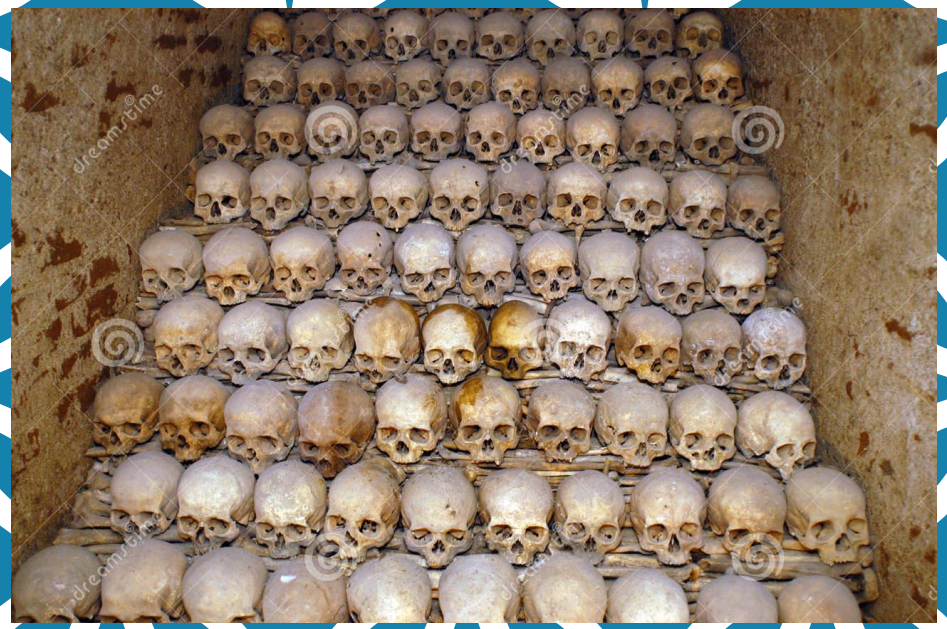
# BONES

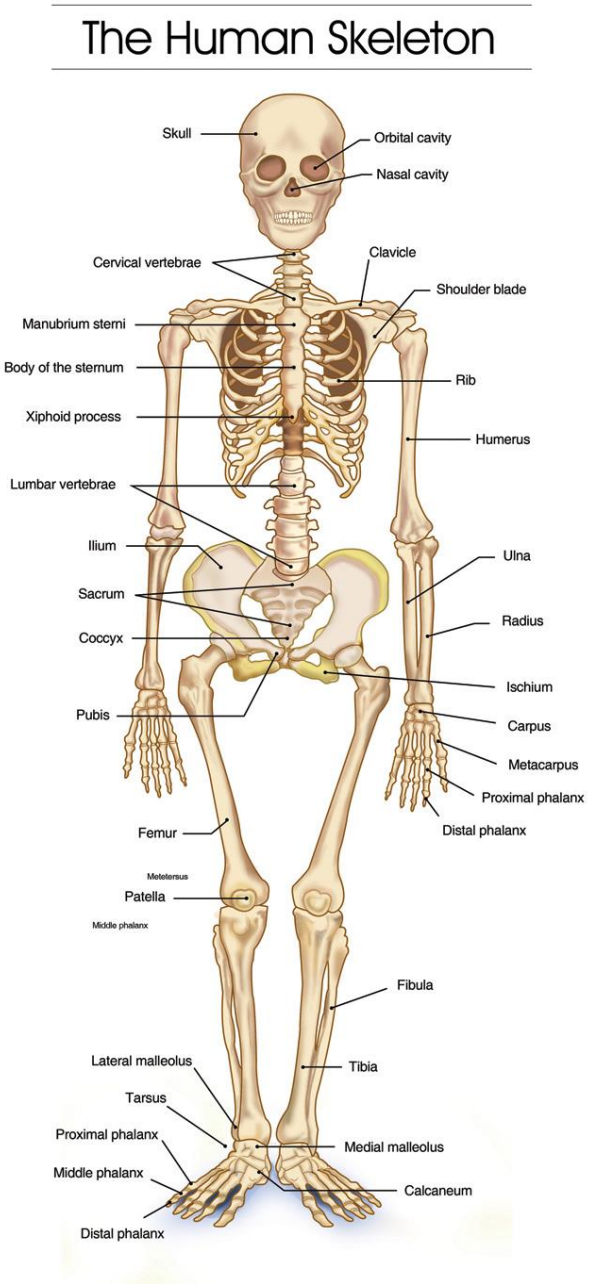


Dr.Priti Acharya

# BONES

Specialized, constantly changing connective tissue

