Cartilage

HUMAN HISTOLOGY

Semester 2, Year 1

Dr . Amira Osman

Associate professor of Human histology & Cell Biology

Learning Objectives

At the end , The student will be able to :-

- **Define and describe the types, structure & functions of Cartilage.**

Cartilage

Cartilage is a type of connective tissue in which the extracellular matrix has a firm consistency.

- **Function:**

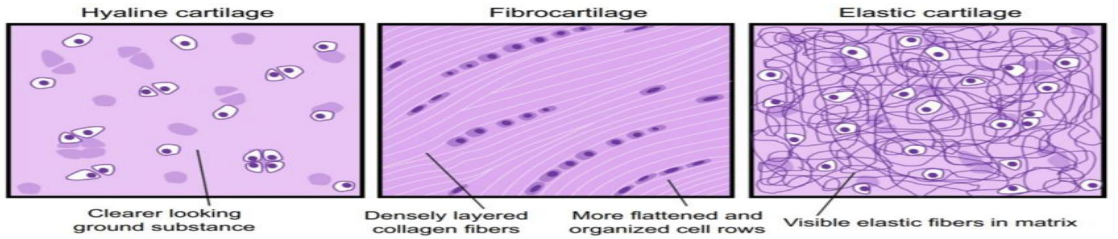
  1- Supportive soft tissue.

  2- Shock absorbing.

  3- Facilitates movements of bone (Joints).

  4- Essential for development and growth of long bones before and after birth.

Types of cartilage



- Based on the fibers present in the matrix.

Cartilage

Hyaline cartilage

Contains collagen fibers type II.

Elastic cartilage

Contains collagen fibers type II & abundant **elastic** fibers.

Fibro cartilage

Contains dense collagen fibers type I.

General characters

- Most cartilage are surrounded by a **dense connective tissue** called **perichondrium** which has rich blood supply.

- **The cartilage is *avascular*.:**

  -Nutrition if Perichondrium is present: By diffusion from BV.

  -Nutrition if Perichondrium is absent:

  - By synovial fluid in hyaline cartilage of articular surfaces.
  - By surrounding C.T. in fibrocartilage.

General characters

Cartilage consists of :

(1) Cells: A- Chondroblasts. B- chondrocytes

(2) Extracellular matrix: composed of :

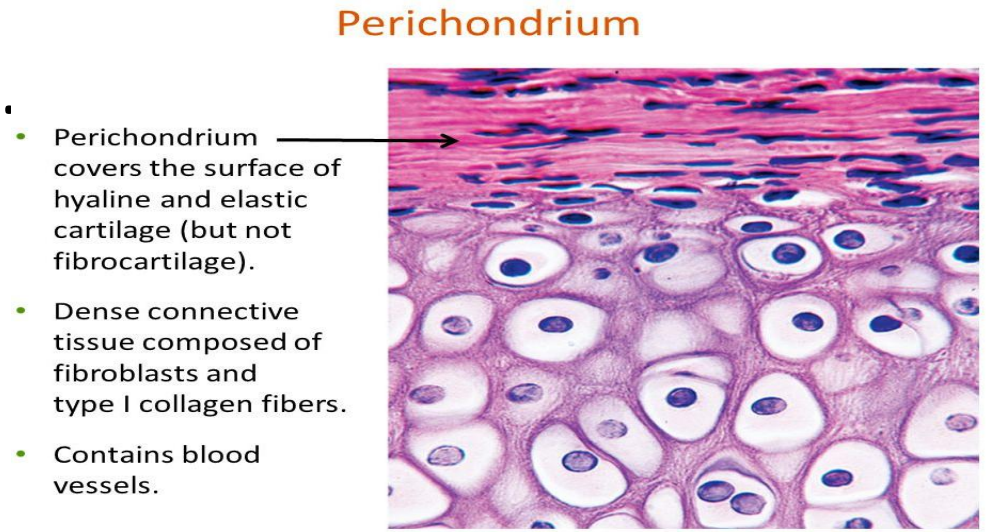
A- Fibers B- Amorphous (ground) substance.

Perichondrium

Definition: (2) - External cover. - Dense CT.

Present in: (2) - Hyaline cartilage (except articular).
- Elastic cartilage.

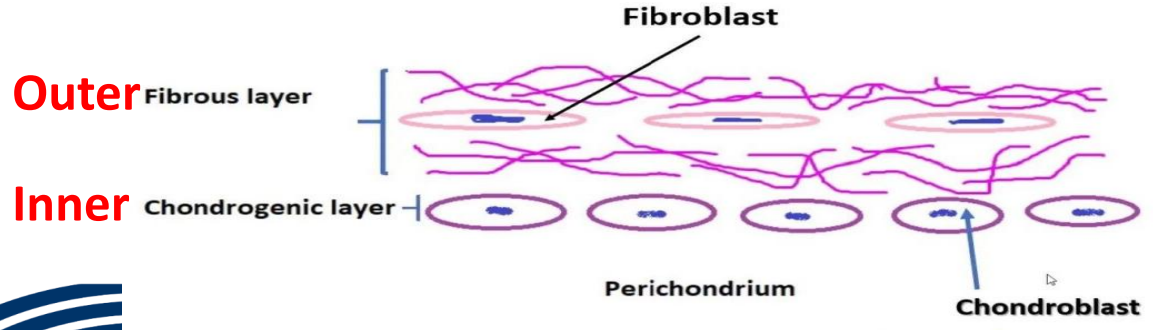
Absent in: (2) - Articular cartilage (hyaline).
- Fibrocartilage.



Layers: (2)

- Outer fibrous layer: (collagen type I, fibroblasts & BV).
- Inner cellular layer: (Fibroblast-like progenitor cells).

Functions: (2) - Nutrition and attachment
- Growth.



A-HYALINE CARTILAGE

A-Color: Fresh → bluish & translucent.

