

Medical Biology

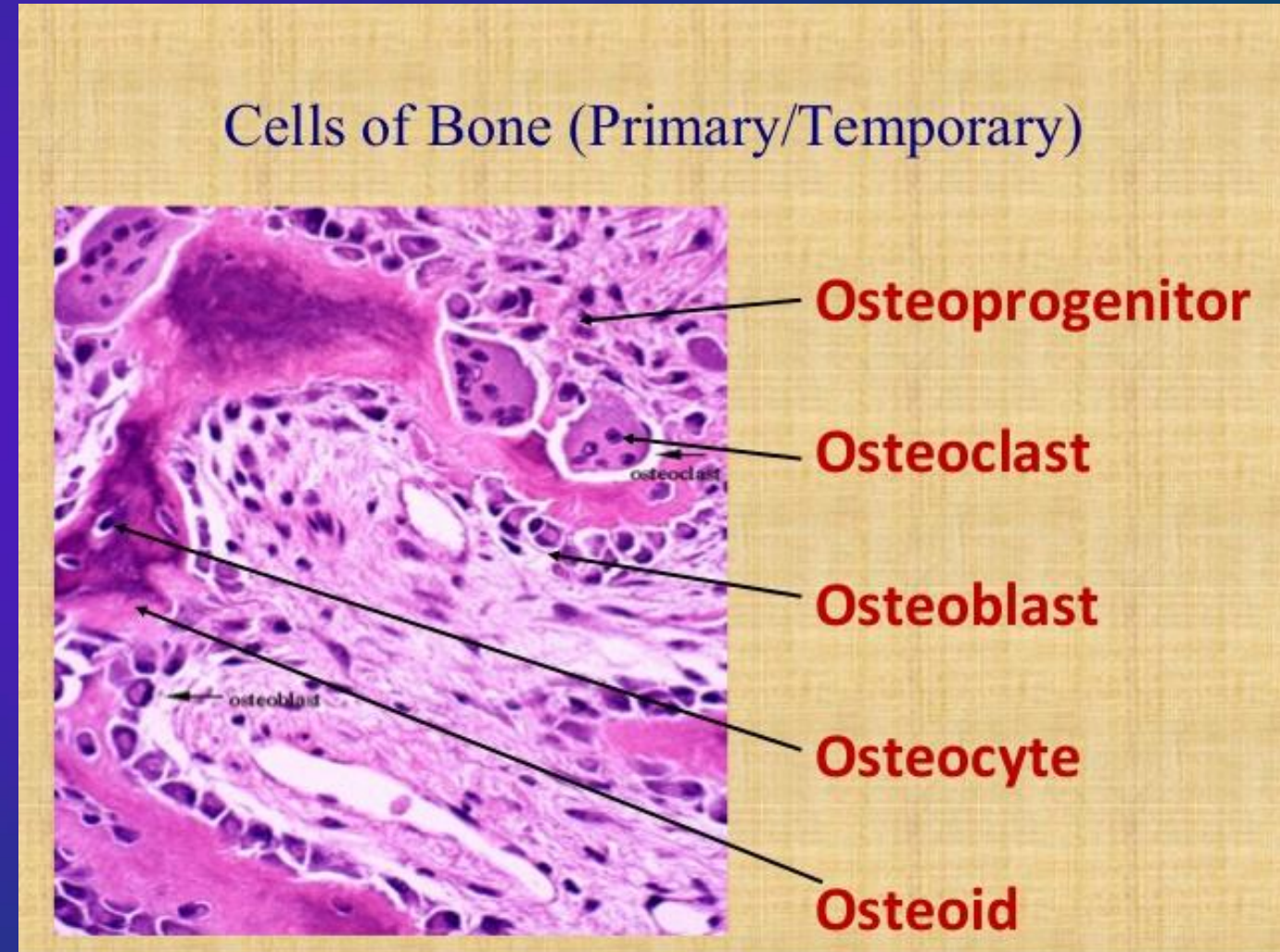
BONE

▶ Bone functions

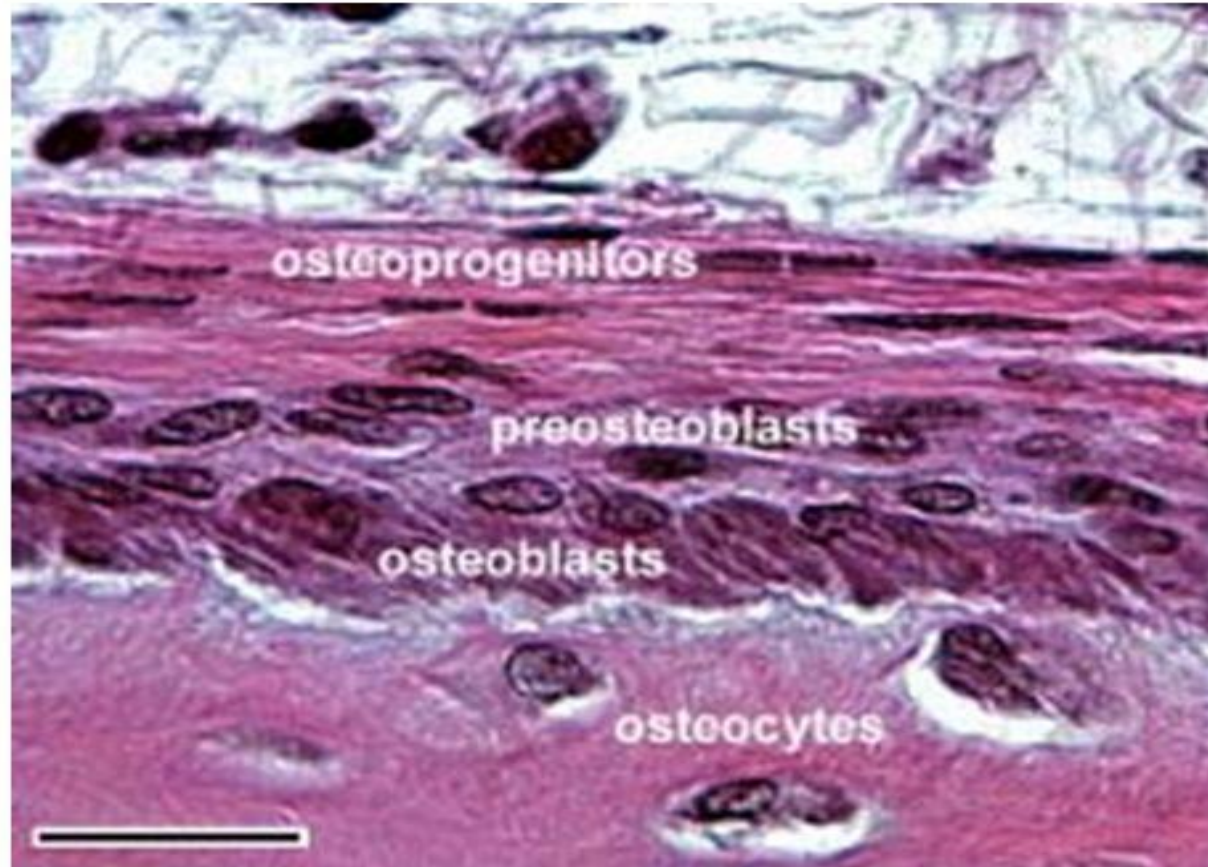
- ▶ Support
- ▶ Protection
- ▶ Movement
- ▶ Minerals homeostasis (maintain blood Ca^{++} & P04^{--} level equilibrium)
- ▶ Bone is a **hard**, but **brittle** tissue. Bone is a **dynamic** tissue, which throughout life bone tissue is continually being **formed** and **resorbed**.

