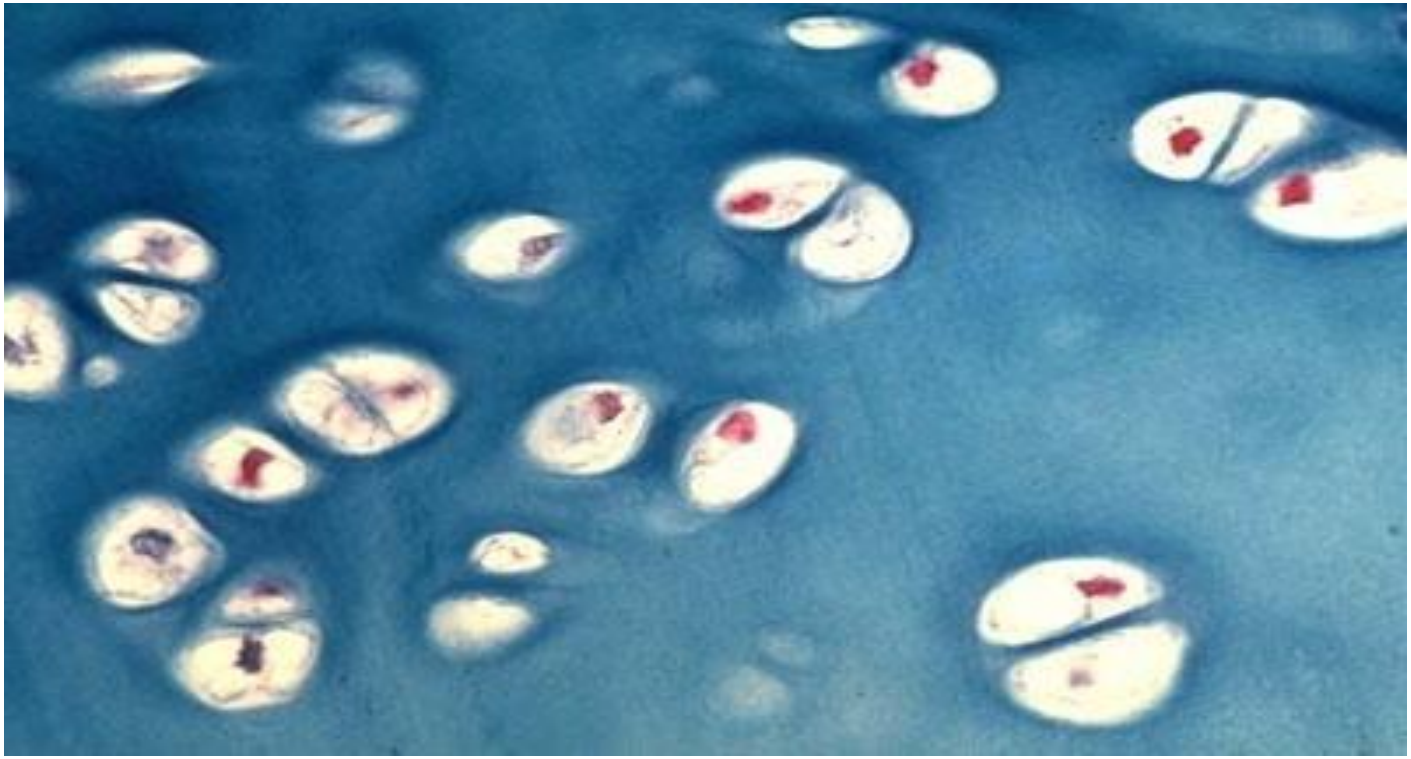
Cartilage



DEFINITION

- Cartilage is a specialized type of connective tissue designed to give support, bear weight and withstand tension, torsion and bending.

FUNCTION OF CARTILAGE

1. Firm consistency of the extracellular matrix allows the tissue to bear mechanical stresses without permanent distortion.
2. Support soft tissues.
3. Cartilage is a shock-absorbing and sliding area for joints and facilitates bone movements.
4. Cartilage is also essential for the development and growth of long bones both before and after birth.

COMPONENTS

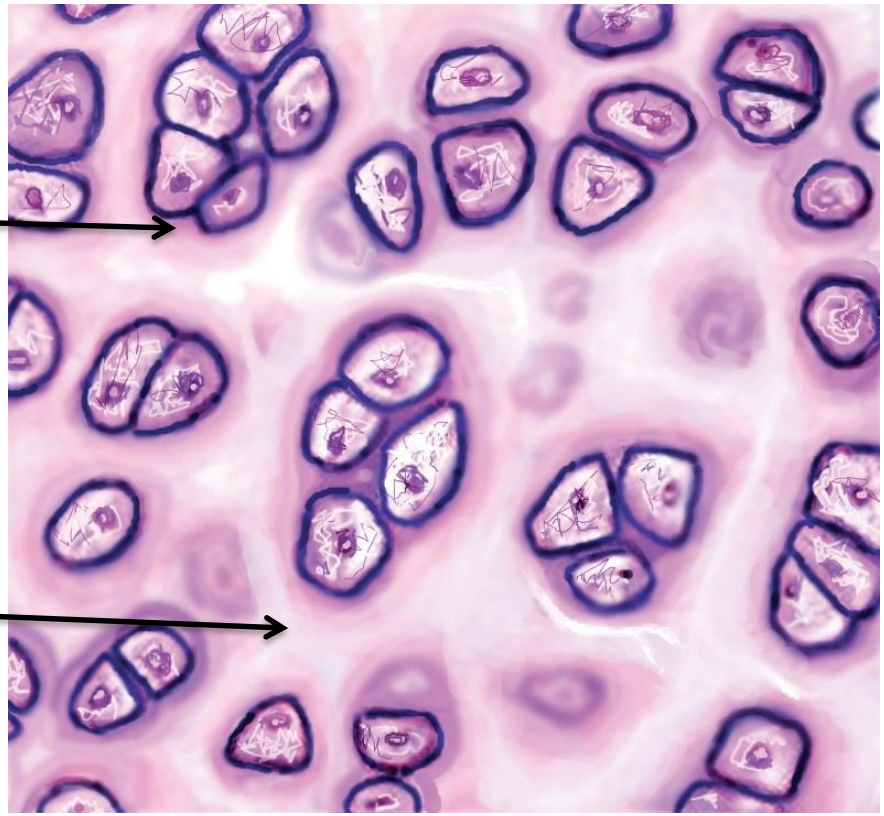
- **Cells- chondroblasts and chondrocytes.**
- **Fibers-collagen and elastic.**
- **Ground substance.**

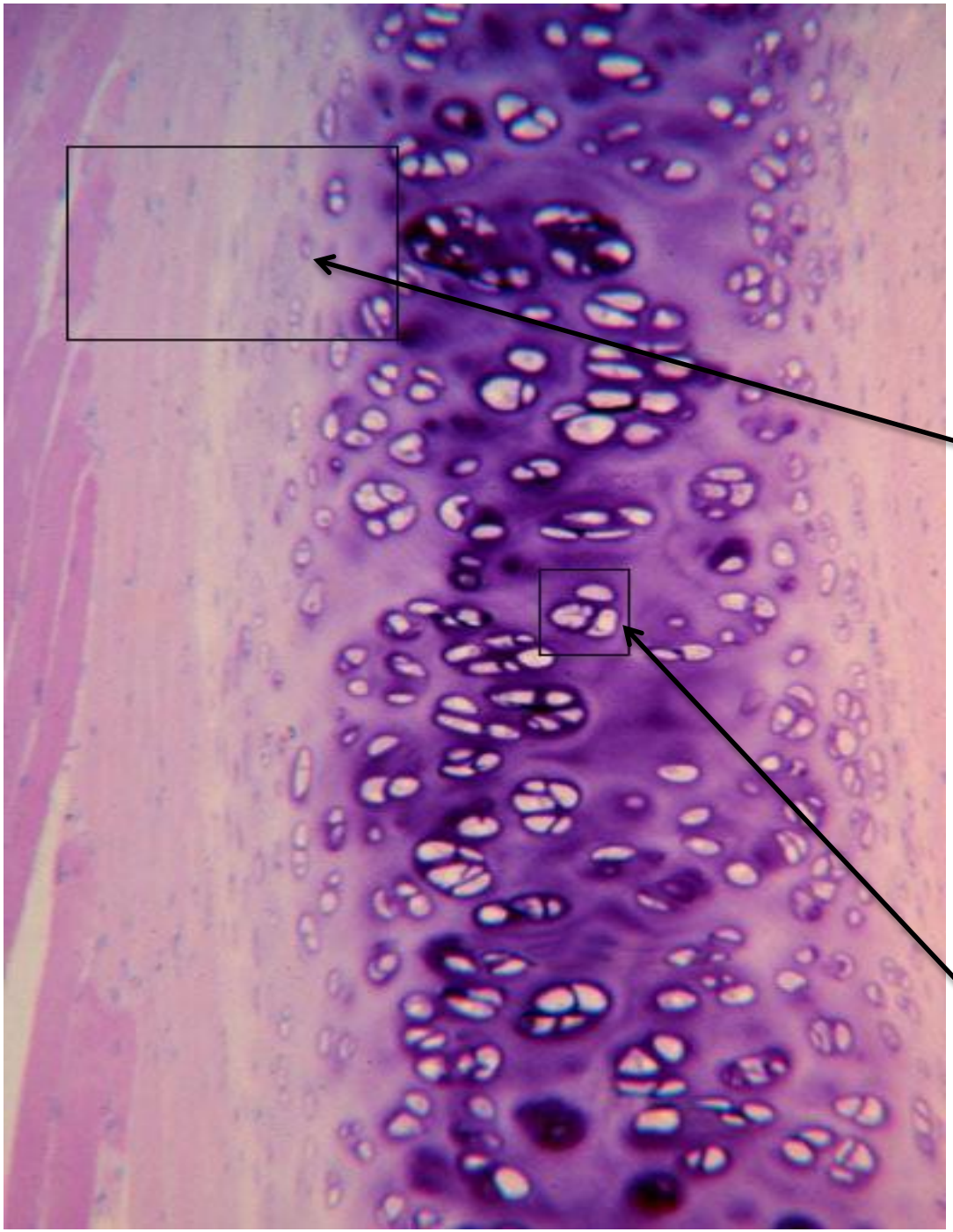
CELLS OF THE CARTILAGE

- They are derived from undifferentiated mesenchymal cells.
- Young cells are small with branched cytoplasmic processes known as chondroblasts, they multiply to chondrocytes.
- Older and mature cells are known as chondrocytes.

- Matrix around the cells is brighter and deep in color than other areas, this matrix is known **territorial matrix**
- Territorial matrix is rich in GAG and poor in collagen.

- Two groups of cells are separated by a lightly colored matrix known **inter-territorial matrix**



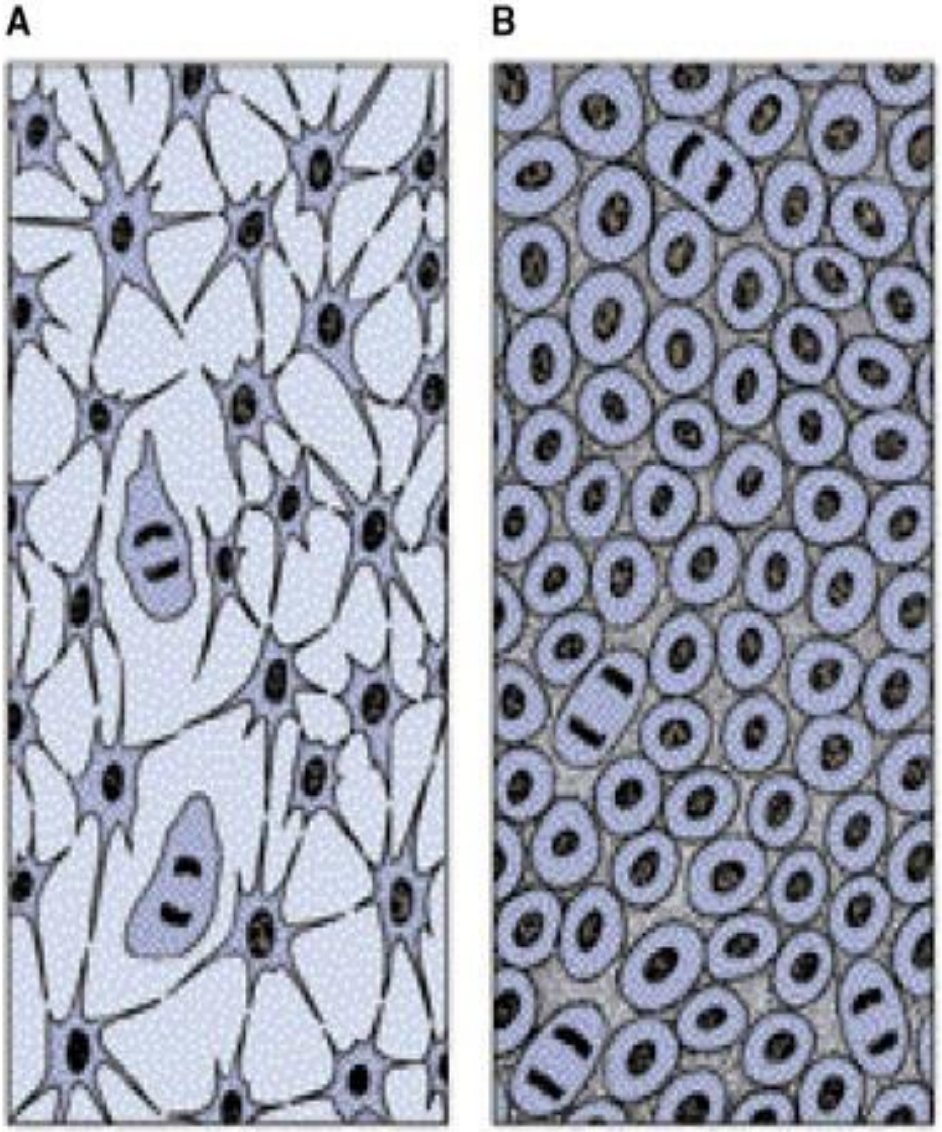


- Cartilage is **AVASCULAR** and is nourished by the diffusion of nutrients from capillaries in adjacent connective tissue (perichondrium) or by synovial fluid from joint cavities.
- As might be expected of cells in an avascular tissue, chondrocytes exhibit low metabolic activity.
- Cartilage has no lymphatic vessels or nerves.

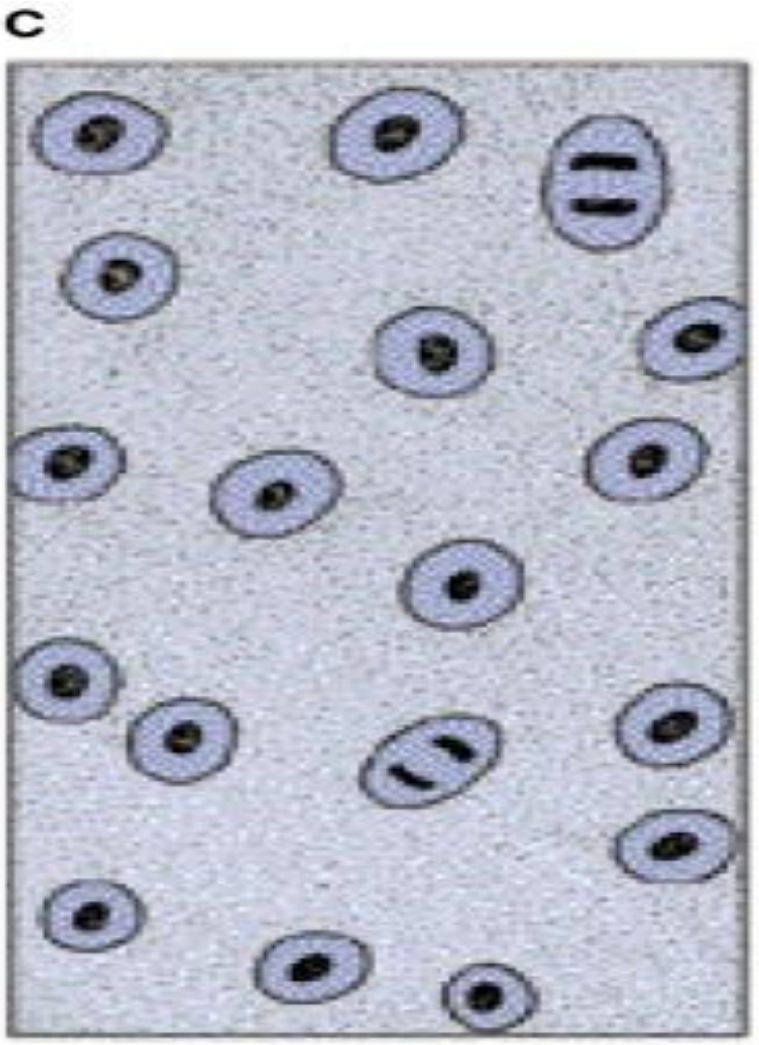
Isogenous group

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.

