
BIOLOGY

Tissues

Levels of Organisation

Cell
- A cell is the basic structural and functional unit of a living organism. Example: Nerve cell

Tissue
- A tissue is a group of cells having a common origin, similar structure and function and held together by a cementing substance. Example: Connective tissue

Organ
- Different types of tissues working together and contributing to specific functions inside the body constitute an organ. Example: Stomach

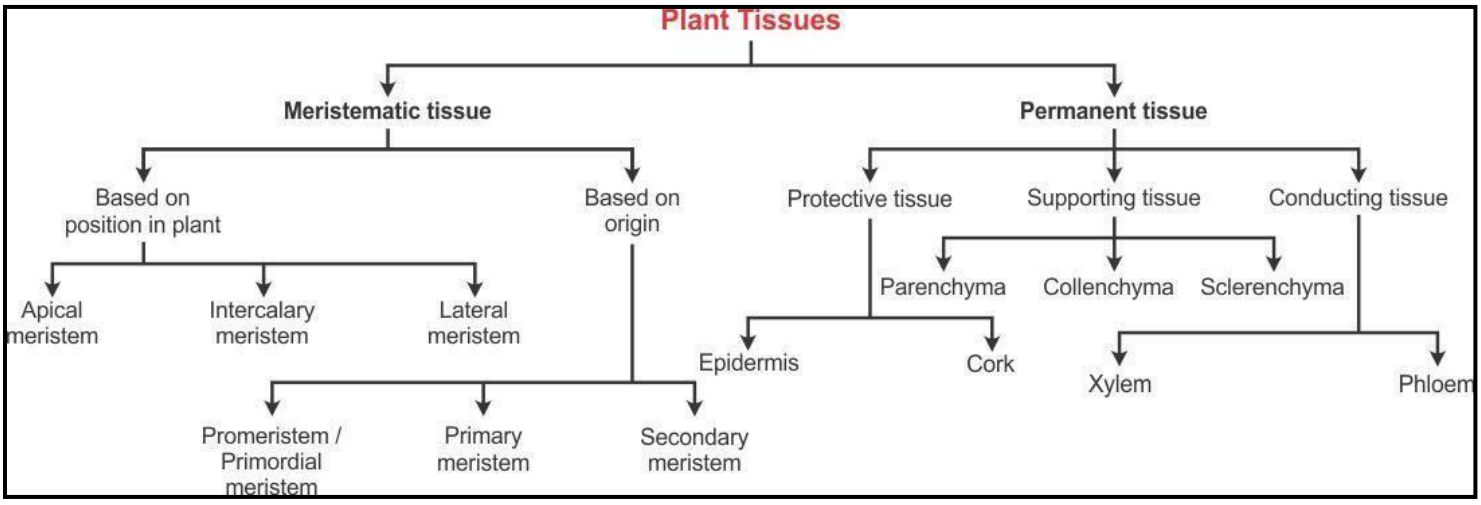
Organ system
- Different organs coordinate to perform a specific life process and form an organ system. Example: Digestive system

Organism
- Various organ systems working simultaneously together constitute an organism. Example: Plants

Differences between Plant and Animal Tissues

PLANT TISSUES	ANIMAL TISSUES
1. Dead supportive tissues are more abundant as compared to living tissues.	1. Living supportive tissues are more abundant as compared to dead tissues.
2. Require less maintenance energy.	2. Require more maintenance energy.
3. Differentiation of meristematic and permanent tissues.	3. No differentiation of meristematic and permanent tissues.
4. Organisation is simple.	4. Organisation is relatively complex.
5. Tissue organisation is meant for stationary habit of plants.	5. Tissue organisation is meant for high mobility of animals.

Classification of Plant Tissues



Meristematic Tissue

Characteristics	Location	Function
•Cells are thin-walled and composed of cellulose.	•Located at the tips of the roots and stems, and the base of the node, internode or leaf.	•The cells of meristematic tissue divide actively, which results in growth (increase in thickness and length) of plants.

