Cartilage

By

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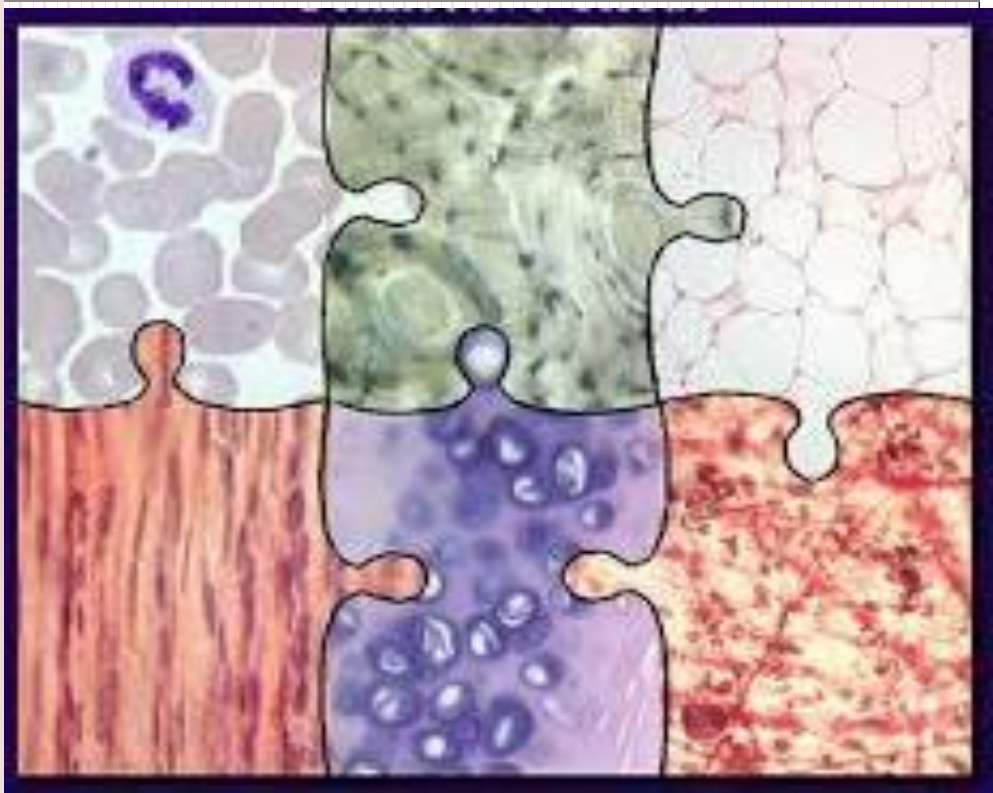
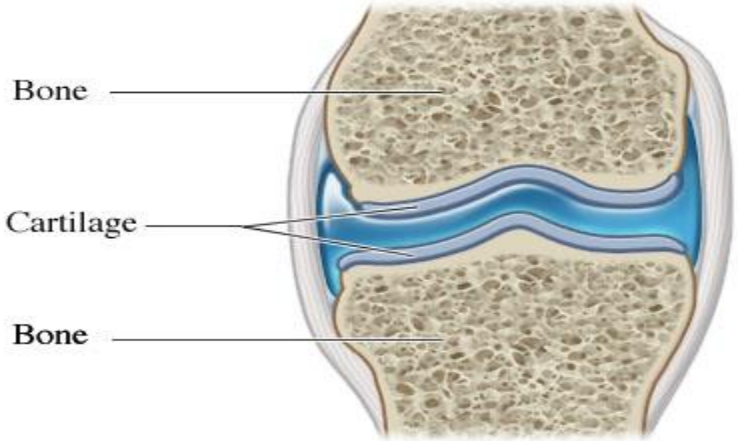


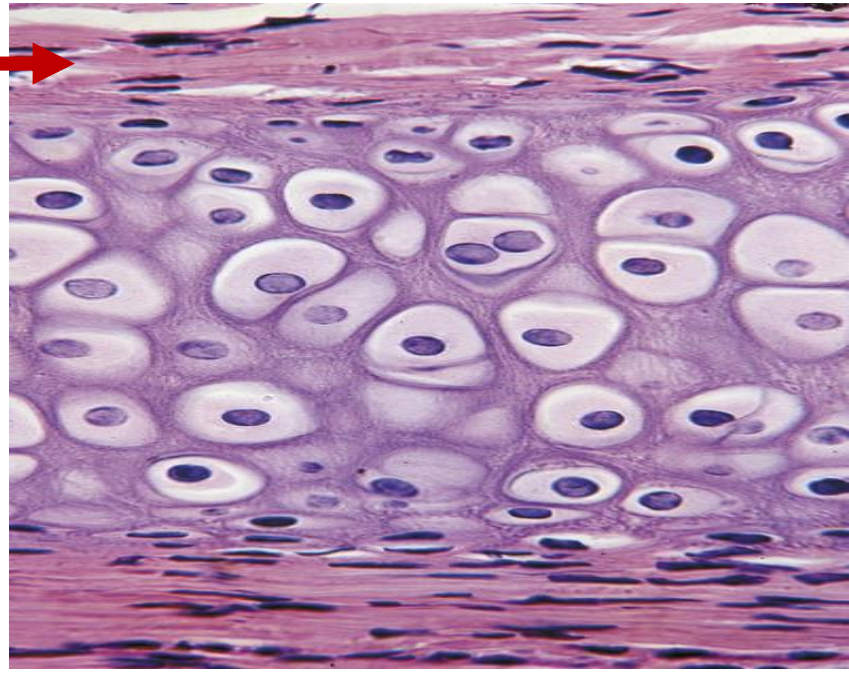
CARTILAGE

- Cartilage is a supportive type of connective tissue & has a firm consistency.
- The firm consistency of the cartilage allows the tissue to bear mechanical stresses without permanent distortion.
- Most cartilages are surrounded by a dense connective tissue called **perichondrium**
- Cartilage lacks nerves, blood and lymphatic vessels and nourished by blood vessels in perichondrium.



Cross section of a joint

- The perichondrium is a sheath of dense C.T formed of
  1) outer fibrous layer
  2) inner cellular layer

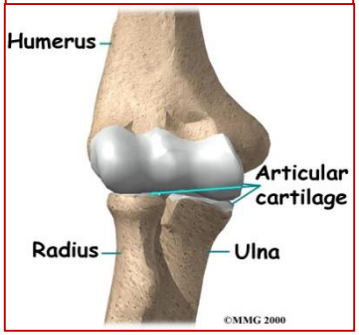


- the perichondrium, is essential for the growth and maintenance of cartilage.
- The perichondrium consists largely of **collagen type I** fibers and **fibroblasts**.
- Among these fibroblasts in the inner layer of the perichondrium are **progenitor cells** for chondroblasts that divide and differentiate into chondrocytes.