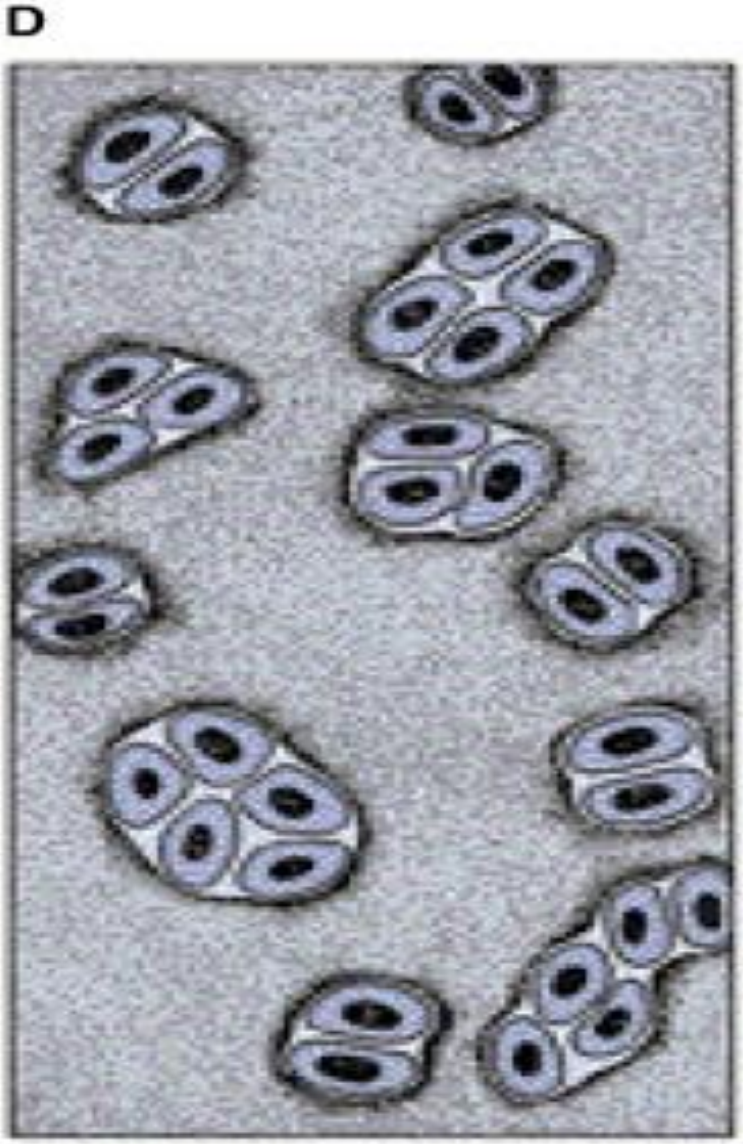


C. Chondroblasts are then separated from one another again by their production of various matrix components, which collectively swell with water and form the very extensive ECM.



D. Multiplication of chondroblasts within the matrix gives rise to isogenous cell aggregates surrounded by a condensation of territorial matrix .

In mature cartilage, this interstitial mitotic activity ceases and all chondrocytes typically become more widely separated by their production of matrix.



INTERSTITIAL GROWTH

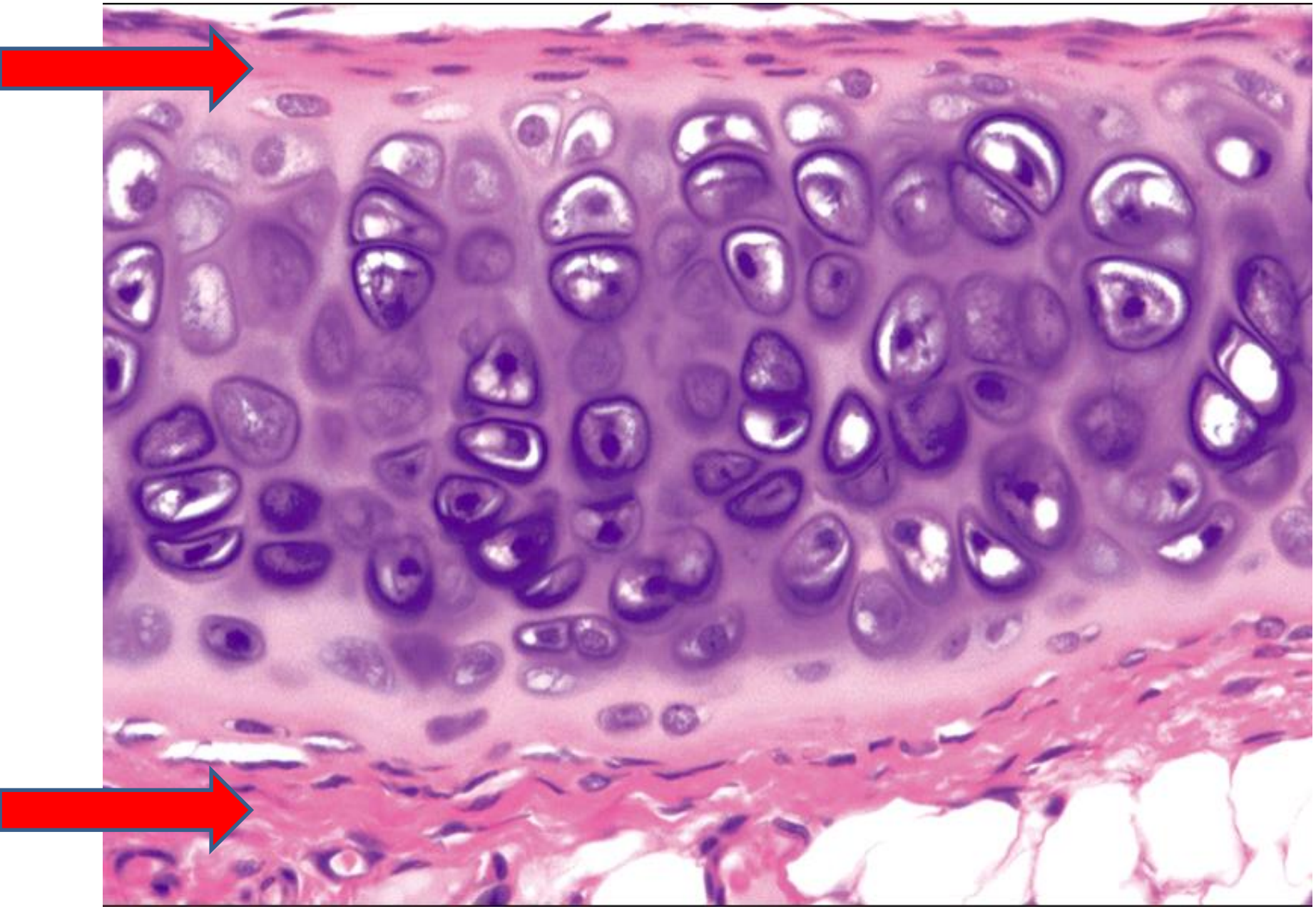
- ✓ Occurs mainly in immature cartilage.
- ✓ Chondroblasts in existing cartilage divide and form small groups of cells (isogenous groups) which produce matrix to become separated from each other by a thin partition of matrix.

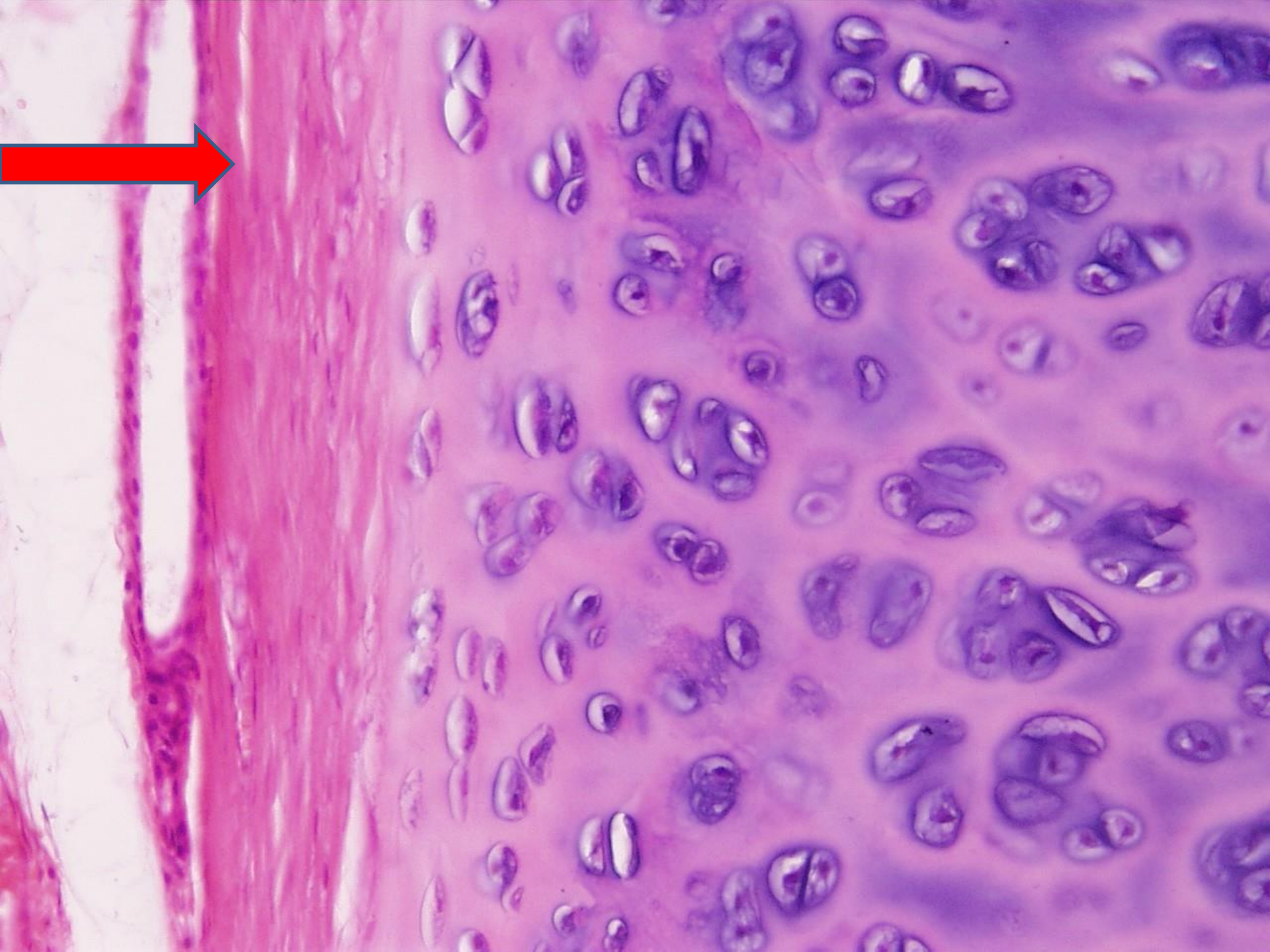
- ✓ “Growth from within”

APPOSITIONAL GROWTH

- ✓ Occurs in mature and immature cartilage.
- ✓ Mesenchymal cells surrounding the cartilage in the deep part of the perichondrium (or the chondrogenic layer) differentiate into chondroblasts.
- ✓ Chrondroblasts in perichondrium secrete matrix.
- ✓ “Growth from outside”