Types of Meristematic Tissues

Type	Location	Function
Apical meristem	Located at the growing points of the stem, roots, branches and in growing young leaves near the tips of stems and axillary buds	Enables the root and stem to grow by increasing the length of plants
Intercalary meristem	Located at the internodes or stem regions between the places at which the leaves attach and at leaf bases	The cells are active and they continuously form several new cells
Lateral meristem/ Cambium	Present laterally (on the sides) on the roots and stem and is situated parallel to the longitudinal axis below the bark	The girth and width/diameter/thickness of the stem or root increases because of the lateral meristem

Permanent Tissues

- Permanent tissues are formed by the division of the meristematic tissue cells which have lost their ability to multiply.

Types of Permanent Tissues

Protective Tissue

- It is found on the surface of the roots, stems and leaves.
- It consists of cells with thick walls.
- It provides protection against mechanical injury or invasion by parasitic fungi.

Types of Protective Tissues			
Type	**Characteristics**	**Location**	**Function**
Epidermis	Cells are elongated and flattened with no intercellular spaces between them.	Present in the outermost layer of leaves, flowers, stem and roots.	Protects the plant from desiccation and infection.
Cork	Cells are rectangular with vacuolated protoplasts.	It is the outermost layer formed after the epidermis undergoes certain changes.	Prevents desiccation, infection and mechanical injury.

Supporting Tissue

- It provides support to the plant.

Types of Supporting Tissues			
Type	**Characteristics**	**Location**	**Function**
Parenchyma	Consists of relatively non-specialised large, thin-walled living cells	Mainly present in the soft parts of the plant and outer cortical region of roots and stems	Provides temporary support and maintains the shape of the plant body
Collenchyma	Cells are living and elongated with cell walls irregularly thickened at the corners	Located in non-woody plants, leaf stalks and below the epidermis of the stems and veins of leaves	Provides mechanical support and elasticity to young dicotyledonous plants
Sclerenchyma	Consists of elongated, narrow and fibre-like cells. Cells are dead, pointed at both ends and thickened	Located in the stems around the vascular bundle, veins of leaves and hard covering of seeds and nuts	Provides strength and toughness to plant parts

Conducting Tissue (Vascular Tissue)

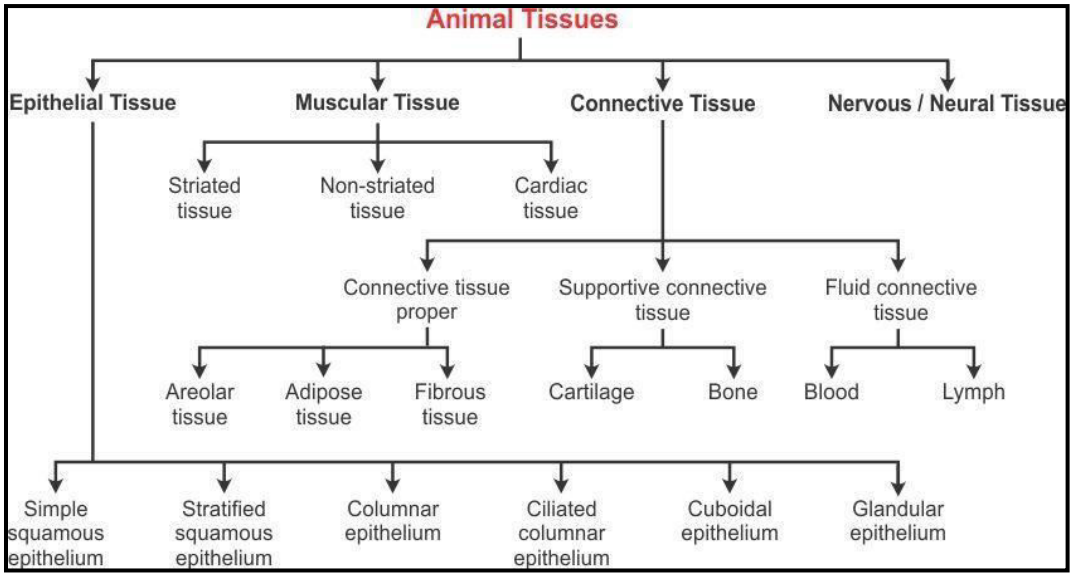
- It is present in stems, roots and leaves.
- It provides a passage for water and dissolved materials to move up and down in the plant body.