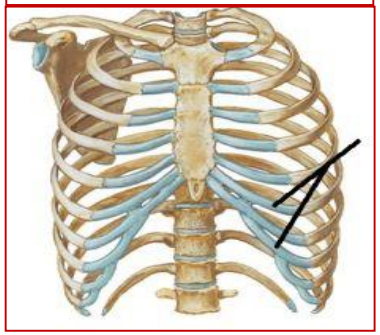
Type of Cartilage

Hyaline

Articular cartilage

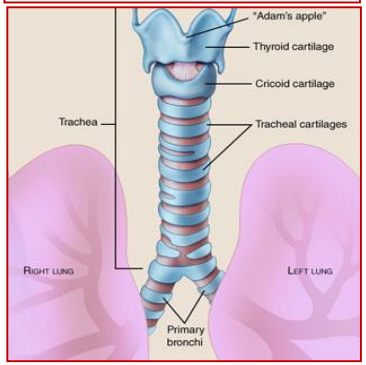


Costal cartilage



Fetal Skeleton

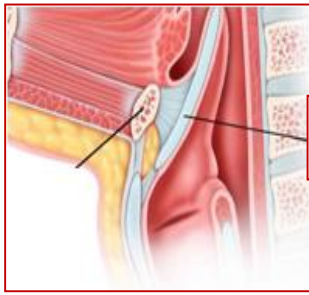
Trachea



Elastic

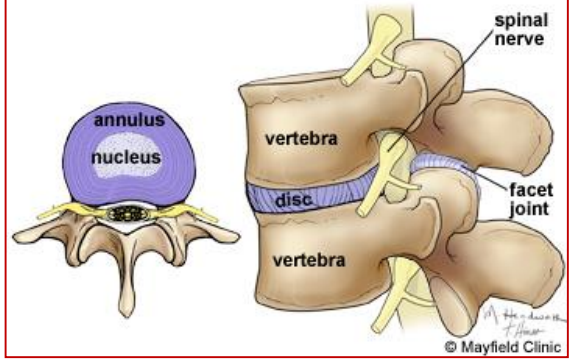
Ear pinna

Epiglottis

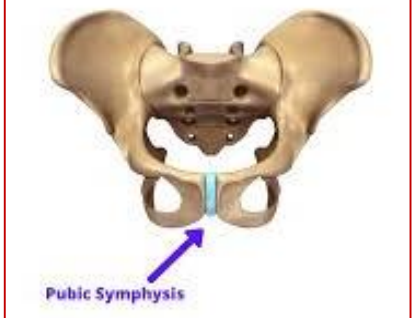


Fibrocartilage

Intervertebral disc

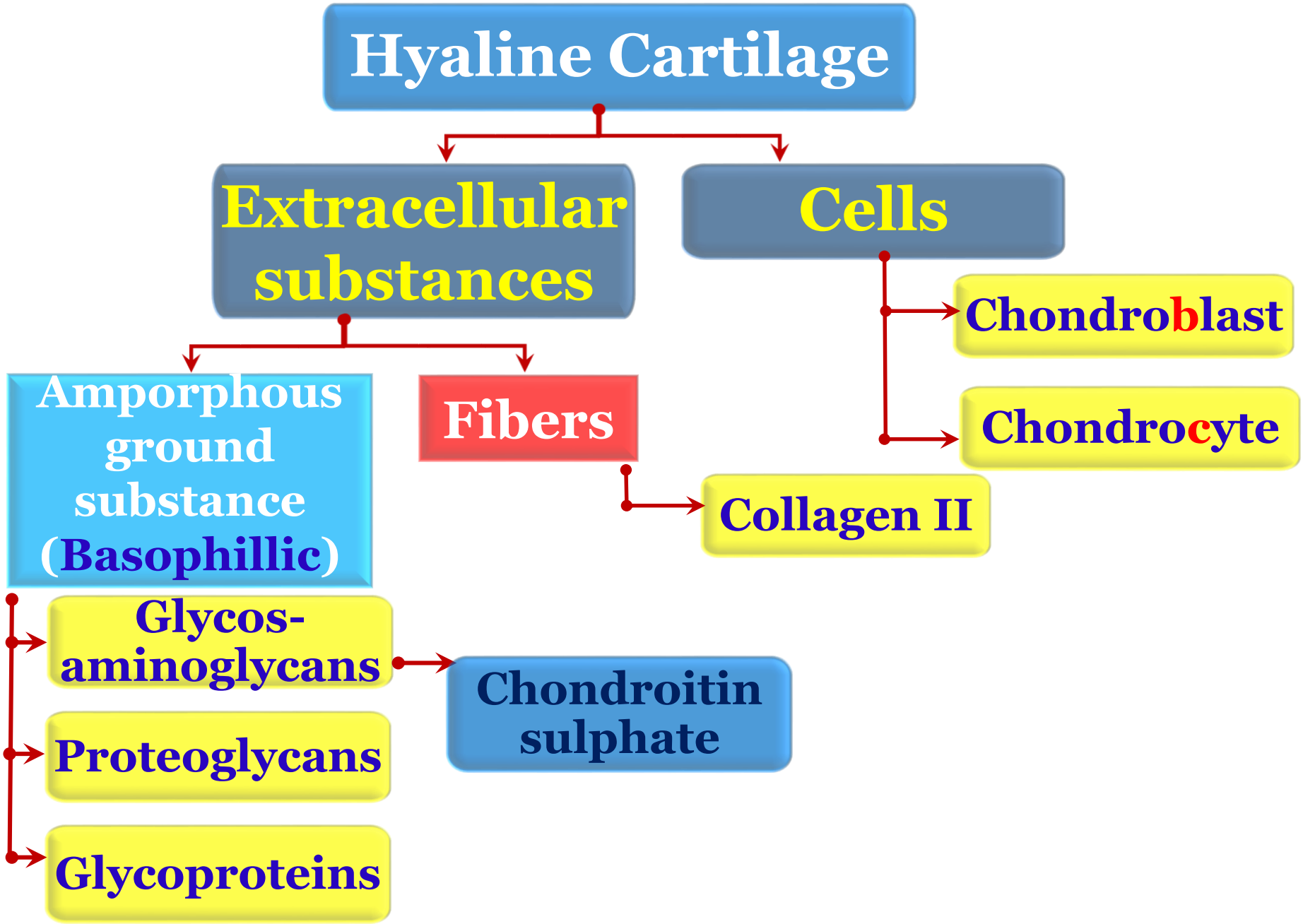


Symphysis pupis



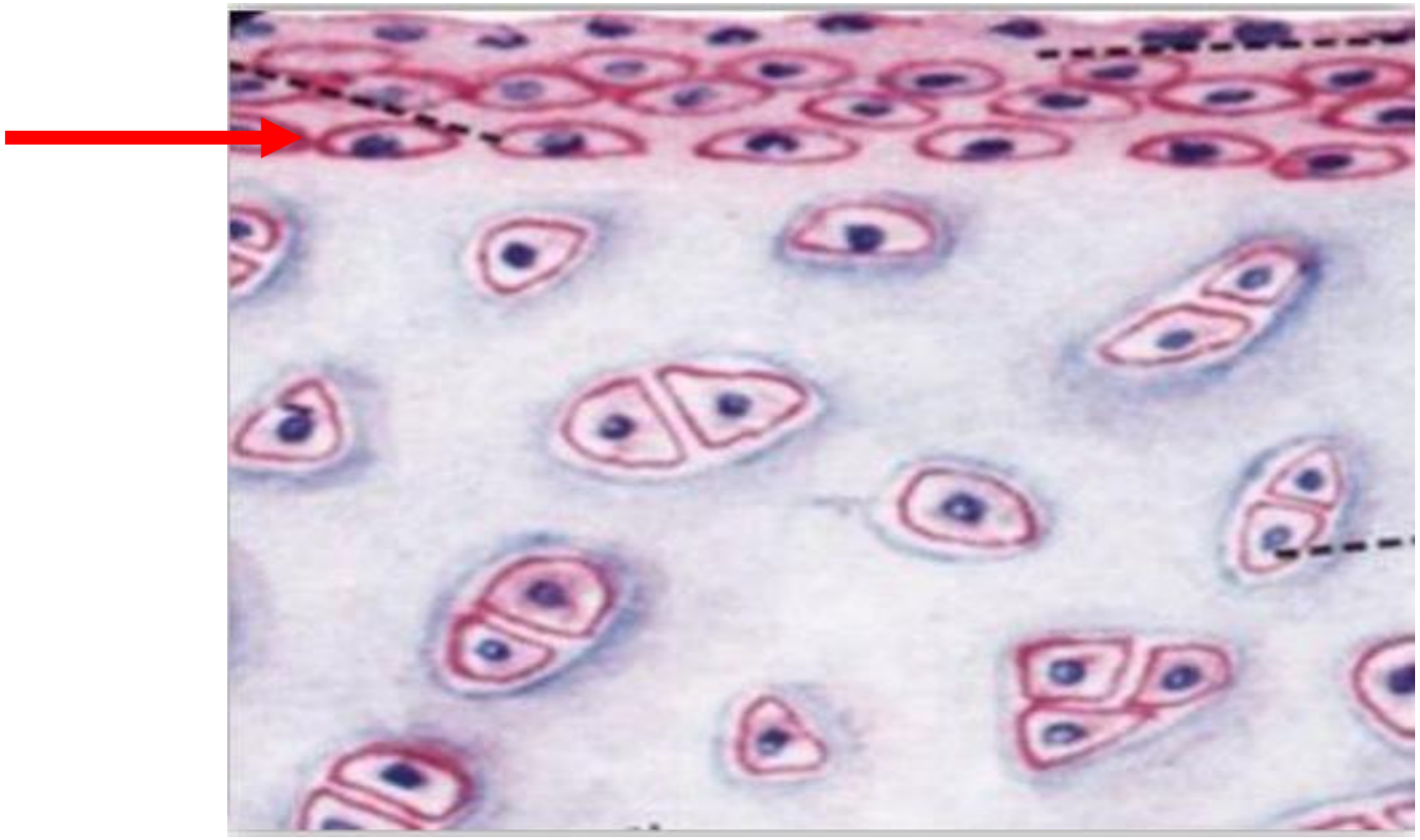
Hyaline cartilage

- It is the most common type of cartilage in the body.
- It is covered by perichondrium.
- When fresh, it is bluish white and translucent.
- Site: **In adults** hyaline cartilage is located in the articular surfaces of movable joints, in the walls of larger respiratory passages (nose, larynx, trachea, bronchi), in the ventral ends of ribs, where they articulate with