

CUET · BIOLOGY · CLASS XI · CODE 304

Morphology of Flowering Plants

CUET unit: Structural Organisation in Plants and Animals →
Morphology of Flowering Plants

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Snapshot

- Establishes the standard vocabulary of angiosperm morphology — root, stem, leaf, inflorescence, flower, fruit, seed — that all later plant biology chapters (anatomy, reproduction, physiology) presuppose.
- Distinguishes the two great angiosperm groups (dicots vs. monocots) on morphological criteria: tap vs. fibrous root, reticulate vs. parallel venation, two vs. one cotyledon.
- Builds the toolkit for semi-technical description: aestivation, placentation, position of ovary (hypogynous / perigynous / epigynous), floral formula symbols.
- Anchors family-level identification through the Solanaceae case study with its diagnostic floral formula.
- CUET tests this chapter heavily because every term here (e.g. vexillary, axile, drupe, scutellum) becomes a one-line MCQ stem.

Detailed Notes

2.1 Core concepts

- Angiosperms, despite vast diversity, are universally characterised by roots, stems, leaves, flowers and fruits; the underground part is the **root system**, the part above ground is the **shoot system** (NCERT §5, p. 57; §5.1 intro, p. 57–58).
- In most dicots the **radicle elongates** directly into a **primary root**, which bears secondary and tertiary lateral roots — together the **tap root system** (e.g. mustard) (NCERT §5.1, p. 57–58).
- In monocots the primary root is short-lived and is replaced by many roots arising from the **base of the stem**, forming the **fibrous root system** (e.g. wheat) (NCERT §5.1, p. 58).
- **Adventitious roots** arise from parts of the plant other than the radicle, e.g. grass, *Monstera*, banyan (NCERT §5.1, p. 58).
- Root functions: absorption of water and minerals, anchorage, storage of reserve food, and synthesis of plant growth regulators (NCERT §5.1, p. 58).
- The root tip shows four distinct regions in acropetal order: **root cap** (thimble-like, protective) → **region of meristematic activity** (small, thin-walled, dense

- protoplasm, dividing cells) → **region of elongation** (cells enlarge and elongate, drive root growth in length) → **region of maturation** (cells differentiate; some epidermal cells produce **root hairs** that absorb water and minerals) (NCERT §5.1.1, p. 59).
- The **stem** is the ascending axis bearing branches, leaves, flowers and fruits; it develops from the **plumule** of the embryo, bears **nodes** (where leaves arise) and **internodes** (region between nodes), and bears terminal or axillary **buds** (NCERT §5.2, p. 59).
 - Stem functions: spreading branches, conducting water/minerals/photosynthates, and in some plants storage of food, support, protection and vegetative propagation (NCERT §5.2, p. 59).
 - The **leaf** is a lateral, generally flattened structure borne at the node with a bud in its axil; leaves originate from the shoot apical meristem in **acropetal order** and are the most important vegetative organs for photosynthesis (NCERT §5.3, p. 59).
 - A typical leaf has three parts — **leaf base, petiole, lamina**; the leaf base may bear two lateral **stipules**, expand into a **sheath** in monocots, or become swollen as the **pulvinus** in some legumes (NCERT §5.3, p. 60).
 - **Venation** is the arrangement of veins/veinlets in the lamina: **reticulate** (network — typical of dicots) and **parallel** (typical of monocots) (NCERT §5.3.1, p. 60).
 - Leaves are **simple** when the lamina is entire or incised but incisions do not reach the midrib; **compound** when incisions reach the midrib breaking it into leaflets. A bud is present in the axil of the petiole but never in the axil of leaflets (NCERT §5.3.2, p. 60).
 - Compound leaves are **pinnately compound** (leaflets on a common axis, the **rachis** — e.g. neem) or **palmately compound** (leaflets attached at a common point at the tip of the petiole — e.g. silk cotton) (NCERT §5.3.2, p. 60–61).
 - **Phyllotaxy** — arrangement of leaves on stem/branch: **alternate** (single leaf per node — china rose, mustard, sunflower), **opposite** (pair per node — **Calotropis**, guava), **whorled** (more than two per node — **Alstonia**) (NCERT §5.3.3, p. 61).
 - **Inflorescence** is the arrangement of flowers on the floral axis; the shoot apical meristem becomes a floral meristem, internodes do not elongate, and the axis condenses. A solitary flower results when the shoot tip itself becomes a flower (NCERT §5.4, p. 61).
 - Two major types: **racemose** — main axis continues to grow, flowers borne laterally in **acropetal succession**; **cymose** — main axis terminates in a flower, growth limited, flowers borne in **basipetal order** (NCERT §5.4, p. 61–62).
 - The **flower** is the reproductive unit of angiosperms with four whorls on the **thalamus/receptacle**: calyx, corolla (accessory), androecium and gynoecium (reproductive). In lily the calyx and corolla are indistinct and together called the **perianth**. Bisexual flowers have both stamens and carpels; unisexual have only one (NCERT §5.5, p. 62).

