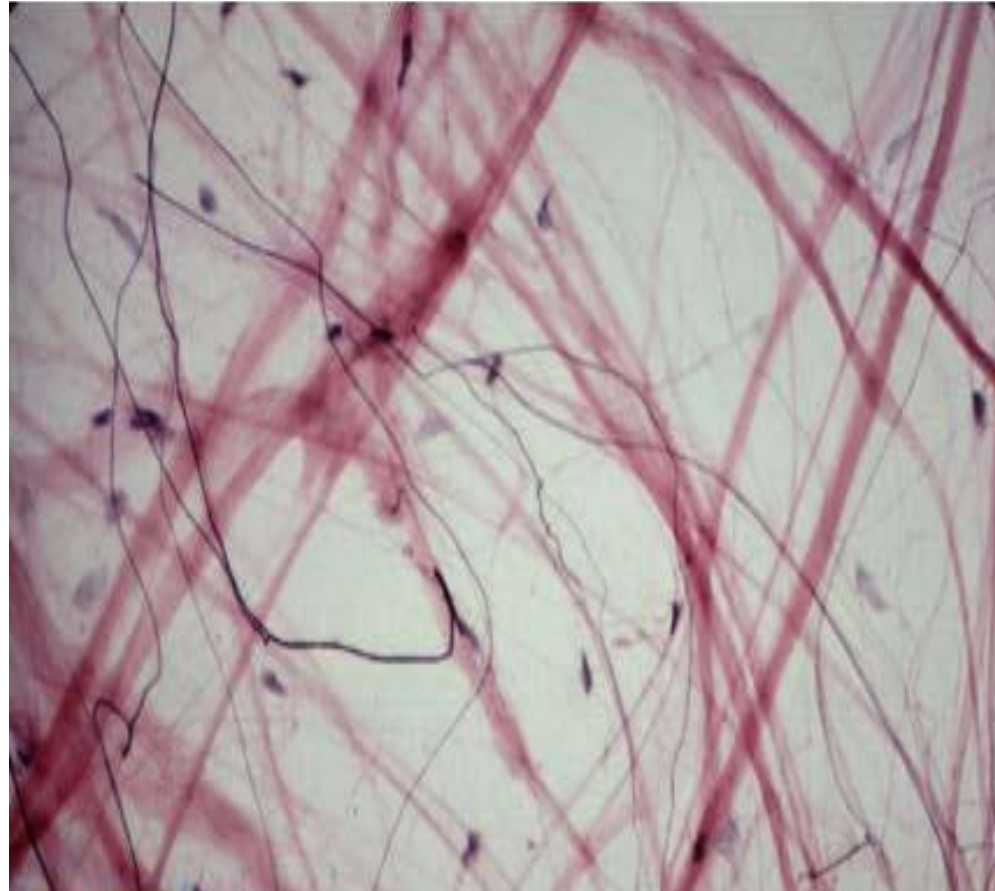


HISTOLOGY LAB- CARTILAGE

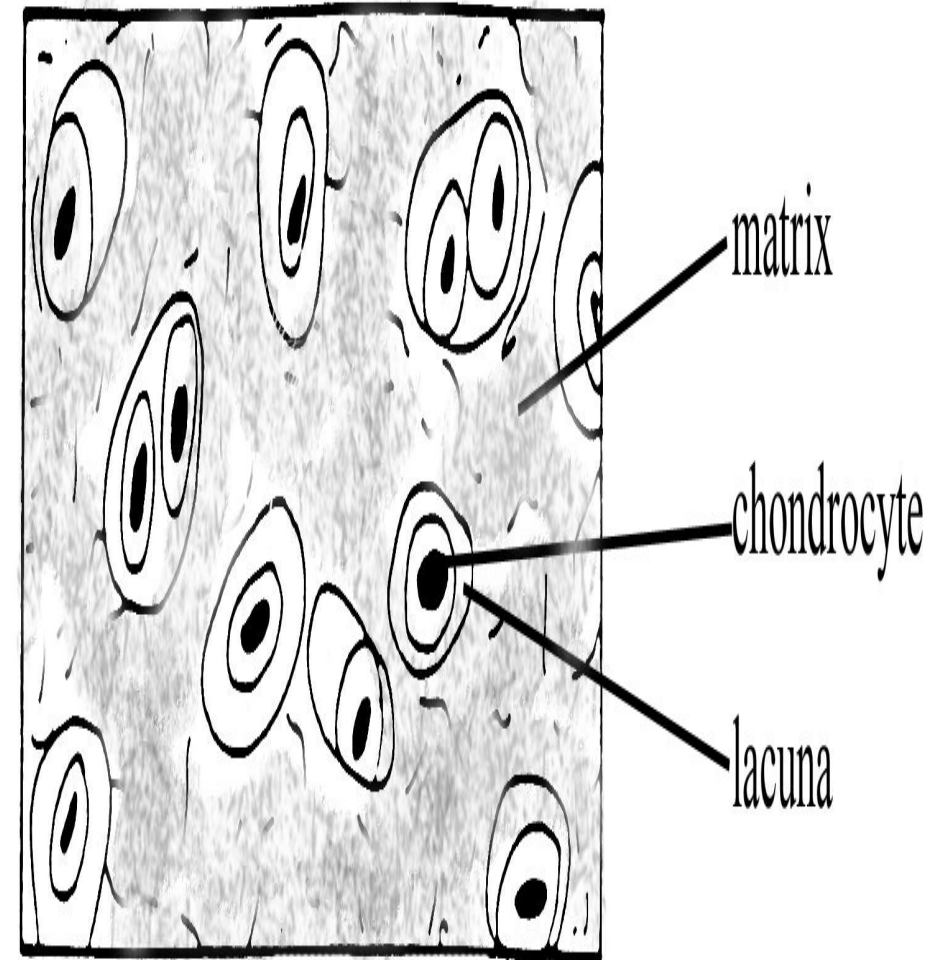
CARTILAGE

- Cartilage are *modified type of connective tissue* in which the extracellular matrix is hardened to provide rigidity, support and attachment for soft tissues.



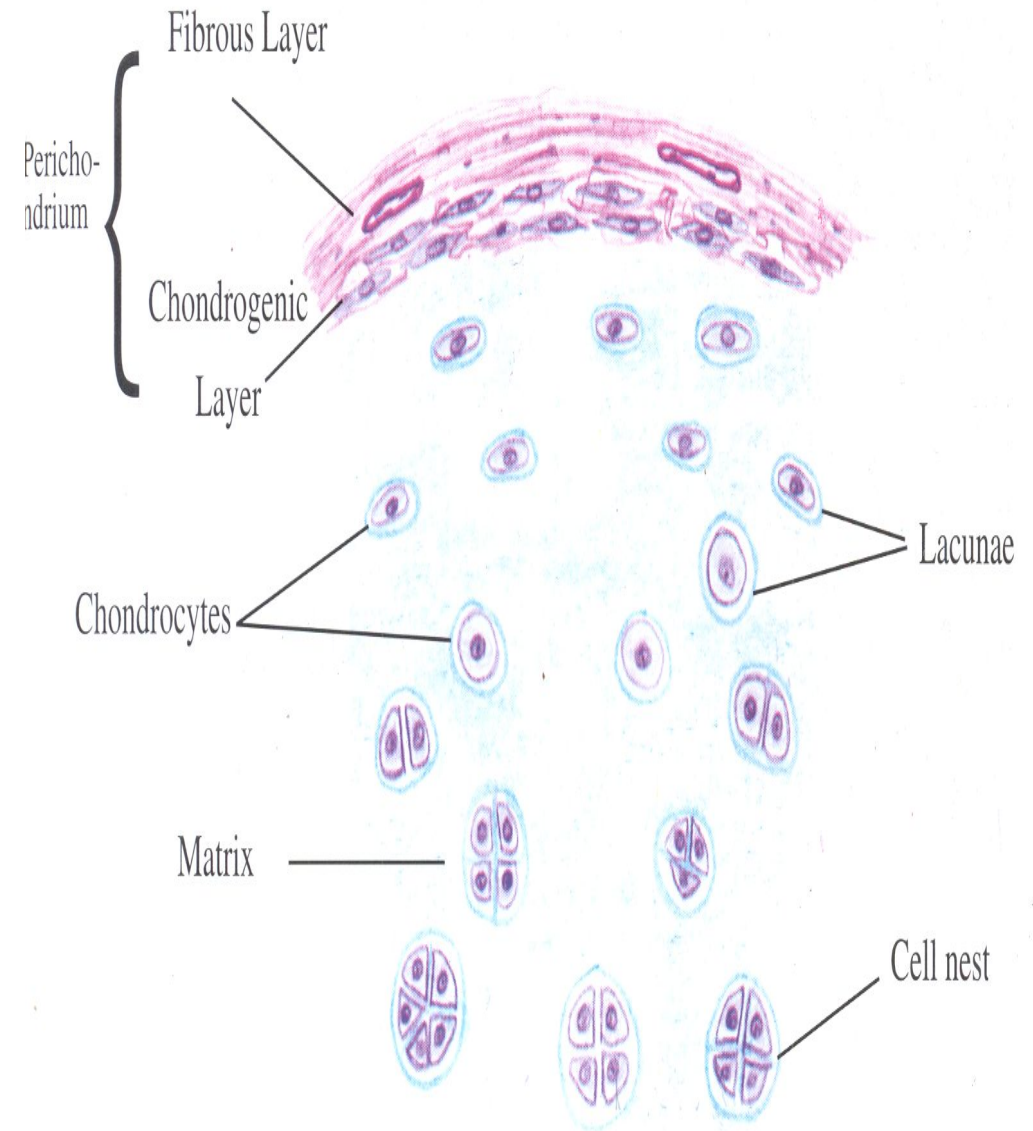
CHARACTERISTIC FEATURES OF CARTILAGE

- 1- The extra cellular matrix is *firm and flexible*.
- 2- It is *avascular*, no lymphatic vessels or nerves.
- 3- It is usually covered by *perichondrium*.
- 4- Cells are isolated in small cavities in the ground substance called *lacunae*.



