Cartilage

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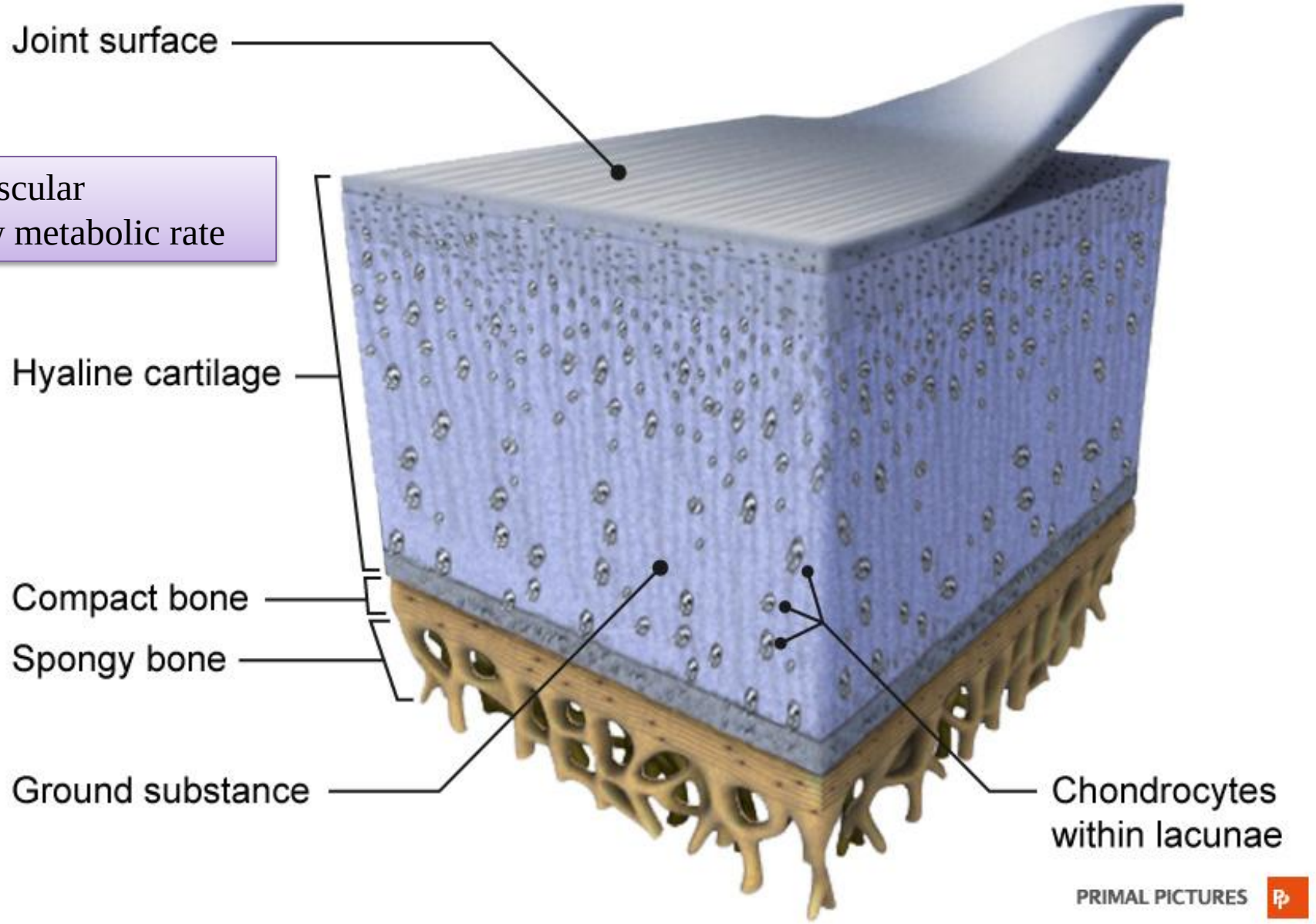
Cartilage is a specialized type of connective tissue designed to give support, bear weight and withstand tension, torsion and bending

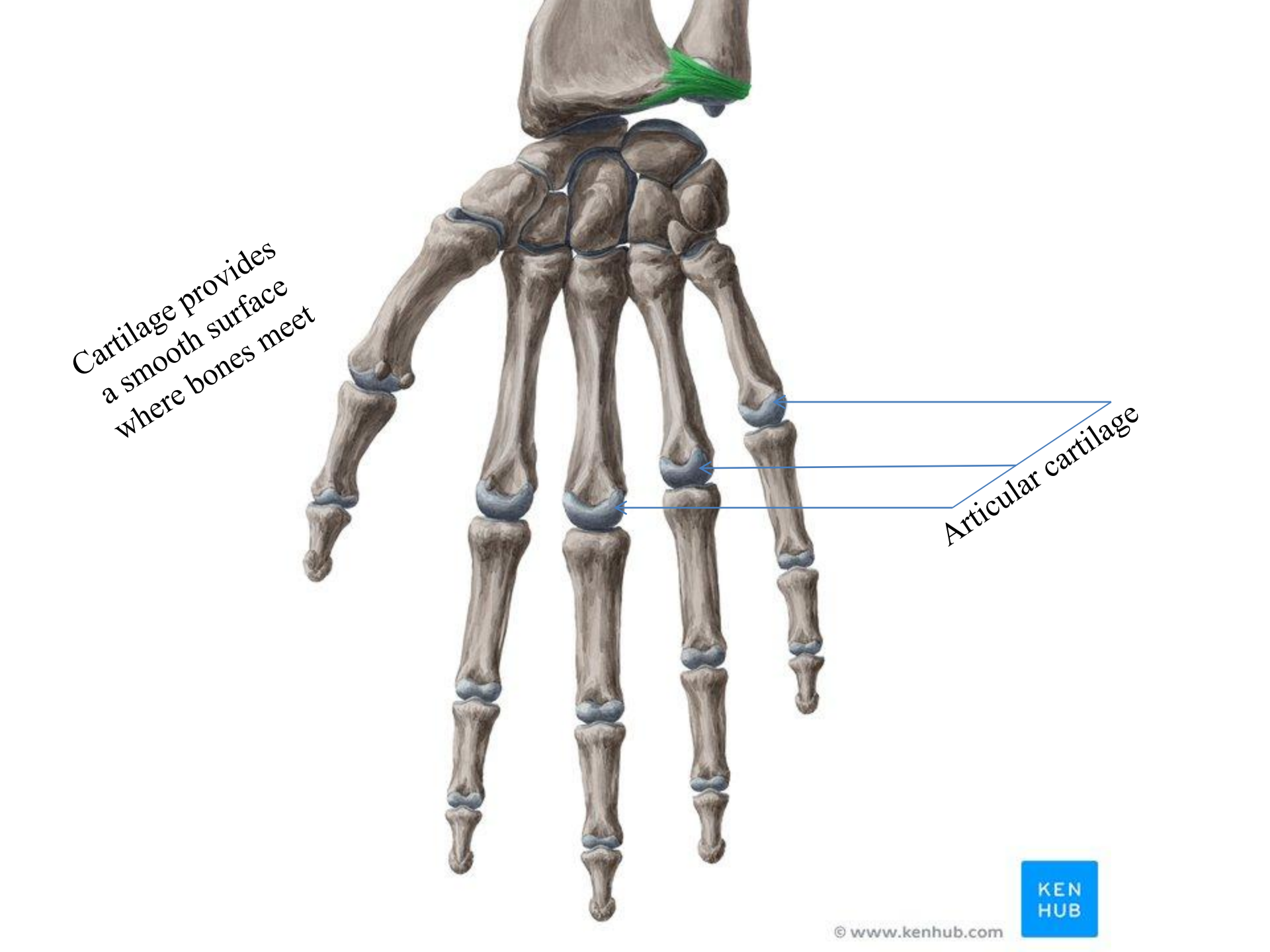
- ✓Avascular
- ✓Low metabolic rate



- 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.

FUNCTIONS 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 essential for the development and growth of long bones both before and after birth.


Cartilage provides
a smooth surface
where bones meet
Articular cartilage
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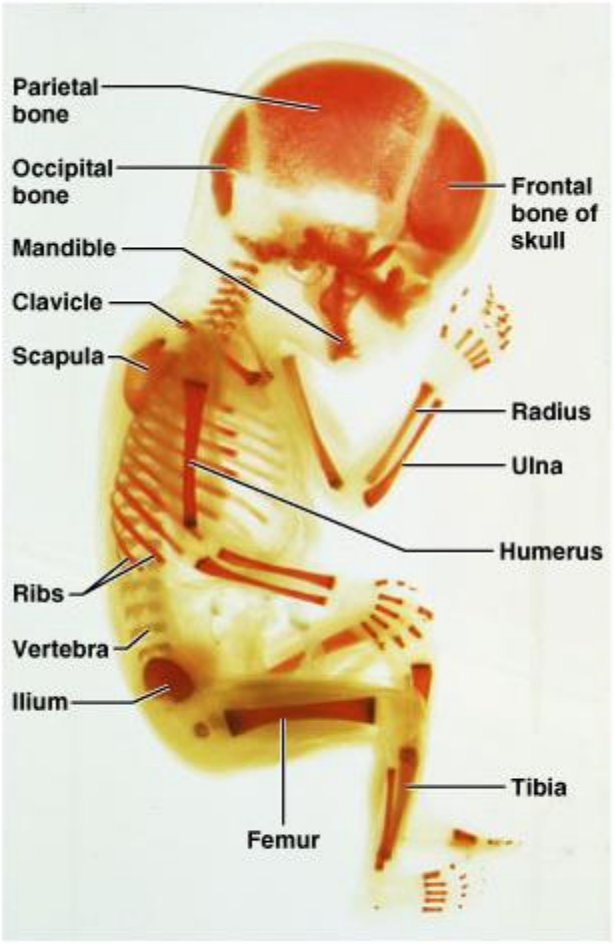
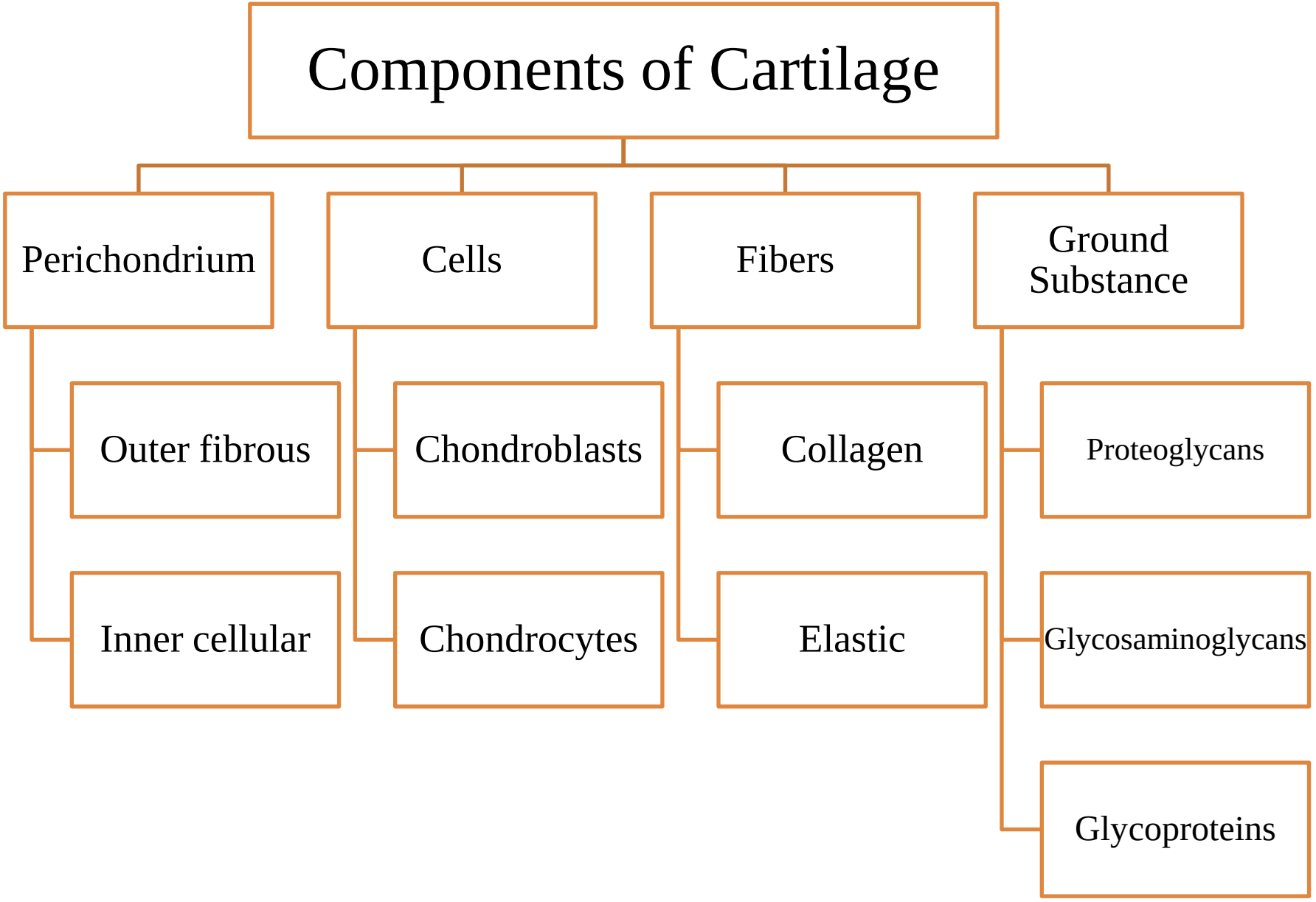
In developing humans, most of the bones of the skeleton are preceded by a temporary cartilage "model".

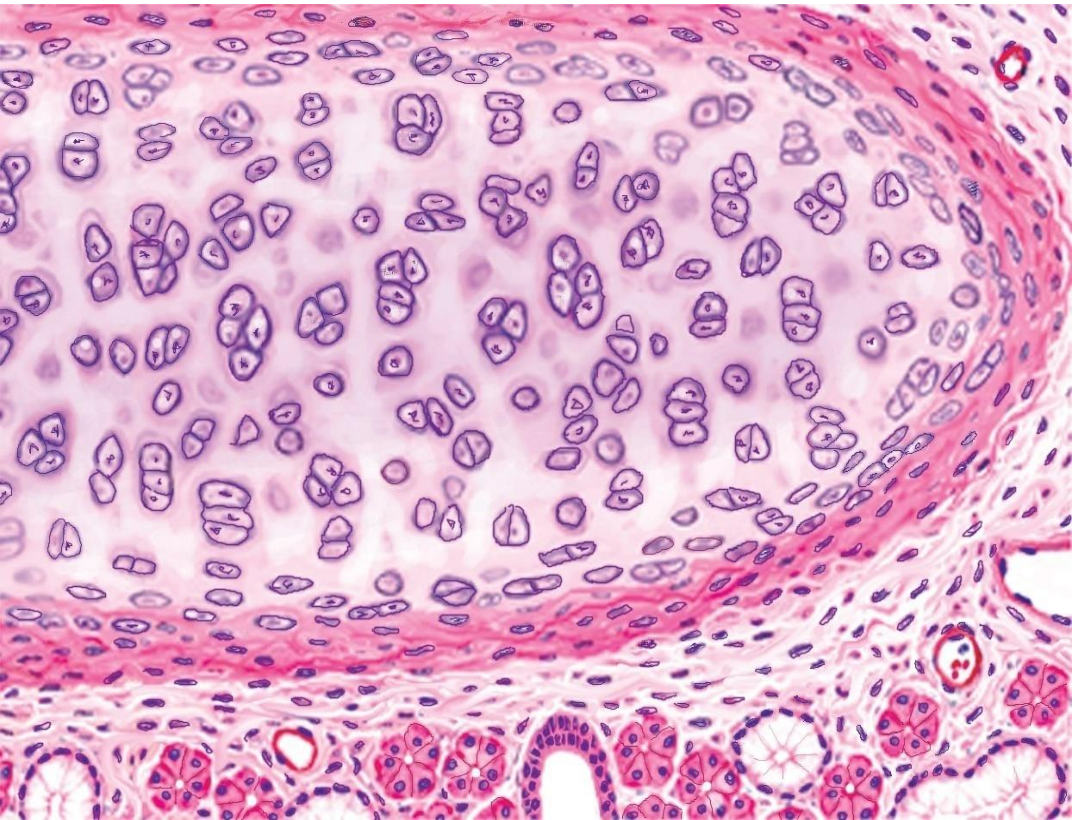



Components of Cartilage
Perichondrium
Cells
Fibers
Ground Substance
Outer fibrous
Inner cellular
Chondroblasts
Chondrocytes
Collagen
Elastic
Proteoglycans
Glycosaminoglycans
Glycoproteins

Cells of cartilage:

Chondroblasts: typical protein synthesizing cells.

