Epihydrophilly
↓
occurs on water surface

Hypohydrophilly
↓
occurs inside water-surface

Hypohydrophilly



- Zoostera (sea grass)
- Pollination occurs below surface of H_2O.
- Flowers are submerged beneath the surface of water.

NEET 2024

Pollen grains
Long and Ribbon shaped
Carried passively with water current

Unwetlable
Mucilaginous sheath

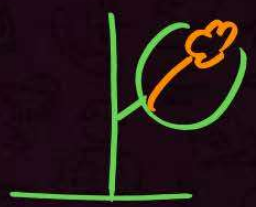
Stigma → surrounded by mucilaginous sheath.

Unwetlable

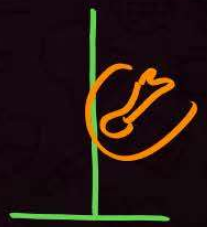
Epihydrophilly

In Vallisneria (Dioecious)

Male plant



Female Plant



At maturity male flowers, separates from male plant and float towards female flower

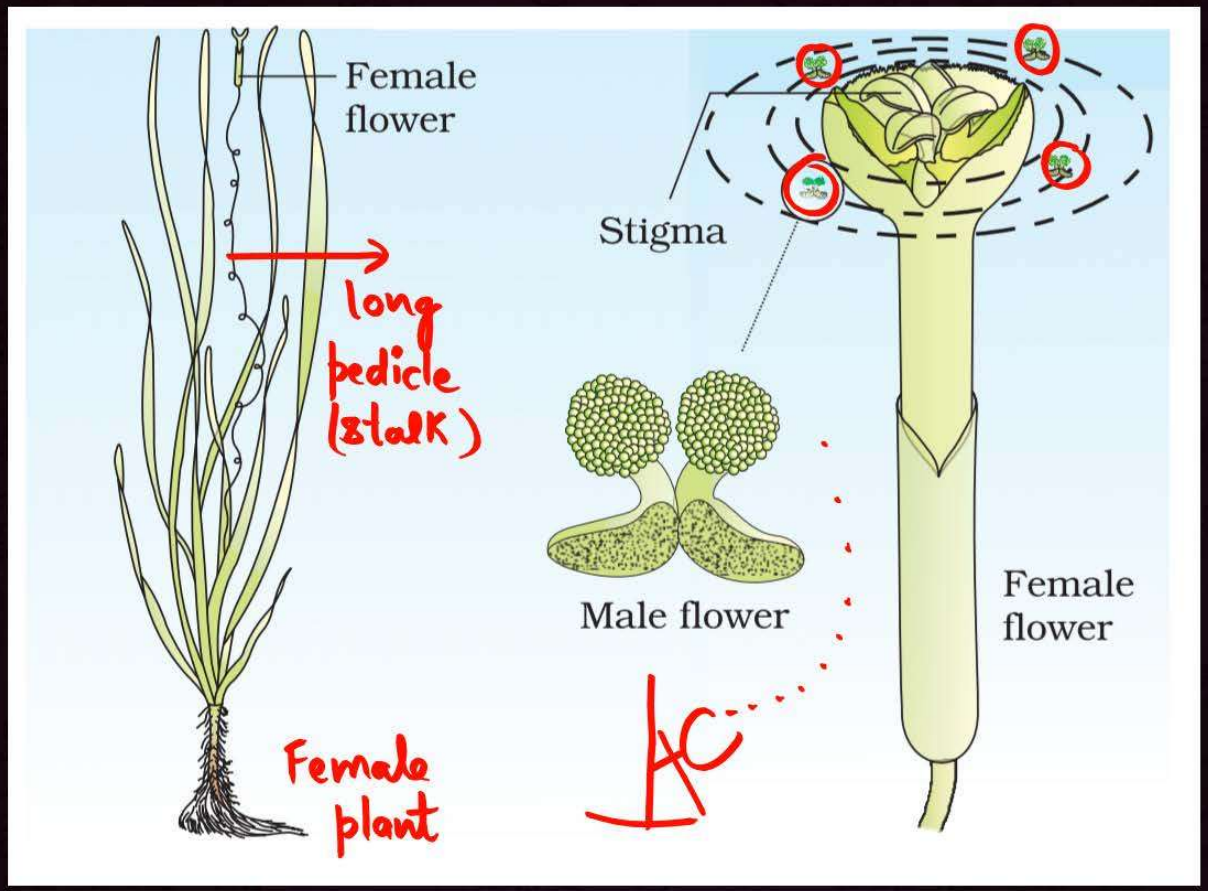
NEET 2024

Pollen grain carried passively by water current.

Pollen grain → Unwettable

Stigma → Unwettable

} Mucilaginous sheath


Female flower
long pedicle (stalk)
Female plant
Stigma
Male flower
Female flower

Entomophilly/Insect Pollination

Most Common

Property of Flowers

- have odour/smell
- Brightly colored (Mostly)
- have Nectar
- Mostly Large sized
- STIGMA:
  - ↳ Sticky

If flower are small sized then they are packed into inflorescence

(To be conspicuous (clear) to the insect)

POLLENGRAIN : Sticky

PollenKit

yellow, sticky covering

Insect → For **FLORAL REWARDS**

6-feet tall flower

Zaminkand
(Amorphophallus)

a) Nectar
b) Pollengrains
c) To have safe place to lay their eggs.

- EXAMPLES:

a) Pronuba moth in Yucca plant
b) wasp in Fig plant
c) Bees in Amorphophallus

Co-evolution or Obligate Mutualism

- Fig and Wasp
- Yucca Plant and Pronuba Moth

In vitro – germination

Method of studying pollen germination in Lab
↳ Pollen tube

Plants:

- Vinca
- Canada balsam
- Atropa
- Pea
- Chickpea

Method – **Hanging drop method**

- Boric Acid (Boron)
- Ca^{2+}
- 10% sucrose (sugar) solution

QUESTION

In entomophily, flowers are

A. Dull colored

B. Nectarless

C. With sticky pollen grains

D. Small sized solitary

QUESTION

Examples of water pollinated flowers are

A. Zostera, Lotus, water lily

B. Lotus, *Vallisneria, Hydrilla*

C. *Yucca, Vallisneria*, Lotus

D. *Vallisneria, Hydrilla, Zostera*

QUESTION

Which of the following is not a characteristic feature of insect pollinated flowers?

A. Fragrance

B. Nectaries

C. Foul odour

D. Mucilaginous covering on pollen grains

Pollen – Pistil Interaction

All the events, occur after deposition of pollengrain on stigma till Entry of pollentube into embryo-sac.

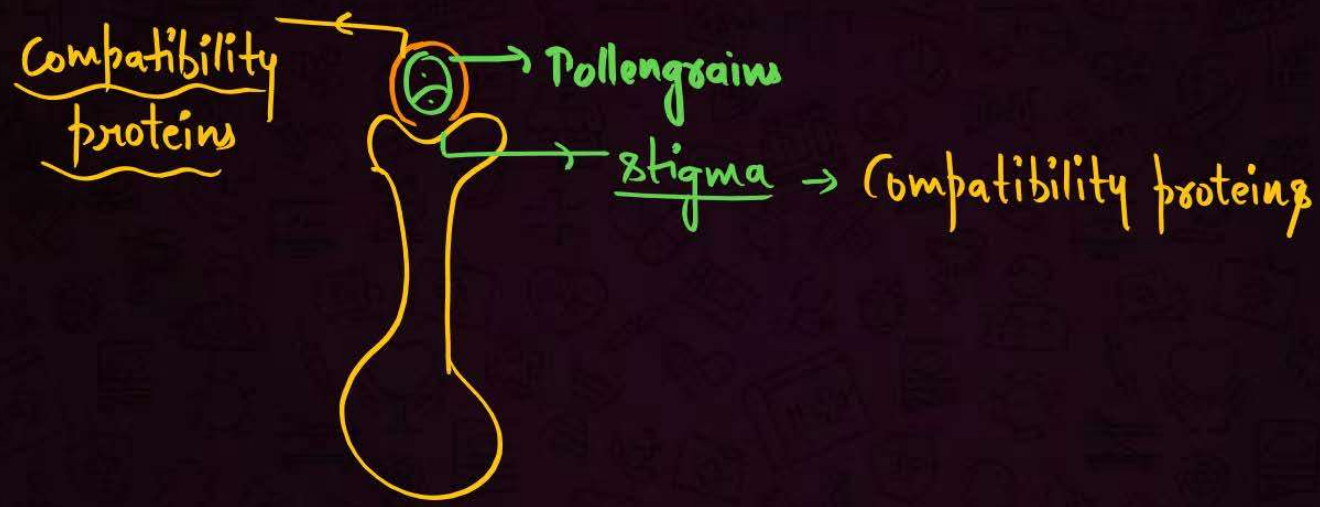
Events:

a) Chemical dialogue between stigma and Pollengrain

b) Development of male gametophyte (Pollengrains)

