CLASS 11 | BIOLOGY | NCERT SOLUTIONS

NCERT Solutions for Class 11 Biology Chapter 6: Anatomy of Flowering Plants – Free PDF Download

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Chapter 6, **Anatomy of Flowering Plants**, takes students inside the plant body to study its tissues and tissue systems in detail. It builds on the tissue basics from earlier classes and explains meristematic and permanent tissues, the epidermal, ground and vascular tissue systems, and how these are organised differently in dicotyledonous and monocotyledonous roots, stems and leaves, along with an introduction to secondary growth. These Class 11 Biology Chapter 6 solutions are also useful as quick revision notes before exams.

Exercises

Q1. Draw illustrations to bring out the anatomical difference between (a) monocot root and dicot root (b) monocot stem and dicot stem.

Since a hand-drawn diagram cannot be reproduced here, the anatomical differences that such a labelled diagram should bring out are summarised below.

(a) Monocot root vs Dicot root

Feature	Dicot Root	Monocot Root
Cortex	Comparatively narrow, made up of parenchymatous cells with a distinct, single-layered **endodermis** showing **casparian strips**	Wide cortex, also parenchymatous, with a prominent endodermis
Xylem bundles (protoxylem groups)	Few, usually **2 to 6** (diarch to hexarch)	Many, usually **more than six** (polyarch)
Pith	Small or absent	Large and well developed, occupying the centre
Conjunctive tissue (between xylem and phloem)	Parenchymatous initially, but some cells become meristematic later to form **vascular cambium**	Remains permanently parenchymatous; never forms cambium
Secondary growth	Present, due to formation of vascular cambium and cork cambium	Absent
Root system	Tap root system	Fibrous/adventitious root system

(b) Monocot stem vs Dicot stem

Feature	Dicot Stem	Monocot Stem
Hypodermis	Collenchymatous (living, provides mechanical flexibility)	Sclerenchymatous (dead, lignified, provides rigidity)
Ground tissue	Differentiated into cortex, endodermis, pericycle, medullary rays and pith	Not differentiated into cortex and pith; a single continuous mass of parenchyma called ground tissue
Vascular bundles	Limited in number, arranged in a **single ring**; conjoint, collateral and **open** (cambium present between xylem and phloem)	Numerous, **scattered** throughout the ground tissue; conjoint, collateral and **closed** (no cambium)
Bundle sheath	Absent	Each vascular bundle is surrounded by a **sclerenchymatous bundle sheath**

Phloem parenchyma	Present	Absent
Xylem vessels	Usually arranged in a "Y" shape with distinct protoxylem and metaxylem	Arranged with a large, water-storing cavity near the protoxylem end
Secondary growth	Present (vascular cambium and cork cambium become active)	Absent

Q2. Cut a transverse section of the young stem of a plant from your school garden and observe it under the microscope. How would you ascertain whether it is a monocot stem or a dicot stem? Give reasons.

The identity of the stem can be established from the arrangement and structure of its **vascular bundles** and ground tissue. If the section shows vascular bundles arranged in a **single ring**, each being conjoint, collateral and **open** (with a strip of cambium between xylem and phloem), and the ground tissue clearly differentiated into hypodermis (collenchyma), cortex, endodermis, pericycle and a central pith, the stem is a **dicot stem**. If instead the vascular bundles are numerous and **scattered** throughout an undifferentiated ground tissue, each bundle is conjoint, collateral and **closed**, surrounded by a sclerenchymatous bundle sheath, the hypodermis is sclerenchymatous, and the xylem vessels are arranged in a Y-shaped pattern with a large water cavity, the stem is a **monocot stem**. The single most reliable feature to check first is whether the vascular bundles are ringed (dicot) or scattered (monocot).

Q3. The transverse section of a plant material shows the following anatomical features – (a) the vascular bundles are conjoint, scattered and surrounded by a sclerenchymatous bundle sheath, (b) phloem parenchyma is absent. What will you identify it as?

This section should be identified as a **monocot stem**. Scattered vascular bundles enclosed by a sclerenchymatous bundle sheath and the absence of phloem parenchyma are diagnostic features found only in the stems of monocotyledonous plants; dicot stems have ringed, open vascular bundles without a sclerenchymatous bundle sheath, and phloem parenchyma is present in them.

Q4. What is stomatal apparatus? Explain the structure of stomata with a labelled diagram.

The **stomatal apparatus** refers to the stomatal pore together with the two surrounding **guard cells** and the adjacent epidermal cells, called **subsidiary cells**, which are often structurally modified. Stomata occur mainly in the epidermis of leaves and regulate **transpiration** and **gaseous exchange**.

Each stoma is bordered by two bean-shaped (kidney-shaped in dicots; dumb-bell shaped in many grasses/monocots) guard cells. The wall of the guard cell facing the pore (inner wall) is thick and rigid, while the wall away from the pore (outer wall) is thin and elastic. Guard cells are the only epidermal cells that contain **chloroplasts**. Changes in the turgor pressure of guard cells, caused by the inflow or outflow of water, alter their shape and thereby open or close the stomatal pore. When guard cells are turgid, the thin outer walls bulge out, forcing the thick inner walls apart and opening the pore; when they lose turgor, the pore closes. Subsidiary cells support the guard cells mechanically and help control this movement.

Q5. Name the three basic tissue systems in flowering plants. Give the tissue names under each system.

The three basic tissue systems in flowering plants, first described by Sachs, are:

1. Epidermal tissue system – comprises the epidermis (a single continuous outer layer, usually covered by a cuticle), stomata, and epidermal appendages such as trichomes (on the stem) and root hairs.

