

## Histology

### **2-Connective tissue**

Is the most abundant and widely distributed tissue in complex animals .It is quite diverse in structure and function ,but even so all types have three components :

#### **1- specialized cells 2- ground substrates 3- protein fibers**

The ground substrates is non cellular material that separates the cells and varies in consistency from solid , semifluid to fluid .the fibers three types 1-**white collagen** fibers contain collagen a protein that give the flexibility and strength 2- **reticular** fibers are very thin collagen fibers that are highly branched and form delicate supporting networks .3- **yellow elastic** fibers contain elastin ,a protein that not as strong as collagen but is more elastic. The ground substance plus the fibers together are referred to as connective tissue matrix .

### **Functions of Connective Tissue**

1-forms capsules that surround the organs of the body and the internal architecture .

2-Makes up tendons ,ligaments and areolar tissue that fills the spaces between the tissues .

3-Bone ,cartilage and adipose tissue are specialized types of c.t that support the soft tissue of the body and store fat .

4-Role in defending the organism due to the phagocytotic & immune-competent cells .

5-Play role in cell nutrition.

6- Provide physical barriers .

7- Specific protein called antibodies are produced by plasma cells in the c.t.

Connective tissue is classified into :-

## ***I-Connective tissue Proper***

### ***I-1 Loose connective tissue:***

#### ***I-1-a- Connective tissue Proper Loose connective tissue ,Areolar :***

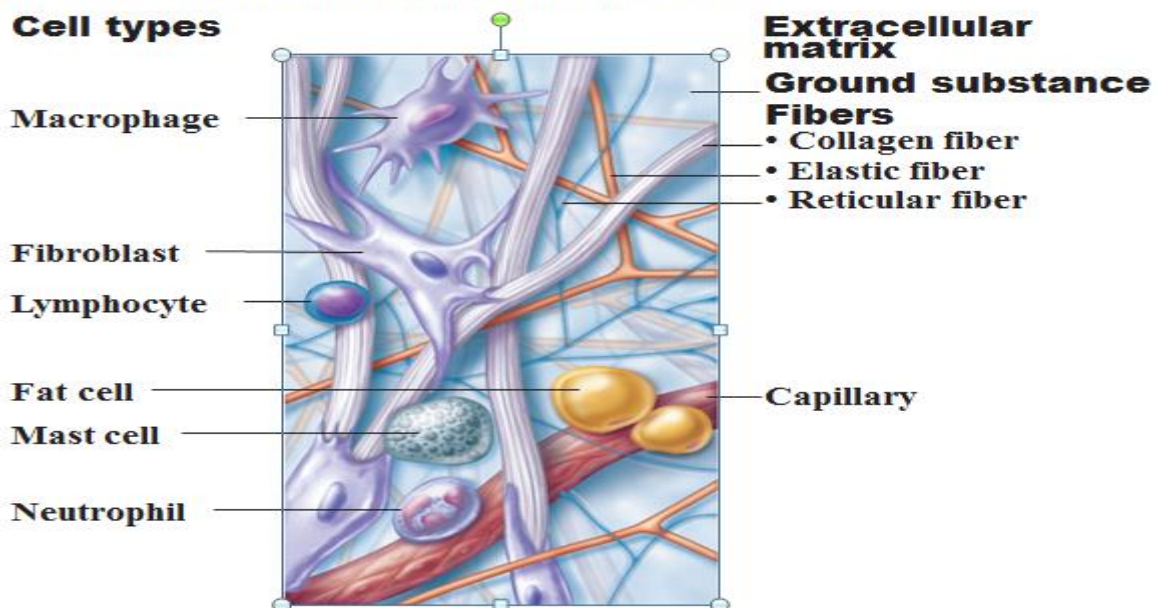
supported epithelium and also many internal organs have cells called fibroblasts separated by jellylike matrix containing whit collagen fibers and yellow elastic fibers ,macrophages cell , mast cells, and somewhite blood cells. found in lungs ,arteries and urinary bladder allows these organs to expand .

