

Unit II CH 7. STRUCTURAL ORGANISATION IN ANIMALS

MODULE: ¼

ANIMAL TISSUES

- In unicellular organisms, all functions like digestion, respiration and reproduction are performed by a single cell.
- In the complex body of multicellular animals the same basic functions are carried out by different groups of cells in a well organised manner.
- The body of a simple organism like *Hydra* is made of different types of cells and the number of cells in each type can be in thousands.
- The human body is composed of billions of cells to perform various functions.
- In multicellular animals, a group of similar cells along with intercellular substances perform a specific function. Such an organisation is called **tissue**.

- All complex animals consist of only four basic types of tissues. These tissues are organised in specific proportion and pattern to form an organ like stomach, lung, heart and kidney.
- When two or more organs perform a common function by their physical and/or chemical interaction, they together form organ system, e.g., digestive system, respiratory system, etc. Cells, tissues, organs and organ systems split up the work in a way that exhibits division of labour and contribute to the survival of the body as a whole.

7.1 ANIMAL TISSUES

- The structure of the cells varies according to their function.
- Therefore, the tissues are different and are broadly classified into four types: (i) Epithelial, (ii) Connective, (iii) Muscular and (iv) Neural.

7.1.1 Epithelial Tissue

- We commonly refer to an epithelial tissue as epithelium (pl.: epithelia). This tissue has a free surface, which faces either a body fluid or the outside environment and thus provides a covering or a lining for some part of the body.
- The cells are compactly packed with little intercellular matrix.
- There are two types of epithelial tissues namely **simple epithelium** and **compound epithelium**.
 - a. Simple epithelium is composed of a single layer of cells and functions as a lining for body cavities, ducts, and tubes.
 - b. Compound epithelium consists of two or more cell layers and has protective function as it does in our skin.
- On the basis of structural modification of the cells, simple epithelium is further divided into three types. These are (i) Squamous, (ii) Cuboidal, (iii) Columnar.
 - a. **Squamous epithelium** is made of a single thin layer of flattened cells with irregular boundaries. They are found in the walls of blood vessels and air sacs of lungs and are involved in functions like forming a diffusion boundary.
 - b. **Cuboidal epithelium** is composed of a single layer of cube-like cells. This is commonly found in ducts of glands and tubular parts of nephrons in kidneys and its

main functions are secretion and absorption. The epithelium of proximal convoluted tubule (PCT) of nephron in the kidney has microvilli.

- c. **Columnar epithelium** is composed of a single layer of tall and slender cells. Their nuclei are located at the base. Free surface may have microvilli. They are found in the lining of stomach and intestine and help in secretion and absorption.
- If the columnar or cuboidal cells bear cilia on their free surface they are called **ciliated epithelium**. Their function is to move particles or mucus in a specific direction over the epithelium. They are mainly present in the inner surface of hollow organs like bronchioles and fallopian tubes.
 - Some of the columnar or cuboidal cells get specialised for secretion and are called **glandular epithelium**. They are mainly of two types: unicellular, consisting of isolated glandular cells (goblet cells of the alimentary canal), and multicellular, consisting of cluster of cells (salivary gland).
 - On the basis of the mode of pouring of their secretions, glands are divided into two categories namely **exocrine** and **endocrine** glands.
 - I. Exocrine glands secrete mucus, saliva, earwax, oil, milk, digestive enzymes and other cell products. These products are released through ducts or tubes.
 - II. In contrast, endocrine glands do not have ducts. Their products called hormones are secreted directly into the fluid bathing the gland.
 - **Compound epithelium** is made of more than one layer (multi-layered) of cells and thus has a limited role in secretion and absorption. Their main function is to provide protection against chemical and mechanical stresses. They cover the dry surface of the skin, the moist surface of buccal cavity, pharynx, inner lining of ducts of salivary glands and of pancreatic ducts.
 - **Cell junctions**: All cells in epithelium are held together with little intercellular material. In nearly all animal tissues, specialised junctions provide both structural and functional links between its individual cells.
 - Three types of cell junctions are found in the epithelium and other tissues. These are called as tight, adhering and gap junctions.
 - i. **Tight junctions** help to stop substances from leaking across a tissue.
 - ii. **Adhering junctions** perform cementing to keep neighbouring cells together.
 - iii. **Gap junctions** facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells, for rapid transfer of ions, small molecules and sometimes big molecules.

7.1.2 Connective Tissue

- Connective tissues are most abundant and widely distributed in the body of complex animals. They are named so because of their special function of linking and supporting other tissues/organs of the body.
- They range from soft connective tissues to specialised types, which include cartilage, bone, adipose, and blood.
- In all connective tissues except blood, the cells secrete fibres of structural proteins called collagen or elastin. The fibres provide strength, elasticity and flexibility to the tissue.
- These cells also secrete modified polysaccharides, which accumulate between cells and fibres and act as matrix (ground substance).

