Unit II Chapter 7.

STRUCTURAL ORGANISATION IN ANIMALS

7.1 Animal Tissues,
7.2 Organ & Organ System,
7.3 Earthworm,
7.4 Cockroach and
7.5 Frogs

Module ¼
7.1 ANIMAL TISSUES

- In unicellular organisms, all functions (digestion, respiration & 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 (*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.**

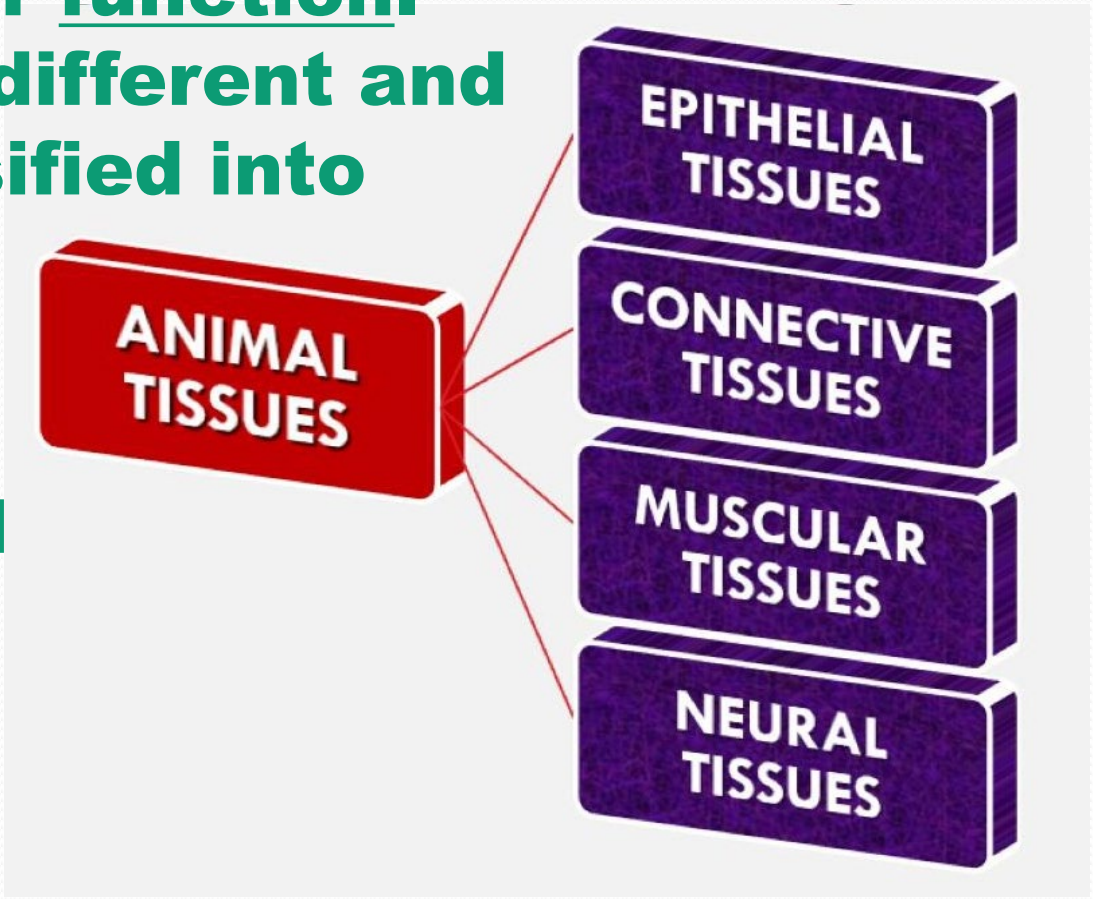
- **In multicellular animals, a group of similar cells along with intercellular substances perform a specific function. Such an organisation is called tissue.**

- **Cells, tissues, organs and organ systems split up the work in a way that ensures the survival of the body as a whole and exhibit division of labour.**

- **A tissue is defined as group of cells along with intercellular substances performing one or more functions in the body.**

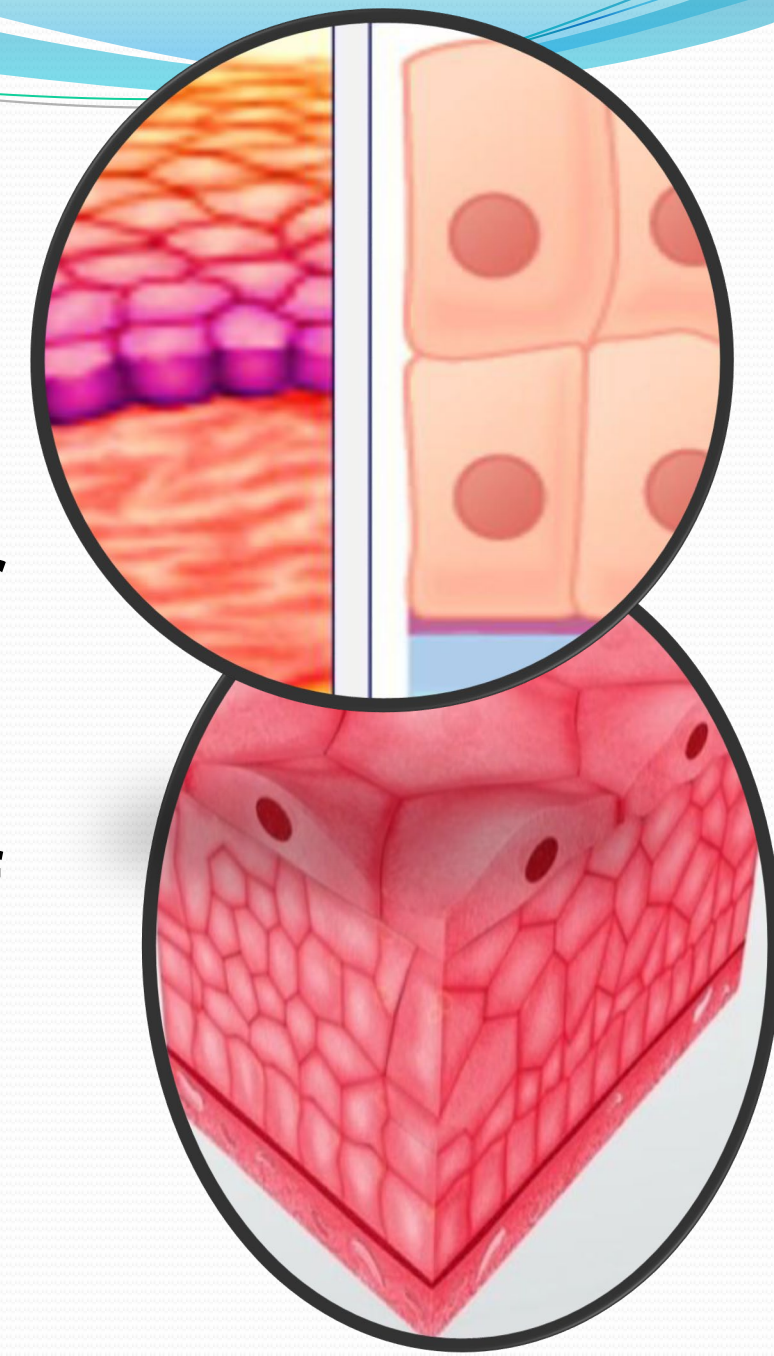
7.1 ANIMAL TISSUES

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

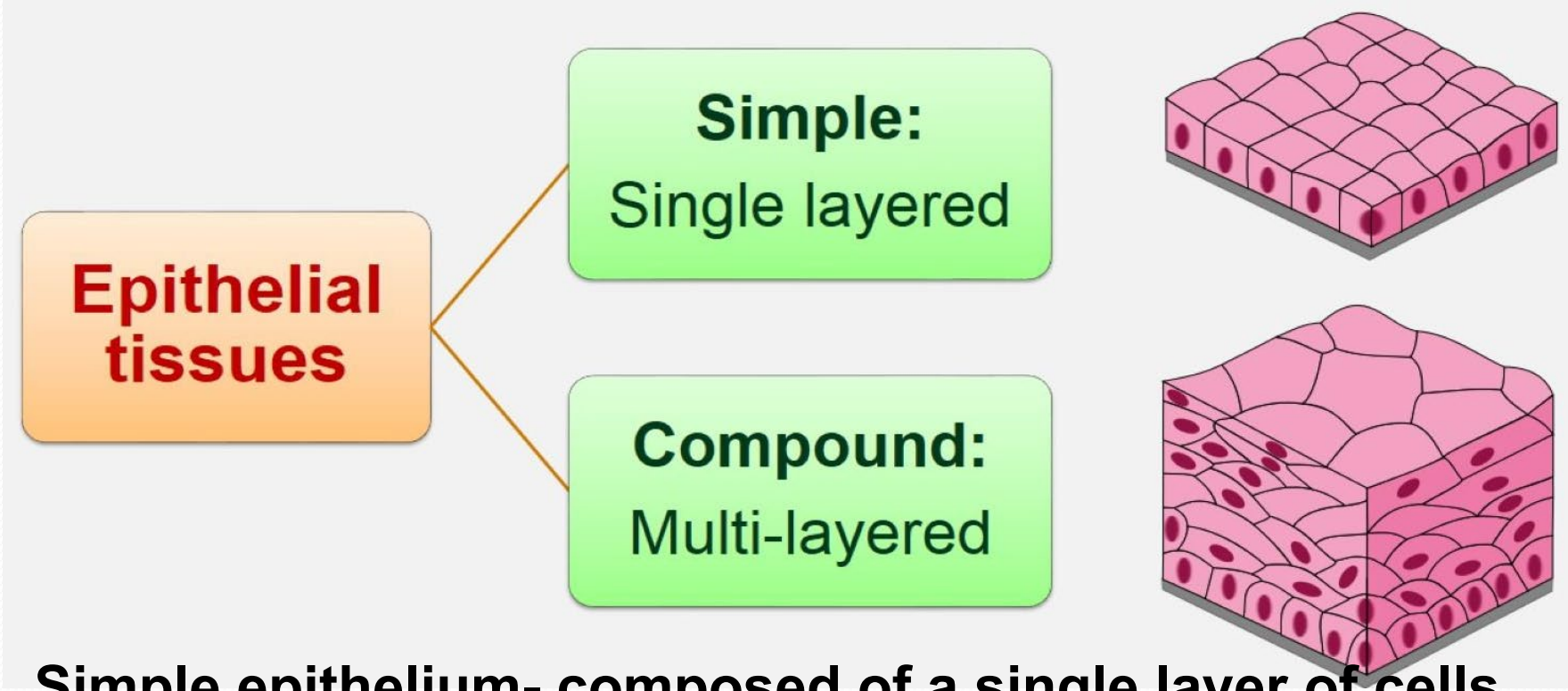


7.1.1 Epithelial Tissue

- An epithelial tissue commonly referred as epithelium(pl.: epithelia).
- has a free surface, which faces either a body fluid or the outside environment & thus provides a covering or a lining for some part of the body.
- Compactly packed cells with little intercellular matrix.