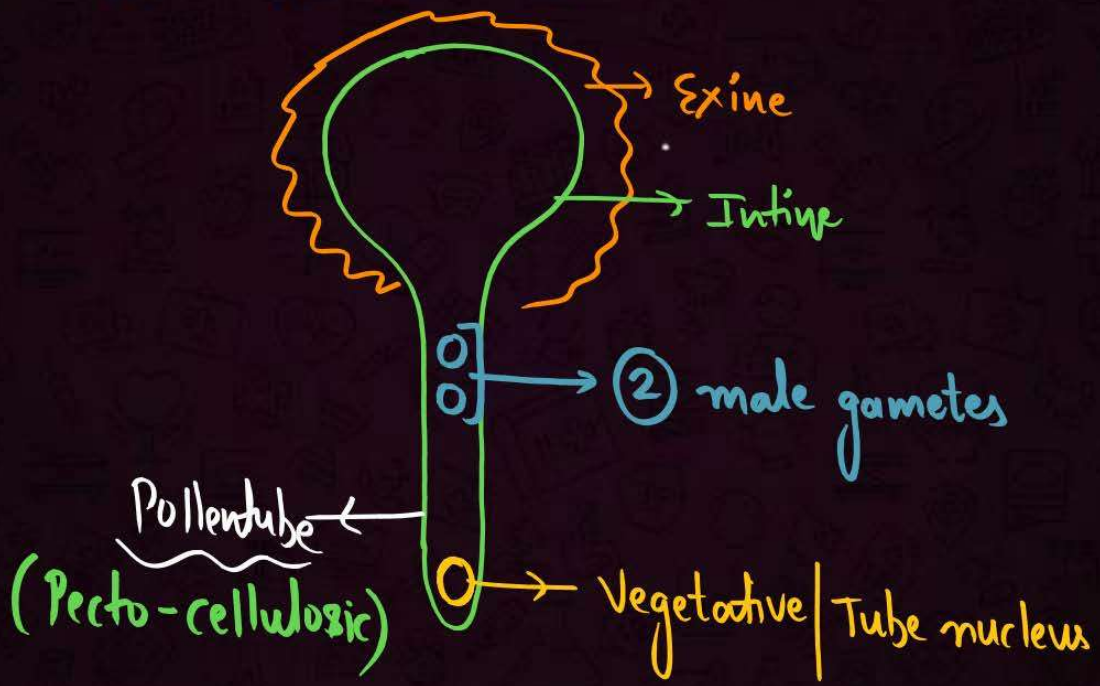
c) Entry of pollentube into Embryo-sac.

a) **Compatibility reaction** between Stigma and Pollengrain.



Note: If pollengrains are compatible with stigma, then Pollengrains are allowed to germinate and form Pollentube.

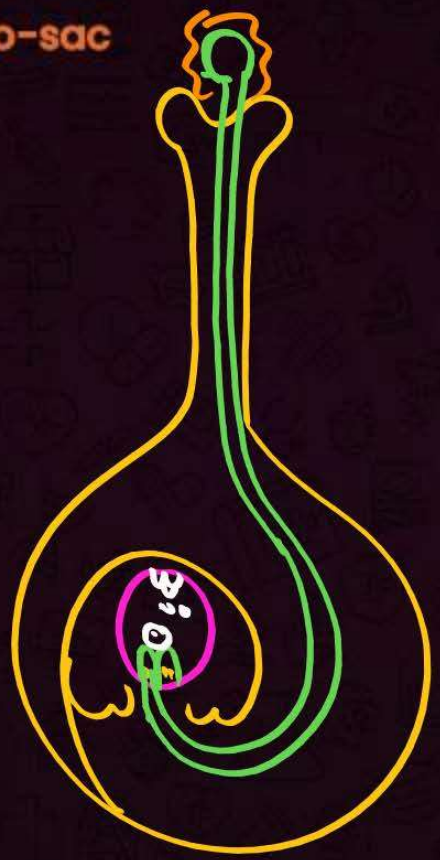
b) **Development of male gametophyte (Pollengrain)**



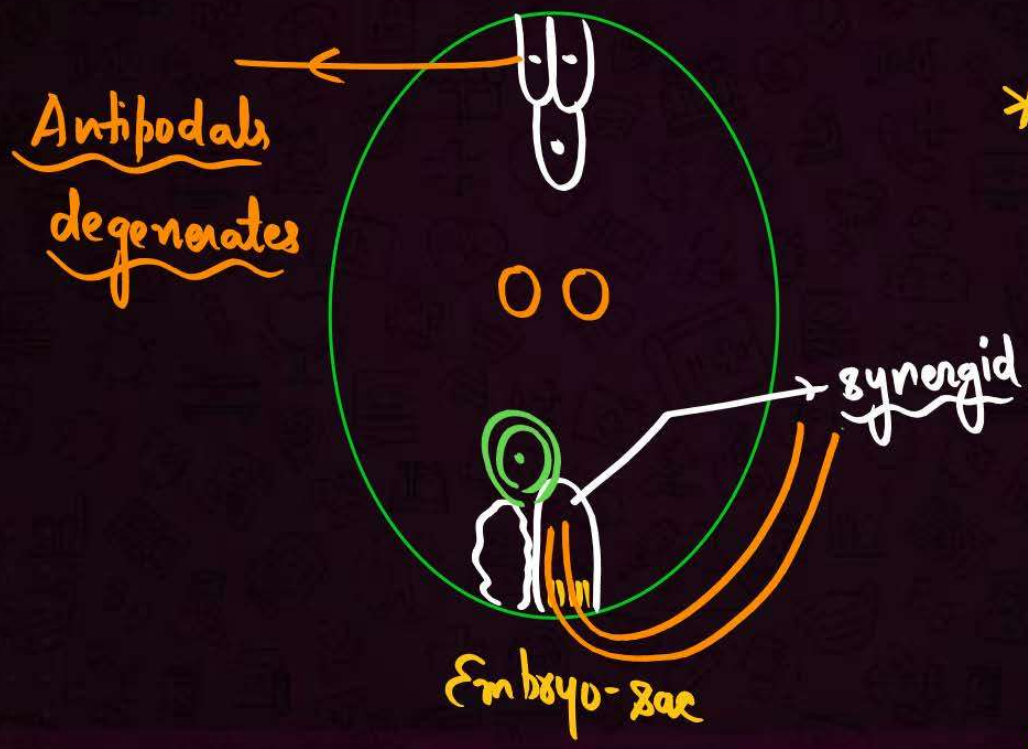
Male Gametes

- Non-motile (Always)
- (Flagella absent)
- Show Amoeboid movement
- Pollentube grows through stigma and style and reaches the embryo-sac

