

CUET · BIOLOGY · CLASS XII · CODE 304

Sexual Reproduction in Flowering Plants

CUET unit: Reproduction → Sexual Reproduction in Flowering
Plants

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Snapshot

- Establishes the flower as the seat of sexual reproduction in angiosperms, dissecting the androecium (stamens) and gynoecium (pistil) into the cellular events that produce male and female gametophytes.
- Walks through pre-fertilisation (microsporogenesis, megasporogenesis, monosporic embryo sac, pollination, pollen-pistil interaction), double fertilisation (syngamy + triple fusion), and post-fertilisation (endosperm, embryo, seed, fruit).
- Introduces apomixis and polyembryony as deviations from the standard sexual cycle, plus practical applications such as bagging, emasculation, parthenocarpy and apomictic hybrid seed technology.
- CUET regularly tests structural facts (7-celled/8-nucleate sac, dithecosus/tetrasporangiate anther), ploidy of cells, pollination categories and agents, outbreeding devices, and post-fertilisation terminology.

Detailed Notes

2.1 Core concepts

- A typical angiosperm anther is bilobed, dithecosus (two theca per lobe) and tetrasporangiate, i.e. four microsporangia located at the four corners (NCERT §1.2.1, p. 5).
- Each microsporangium is surrounded by four wall layers — epidermis, endothecium, middle layers and tapetum; the tapetum nourishes the developing pollen grains and its cells have dense cytoplasm and often more than one nucleus (NCERT §1.2.1, p. 5).
- Sporogenous tissue at the centre of a young microsporangium gives rise to pollen mother cells (PMC); meiosis of the PMC (microsporogenesis) yields a microspore tetrad, and microspores mature into pollen grains released on anther dehiscence (NCERT §1.2.1, pp. 5–6).
- Pollen grains are generally spherical, 25–50 μm across, with a two-layered wall: a hard exine made of sporopollenin (highly resistant to acids, alkali and high temperature; no known enzyme degrades it) bearing germ pores, and an inner intine of cellulose and pectin (NCERT §1.2.1, p. 7).

- At shedding, pollen is 2-celled in over 60% of angiosperms (a large vegetative cell + a small spindle-shaped generative cell); in the remaining species the generative cell divides mitotically before shedding to give the 3-celled stage (NCERT §1.2.1, p. 7).
- Pollen viability varies — only ~30 minutes in rice and wheat, but months in some Rosaceae, Leguminosae and Solanaceae; pollen can be stored for years in liquid nitrogen at -196°C as pollen banks (NCERT §1.2.1, p. 8).
- The gynoecium may be monocarpellary, or multicarpellary with pistils fused (syncarpous, e.g. Papaver) or free (apocarpous, e.g. Michelia); each pistil has stigma, style and ovary, with ovules (megasporangia) borne on the placenta (NCERT §1.2.2, pp. 8–9).
- A typical ovule has a funicle, hilum, one or two integuments, a micropyle, a chalaza, a nucellus, and an embryo sac (female gametophyte) (NCERT §1.2.2, p. 9).
- Megasporogenesis: the megaspore mother cell (MMC) in the micropylar nucellus undergoes meiosis to form four megaspores; typically one is functional and the other three degenerate — monosporic development (NCERT §1.2.2, pp. 9–10).
- The functional megaspore nucleus undergoes three free-nuclear mitotic divisions ($2 \rightarrow 4 \rightarrow 8$ nuclei); cell walls then form, organising a typical mature embryo sac that is 8-nucleate but 7-celled — 2 synergids + 1 egg (egg apparatus at micropylar end), 3 antipodals at chalazal end, and 1 large central cell with 2 polar nuclei (NCERT §1.2.2, pp. 10–11).
- Synergids bear filiform apparatus at the micropylar tip that guides the pollen tube into the synergid (NCERT §1.2.2, p. 11; §1.2.3, p. 17).
- Pollination = transfer of pollen from anther to stigma; by source, it is autogamy (same flower), geitonogamy (different flower of same plant — functionally cross-pollination but genetically autogamous), or xenogamy (different plant — the only type that brings genetically different pollen) (NCERT §1.2.3, pp. 11–12).
- Cleistogamous flowers (e.g. some Viola, Oxalis, Commelina) never open and are invariably autogamous, ensuring seed-set even without pollinators; chasmogamous flowers open and expose anthers and stigma (NCERT §1.2.3, p. 12).
- Agents of pollination are abiotic (wind, water) and biotic (animals); majority of plants use biotic agents. Wind pollination needs light, non-sticky pollen, well-exposed stamens and large feathery stigma; common in grasses, e.g. corn cob (NCERT §1.2.3, pp. 12–13).
- Water pollination is rare (~30 genera, mostly monocots), e.g. Vallisneria, Hydrilla and the marine sea-grass Zostera; pollen is often long, ribbon-like and protected by a mucilaginous covering (NCERT §1.2.3, p. 13).
- Insect-pollinated flowers tend to be large, colourful, fragrant and rich in nectar; rewards include nectar, pollen, and even safe egg-laying sites (Amorphophallus; the obligate Yucca-moth mutualism) (NCERT §1.2.3, pp. 14–15).