the sternum, and in the epiphyseal plates of long bones, where it makes possible longitudinal bone growth. **In the embryo,** hyaline cartilage forms the temporary skeleton that is gradually replaced by bone.


Hyaline Cartilage
Extracellular substances
Cells
Chondroblast
Chondrocyte
Amporphous ground substance (Basophillic)
Fibers
Collagen II
Glycos-aminoglycans
Chondroitin sulphate
Proteoglycans
Glycoproteins

a) The chondroblasts

- It is present under the perichondrium.
- L.M: They are oval or spindle in shape with basophilic cytoplasm and pale nucleus.



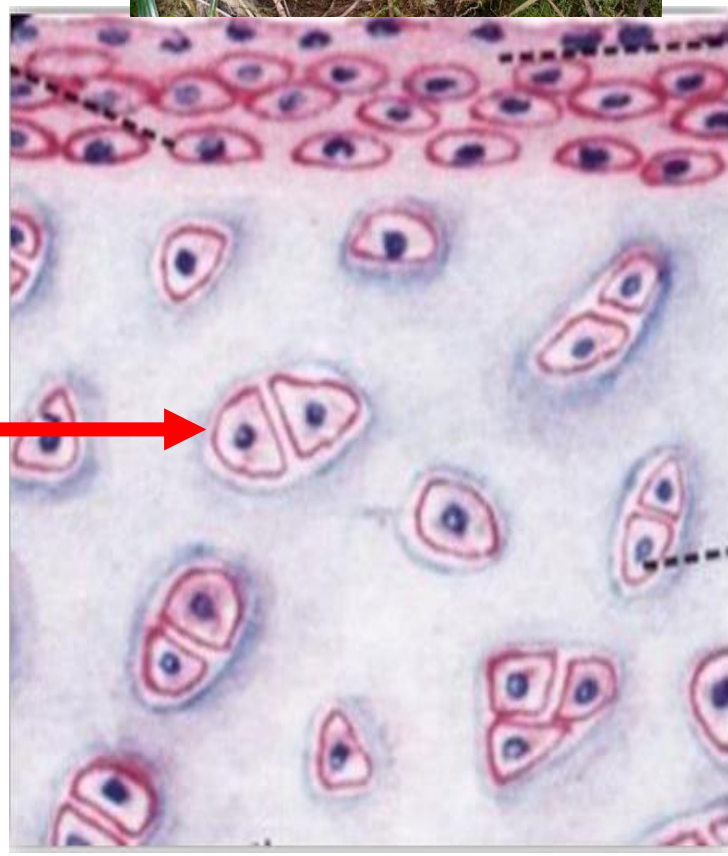
- E/M: The cytoplasm contains organelles concerned with protein synthesis e.g. RER, a well developed Golgi complex, numerous mitochondria and abundant secretory vesicles.

- Chondroblasts change into **chondrocytes** when they are trapped inside **lacunae.**

