

# CONNECTIVE TISSUE- II

**DR. DIGVIJAY SHARMA**  
**DEPARTMENT OF PHYSIOTHERAPY**  
**U.I.H.S**  
**KANPUR**

# LIGAMENTS

Def: Ligament are connective tissue structure that connect or bend one bone to another either at or near joint.

They are named according to their shape, location, bony attachment, relationship with other.

Examples: Ligament of knee- Medial and Lateral Collateral ligament named according to location.

Ligament of ankle- Deltoid, named according to shape

Ligament of Hip- Ligament of Bigelow (Y shaped) named according to shape

## Composed of:-

Heterogeneous structure composed of small amount of cells(20%), extracellular matrix(30%-40%)

Cellular component consist of fibroblast

Interfibrillar component composed of PG's and glycoprotein.

# PROPERTIES

The visco-elastic behaviour is exhibited by the creep and stress relaxation behaviour.

Ligaments exhibit creep when fixed load applies the length of ligament starts increasing.

Ligaments exhibit stress relaxation when fixed load is pulled and maintained at same length over time the load decreases.

Ligament can withstand shear, compressive and tensile forces

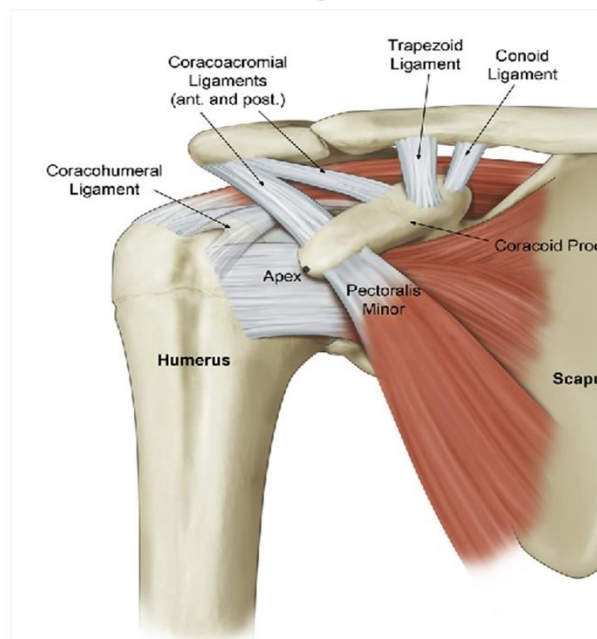
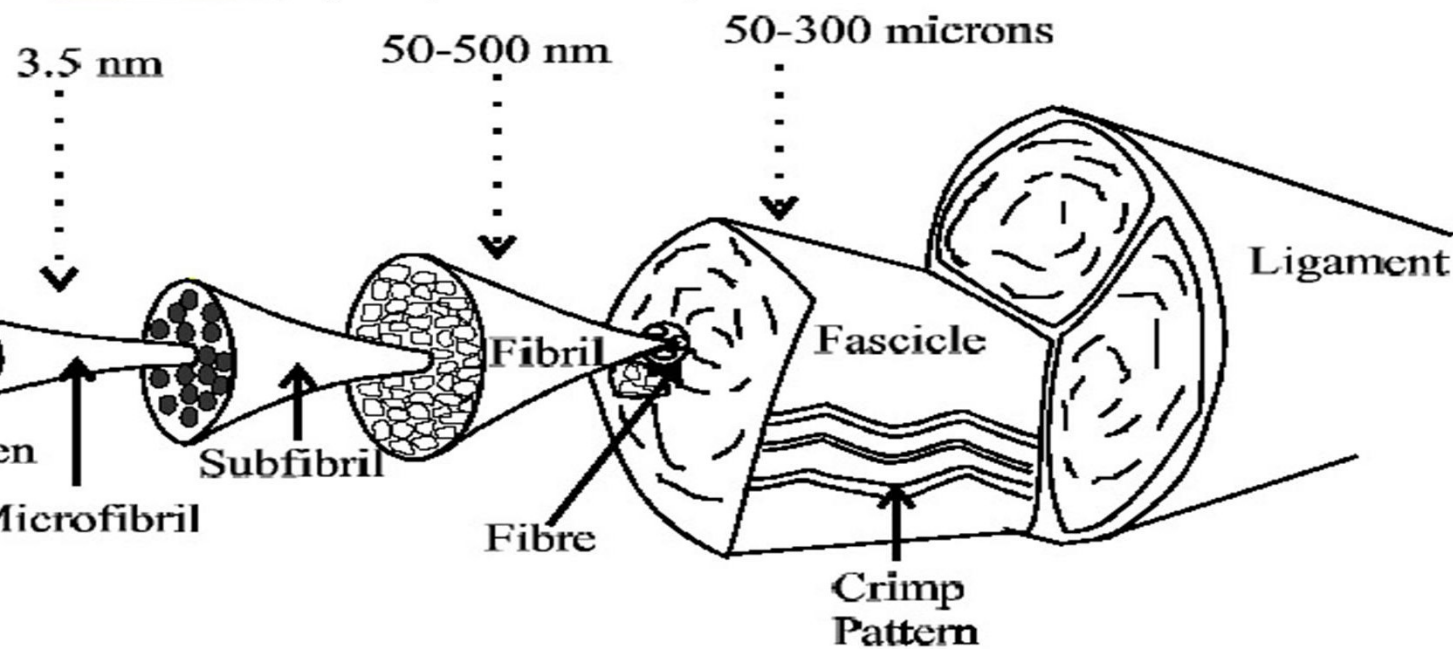
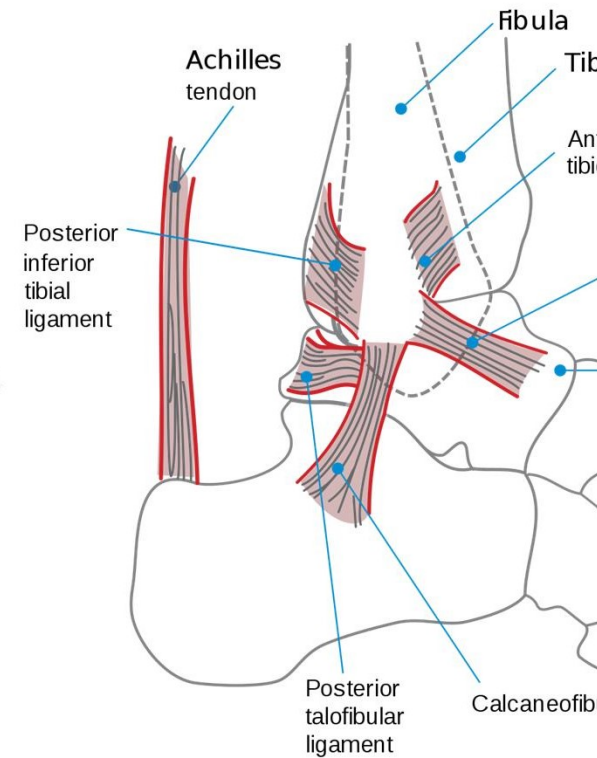
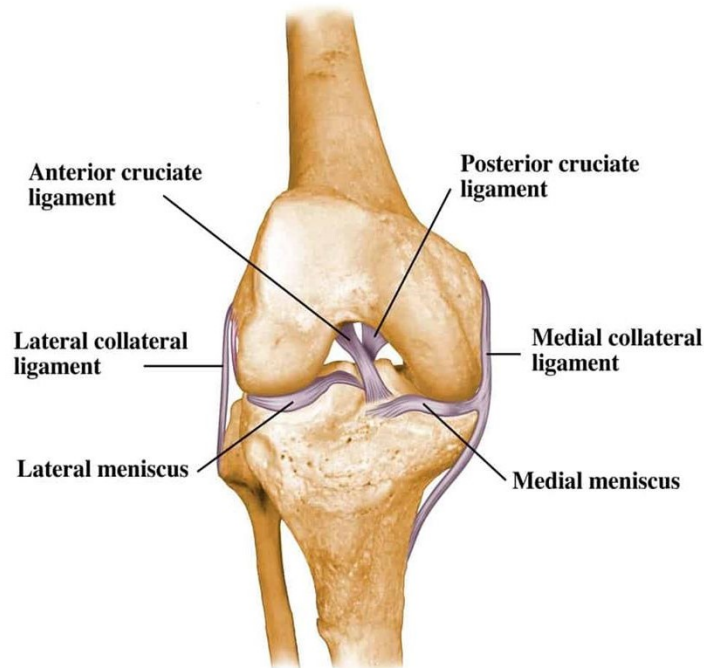
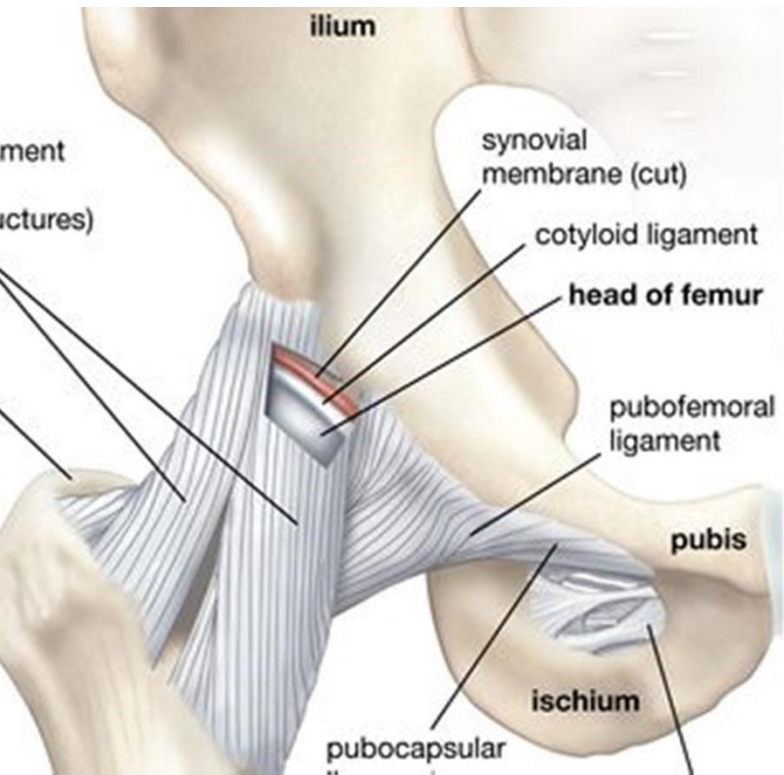


Fig 4. Schematic representation showing

# TENDONS

Definition: Tendon is a tough band of fibrous connective tissue that connects muscle to bone and is capable of withstanding tension.

