Biology

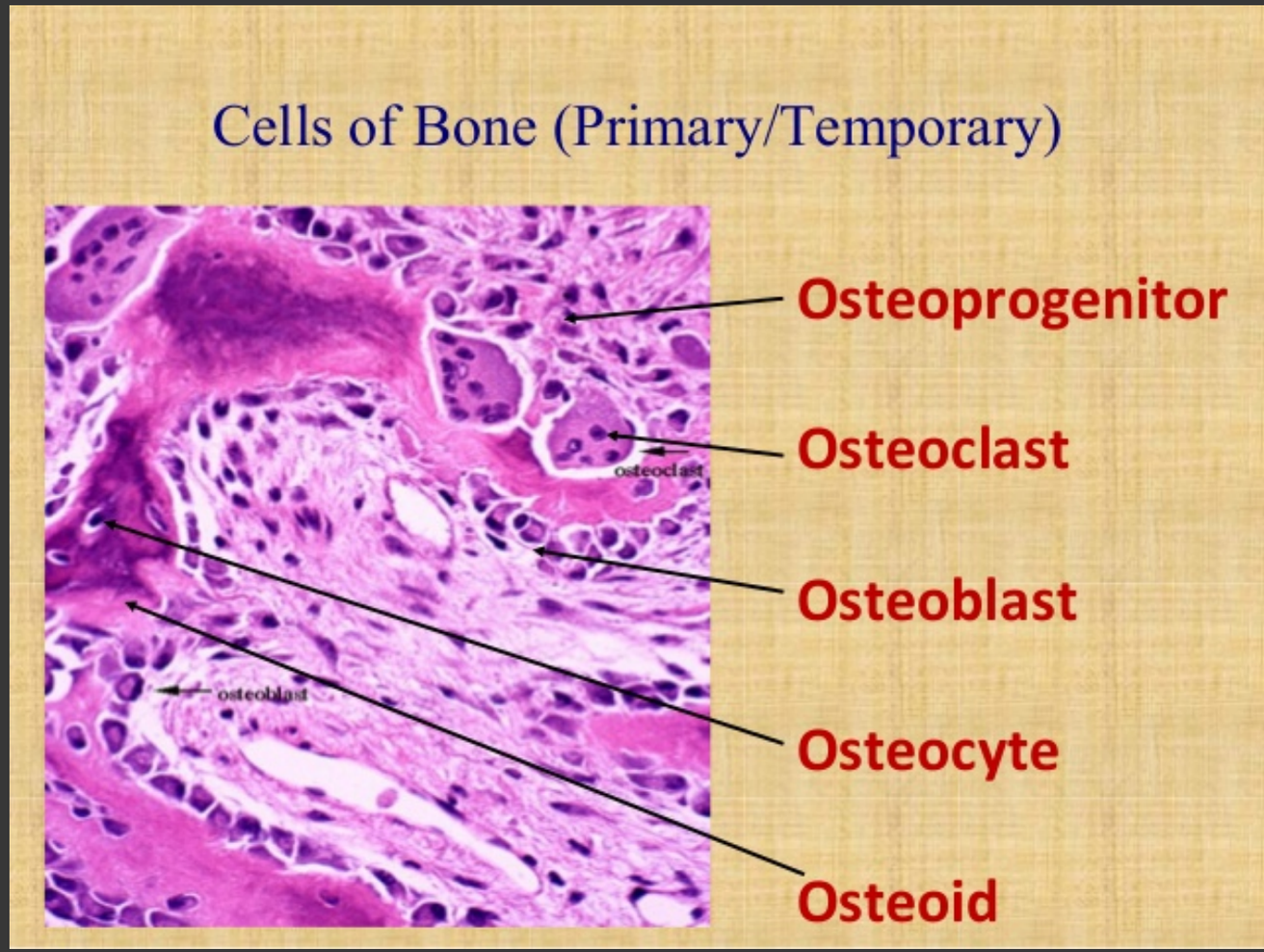
BONE

- **Bone functions**
  - Support
  - Protection
  - Movement
- Minerals homeostasis (maintain blood Ca++ & P04-- level equilibrium)

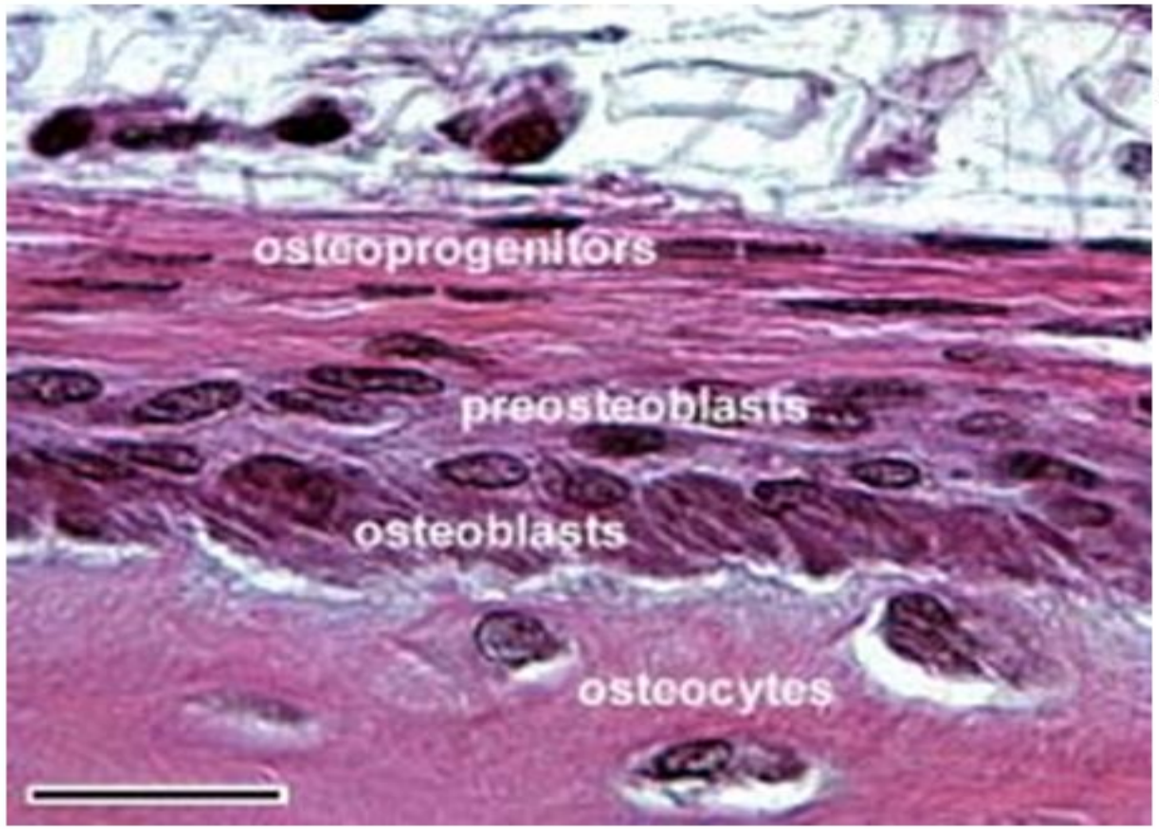
- Bone is a hard, but brittle tissue. Bone is a dynamic tissue, which throughout life bone tissue is continually being formed and resorbed.

