

A microscopic image of bone tissue, showing several osteons. Each osteon is a circular structure with a central canal (Haversian canal) containing a blood vessel. The osteons are arranged in a regular, repeating pattern. The tissue is stained, likely with hematoxylin and eosin (H&E), giving it a brownish-yellow appearance. The central canal of one osteon is clearly visible in the center of the image.

# Histology of Bone

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# **Bone is a specialized connective tissue**

## **the function is :**

- Support
- Protection (protect internal organs)
- Movement (provide leverage system for skeletal muscles, tendons, ligaments and joints)
- Mineral homeostasis (bones act as reserves of minerals important for the body like calcium or phosphorus)
- Hematopoiesis: blood cell formation
- Storage of adipose tissue: yellow marrow

# Bone matrix

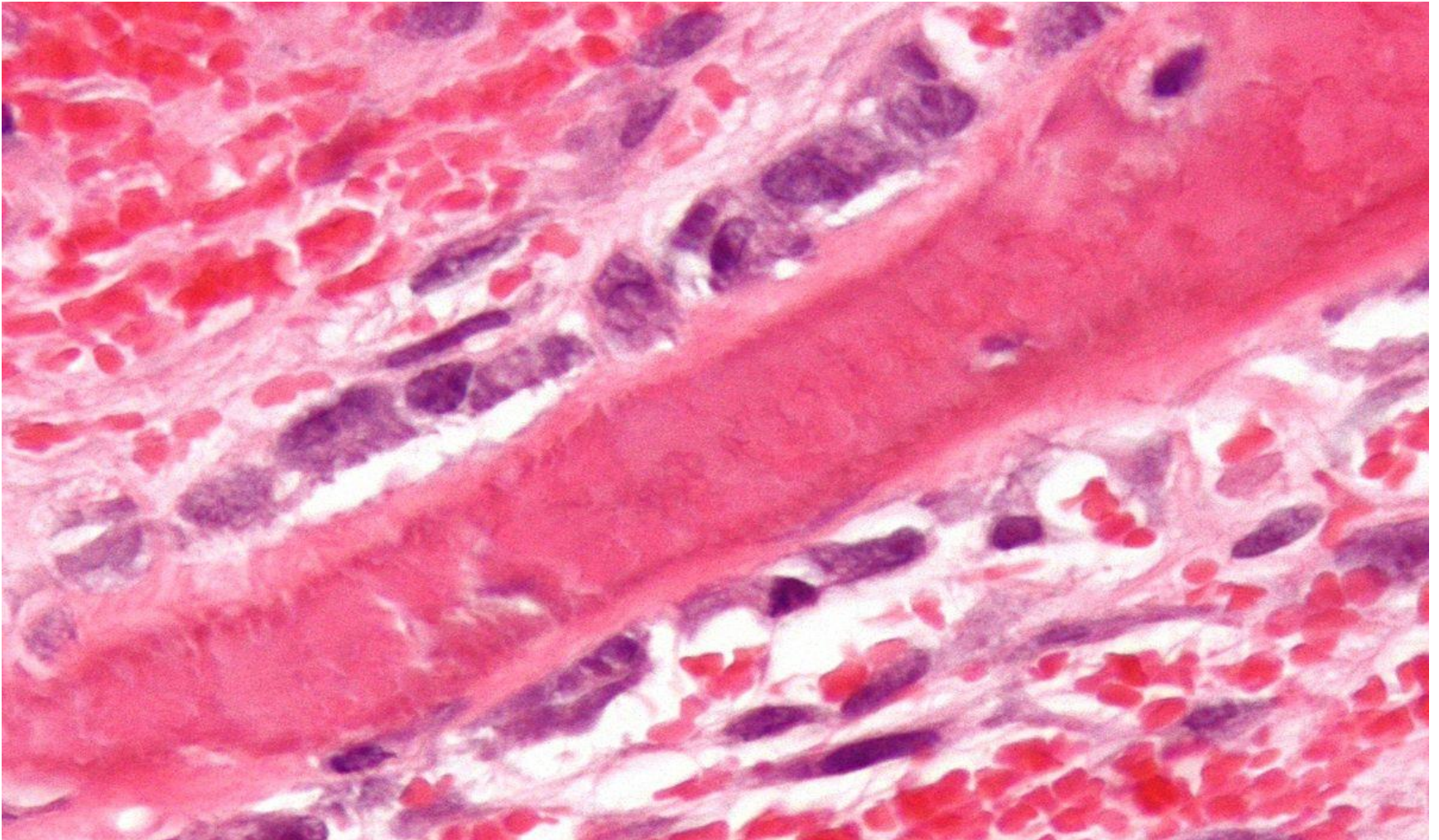
**The matrix consist of lamellae of calcified collagen fibers type 1 embedded in intercellular substance of protein and carbohydrates .**