They are usually named for the muscle to which they are attached.

**EXAMPLE-** Biceps tendon for biceps brachia.

Triceps tendon for Triceps.

Tendons are composed of-

**Fibrillar Compound-** Compound of varying proportion of collagen and elastin.

**Extra cellular Matrix-** Contains water, proteoglycans PG's GAG glycosaminoglycans components

**Endotendon-** Groups of fibre bundles enclosed by loose connecting tissue

**Epitendon-** Endotendon also encloses nerves lymphatic's, and blood vessel supplying tendon to form secondary bundle.

**Epitenon-** The sheath that covers all secondary bundles

**Epitendon-** Group of fibre bundles enclosed by loose connective tissue sheath.

**Synovium-** Peritoneum may become a synovial filled sheath.

**Myotendinous Junction-** The attachment of tendons to muscle is formed as collagen

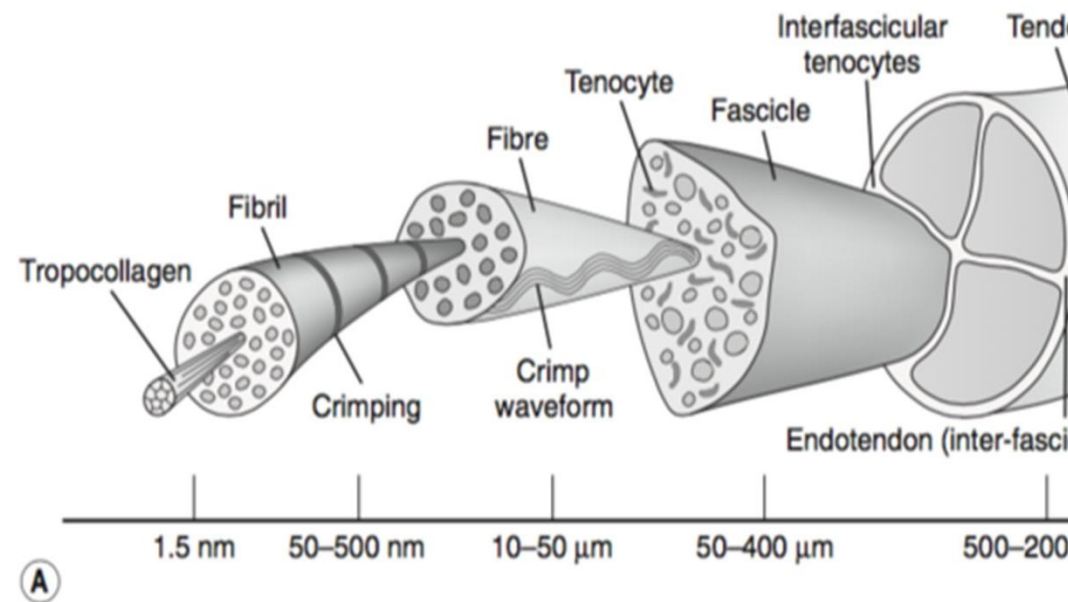
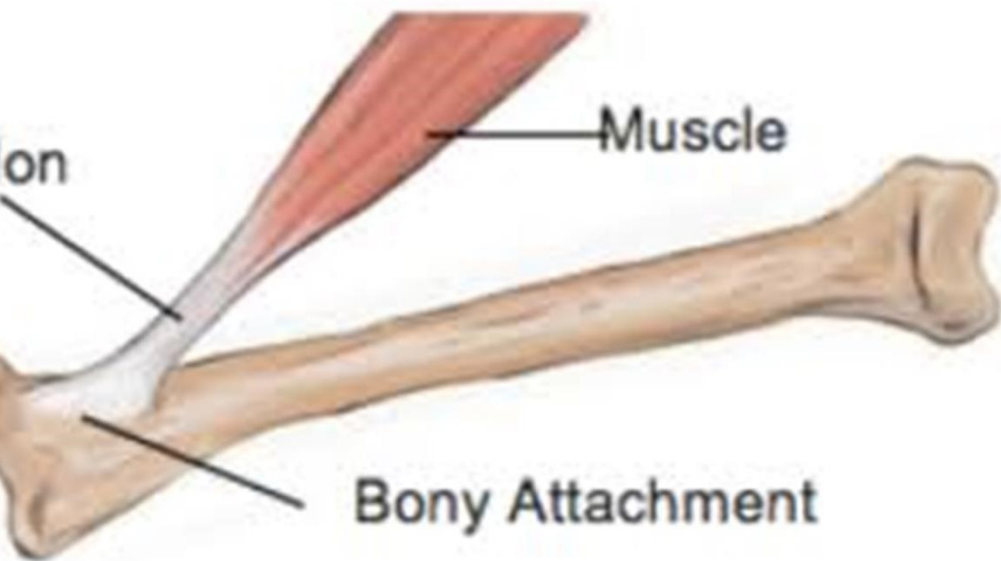
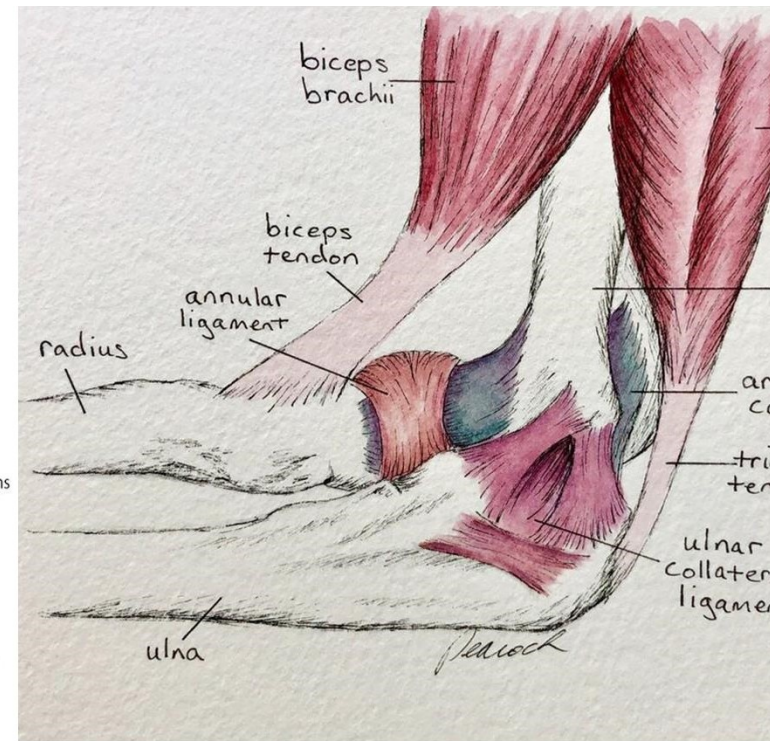
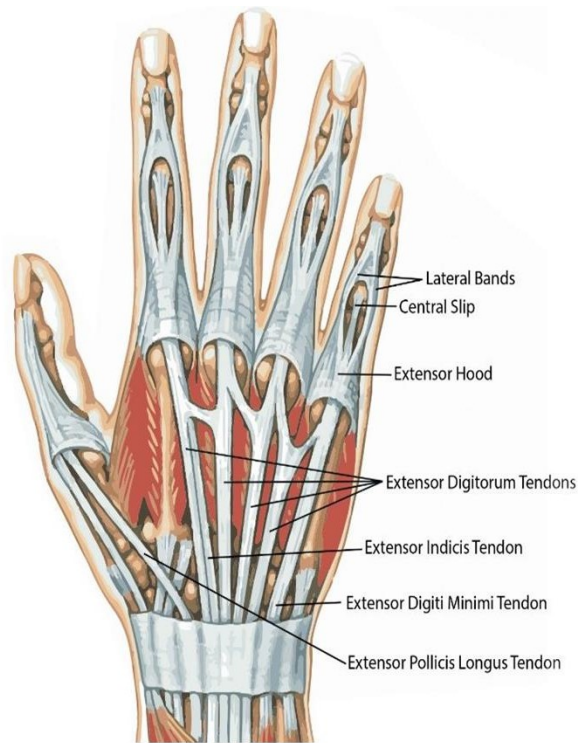
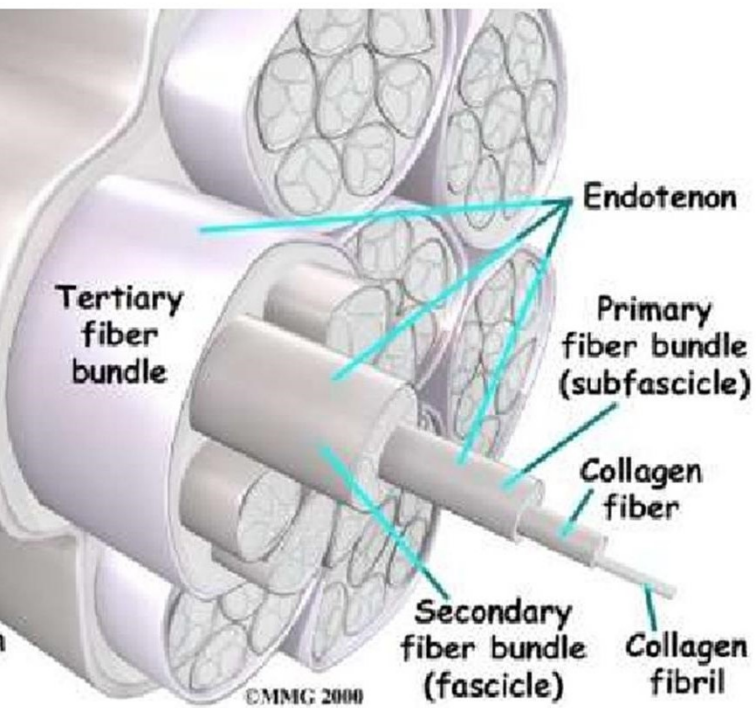
# PROPERTIES

