

# DEPTH OF BIOLOGY

## Unit - I

Introduction to human body

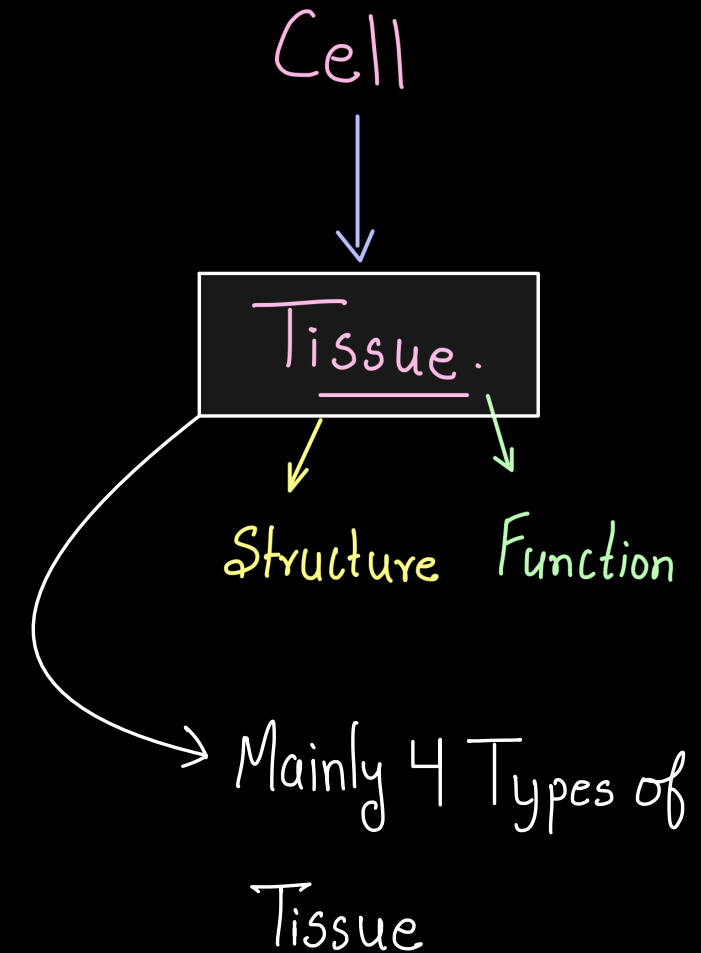
Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.

### Cellular level of organization

Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine

### Tissue level of organization

Classification of tissues, structure, location and functions of **epithelial**, **muscular** and **nervous** and **connective tissues**. → found in Bone, Blood, Fat.



Skin is Made up of Epithelial Tissue.

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## Tissue level organization

Tissue-level organization refers to the way cells in multicellular organisms are grouped together to perform specific functions. These groups of cells, called tissues, work together to carry out tasks that single cells cannot do alone. There are four main types of tissues in animals:

**Epithelial Tissue:** This tissue covers and protects the body and its organs. It also helps in absorption, secretion, and sensation. For example, the skin is made of epithelial tissue.

**Connective Tissue:** This tissue supports and connects other tissues. It also stores energy and helps in transport. Examples include bones, blood, and fat.

