Part II Zoology

Living organisms can be classified into tow organisms the unicellular and multicellular and the multicellular regarded as complex group composed of variable cells and organs collected together to form the systems with different functions and multicellular(large)organisms function more efficiently if cells become specialized for specific functions.

A tissue is composed of cells or a group of cells that function together in a specialized activity for the performance of a common function Histology (Gr. *histo,* web or tissue, + *logos,* study) is the study of the tissues of the body and of how these tissues are arranged to constitute organs. Four fundamental tissues are recognized: epithelial tissue, connective tissue, muscular tissue, and nervous tissue.

Tissues are made of cells and extracellular matrix, two components that were formerly considered separate entities. The extracellular matrix consists of many kinds of molecules, some of which are highly organized and form complex structures, such as collagen fibrils and basement membranes. The main functions formerly attributed to the extracellular matrix were to furnish mechanical support for the cells, to transport nutrients to the cells, and to carry away catabolites and secretory products. In addition to these functions, it is now known that cells not only produce extracellular matrix components but are also influenced by them. There is thus an intense interaction between cells and matrix. Moreover, many molecules of the matrix are recognized by and attach to receptors present on cell surfaces. Most of these receptors are molecules that cross the cell membranes and connect to molecules within the cytoplasm. Thus, cells and extracellular matrix form a continuum that functions together

There are four types of tissues found in a multicellular animal.

Table 4–1. Main Characteristics of the Four Basic Types of Tissues.

Tissue	Cells	Extracellular Matrix	Main Functions
Nervous	Intertwining elongated processes	None	Transmission of nervous impulses
Epithelial	Aggregated polyhedral cells	Very small amount	Lining of surface or body cavities, glandular secretion
Muscle	Elongated contractile cells	Moderate amount	Movement
Connective	Several types of fixed and wandering cells	Abundant amount	Support and protection

The major functions of each animal tissue types:

1. Epithelial tissue

Forming tight covering and protecting layers below or lining the body cavities

2. Connective tissue (supporting tissues)

Holding other tissues together and are surrounded by lot of non living material.

3. Muscle tissue

Shortening and lengthening to move other tissues.there are three types of muscles skeletal ,smooth and cardiac muscle.

4. Nervous tissue

It allows rapid flow of ions in and out to conduct signals the most conducting cells was the neurons.

1. Epithelial tissues:

There are two types of epithelial tissues:

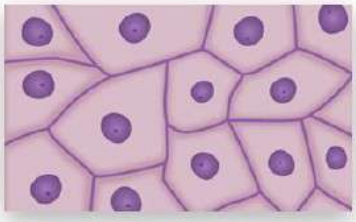
1. Covering and lining epithelium (outer layer of the skin and some organs) .

2. Glandular epithelium (constitute the secreting portion of glands) .

There are two types of epithelial tissues according to the number of layers:

1- Simple epithelial tissues and this classified according to cell shape to:

1. Simple Squamous epithelial tissue with thin flat cells and ovoid

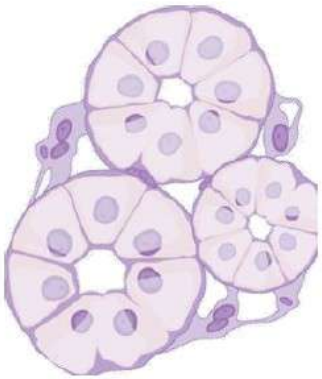


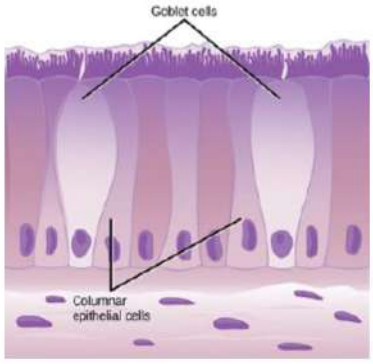
nucleus

2. Simple Cuboidal epithelial tissues ,cells are roughly square ,spherical nucleus

3. Simple columnar epithelial , elongated ,tall cells,with elongated nucleus .

The goblet cells distribute between the columnar cells. Each cell in this tissue end with cilia on free surface.





