Animal tissues: Tissues consist of a group of cells with similar structure performing similar function. Tissues constitute organs. Animal tissues are of four major types—epithelial, or covering tissue; connective, or supportive tissue; muscular, or contractile tissue and nervous tissue.

Epithelial Tissue: This is the thin protective layer of cells which covers the surface of the body and lines the internal organs. The cells are generally packed close together. The shape of the cells depends on the location and function of the tissue. And based on the shape of the cells, epithelial tissue is classified into four types—squamous, cuboidal, columnar and ciliated. Epithelial tissue originates from the ectoderm.

But, epithelial tissue lining the intestine originates from the endoderm.

1. Squamous epithelium: This tissue is composed of a single layer of thin and flat, plate-like cells. The cells fit closely, like the bricks in a wall, to form a smooth membrane. It is found in the outer layer of the skin, and covers internal cavities and ducts. Tongue, oesophagus and the lining of the mouth are made up of squamous epithelium. It is also found in blood vessels and alveoli. Its functions include protecting the internal organs and allowing diffusion to take place easily, for instance, in blood vessels and alveoli.

2. Cuboidal epithelium: This is composed of cube-like cells that fit closely. The cells look like squares in section, but the free surface appears hexagonal. This tissue lines the inside of the kidney tubules (the tubes leading from the cups of nephrons) and the salivary glands. The functions of this tissue are secretion and absorption, in addition to providing support.

3. Columnar epithelium: This tissue is generally composed of a single layer of column like cells. A conspicuous striated border of microvilli at the free surface end of each cell increases the surface area of the cell for absorption and secretion. Found in the inner lining of the alimentary canal, the functions of this tissue include secretion and absorption. It also provides mechanical support.

4. Ciliated epithelium: In some parts of the body, columnar epithelium develops protoplasmic outgrowths called cilia. The constant lashing movements of the cilia help move substances. Ciliated epithelium helps the movement of ova in the fallopian tubes and the movement of mucus in the respiratory tract.

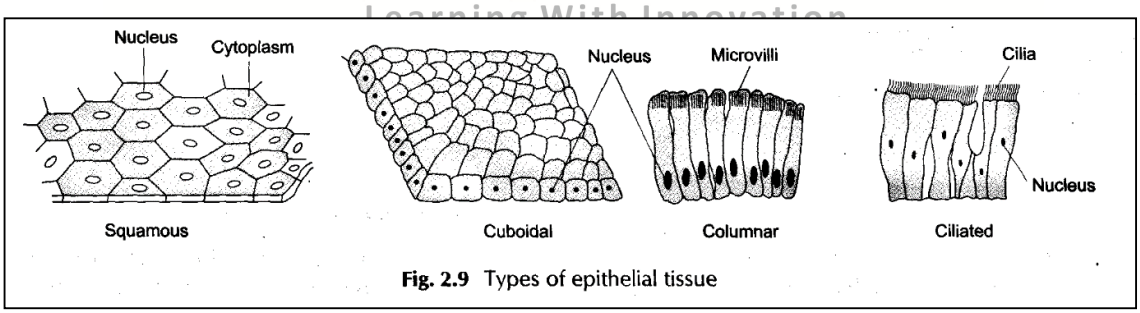

Fig. 2.9 Types of epithelial tissue

Connective Tissue: The cells of the connective tissue are widely spaced and embedded in an intercellular matrix. This matrix may be jelly-like, fluid or dense and rigid. Fibres are present in the matrix of some connective tissues. The nature of the matrix decides the function of tissue. The basic functions of this tissue are providing support to different organs and keeping them in place. Connective tissues can be divided into three main groups—connective tissue proper; skeletal, or supportive tissue; and fluid, or vascular tissue.

1. Connective tissue proper: Connective tissue proper includes areolar, adipose, white fibrous, yellow elastic and reticular tissues.

a. Areolar tissue -This is the most widely distributed connective tissue in the body. It consists of ground substance (matrix), white and yellow fibres and irregular cells scattered in the matrix. Fine threads run through the matrix, crossing each other in every

direction, and leaving small spaces (areolae) between them. This tissue fills spaces inside organs and is found between the skin and muscles, around blood vessels and nerves, and in the bone marrow. It supports internal organs and helps in the repair of tissues.

b. Adipose tissue - It consists of oval and round cells filled with fat globules. These cells are scattered in a matrix. This tissue is found below the skin, between internal organs and in the yellow bone marrow. It stores fat and acts as an insulator. Too much of this tissue makes a person fat. Animals living in cold climates have a lot of this tissue to protect them from the cold.

c. White fibrous tissue -It contains compactly arranged white fibres which lie almost in parallel bundles. There is very little matrix and the few cells lie between the fibres. This tissue forms cords called tendons which connect muscles with bones. It has great strength, but limited flexibility.

d. Yellow elastic tissue- The yellow fibres of this tissue are thicker than those found in the areolar tissue. This tissue, containing very little matrix and a few cells, has considerable strength and remarkable elasticity. Like white fibres, it forms cords called ligaments, which join bones together.

e. Reticular tissue- It consists of star-shaped cells with protoplasmic processes. The network occurring in the matrix is formed by very thin fibres. The matrix also contains other types of cells. This tissue is present in the spleen, liver, bone marrow, etc.

