Anatomy of Flowering Plants - NCERT Exercise Answer Key

Chapter 6 - Class XI Biology

EXAMSPRINT | Answer Key | Anatomy of Flowering Plants | NCERT Exercises

1. Draw illustrations to... and Dicot stem

Answer:

A. Monocot Root vs. Dicot Root:

Monocot Root features:

- **Epidermis:** With root hairs for absorption
- **Cortex:** Multiple layers of parenchyma
- **Endodermis:** With Casparian strips
- **Pericycle:** Single layer, gives rise to lateral roots
- **Vascular bundles:** Polyarch (6 or more xylem bundles)
- **Pith:** Large and well-developed
- **Xylem:** Exarch arrangement (protoxylem towards periphery)

Dicot Root features:

- **Epidermis:** Similar structure with root hairs
- **Cortex:** Parenchymatous layers
- **Endodermis:** With Casparian strips

- **Pericycle:** Gives rise to lateral roots and cambium
- **Vascular bundles:** 2-6 xylem bundles (diarch to hexarch)
- **Pith:** Small or absent
- **Secondary growth:** Present due to cambium formation

Key differences:

- Number of xylem bundles (polyarch vs. limited)
- Pith development (large vs. small/absent)
- Secondary growth (absent vs. present)

B. Monocot Stem vs. Dicot Stem:

Monocot Stem features:

- **Epidermis:** Single layer with cuticle
- **Hypodermis:** Sclerenchymatous (provides mechanical support)
- **Ground tissue:** Undifferentiated parenchyma throughout
- **Vascular bundles:** Scattered, conjoint, collateral, closed
- **Bundle sheath:** Sclerenchymatous around each bundle
- **No cambium:** No secondary growth

Dicot Stem features:

- **Epidermis:** Single layer with cuticle and stomata
- **Cortex:** Three zones - hypodermis (collenchyma), general cortex, endodermis
- **Pericycle:** Patches of sclerenchyma
- **Vascular bundles:** Arranged in ring, conjoint, collateral, open
- **Cambium:** Present between xylem and phloem

- **Pith:** Central parenchymatous region
- **Secondary growth:** Occurs due to cambial activity

Key differences:

- Bundle arrangement (scattered vs. ring)
- Hypodermis type (sclerenchymatous vs. collenchymatous)
- Cambium presence (absent vs. present)
- Ground tissue organization (uniform vs. differentiated)

---

2. Cut a transverse... Give reasons.

Answer:

Identification criteria for Monocot vs. Dicot stem:

For Monocot stem identification:

- **Scattered vascular bundles:** Throughout the ground tissue
- **Closed vascular bundles:** No cambium between xylem and phloem
- **Sclerenchymatous hypodermis:** Below epidermis
- **Uniform ground tissue:** No distinction between cortex and pith
- **Bundle sheath:** Sclerenchymatous covering around each vascular bundle

For Dicot stem identification:

- **Ring arrangement:** Vascular bundles in a circular pattern
- **Open vascular bundles:** Cambium present between xylem and phloem
- **Collenchymatous hypodermis:** Below epidermis

- **Differentiated regions:** Distinct cortex, pericycle, and pith
- **Medullary rays:** Parenchymatous tissue between vascular bundles

Observation procedure:

1. **Low magnification:** Observe overall organization
2. **Bundle arrangement:** Note scattered vs. ring pattern
3. **High magnification:** Look for cambium presence
4. **Tissue identification:** Check hypodermis type

Reasons for identification:

- **Evolutionary difference:** Reflects monocot vs. dicot classification
- **Growth pattern:** Related to presence/absence of secondary growth
- **Mechanical support:** Different strategies for structural support
- **Functional adaptation:** Suited to different plant architectures

---

3. The transverse section... identify it as?

Answer:

Identification: Monocot stem

Analysis of given features:

A. Conjoint, scattered vascular bundles with sclerenchymatous bundle sheaths:

- **Conjoint:** Xylem and phloem together in same bundle
- **Scattered:** Distributed throughout ground tissue (characteristic of monocots)
- **Bundle sheaths:** Sclerenchymatous covering provides mechanical support

- **Arrangement:** No ring formation (rules out dicot stem)

B. Phloem parenchyma absent:

- **Monocot characteristic:** Phloem parenchyma is typically absent in monocot stems
- **Dicot difference:** Dicot stems usually have phloem parenchyma
- **Functional implication:** Different organization of phloem tissue

Supporting evidence for monocot stem:

- **Ground tissue:** Likely undifferentiated (no cortex-pith distinction)
- **No cambium:** Closed vascular bundles indicate no secondary growth
- **Hypodermis:** Probably sclerenchymatous
- **Bundle distribution:** Peripheral bundles smaller than central ones

Why not other plant parts:

- **Not root:** Vascular bundles are conjoint (roots have radial arrangement)
- **Not dicot stem:** Bundle arrangement is scattered, not in ring
- **Not leaf:** Bundle organization and sclerenchymatous sheaths indicate stem

Conclusion: The described anatomy is characteristic of a **monocotyledonous stem**.

