Chapter 4
Tissues of Living Organisms

- **Tissue** is a group of similar cells.
- In organization (hierarchy of life), **tissues** lie at intermediate level between cells and organs.
- Organs are then formed by combining the functional groups of multiple **tissues.**
- **2 types of Tissues**:

1. Plant tissues
2. Animal tissues

Plant Tissues	Animal Tissues
Plants do not move from place to place Most of the cells provide mechanical support So most of them are dead cells	Animals move from place to place So most cells in animals are living cells
The growth of plants takes place only in some regions of the body	The growth of animals is more uniform

Plant tissues are of 2 main types:

They are Meristematic and Permanent tissues.

1. **Meristematic tissues** (3 types):
   a. Apical meristematic
   b. Lateral meristematic
   c. Intercalary meristematic
2. **Permanent tissues** (2 types):
   a. Simple permanent tissues (3 types)
   (Parenchyma – Collenchyma – Sclerenchyma)
   b. Complex permanent tissues (2 types):
   (Xylem – Phloem)

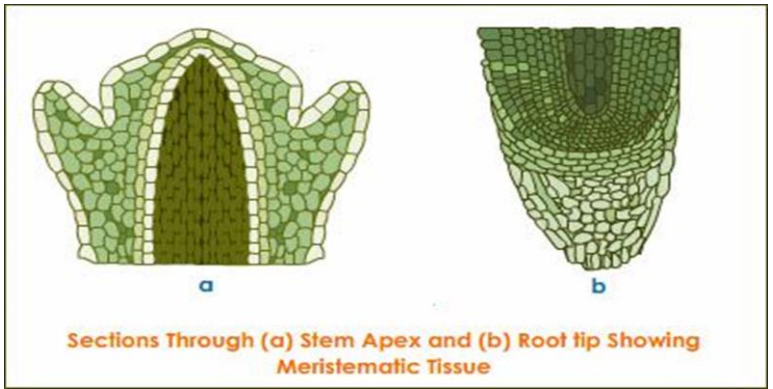
1. Meristematic tissues

- Meristematic tissues are found in the growing regions of the plant like the tips of root, stem and branches.
- They divide continuously and help in plant growth.
- They are 3 types:

a. **Apical meristematic:** at the tips of stems and roots. They help in the growth of stems and roots.

b. **Lateral meristematic:** at the sides of stems and roots. They help to increase the width of the stems and roots.

c. **Intercalary meristematic:** at the base of leaves and internodes and help in the growth of those parts.



Sections Through (a) Stem Apex and (b) Root tip Showing Meristematic Tissue

2. Permanent tissues

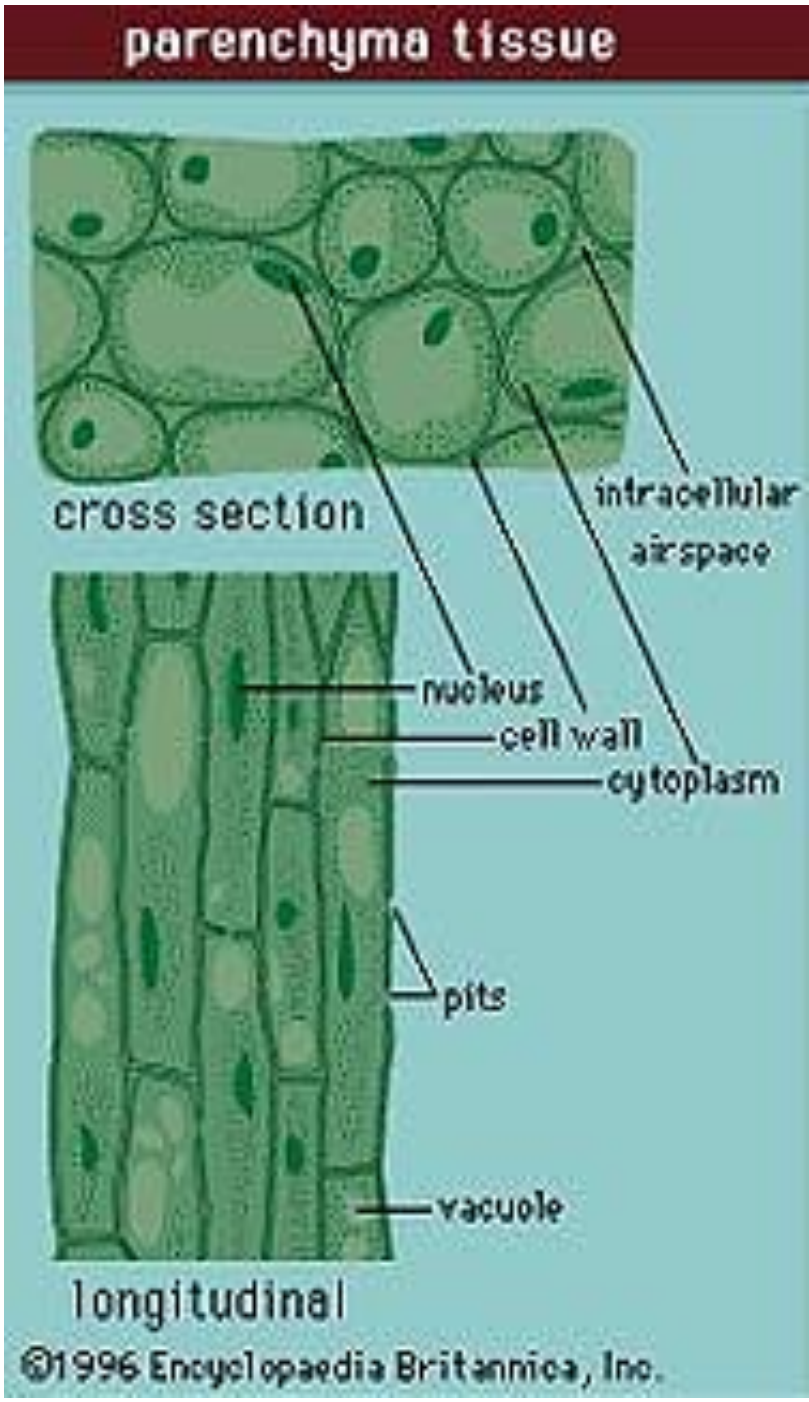
- Permanent tissues are formed from meristematic tissues.
- They do not divide and have permanent shape and size.
- They are 2 types: simple and complex permanent tissues.

a. Simple permanent tissues:

- Consist of one type of cells.
- These cells may be Parenchyma or Collenchyma or Sclerenchyma.