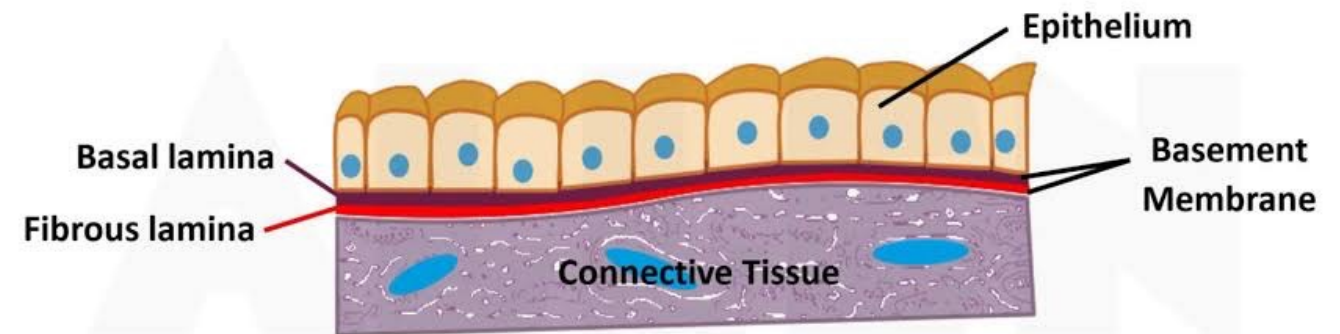
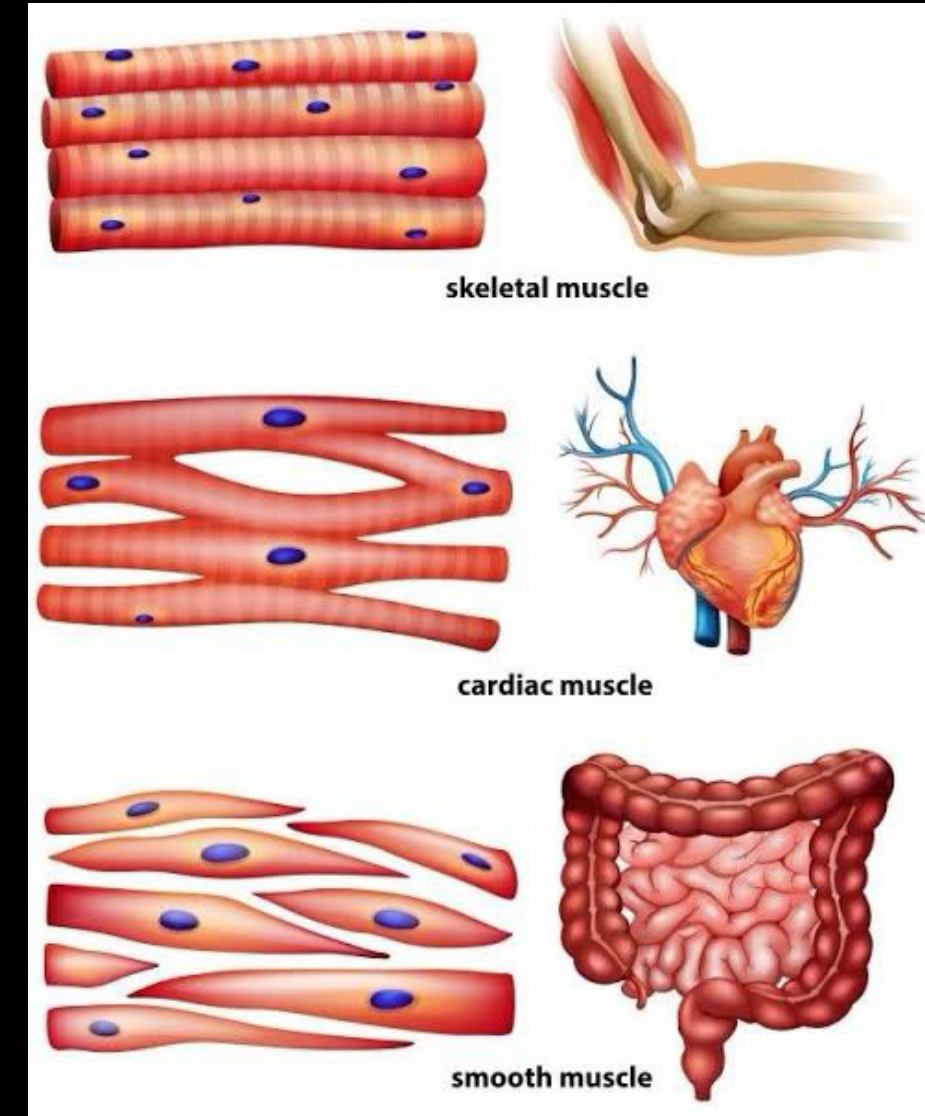


Figure : Epithelial Tissue

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**Muscle Tissue:** This tissue is responsible for movement. It can be voluntary (like skeletal muscles that move your limbs) or involuntary (like heart muscles that pump blood).

