

Biology



BONE

- ▶ **Bone functions**

- ▶ Support
- ▶ Protection
- ▶ Movement
- ▶ Minerals homeostasis (maintain blood Ca^{++} & P04^{--} level equilibrium)

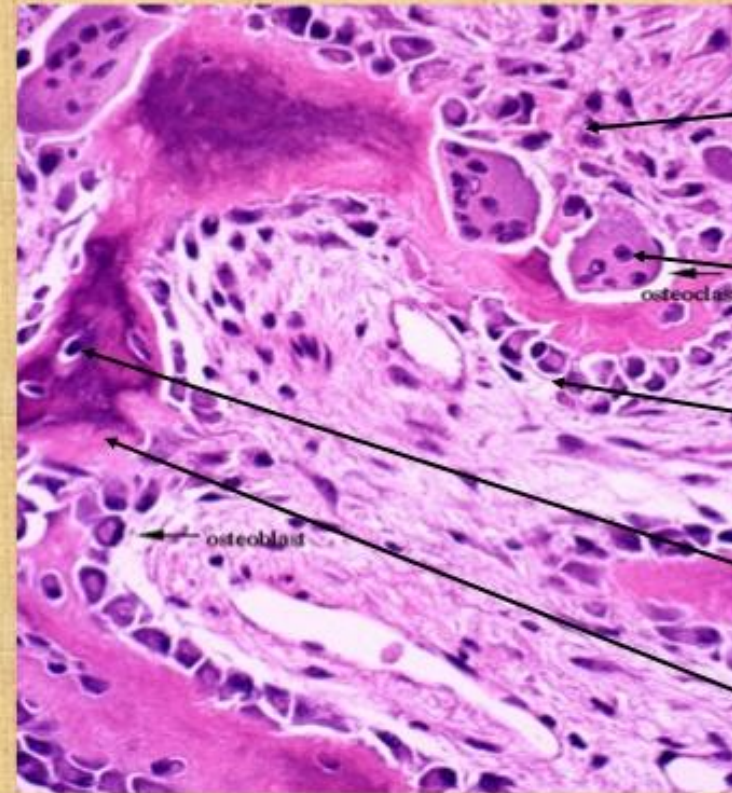
▶ Bone is a hard, but brittle tissue. Bone is a dynamic tissue, which throughout life bone tissue is continually being formed and resorbed.



Bone Cells

- Osteoprogenitor cells
- Osteoblast (bone forming cells)
- Osteocyte (bone maintaining cells)
- Osteoclast (bone resorption cells)

Cells of Bone (Primary/Temporary)