2 **Skeletal tissue:** Skeletal tissue is of two types—cartilage and bone. Cartilage is a connective tissue in which the intercellular matrix is composed of proteins, slightly hardened by calcium salts. The cartilage cells (chondroblasts) are widely spaced and the matrix is reinforced by fibres. Cartilage occurs at the joints of bones, in the nose, ear, trachea and larynx. It helps smooth the surface at the joints. It lends support and provides flexibility. Bone cells (osteoblasts) have very fine canals (canaliculi) emerging from the cell membrane. Bone cells are embedded in a hard matrix, which is strengthened by fibres, and hardened by calcium and phosphorus salts. The matrix is deposited in the form of concentric layers of lamellae formed around a central canal (Haversian canal). The bone cells occupy small spaces between the concentric layers of matrix. There may be a few bone-dissolving cells in the matrix called osteoclasts.

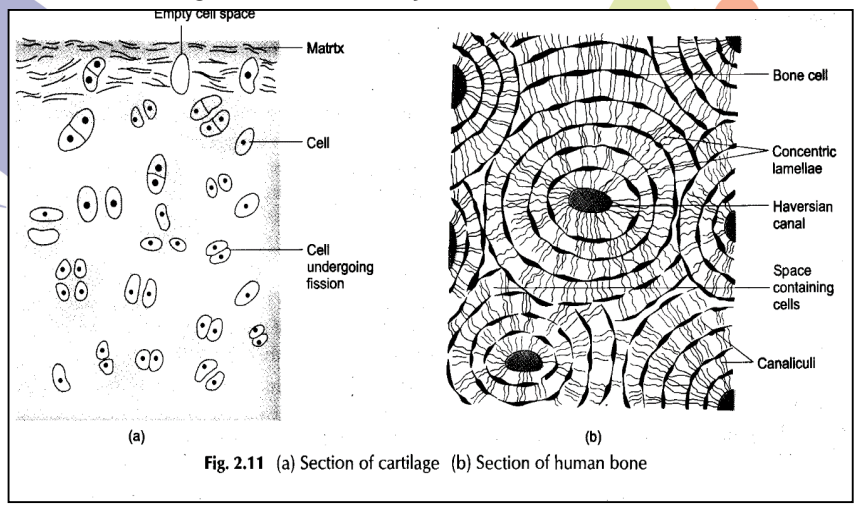

Fig. 2.11 (a) Section of cartilage (b) Section of human bone

3. Fluid tissue: Blood and lymph are the two fluid connective tissues. The liquid matrix of blood, as you know, is called plasma. The three types of cells suspended in the plasma are erythrocytes, red blood corpuscles (RBC); leucocytes, white blood corpuscles (WBC) and platelets, thrombocytes. Proteins, salts and hormones are dissolved in the plasma.

Of the three types of blood cells, erythrocytes are the most abundant. Their characteristic feature is the presence of haemoglobin. It is a protein that carries oxygen and carbon dioxide and gives blood its red colour. These cells are biconcave discs without a nucleus. These cells are made in the bone marrow and are replaced from time to time.

Leucocytes, or WBCs, do not have haemoglobin, so they are colourless. They have granules in their cytoplasm and a lobed nucleus. There are five types of Leucocytes. One of them is lymphocyte that forms proteins called antibodies for defence against infection. Others engulf and digest bacteria and other foreign particles and thus defend the body against infections. They also engulf cell debris that form when cells are damaged. These leucocytes exhibit amoeboid movement. This allows them to squeeze out of vessels and reach the sites of infections and wounds.

Platelets lack haemoglobin and are non-nucleated, disclike bodies. Platelets contain an enzyme that helps in the clotting of blood.

If all the corpuscles of blood are removed, the remaining fluid which is about 55% of the blood volume, is called the plasma. Plasma is a complex fluid. Several proteins are dissolved in it. If the protein fibrinogen is removed from plasma, the remaining fluid is called serum.

The two major functions of blood are transport and temperature regulation. The blood transports gases, digested food, hormones and waste materials to and from various organs. It also helps maintain uniform temperature.

Lymph is a straw-coloured fluid surrounding the cells. It is similar to blood in composition except that it does not have RBCs and proteins, and contains less calcium and phosphorus than blood. The WBCs present in the lymph can reach any part of the body, where they are required, by amoeboid movement. There they 'ingest' germs the way Amoebae ingest food. The lymph forms the defence system of the body. It also transports nutrients.

