FREE NOTES · NCERT + NEET LEVEL

Sexual Reproduction in Flowering Plants

Flower as the site of reproduction, stamen and microsporogenesis, pollen grain, pistil and megasporogenesis, embryo sac, pollination, pollen–pistil interaction, double fertilisation, post-fertilisation events, apomixis and polyembryony.

01 Flower and stamen
02 Pollen grain
03 Pistil and embryo sac
04 Pollination
05 Pollen–pistil interaction and fertilisation
06 Post-fertilisation events
07 Extra + tricks
08 Important Q&A
09 Common mistakes
10 Practice (NEET style)
11 Quick revision

01 Flower and stamen

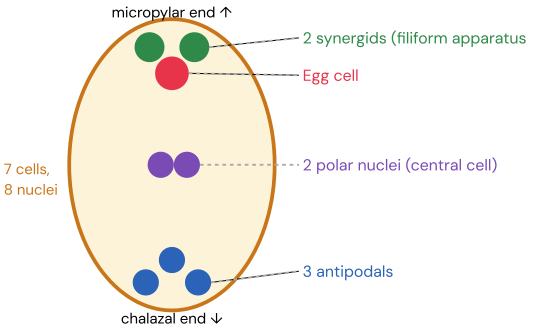
- Flower = site of sexual reproduction; androecium (stamens: male), gynoecium (pistil: female).
- Stamen: filament + anther. Typical anther is **bilobed**, each lobe with 2 theca (dithecous) ⇒ **tetragonal** with 4 microsporangia (pollen sacs).
- Wall layers of microsporangium (outer → inner): epidermis, endothecium, middle layers, **tapetum** (nourishes developing pollen; cells often multinucleate, dense cytoplasm).
- Sporogenous tissue: each **pollen mother cell** (PMC, 2n) undergoes meiosis ⇒ **microspore tetrad**: **microsporogenesis**.

02 Pollen grain

- Two-layered wall: **exine** of **sporopollenin** (most resistant organic material; withstands high temperature, strong acids, alkalis; no enzyme degrades it) with **germ pores** (no sporopollenin); **intine** of cellulose and pectin.
- Mature pollen: **vegetative cell** (bigger, food reserve, large irregular nucleus) and **generative cell** (small, spindle-shaped, floats in vegetative cell; divides into 2 male gametes).
- Shed at 2-celled stage in over 60% angiosperms, 3-celled in rest.
- Viability: rice and wheat ~30 min; Rosaceae, Leguminosae, Solanaceae: months. Pollen stored in liquid nitrogen (-196 °C) in pollen banks. Pollen allergy (*Parthenium*/carrot grass); pollen tablets as food supplements.

03 Pistil and embryo sac

- Pistil: stigma (landing platform), style, ovary with ovules (megasporangia) on placenta. Monocarpellary or multicarpellary (syncarpous / apocarpous).
- Ovule: funicle, hilum, 1–2 integuments, micropyle, chalaza, **nucellus** (food).
- **Megasporogenesis**: megaspore mother cell (MMC) at micropylar region undergoes meiosis ⇒ 4 megaspores; usually 3 degenerate.
- **Monosporic** development: functional megaspore nucleus divides mitotically 3 times ⇒ 8 nuclei (free nuclear divisions, then walls) ⇒ **7-celled, 8-nucleate embryo sac** (female gametophyte). Egg apparatus = egg + 2 synergids.



Mature embryo sac

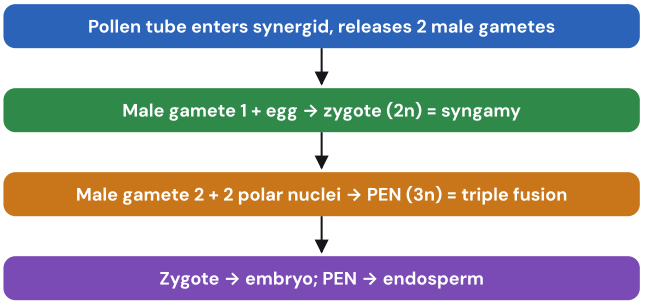
04 Pollination

Type	Meaning	Notes
Autogamy	Same flower	Chasmogamous (open) flowers; **cleistogamous** (never open: *Viola*, *Oxalis*, *Commelina*) assure seed set
Geitonogamy	Different flower, same plant	Functionally cross, genetically like autogamy
Xenogamy	Different plant	Genetically different pollen

- Agents: wind (light, non-sticky pollen; well-exposed stamens; large feathery stigma; single ovule; e.g. grasses, maize tassels), water (*Vallisneria*, *Hydrilla*, *Zostera* (marine); pollen with mucilage), animals (bees most common; large colourful fragrant nectar-rich flowers; *Amorphophallus* tallest flower; yucca–moth mutualism).
- Outbreeding devices: pollen release and stigma receptivity not synchronised; anther and stigma at different positions; **self-incompatibility**; unisexual flowers (castor, maize monoecious; papaya dioecious).