Osteoprogenitor

Osteoclast

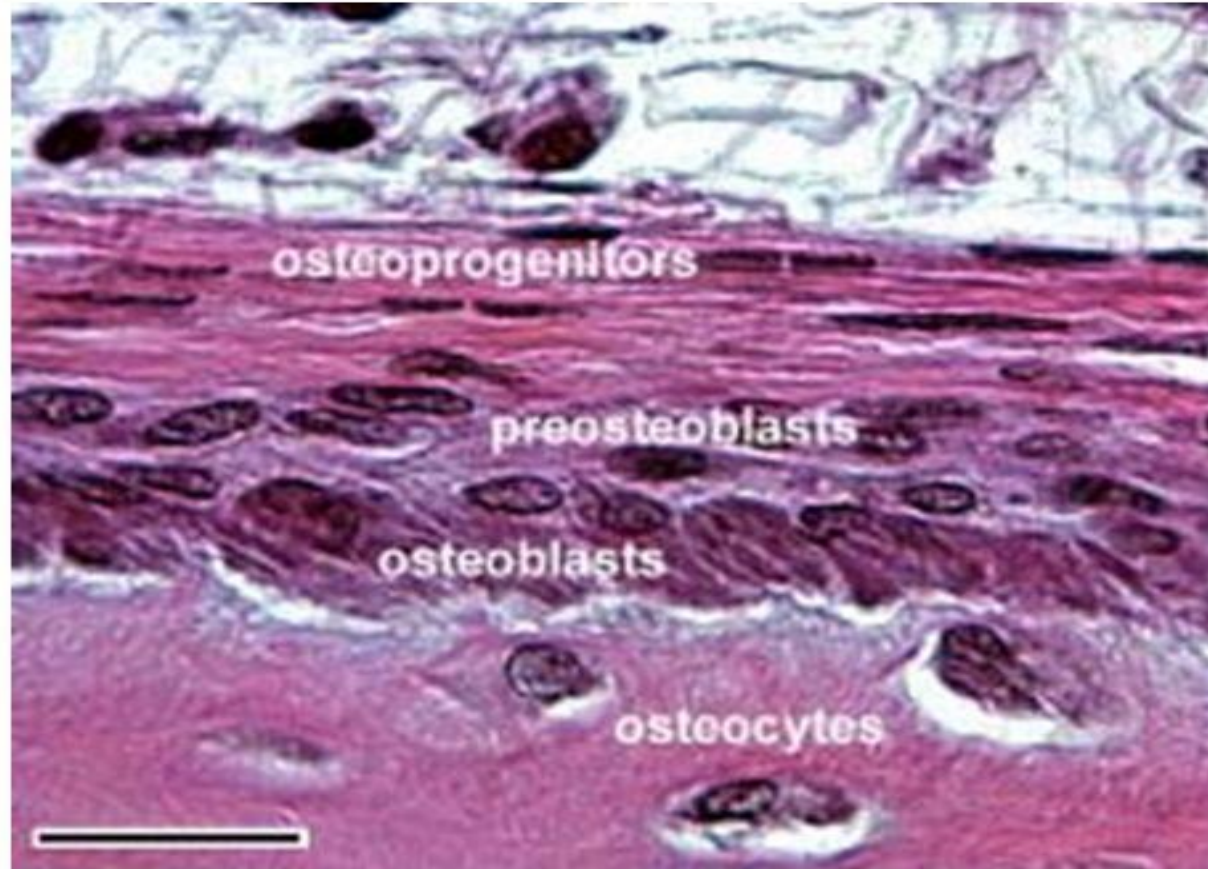
Osteoblast

Osteocyte

Osteoid



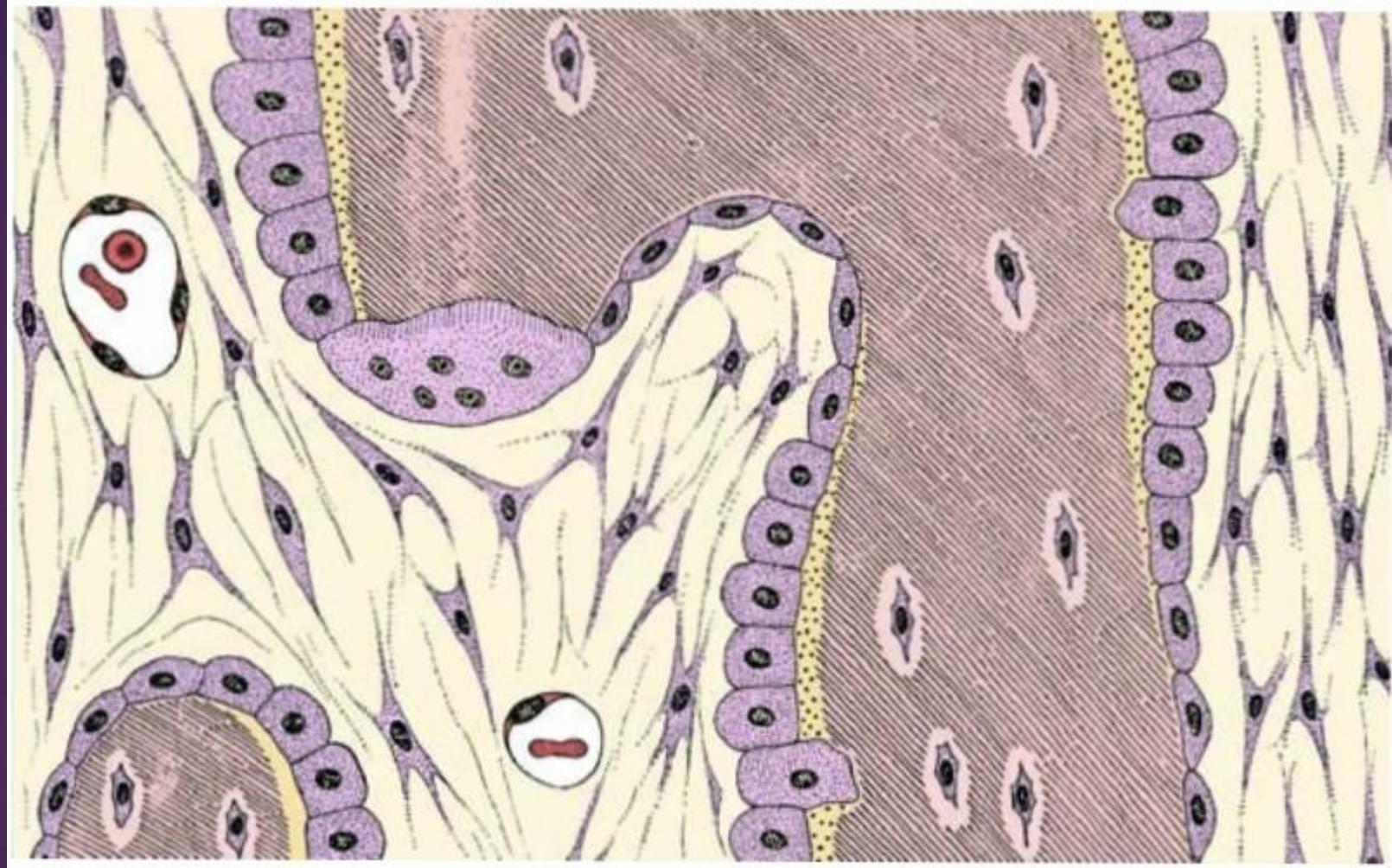
OSTEOPROGENITOR CELLS



- Located in the periosteum and endosteum. Flat squamous cells. They are very difficult to distinguish from the surrounding connective tissue cells.



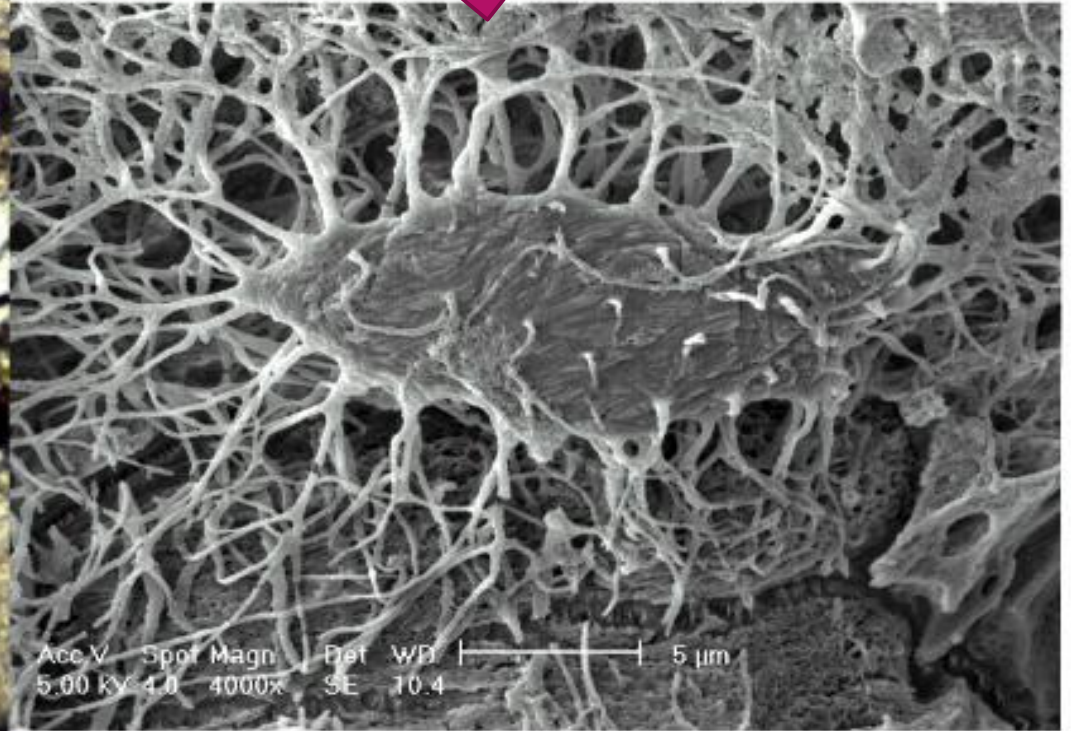
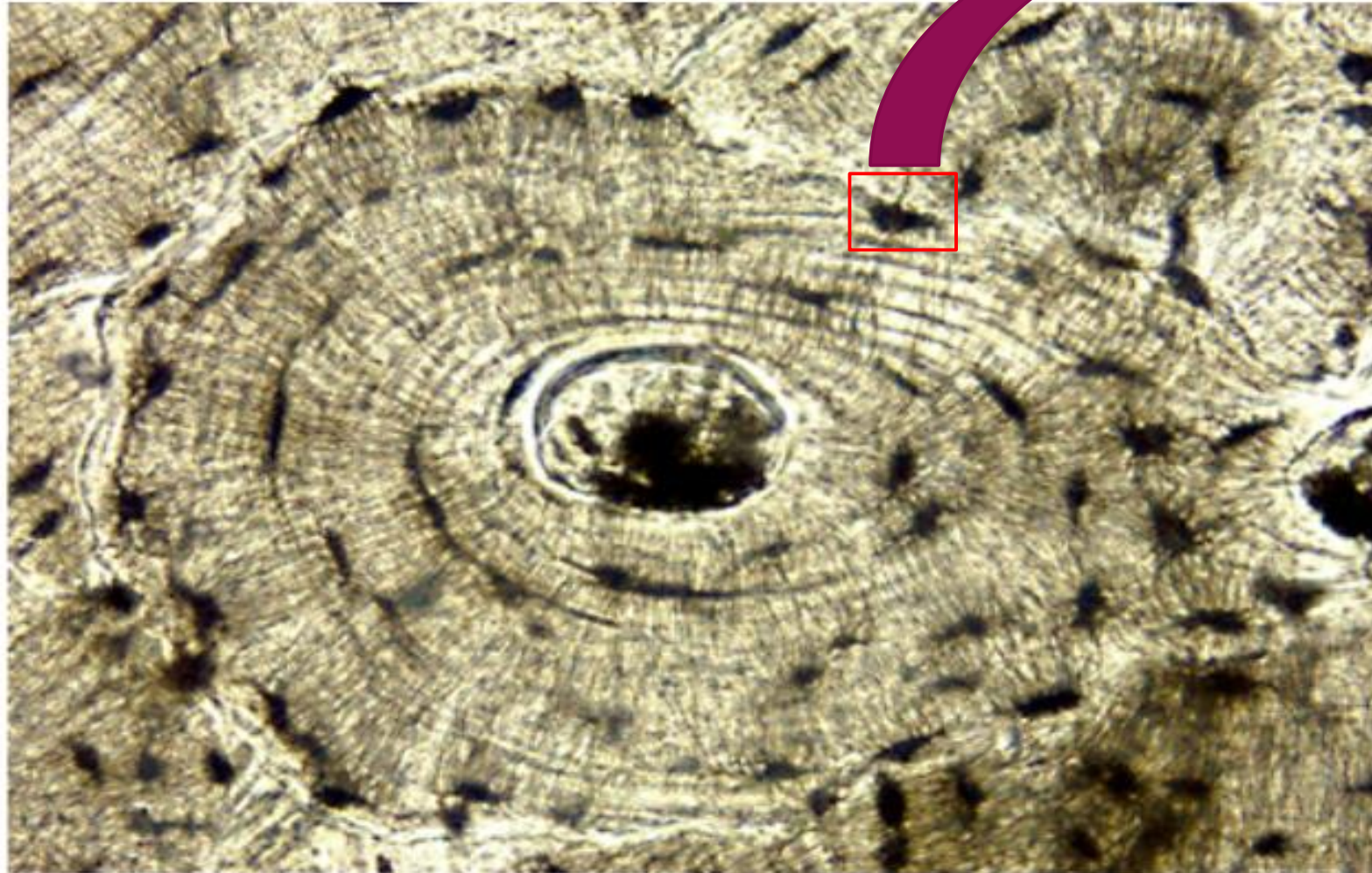
Osteoblasts



Osteoblasts are rich in the enzyme alkaline phosphatase, which plays a major role in the formation of the mineral deposits in the matrix.

