بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

HISTOLOGY

وَلَقَدْ خَلَقْنَا الْإِنسَانَ وَنَعْلَمُ مَا تُوَسْوِسُ بِهِ نَفْسُهُ ۖ وَنَحْنُ أَقْرَبُ إِلَيْهِ مِنْ حَبْلِ الْوَرِيدِ

FINAL | Lecture 5

Bone and cartilage lab

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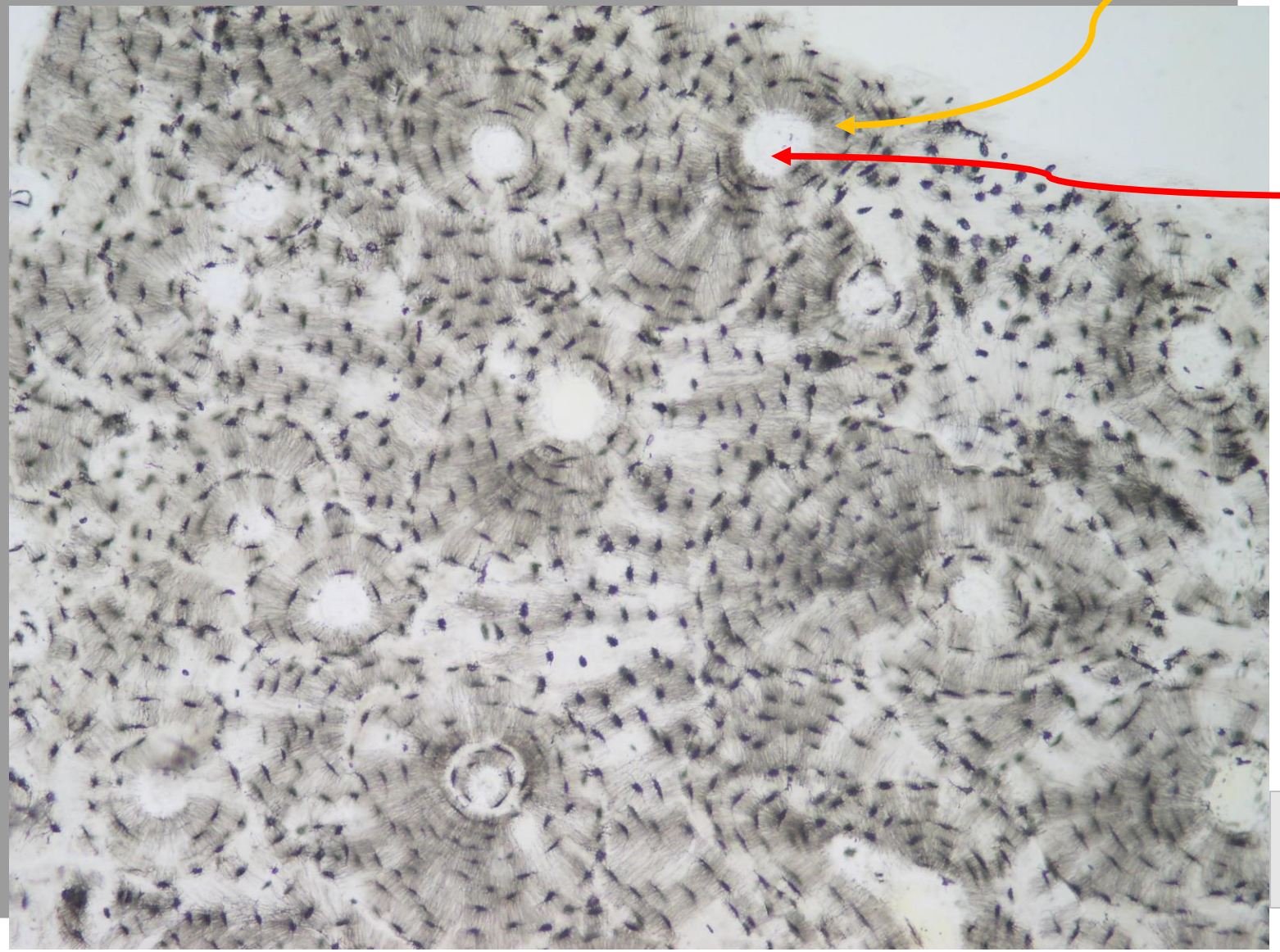
Color coding used in the modified:

- *Black: the original slides*
- *Maroon: the doctor’s explanation/words*
- *Gray: additional information and explanation*
- *Red: important information*

Compact Bone ground

Taken with light microscope

Ground section of bone :
Sand and Trim the section as thin as possible and nothing else
+
Hard tissue that cannot be stained as it's fully impregnated by the inorganic material



Osteons onion rings

Central Canals inside there are the neurovascular bundles and sometimes osteogenic cells that give rise to osteoblasts. You can visualize the canaliculi

An area with more concentric lamellae will be older than an area with less concentric lamellae

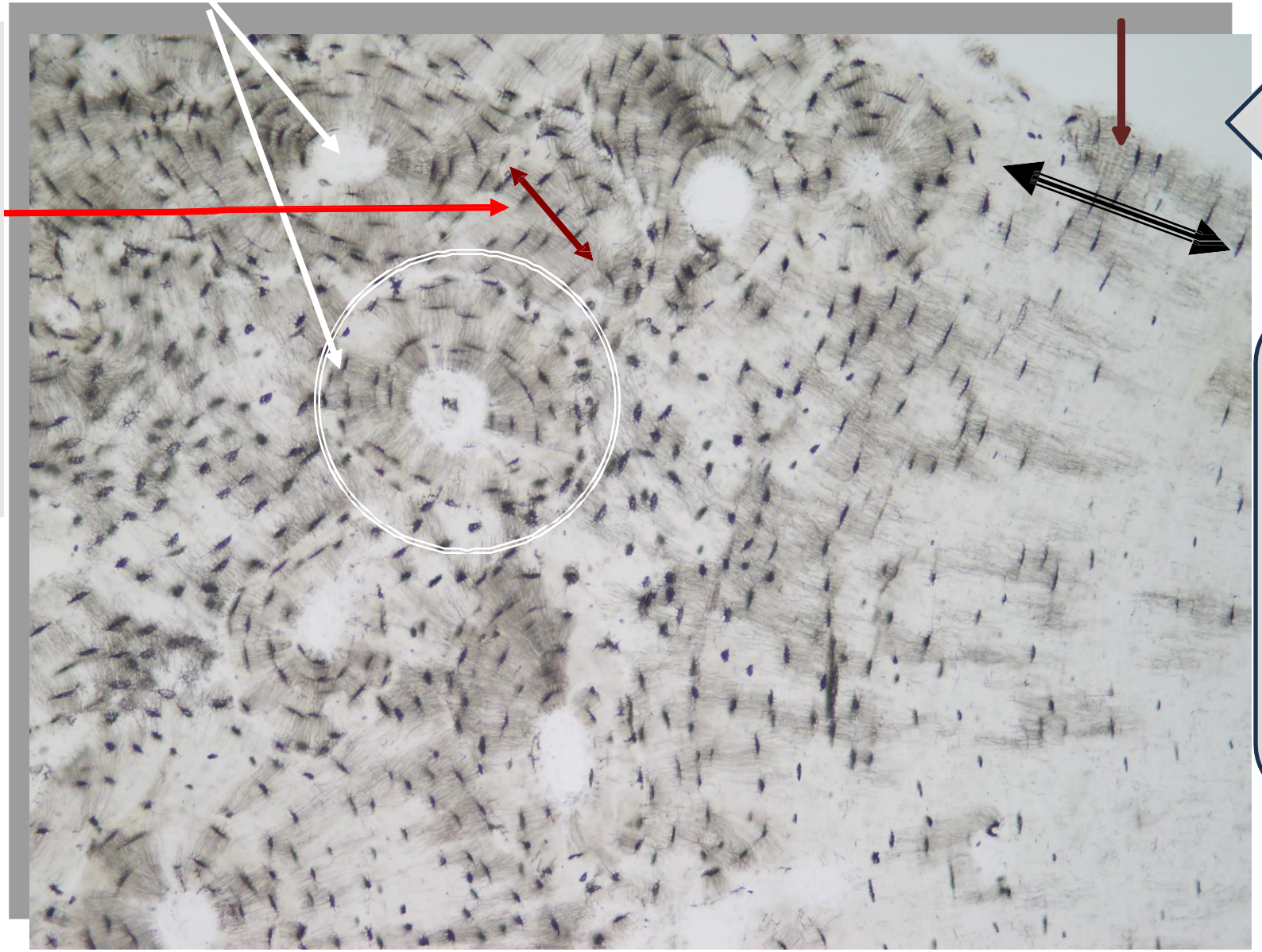
These black dots are the lacunas

Found under the periosteum

Osteons

Outer circumenferrintial lamellae

Interstitial lamellae (randomly arranged).
These were part of older osteons but the bone is in a constant state of remodelling (removing older osteons and adding new ones)

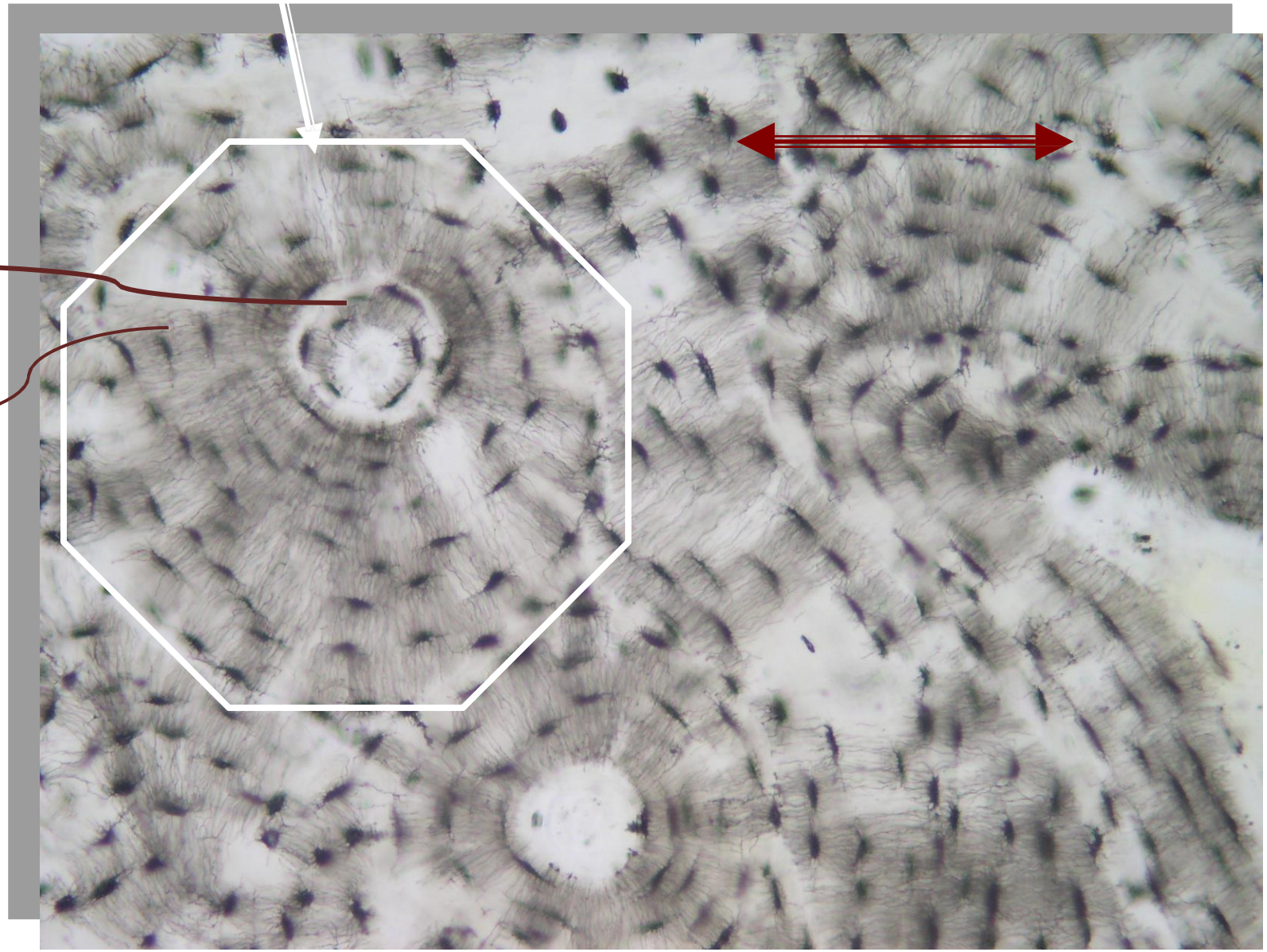


highway

canaliculi are tiny canals in the matrix in which the osteocytes send out their processes to communicate with each other via gap junctions