- Covering and lining epithelium can be divided into seven types:
- 1- simple squamous epithelium
- 2- stratified squamous epithelium
- 3- simple cuboidal epithelium
- 4- stratified cuboidal epithelium
- 5- simple columnar epithelium
- 6- stratified columnar epithelium

Glandular epithelium

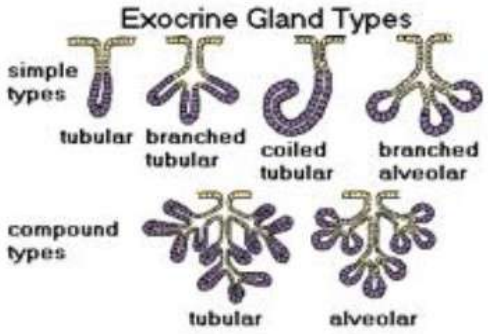
Glandular epithelium constitute the secreting portion of glands. There are two types of glands.

1. Exocrine - Secrete their products in to ducts

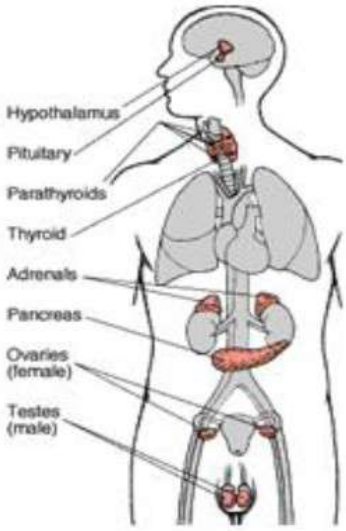
Eg . Salivary glands and mammary glands .

2. Endocrine - Secrete their products into blood stream eg. thyroid gland.

Glandular epithelium



Exocrine glands



Endocrine glands

Functions of epithelial tissues

1. Provides physical protection
2. Controls permeability
3. Detects sensations (sight, smell , taste, equilibrium)

Connective Tissue: Introduction

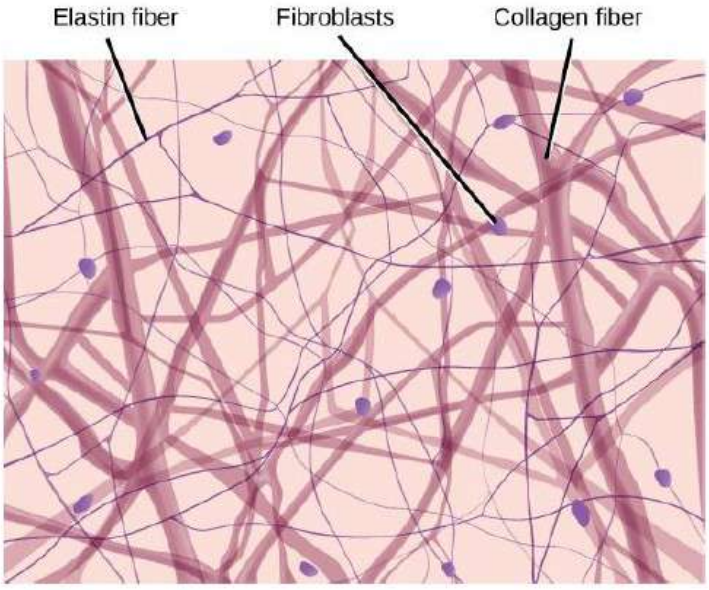
The different types of connective tissues are responsible for providing and maintaining form in the body. Functioning mechanically, they provide a matrix that connects and binds the cells and organs and ultimately gives support to the body.

Structurally, connective tissue is formed by three classes of components: cells, fibers, and ground substance. Unlike the other tissues (epithelium, muscle, and nerve), which are formed mainly by cells, the major constituent of connective tissue is the **extracellular matrix.** Extracellular matrices consist of different combinations of **protein fibers** (collagen, reticular, and elastic) and **ground**

substance. These tissues are the most abundant and most widely distributedtissue in the body. They provide support for organs and the body as a whole, protect and insulate internal organs and compartmentalize structures such as skeletal muscles, nerves.Connective tissue is made up of cells, ground substances and fibers. Ground substances together with fibers make matrix.