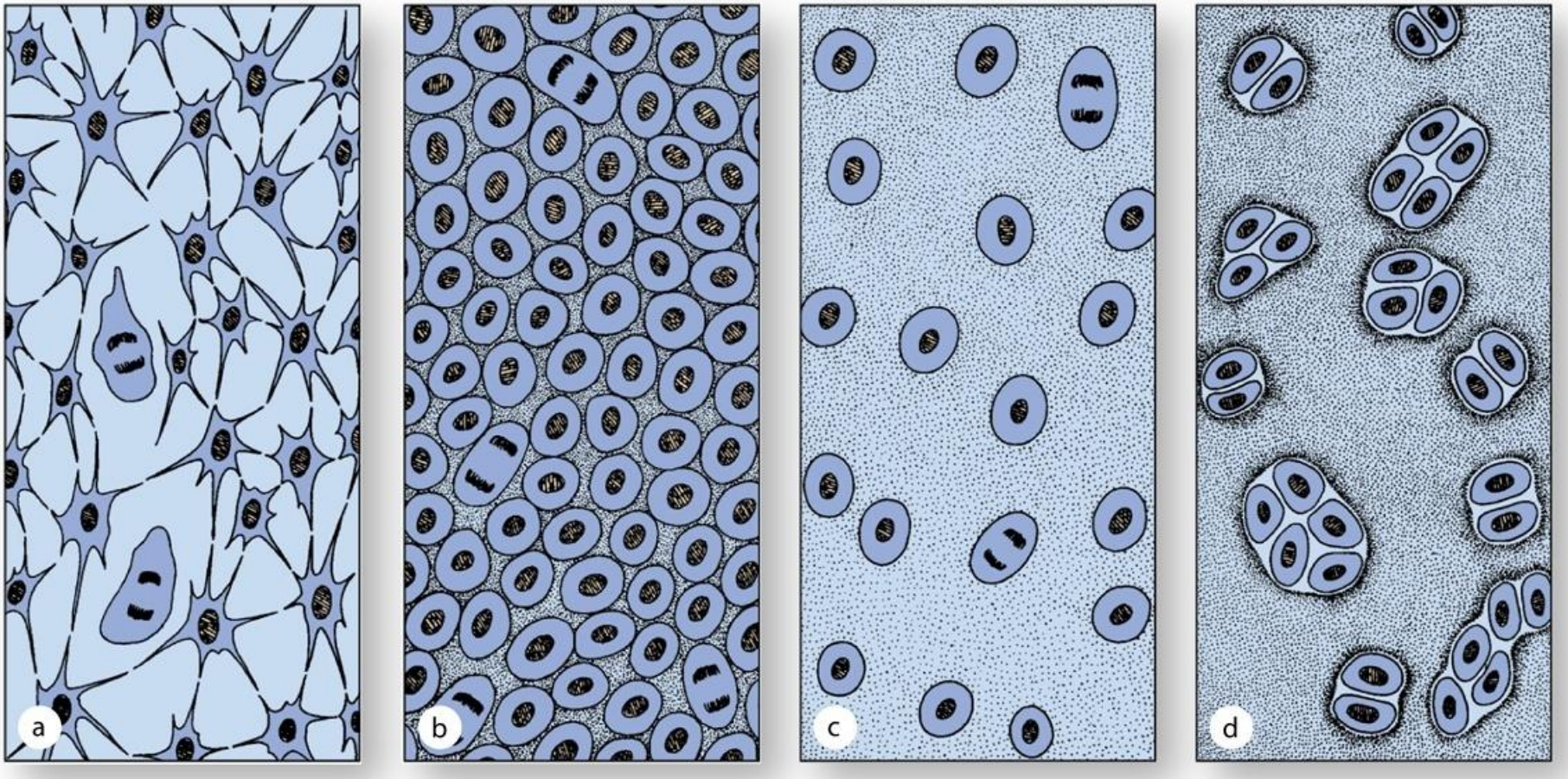
Chondrocytes: situated in lacuna. Usually seen in isogenous groups.



Lacuna= space occupied by chondrocyte.

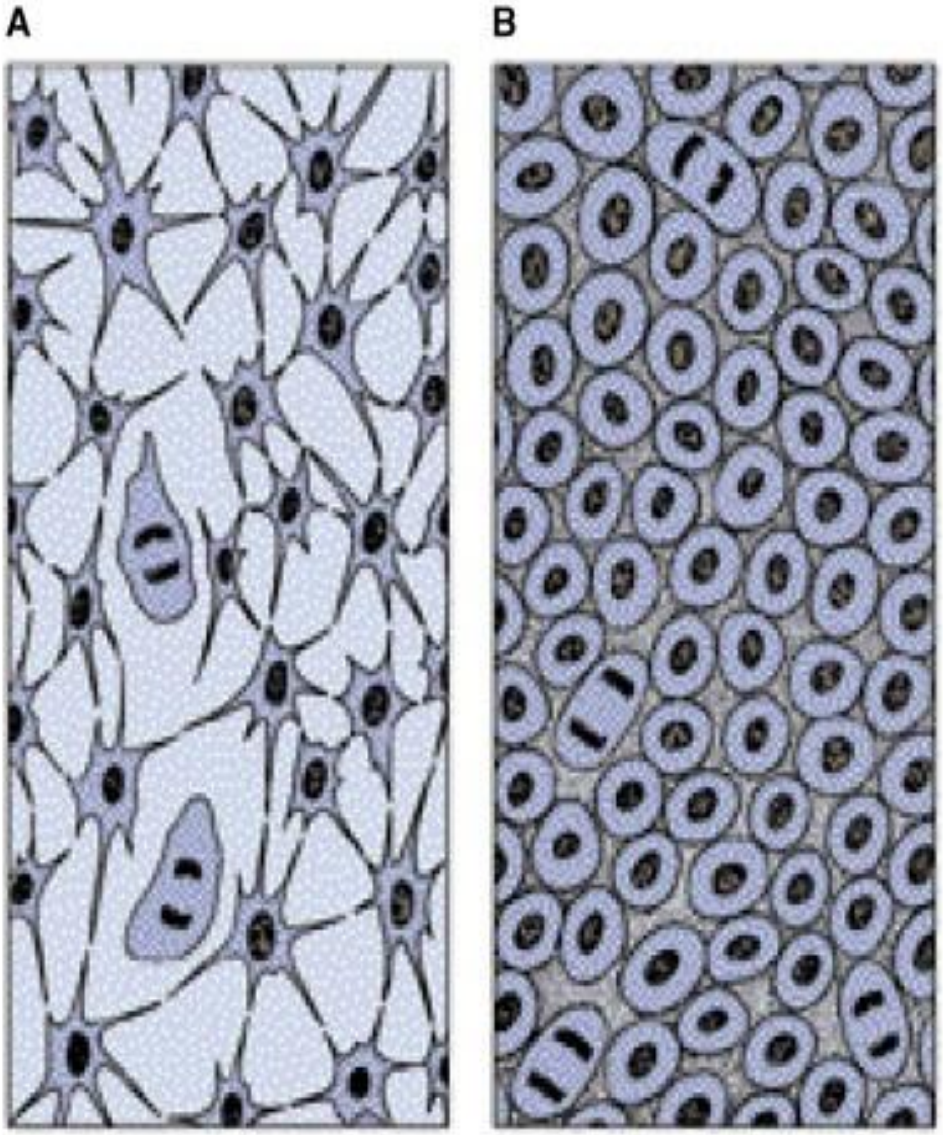
Isogenous group= cells originating from the mitotic activity of one chondroblast.

Chondrogenesis

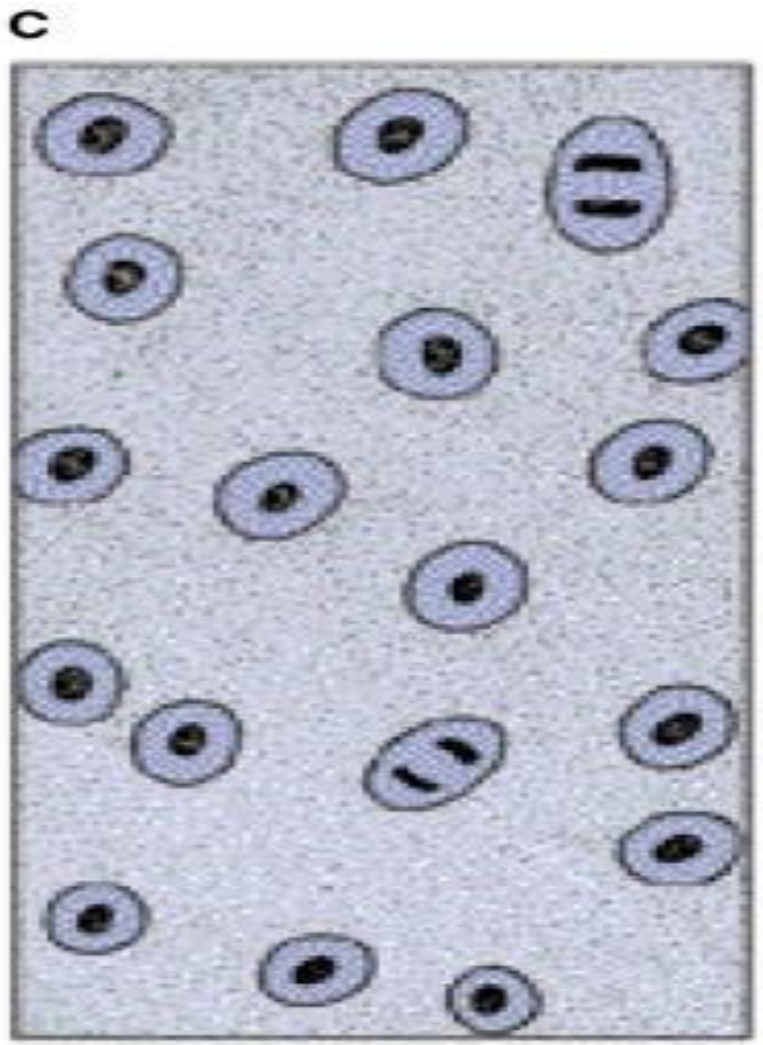


A. Mesenchyme is the precursor for all types of cartilage.

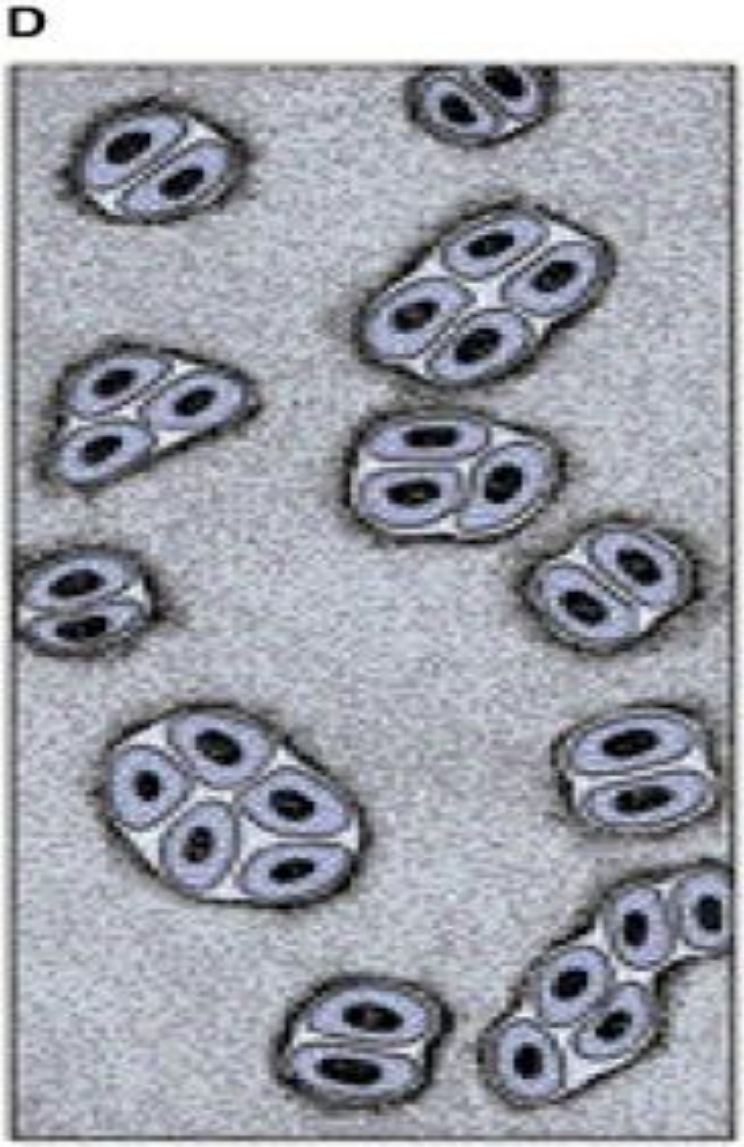
B. Mitosis and early differentiation produces a tissue with condensations of rounded cells called chondroblasts.



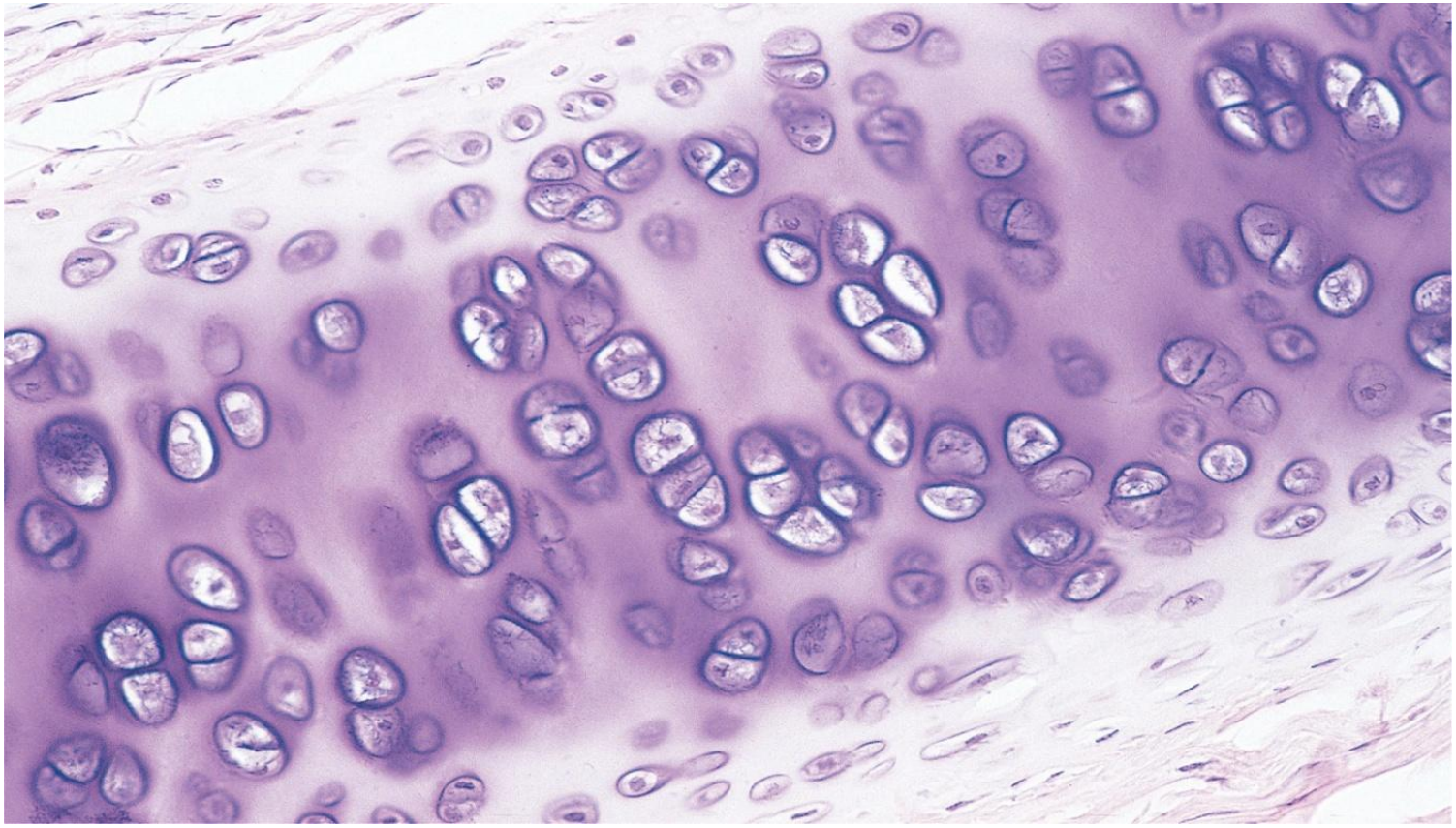
C. Chondroblasts are then separated from one another again by their production of ECM, which collectively swell with water and form the very extensive ECM.