PERICHOONDRIUM

- ❑ **Site:** Cartilage is usually covered by a membrane called perichondrium *except* inside joint cavities.
- ❑ **Structure:** It consists of two layers:
 - 1- *An outer fibrous layer:* dense CT, rich in type I collagen & few in blood vessels.
 - 2- *An inner vascular&cellular layer(chondrogenic layer):* contain chondroblasts (forming new cartilage).

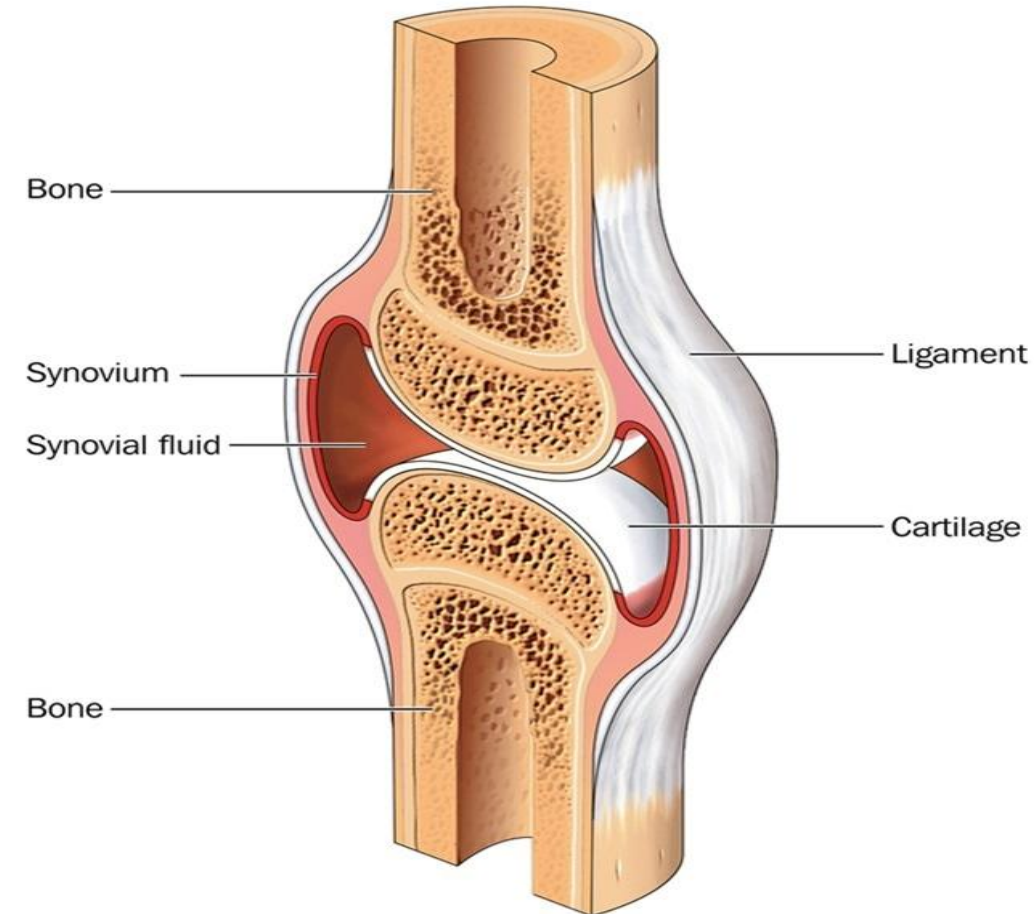


PERICHONDRIUM

▣ Functions:

- 1- *Growth* of cartilage at its periphery.
- 2- *Nourishment* as it contains blood vessels

▣ Inside joint cavities: these functions are committed by synovial fluid

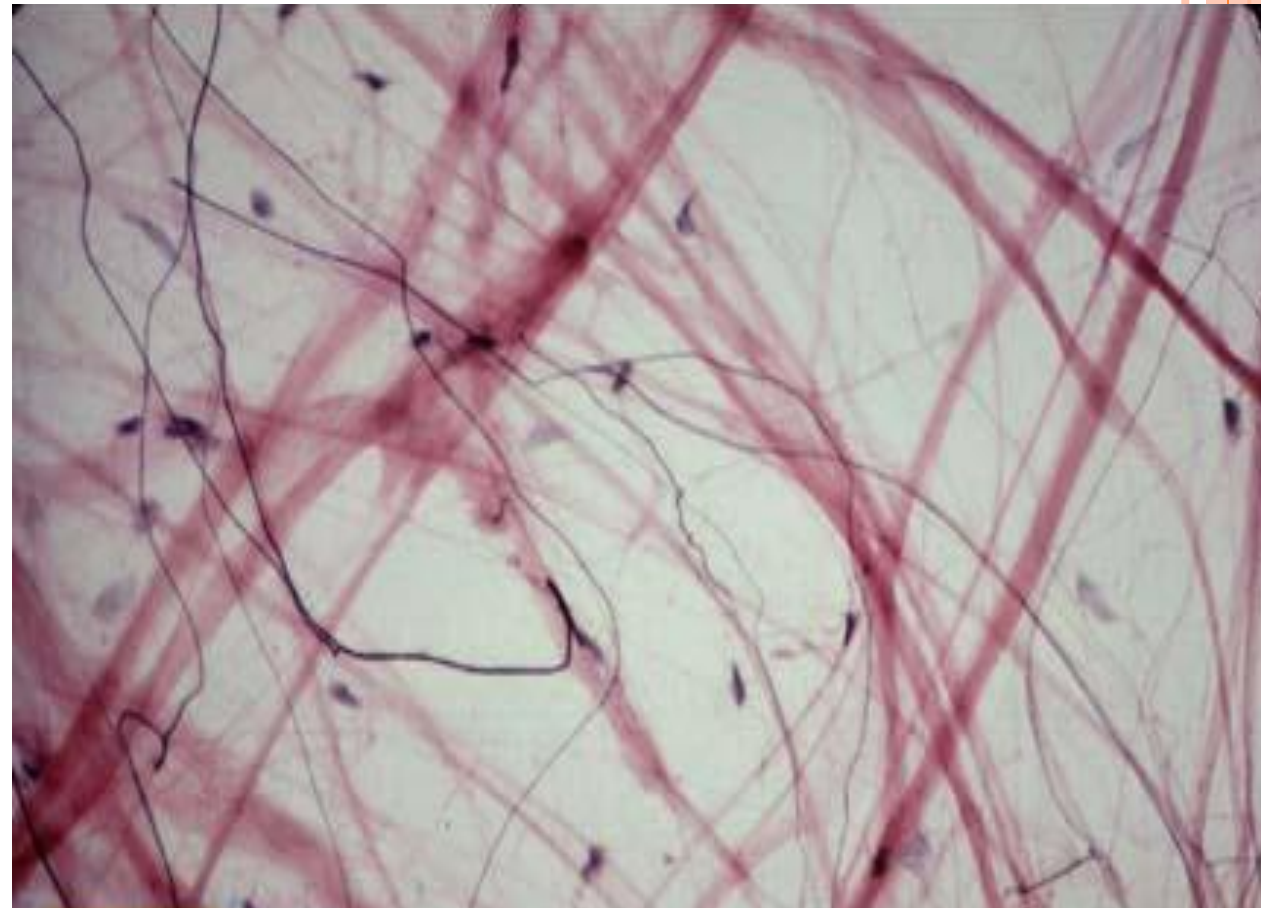


COMPONENTS OF CARTILAGE

1- **Extracellular matrix** including:

- Ground substance.
- Fibers: Collagen & elastic fibers.

2- **Cartilage cells**: chondroblasts & chondrocytes.



I- EXTRACELLULAR MATRIX

- It is responsible for the firmness and flexibility of the cartilage. It is produced by cartilage cells.

- **Structure:**

- 1- **Ground substance:**

- A- **Water:** 60-80% of cartilage weight.

- Function:** Diffusion of metabolites to the cartilage cells.