Bone Cells

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

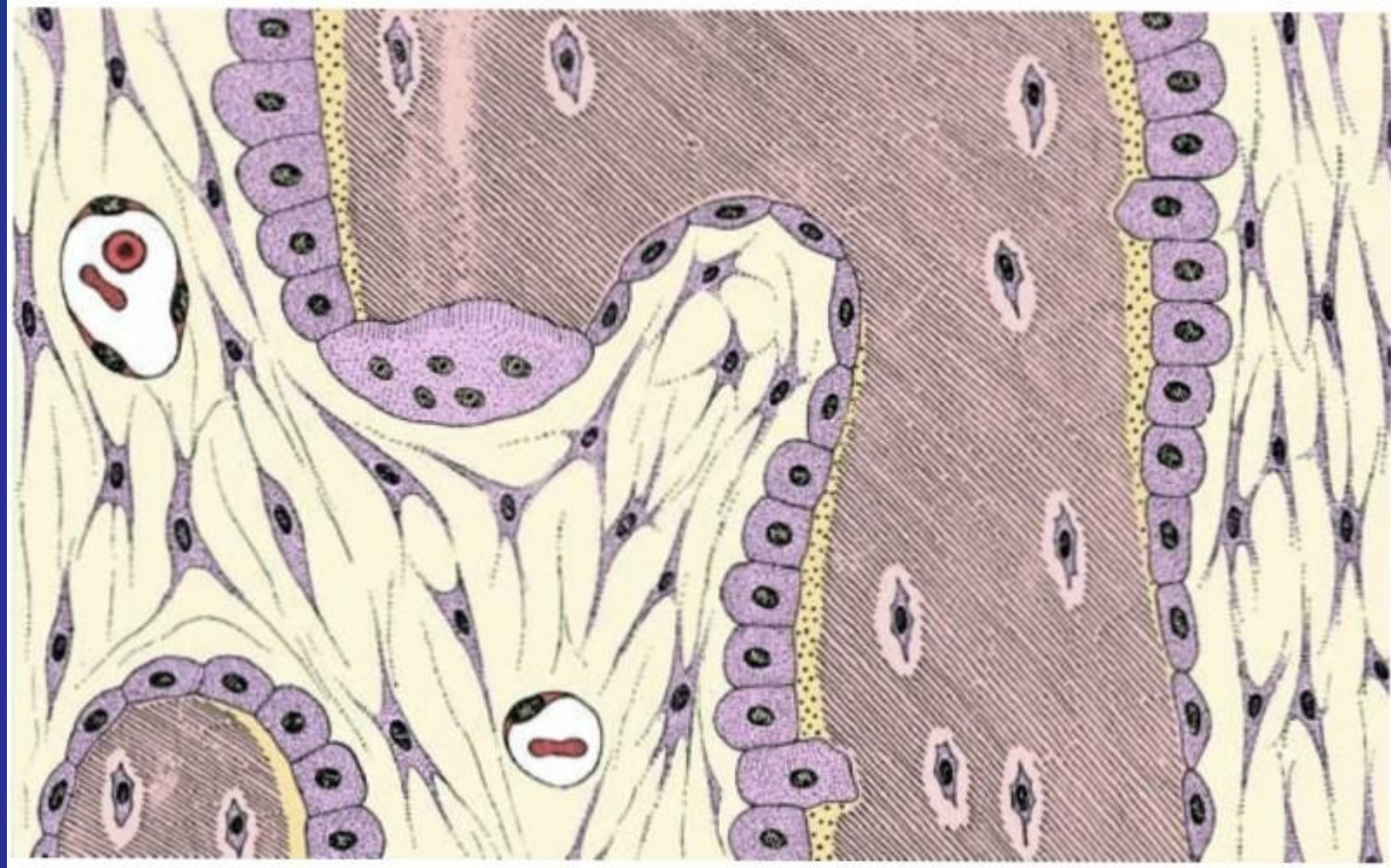


OSTEOPROGENITOR CELLS



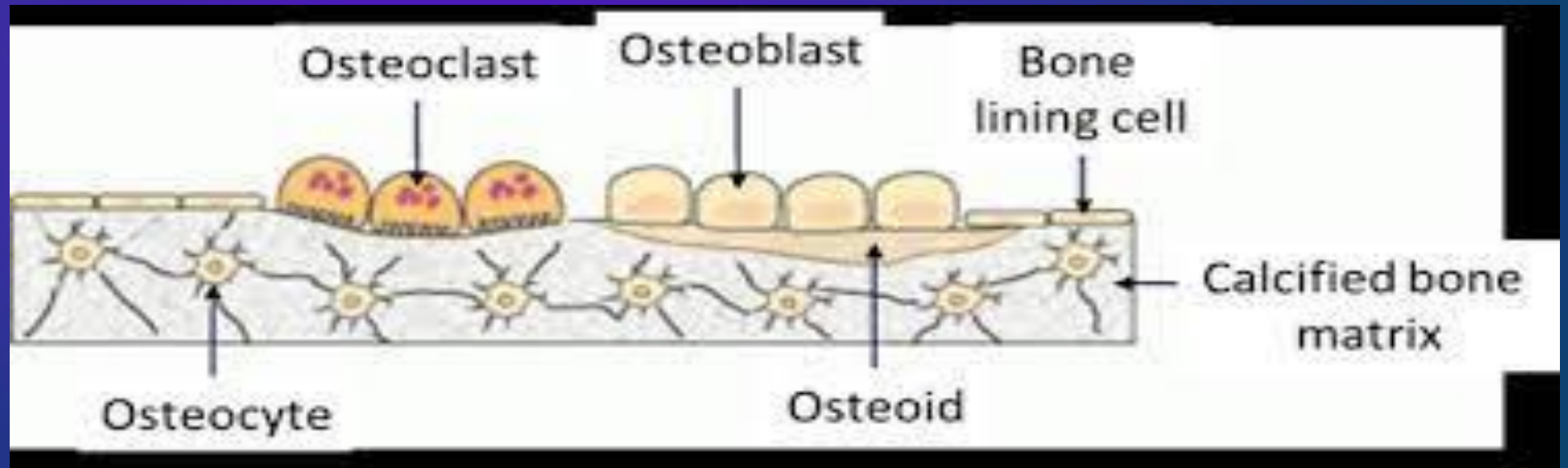
- Located in the periosteum and endosteum. Flat squamous cells. They are very difficult to distinguish from the surrounding connective tissue cells.

Osteoblasts



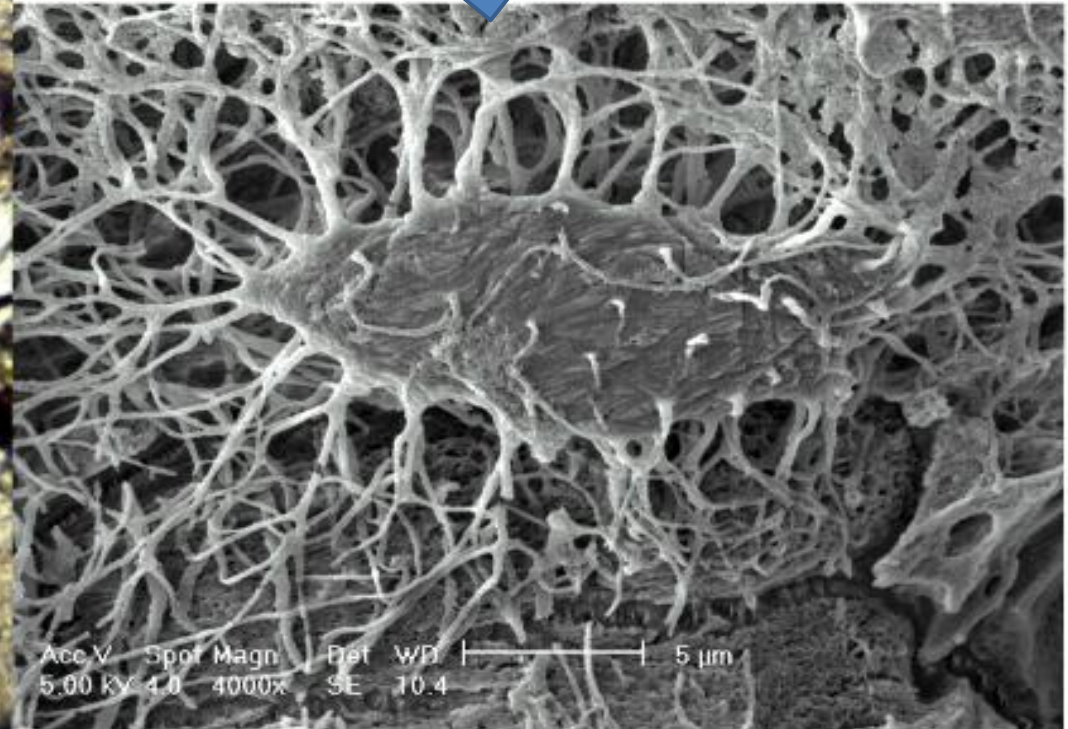
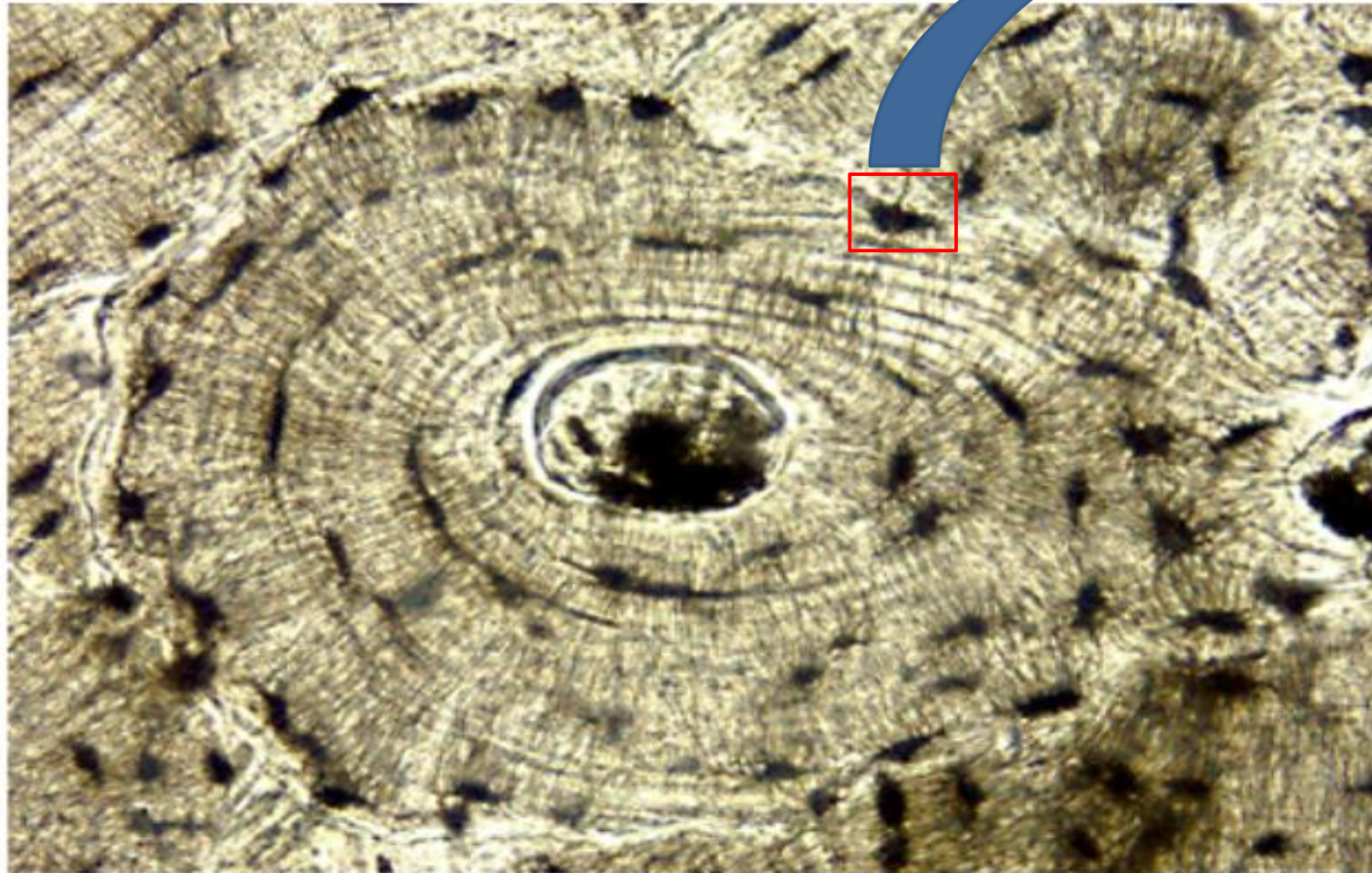
Osteoblasts are rich in the enzyme alkaline phosphatase, which plays a major role in the formation of the mineral deposits in the matrix.