B-Sites: most common in:

1-Fetal skeleton

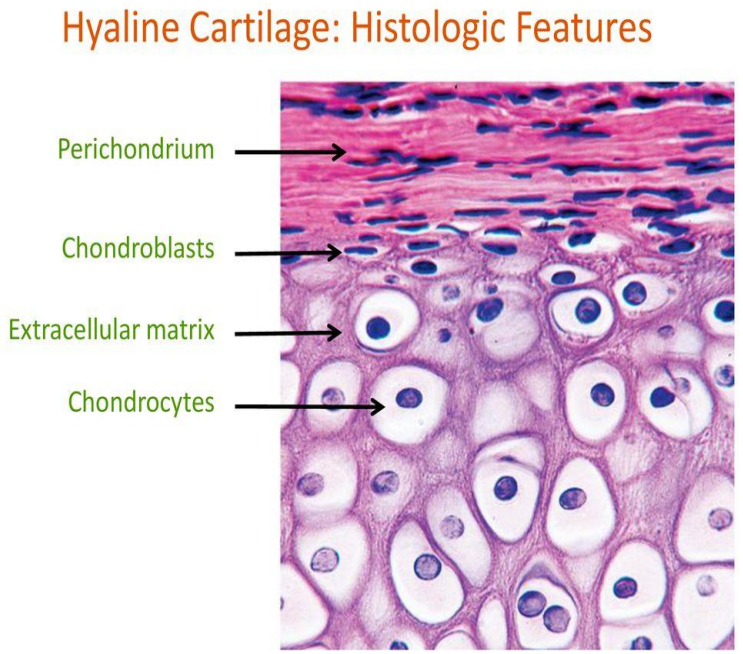
2-Epiphyseal plate

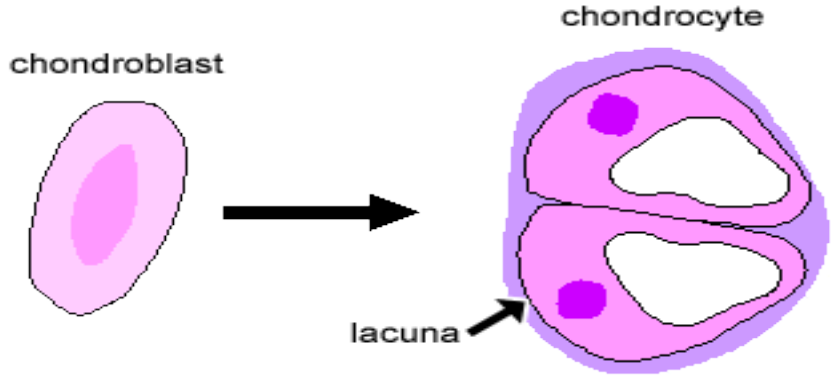
3-Articular joints:

Because of its flexibility, smoothness and lubricated surface, cartilage provides sliding regions within skeletal joints and facilitates bone movements.

4-Costal cartilages

5-Large airways (nose, larynx, trachea and bronchi)





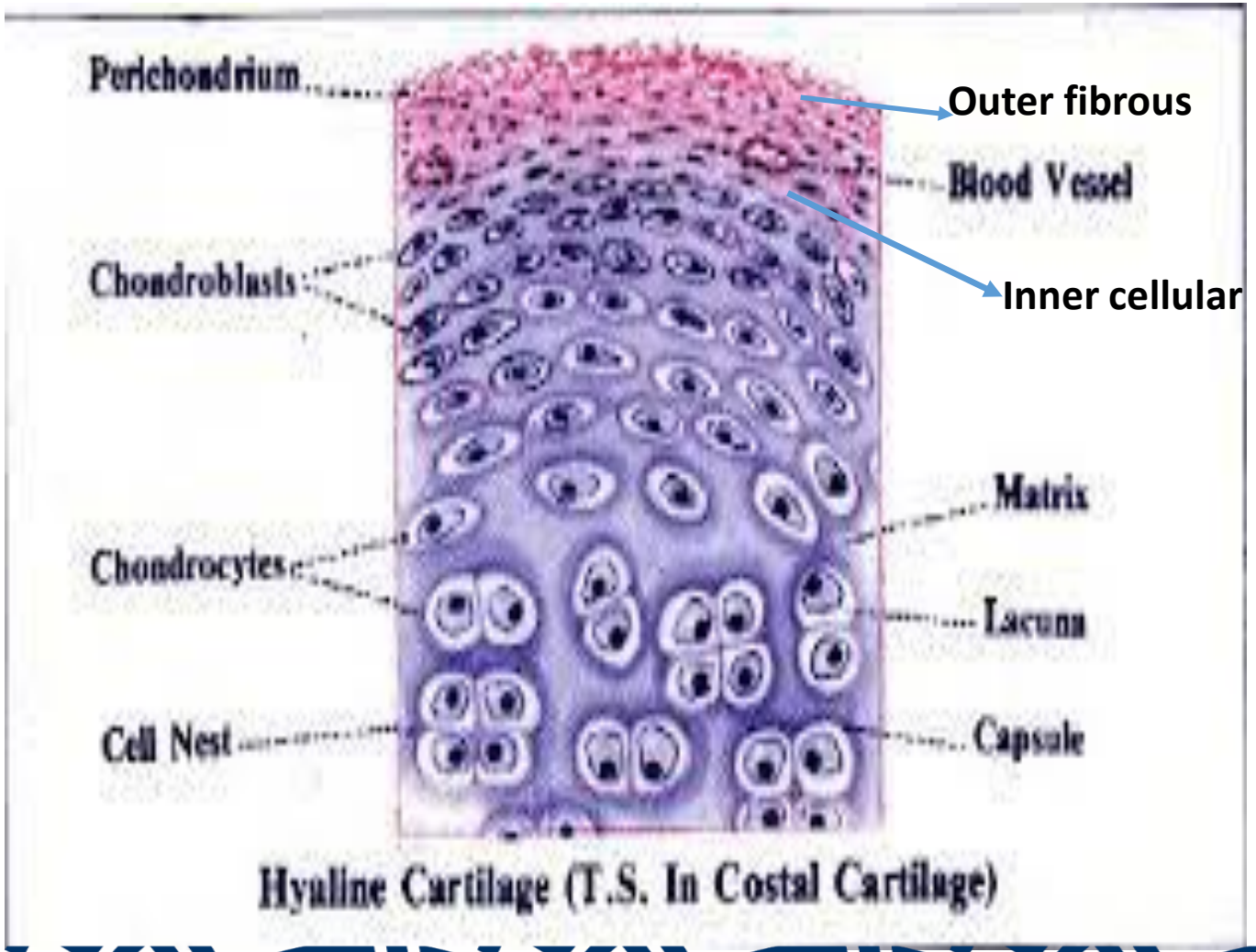
HYALINE CARTILAGE

C-Structure:

1- Cells: A-Chondroblasts.