**Nervous Tissue:** This tissue is responsible for transmitting electrical signals, allowing communication between different parts of the body. It includes the brain, spinal cord, and nerves.



In tissue-level organization, these different tissues come together to form organs (like the heart, lungs, or skin), which work together in organ systems (like the digestive or nervous systems) to keep the body functioning.

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## Classification of Tissue

Tissues in animals can be classified into four main types based on their structure, function, and location. These are:

Epithelial Tissue  
Connective Tissue  
Muscle Tissue  
Nervous Tissue

So, It receive Nutrition  
from Underlying Tissue.

↑  
Avascular  
X (Blood Vessle)

Lining of Body Surface → Inner-  
→ Outer.

→ Protection  
Filtration  
Absorbtion  
Secretion  
Lubrication.

### 1. Structure, location and functions of **epithelial Tissue**

Epithelial tissue is one of the four primary tissue types in the body. It forms the lining of body surfaces, both inside and outside, and it is involved in a variety of crucial functions, such as protection, secretion, absorption, and filtration.

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Structure of **Epithelial Tissue** → Consist of Tightly Packed Cell.  
Arrange in Continuous Layer.  
Or Sheet.

## 1. Cell Shape and Arrangement:

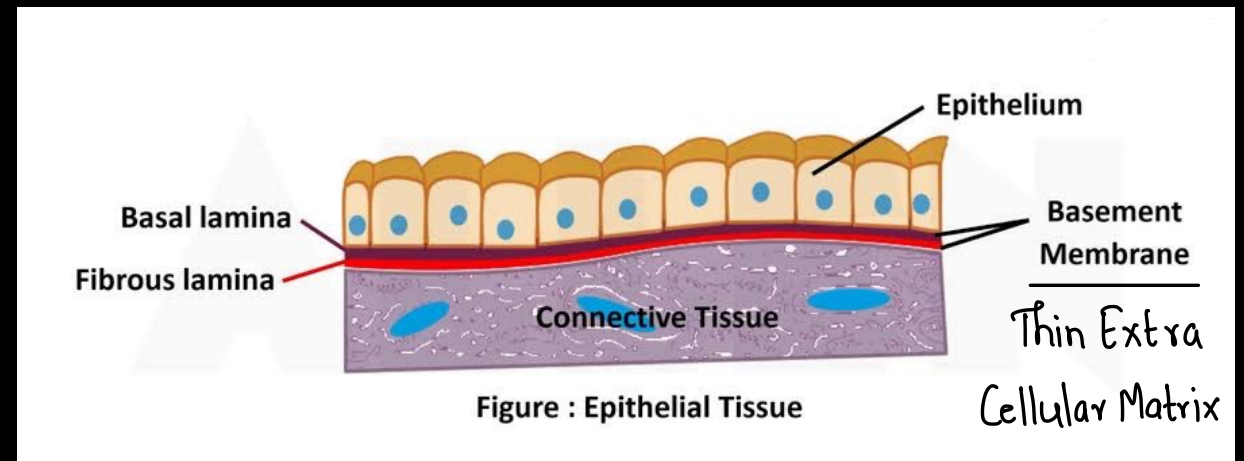
**Cellularity:** Epithelial tissue consists of tightly packed cells with very little extracellular matrix between them. The cells are arranged in continuous layers or sheets, making it effective for protection and covering surfaces.