The matrix closest to the osteoblasts is not yet calcified and is known as **osteoid or prebone**. This osteoid is rich in collagen fibers. Small membrane-bound matrix vesicles are budded off processes of the osteoblast cell membrane and secreted to the matrix. These play an important role in the calcification process of the matrix.



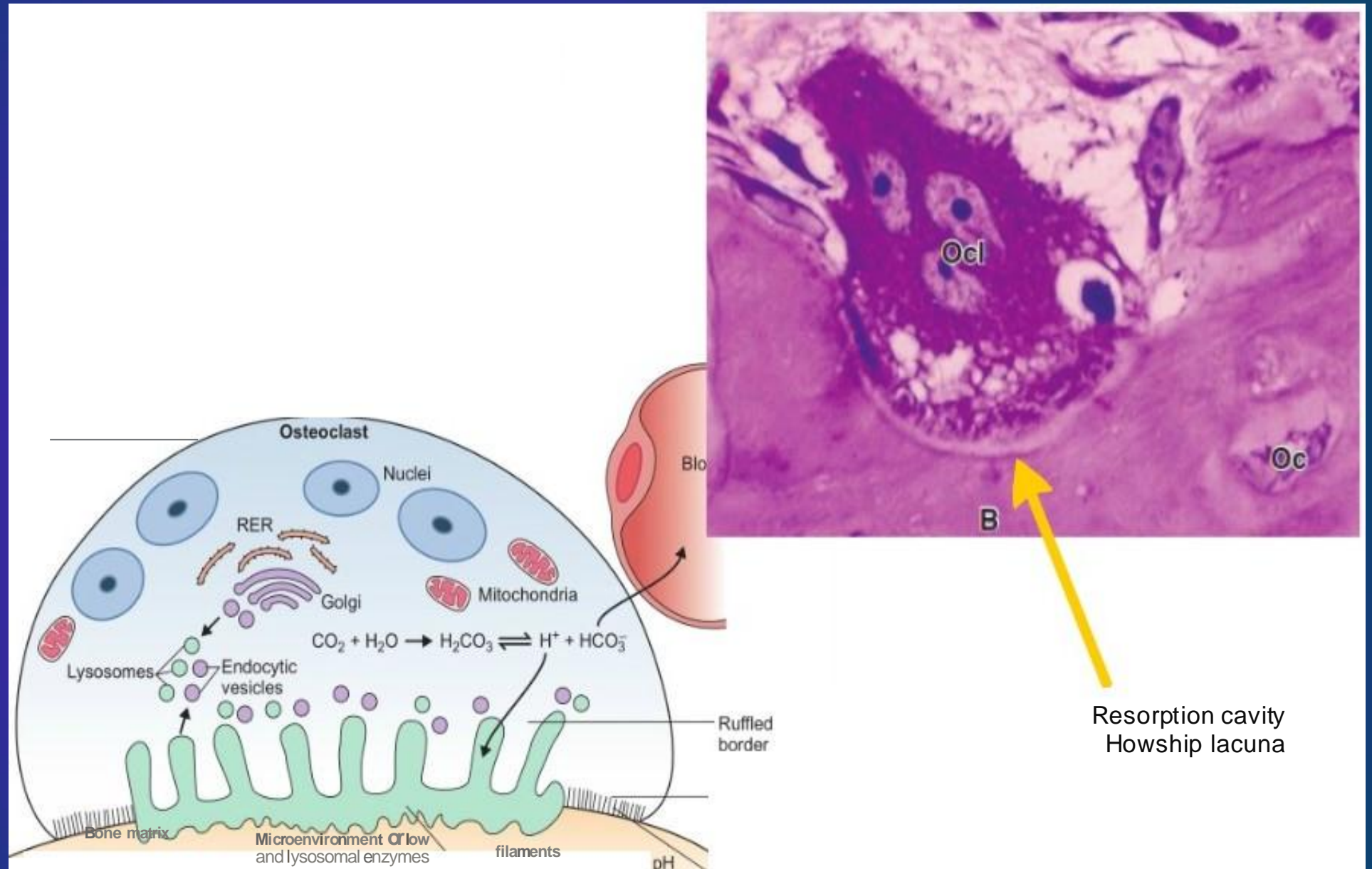
Osteocytes

Osteocytes cytoplasmic processes communicate cells with each other & with other cells via gap junctions



Osteoclasts

- ❑ large, motile &
- ❑ Multinucleated (50)
- ❑ eroding surface (ruffled border)
- ❑ Howship's lacunae
- ❑ originate from monocytes and are included in the mononuclear phagocyte system.



Researchers have discovered a new type of bone cells, called "osteomorphs," which may be targeted for osteoporosis and other skeletal diseases.

