- In multi-cellular organisms there are millions of cells. Most of these cells are specialised to carry out a few functions. Each specialised function is taken up by a different group of cells. Since these cells carry out only a particular function, they do it very efficiently.
- Multi-cellular organisms show division of labour. Cells specialising in one function are often grouped together in the body. This means that a particular function is carried out by a cluster of cells at a definite place in the body. This cluster of cells, called a tissue, is arranged and designed so as to give the highest possible efficiency of function.
- A group of cells that are similar in structure and/or work together to achieve a particular function forms a tissue.
- Plants are stationary or fixed – they don't move. Most of the tissues they have are supportive, which provides them with structural strength. Most of these tissues are dead, since dead cells can provide mechanical strength and need less maintenance.
- Animals on the other hand move around in search of food, mates and shelter. They consume more energy as compared to plants. Most of the tissues they contain are living.
- Another difference between animals and plants is in the pattern of growth. The growth in plants is limited to certain regions, while this is not so in animals.
- There are some tissues in plants that divide throughout their life. These tissues are localised in certain regions.
- Based on the dividing capacity of the tissues, various plant tissues can be classified as **growing or meristematic tissue** and **permanent tissue.**
- Cell growth in animals is more uniform. So, there is no such demarcation of dividing and non-dividing regions in animals.
- The structural organisation of organs and organ systems is far more specialised and localised in complex animals than even in very complex plants. This fundamental difference reflects the different modes of life pursued by these two major groups of organisms, particularly in their different feeding methods.

Plant Tissues

MERISTEMATIC TISSUE

- The growth of plants occurs only in certain specific regions. This is because the dividing tissue, also known as meristematic tissue, is located only at these points.
- Depending on the region where they are present, meristematic tissues are classified as apical, lateral and intercalary
- New cells produced by meristem are initially like those of meristem itself, but as they grow and mature, their characteristics slowly change and they become differentiated as components of other tissues.
- Apical meristem is present at the growing tips of stems and roots and increases the length of the stem and the root.

- The girth of the stem or root increases due to lateral meristem (cambium). Intercalary meristem is the meristem at the base of the leaves or internodes (on either side of the node) on twigs
- As the cells of this tissue are very active, they have dense cytoplasm, thin cellulose walls and prominent nuclei. They lack vacuoles.

PERMANENT TISSUE

- They take up a specific role and lose the ability to divide. As a result, they form a permanent tissue.
- This process of taking up a permanent shape, size, and a function is called differentiation.

SIMPLE PERMANENT TISSUE

- A few layers of cells form the basic packing tissue. This tissue is **parenchyma**, a type of permanent tissue.
- It consists of relatively unspecialised cells with thin cell walls. They are live cells. They are usually loosely packed, so that large spaces between cells (intercellular spaces) are found in this tissue.
- This tissue provides support to plants and also stores food. In some situations, it contains chlorophyll and performs photosynthesis, and then it is called **chlorenchyma.**
- In aquatic plants, large air cavities are present in parenchyma to give buoyancy to the plants to help them float. Such a parenchyma type is called **aerenchyma.**
- The parenchyma of stems and roots also stores nutrients and water
- The flexibility in plants is due to another permanent tissue, **collenchyma**.
- It allows easy bending in various parts of a plant (leaf, stem) without breaking.
- It also provides mechanical support to plants. This tissue is present in leaf stalks below the epidermis.
- The cells of this tissue are living, elongated and irregularly thickened at the corners. There is very little intercellular space
- **Sclerenchyma**: It is the tissue which makes the plant hard and stiff. The cells of this tissue are dead. They are long and narrow as the walls are thickened due to lignin (a chemical substance which acts as cement and hardens them). Often these walls are so thick that there is no internal space inside the cell
- This tissue is present in stems, around vascular bundles, in the veins of leaves and in the hard covering of seeds and nuts. It provides strength to the plant parts.
- **Epidermis**, outermost layer of cells. The epidermis is usually made of a single layer of cells.
- In some plants living in very dry habitats, the epidermis may be thicker since protection against water loss is critical.
- The entire surface of a plant has this outer covering of epidermis. It protects all the parts of the plant.
- Epidermal cells on the aerial parts of the plant often secrete a waxy, water-resistant layer on their outer surface. This aids in protection against loss of water, mechanical injury and

invasion by parasitic fungi. Since it has a protective role to play, cells of epidermal tissue form a continuous layer **without intercellular spaces**.