Types of Conducting Tissues			
Type	**Characteristics**	**Location**	**Function**
Xylem	Complex permanent tissue with thick-walled cells; most of the cells are dead	Present in the stem, roots and leaves	Provides upward movement of water and dissolved materials
Components of Xylem			
Tracheids	Made of elongated cells with flat and tapering ends	-	Provide a network of hollow and connected cells for the transport of water
Xylem vessels	Tubular structures which consist of dead cells	-	Allow free flow of water and minerals from the roots to the leaves
Xylem parenchyma	Consists of living parenchyma cells associated with xylem	-	Stores food in the plant body
Xylem fibres	Separated by thin cross walls	-	Mainly support the plant
Types of Conducting Tissues			
Type	**Characteristics**	**Location**	**Function**
Phloem	Complex permanent tissue	Lies just beneath the bark of the tree	Provides a passage for the downward movement of food
Components of Phloem			
Sieve tubes	Tubular cells with perforated walls and arranged end to end	-	Translocation of organic substances
Companion cells	Cells are living and keep their nuclei and other organelles throughout their life	-	Help to control the activity of sieve tube elements
Phloem fibres	Elongated, tapering and dead cells with thickened cell walls	Found particularly in the stem	Provide mechanical strength to plants
Phloem parenchyma	Cells are alive and filled with cytoplasm	-	Transports food from the leaves to the other non-green parts of the plants

Differences between Meristematic and Permanent Tissues

MERISTEMATIC TISSUE	PERMANENT TISSUE
1. Simple tissue	1. Simple, complex or specialised tissue
2. Component cells are small, spherical or polygonal and undifferentiated	2. Component cells are large, differentiated with different shapes
3. Intercellular spaces are absent	3. Intercellular spaces are present
4. Cells grow and divide regularly	4. Cells do not divide
5. Metabolically active	5. Metabolic rate is slow
6. Provides growth to the plant	6. Provides protection, support, conduction, photosynthesis, storage

Classification of Animal Tissues



Epithelial Tissue

Characteristics	Location	Function
•Flat, cuboidal or columnar cells	•Covers the whole body surface	•Protection, absorption, secretion, sensory perception

Types of Epithelial Tissues

Type	Characteristics	Location	Function
Simple squamous epithelium	Cells are large, extremely thin and flat	Lining of blood vessels, lung alveoli, oesophagus, the lining of the mouth and cheek	Transport of substances through a selectively permeable membrane
Stratified squamous epithelium	Cells are arranged in a pattern of layers	Outer protective covering all over the body surface	Provides protection to underlying tissues
Columnar epithelium	Cells are tall and cylindrical-like pillars	Inner lining of the stomach and intestines	Absorption of nutrients from the digested food
Ciliated columnar epithelium	Cells possess fine hair-like cilia	Inner lining of the trachea, lungs, respiratory system and buccal chambers	In the respiratory tract, the movement of cilia pushes the mucus forward to clear it
Cuboidal epithelium	Cells are cube-shaped and are placed on a basement membrane	Lining of the kidney tubules as well as in the ducts of the salivary glands	Helps in the absorption of useful material from urine before it is passed out
Glandular epithelium	Epithelial tissue which folds inwards to form a multicellular gland	Present in the stomach, intestine and pancreas	Synthesis and secretion of substances at the epithelial surface

Connective Tissue

Characteristics	Location	Function
•Consists of a matrix and the cells are embedded in it	•Found in the deeper parts of the body, between the skin and muscles	•Connects various organs and keeps them in place

Types of Connective Tissues

Connective Tissue Proper/Loose Connective Tissue

- It is composed of irregular cells scattered and embedded in a soft matrix and encompasses all internal organs and body cavities.
- It acts as a binding and supporting structure within the body.