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

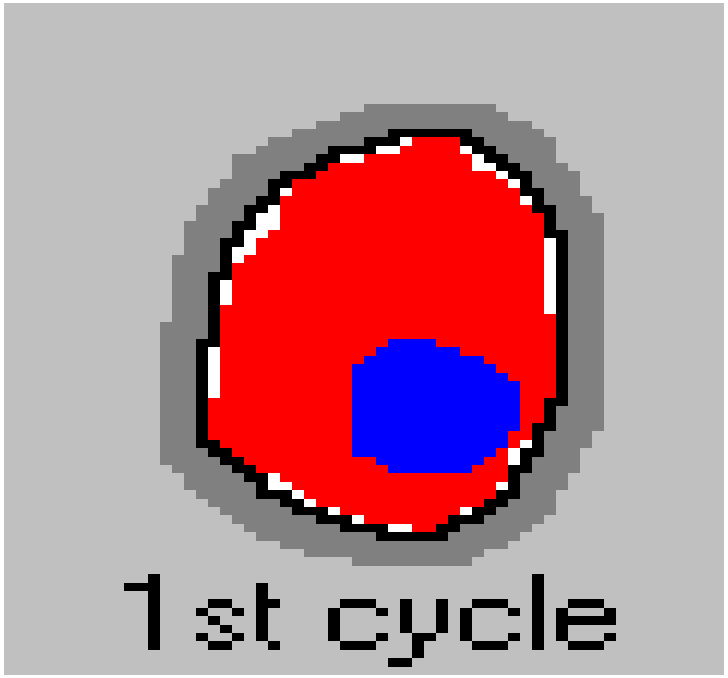


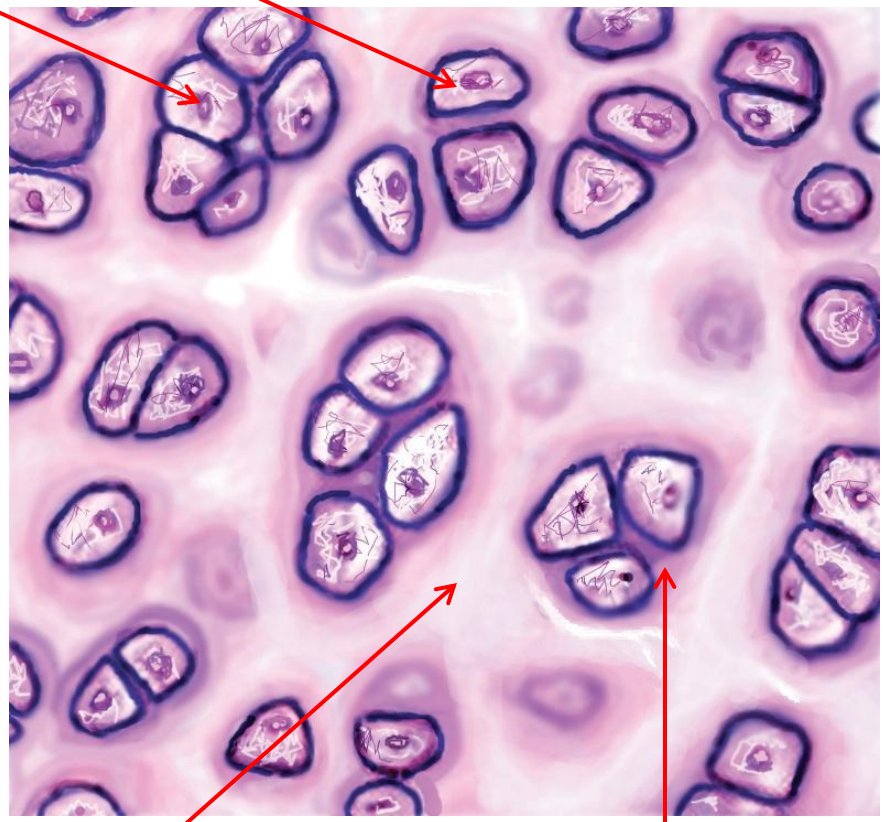
As the amount of matrix increases the chondroblasts become separated from each other and are, from this time on, located isolated in small cavities within the matrix, the **lacunae.** Concurrently the cells differentiate into mature cartilage cells, chondrocytes



Chondrocyte

Lacuna

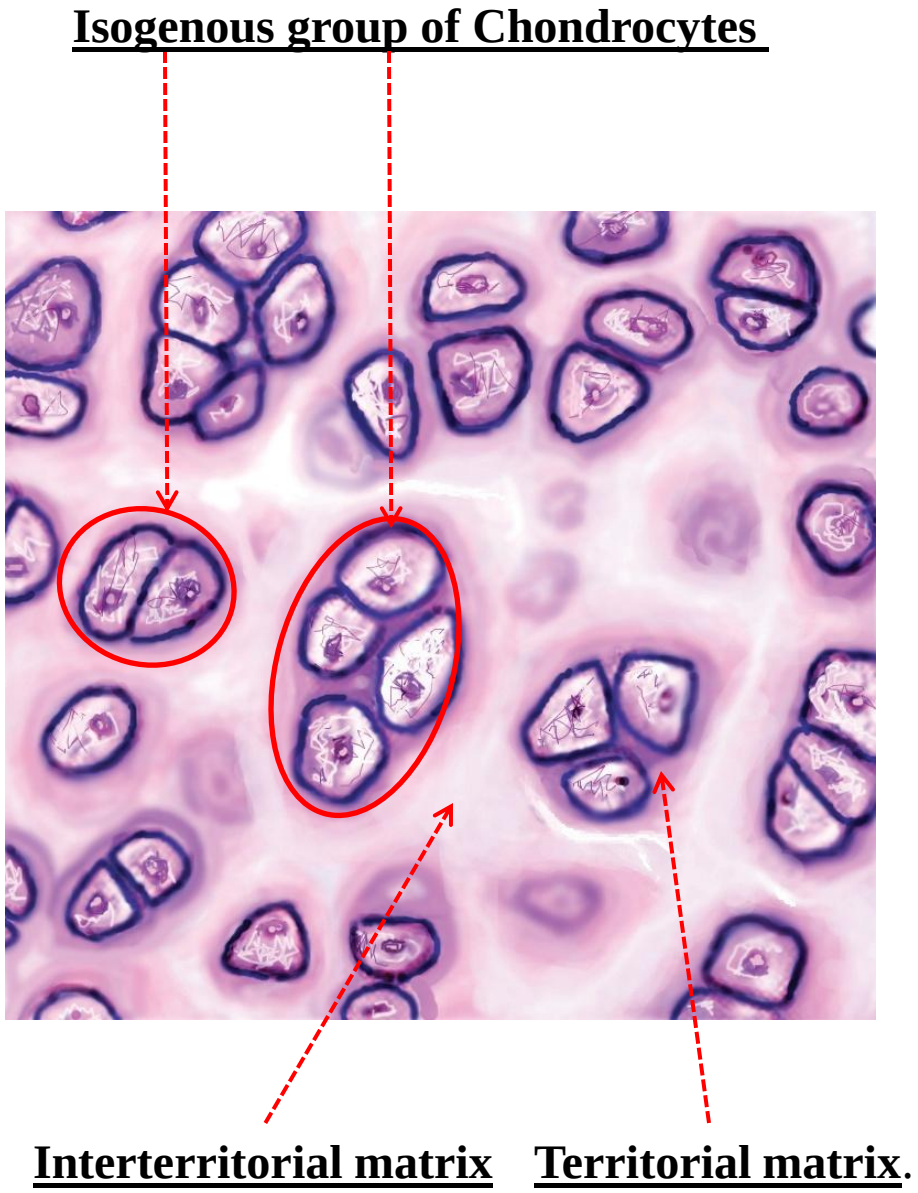




Interterritorial matrix

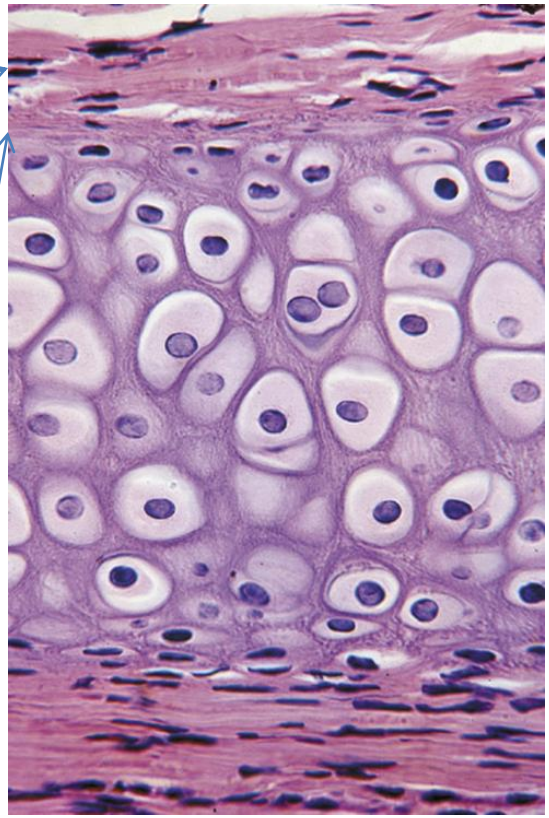
Territorial matrix.

The matrix near the isogenous groups of chondrocytes contains larger amounts of GAGs than the matrix further away from the isogenous groups. This part of the matrix is termed **territorial matrix**. In H&E stained sections the territorial matrix is more basophilic, i.e. it stains darker. The remainder of the matrix is called the **interterritorial matrix**

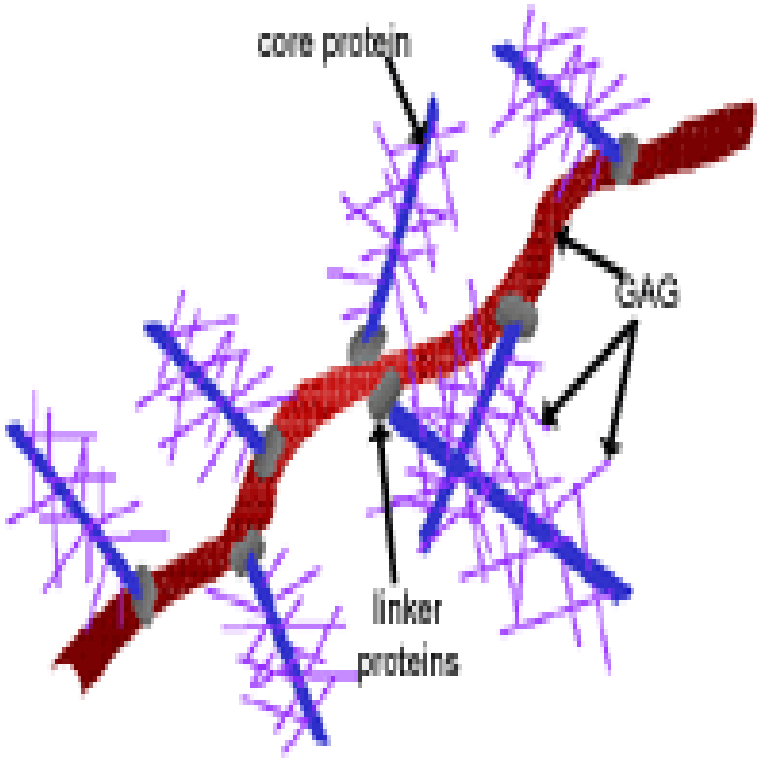


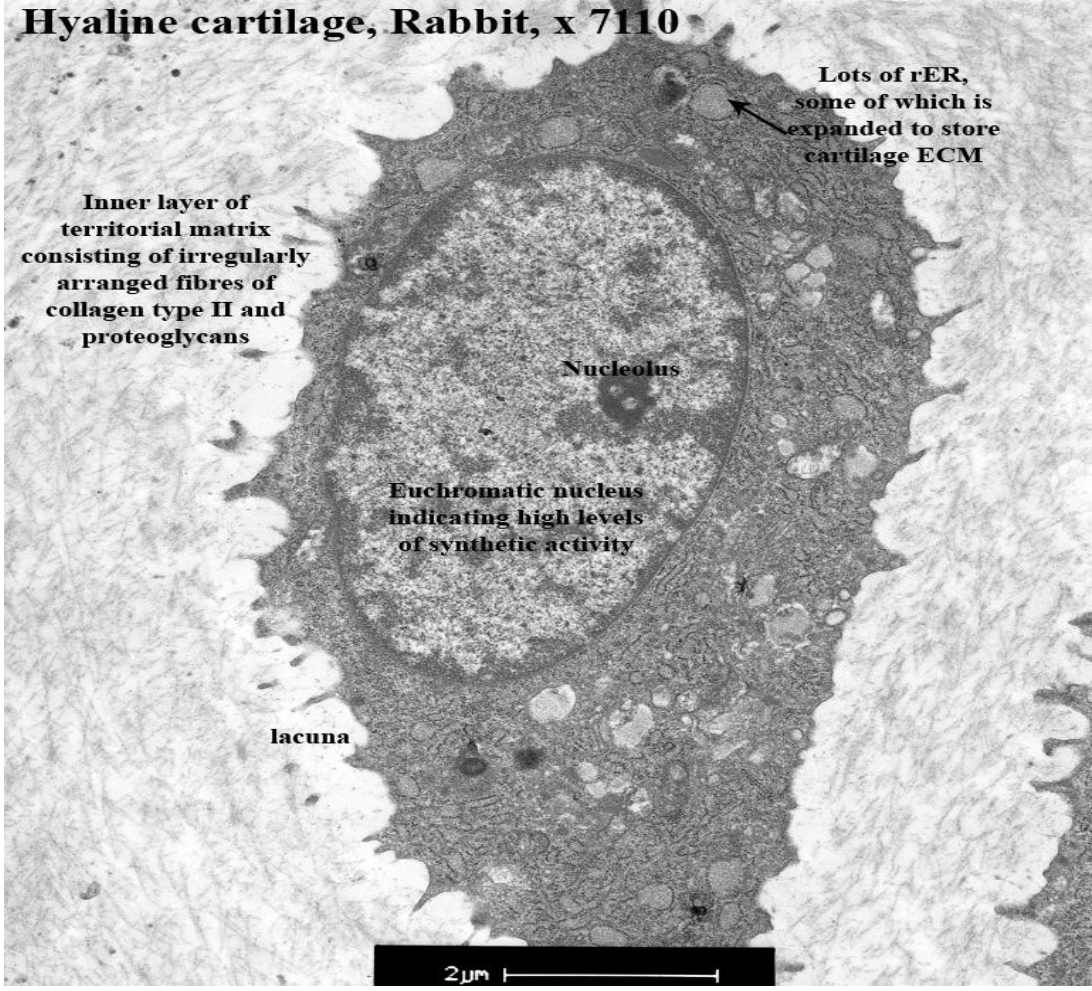
Perichondrium: present in all types of cartilage except fibrous and articular cartilages

Outer fibrous: dense irregular connective tissue, fibroblasts and type I collagen fibers