**Also the matrix consist of organic and inorganic component .**

# Types of cells

- **Osteoblasts** are polarized cells that synthesize and secrete the organic components of bone matrix, which include type I collagen fibers, proteoglycans,
- Mature osteoblasts are located exclusively at the surfaces of bone matrix, usually side by side in a layer somewhat resembling a simple epithelium . When actively engaged in matrix synthesis, osteoblasts have a cuboidal to columnar shape and basophilic cytoplasm.
- When their synthesizing activity declines, they flatten and basophilia is reduced; inactive osteoblasts represent most of the flattened bone lining cells in both the endosteum and periosteum.

# osteoblast



# osteoclast

**OSTEOCLASTS** are large cells that dissolve the bone. They come from the bone marrow and are related to white blood cells. They are formed from two or more cells that fuse together, so the osteoclasts usually have more than one nucleus. They are found on the surface of the bone mineral next to the dissolving bone.

# osteoclast



# osteocyte

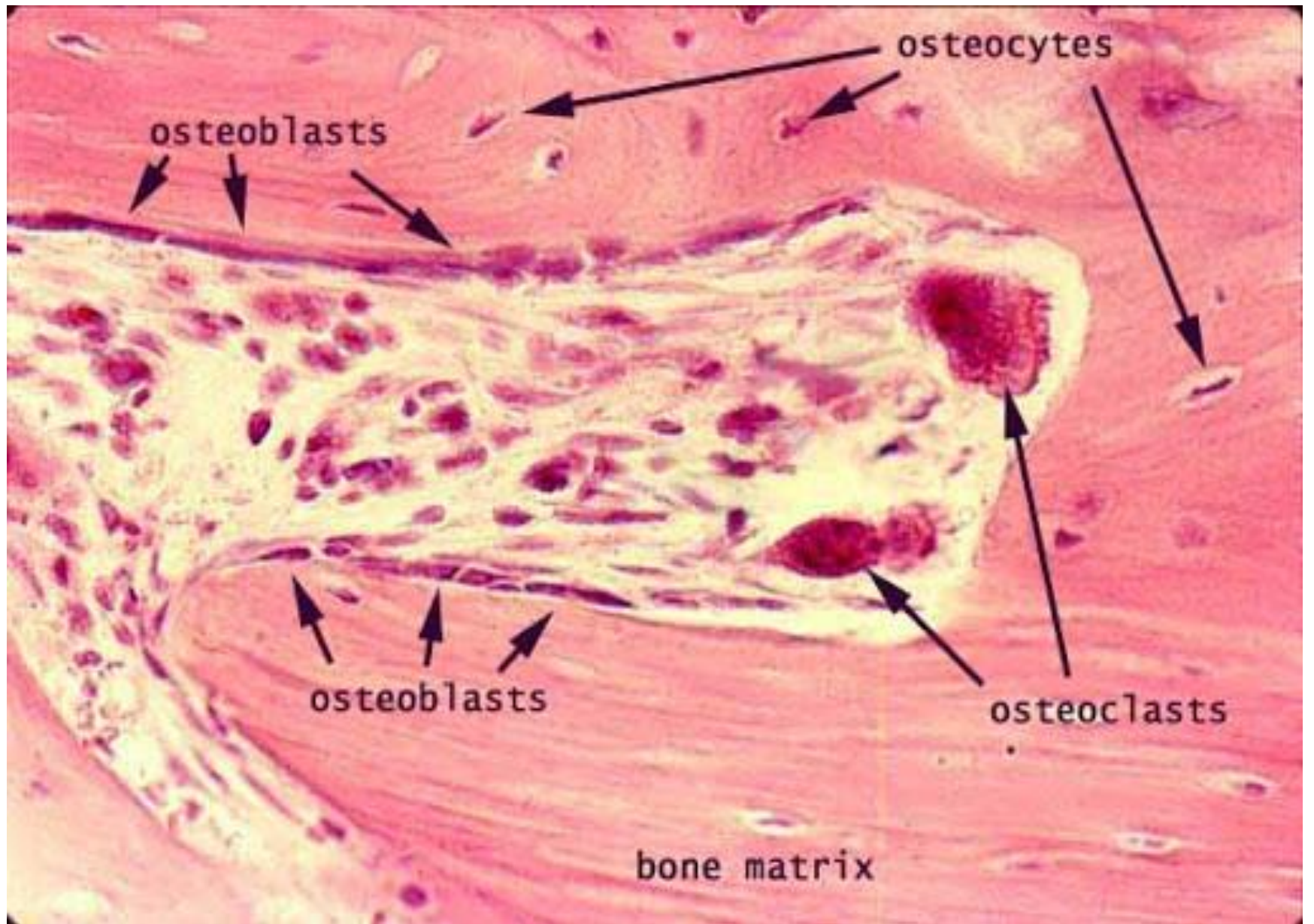
- **OSTEOCYTES** are cells inside the bone. They also come from osteoblasts. Some of the osteoblasts turn into osteocytes while the new bone is being formed, and the osteocytes then get surrounded by new bone. These cells can sense pressures or cracks in the bone and help to direct where osteoclasts will dissolve the bone.