Bone Cells

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

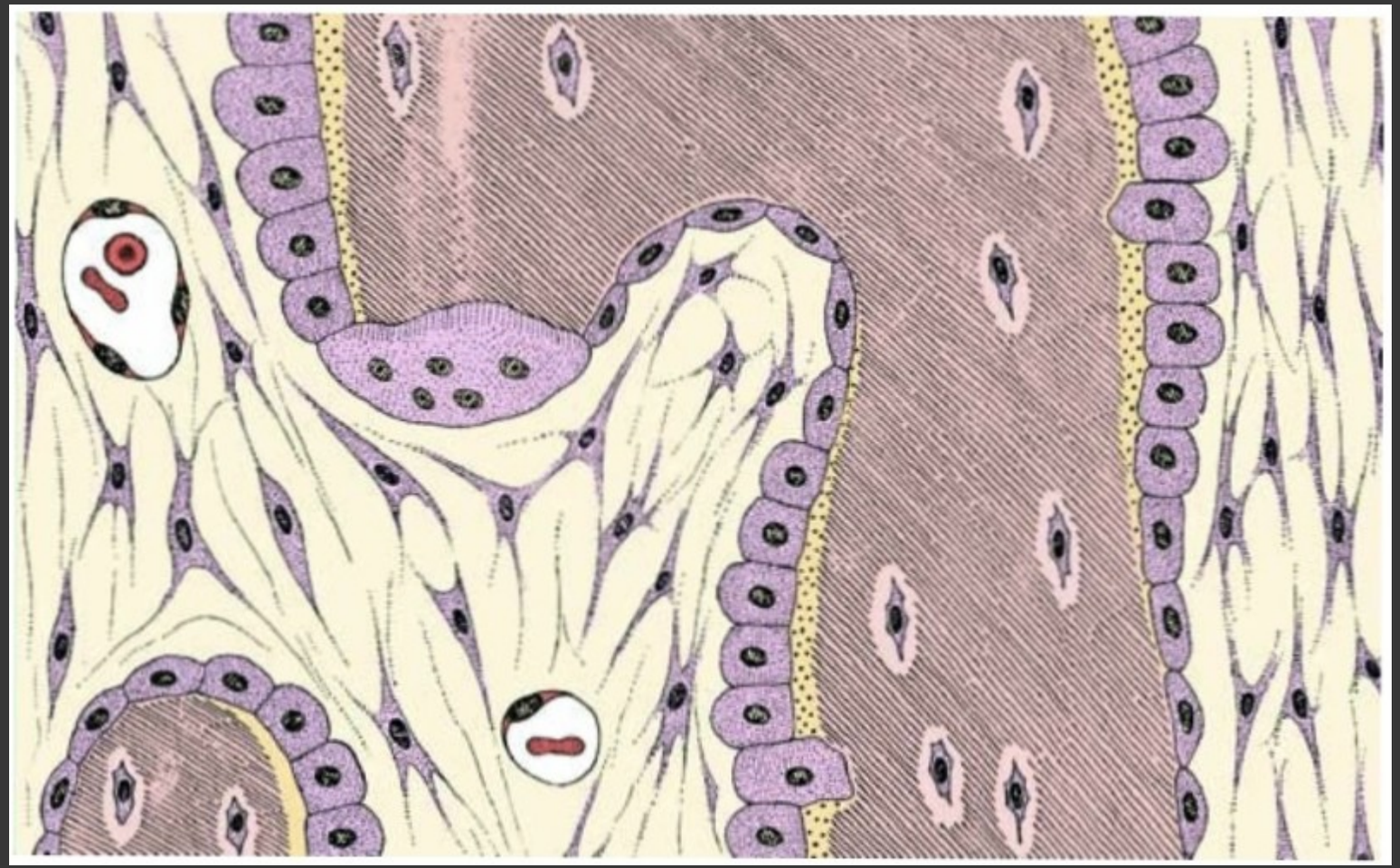


OSTEOPROGENITOR CELLS



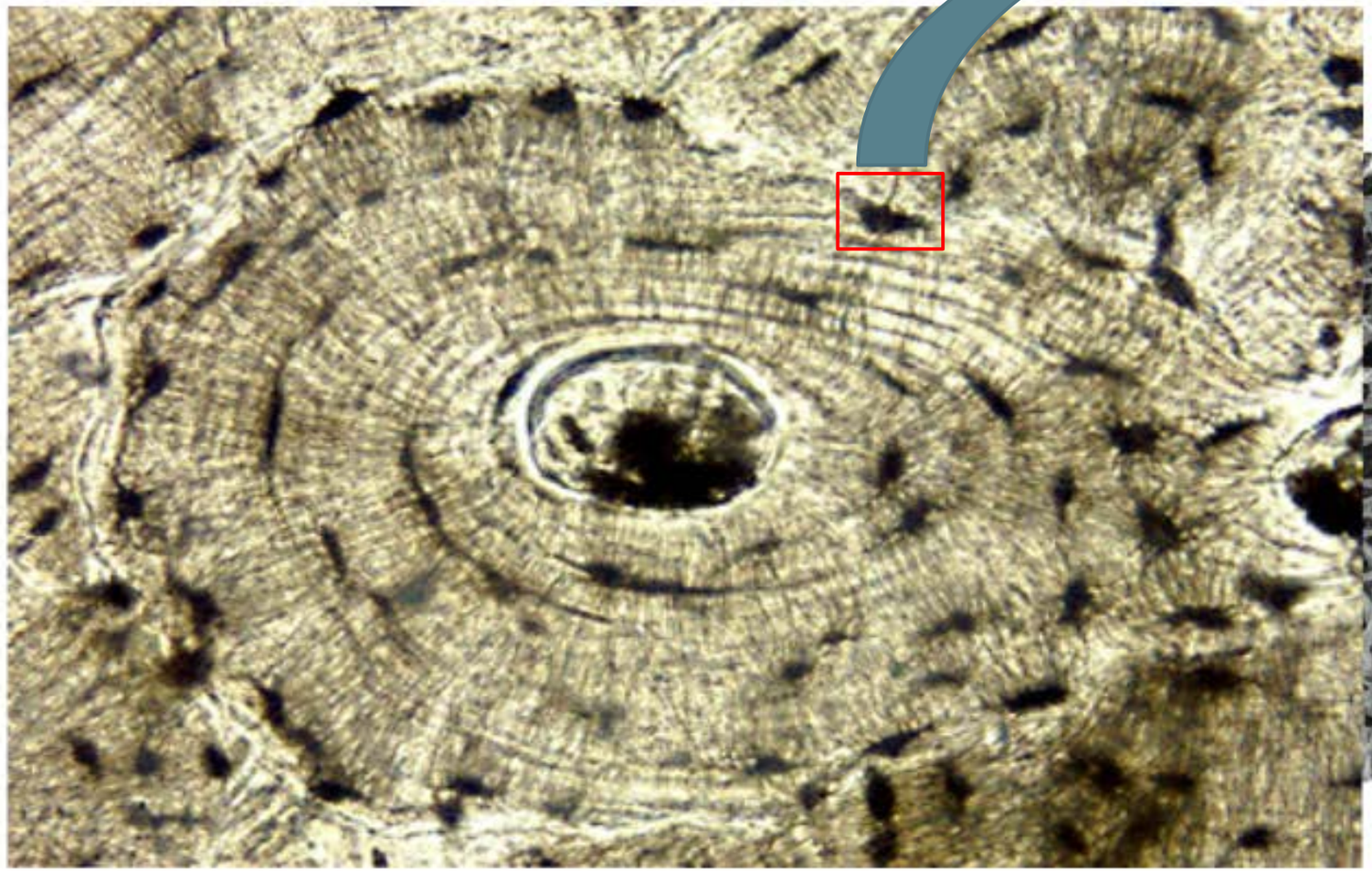
- Located in the periosteum and endosteum.Flat squamous cells. They are very difficult to distinguish from the surrounding connective tissue cells.

