

ðŸŒ± Tissues

Complete NCERT-Based Notes & 2026/2027 Examination

Explanation + Visuals + Reasoning + Competency Questions + MCQs

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1. What is a Tissue?

Short Explanation: A tissue is a group of similar cells that work together to perform a particular function. In multicellular organisms, tissues create **division of labour**.

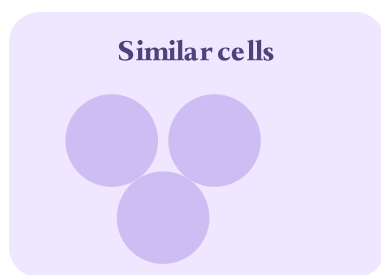
In a unicellular organism such as Amoeba, a single cell performs all essential life processes. In multicellular organisms such as plants and humans, millions of cells are present. Different cells become specialised for different jobs.

☞ Muscle cells → movement

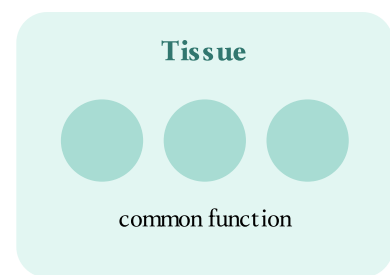
☞ Nerve cells → signals

☞ Epithelial cells → protection

☞ Blood → transport



→



Reasoning Question: Why is division of labour necessary in multicellular organisms?

Answer: Multicellular organisms contain many specialised cells. When different groups of cells perform different functions, each function can be carried out more efficiently.

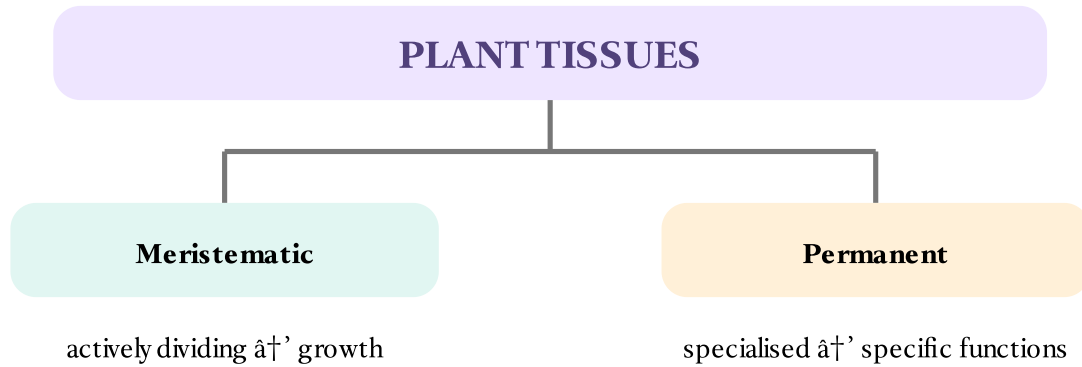
Think: Why does Amoeba not require tissues?

Answer: Amoeba is unicellular, so its single cell performs all the necessary life processes.

Exam Alert: Tissue = group of similar cells performing a specific function. Main advantage = **division of labour**.

2. Plant Tissues

Plant tissues are mainly divided into **meristematic tissues** and **permanent tissues**.



Q Reasoning: Why do plants need specialised tissues even though they cannot move from place to place?

Answer: Plants still need growth, support, protection, storage and transport. Specialised tissues perform these functions efficiently.

3. Meristematic Tissue

Short Explanation: Meristematic tissue consists of actively dividing cells and is responsible for plant growth.

Cell wall: thin

Cytoplasm: dense

Nucleus: prominent

Vacuoles: little/absent

Intercellular spaces: very little

Main function: cell division

Q Reasoning: Why are meristematic cells closely packed?

Answer: They are continuously dividing cells, so there is very little intercellular space between them.

Q Reasoning: Why do meristematic cells have little or no large vacuole?

Answer: Their main activity is cell division. Dense cytoplasm and a prominent nucleus occupy much of the cell, while large storage vacuoles are not a major requirement.