Lacunae

Osteocytes



# Osteoprogenitor cells

give rise to osteoblasts under the influence of transforming growth factor- $\beta$  and bone morphogenic protein. However, under hypoxic conditions, osteoprogenitor cells become chondrogenic cells.

therefore, these two cells are really the same cell that expresses different factors under differing oxygen tension

# Type of bones

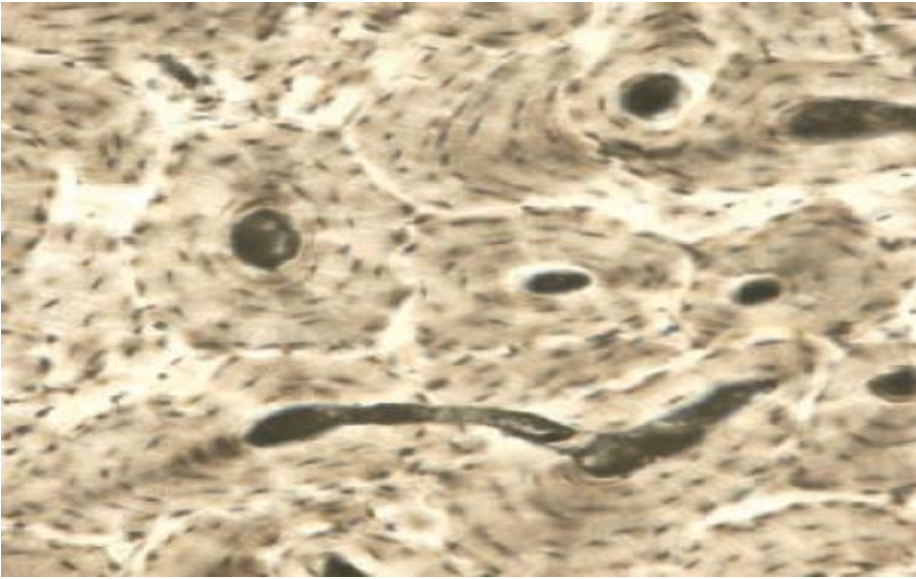
- In long bones, the bulbous ends called epiphyses are composed of **spongy bone**. The cylindrical part—the diaphysis is almost totally composed of **compact bone**.
- Short bones such as those of the wrist and ankle usually have cores of spongy bone surrounded completely by compact bone. The flat bones that form the skull cap have two layers of compact bone called plates separated by a thicker layer of spongy bone.