c) Entry of pollentube into Embryo-sac

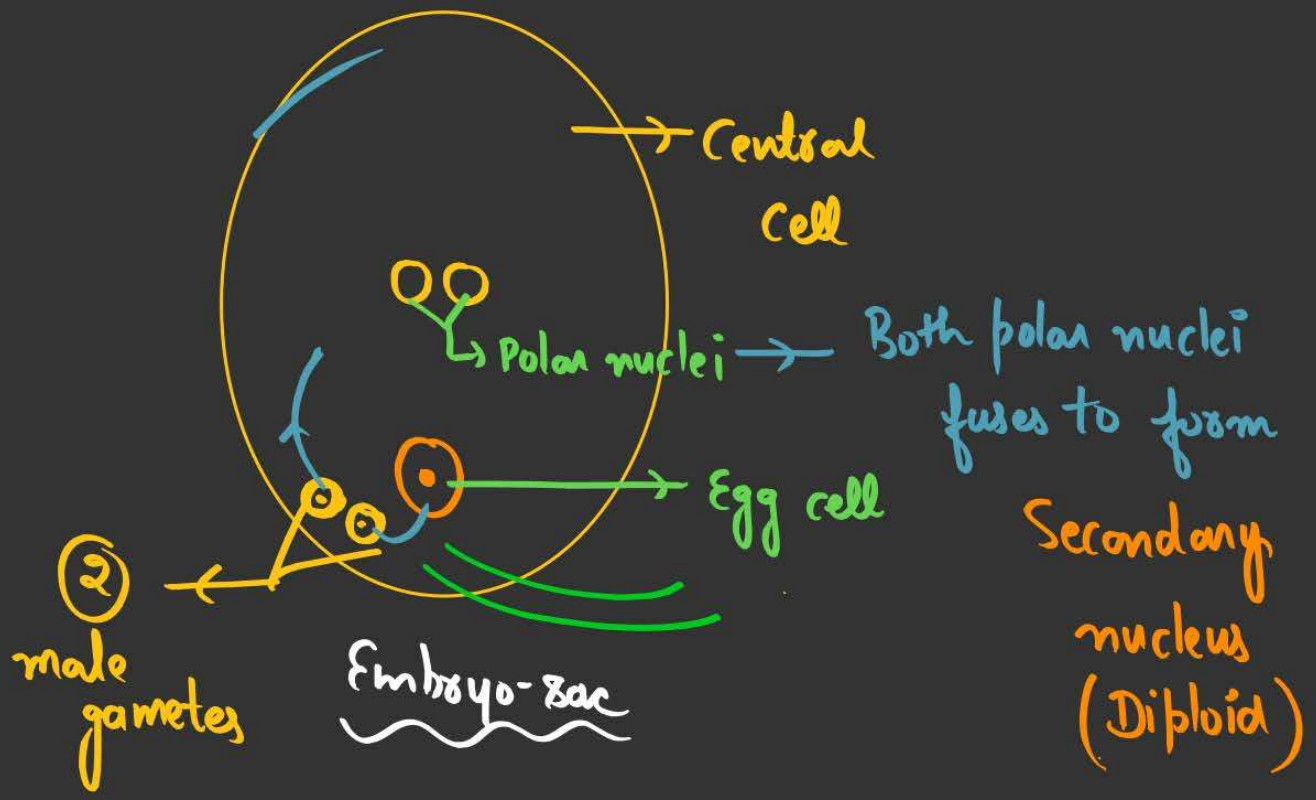


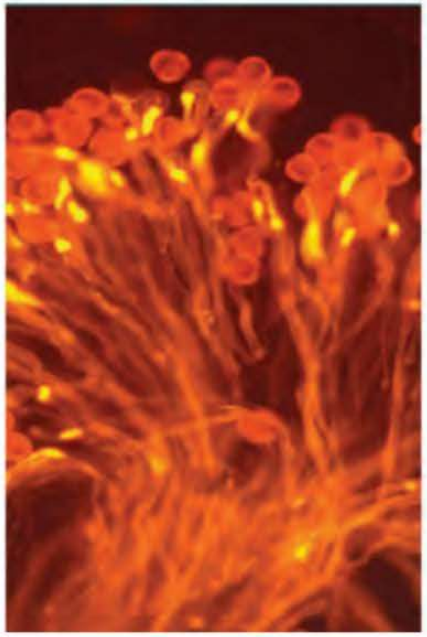
Changes in Embryo-sac before Fertilisation



one of the synergids
* degenerates before the entry of pollentube

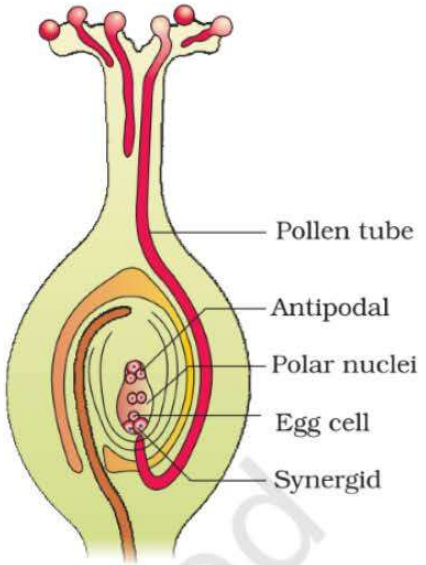
* Pollentube takes entry into cytoplasm of the synergid (and then this synergid also degenerates).


Central Cell
Polar nuclei
Both polar nuclei fuses to form Secondary nucleus (Diploid)
Egg cell
2
male gametes
Embryo-sac



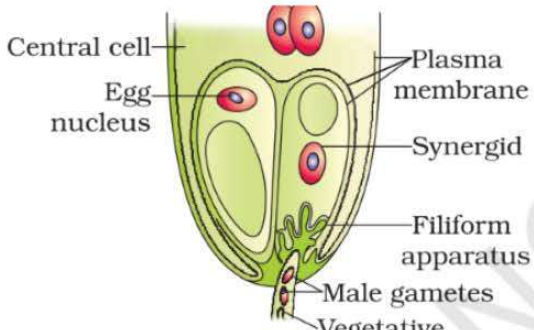
(a)

(b)

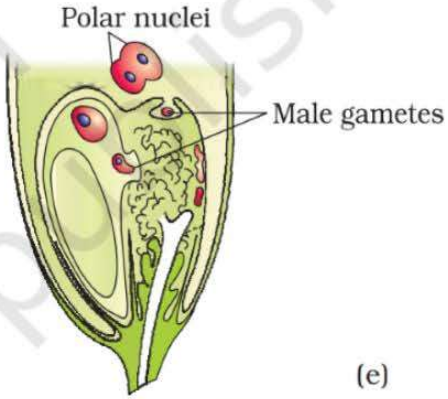


Longitudinal section of a flower showing growth of pollen tube

(c)



(d)



(e)

Double Fertilisation

Syngamy

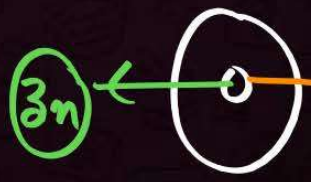
(1) male gamete (n) + Egg cell (n)

→ Diploid zygote

Triple Fusion

2nd male gamete (n) + Central Cell (Secondary nucleus) (2n)

→ PEC (Primary Endosperm Cell)



QUESTION

How many total cells and nuclei respectively involved in double fertilisaiton.

A. 4 and 4

B. 5 and 4

C. 4 and 5

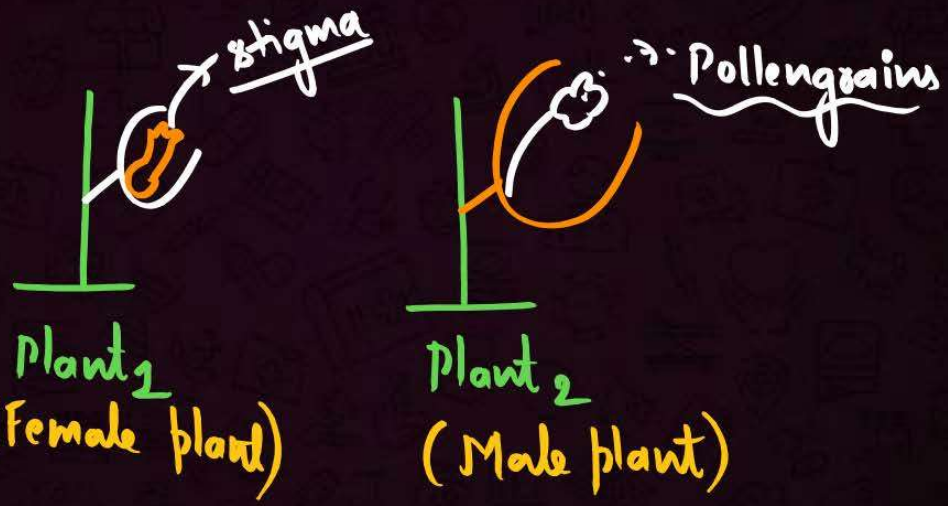
D. 4 and 3

Artificial Hybridisaiton

Artificial Cross-pollination.