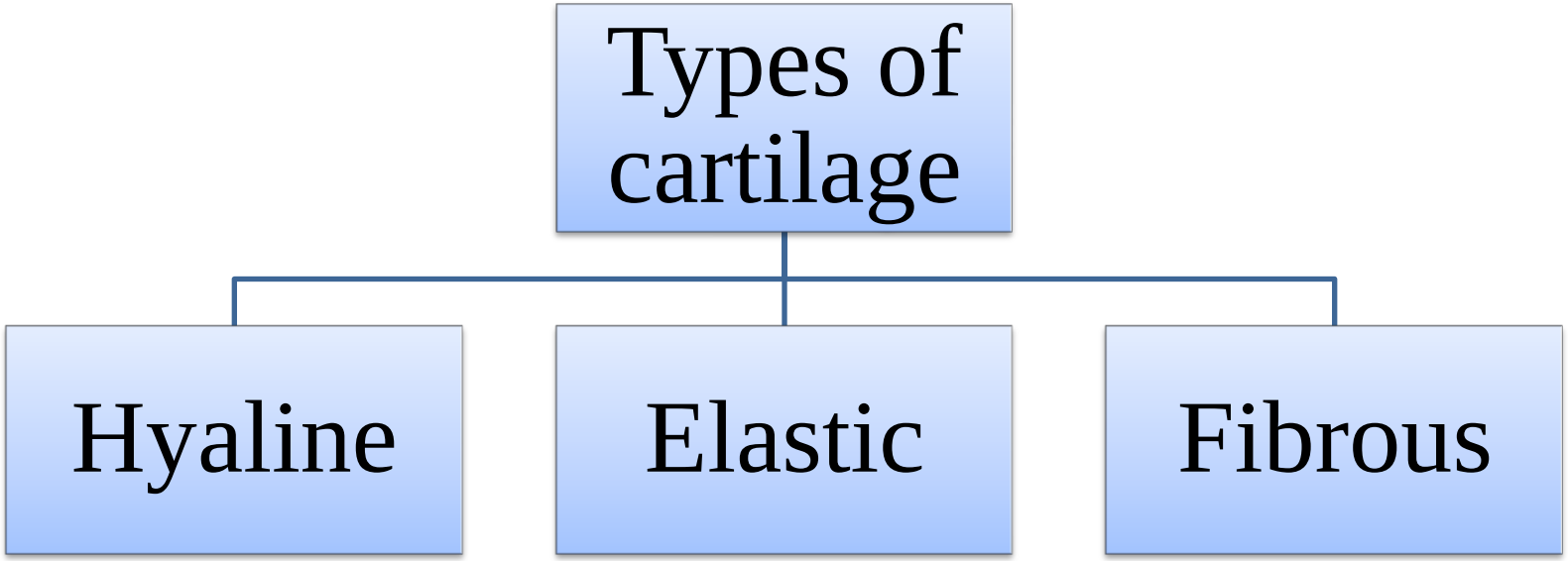


Inner cellular: contains undifferentiated cells (chondrogenic), essential for growth





The extracellular matrix consists of ground substance (hyaluronan, chondroitin sulfate and keratan sulfate) and collagen type 2


Types of cartilage
Hyaline
Elastic
Fibrous

Hyaline Cartilage

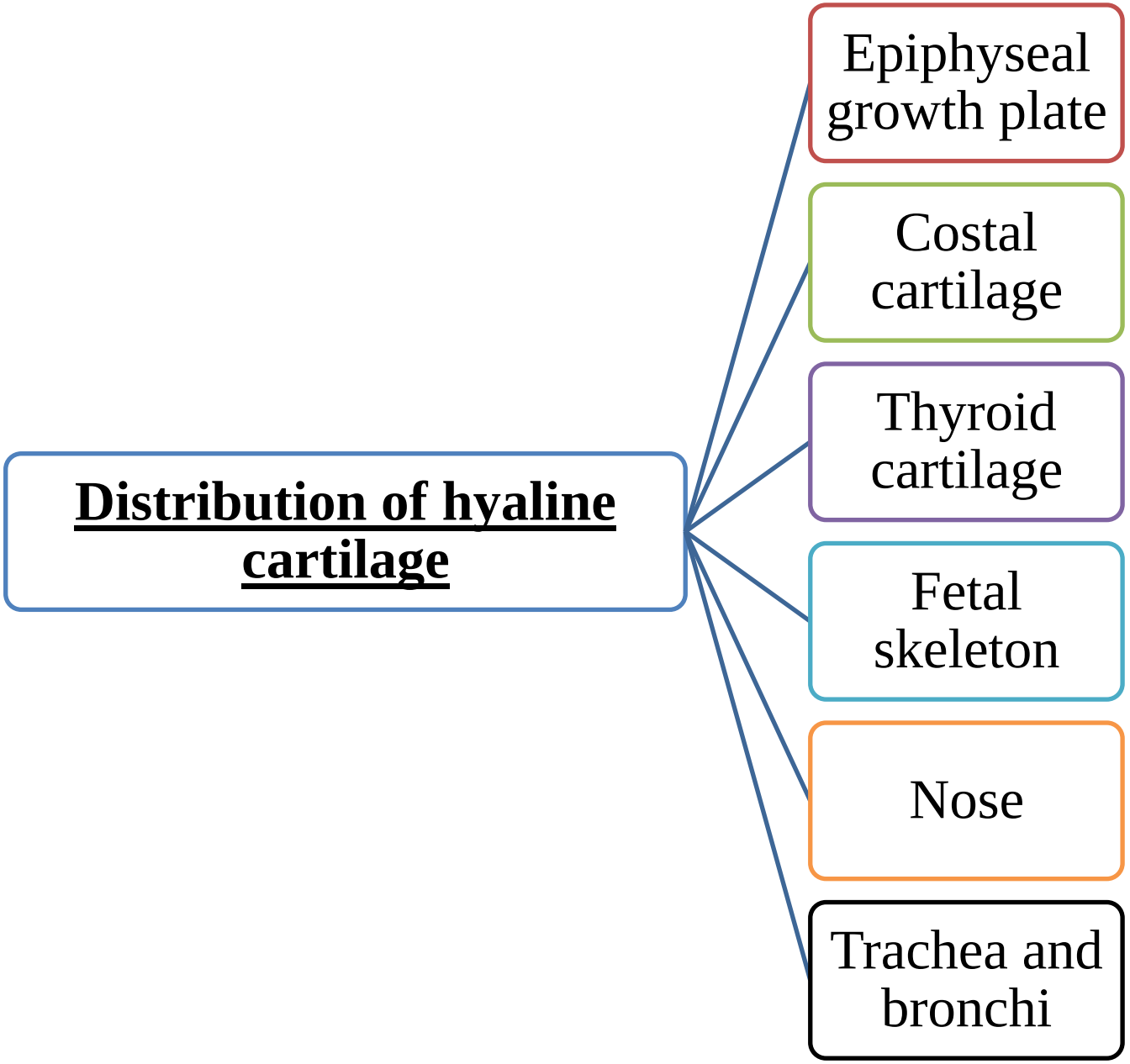
✓ Most common in the body

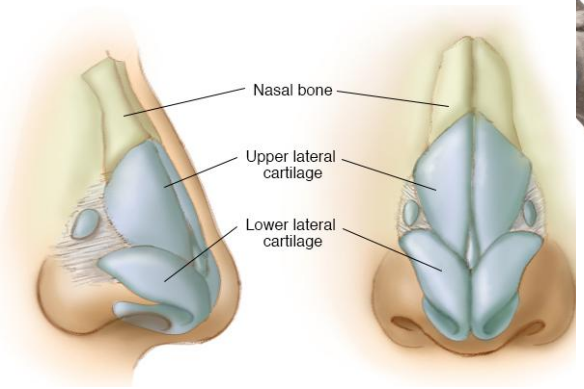
✓Contains type II collagen fibrils, which are not seen in histologic sections due to reflective index that is similar to that of ground substance

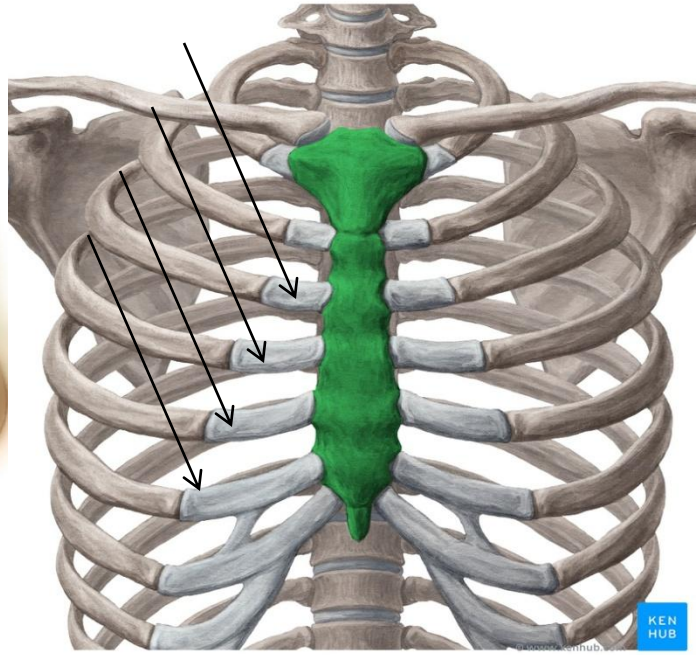
✓In adults, presents on articular surfaces of bones, ends of ribs, nose, larynx, trachea and bronchi

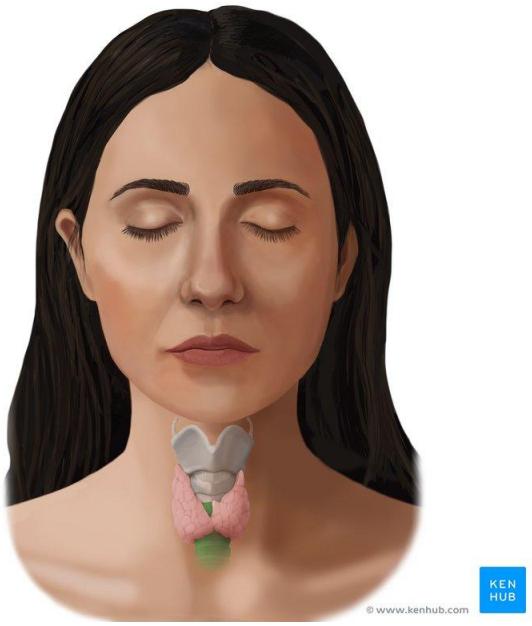
✓In developing bones, cartilage present in epiphyseal plates for bone growth in length

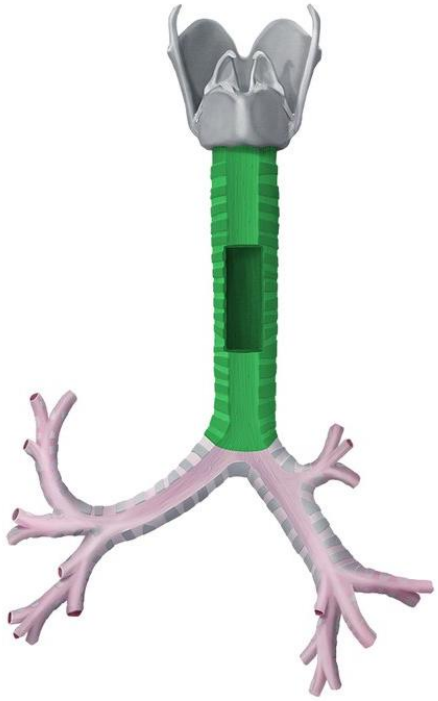
✓Replaced by bone during endochondral ossification

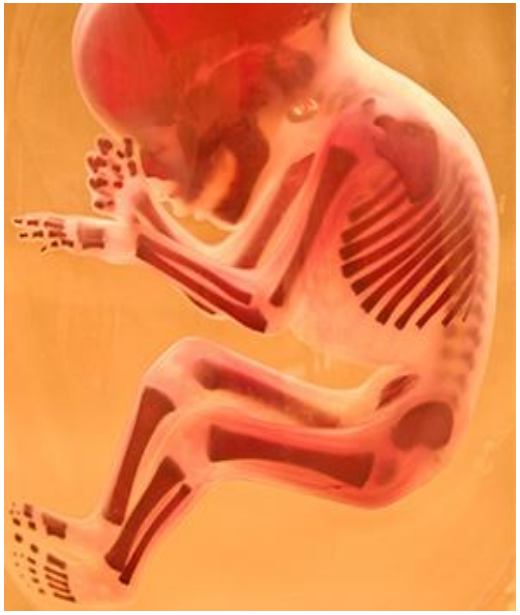

Distribution of hyaline cartilage
Epiphyseal growth plate
Costal cartilage
Thyroid cartilage
Fetal skeleton
Nose
Trachea and bronchi