B-Chondrocytes

2- Extracellular matrix: Fibers & Ground substance.

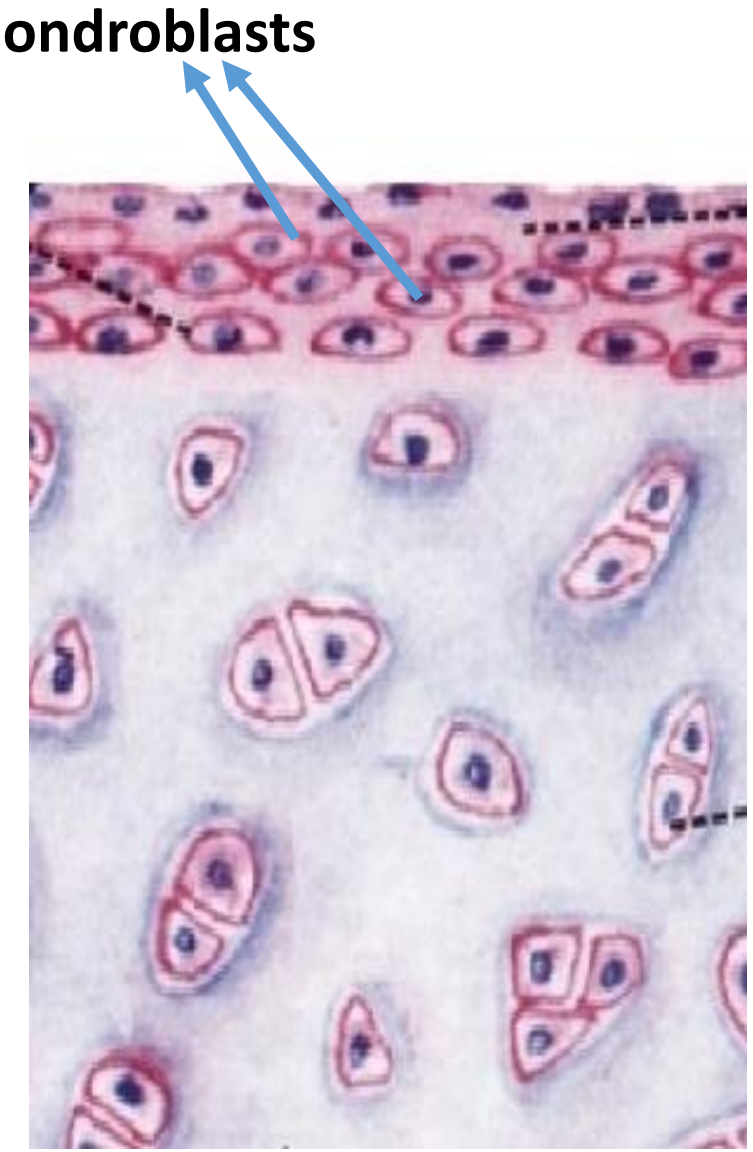


Hyaline Cartilage (T.S. In Costal Cartilage)

A) Chondroblasts

- **Definition:** young surface chondrocytes.
- **Site:** peripheral in cellular layer of perichondrium.
- **L/M:** Spindle-shaped, basophilic cytoplasm, pale nucleus (protein secreting cell) .
- **Function:**

. They synthesize fibers and components of the matrix.



B) Chondrocytes

- **Definition:**

  Mature deep chondrocytes inside lacunae.

  They are formed when chondroblasts imprisoned inside lacunae within the matrix.

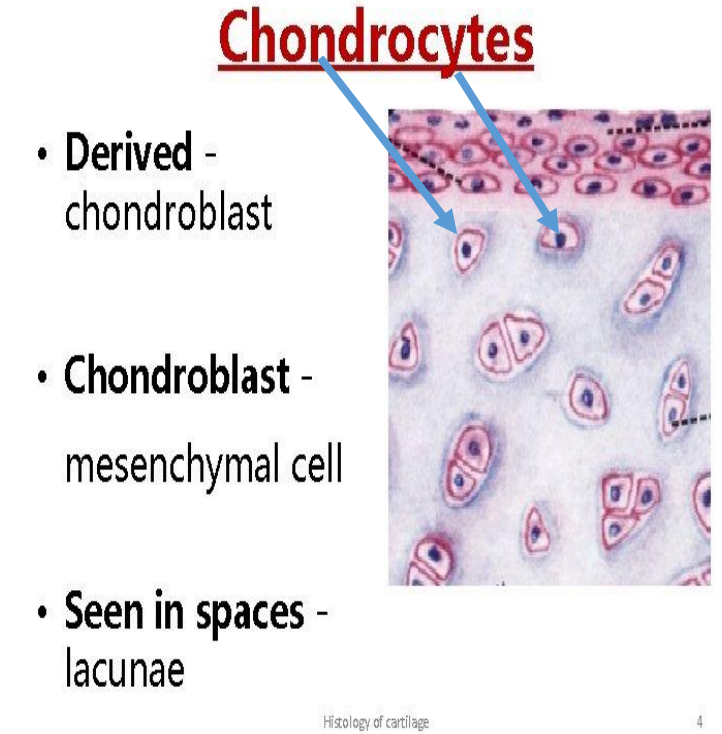
- **Site:** deeper in the cartilage.