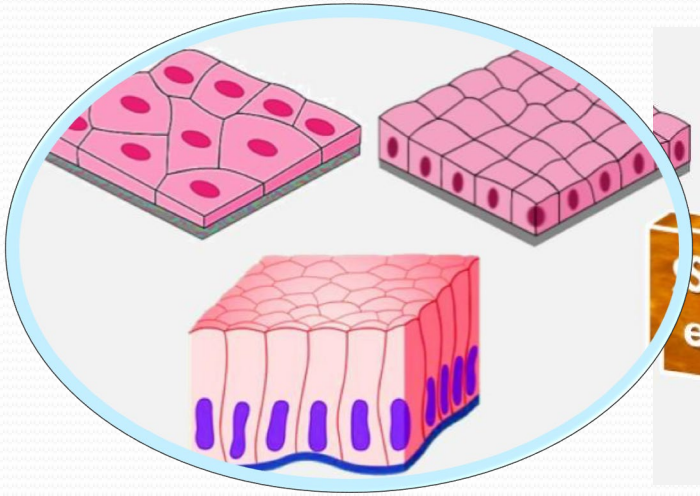
Two types of Epithelial Tissues

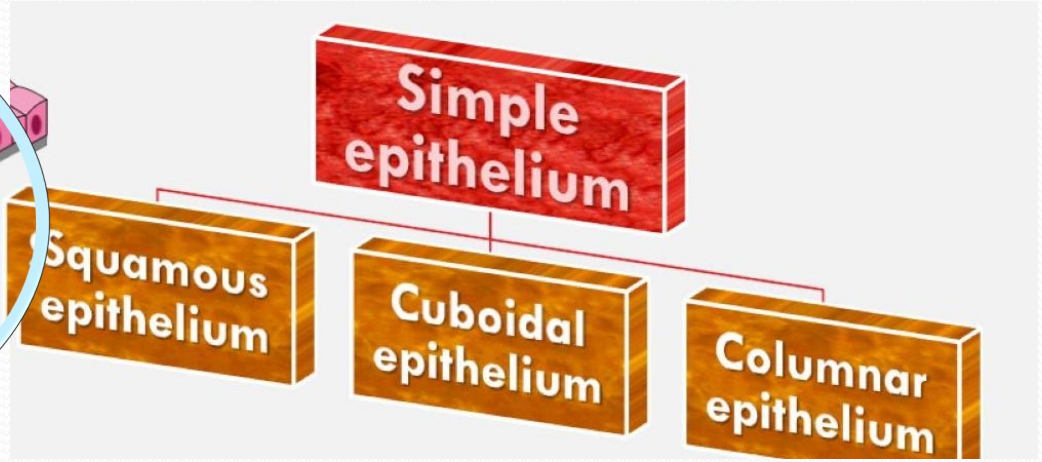


Simple epithelium- composed of a single layer of cells - functions as a lining for body cavities, ducts, and tubes. Compound epithelium - consists of two or more cell layers and

- protective function as it does in our skin.

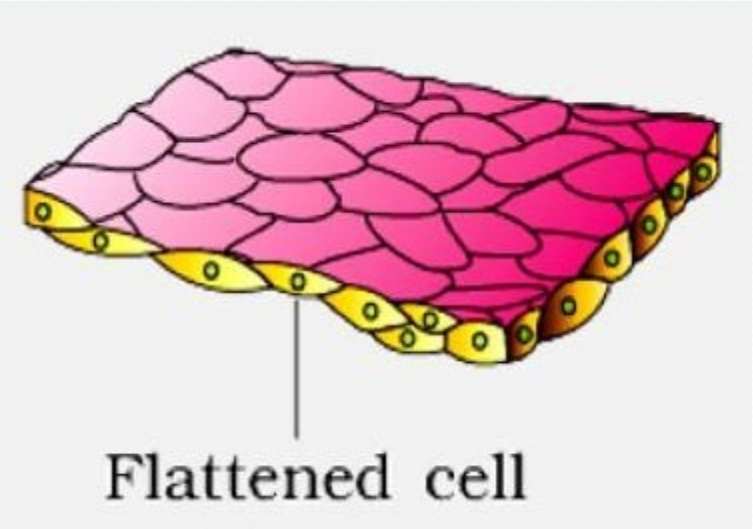
- **Simple epithelium divided on the basis of structural modification of the cells into <u>three types</u>:**
  - **(i) Squamous,**
  - **(ii) Cuboidal, and**
  - **(iii) Columnar**





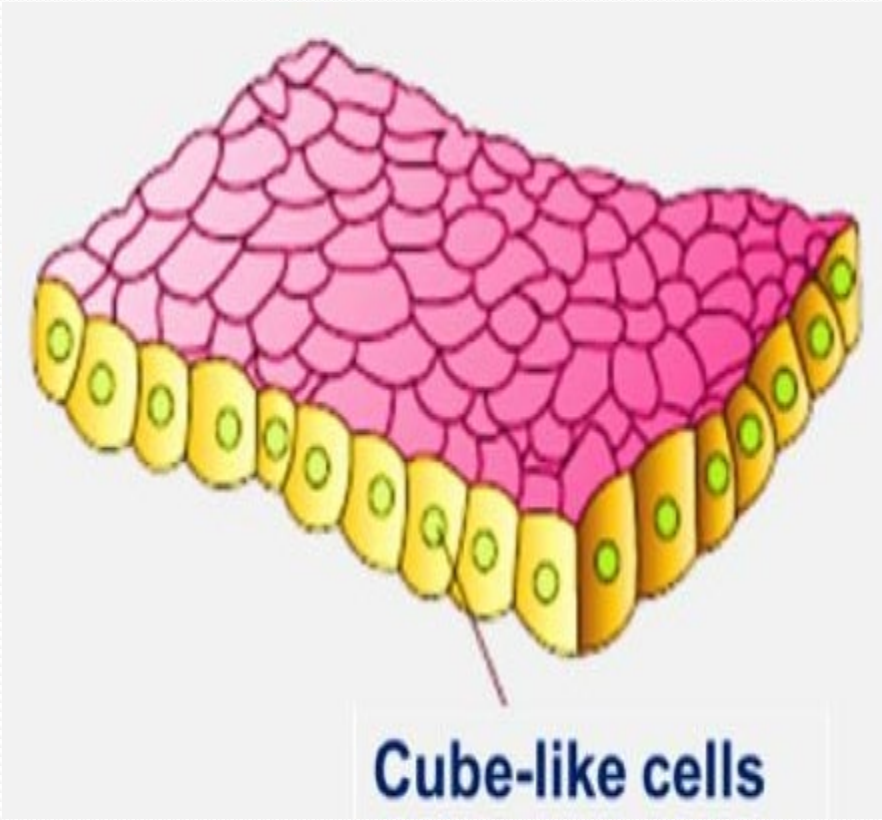
i. Squamous epithelium

- made of a single thin layer of flattened cells with irregular boundaries.
- found in the walls of blood vessels and air sacs of lungs.
- functions like forming a diffusion boundary.



ii. Cuboidal epithelium

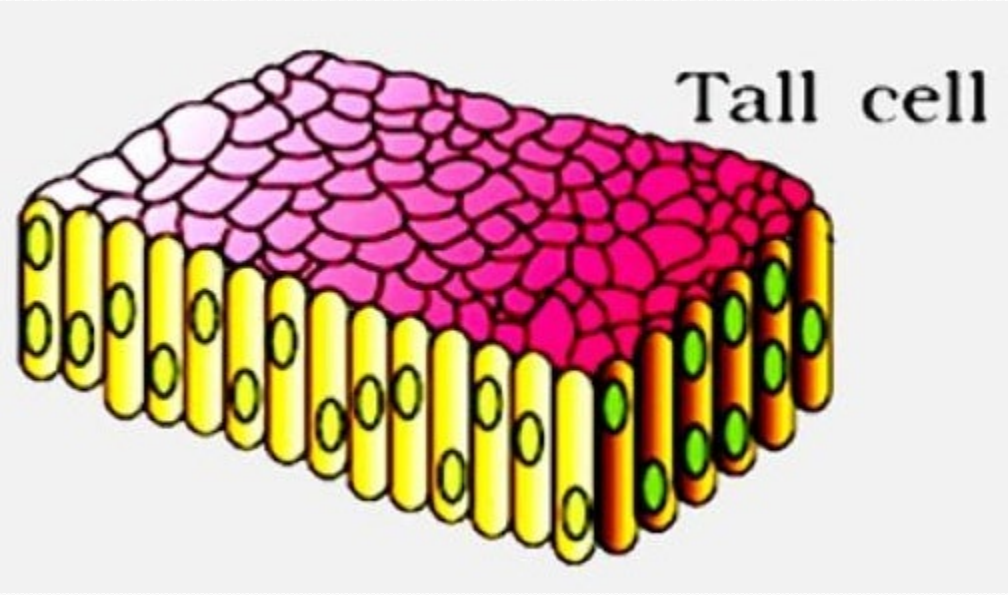
- composed of a single layer of cube-like cells.
- commonly found in ducts of glands and tubular parts of nephrons in kidneys.
- main functions are secretion and absorption.
- The epithelium of proximal convoluted tubule (PCT) of nephron in the kidney has microvilli.