- Outbreeding devices to prevent inbreeding depression: (i) non-synchronous pollen release and stigma receptivity, (ii) different positions of anther and stigma, (iii) self-incompatibility (genetic — prevents self-pollen from fertilising by inhibiting germination/tube growth), (iv) unisexual flowers — monoecy (prevents autogamy only) and dioecy (prevents both autogamy and geitonogamy) (NCERT §1.2.3, p. 15).
- Pollen-pistil interaction is a chemical dialogue allowing the pistil to accept compatible pollen or reject incompatible pollen; compatible pollen germinates through a germ pore, the tube grows through the style, enters the ovule via the micropyle, and enters one synergid via the filiform apparatus (NCERT §1.2.3, pp. 15–17).
- Artificial hybridisation tools: emasculation (removal of anthers from a bisexual flower bud before dehiscence) and bagging (covering the emasculated flower with butter paper to exclude unwanted pollen); unisexual female flowers need only bagging (NCERT §1.2.3, p. 17).
- Double fertilisation (unique to flowering plants): one male gamete fuses with the egg (syngamy → diploid zygote); the other fuses with the two polar nuclei in the central cell (triple fusion → triploid primary endosperm nucleus, PEN). The central cell becomes the primary endosperm cell (PEC) (NCERT §1.3, p. 18).
- Endosperm development precedes embryo development: in the common pattern, the PEN undergoes successive free-nuclear divisions (free-nuclear endosperm), then cell walls form (cellular endosperm). Coconut water = free-nuclear endosperm; surrounding white kernel = cellular endosperm (NCERT §1.4.1, pp. 18–19).
- Embryogeny: zygote → proembryo → globular → heart-shaped → mature embryo; early stages are similar in dicots and monocots (NCERT §1.4.2, p. 19).
- A typical dicot embryo has an embryonal axis with two cotyledons; the part above cotyledons is the epicotyl (ending in plumule), the part below is the hypocotyl (ending in radicle with root cap) (NCERT §1.4.2, p. 19).
- A monocot embryo (grass family) has one cotyledon called scutellum (lateral); the radicle and root cap are enclosed in a coleorrhiza, and the shoot apex with leaf primordia is enclosed in a coleoptile (NCERT §1.4.2, pp. 19–20).
- Seed = fertilised ovule; consists of seed coat(s), cotyledon(s) and an embryo axis. Mature seeds are non-albuminous (endosperm fully consumed, e.g. pea, groundnut) or albuminous (endosperm persists, e.g. wheat, maize, barley, castor). Persistent nucellus, when present, is the perisperm (e.g. black pepper, beet) (NCERT §1.4.3, p. 20).
- Integuments harden into the seed coat; the micropyle remains as a pore allowing entry of oxygen and water during germination (NCERT §1.4.3, p. 20).
- Ovary wall develops into the fruit wall (pericarp). False fruits (e.g. apple, strawberry, cashew) involve the thalamus in fruit formation; true fruits develop only from the ovary (NCERT §1.4.3, p. 20).
- Parthenocarpic fruits form without fertilisation (e.g. banana) and can be induced by growth hormones — such fruits are seedless (NCERT §1.4.3, p. 21).

