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CHAPTER NOTES

Sexual Reproduction in Flowering Plants Class 12 Notes — CBSE Biology Chapter 2

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Sexual Reproduction in Flowering Plants Class 12 Notes — CBSE Biology Chapter 2

Chapter 2 — **Sexual Reproduction in Flowering Plants** — is one of the most important and high-scoring chapters in Class 12 Biology, carrying **8-10 marks** in Board exams. It covers everything from flower structure to pollination, fertilisation, and seed formation. Diagrams of the embryo sac and microsporangium are frequently asked.

Key Concepts

Flower — The Reproductive Organ

A flower has four whorls:

Whorl	Parts	Function
Calyx	Sepals (green)	Protection of bud
Corolla	Petals (coloured)	Attract pollinators
Androecium	Stamens (male)	Produce pollen grains (microsporangia)
Gynoecium	Carpels/Pistil (female)	Produce ovules (megasporangia)

Microsporogenesis & Male Gametophyte

Occurs in the **anther** (part of stamen).

Process: Microspore mother cell (2n) →(meiosis) 4 microspores (n) →(mitosis) pollen grain (2-celled: vegetative + generative cell)

Pollen grain structure:
– Outer wall: **Exine** (made of sporopollenin — most resistant biological material; has apertures called germ pores)
– Inner wall: **Intine** (thin, made of cellulose and pectin)
– 2-celled stage: large vegetative cell + small generative cell
– 3-celled stage: generative cell divides → 2 male gametes (sperm cells)

Sporopollenin is the most resistant organic material known — resists high temperature, strong acids, strong alkali, and enzymes. This is why pollen grains are well-preserved in fossils!

Megasporogenesis & Female Gametophyte

Occurs in the **ovule** (inside the ovary).

Process: Megaspore mother cell (2n) →(meiosis) 4 megaspores (n) → 3 degenerate + 1 functional megaspore →(3 mitotic divisions) 8-nucleate, 7-celled embryo sac

Embryo sac (female gametophyte) structure:
– Micropylar end: 1 egg cell + 2 synergids (with filiform apparatus)
– Chalazal end: 3 antipodal cells
– Centre: 2 polar nuclei → fuse to form central cell (2n)
Total: 8 nuclei, 7 cells

Diagram Alert: The structure of the embryo sac is one of the most frequently asked diagrams. Remember the arrangement: 3+2+3 (egg apparatus at micropylar end, 2 polar nuclei in centre, 3 antipodals at chalazal end).

Pollination

Type	Description	Features
Self-pollination (Autogamy)	Pollen from same flower to stigma	Less variation, genetically uniform
Geitonogamy	Pollen from different flower of same plant	Genetically similar to self-pollination
Cross-pollination (Xenogamy)	Pollen from different plant	Genetic variation, requires agents

Pollinating Agents

Agent	Features of Flowers	Examples
Wind (Anemophily)	Light pollen, feathery stigma, no colour/scent/nectar	Grasses, corn, wheat
Water (Hydrophily)	Pollen water-resistant, mucilaginous coating	Vallisneria, Zostera, Hydrilla
Insects (Entomophily)	Colourful, fragrant, nectar, sticky pollen	Rose, sunflower, Salvia
Birds (Ornithophily)	Large, colourful, tubular, copious nectar	Bombax, Butea (Palash)

Outbreeding Devices (Prevent Self-pollination)

- **Dichogamy:** Pollen and stigma mature at different times
- **Herkogamy:** Physical barrier between anther and stigma
- **Self-incompatibility:** Pollen of same genotype rejected by pistil
- **Unisexuality (Dioecy):** Male and female flowers on separate plants (papaya, date palm)

Double Fertilisation (Unique to Angiosperms!)

Pollen tube enters embryo sac through micropyle

Syngamy: One male gamete + egg cell → Zygote (2n)
Triple fusion: One male gamete + 2 polar nuclei → Primary Endosperm Nucleus (PEN, 3n)

Since TWO fusions occur, it's called **double fertilisation**.
Zygote → Embryo; PEN → Endosperm (nutritive tissue for developing embryo)

Double fertilisation was discovered by S.G. Nawaschin (1898). It is UNIQUE to angiosperms — not found in gymnosperms, animals, or any other group!