Perichondrium

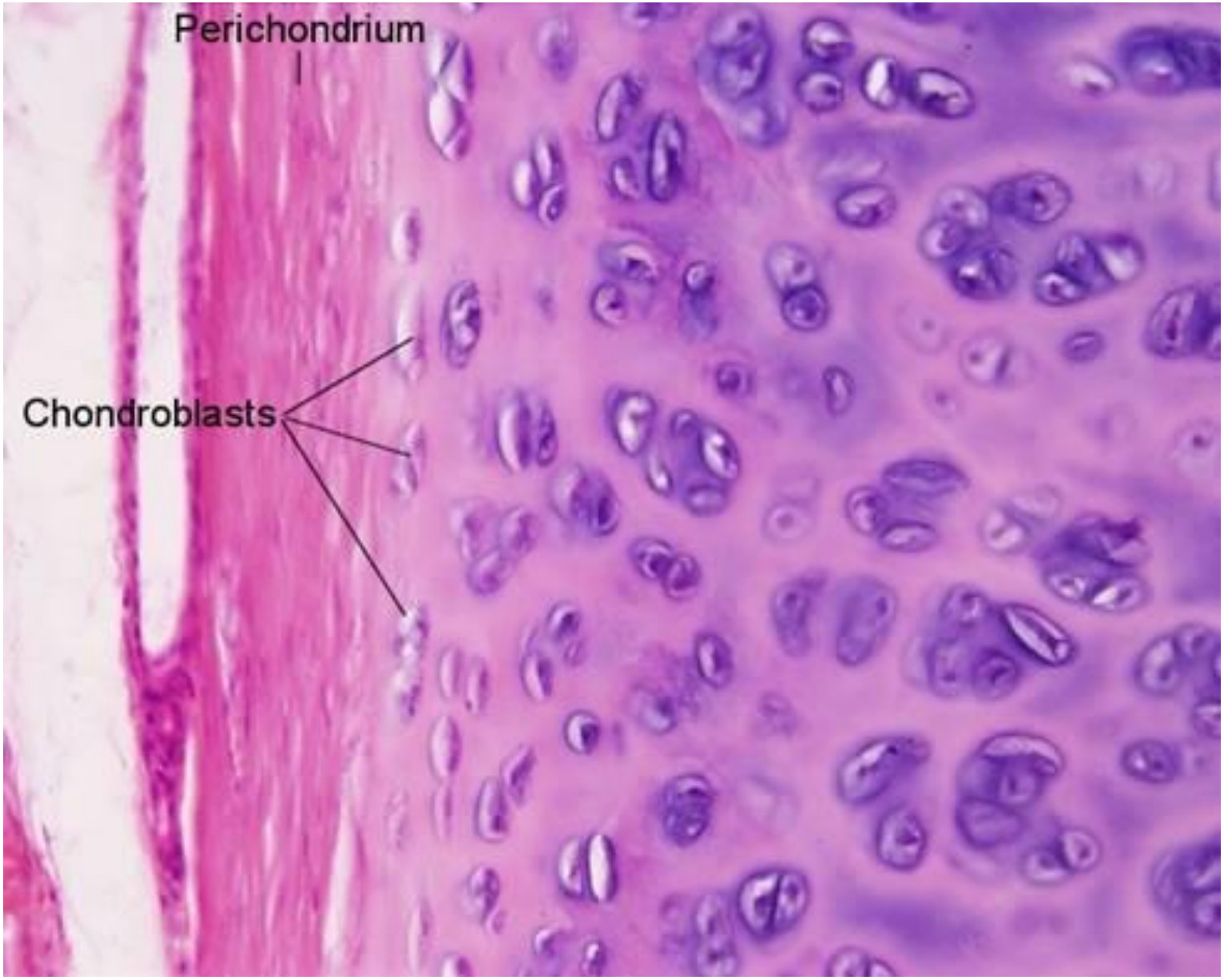


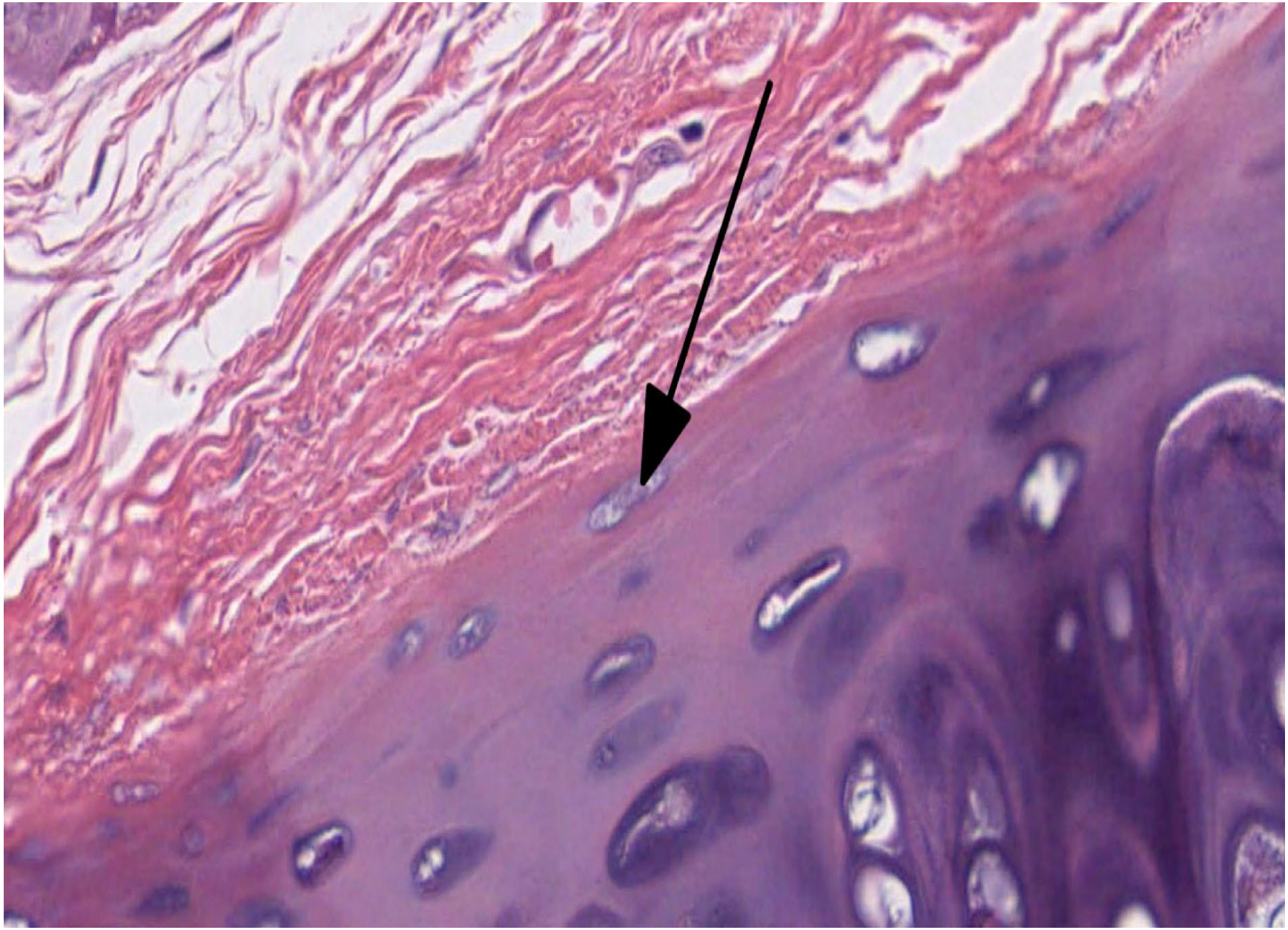


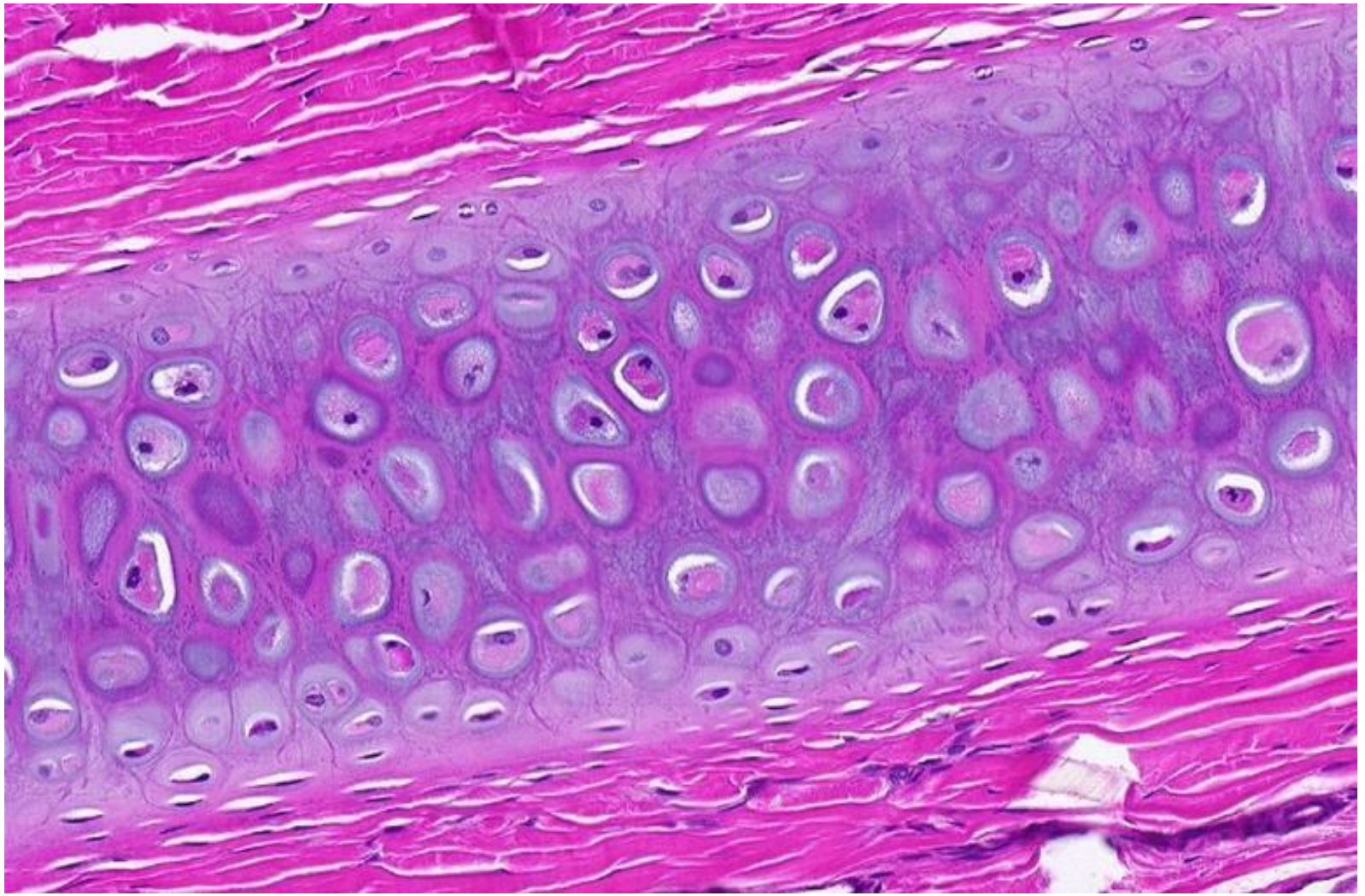
PERICHONDRIUM

- **OUTER LAYER** is rich in **COLLAGEN TYPE I** fibers and contains numerous **FIBROBLASTS**.

- Cells in the **INNER LAYER** of the perichondrium resemble fibroblasts, they are **CHONDROGENIC** and easily differentiate into chondblasts.

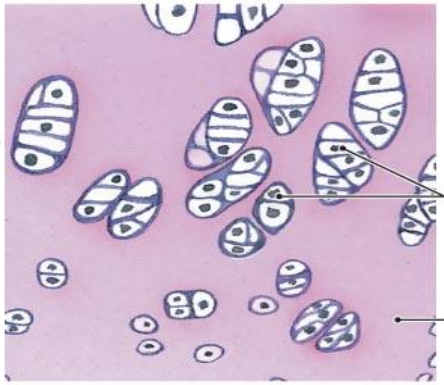

Perichondrium
Chondroblasts

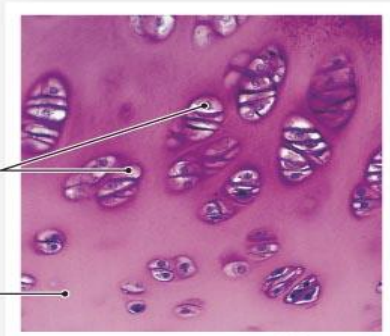




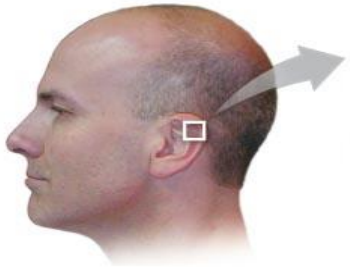
CLASSIFICATION OF CARTILAGE

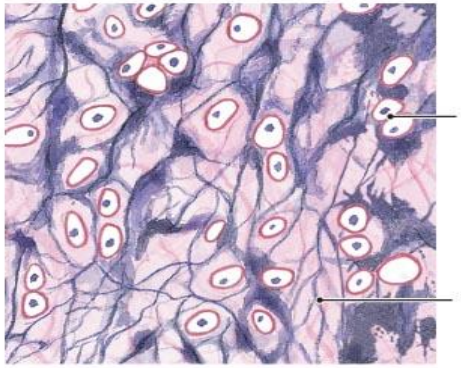
The three types of cartilage

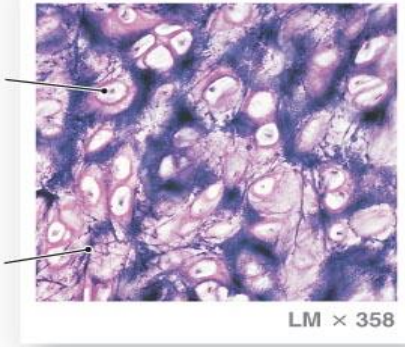




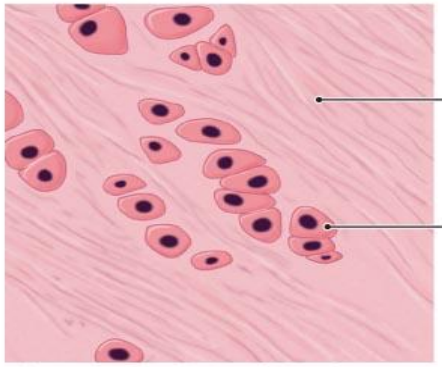
Hyaline cartilage from shoulder joint

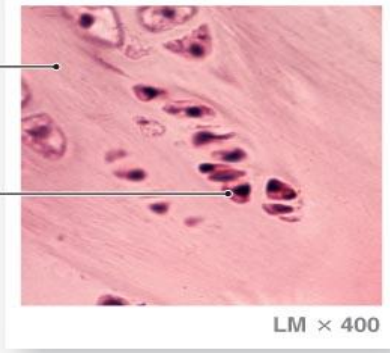






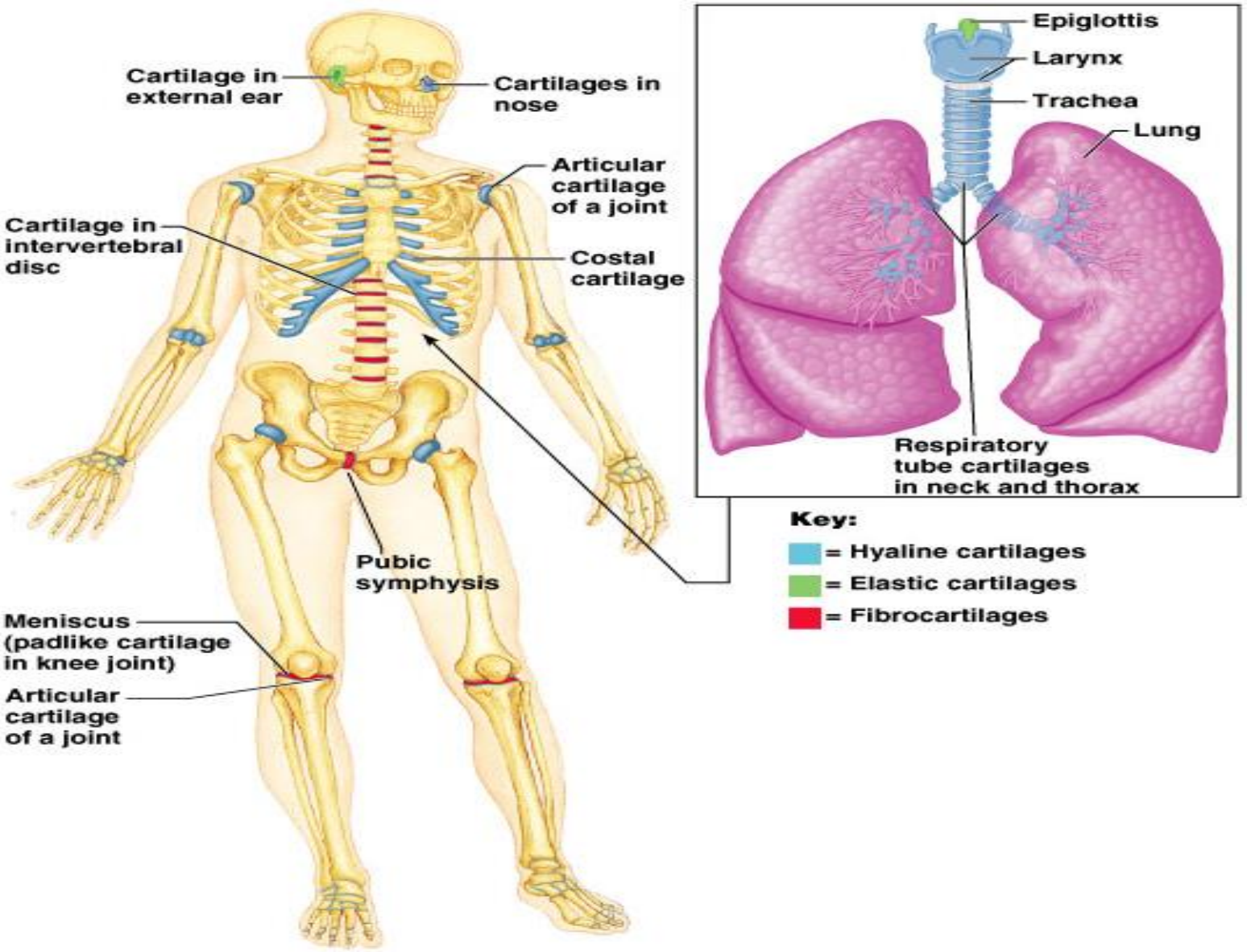
Elastic cartilage from external ear



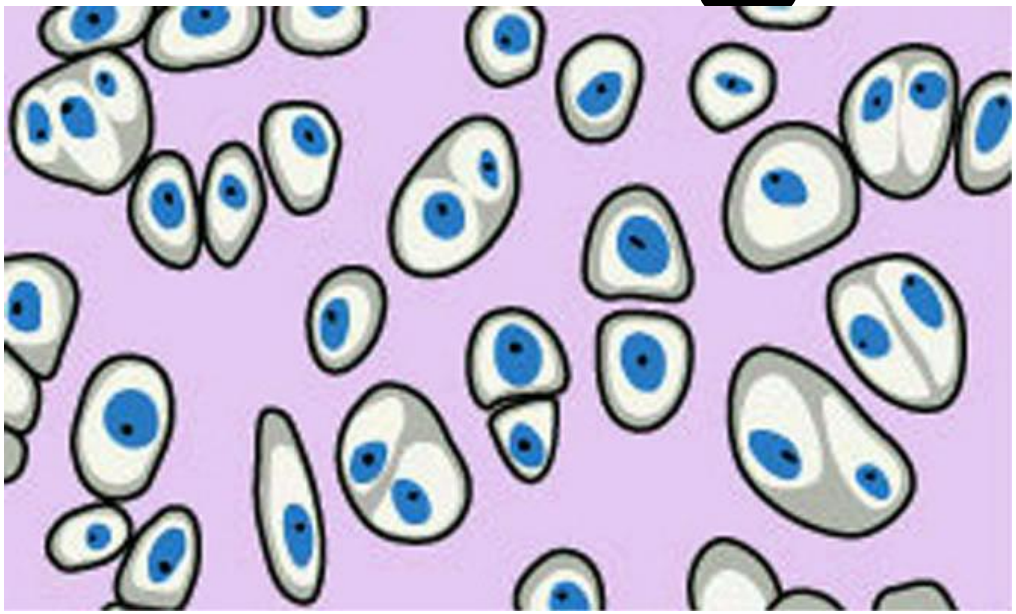


Fibrous cartilage from intervertebral disc

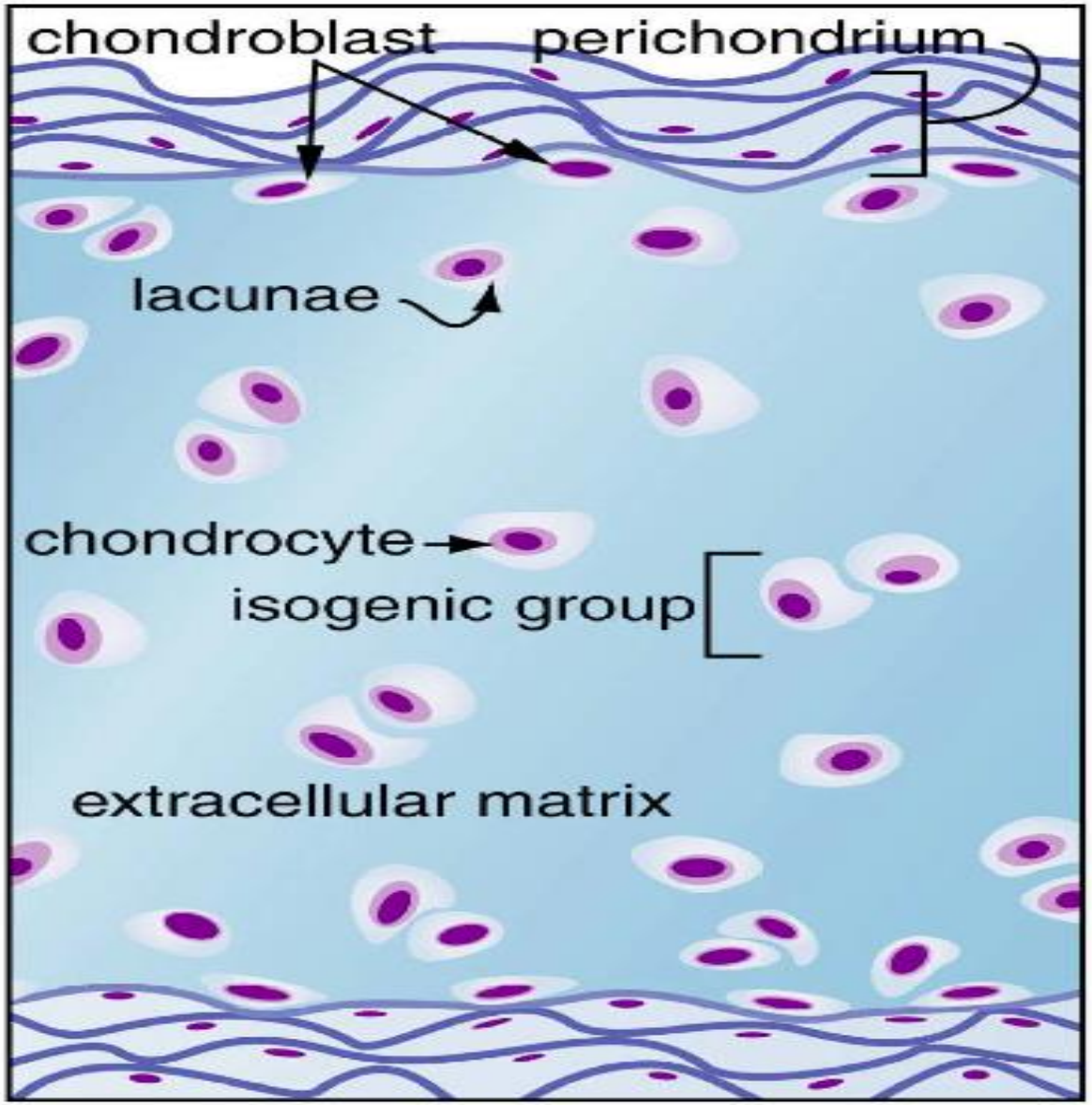
Locations of the different kinds of cartilage



Hyaline Cartilage



Hyaline Cartilage



LOCATIONS:

- **<u>In the embryo:</u>**

It serves as a temporary skeleton until it is gradually replaced by bone.