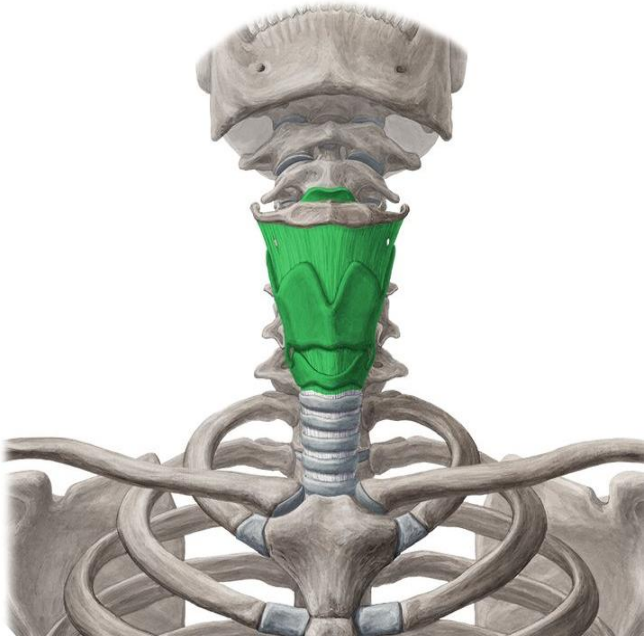


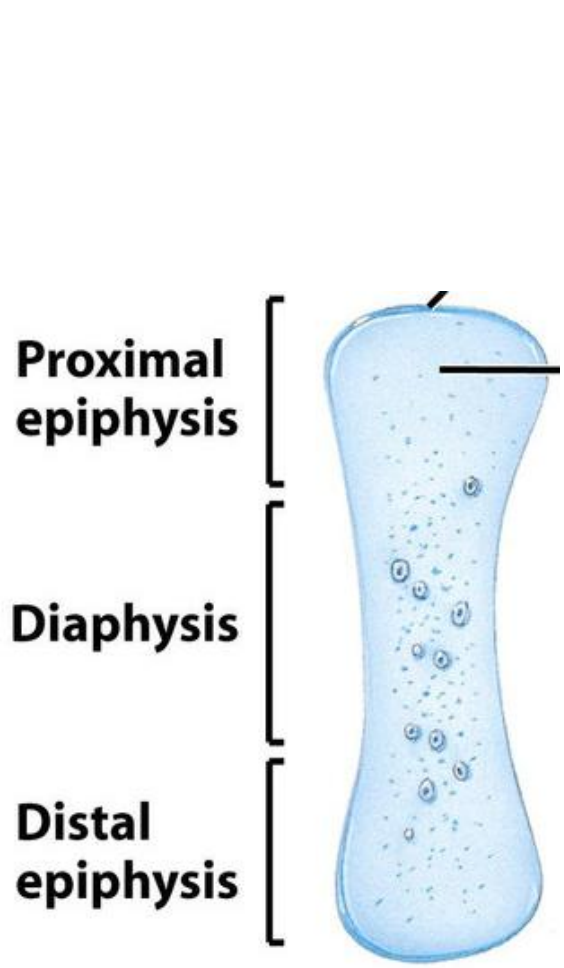


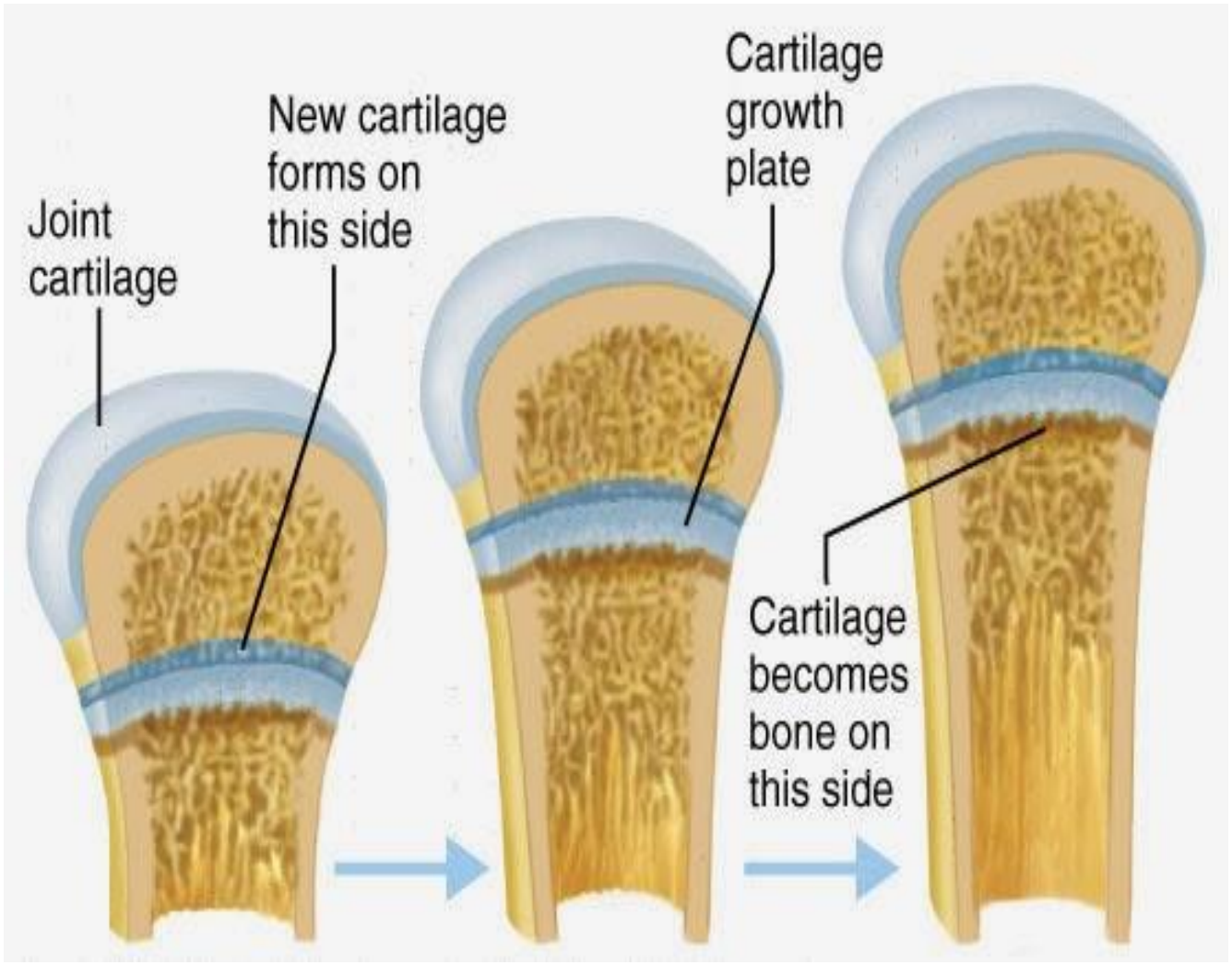




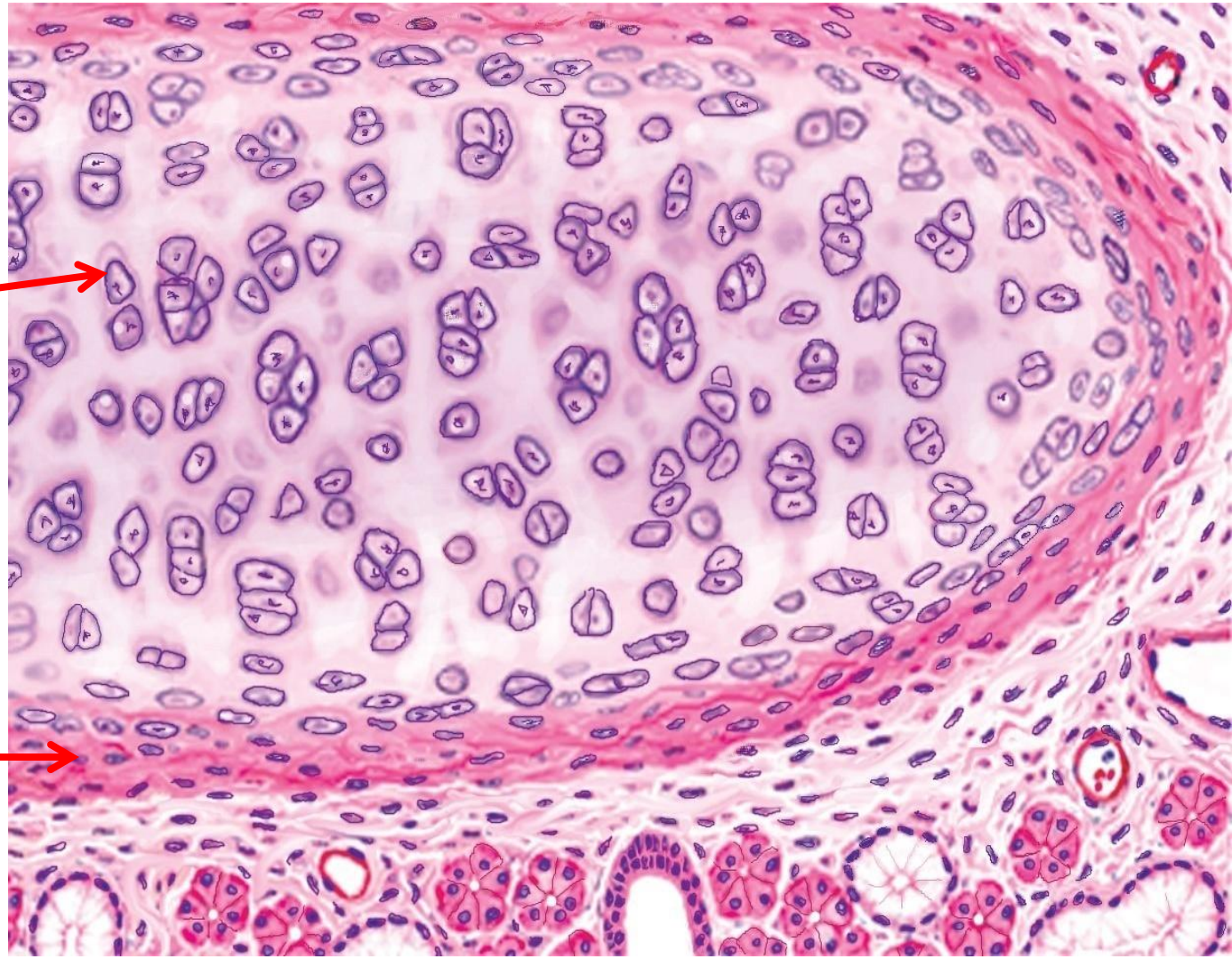





Proximal epiphysis
Diaphysis
Distal epiphysis


Joint cartilage
New cartilage forms on this side
Cartilage growth plate
Cartilage becomes bone on this side

Hyaline Cartilage



ELASTIC CARTILAGE

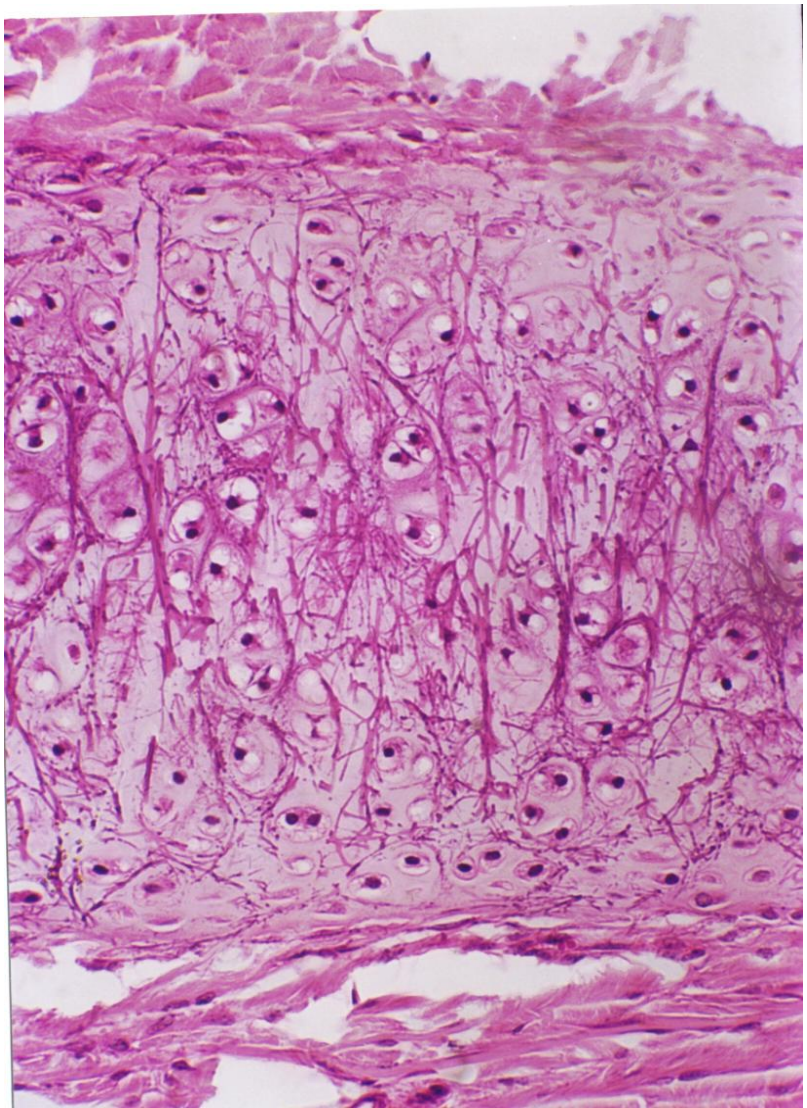
- Similar to hyaline cartilage but has elastic fibers running in all directions in addition to collagen.

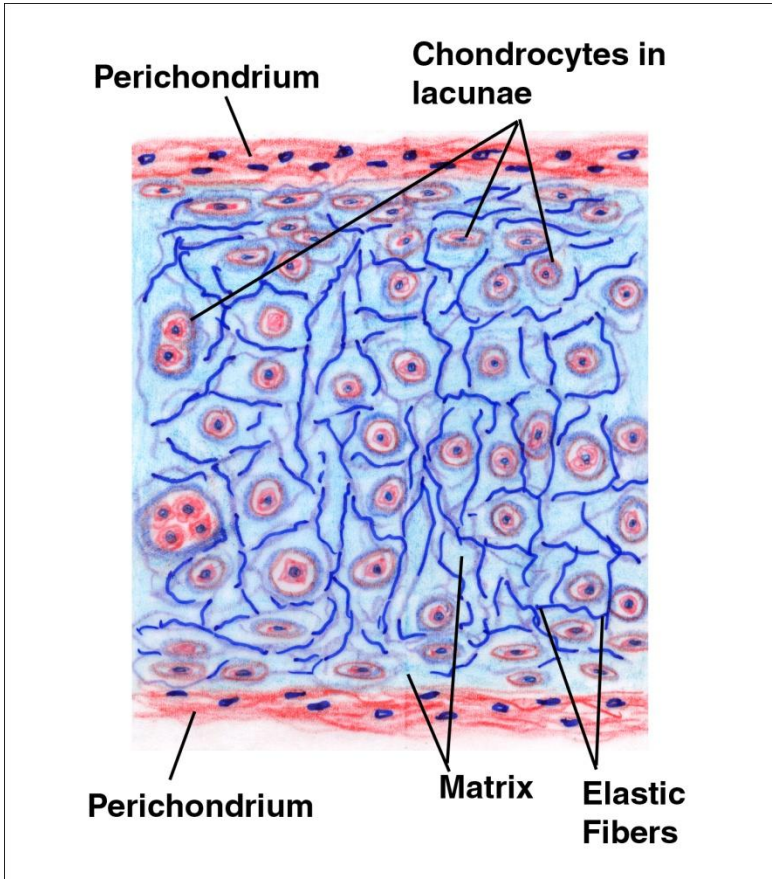
- Found in auricle of ear, walls of external auditory canals, eustachian tubes, epiglottis

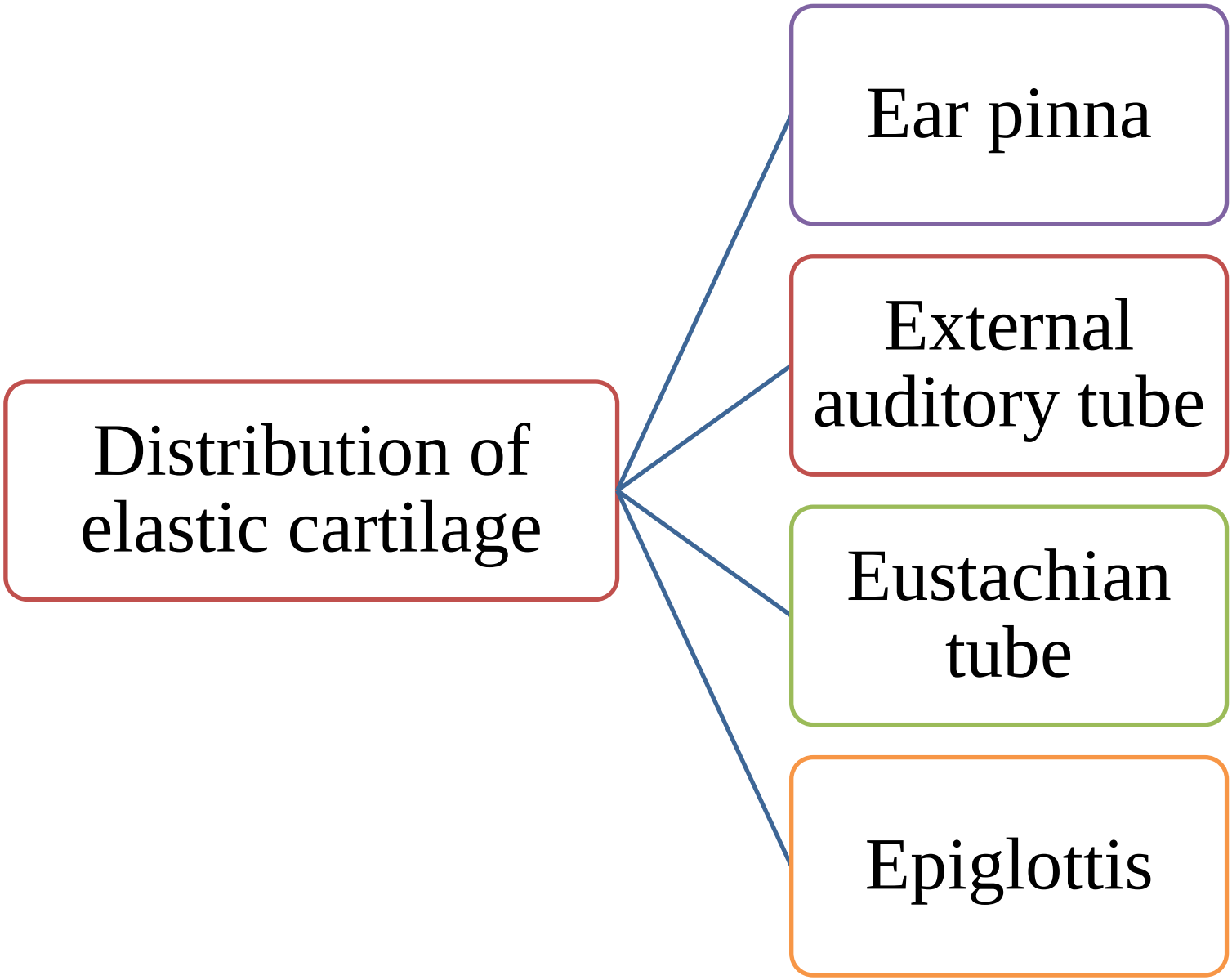
- Maintains shape, deforms but returns to shape; flexibility of organ; strengths and supports structures.