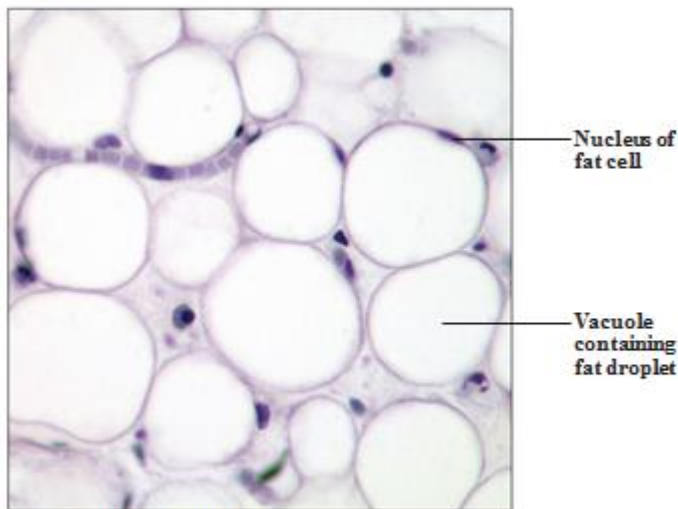
**.Function:** It forms a protective, Wraps and cushions organs. such as muscles , blood vessels and nerves ; its macrophages phagocytize bacteria; plays important role in inflammation; holds and conveys tissue fluid.

***I-1-b- Connective tissue proper : loos connective tissue ,Adipose:*** serves as the body's primary energy reservoir and protects organs .It is loose c.t composed mostly of enlarged fibroblasts that store fat .This specialized fibroblasts are called adipocytes nucleus pushed to the side by large fat droplet. In mammals ,adipose tissue is found particularly beneath the skin ,around kidneys and on the surface of the heart .

The number of adipocytes in an individual is fixed .When a person gains weight ,the cells become larger and when weight is lost ,the cells shrink . In obese people the individual cells may be up to five times larger than normal .Most adipose tissue is white but in newborns and hibernating mammals some is brown due to an increased number of mitochondria that can produce heat .

Figure 4.7 Areolar connective tissue: A prototype (model) connective tissue.





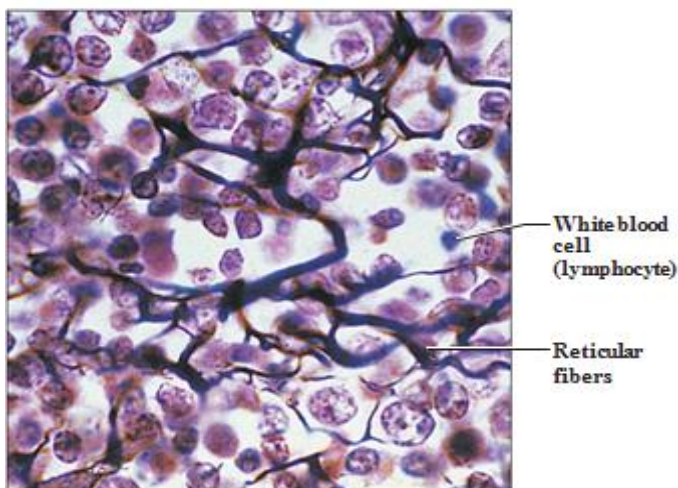
**Photomicrograph:** Adipose tissue from the subcutaneous layer under the skin (350x).

***1-1-c- Connective tissue proper: loose connective tissue, reticular :***

Network of reticular fibers in a typical loose ground substance; reticular cells lie on the network.

**Function:** Fibers form a soft internal skeleton (stroma) that supports other cell types including white blood cells mast cells ,macrophage .

**Location:** Lymphoid organs (lymph nodes, bone marrow, and spleen).



**Photomicrograph:** Dark-staining network of reticular connective tissue fibers forming the internal skeleton of the spleen (350x).