They exhibit creep when subjected to constant or cyclic tensile loading.

They resist the amount of elongation.

They can withstand tensile forces without injury.





# BURSÆ

Def: Bursae are fluid filled sac or like cavity, especially one countering friction at a joint.

They are similar in structure and function to tendon sheath.

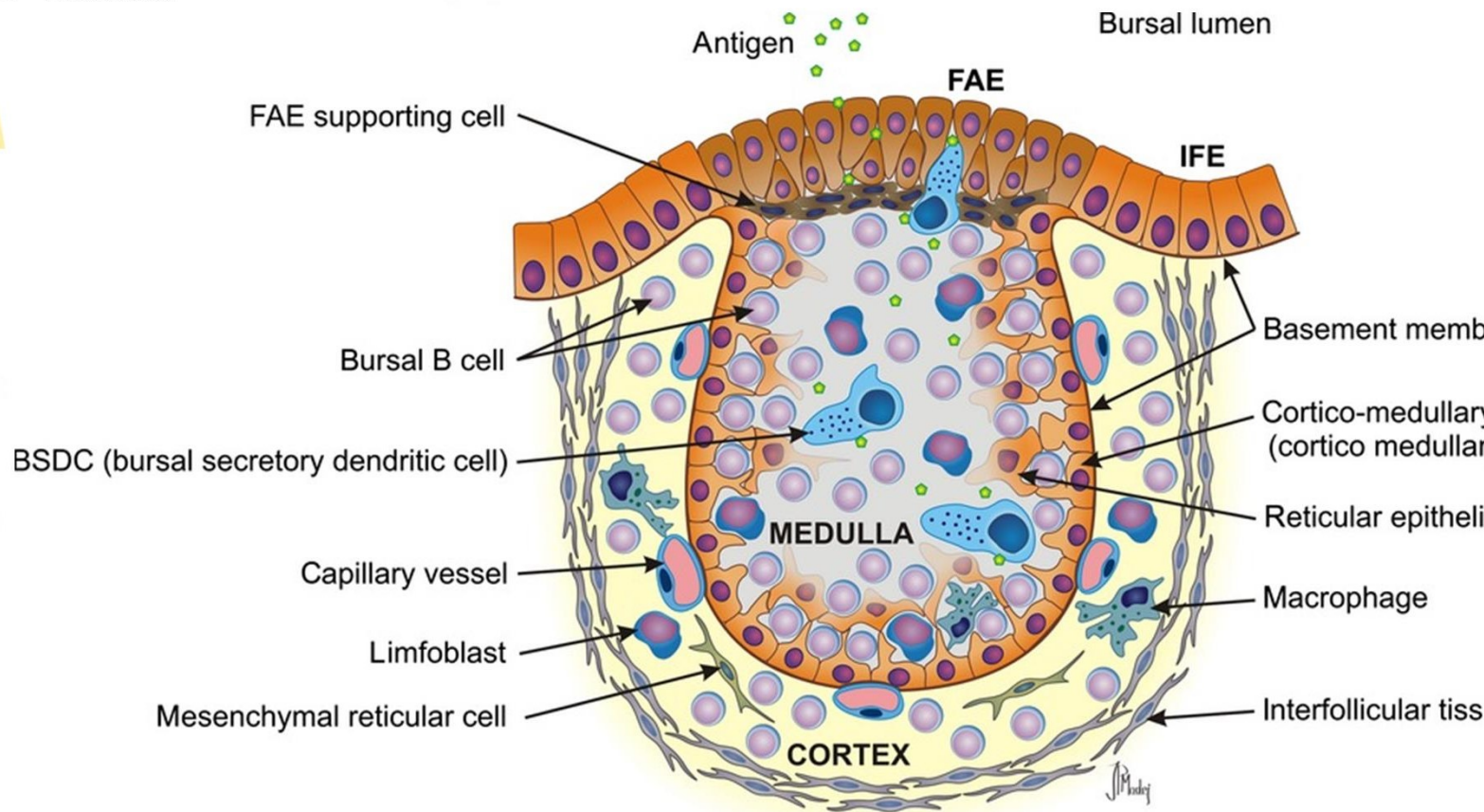
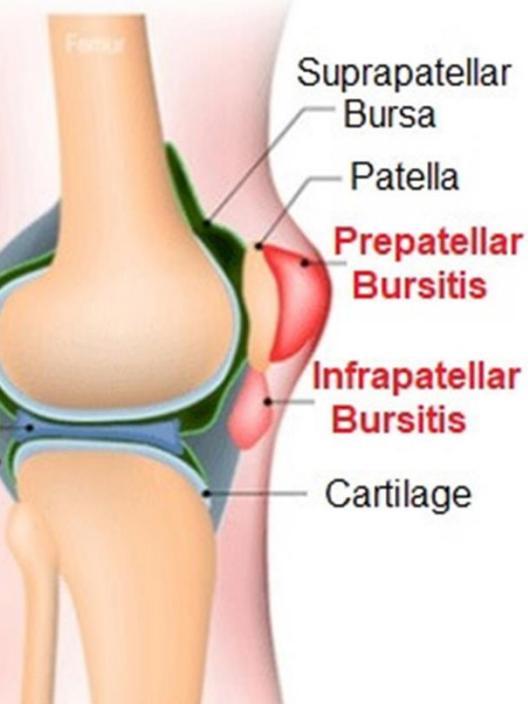
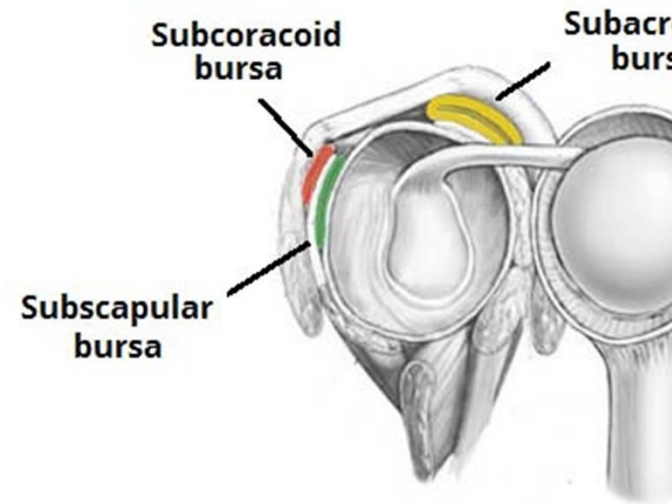
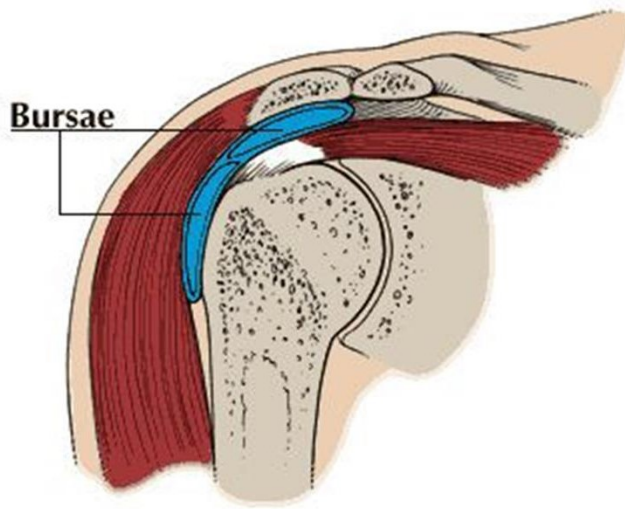
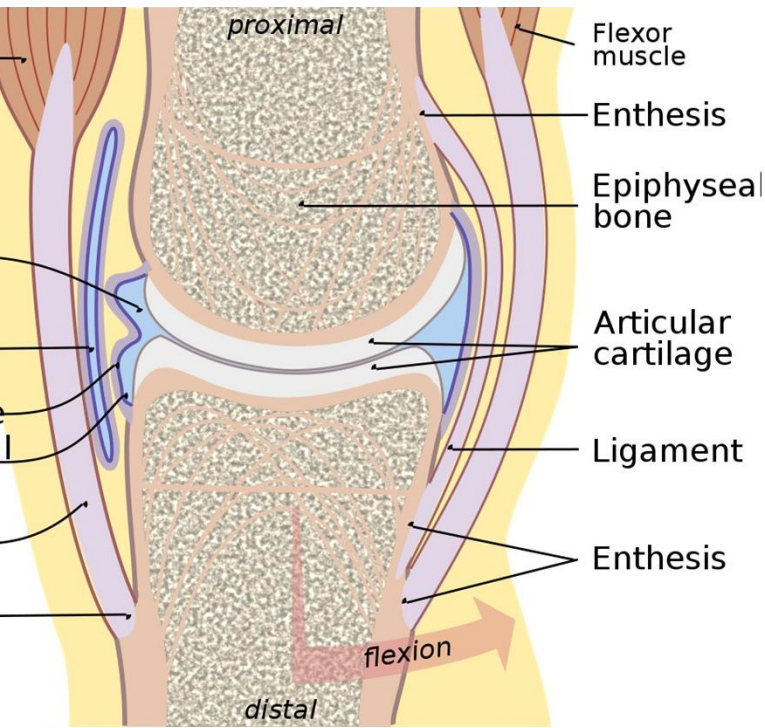
They are located between tendon and bone , bone and skin, muscle and bone.