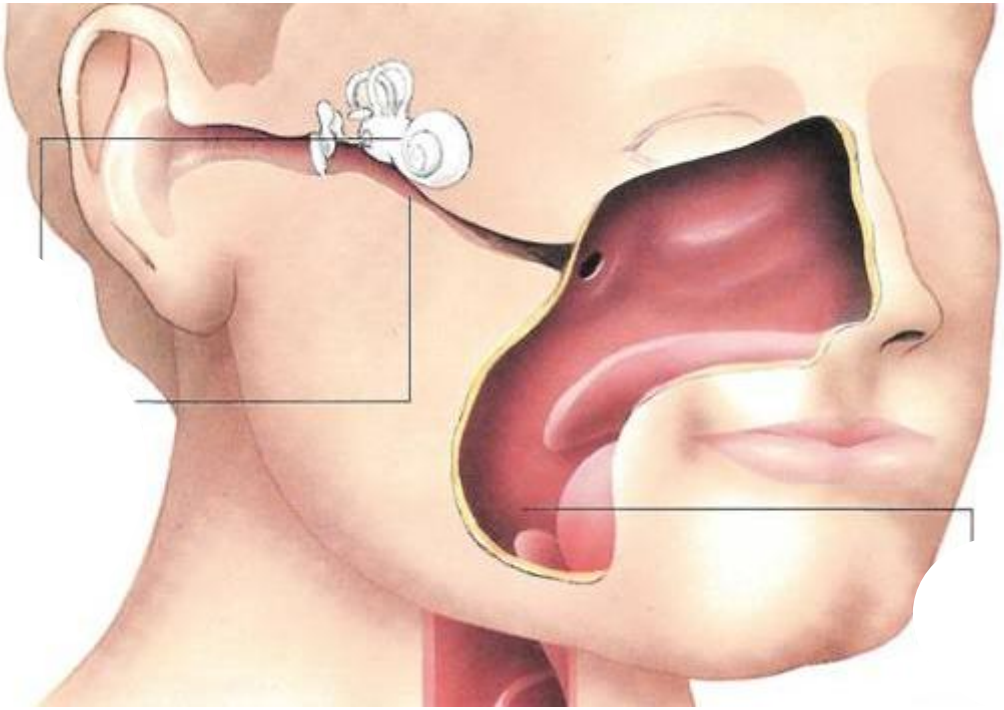
- In contrast to hyaline cartilage, which can calcify with aging, the matrix of elastic cartilage does not calcify, and the cartilage maintains its high flexibility

Elastic Cartilage (Epiglottis)






Distribution of elastic cartilage
Ear pinna
External auditory tube
Eustachian tube
Epiglottis



Fibrocartilage

- Is a form of connective tissue transitional between dense connective tissue and hyaline cartilage.

- Chondrocytes may lie singly or in pairs, but most often they form short rows between dense bundles of collagen fibers.

- Collagen type I is dominant in fibrous cartilage.

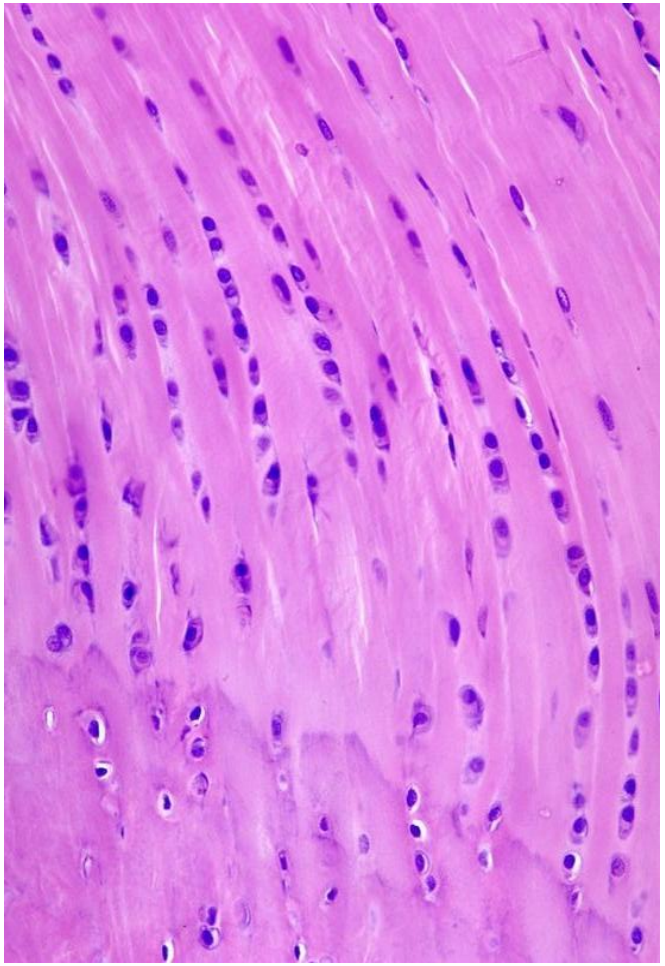
- Is typically found in knee joint (menisci), intervertebral disks, symphysis pubis

- Is found at insertion of tendons into bones

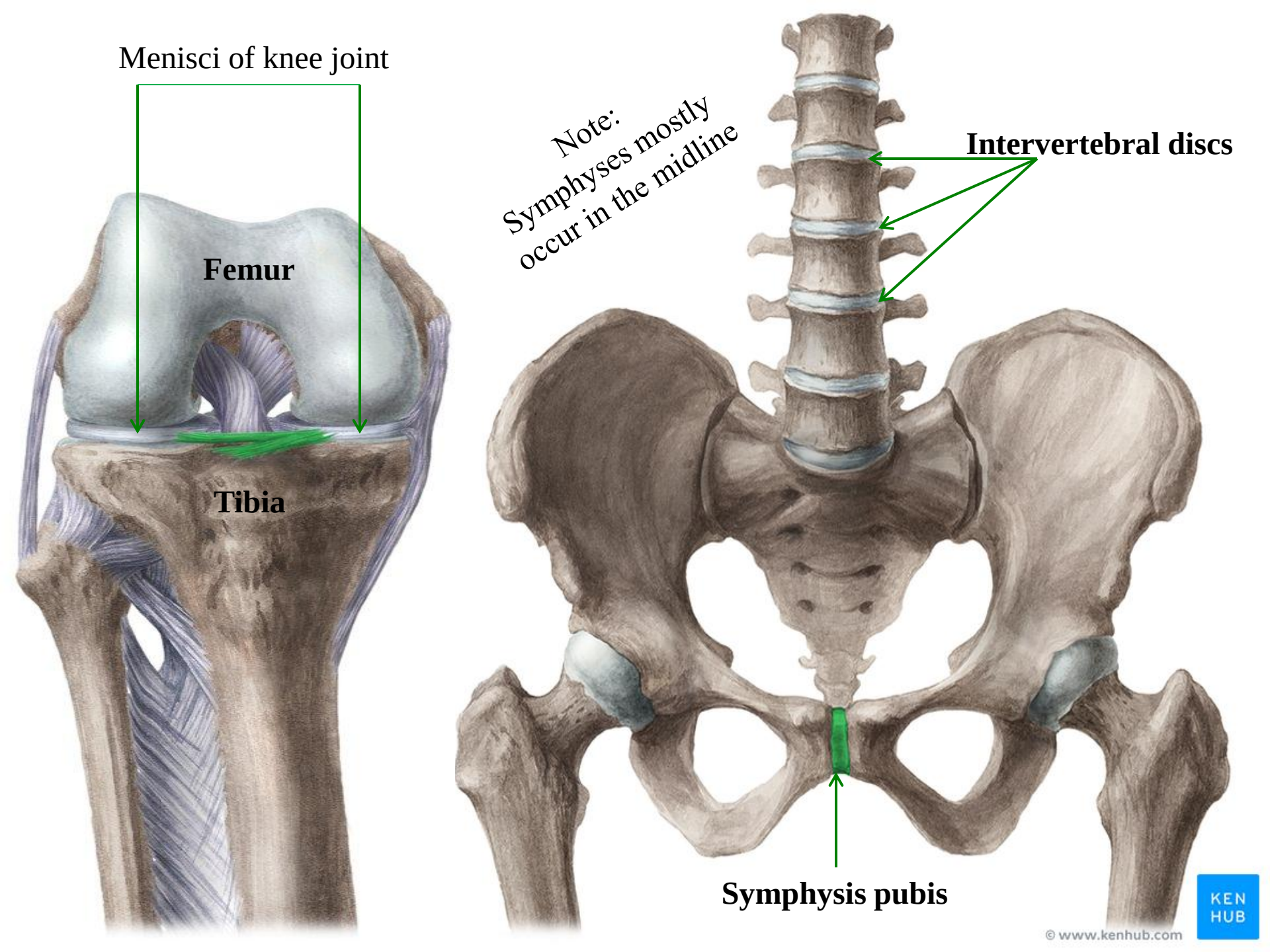
- It is difficult to define the perichondrium because of the fibrous appearance of the cartilage and the gradual transition to surrounding tissue types.