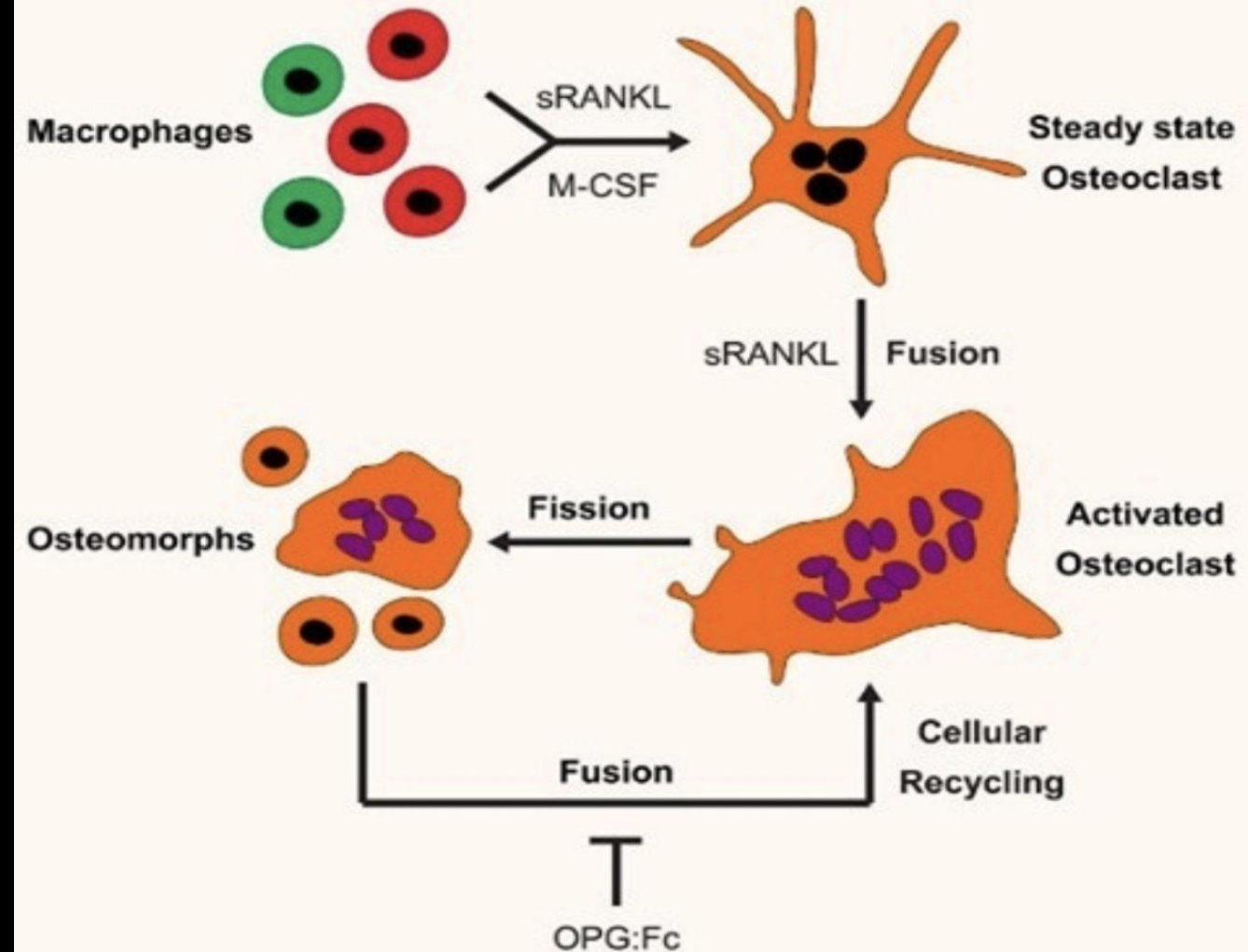
The discovery came when Dr. Tri Giang Phan of the Garvan Institute of Medical Research in Darlinghurst, New South Wales and colleagues were studying osteoclasts, cells that resorb bone.

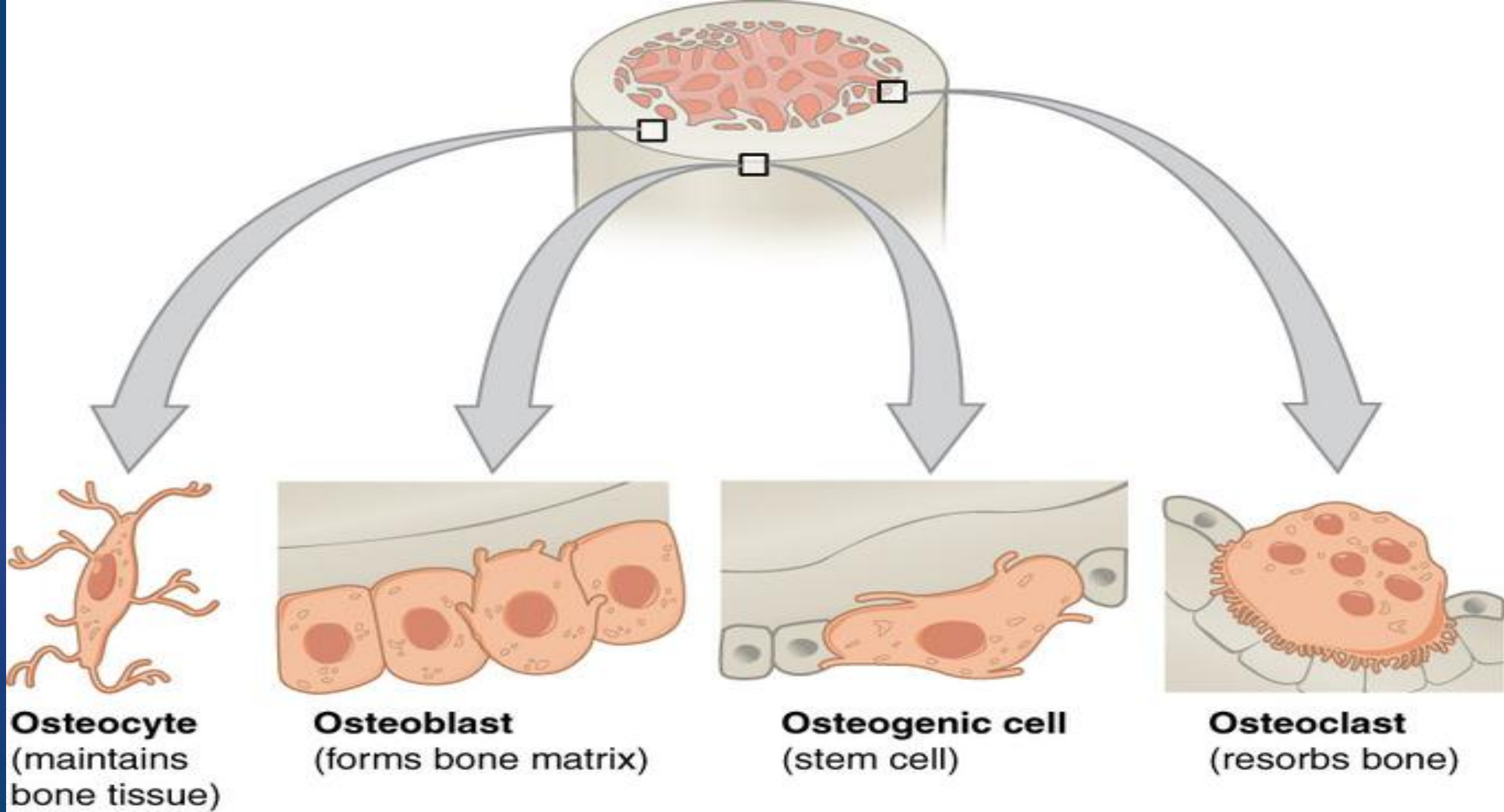
"The dogma until now was that osteoclasts died after they finished resorbing bone," Dr. Phan told Reuters Health by email. However, he said, "intravital imaging revealed that the bone-resorbing osteoclasts split up into daughter cells, which we called osteomorphs.

This had never been seen before and was totally unexpected. The new finding suggests that the dogma is wrong."

The osteomorphs were able to fuse together to form osteoclasts in a process the team calls "cellular recycling."

It's not often we discover a new human cell that has gone undetected until now. The study was published in the journal Cell. If you tap the link in bio, you can read the full story of this fascinating scientific find.





Osteo**C**lasts **C**rushing



Osteo**B**lasts **B**uilding



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

If a bone is decalcified, its shape is preserved, but it becomes flexible. If a bone is devoid of collagen, its shape is also preserved, but it becomes fragile.

medicosworld_ 🧑🏻 This little angel is Ainsley Grace. She is suffering from a condition called Osteogenesis Imperfecta.

Osteogenesis imperfecta (also called Brittle bone disease) is a rare genetic disorder that mainly affect the bones. It is associated with connective tissue problems due to a lack of type I collagen.

Shortly after birth, Ainsley was diagnosed with osteogenesis imperfecta type 3. Her condition is so severe that, if touched the wrong way, her bones will fracture or break.

Ainsley was delivered via c-section with so many fractures radiology couldn't count them all. Still she fought for her life and was finally allowed to go home 5 weeks later. "To help you understand her fragility, when she was 8 months old she had her first orthopedic surgery to rotate her left leg down and when the surgeon came out of surgery he described her bones as "wafer thin" and told us they don't really break, they "mush" because they're so fragile." At her 2 month check-up we learned that every bone had been re-broken at least once. At 3 months old she developed hydrocephalus and had her first brain surgery and a month later was her second brain surgery when they placed a shunt. This was also when we learned she had a chiari one malformation and basilar invagination.