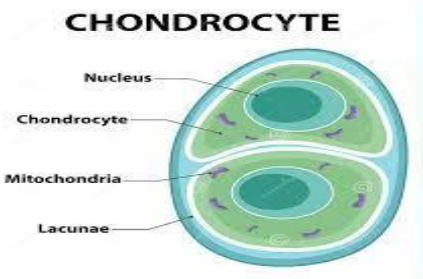
- **L/M: They are less active than chondroblasts**

  Irregular spherical or ovoid cells

  Less basophilic cytoplasm

  Darker spherical central nucleus



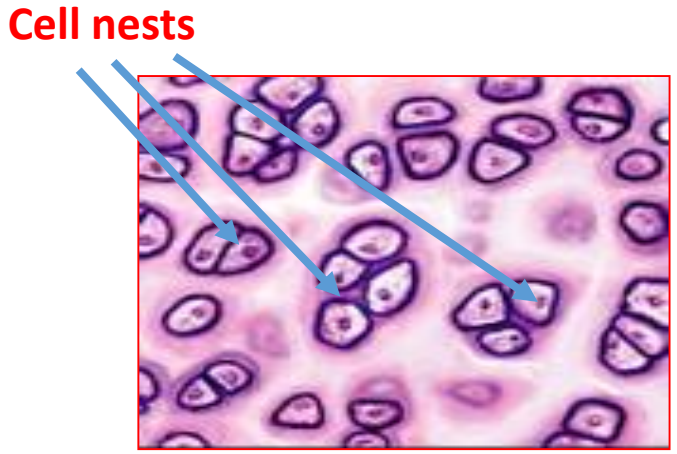


B) Chondrocytes

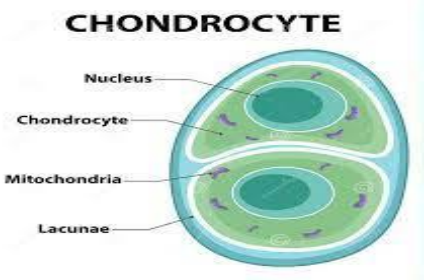
Cell nests:

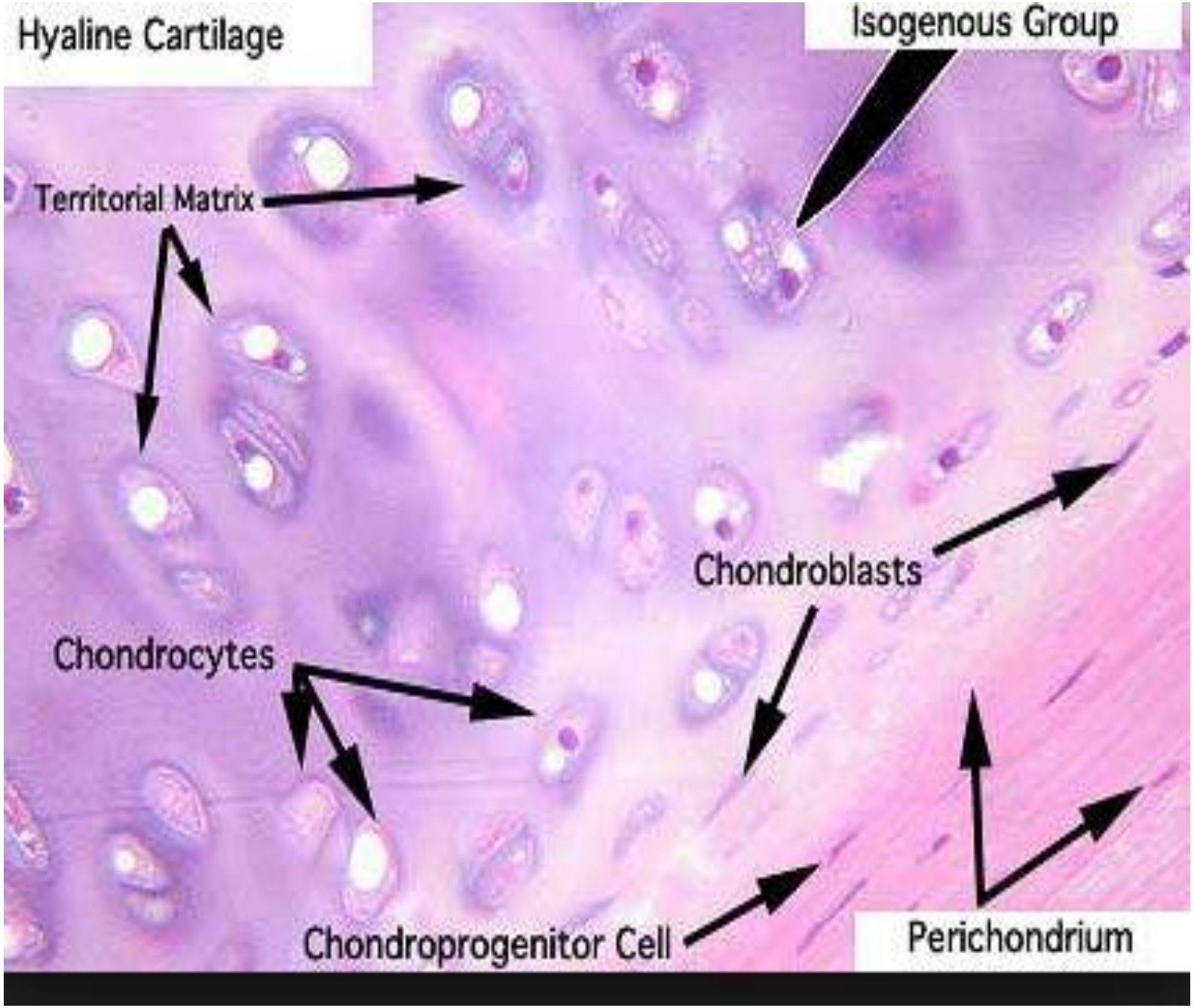
Chondrocytes present within spaces called lacunae either single or in-groups (up to 8 cells in the same lacuna) called cell nest.

The lacunae are surrounded by homogenous deep basophilic matrix.



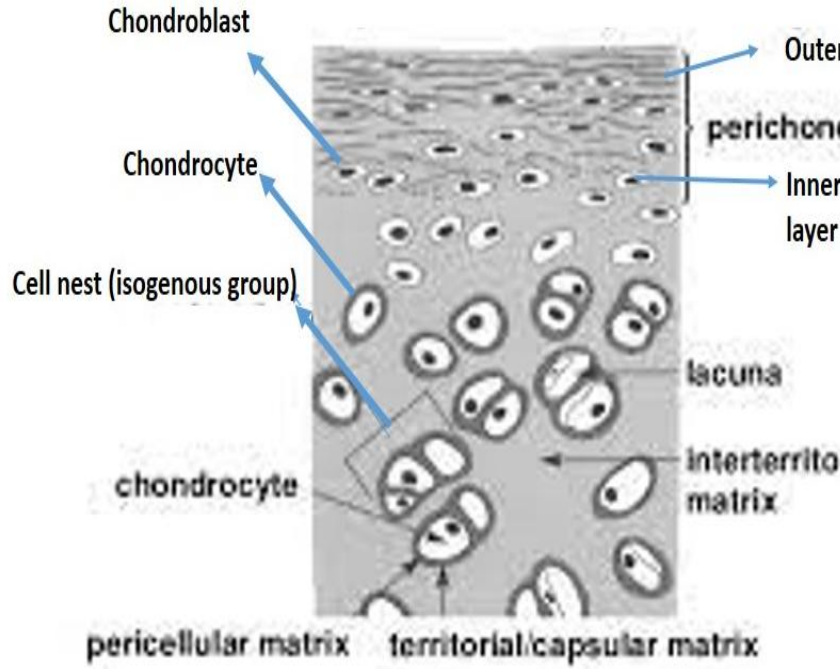
- **Function:** maintain synthesis of fibers and matrix.