**Sub cutaneous bursae-** bursae found between the patella and the skin and olecranon process of ulna and the skin.

**Subtendinous bursae-** lie between the tendon and bone.

**Submuscular bursae –** lie between muscle and bone.





# CARTILAGE

Def: Cartilage is a specialised type of connective tissue which is subjected to bear weight and have tensile strength .

It is found in that area where rigidity and elasticity are required  
It is a vascular and Non nervous.

It is a type of dense connective tissue belonging to sclerous tissue

It is subjected to bear weight and has tensile strength

It is found in the regions in body where elasticity and some rigidity is required

Structurally it consists of cells and intercellular substances

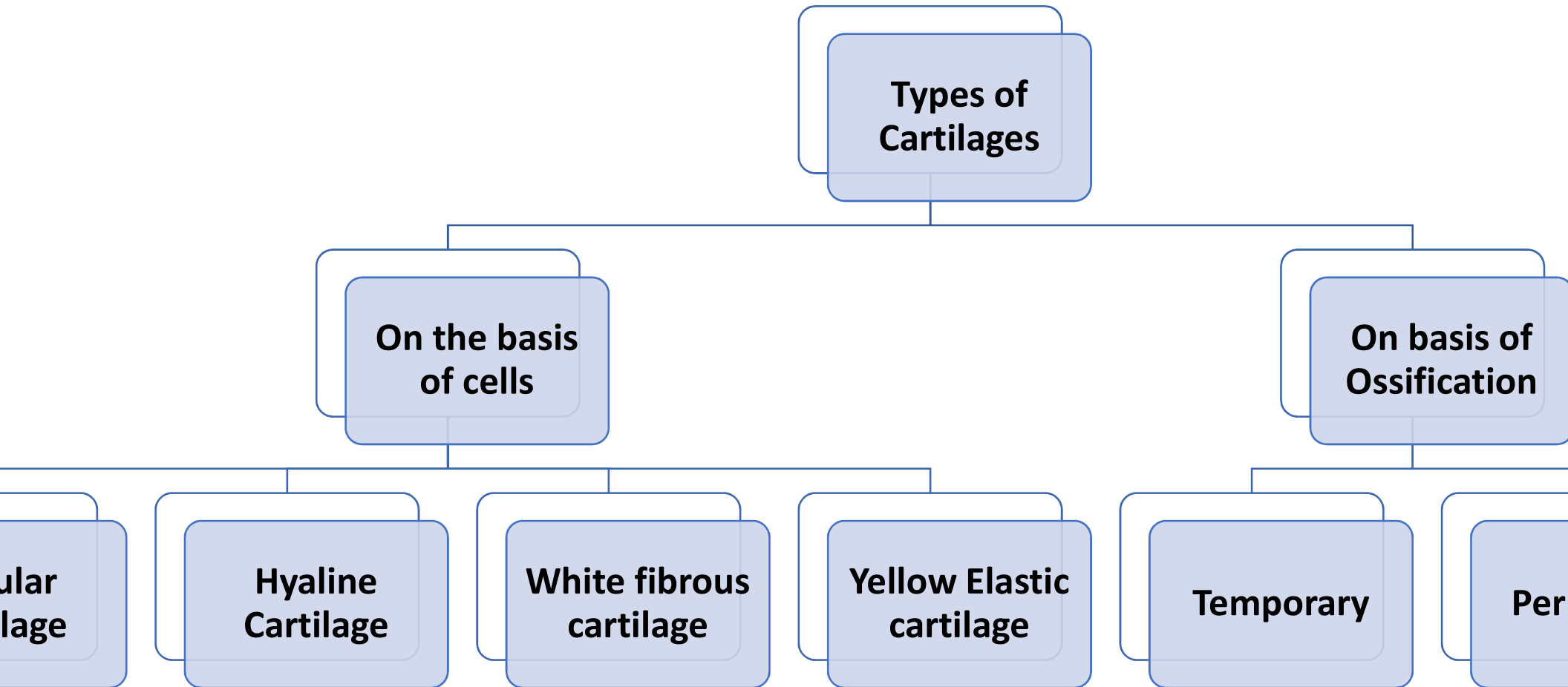
# CARTILAGE GROWTH

It grows by two methods-

**Interstitial Method -:** In this there is proliferation of cells with the help of mitosis which enables it to increase in its length.

**Appositional Method-:** In this method, there is deposition of cartilage cells at the surface thereby increasing the width of the cartilage.

# TYPES OF CARTILAGE



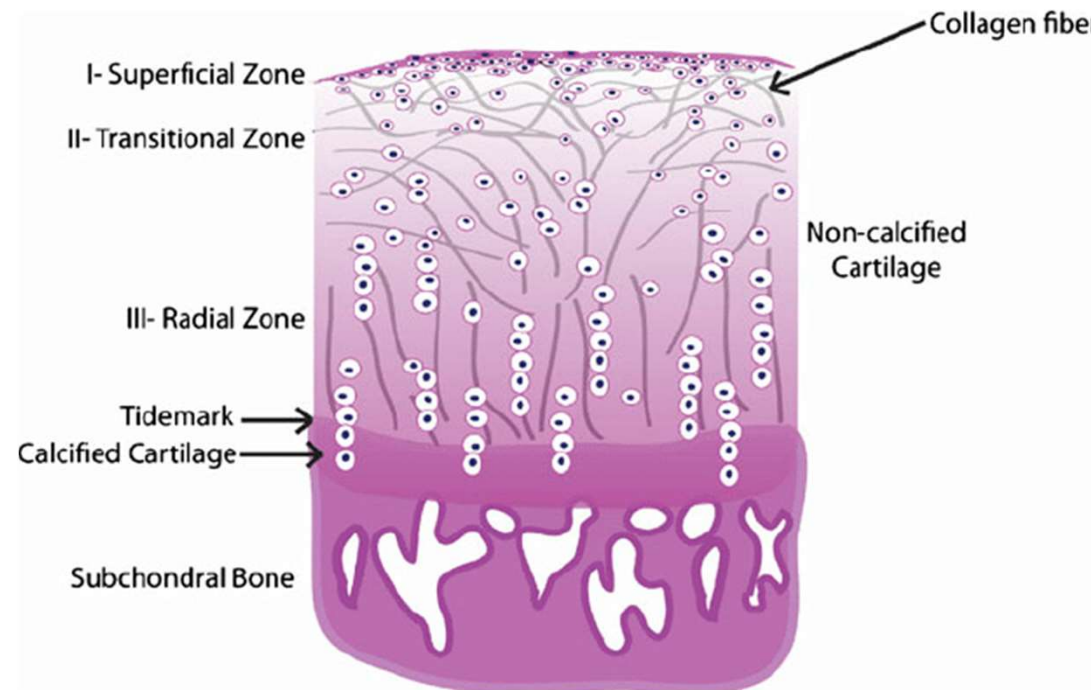
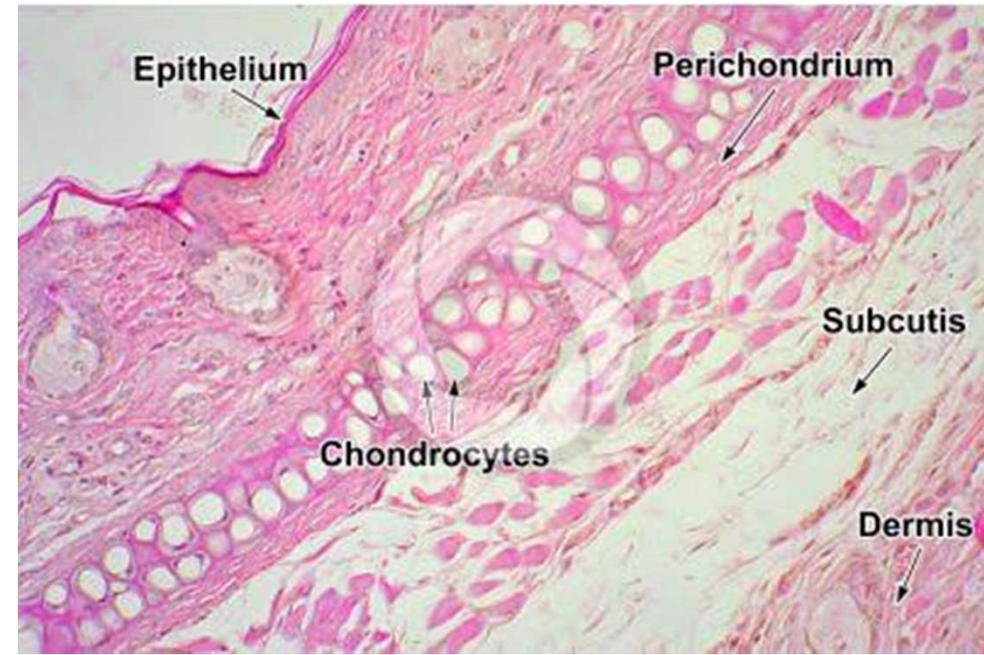


# CELLULAR CARTILAGE

DEF: A cellular cartilage is one which is made up of chondrocytes producing large amount of extracellular material with no blood vessels.