- Most epidermal cells are relatively flat. Often their outer and side walls are thicker than the inner wall.
- The pores in the epidermis of the leaf are called stomata . Stomata are enclosed by two kidney-shaped cells called guard cells. They are necessary for exchanging gases with the atmosphere.
- Transpiration (loss of water in the form of water vapour) also takes place through stomata.
- Epidermal cells of the roots, whose function is water absorption, commonly bear long hair-like parts that greatly increase the total absorptive surface area.
- In some plants like desert plants, epidermis has a thick waxy coating of cutin(chemical substance with waterproof quality) on its outer surface.
- As plants grow older, the outer protective tissue undergoes certain changes. A strip of secondary meristem replaces the epidermis of the stem. Cells on the outside are cut off from this layer. This forms the several-layer thick cork or the bark of the tree. Cells of cork are dead and compactly arranged without intercellular spaces. They also have a chemical called suberin in their walls that makes them impervious to gases and water.

COMPLEX PERMANENT TISSUE

- One type of cells, which look like each other. called simple permanent tissue.
- Complex tissues are made of more than one type of cells. All these cells coordinate to perform a common function.
- Xylem and phloem are examples of such complex tissues. They are both conducting tissues and constitute a vascular bundle.
- Vascular or conductive tissue is a distinctive feature of the complex plants, one that has made possible their survival in the terrestrial environment.
- Xylem consists of tracheids, vessels, xylem parenchyma and xylem fibres.
- The cells have thick walls, and many of them are dead cells.
- Tracheids and vessels are tubular structures. This allows them to transport water and minerals vertically.
- The parenchyma stores food and helps in the sideways conduction of water.
- Fibres are mainly supportive in function.
- Phloem is made up of four types of elements: sieve tubes, companion cells, phloem fibres and the phloem parenchyma
- Sieve tubes are tubular cells with perforated walls. Phloem is unlike xylem in that materials can move in both directions in it.
- Phloem transports food from leaves to other parts of the plant. Except for phloem fibres, phloem cells are living cells.

Animal Tissues

EPITHELIAL TISSUE

- The covering or protective tissues in the animal body are epithelial tissues.
- Epithelium covers most organs and cavities within the body. It also forms a barrier to keep different body systems separate.
- The skin, the lining of the mouth, the lining of blood vessels, lung alveoli and kidney tubules are all made of epithelial tissue.
- Epithelial tissue cells are tightly packed and form a continuous sheet. They have only a small amount of cementing material between them and almost no intercellular spaces.
- Anything entering or leaving the body must cross at least one layer of epithelium. As a result, the permeability of the cells of various epithelia play an important role in regulating the exchange of materials between the body and the external environment and also between different parts of the body.
- All epithelium is usually separated from the underlying tissue by an extracellular fibrous basement membrane.
- Different epithelia has differing structures that correlate with their unique functions.
- In cells lining blood vessels or lung alveoli, where transportation of substances occurs through a selectively permeable surface, there is a simple flat kind of epithelium. This is called the **simple squamous epithelium.**
- Simple squamous epithelial cells are extremely thin and flat and form a delicate lining. The oesophagus and the lining of the mouth are also covered with **squamous epithelium**.
- The skin, which protects the body, is also made of squamous epithelium.
- Skin epithelial cells are arranged in many layers to prevent wear and tear. Since they are arranged in a pattern of layers, the epithelium is called **stratified squamous epithelium**.
- Where absorption and secretion occur, as in the inner lining of the intestine, tall epithelial cells are present. This **columnar (meaning 'pillar-like') epithelium** facilitates movement across the epithelial barrier.
- In the respiratory tract, the columnar epithelial tissue also has cilia, which are hair-like projections on the outer surfaces of epithelial cells. These cilia can move, and their movement pushes the mucus forward to clear it. This type of epithelium is thus **ciliated columnar epithelium.**
- **Cuboidal epithelium** (with cube-shaped cells) forms the lining of kidney tubules and ducts of salivary glands, where it provides mechanical support.
- Epithelial cells often acquire additional specialisation as gland cells, which can secrete substances at the epithelial surface. Sometimes a portion of the epithelial tissue folds inward, and a multicellular gland is formed. This is **glandular epithelium.**