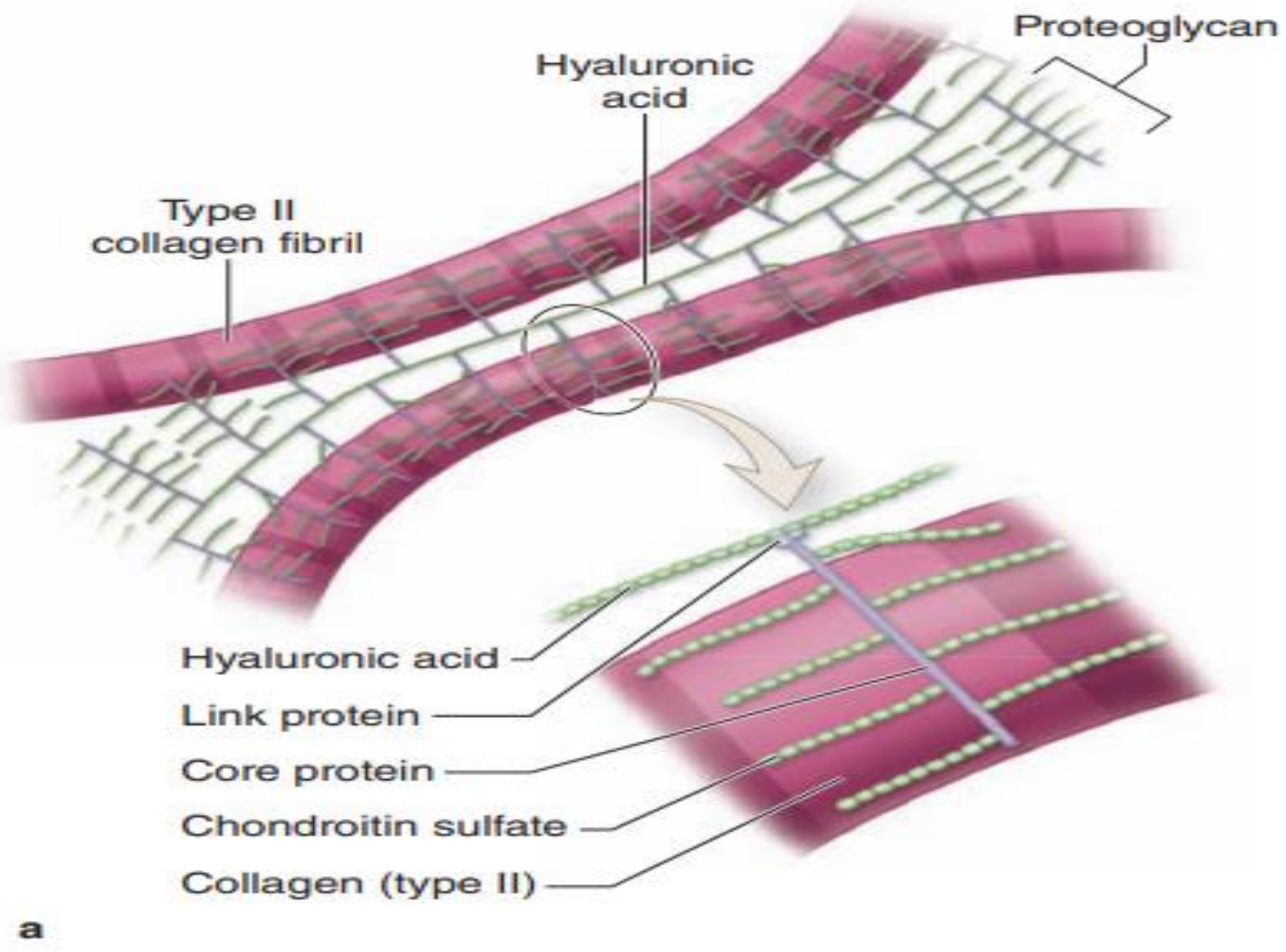
- **Function:** They synthesize proteins and fibers of the matrix.

b) The chondrocytes

- It is present within spaces called **lacunae** either single or in-groups (up to 8 cells in the same lacuna) called **cell nest** that originate from mitotic divisions of a single chondrocyte and are called isogenous aggregates.
- The lacunae are surrounded by rigid intercellular substance formed of fibers and matrix.
- Their cytoplasm is less basophilic, and their nuclei are deeply stained.
- They are less active than chondroblasts



Matrix (Extracellular substances)



Matrix (Extracellular substances)

1-Ground substance which contains:-

-**Aggrecan** is GAG with side chains of chondroitin sulfate and keratan sulfate, is the most abundant proteoglycan of hyaline cartilage.

-Hundreds of these proteoglycans are bound by link proteins to long polymers of hyaluronic acid. These **proteoglycan hyaluronate complexes** bind further to the surface of type II collagen fibrils.

-**glycoprotein chondronectin**. chondronectin binds specifically to GAGs, collagen type II, and integrins, mediating the adherence of chondrocytes to the ECM.

2- Type II collagen fibrils:

- Collagen fibrils cannot be seen with L/M because

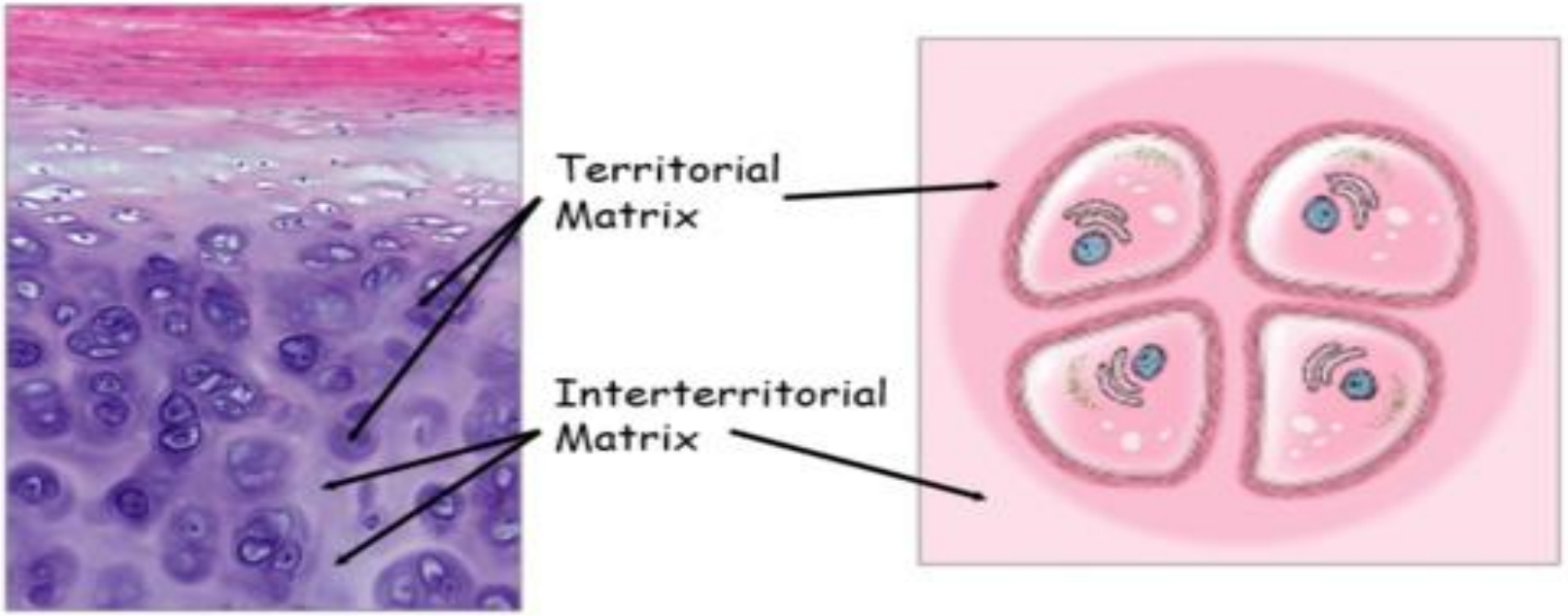
A- The refractive index of the collagen fibrils and the ground substance is the same.

B- Type II collagen dose not form bundles.

- The matrix is basophilic (GAG), PAS +ve and can be stained metachromatic with toluidine blue stain.