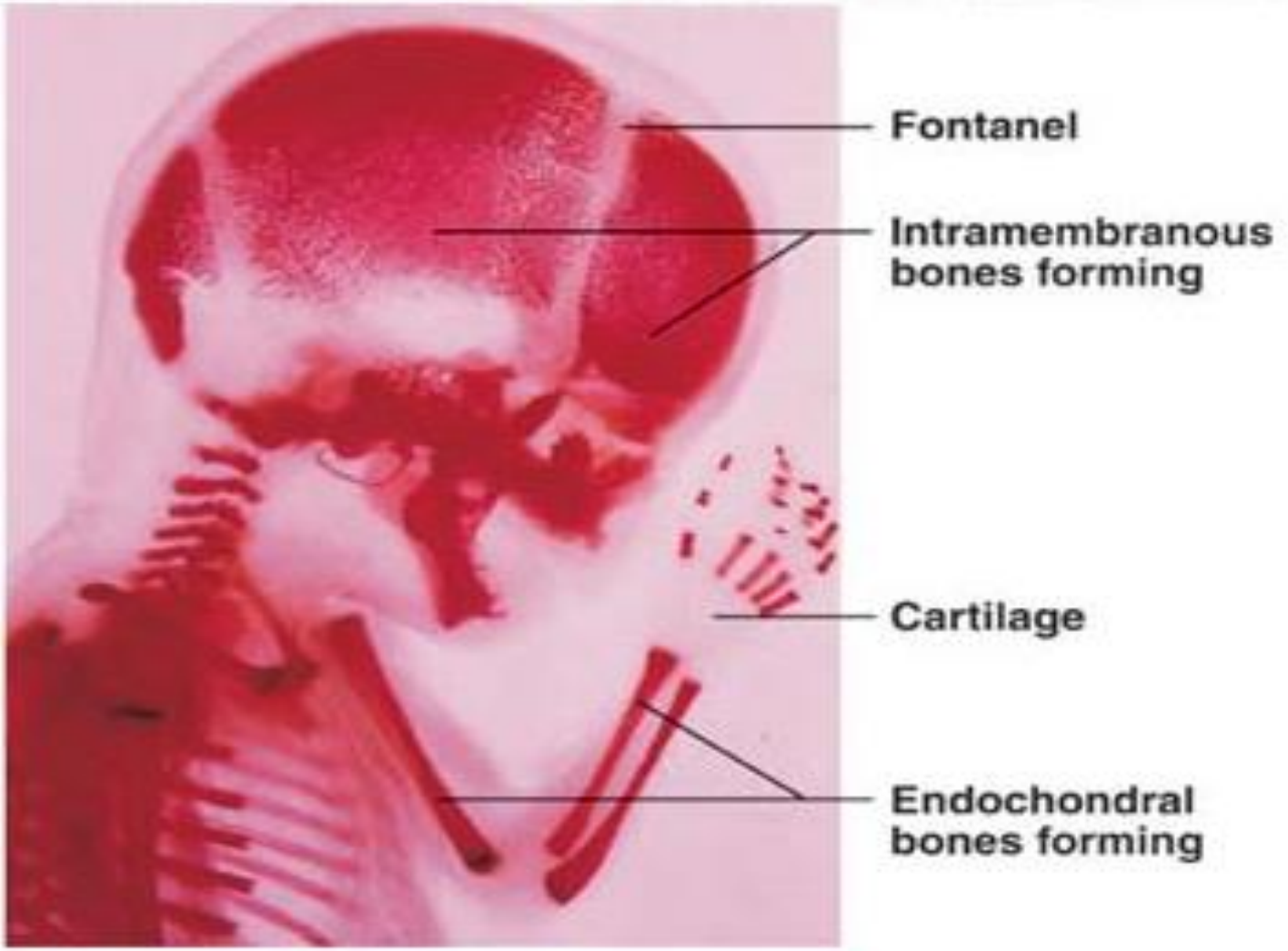
- **<u>In adult:</u>**

✓ Articular surfaces of the movable joints

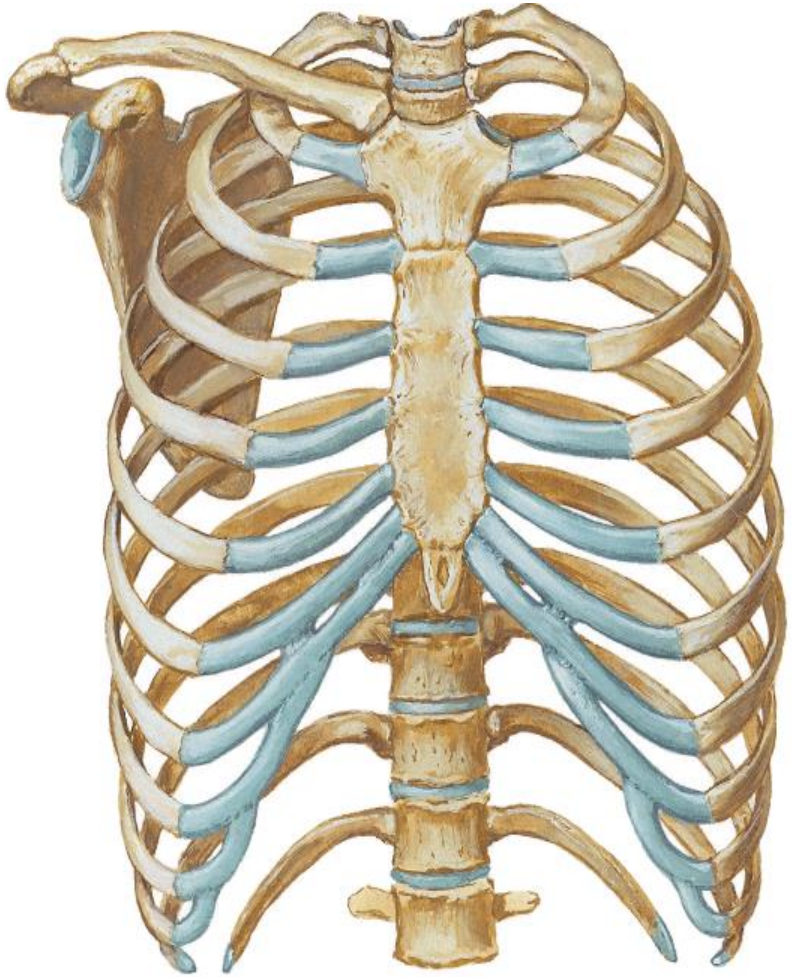
✓In the ventral ends of ribs, where they articulate with the sternum.

✓ In the walls of larger respiratory passages (nose, larynx, trachea, bronchi).

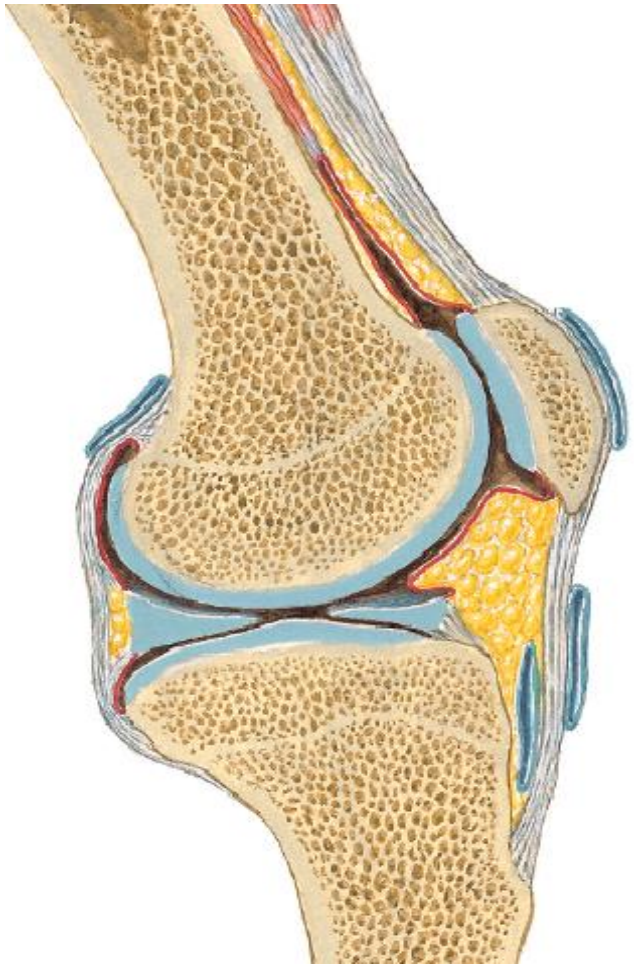
✓In the epiphyseal plate, where it is responsible for the longitudinal growth of bone .



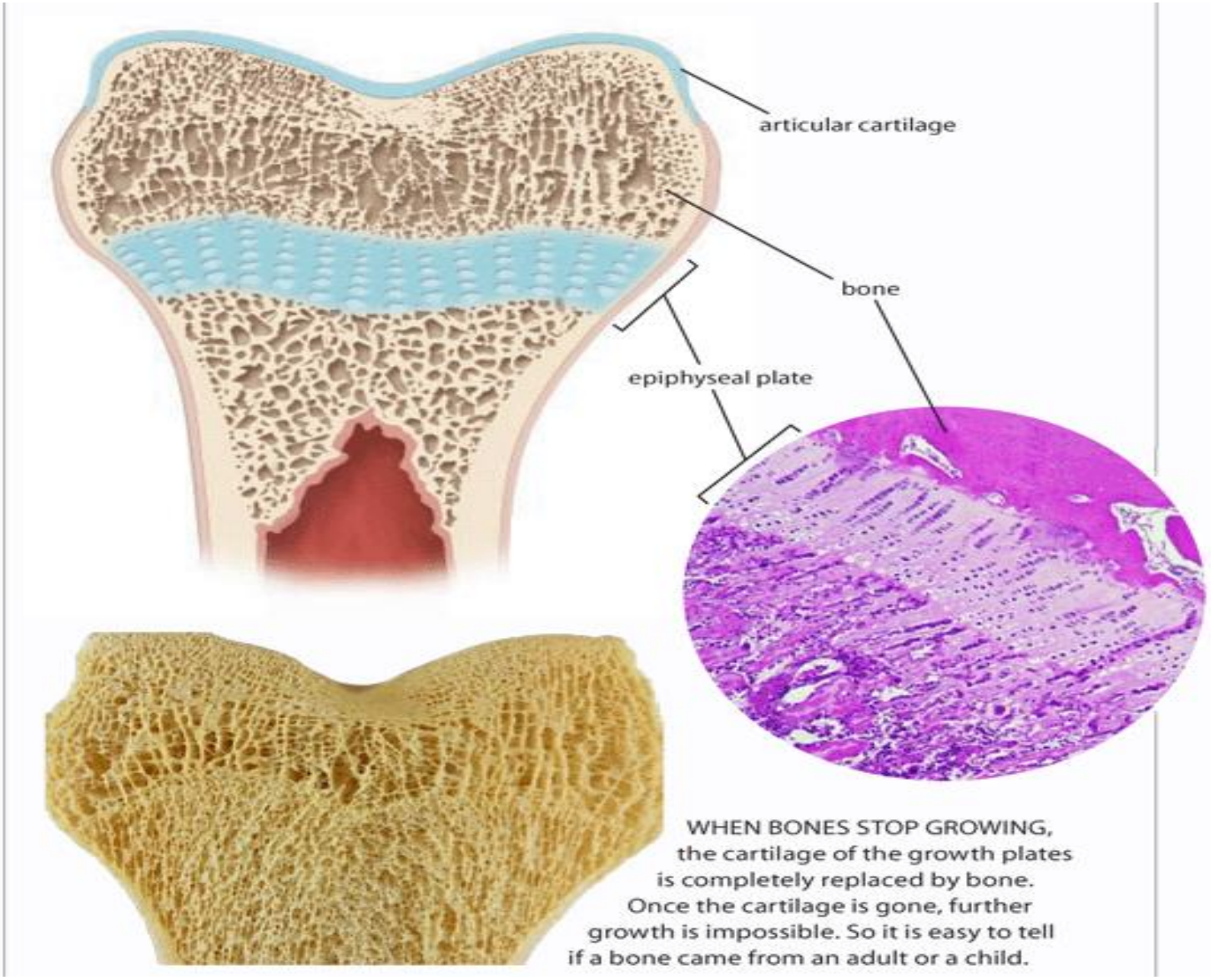
<u>In the embryo</u>: It serves as a temporary skeleton until it is gradually replaced by bone.



In the ventral ends of ribs, where they articulate with the sternum.



Articular surfaces of the movable joints

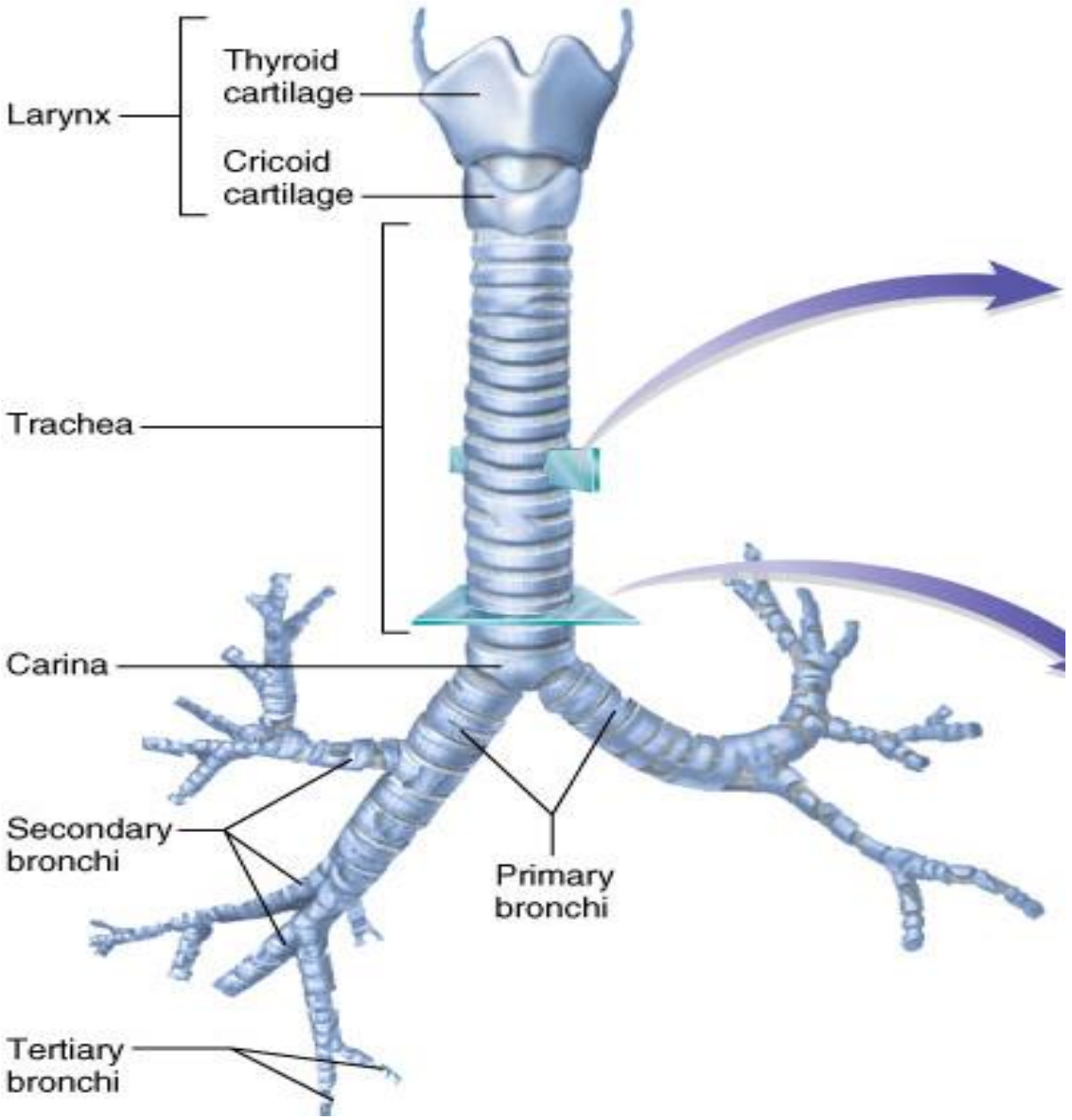


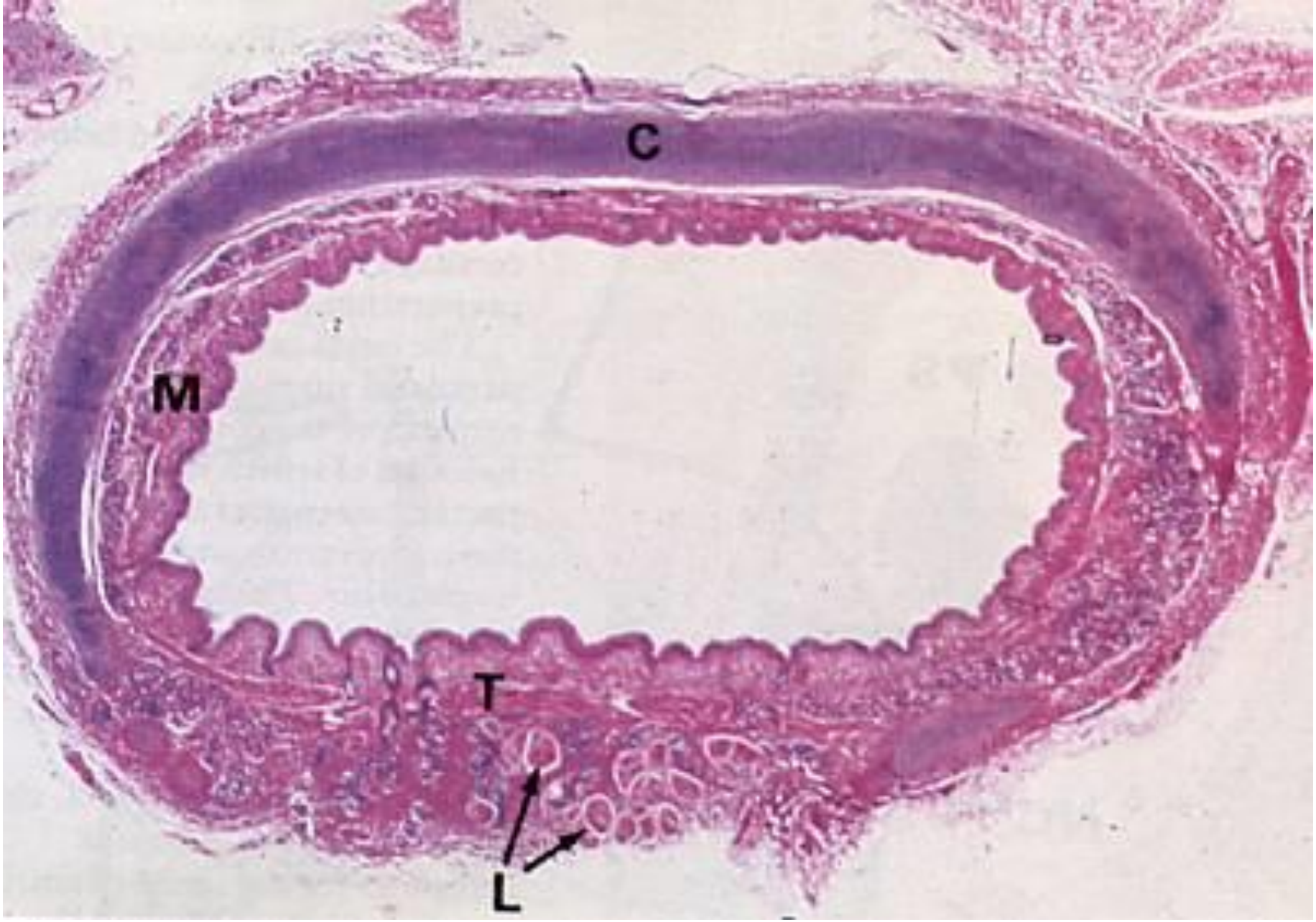
Epiphyseal plate: it is responsible for the longitudinal growth of bone .