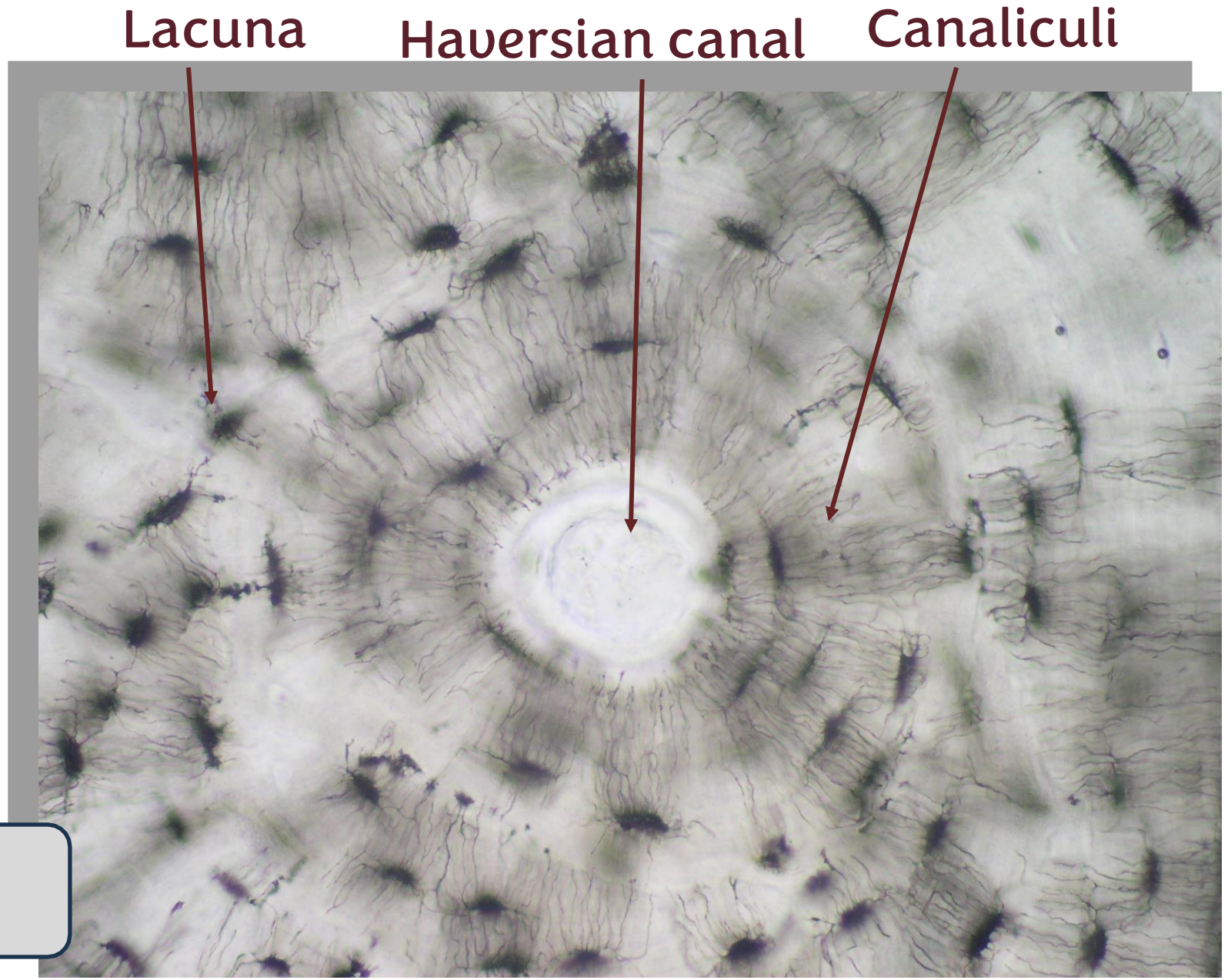
Osteon

interstitial lamellae

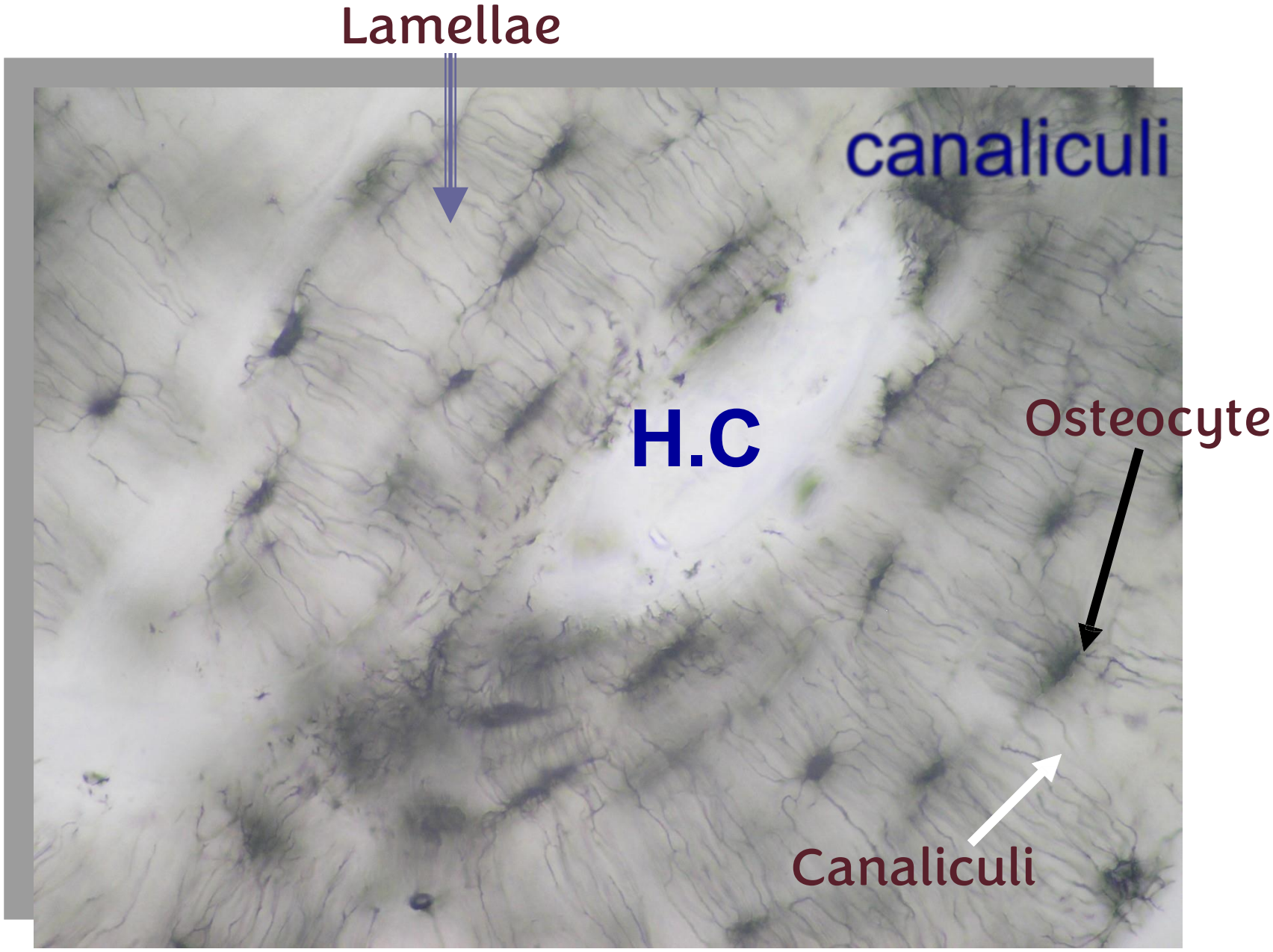


Concentric lamellae

All the tiny hairy structures are the canaliculi Where processes connect via gap junctions

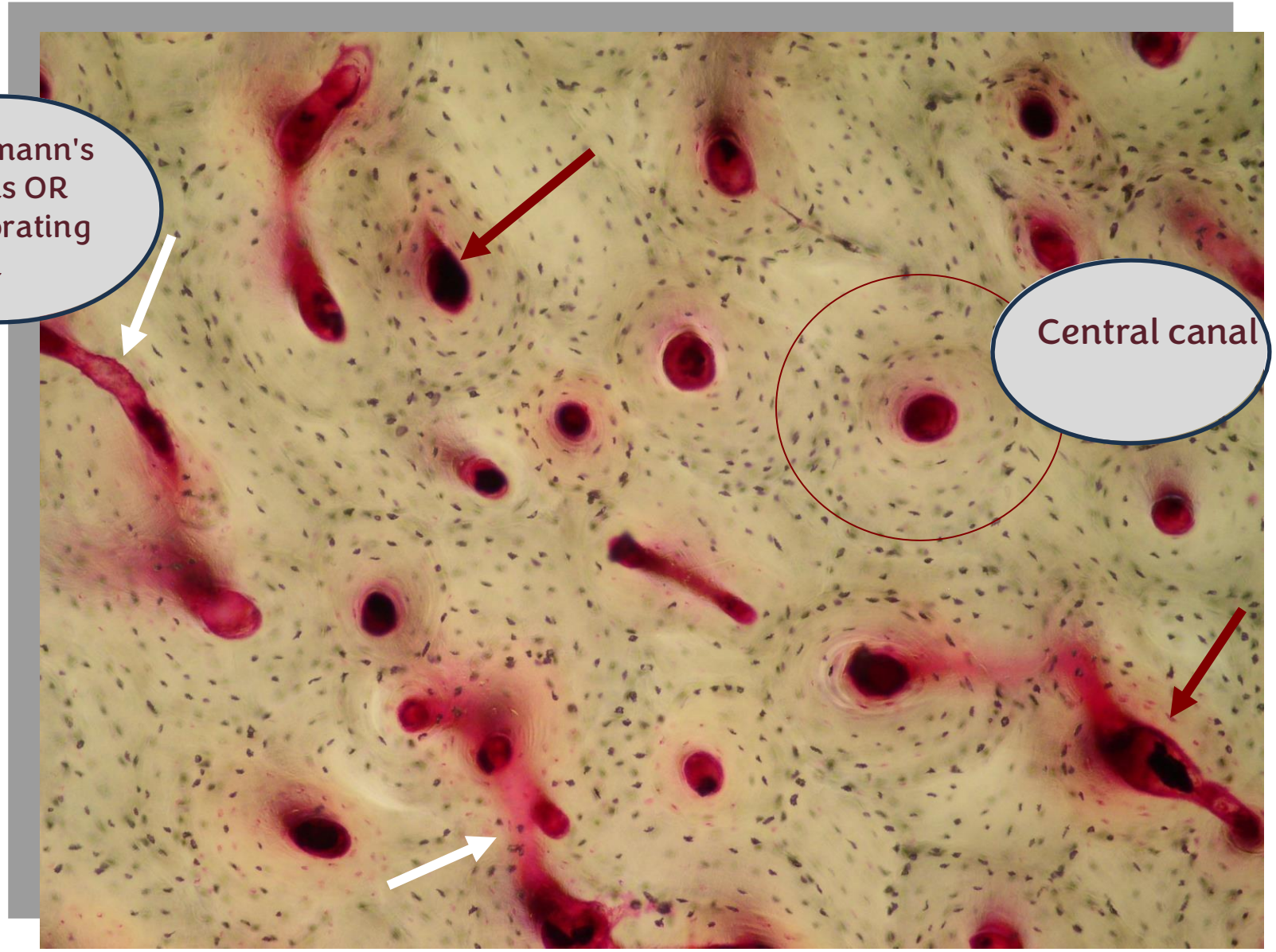


Haversian canal=Central



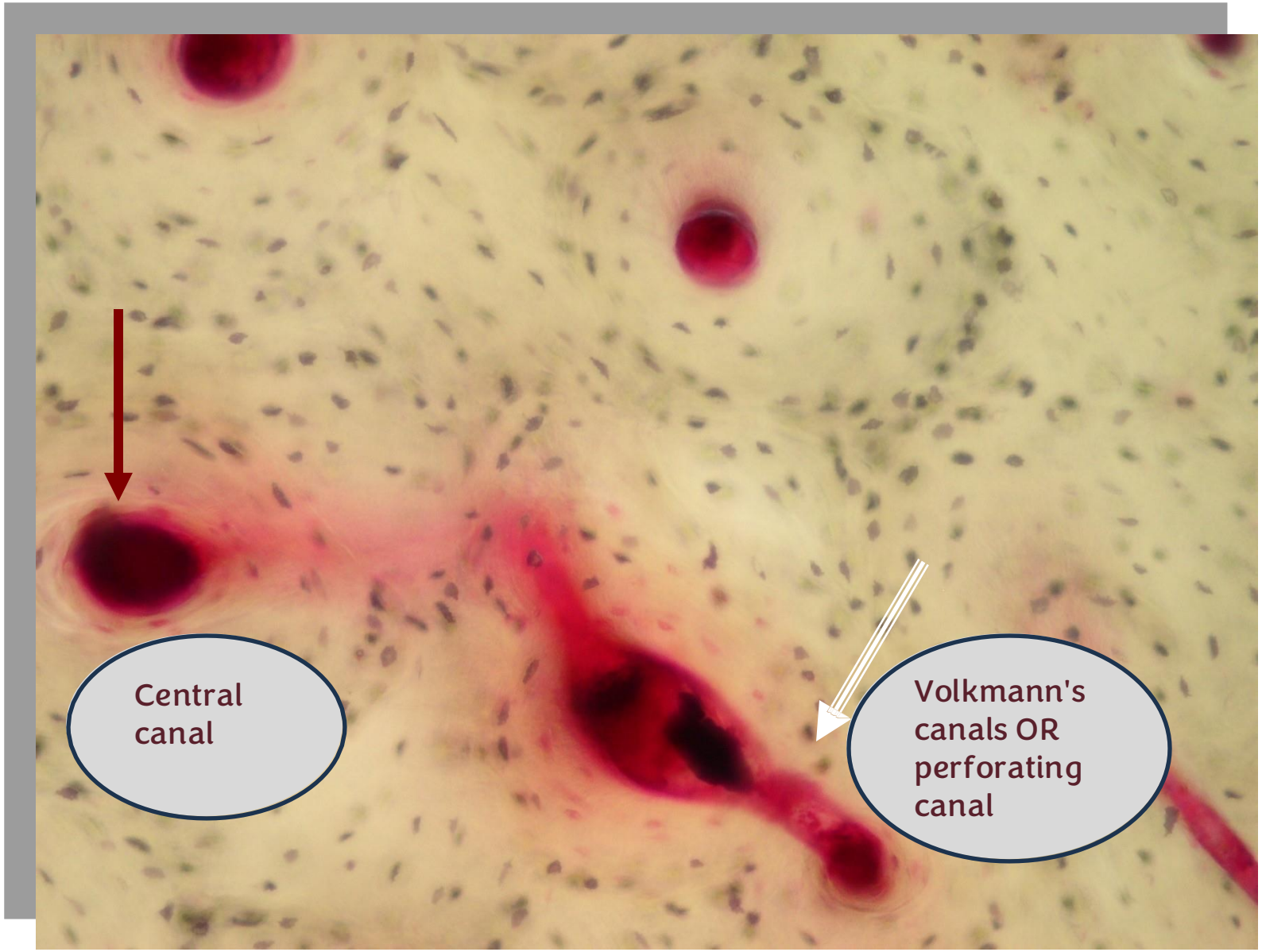
H.C = C.C = Haversian canal/central canal

Compact bone(injected ink)



Ink was injected to visualize the canal network

Haversian&Volkman's canal



Decalcified compact bone

Decalcified: removing the inorganic material so the organic components can be stained

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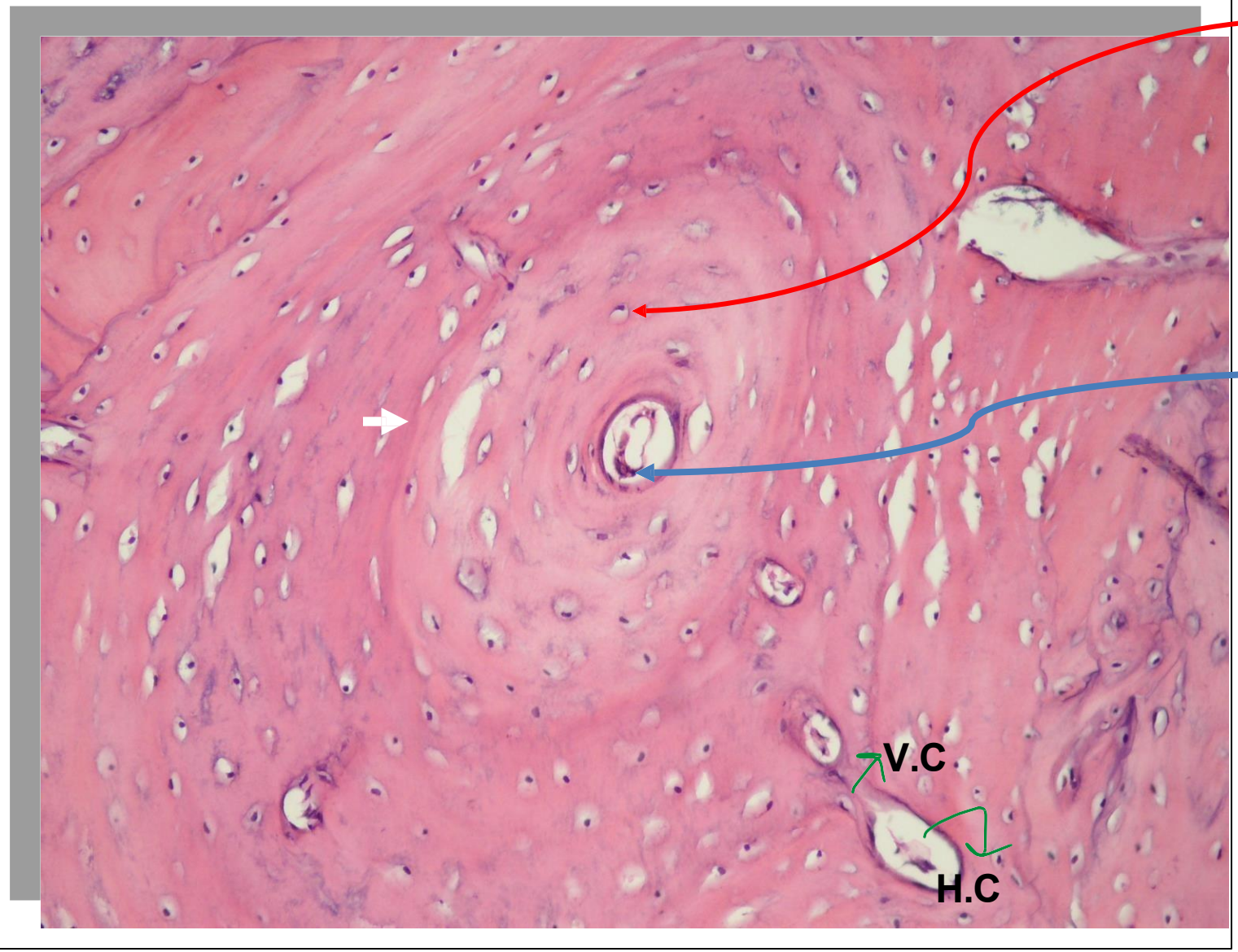
This image was taken by a bright field LM and the stains used are H&E



lacuna with Osteocytes inside more rounded in decalcified due to fewer minerals which makes it MORE RELAXED

centralmost canals

Most eosinophilic = from collagen= more pinkish.