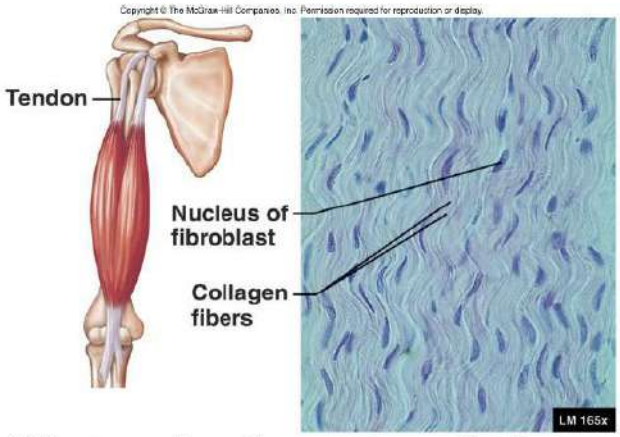
Connective tissues can be classified as;

A- **Loose connective tissue** (fibers are loosely woven) It holds organs in place and attaches epithelial tissue to other underlying tissues. It also surrounds the blood vessels and nerves .

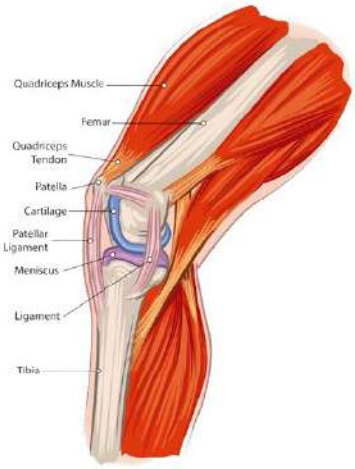


B. Dense connective tissue(regular and irregular).

Dense connective tissue forms strong, rope-like structures such as tendons and ligaments. Tendons attach skeletal muscles to bones; ligaments connect bones to bones at joints. Ligaments are more stretchy and contain more elastic fibers than tendons.



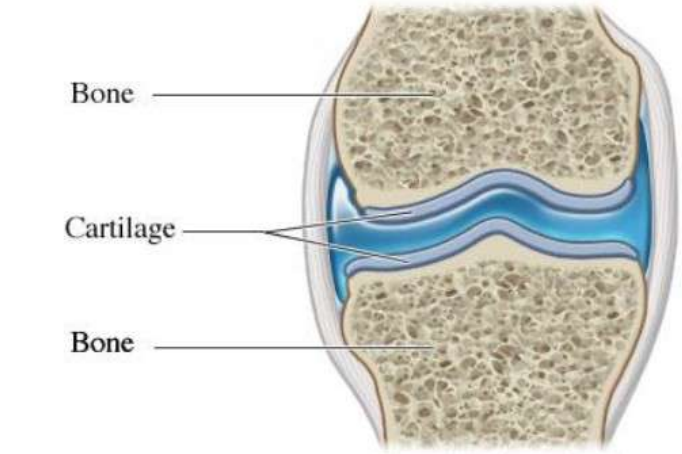
(b) Dense regular collagenous connective tissue



C. Cartilage (tough but flexible)including the joints between bones, the rib cage, the ear, the nose, the bronchial tubes and the intervertebral discs.

Cartilage is characterized by an extracellular matrix enriched with glycosaminoglycans and proteoglycans, macromolecules that interact with collagen and elastic fibers. Variations in the composition of these matrix components produce three types of cartilage adapted to local biomechanical needs.

Cartilage is a specialized form of connective tissue in which the firm consistency of the extracellular matrix allows the tissue to bear mechanical stresses without permanent distortion. Another function of cartilage is to support soft tissues. Because it is smooth surfaced and resilient, cartilage is a shock-absorbing and sliding area for joints and facilitates bone movements. Cartilage is also essential for the development and growth of long bones both before and after birth .



Cross section of a joint

Bone: Introduction

As the main constituent of the adult skeleton, bone tissue supports fleshy structures, protects vital organs such as those in the cranial and thoracic cavities, and harbors the bone marrow, where blood cells are formed. Bone tissue is highly vascularized and metabolically very active. It serves as a reservoir of calcium, phosphate, and other ions that can be released or stored in a controlled fashion to maintain constant concentrations of these important ions in body fluids.

In addition, bones form a system of levers that multiplies the forces generated during skeletal muscle contraction and transforms them into bodily movements. This mineralized tissue confers mechanical and metabolic functions to the skeleton.