This little girl has been through more than most people experience in a lifetime. But despite the struggles, Ainsley continues to heal those around her with smiles and laughter. Credit: Prayers for Ainsley Grace, at Facebook.com

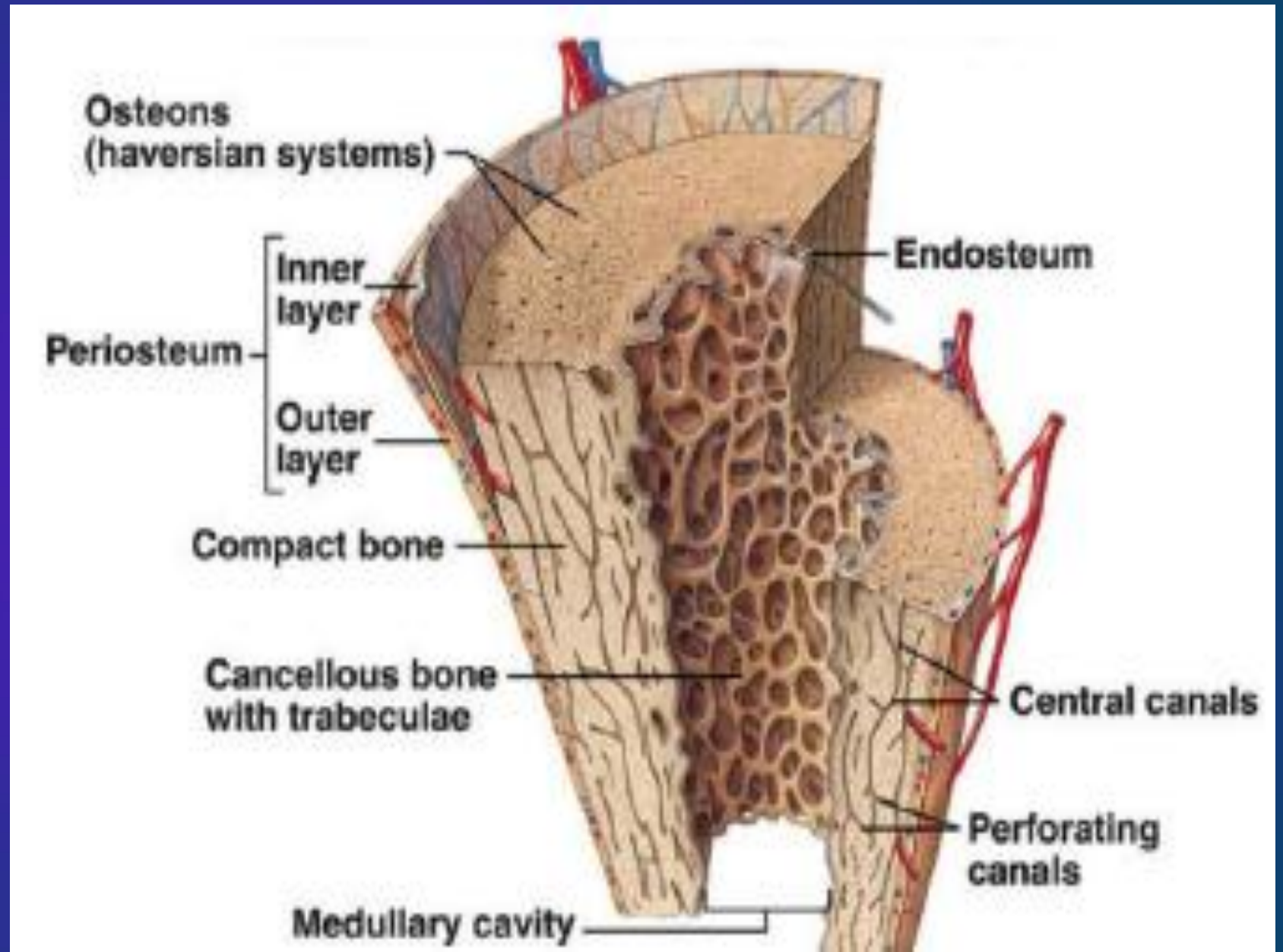


Periosteum (fibrous and cellular layers)
Sharpey's fibers

Endostem (cellular layer)

Functions

- 1. nutrition of osseous tissue**
- 2. provision of a continuous supply of new osteoblasts for repair or growth of bone.**

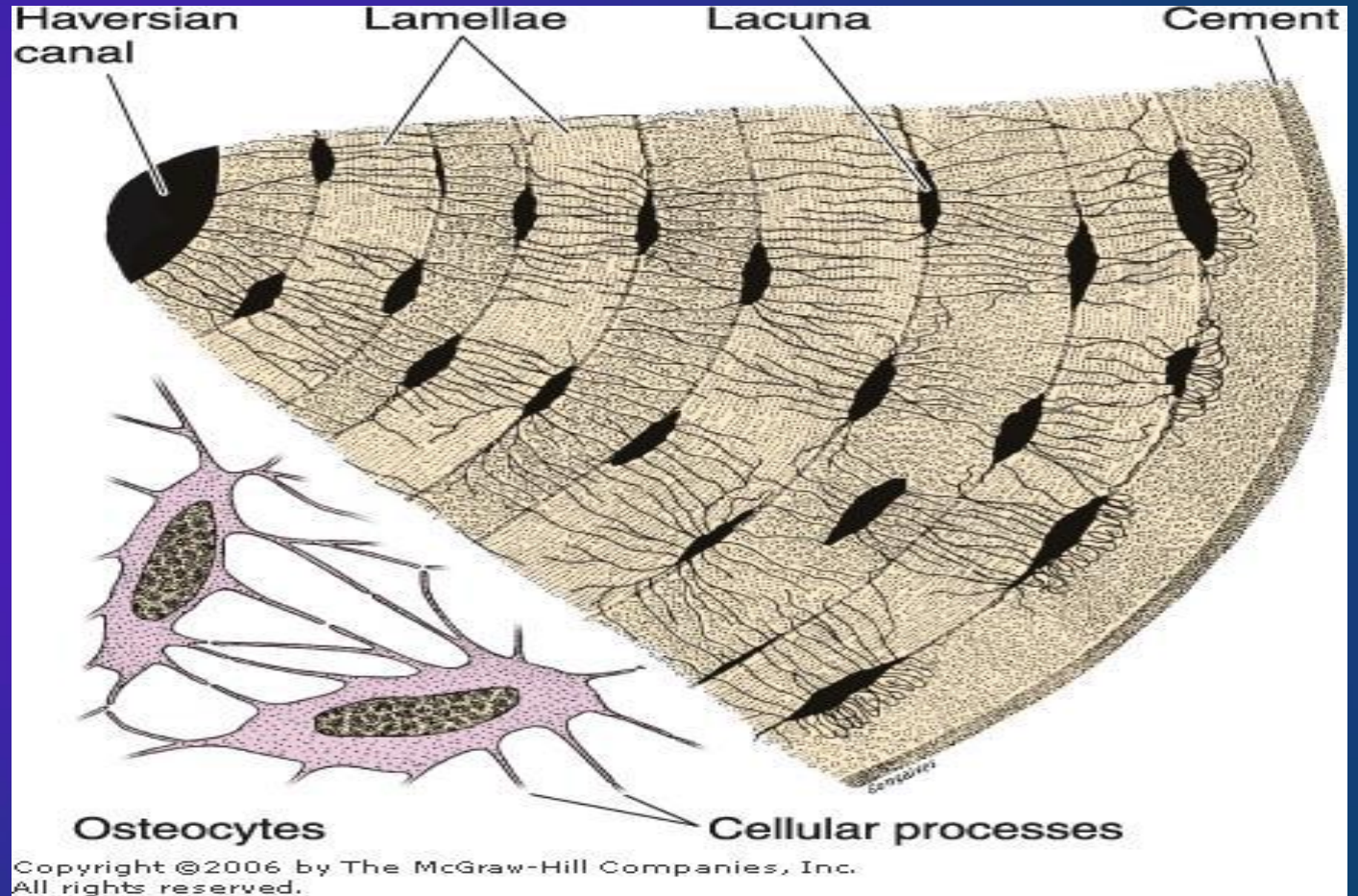
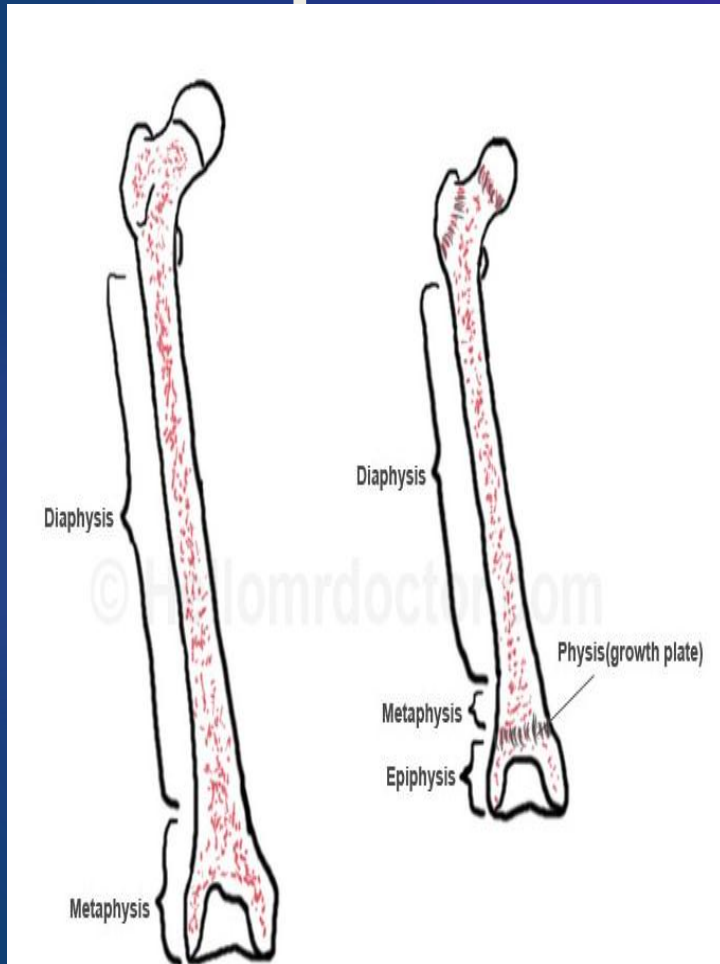