Hyaline Cartilage
Isogenous Group
Territorial Matrix
Chondroblasts
Chondrocytes
Chondroprogenitor Cell
Perichondrium

Matrix of hyaline cartilage:

- It appears homogenous and basophilic with L/M.



The main components of hyaline cartilage (wet weight) are approximately:

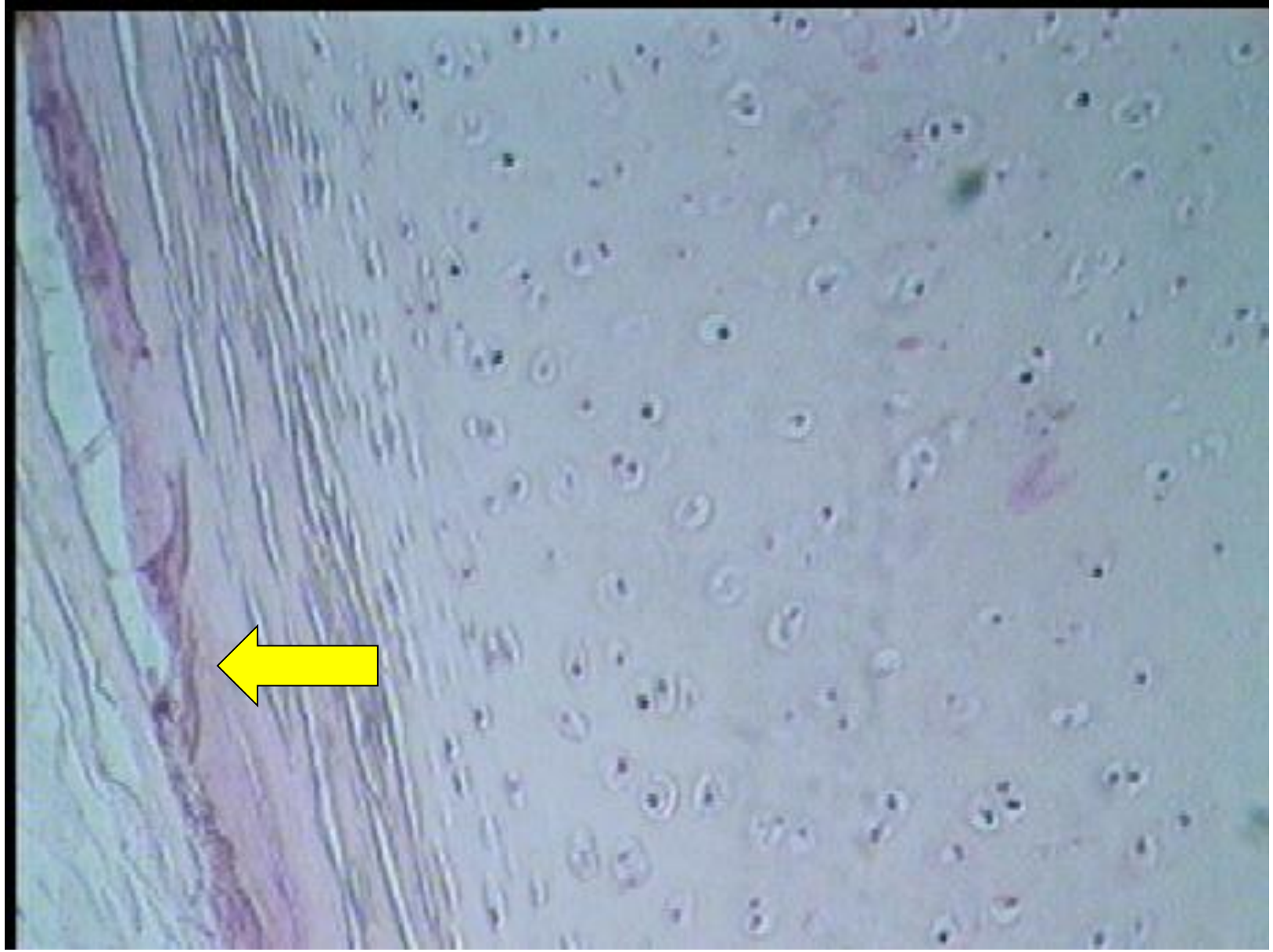
-Water 70-75%
-Proteoglycans 10%
-Collagen (type II) 16%
-Other glycoproteins 1.6%
-Minerals 0.5%

Hyaluronic acid (non-sulfated glycosaminoglycans)

Sulfated glycosaminoglycans (composed of **chondoriotin sulphate** and **keratan sulphate**)

In cartilage the protein core of the proteoglycan molecule binds through a linking protein to hyaluronic acid to form a proteoglycan aggregate which binds to the fibres by electrostatic inter action

- The highest concentration of proteoglycan around the chondrocyte lacunae (intense stain) called **territorial matrix**
- Low concentration far from cells **interterritorial matrix**