**Cell Shape:** Epithelial cells can have different shapes depending on the specific type of epithelium:

**Squamous:** Flat, scale-like cells.

**Cuboidal:** Cube-shaped cells.

**Columnar:** Tall, column-like cells.





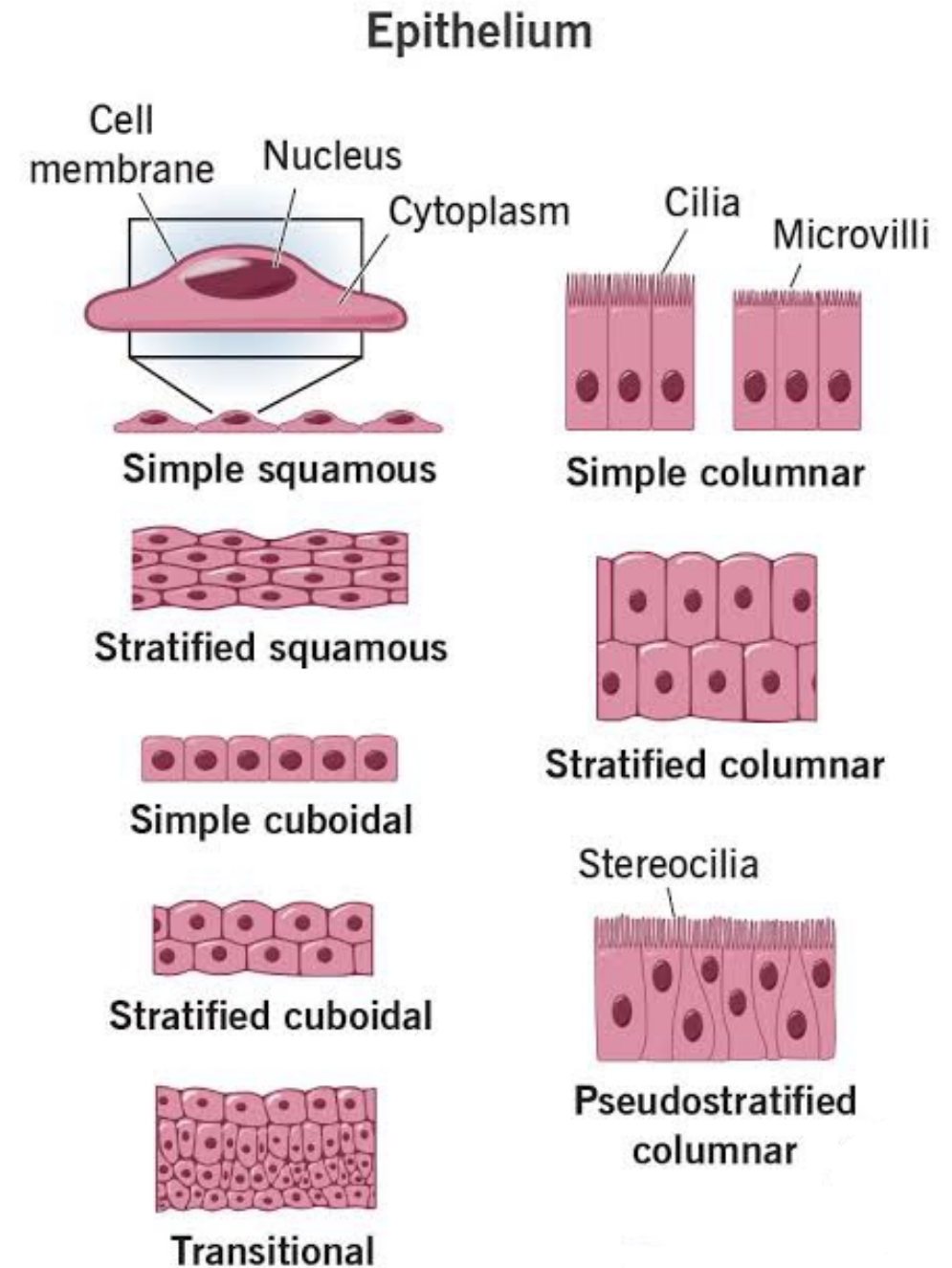
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## Cell Arrangement / Structure

**Simple epithelium:** Simple epithelium is a type of epithelial tissue characterized by a single layer of cells directly resting on the basement membrane, and it's commonly found in areas where absorption, secretion, and filtration occur, such as lining blood vessels and body cavities

**Stratified squamous epithelium:** Stratified squamous epithelium is a type of tissue characterized by multiple layers of flattened cells, serving primarily a protective function, found in areas subject to wear and tear, like the outer layer of skin (epidermis).

