

# Histology Notes J.Sasser

**Histology** is the study of tissues.

A **tissue** is a group of cells with similar structure and function plus the extracellular substances located between the cells. The **extracellular matrix** is nonliving chemical substances located between cells.

## Four basic tissue types:

- Epithelial tissue
- Connective tissue
- Muscular tissue
- Nervous tissue

## Epithelial Tissue

**Epithelial tissue** covers surfaces, usually has a basement membrane, has little extracellular material, and has no blood vessels.

A **basement membrane** attaches the epithelial cells to underlying tissues.

Most epithelia have a **free surface**, which is not in contact with other cells.

Epithelia are classified according to the **number of cell layers** and the **shape of the cells**.

## Categories of epithelium based on cell layers:

- **Simple epithelium** has one layer of cells.
- **Stratified epithelium** has more than one layer of cells.
- **Pseudostratified epithelium** consists of a single layer of cells, in which some cells are tall and thin and reach the free surface and others do not.

## Categories of epithelium based on cell shape:

- **Squamous** (flat)
- **Cuboidal** (cubelike)
- **Columnar** (tall and thin)
- **Transitional** (changes shape when relaxed or distended by fluid)

## Functions of Epithelium:

- **Simple epithelium** involved with **diffusion, filtration, secretion, or absorption**
- **Stratified epithelium** **protects from abrasion**
- **Squamous cells** function in **diffusion or filtration**
- **Cuboidal or columnar cells** **secrete or absorb**

A **gland** is a single cell or a multicellular structure that secretes substances onto a surface, into a cavity, or into the blood.

Most glands are composed primarily of **epithelium**.

**Exocrine glands** have ducts.

A **duct** is a tube or vessel which carries a secretion from a gland.

Ducts can be **simple** or **compound**.

The end of a duct can be **tubular** or expanded into a sac-like structure called an **acinus** or **alveolus**.

## Types of exocrine glands:

- **Unicellular** (e.g., goblet cells in mucous membranes)
- **Simple tubular** (e.g., sweat glands and stomach glands)
- **Simple acinar or alveolar** (e.g., sebaceous glands)
- **Compound tubular** (e.g., duodenal glands)
- **Compound acinar or alveolar** (e.g., pancreas)

**Endocrine glands** have no ducts and empty their secretions (hormones) directly into the blood.

# **Connective Tissue**

## **Functions of Connective tissue:**

- joins together other tissues
- supporting framework for the body (bone)
- fat stores energy
- blood transports substances

**Connective tissue** is usually characterized by large amounts of extracellular materials that separate cells from each other, whereas **epithelial tissue** is mostly cells with very little extracellular material. The **extracellular substance** of connective tissue consists of **protein fibers** which are embedded in **ground substance** containing **tissue fluid**.

## **Fibers in connective tissue can be divided into three types:**

- **Collagen fibers** are the most abundant protein fibers in the body.
- **Elastic fibers** are made of elastin and have the ability to recoil to original shape.
- **Reticular fibers** are very fine collagen fibers that join connective tissues to other tissues.

## **Connective tissue cells are named according to their functions:**

- **Blast cells** produce the matrix of connective tissues
- **Cyte cells** maintains the matrix of connective tissues
- **Clast cells** breaks down the matrix for remodeling (found in bone)

## **Word parts:**

- **fibro** (fibrous connective tissue- tendons and ligaments)
- **chondro** (cartilage)
- **osteo** (bone)

## **Specific Types of connective tissue cells:**

- |                 |                |               |
|-----------------|----------------|---------------|
| ➤ fibroblasts   | ➤ chondrocytes | ➤ osteoclasts |
| ➤ fibrocytes    | ➤ osteoblasts  |               |
| ➤ chondroblasts | ➤ osteocytes   |               |

**Mast cells** release chemicals promoting inflammation.  
**Macrophages** are large cells, capable of moving about and ingesting foreign substances, including microorganisms that are found in connective tissue.

**Adipose-** very little extracellular matrix; large cells filled with lipids

**Bone-** hard tissue with mineralized matrix; strong and rigid (two types- compact and cancellous)

- **Compact bone-** found in the shaft of a long bone
- **Cancellous bone-** found in the ends of long bones and in flat bones (contains red marrow).