4. Types of Meristematic Tissue

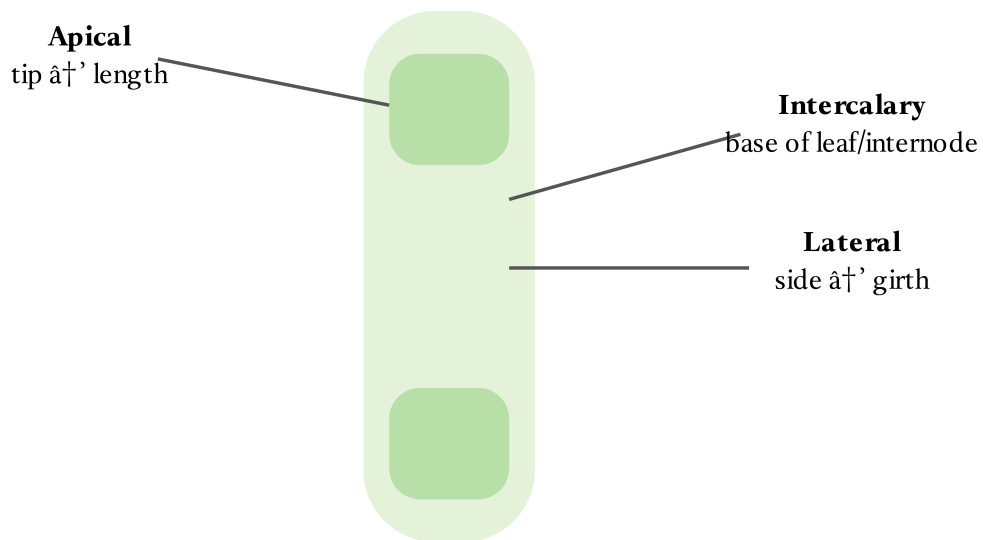


Diagram is a learning schematic, not a microscopic figure.

Type	Location	Main function
Apical	Tips of roots and shoots	Increase in length
Intercalary	Base of leaves / internodes	Growth of particular regions
Lateral	Sides of stems and roots	Increase in girth/thickness

Q Reasoning: A plant's height increases. Which meristem is mainly responsible?

Answer: Apical meristem, because it is present at the growing tips and increases length.

ðŸ§ Reasoning: A stem becomes thicker. Which meristem is responsible?

Answer: Lateral meristem, because it increases the girth of stems and roots.

ðŸ§ Reasoning: Why can grass regrow after being cut?

Answer: Intercalary meristematic regions can continue cell division and produce new growth.

5. Permanent Tissue

When meristematic cells stop dividing and become specialised for specific functions, they form **permanent tissues**. This process is called **differentiation**.

ðŸ§ Reasoning: Why are permanent tissues specialised?

Answer: Their cells differentiate and acquire structures suited to functions such as storage, support, protection or transport.

âŸ Important: Do not assume every permanent-tissue cell is dead. Many permanent tissues contain living cells.

6. Simple Permanent Tissues

Simple permanent tissues are mainly composed of one type of cell. The three important types are **parenchyma, collenchyma and sclerenchyma**.

☛ Parenchyma

Storage; photosynthesis when chloroplasts are present.

☛ Collenchyma

Support + flexibility.

☛ Sclerenchyma

Strength + rigidity.

Feature	Parenchyma	Collenchyma	Sclerenchyma
Cells	Living	Living	Dead at maturity
Wall	Thin	Unevenly thickened	Very thick, lignified
Intercellular spaces	Usually present	Very little	Usually absent
Main role	Storage/photosynthesis	Support + flexibility	Strength + rigidity

☞ **Reasoning:** Why is collenchyma suitable for a young bending stem?

Answer: It gives mechanical support while allowing flexibility, so the young stem can bend without easily breaking.

☞ **Reasoning:** Why is sclerenchyma rigid?

Answer: Its cells have very thick, lignified walls, giving high mechanical strength.

☞ **Reasoning:** Why is parenchyma suitable for storage?

Answer: Its living cells commonly have large vacuoles and are adapted for storing substances such as food and water.

Special Forms of Parenchyma

Chlorenchyma: parenchyma containing chloroplasts; helps photosynthesis.

Aerenchyma: parenchyma with large air spaces; helps buoyancy in aquatic plants.

ðŸ§ Reasoning: Why does aerenchyma help an aquatic plant float?

Answer: Its large air spaces provide buoyancy and lower the effective density of the tissue.

7. Complex Permanent Tissues

Complex permanent tissues contain different types of cells working together. The two major examples are **xylem** and **phloem**.

XYLEM

Water + minerals
mainly roots + aerial parts

Tracheids + vessels + parenchyma + fibres

PHLOEM

Food / sugars
source + sink

Sieve tubes + companion cells + parenchyma + fibres

ðŸ§ Reasoning: Why is xylem called a complex tissue?

Answer: It contains several different cell types that work together for conduction and support.

ðŸ§ Reasoning: Is phloem transport always downward?

Answer: No. Food is transported from a source to a sink, so its direction depends on where food is produced and where it is required.

â€ Memory: Xylem â†’ water and minerals. Phloem â†’ food.

8. Animal Tissues

Animal tissues are broadly classified into **epithelial, connective, muscular and nervous tissues**.

