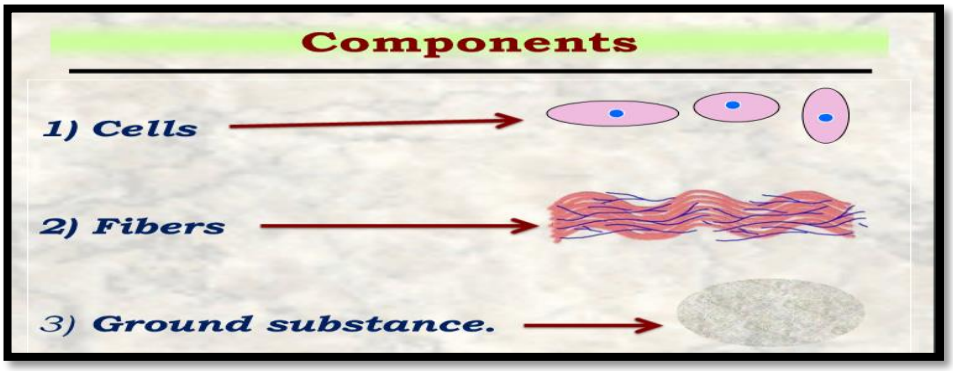
Connective tissues: is the term applied to tissues which provide general structure, mechanical strength, space filling , physical and metabolic support for more specialized tissues is formed by three classes: **cells, fibers,** and **ground substance**.

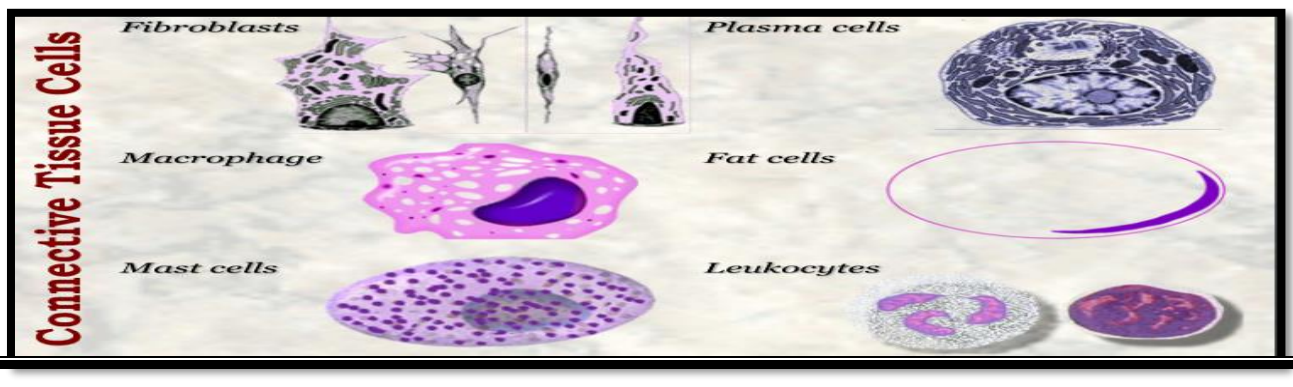


Function of connective tissues: many structural properties with corresponding construction materials:

1. Inclosing, supporting and separated organs
2. Connect tissue to one another
3. Skeletal movements (bones)
4. Storage material (fat)
5. Transport and distribution of material (blood).
6. Protection (immune cells).

Cells of connective tissue:

1. Mesenchymal cells are undifferentiated, spindle (***fusiform***) shape have large nuclei, this cell form Mesenchymal tissues.
2. Fibroblasts cell the principal active cells of connective tissue originate locally from mesenchymal cells and are permanent residents of this tissue.
3. Macrophages, plasma cells, and mast cells originate from hematopoietic stem cells in bone marrow, circulate in the blood, and then move into connective tissue where they function.
4. Leukocytes: are transient cells, they also originate in the bone Marrow and move to the connective tissue where they function for a few days, then die by apoptosis.
5. Adipocytes: fat cells are found in connective tissue of many organs. Specialized for cytoplasmic storage of lipid as neutral fats, or production of heat. Also serve to cushion and insulate the skin and other organs.



Connective tissue Fibers

They formed from proteins after secretion from fibroblasts, amounts of these fibers depending on the structural or function of the connective tissue. There are three main types of fibers include collagen, reticular, and elastic fibers.