---

4. What is stomatal... labelled diagram.

Answer:

Stomatal Apparatus Definition: The **stomatal apparatus** is the complete functional unit consisting of stomatal pore, guard cells, and associated subsidiary cells that regulates gas exchange and transpiration.

Components of stomatal apparatus:

A. Stomatal Pore:

- **Structure:** Opening between guard cells
- **Function:** Pathway for gas exchange (CO_2 in, O_2 out)
- **Regulation:** Size controlled by guard cell turgor
- **Dimensions:** Variable (0.5-50 μm length)

B. Guard Cells:

- **Shape:** Bean-shaped (dicots) or dumbbell-shaped (monocots)
- **Wall structure:** Thin outer walls, thick inner walls
- **Chloroplasts:** Present (unlike other epidermal cells)
- **Function:** Control stomatal opening and closing

C. Subsidiary Cells:

- **Definition:** Specialized epidermal cells surrounding guard cells
- **Number:** Variable (2-6 or more)
- **Shape:** Often different from ordinary epidermal cells
- **Function:** Support guard cell movement

Mechanism of stomatal movement:

- **Opening:** Guard cells absorb water, become turgid
- **Closing:** Guard cells lose water, become flaccid
- **Factors:** Light, CO_2 concentration, temperature, humidity

Types based on subsidiary cell arrangement:

- **Anomocytic:** No subsidiary cells
- **Paracytic:** Two subsidiary cells parallel to guard cells
- **Anisocytic:** Three subsidiary cells of unequal size
- **Diacytic:** Two subsidiary cells perpendicular to guard cells

Functions:

- **Gas exchange:** CO_2 uptake for photosynthesis
- **Transpiration:** Water vapor loss regulation
- **Temperature regulation:** Cooling through transpiration
- **Pressure regulation:** Maintaining leaf turgor

---

5. Name the three... each system.

Answer:

Three Basic Tissue Systems in Flowering Plants:

A. Epidermal Tissue System: *Function:* Protection and regulation

Tissues included:

- **Epidermis:** Outer protective layer
- **Cuticle:** Waxy covering on epidermis
- **Stomatal apparatus:** Guard cells and subsidiary cells
- **Trichomes:** Epidermal hairs (unicellular or multicellular)
- **Root hairs:** Extensions of epidermal cells for absorption

B. Ground Tissue System: *Function:* Storage, support, and photosynthesis

Tissues included:

- **Parenchyma:** Living cells for storage and photosynthesis
- **Collenchyma:** Living cells with thickened corners for flexible support
- **Sclerenchyma:** Dead cells with lignified walls for rigid support
  - **Fibers:** Elongated sclerenchyma cells
  - **Sclereids:** Short, branched sclerenchyma cells

C. Vascular Tissue System: *Function:* Transport of water, minerals, and food

Tissues included:

- **Xylem:** Water and mineral transport
  - **Tracheids:** Elongated cells with tapered ends
  - **Vessels:** Shorter, wider cells with perforated end walls
  - **Xylem parenchyma:** Storage cells
  - **Xylem fibers:** Support cells
- **Phloem:** Food transport
  - **Sieve tubes:** Conducting elements
  - **Companion cells:** Associated with sieve tubes
  - **Phloem parenchyma:** Storage cells
  - **Phloem fibers:** Support cells
- **Cambium:** Meristematic tissue for secondary growth (when present)

Integration of systems:

- All three systems work together for plant function
- Systems are present in all plant organs (root, stem, leaf)

- Proportion and organization vary with organ function

---

6. How is the... useful to us?

Answer:

Practical applications of plant anatomy:

A. Taxonomic Identification:

- **Species identification:** Anatomical features help distinguish closely related species
- **Systematic classification:** Internal structures support phylogenetic relationships
- **Fossil studies:** Anatomical features preserved in fossils aid paleobotany
- **Biodiversity studies:** Understanding plant diversity and evolution

B. Agricultural Applications:

- **Crop improvement:** Understanding tissue organization for breeding programs
- **Disease diagnosis:** Anatomical changes indicate plant diseases
- **Quality assessment:** Internal structure relates to crop quality
- **Stress tolerance:** Anatomical adaptations to environmental stress

C. Forestry and Wood Science:

- **Wood identification:** Anatomical features distinguish different timber species
- **Wood quality:** Understanding xylem structure for industrial use
- **Growth analysis:** Annual ring studies for age and growth rate
- **Conservation:** Identifying rare and endangered plant species

D. Medical and Pharmaceutical:

- **Drug discovery:** Identifying plants with medicinal compounds
- **Quality control:** Ensuring authenticity of herbal medicines
- **Adulteration detection:** Preventing substitution of medicinal plants
- **Tissue culture:** Understanding cell organization for propagation

E. Environmental Studies:

- **Pollution monitoring:** Anatomical changes indicate environmental stress
- **Climate studies:** Plant anatomy reflects adaptation to climate
- **Ecological research:** Understanding plant-environment interactions
- **Conservation biology:** Assessing ecosystem health