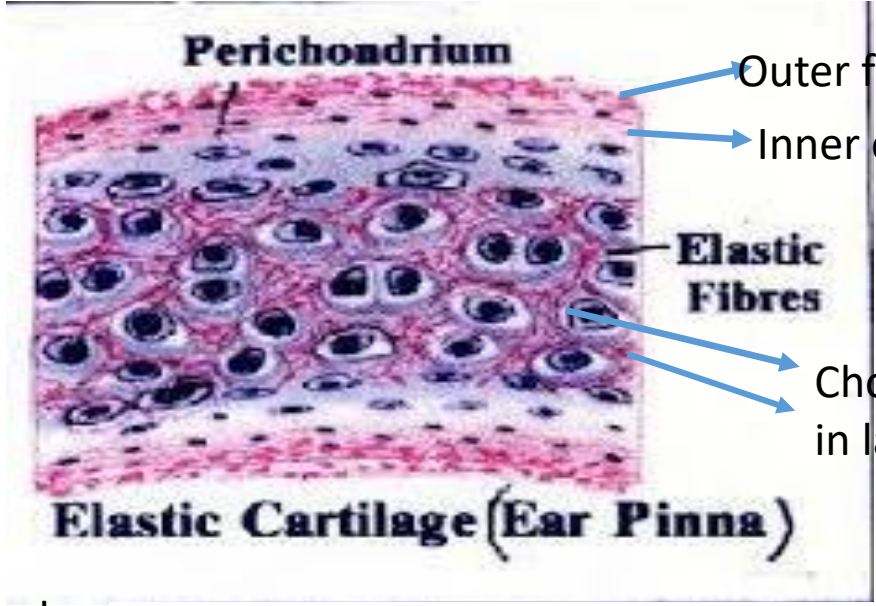


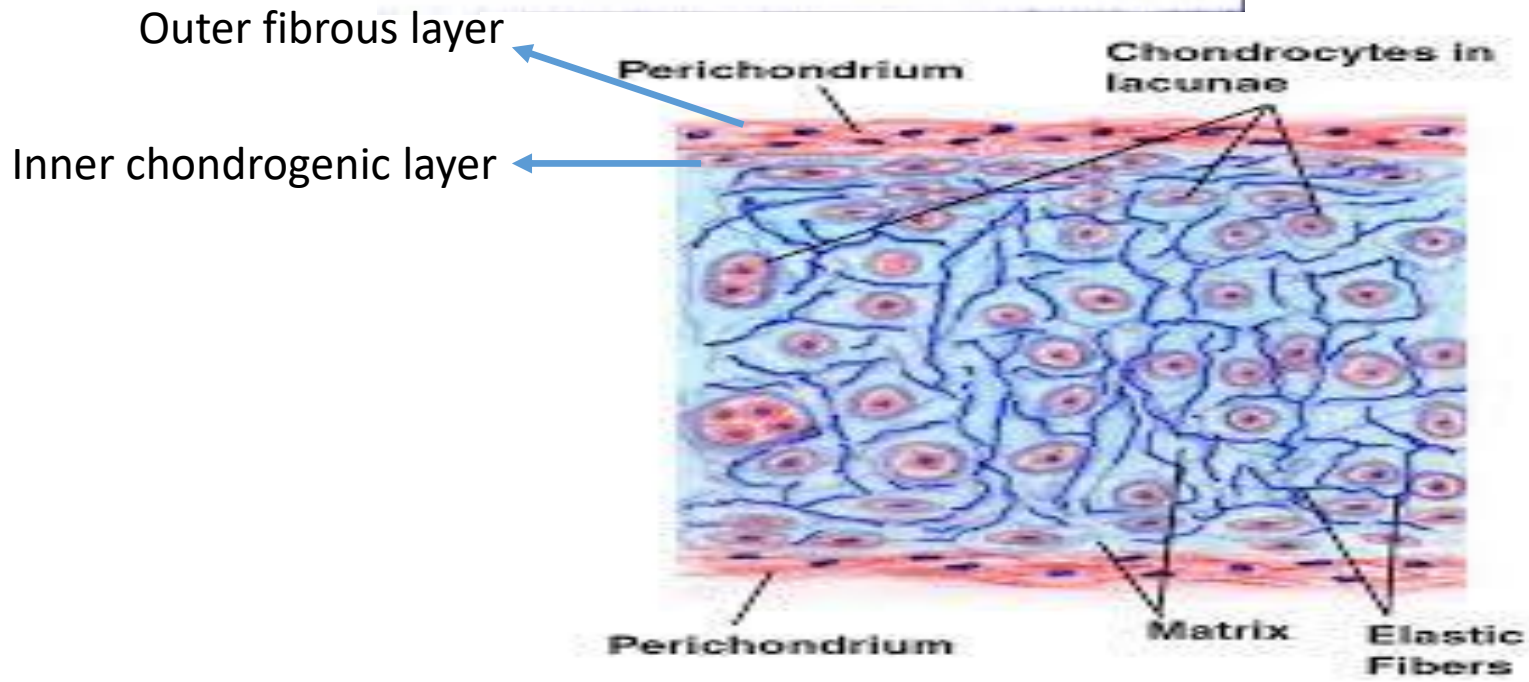
This is hyaline cartilage. The ← indicates the perichondrium. In the perichondrium there are oval chondroblasts that will change to round chondrocytes

ELASTIC CARTILAGE

Similar to hyaline cartilage except that:

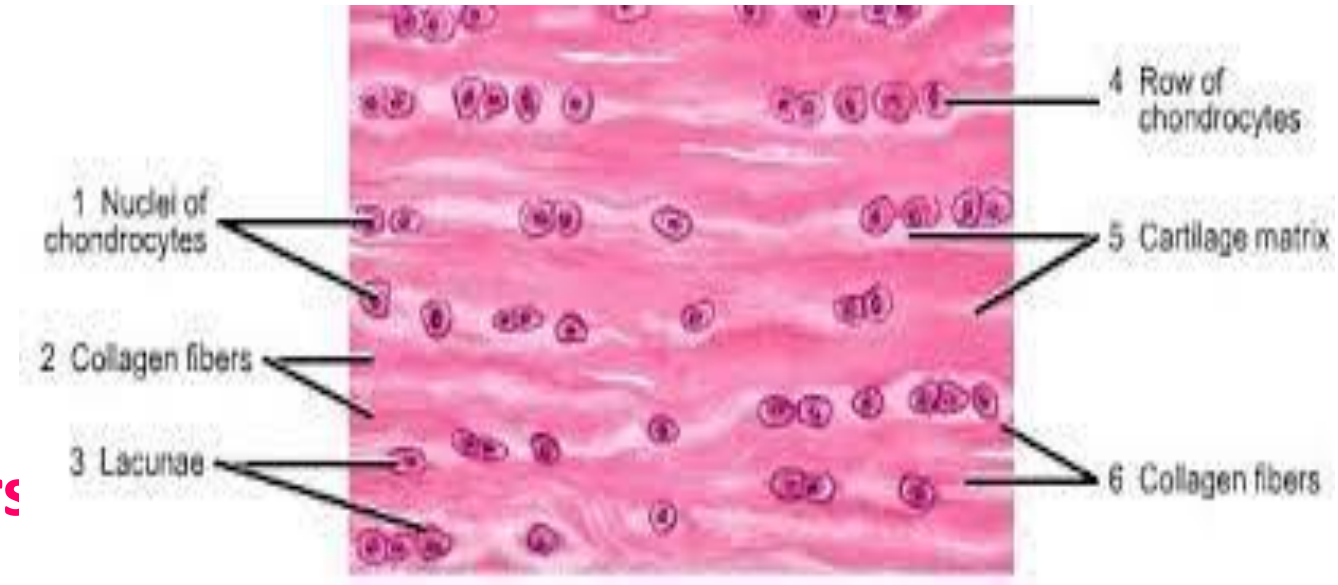
- Collagen fibers type II & abundant branching **Elastic** fibers.
- Yellow colour (when fresh).
- **Site**:
  - Ear pinna
  - External auditory canal,
  - Eustachian tube,
  - Epiglottis.
- **Function:** Flexible support.

