

Sexual Reproduction in Flowering Plants — Assignment 2

Class 12 Biology · Higher-difficulty challenge set + integrated problems · Answer key included · Narayan Gurukul Academy

Instructions: (1) Attempt all questions; start with the topic-wise challenge set, then attempt the integrated (multi-topic) problems.
(2) Give all answers with correct SI units. $g = 10 \text{ m/s}^2$ unless stated.
(3) A final answer key is provided at the end — try the full set before checking it.

Part A — Topic-wise challenge questions

Structure of a Flower and Reproductive Organs

1. Name the male and female reproductive organs of a flower.
2. Distinguish between self-pollination and cross-pollination.
3. Describe the structure of a typical angiosperm flower.

Microsporogenesis and the Male Gametophyte

1. Name the layers of a microsporangium.
2. Describe the structure of a mature pollen grain.
3. Explain microsporogenesis.

Megasporogenesis and the Female Gametophyte

1. Describe the structure of an ovule.
2. Explain the 7-celled, 8-nucleate nature of the embryo sac.
3. Explain megasporogenesis.

Pollination and Its Agents

1. Distinguish between autogamy and geitonogamy.
2. Mention two adaptations of wind-pollinated flowers.
3. Describe the agents of pollination with examples.

Double Fertilization

1. Why is fertilisation called double fertilisation in angiosperms?
2. What are the products of double fertilisation?
3. Describe the process of double fertilisation.

Post-Fertilization Changes

1. Distinguish between albuminous and non-albuminous seeds.
2. Describe the structure of a typical monocot seed.
3. Describe the post-fertilisation changes in the ovule and ovary.

Apomixis, Polyembryony and Pollen Application

1. Give one example of polyembryony.
2. State two advantages of apomixis in agriculture.
3. What is apomixis? Discuss its importance in plant breeding.

Part B — Integrated problems (multi-topic)

1. Describe the development of the male gametophyte in angiosperms.
2. Describe the development of the female gametophyte (Polygonum type).
3. Explain the process of double fertilisation and its significance.
4. Describe the post-fertilisation changes leading to seed and fruit formation.
5. What is apomixis? How does it differ from polyembryony? Give their significance.
6. Explain the role of the tapetum and the importance of sporopollenin.

Answer Key

Structure of a Flower and Reproductive Organs

Male organ: stamen; female organ: carpel. Self-pollination occurs within the same flower/plant; cross-pollination occurs between different plants. A flower has four whorls: calyx (sepals), corolla (petals), androecium (stamens) and gynoecium (carpels); the stamen has anther and filament, the carpel has stigma, style and ovary.

Microsporogenesis and the Male Gametophyte

Microsporangium layers: epidermis, endothecium, middle layer and tapetum. A mature pollen grain has a generative cell and a vegetative cell, with a two-layered wall (exine + intine). Microsporogenesis: the diploid pollen mother cell undergoes meiosis to form a microspore tetrad; the microspores separate and develop into pollen grains (male gametophytes).

Megasporogenesis and the Female Gametophyte

Ovule: funicle, hilum, integuments, micropyle, chalaza, nucellus and embryo sac. The embryo sac is 7-celled and 8-nucleate: 3 antipodals, 2 synergids, 1 egg and 1 central cell with 2 polar nuclei. Megasporogenesis: the megaspore mother cell undergoes meiosis to form four megaspores; the functional megaspore develops into the embryo sac.

Pollination and Its Agents

Autogamy is pollination within the same flower; geitonogamy is pollination between flowers of the same plant. Wind-pollinated flowers have small, dull, nectarless flowers, light dry pollen and feathery stigmas. Agents: abiotic (wind/anemophily, water/hydrophily) and biotic (insects, birds, bats).

Double Fertilization

Two fusion events occur: syngamy (male gamete + egg → diploid zygote) and triple fusion (male gamete + two polar nuclei → triploid PEN). Products: zygote and primary endosperm nucleus (endosperm). One pollen tube delivers two male gametes; one fuses with the egg and the other with the two polar nuclei, so fertilisation is double.

Post-Fertilization Changes

Albuminous seeds retain endosperm (e.g. wheat, maize); non-albuminous seeds use it up (e.g. pea, groundnut). A monocot seed has a single cotyledon (scutellum), endosperm and a coleoptile/coleorhiza covering the plumule/radicle. The ovule becomes the seed (integuments → seed coat), the ovary becomes the fruit (ovary wall → pericarp) and the zygote develops into the embryo.

Apomixis, Polyembryony and Pollen Application

Example of polyembryony: citrus (and mango). Advantages of apomixis: genetically uniform progeny and preservation of hybrid vigour. Apomixis is the formation of seeds without fertilisation; it maintains hybrid characters over generations, so hybrid seed can be produced without re-crossing.

Integrated problems

1: Microspore mother cell ($2n$) → meiosis → microspore tetrad → pollen grain (male gametophyte) with generative + vegetative cells. 2: Megaspore mother cell ($2n$) → meiosis → 4 megaspores → functional megaspore → embryo sac (7-celled, 8-nucleate). 3: Syngamy → zygote ($2n$); triple fusion → triploid endosperm; significance: nutritive endosperm + diploid embryo. 4: Ovule → seed, ovary → fruit, integuments → seed coat, zygote → embryo. 5: Apomixis — seeds without fertilisation; polyembryony — more than one embryo per seed; both preserve hybrid characters. 6: Tapetum nourishes pollen and supplies sporopollenin; sporopollenin makes the exine resistant to decay.