1. Selection of Parents

Flower can be unisexual flower or bisexual flower



Female plant (where stigma is used)

Male Plant (where pollengrains are taken)

Artificial Hybridisaiton

2. Emasculation

Female Plant

If female plant has _bisexual_ flower

Anthers are removed from flower _before_ maturation called as Emasculation

Female plant

If female plant has _Unisexual_ flower than Emasculation is not needed

Artificial Hybridisaiton

3. Bagging of female flower

(Emasculated flower)

(Polythene, Butter paper)
(To prevent unwanted pollengrains)

4. Debagging

5. Dusting of desired pollengrain on stigma

6. Artificial hybridization / Cross pollination

7. Re-bagging
(For proper formation of seed and fruit)

Post Fertilisant Event

Ovule → (After fertilisaion) Seed

Integuments → (After fertilisaion) Seed coat

Ovary → (After fertilisaion) Fruit

Ovary wall → (After fertilisaion) Pericarp/ Fruit wall

Zygote (2n) → Embryo (2n)

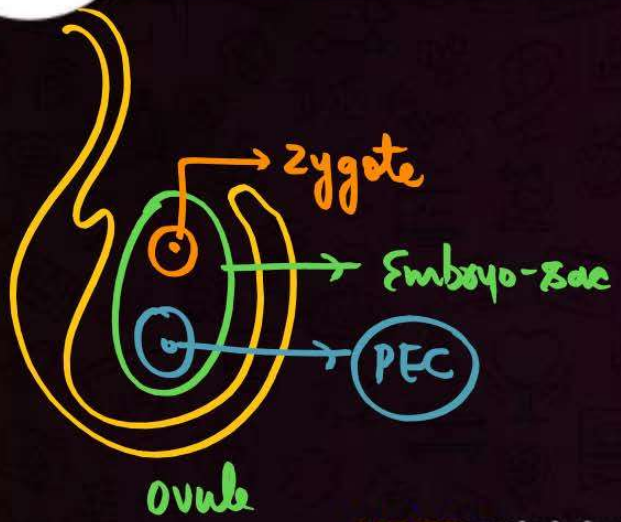
PEC (3n) → Endosperm (3n)

Ques : Angiosperm → Leaf (2n) → "24 Chromosomes"

Endosperm = Chromosomes ? =
zygote = Chromosomes? =

FOR NOTES & DPP CHECK DESCRIPTION

Endosperm Development



NOTE : Division in PEC always precedes division in zygote (Imp)

Reason: Division in PEC occurs first so that some amount of Endosperm is formed before embryo-development to give nourishment to Embryo.

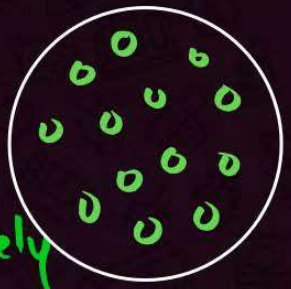
Types of Endosperm

on the basis of division

Free nuclear Endosperm

Most Common

PEC → Many Free-nuclear division (CytoKinesis do not occur immediately after KaryoKinesis)



Multinucleated structure

Ultimately → cytoKinesis occurs

Multicellular Endosperm

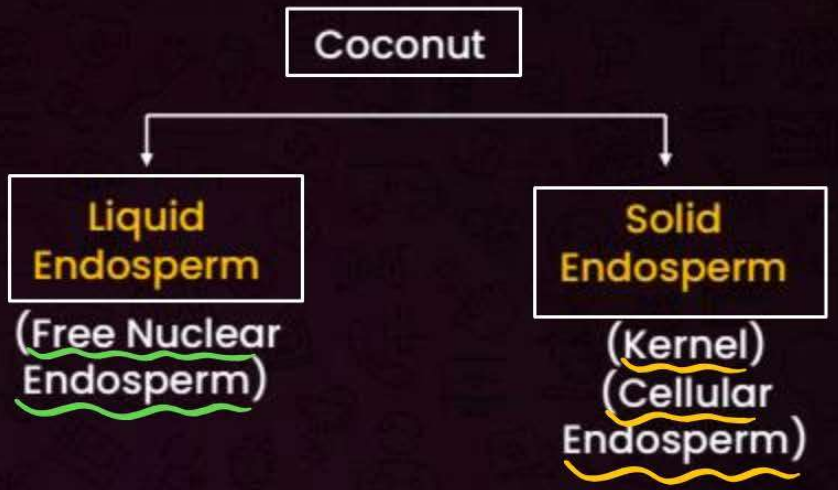
Cellular Endosperm

Datura

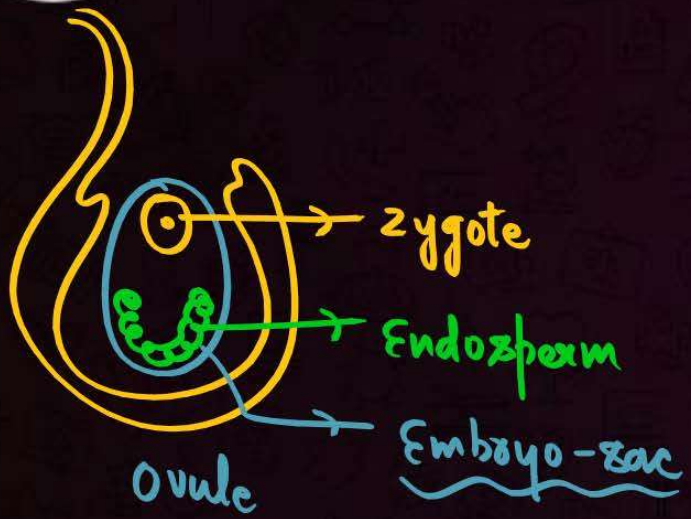
Petunia

PEC → CytoKinesis occurs just after KaryoKinesis

Endosperm


Coconut
Liquid Endosperm
(Free Nuclear Endosperm)
Solid Endosperm
(Kernel)
(Cellular Endosperm)

Embryo-Development



Imp

Zygote development into Embryo occurs at _Micropylar end_

- Zygote gets nourishment from "Endosperm"

Embryo-Development

Zygote(2n)