Composed of cells, composed of calcified extracellular materials, the bone matrix.



# FUNCTIONS

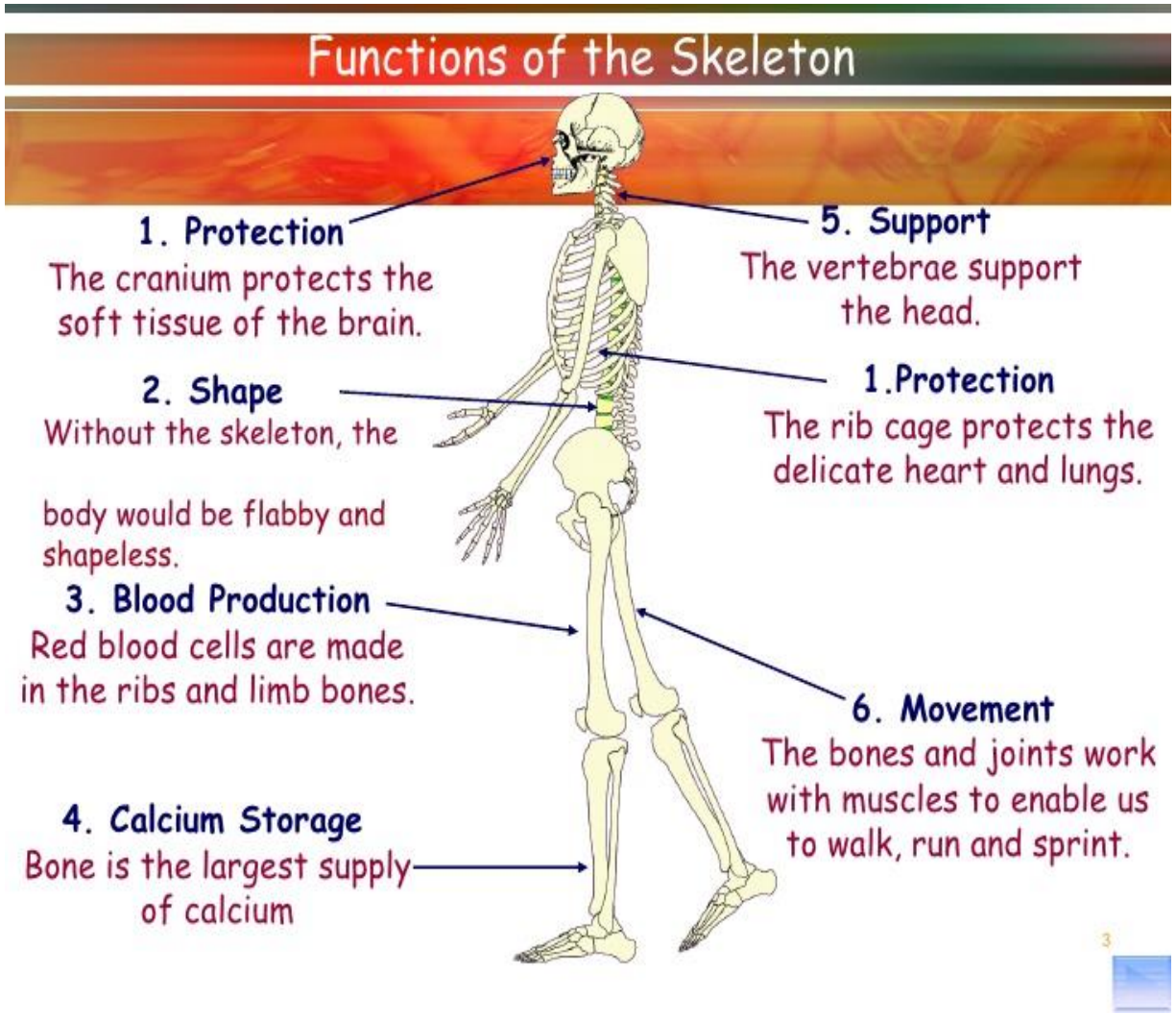
Forms rigid frame-work of the body.