- Symmetry: **actinomorphic** (radial — mustard, datura, chilli), **zygomorphic** (bilateral — pea, gulmohur, bean, **Cassia**), **asymmetric** (canna). Flowers are **trimerous/tetramerous/pentamerous** if parts come in multiples of 3/4/5; **bracteate** if bracts are present at the base of the pedicel, otherwise **ebracteate** (NCERT §5.5, p. 62).
- Position of ovary on thalamus: **hypogynous** — ovary superior, other parts below (mustard, china rose, brinjal); **perigynous** — ovary half-inferior, other parts on the thalamus rim at the same level (plum, rose, peach); **epigynous** — ovary inferior, thalamus encloses and fuses with ovary, other parts arise above (guava, cucumber, ray florets of sunflower) (NCERT §5.5, p. 63).
- **Calyx** = sepals (outermost, green, protective); **gamosepalous** (united) or **polysepalous** (free). **Corolla** = petals (often coloured, attract pollinators); **gamopetalous** or **polypetalous**; shapes — tubular, bell-, funnel-, wheel-shaped (NCERT §5.5.1.1–5.5.1.2, p. 63).
- **Aestivation** — arrangement of sepals/petals in the bud: **valvate** (margins touch, no overlap — **Calotropis**), **twisted** (one margin overlaps the next consistently — china rose, lady's finger, cotton), **imbricate** (overlap not in any particular direction — **Cassia**, gulmohur), **vexillary/papilionaceous** (standard overlaps two wings which overlap two keel petals — pea, bean) (NCERT §5.5.1.2, p. 63–64).
- **Androecium** = stamens; each stamen has a filament and an anther; anther is usually bilobed with two pollen-sacs per lobe. A sterile stamen is a **staminode**. Stamens may be **epipetalous** (attached to petals — brinjal), **epiphyllous** (attached to perianth — lily), **polyandrous** (free), **monoadelphous** (one bundle — china rose), **diadelphous** (two bundles — pea), **polyadelphous** (more than two bundles — citrus); filament length may vary within a flower (**Salvia**, mustard) (NCERT §5.5.1.3, p. 64).
- **Gynoecium** = female part of one or more carpels; carpel has stigma, style and ovary; ovules sit on the cushion-like **placenta**. Multiple carpels are **apocarpous** if free (lotus, rose) or **syncarpous** if fused (mustard, tomato). After fertilisation, ovules become seeds and the ovary matures into a fruit (NCERT §5.5.1.4, p. 65).
- **Placentation** — arrangement of ovules within the ovary: **marginal** (ovules on a ridge along the ventral suture — pea); **axile** (placenta is axial in a multilocular ovary — china rose, tomato, lemon); **parietal** (ovules on inner wall; one-chambered ovary becomes two-chambered by a false septum — mustard, **Argemone**); **free central** (ovules on central axis with no septa — **Dianthus**, primrose); **basal** (single ovule at the base — sunflower, marigold) (NCERT §5.5.1.4, p. 65).
- The **fruit** is a mature/ripened ovary developed after fertilisation; a fruit formed without fertilisation is **parthenocarpic**. Fruit wall = **pericarp** (dry or fleshy); if fleshy, differentiates into **epicarp / mesocarp / endocarp** (NCERT §5.6, p. 65).