**Loose or areolar connective tissue-** found covering muscles, glands, and nerves (has widely separated collagen fibers running in random directions)

**Dense connective tissue-** found in the dermis, also in tendons and ligaments (has an extracellular matrix consisting mostly of collagen fibers)

**Blood-** fluid matrix allows cells to travel freely

## **Cartilage- 3 Types:**

- **Hyaline cartilage**- most abundant type of cartilage, very smooth, and can withstand compression (makes up skeleton of embryos, found many other places such as covering the ends of long bones at joints). Has cells located in spaces in the matrix (lacunae), has a small quantity of collagen fibers, no elastic fibers, and no blood vessels in the matrix.
- **Elastic cartilage**- recoils to original shape when bent (found in the external ear)
- **Fibrocartilage**- compressible, but resists tearing or pulling forces (found in intervertebral disks).

## **Muscular tissue**

The main characteristic of **muscle tissue** is the ability to **contract** (shorten).  
Muscle contraction results from **contractile proteins** found inside muscle cells.  
Muscle cells are called **muscle fibers** because they often resemble tiny threads.

### **Three types of muscle tissue:**

- **Skeletal muscle**- has cylindrical shaped cells with striations, cells have many nuclei, is under voluntary control, comprises about 40% of a person's body weight, and connects to the skeleton.
- **Cardiac muscle**- has cylindrical shaped cells that branch, has striations, has intercalated disks connecting the cells together, has one nucleus per cell, is under involuntary control, and is found only in the walls of the heart.
- **Smooth muscle**- has spindle shaped cells with one nucleus per cell, does not have striations, is under involuntary control, and is the most varied in location and function of the muscle tissue types.  
Found inside the eye, inside hollow tubes such as blood vessels, respiratory tract, digestive tract, and inside hair follicles.

## **Nervous tissue**

Nervous tissue is specialized to conduct **action potentials** (electrical signals).

**Neurons** are cells that conduct action potentials.

**Neuroglia** are cells which support the neurons.

### **Components of a nerve cell:**

- The **cell body** is the part of the nerve cell in which the nucleus is located.
- **Axons** are nerve cell processes that conduct action potentials away from the cell body.
- **Dendrites** are nerve cell processes that receive action potentials and conduct them toward the nerve cell body.

## **Membranes**

- ❖ **Mucous membranes** line cavities that open to the outside of the body (digestive, respiratory, excretory, and reproductive tracts). They contain glands and secrete mucus.
- ❖ **Serous membranes** line trunk cavities that do not open to the outside of the body (pleural, pericardial and peritoneal cavities). They do not contain glands, but do secrete serous fluid.
- ❖ Other membranes include **cutaneous membranes** (skin), **synovial membranes** (line joint cavities), and **periosteum** (surrounds bone).

# **Inflammation**

**The inflammatory response occurs when tissues are damaged.**

## **Major symptoms of inflammation:**

1. **Redness**
2. **Heat**
3. **Swelling**
4. **Pain**
5. **Disturbance of function**

Following an injury, chemicals (**mediators of inflammation**) are released or activated in the injured tissues.

## **Mediators of inflammation include:**

- **Histamine**
- **Kinins**
- **Prostaglandins**

## **The presence of mediators of inflammation results in:**

- **vasodilation of blood vessels**
- **increased permeability of blood vessels**
- **pain**
- **symptoms of redness and heat**

**Edema** (swelling of the tissues) results when water, proteins, and other substances from the blood move into the tissues.

## **Tissue Repair**

**Tissue repair** is the substitution of viable cells for dead cells, and it can occur by regeneration or replacement.

In **regeneration**, the new cells are the same type as those that were destroyed, and normal function is usually restored.

In **replacement**, a new type of tissue develops that eventually causes scar production and the loss of some tissue function.

When the edges of a wound are close together, the wound fills with blood, and a **clot** forms. The clot contains a threadlike protein, fibrin, which binds the edges of the wound together and stops the bleeding.

The clot is replaced by **granulation tissue**, a delicate connective tissue which consists of fibroblasts, collagen, and capillaries.

## **Cells can be classified into three groups on the basis of their ability to divide and produce new cells:**

- **Labile cells** (skin and mucous membranes) continue to divide throughout life.
- **Stable cells** do not actively divide after growth ceases, but they do retain the ability to divide after an injury. For example, connective tissue and glands, including the liver and pancreas, are capable of regeneration.
- **Permanent cells** (neurons and skeletal muscle cells) have little or no ability to divide. If they are killed, they usually are replaced by connective tissue.