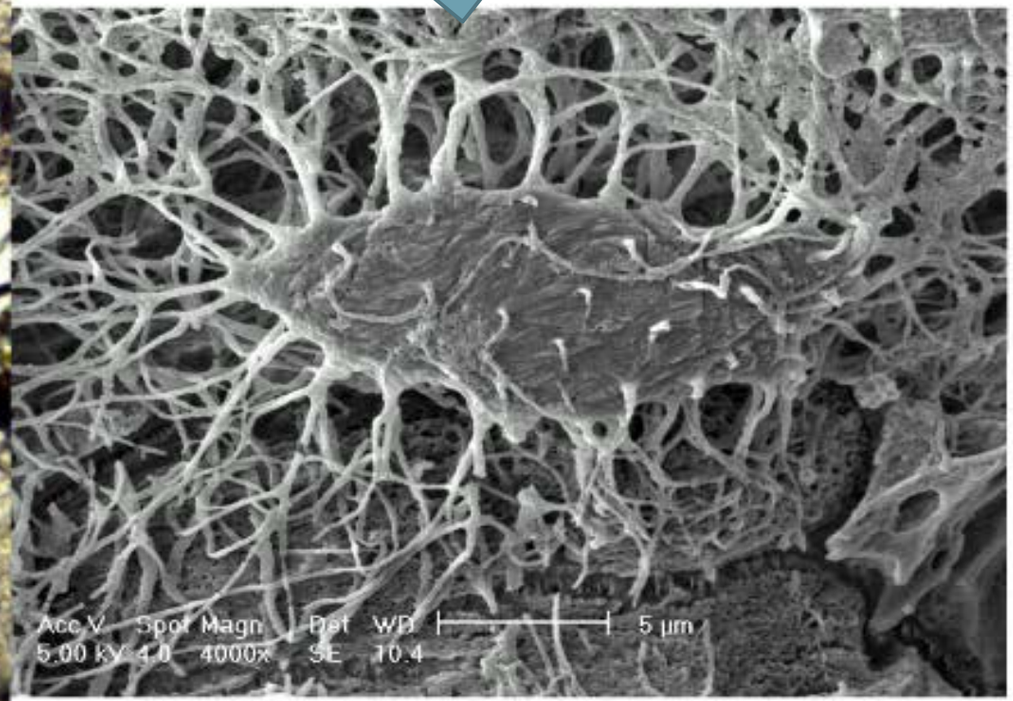
Osteoblasts



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

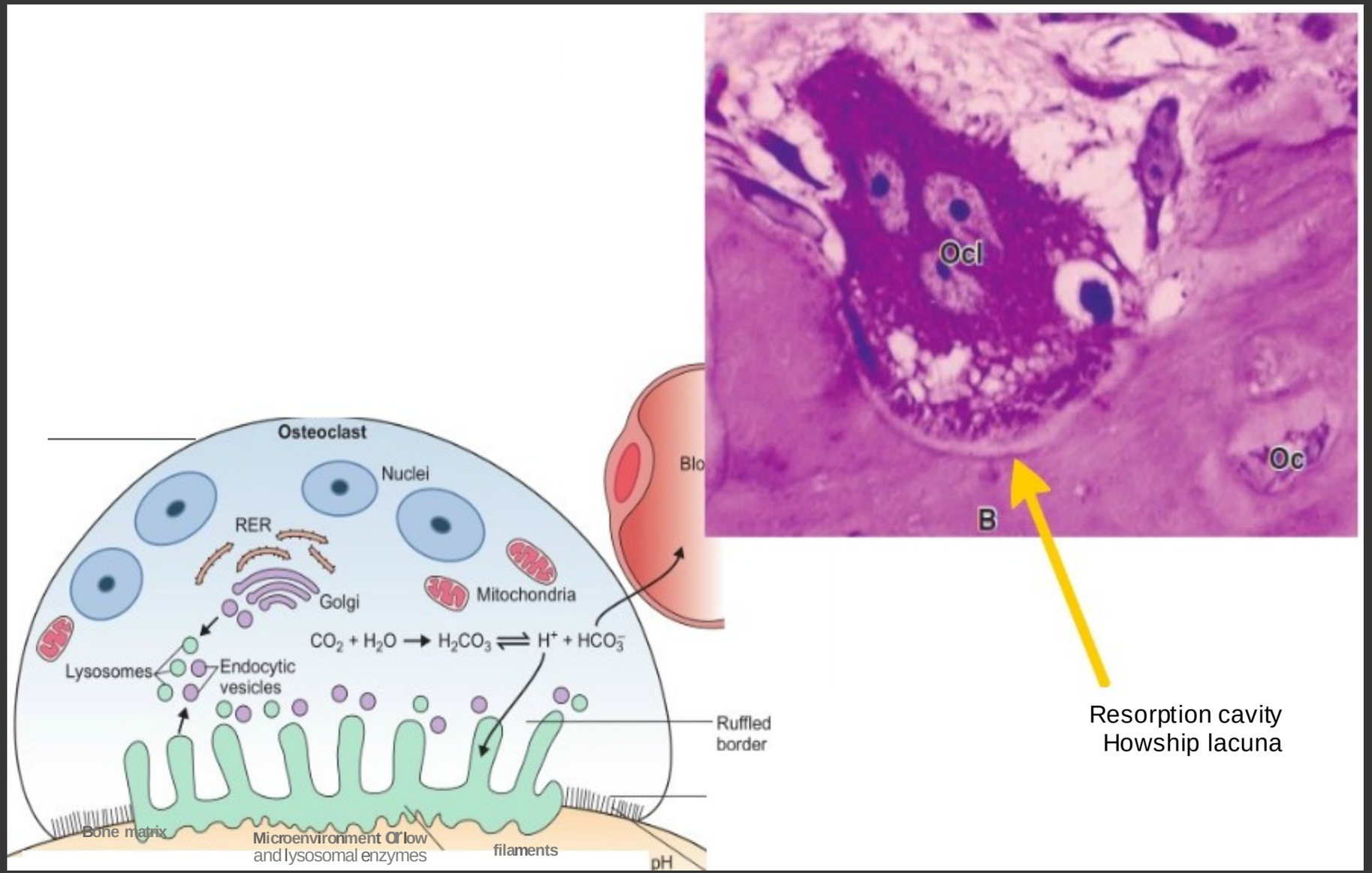
Osteocytes

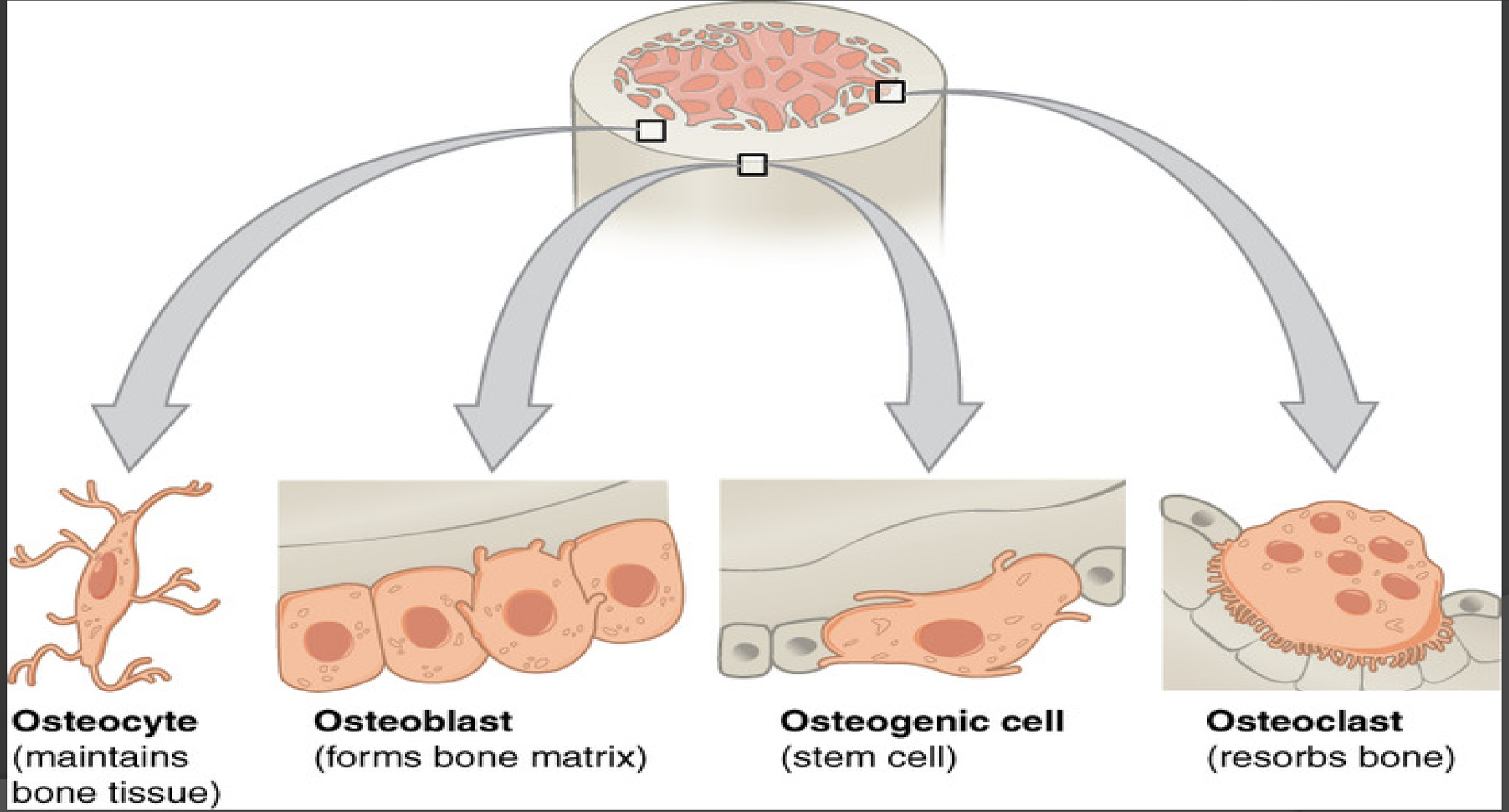




Osteoclasts

large, motile & multinucleated




Osteocyte
(maintains
bone tissue)
Osteoblast
(forms bone matrix)