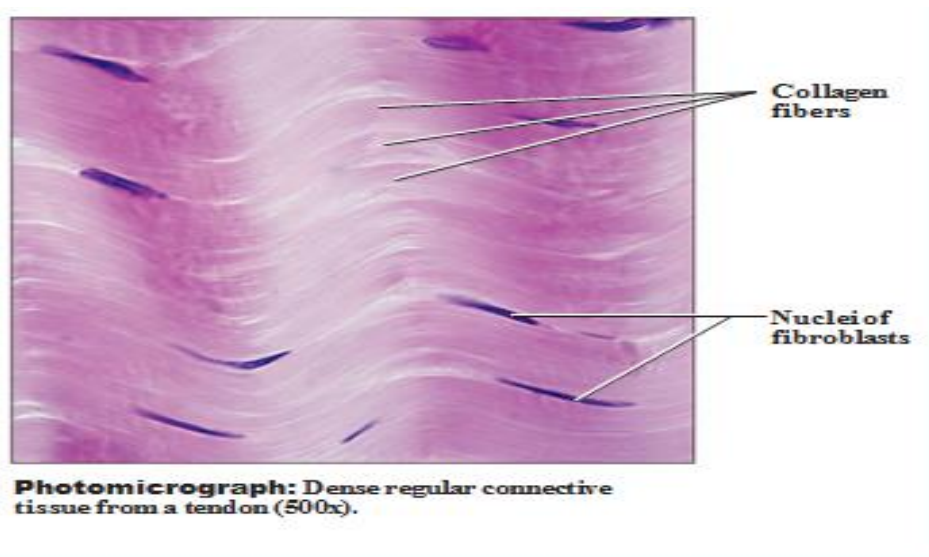
***1-2-Dense connective tissue:-,***

***a-dense connective tissue: dense regular***

contains many collagen fibers that are packed together. Primarily parallel collagen fibers; a few elastic fibers. Major cell type is the fibroblast.

**Function:** Attaches muscles to bones or to muscles; attaches bones to bones; withstands great tensile stress when pulling force is applied in one direction.

This type of tissue has more specific functions than loose c.t. found in tendons, which connect muscles to bones and ligaments which connect bone to other bones at joints.



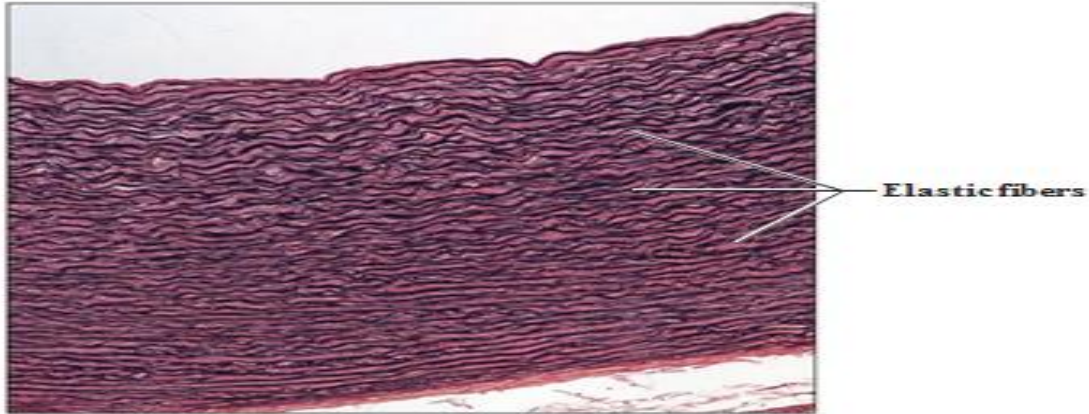
### **b:- dense connective tissue, dense irregular**

Primarily irregularly arranged collagen fibers; some elastic fibers. Major cell type is the fibroblast. Able to withstand tension exerted in many directions; provides structural strength.

Found in fibrous capsules of organs and of joints; dermis of the skin; submucosa of digestive tract.