Types of Bone

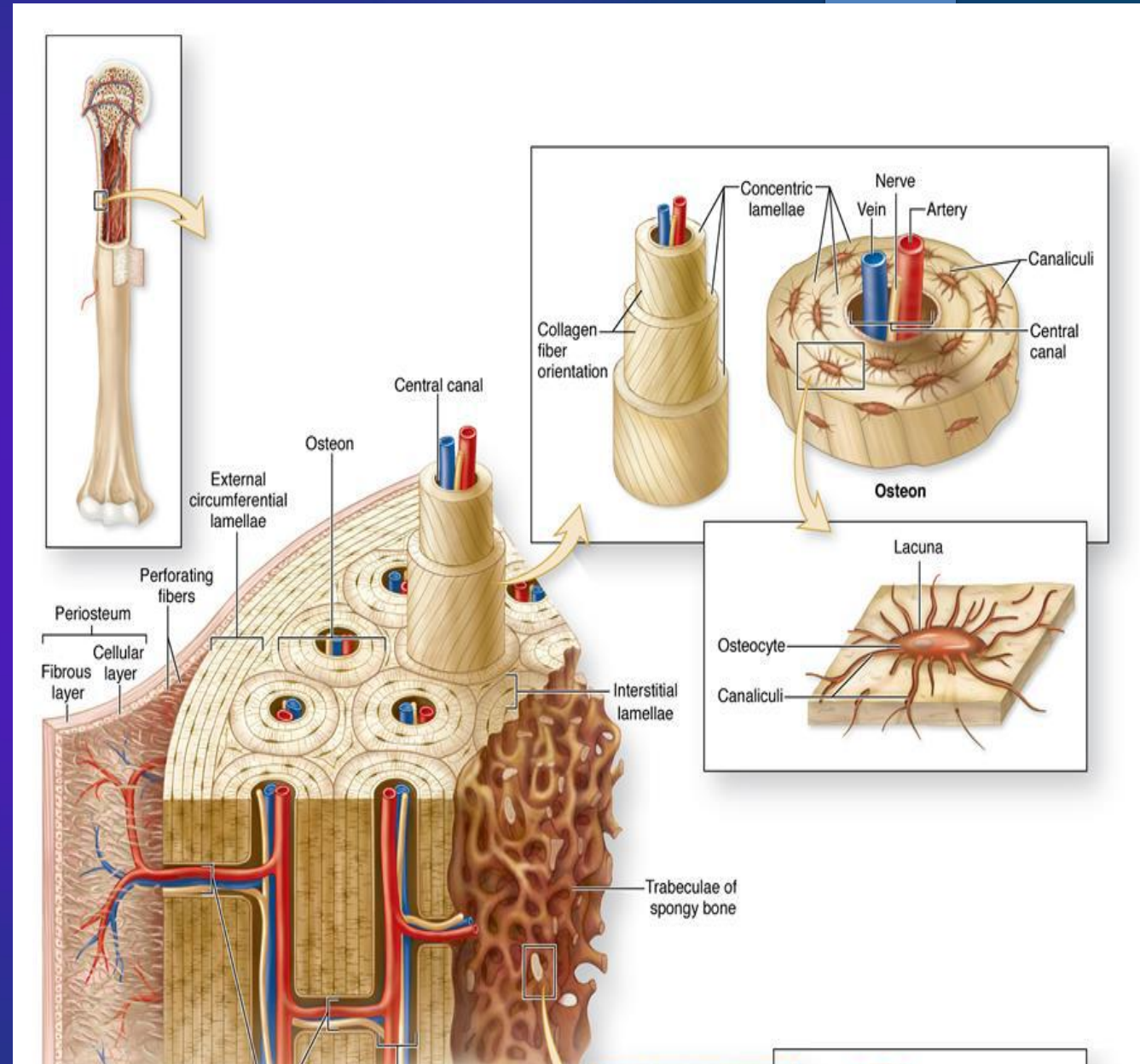
- ▶ Anatomical classification of **bones**: long, short, flat, & irregular bones.
- ▶ Macroscopic classification of **bone tissue**: compact bone, cancellous bone (microscopically they are almost identical).
- ▶ Developmental classification of bone tissue: primary & secondary.

Macroscopic classification of bone tissue:

Compact bone:



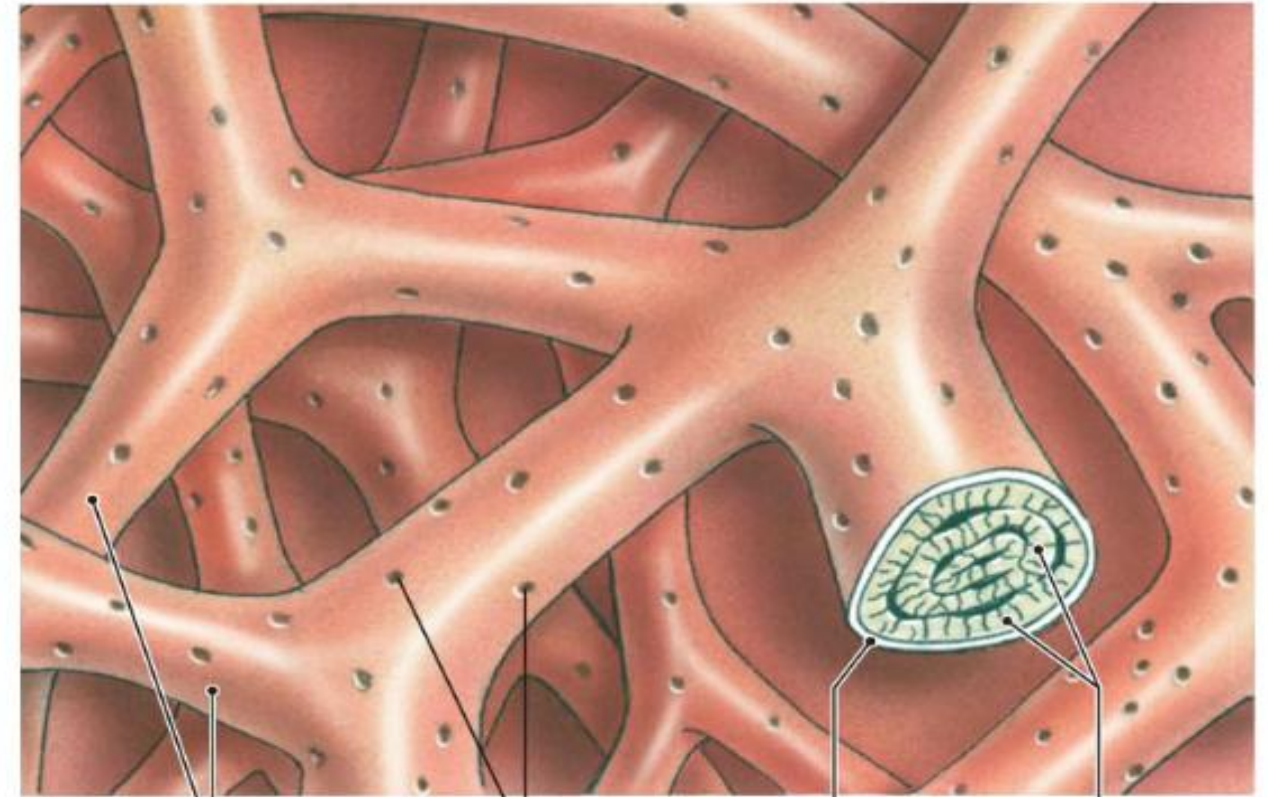
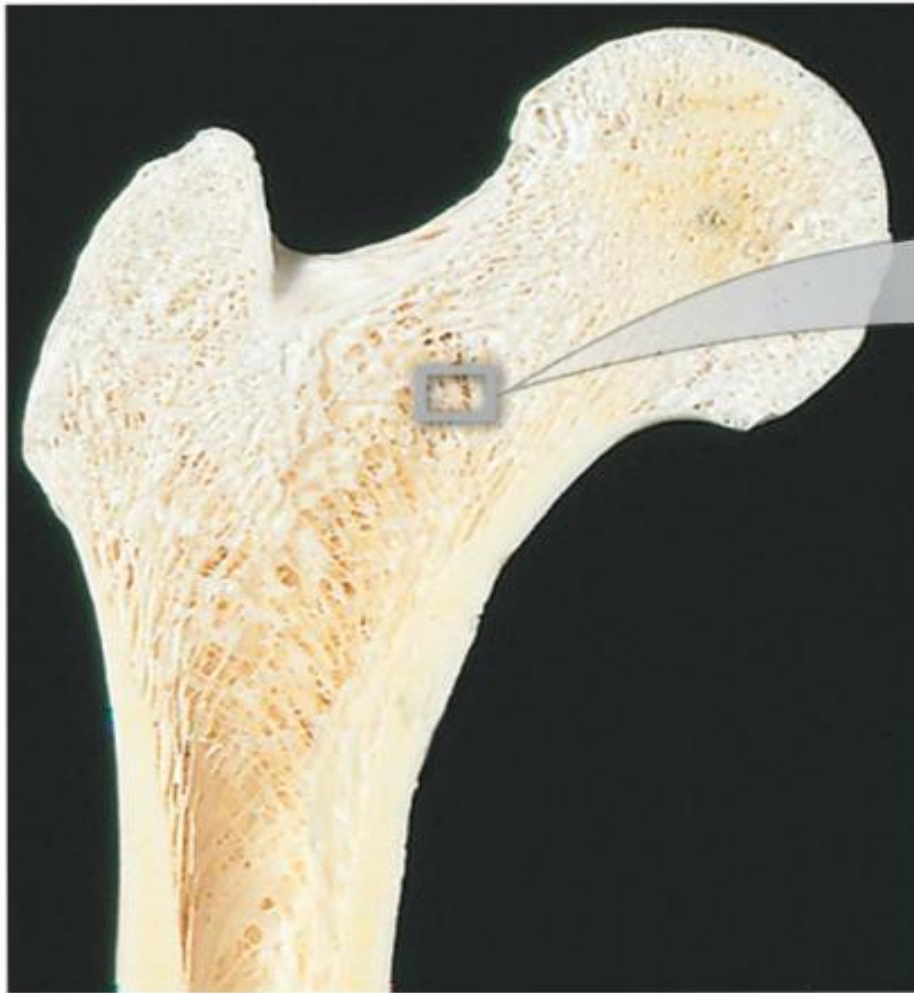
- ▶ - Outer circumferential lamellae:
- ▶ - Inner circumferential lamellae:
- ▶ - Osteons (Haversian systems):
- ▶ - Interstitial lamellae:



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)

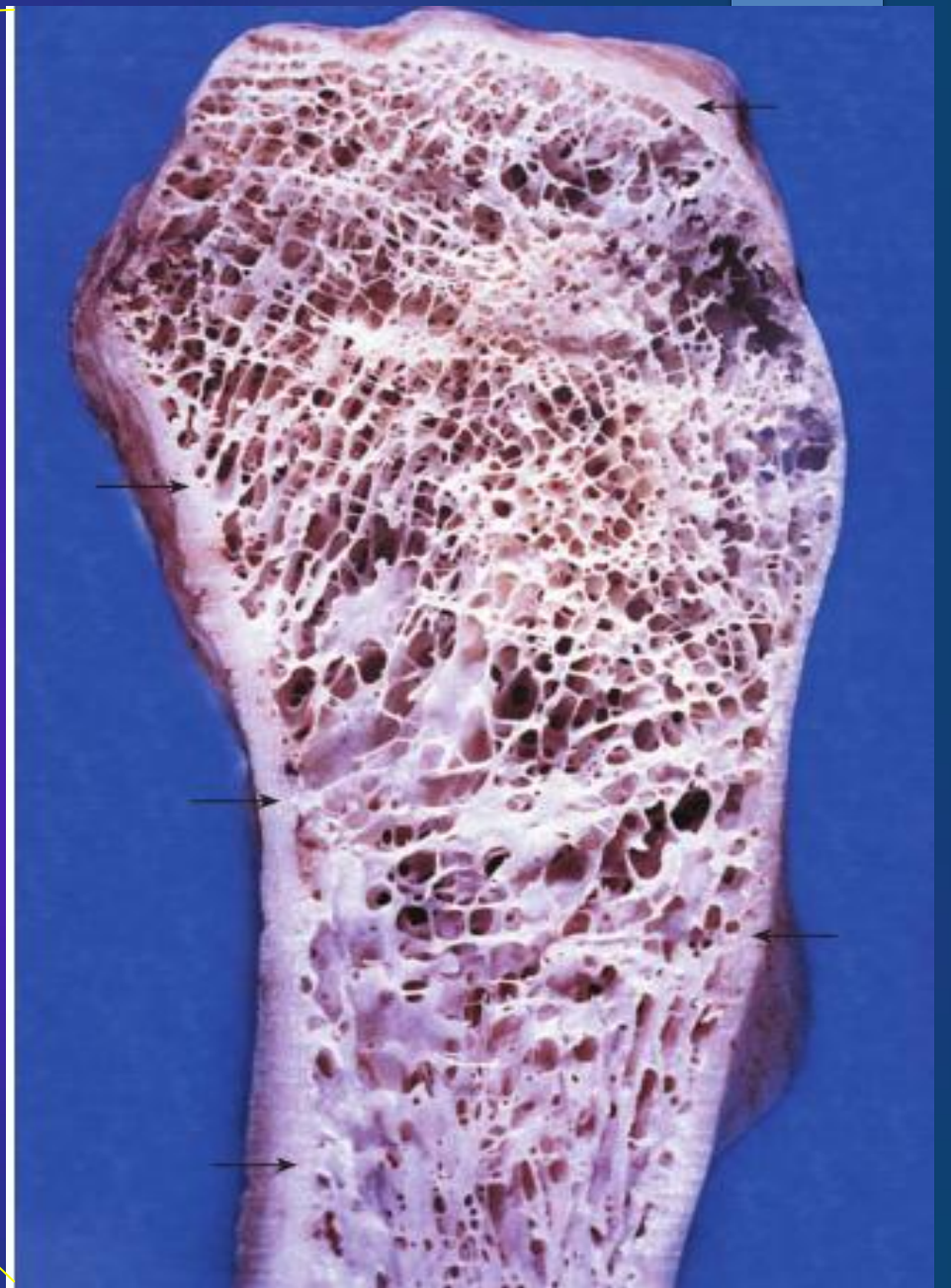
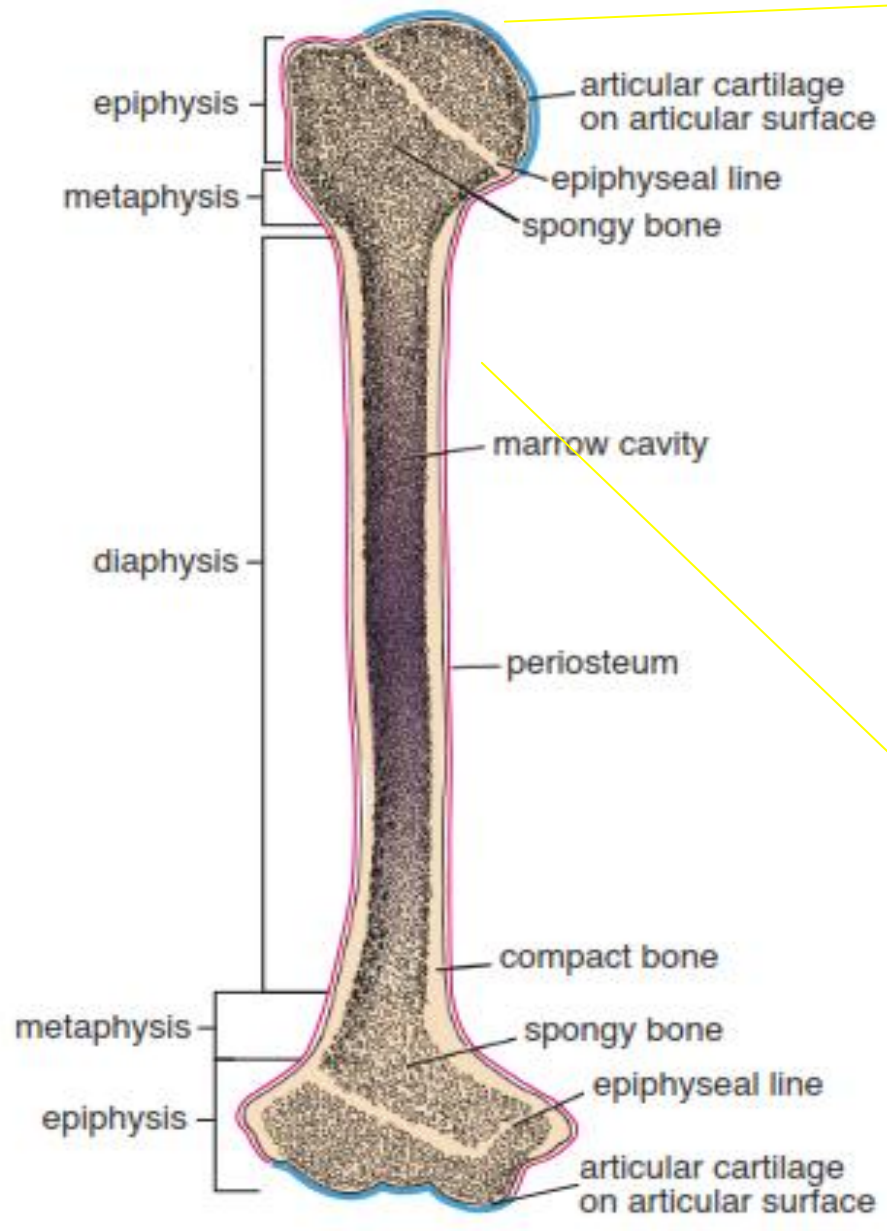