1. **Collagen fibers (white fiber)**: Collagen is the most abundant protein in the human body, representing 30% of its dry weight. At least 28 different types of collagen, all extremely strong and resistant to shearing and tearing forces. Collagen is a key element of all connective tissues, as well as epithelial basement membranes and the external laminae of muscle and nerve cells.
2. **Reticular fibers**: a fine network of branching fibers for many cellular organs such as endocrine glands, lymph nodes, bone marrow and liver. Collagen and reticular fibers are both formed by proteins of the **collagen** family, and elastic fibers are composed mainly of the protein **elastin.**
3. **Elastic fibers**: is arranged as fibers and/or discontinuous sheets allowing tissues to be stretched or distended and return to their original shape. Found in the wall of large blood vessels of lung, skin and urinary bladder.

Ground substance (extracellular matrix)

Is a highly hydrophilic, viscous complex of anionic macromolecules (glycosaminoglycans (GAGs), proteoglycans and glycoproteins) (laminin, fibronectin, and others) that imparts strength and rigidity to the matrix.

Classification of connective tissue: in general connective tissues contain two types:

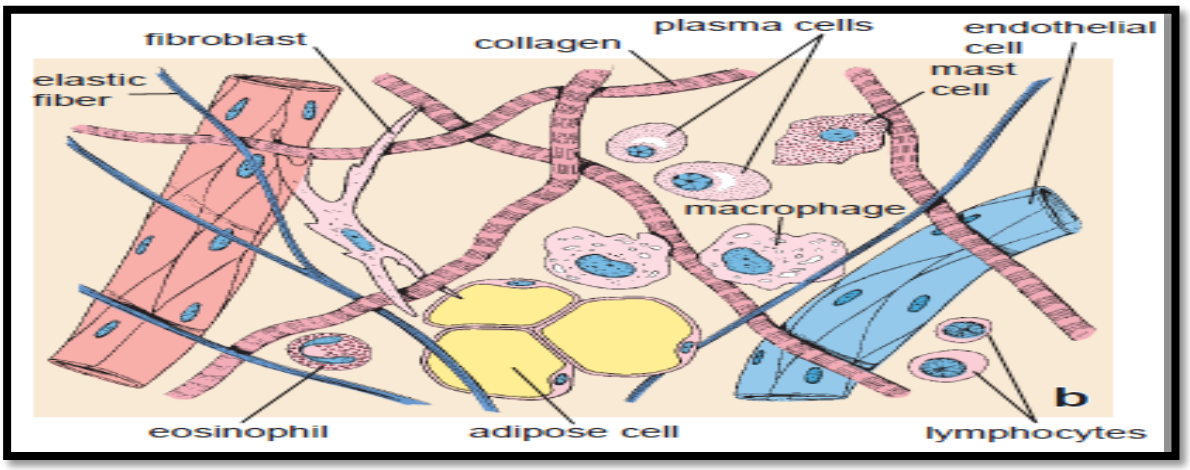
1. **connective tissue proper**
2. **Specialized connective tissue**

Connective tissue proper: Connective tissues that belong to this category are divided into two general subtypes:

1. **Loose connective tissue**, sometimes called **areolar tissue:** is primarily located beneath the epithelia. It is also associated with the epithelium of glands and surrounds the smallest blood vessels. It can be divided to many subtypes:
    - **Mucous connective tissue**
    - **Adipose connective tissue**
    - **Reticular connective tissue**
    - **Mesenchyme connective tissue**

2. **Dense connective tissue,** divided into two basic types based on the organization of its collagen fibers:

- **Dense irregular connective tissue:** contains mostly collagen fibers arranged randomly. This tissue also contains relatively little ground Substance. Because of its high portion of collagen fibers provides significant strength. Found in perichondrium, periosteum and dermis.
- **Dense regular connective tissue**: is characterized by ordered and densely packed in parallel arrays of fibers and cells to provide maximum strength. The main functional component of tendons and ligaments.