### **c-dense connective tissue, elastic**

Containing a high proportion of elastic fibers. Allows recoil of tissue following stretching; maintains pulsatile flow of blood through arteries; aids passive recoil within certain parts of lungs following inspiration. Found in walls of large arteries, ligaments associated with the vertebral column; within the walls of the bronchial tubes.



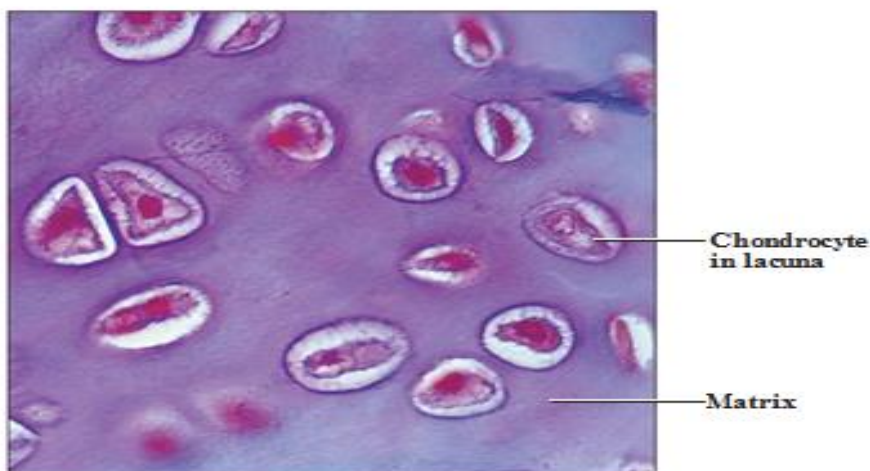
**Photomicrograph:** Elastic connective tissue in the wall of the aorta (250x).

## II- Specialize connective tissue

**II-1- Special C.T. Cartilage** in cartilage the cells lie in small chambers called lacunae separated by matrix that is solid yet flexible .unfortunately because this tissue lacks a direct blood supply ,it heals very slowly .there are three types of cartilage distinguished by the type of fiber in the matrix .

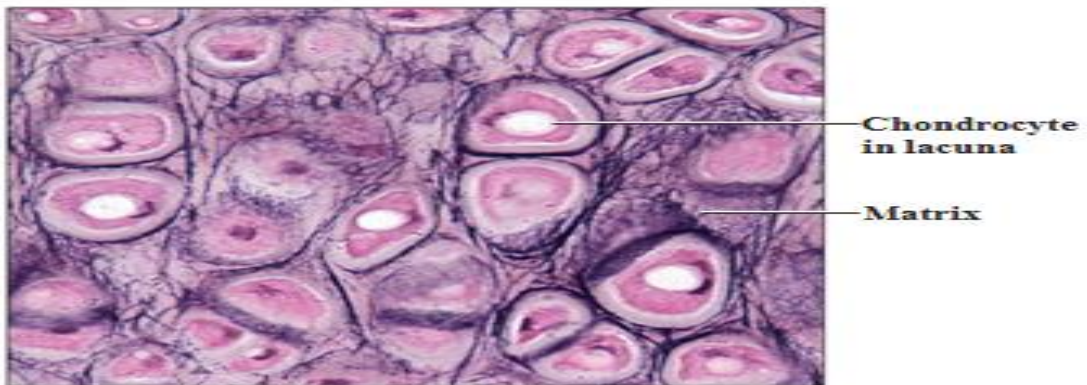
**Hyaline cartilage :** most common type contain only very fine collagen fibers .The matrix has a white ,translucent appearance chondroblasts produce the matrix and when mature(chondrocytes) lie in lacunae .Supports and reinforces; has resilient cushioning properties resists compressive stress

It is found in nose and at the ends of long bones and ribs .and it forms rings in the walls of respiratory passages .The fetal skeleton also is made of this type of cartilage. Later, the cartilaginous fetal skeleton is replaced by bone .