Fibrocartilage

Collagen 1



Chondrocyte in lacuna


Menisci of knee joint
Femur
Tibia
Note:
Symphyses mostly
occur in the midline
Intervertebral discs
Symphysis pubis
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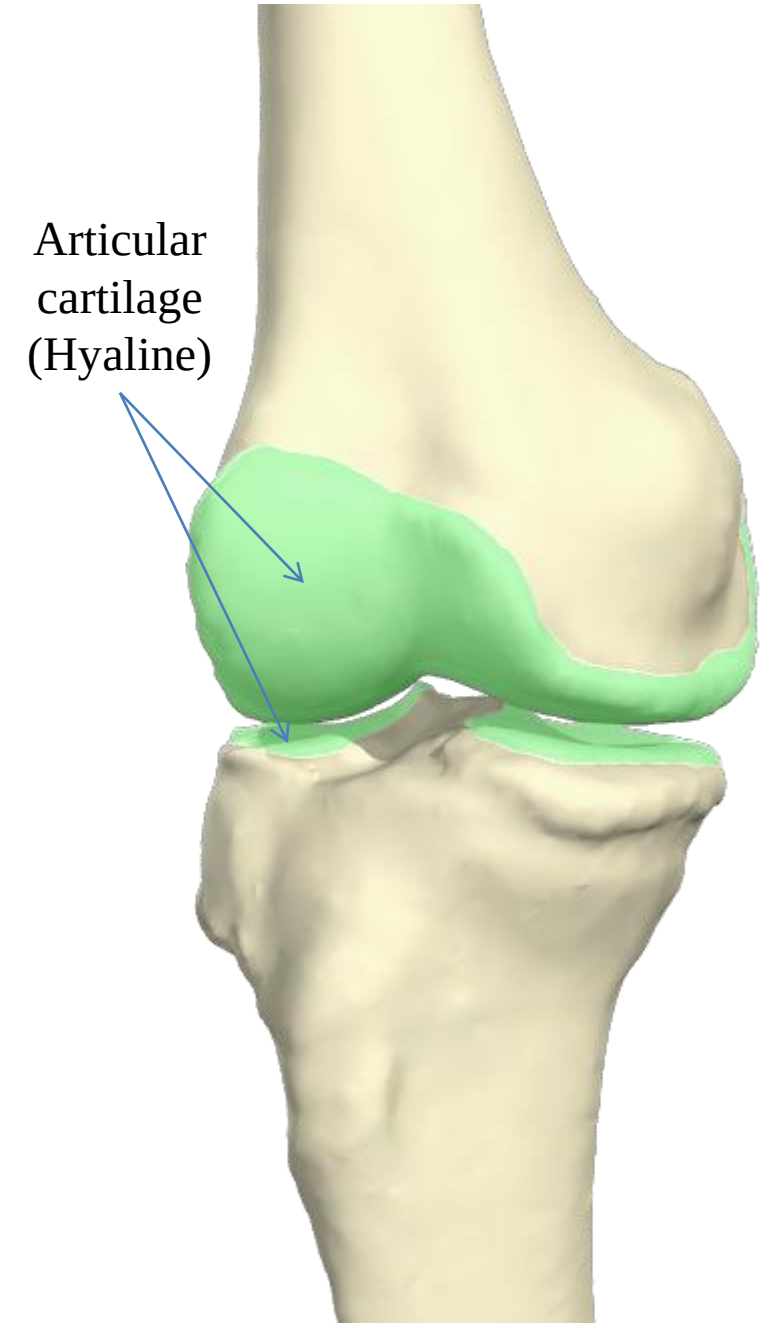
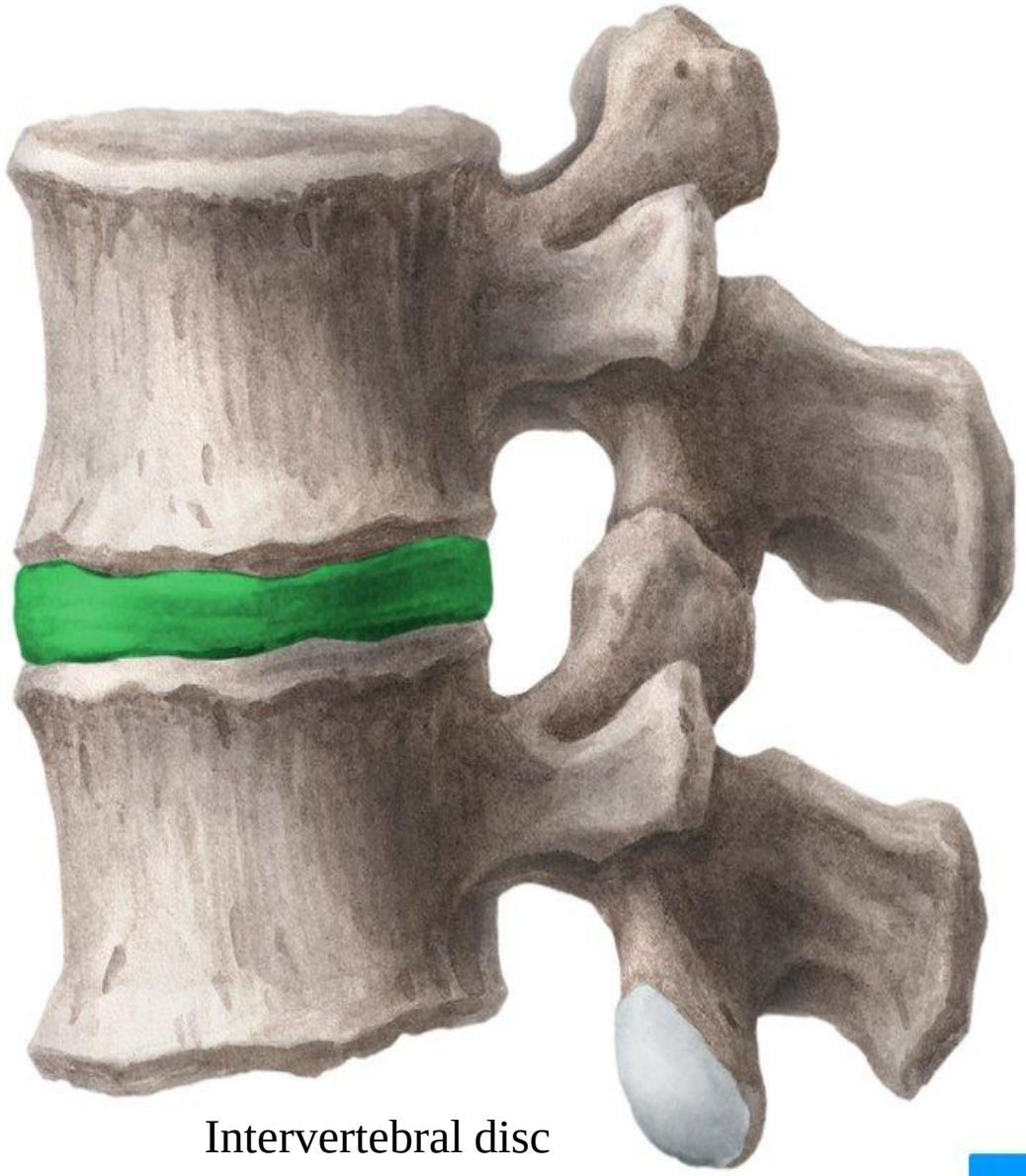
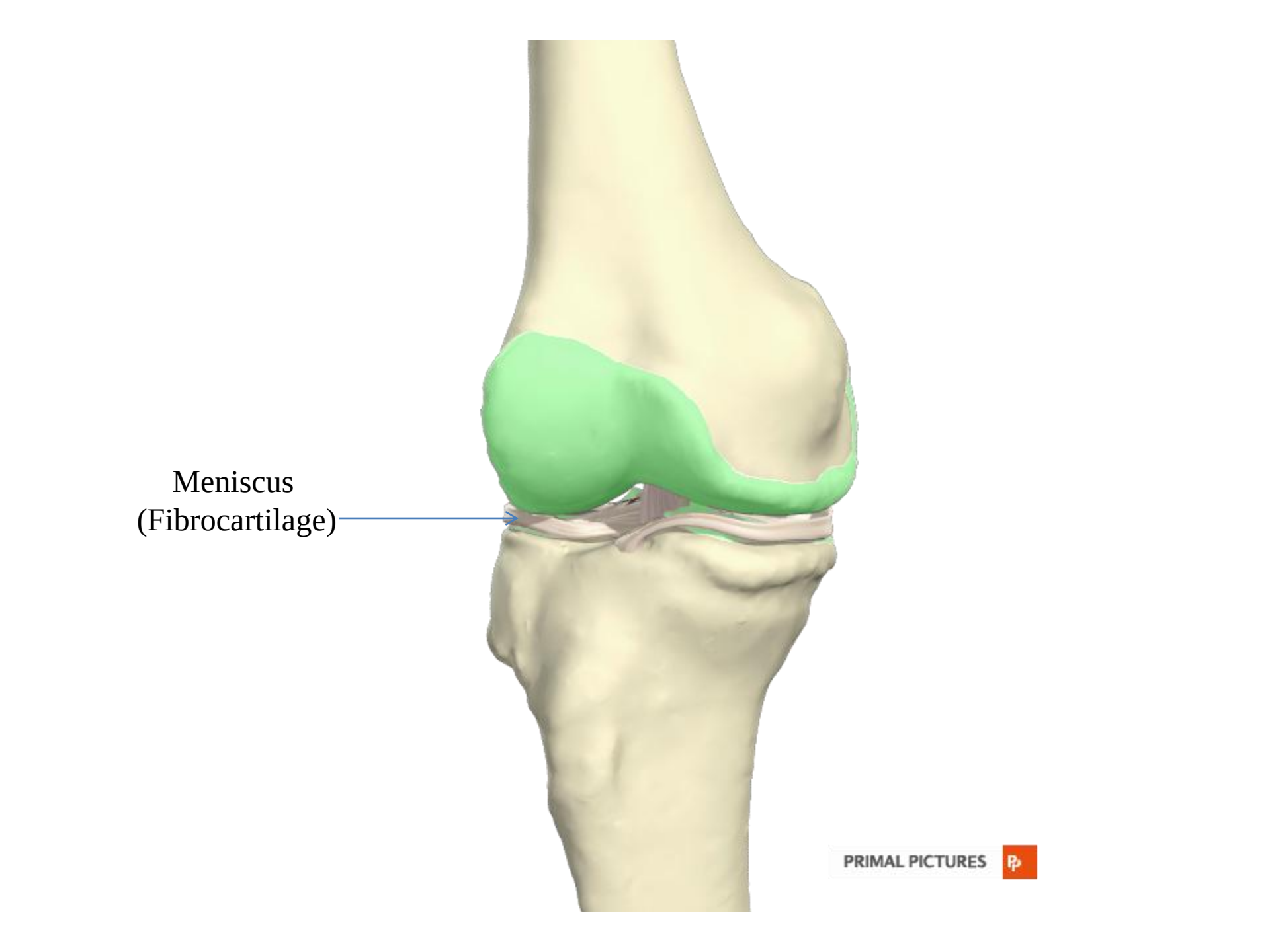
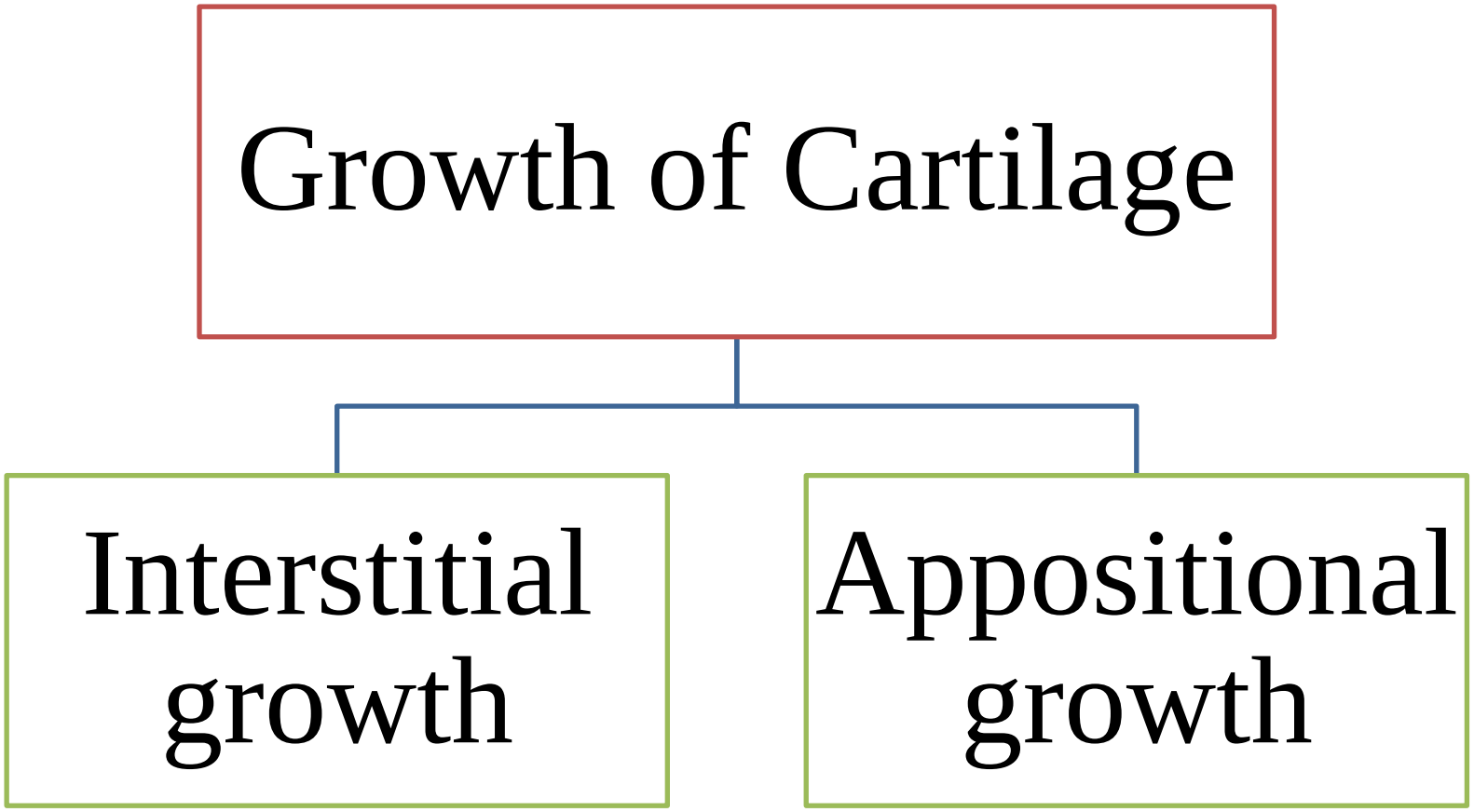




Intervertebral disc
(Fibrocartilage)

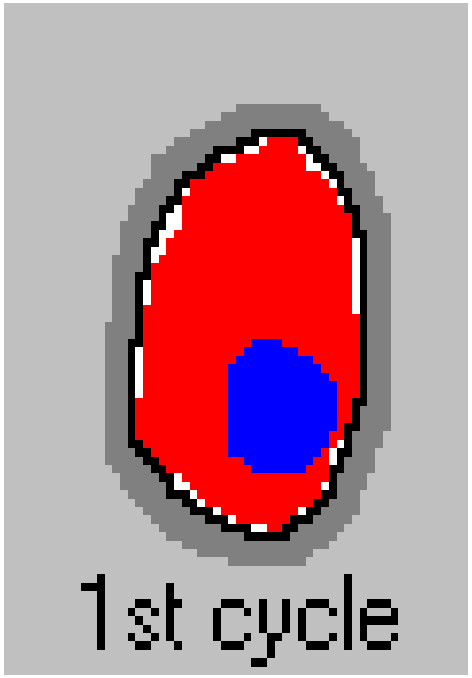

Meniscus
(Fibrocartilage)
PRIMAL PICTURES


Growth of Cartilage
Interstitial growth
Appositional growth
Growth from within
Growth from outside

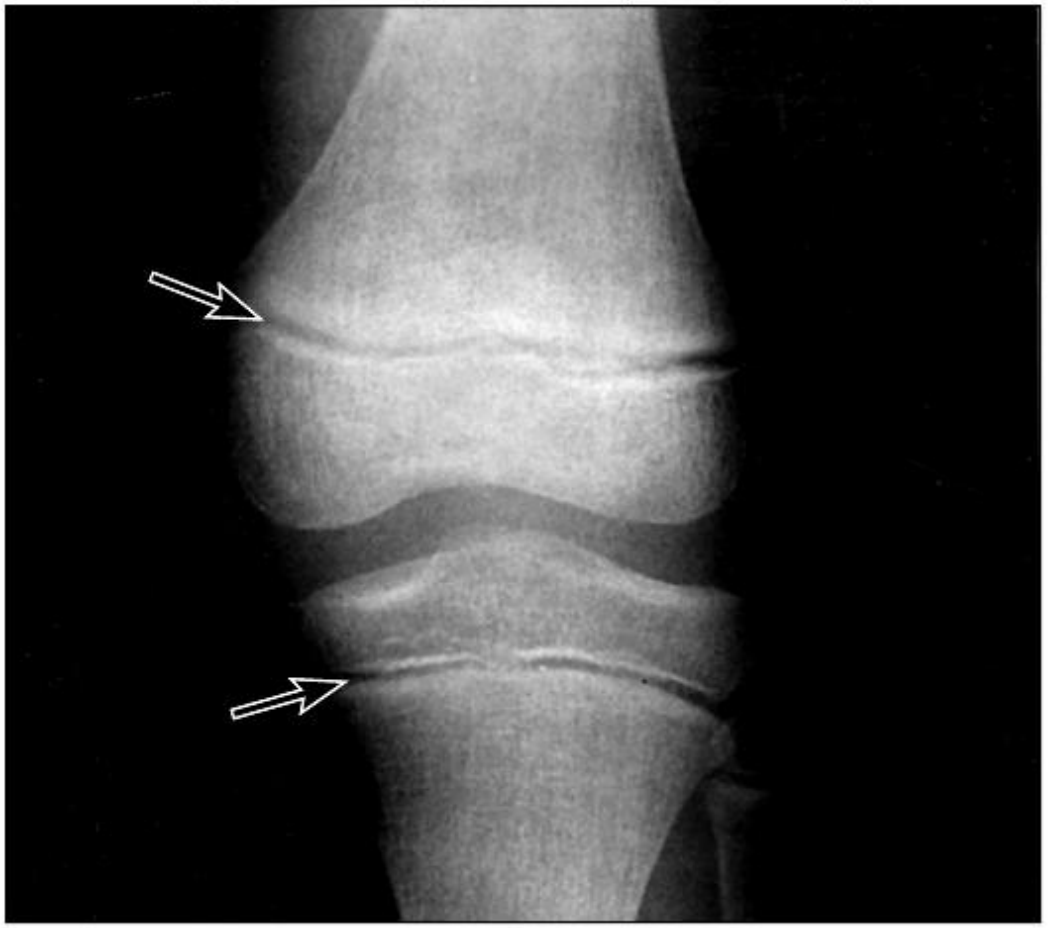
Growth occurs by two mechanisms

Interstitial growth - Chondroblasts within the 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. Interstitial growth occurs mainly in immature cartilage.

Appositional growth - Chondrogenic cells surrounding the cartilage in the inner layer of the perichondrium differentiate into chondroblasts. Appositional growth occurs in both immature and mature cartilage.