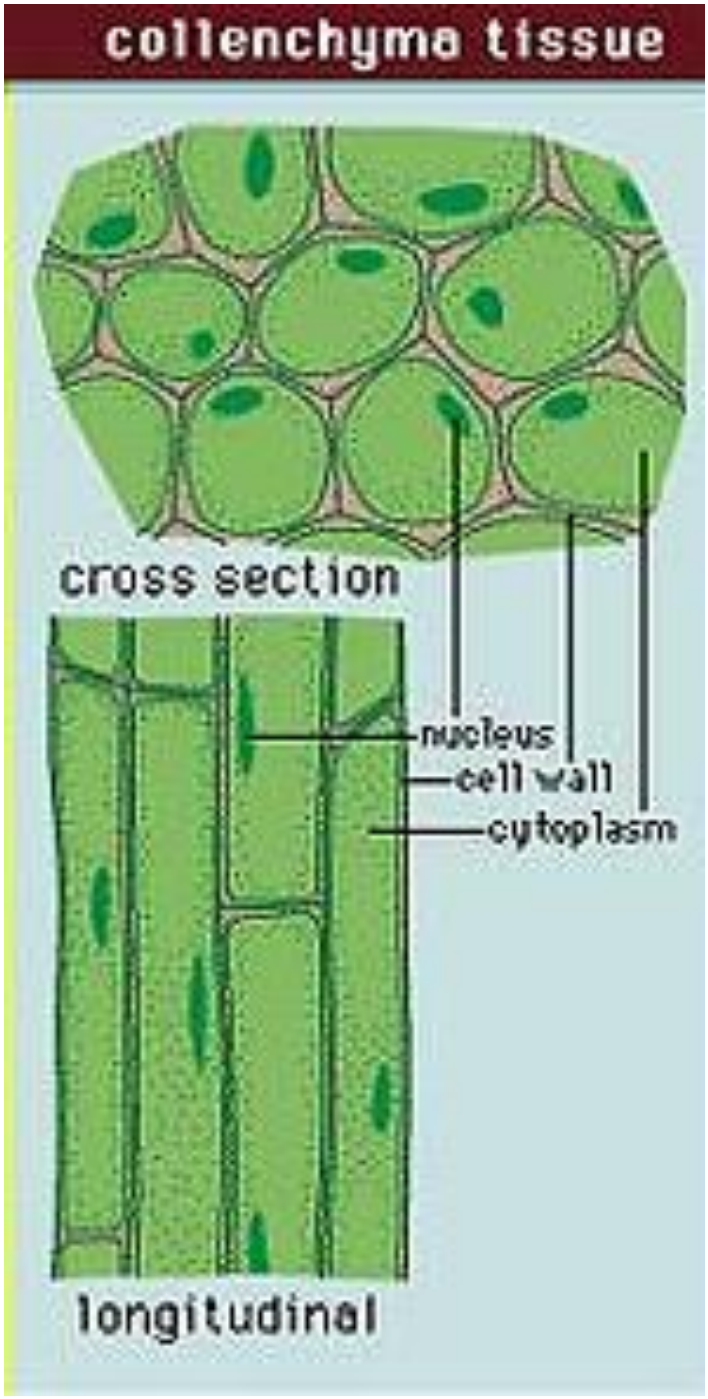
Parenchyma

- Loosely packed thin walled cells having more intercellular spaces.
- Some parenchyma cells in leaves contain chloroplasts and do photosynthesis.
- Some parenchyma cells have large air cavities which help the plant to float on water.
- Some parenchyma cells of roots and stem store water and minerals.



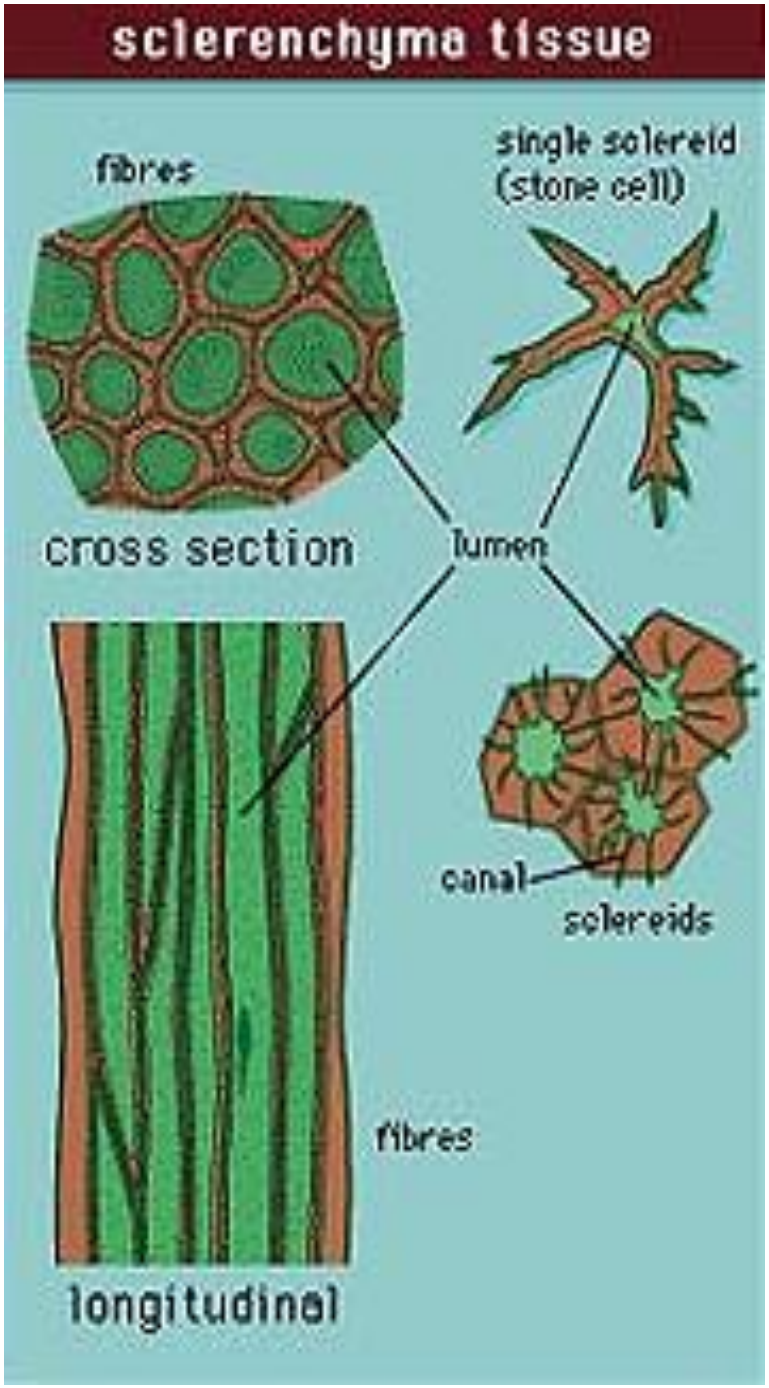
Collenchyma

- Elongated cells having less intercellular spaces and thicker at the corners.
- They give flexibility and allows easy bending of different parts like stem, leaf etc.
- They give mechanical support to the plant.