Territorial and Interterritorial Matrix

(Ross, Figs. 7.4; 7.7, pgs. 201 ; 203)

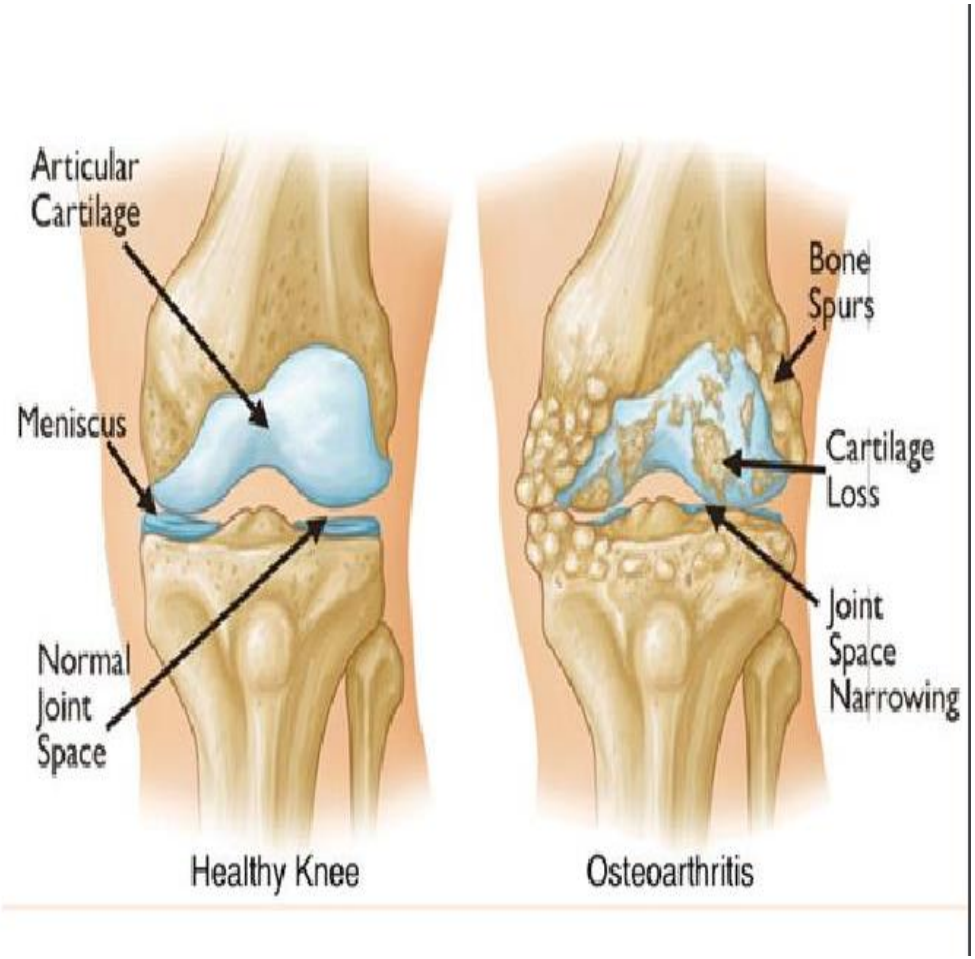


- Immediately surrounding each chondrocyte, the ECM is relatively richer in GAGs, often causing these areas of **territorial matrix** to stain differently from the intervening areas of **interterritorial matrix**

Articular Cartilage

- Specialised form of hyaline cartilage covers articulating ends of the bones for:

- ❑Lubrication
- ❑slightly compressible
- ❑exhibit very little friction.

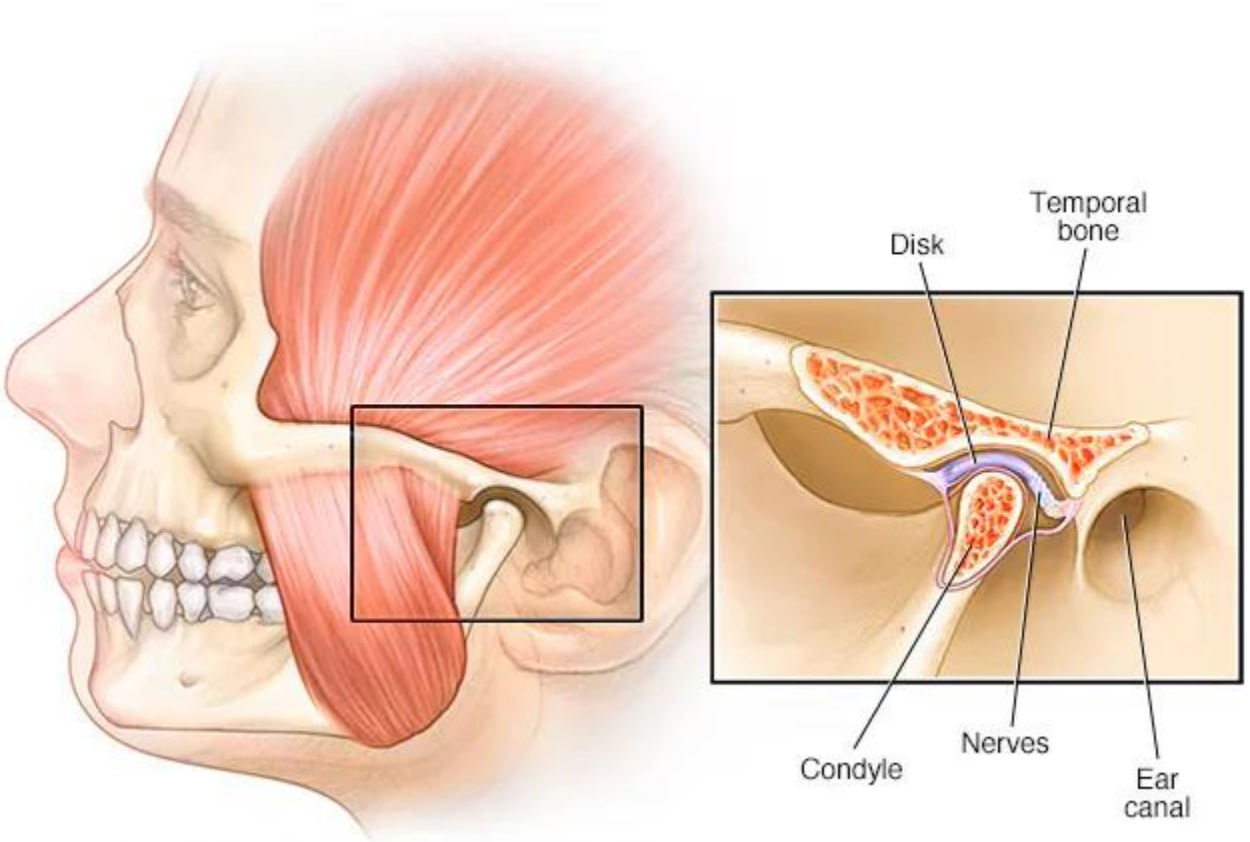


N.B: Articular cartilage lacks perichondrium and is sustained by the diffusion of oxygen and nutrients from the synovial fluid.

Osteoarthritis, a chronic condition that commonly occurs during aging, involves the gradual loss or changed physical properties of the hyaline cartilage that lines the articular ends of bones in joints.

- Joints that are weight bearing (knees, hips) or heavily used (wrist, fingers) are most prone to cartilage degeneration.
- The TMJ (tempromandibular joint) may be affected by osteoarthritis usually in people > 50 years. Occasionally, patients complain of stiffness, a grating sound on jaw movement, or mild pain.