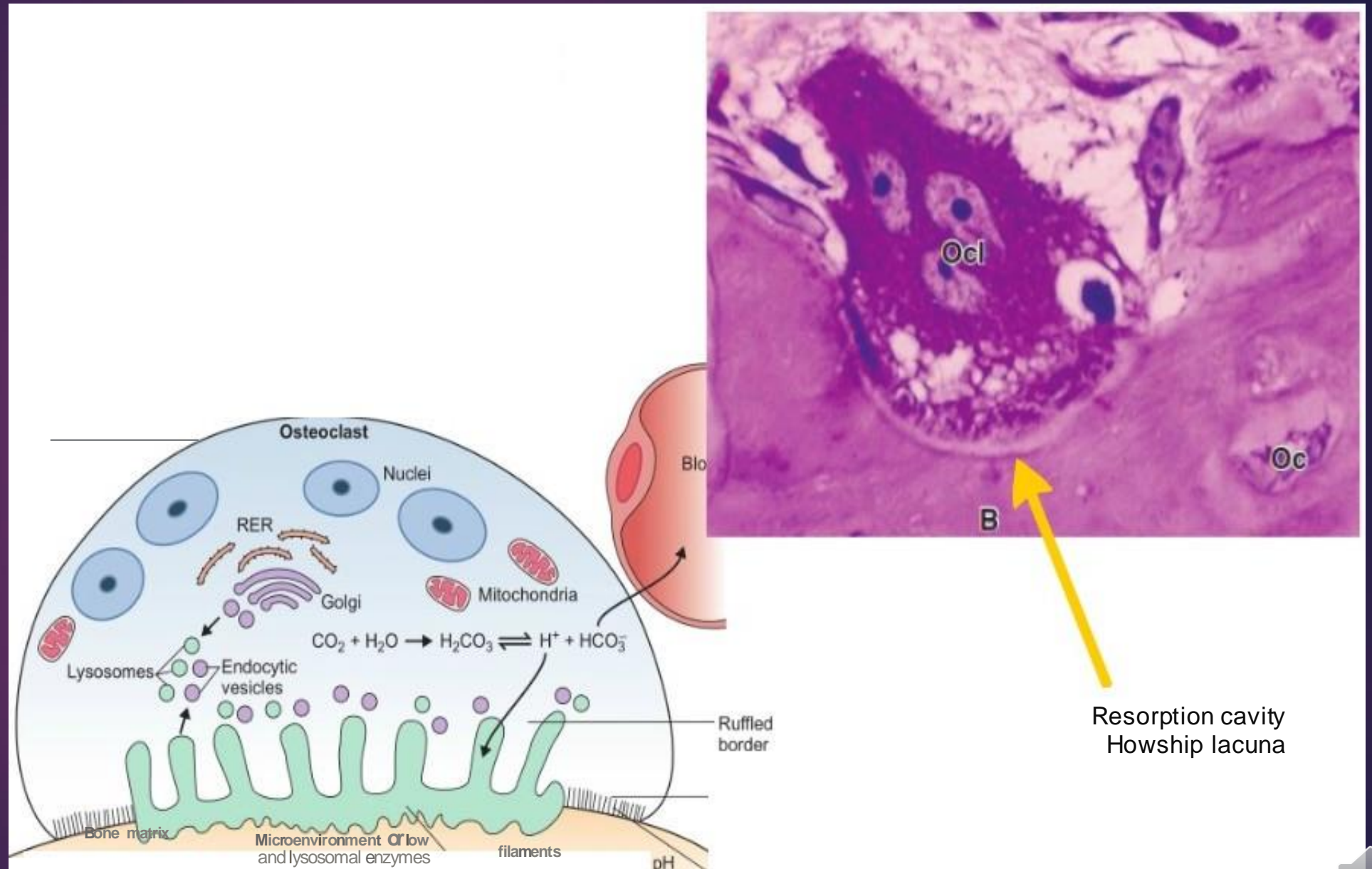


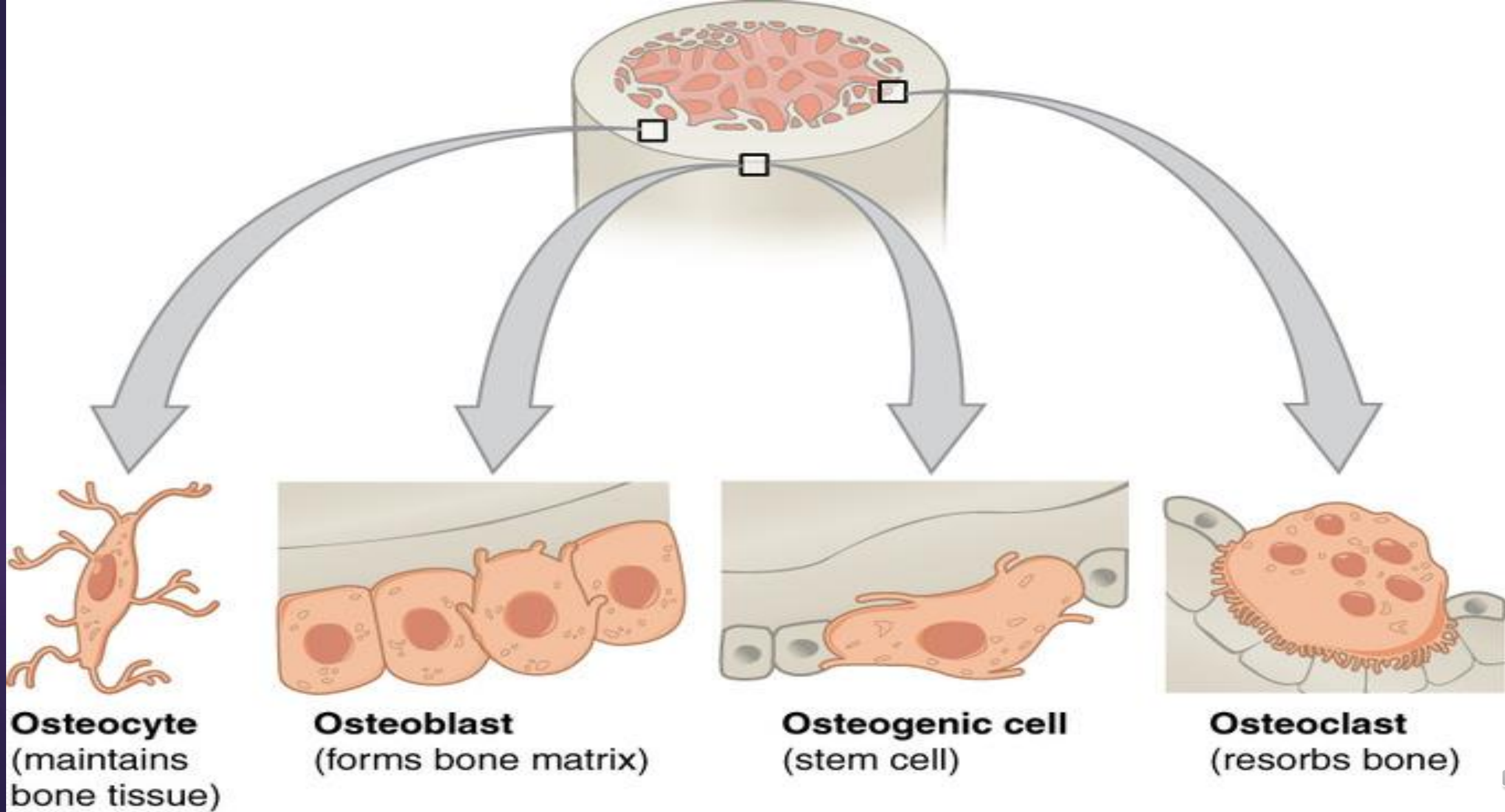
Osteocytes



Osteoclasts

large, motile & multinucleated





Bone matrix

30% organic (type I collagen, proteoglycan and glycoproteins)