iii. Columnar epithelium

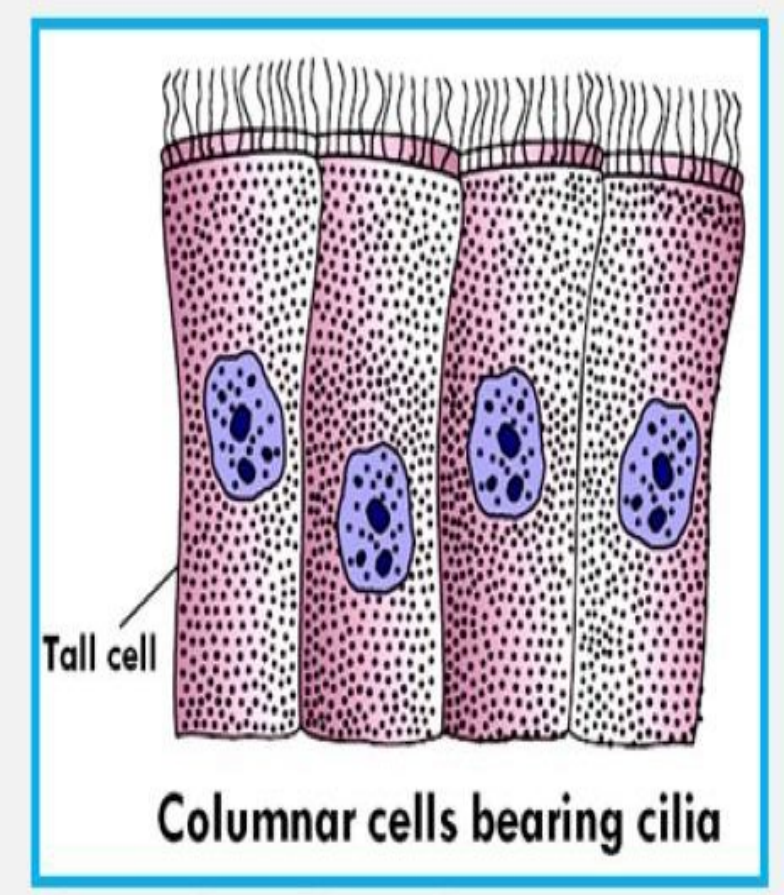
- Composed of a single layer of tall and slender cells.
- Their nuclei are located at the base.
- Free surface may have microvilli.

- Found in the lining of stomach and intestine.
- Helps in secretion and absorption.



Ciliated epithelium

- Cilia present on the free surface of columnar or cuboidal cells.
- Function - to move particles or mucus in a specific direction over the epithelium.
- Present in the inner surface of hollow organs like bronchioles and fallopian tubes.



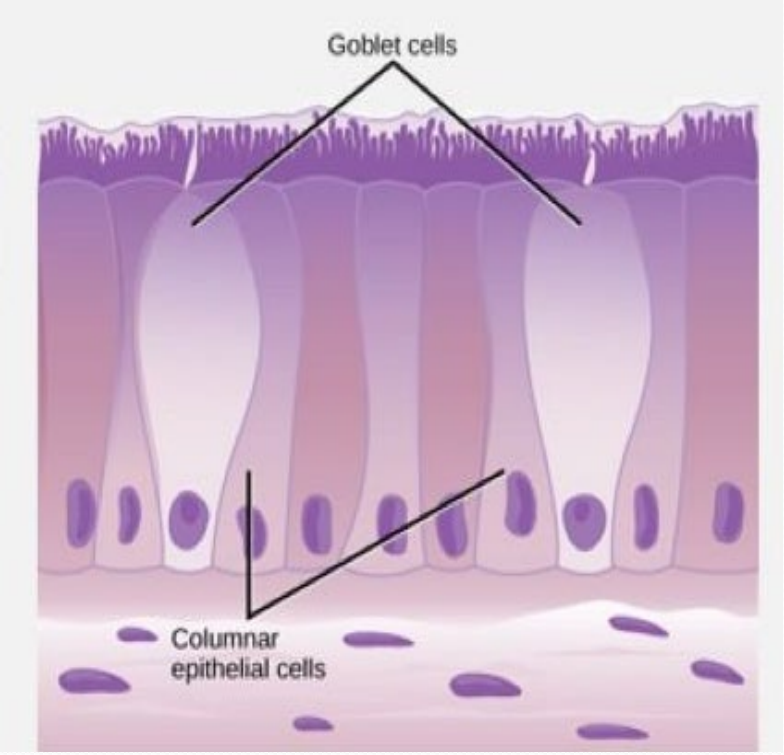
Glandular epithelium

Some of the columnar or cuboidal cells get specialised for secretion.

- Two types:

  i. unicellular, consisting of isolated glandular cells (Goblet cells of the Alimentary canal) &

  ii. multicellular, consisting of Cluster of cells (Salivary gland).



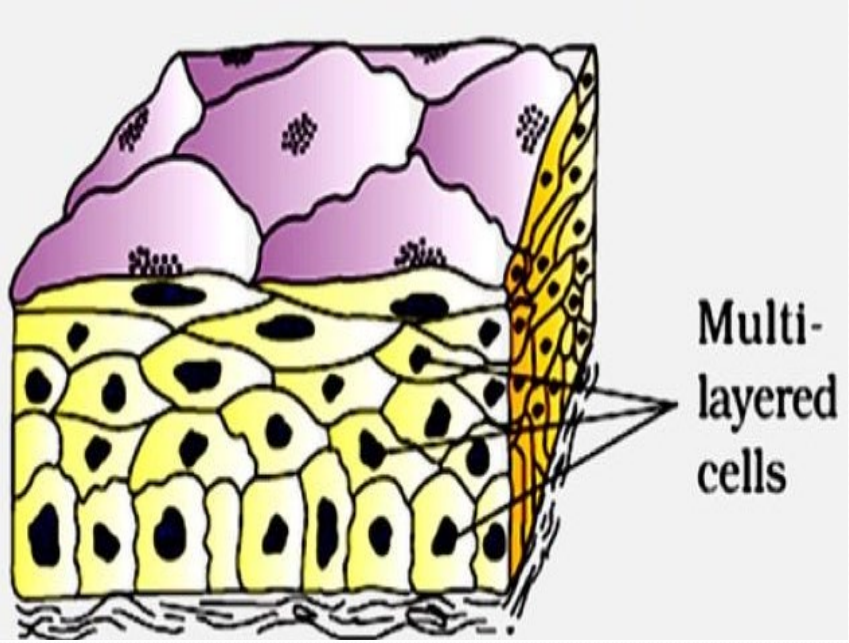
On the basis of the mode of pouring of their secretions, Glands are divided into two categories – Exocrine and Endocrine glands.

- **i. Exocrine glands secrete mucus, saliva, earwax, oil, milk, digestive enzymes & other cell products. These products are released through ducts or tubes.**
- **ii. Endocrine glands do not have ducts. Their products called hormones are secreted directly into the fluid bathing the gland.**

Compound epithelium

- made of more than one layer (multi-layered) of cells and thus has a limited role in secretion & absorption).
- Function - to provide protection against chemical and mechanical stresses.

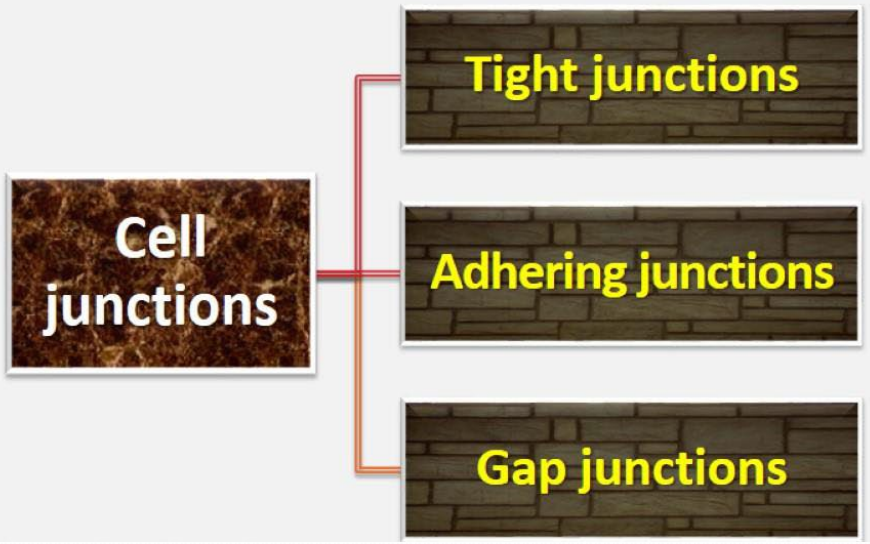
- cover the dry surface of the skin, the moist surface of buccal cavity, pharynx, inner lining of ducts of salivary glands and of pancreatic ducts.
- All cells in epithelium are held together with little intercellular material.