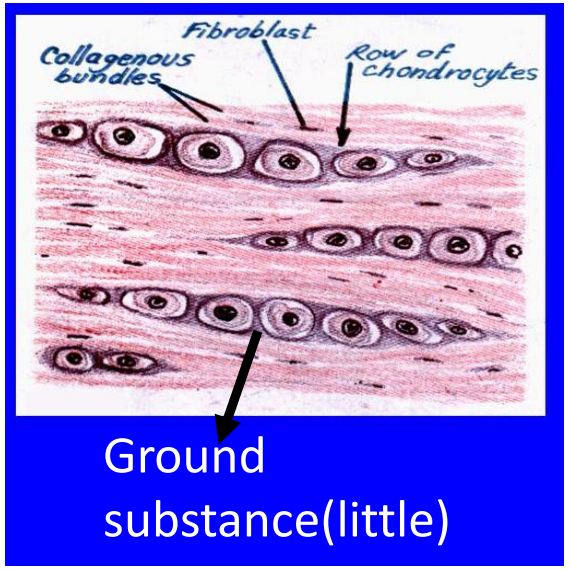




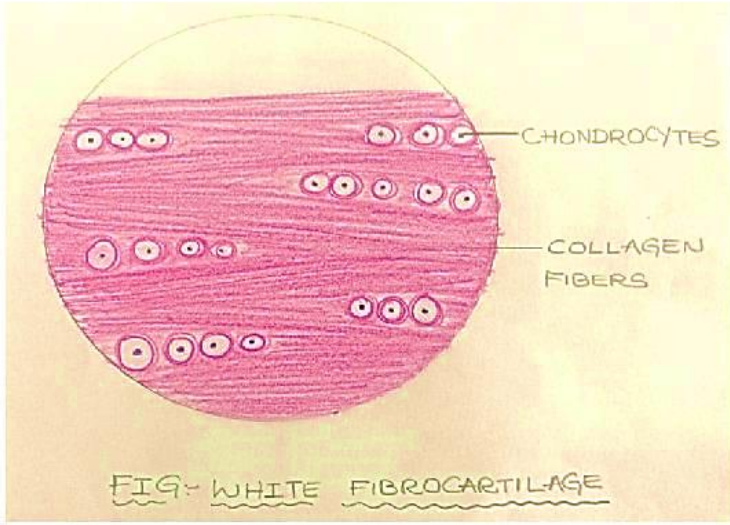
FIBROCARTILAGE

- **No** perichondrium.
- **Little** Ground substance.
- Acidophilic bundles of **collagen fibers type I**.
- Chondrocytes inside lacunae **in rows.**
- **Site:** Intervertebral discs , Symphysis pubis & Tempro-mandibular joint.
- **Function**: shock absorber.





White fibrocartilage



Chondrogenesis

Mesenchyme cells grow and differentiate into **chondroblasts** that are very active in secreting the surrounding matrix. The chondroblasts grow and develop in lacunae. These chondroblasts further differentiate into mature cartilage cells or **chondrocytes**.

*** The ability of cartilage to repair it self is **limited** particularly in adults.
Mainly due to the activity of the perichondrium during the period of growth in young individuals

Two different types of chondrogenesis

- ***Appositional growth*** takes place in **the perichondrium** the fibroblasts (**chondrogenic cells**) of the perichondrium change to **chondroblasts** which later change to round **chondrocytes** (addition from **outside**)

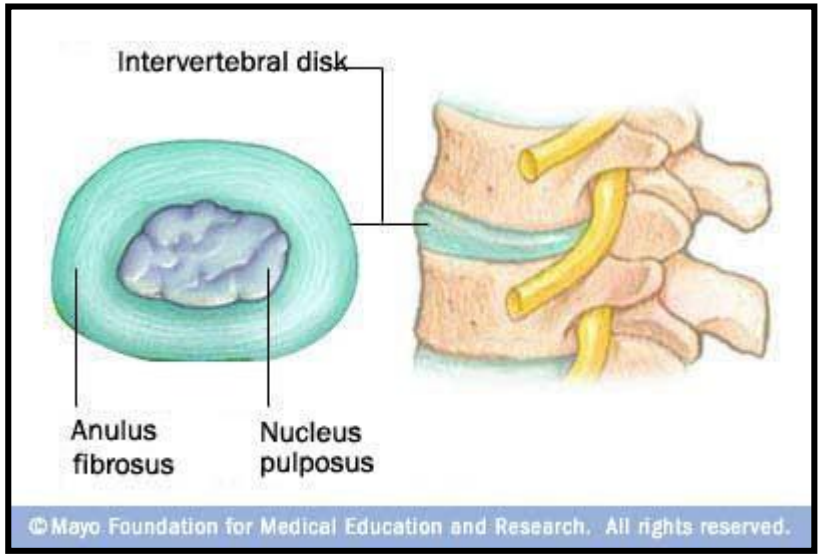
- ***Interstitial growth*** (addition from **inside**) takes place around the **lacunae** providing new cells for growth in areas where perichondrium is absent like
  - articular surfaces in joints