It is composed mainly of cartilage cells which have minimum component of intercellular substance or matrix

**Ex-** Present in intra-uterine life



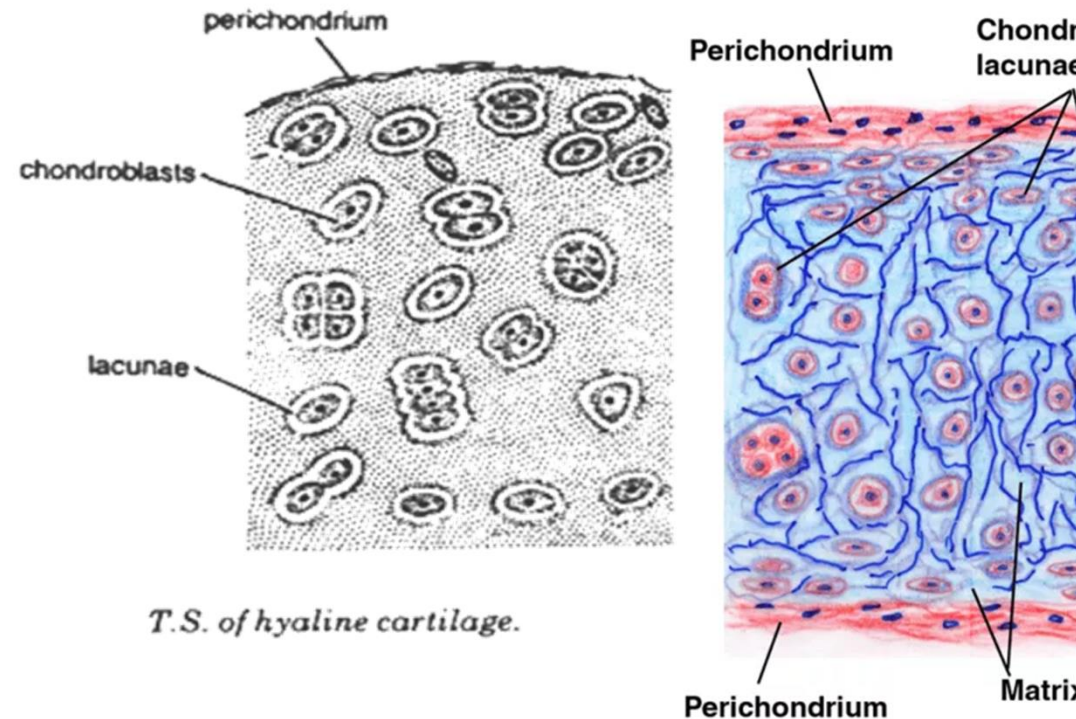
# HYALINE CARTILAGE

Def: A bluish white translucent cartilage embedded in homogenous matrix forming most of the fetal skeleton.

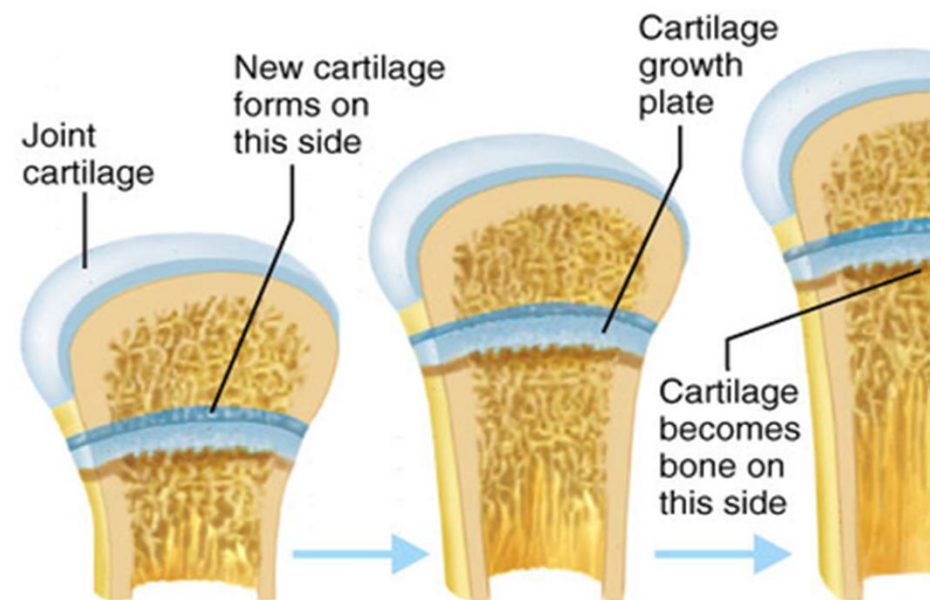
Perichondrium covers the outer surface except the articular surface

Ground substance or matrix is homogenous.

Ex- Present in articular cartilage, tracheal rings, Thyroid, Cricoid cartilage



*T.S. of hyaline cartilage.*





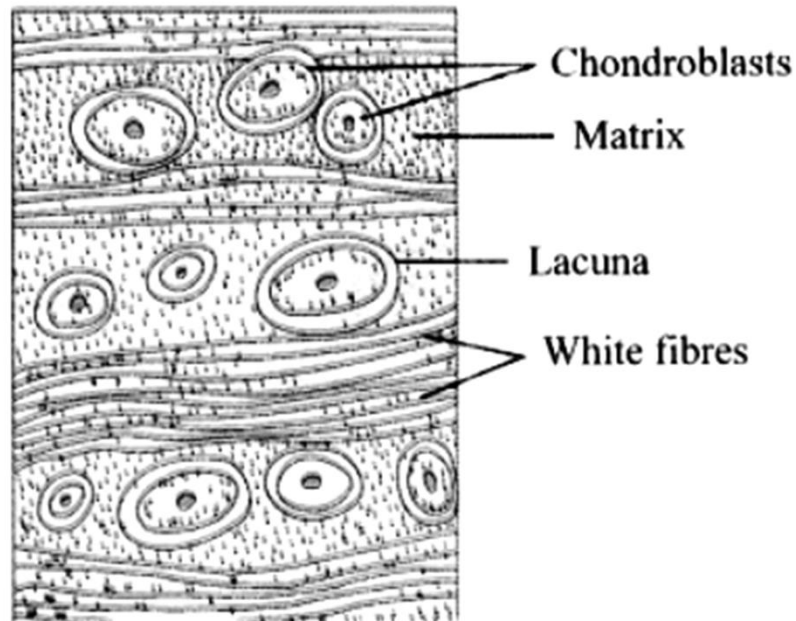
# WHITE FIBROUS CARTILAGE

Chondrium is absent.

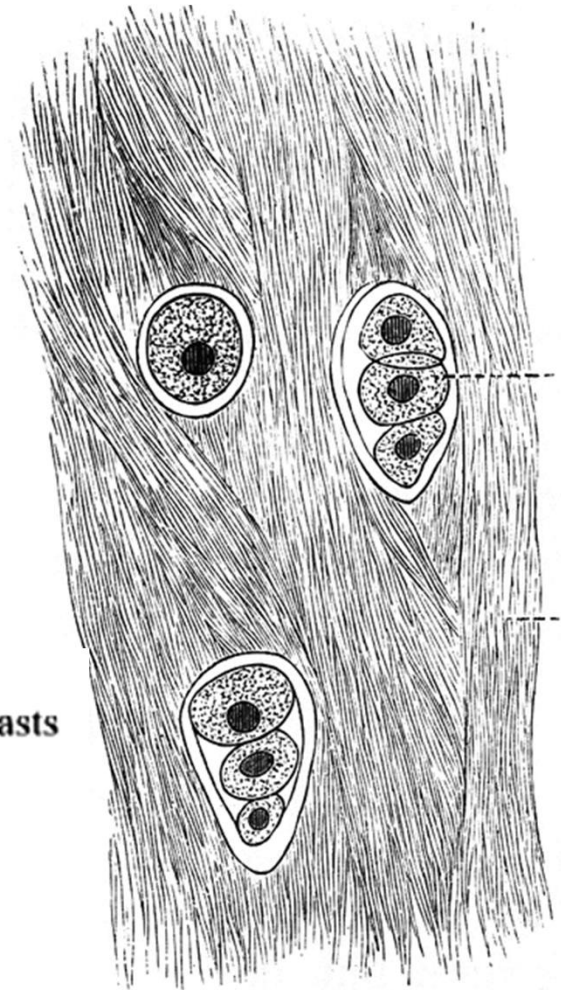
There are few encapsulated cartilage cells.

Thick bundles of collagen fibre present in the ground substance.