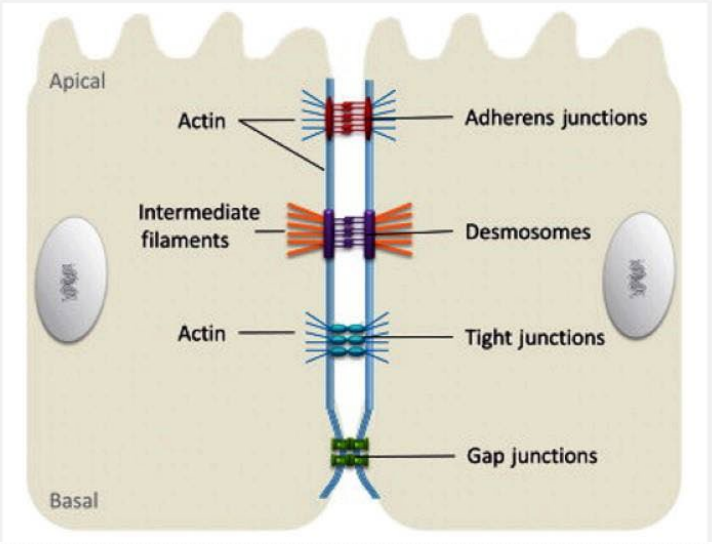


In nearly all animal tissues, **specialised junctions** provide both structural and functional links between its individual cells.

CELL JUNCTIONS

- These are the junctions that provide structural and functional links between adjacent cells.
- They are 3 types:





CELL JUNCTIONS

Tight junctions

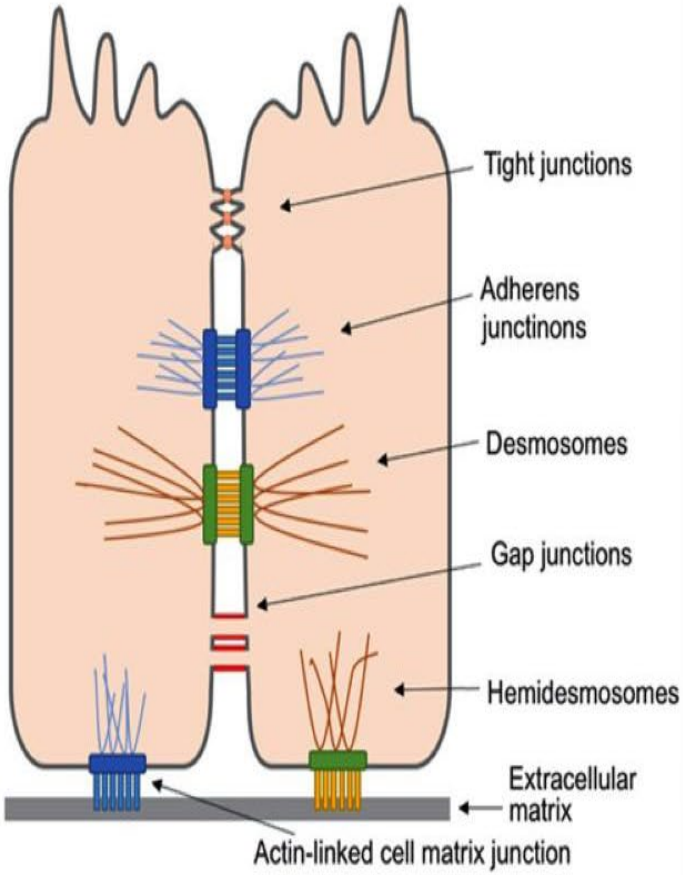
- Help to stop substances from leaking across a tissue.

Adhering junctions

- Perform cementing to keep neighbouring cells together.

Gap junctions

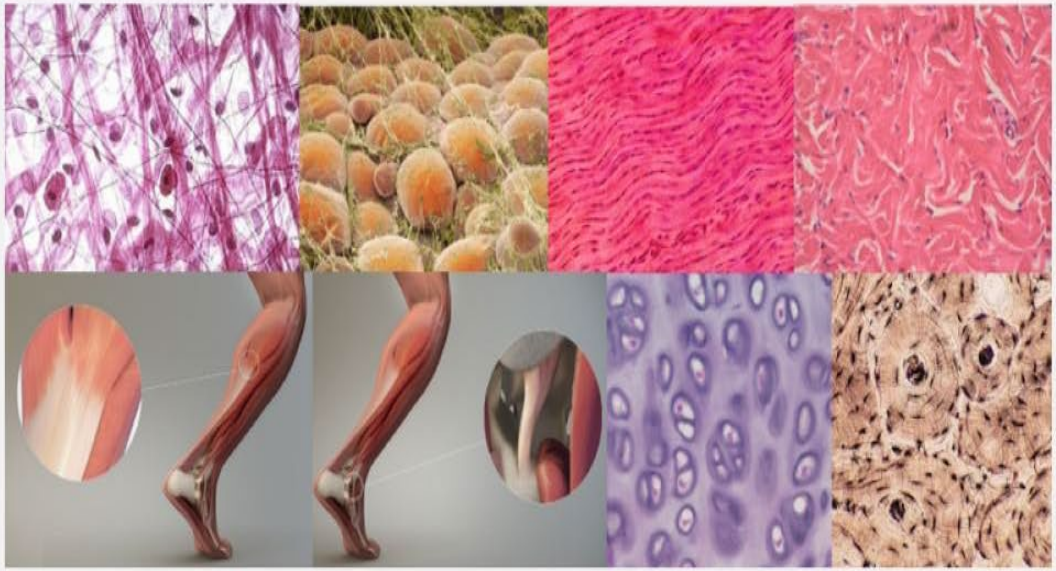
- Facilitate the cells to communicate with each other by connecting cytoplasm of adjoining cells, for rapid transfer of ions, small molecules & big molecules.

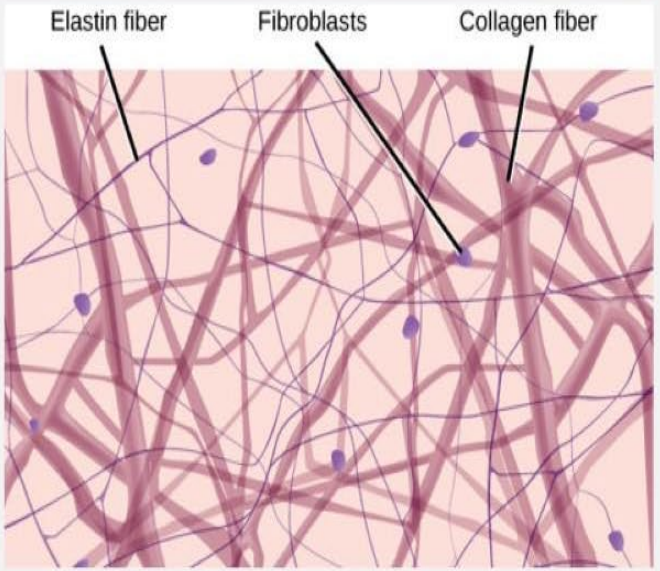


7.1.2 Connective tissues

- **most abundant and widely distributed in the body of complex animals.**
- **named connective tissues because of their special function of linking and supporting other tissues/organs of the body.**
- **range from soft connective tissues to specialised types, which include cartilage, bone, adipose, and blood.**

Connective Tissue



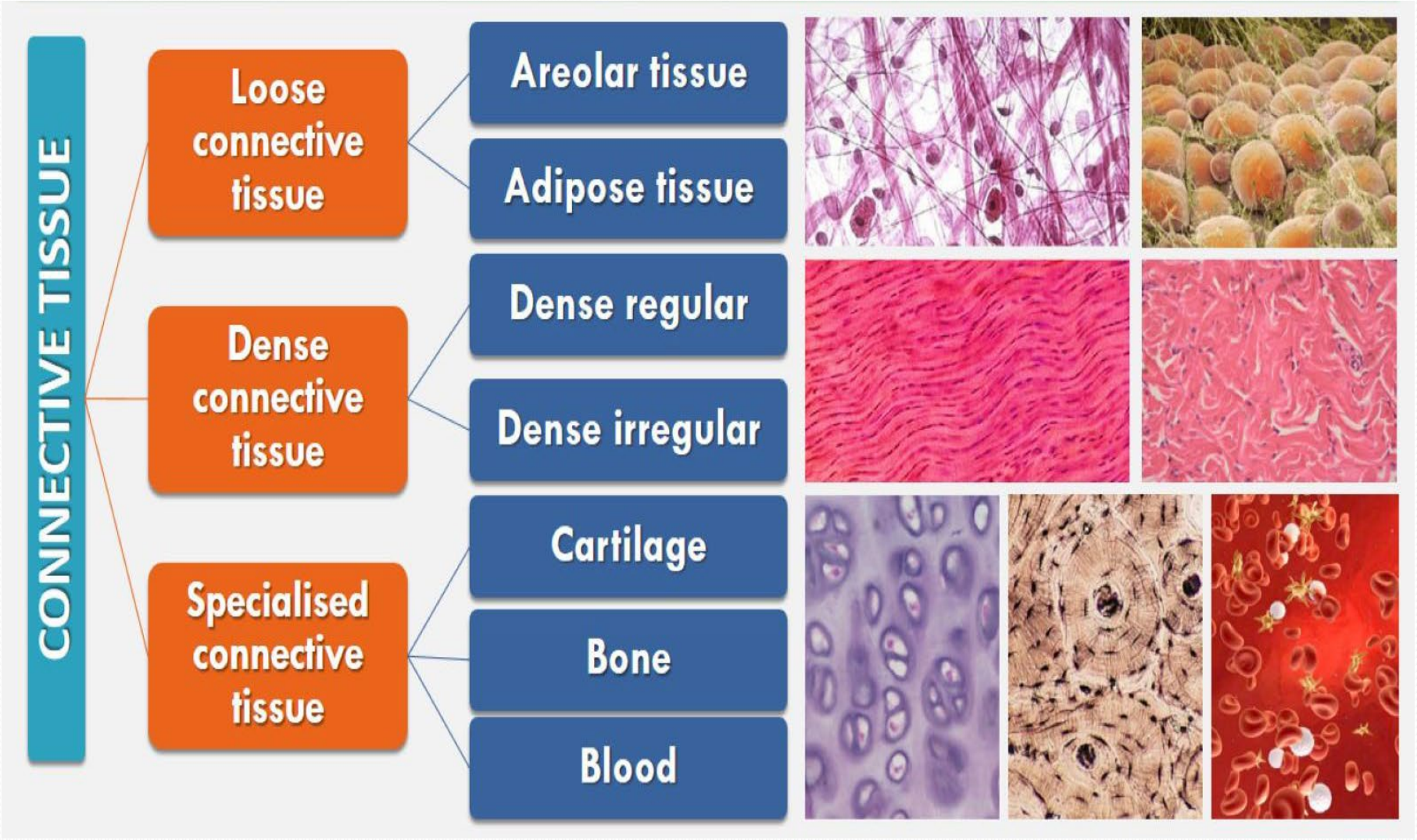


- It links and supports other tissues/organs.
- Most abundant in complex animals.
- All connective tissues except blood have fibroblast cells. They secrete fibrous proteins called collagen & elastin. They give strength, elasticity & flexibility to tissue.
- The cells also secrete modified polysaccharides (matrix), which accumulate between cells and fibres.