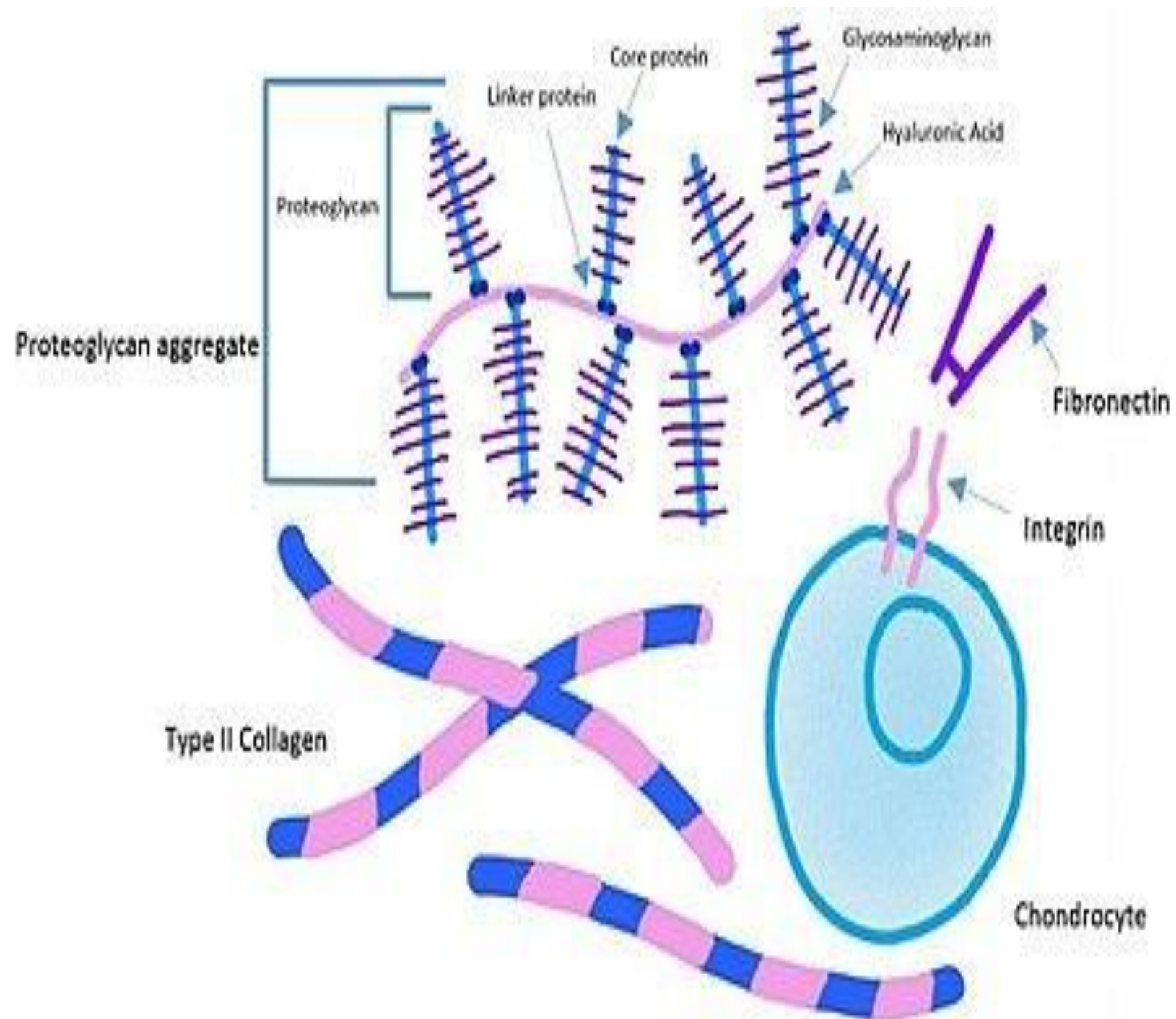
- B- **Proteoglycans:** glycosaminoglycans as

- Chondroitin sulfate
 - Keratan sulfate.
 - Hyaluronic acid.

- C- **Glycoproteins:** such as chondronectin (anchors chondrocytes to the matrix).

- 2- **Fibers:** mainly *collagen fibrils type II*, in addition to type I collagen and elastic fibers according to type of cartilage.