- A **drupe** develops from a monocarpellary superior ovary and is one-seeded: mango (thin epicarp, fleshy edible mesocarp, stony endocarp) and coconut (fibrous mesocarp) (NCERT §5.6, p. 65–66).
- The **seed** = seed coat + embryo (radicle + embryonal axis + one cotyledon as in wheat/maize OR two cotyledons as in gram/pea) (NCERT §5.7, p. 66).
- **Dicot seed**: seed coat has outer **testa** and inner **tegmen**; **hilum** is the scar where the seed was attached to the fruit; **micropyle** is a small pore above the hilum; embryo has two cotyledons (often fleshy with reserve food) plus radicle and plumule. Seeds with persistent **endosperm** (from double fertilisation) are **endospermic** (castor); without endosperm in mature stage are **non-endospermous** (bean, gram, pea) (NCERT §5.7.1, p. 66).
- **Monocot seed**: generally endospermic (orchids are exceptions). In cereals like maize the seed coat is membranous and fused with the fruit wall; the bulky endosperm stores food and is separated from the embryo by a proteinous **aleurone layer**. The embryo has one large shield-shaped cotyledon called the **scutellum** and a short axis; the **plumule is enclosed by the coleoptile** and the **radicle by the coleorhiza** (NCERT §5.7.2, p. 66–67).
- **Semi-technical description** proceeds in order: habit → vegetative characters (root, stem, leaves) → floral characters (inflorescence, flower parts) → floral diagram and floral formula (NCERT §5.8, p. 67).
- **Floral formula symbols**: Br = bracteate, K = calyx, C = corolla, P = perianth, A = androecium, G = gynoecium; **G with a line below** = superior ovary, **G with a line above** = inferior ovary; ♂ = male, ♀ = female, ♂/♀ = bisexual; ⊕ = **actinomorphic**, %/↑ = **zygomorphic**; fusion shown by enclosing the figure in brackets, adhesion by a line above the symbols (NCERT §5.8, p. 67–68).
- A **floral diagram** shows the number, arrangement and relations of floral parts; the position of the mother axis is indicated by a dot at the top, and whorls are drawn from calyx (outermost) to gynoecium (centre) (NCERT §5.8, p. 68). The mustard floral formula illustrated is $\oplus \frac{\%}{\uparrow} K_{2+2} C_4 A_{2+4} G_{(2)}$ (Family: Brassicaceae) (NCERT Figure 5.16, p. 67–68).
- **Solanaceae** (potato family) — widely distributed in tropical, subtropical and temperate zones; mostly herbs/shrubs, rarely small trees. Leaves alternate, simple (rarely pinnately compound), exstipulate, reticulate venation. Underground stem in potato (*Solanum tuberosum*) (NCERT §5.9, p. 68).
- Solanaceae floral characters: inflorescence solitary/axillary or cymose; flowers bisexual, actinomorphic; calyx 5, united, persistent, valvate; corolla 5, united, valvate; androecium 5, epipetalous; gynoecium bicarpellary syncarpous, ovary superior, bilocular, axile placentation with swollen placenta and many ovules; fruit berry or capsule; seeds many, endospermous. **Floral formula**: $\oplus \frac{\%}{\uparrow} K_{(5)} C_{(5)} A_5 G_{(2)}$ (NCERT §5.9, p. 69).