Tempromandibular joint

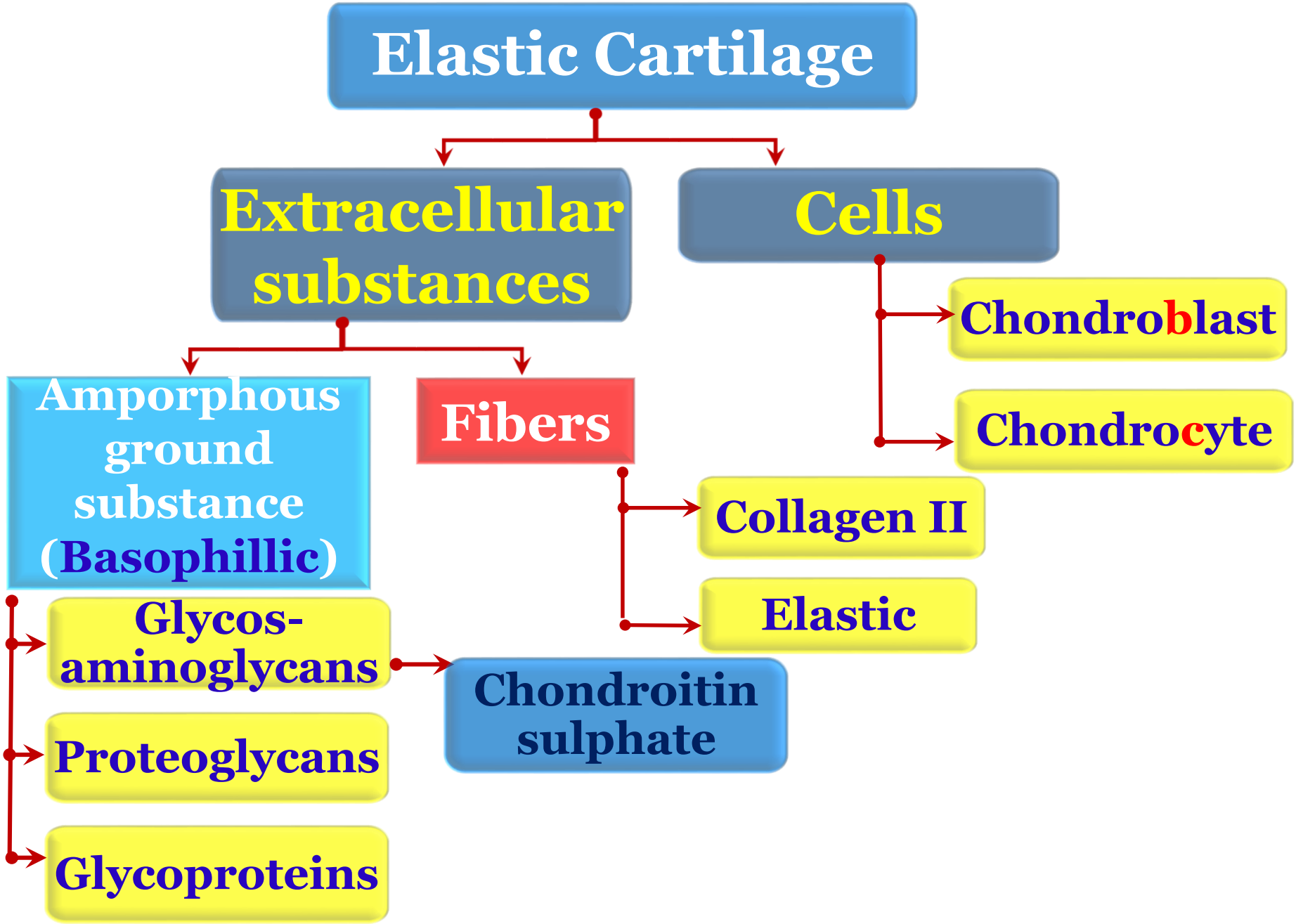


Growth of hyaline cartilage

Cartilage is capable of two kinds of growth:

1- **Appositional growth:** It is the process that forms new cartilage from outside by proliferation of progenitor cells present in the perichondrium.

2- **Interstitial growth:** The process that forms new cartilage within the cartilage. The new cartilage cells arise from pre-existing chondroblasts within the substance of the cartilage.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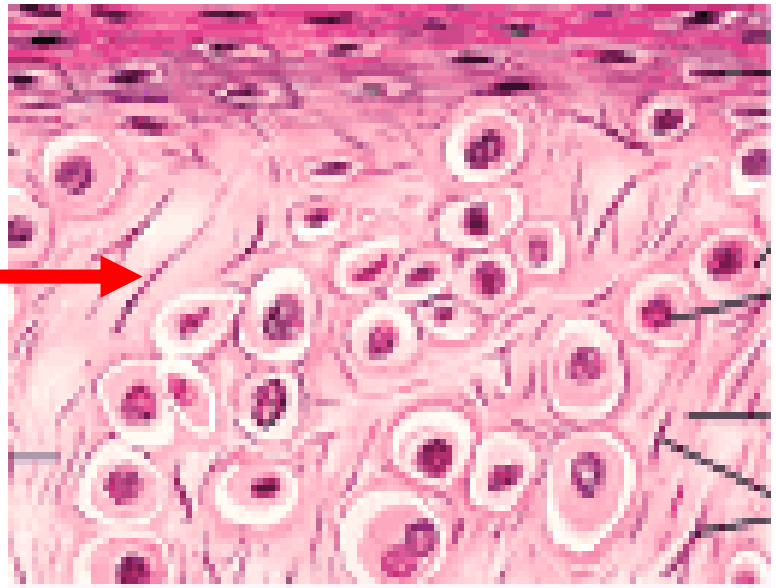
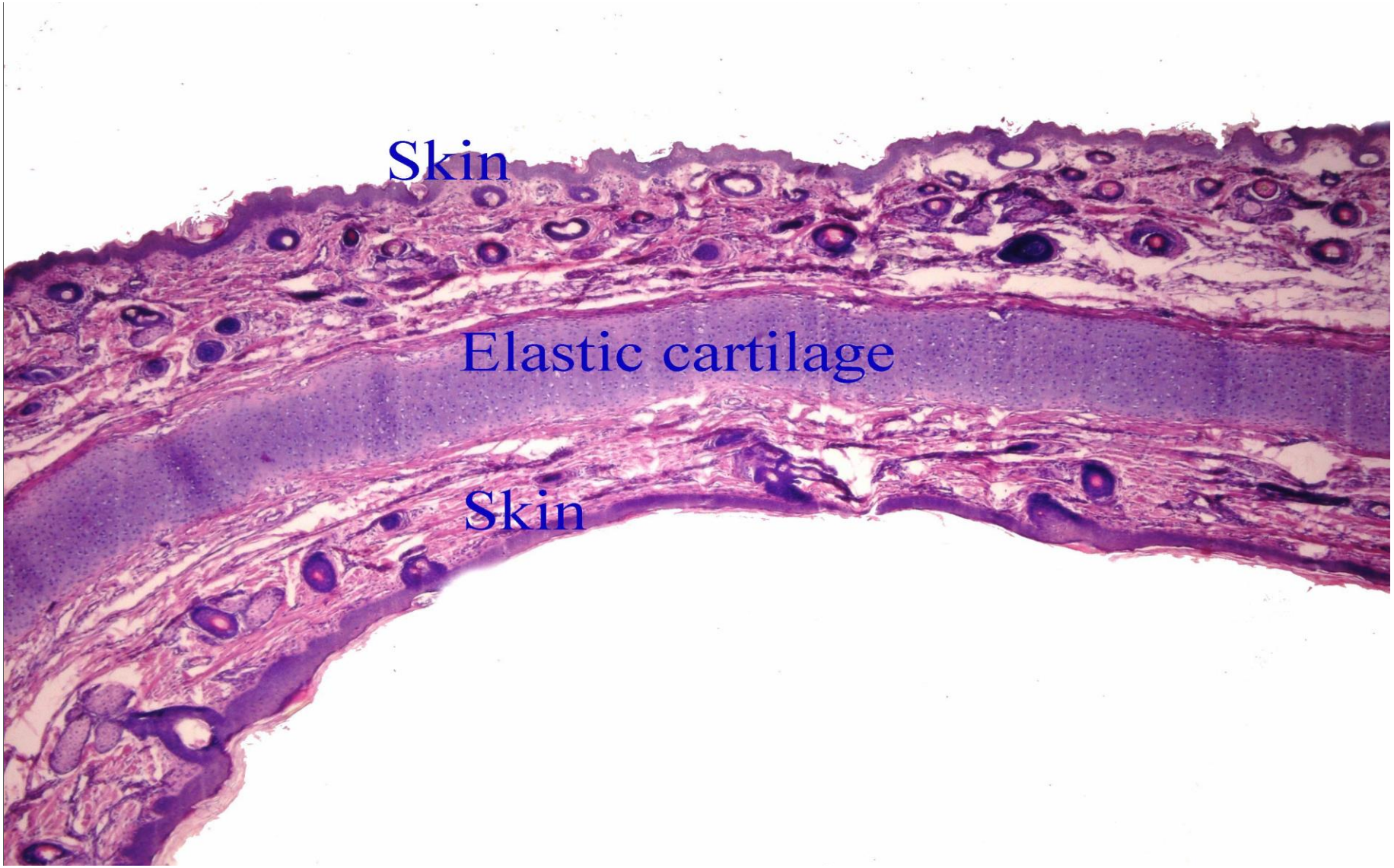
Elastic cartilage