F. Industrial Applications:

- **Fiber production:** Understanding fiber structure and quality
- **Paper industry:** Knowledge of wood anatomy for pulp production
- **Food industry:** Identifying plant materials in processed foods
- **Textile industry:** Plant fiber characteristics for textile production

G. Educational Value:

- **Teaching tool:** Understanding plant structure-function relationships
- **Research training:** Developing observational and analytical skills
- **Scientific literacy:** Basic knowledge for informed citizenship
- **Career preparation:** Foundation for botanical careers

---

7. Describe the internal... labelled diagrams.

Answer:

Internal Structure of Dorsiventral (Dicot) Leaf:

A. Upper Epidermis (Adaxial):

- **Structure:** Single layer of compactly arranged cells
- **Cuticle:** Thick waxy layer to reduce water loss
- **Stomata:** Few or absent (reduced transpiration)
- **Function:** Protection from excessive water loss and UV radiation

B. Lower Epidermis (Abaxial):

- **Structure:** Similar to upper epidermis
- **Cuticle:** Thinner than upper surface
- **Stomata:** Numerous (100-1000 per mm^2)
- **Guard cells:** Control gas exchange and transpiration

C. Mesophyll Tissue: *Primary photosynthetic region between upper and lower epidermis*

Palisade Mesophyll:

- **Location:** Below upper epidermis
- **Cell shape:** Elongated, columnar cells arranged vertically
- **Chloroplasts:** High density (30-40 per cell)
- **Arrangement:** 1-2 layers of tightly packed cells
- **Function:** Primary site of photosynthesis
- **Intercellular spaces:** Small, maximizing light capture

Spongy Mesophyll:

- **Location:** Below palisade mesophyll, above lower epidermis
- **Cell shape:** Oval to rounded, irregularly shaped
- **Arrangement:** Loosely packed with large intercellular spaces
- **Chloroplasts:** Moderate density (10-20 per cell)
- **Function:** Gas exchange and some photosynthesis
- **Air spaces:** 15-40% of tissue volume for gas circulation

D. Vascular System:

Vascular Bundles (Veins):

- **Arrangement:** Reticulate venation pattern
- **Types:** Midrib (largest), lateral veins, minor veins
- **Structure:** Conjoint, collateral, closed type
- **Xylem position:** Towards upper surface (adaxial)
- **Phloem position:** Towards lower surface (abaxial)

Bundle Sheath:

- **Composition:** Parenchymatous cells around small veins
- **Function:** Protection and support of vascular tissue
- **In larger veins:** May be sclerenchymatous
- **Characteristics:** Thick-walled, usually without chloroplasts

Midrib Structure:

- **Prominence:** Projects on both surfaces

- **Vascular tissue:** Large vascular bundle
- **Supporting tissue:** Collenchyma and sclerenchyma
- **Parenchyma:** Storage and support tissue

Functional Adaptations:

Light Capture Optimization:

- **Palisade cells:** Vertical arrangement maximizes light interception
- **Chloroplast positioning:** Along cell walls for optimal light capture
- **Cell shape:** Columnar form increases surface area

Gas Exchange Efficiency:

- **Stomatal distribution:** More on lower surface reduces water loss
- **Spongy mesophyll:** Large air spaces facilitate CO_2 diffusion
- **Internal surface area:** Extensive for gas exchange

Water Management:

- **Cuticle thickness:** Varies with environmental conditions
- **Stomatal control:** Regulates water loss
- **Vascular arrangement:** Efficient water and nutrient transport

Mechanical Support:

- **Bundle sheath:** Protects vascular tissue
- **Sclerenchyma:** In larger veins for structural support
- **Turgor pressure:** Maintains leaf shape and orientation

This organization represents the perfect balance between maximizing photosynthesis while minimizing water loss, making dorsiventral leaves highly efficient in terrestrial environments.

Additional Important Concepts

Key Tissue System Functions:

Epidermal System:

- Primary protection barrier
- Gas exchange regulation
- Water loss control
- Environmental interface

Ground System:

- Metabolic activities (photosynthesis, storage)
- Structural support (flexible and rigid)
- Space filling and organ shape
- Wound healing and regeneration

Vascular System:

- Long-distance transport
- Structural support
- Communication between organs
- Secondary growth (in dicots)

Anatomical Adaptations:

Environmental Factors:

- **Xerophytic:** Thick cuticle, sunken stomata, reduced leaf area
- **Hydrophytic:** Reduced cuticle, large air spaces, flexible support
- **Mesophytic:** Balanced features for moderate conditions

Functional Specializations:

- **Storage organs:** Enlarged parenchyma cells
- **Climbing plants:** Flexible support tissues
- **Aquatic plants:** Aerenchyma for buoyancy
- **Desert plants:** Water storage tissues

Comparative Anatomy Significance:

Evolutionary Relationships:

- Similar anatomy indicates common ancestry
- Anatomical diversity shows adaptive radiation
- Structural modifications reveal evolutionary trends

Taxonomic Importance:

- Anatomical characters supplement morphological data
- Internal structure often more stable than external features
- Useful for identifying fragmentary plant material