LARYNX

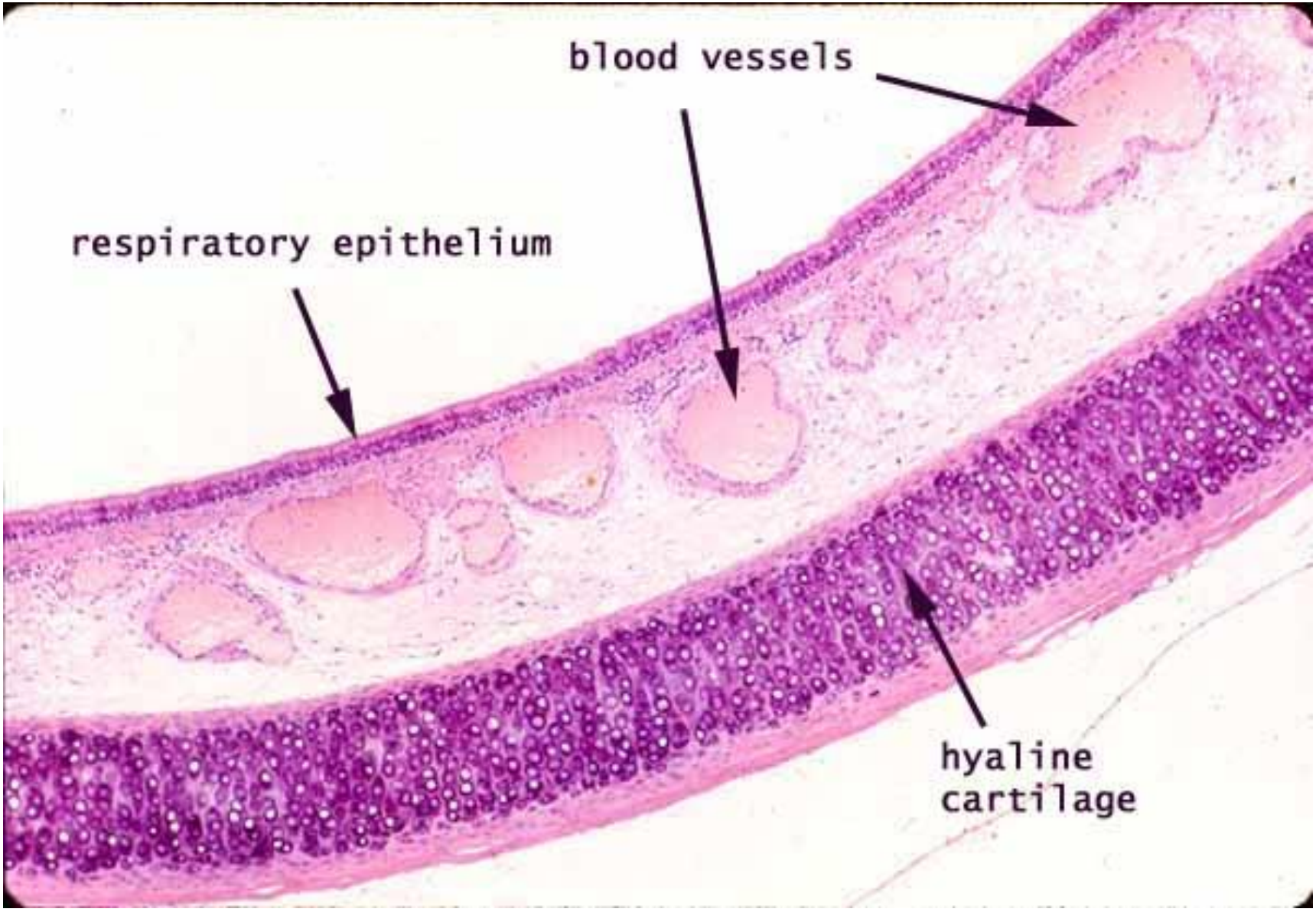
TRACHEA

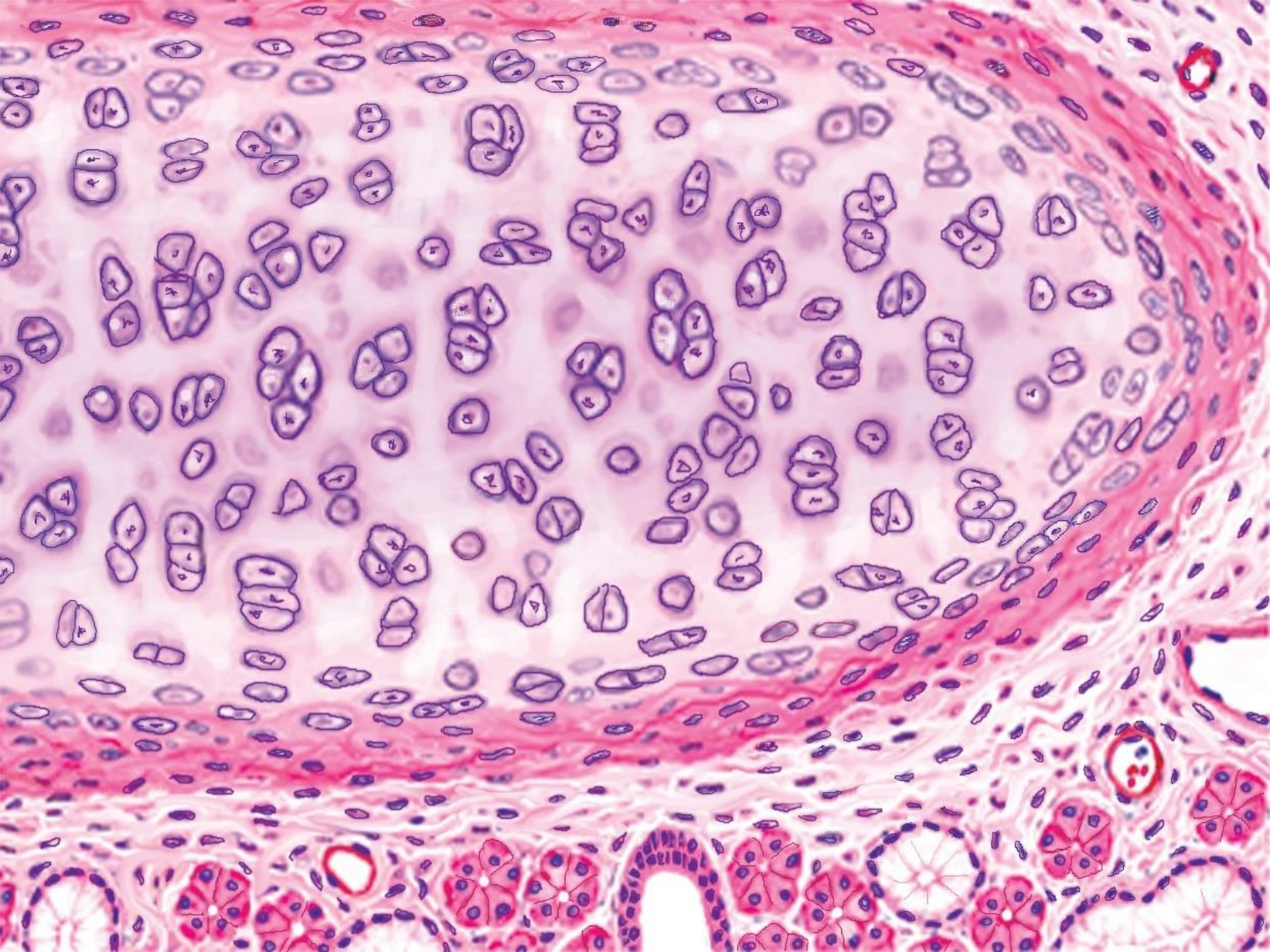
BRONCHI

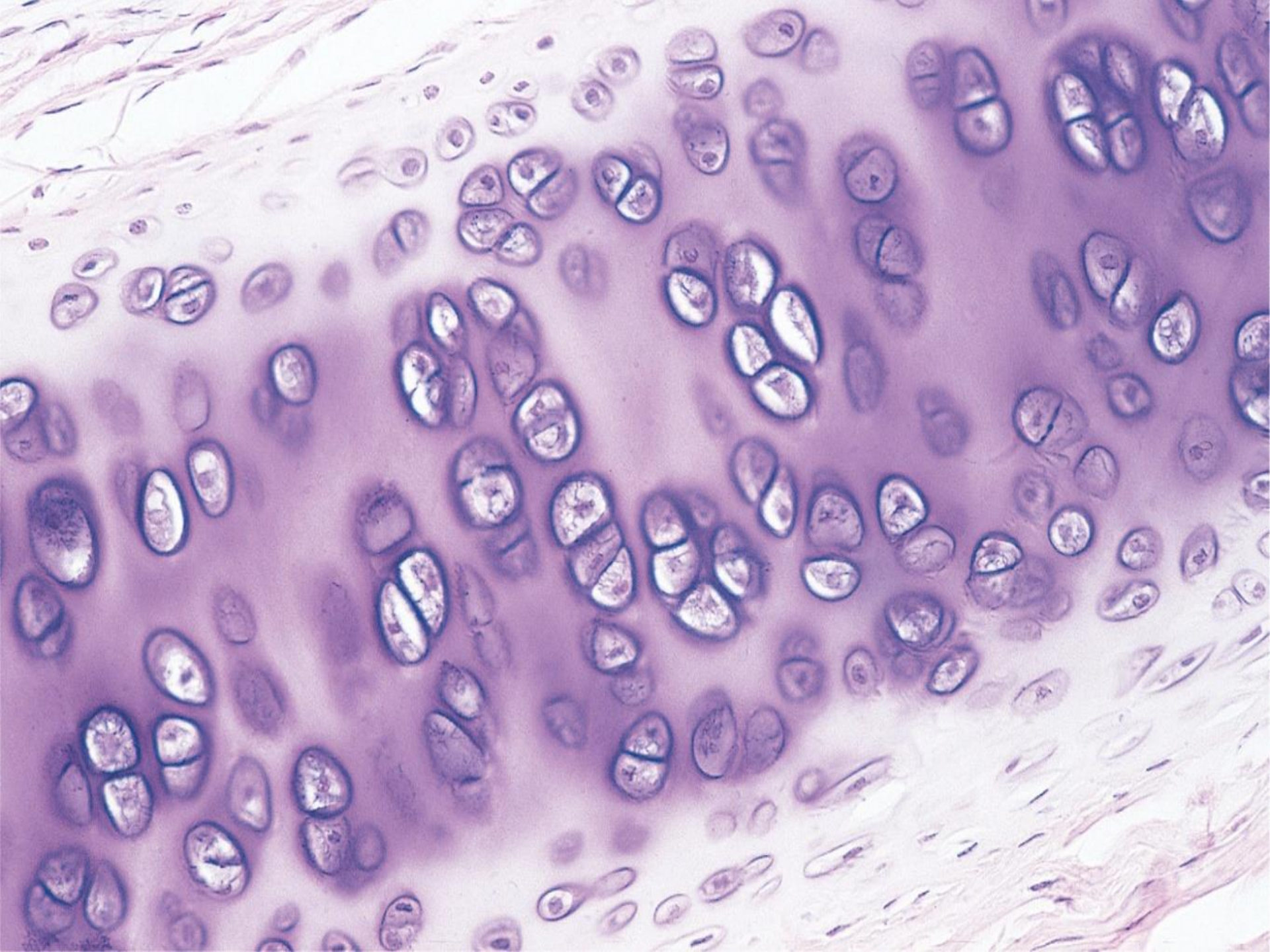




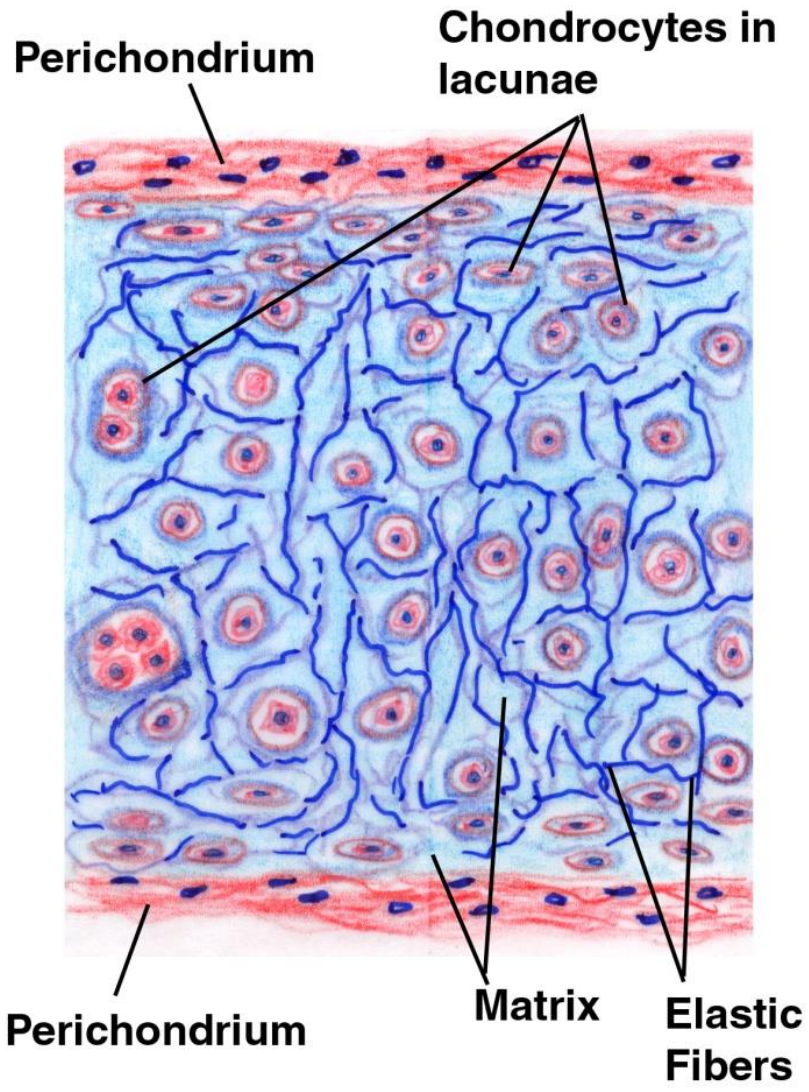
Trachea


blood vessels
respiratory epithelium
hyaline
cartilage



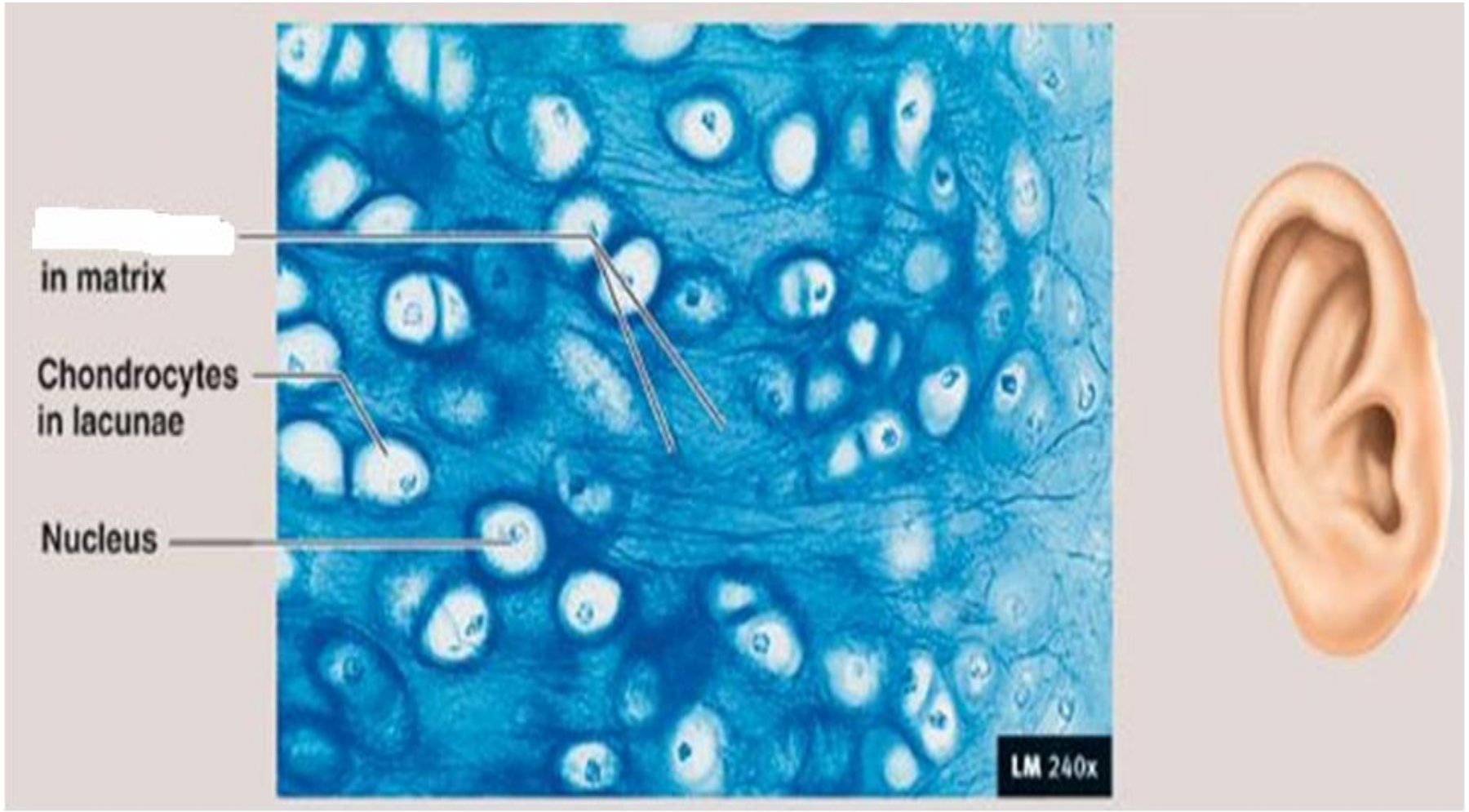


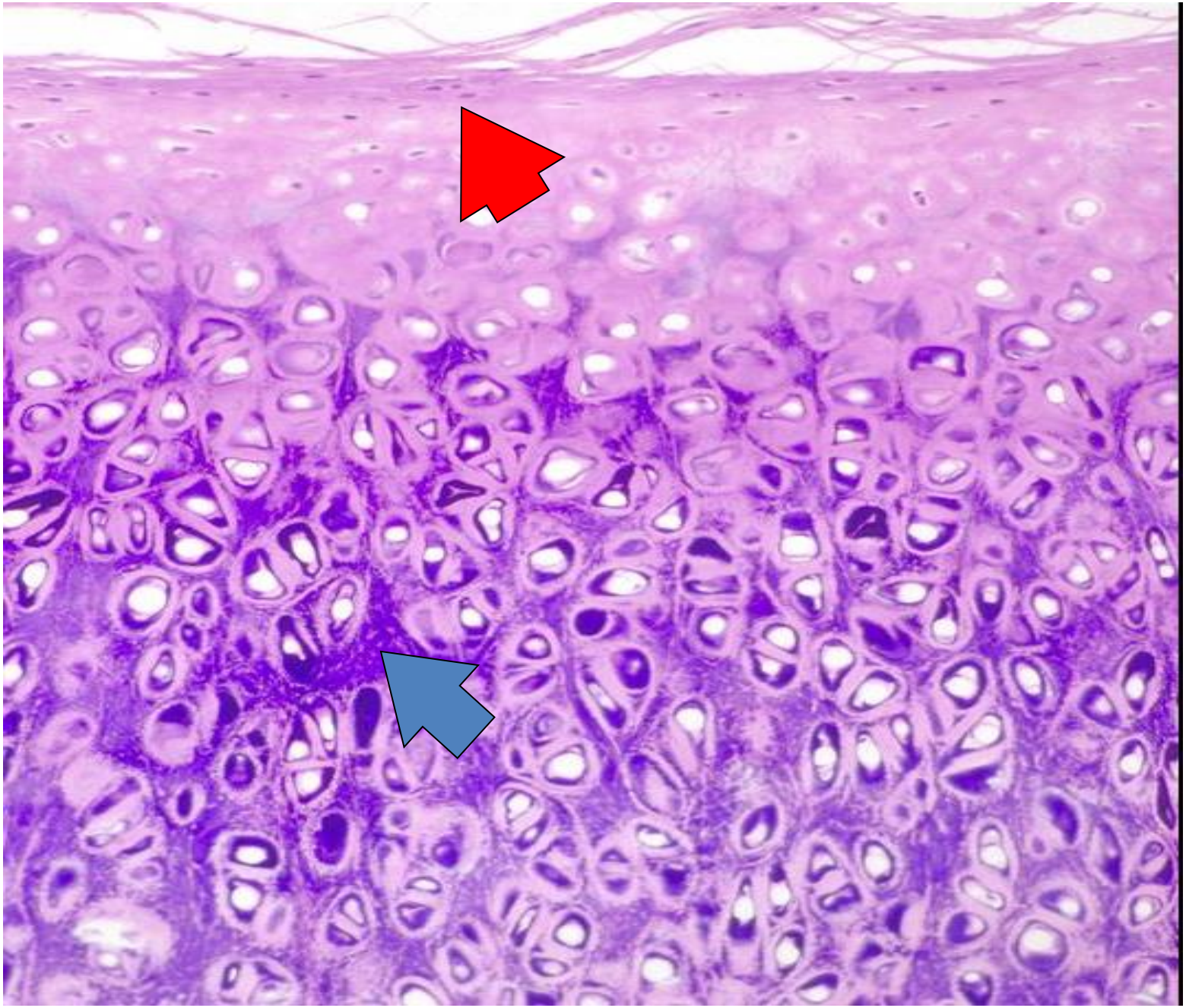