More basophilic = from GAGs(less than cartilage)

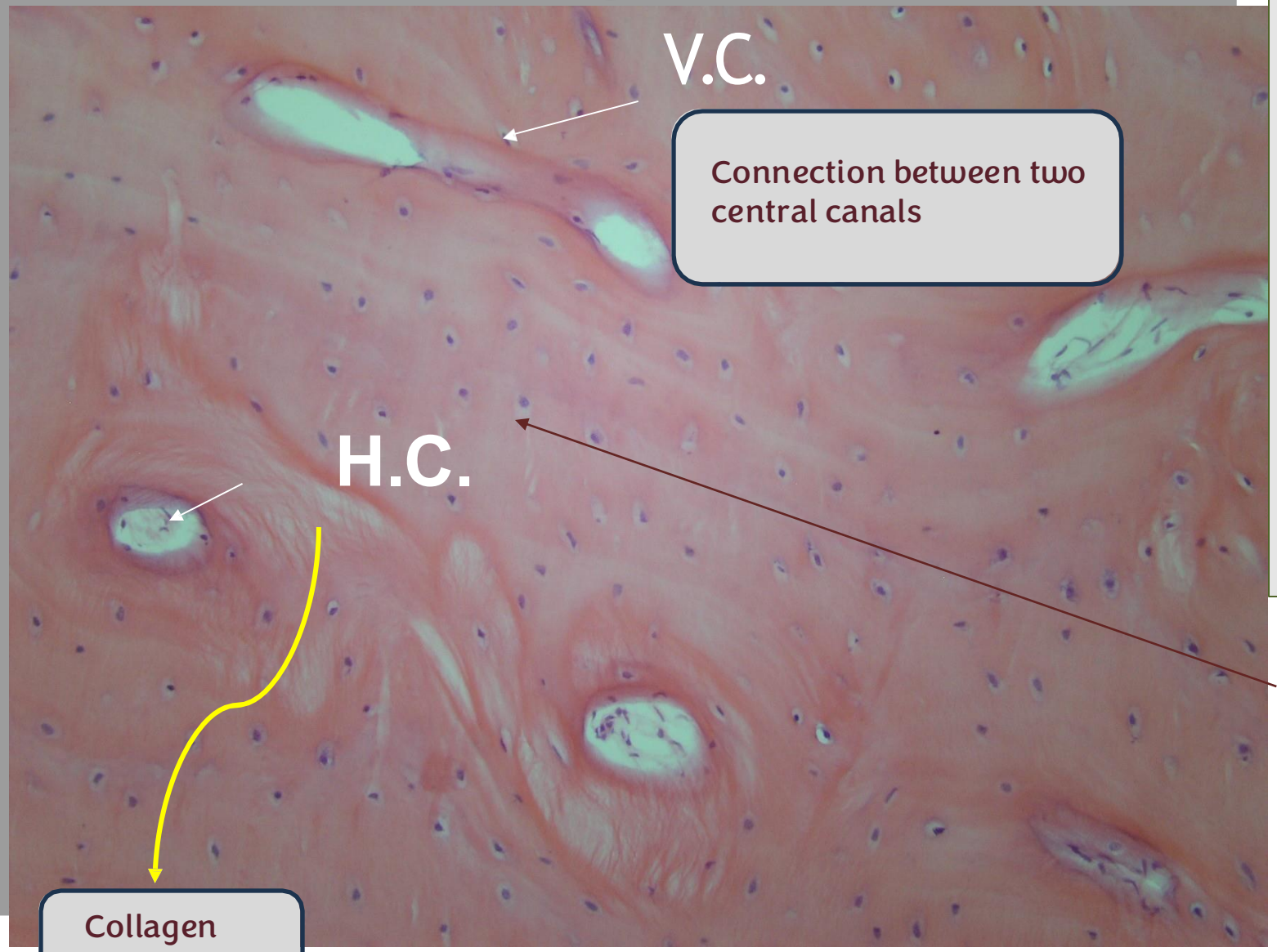
An osteon can be identified more clearly in the bone- ground section

The following cannot be identified in the picture:

- Circumferential lamellae
- Canaliculi

To visualize the canaliculi , we can inject any material that binds to the process of the osteocytes that are found in the canaliculi , and then we use IMMUNOSTAINING

compact bone



It is quite hard to tell between dense irregular ct and decalified bone, but there are some hints that could help you tell between them such as:

Decalcified bone has a lot of big spaces unlike cartilage and dense irregular CT (you can see the osteons, central canal , concentric lamellae within the section of decalcifed bone)

The nuclei that are shown are for OSTEOCYTES

Spongy bone = cancellous bone

Spongy bone (articular surface)

2 types of tissues

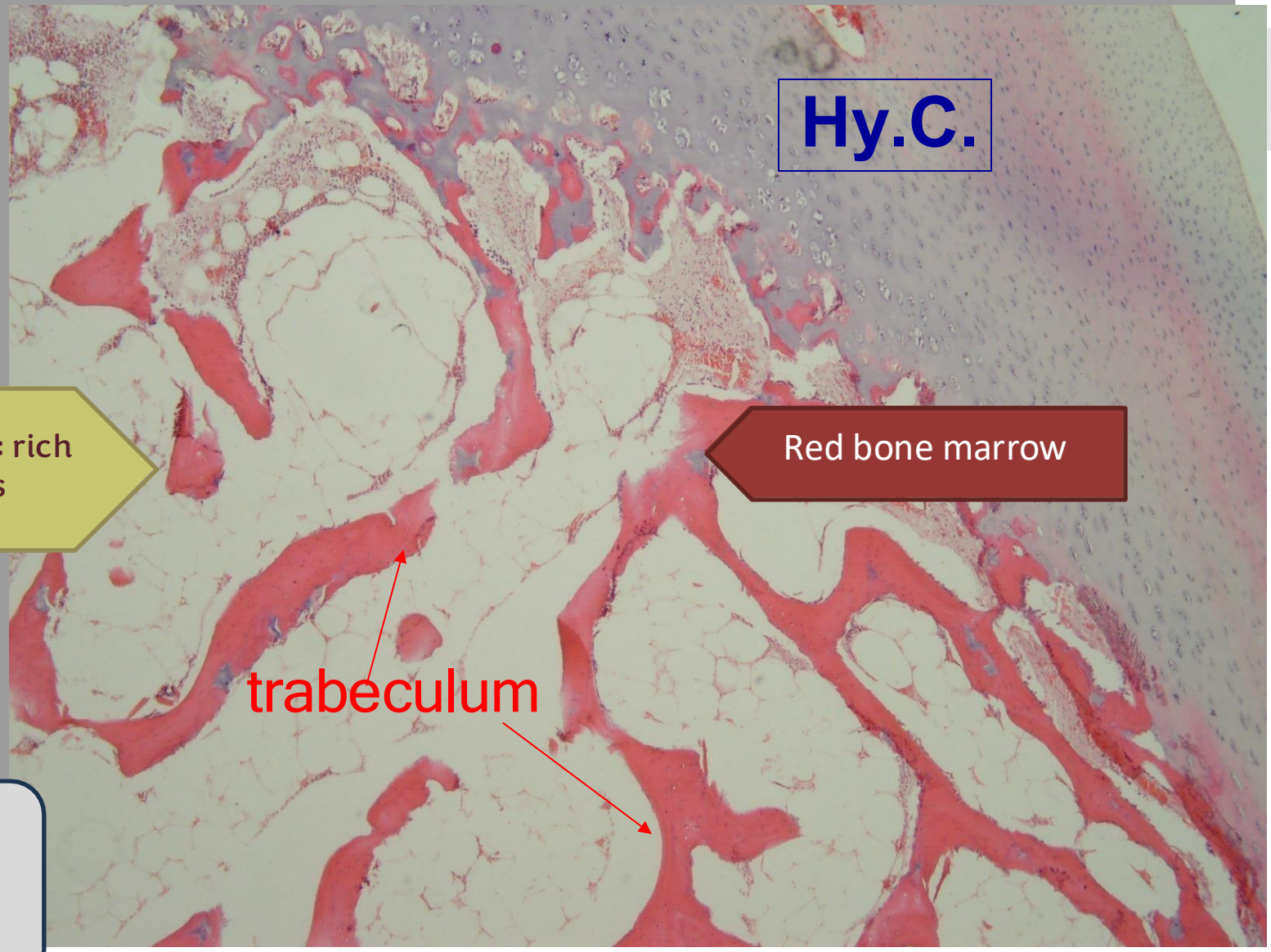
Hyaline cartilage with bone tissue

As we age, yellow bone marrow increase, red bone marrow decrease.

Yellow marrow: rich with adipocytes

There is no perichondrium in articular surfaces. Fibrocartilage doesn't have a perichondrium.

Doesn't have osteons osteocytes are randomly distributed



Hy.C = hyaline cartilage

Decalcified because we were able to stain it and identify the basophilia and eosinophilia.

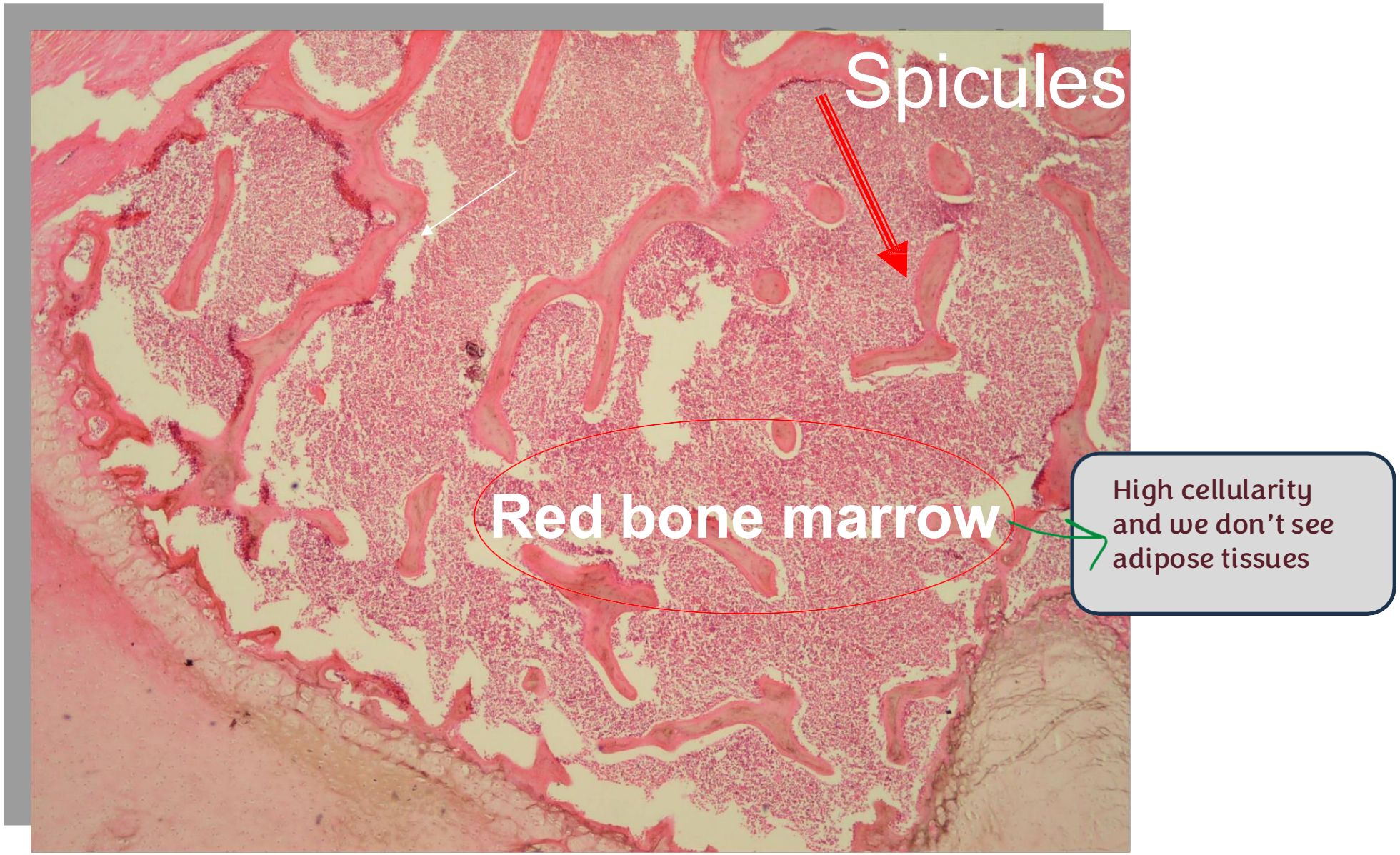
Why is trabeculae so eosinophilic ?
Because it has a lot of collagen fibers

Low magnification

vertebrae

There are no fats at all

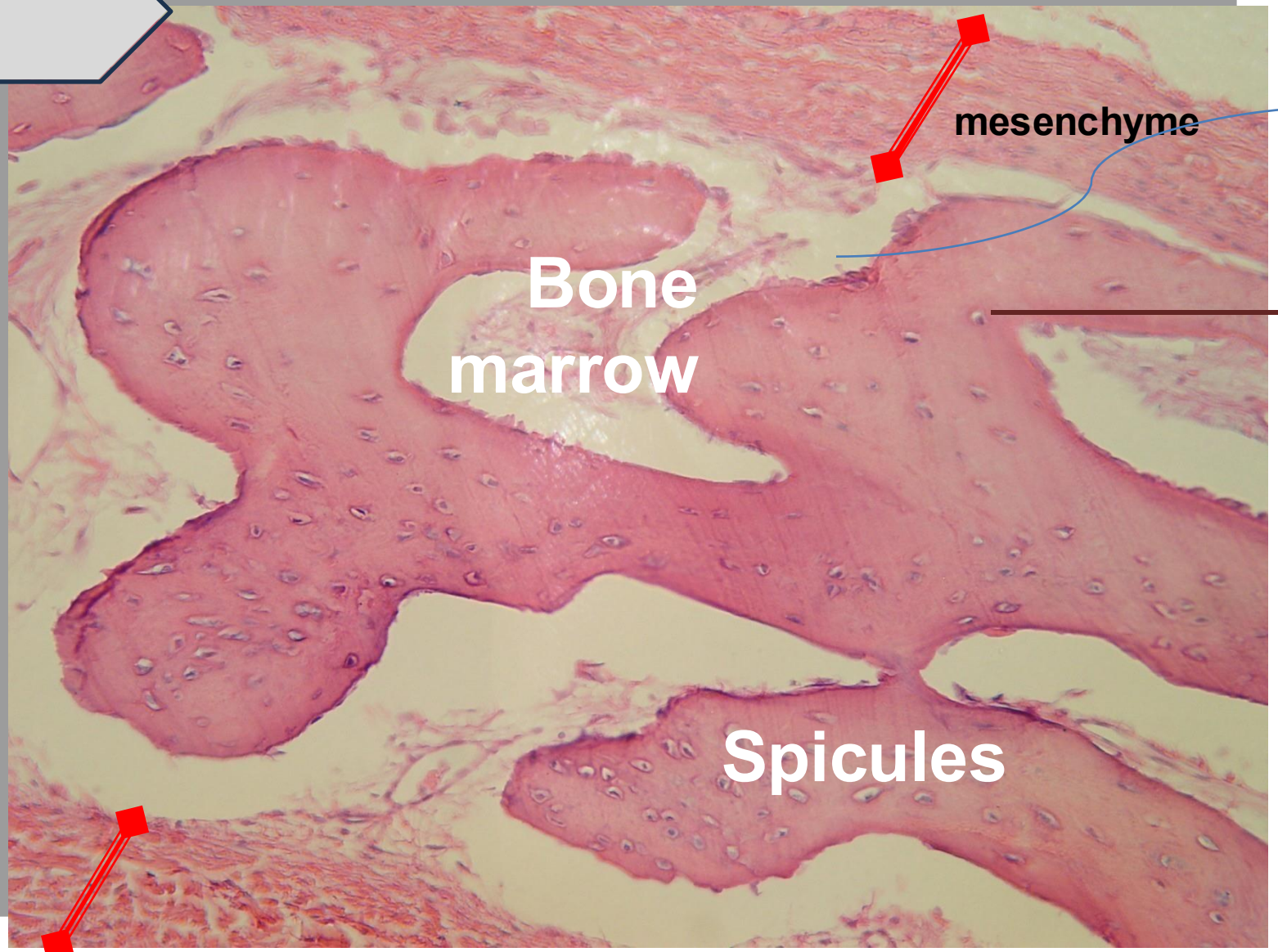
IT IS ONLY FILLED WITH RED BONE MARROW



Mesenchyme C.T

Decalcified –>bright field microscopy –> H&E

Osteocytes can be recognized better in mesenchyme C.T than adult bone.