Types of Connective Tissues Proper			
Type	**Characteristics**	**Location**	**Function**
Areolar tissue	Made of gelatinous matrix containing cells and irregularly arranged fibres	Found between the skin and muscles, around the blood vessels, nerves and in the bone marrow	Supports and strengthens the internal organs
Adipose tissue	Cells are filled with fat globules	Found beneath the skin, around the kidneys and other internal organs such as intestines	Insulates the body and prevents the loss of heat
Fibrous tissue	Mainly formed of fibre-forming cells, which form the tendons and ligaments	Found in the spaces between the bones and muscles	Tendons help to attach muscles to the bones. Ligaments serve to hold the structures together and keep them strong and stable

Supportive Connective Tissue/Dense Connective Tissue

- It is composed of fibres as its main matrix element and is found in bones and cartilages.
- It connects different tissues.

Types of Supportive Connective Tissues			
Type	**Characteristics**	**Location**	**Function**
Cartilage	Non-porous, semi-transparent and elastic tissue	Present in the nose, external ear, trachea, larynx, ends of the long bones and between the vertebrae	Smoothens the bone surface at joints, allowing smooth movement of these joints
Bone	Hard, strong and non-flexible porous tissue which consists of living cells	Forms a rigid part of the skeletal system	Forms the supporting framework of the body Gives shape and rigidity to the body

Fluid Connective Tissue

- It consists of liquid as the ground substance and is present throughout the body.
- It provides nutrition, helps in transport of nutrients and gets rid of waste matter.

Types of Fluid Connective Tissues			
Type	**Characteristics**	**Location**	**Function**
Blood	Red-coloured fluid matrix which consists of plasma and cells such as RBCs, WBCs and platelets	Present throughout the body	Connects different parts of the body and establishes continuity within the body
Lymph	Fluid surrounding the body cells which contains WBCs	Present throughout the body	Transports nutrients and provides protection against diseases

Muscle Tissue

Characteristics	Location	Function
•Consists of elongated, narrow, muscle cells called muscle fibres	•Mostly attached to the bones	•Helps in contraction and relaxation of the body

Types of Muscle Tissues

Type	Characteristics	Location	Function
Striated/skeletal/ striped/voluntary muscles	Muscle fibres are long, cylindrical, unbranched and multinucleate	Found attached to the bones	Help in voluntary muscle movement and locomotion
Non-striated/ smooth/non-striped/ involuntary muscles	Muscle fibres are smooth and without striations	Found in the uterus, digestive tract, urinary bladder, iris of the eye, bronchi of the lungs and other internal organs	Carry out movements which cannot be carried out by our conscious will
Cardiac/heart muscles	Muscle cells are short, cylindrical and have a single, centrally placed nucleus	Found only in the walls of the heart	Rhythmic contraction and relaxation of cardiac muscles help to pump and distribute the blood to various parts of the body

Differences between Smooth, Skeletal and Cardiac Muscles

SMOOTH MUSCLE	SKELETAL MUSCLE	CARDIAC MUSCLE
1. Not striated	1. Striated	1. Striated
2. Spindle-shaped	2. Cylindrical	2. Cylindrical
3. Not branched	3. Not branched	3. Branched
4. Nucleus - central	4. Nuclei - peripheral	4. Nuclei - central
5. No discs	5. No discs	5. Intercalated discs
6. Involuntary	6. Voluntary	6. Involuntary
7. Slow	7. Fast	7. Fast
8. Contraction not inherent	8. Contraction not inherent	8. Contraction inherent

Nervous/Neural Tissue

Characteristics	Location	Function
• Made up of elongated cells called neurons • Each neuron consists of three parts—cell body, axon and dendrites	• Component of the nervous system and encompasses the brain, spinal cord and nerves	• Nerve cells mediate the transmission of messages from the brain to different parts of the body and vice versa