- Record seed longevity: *Lupinus arcticus* seed from Arctic Tundra germinated after ~10,000 years; a 2,000-year-old viable date palm (*Phoenix dactylifera*) seed was recovered near the Dead Sea (NCERT §1.4.3, p. 22).
- Apomixis: production of seeds without fertilisation (a form of asexual reproduction mimicking sexual), occurring in some Asteraceae and grasses; mechanisms include a diploid (unreduced) egg developing without fertilisation, and nucellar cells dividing into embryos (common in many Citrus and Mango varieties) (NCERT §1.5, pp. 22–23).
- Polyembryony: occurrence of more than one embryo in a seed — common in the nucellar-embryony Citrus/Mango varieties (NCERT §1.5, p. 23).
- Apomixis is being researched intensively because, if hybrid varieties could be made apomictic, farmers would not need to buy hybrid seed every year as character segregation in the progeny would be avoided (NCERT §1.5, p. 23).

2.2 Definitions to memorise

Term	Definition	Page
Microsporogenesis	Formation of microspores from a pollen mother cell through meiosis	6
Sporopollenin	Highly resistant organic material forming the exine; withstands acids, alkalis and high temperature; no known enzyme degrades it	7
Germ pore	Aperture in the exine where sporopollenin is absent; site of pollen tube emergence	7
Intine	Inner pollen wall made of cellulose and pectin	7
Monosporic development	Embryo-sac formation from a single (functional) megaspore	10
Filiform apparatus	Special cellular thickenings at the micropylar tip of synergids that guide the pollen tube	11
Autogamy	Transfer of pollen from anther to stigma of the same flower	11
Geitonogamy	Transfer of pollen between flowers of the same plant (functionally cross-pollination, genetically autogamy)	12
Xenogamy	Transfer of pollen from anther to stigma of a different plant — the only type bringing genetically different pollen	12
Chasmogamous flowers	Flowers that open and expose anthers and stigma	12
Cleistogamous flowers	Flowers that do not open at all; invariably autogamous; produce assured seed-set without pollinators	12
Self-incompatibility	Genetic mechanism preventing self-pollen from fertilising by inhibiting pollen germination or tube growth	15

Term	Definition	Page
Emasculation	Removal of anthers from a bisexual flower bud before dehiscence	17
Bagging	Covering an emasculated flower to prevent contamination of its stigma	17
Syngamy	Fusion of one male gamete with the egg → diploid zygote	18
Triple fusion	Fusion of the second male gamete with the two polar nuclei → triploid PEN	18
Double fertilisation	Occurrence of both syngamy and triple fusion in an embryo sac; unique to flowering plants	18
Perisperm	Persistent, residual nucellus in some mature seeds (e.g. black pepper, beet)	20
Parthenocarpy	Development of fruit without fertilisation; produces seedless fruit (e.g. banana)	21
Apomixis	Production of seeds without fertilisation; a form of asexual reproduction mimicking sexual	22
Polyembryony	Occurrence of more than one embryo in a seed	23