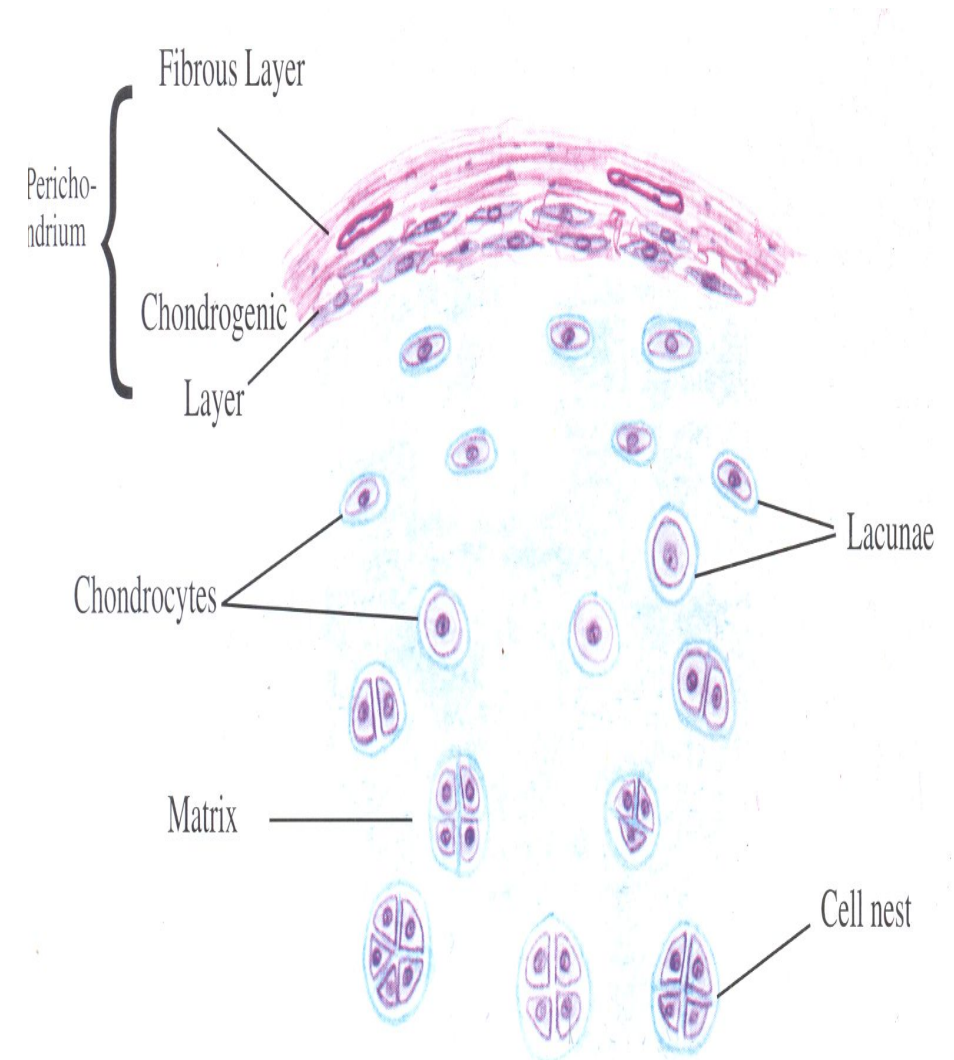




II-CARTILAGE CELLS

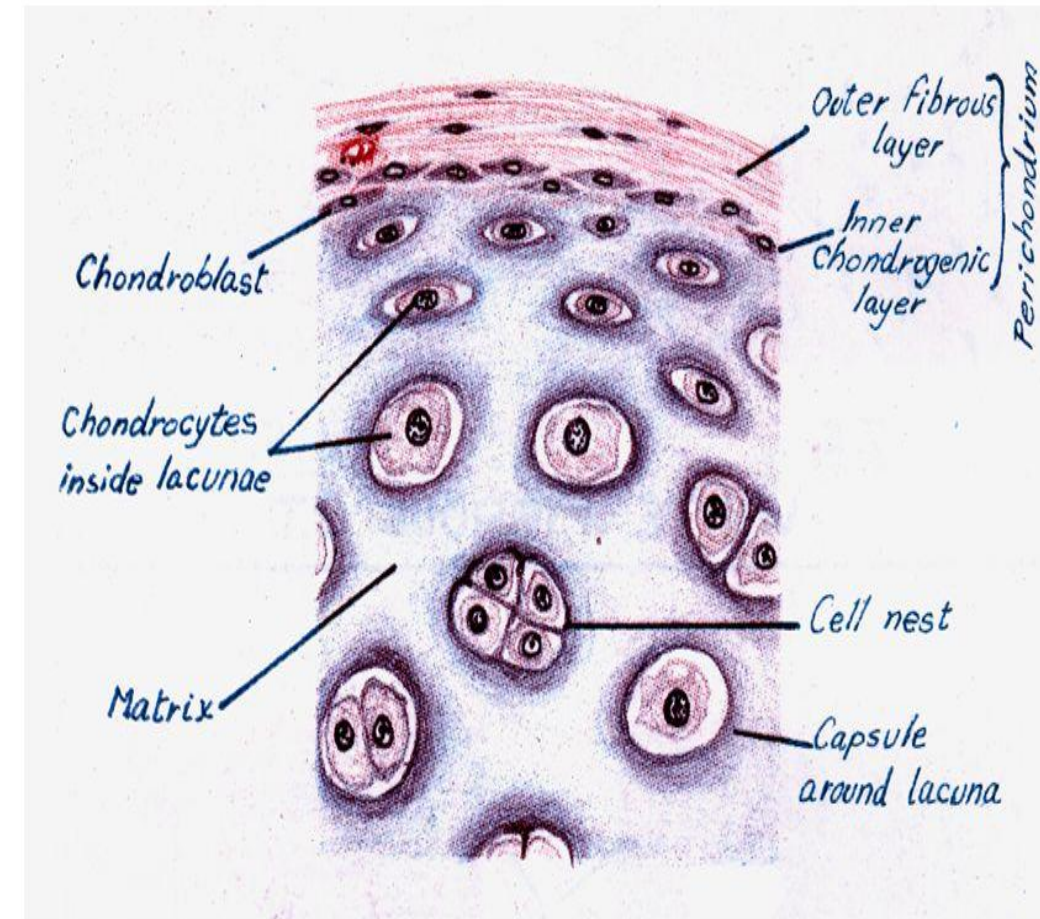
1-CHONDROBLASTS

- ❑ **Origin:** from undifferentiated mesenchymal cells.
- ❑ **Site:** in the inner cellular layer of perichondrium.
- ❑ **Function:**
 - 1- They secrete the extracellular matrix,
 - 2- They become imprisoned inside lacunae forming chondrocytes.
- ❑ **Structure:**
- ❑ **Shape:** Oval.
- ❑ **Nucleus:** Oval.
- ❑ **Cytoplasm:** basophilic.



2-CHONDROCYTES

- ❑ **Origin:** From the chondroblasts after secreting the matrix, trapped in *lacunae*.
- ❑ **Site and shape:**
 - 1- **Young chondrocytes:** underneath the perichondrium, spindle in shape and can undergo mitosis.
 - 2- **Mature chondrocytes:** deeply situated, rounded in shape.The matrix is condensed around the lacunae forming *the capsule* rich in chondroitin sulphates
- ❑ **Function:** They maintain the extracellular matrix.



TYPES OF CARTILAGE

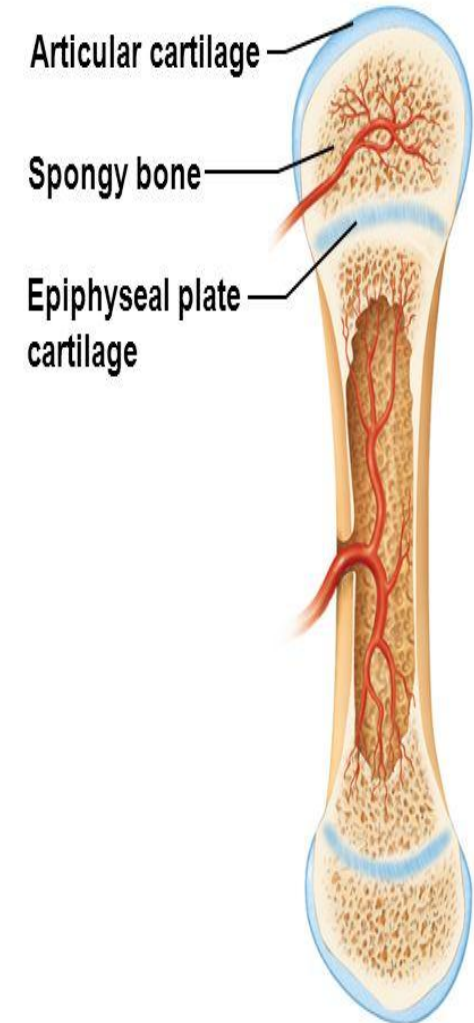
- 1- Hyaline cartilage.**
- 2- Elastic cartilage.**
- 3- White fibrocartilage.**



1- HYALINE CARTILAGE

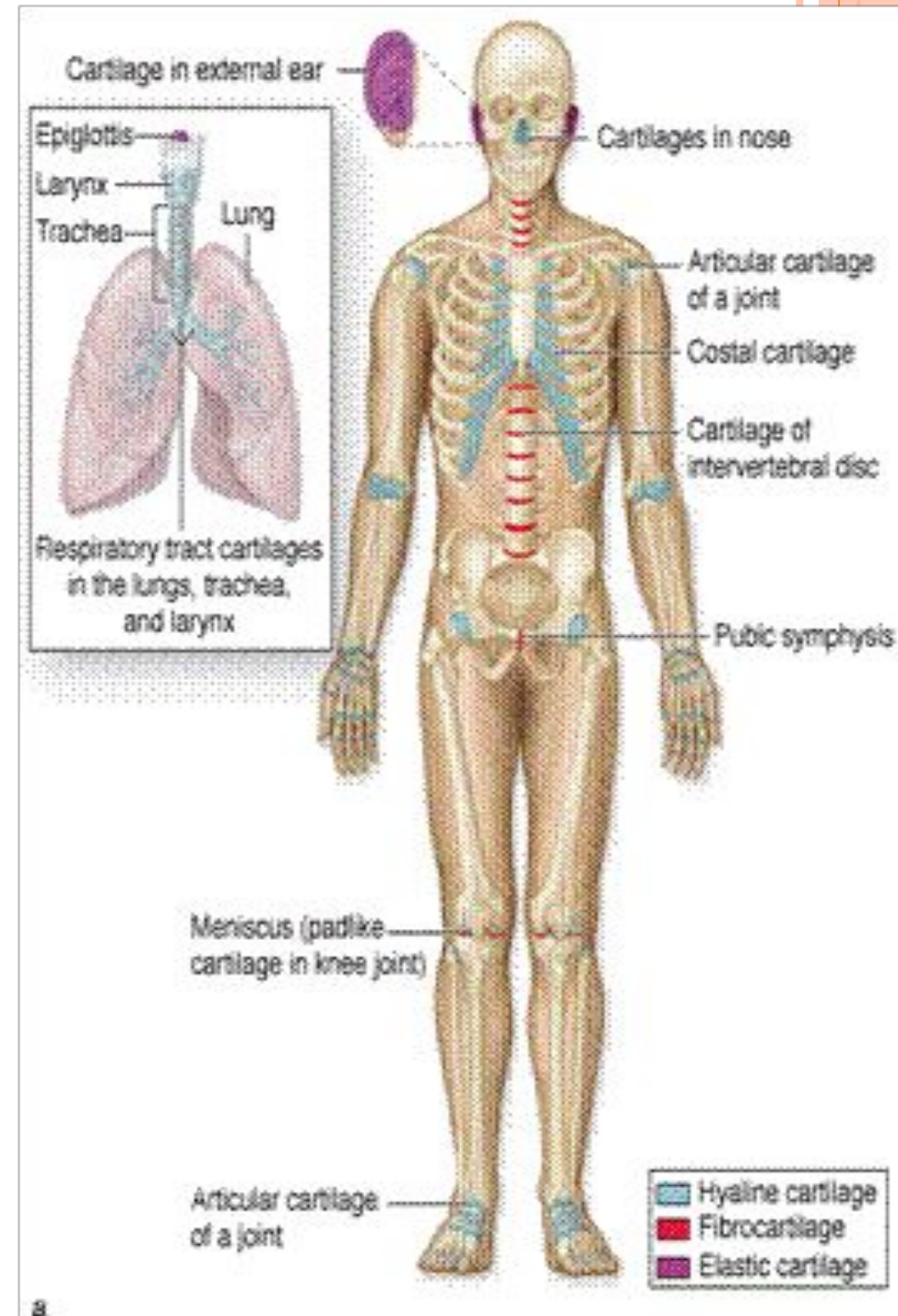
▣ **Fresh state:**

- 1- Smooth & firm.
- 2- Bluish in color.