ðŸŸ¶ Epithelial

Covering and protection

ðŸ” — Connective

Binding, support, transport

ðŸ’^a Muscular

Movement

ðŸ§ Nervous

Control and coordination

ðŸ§ Reasoning: Why do animals need specialised muscular and nervous tissues?

Answer: Animals generally move and respond rapidly to their surroundings, so they need tissues for movement and fast communication.

9. Epithelial Tissue

Epithelial tissue forms the protective covering of the body and lines internal organs and cavities. Its cells are generally closely packed.

Type	Structure	Typical function/location
Squamous	Thin, flat cells	Diffusion/exchange; e.g. alveoli
Stratified squamous	Many layers	Protection; e.g. skin
Cuboidal	Cube-shaped	Absorption/secretion; e.g. kidney tubules
Columnar	Tall cells	Absorption/secretion; e.g. intestine
Ciliated	Cilia on surface	Moves material in a particular direction
Glandular	Secretory cells	Secretion of useful substances

ðŸ§ Reasoning: Why are alveoli lined by thin squamous epithelium?

Answer: Thin cells provide a short diffusion distance, allowing efficient exchange of oxygen and carbon dioxide.

ðŸ§ Reasoning: Why does skin need stratified squamous epithelium?

Answer: Skin faces friction and mechanical injury. Multiple layers provide better protection and durability.

ðŸ§ Reasoning: How do cilia help in the respiratory tract?

Answer: They help move mucus and trapped particles towards the throat, helping clear the air passages.

10. Connective Tissue

Connective tissue connects, supports, protects and transports. Its cells are generally embedded in an **intercellular matrix**.

Tissue	Main function	Key fact
Areolar	Fills spaces, supports, repair	Packing tissue
Adipose	Energy storage, insulation, cushioning	Stores fat
Tendon	Connects muscle to bone	Strong, relatively less flexible
Ligament	Connects bone to bone	Strong and flexible
Cartilage	Support, smooth joint surfaces	Firm but flexible
Bone	Support and protection	Hard mineral-rich matrix
Blood	Transport, defence, clotting	Fluid matrix: plasma

ðŸ§ Reasoning: Why is blood classified as connective tissue even though it is liquid?

Answer: Blood connects different body regions functionally by transporting substances. Its cells are suspended in a fluid matrix called plasma.

ðŸ§ Reasoning: Why is cartilage present at joints?

Answer: Cartilage provides smooth surfaces and helps reduce friction between bones during movement.

⚠ **Never confuse:** Tendon = **muscle** + **bone**. Ligament = **bone** + **bone**.

11. Muscular Tissue

Muscular tissue consists of specialised cells capable of contraction and relaxation, enabling movement.

Type	Control	Key feature	Example/location
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Striated	Voluntary	Light/dark bands	Attached to bones
Smooth	Involuntary	No visible striations	Alimentary canal, blood vessels
Cardiac	Involuntary	Rhythmic contraction	Heart

ðŸ§ Reasoning: Why are skeletal/striated muscles called voluntary muscles?

Answer: Their contraction can generally be controlled consciously, such as when moving an arm or leg.

ðŸ§ Reasoning: Why must cardiac muscle be involuntary?

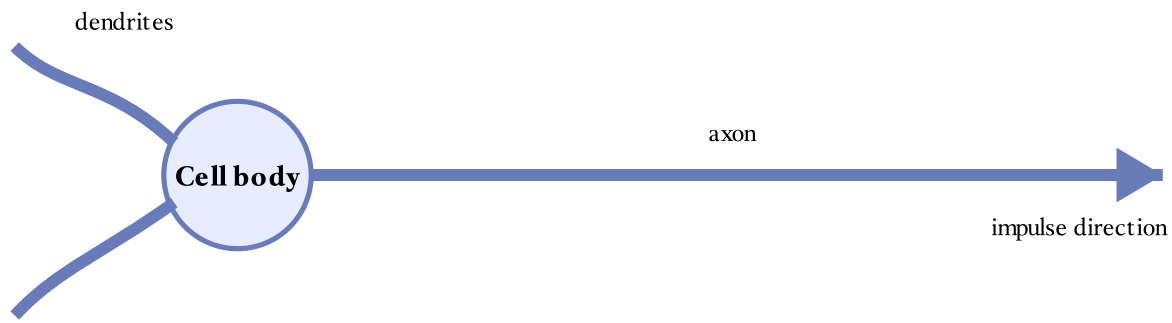
Answer: The heart must contract continuously throughout life without conscious attention.

ðŸ§ Reasoning: Why is smooth muscle suitable for the intestine?

Answer: Its involuntary contractions help move food through the digestive tract without conscious control.

12. Nervous Tissue

Nervous tissue receives stimuli and transmits electrical signals. Its main functional cells are **neurons**.