Synthesize and release the matrix (osteoblasts on the surface)

Osteocyte

This was taken from an embryo due to the mesenchyme CT being shown clearly

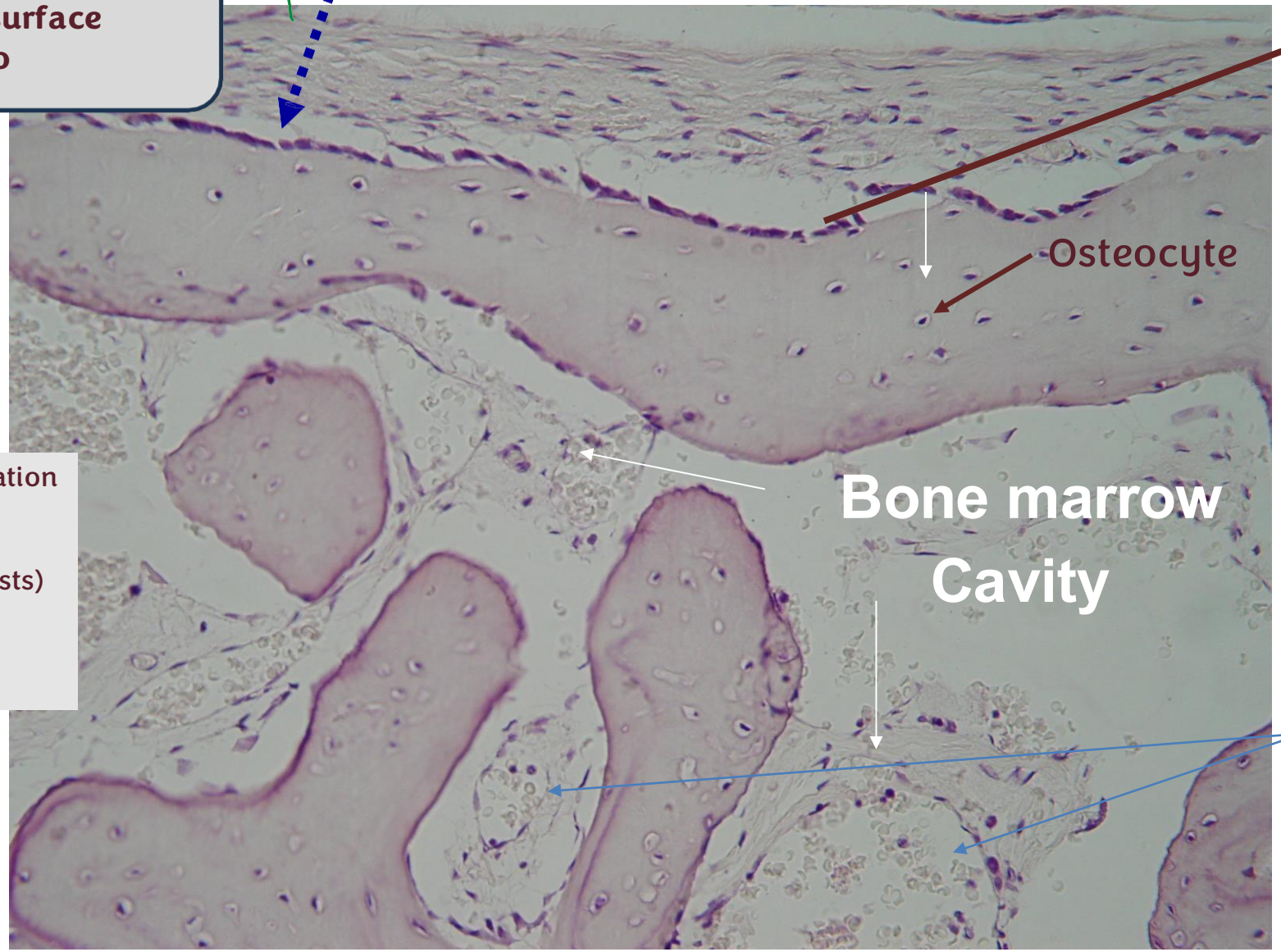
The outer Mesenchyme will form the periosteum

Periosteum = covering of the bone

Osteoblast cell

This part of the mesenchyme will remain at the surface and differentiate to periosteum

decalcified



Differentiated into osteoblast but most of the cells here are the flattened bone lining cells

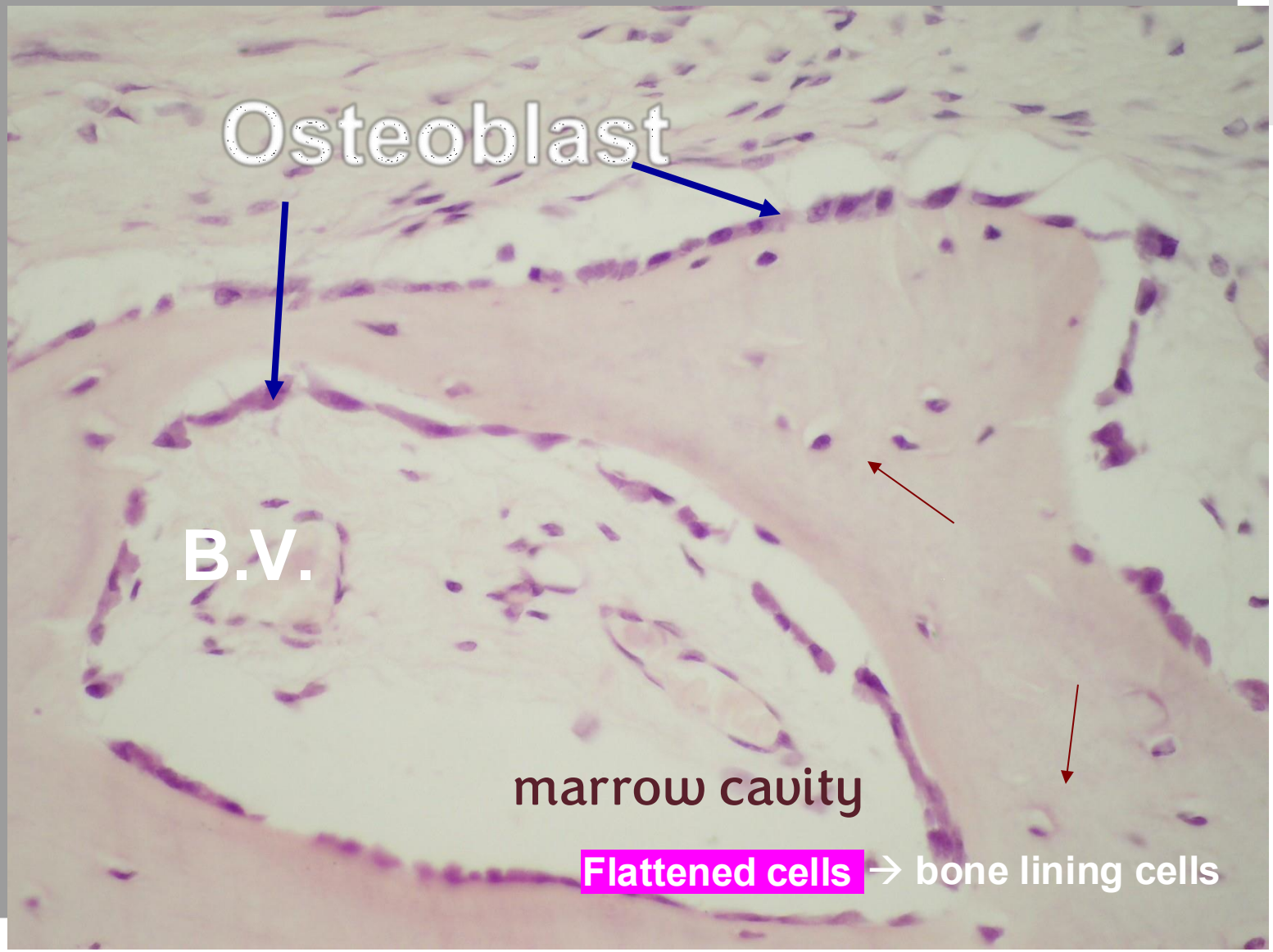
According to Dr.Ghada, a question on exam from this image or from a similar image is expected on the final exam.

Those flattened (squamous) cells are endothelial cells that line the interior surface of blood vessels

The developing bone (ossification region) is highly vascularized, because active bone-forming cells (osteoblasts) require oxygen, nutrients, minerals, and removal of metabolic waste.

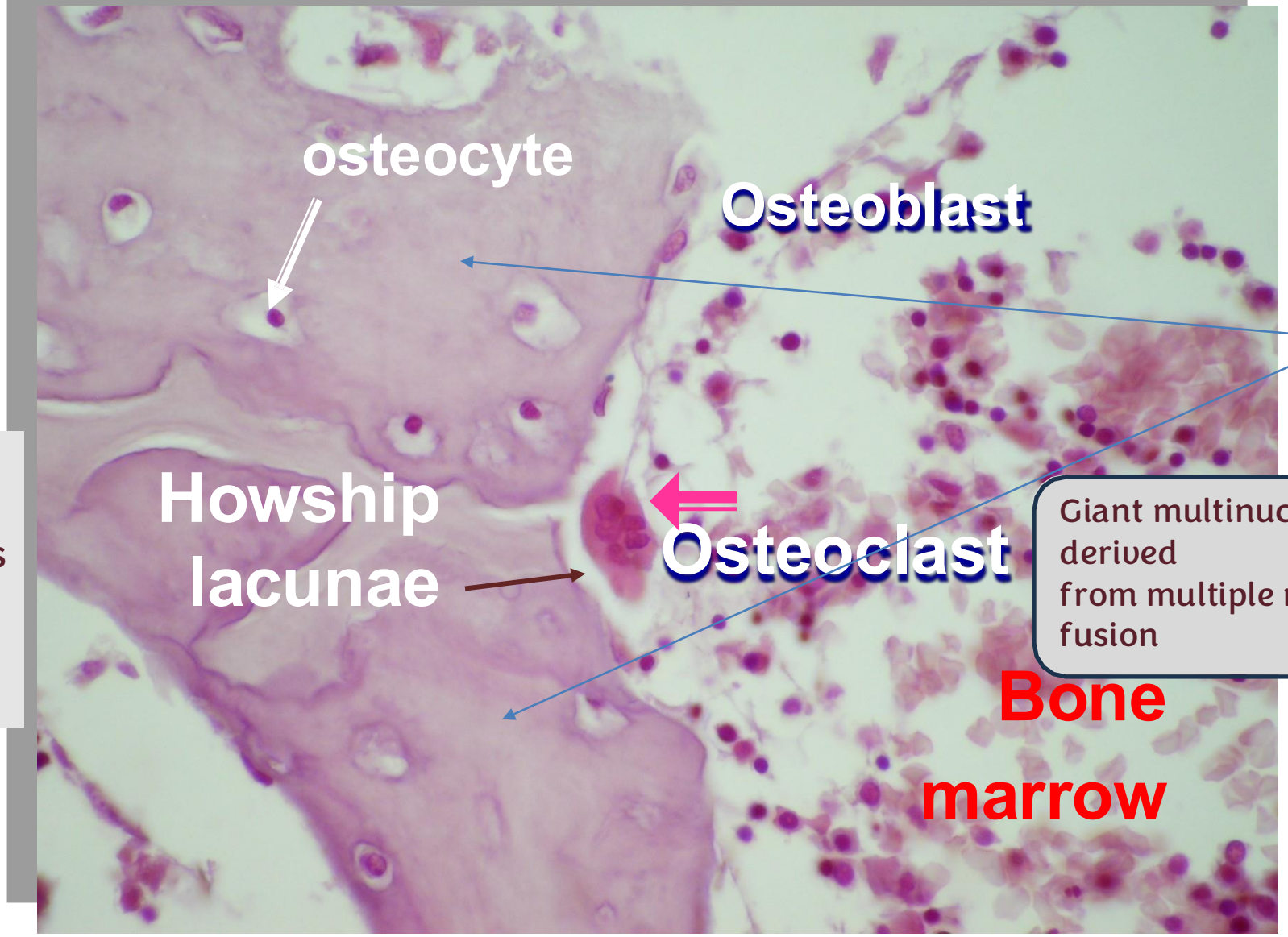
This is not human bone.

The bigger cells are osteoblasts while the flattened ones are bone lining cells



This is the same as last image but magnified

B.V = blood vessels



Howship's lacuna
Depression beneath cells where it digests the matrix and release inorganic components

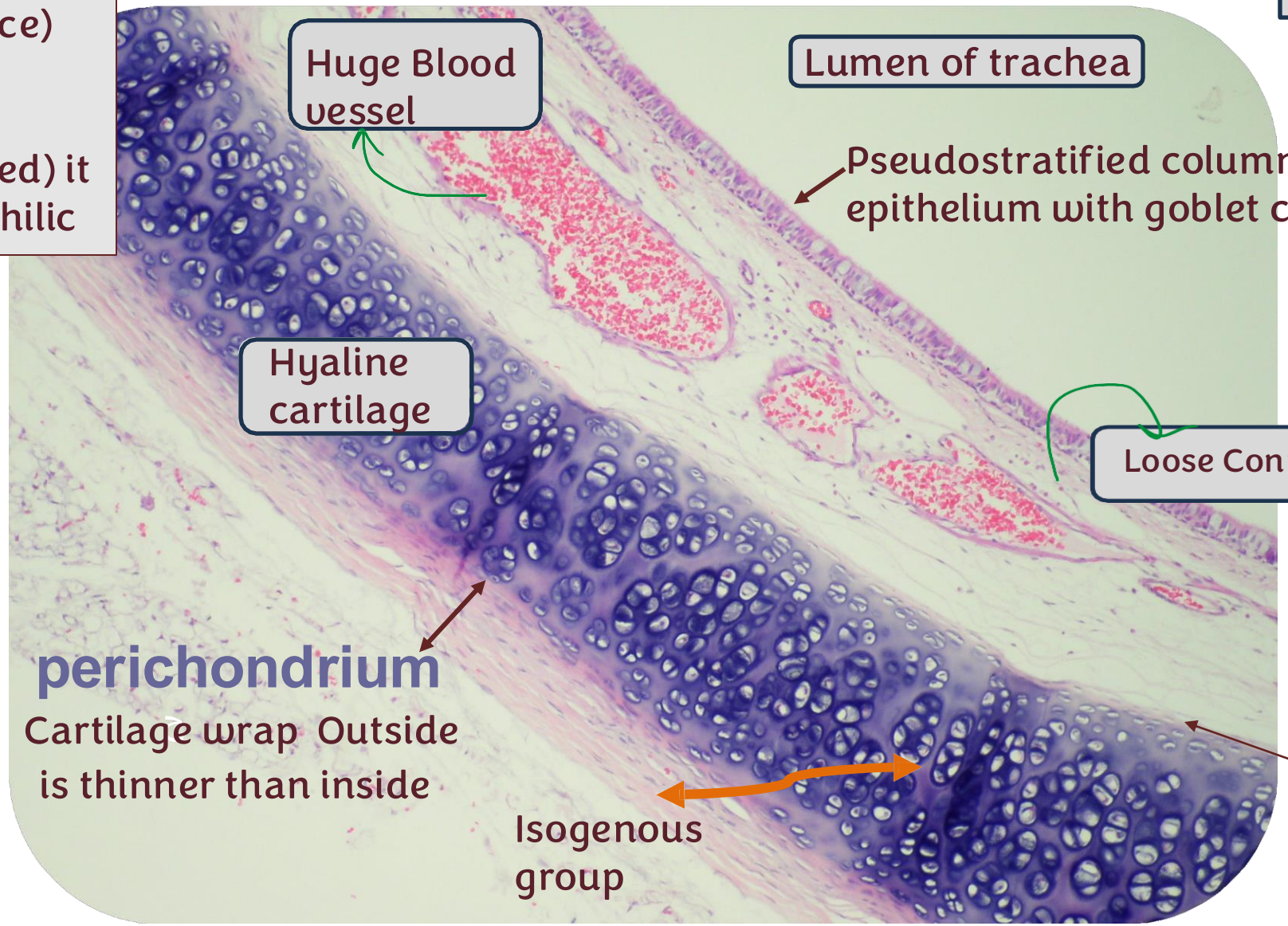
Bone Trabeculae or Bone spicules are present, so this is a spongy bone.

Hyaline Cartilage(e.g :Trachea)

Cells surrounded with matrix (Fibers + ground substance) And because it contains GAGs (negatively charged) it will appear basophilic

The stain used here is H&E

Most abundant type



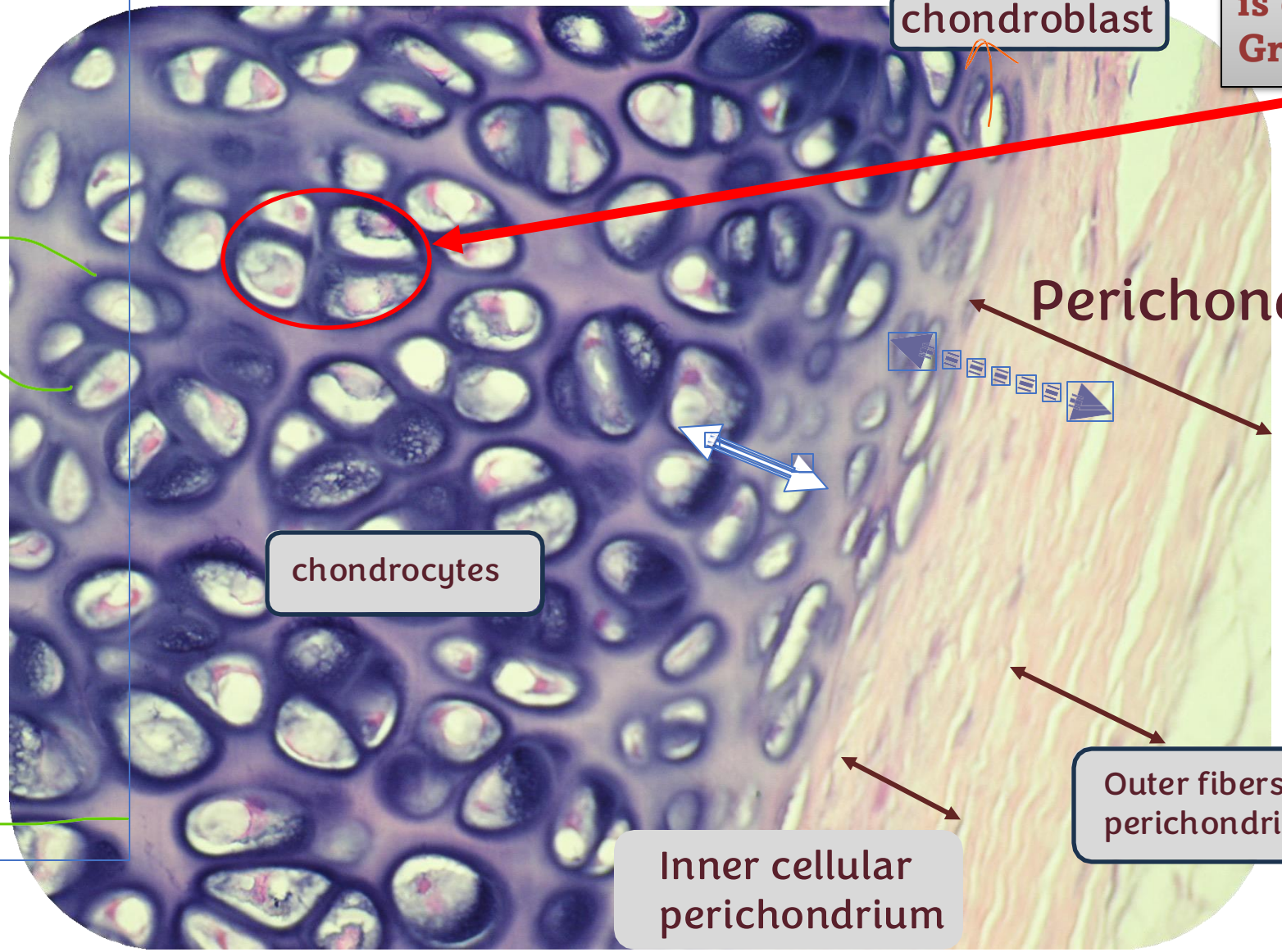
Perichondrium: fibrous + Cellular

This group of cells in hyaline cartilage is called Isogenous Group or Cell Nest

territorial matrix : (More basophilic Rich with GAGs) Immediately surrounds the lacuna