# Compact bone

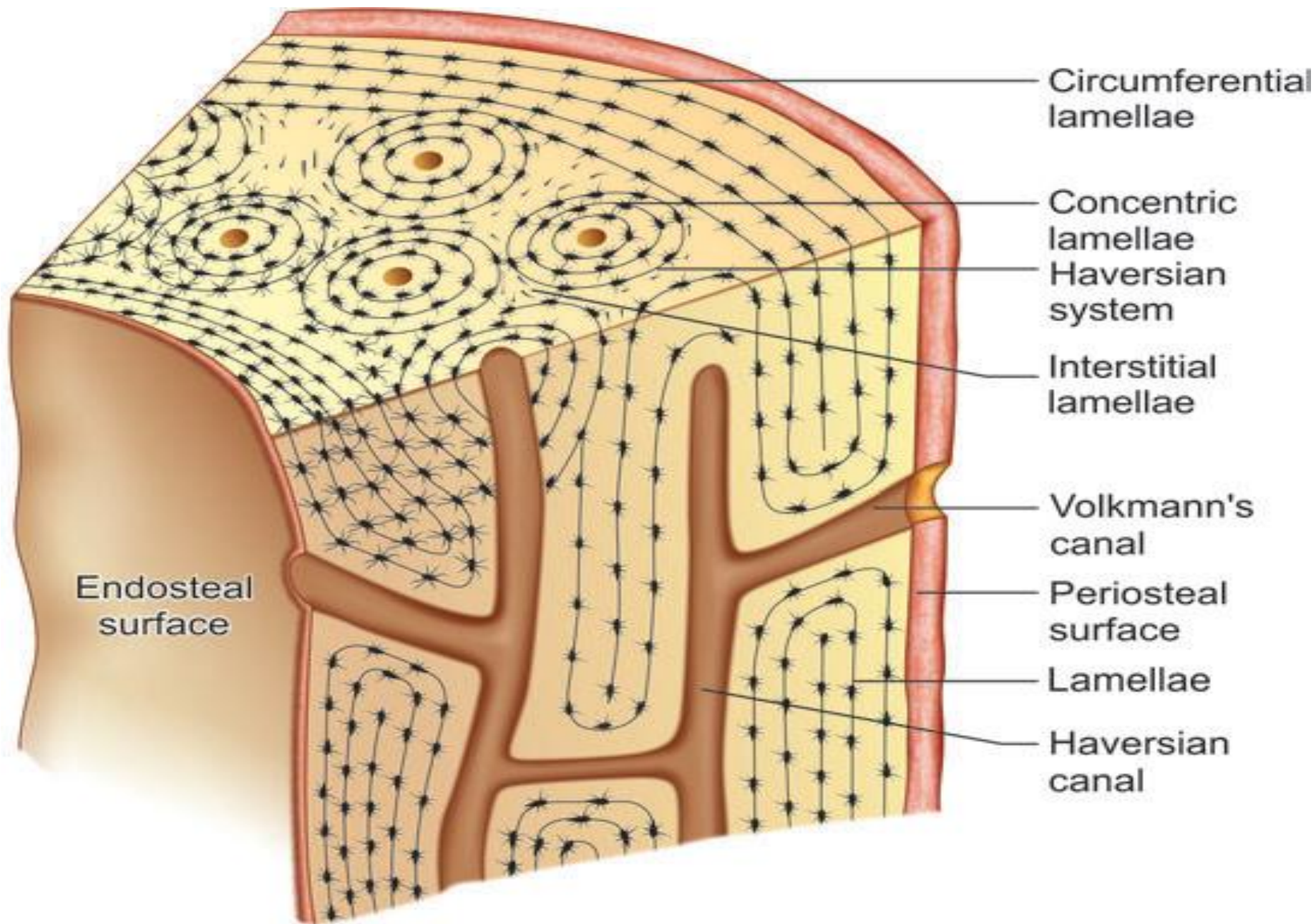
Made up of concentric lamellae, and is pervaded by lacunae (containing osteocytes), and by canaliculi. Most of the lamellae are arranged in the form of concentric rings that surround a narrow **Haversian canal** present at the center of each ring. The Haversian canal is occupied by blood vessels, nerve fibres, and some cells. One Haversian canal and the lamellae around it constitute a **Haversian system or osteon**

- Compact bone consists of several such osteons. Between adjoining osteons there are angular intervals that are occupied by **interstitial lamellae**. These lamellae are remnants of osteons. Near the surface of compact bone the lamellae are arranged parallel to the surface: these are called **circumferential lamellae**