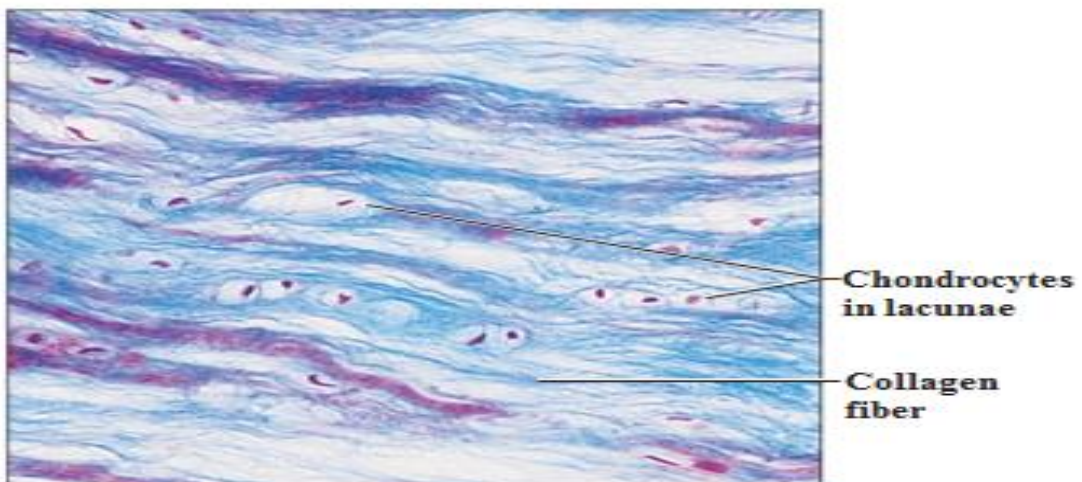
**Photomicrograph:** Hyaline cartilage from the trachea (750x).

**Elastic cartilage:** Similar to hyaline cartilage, but more elastic fibers in matrix for this reason its more flexible .Maintains the shape of a structure while allowing Supports the external ear (pinna); epiglottis .



**Photomicrograph:** Elastic cartilage from the human ear pinna; forms the flexible skeleton of the ear (800x).

**Fibrocartilage:** Matrix similar to but less firm than that in hyaline cartilage; strong , thick collagen fibers predominate. Tensile strength with the ability to absorb compressive shock Intervertebral discs; and the wedges in knee joint.



**Photomicrograph:** Fibrocartilage of an intervertebral disc (125x). Special staining produced the blue color seen.

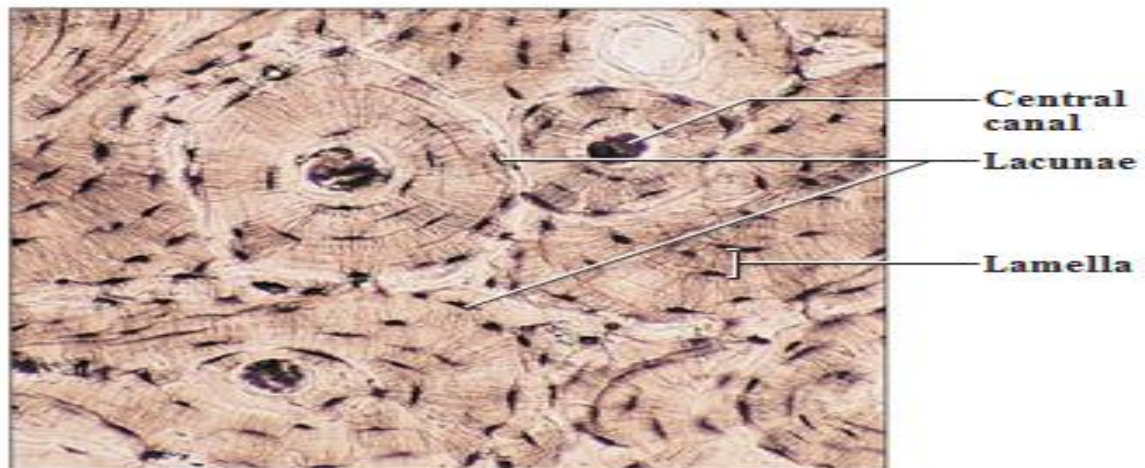
**II-2-Special C.T. Bone :-** Bone is the most rigid it consists of an extremely hard matrix of inorganic salts ,notably calcium salts ,deposit around protein fibers ,especially collages fibers .The inorganic salts give bones rigidly and the protein fibers provide elasticity and strength much as steel rods do in reinforced concrete

- Hard, calcified matrix containing many collagen fibers; osteocytes lie in lacunae.