CONNECTIVE TISSUE

- The cells of connective tissue are loosely spaced and embedded in an intercellular matrix.
- The matrix may be jelly like, fluid, dense or rigid. The nature of matrix differs in concordance with the function of the particular connective tissue.

- Blood is a type of connective tissue. Blood has a fluid (liquid) matrix called plasma, in which red blood cells (RBCs), white blood cells (WBCs) and platelets are suspended. The plasma contains proteins, salts and hormones. Blood flows and transports gases, digested food, hormones and waste materials to different parts of the body.
- Bone is another example of a connective tissue. It forms the framework that supports the body. It also anchors the muscles and supports the main organs of the body. It is a strong and nonflexible tissue . Bone cells are embedded in a **hard matrix** that is composed of calcium and phosphorus compounds.
- Two bones can be connected to each other by another type of connective tissue called **the ligament.** This tissue is very elastic. It has considerable strength. Ligaments contain very little **matrix.**
- **Tendons** connect bones to muscles and are another type of connective tissue. Tendons are fibrous tissue with great strength but limited flexibility.
- Another type of connective tissue, **cartilage**, has widely spaced cells. The solid matrix is composed of proteins and sugars. Cartilage smoothens bone surfaces at joints and is also present in the nose, ear, trachea and larynx.
- **Areolar connective tissue** is found between the skin and muscles, around blood vessels and nerves and in the bone marrow. It fills the space inside the organs, supports internal organs and helps in repair of tissues.
- Fat storing **adipose tissue** is found below the skin and between internal organs. The cells of this tissue are filled with fat globules. Storage of fats also lets it act as an insulator.

MUSCULAR TISSUE

- **Muscular tissue** consists of elongated cells, also called **muscle fibres**. This tissue is responsible for movement in our body.
- Muscles contain special proteins called contractile proteins, which contract and relax to cause movement.
- Muscle that is under the control of the will are called **voluntary muscles**. These muscles are also called skeletal muscles as they are mostly attached to bones and help in body movement. , these muscles show alternate light and dark bands or striations when stained appropriately. As a result, they are also called **striated muscles**.
- The cells of this tissue are long, cylindrical, unbranched and multinucleate (having many nuclei).
- The movement of food in the alimentary canal or the contraction and relaxation of blood vessels are involuntary movements. Smooth muscles or involuntary muscles control such movements. They are also found in the iris of the eye, in ureters and in the bronchi of the lungs. The cells are long with pointed ends (spindle-shaped) and uninucleate (having a single nucleus). They are also called unstriated muscles.
- The muscles of the heart show rhythmic contraction and relaxation throughout life. These involuntary muscles are called **cardiac muscles**. Heart muscle cells are cylindrical, branched and uninucleate.

NERVOUS TISSUE

- All cells possess the ability to respond to stimuli. Cells of the nervous tissue are highly specialised for being stimulated and then transmitting the stimulus very rapidly from one place to another within the body.
- The brain, spinal cord and nerves are all composed of the nervous tissue. The cells of this tissue are called nerve cells or neurons.
- A neuron consists of a cell body with a nucleus and cytoplasm, from which long thin hair-like parts arise. Neuron has a single long part, called the axon, and many short, branched parts called dendrites.
- An individual nerve cell may be up to a metre long. Many nerve fibres bound together by connective tissue make up. The functional combination of nerve and muscle tissue is fundamental to most animals. This combination enables animals to move rapidly in response to stimuli.