**Simple cuboidal epithelium** is a type of epithelium that consists of a single layer of cuboidal (cube-like) cells which have large, spherical and central nuclei.



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Single Layer of Cell directly.

Resting on Basement Membrane

Commonly found in Area

Where Absorption, Filtration

& Secretion Occur. (Blood Vessel).

Multiple Layer of Flattened Cell.

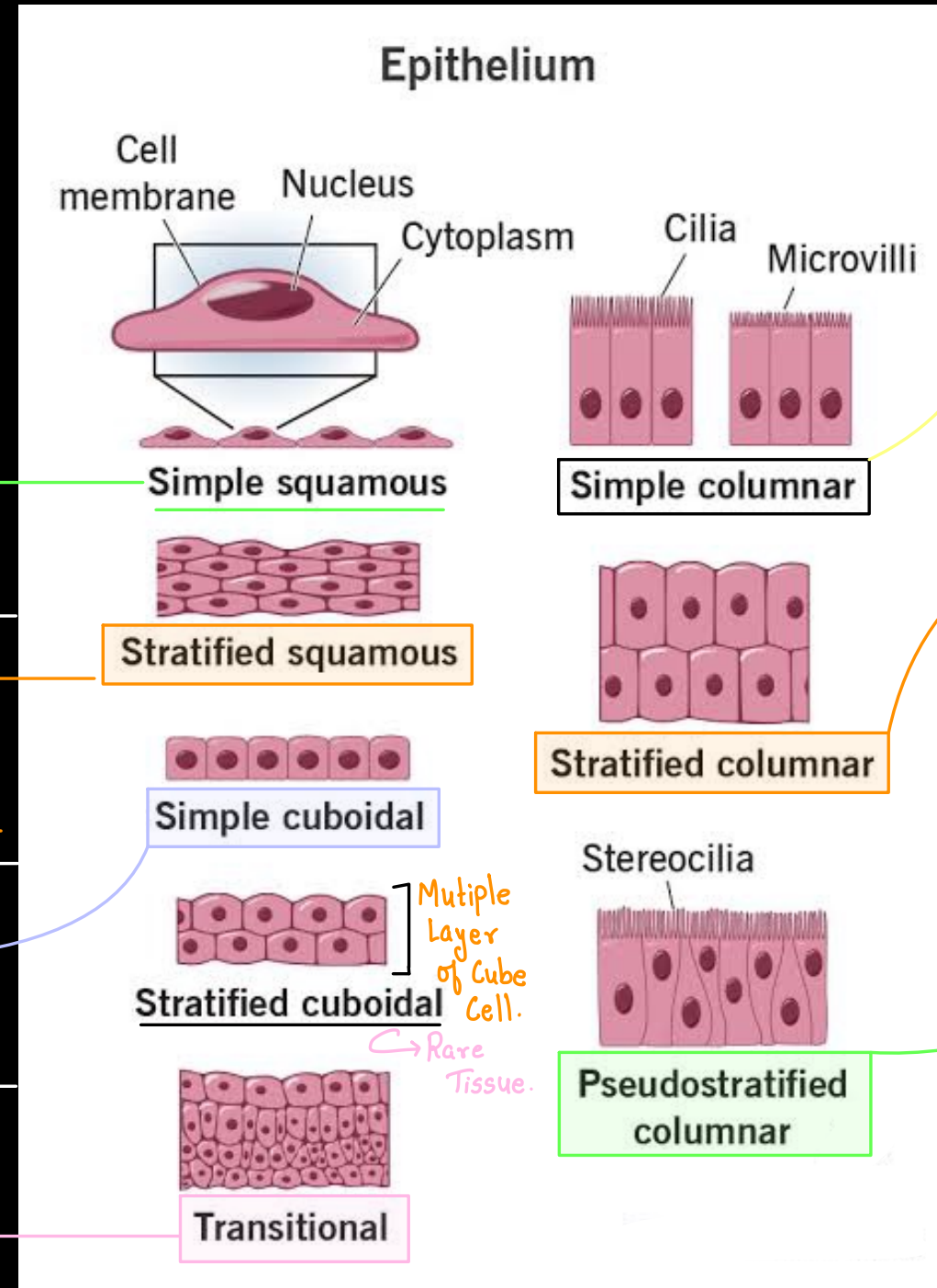
It have protective function (Skin, Epidermis).