Unequal mitosis

Suspensor cell

Embryonal cell

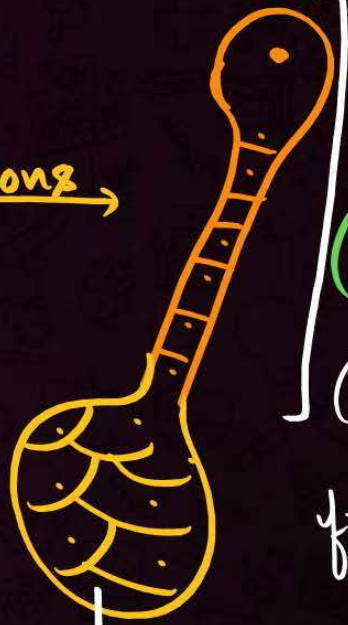
Mitosis

2-celled Embryo

4-celled Embryo

8-celled Embryo

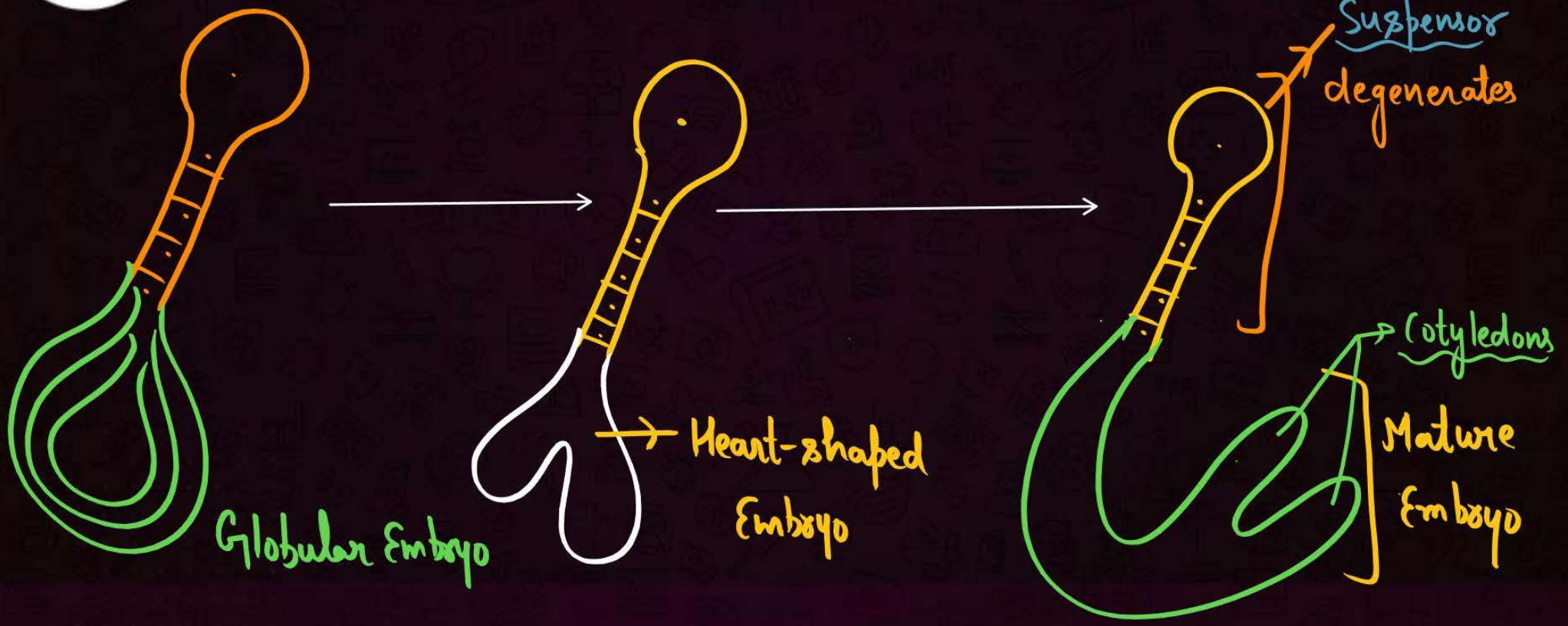
Divisions



Suspensor (6-10 celled) (derive nourishment from Endosperm)

PROEMBRYO

Embryo-Development



Embryo-Development

Stages of Embryo-development

Proembryo

↓

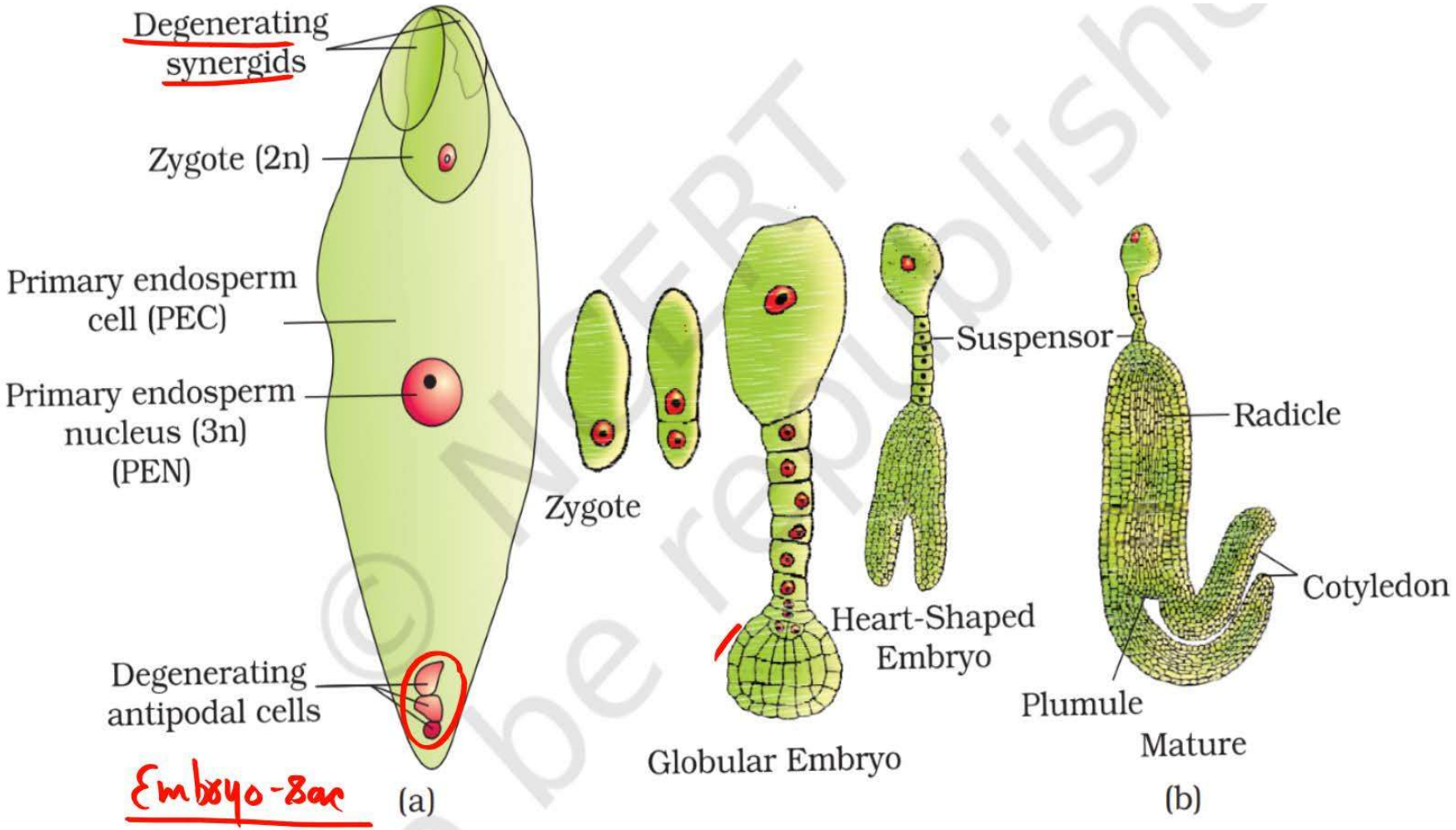
Globular embryo

↓

Heart shaped embryo

↓

Mature Embryo



Embryo-Sac

Embryogeny in Dicots and Monocots is almost similar with following differences

Dicot Embryogeny

- Suspensor (6-10 celled)
- 2 Cotyledons

Monocot Embryogeny

- Suspensor (Single celled)
- Single Cotyledon called as SCUTELLUM
  - imp (lateral in Position)