In all connective tissues

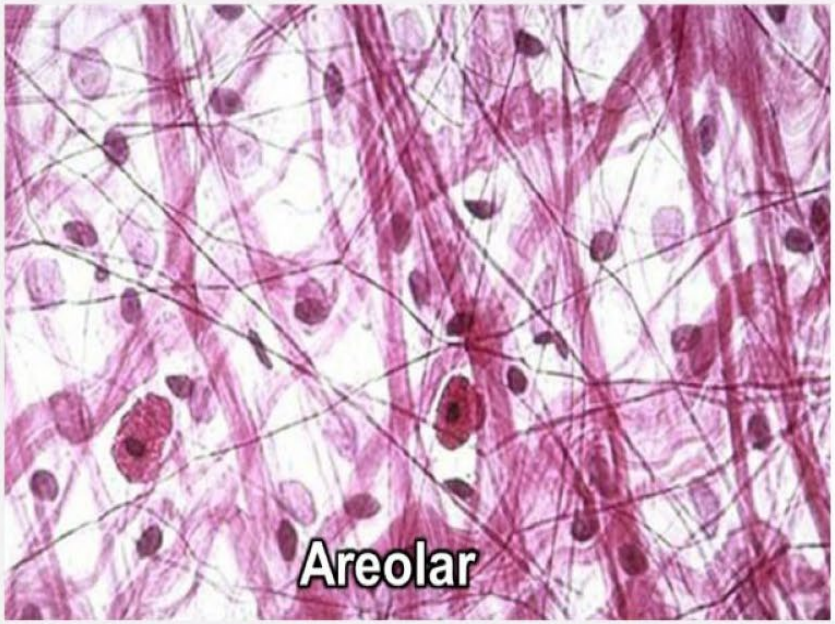
- **except blood, the cells secrete fibres of structural proteins called collagen or elastin.**
- **The fibres provide strength, elasticity and flexibility to the tissue.**
- **These cells also secrete modified polysaccharides, which accumulate between cells and fibres and act as matrix (ground substance).**

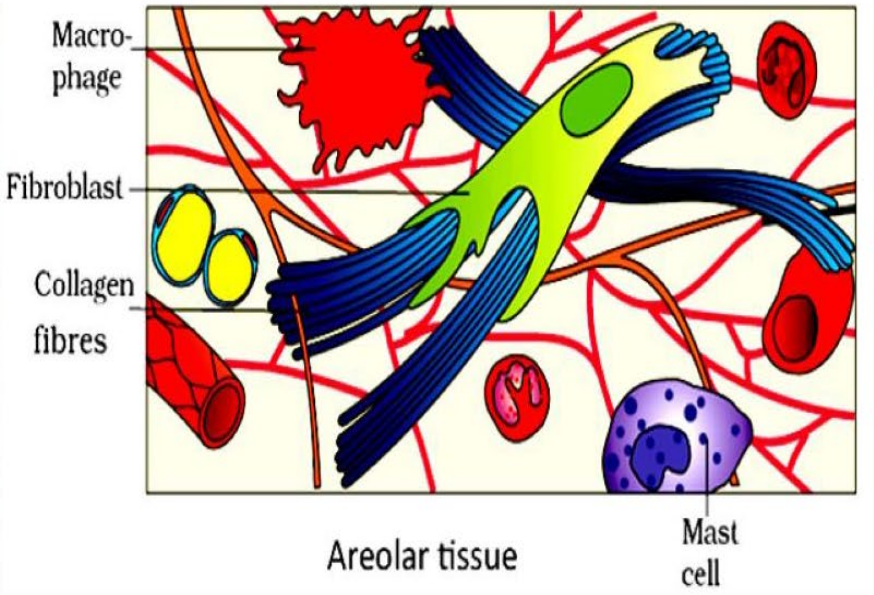
Connective tissues



a. Loose connective tissue:

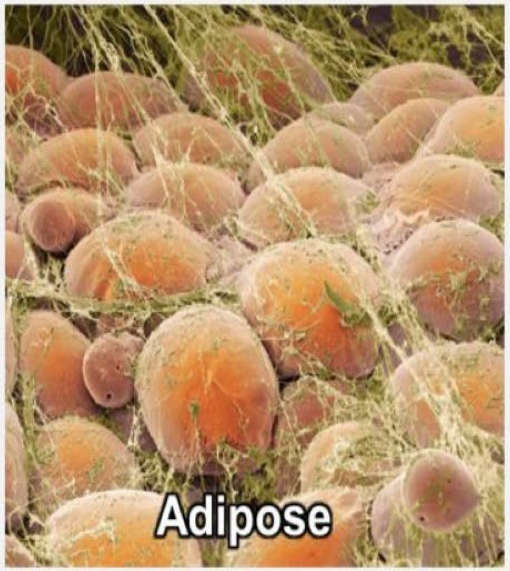
- **i. Areolar Tissue:** Cells and fibres loosely arranged in a semi-fluid ground substance,
- present beneath the skin.
- serves as a support framework for epithelium.
- contains fibroblasts (cells that produce and secrete fibres), macrophages and mast cells.

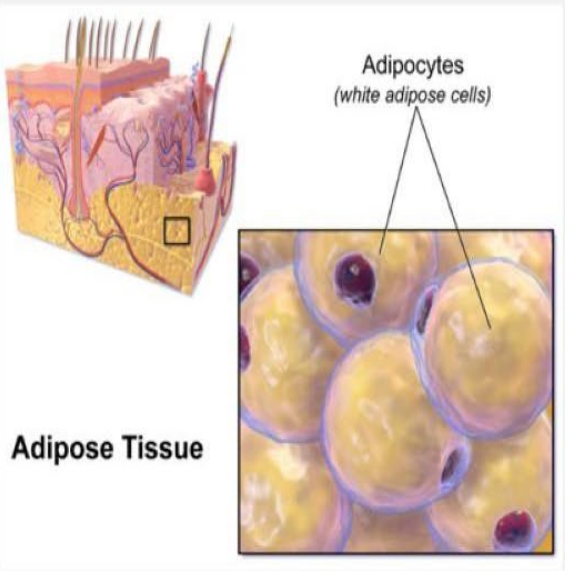


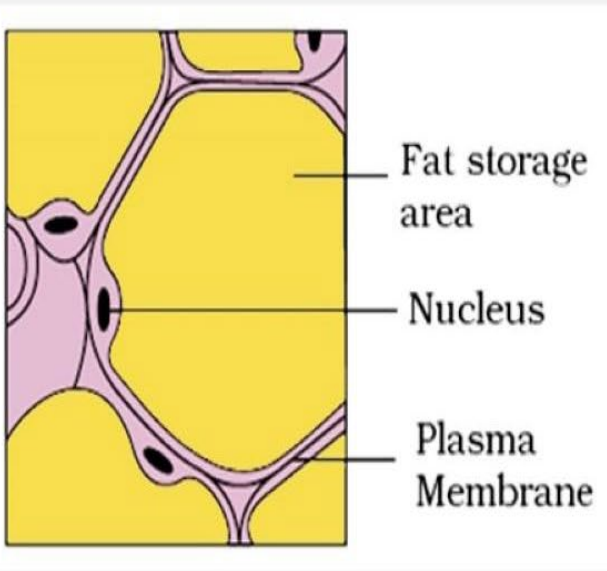


ii. Adipose tissue

- **located mainly beneath the skin.**
- **specialised to store fats.**
- **excess of nutrients which are not used immediately are converted into fats and are stored in this tissue.**