- It is identical to hyaline cartilage except that its matrix contains abundant network of **elastic fibers** in addition to collagen fibers.



- Elastic fibers give fresh elastic cartilage a yellowish color
- Site: the ear pinna, external & internal auditory tubes, epiglottis

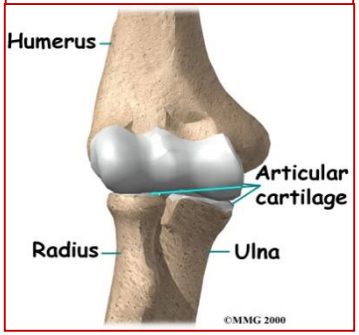
Elastic cartilage



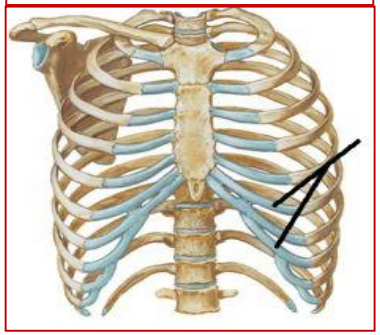
Type of Cartilage

Hyaline

Articular cartilage

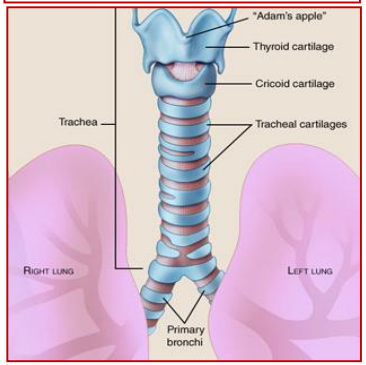


Costal cartilage



Fetal Skeleton

Trachea



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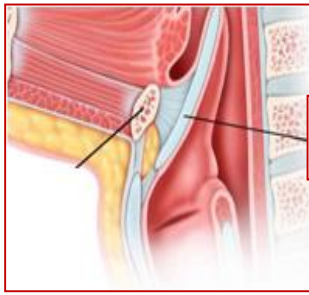
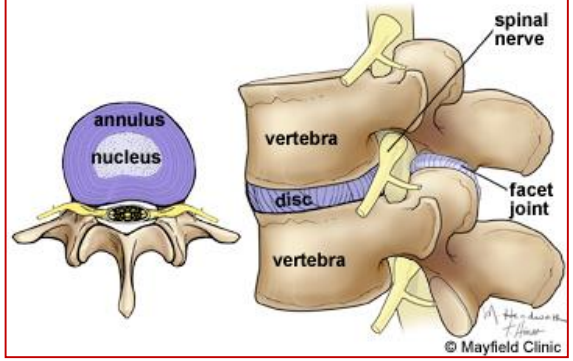
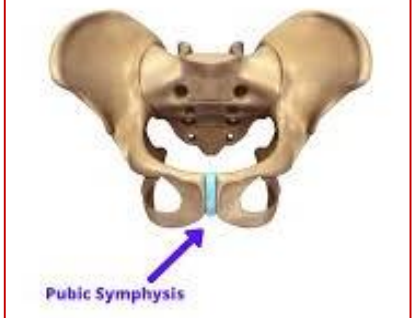