Sclerenchyma

- Long, narrow, dead thick walled cells.
- The cell walls contain lignin (a chemical substance which act like cement and hardens them).
- It gives strength and hardness to the plant parts.

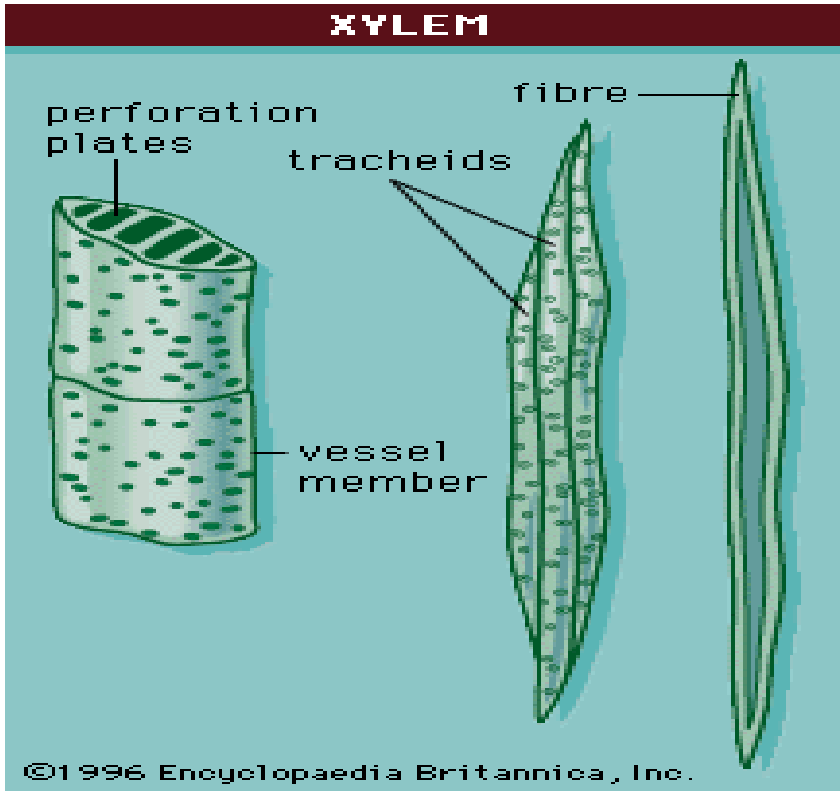


b. Complex permanent tissues

- Consist of more than one type of cells.
- There are two types: Xylem and Phloem. They are called vascular or conducting tissues.

Xylem: consists of tracheid, vessels, xylem parenchyma and xylem fibers.

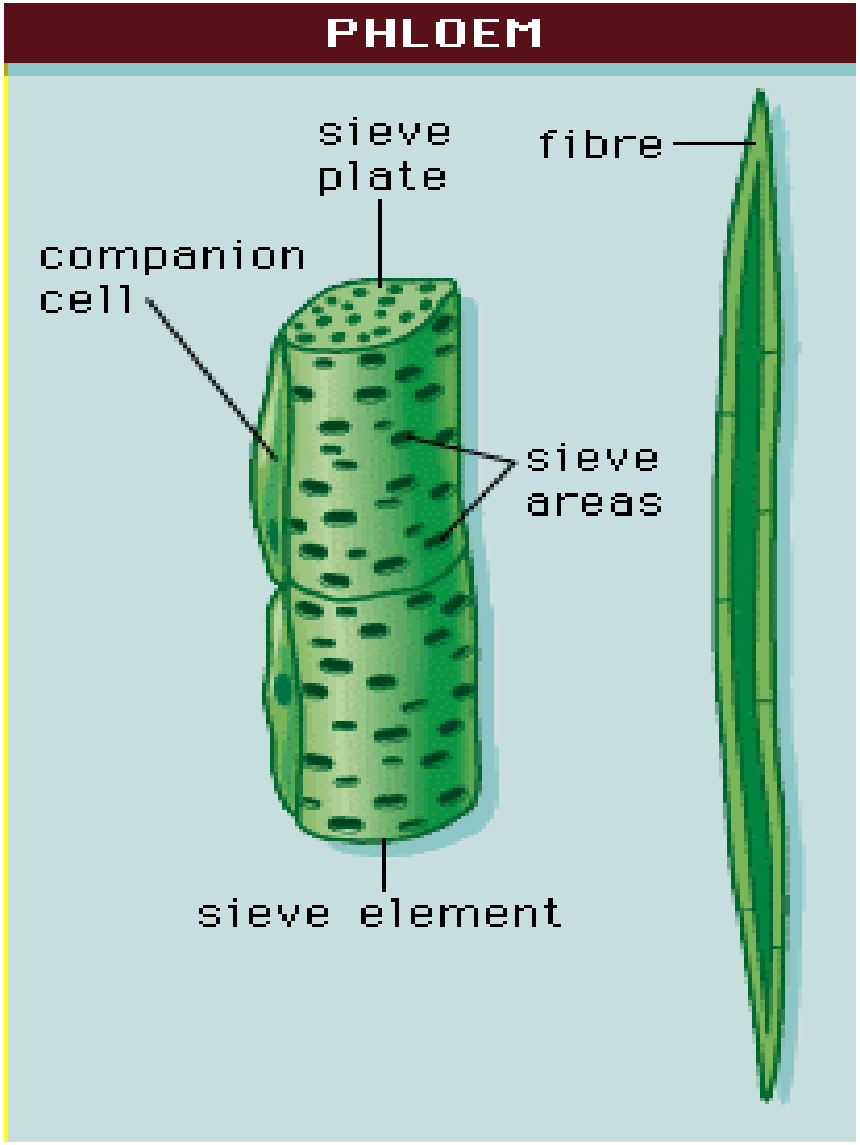
- The tracheid and vessels transport water and minerals from roots to all part of the plant.
- Xylem parenchyma stores food.
- Xylem fibers help in support.