- Solanaceae economic importance: food (tomato, brinjal, potato), spice (chilli), medicine (belladonna, ashwagandha), fumigatory (tobacco), ornamentals (petunia) (NCERT §5.9, p. 69).

2.2 Definitions to memorise

Term	Definition	Page
Tap root system	Primary root from radicle plus its lateral branches (dicots)	57–58
Fibrous root system	Many roots arising from the base of the stem (monocots)	58
Adventitious root	Root arising from any part of the plant other than the radicle	58
Root cap	Thimble-like protective covering of the root apex	59
Region of meristematic activity	Zone of small, thin-walled, dividing cells just above root cap	59
Region of elongation	Zone where cells enlarge/elongate, causing root growth in length	59
Region of maturation	Zone of differentiated cells; some epidermal cells form root hairs	59
Node / internode	Region where leaves arise / region between two nodes on a stem	59
Pulvinus	Swollen leaf base seen in some leguminous plants	60
Venation (reticulate / parallel)	Veinlet pattern — network (dicots) / parallel veins (monocots)	60
Simple leaf	Lamina entire, or incised but incisions do not reach the midrib	60
Compound leaf	Incisions of the lamina reach the midrib, breaking it into leaflets	60
Pinnately compound	Leaflets on a common axis (rachis), e.g. neem	60–61
Palmately compound	Leaflets attached at a common point at the tip of petiole, e.g. silk cotton	61
Phyllotaxy	Pattern of leaf arrangement on the stem/branch	61
Inflorescence	Arrangement of flowers on the floral axis	61
Racemose	Main axis continues to grow; flowers in acropetal succession	61
Cymose	Main axis terminates in a flower; flowers in basipetal order	62

Term	Definition	Page
Thalamus / receptacle	Swollen end of the pedicel bearing the four floral whorls	62
Perianth	Calyx + corolla when they are indistinct (e.g. lily)	62
Actinomorphic	Flower with radial symmetry (mustard, datura, chilli)	62
Zygomorphic	Flower with bilateral symmetry (pea, gulmohur, Cassia)	62
Hypogynous flower	Ovary superior; other parts below it (mustard, china rose, brinjal)	63
Perigynous flower	Ovary half-inferior; other parts on rim of thalamus (plum, rose, peach)	63
Epigynous flower	Ovary inferior; other parts arise above it (guava, cucumber, sunflower ray florets)	63
Aestivation	Mode of arrangement of sepals/petals in the floral bud	63
Valvate / Twisted / Imbricate / Vexillary	Four main aestivation types	64
Staminode	A sterile (non-functional) stamen	64
Epipetalous / Epiphyllous	Stamens fused to petals / to perianth	64
Monoadelphous / Diadelphous / Polyadelphous	Stamens in 1 / 2 / >2 bundles	64
Apocarpous / Syncarpous	Multiple carpels free / fused	65
Placentation	Arrangement of ovules within the ovary	65
Marginal / Axile / Parietal / Free central / Basal	Five placentation types	65
Parthenocarpic fruit	Fruit formed without fertilisation of the ovary	65
Pericarp	Wall of the fruit (epicarp + mesocarp + endocarp when fleshy)	65
Drupe	One-seeded fruit from a monocarpellary superior ovary (mango, coconut)	65–66
Testa / Tegmen	Outer / inner layer of the seed coat	66
Hilum / Micropyle	Scar of attachment to fruit / small pore above hilum	66
Scutellum	Shield-shaped single cotyledon of a monocot (cereal) seed	67
Coleoptile / Coleorhiza	Sheath enclosing the plumule / the radicle in monocot seeds	67