• Single Layer of Cuboidal Cell

Which have large Spherical Central Nuclei

Stretchy Tissue that Line the Urinary

Tract, Bladder, Ureter, Urethra. / Also Known as Urothelium.



Single Layer of tall Elongated Cell. (for Absorption, Secretion) found in Lining of Digestive Tract.

Rare type of Epithelial Tissue

Multiple Layer of Column Shape

Cell. (for Absorption & Secretion)

found in Digestive Tract.

Appeared Layer but it is Single Layer of Cell with Varying Height & Nuclei position.

found in → Respiratory Tract & Male Reproductive System.

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**Stratified cuboidal epithelium**– is a rare type of tissue made of multiple layers of cube-shaped cells. It's found in the lining of excretory ducts, such as those of the salivary and sweat glands. It also appears in the mammary glands and developing ovarian follicles

**Transitional epithelium** is a stretchy tissue that lines the urinary tract, including the bladder, ureters, and urethra. It's also known as urothelium.

**Simple columnar epithelium** is a tissue type characterized by a single layer of tall, elongated cells, often specialized for absorption and secretion, and commonly found lining the digestive tract and other areas involved in these processes

**Stratified columnar epithelium** is a rare type of epithelial tissue characterized by multiple layers of column-shaped cells, typically found in the conjunctiva, pharynx, anus, and male urethra, primarily serving protective and mucus-secreting functions



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**Pseudostratified columnar epithelium** appears layered but is actually a single layer of cells with varying heights and nuclei positions, commonly found in the respiratory tract and male reproductive system

**Basement Membrane:** Epithelial tissue rests on a thin extracellular matrix called the basement membrane, which helps anchor the epithelium to underlying tissues. It consists of proteins like collagen and glycoproteins.

**Avascular:** Epithelial tissue does not have blood vessels. It receives nutrients through diffusion from underlying tissues.

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## Location of Epithelial Tissue:

Epithelial tissues are found throughout the body, lining both external and internal surfaces. Some of the key locations include:

### External Surfaces:

**Skin:** Stratified squamous epithelium (epidermis) serves as a protective layer.

### Internal Surfaces:

Lining of the digestive tract: Simple columnar epithelium, which is specialized for absorption.

Lining of blood vessels: Simple squamous epithelium (endothelium).

Lining of the respiratory tract: Pseudostratified columnar epithelium, often with cilia to help move mucus and foreign particles.

Lining of the urinary bladder: Transitional epithelium, which allows stretching as the bladder fills.

**Kidneys:** Simple cuboidal epithelium in the tubules for filtration and absorption.

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## Glands:

Exocrine glands: These glands secrete substances like enzymes, sweat, or mucus into ducts.

Epithelial tissue forms the glands and ductal systems (e.g., salivary glands, sweat glands).

Endocrine glands: Epithelial tissue also forms endocrine glands, which secrete hormones directly into the bloodstream (e.g., thyroid, adrenal glands).

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## 3. Functions of Epithelial Tissue:

Epithelial tissue has a variety of functions based on its location and structure. These include:

### Protection:

Epithelial tissue acts as a physical barrier, protecting underlying tissues from mechanical damage, pathogens, and dehydration.

For example, the skin's stratified squamous epithelium protects against physical abrasion and microbial invasion.