Phloem:

consists of sieve tubes, companion cells, phloem parenchyma and phloem fibers.

- The sieve tubes and companion cells transport nutrients from leaves to all parts of the plant.
- Phloem parenchyma stores food
- Phloem fibers help in support.



Animal tissues

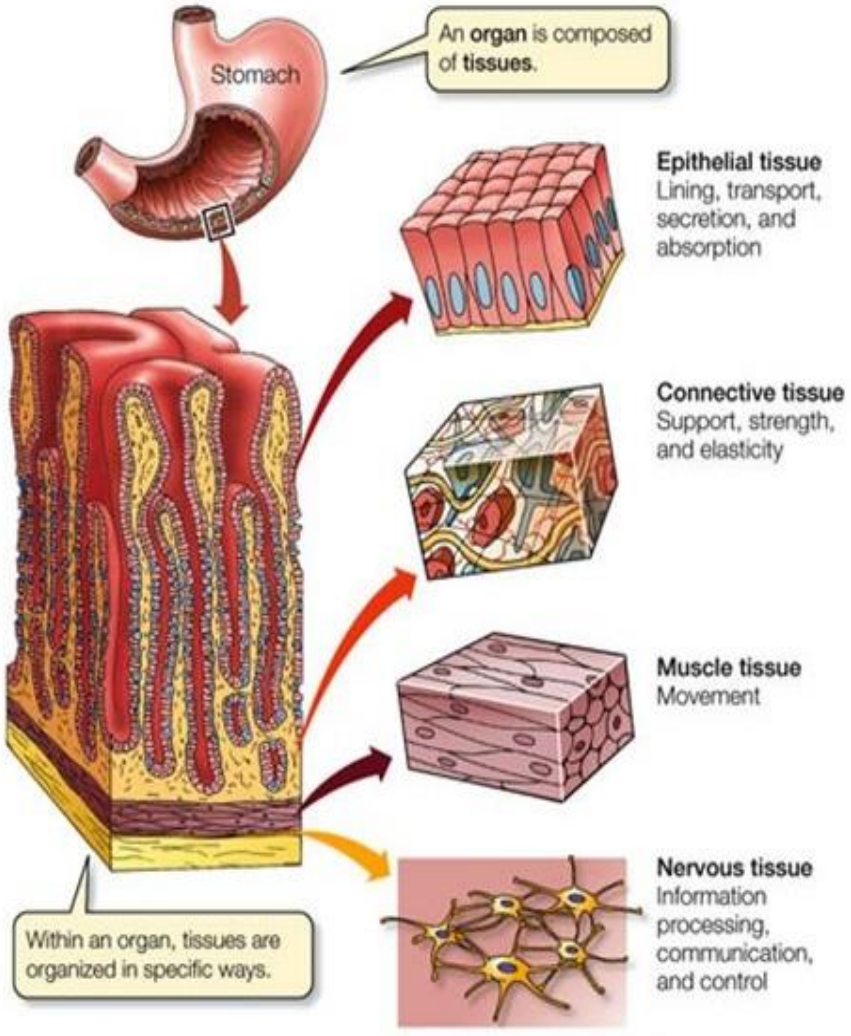
There are 4 types of tissues:

1- Epithelial tissue

2- Connective tissue

3- Muscular tissue

4- Nervous tissue



1- Epithelial tissue

Functions: line, cover and protect.

A. Types of epithelial tissue:

- **Covering and lining epithelium:**
  Include epidermis of skin, lining of blood vessels and ducts, lining of the respiratory, reproductive and urinary tract.
- **Glandular epithelium**:
  The secreting portion of glands (Example: thyroid, adrenal, and sweat glands).

B. General characteristics:

- Found on body surface (internal or external).
- Less extracellular matrix.
- Have free border or free surface.
- Cells rest on basement membrane.
- Origin: ectoderm or mesoderm or endoderm.

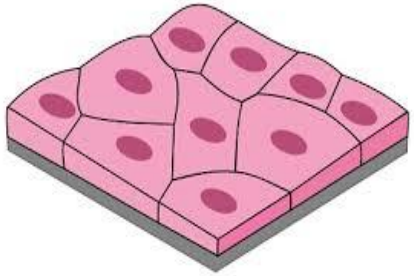
C. Epithelial tissue named by cell shape (squamous, cuboidal, columnar and pseudostratified) and by number of cell rows either one raw of cells (simple) or more than one raw of cells (stratified).

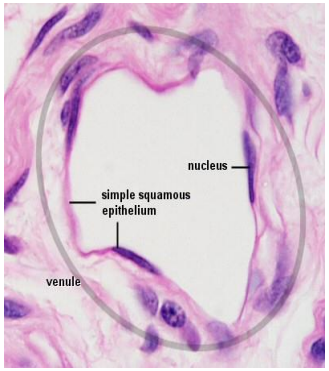
When cells are covered with cilia they are called ciliated.

A- Simple epithelium (One raw of cells)

1- Simple squamous:

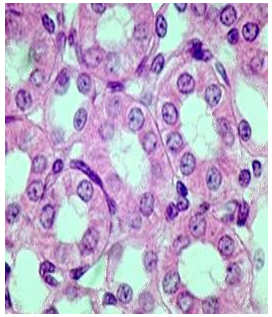
- Flat cells.
- Ex: lining of blood vessels.



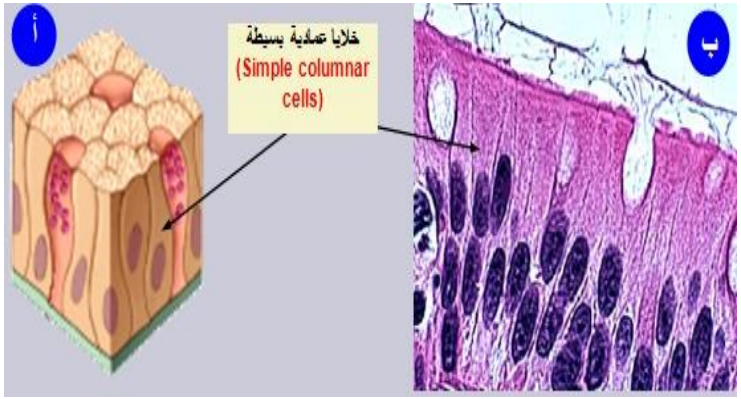


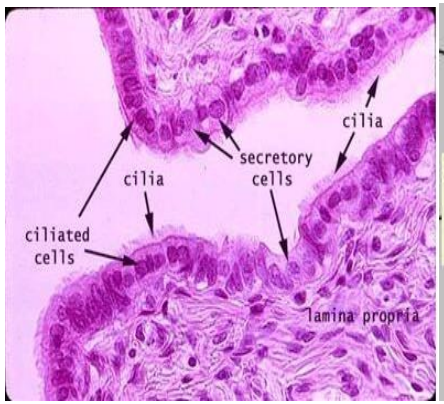
2- Simple cuboidal:

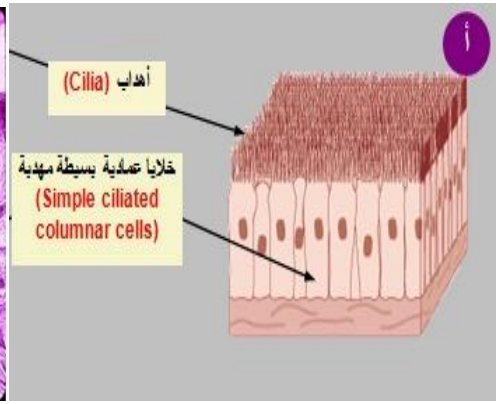
- Cuboidal cells.
- May be ciliated or non-ciliated.
- Ex: lining of Thyroid follicles.



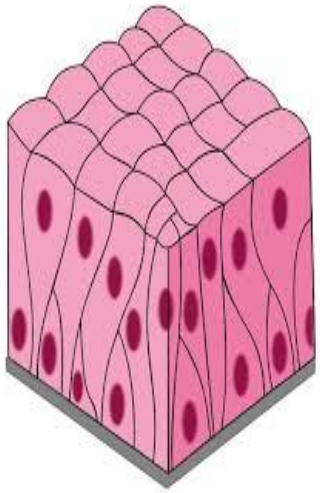
3- Simple columnar: Columnar cells, either ciliated (as in fallopian tube) or non-ciliated (as in small intestine).

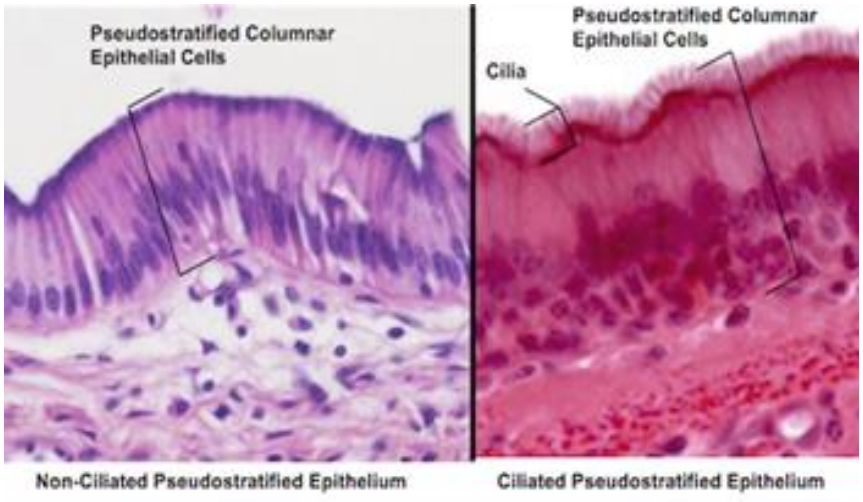


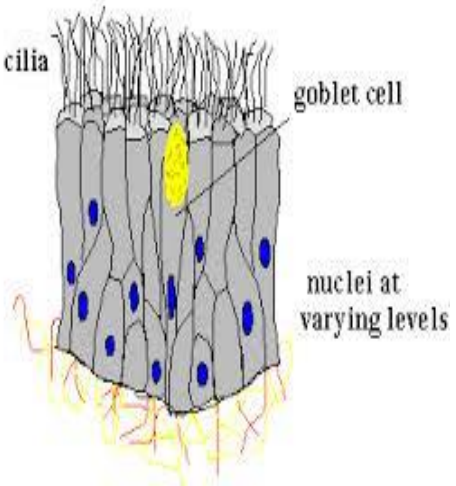




4- Pseudostratified: One layer of cells which are different in height, ciliated (as in Trachea) or non-ciliated (as in ureter).



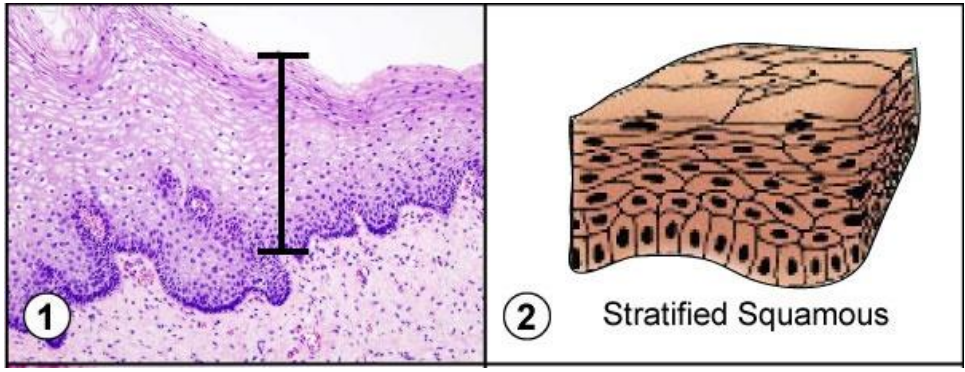




B- Stratified epithelium
(More than one raw of cells)

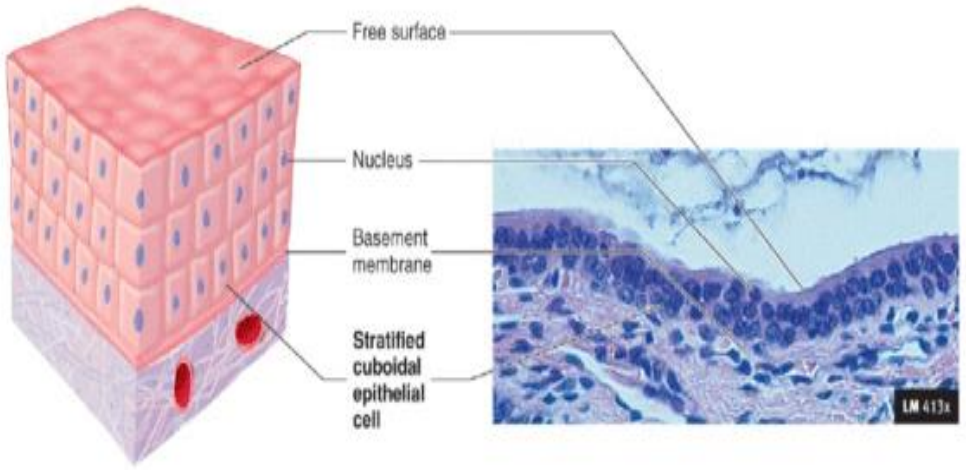
1- Stratified squamous:

- Flat cells at the surface.
- Ex: lining of the pharynx.