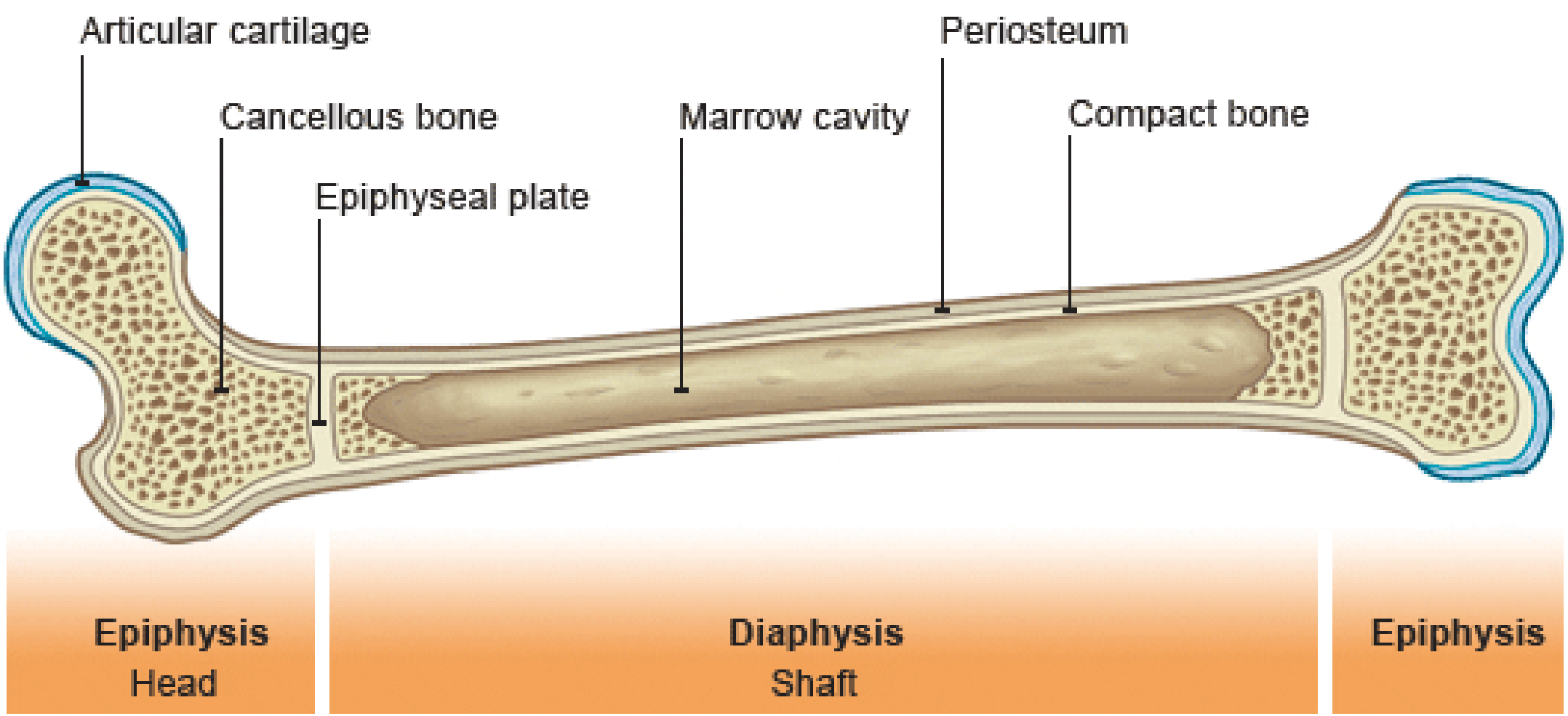
Serves as lever for muscles.