Post-fertilisation Events

Seed Development

Part	Develops From	Ploidy
Embryo	Zygote	2n
Endosperm	Primary endosperm nucleus (PEN)	3n
Seed coat	Integuments of ovule	2n (maternal)
Fruit wall (pericarp)	Ovary wall	2n (maternal)

Embryo Structure

- **Dicot embryo:** Radicle + Plumule + 2 cotyledons + Embryonal axis
- **Monocot embryo:** Radicle (covered by coleorhiza) + Plumule (covered by coleoptile) + 1 cotyledon (scutellum)

Endosperm

- Develops BEFORE the embryo (provides nutrition)
- **Endospermic/Albuminous seeds:** Endosperm persists (wheat, maize, castor, coconut)
- **Non-endospermic/Exalbuminous seeds:** Endosperm consumed by embryo (pea, bean, groundnut)

Special Phenomena

- **Apomixis:** Seed formation without fertilisation (e.g., some grasses, citrus). Produces clones.
- **Polyembryony:** More than one embryo in a seed (e.g., citrus → nucellar embryos)
- **Parthenocarpy:** Fruit development without fertilisation → seedless fruits (banana, grape)

Important Definitions

Term	Definition
Microsporogenesis	Formation of microspores (pollen) from microspore mother cells by meiosis
Megasporogenesis	Formation of megaspores from megaspore mother cell by meiosis
Pollination	Transfer of pollen from anther to stigma
Double Fertilisation	Two fusions in embryo sac: syngamy + triple fusion
Endosperm	Triploid nutritive tissue that nourishes the developing embryo
Apomixis	Asexual seed production without fertilisation
Parthenocarpy	Fruit development without fertilisation (seedless fruit)

Solved Examples — NCERT Based

Example 1

Q: What is the significance of double fertilisation?

Solution: Double fertilisation ensures: (1) Formation of diploid **zygote** that develops into embryo, and (2) Formation of triploid **endosperm** that provides nutrition to the developing embryo. The endosperm develops only when fertilisation occurs — this is an energy-efficient mechanism as the plant doesn't invest resources in endosperm formation unless fertilisation is successful.

Example 2

Q: Describe the structure of a mature embryo sac. Why is it called 7-celled and 8-nucleate?

Solution: The mature embryo sac contains:
Micropylar end: 1 egg cell + 2 synergids = 3 cells
Centre: 2 polar nuclei in one large central cell = 1 cell
Chalazal end: 3 antipodal cells = 3 cells
Total: **7 cells, 8 nuclei** (the central cell has 2 nuclei but is counted as 1 cell).

Example 3

Q: Distinguish between geitonogamy and xenogamy.

Solution: Geitonogamy: Transfer of pollen from one flower to another flower on the SAME plant. Functionally cross-pollination but genetically similar to self-pollination (no new genes introduced). **Xenogamy:** Transfer of pollen from a flower on one plant to a flower on a DIFFERENT plant. True cross-pollination — introduces genetic variation.

Example 4

Q: What are the differences between apomixis and parthenocarpy?

Solution: Apomixis: Seeds develop without fertilisation → seeds are present but genetically identical to parent. **Parthenocarpy:** Fruits develop without fertilisation → fruits are seedless. Apomixis produces seeds; parthenocarpy produces seedless fruits.

Important Questions for Board Exams

1 Mark Questions

1. What is sporopollenin? Why is it significant?
2. What is the function of filiform apparatus in synergids?
3. Define double fertilisation.
4. What is apomixis?

2 Mark Questions

1. Draw a labelled diagram of a mature pollen grain.
2. What are outbreeding devices? Name any two.
3. Differentiate between endospermic and non-endospermic seeds.
4. What is self-incompatibility and what is its significance?

3 Mark Questions

1. Describe the development of the female gametophyte in angiosperms.
2. Explain the process of double fertilisation and its significance.

3. What are the adaptations of wind-pollinated flowers?
4. Draw a labelled diagram of a mature embryo sac and describe its structure.

5 Mark Questions

1. Describe microsporogenesis. Draw a labelled diagram of a T.S. of anther showing microsporangia.
2. Explain post-fertilisation changes in a flower. How does the ovule become a seed and the ovary become a fruit?

Quick Revision Points

- Flower: 4 whorls — calyx, corolla, androecium (male), gynoecium (female)
- Microsporogenesis: MMC (2n) → meiosis → 4 microspores (n) → pollen
- Pollen: exine (sporopollenin) + intine (cellulose); 2 or 3 cells
- Megasporogenesis: MMC → 4 megaspores → 1 functional → 7-celled, 8-nucleate embryo sac
- Embryo sac: 3 (egg+2 synergids) + 1 (central cell, 2 polar nuclei) + 3 (antipodals)
- Double fertilisation: sperm + egg → zygote (2n); sperm + polar nuclei → PEN (3n)
- Ovule → seed; Ovary → fruit
- Endospermic seeds: wheat, maize; Non-endospermic: pea, bean
- Apomixis: seeds without fertilisation; Parthenocarpy: seedless fruits
- Sporopollenin: most resistant biological material

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