

Overview

- Angiosperms (flowering plants) reproduce sexually.
- **Flowers** are the main reproductive organs where **male and female gametes** are produced, fertilization occurs, and seeds and fruits develop.
- Sexual reproduction introduces **genetic variation**, ensuring species continuity and evolution.

1.1 FLOWER – THE REPRODUCTIVE UNIT

- Flowers may be **bisexual** (both male and female whorls present) or **unisexual** (only one).
- **Complete Flower**: All 4 whorls present – Calyx, Corolla, Androecium, Gynoecium.

Functions of floral parts:

- **Calyx (Sepals)**: Protection in bud stage.
- **Corolla (Petals)**: Attract pollinators.
- **Androecium (Stamens)**: Male reproductive whorl → Produces pollen.
- **Gynoecium (Carpels)**: Female reproductive whorl → Produces ovules.

Diagram reference: NCERT Fig. 1.1 – Parts of a flower

1.2 MALE REPRODUCTIVE ORGAN – STAMEN

- **Structure**: Stalk (**filament**) + swollen tip (**anther**).
- **Anther**: Typically bilobed and **dithecal**, each lobe has 2 microsporangia → total **4 pollen sacs**.
- Each pollen sac produces numerous **pollen grains**.

1.2.1 MICROSPORANGIUM (Anther Structure)

Layers of anther wall (outer to inner):

1. **Epidermis**: Protective.
2. **Endothecium**: Assists in dehiscence (splitting open).
3. **Middle layers**: 2–3 cell layers; ephemeral.
4. **Tapetum**: Nourishes developing pollen grains; secretes precursors for pollen wall (sporopollenin).

Inside: **Sporogenous tissue** → **Microspore Mother Cells (MMCs)**.

Diagram reference: NCERT Fig. 1.2

1.2.2 MICROSPOROGENESIS (Formation of Microspores)

- MMC (diploid) undergoes **meiosis** → **haploid microspore tetrad**.
- Each microspore separates → develops into pollen grain (**male gametophyte**).

1.2.3 POLLEN GRAIN STRUCTURE

- Shape: Spherical; size: 25–50 μm .
- **Wall layers:**
 - **Exine:** Outer, made of sporopollenin (most resistant substance in nature – resists degradation).
 - Has germ pores (thin regions for pollen tube emergence).
 - **Intine:** Inner, cellulose and pectin.
- **Cytoplasm contains:**
 - **Vegetative cell:** Large, food reserve, vacuolated.
 - **Generative cell:** Small, spindle-shaped; divides to form **2 male gametes**.
- **Viability:** Ranges from 30 min (rice/wheat) to months (Leguminosae).
- **Storage:** Pollen grains stored in **liquid nitrogen (-196°C)** for long-term hybridization programs.

Diagram reference: NCERT Fig. 1.3

1.3 FEMALE REPRODUCTIVE ORGAN – CARPEL (Gynoecium)

- **Structure:** Ovary (basal swollen part) + Style + Stigma.
- Ovary contains **ovules attached to placenta**.

1.3.1 OVULE STRUCTURE

- Funicle (stalk), Hilum (junction), Integuments (form seed coat),
- Micropyle (entry point for pollen tube),
- Nucellus (nutrition),
- **Embryo sac** (female gametophyte).

Diagram reference: NCERT Fig. 1.4

1.3.2 MEGASPOROGENESIS

- In nucellus, one **MMC (diploid)** undergoes meiosis → **4 haploid megaspores** (arranged in linear tetrad).
- Usually, **only one functional megaspore** survives → develops into embryo sac.

1.3.3 EMBRYO SAC (Female Gametophyte)

- **Type:** Polygonum type (commonest).
- Develops from functional megaspore via **3 mitotic divisions** → **8 nuclei, 7 cells:**
 - 3 **antipodals** (chalazal end)
 - 2 **synergids** + 1 **egg cell** (micropylar end)
 - 2 **polar nuclei** in central cell

Mnemonic: 3A, 2S, 1E, 2P

Diagram reference: NCERT Fig. 1.5

1.4 POLLINATION

Definition: Transfer of pollen from anther to stigma.

Types:

- **Autogamy:** Same flower (requires bisexuality + synchronized maturation).
- **Geitonogamy:** Different flowers on same plant.
- **Xenogamy:** Different plants (genetic variation).

Agents of Pollination:

- **Abiotic:**
 - Wind (Anemophily) – e.g., maize
 - Water (Hydrophily) – e.g., Vallisneria, Hydrilla
- **Biotic:**
 - Insects (Entomophily) – e.g., Sunflower
 - Birds (Ornithophily) – e.g., Sunbirds
 - Bats (Chiropterophily)

Adaptations:

- Wind: Light pollen, feathery stigma
- Water: Mucilaginous pollen
- Insects: Nectar, color, fragrance

1.5 DOUBLE FERTILIZATION

- Unique to angiosperms.
- Pollen tube enters ovule via micropyle (synergid helps entry).
- **Two male gametes released:**
 - One + Egg → Zygote (Syngamy)
 - Other + 2 Polar nuclei → Primary Endosperm Nucleus (PEN, triploid) → Endosperm

Diagram reference: NCERT Fig. 1.8

Significance: Provides nourishment to developing embryo before seed germination.

1.6 POST-FERTILIZATION CHANGES

- Zygote → Embryo
- Ovule → Seed
- Ovary → Fruit
- Endosperm → Nutrition for embryo

1.7 SEED AND FRUIT

- **Dicot seed:** 2 cotyledons, embryo axis (radicle, plumule), seed coat
- **Monocot seed:** Endosperm present (maize); structures: Scutellum, coleoptile, coleorhiza

1.8 APOMIXIS AND POLYEMBRYONY

- **Apomixis:** Formation of seeds without fertilization.
 - Seen in: Some grasses, Citrus
 - **Advantage:** Produces **true-to-type plants**, useful for maintaining hybrid vigour.
- **Polyembryony:** More than one embryo in a seed (Citrus).

Advantages of Apomixis:

- Fixes hybrid characters for generations.
- No need for repeated hybridization.

Common Exam Questions from CBSE:

- Explain double fertilization with a neat diagram.
- Describe structure of dicot embryo.
- Define apomixis; give its significance in plant breeding.

IMPORTANT

THESE NOTES ARE A SUPPLEMENT TO NCERT BOOK, PLEASE READ THE BOOK THOROUGHLY.

FOR DIAGRAMS, PLEASE REFER TO NCERT BOOK