Afford protection to certain viscera.

Contains bone marrow; manufactures blood cells.

Acts as store house of calcium and phosphorus

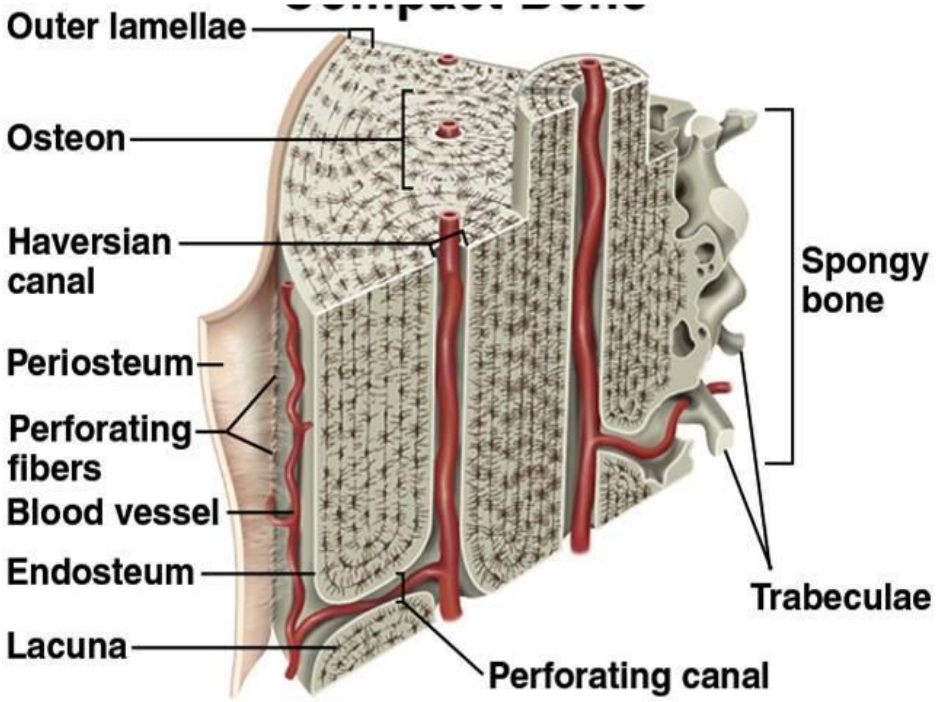



Articular cartilage
Cancellous bone
Epiphyseal plate
Marrow cavity
Periosteum
Compact bone
Epiphysis
Head
Diaphysis
Shaft
Epiphysis

# PERIOSTEUM

CONSISTS OF TWO LAYERS

- Outer fibrous layer- composed of collagen fibres
- Inner cellular and vascular layer-
  - k/a osteogenic layers
  - Contains osteoblasts



# FUNCTIONS OF PERIOSTEUM

Protects the bone, receives the attachments of muscles and maintains the shape of bone