- Connective tissues are classified into three types: (i) Loose connective tissue, (ii) Dense connective tissue and (iii) Specialised connective tissue.
 - a. **Loose connective tissue** has cells and fibres loosely arranged in a semi-fluid ground substance, for example, **areolar tissue** present beneath the skin.
 - It serves as a support framework for epithelium.
 - It contains fibroblasts (cells that produce & secrete fibres), macrophages & mast cells.
 - b. **Adipose tissue** is another type of loose connective tissue located mainly beneath the skin. The cells of this tissue are specialised to store fats.
 - The excess of nutrients which are not used immediately are converted into fats and are stored in this tissue.
 - Fibres and fibroblasts are compactly packed in the **dense connective tissues**.
 - Orientation of fibres show a regular or irregular pattern and are called **dense regular** and **dense irregular tissues**.
 - In the dense regular connective tissues, the collagen fibres are present in rows between many parallel bundles of fibres.
 - Tendons, which attach skeletal muscles to bones and ligaments which attach one bone to another are examples of this tissue.
 - Dense irregular connective tissue has fibroblasts and many fibres (mostly collagen) that are oriented differently. This tissue is present in the skin.
 - c. Cartilage, bones and blood are various types of **specialised connective tissues**.
 - i. The intercellular material of **cartilage** is solid and pliable and resists compression. Cells of this tissue (chondrocytes) are enclosed in small cavities within the matrix secreted by them. Most of the cartilages in vertebrate embryos are replaced by bones in adults. Cartilage is present in the tip of nose, outer ear joints, between adjacent bones of the vertebral column, limbs and hands in adults.
 - ii. **Bones** have a hard and non-pliable ground substance rich in calcium salts and collagen fibres which give bone its strength. It is the main tissue that provides structural frame to the body. Bones support and protect softer tissues and organs. The bone cells (osteocytes) are present in the spaces called lacunae. Limb bones, such as the long bones of the legs, serve weight-bearing functions. They also interact with skeletal muscles attached to them to bring about movements. The bone marrow in some bones is the site of production of blood cells.
 - iii. **Blood** is a fluid connective tissue containing plasma, red blood cells (RBC), white blood cells (WBC) and platelets. It is the main circulating fluid that helps in the transport of various substances.

7.1.3 Muscle Tissue

- Each muscle is made of many long, cylindrical fibres arranged in parallel arrays.
- These fibres are composed of numerous fine fibrils, called myofibrils.
- Muscle fibres contract (shorten) in response to stimulation, then relax (lengthen) and return to their uncontracted state in a coordinated fashion.
- Their action moves the body to adjust to the changes in the environment and to maintain the positions of the various parts of the body.

- In general, muscles play an active role in all the movements of the body.
- Muscles are of three types, skeletal, smooth, and cardiac.
- a) **Skeletal muscle** tissue is closely attached to skeletal bones.
 - In a typical muscle such as the biceps, striated (striped) skeletal muscle fibres are bundled together in a parallel fashion.
 - A sheath of tough connective tissue encloses several bundles of muscle fibres.
- b) **Smooth muscle** fibres taper at both ends (fusi-form) and do not show striations.
 - Cell junctions hold them together and they are bundled together in a connective tissue sheath.
 - The wall of internal organs such as the blood vessels, stomach and intestine contains this type of muscle tissue.
 - Smooth muscles are involuntary as their functioning cannot be directly controlled.
 - They do not contract just by thinking/willing etc about them as we can do with skeletal muscles.
- c) **Cardiac muscle tissue** is a contractile tissue present only in the heart.
 - Cell junctions fuse the plasma membranes of cardiac muscle cells and make them stick together.
 - Communication junctions (intercalated discs) at some fusion points allow the cells to contract as a unit, i.e., when one cell receives a signal to contract, its neighbours are also stimulated to contract.

7.1.4 Neural Tissue

- Neural tissue exerts the greatest control over the body is responsiveness to changing conditions. Neurons, the unit of neural system are excitable cells.
- The neuroglial cell which constitute the rest of the neural system protect and support neurons.
- Neuroglia make up more than onehalf the volume of neural tissue in our body.
- When a neuron is suitably stimulated, an electrical disturbance is generated which swiftly travels along its plasma membrane.
- Arrival of the disturbance at the neuronís endings, or output zone, triggers events that may cause stimulation or inhibition of adjacent neurons and other cells.