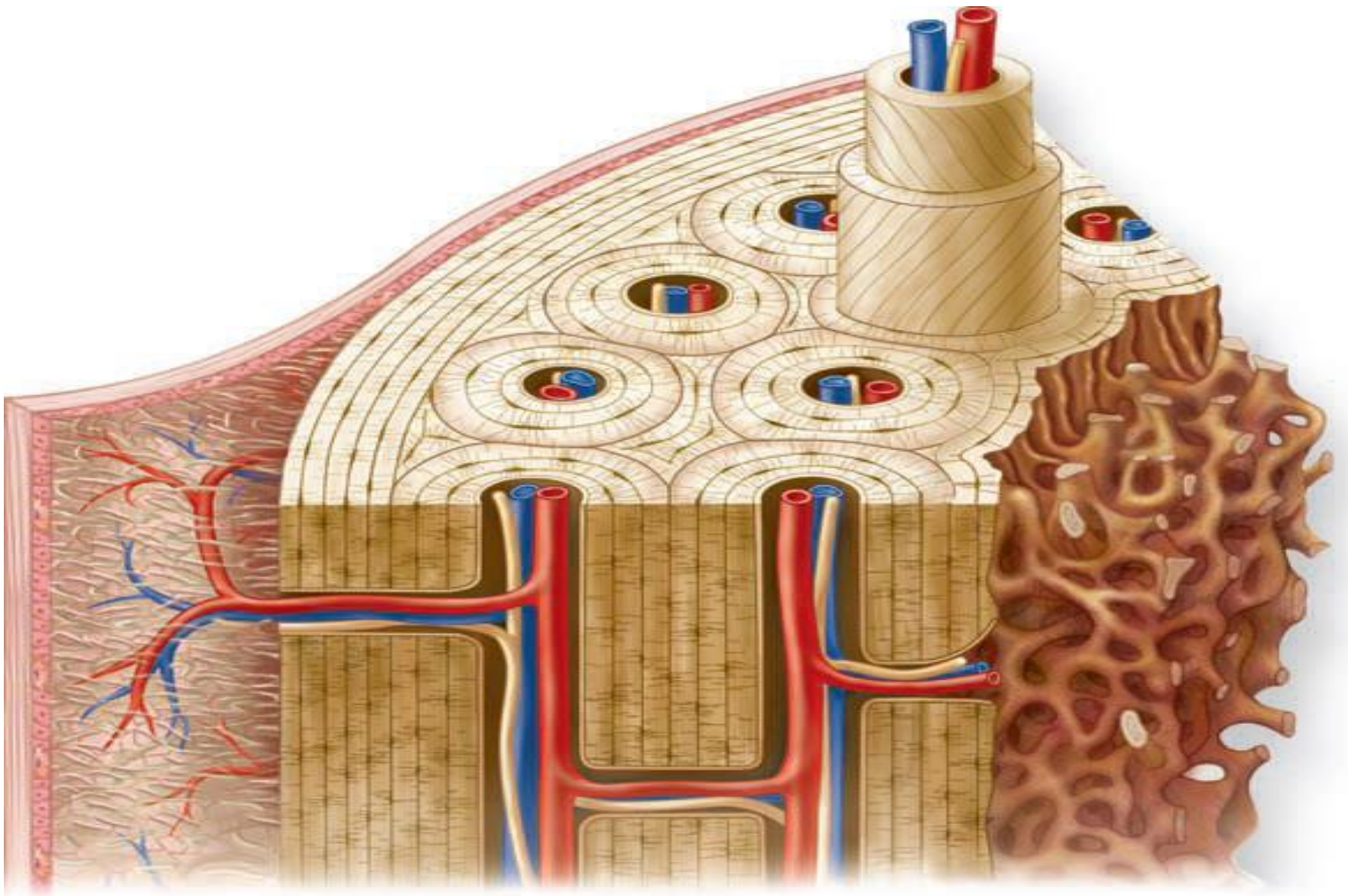
## Volkman's canal



- channels in bone that transmit blood vessels from the periosteum into the bone and and communicate with the Haversian canals and connected the Haversian system with each other







# spongy bone

consists of delicate interconnecting rods or plates of bone called trabeculae, which add strength to the bone without the added weight.

The spaces between the trabeculae are filled with **marrow**. Each trabecula consists of several lamellae with osteocytes between the lamellae. Usually no blood vessels penetrate the trabeculae, and the trabeculae have no central canals. Nutrients exit vessels in the marrow and pass by diffusion through canaliculi to the osteocytes of the trabeculae.

# Osteogenesis

## 1- Intramembranous ossification

arises in a richly vascularized mesenchymal membrane where **mesenchymal cells** differentiate into osteoblasts (possibly via osteoprogenitor cells), which begin to elaborate bone matrix, thus forming trabeculae of bone. As more and more trabeculae form in the same they will become interconnected. As they fuse with each other, they form **cancellous bone**, the peripheral regions of which will be remodeled to form **compact bone**.

# Intramembranous Ossification

Know the steps.



# Endochondral ossification

is the process by which growing cartilage is systematically replaced by bone to form the growing skeleton.