Osteogenic cell
(stem cell)
Osteoclast
(resorbs bone)

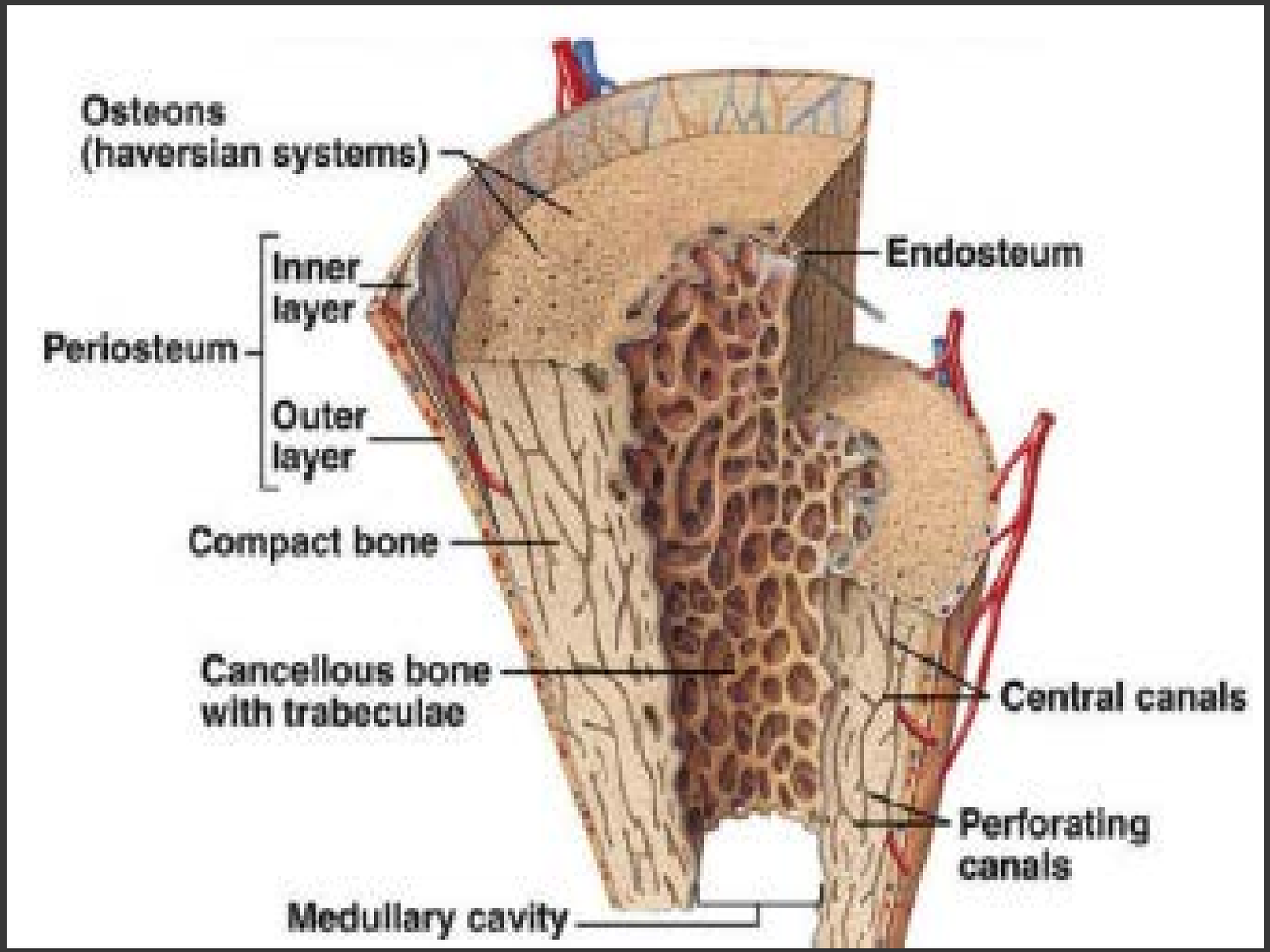
Bone matrix

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

70%non-organic calcium, phosphate (bicarbonate, citrate, magnesium, potassium, and sodium are also found)
*crystals $Ca_{10}(PO_4)_6(OH)_2$
*noncrystalline