Epiblast → 2nd reduced cotyledon or Rudimentary cotyledon

Dicot Embryogeny

Coleoptile and Coleorrhiza
Absent

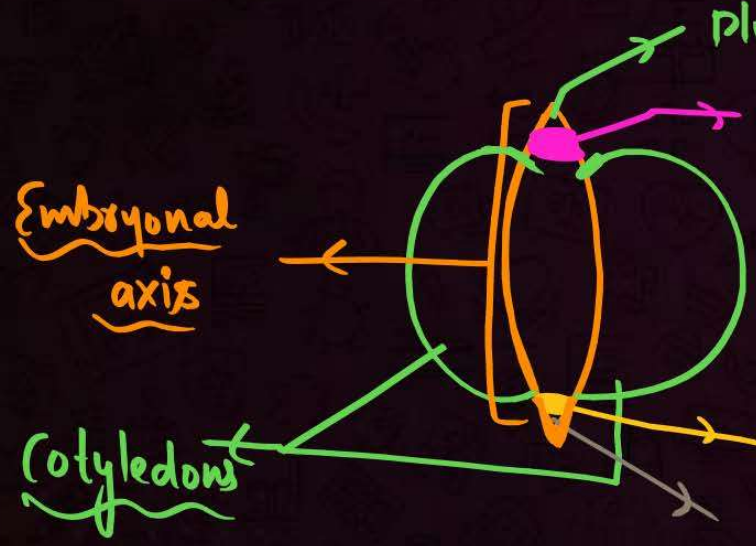
Monocot Embryogeny

COLEOPTILE – Leaf like protective structure around _Plumule_

COLEORRHIZA – Leaf like protective structure around _Radicle_

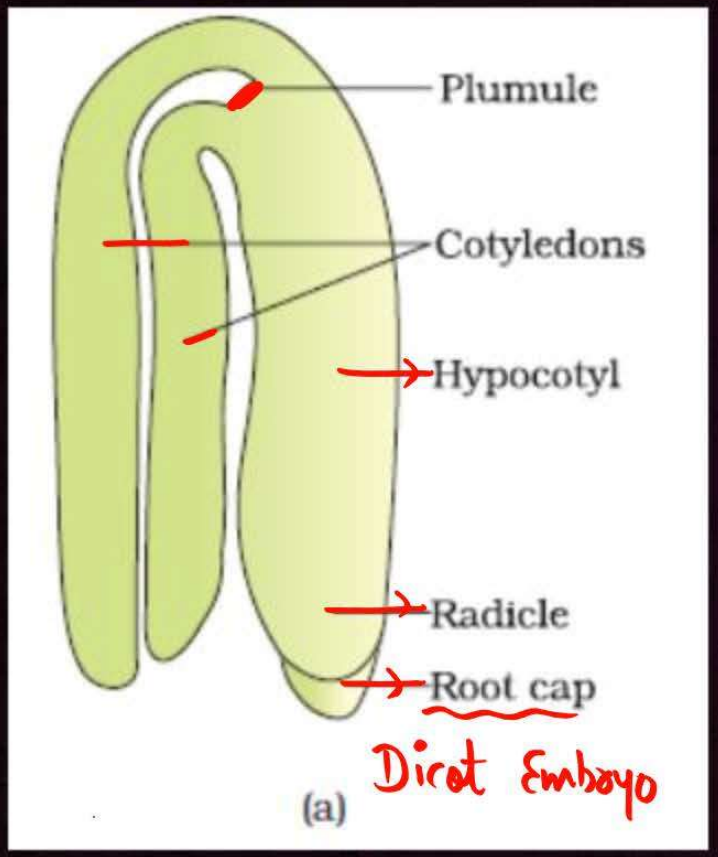
Dicot Embryo

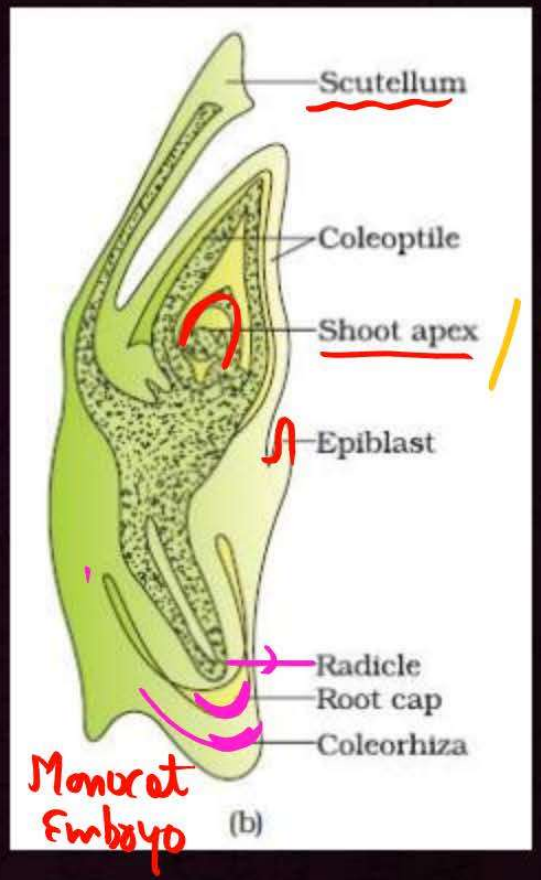
* Root-tip surrounded by Root-cap.



Epicotyl → Part of Embryonal axis above the level of cotyledons.
Terminates into plumule / stem tip

Hypocotyl → Part of Embryonal axis below the level of cotyledons
Terminates into Radicle / Root tip


Plumule
Cotyledons
Hypocotyl
Radicle
Root cap
(a)
Dicot Embryo


Scutellum
Coleoptile
Shoot apex
Plumule
Epiblast
Radicle
Root cap
Coleorhiza
(b)
Monocot Embryo

QUESTION

In embryogeny of dicot plants, the suspensor cell undergoes transverse divisions forming suspensor which is

A. 6-10 celled

B. 1-5 celled

C. 11-15 celled

D. 16-21 celled

QUESTION

The remains of second cotyledon occur in some grasses. It is called

monocots

A. Scutellum

B. Hypocotyl

C. Epicotyl

D. Epiblast

QUESTION

The portion of the embryonal axis above the level of cotyledons is

A. Hypocotyl

B. Epicotyl

C. Coleorhiza

D. Radicle

QUESTION

Which of the following change does not occur in ovary as a result of sexual reproduction?

(A) Ovary wall → Pericarp

(B) Ovary → Fruit

(C) Ovule → Fruit wall

(D) Integument → Seed coat

QUESTION

The central cell after triple fusion becomes the

A PEC

B PEN

C Endosperm

D Embryo

QUESTION

Hydrophily is limited to 30 genera which are mostly

A. Gymnosperms

B. Monocots

C. Dicots

D. More than one option is correct

Seed

Seed is a fertilsied ovule.

Ovule $\xrightarrow[\text{fertilisation}]{}$ Forms Seed

Integuments (2) $\xrightarrow[\text{fertilisation}]{}$ Forms Seed coat

Number of seeds $\leq$ Number of ovule

No. of seeds
Either less than or equal to number of ovules

Number of seeds in never more than number of ovules

Orchid
(Monocot)

(Thousands
of tiny seeds)

Orobanche
Striga
} Parasitic plants

Many tiny seeds

Parts of a Seed

1. Embryo
2. Endosperm
3. Seed coat

(2) in number

Outer seeds coat called as	Inner seed coat called as
TESTA	TEGMEN

4. Microbyle
   Opening from where water and O_2 enters into Seed
5. Hilum
   is present are a scar.

Properties of Seed

Dehydration

when a seed matures it dehydrates and only 10-15% water (by mass) remains.

Dormancy

Inactive State

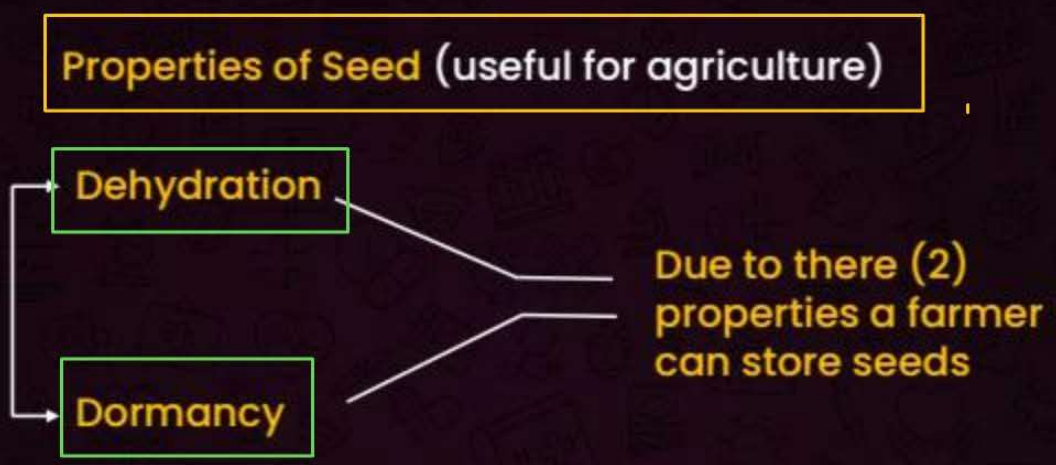
during unfavourable conditions

Germination

During favourable conditions

(Water, O_2, light)

seed germinates to give rise to plant.