Both are in hyaline cartilage

More eosinophilic matrix: rich with collagen and less GAGs –> interterritorial matrix

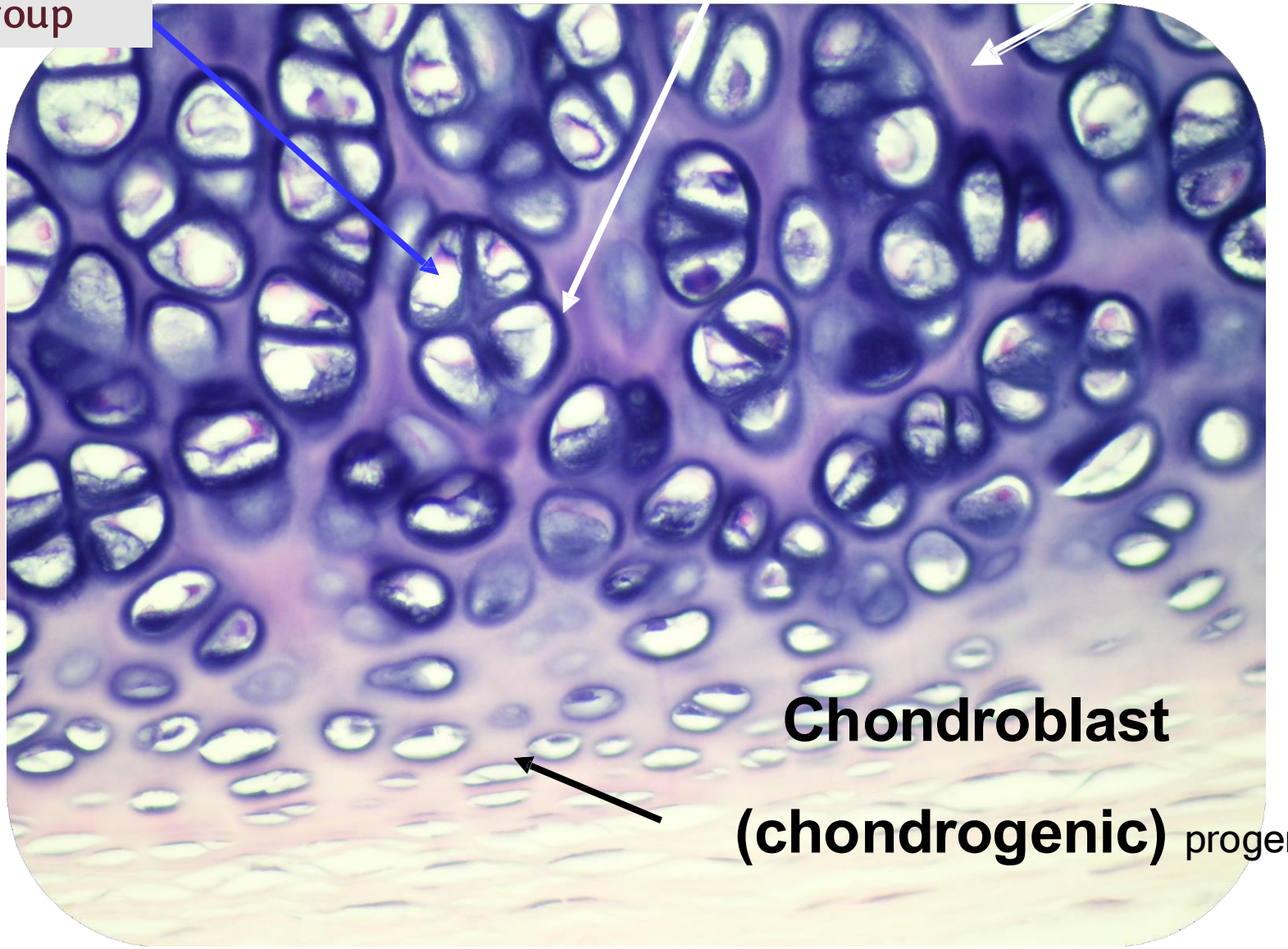


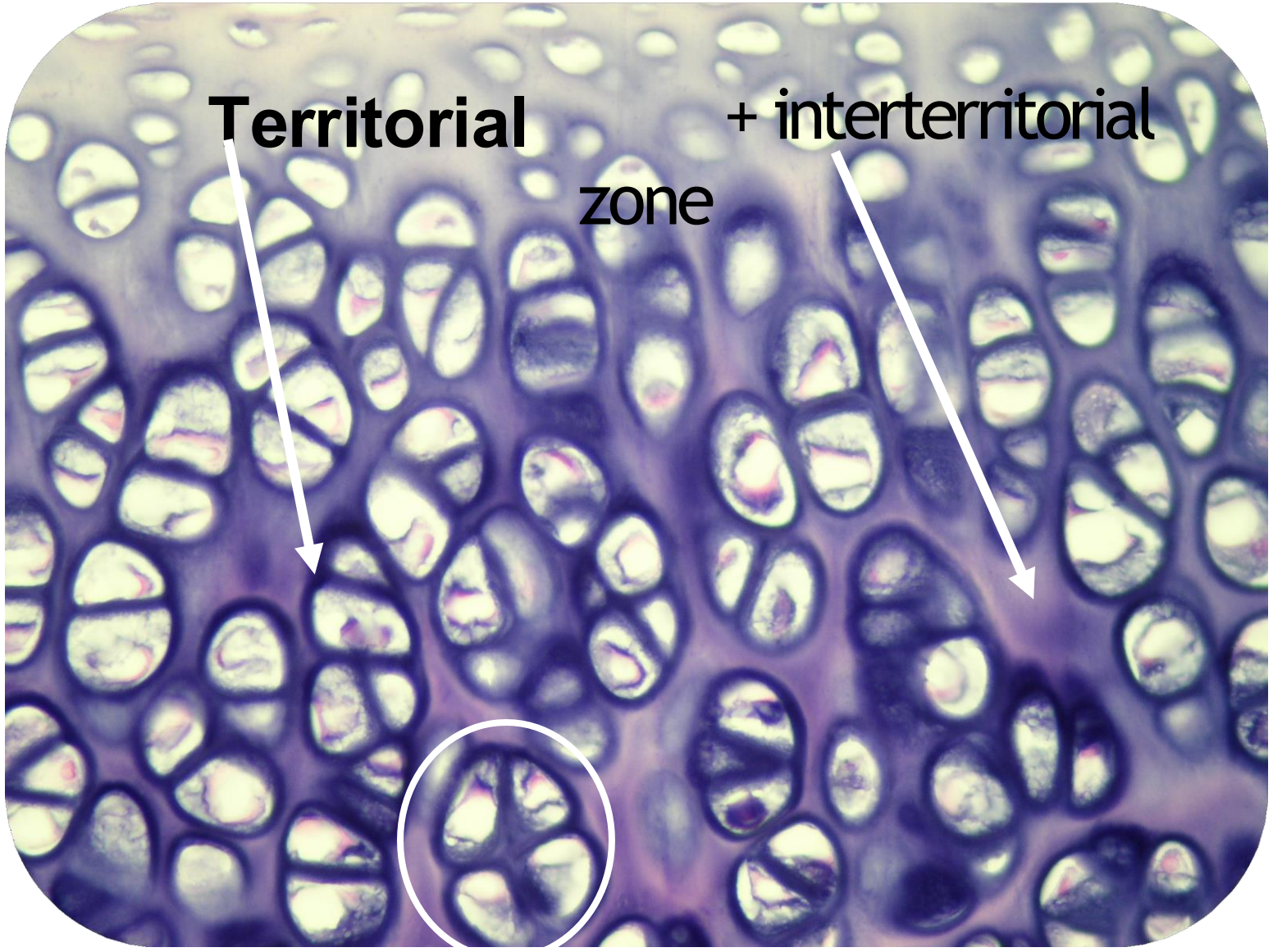
Immunostaining can help identify chondrogenic cells from fibroblast

Chondrocyte in lacunae: Territorial+ interterritorial

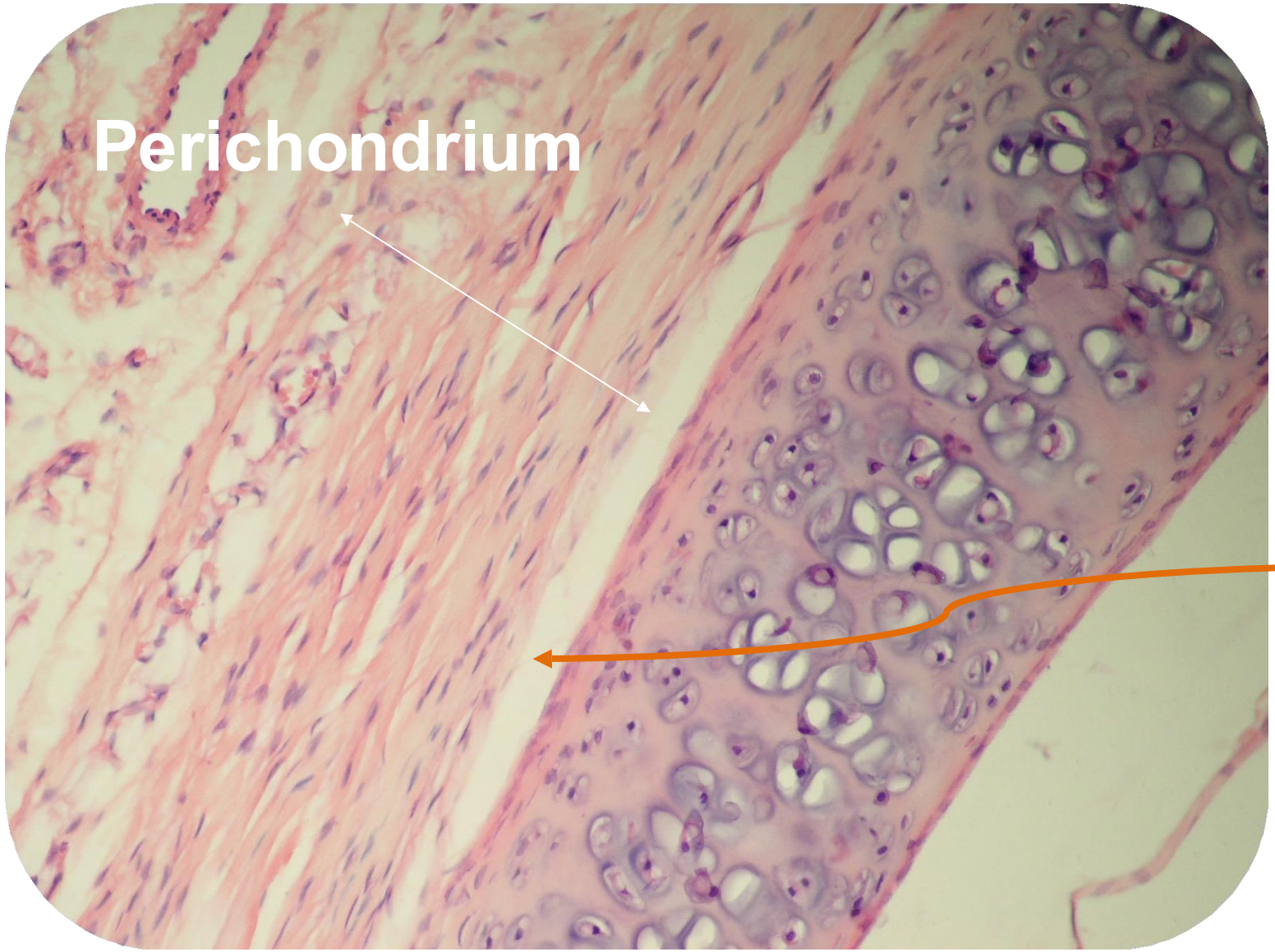
Isogenous group

Extra : isogenous group is a cluster of two to eight genetically identical chondrocytes (cartilage cells) located within a single lacuna (space) in hyaline or elastic cartilage



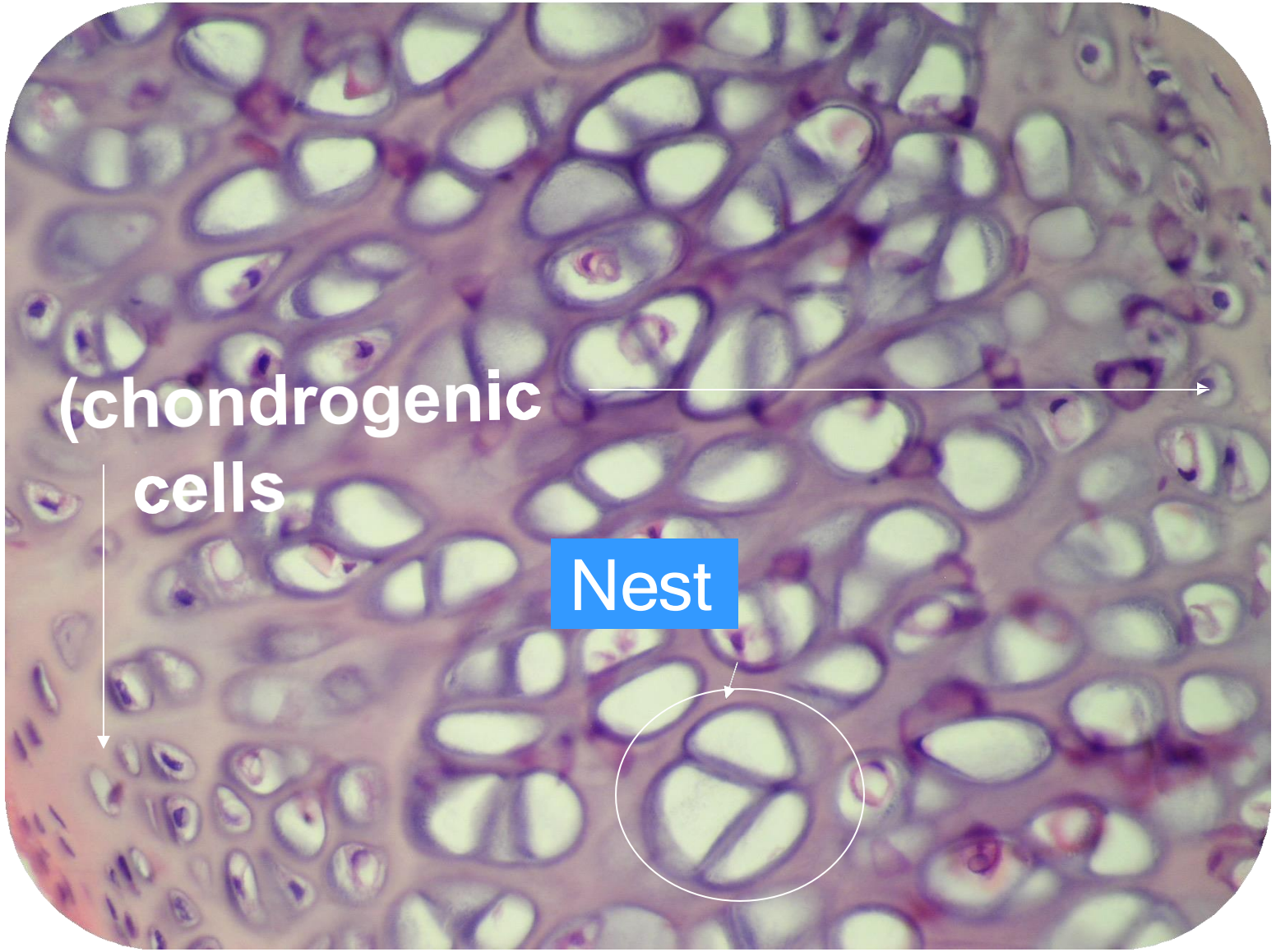

Territorial
zone
+ interterritorial
Nest

Hyaline Cartilage (e.g: Trachea)