2- Stratified cuboidal:

- Cuboidal cells.
- Ex: Lining of sweat glands.



2- Connective tissue

General characteristics:

- Abundant extracellular matrix (ground substance).
- Mostly, the ground substance contains fibers.
- Cells do not rest on basement membrane.
- Origin: mesoderm.

Functions of connective tissue:

(connect, support and bind other tissues in the body**)**

- Binding of tissues and organs.
- Mechanical support.
- Storage of fat and certain minerals.
- Exchange of metabolite.
- Repair and healing of wounds.
- Protection against infection.

Types of connective tissues (CT)

1. Connective tissue proper

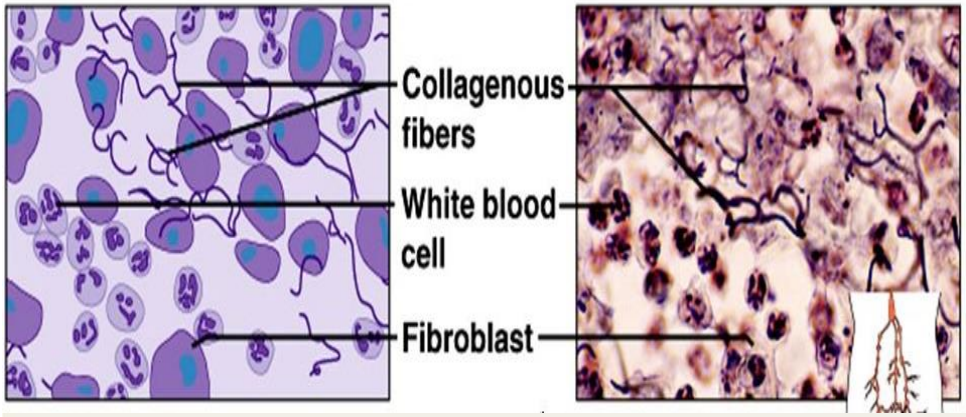
- **Areolar (loose) CT:** Supporting tissue of organs.
- **Adipose CT:** Store fat.
- **Fibrous (tendon) CT:** Forms strong, rope-like structures such as tendons and ligaments.
- **Reticular CT:** Crosslink fibers.
- **Mucous CT:** Found in the umbilical cord of the embryo.
- **Elastic CT:** Bundles of collagen and elastic fibers.

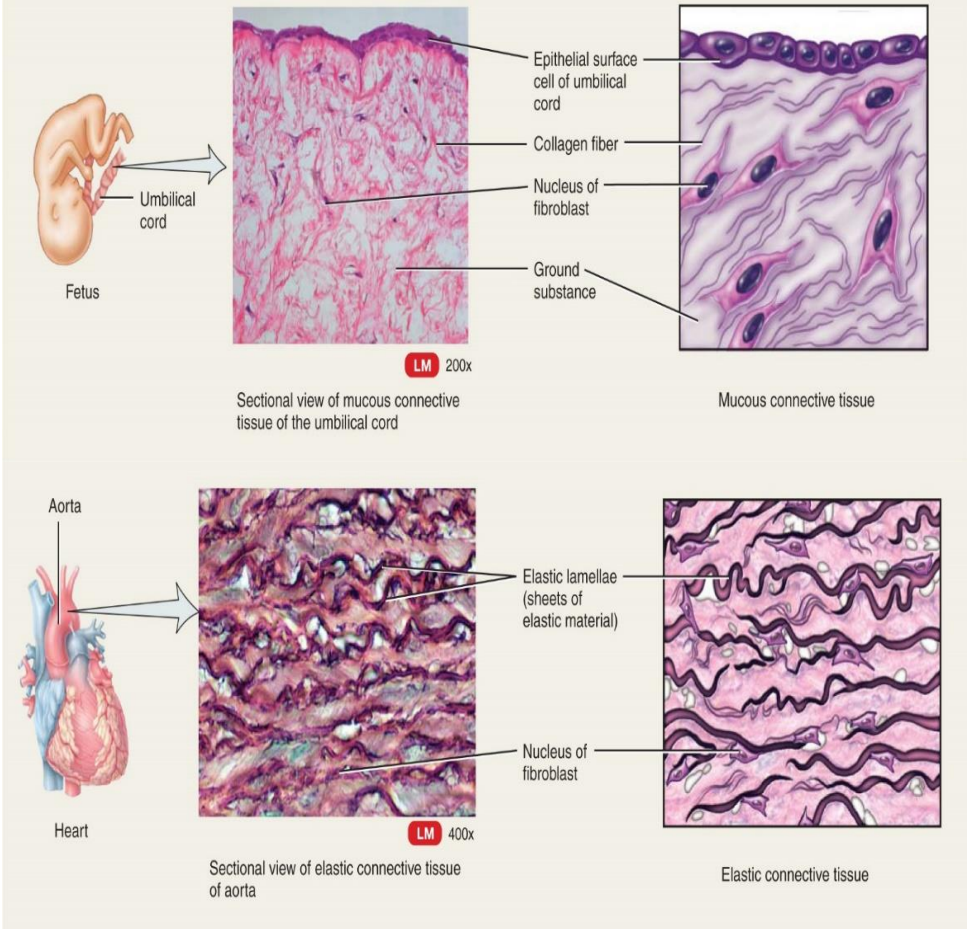
2. Supporting connective tissue

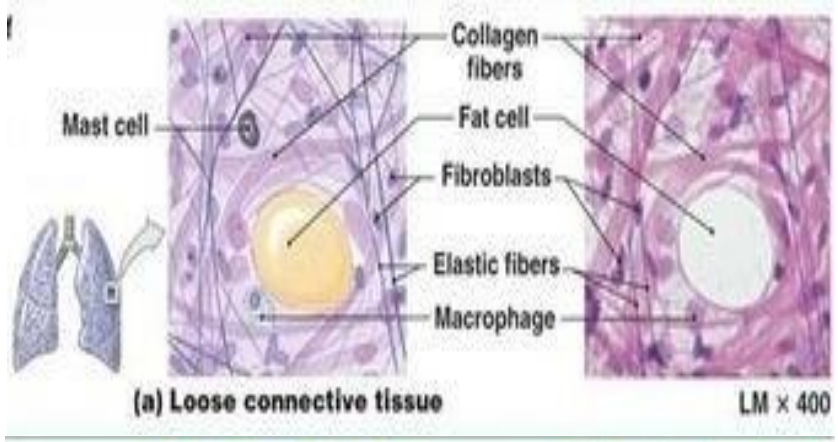
- Includes bone and cartilage.
- The ground substance is solid (as in bone) or semi-solid (as in cartilage).
- Both bone and cartilage have collagen and elastic fibers in their ground substance.