### Absorption:

Specialized epithelial tissues absorb nutrients and other substances. For instance, simple columnar epithelium in the intestines absorbs nutrients, while epithelial tissue in the kidneys helps absorb water and electrolytes.

 Intestine (Simple Columnar Epithelium) → Absorb Nutrient

### Secretion:

Glandular epithelial cells produce and secrete various substances. For example, exocrine glands secrete sweat, mucus, or digestive enzymes, and endocrine glands secrete hormones into the bloodstream.



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## Excretion:

Epithelial tissue also plays a role in removing waste products from the body, such as in the kidneys where epithelial cells in the tubules help to filter out waste.

## Sensation:

Epithelial tissue contains sensory receptors that help detect changes in the environment, such as in the skin where it is involved in sensing touch, temperature, and pain.

## Gas Exchange:

In organs like the lungs, the simple squamous epithelium allows for the efficient exchange of gases (oxygen and carbon dioxide) across the alveolar walls.

## Lubrication:

The epithelial tissue in the respiratory tract secretes mucus, which helps in trapping dust and microorganisms, and provides a smooth surface to facilitate movement.

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## 2. Structure, location and functions of **muscular Tissue**

→ Contract to produce Movement.  
→ Maintain the position of Body part.

Muscular tissue is a specialized type of tissue that contracts to produce movement or maintain the position of body parts. It is one of the four main tissue types in the body (along with epithelial, connective, and nervous tissues).

The primary characteristic of muscular tissue is its **ability to contract** and generate force, enabling a **variety of movements in the body**.

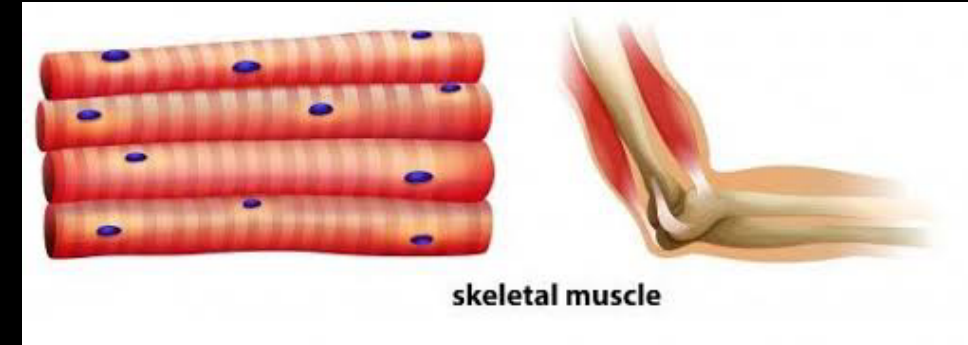
### 1. Structure of Muscular Tissue:

**Muscular tissue consists of muscle fibers (cells)** that are specialized to contract. The structural features of muscular tissue are directly related to its function of contraction and force generation. There are three types of muscular tissue, each with distinct structures:

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## 1. Skeletal Muscle Tissue:

Cell Shape: Long, cylindrical, multinucleated cells (fibers).



Striations: Visible striations (alternating light and dark bands) under a microscope due to the arrangement of actin and myosin filaments in a regular pattern.

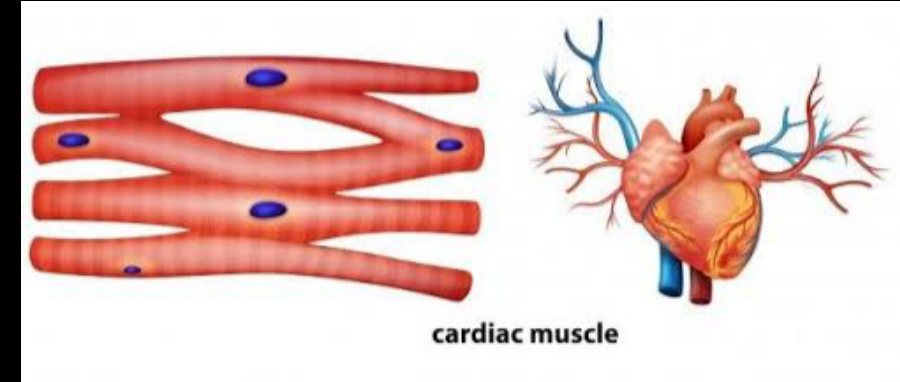
Nucleus: Multiple peripheral nuclei along the edges of the cell.