Fibrocartilage

Intervertebral disc

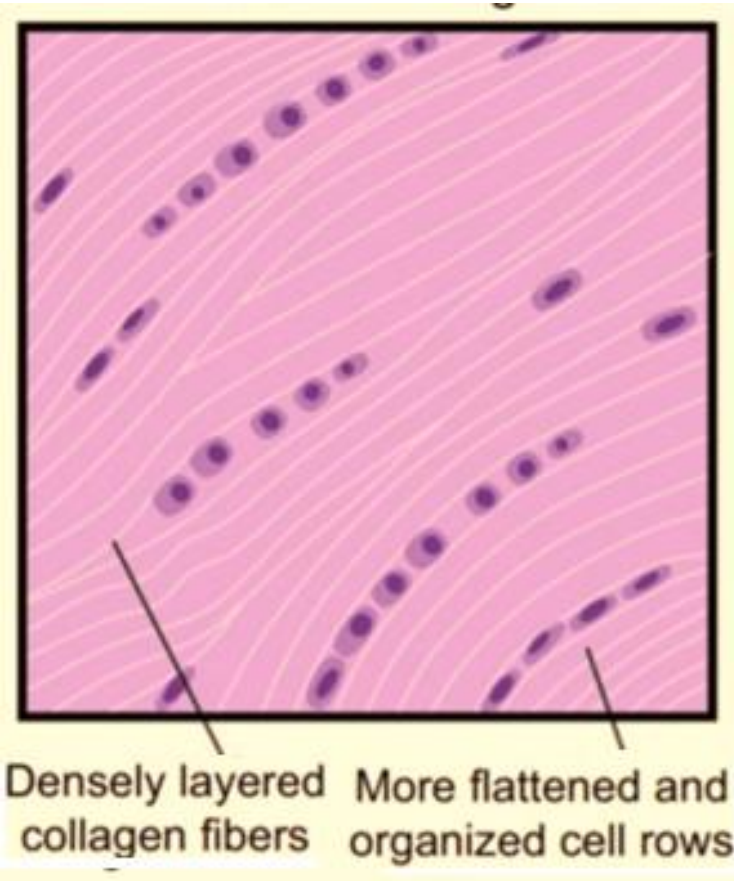


Symphysis pupis

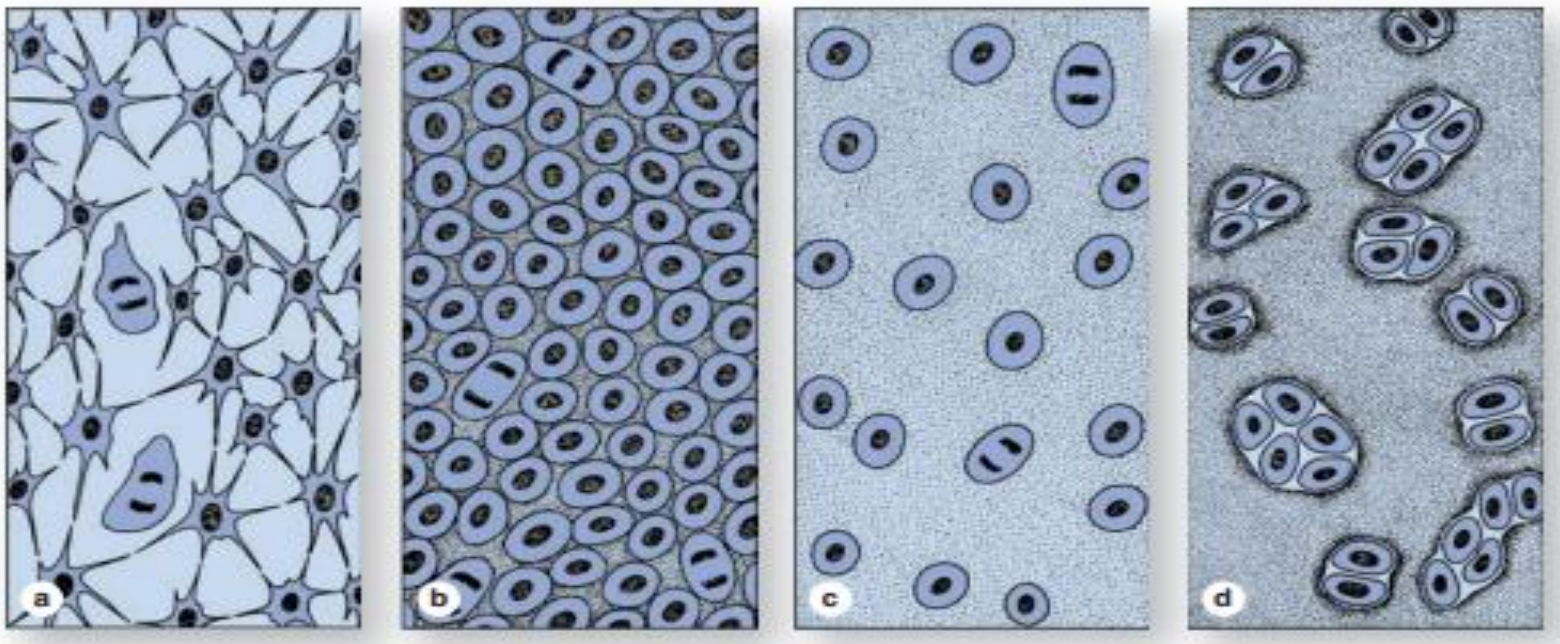


Fibrocartilage

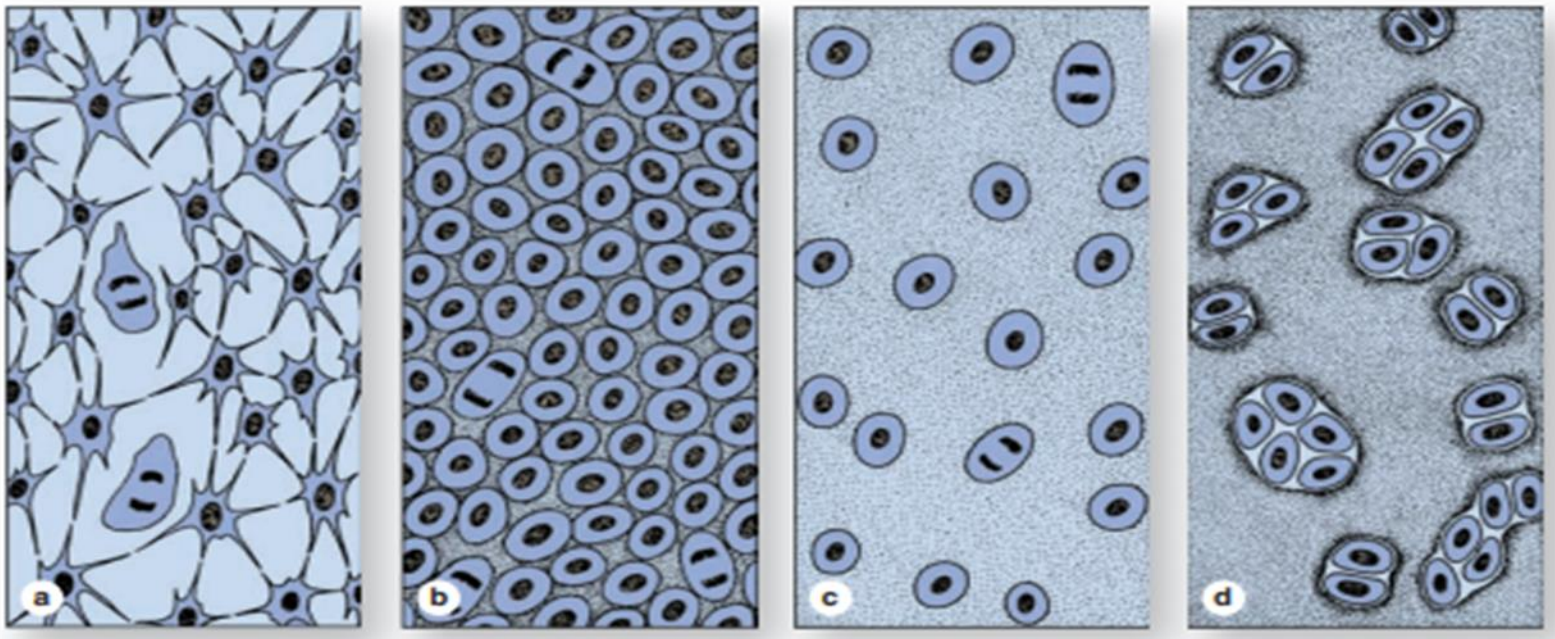
- It has no perichondrium
- Site: intervertebral discs, symphysis pubis,
- It is a combination of hyaline cartilage and dense connective tissue with gradual transitions between these tissues
- The chondrocytes inside lacunae are usually present in rows surrounded by **collagen I** bundles in great amount that give **acidophilia** to matrix.



Chondrogenesis



(a) Mesenchyme is the precursor for all types of cartilage.
(b) Mitosis and early differentiation produces a tissue with condensations of rounded cells called chondroblasts.
(c) Chondroblasts are then separated from one another again by their production of various matrix components, which collectively swell with water and form the very extensive ECM.



(d) Multiplication of chondroblasts within the matrix gives rise to isogenous cell aggregates (chondrocytes) surrounded by a condensation of territorial matrix.

THANK YOU