2.3 Diagrams / processes to remember

- Figure 1.1 (p. 4) — L.S. of a flower showing thalamus, sepals, petals, stamens and pistil.
- Figure 1.2 (p. 5) — Typical stamen (filament + bilobed anther) and 3-D cut section of an anther showing four microsporangia.
- Figure 1.3 (p. 6) — T.S. of a young anther; enlarged microsporangium with the four wall layers; mature dehisced anther.
- Figure 1.5 (p. 7) — Pollen tetrad and stages of microspore maturation into a 2-celled pollen grain (vegetative + generative cell).
- Figure 1.7 (p. 9) — Hibiscus pistil; syncarpous Papaver; apocarpous Michelia; anatropous ovule (funicle, hilum, integuments, micropyle, nucellus, embryo sac, chalaza).
- Figure 1.8 (p. 10) — MMC, dyad and megaspore tetrad; 2-, 4-, 8-nucleate embryo sac and the mature 7-celled/8-nucleate sac (egg apparatus, central cell, antipodals).
- Figure 1.9 (p. 12) — Self-pollinated, cross-pollinated and cleistogamous flowers.
- Figure 1.11 (p. 14) — Pollination by water (Vallisneria) and by insects.
- Figure 1.12 (p. 16) — Pollen germination on stigma; pollen tube growth through style; entry of pollen tube into a synergid via filiform apparatus; discharge of two male gametes — one into the egg, the other into the central cell.

- Figure 1.13 (p. 18) — Fertilised embryo sac with zygote and PEN; stages of dicot embryo development.
- Figure 1.14 (p. 19) — Typical dicot embryo (epicotyl, hypocotyl, cotyledons, radicle); L.S. of a grass embryo (scutellum, coleoptile, coleorrhiza).
- Figure 1.15 (pp. 20–21) — Structures of some seeds; false fruits of apple and strawberry.

2.4 Common confusions / NTA trap points

- 7-celled vs 8-nucleate: the mature embryo sac has 8 nuclei but only 7 cells, because the two polar nuclei sit together inside one large central cell.
- Geitonogamy looks like cross-pollination (a pollinator is involved, pollen comes from a different flower) but is genetically equivalent to autogamy — the pollen comes from the same plant. Only xenogamy brings genetically different pollen.
- Dioecy prevents both autogamy and geitonogamy; monoecy (e.g. castor, maize) prevents autogamy but not geitonogamy.
- Triple fusion involves three haploid nuclei (one male gamete + two polar nuclei), but it is a single fusion event yielding a triploid PEN — not three separate fusions.
- "Pollination" is just transfer; "fertilisation" is fusion. CUET often disguises this in stems about Vallisneria, corn cob, etc.
- False fruit (apple, strawberry, cashew) involves the thalamus, not just the ovary; true fruit develops only from the ovary.
- Albuminous seeds (wheat, maize, barley, castor) retain endosperm; non-albuminous seeds (pea, groundnut) consume it entirely.
- Coleoptile encloses the shoot apex (above), coleorrhiza encloses the radicle (below) — students often swap them.

Practice MCQs

Q1. A typical angiosperm anther is best described as:

- A.** Monothealous and bisporangiate
- B.** Dithealous and tetrasporangiate
- C.** Trithealous and hexasporangiate
- D.** Dithealous and bisporangiate

Q2. Which wall layer of the microsporangium nourishes the developing pollen grains and characteristically contains cells with dense cytoplasm and often more than one nucleus?

- A. Epidermis
- B. Endothecium
- C. Middle layers
- D. Tapetum

Q3. The hard outer wall of a pollen grain (exine) is made up of:

- A. Cellulose and pectin
- B. Lignin
- C. Sporopollenin
- D. Cutin

 **15 more MCQs + answer key**

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PYQ Alignment

This chapter is a perennial CUET (UG) Biology hot-spot — roughly 15–20 MCQs across CUET 2023–2025 papers have tested its content, with recurring questions on the 7-celled/8-nucleate embryo sac, ploidy of cells (MMC, megaspore, endosperm, zygote), tapetum function, pollination types and agents (especially distinguishing geitonogamy from xenogamy, and water-pollination examples), double fertilisation, false vs true fruits, parthenocarpy, and apomixis/polyembryony in Citrus and Mango. Expect a mix of direct recall, statement-based, match-the-following and assertion-reason items in the actual exam.

CUET 2025 — Actual PYQs from this chapter

Q.1 (CUET 2025) Which one of the following guides the entry of the pollen tube into the embryo sac?

- A) Antipodal cell
- B) Filiform apparatus
- C) Micropyle

- D) Synergids

Tests: aligns with §2 (sexual reproduction in flowering plants) **Answer:** Not in extracted key — verify against official NTA key

Q.6 (CUET 2025) Which of the following is opposite to the micropylar end of ovule?