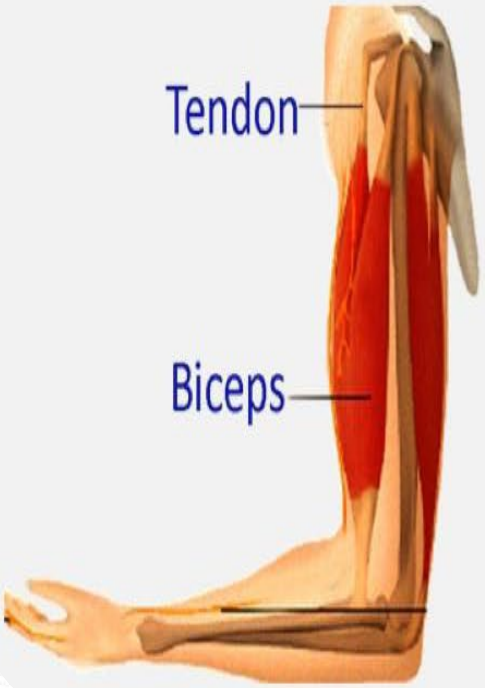
Dense Connective Tissues

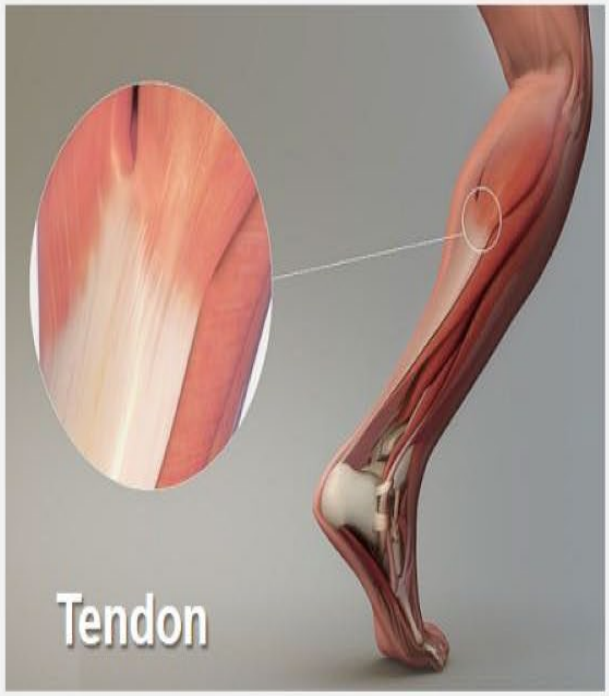
- Fibres and fibroblasts are compactly packed.
- Orientation of fibres show a regular or irregular pattern and are called **dense regular** and **dense irregular tissues**.
- In the dense regular connective tissues, the collagen fibres are present in rows between many parallel bundles of fibres.
- E.g.,Tendons, which attach skeletal muscles to bones and
- ligaments which attach one bone to another.

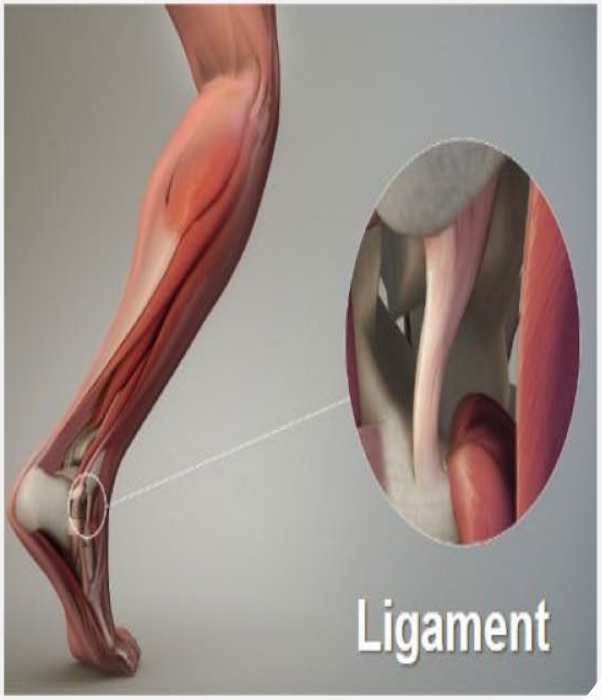
2. Dense Connective Tissue

a. Dense regular

- **Tendons:** Attach skeletal muscles to bones.
- **Ligaments:** Attach one bone to another.

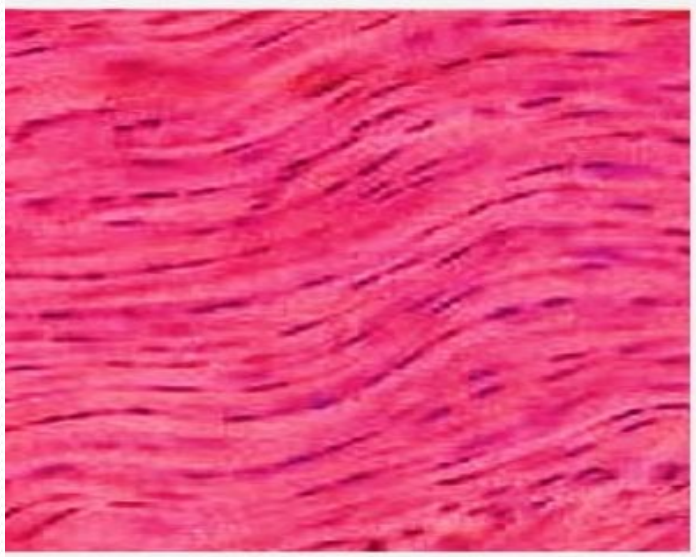


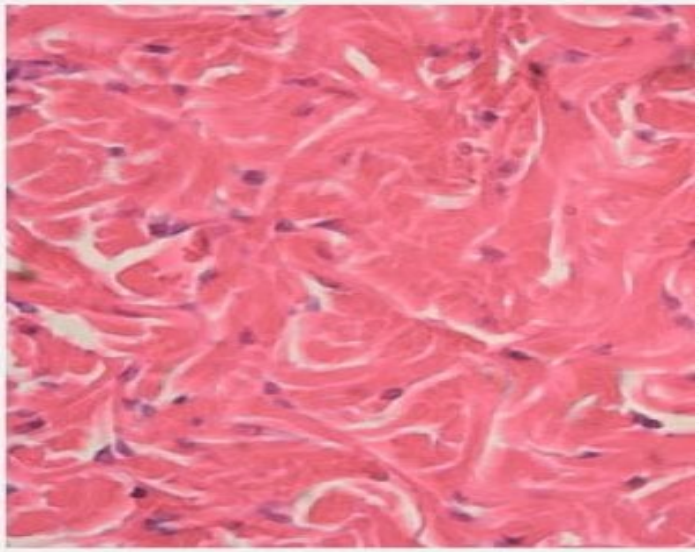




Dense irregular connective

- tissue has fibroblasts and many fibres (mostly collagen) that are oriented differently.
- present in the skin.





Specialised Connective Tissues

- E.g., Cartilage, bones and blood
- The intercellular material of Cartilage is solid and pliable and resists compression.
- Cells of cartilage (chondrocytes) - 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.

Cartilage

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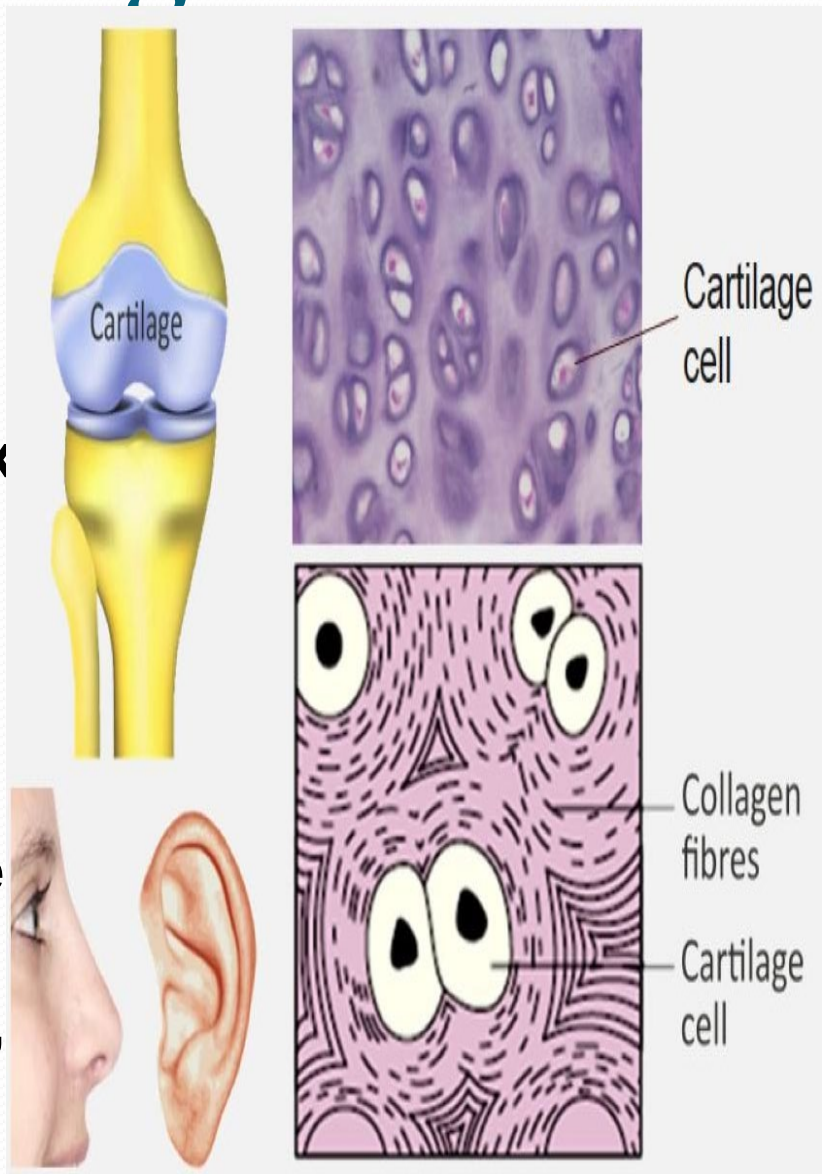
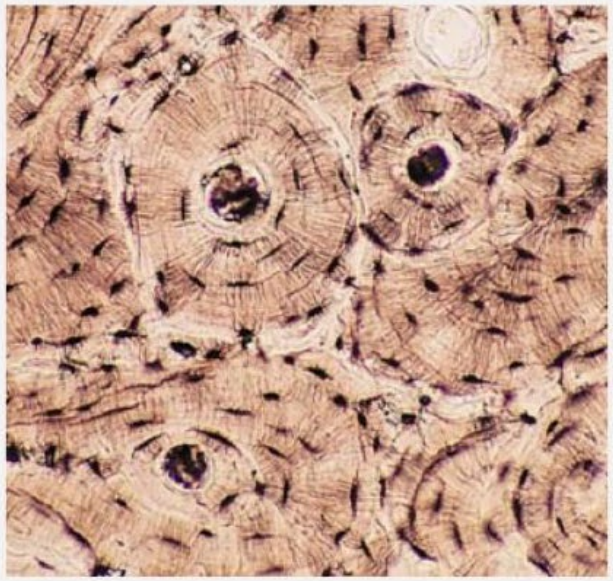
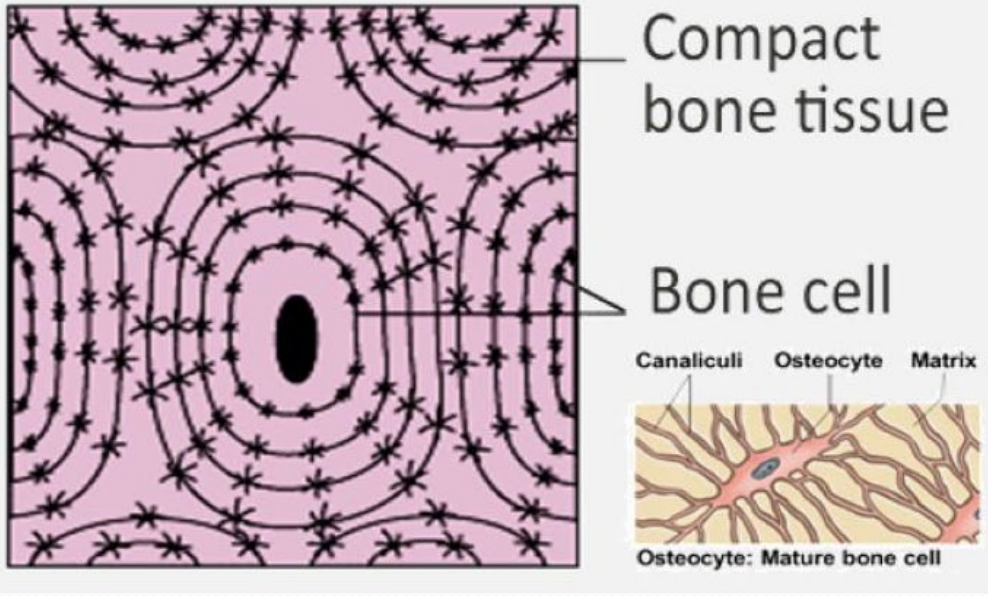