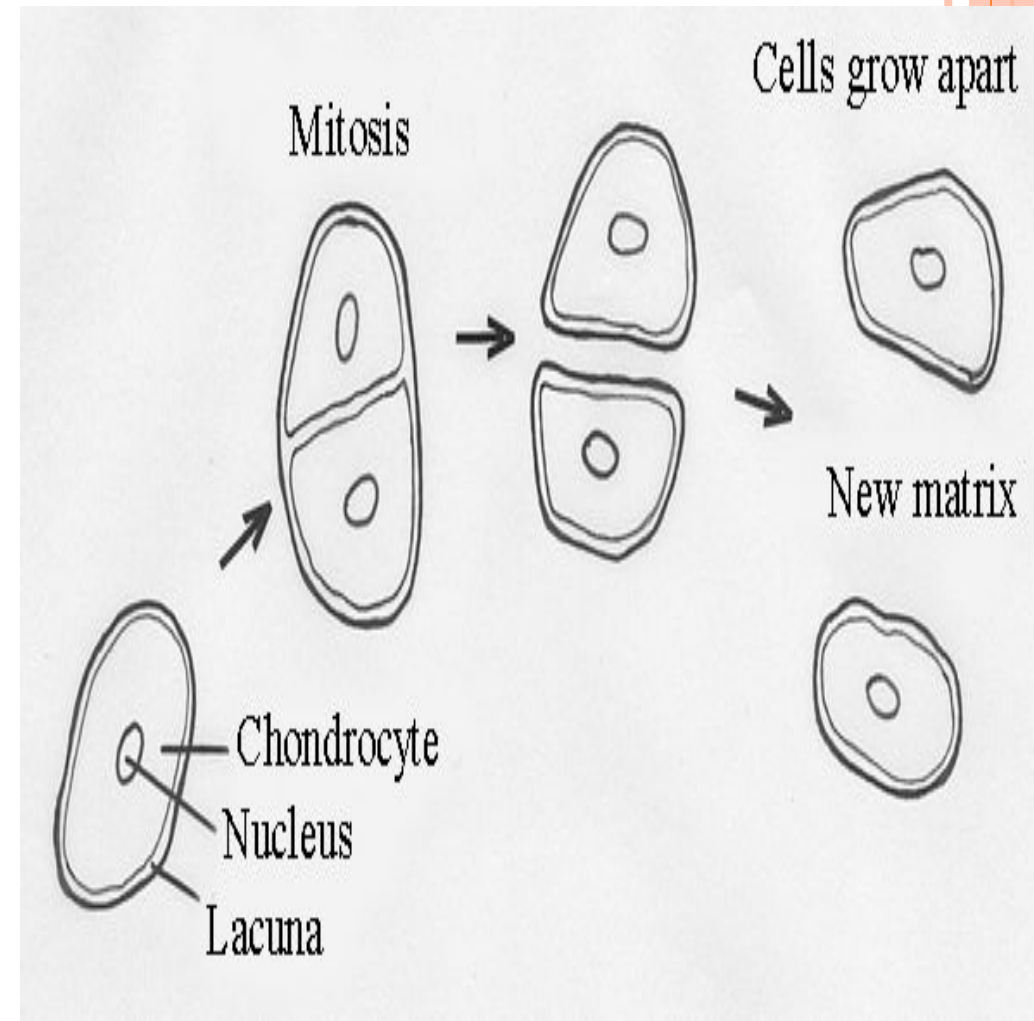
▣ Sites:

- 1- Skeleton of the embryo.
- 2- Epiphyseal plates in growing age.
- 3- Costal cartilages.
- 4- Nose, larynx, trachea and bronchi in the respiratory system.
- 5- Articular surfaces of synovial joints.



❑ **Characteristic features:**

- ❑ **Perichondrium:** It is *usually* covered with perichondrium except inside joint cavity.
- ❑ **Nutrition:** from perichondrium, but if it is present inside the joint cavity, it is nourished by diffusion from the synovial fluid.
- ❑ **Matrix:** abundant, glassy, pale basophilic & no apparent fibers (**WHY**).
- ❑ **Fibers:** Type II collagen fibrils.
- ❑ **Chondrocytes:** widely scattered, number of chondrocytes/capsule is 1-8 forming *a cell nest*.



2- ELASTIC CARTILAGE

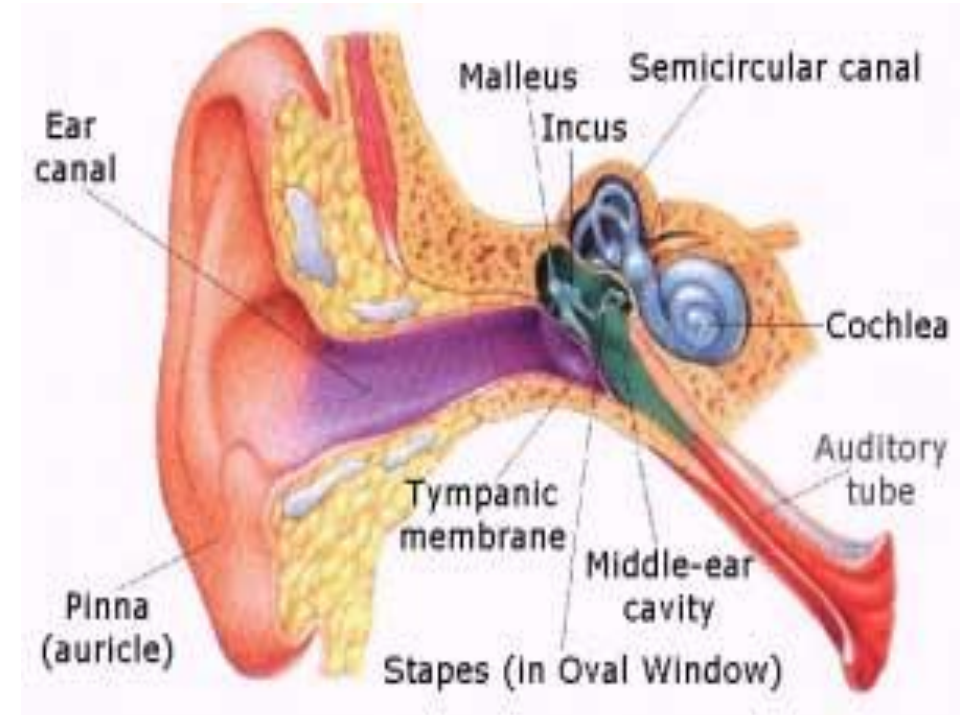
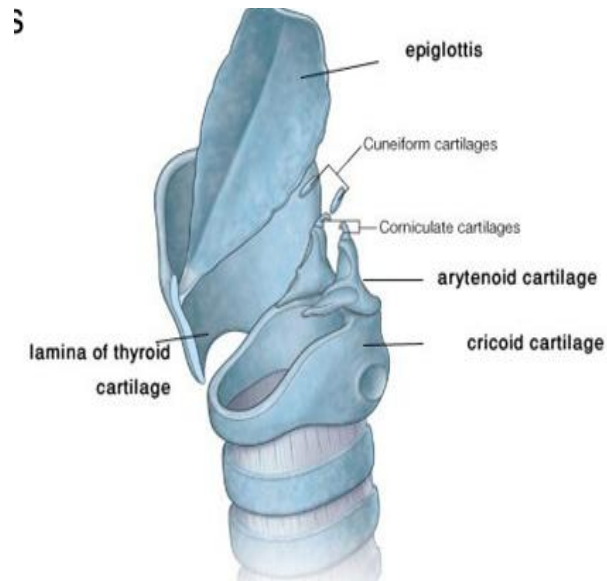
▣ **Fresh state:**

- 1- Flexible, can bear mechanical stress without permanent deformation.
- 2- Yellowish in color.

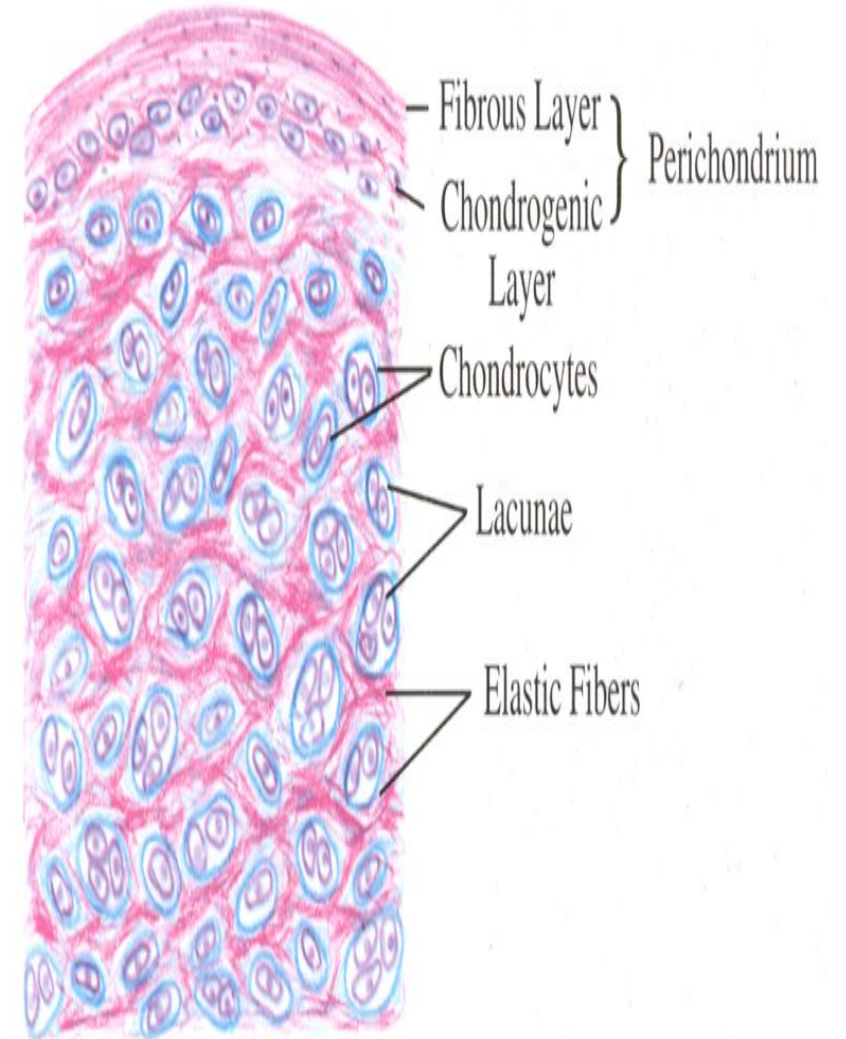


▣ Sites:

- 1- The auricle of the ear (ear pinna).
- 2- External auditory meatus.
- 3- Epiglottis.