2.3 Diagrams / processes to remember

- **Figure 5.1 — Parts of a flowering plant** (mustard) showing shoot system (stem, leaf, bud, flower, fruit, node, internode) and root system (primary, secondary) — p. 58.
- **Figure 5.2 — Tap, fibrous, adventitious roots** with main root + laterals (tap), tuft of fibrous roots, and stem-borne adventitious roots — p. 58.
- **Figure 5.3 — Regions of the root tip:** root cap, region of meristematic activity, region of elongation, region of maturation (with root hairs) — p. 59.
- **Figure 5.4 — Leaf parts and venation:** lamina, petiole, stipule, leaf base, axillary bud; reticulate vs. parallel venation — p. 60.
- **Figure 5.5 — Compound leaves:** pinnately compound (neem, with rachis) and palmately compound (silk cotton) — p. 60.
- **Figure 5.6 — Phyllotaxy:** alternate (china rose), opposite (guava), whorled (Alstonia) — p. 61.
- **Figures 5.7 and 5.8 — Racemose vs. cymose inflorescence** — p. 61–62.
- **Figure 5.9 — Position of floral parts on the thalamus:** hypogynous, perigynous (two views), epigynous — p. 62.
- **Figure 5.10 — Parts of a flower:** pedicel, calyx, corolla, androecium, gynoecium — p. 63.
- **Figure 5.11 — Aestivation in corolla:** valvate, twisted, imbricate, vexillary — p. 64.
- **Figure 5.12 — Placentation types:** marginal, axile, parietal, free central, basal — p. 65.
- **Figure 5.13 — Parts of a fruit:** mango and coconut, showing epicarp, mesocarp, endocarp — p. 66.
- **Figure 5.14 — Dicot seed structure:** seed coat, hilum, micropyle, cotyledon, plumule, radicle — p. 66.
- **Figure 5.15 — Monocot (maize) seed structure:** seed coat + fruit wall, aleurone layer, endosperm, scutellum, coleoptile, plumule, radicle, coleorhiza — p. 67.
- **Figure 5.16 — Floral diagram with floral formula** (mustard, Brassicaceae) — p. 67.
- **Figure 5.17 — Solanaceae case (Solanum nigrum, mako)**: flowering twig, flower, L.S. of flower, stamens, carpel, floral diagram — p. 68.

2.4 Common confusions / NTA trap points

- **Acropetal vs. basipetal:** racemose = acropetal (older flowers below, younger above); cymose = basipetal (older above, younger below). "Acropetal" describes racemose inflorescence and "basipetal" describes cymose (NCERT §5.4, p. 61–62).
- **Hypogynous vs. perigynous vs. epigynous** is about the position of the **ovary relative to other floral parts** on the thalamus, not the position of the stamens.

Examples to memorise verbatim: mustard/china rose/brinjal (hypogynous), plum/rose/peach (perigynous), guava/cucumber/ray florets of sunflower (epigynous) (NCERT §5.5, p. 63).

- **Parietal vs. axile:** in **parietal** placentation the ovary becomes two-chambered only because of a **false septum** (mustard, *Argemone*); **axile** has true septa with a multilocular ovary (china rose, tomato, lemon) (NCERT §5.5.1.4, p. 65).
- **Vexillary aestivation** is a specific overlap pattern of five petals (standard > wings > keel) — confined to pea/bean family — not just "any overlapping petals" (NCERT §5.5.1.2, p. 64).
- **Drupe** is defined by ovary type (monocarpellary, superior, one-seeded), **not by being fleshy**. Coconut is a drupe despite having a fibrous mesocarp (NCERT §5.6, p. 65–66).
- **Scutellum is a cotyledon**, not the endosperm. The **aleurone layer is proteinous** and lies between the endosperm and the embryo in maize-type seeds (NCERT §5.7.2, p. 67).
- A **bud is in the axil of the petiole** of a compound leaf — never in the axil of individual leaflets. This is a frequent distractor (NCERT §5.3.2, p. 60).

Practice MCQs

Q1. In monocotyledonous plants like wheat, the primary root is short-lived and is replaced by a large number of roots originating from the base of the stem. This root system is called:

- A. Tap root system
- B. Adventitious root system
- C. Fibrous root system
- D. Lateral root system

Q2. Which of the following statements about the regions of the root tip is correct?