70% non-organic calcium, phosphate (bicarbonate, citrate, magnesium, potassium, and sodium are also found)

*crystals $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$

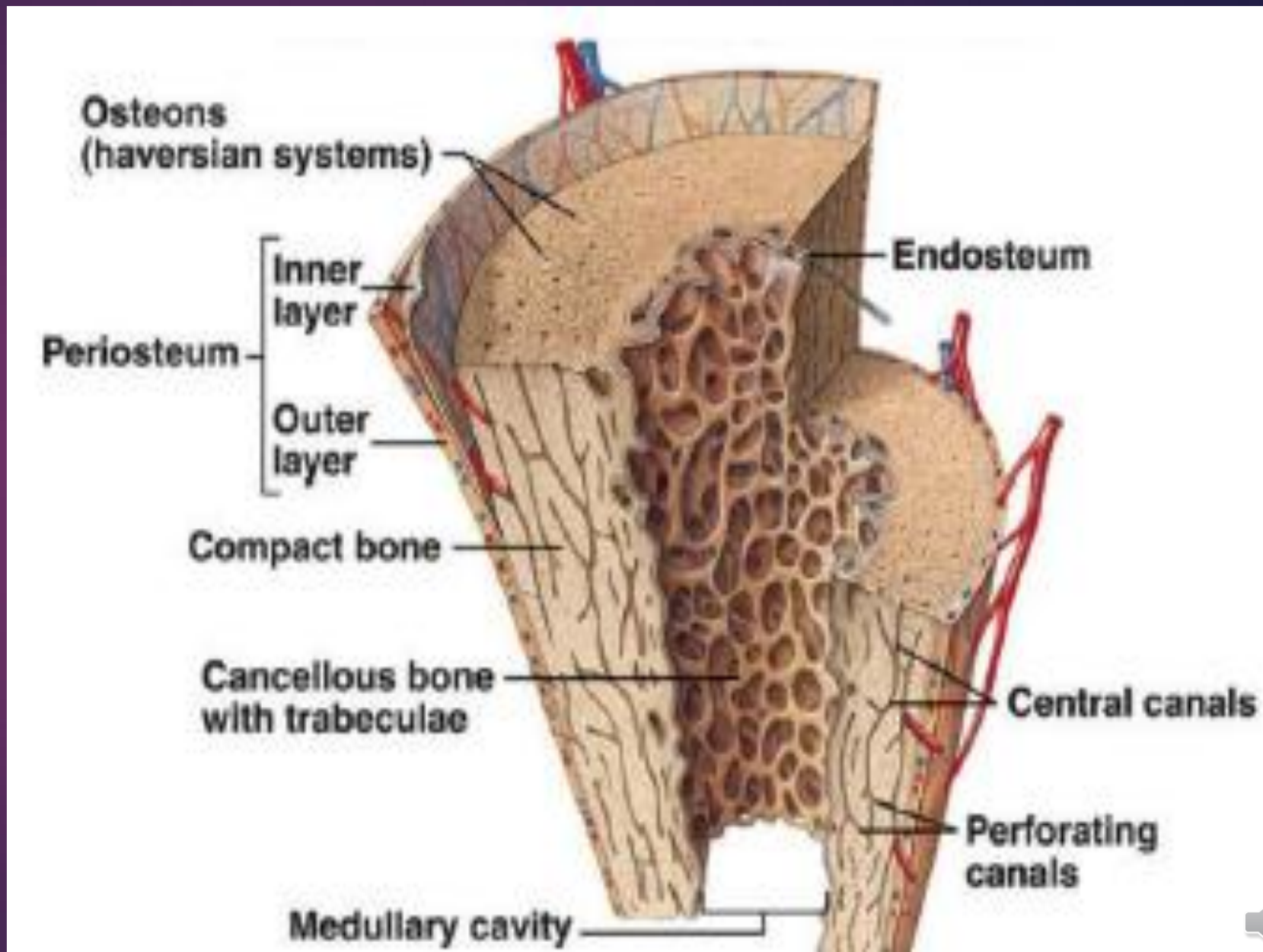
*noncrystalline

association of minerals with collagen fibers is responsible for the hardness and resistance of bone