Osteoblasts and osteocytes are involved in the formation and mineralization of bone; osteoclasts are involved in the resorption of bone tissue. Modified (flattened) osteoblasts become the lining cells that form a protective layer on the bone surface. The mineralised matrix of bone tissue has an organic component of mainly collagen called ossein and an inorganic component of bone mineral made up of various salts. Bone tissue is a mineralized tissue of two types, cortical bone and cancellous bone. Other types of tissue found in bones include bone marrow, endosteum, periosteum, nerves, blood vessels and cartilage.

In the human body at birth, there are over 270 bones. but many of these fuse together during development, leaving a total of 206 separate bones in the adult. The largest bone in the body is the femur or thigh-bone, and the smallest is the stapes in the middle ear.

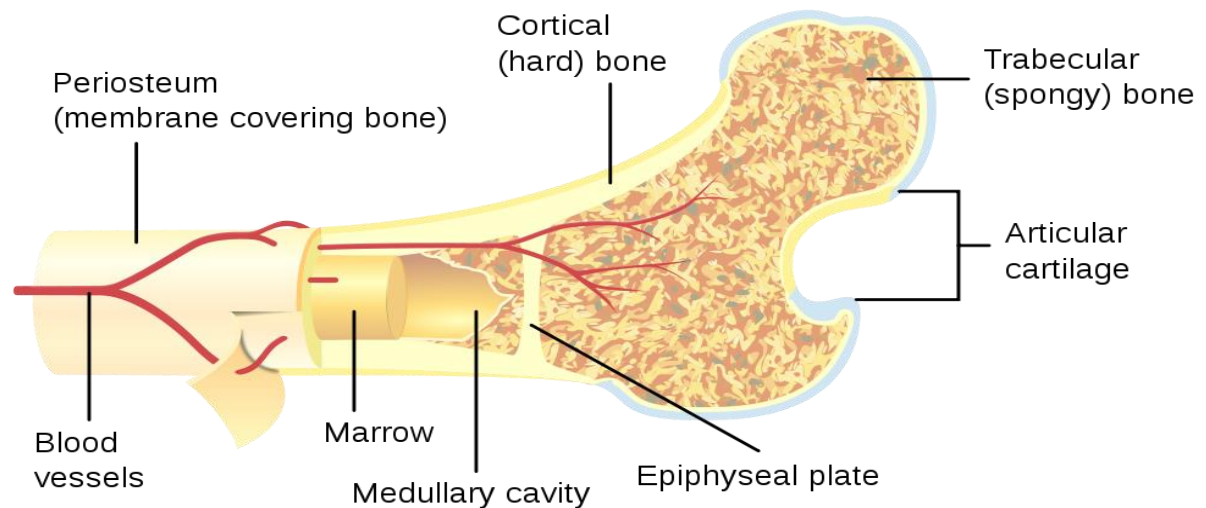
### Structure of bone



**Photomicrograph: Cross-sectional view of bone (125x).**

**Compact bone** : makes up the shaft of along bone .It contains cylindrical structural units called osteons ( haversian system ) the central canal of each osteon surrounded by rings of hard matrix Bone cells ( osteocyte ) are located in spaces called lacunae between the ring of matrix .blood vessels in the central canal carry nutrients that allow bone to renew itself . Thin extension of bone cells within canaliculi(minutes canals ) connect the cells to each others and to the central canal . The hollow shaft of long bones such as the femur ( thigh bone) is filled with yellow bone marrow . The ends of long bone contains spongy bone .