Control: **Voluntary control** (controlled consciously).

**Functions** – Skeletal muscles are primarily responsible for movement, maintaining posture, and generating heat in the body. They also play a role in protecting internal organs and stabilizing joints.

## 2. Cardiac Muscle Tissue:

Cell Shape: Short, branched cells.



Striations: Striated, similar to skeletal muscle, but with less regularity.

Nucleus: Typically one central nucleus per cell (sometimes two).

Control: Involuntary control (automatically controlled by the autonomic nervous system and pacemaker cells.)

CMF — CMF → Intercalated Disc.

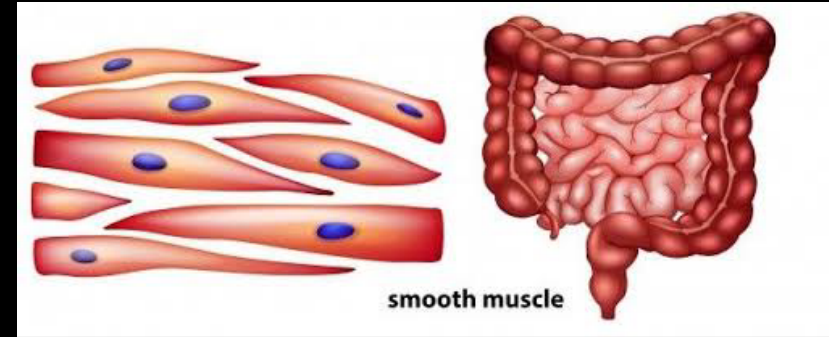
Other Features: Cardiac muscle fibers are connected by specialized junctions called intercalated discs, which allow synchronized contraction of the heart muscle. These discs contain gap junctions and desmosomes.



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## 3. Smooth Muscle Tissue:

Cell Shape: Spindle-shaped cells with a single central nucleus.



Striations: Non-striated (lacks the regular arrangement of actin and myosin).

Control: Involuntary control (regulated by the autonomic nervous system).

Other Features: Smooth muscle cells are arranged in sheets or layers and often form part of the walls of hollow organs and blood vessels. The muscle fibers are arranged in two layers: an inner circular layer and an outer longitudinal layer, which allow the organs to contract and expand.

↓  
Stomach, Intestine, Heart.



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## 2. Location of Muscular Tissue:

Each type of muscular tissue is found in specific locations in the body, where it carries out its specialized functions.

### 1. Skeletal Muscle Tissue:

**Location:** Attached to bones and sometimes to the skin (in the case of facial muscles).

**Function:** Skeletal muscle allows voluntary movements of the skeleton, including locomotion.

**Heat Production:** Muscular contractions produce heat, which helps maintain body temperature through thermogenesis.

**Protection:** Skeletal muscles help protect the internal organs by acting as a physical barrier.

## 2. Cardiac Muscle Tissue:

**Location:** Found only in the heart.

**Function:** Cardiac muscle is responsible for the rhythmic contraction of the heart, pumping blood throughout the circulatory system. It contracts involuntarily, without conscious control, driven by electrical impulses generated within the heart.

## 3. Smooth Muscle Tissue:

**Location:** Found in the walls of hollow organs and structures, including:

Digestive tract: Esophagus, stomach, intestines.

Blood vessels: Arteries, veins.

Respiratory tract: Bronchi and bronchioles.

Urinary system: Bladder, ureters.

Reproductive system: Uterus and vas deferens.

**Function:** Smooth muscle facilitates involuntary movements such as the peristalsis (wave-like contractions) of food through the digestive tract, the constriction and dilation of blood vessels, and the control of airflow in the respiratory system.