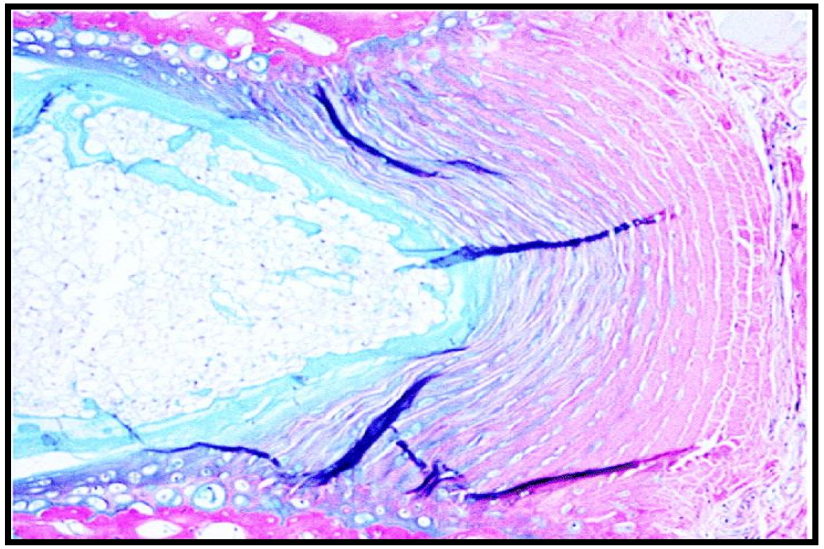
As a consequence of this mitotic activity, lacunae may possess two, four, eight daughter chondrocytes. These are known as **isogenous** or **nest cells**

Intervertebral disks

consist of fibrocartilage plates between the vertebrae and act as mechanical shock absorbers. In sections they are seen to be formed of two components:

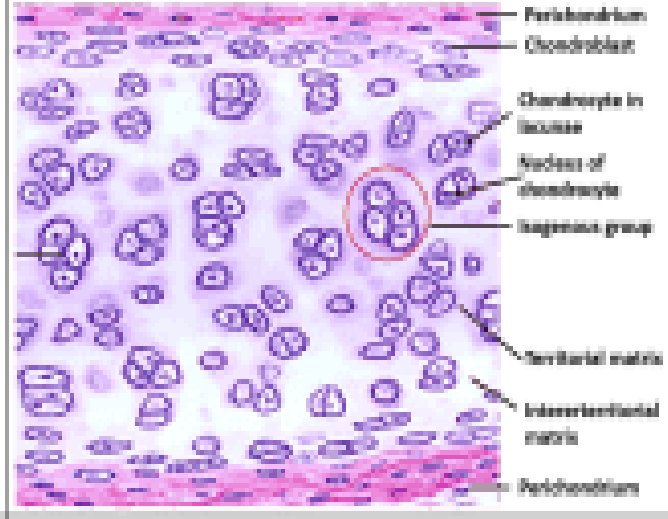
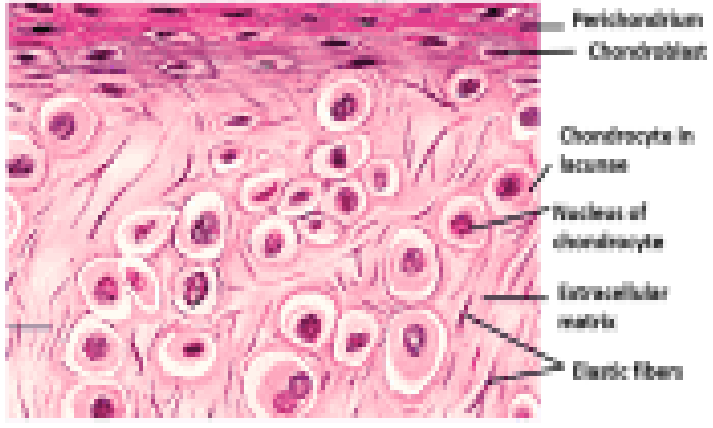
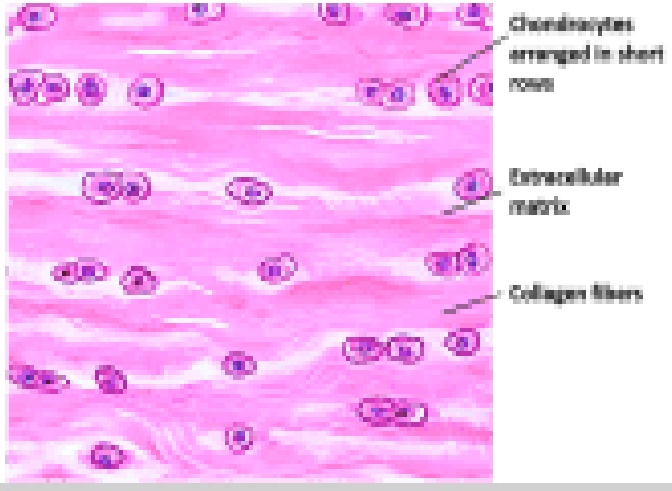
annulus fibrosus, which is the outer region consisting of orderly concentric arrangements of cells and matrix dominated by **type I collagen**
nucleus pulposus large vacuolated cells.





Type	Hyaline	Elastic	Fibro
Definition: supportive CT	Firm gel–like	Elastic	Intermediate between dense CT & HC
Fresh Colour	Bluish white & translucent.	Yellow	White
Site	Most common type 1-Fetal skeleton 2-Epiphyseal plate 3-Articular joints 4-Costal cartilages 5-Large airways (from nose to bronchi)	4E Ear pinna, External auditory canal Eustachian tube Epiglottis	IVD Symphysis pubis.
Perichondrium	Present Except articular joints	Present	NO
Fibers	Collagen II	Collagen II & Elastic.	Collagen I.
Chondrocytes	Cell nests	Cell nests	Few in Rows

	Hyaline	Elastic	Fibro
Ground substance	Basophilic	Basophilic	Acidophilic
Function	1-Growth of long bones 2-Sliding of joints. 3-Support soft tissue	Flexible	Shock absorber
Growth	Appositional & interstitial		Interstitial

Hyaline cartilage	Elastic cartilage	Fibrous cartilage
		

Thank You

Dr . Amira Osman