Bones

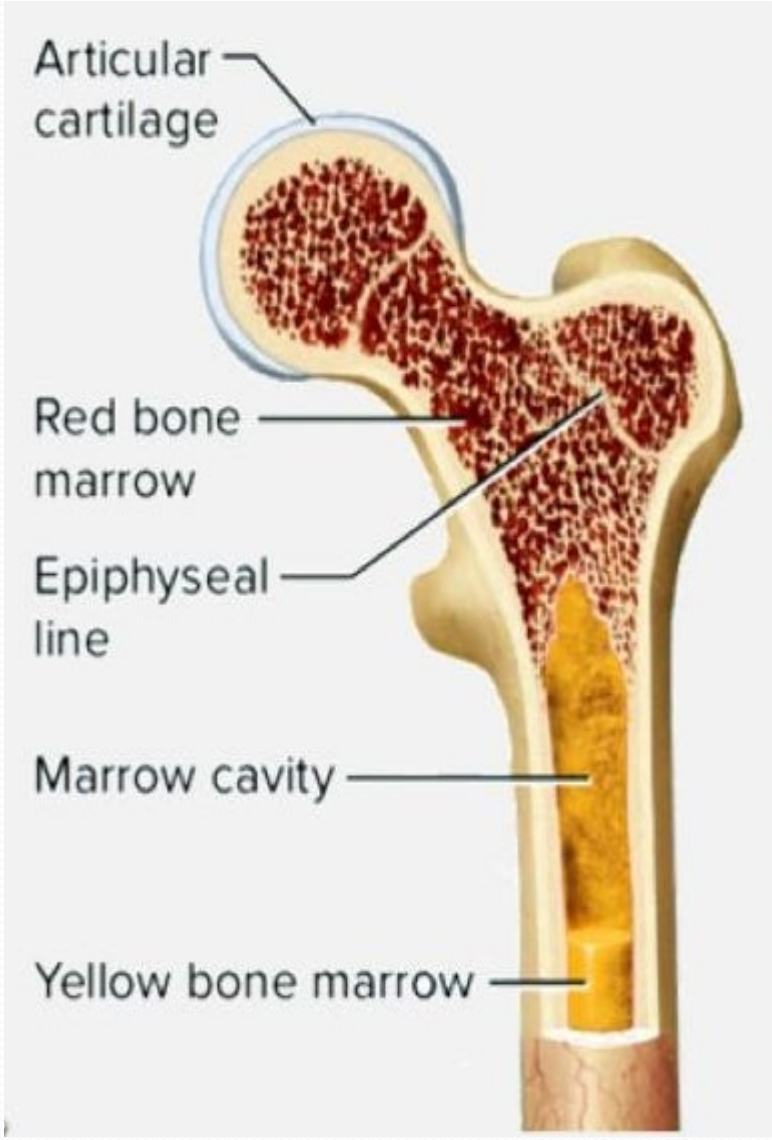
- **a hard and non-pliable ground substance rich in calcium salts and collagen fibres which give bone its strength.**
- **bone cells (*osteocytes*) are present in the spaces called lacunae.**





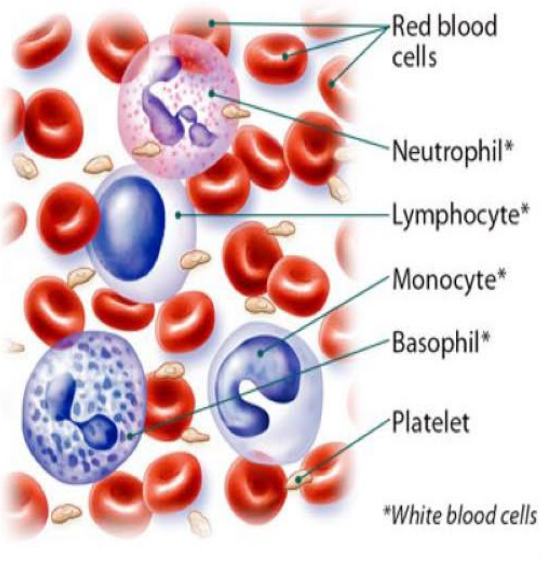
Functions of Bones:

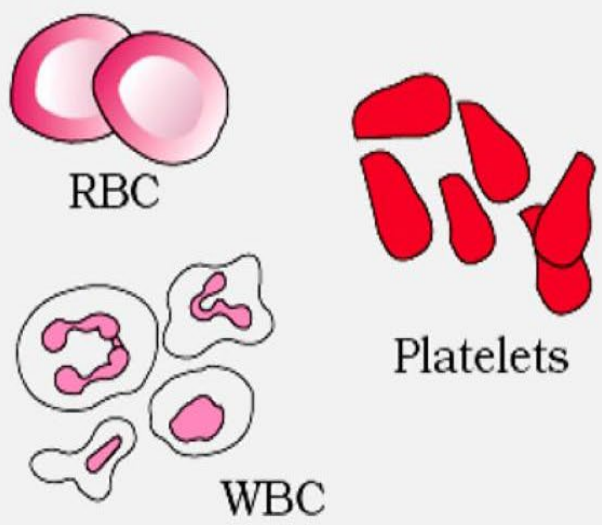
- provide structural frame to the body.
- support and protect softer tissues and organs.
- Limb bones, e.g.long bones of the legs, serve weight-bearing functions.
- Also interact with skeletal muscles attached to them to bring about movements.
- The bone marrow in bones is the site of production of blood cells.



Blood

- a fluid connective tissue containing plasma, red blood cells (RBC), white blood cells (WBC) and platelets.
- main circulating fluid that helps in the transport of various substances.