Inter-vertebral cartilage



**White fibrous cartilage**



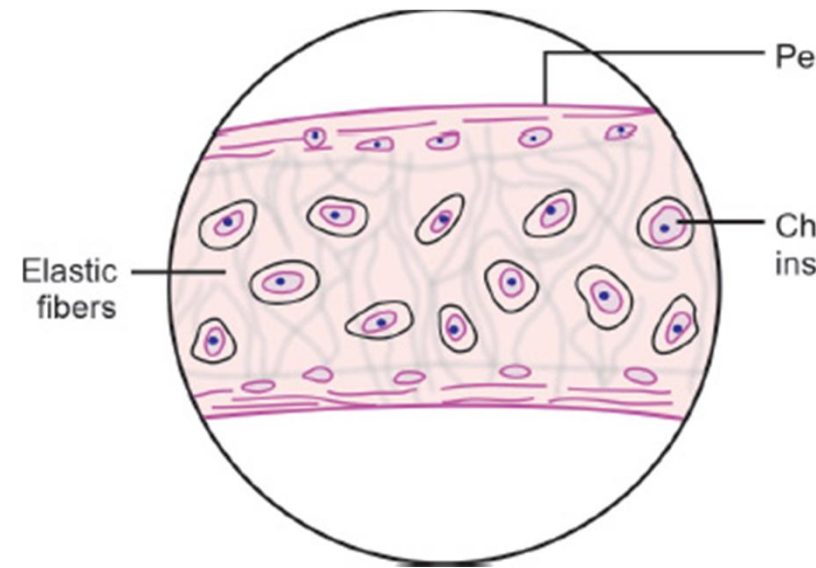
# LOW ELASTIC CARTILAGE

Perichondrium is present.

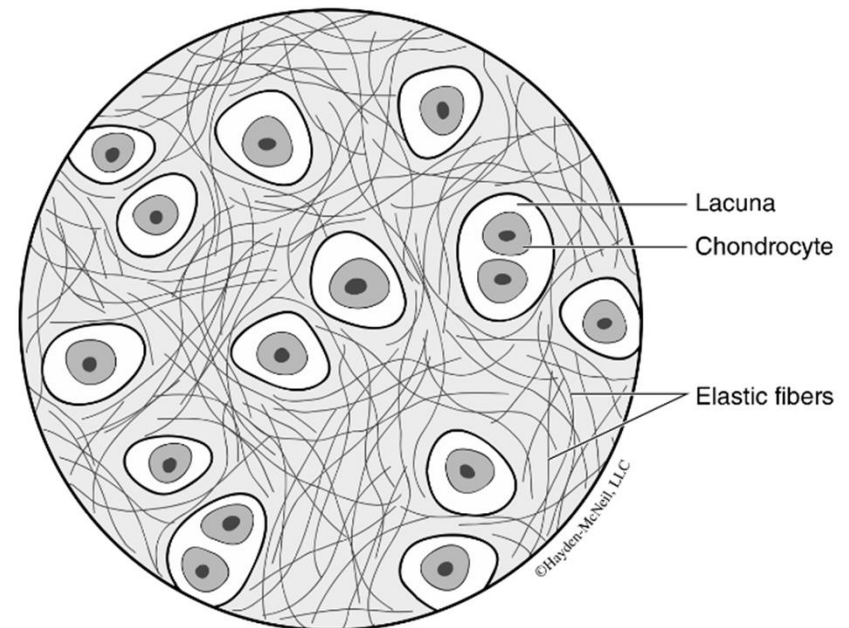
Encapsulated cartilage cells may be singly or in group.

Yellow elastic fibres branch

**Ex-** Cartilage of external ear, epiglottis



1. View the diagram of elastic cartilage (**Figure 19**)



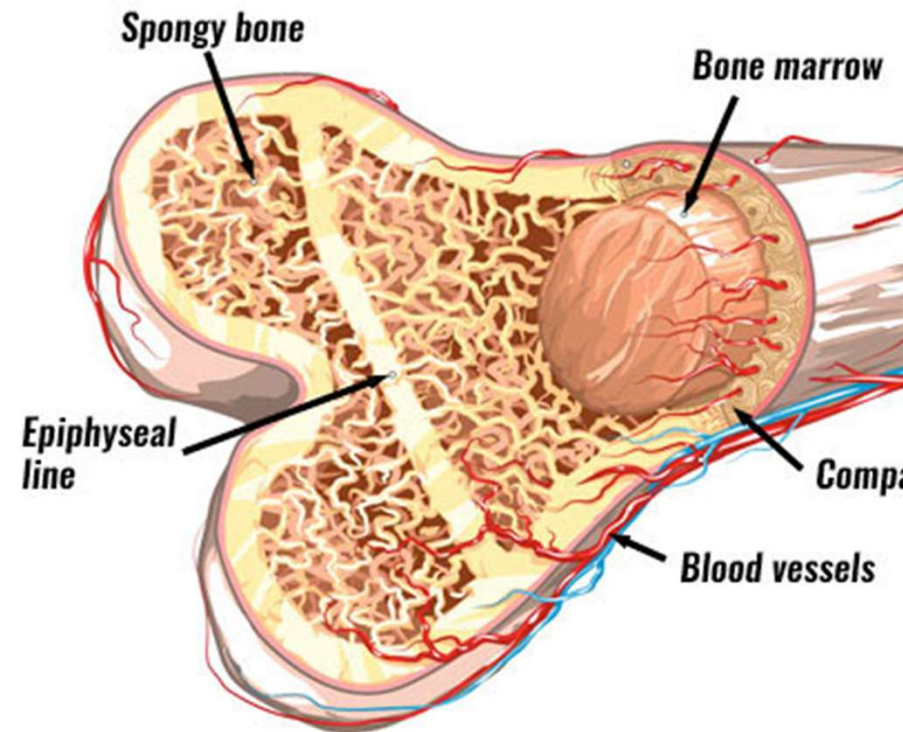
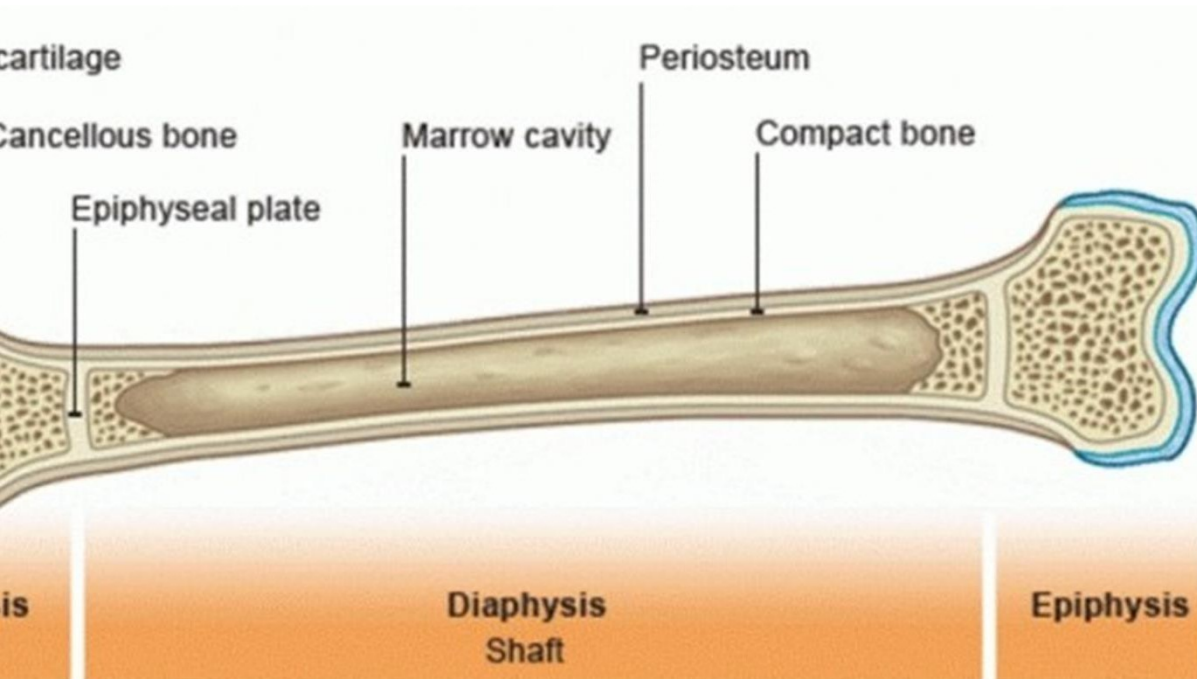
# ON BASIS OF OSSIFICATION

On the basis of ossification, there are further two types of Cartilages:

- **Temporary Cartilages-** These are those cartilages which ossify in later life stages and are replaced by the bone. For example:  
Epiphyseal Cartilage, Costal Cartilage
- **Permanent Cartilage-** These are the cartilages that remain cartilage throughout life and does not ossify. For example:  
Articular Cartilage, Intervertebral disk cartilage

# BONE

Definition: Bone is a specialised type of connective tissue that forms the skeleton of the body and is basically composed of Calcium salts, calcium Phosphate and Calcium Carbonate.



# CHARACTERISTICS OF BONE

It is highly vascular and mineralised.

It is hard, rigid and a little resilient.

It is constantly changing and has a regenerating capacity.

It grows by interstitial and oppositional methods.

it has canalicular system of transport and distribution of nutrients

It may also develop by transformation of condensed mesenchyme or through formation of a cartilaginous model which is replaced later by bone.

# **FUNCTIONS OF BONE**

It give rigid structural framework of the body.