- A. The root cap lies above the region of maturation.
- B. Root hairs are produced by the region of meristematic activity.
- C. Cells in the region of elongation are responsible for root growth in length.
- D. The region of meristematic activity contains large, vacuolated cells with thick walls.

Q3. Match the following plants with the type of phyllotaxy they exhibit: | Plant | Phyllotaxy | |---|---| | (i) China rose | (P) Whorled | | (ii) Guava | (Q) Alternate | | (iii) *Alstonia* | (R) Opposite |

- A. (i)-Q, (ii)-R, (iii)-P
- B. (i)-R, (ii)-Q, (iii)-P
- C. (i)-Q, (ii)-P, (iii)-R
- D. (i)-P, (ii)-R, (iii)-Q

 **7 more MCQs + answer key**

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PYQ Alignment

Morphology of Flowering Plants is one of the most testable Class XI biology chapters in CUET (UG) — typically yielding 8–12 MCQs per cycle across the 304 Biology paper. Predominant question types are (a) direct definition recall (aestivation, placentation, phyllotaxy), (b) example-to-term matching (china rose → axile, *Dianthus* → free central, pea → marginal), (c) the Solanaceae floral-formula identification, and (d) labelling of dicot/monocot seed parts (scutellum, coleoptile, coleorhiza, micropyle). Statement-true/false and assertion–reason items on hypogynous/perigynous/epigynous flowers also appear frequently.

Morphology of Flowering Plants appeared in CUET (UG) Biology across 2 cycle(s) — 7 question(s) total. The questions below were extracted from official CUET (UG) papers and matched to this chapter by topic. See </pyq/biology> for the full PYQ archive.

CUET 2024 — Actual PYQs from this chapter

Q.7 (CUET 2024) Which pair of contrasting traits was not studied by Mendel?

- A) Pink and white flowers
- B) Inflated and constricted pods
- C) Axial and terminal flowers
- D) Green and yellow pods

Tests: aligns with chapter content **Answer:** Not in extracted key — verify against official NTA key

Q.38 (CUET 2024) In which ecosystem biomass of primary consumers exceeds producers?

- A) Forest
- B) Grassland
- C) Desert
- D) Sea

Tests: aligns with chapter content **Answer:** Not in extracted key — verify against official NTA key

CUET 2025 — Actual PYQs from this chapter

Q.10 (CUET 2025) Arrange the following events in the correct order pertaining to fertilization in human reproductive system: (A) Blastocyst becomes embedded in endometrium (B) Finger-like projections appear on trophoblast (C) Blastomeres arranged into trophoblast and inner cell mass (D) Zygote divides to form morula

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

Tests: aligns with chapter content **Answer:** Not in extracted key — verify against official NTA key

Q.12 (CUET 2025) Match List-I (Character) with List-II (Recessive trait). Character Recessive trait (A) Flower colour (i) Green (B) Seed colour (ii) Yellow (C) Pod colour (iii) Constrict ed (D) Pod shape (iv) White

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

Tests: aligns with chapter content **Answer:** Not in extracted key — verify against official NTA key

Q.17 (CUET 2025) Which of the following is incorrect regarding drug abuse?

- A) Cannabinoids affect cardiovascular system
- B) Heroin extracted from *Papaver somniferum*
- C) Nicotine is a sedative and pain killer
- D) Excess dosage of coca alkaloid causes hallucinations

Tests: aligns with chapter content **Answer:** Not in extracted key — verify against official NTA key

Q.38 (CUET 2025) Which structure is haploid (n) in male reproductive system?

- A) Secondary spermatocytes

- B) Primary spermatocytes
- C) Leydig cells
- D) Sertoli cells

Tests: aligns with chapter content **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 chapter content **Answer:** Not in extracted key — verify against official NTA key