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

Periosteium & Endosteum Sharpey’s fibers

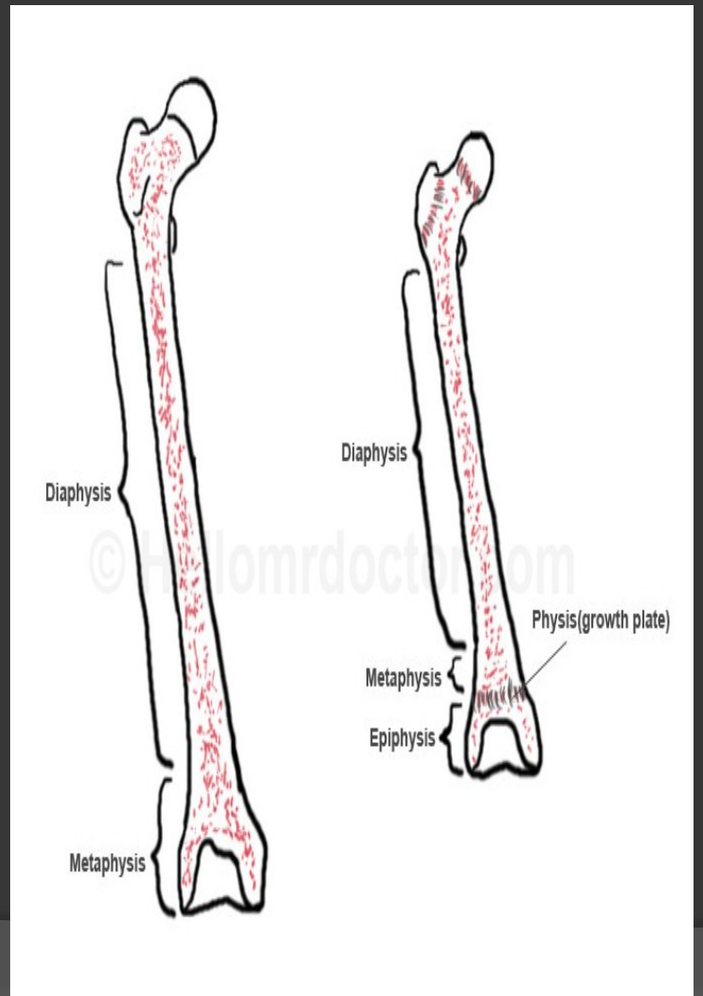


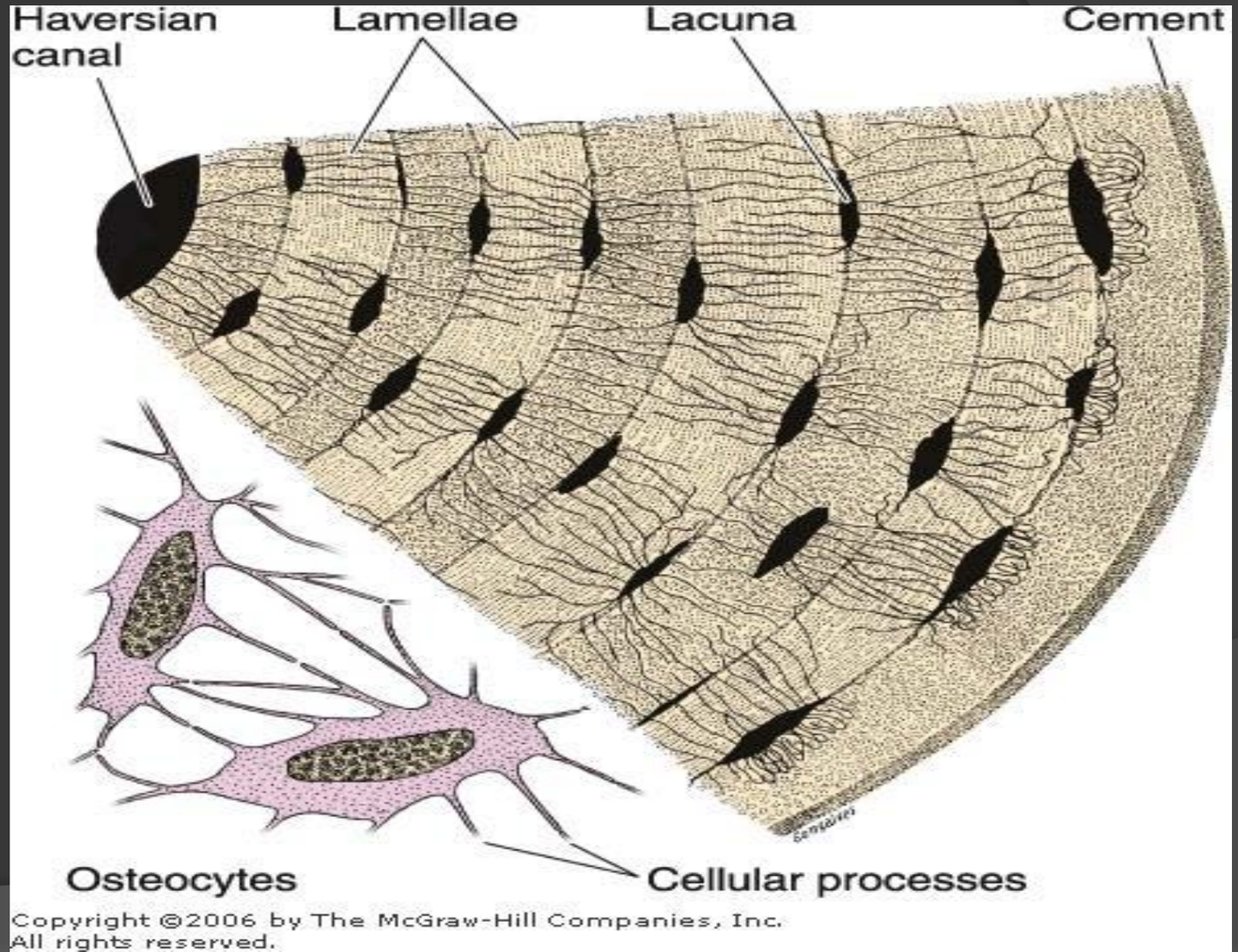
Types of Bone

- 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.