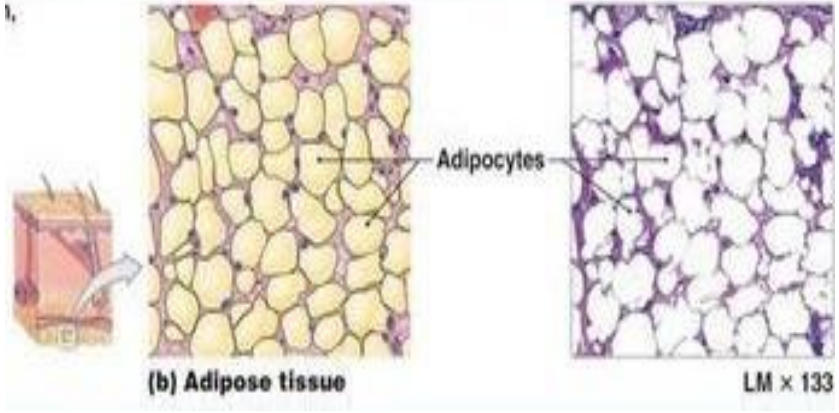
3. Fluid connective tissue

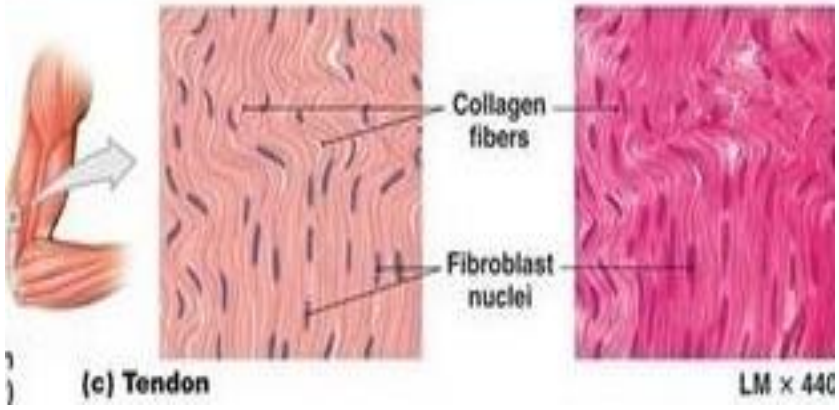
- Includes blood and lymph.
- The ground substance is fluid and do not contain fibers.
- Transport oxygen, carbon dioxide, nutrients and wastes throughout the body.


Collagenous fibers
White blood cell
Fibroblast


Umbilical cord
Fetus
Epithelial surface cell of umbilical cord
Collagen fiber
Nucleus of fibroblast
Ground substance
LM 200x
Sectional view of mucous connective tissue of the umbilical cord
Mucous connective tissue
Aorta
Heart
Elastic lamellae (sheets of elastic material)
Nucleus of fibroblast
LM 400x
Sectional view of elastic connective tissue of aorta
Elastic connective tissue


Collagen fibers
Mast cell
Fat cell
Fibroblasts
Elastic fibers
Macrophage
(a) Loose connective tissue
LM × 400


Adipocytes
(b) Adipose tissue
LM × 133


Collagen fibers
Fibroblast nuclei
(c) Tendon
LM × 440

3- Muscular tissue

- **Function**: movement of the body.
- There are 3 types of muscular tissues:

1. **Striated muscles**:

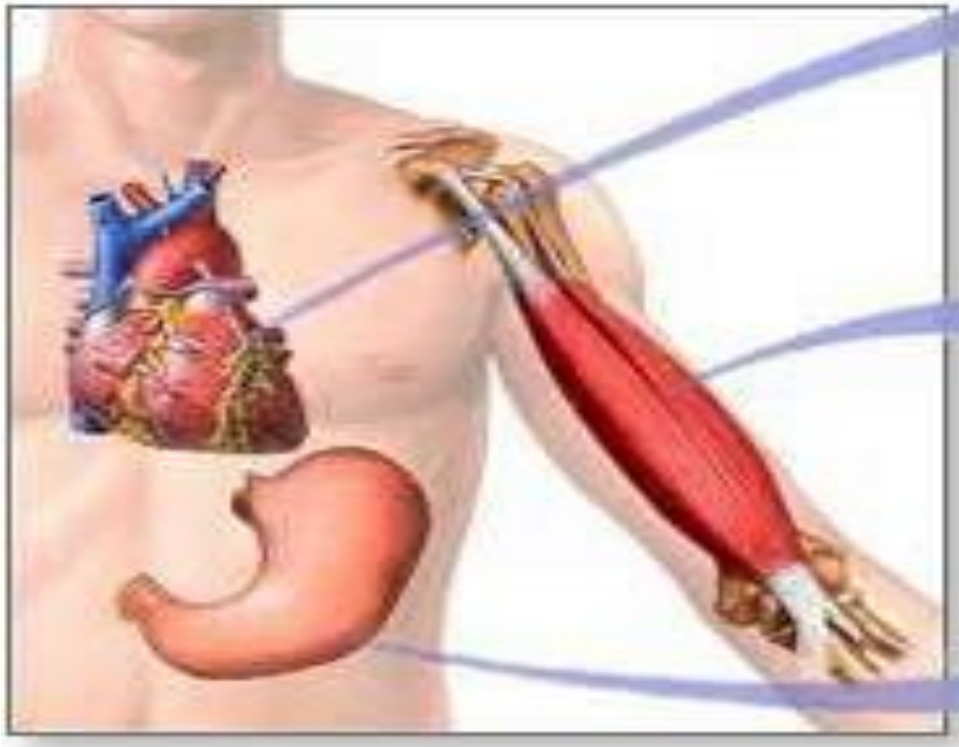
- Voluntary muscles with light and dark striations.
- Attached to skeleton so called skeletal muscles.