2. Ground tissue system – includes all tissue except the epidermis and vascular bundles: the simple tissues **parenchyma**, **collenchyma** and **sclerenchyma**. In roots and stems this forms the cortex, endodermis, pericycle, pith and medullary rays; in leaves it forms the **mesophyll**.

3. Vascular tissue system – consists of the complex tissues **xylem** (tracheids, vessels, xylem fibres, xylem parenchyma) and **phloem** (sieve tube elements, companion cells, phloem fibres, phloem parenchyma), organised into vascular bundles.

Q6. How is the study of plant anatomy useful to us?

Plant anatomy, the study of the internal structure of plants, has several practical and academic applications:

It helps in understanding the **structural adaptations** plants develop in response to different climatic and habitat conditions (for example, xerophytic or hydrophytic modifications). It is used to **distinguish monocots, dicots and gymnosperms** on the basis of internal structure, which is valuable in plant classification and solving taxonomic problems. It assists in judging the **quality and strength of wood and commercial fibres** (such as jute and flax), helping identify superior versus substandard timber for industrial use. It also supports **pharmacognosy** — establishing the correct identity and purity of plant-derived drug material — and helps trace evolutionary relationships (homology and analogy) among plant groups.

Q7. Describe the internal structure of a dorsiventral leaf with the help of a labelled diagram.

A dorsiventral (bifacial) leaf, typical of dicotyledons, is oriented horizontally and shows structural differences between its upper and lower surfaces. In transverse section it shows the following layers:

Upper (adaxial) epidermis – a single outer layer of parenchymatous cells covered by a cuticle that reduces water loss; it is generally without chloroplasts and has few or no stomata.

Lower (abaxial) epidermis – similar in structure to the upper epidermis, but it bears a greater number of **stomata**, through which most gaseous exchange and transpiration occur.

Mesophyll – the ground tissue between the two epidermal layers, made of thin-walled, chloroplast-containing parenchyma, differentiated into two zones: (i) **palisade parenchyma** — tall, columnar cells arranged compactly (usually in one to three rows) just beneath the upper epidermis, containing most of the chloroplasts and carrying out the bulk of photosynthesis; and (ii) **spongy parenchyma** — rounded or oval, loosely arranged cells with large intercellular spaces, located towards the lower epidermis, which facilitate gaseous exchange.

Vascular bundles – found within the mesophyll, running through the veins; each is **conjoint, collateral and closed**, with xylem oriented towards the upper epidermis and phloem towards the lower epidermis, and is surrounded by a parenchymatous bundle sheath. The vascular bundle in the midrib region is the largest.

Class 11 Biology Chapter 6 – Notes and Extra Questions

The current (2023 rationalised) NCERT exercise for this chapter has been trimmed down to just **7 questions**, focused mainly on the anatomical comparison of monocot and dicot organs, stomatal structure, the three tissue systems, and dorsiventral leaf anatomy. Five questions that appeared in the older, pre-2023 edition — on the location/function of meristems, the statement that cork cambium forms the cork, a full schematic explanation of secondary growth in woody stems, why xylem and phloem are called complex tissues, and periderm formation — have been officially dropped along with large parts of the “Meristematic Tissues” and “Secondary Growth” sections of the chapter text (including vascular cambium activity, spring/autumn wood, heartwood/sapwood, cork cambium and secondary growth in roots). While these dropped topics are no longer examined directly through the textbook exercise, students should still know the terms *parenchyma*, *collenchyma*, *sclerenchyma*, *casparian strips*, *bulliform cells* and the basic idea of secondary growth, since they are frequently tested in school unit tests, board pre-boards and competitive exams such as NEET even when not part of the current CBSE textbook exercise.

What is the difference between simple and complex tissues in plants?

Simple tissues (parenchyma, collenchyma, sclerenchyma) are made up of only one type of cell that is structurally and functionally similar throughout. **Complex tissues** (xylem and phloem) are made up of more than one type of cell that work together as a single functional unit — for example, xylem includes tracheids, vessels, xylem fibres and xylem parenchyma, all cooperating in water conduction, while phloem includes sieve tube elements, companion cells, phloem fibres and phloem parenchyma, cooperating in food transport.

Why does a dicot stem show secondary growth while a monocot stem generally does not?

Secondary growth occurs because of lateral meristems — the **vascular cambium** and **cork cambium**. Dicot stems have **open** vascular bundles, meaning a strip of cambium is already present between the xylem and phloem; this fascicular cambium connects with interfascicular cambium (formed from medullary ray cells) to form a complete ring capable of adding secondary xylem and phloem. Monocot stems have **closed** vascular bundles with no cambium between the xylem and phloem, so they lack the meristematic tissue needed to increase in girth, and therefore almost never show secondary growth.

What are casparian strips and where are they found?

Casparian strips are band-like thickenings of suberin (a waxy, waterproofing substance) deposited on the radial and transverse walls of the **endodermal cells** that surround the vascular cylinder of a root. They force water and dissolved minerals travelling through the cell walls (the apoplast pathway) to enter the endodermal cell membrane and cytoplasm (the symplast pathway) before reaching the xylem, giving the plant control over which substances are absorbed into the vascular tissue.

What are bulliform cells and what is their function in monocot leaves?

Bulliform cells are large, empty, thin-walled, colourless cells found on the upper (adaxial) epidermis of many monocot leaves, especially grasses, usually occurring in groups along the veins. When water is plentiful, they remain turgid and the leaf stays flat and expanded. During water stress, they lose turgor and shrink, causing the leaf to roll or fold inward, which reduces the exposed surface area and minimises water loss through transpiration.