Compare between epithelial and connective tissues

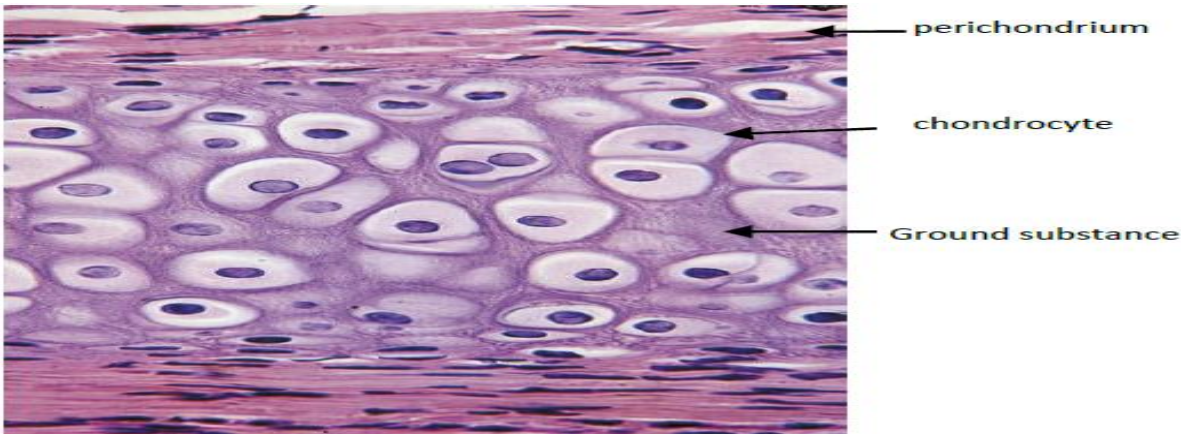
Epithelial tissues	Connective tissues
1. Origen from three germ layers.	Origen from only mesoderm layer
2. Its have free surface.	Don't have free surface
3. Cover external surface or lining internal cavity	Major functions connect and support tissues.
4. Attached to basement membrane.	Loss basement membrane.
5. Its have specializations of cell surfaces.	Loss specializations of cell surfaces.
6. The cell attach to each other by cell junctions.	Loss cell junctions.
7. The tissue formed from cells and very little of ground substance.	The tissue formed from three components: cells, fibers and much of ground substance).
8. A vascularity (loss blood vessels)	Contain blood and lymph vessels.

Specialized connective tissue (skeletal connective tissue, Cartilage and bone)

Cartilage: is formed from highly specialized types of supporting connective tissue. Is a tough and flexible characterized by an extracellular matrix (ECM) with high concentrations of GAGs and proteoglycans interact with collagen and elastic fibers. The firm consistency of the cartilage ECM allows the tissue to bear mechanical stresses

without permanent distortion. In the respiratory tract, ears, and nose, cartilage forms the framework supporting soft tissues. Cartilage consists of cells called chondrocytes embedded in an extensive ECM. Chondrocytes synthesize and maintain ECM components and are located in matrix cavities called lacunae. Cartilage is *avascular* and receives nutrients by diffusion from capillaries in adjacent connective tissue called **perichondrium**. Cartilage also lacks lymphatic vessels and nerves. There are three forms of cartilage **Hyaline cartilage**, **Elastic cartilage** and **Fibrocartilage.**

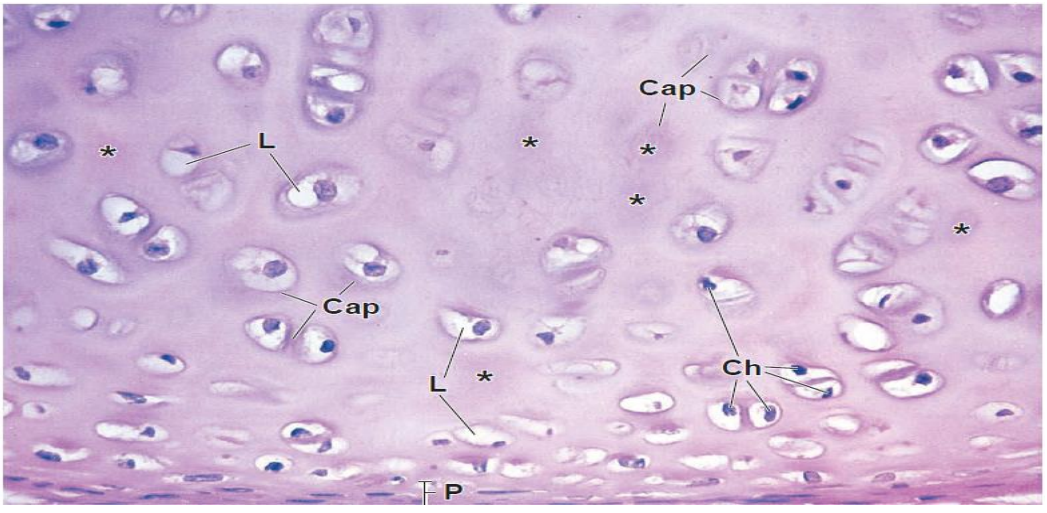
The perichondrium: is a sheath of dense connective tissue that surrounds cartilage in most places, forming an interface between the cartilage and the tissues supported by the cartilage. When actively growing, the perichondrium appears divided into an inner cellular layer it called **chondrogenic layer**, which gives rise to new cartilage cells, and an outer fibrous layer called **fibrous layer**.