Periosteum & Endosteum

Sharpey's fibers



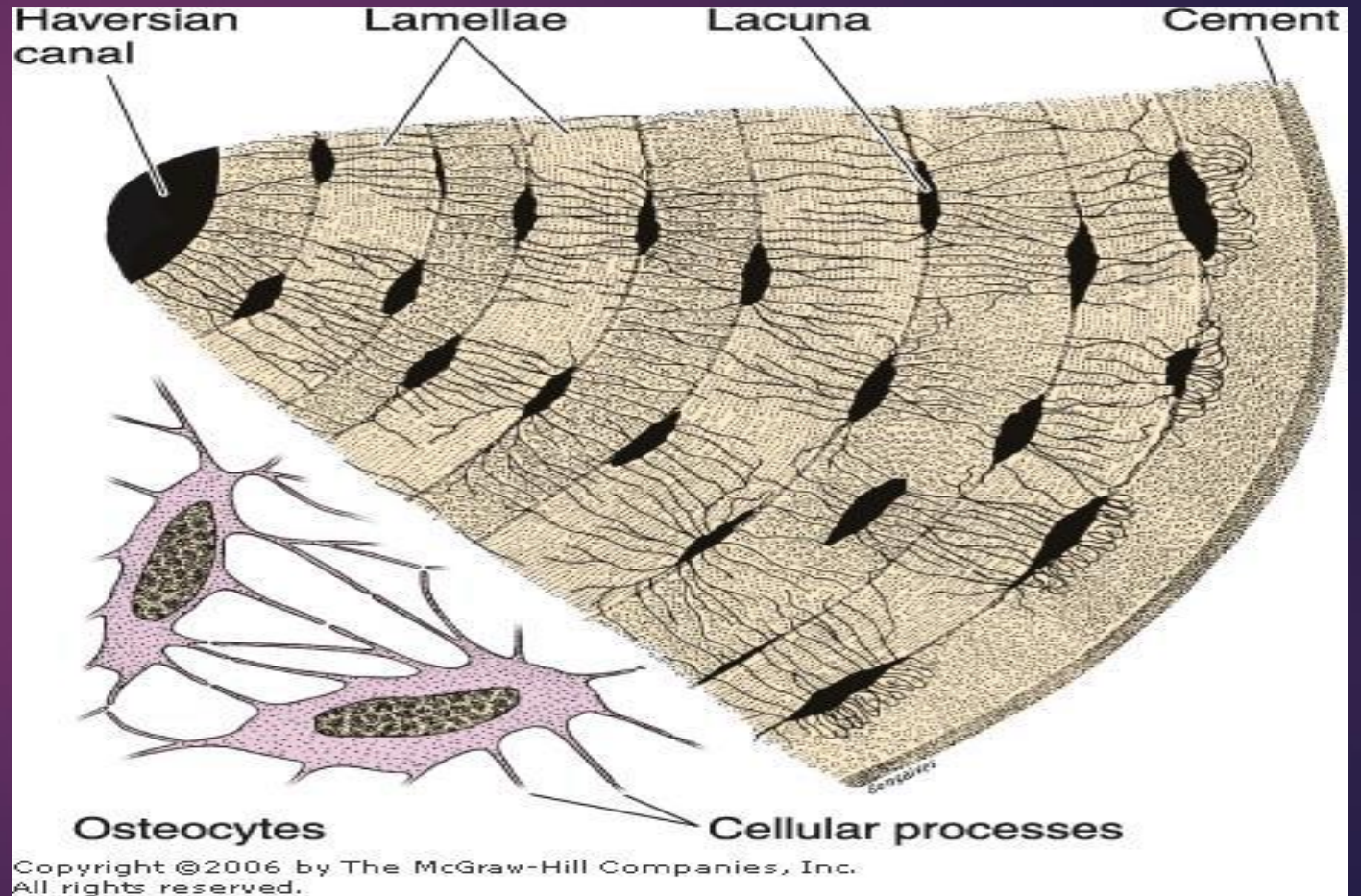
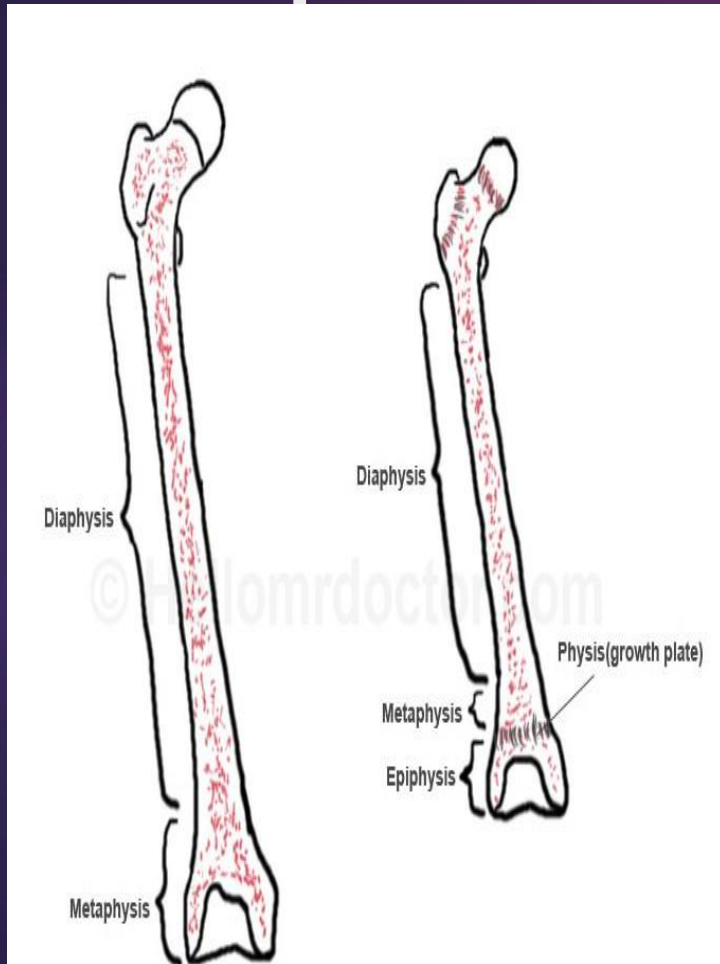
Types of Bone

- ▶ Anatomical classification of **bones**: long, short, flat, & irregular bones.
- ▶ Macroscopic classification of **bone tissue**: compact bone, cancellous bone (microscopically they are almost identical).
- ▶ Developmental classification of bone tissue: primary & secondary.

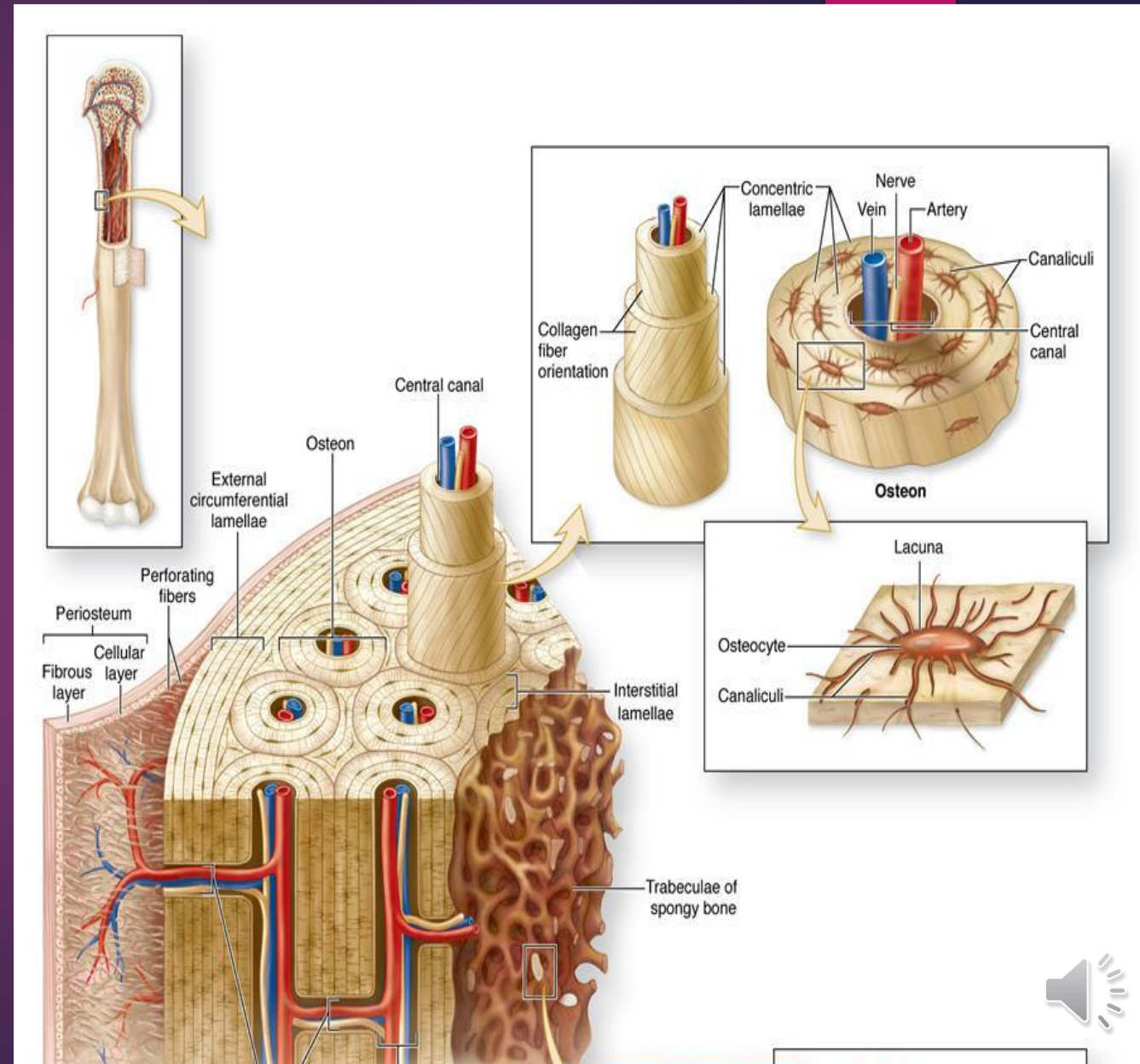


Macroscopic classification of bone tissue:

Compact bone:



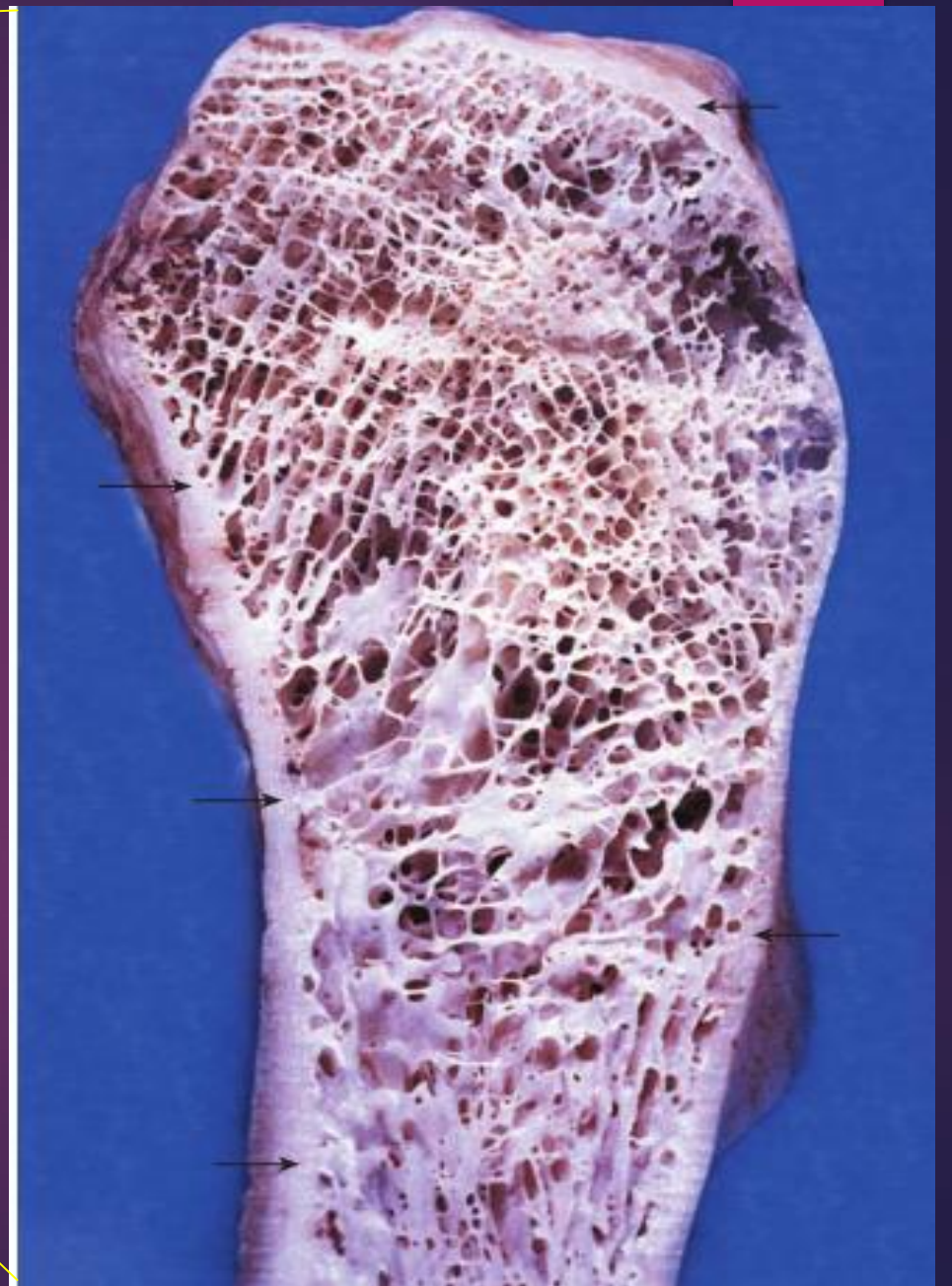
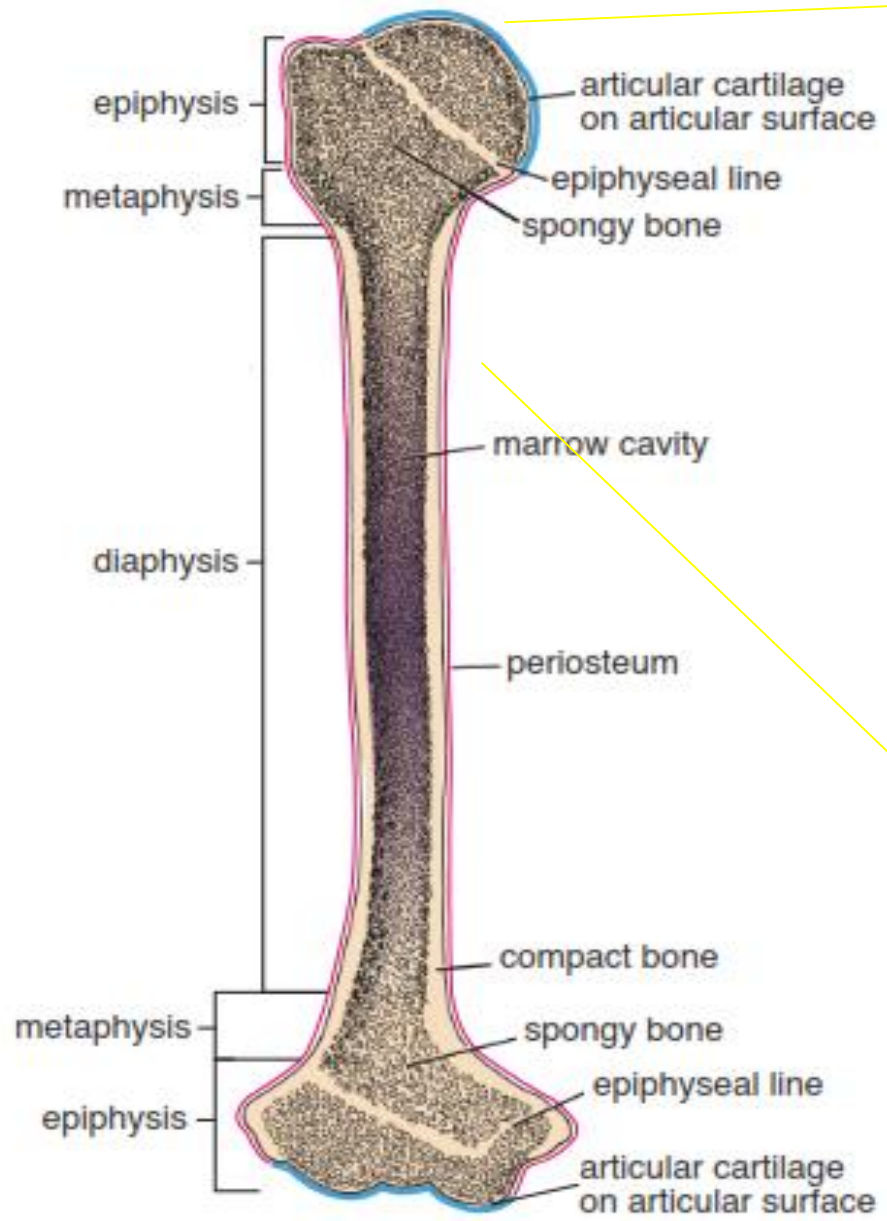
- ▶ - Outer circumferential lamellae:
- ▶ - Inner circumferential lamellae:
- ▶ - Osteons (Haversian systems):
- ▶ - Interstitial lamellae:



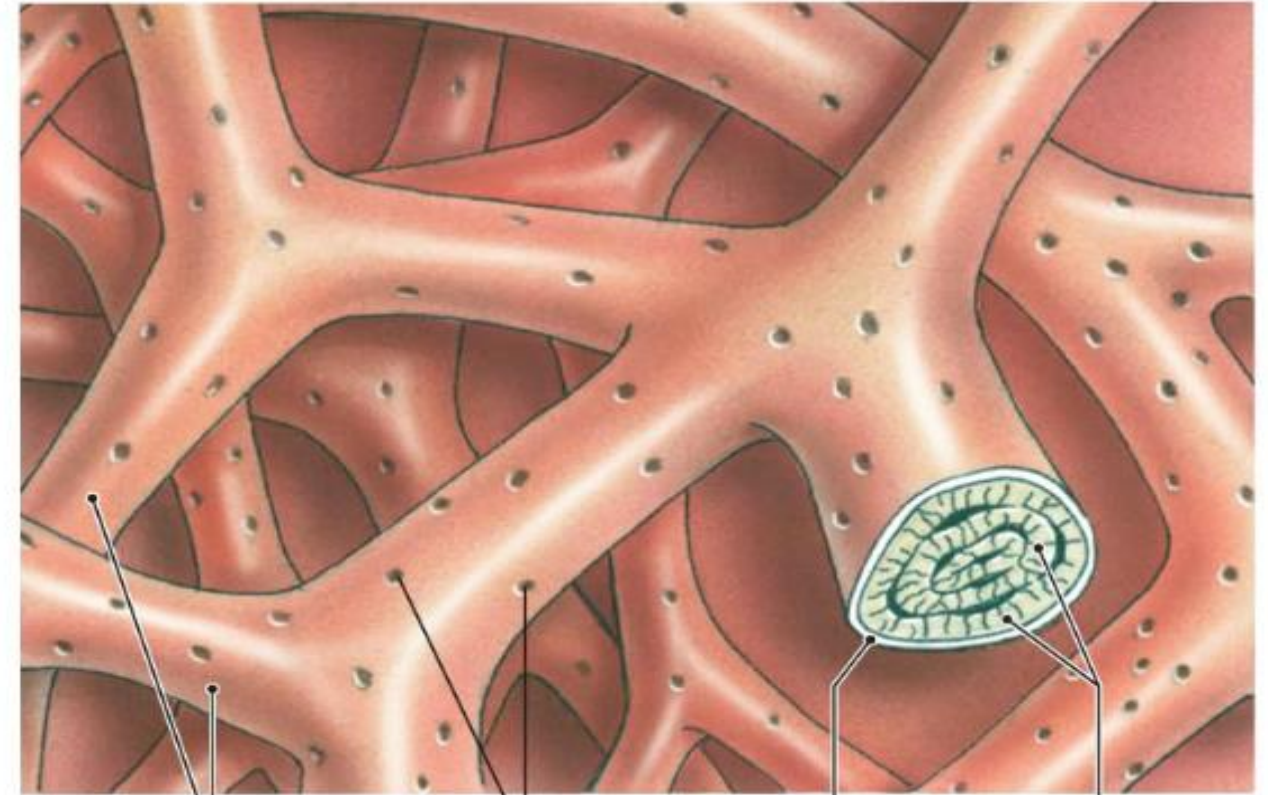
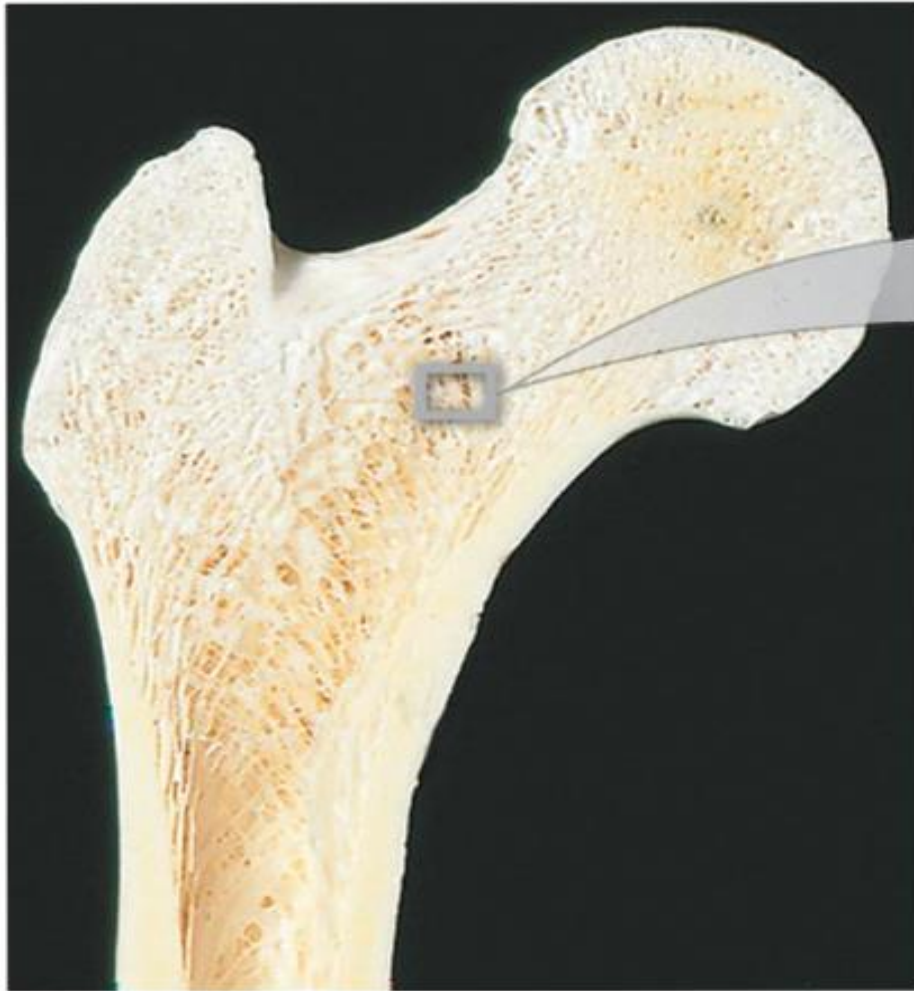
Notes:

- ▶ □ In each lamella, collagen fibers are arranged spirally, in a direction opposite to that of the collagen fibers of the adjacent lamella.
- ▶ □ Osteons are in a continuous renewal process, therefore, they differ in diameter & number of lamellae.
- ▶ □ Surrounding each osteon is a layer of amorphous material called the **cementing substance** that consists of mineralized matrix with few collagen fibers.
- ▶ □ Perforating canals are not surrounded by concentric lamellae, they perforate the lamellae of haversian systems. Perforating canals are lined with endosteum & filled with loose connective tissue.
- ▶ □ Blood vessels & nerves enter the bone via foramina & are distributed through all central & perforating canals.





Spongy (Trabecular bone)