Muscular Tissue:

Muscles, which contract and relax to make the movements of the body possible, are made up of muscular tissue. There are three types of muscles—striated, nonstriated and cardiac.

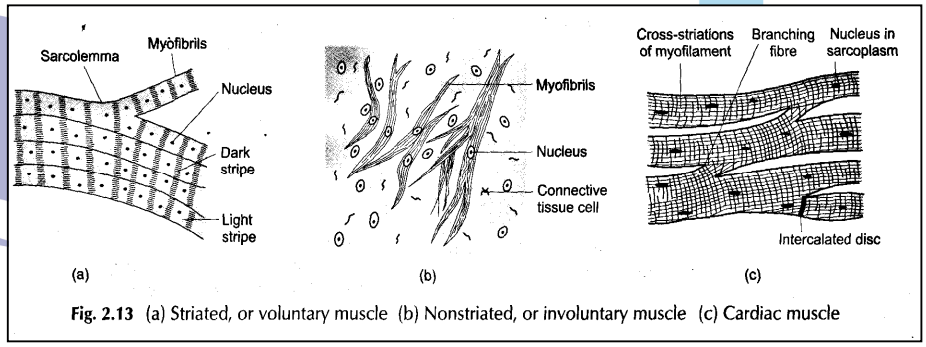

Fig. 2.13 (a) Striated, or voluntary muscle (b) Nonstriated, or involuntary muscle (c) Cardiac muscle

1. **Striated muscles:** Striated muscles are also called voluntary muscles because they are under the direct control of one's will. The muscle fibres, or cells which make up striated muscles, are multinucleate and unbranched. Each cell, or fibre, is enclosed in a thin definite membrane balled sarcolemma. The cytoplasm of the muscle fibre, called sarcoplasm, contains filaments called myofibrils. It is these contractile filaments which cause the movements of the muscle and also give rise to the striations. Striated muscles constitute about 50% of the body weight and are attached primarily to the bones. They are found in the arms, legs, neck, etc. These muscles get tired and need rest.

2. **Nonstriated muscles:** These are also called involuntary muscles because they are not under the direct control of one's will. The muscle fibres, or cells, are uninucleate and spindle-shaped. The ends of these cells may be branched. Each cell is not enclosed in a membrane, but many fibres are joined together in bundles by loose connective tissue. Myofibrils run longitudinally through the fibres of these muscles, which are also called smooth.

Movement in the alimentary canal which causes the passage of food is due to the contraction of nonstriated muscles. Smooth muscles are also found in blood vessels, the iris of the eye, ureter, bronchi and the skin.

3. **Cardiac muscles:** These too are involuntary muscles, but they are found only in the heart. The muscle fibres are uninucleate and branched. These branches are united by intercalated discs. They also have some characteristics of the nonstriated and striated muscles. Each fibre is surrounded by sarcolemma. And the myofibrils present in the sarcoplasm gives the muscles a striated appearance. The nucleus is centrally located. These muscles contract rapidly and rhythmically throughout life without any external stimulation. They never get tired and continually help pump blood throughout the life of an individual.

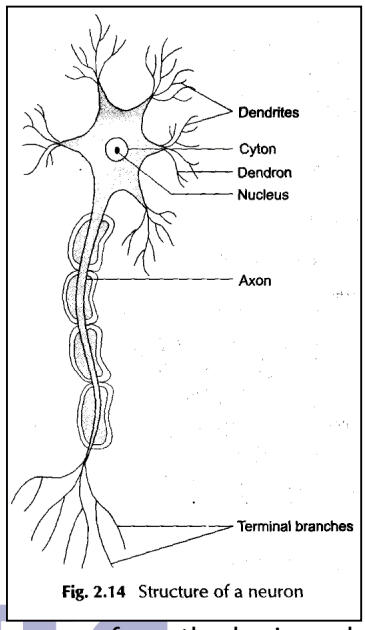

Fig. 2.14 Structure of a neuron

Nervous Tissue: This tissue is made of elongated cells called neurons. The cell body of a nerve cell, or neuron, contains a nucleus and cytoplasm and is called the cyton. Short, hairlike extensions arising from the cyton are called dendrons. These dendrons further branch into thin dendrites. The axon is a long, tail-like cylindrical process with fine branches at the end. The axon is covered by a sheath.

The dendrites of a neuron are in close contact with the branches of the axon of another neuron. Bundles of nerve fibres form a nerve.

The spinal cord and brain are made of nervous tissue. Nerves run to and from these organs, connecting them to various parts of the body. Some of these nerves receive stimuli from within the body or from the external world, and carry these messages to the brain and spinal cord in the form of short bursts of electric current, or impulses. Other nerves carry messages from the brain and spinal cord to various parts of the body which then act (respond) accordingly.