Microscopic examination of bone shows two varieties: **primary, immature,** or **woven bone** and **secondary, mature,** or **lamellar bone.** Primary bone is the first bone tissue to appear in embryonic development and in fracture repair and other repair processes. It is characterized by random disposition of fine collagen fibers, in contrast to the organized lamellar disposition of collagen in secondary bone.

Primary Bone Tissue

Primary bone tissue is usually temporary and, except in a very few places in the body (eg, near the sutures of the flat bones of the skull, in tooth sockets, and in the insertions of some tendons), is replaced in adults by secondary bone tissue.

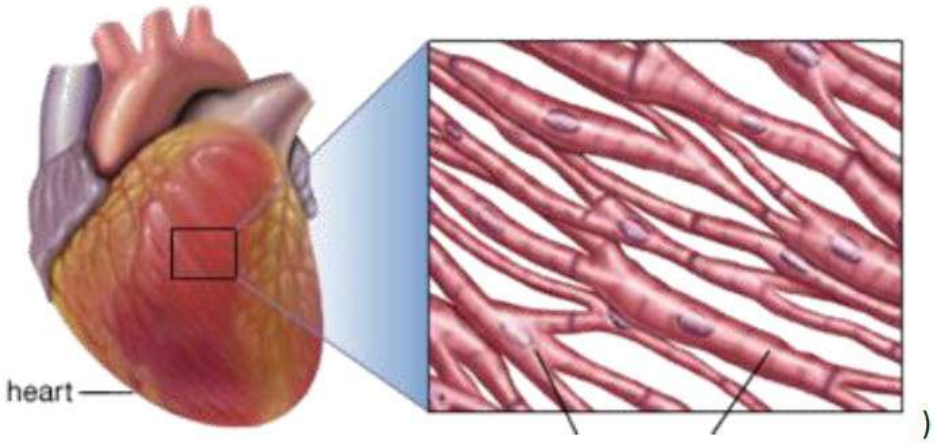
In addition to the irregular array of collagen fibers, other characteristics of primary bone tissue are a lower mineral content (it is more easily penetrated by x-rays) and a higher proportion of osteocytes than in secondary bone tissue.

Secondary Bone Tissue

Secondary bone tissue is usually found in adults. It characteristically shows collagen

fibers arranged in lamellae (3â€“7 m thick) that are parallel to each other or concentrically organized around a vascular canal. The whole complex of concentric lamellae of bone surrounding a canal containing blood vessels, nerves, and loose connective tissue is called a **haversian system,** or **osteon** (Figures 8â€“6 and 8â€“8). Lacunae containing osteocytes are found between, and occasionally within, the lamellae. In each lamella, collagen fibers are parallel to each other. Surrounding each haversian system is a deposit of amorphous material called the **cementing substance** that consists of mineralized matrix with few collagen fibers.

spongy - no osteons



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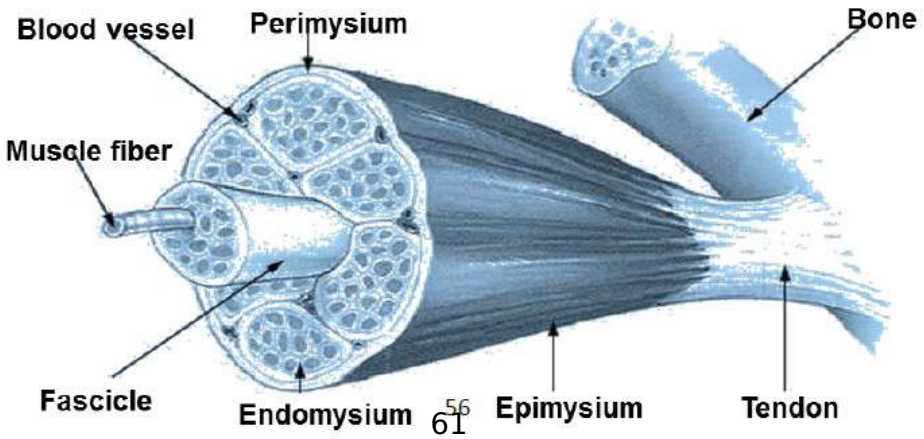
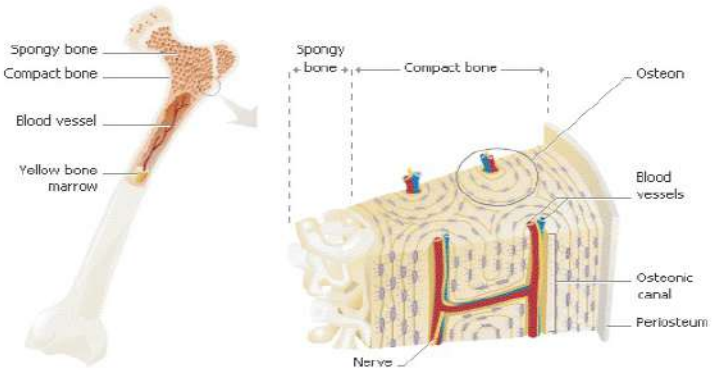
Skeletal muscles are known as striated muscles or voluntary muscles.These muscles are attached to bones by tendons and are responsible for skeletal movements. Basic unit of a skeletal