Elastic Cartilage

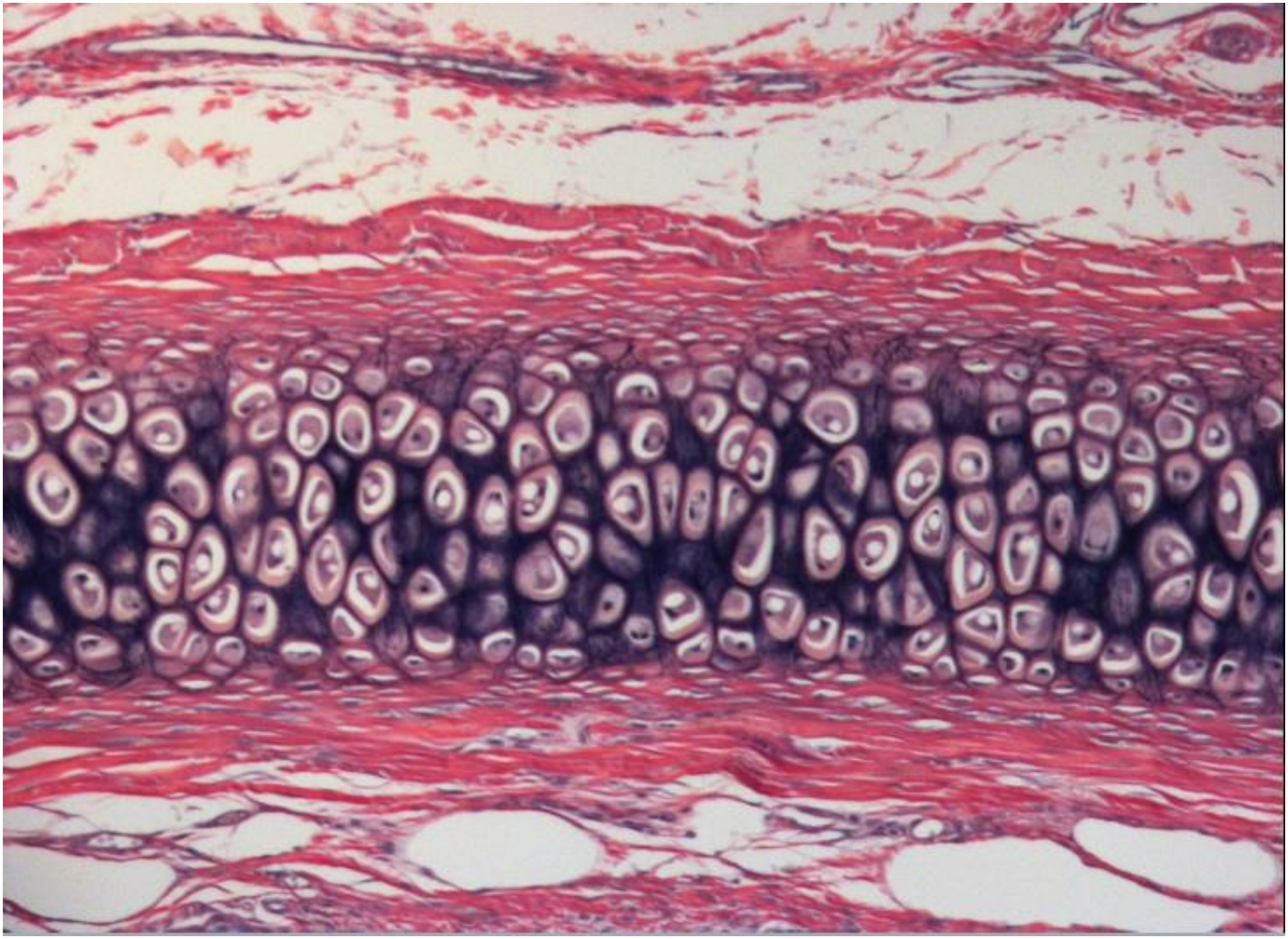

Perichondrium
Chondrocytes in lacunae
Perichondrium
Matrix
Elastic Fibers

LOCATIONS

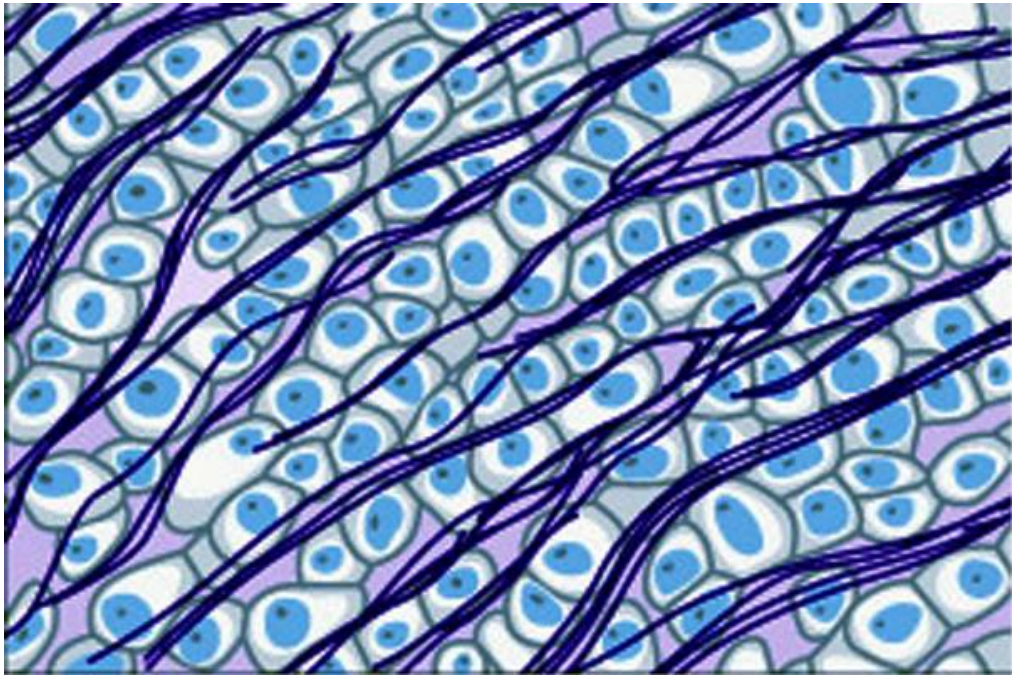
- In the auricle of the ear
- The walls of the external auditory canals
- The auditory (eustachian) tubes
- The epiglottis
- The cuneiform cartilage in the larynx