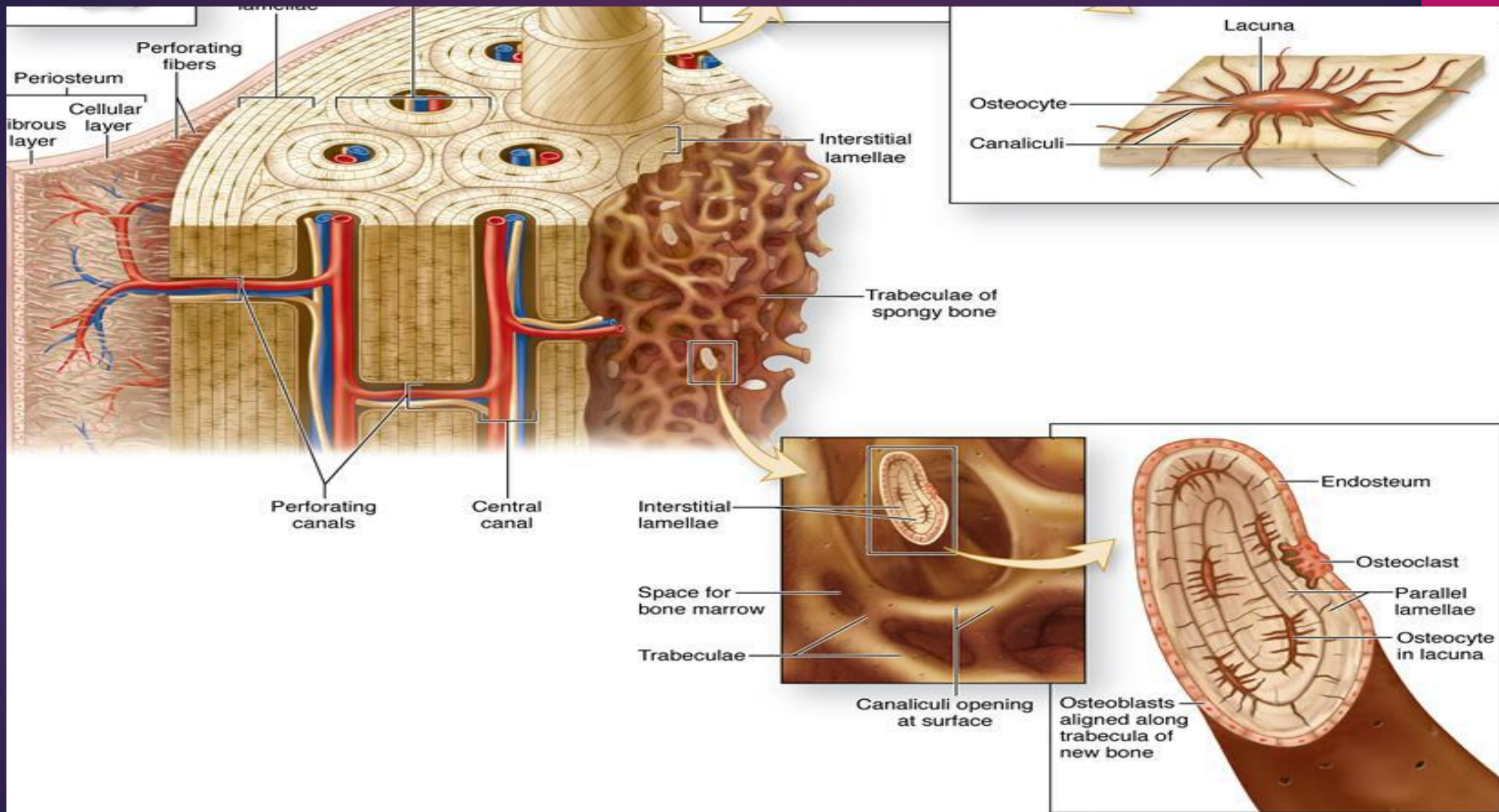
Trabeculae of spongy bone

Canaliculi opening on surface

Endosteum

Lamellae



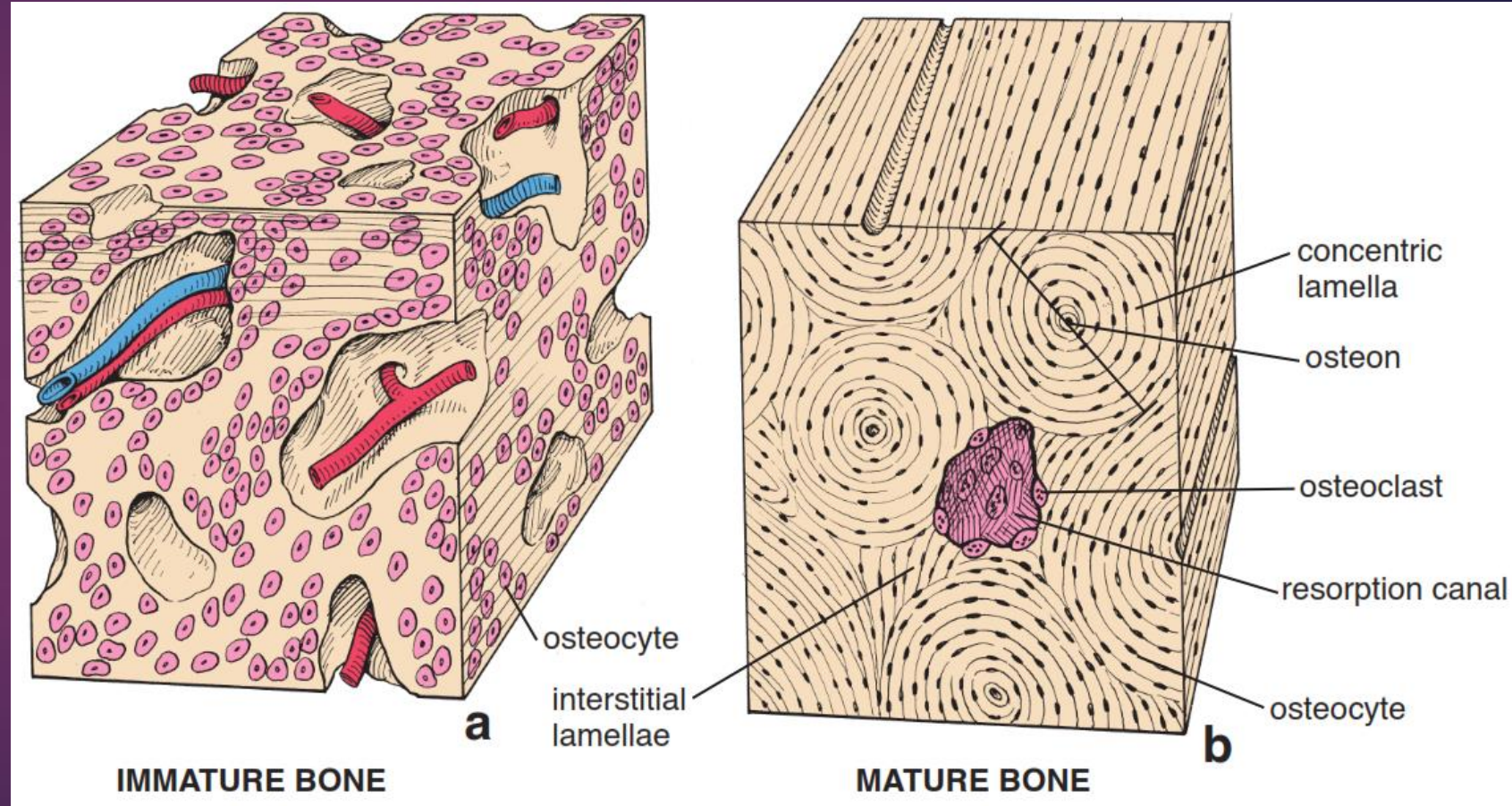


Developmental classification of bone tissue:

- ▶ **Primary bone tissue** (immature, woven) :
- ▶ Primary bone tissue is usually temporary, it is replaced in adults by secondary bone tissue except in few places (near the sutures of the flat bones of the skull, in tooth sockets, and in the insertions of some tendons).
- ▶ **Secondary bone tissue** (mature, lamellar) :



- Immature bone does not display an organized lamellar appearance
- Immature bone contains relatively more cells per unit area than does mature bone
- The cells in immature bone tend to be randomly arranged, whereas cells in mature bone are usually arranged with their long axes in the same direction as the lamellae
- The matrix of immature bone has more ground substance than does the matrix of mature bone



Green stick fracture



Quiz:

- ▶ An insect bite to the pinna of the left ear occurred to a 23 years woman, the symptoms appeared as redness, swelling and severe pain...

The bite produce an infection to the pinna (perichodrium) which treated by simple antibiotics and analgesic, when the pain releaved, the woman neglect further follow up of the schedule of treatment, after 4 weeks deformity of the pinna occur and the external ear appear as a cauliflower shape..

Explain the causes of this deformity



Quiz:

- ▶ A football player during a match gain a knock on his right knee, he felt a sever pain and disability..

When the match end, he see a doctor and referred him to do an x-ray which appear negative for any bony fractures.

The doctor diagnose the case as an injury to the meniscus of the right knee, he describe a drugs and rest to relieve the pain but he told the player that he never be able to play again and the menisci will not recur normal 😞😞😞😞

Explain the decision of the doctor?