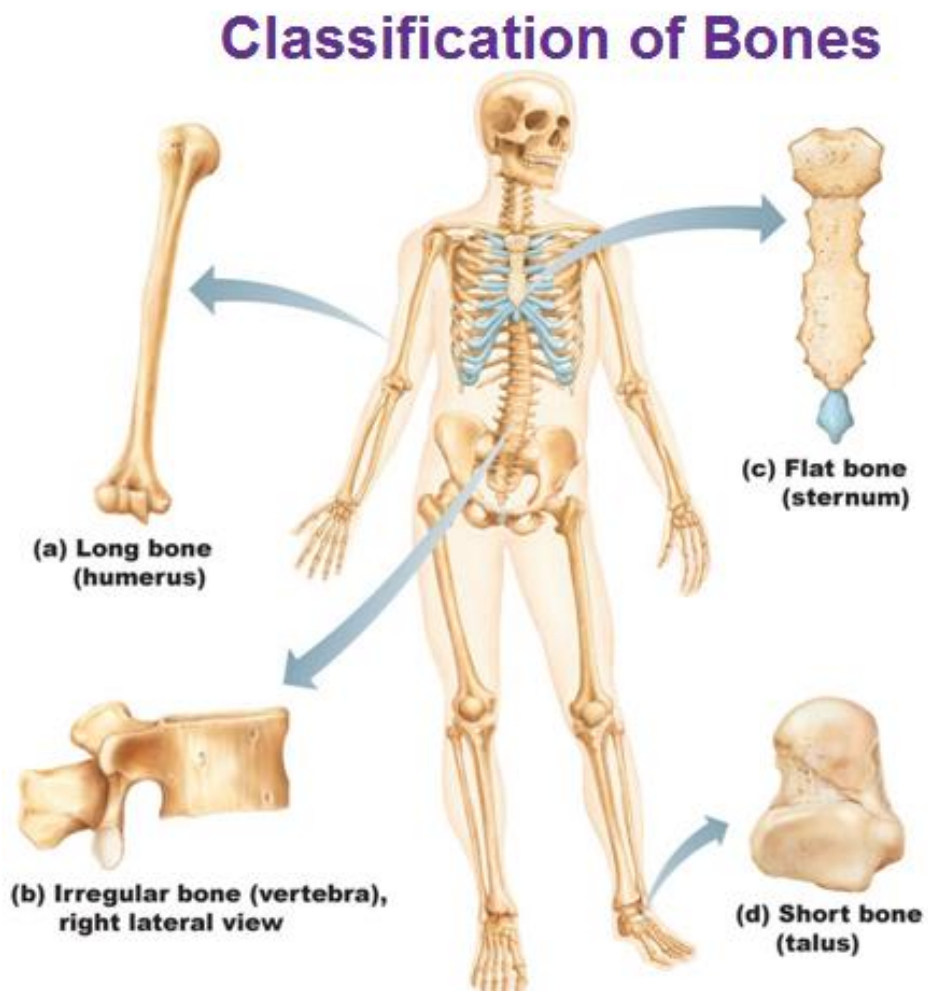
Gives nutrition to the outer part of compact bone by periosteal vessels

Helps in sub-periosteal deposits of bone formation, increasing the width of the bone

# CLASSIFICATION OF BONES

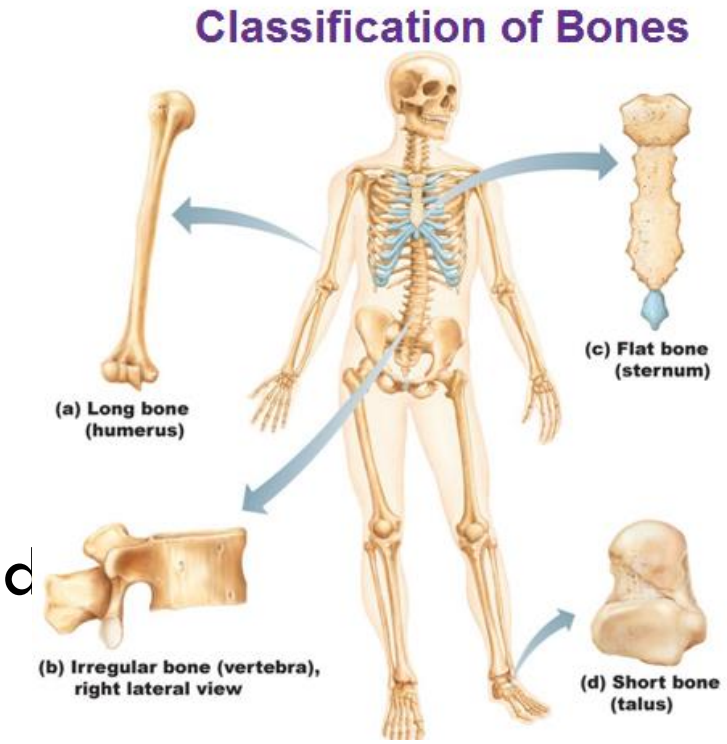
A. According to Position

- Axial bones
  - Skull bones
  - Vertebrae
  - Ribs
  - Sternum
- Appendicular bones
  - Upper limb- Pectoral girdle
  - Lower limb- Pelvic girdle