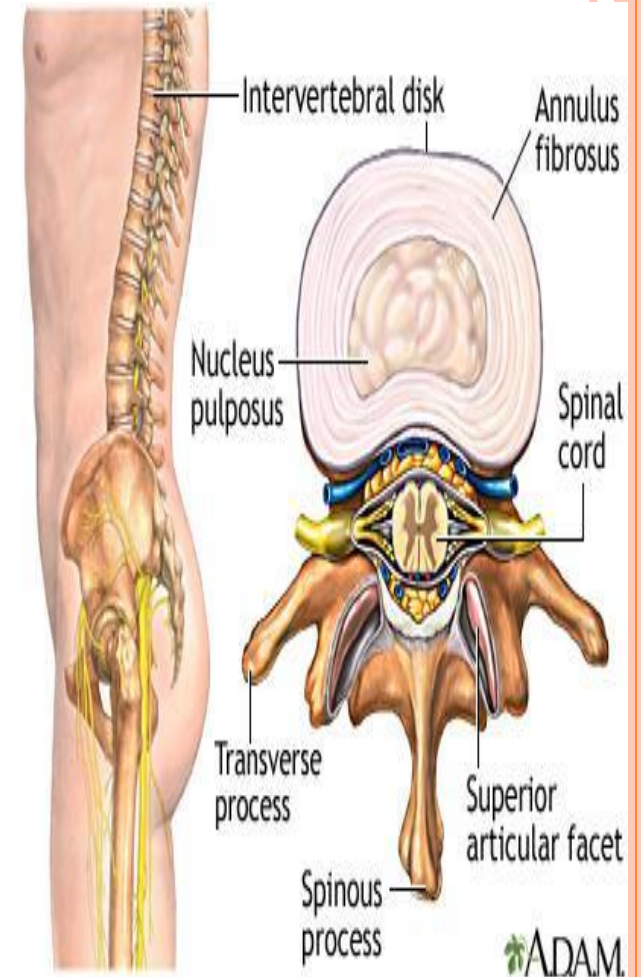
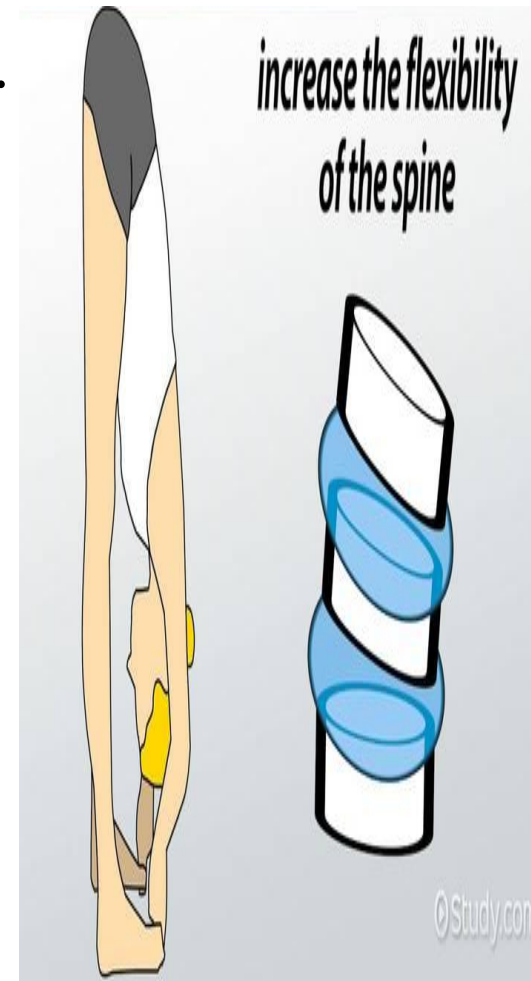
- ❑ **Characteristic features:**
- ❑ **Perichondrium:** covered *always* with perichondrium.
- ❑ **Nutrition:** Perichondrium.
- ❑ **Fibers:** large number of *elastic fibers*, in addition to collagen type II.
- ❑ **Chondrocytes:** Numerous, number of chondrocytes/capsule is 1-3.



3-WHITE FIBRO CARTILAGE

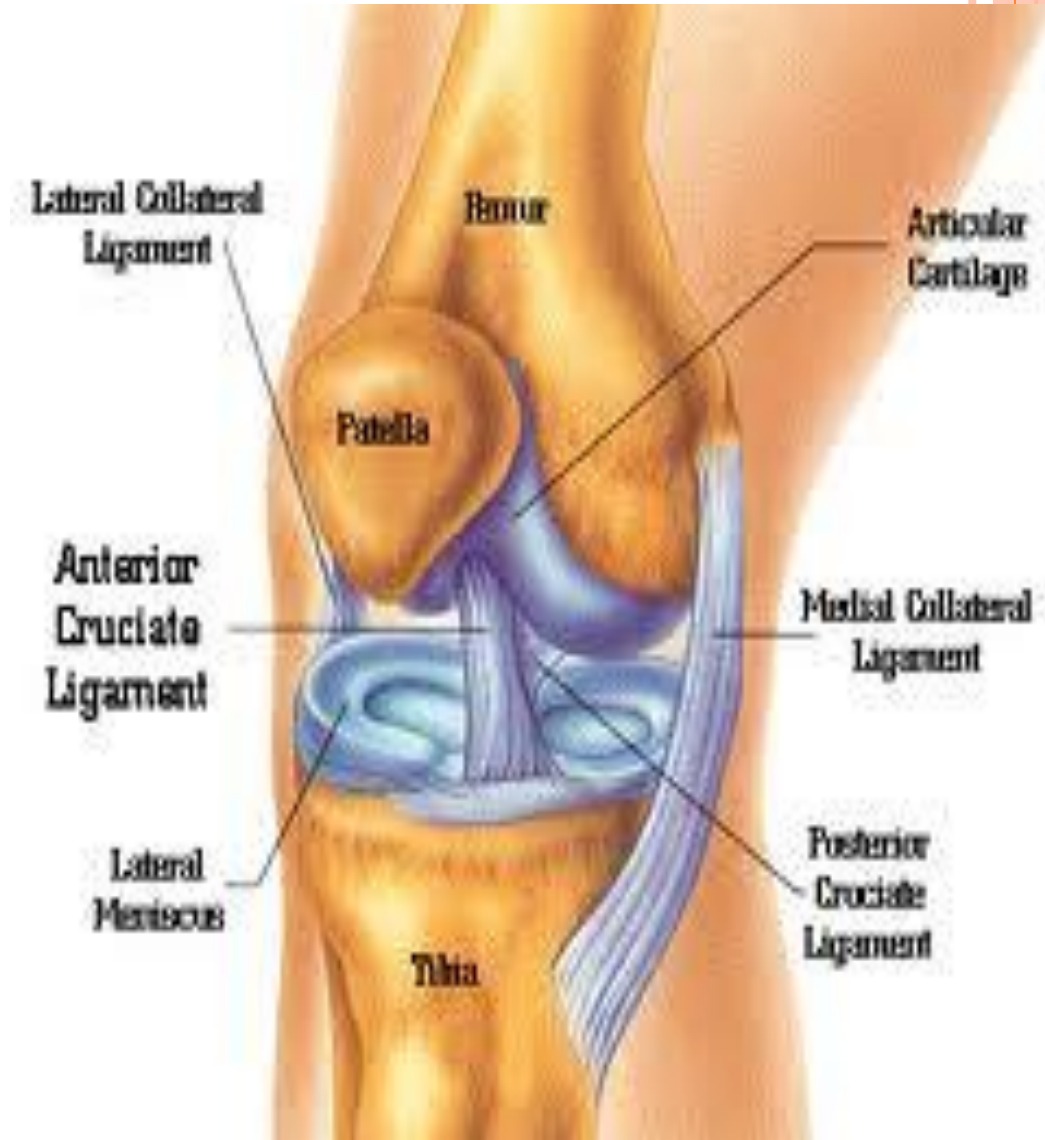
▣ **Fresh state:**

- 1- It has a great strength & flexibility.
- 2- Whitish in color.