Less basophilia —>due to technique of staining (like applying hematoxylin for a short period of time) and not having “fewer GAGs”

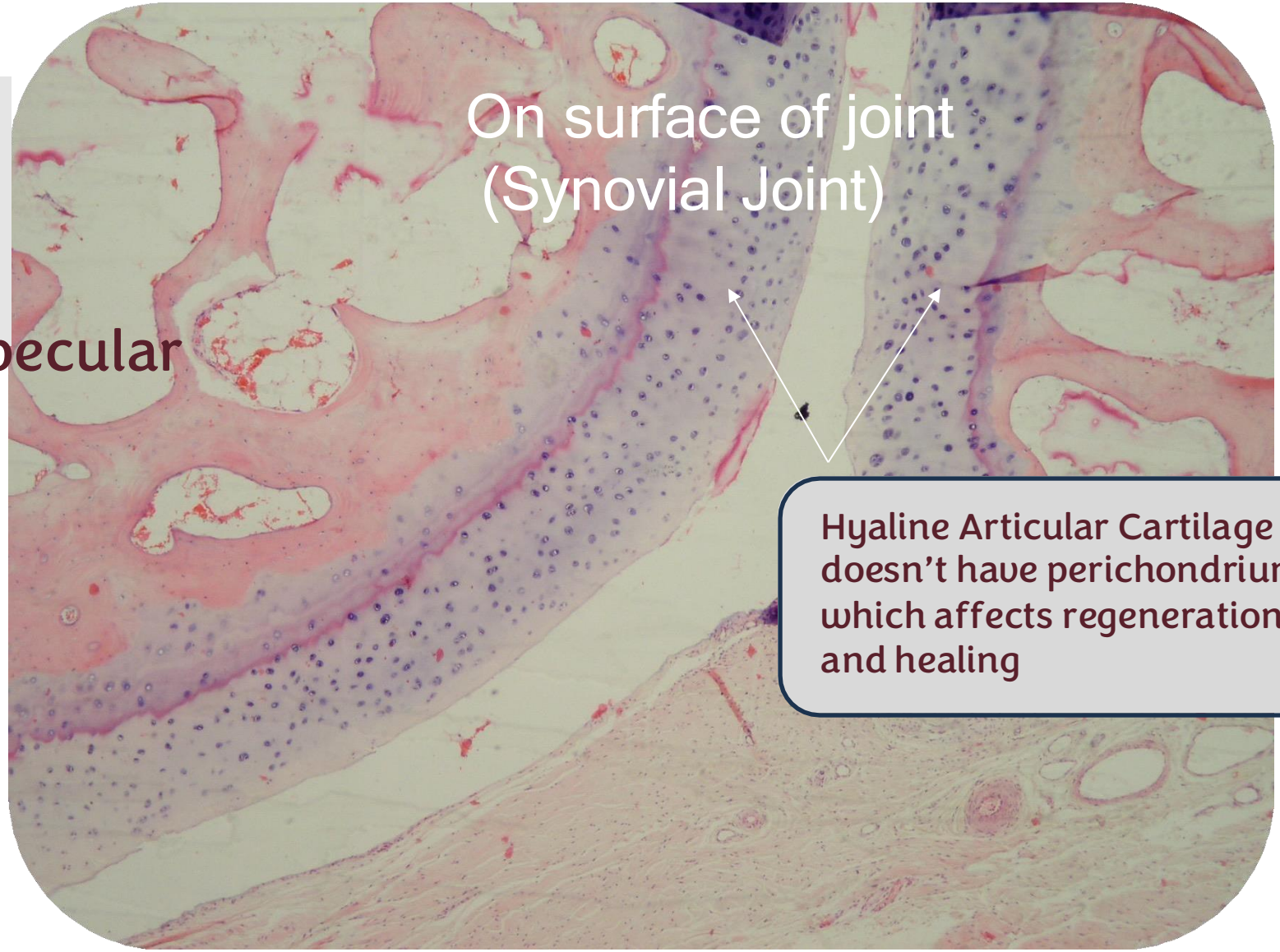
The Space is an artifact (separation between perichondrium and cartilage and part of the inner cellular layer)


(chondrogenic
cells
Nest

Articular cartilage

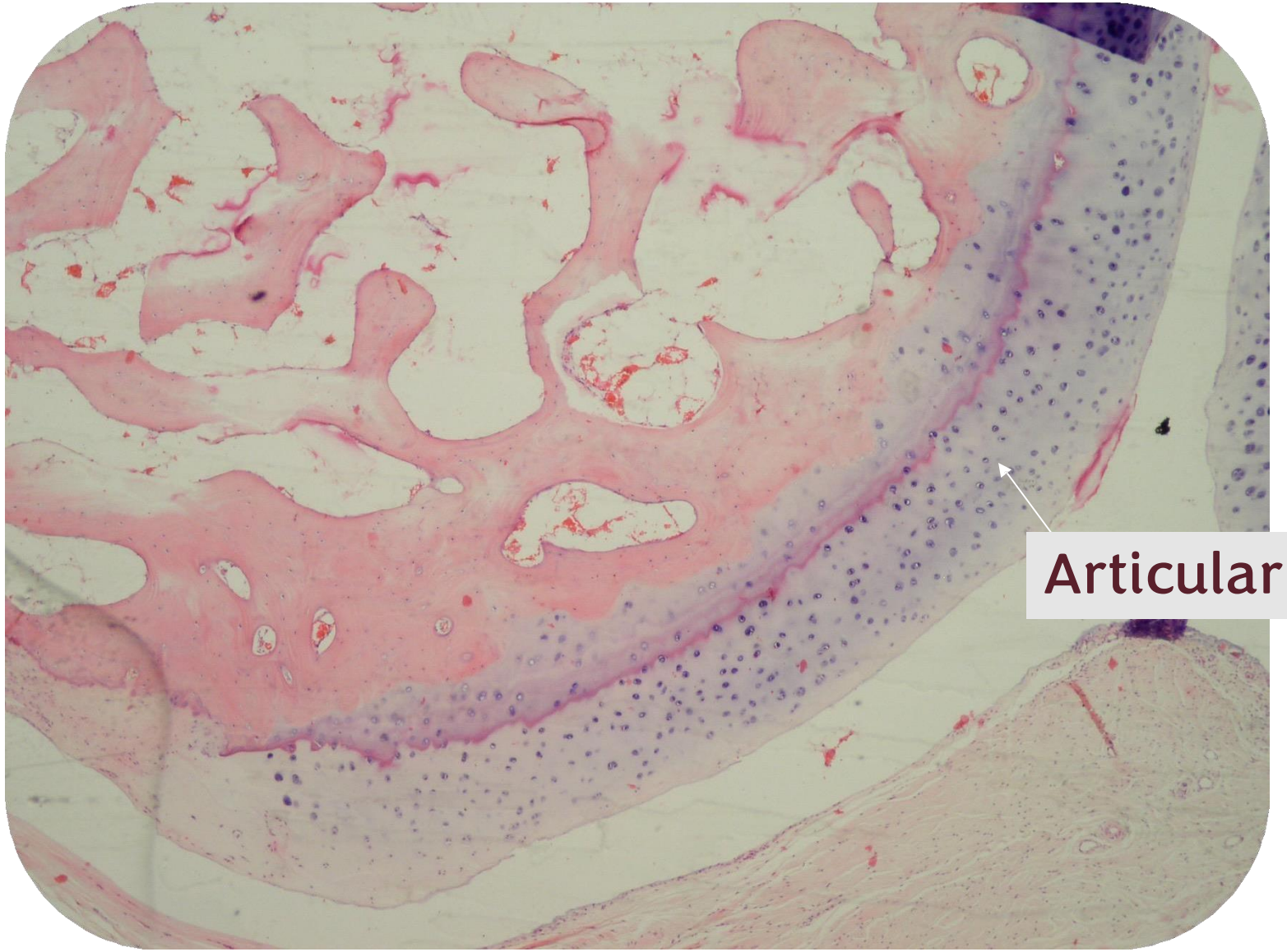
More yellow bone marrow than red bone marrow (we knew because there is less cells and there are fat cells)

trabecular



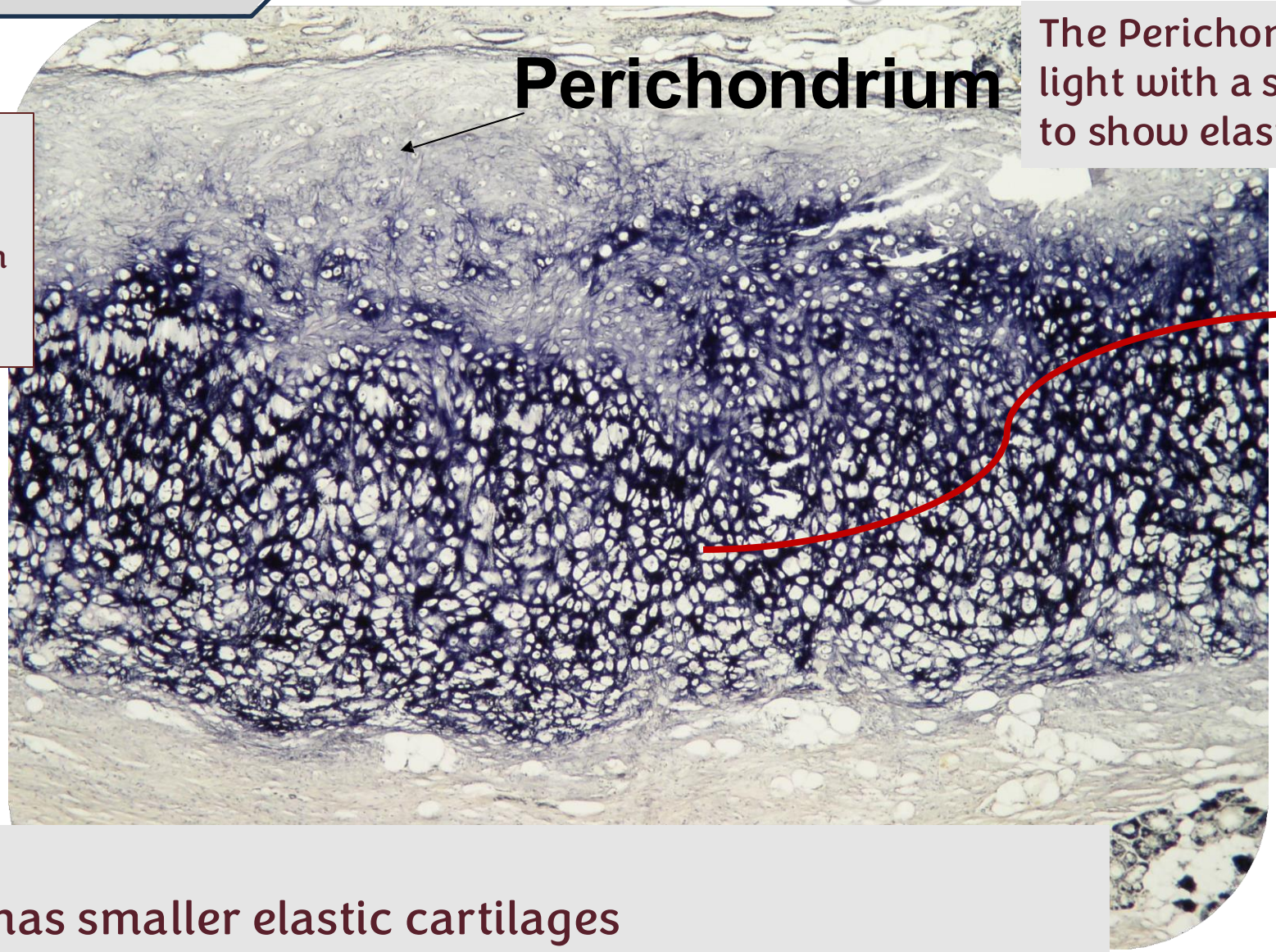
Hyaline Articular Cartilage doesn't have perichondrium which affects regeneration and healing

On surfaces of joint



Elastic Cartilage:

Rich with elastic fibers



The Perichondrium stains light with a special stain used to show elastic fibers

Found in the respiratory tract ,external part of the ear (auricle and part of the auditory canal) and in the epiglottis (a cartilage found in the larynx)

Lacuna for the chondrocytes

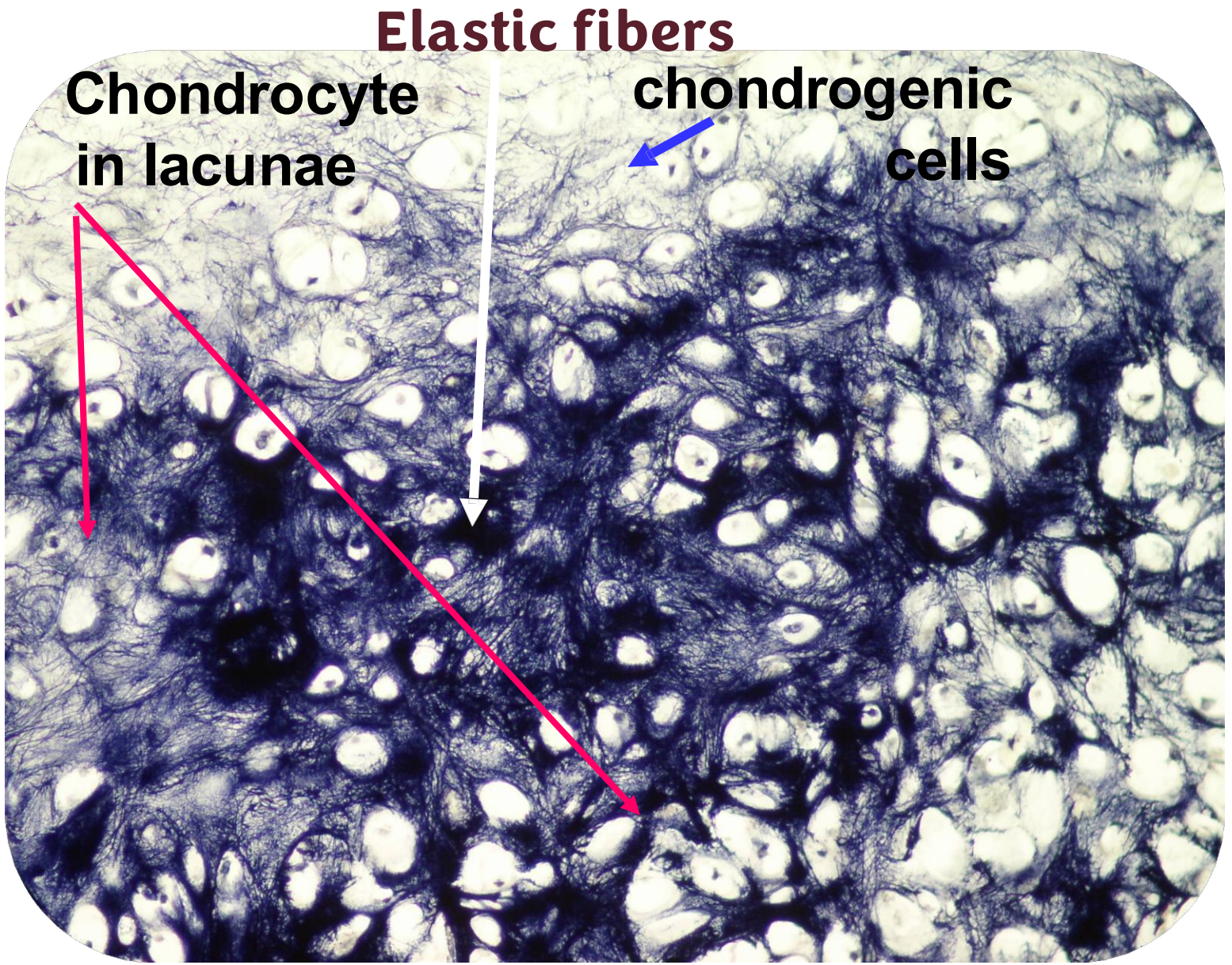
Notes:

1. The larynx also has smaller elastic cartilages
2. The circles in the tissue are all lacunas for chondrocytes

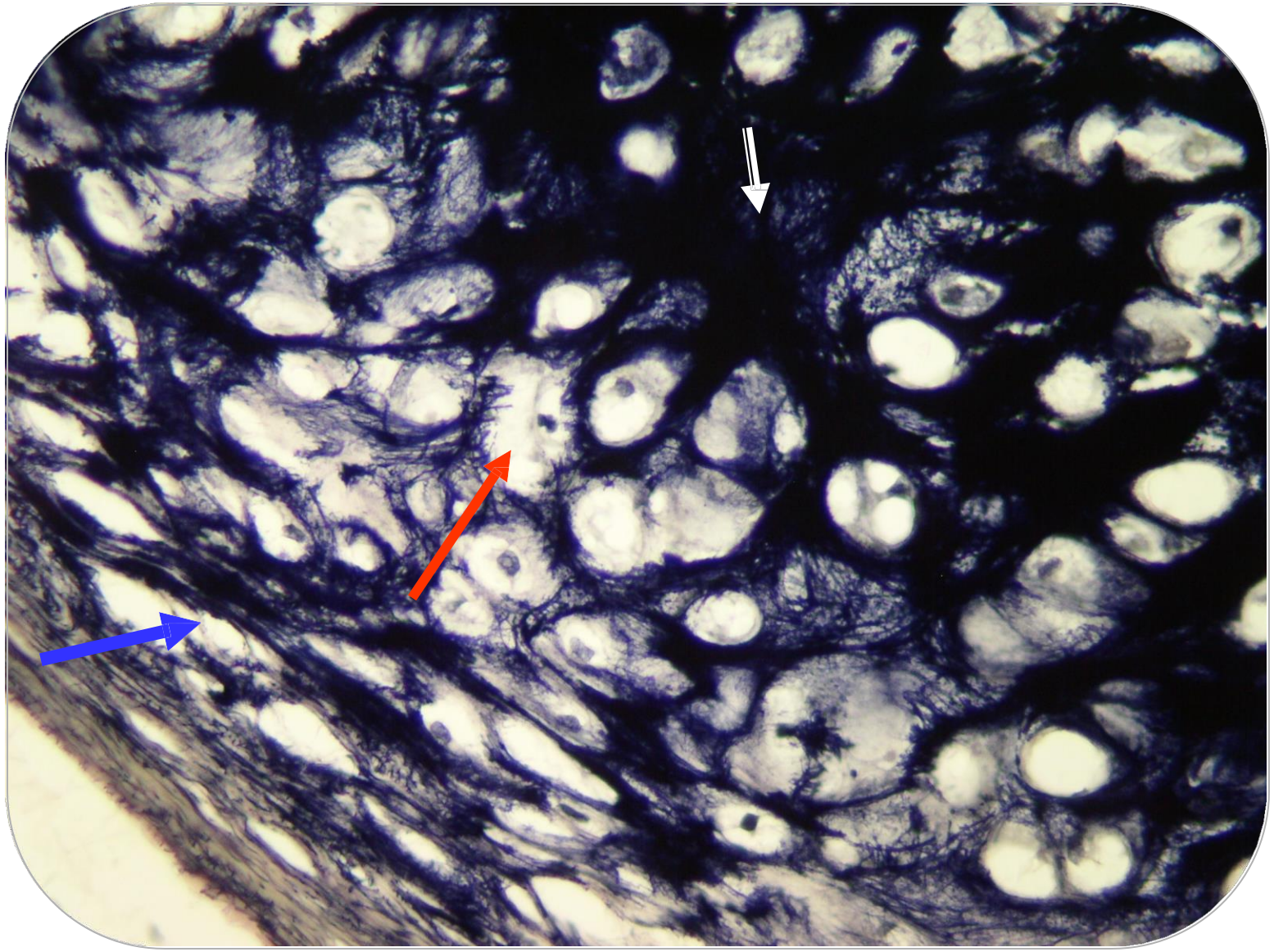
Going outside → less elastic fibers→ less staining→ closer to outer of elastic cartilage and perichondrium

Higher magnification.

Some isogenous groups

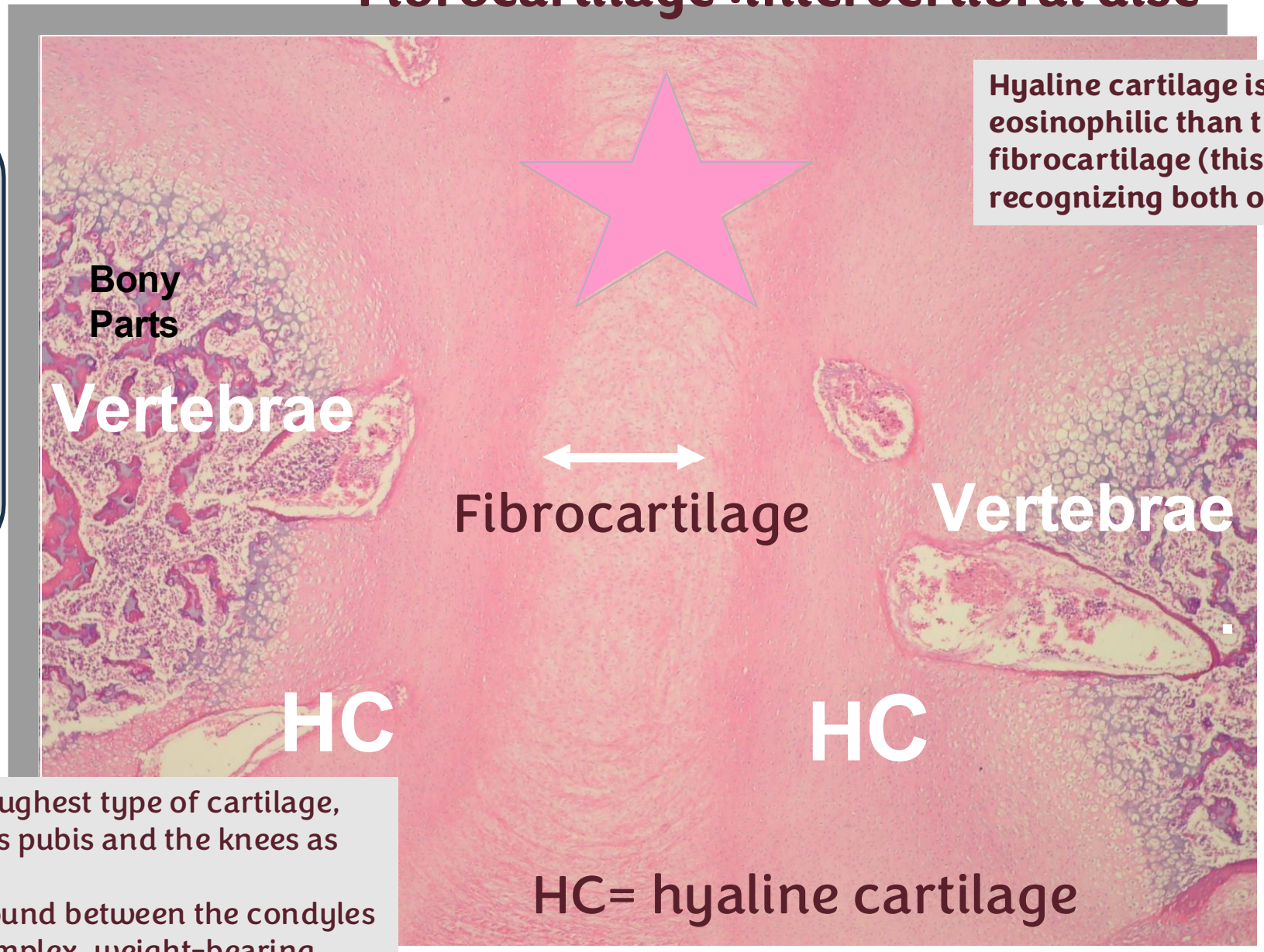


The same as previous, but with higher magnification



Fibrocartilage :intervertibral disc

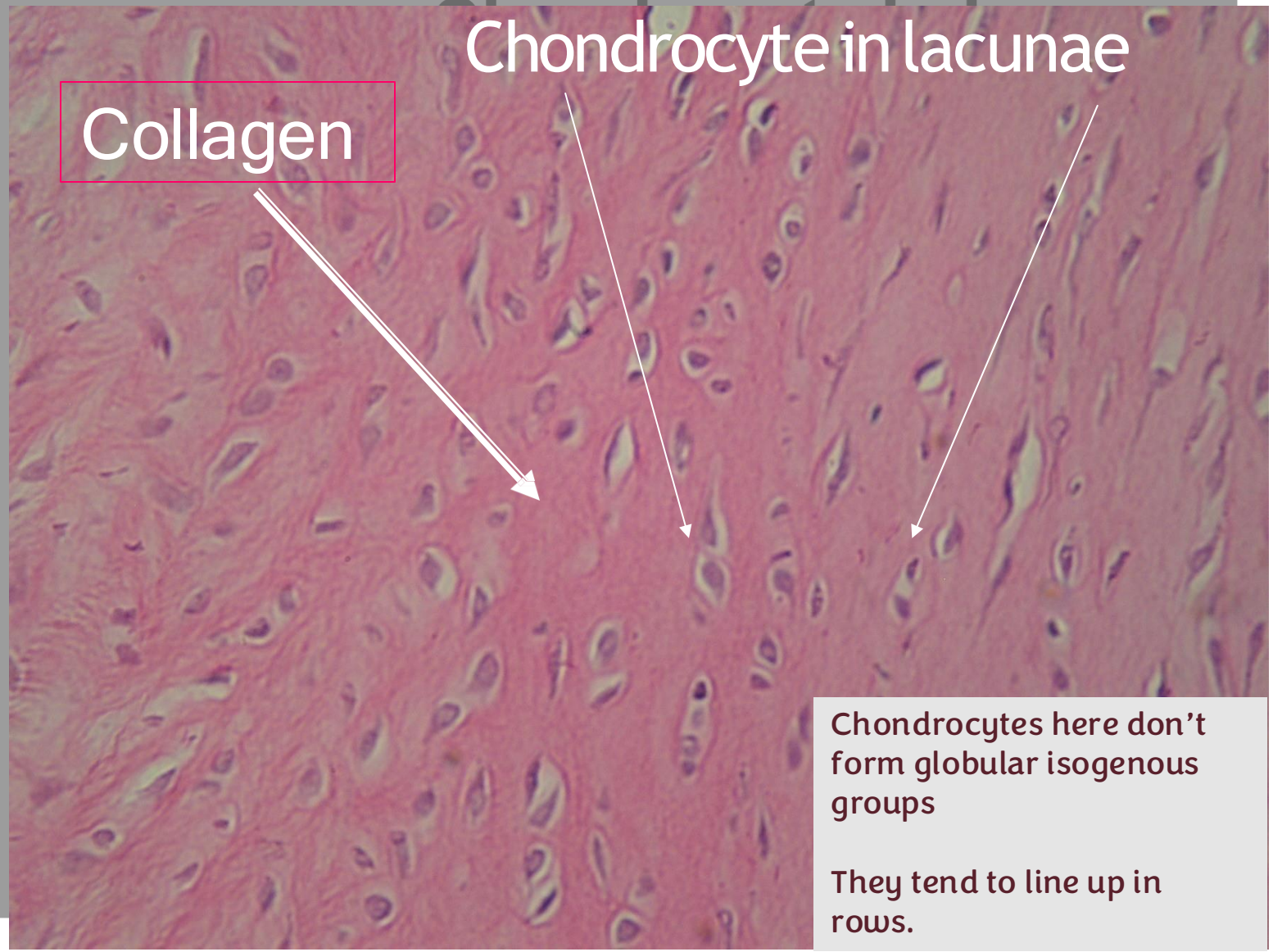
The intervertebral disc has a complex structure consisting of hyaline cartilage and fibrocartilage

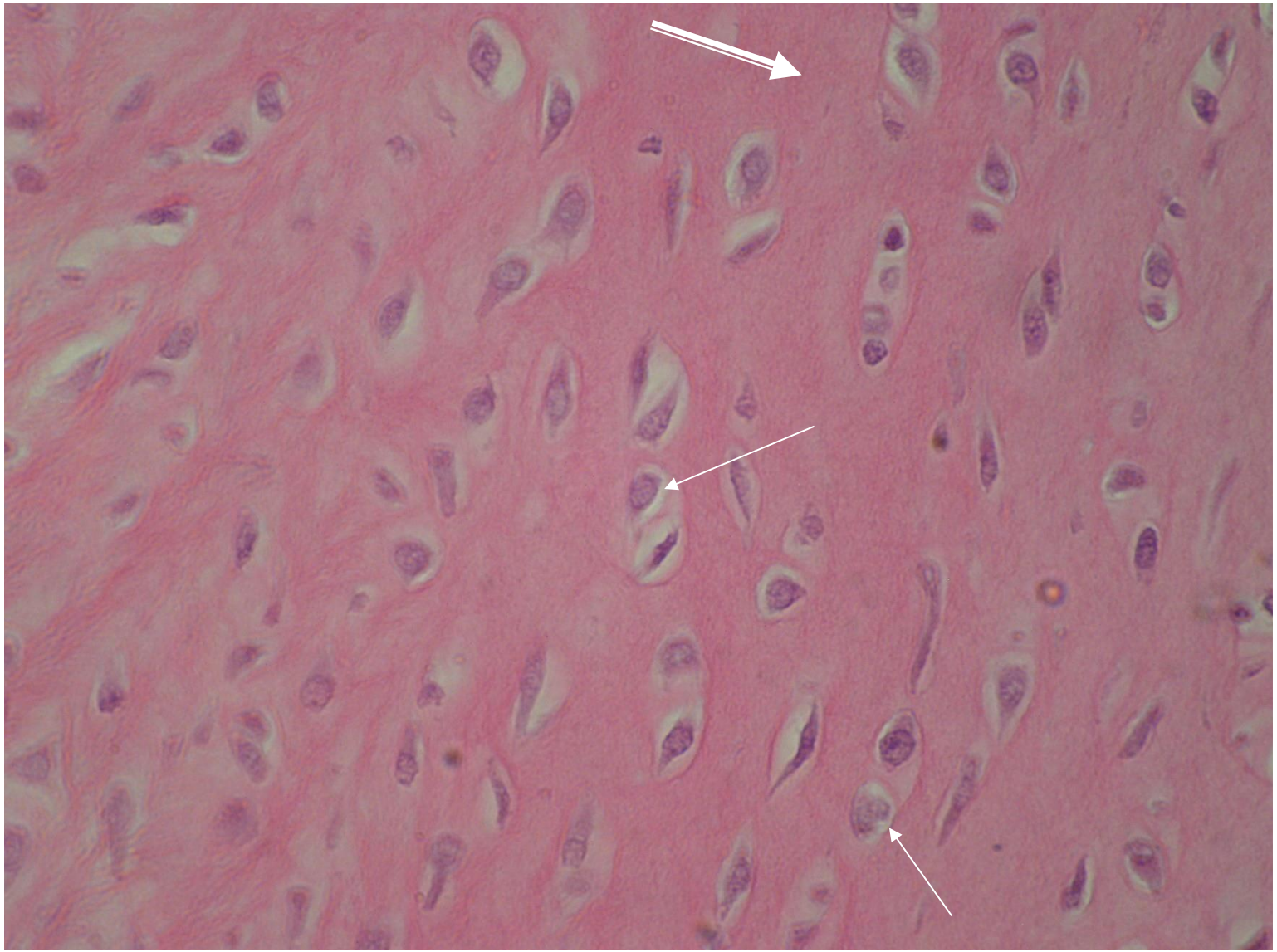


Hyaline cartilage is more eosinophilic than the fibrocartilage (this helps with recognizing both of them)

Fibrocartilage is the toughest type of cartilage, found in the symphysis pubis and the knees as the menisci
(fibrocartilage discs found between the condyles of the bones in this complex, weight-bearing joint)