Reasoning: Why does a neuron have long extensions?

Answer: Long extensions allow neurons to receive signals and transmit them over relatively large distances.

13. Competency-Based Questions

Q1. A plant grows taller, but the stem does not initially become much thicker. Which tissue is mainly active?

Answer: Apical meristem. **Reason:** It increases length.

Q2. A young leaf stalk bends but does not easily break. Which tissue helps?

Answer: Collenchyma. **Reason:** It combines support with flexibility.

Q3. A tissue has dead cells with very thick lignified walls. Identify it.

Answer: Sclerenchyma. **Reason:** Thick lignified walls provide rigidity and strength.

Q4. A student says, "Food always travels downward through phloem." Is this correct?

Answer: No. Phloem transports food from source to sink, so direction depends on where food is produced and where it is needed.

Q5. Why would replacing the thin lining of an alveolus with a much thicker tissue reduce gas exchange?

Answer: A thicker barrier increases the diffusion distance, making gas exchange less efficient.

Q6. A joint needs a tissue that is supportive but somewhat flexible and reduces friction. Which tissue is appropriate?

Answer: Cartilage.

Q7. Why can damage to nervous tissue affect coordination?

Answer: Nervous tissue transmits information and helps coordinate body activities. Damage can interfere with signal transmission.

14. Assertionâ€™Reason Practice

Q1. Assertion: Meristematic cells have a high capacity for division.

Reason: Meristematic tissue is responsible for plant growth.

Answer: Both statements are true, and the Reason correctly explains the Assertion.

Q2. Assertion: Sclerenchyma provides rigidity.

Reason: Its cells generally have thick lignified walls.

Answer: Both statements are true, and the Reason correctly explains the Assertion.

Q3. Assertion: Blood is a connective tissue.

Reason: Blood has a fluid matrix called plasma and transports substances between body regions.

Answer: Both statements are true, and the Reason correctly explains the Assertion.

Q4. Assertion: Cardiac muscle is voluntary.

Reason: We can consciously decide when the heart should beat.

Answer: Both statements are false. Cardiac muscle is involuntary and the heartbeat is not under conscious control.

15. MCQs – Quick Test

1. Which tissue increases the length of a plant?

A. Lateral meristem B. Apical meristem C. Sclerenchyma D. Phloem

Answer: B

2. Which tissue provides flexibility in young plant parts?

A. Collenchyma B. Sclerenchyma C. Xylem D. Cork

Answer: A

3. Which tissue transports food?

A. Xylem B. Phloem C. Parenchyma D. Bone

Answer: B

4. Tendon connects:

A. bone to bone B. muscle to bone C. nerve to muscle D. skin to bone

Answer: B

5. Which is a fluid connective tissue?

A. Bone B. Cartilage C. Blood D. Tendon

Answer: C

6. Which tissue is present in the heart?

A. Smooth muscle B. Cardiac muscle C. Striated epithelial tissue D. Adipose tissue

Answer: B

7. Which epithelial tissue is best suited for diffusion?

A. Squamous B. Cuboidal C. Stratified D. Glandular

Answer: A

8. Which tissue stores fat?

A. Areolar B. Adipose C. Cartilage D. Nervous

Answer: B

16. 🏠 Final Revision Map

Apical ↑ length Lateral ↑ girth Intercalary ↑ regional growth

Parenchyma ↑ storage Collenchyma ↑ flexibility

Sclerenchyma ↑ strength

Xylem ↑ water + minerals Phloem ↑ food

Epithelium ↑ covering Connective ↑ support/transport

Muscular ↑ movement Nervous ↑ signals

Tendon ↑ muscle to bone Ligament ↑ bone to bone

Blood ↑ fluid connective tissue

🏠 10 Last-Minute Exam Traps

1. Apical = increase in length; lateral = increase in girth.
2. Intercalary meristem occurs near bases of leaves/internodes in suitable plants.

3. Parenchyma and collenchyma are living tissues; sclerenchyma cells are generally dead at maturity.
4. Collenchyma = support + flexibility; sclerenchyma = rigidity.
5. Xylem transports water and minerals; phloem transports food.
6. Phloem transport is not simply 'downward' ; it is source-to-sink.
7. Tendon = muscle to bone; ligament = bone to bone.
8. Blood is connective tissue because it has cells in a fluid matrix and performs transport.
9. Cardiac muscle is involuntary and rhythmic.
10. Thin squamous epithelium is suited for rapid diffusion, such as in alveoli.

How to Study This Chapter

First learn the **function**, then connect it with the **structure**. In reasoning questions, always ask: 'How does this structure help the tissue perform its function?'

This is an NCERT-focused learning resource. For the 2027 examination, also follow the exact syllabus and textbook edition prescribed by your school/board.

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