Provides area for attachment of muscle, tendons and ligaments

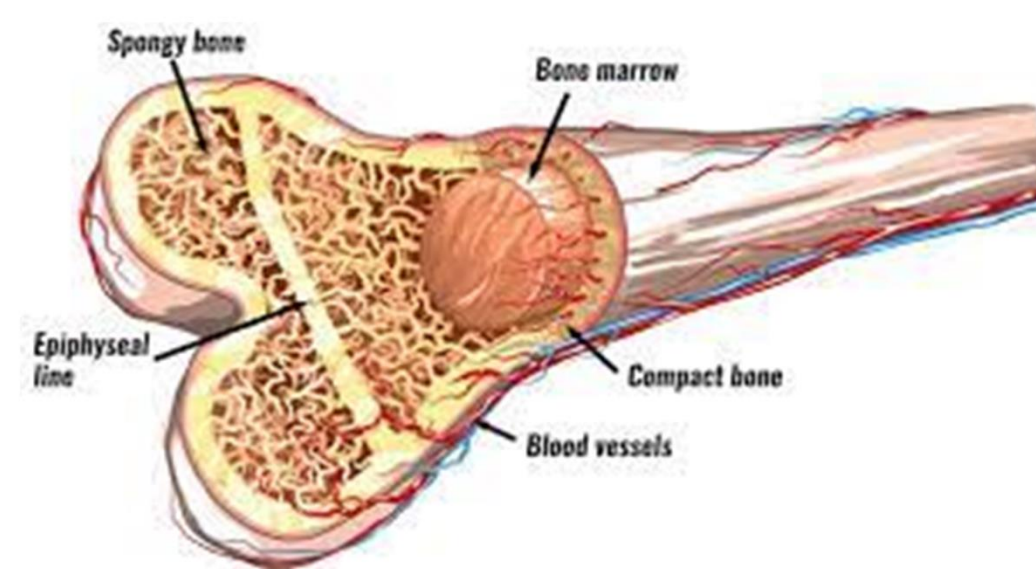
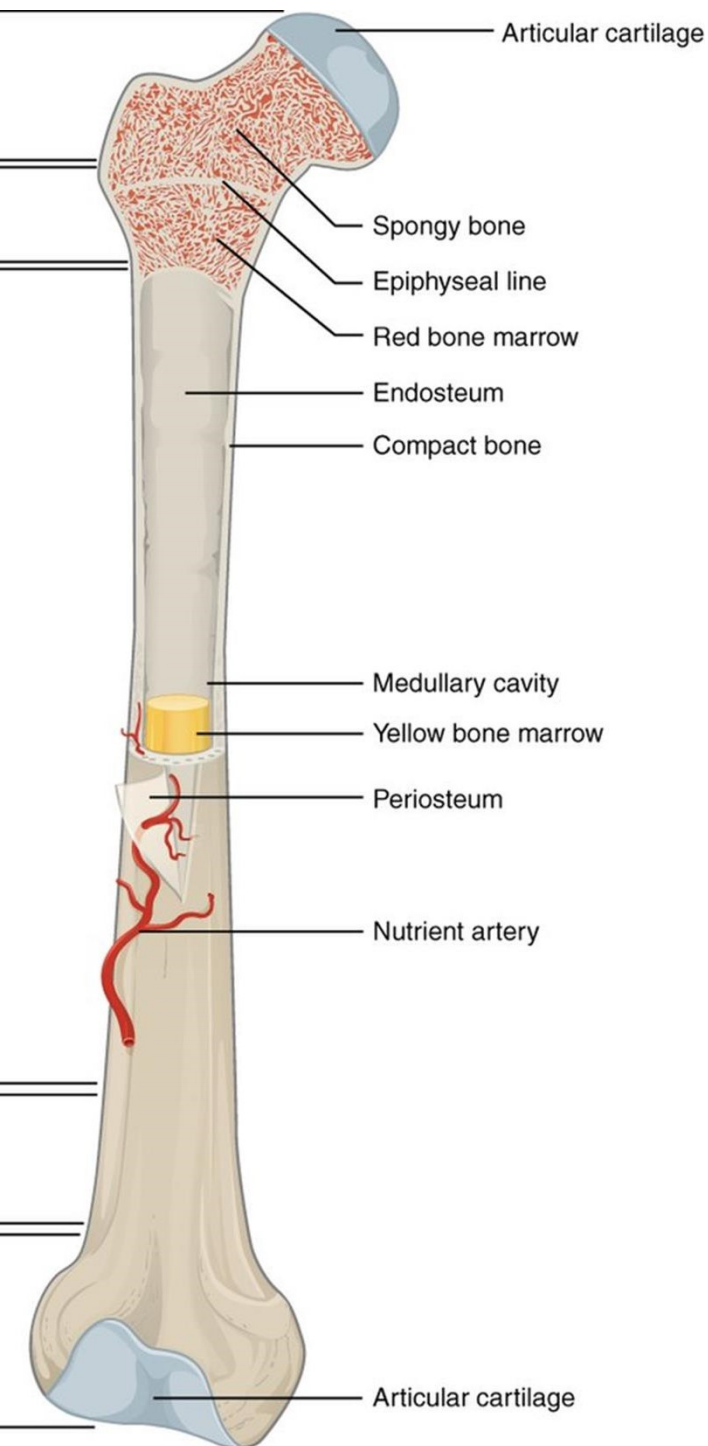
Contains bone marrow which manufacture blood cells.

It protect certain vital organs.

It acts as lever for muscle movements

It act as storehouse for calcium and phosphates.



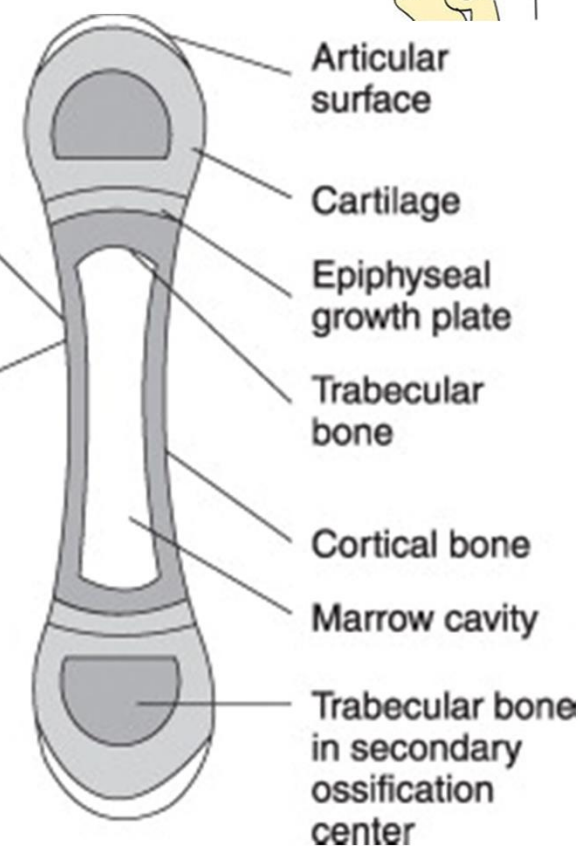
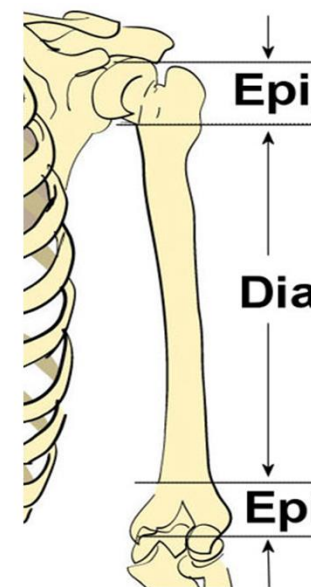


Haversian canal:  
contains blood  
vessels and  
nerves

Volkman's  
canal

Periosteum

Osteon: cylinder of bone matrix  
in the long axis of the bone;  
consists of 20–30 concentric  
layers of matrix