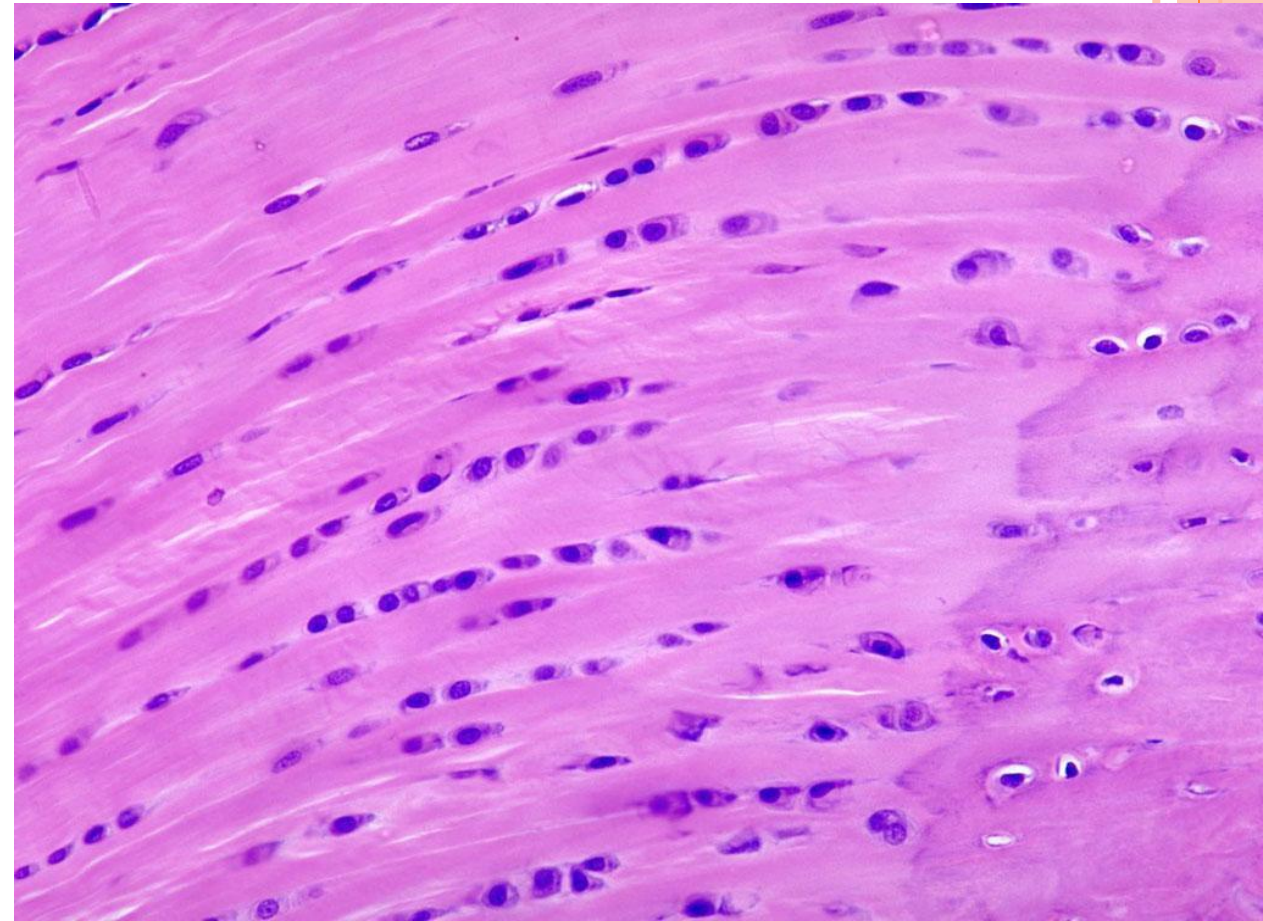


- **Sites:**

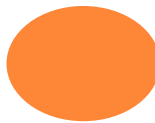
- 1-The intervertebral disc.
- 2-The symphysis pubis.
- 3-The temporomandibular joint
- 4- The sternoclavicular joint.
- 5- The menisci of knee joint.



- ❑ **Characteristic features:**
- ❑ **Perichondrium:** *Never* covered with perichondrium.
- ❑ **Nutrition:** from the surrounding connective tissue of joint capsule and ligaments.
- ❑ **Fibers:** large number of *type I collagen fibers*, in addition to type II collagen.
- ❑ **Chondrocytes:** Few, number of chondrocytes/capsule is 1-2.

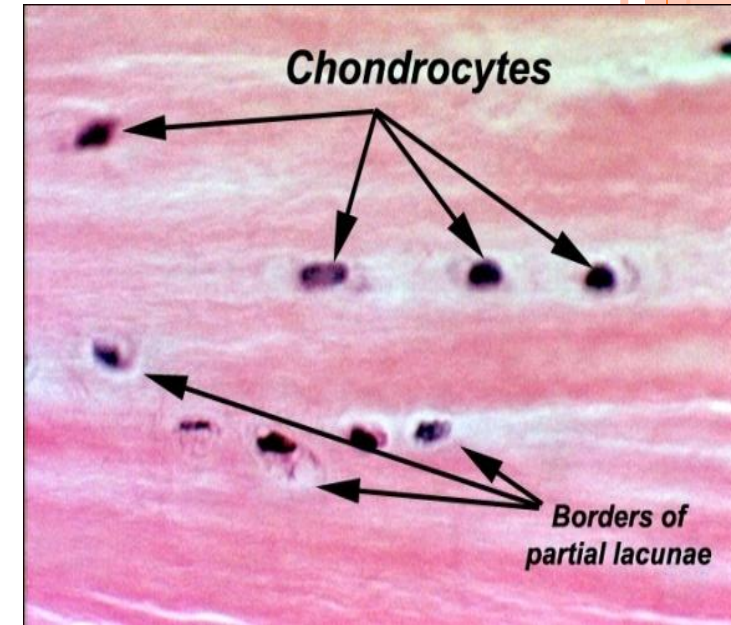
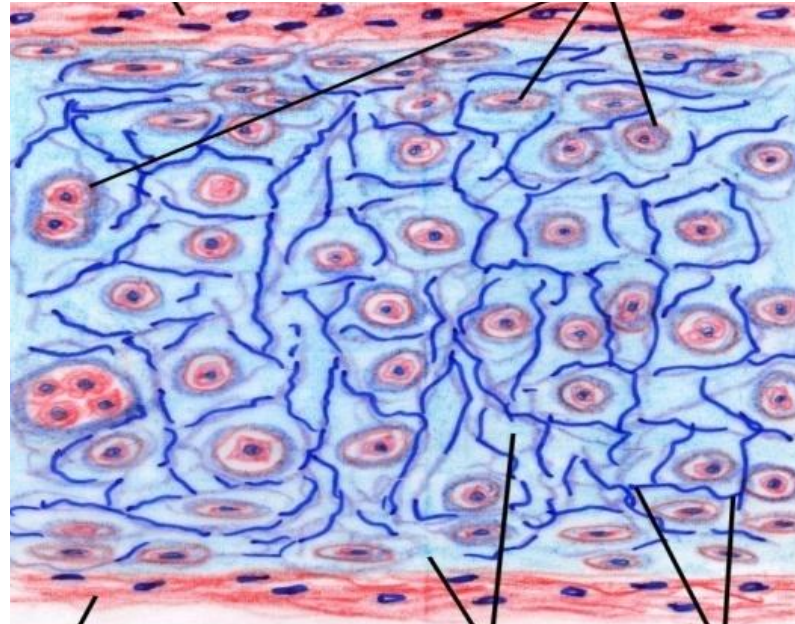
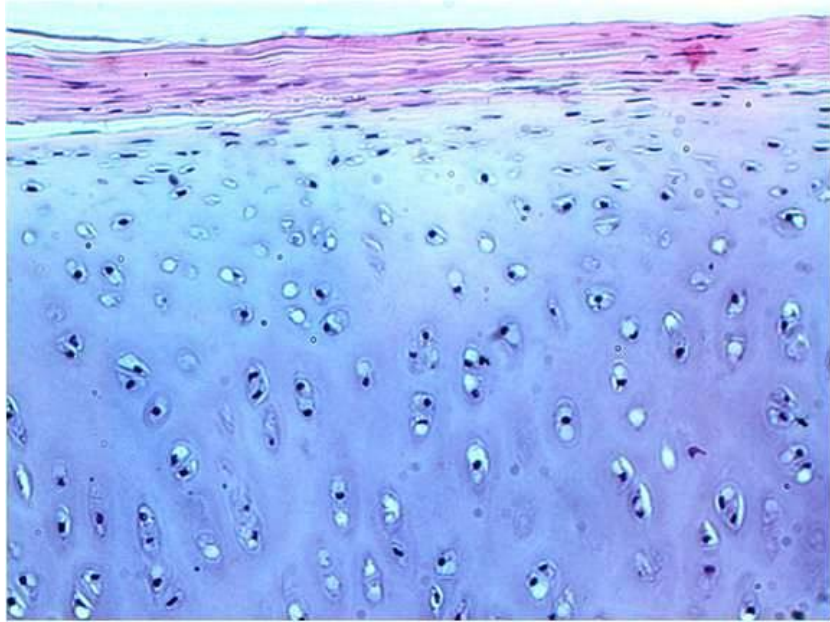


	Hyaline cartilage	Elastic cartilage	White fibrocartilage
Character	Smooth, firm, bluish in fresh state.	Flexible, yellow in fresh state.	Strong , flexible, white in fresh state.
Perichondrium	Covered with perichondrium, except inside joint cavity.	Always covered with perichondrium.	Never covered with perichondrium.
Nutrition	1- Perichondrium. 2- Inside joint cavity by synovial fluid.	Perichondrium.	from the surrounding connective tissue of joint capsule and ligaments.
Extracellular matrix:	• Type II collagen fibrils (not appear) • It is pale basophilic, glassy appearance.	• Large number of elastic fibers + type II collagen fibrils.	• Type I collagen fibers + type II collagen.