Fibrocartilage→ hyaline + dense CT → collagen type 1+2

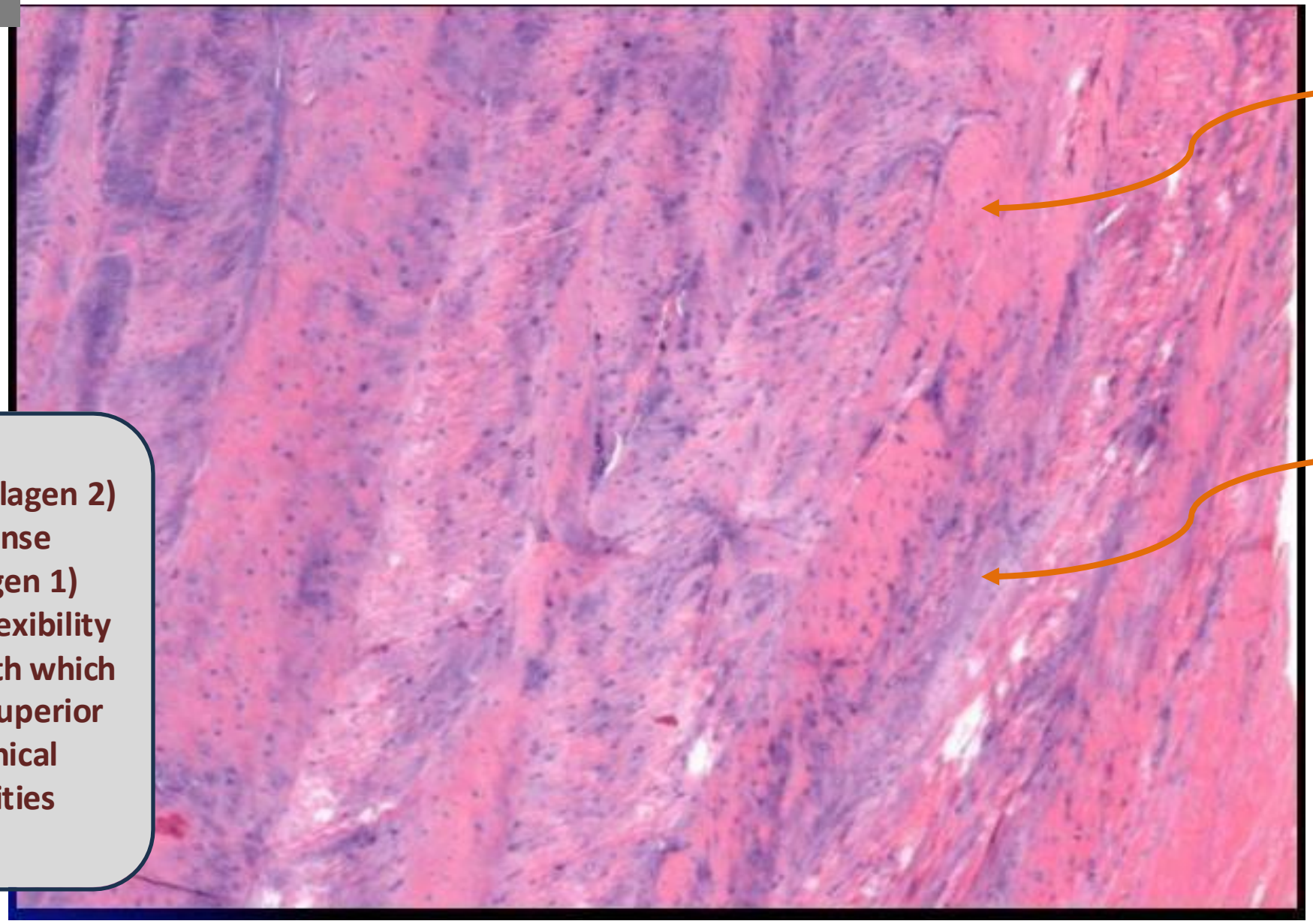




Identify

Low magnification image

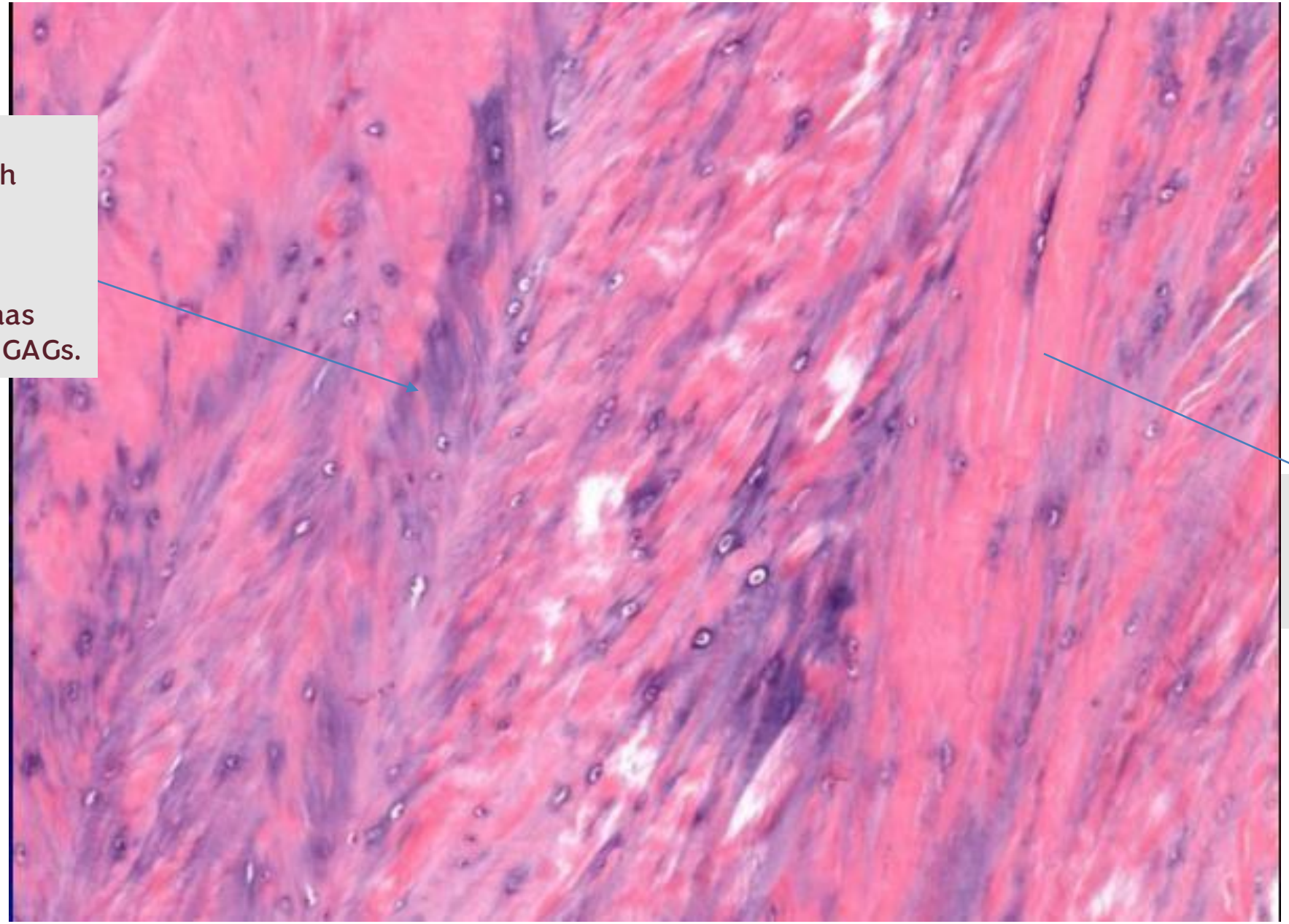
Two types of tissues



Hyaline(collagen 2) and dense CT(collagen 1) Provides flexibility and strength which provides superior mechanical properities

High magnified image

Identify

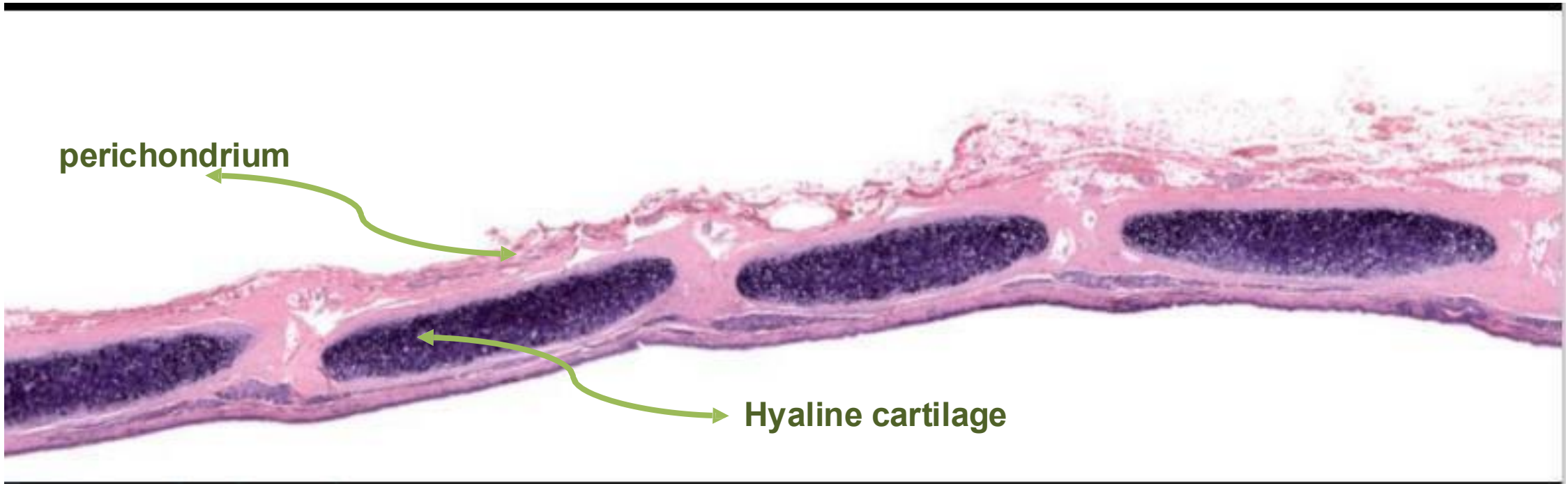


Hyaline cartilage:
Collagen Type II rich zone .
Hyaline cartilage is usually rich with collagen type II. It has proteoglycans and GAGs.

Dense ct:
Rich with type I collagen and fibroblasts

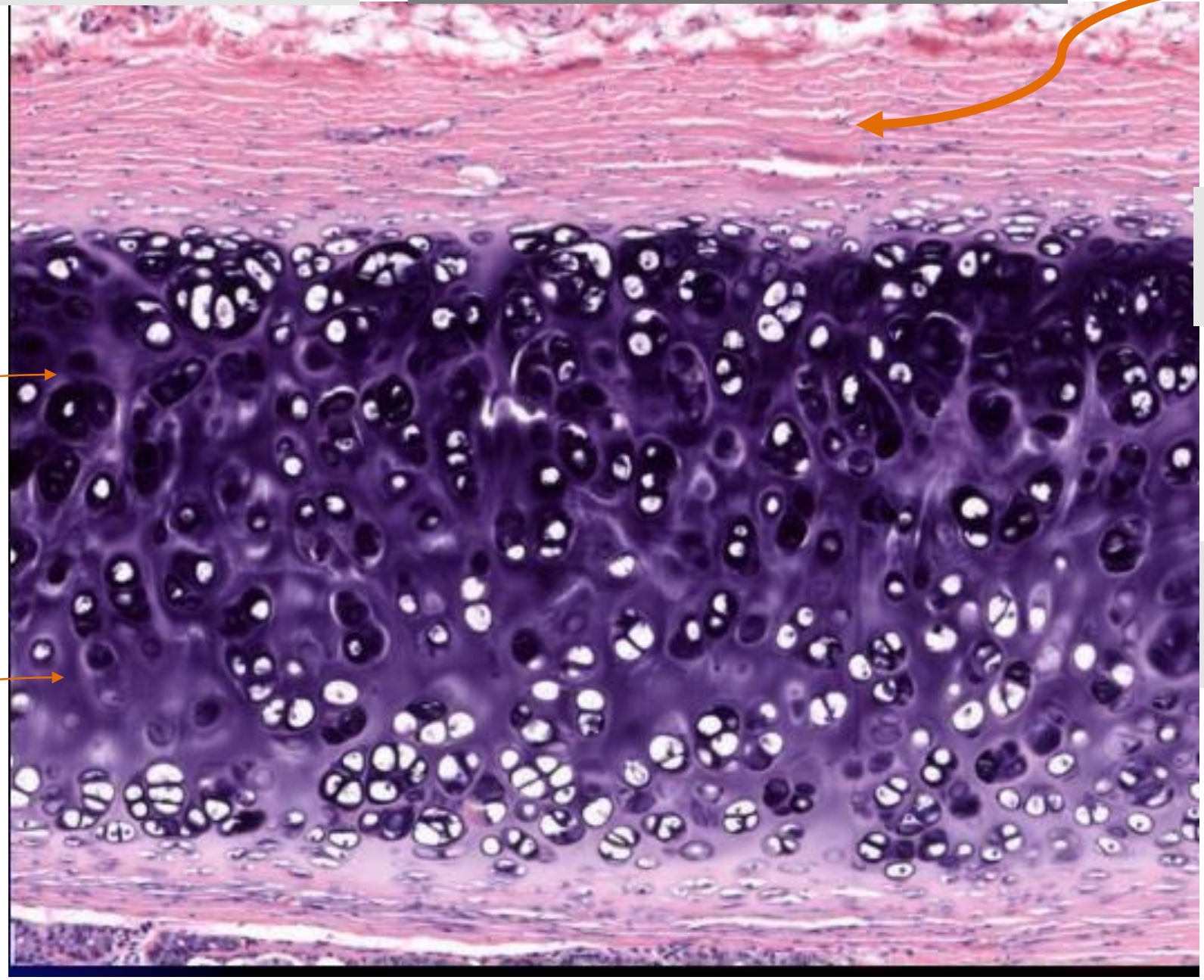
Low magnification

Identify



Magnified image of the inner tissue of hyaline cartilage

Identify→ hyaline cartilage



Perichondrium

The outer layer contains chondroblasts and chondrogenic.

territorial

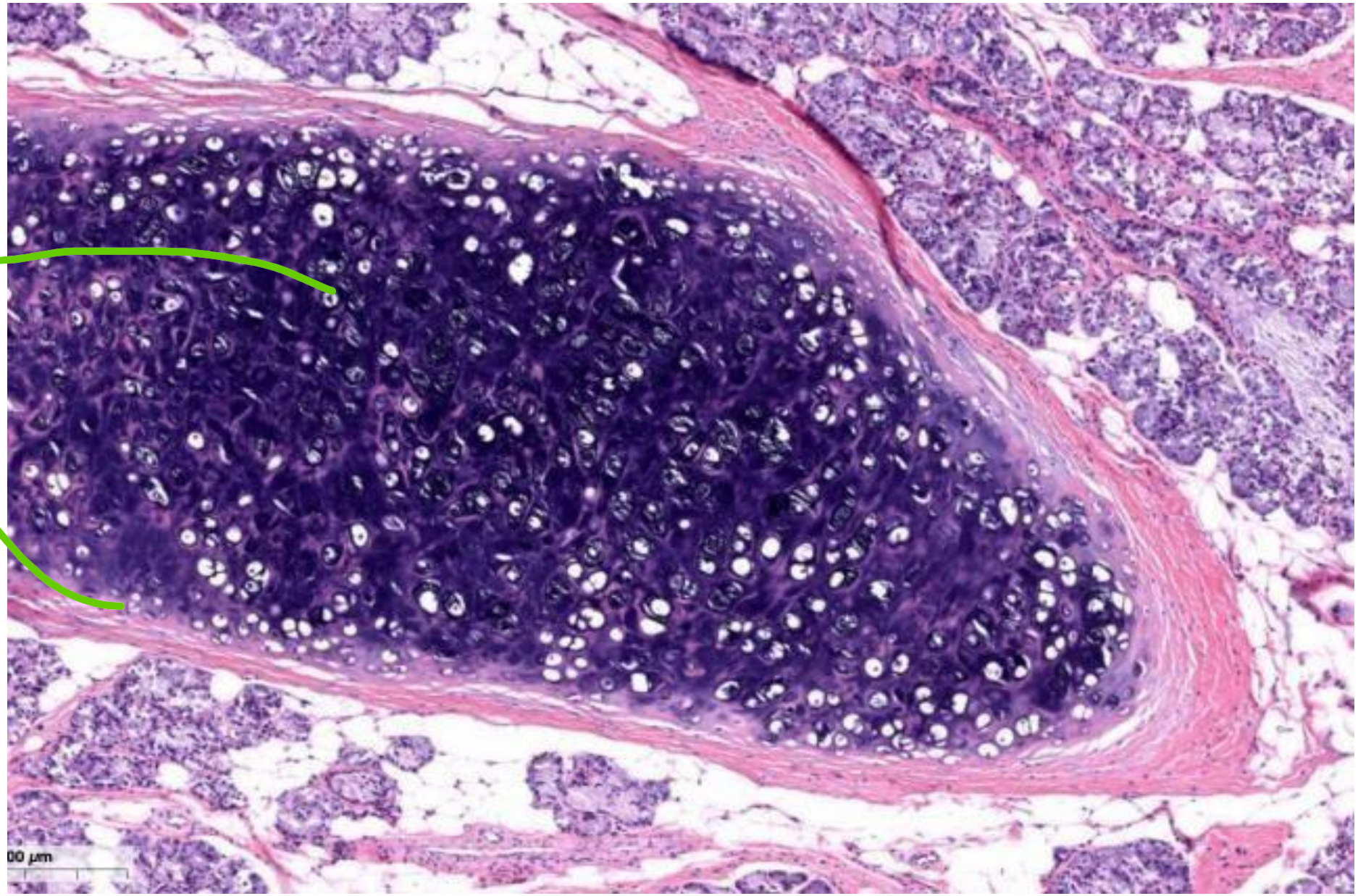
interterritorial

You can see the chondrocytes in isogenous groups

Thinner Perichondrium

Identify

Chondrocytes→ inside
Chondroblasts→ on the junction (between tissue and perichondrium)
Osteogenic → deeper within the perichondrium



Quiz

For any feedback, scan the code or click on it.

Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1			
V1 → V2			

Additional Resources:

رسالة من الفريق العلمي:

الحمدلله الذي بنعمه تتم الصالحات، الحمدلله على الفضل والنعم والبركات، والحمدلله حمدا كثيرا طيبا مباركا فيه على ما وفقتنا وباركت لنا في سعينا.

إن شاء الله أن تكونوا حصدتم أعلى العلامات في الامتحانات الماضية والآن بداية جديد وعزم أقوى لتحقيق العلا إن شاء الله
❤️ ❤️ ❤️