in matrix
Chondrocytes in lacunae
Nucleus
LM 240x

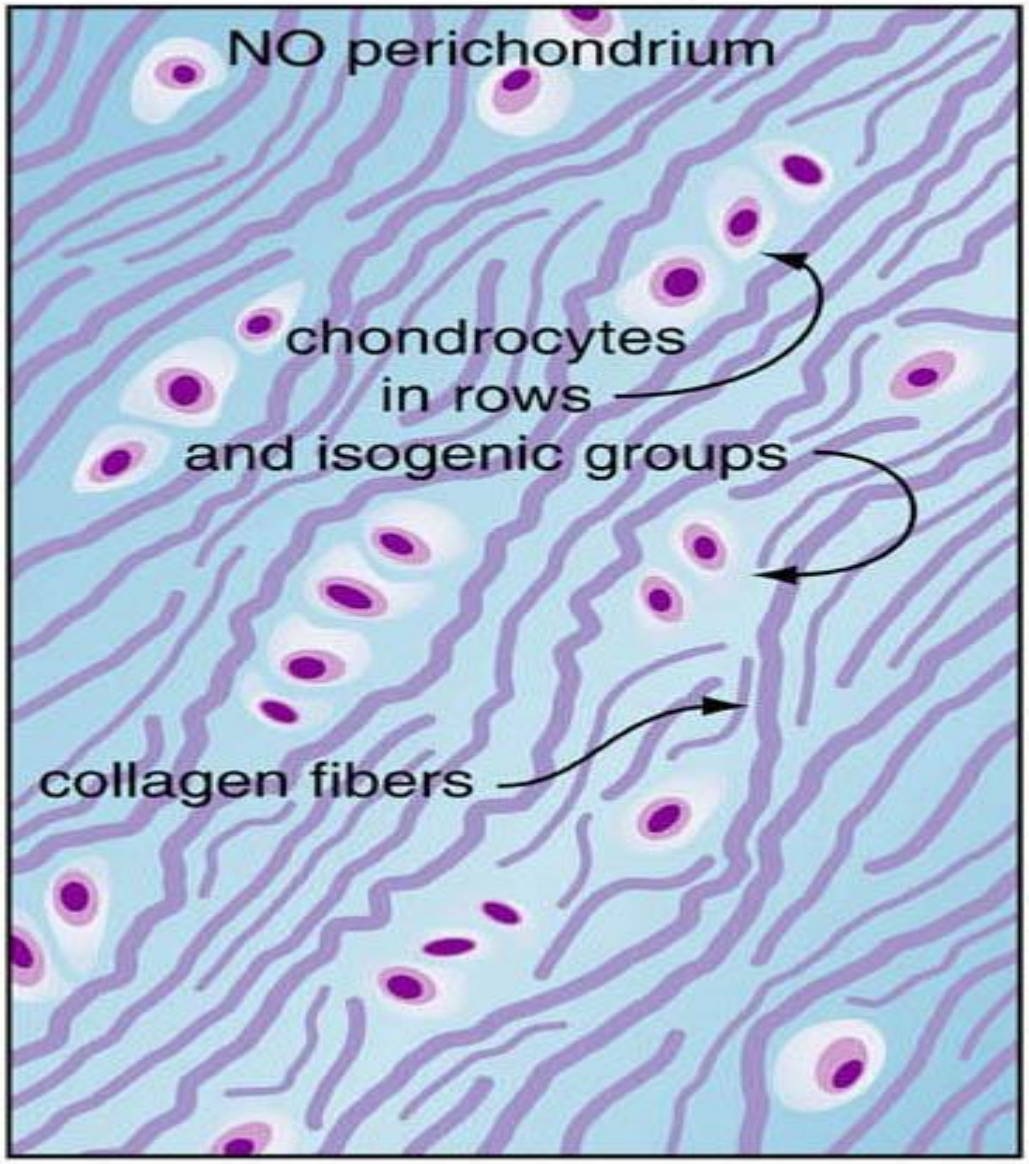




Fibrocartilage

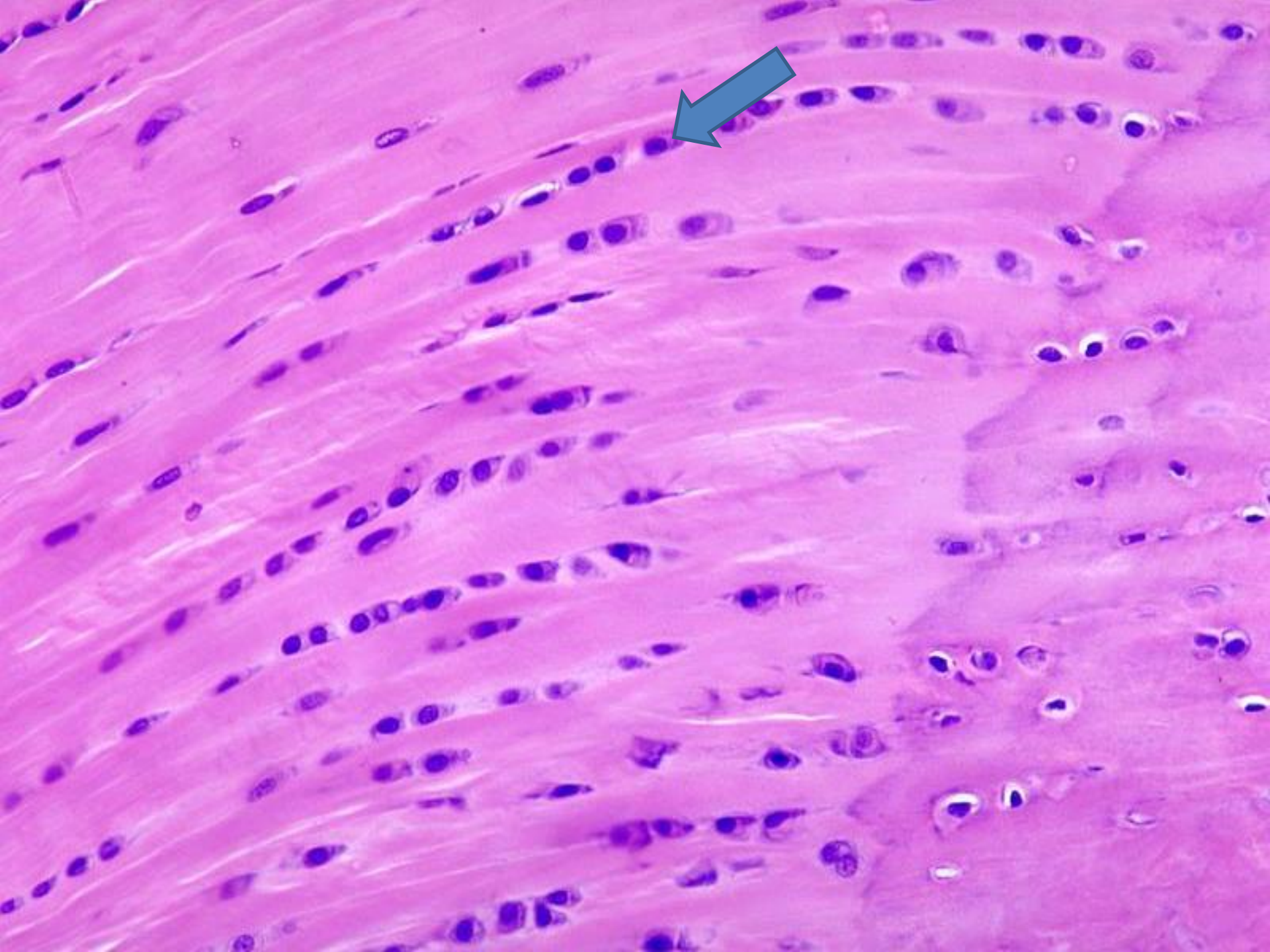


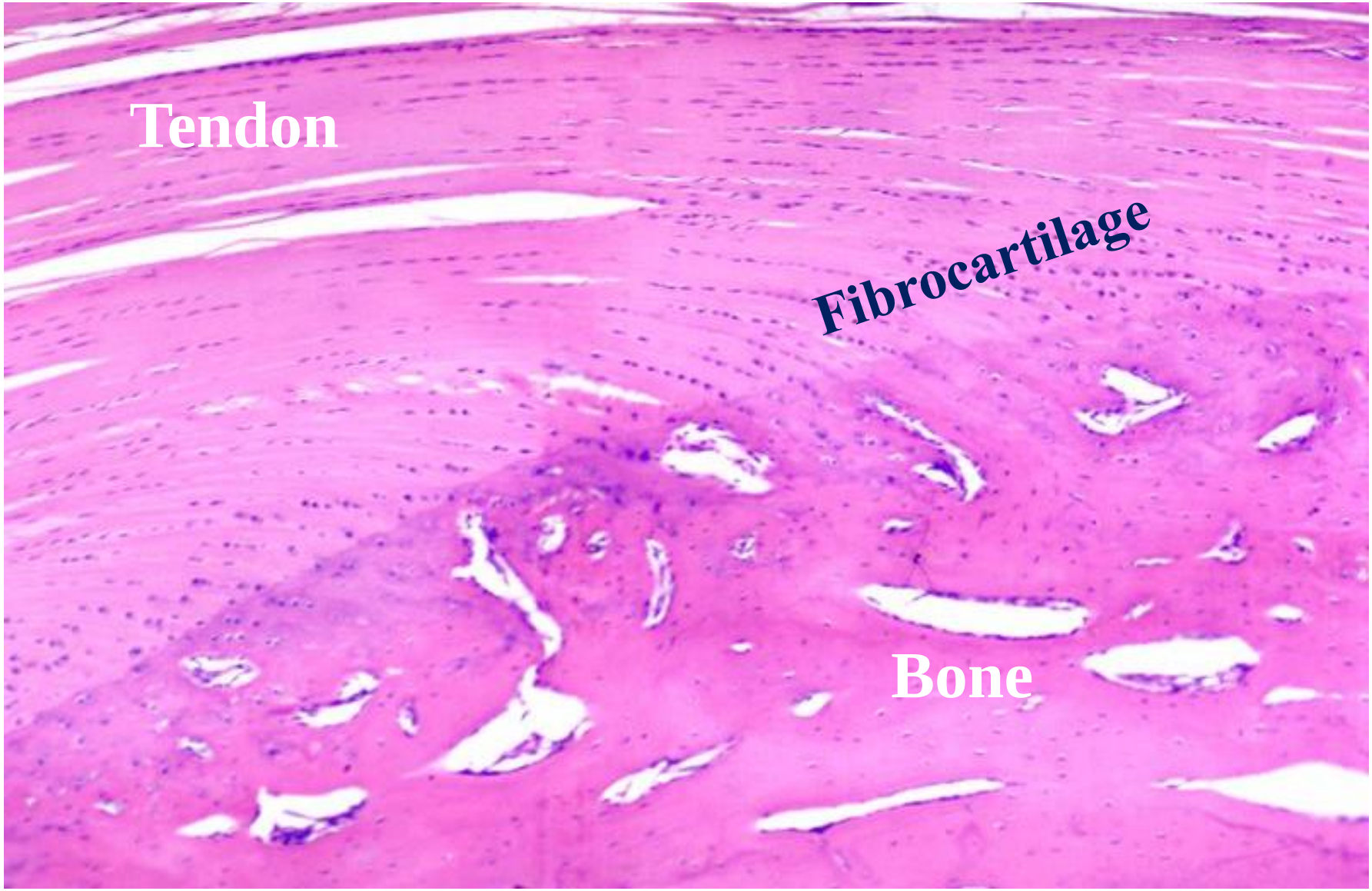
Fibrocartilage



LOCATIONS:

- Intervertebral discs
- Pubic symphysis
- Meniscus (padlike cartilage in knee joints)
- Insertions of tendons



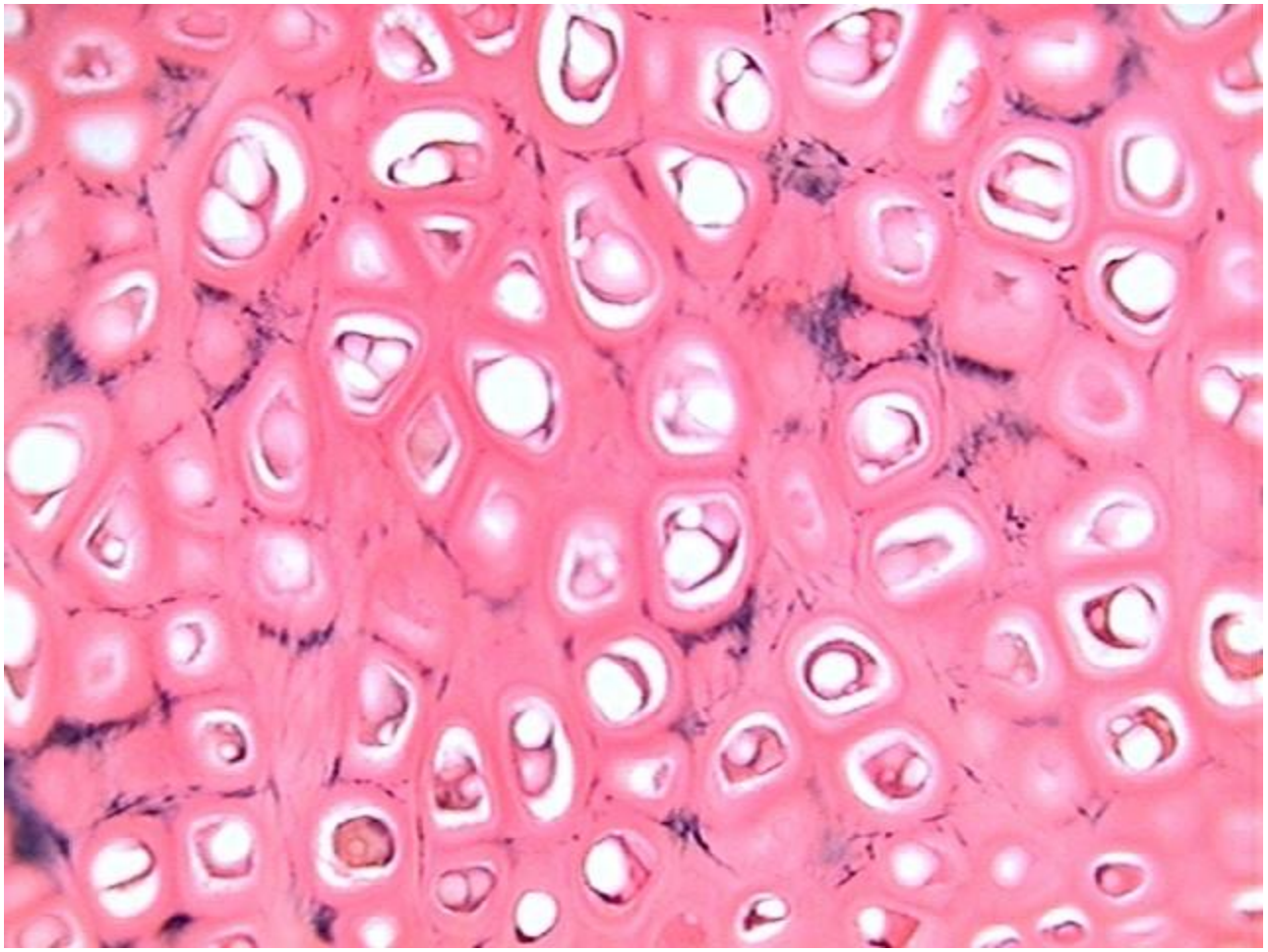


Fibrocartilage found where tendon connects to bone

	Hyaline cartilage	Elastic cartilage	Fibrocartilage
Main features of the extracellular matrix	Homogeneous, with type II collagen and aggrecan	Type II collagen, aggrecan and darker elastic fibers	Type II collagen and large areas of dense CT with type I collagen
Major cells	Chondrocytes, chondroblasts	Chondrocytes, chondroblasts	Chondrocytes, fibroblasts
Presence of perichondrium	Yes (except at articular cartilage)	Yes	No

	Hyaline cartilage	Elastic cartilage	Fibrocartilage
Main locations / examples	Many components of upper respiratory tract; articular ends & epiphyseal plates of long bones; fetal skeleton	External ear, external acoustic meatus, auditory tube; epiglottis and certain other laryngeal cartilages	Intervertebral discs, pubic symphysis, meniscus, and certain other joints; insertions of tendons
Main functions	Provides smooth, low-friction surfaces in joints; structural support for respiratory tract	Provides flexible shape and support of soft tissues	Provides cushioning, tensile strength and resistance to tearing and compression

Identify



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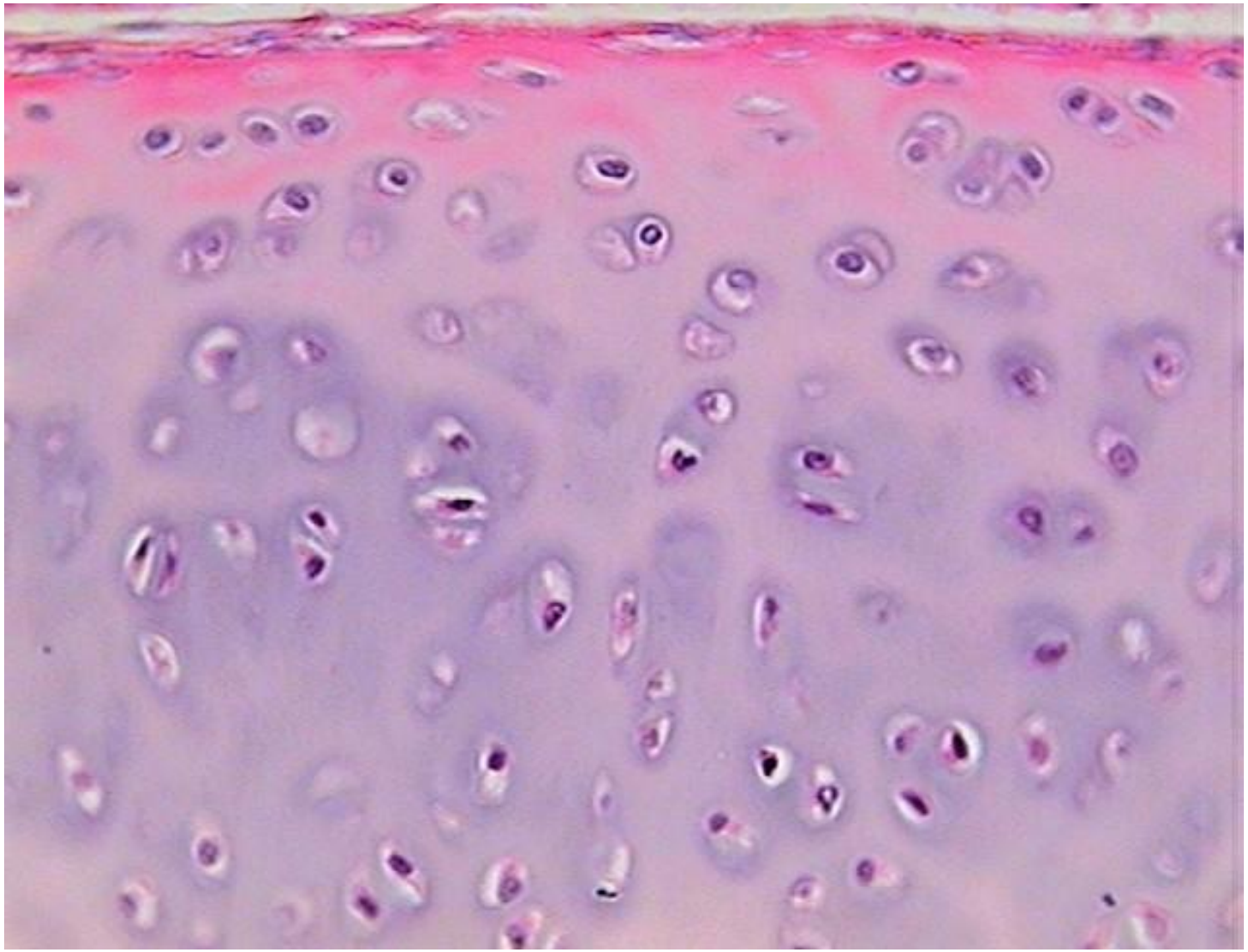