2. **Un-striated muscles (Smooth muscles)**:

- Involuntary muscles with no striations.
- Present in the alimentary canal, blood vessels and bronchi of lungs.

2. **Cardiac muscles**:

- Involuntary muscles with light and dark striations.
- Present in the heart only.



Cardiac muscle cell

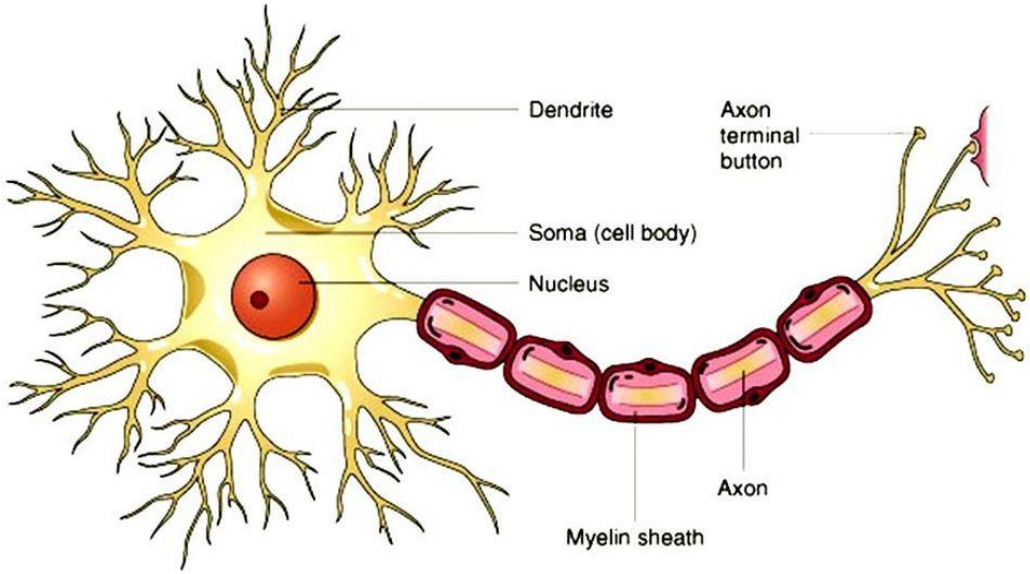
Skeletal muscle cell

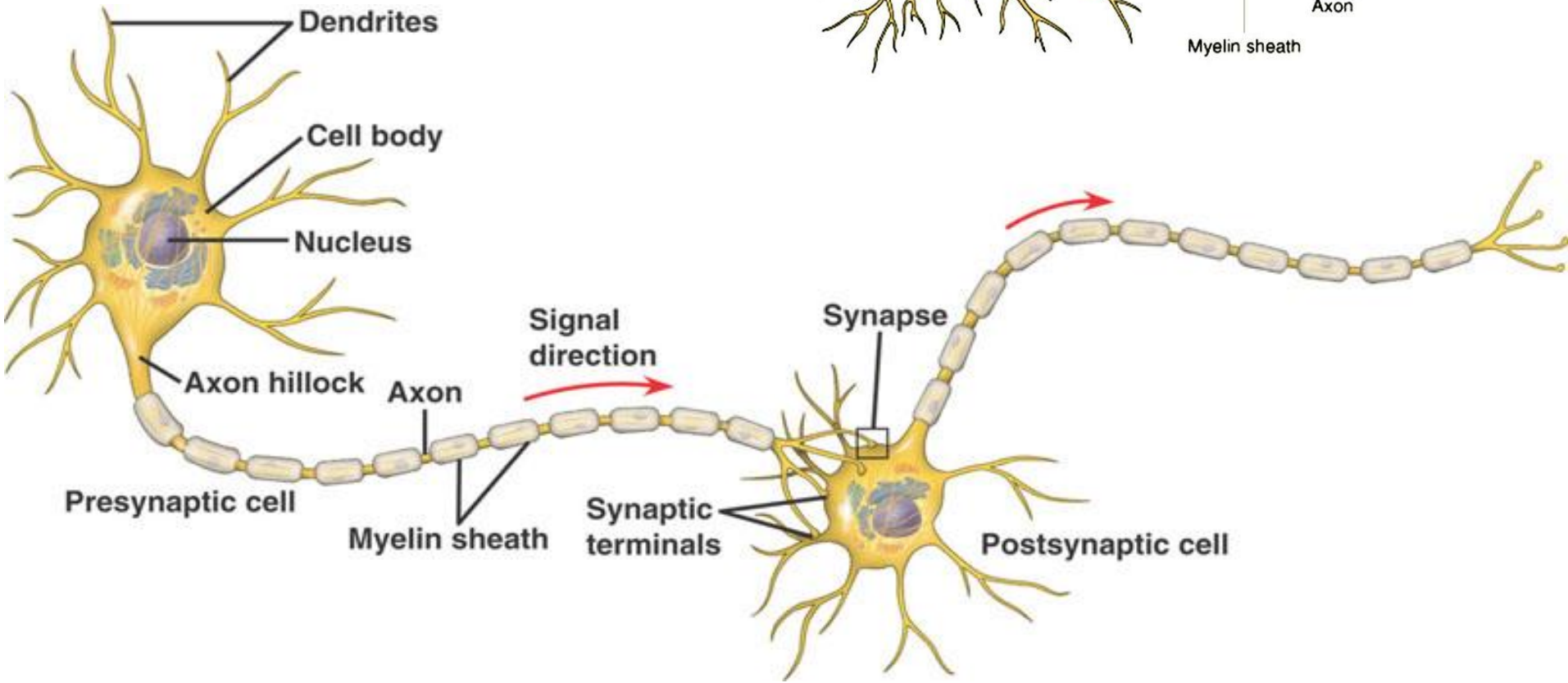
Smooth muscle cell

4- Nervous tissue

- Found in the nervous system (brain, spinal cord and nerves).
- Consists of nerve cells called **neurons**.
- Nervous tissue carry messages from one part of the body to the other and responds to stimuli.
- **Neuron (Nerve cell)**: Consist of
  1. **Cell body**: contain a nucleus and cytoplasm.
  2. **Dendrites**: many hair-like structures.
  3. **Axon**: single, long and ends with nerve endings. The axon is covered by a myelin sheath.

Neuron


Dendrite
Axon terminal button
Soma (cell body)
Nucleus
Axon
Myelin sheath


Dendrites
Cell body
Nucleus
Axon hillock
Axon
Signal direction
Synapse
Presynaptic cell
Myelin sheath
Synaptic terminals
Postsynaptic cell