**Spongy bone** contains numerous bony bars and plates ,separated by irregular spaces although lighter than compact bone spongy bone is still designed for strength . Just as braces are used for support in buildings the solid proteins of spongy bone follow lines of streets .Spongy bone is also the sit of red bone marrow which is critical to produced of blood cells .



**II-c-Blood:-** Which consists of formed elements and plasma , formed elements in the blood consist of the many kinds of blood cells and the platelets .Blood transports nutrients and oxygen to tissue fluid and removes carbon dioxide and other wastes . It helps distribute heat and also play role in fluid ,ion and pH balance .

**Red blood cells :-** are small disk-shaped cells without nuclei .The absence of nucleus makes the cells biconcave . red pigment because of hemoglobin .

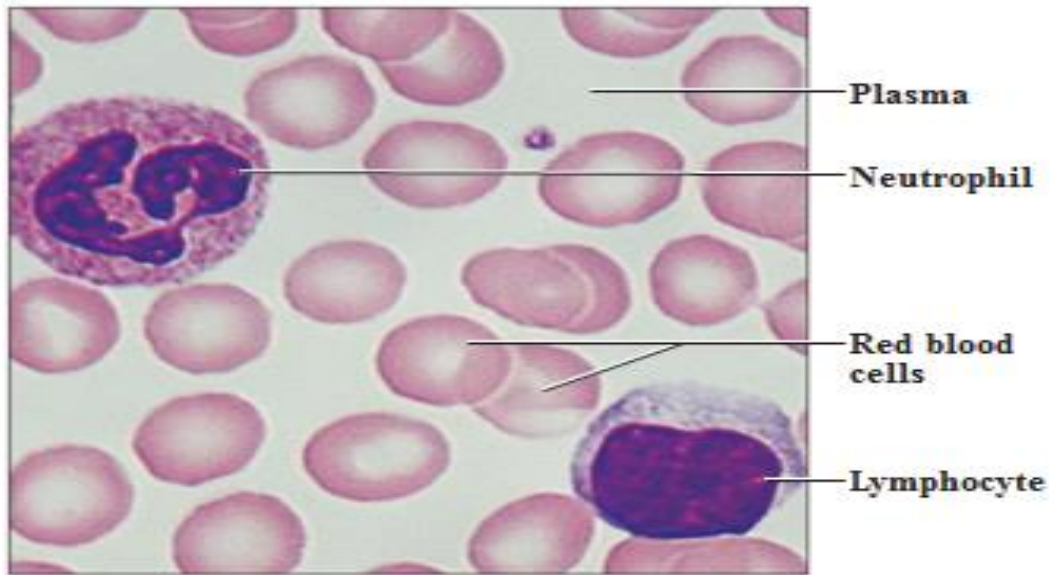
**White blood cells Leucocytes:-** usually large have nucleus without staining would appear translucent .When blood smear staining W.B.C looks blue or purple .The function is fight by two way 1- Phagocytosis 2- Produced antibodies .Neutrophils ,lymphocyte ,Monocyte ,Eosinophil ,Basophils

**Platelets :-** are not complete cells they are fragments of large cells present only in bone marrow .When blood vessels is damaged platelets help to form plug that seals the vessel and injured tissues release molecules that help the clotting process.

**Lymph :-** is a fluid connective tissue located in lymphatic vessels .Lymphatic vessels absorb excess tissue fluid and return it to the cardiovascular system .

Lymph node composed of reticular c.t .plus specialized white blood cells called lymphocyte remove any foreign materials from lymph .lymph node may enlarge when these cell respond to an infection .





**Photomicrograph:** Smear of human blood (1860x); two white blood cells (neutrophil in upper left and lymphocyte in lower right) are seen surrounded by red blood cells.

**References:-**

- 1-Inderbir Singh's Textbook of Human Histology with Colour Atlas and Practical Guide. 2014 ,7<sup>th</sup> edition.
- 2- Textbook of histology .2017, 4<sup>th</sup> edition.