05 Pollen–pistil interaction and fertilisation

- Pistil recognises compatible pollen (chemical dialogue); incompatible pollen rejected.
- Compatible pollen germinates; pollen tube grows through stigma and style, enters ovule through micropyle, enters a synergid guided by **filiform apparatus**.
- **Artificial hybridisation**: emasculation (remove anthers before dehiscence) + **bagging** (butter paper) ⇒ dust desired pollen ⇒ rebag. Unisexual female flowers need no emasculation.
- **Double fertilisation** (unique to angiosperms) = syngamy + triple fusion.



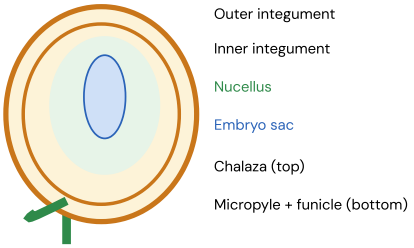
Double fertilisation

06 Post-fertilisation events

- **Endosperm** develops before embryo. Free-nuclear endosperm (coconut water = free nuclear; white kernel = cellular). Non-albuminous seeds (pea, groundnut, beans: endosperm used up); albuminous seeds (wheat, maize, barley, castor, sunflower). **Perisperm** = residual nucellus (black pepper, beet).
- **Embryo** at micropylar end: proembryo → globular → heart-shaped → mature. Dicot: embryonal axis, 2 cotyledons, epicotyl (plumule), hypocotyl (radicle). Monocot (grass): one cotyledon = **scutellum**; coleoptile, coleorhiza.
- Ovule → seed (integuments → testa, tegmen); ovary → fruit (wall → pericarp). **False fruits**: thalamus also forms fruit (apple, strawberry, cashew). Parthenocarpic fruits (banana) without fertilisation. Seeds may stay viable for long: lupine 10,000 years; date palm ~2000 years.
- **Apomixis**: seeds without fertilisation (Asteraceae, grasses); useful to keep hybrid vigour. **Polyembryony**: more than one embryo (citrus, mango; nucellar cells form embryos).

07 Extra + tricks

- Most common ovule: **anatropous** (inverted; micropyle near funicle). Orthotropous: straight (*Polygonum*).
- **Parthenocarpy**: fruit without fertilisation (banana); can be induced by auxins/GA.
- Significance of seeds: dormancy helps survive harsh conditions; dispersal to new areas; stored food for seedling; genetic variation from sexual reproduction.
- Trick for ploidy: **"3 in endosperm, 2 in embryo, 1 in gametes"**; nucellus and integuments are 2n (maternal).
- Pollen viability tricks: cereals ~30 min; storage in liquid N_2 (-196 °C) in pollen banks.



Anatropous ovule (simplified)

08 Important Q&A

Q1. Why is sporopollenin important?

It makes exine extremely resistant, so pollen survives harsh conditions and is preserved as fossils.

Q2. Ploidy of: PMC, microspore, nucellus, endosperm, synergid.

2n, n, 2n, 3n, n.

Q3. Why are cleistogamous flowers invariably autogamous?

They never open, so only their own pollen can reach the stigma.

09 Common mistakes

- Saying embryo sac has 8 cells (7 cells, 8 nuclei).
- Calling geitonogamy genetically cross pollination.
- Writing perisperm as triploid (it is nucellus, 2n).
- Forgetting emasculation is not needed for unisexual female flowers.

10 Practice (NEET style)

1. Layer nourishing pollen?
2. Water pollinated marine plant?
3. Endosperm of coconut water is?
4. Guides pollen tube into synergid?
5. Seeds without fertilisation?

ANSWERS

1) Tapetum · 2) *Zostera* · 3) Free nuclear · 4) Filiform apparatus · 5) Apomixis

11 Quick revision: 5 minutes before the exam

MALE

- Anther tetrasporangiate
- Tapetum nourishes
- Exine sporopollenin

FEMALE

- Monosporic
- 7 cells, 8 nuclei
- Egg + 2 synergids

POLLINATION

- Cleistogamy: Viola, Oxalis
- Vallisneria water
- Emasculation + bagging

AFTER

- Syngamy + triple fusion
- Endosperm 3n first
- Apomixis, polyembryony

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.