Bone

Bone is **a specialized connective tissue that provides structural support, facilitates movement, and protects vital organs**. **Bone is composed of calcified extracellular matrix with collagen fibers and bone cells**

Uncalcified matrix of the bone is called *osteoid* which becomes mineralised by the deposition of *calcium hydroxyapatite*, thus giving the bone considerable rigidity and strength.

The adult human skeleton is composed of 206 bones.

Bone has nerve and blood supply.

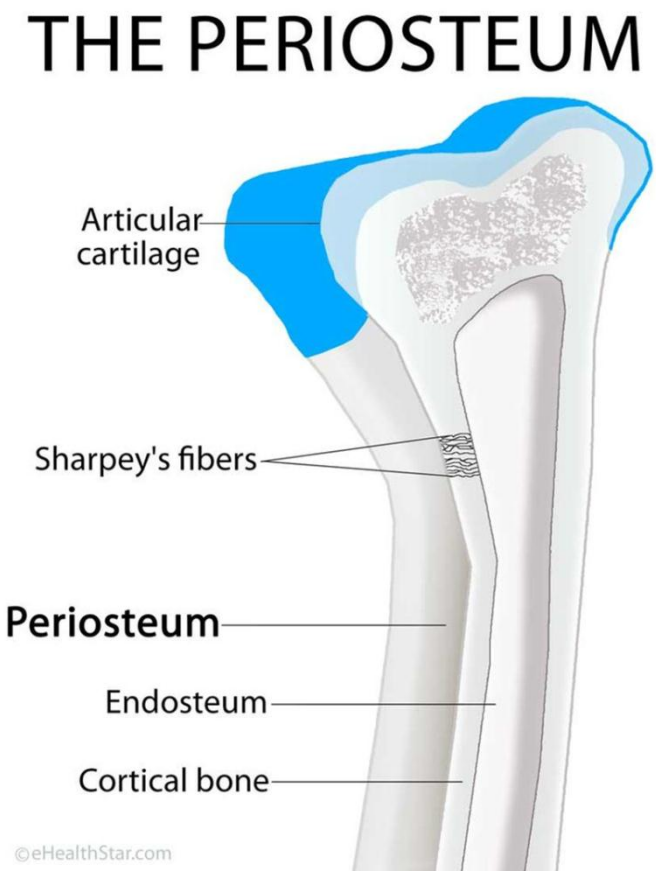
It also has four main types of cells:

1. Osteoblast: Bone forming cell

2. Osteoclast: Bone resorbing cell originates from circulating monocyte..

3. Osteocytes: Osteocytes are found in cavities or lacunae between the layers of the bone matrix and assist with the nutrition of the bone.

Bone is covered by periosteum and lined by endosteum.



4. Osteogenic (osteoprogenitor) cell : Stem cell found on outer surface (periosteum) and inner surfaces endosteum) of the bone responsible for continuous formation of new generations of osteoblast.

The bone is in continuous process of remodeling or renewal through the life.

The remodeling involves resorption by osteoclast and formation of new bone by osteoblast. The adult skeleton is renewed by remodeling every 10 years.

Why remodeling of the bone is important:

1. Allows bone to respond to loads (stresses) :This important in orthodontic.

2. Maintain materials properties.

3. Allows repair of microdamage.

4. Participates in serum Ca2+ regulation.

Functions of Bone:

***Structural support**

***Protection**

***Movement**

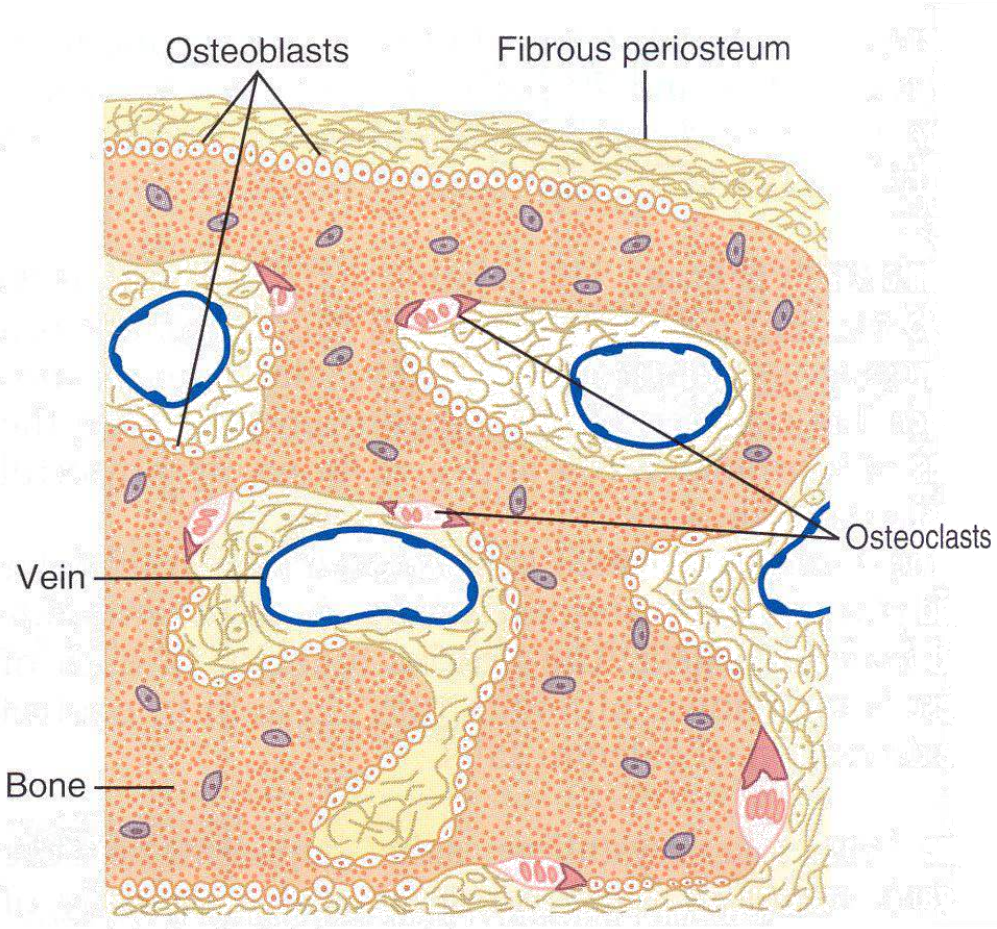
***Mineral storage for calcium and phosphate ions : Bone composition**

- **70% mineral**
- **22% organic substance mainly collagen fibers.**
- **8% water**

- **Two major types of bone**
  - **Compact (cortical, i.e., long bones)**

Which gives mechanical and protective functions
Cancellous (spongy, i.e., vertebrae.

Volkmann's canal: small channels in bone that transmit blood vessels from the periosteum into the bone and that lies perpendicular to and communicates with the Haversian canals.



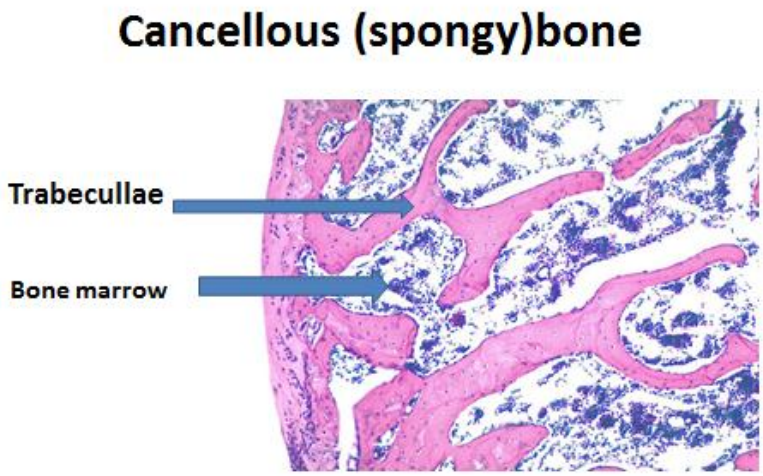
Types of bone:

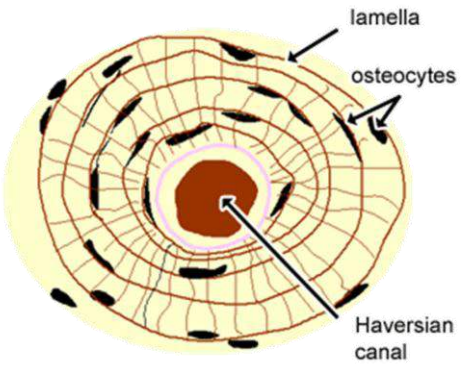
1. Primary bone (embryonic) : All the bones of the embryo are primary bones when first formed. It has low mineral content.

2. Secondary Bone has two types:

a. Compact bone : is usually found in adults.

b. Cancellous or spongy bone: is a network of interconnecting trabeculae orientated in a position to provide the maximum strength for the minimum mass.It is found in the bones of skull, the head of the femur, and part of the alveolar bone. The trabeculae have a thin external coating of endosteum containing osteoblasts.





The image is showing the Haversian canal in compact bone

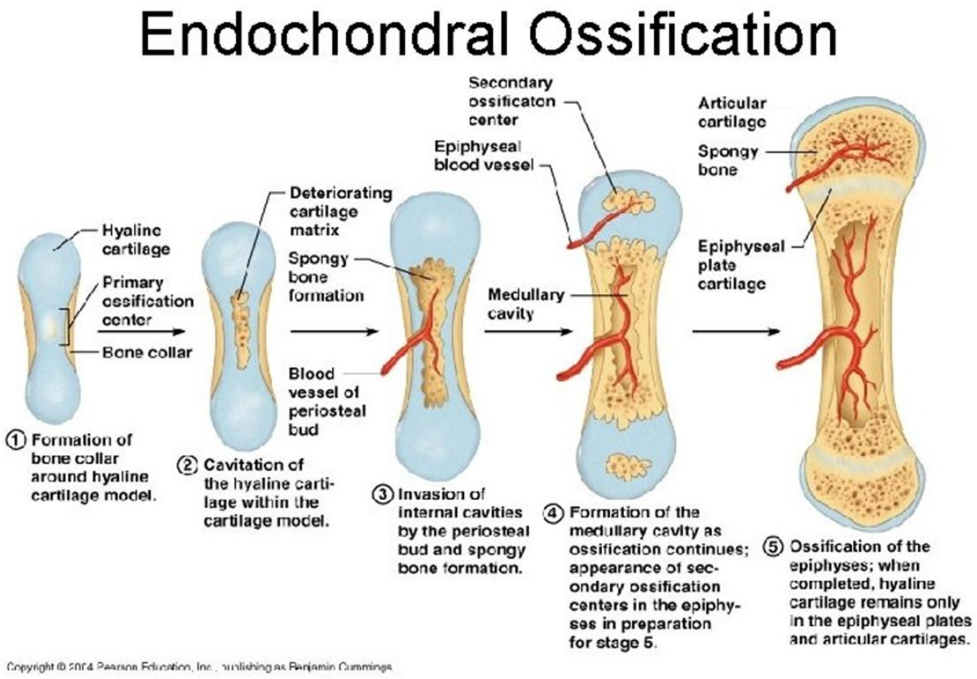
Bone formation (ossification): Ossification is the process of the synthesis of bone. There are two types of ossification.

N.B.: Osteoid, which is the unmineralized matrix composed of type I collagen and glycosaminoglycans.

1. Intramembranous ossification: forms flat and irregular bones. It takes place within condensations of mesenchymal tissue. In this process, mesenchymal cells differentiate directly into osteoblasts; specialized cells that secrete bone matrix. . The osteoblasts differentiate into osteocytes .

2. Endochondral ossification : Occurs in long and short bones.

Endochondral ossification takes place within a piece of hyaline cartilage.



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The epiphyseal growth plate lies at the interface between the shaft and the epiphysis and is the region in which cartilage proliferates to cause the elongation of the bone.