# CLASSIFICATION OF BONES

**Long –** Humerus, Radius, Ulna, Femur, Tibia

**Short –** Metacarpals, Metatarsals

**Irregular –** Hip bone, Vertebrae

**Flat -** Scapulae, Ribs

**Sesamoid-** Patella

**Accessory –** Sutural

**Pneumatic -** Ethmoid, Sphenoid

**According to Regions:** Appendicular: Skull, Vertebrae, Sternum, Humerus, Radius, Ulna, Tibia, Fibula

**According to Ossification:** Membranous, Cartilaginous

**According to Structure**

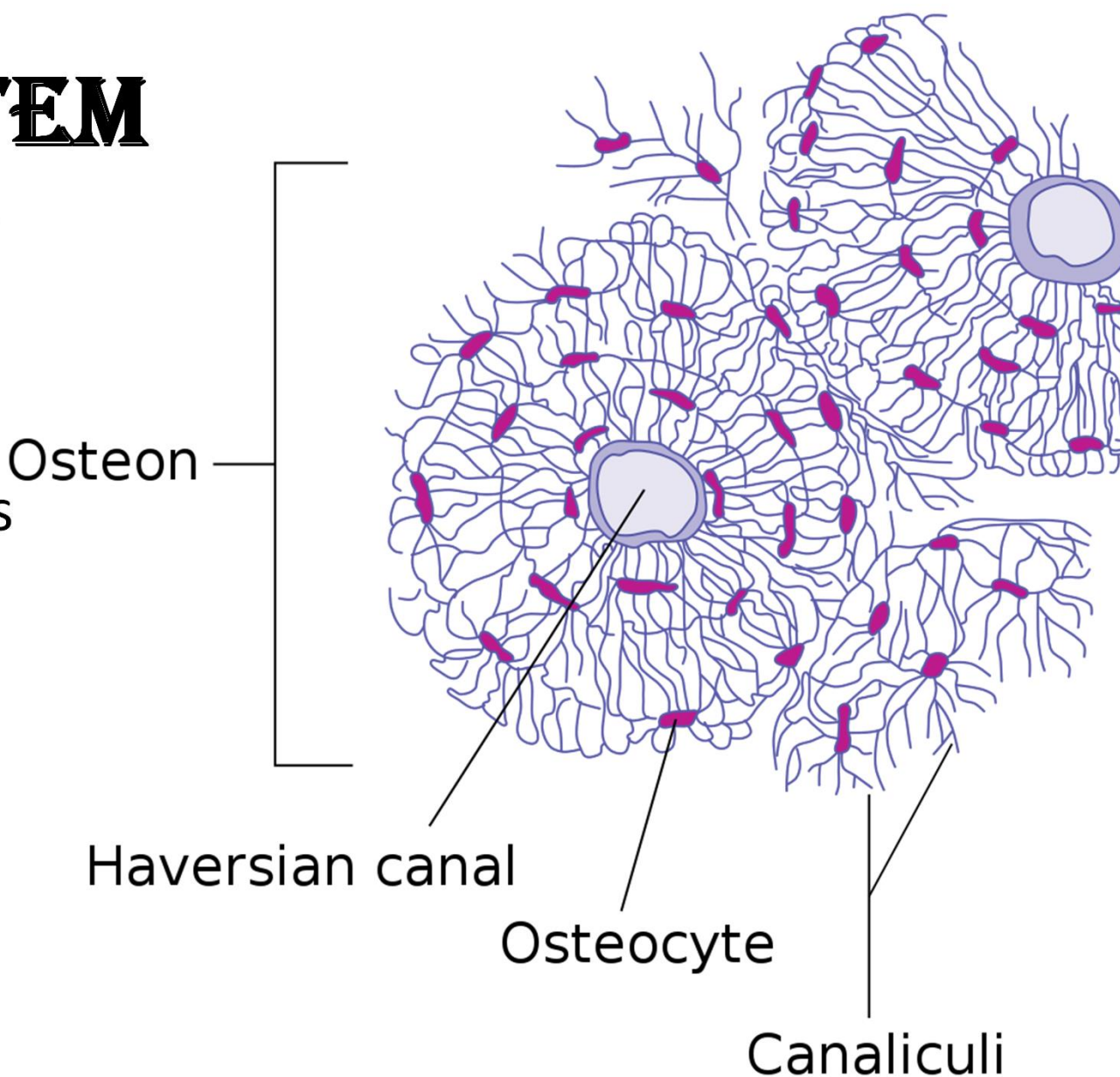
**Macroscopic-** Compact, Spongy

**Microscopic –** Lamellar, Dendrite, Cement

# Haversian System

A haversian canal system or system of haversian canal tubes lined by lamellae surrounded by blood and nerve vessels, and which communicates with osteocytes is known as Haversian system.

Osteon or Haversian System is the fundamental functional unit of compact bone. It has a longitudinal orientation.



# CONSTITUENTS OF HARVESIAN SYSTEM

## **Haversian Canal:-**

They are centrally located canal running parallel to long axis of bone.

Each canal contains nerves, blood vessel and lymphatics.

They are united to other canal by the side branches called VOLKSMAN CANAL.

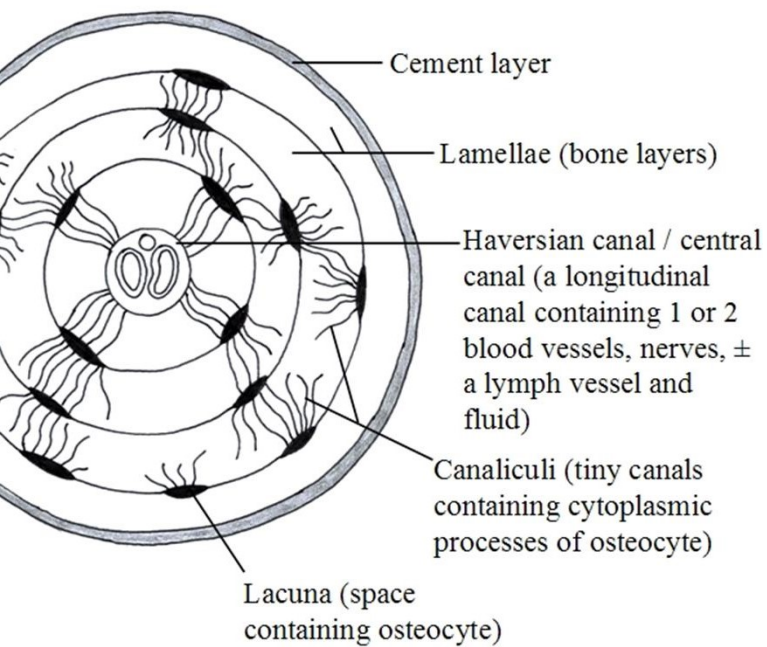
**Concentric Bony Lamellae:-** It is made up of five collagen bundles of calcified matrix which surrounds the Haversian Canal.

**Lacunae:-** Oval spaces which bear lamellae containing osteocytes.

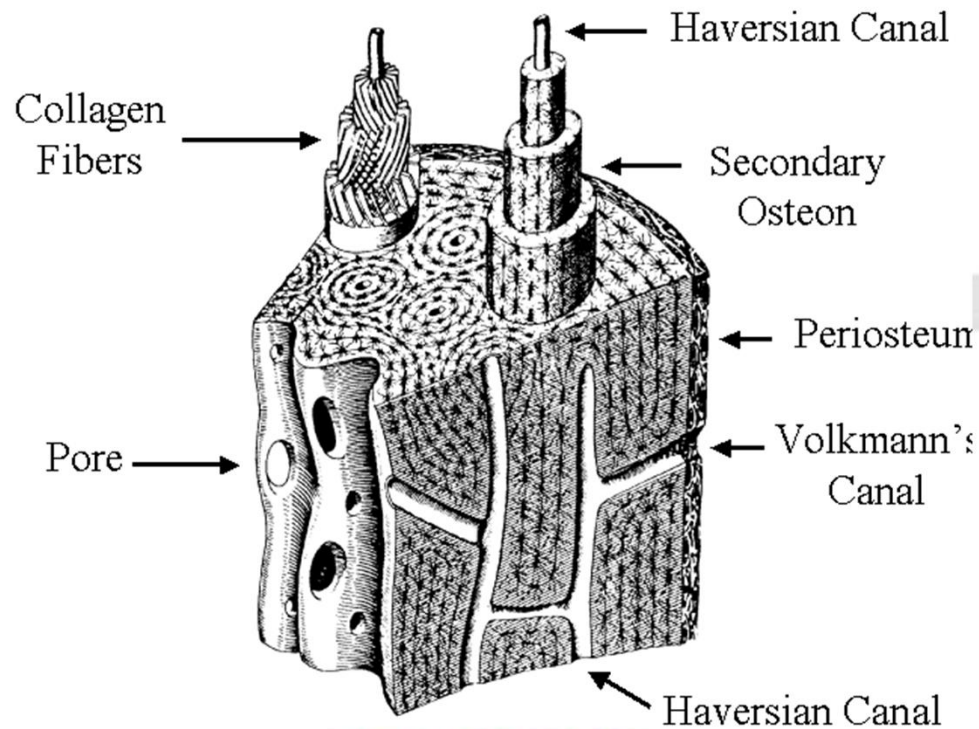
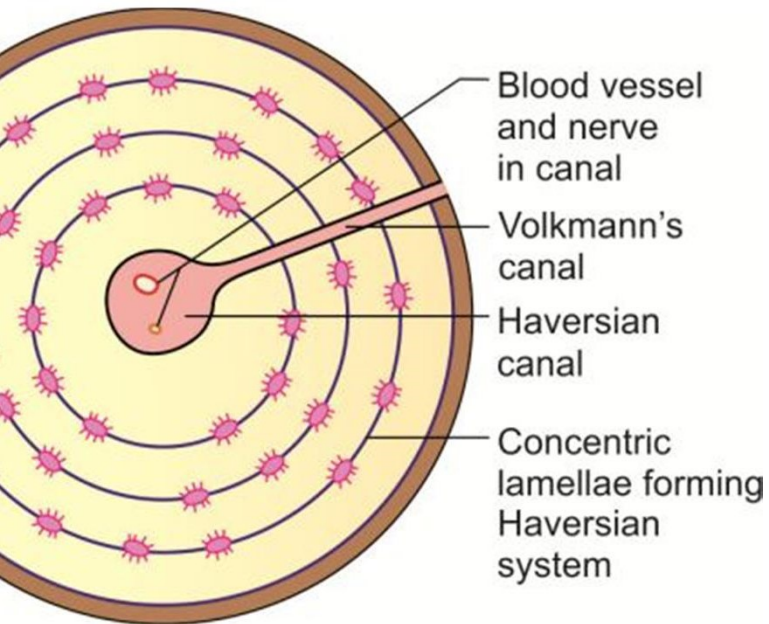
**Canaliculi:-** These are fine radiating channel which interconnect the lacunae and Haversian Canal.

**Interstitial Lamellae:-** It is along lamellae and canaliculi occupies the angular intervals between secondary osteons.





**A single osteon in cross-section**



**BONE MATRIX**