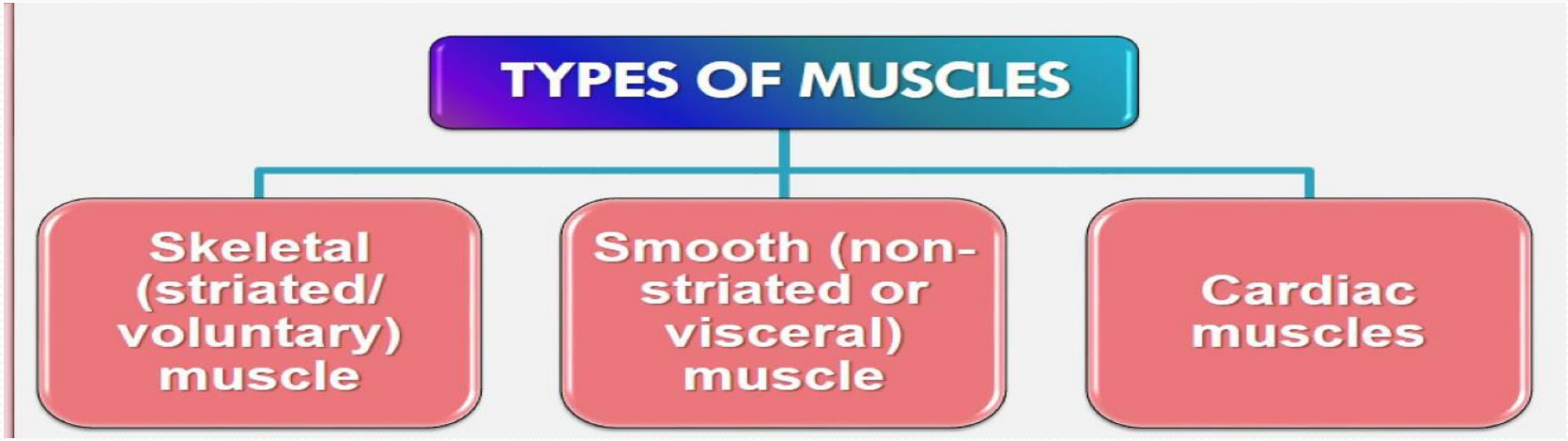


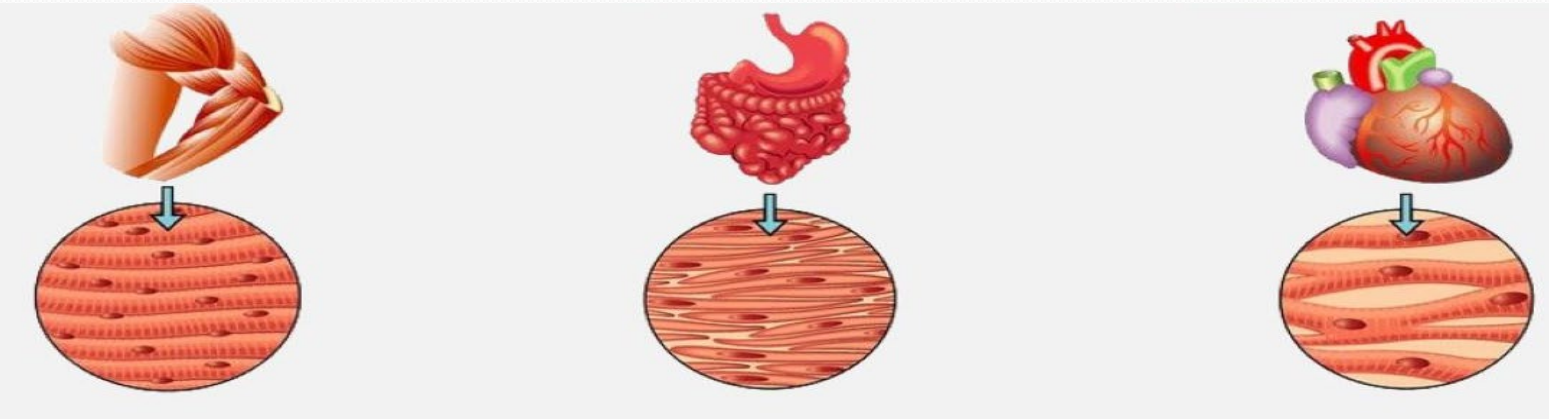


7.1.3 Muscle Tissue

- 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.



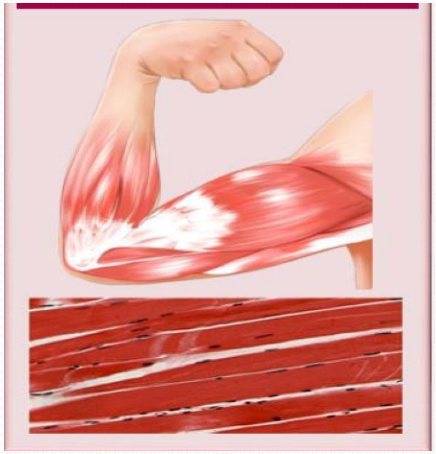


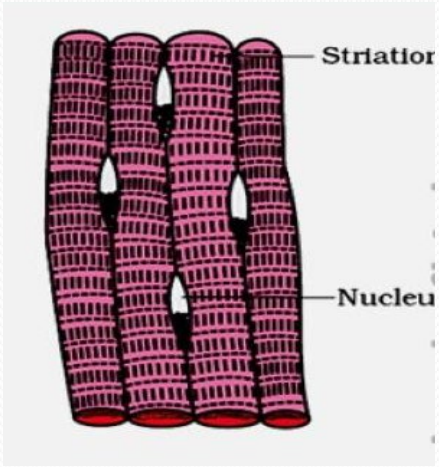
i. Skeletal (Striated/Voluntary) Muscle

- closely attached to skeletal bones.
- Striations present in muscle fibre.
- In a typical muscle [biceps]

  striated (striped) skeletal muscle fibres are bundled together

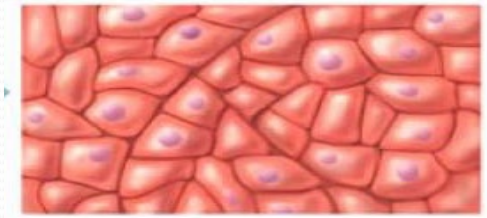
  in a parallel fashion.
- A sheath of tough connective tissue encloses several bundles of muscle fibres.





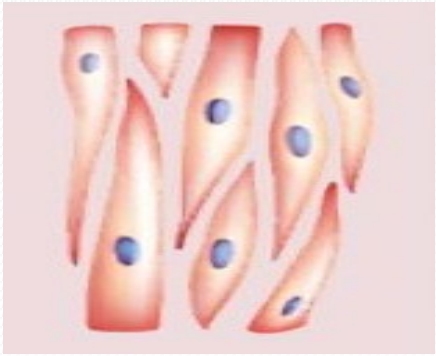
ii. Smooth (Non-striated/ Visceral) muscle

- 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.
- Found in the wall of internal organs such as the blood vessels, stomach and intestine.
- 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.]



Longitudinal layer of smooth muscle

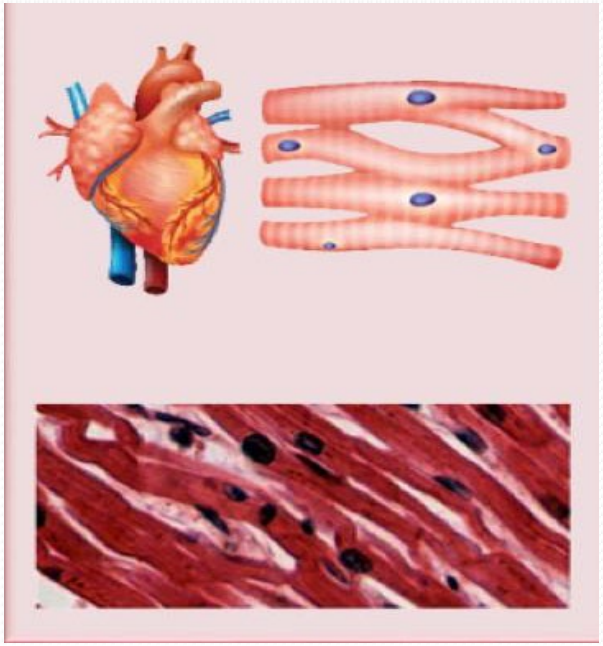
Circular layer of smooth muscle



iii. Cardiac muscle tissue

- a contractile tissue [involuntary] 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

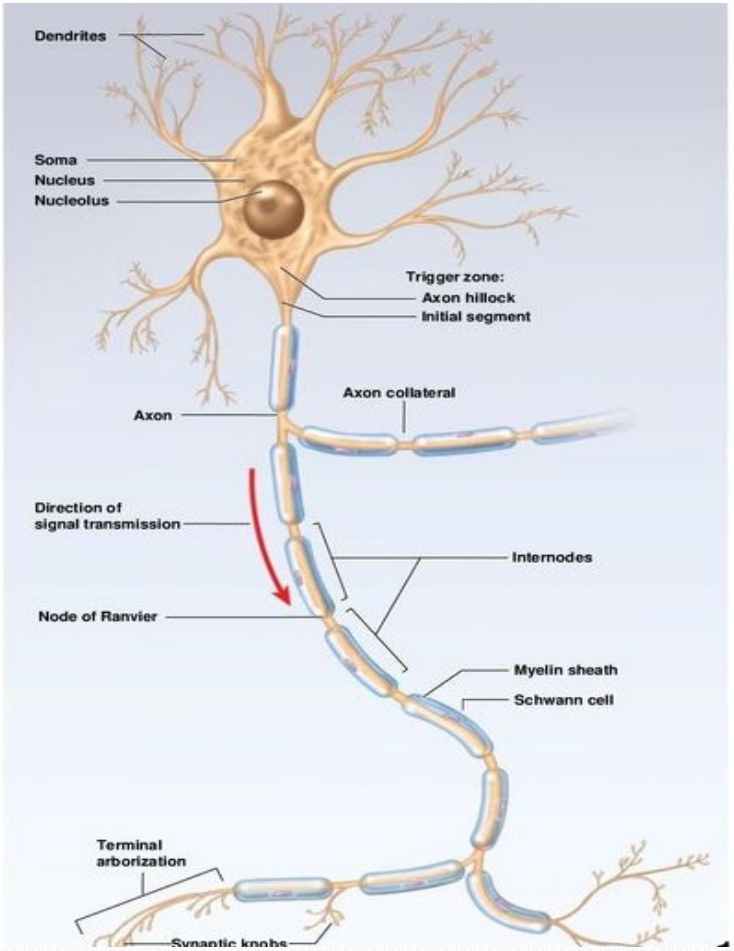
- Neural tissue exerts the greatest control over the body is responsiveness to changing conditions.
- Responsible for control & coordination of body.
- Neurons, the unit of neural system are excitable cells.
- The neuroglial cell which constitute the rest of the neural system protect and support neurons.
- Neuroglia make up more than one half (1½) 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.

7.1.4 Neural Tissue

- makes the nervous system and composed of specialized cells called neuron.
- A neuron consists of a **cell body (cyton)** with a nucleus and cytoplasm from which numerous hair like structures arise called **dendrites**.
- One long extension is called **Axon**.
-Neurons are connected end to end to form nerves through connective tissue. Nervous tissues are found in brain, spinal cord and nerves.

Functions: i. give us ability to respond to stimuli.
ii. transmit information from body parts to brain.
iii. transmit orders from brain to body parts.
Nervous and muscular tissue together control body movement in all animals.



- *THANK YOU.!*