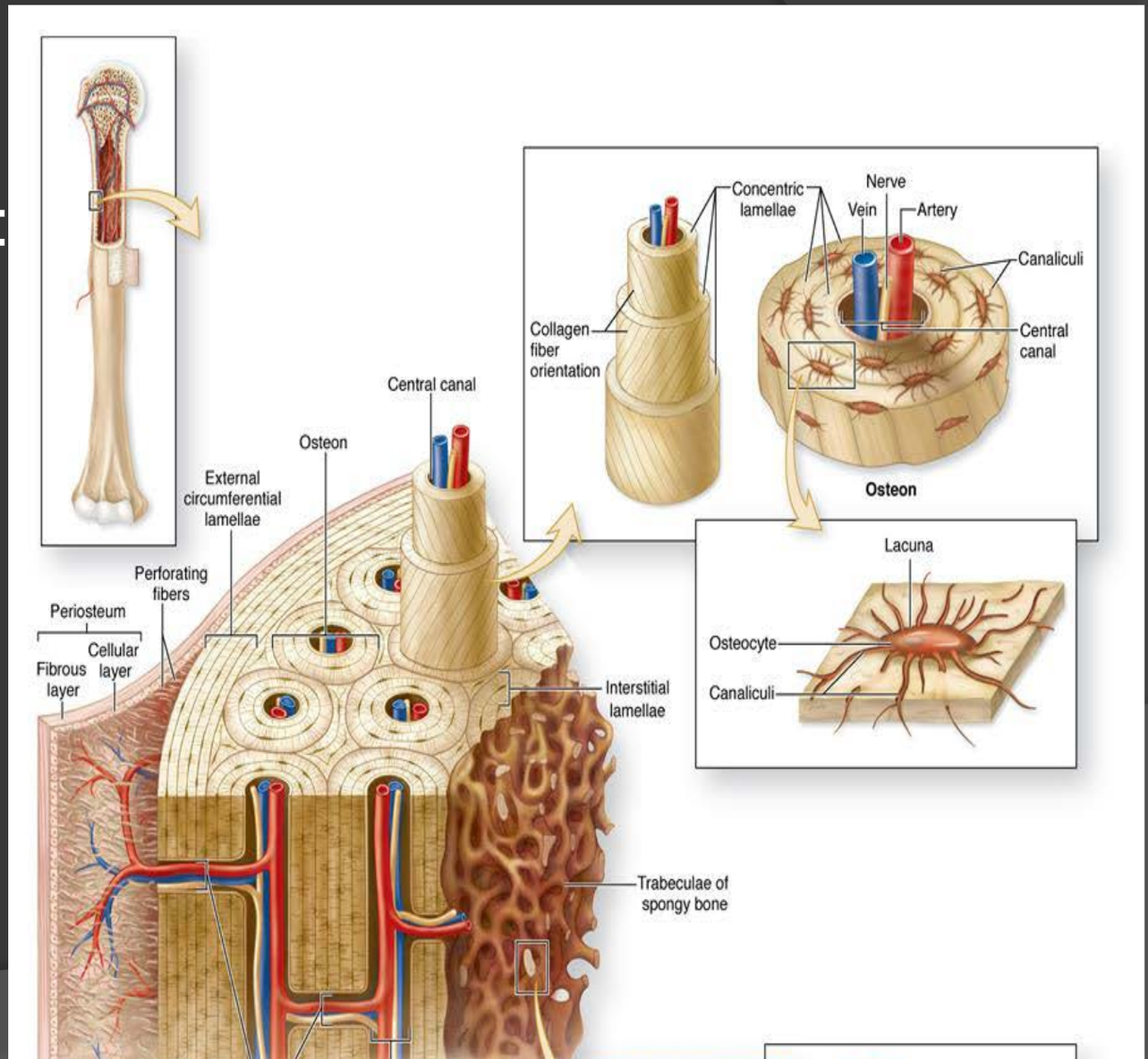
Macroscopic classification of **bone tissue**:

Compact bone:



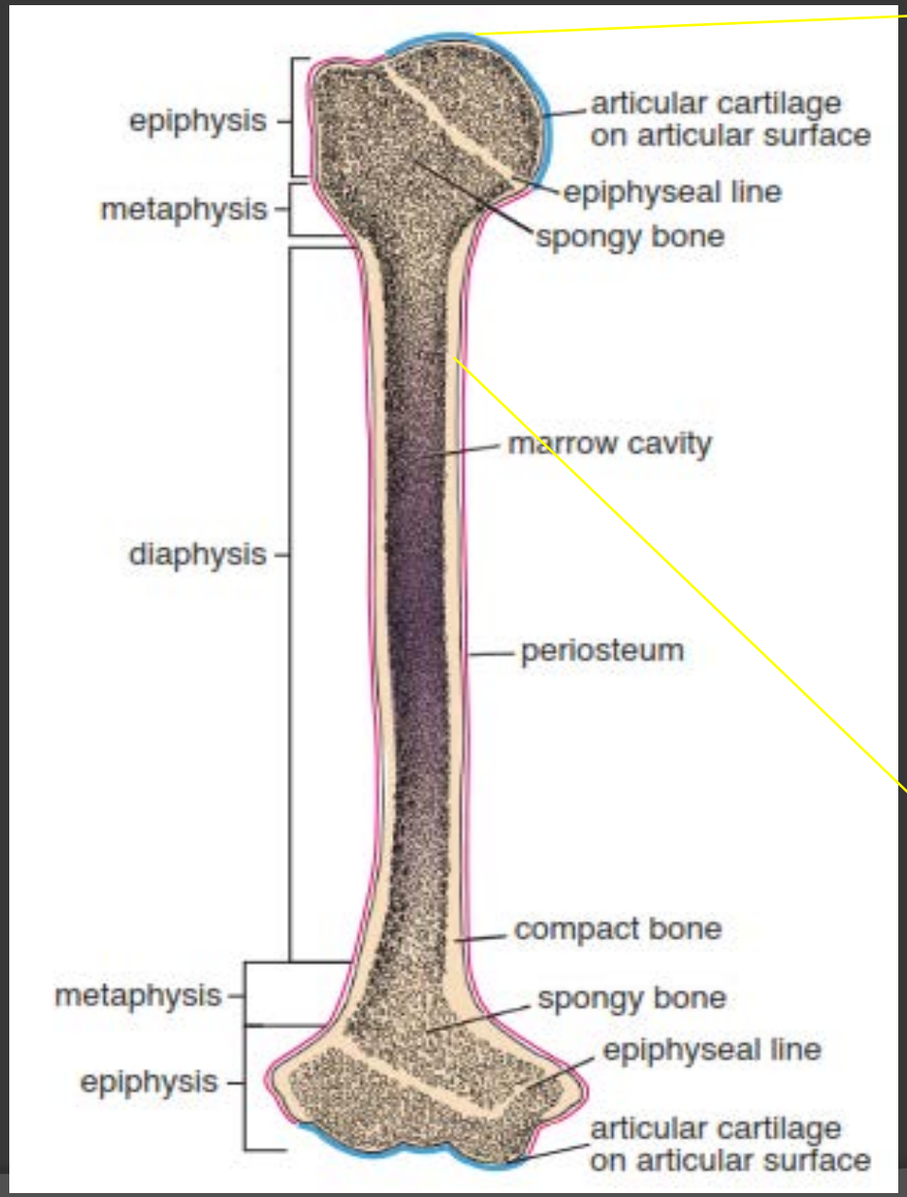


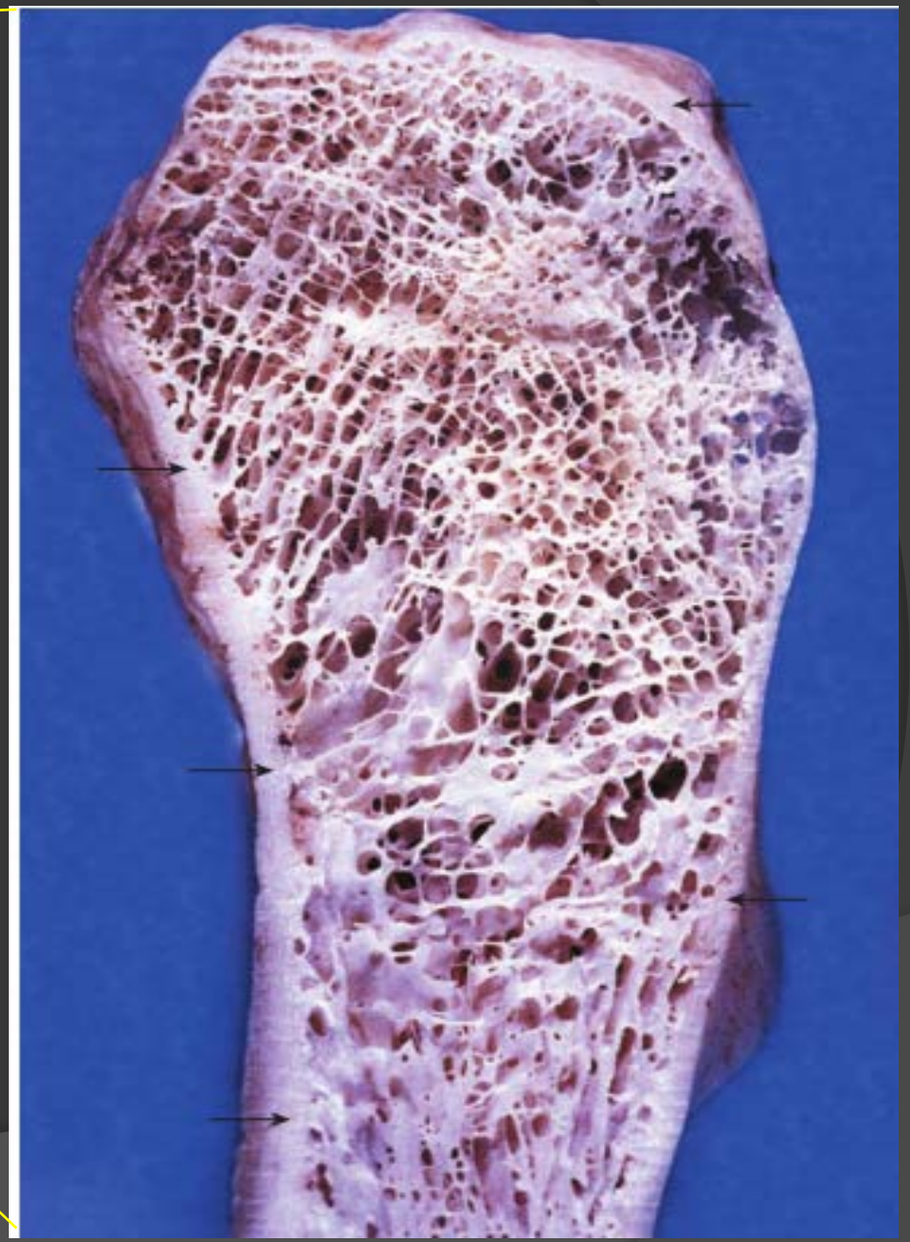
- - Outer circumferential lamellae:
- - Inner circumferential lamellae:
- - Osteons (Haversian systems):
- - Interstitial lamellae:



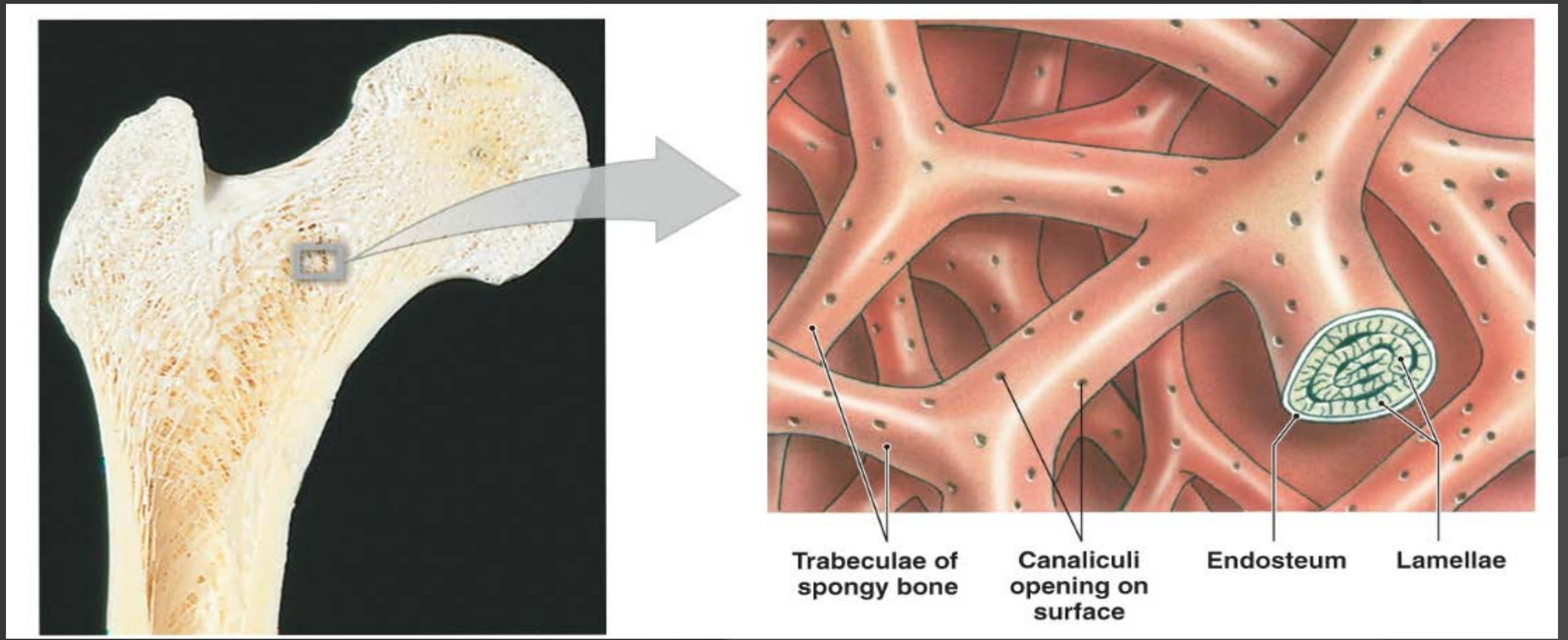
Notes:

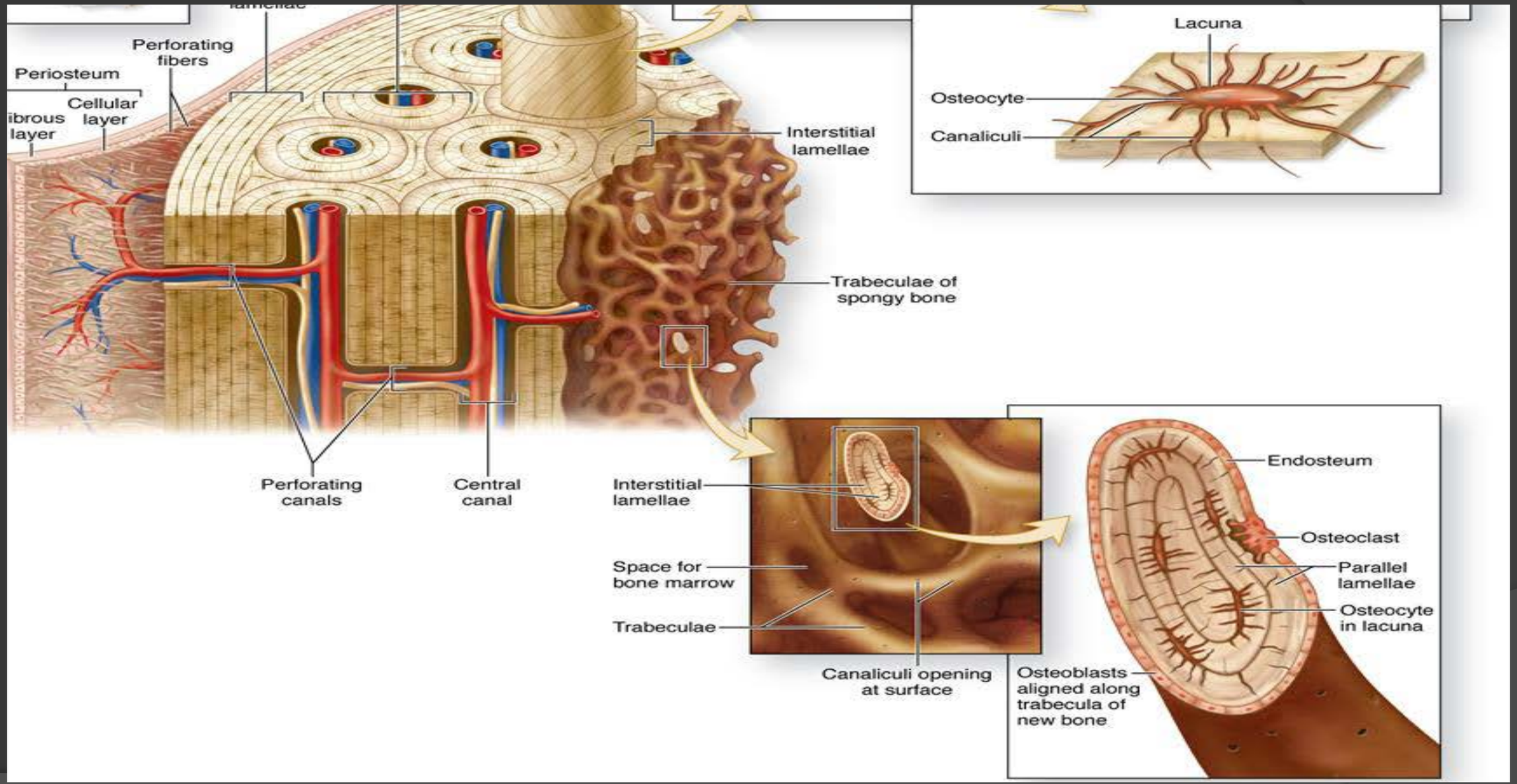
- In each lamella, collagen fibers are arranged spirally, in a direction opposite to that of the collagen fibers of the adjacent lamella.
- Osteons are in a continuous renewal process, therefore, they differ in diameter & number of lamellae.
- Surrounding each osteon is a layer of amorphous material 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.


epiphysis
metaphysis
diaphysis
metaphysis
epiphysis
articular cartilage on articular surface
epiphyseal line
spongy bone
marrow cavity
periosteum
compact bone
spongy bone
epiphyseal line
articular cartilage on articular surface



Spongy (Trabecular bone)

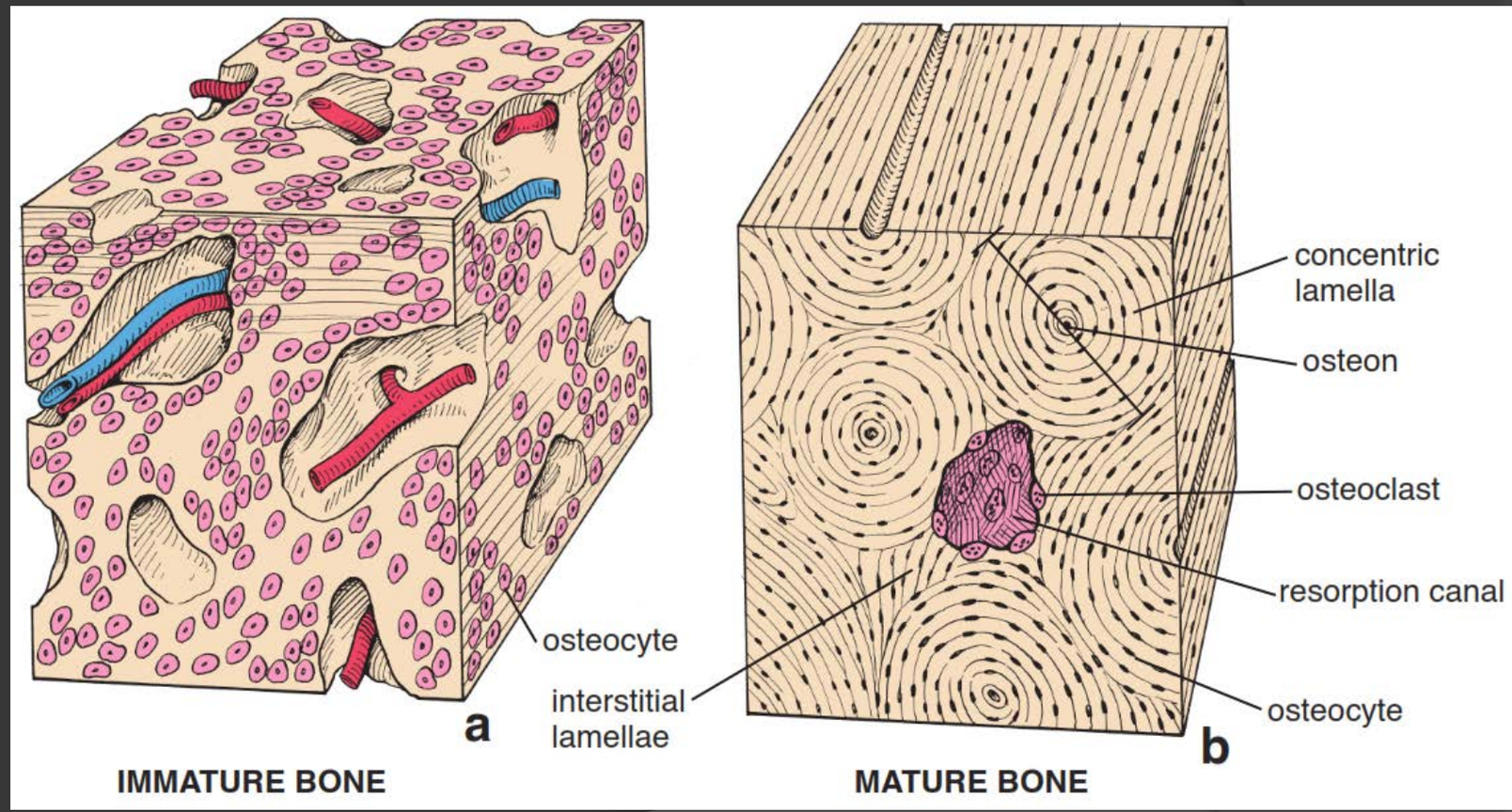



Perforating fibers
Periosteum
Cellular layer
ibrous layer
Interstitial lamellae
Trabeculae of spongy bone
Perforating canals
Central canal
Lacuna
Osteocyte
Canaliculi
Interstitial lamellae
Space for bone marrow
Trabeculae
Canaliculi opening at surface
Endosteum
Osteoclast
Parallel lamellae
Osteocyte in lacuna
Osteoblasts aligned along trabecula of new bone

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

Prezi