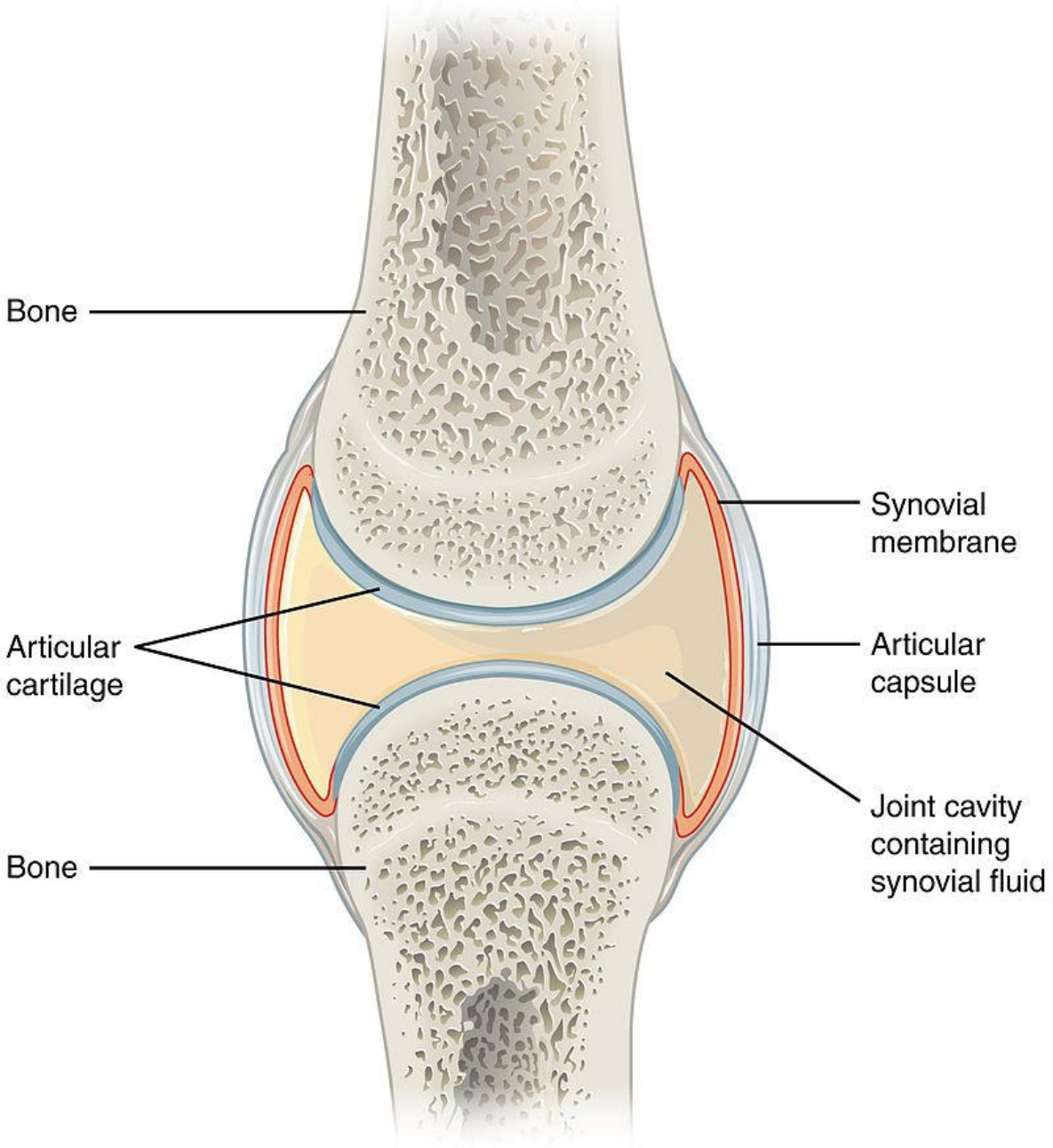


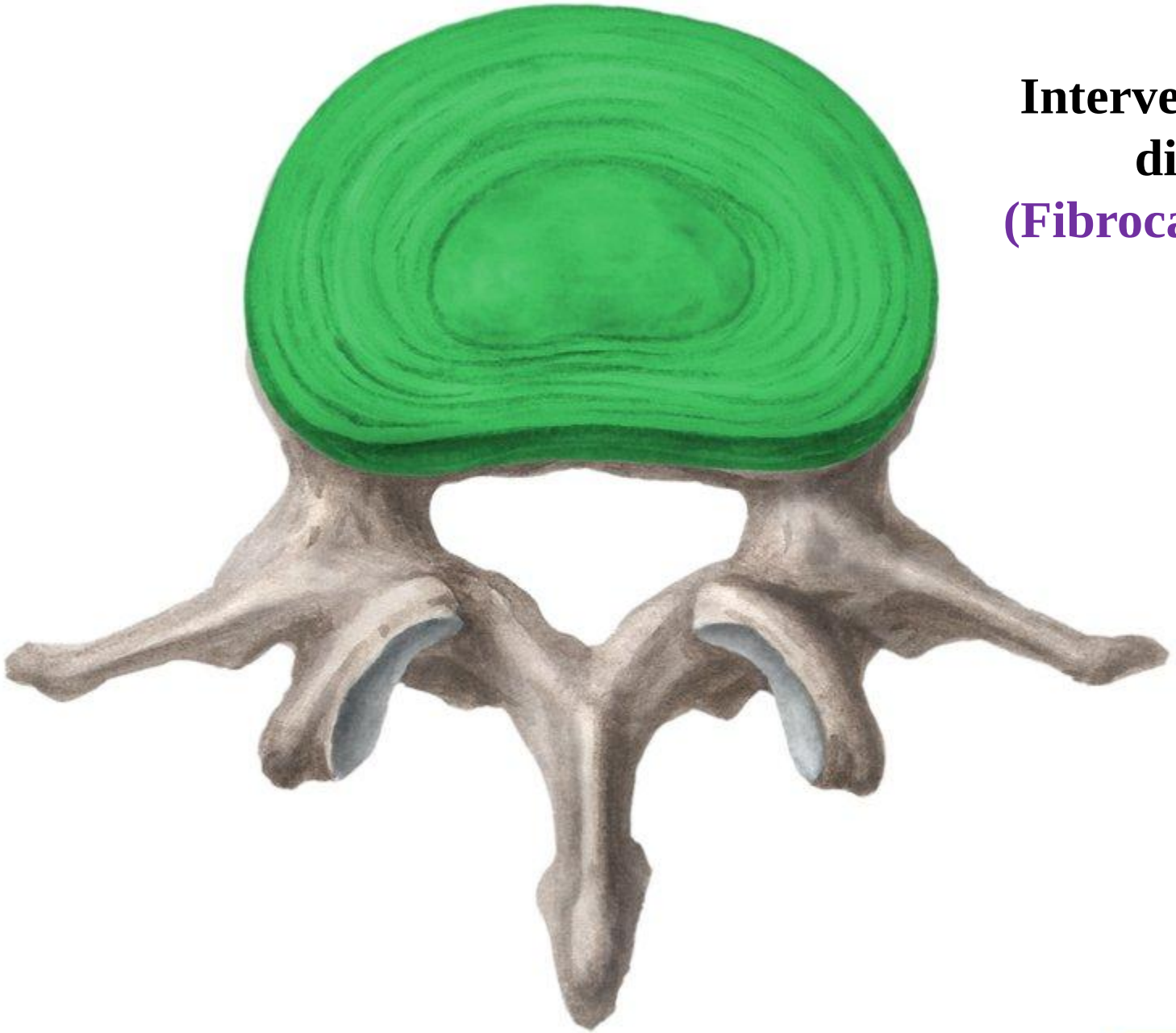
Growth in the Epiphyseal Plate



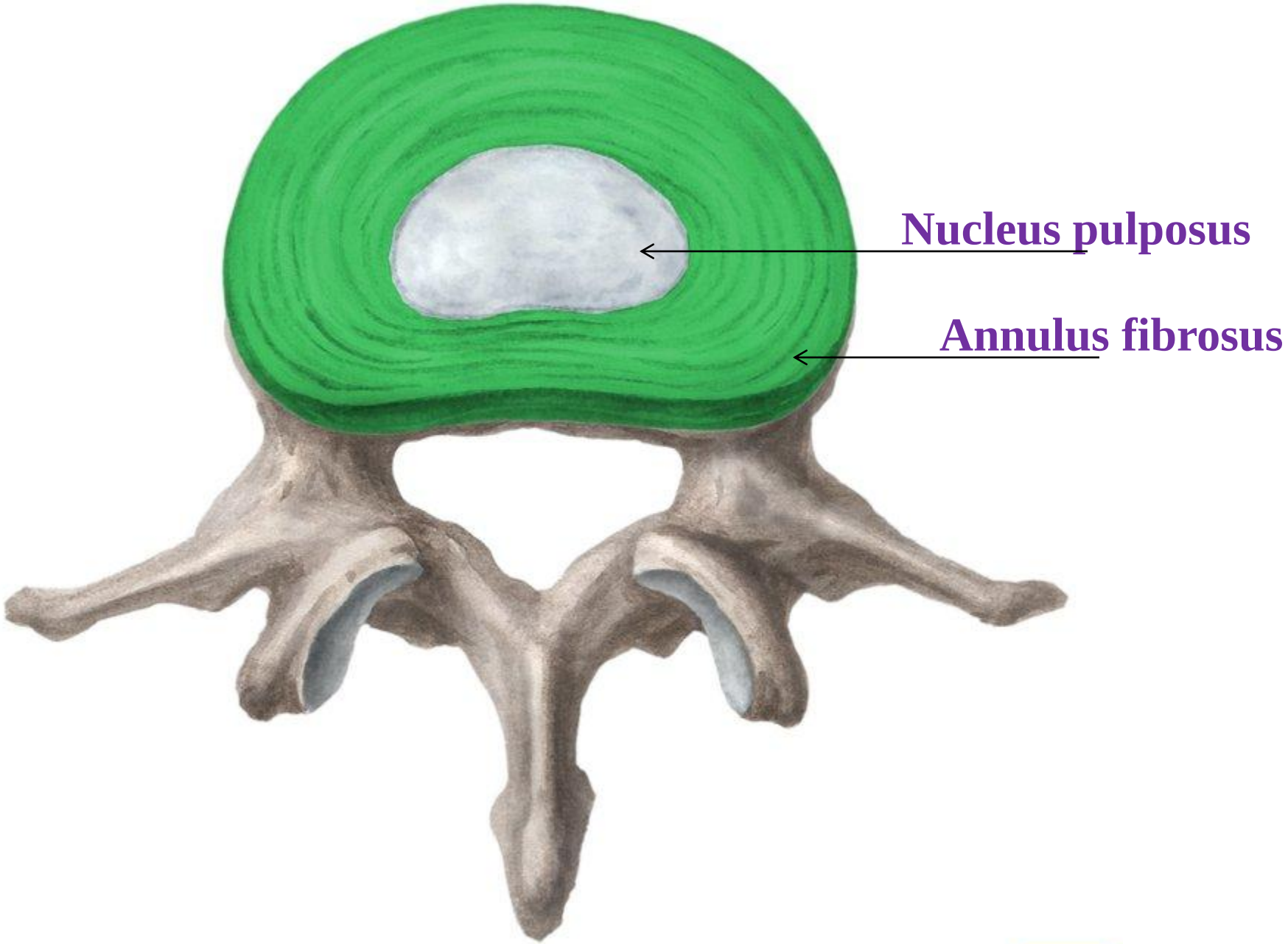
Clinical Problems

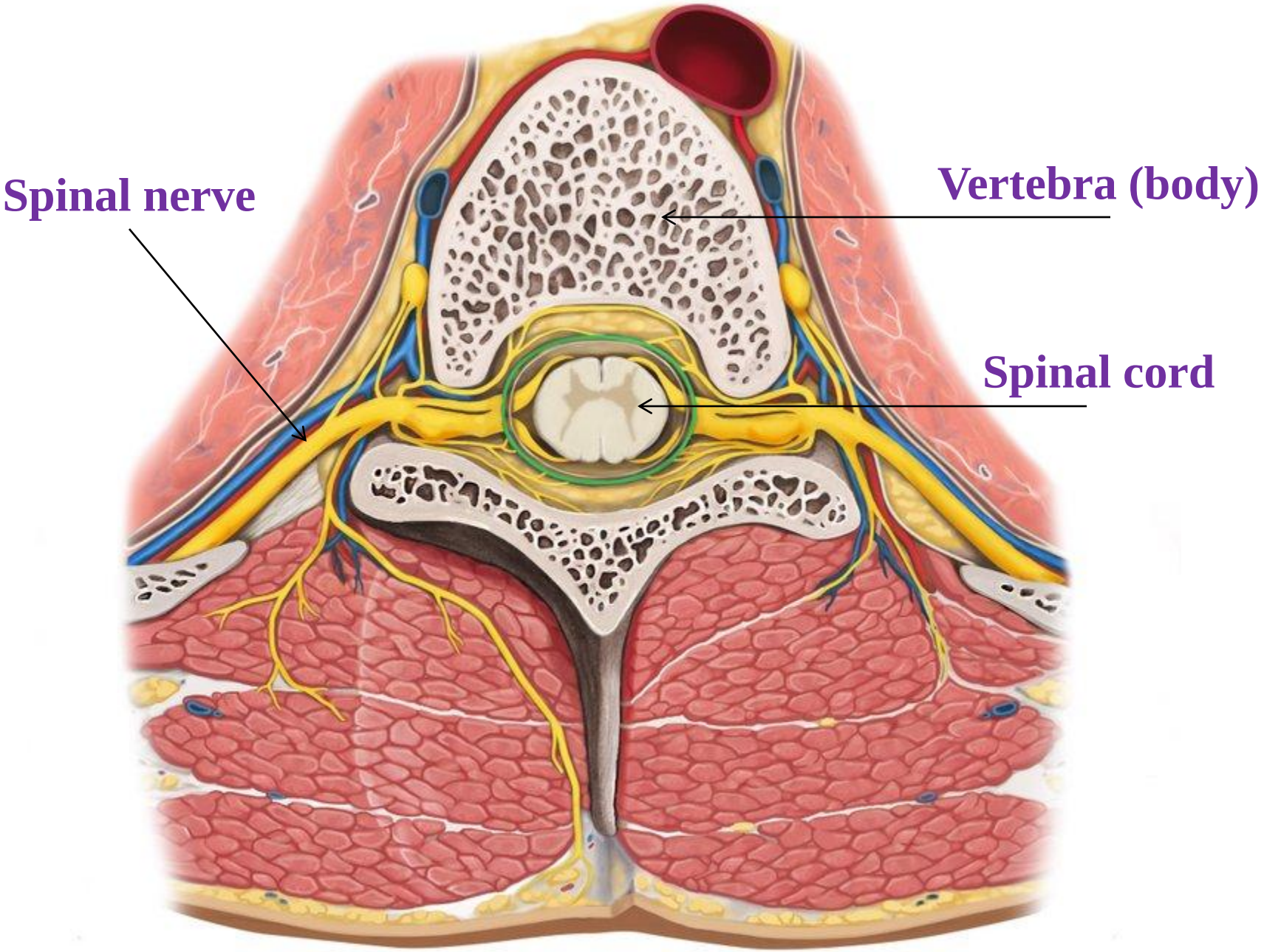
- Degenerative changes
- Herniation of the intervertebral disc


Bone
Articular cartilage
Bone
Synovial membrane
Articular capsule
Joint cavity containing synovial fluid



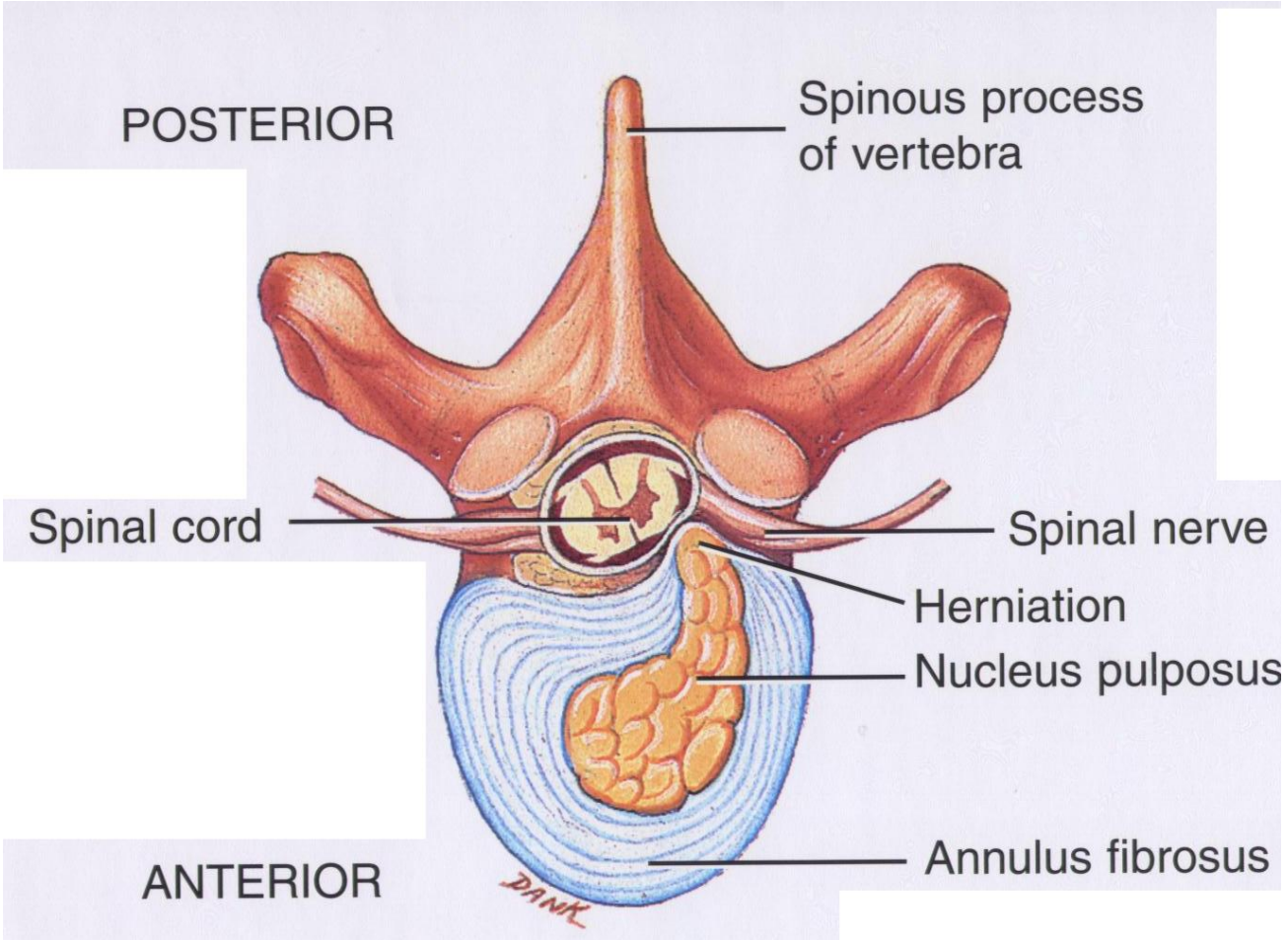
Intervertebral disc
(Fibrocartilage)


Nucleus pulposus
Annulus fibrosus


Spinal nerve
Vertebra (body)
Spinal cord

Herniated Disc/ ruptured disc/ slipped disc

Risk factors: Degeneration due to aging, heavy weight lifting, obesity, sudden strain from twisting or quick movements and strenuous activity



Elastic cartilage and gravity are the reason why
it seems our ears keep growing