muscle is a muscle fiber.



2. Muscular Tissue

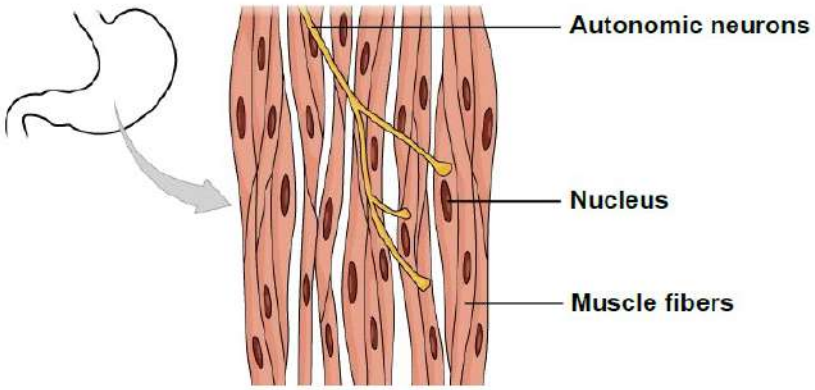
Muscle cells are elongated and are called as muscle fibers

These cells have these main characteristics:

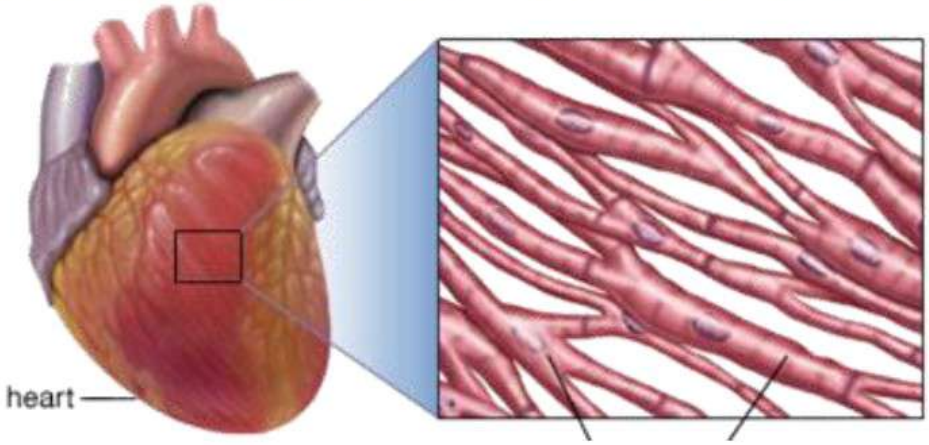
a- Excitability (ability to respond to stimuli)
b- Contractibility (ability to contract)
c- Extensibility (ability to be stretched without tearing)
d- Elasticity (ability to return to its normal shape)

Muscle tissue can be classified into three types

1- **Smooth muscle** tissue is made up of thin elongated muscle cells called smooth muscle fibers. These fibers are pointed at their ends and each has a single, large oval nucleus.Each cell has many myofibrils which lie parallel to one another in striated pattern, as in skeletal muscles.



3. Cardiac muscle is unique and found only in the wall of the heart.



Nervous Tissue

Nervous tissue is found in the brain, spinal cord and nerves. It consists of only two principal kinds of cells:(neurons and neuroglia).

Cells of neurons tissue have three principal parts

1. Dendrites
2. Cell body
3. Axon