Properties of Seed (useful for agriculture)
Dehydration
Dormancy
Due to there (2) properties a farmer can store seeds

Advantages of Seed to Angiosperms

a. Seeds have adaptive strategies for dispersal.

b. _Seed coat_ protects the embryo.

c. Seed has large amount of reserve food material.

d. Seed is a product of Sexual reproduction, thus helps in _Variation_ and evolution.

Seed Viability

The duration upto which a seed is capable of giving rise to new plant.

1. Oxalis → Few months
2. Lupinus (Lupine) → 10,000 years → Excavated from Arctic tundra
3. Date Palm (Phoenix) → 2,000 years → Excavated from King Herod's Palace near Dead Sea

Types of Seed

Non-Endospermic / Exalbuminous Seed

During embryo development, if embryo consumes whole endosperm and endosperm is not left in seed

Ex → In Dicots

Exception: Orchid (monocot)

Endospermic / Albuminous Seed

Embryo do not consume whole endosperm and endosperm remain in seed

Ex → In Monocots

Exception: In some dicots

a) Castor
b) Sunflower
c) Some members of Solanaceae family.

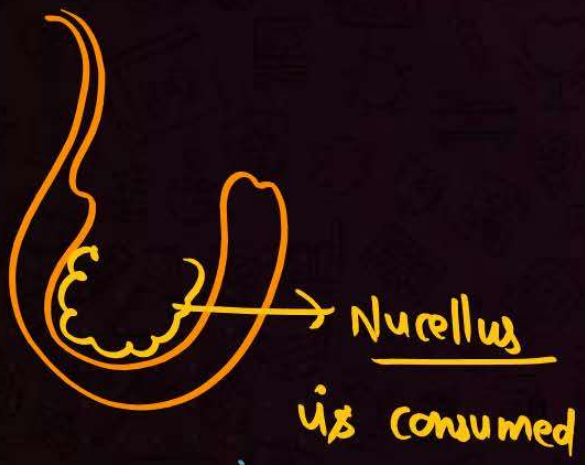
Perispermic Seed

Seed in which Perisperm is present is Perispermic Seed.

- Perisperm → Remains of Nucellus

Ex →

* Beet
* Piper nigrum (Black-pepper)
* Castor



QUESTION

Choose the correct option from the following

I. Dehydration and dormancy of mature seed are crucial for seed storage.
II. Seed of *Lupinus arcticus* is the oldest one which germinated after 2000 year.
III. Orchid seed is one of largest seed in plant Kingdom.
IV. Seeds of parasitic plants Orobanche and Striga are tiny seeds.

1. I, II are correct but III, IV are incorrect
2. I, IV are correct but II, III are incorrect
3. III, IV are correct but I, II are incorrect
4. II, III are correct but I, IV are incorrect

Fruit

A fertilised ovary is called as fruit.

Ovary $\xrightarrow[\text{fertilisation}]{}$ Fruit

Ovary wall $\xrightarrow[\text{fertilisation}]{}$ Fruit wall / Pericarp

Types of Fruit

True Fruit

Fruit in which only ovary participates is true fruit

Ex → Most common
- Guava
- water-melon
- Papaya

False Fruit

when alongwith ovary other parts of flower such as thalamus participates in the formation of fruit

Ex → Apple
- Pear
- Strawberry

Parthenocarpic Fruit

when ovary forms fruit without fertilization

Ex → Banana
- Grapes

- Parthenocarpic fruits can be formed with help of **Auxin Hormone**
- Parthenocarpy is useless in Pomegranate.


True Fruit
Dry Fruit
Pericarp is not differentiated
Fleshy Fruit
Pericarp is differentiated
• Epicarp
• Mesocarp
• Endocarp
Ex → Drupe
Mango (Mesocarp) (Edible) Coconut (Endosperm)

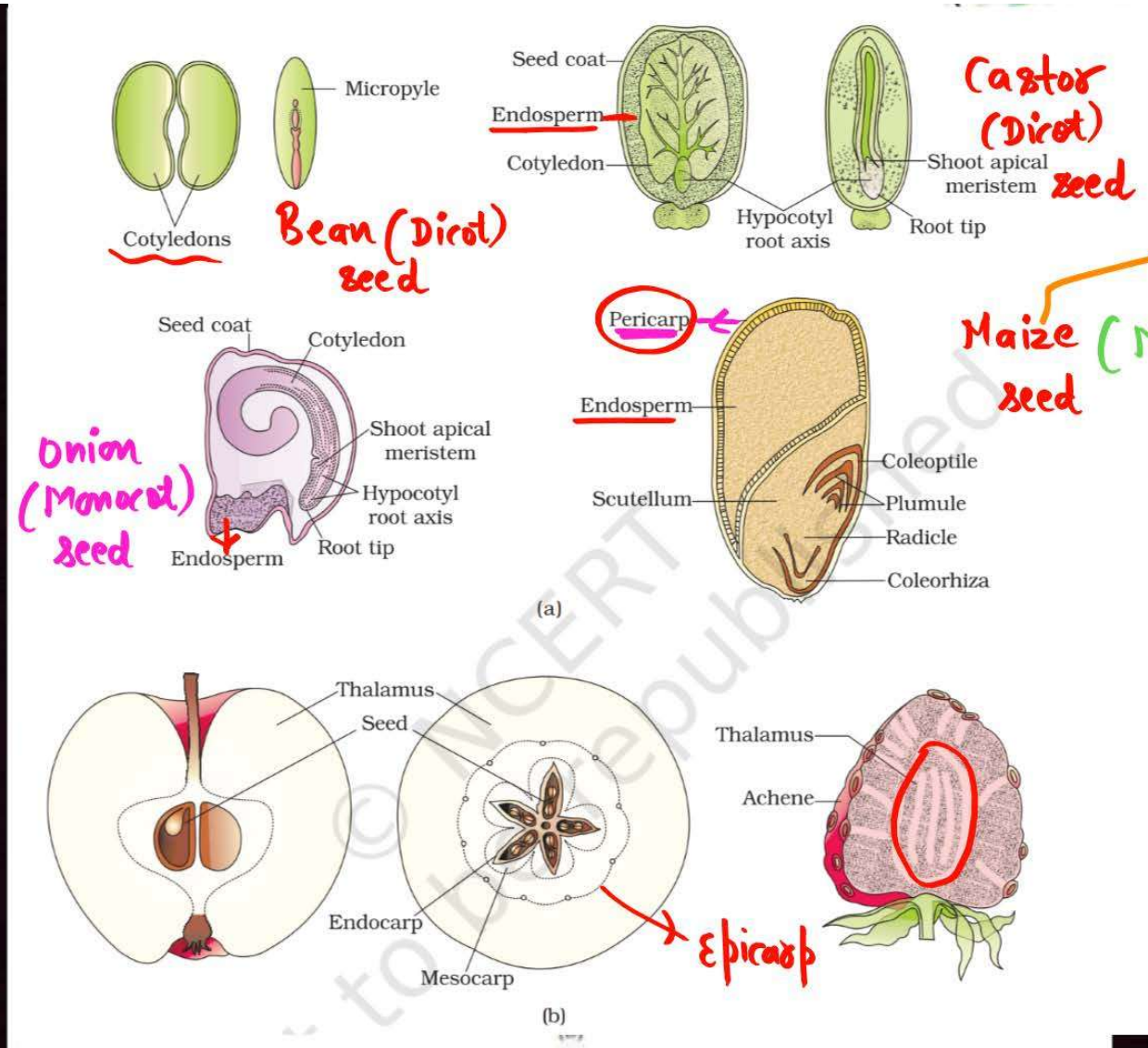


Figure 1.15 (a) Structure of some seeds. (b) False fruits of apple and strawberry

Apomixis

- Formation of _Seed_ → without fertilization.
- Apomixis is a type of _Asexual_ reproduction. which mimics _Sexual_ reproduction.