- A) Hilum
- B) Chalaza
- C) Funicle
- D) Nucellus

Tests: aligns with §2 (sexual reproduction in flowering plants) **Answer:** Not in extracted key — verify against official NTA key

Q.42 (CUET 2025) Which of the following does not exhibit a narrowly utilitarian argument for conserving biodiversity?

- A) Construction materials
- B) Pollination
- C) Industrial products
- D) Medicines

Tests: aligns with §2 (sexual reproduction in flowering plants) **Answer:** Not in extracted key — verify against official NTA key

Q.46 (CUET 2025) With reference to reproduction in flowering plants, which of the following is incorrect?

- A) Endosperm develops into seed
- B) Ovary develops into fruit
- C) Ploidy of PEN is $3n$
- D) Syngamy is fusion of male and female gamete

Tests: aligns with §2 (sexual reproduction in flowering plants — overview) **Answer:** Not in extracted key — verify against official NTA key

Q.48 (CUET 2025) The coconut water from tender coconut is actually:

- A) Free-nuclear endosperm
- B) Synergids
- C) Antipodal cells
- D) Scutellum

Tests: aligns with §2 (sexual reproduction in flowering plants) **Answer:** Not in extracted key — verify against official NTA key

CUET 2024 — Actual PYQs from this chapter

Q.1 (CUET 2024) Cells present in the mature pollen grains are ____.

- A) Central cell and generative cell

- B) Antipodal cell and vegetative cell
- C) Vegetative cell and generative cell
- D) Filiform cell and micropylar cell

Tests: aligns with §2 (sexual reproduction in flowering plants) **Answer:** Not in extracted key — verify against official NTA key

Q.2 (CUET 2024) Match List-I with List-II. List-I (Structur es) List-II (Functions) (A) Filiform apparatus (I) Made up of sporopollenin (B) Tapetum (II) Attachment of ovule to placenta (C) Exine (III) Guides pollen tube into the synergid (D) Funicle (IV) Nourishes the pollen grain Choose the correct option.

- A) [option not extracted — see source]
- B) [option not extracted — see source]
- C) [option not extracted — see source]
- D) [option not extracted — see source]

Tests: aligns with §2 (sexual reproduction in flowering plants) **Answer:** Not in extracted key — verify against official NTA key

Q.3 (CUET 2024) Primary Endosperm Nucleus is the product of:

- A) Double fusion
- B) Triple fusion
- C) Parthenogenesis
- D) Apomixis

Tests: aligns with §2 (sexual reproduction in flowering plants) **Answer:** Not in extracted key — verify against official NTA key

CUET 2023 — Actual PYQs from this chapter

Q.1 (CUET 2023) Parthenogenesis does not occur in

- A) Rotifers
- B) Honeybees
- C) Lizards
- D) Mammals

Tests: aligns with §2 (sexual reproduction in flowering plants) **Answer:** Not in extracted key — verify against official NTA key

Q.3 (CUET 2023) Match List-I with List-II List-I (A) Polyembryony (B) Parthenocarpy (C) False fruit (D) Embryo sac List-II (I) Apple (II) Female gametophyte (III) Orange (IV) Banana Choose the correct answer:

- A) A-III, B-I, C-II, D-IV
- B) A-III, B-IV, C-I, D-II
- C) A-I, B-IV, C-III, D-II

- D) A-III, B-IV, C-II, D-I

Tests: aligns with §2 (sexual reproduction in flowering plants) **Answer:** Not in extracted key — verify against official NTA key

Q.4 (CUET 2023) Arrange the stages of development of a dicot embryo in correct order: (A) Formation of heart-shaped embryo (B) Formation of typical dicot embryo (C) Formation of zygote (D) Formation of globular embryo

- A) A, B, C, D
- B) C, D, A, B
- C) C, A, B, D
- D) D, A, B, C

Tests: aligns with §2 (sexual reproduction in flowering plants) **Answer:** Not in extracted key — verify against official NTA key



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