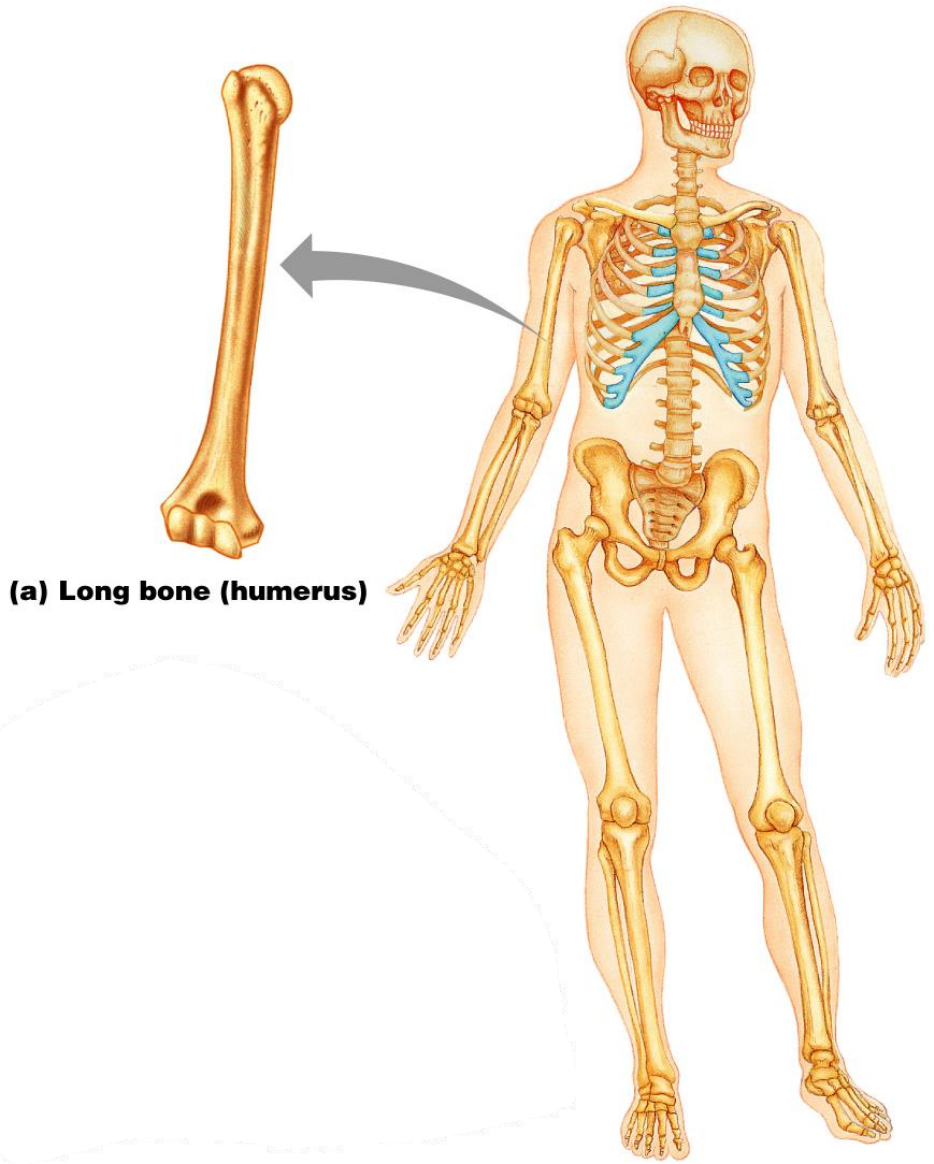
A. According to ossification
   - Membrane bone
   - Cartilaginous bone
   - Membrano-cartilaginous bone