	Hyaline cartilage	Elastic cartilage	White fibrocartilage
Chondrocytes	Widely scattered. Cell (1- 8 chondrocytes/ lacuna)	Numerous. 1-3 chondrocytes/lacuna	Few . 1-2 chondrocytes/lacuna.
Sites:	1. Costal cartilages. 2. Nose, larynx, trachea, bronchi 3. Articular surfaces of joints. 4. Skeleton of embryo. 5. Epiphyseal plate.	1. Auricle of the ear. 2. External auditory canal. 3- Epiglottis.	1. The intervertebral disc. 2. The symphysis pubis. 3. Tempromandibular j. 4. Sternoclavicular j. 5. Menisci of knee j.





GROWTH OF CARTILAGE

Growth of cartilage is very limited in adults.

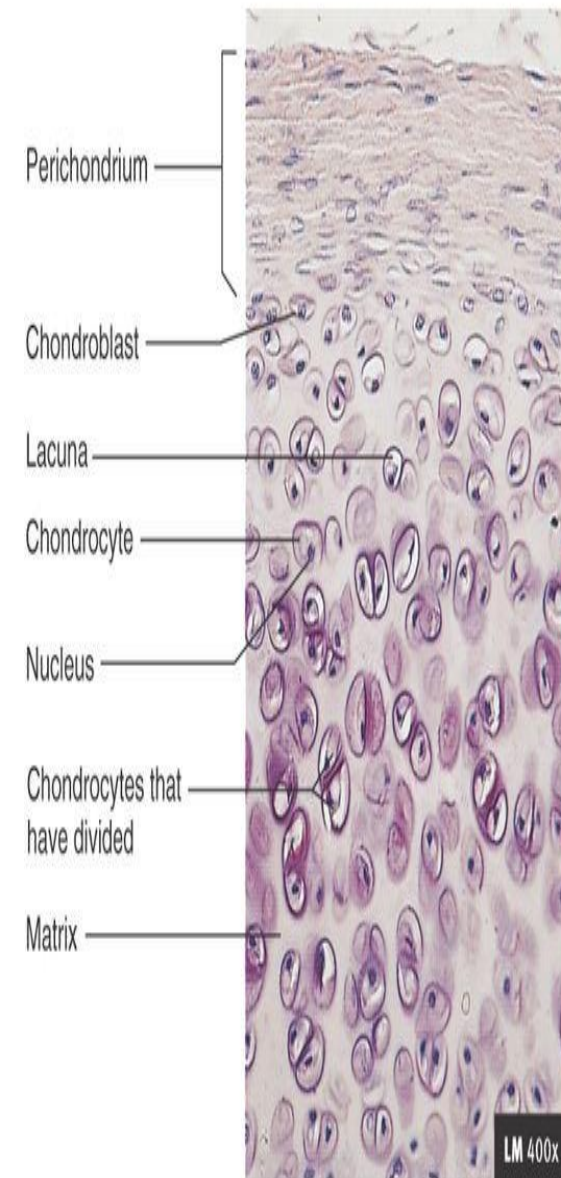
□ **There are 2 types of growth:**

1- Appositional growth:

- It is growth of cartilage at its periphery by adding new layers from *perichondrium*.
- It is caused by mitosis of chondroblasts in the perichondrium.
- They secrete new matrix on the surface, then transform to chondrocytes.

2- Interstitial growth:

- It is growth of cartilage from *inside*.
- It occurs as a result of mitosis of chondrocytes within the cartilage.
- They form cell nests in the lacunae & secrete more matrix.
- This causes cartilage to expand from within.



Appositional growth

(new cartilage is added to the surface of the cartilage by chondroblasts from the inner layer of the perichondrium)

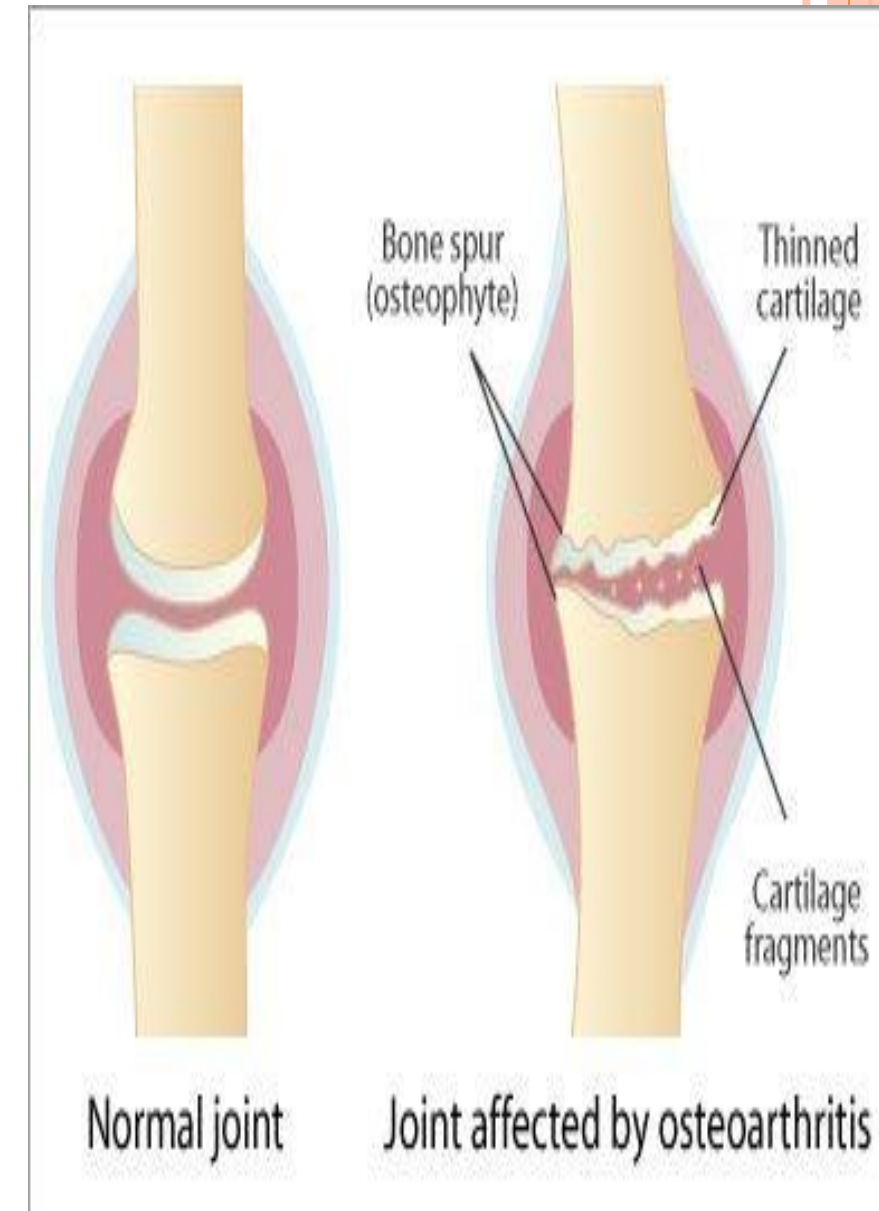
Interstitial growth

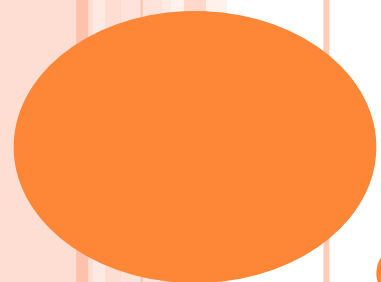
(new cartilage is formed within the cartilage by chondrocytes that divide and produce additional matrix)

Types	Appositional growth	Interstitial growth
Definition	It is growth of cartilage at its periphery by adding new layers from outside	It is growth of cartilage from inside
Events	Mitosis of chondroblasts in the <i>perichondrium</i> . They secrete new matrix on the surface, then transform to chondrocytes.	Mitosis of chondrocytes <i>within the cartilage</i> . They form cell nests in the lacunae and secrete more matrix.

HEALING OF CARTILAGE

- Cartilage has a limited ability to repair (WHY), if extensively damaged, the cartilage tear will be repaired with fibrous tissue.





THANK YOU