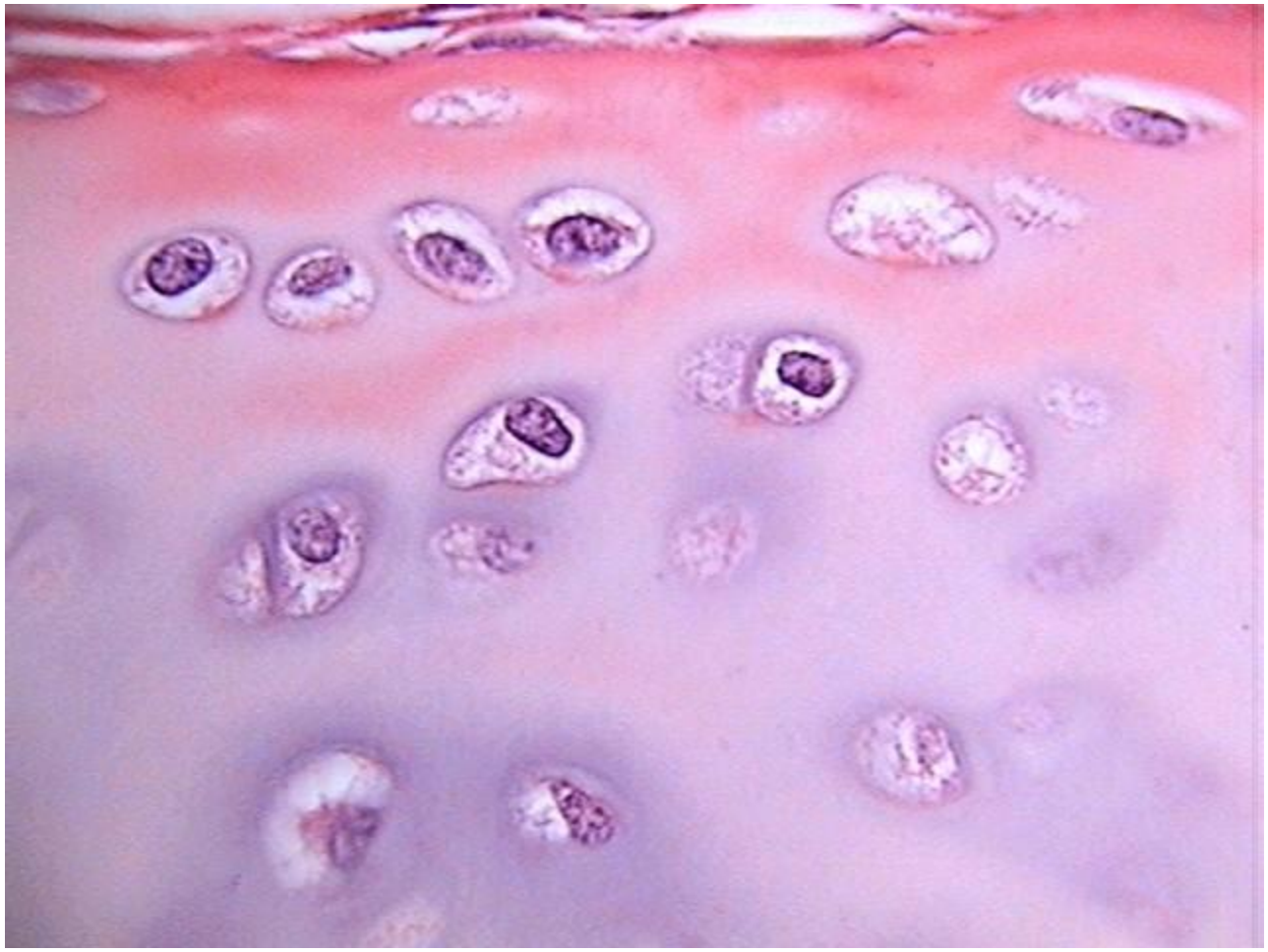

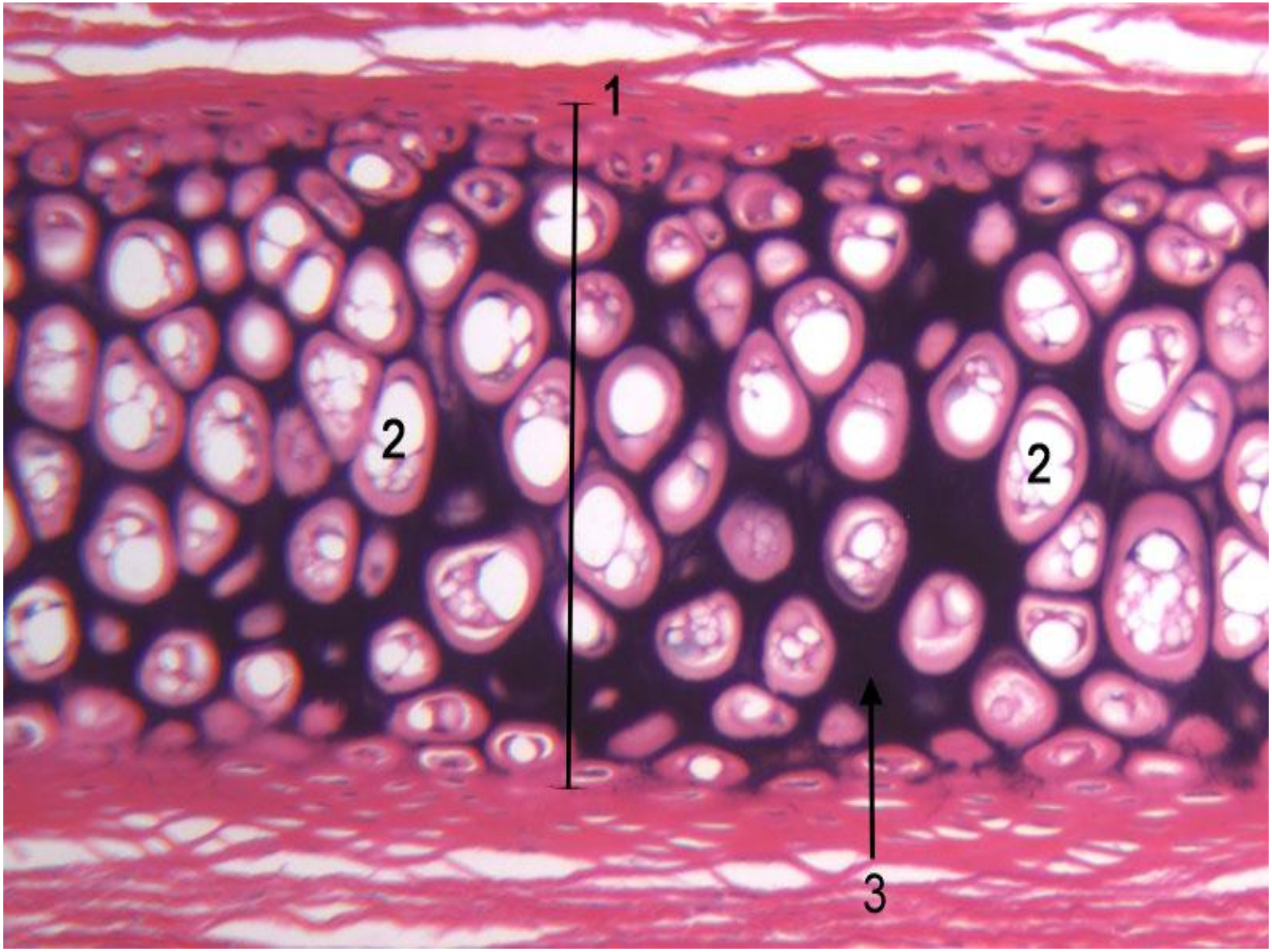

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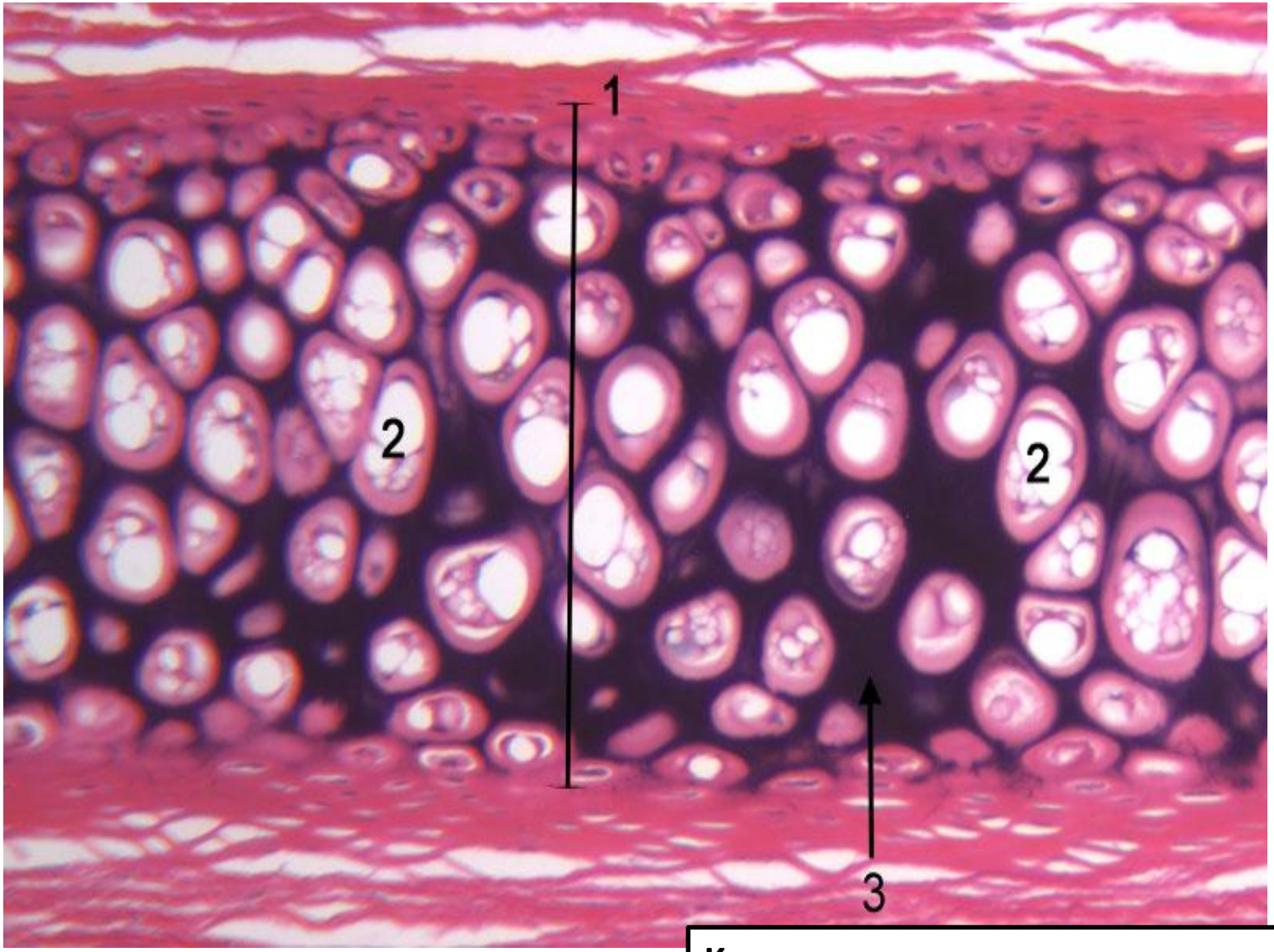
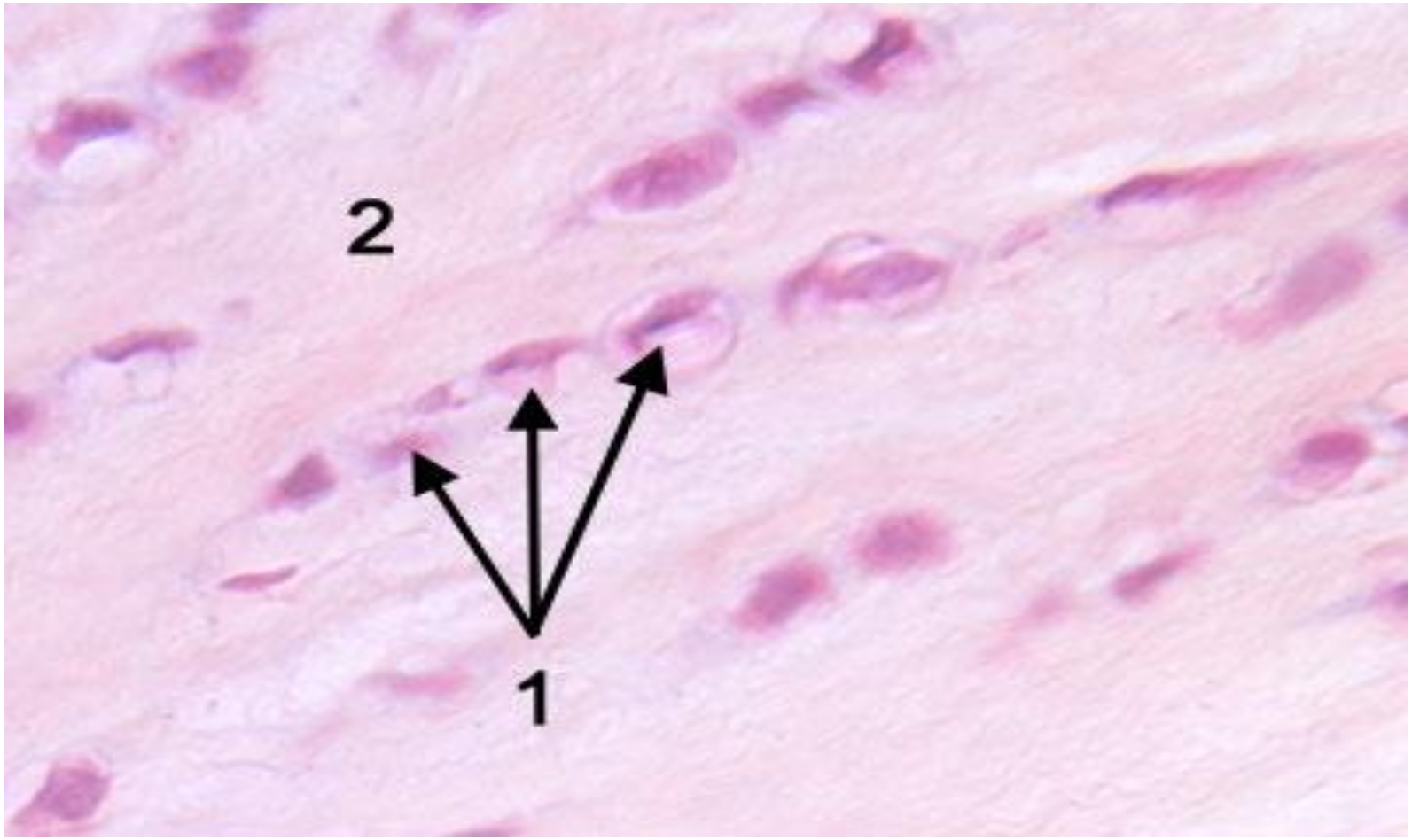


Key

1. Elastic cartilage
2. lacuna
3. Densely packed elastic fibers



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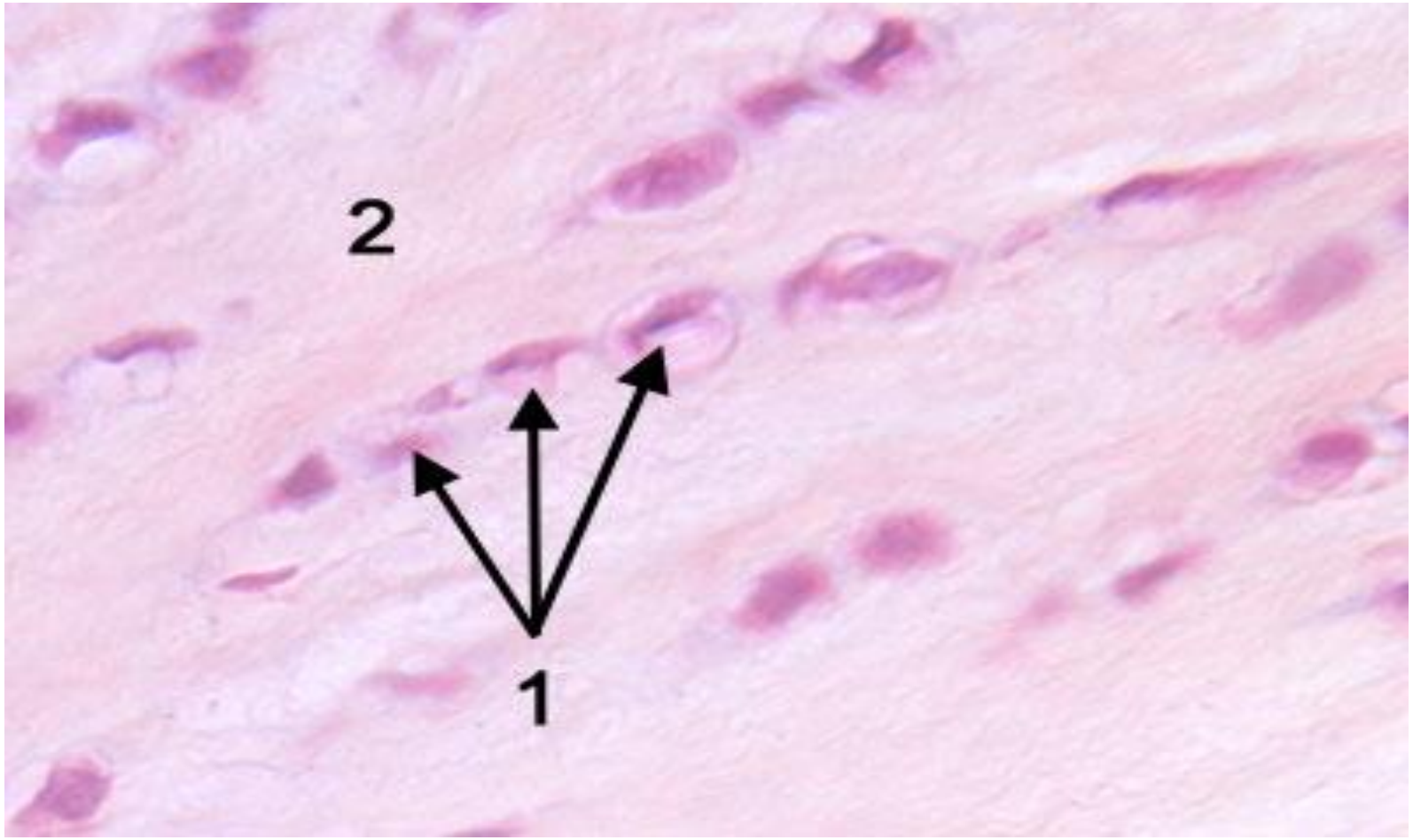
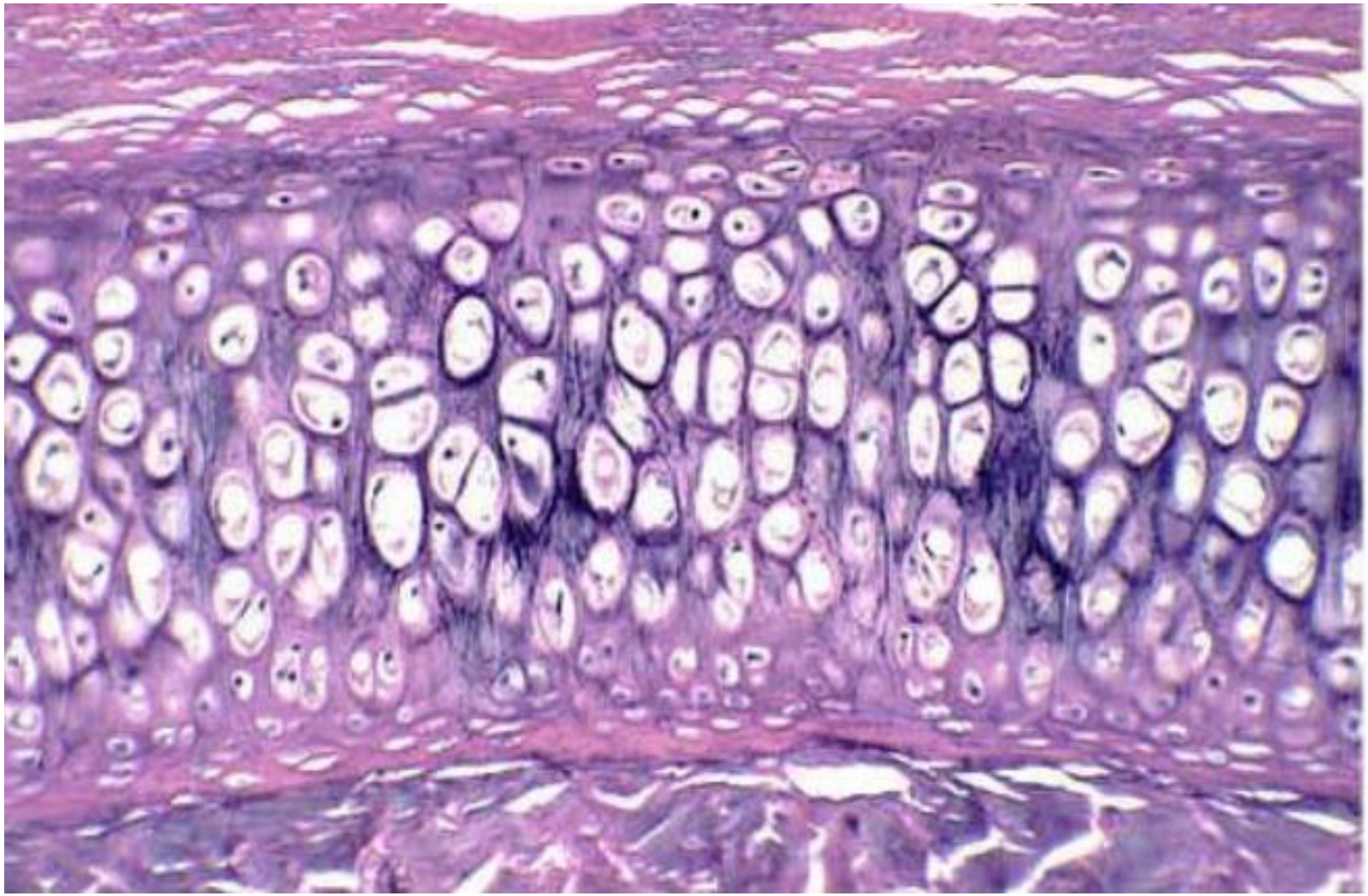


1. Chondrocytes
2. Collagen fibers (type 1)



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