Type of cartilage:

Three types of cartilage that differ in appearance basis on the characteristics of their matrix:

• **Hyaline cartilage** is characterized by matrix containing type II collagen fibers, GAGs, proteoglycans and glycoproteins. The matrix of hyaline cartilage appears glassy in the living state: hence, the name hyaline. Found in in trachea and end of ribs.



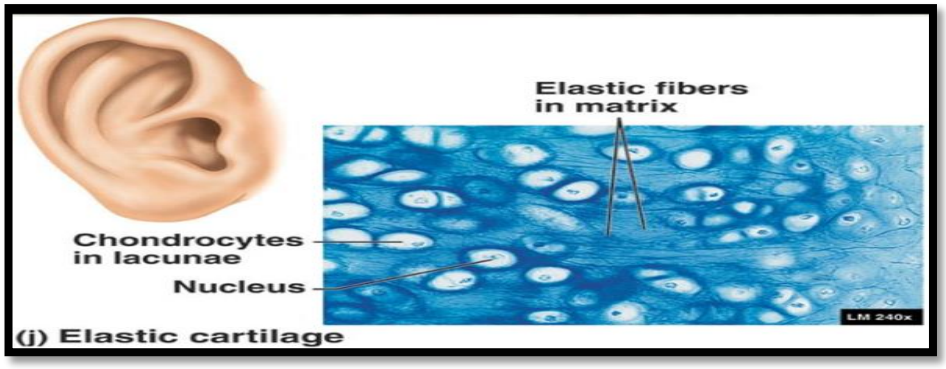
Cap=capsule

Ch=chondrocyte

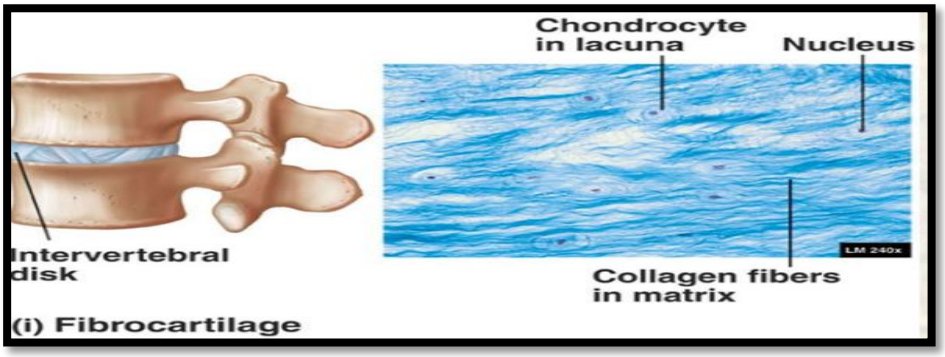
L=lacuna

P=perichondrium

Elastic cartilage yellowish in color is characterized by elastic fibers in addition to the matrix material of hyaline cartilage. Found in area that have rigid but elastic e.g. ear and larynx.



• **Fibrocartilage** is characterized by abundant type I collagen fibers as well as the matrix material of hyaline cartilage, it consider transition between CT and hyaline cartilage. Found in area great deal with pressure is applied to joints and intervertebral disc.



Cartilage Growth and Formation

All cartilage derives from the embryonic **mesenchyme cells** in the process of **chondrogenesis**. The first indication of cell differentiation is called **chondroblasts.** During embryonic development, the differentiation of cartilage takes place primarily from the center outward; therefore, the more central cells have the characteristics of **chondrocytes.** The superficial mesenchyme develops into the **perichondrium.**

Type of Cartilage Growth: there are two kinds of growth

- **Appositional growth**, the process that forms new cartilage at the surface of an existing cartilage; resulting from the differentiation of perichondrial cells.
- **Interstitial growth**, the process that forms new cartilage within an existing cartilage mass, resulting from the mitotic division of preexisting chondrocytes.