- Reason of Apomixis
  Expression of **Apomictic genes**

Cells of _Nucellus_
Cell of _Integuments_
} Due to expression of Apomictic genes, behave directly as Embryo


Found in
Asteraceae family
(Sunflower family)
Poaceae / Graminae
In Cereals

Types of Apomixis / Agamospermy

Adventive Embryony/ Sporophytic Apomixis

Nucellus / Integument

↓

Directly forms Embryo

Gametophytic Apomixis

Nucellus

↓

Megaspore-mother cell

↓ No meiosis (Reductional division)

Diploid Embryo-sac

↓

Diploid Egg cell

↓

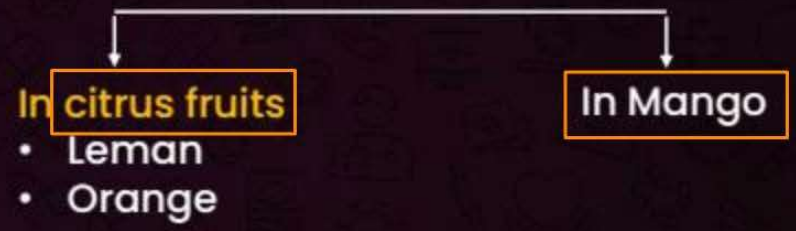
Embryo.

- Generally
  A seed has _one_ Embryo

Polyembryony

↓

Phenomenon where a seed has _more than one_ Embryo



Polyembryany : was discovered by **Anton Van Leeuwenhoek** in **Citrus fruits.**

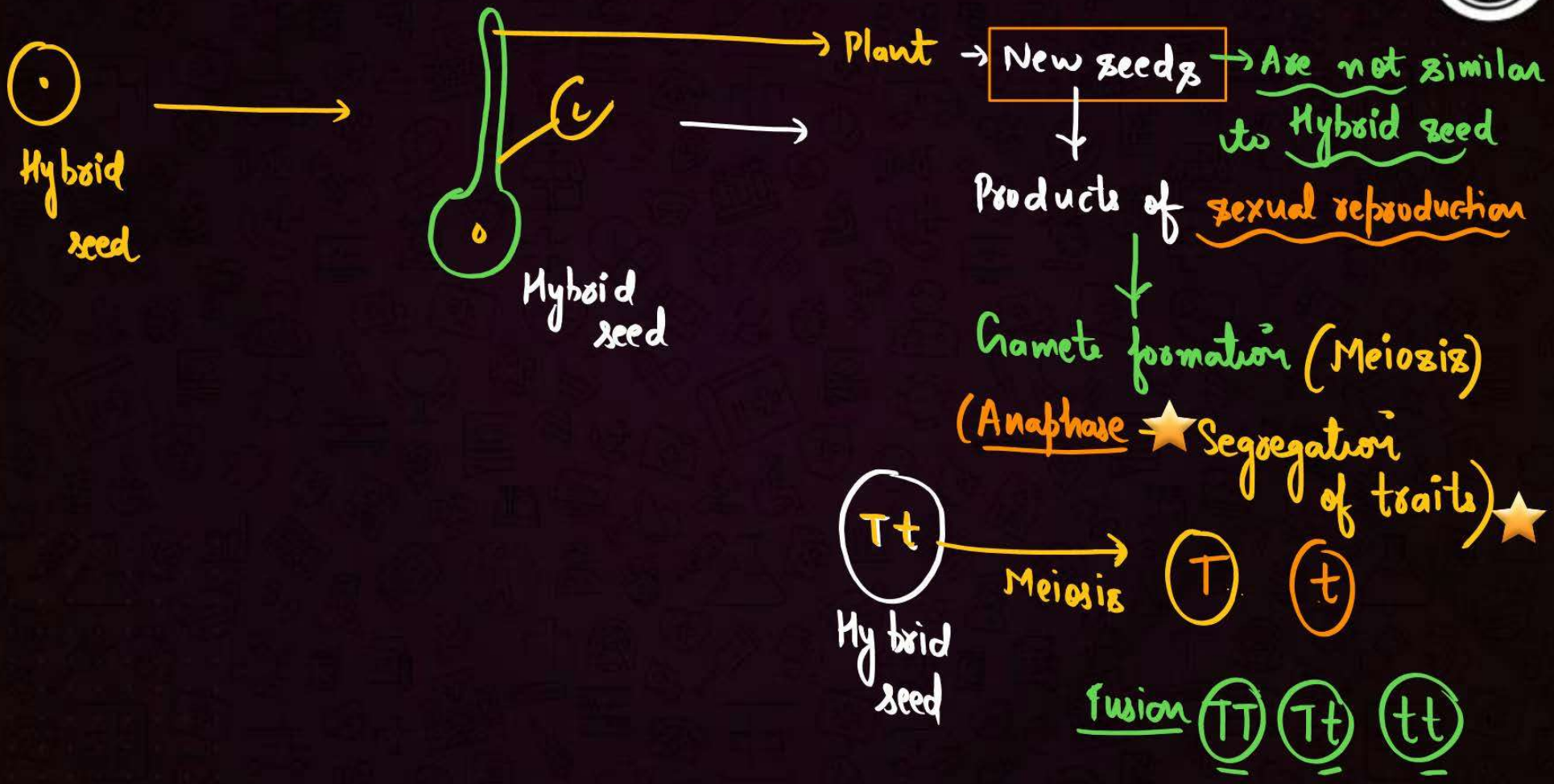
Parthenocarpy

Formation of fruit without fertilisation

Apomixis / Parthenogenesis

Formation of seed without fertilisation

Advantage of Apomixis in Agriculture

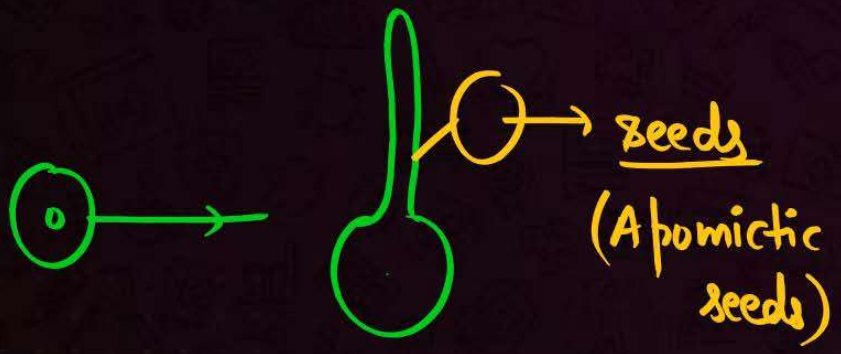


If Apomictic genes

Are discovered

Then by Genetic Engineering

Seed has Apomictic genes



- These Apomictic seeds will be clone to Parent seed
- Farmer will not have to buy now seeds again.
- During Apomixis there is no segregation of traits (No meiosis)

During Sexual Reproduction

↓

There is Segregation of traits during gamete formation

Seed on this plants are product of sexual reproduction which are not similar to parent hybrid seed.
So, due to this Farmer has to buy hybrid seeds every year.

QUESTION

Choose the correct option from the following statements.

I. Apomixis is form of asexual reproduction which mimics sexual reproduction.
II. In Apomixis seeds develop either from diploid egg cell or from cells of nucellus.
III. Seeds collected from hybrids plant maintain hybrid character for a longer times.
IV. In Apomixis, there is segregation of characters.

1. All are correct
2. All are incorrect
3. Only I and II are correct
4. Only II, IV are correct

QUESTION

Assertion: Apomictic embryo is asexual mode of reproduction.
Reason: It prevents the segregation of traits.

(A)

1. Both Assertion & Reason are true and the Reason is a correct explanation of the Assertion.
2. Both Assertion & Reason are true but Reason is not a correct explanation of the Assertion.
3. Assertion is true but Reason is false.
4. Assertion is false but the Reason is true.