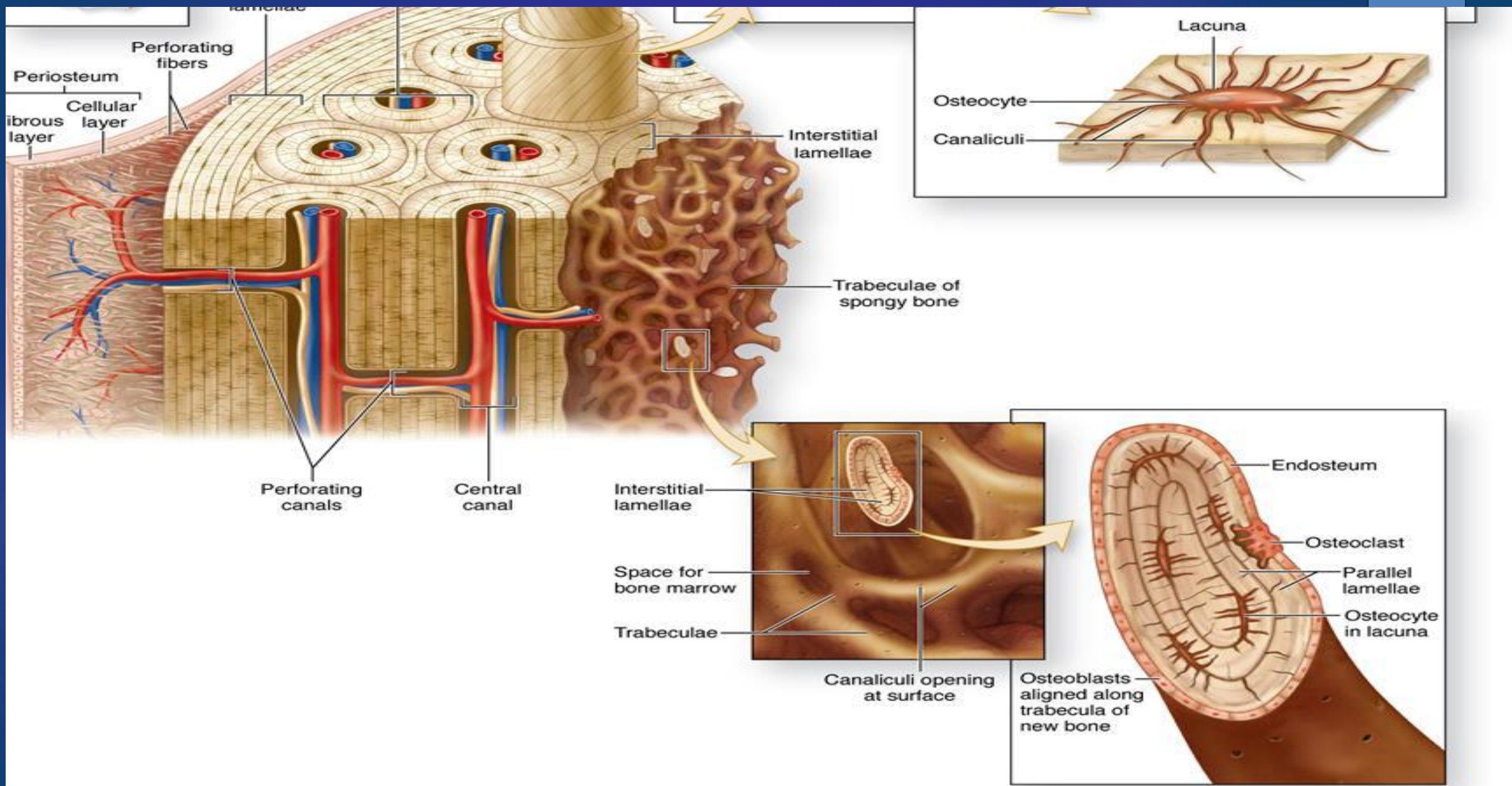
Trabeculae of
spongy bone

Canaliculi
opening on
surface

Endosteum

Lamellae

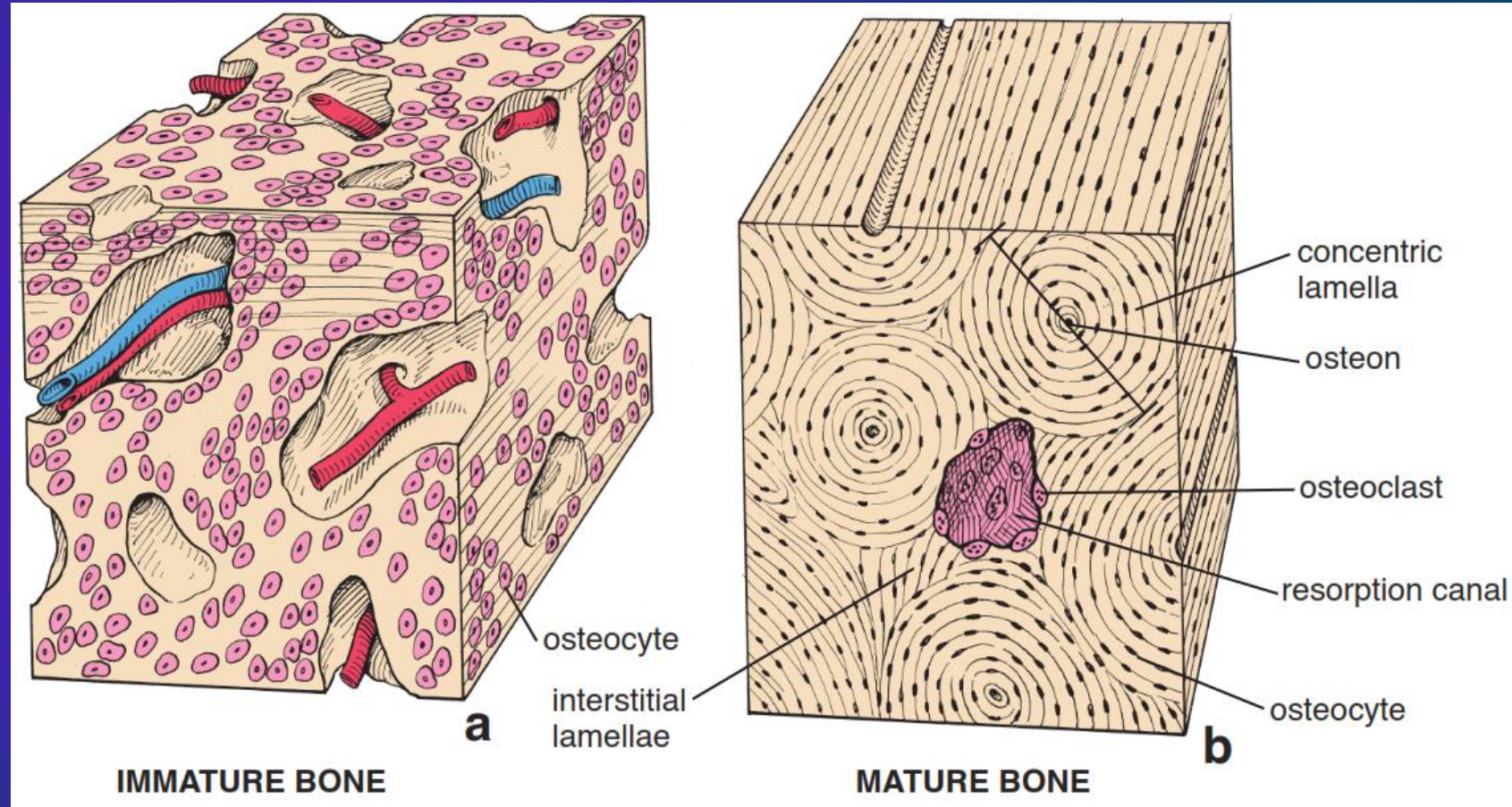




Developmental classification of bone tissue:

- ▶ **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