B. According to shape
   - Long, short, Irregular, Pneumatic, Sesamoid



# CLASSIFICATION OF BONES: BY SHAPE

Long bones – longer than they are wide (e.g., humerus)




gure 6.2a

# CLASSIFICATION OF BONES: BY SHAPE

Short bones

- Cube-shaped bones of the wrist and ankle
- Bones that form within tendons (e.g., patella)

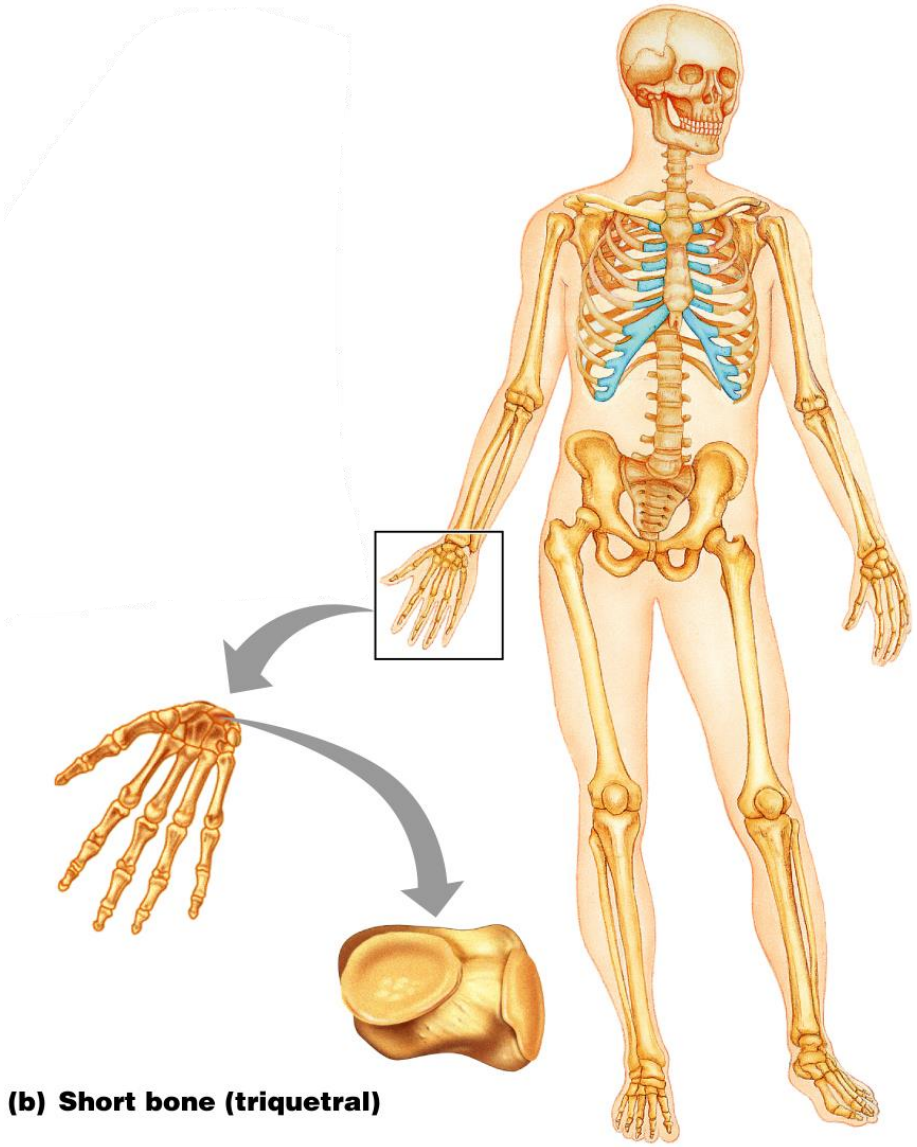
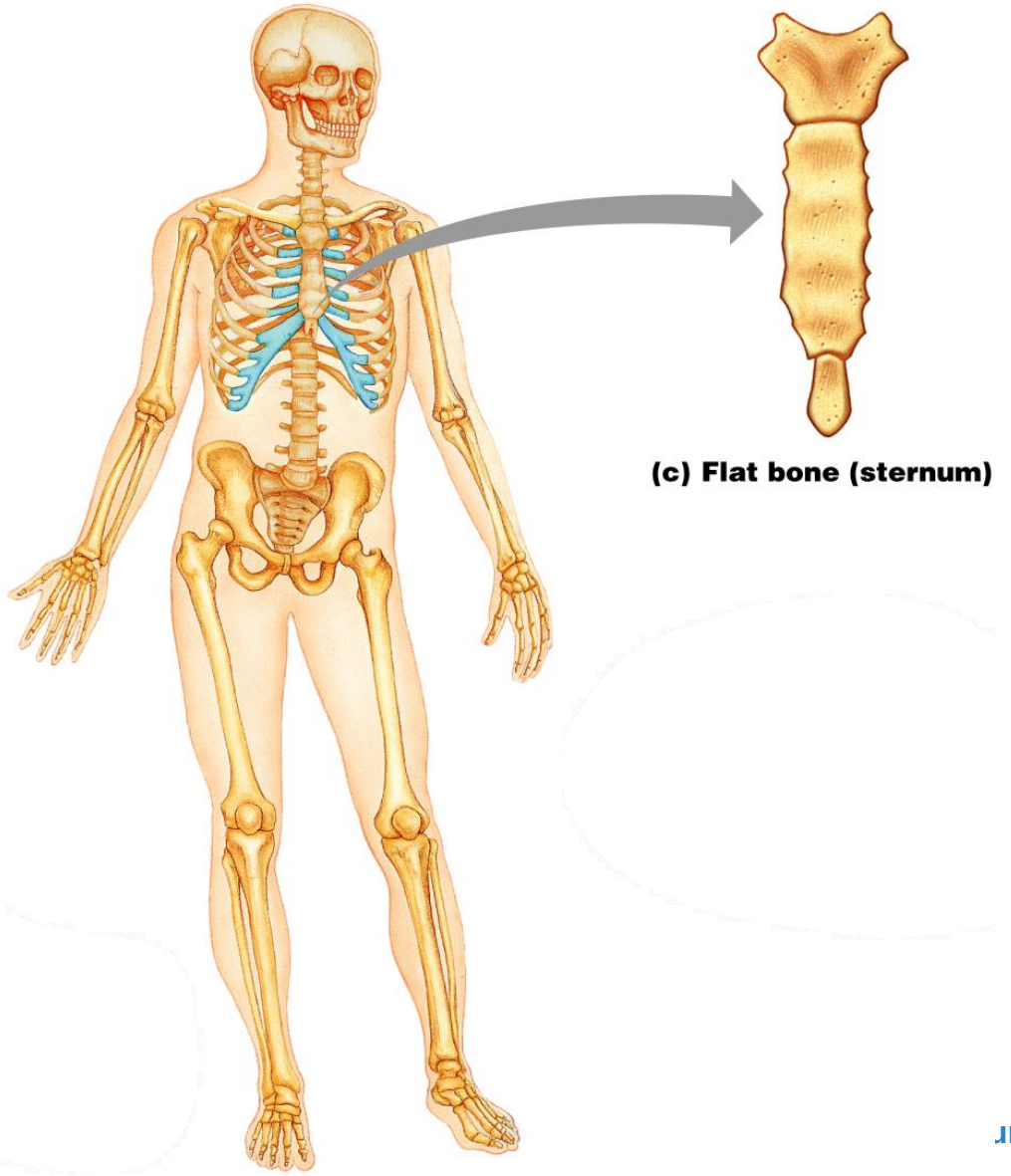



Figure 6.2b

# CLASSIFICATION OF BONES: BY SHAPE

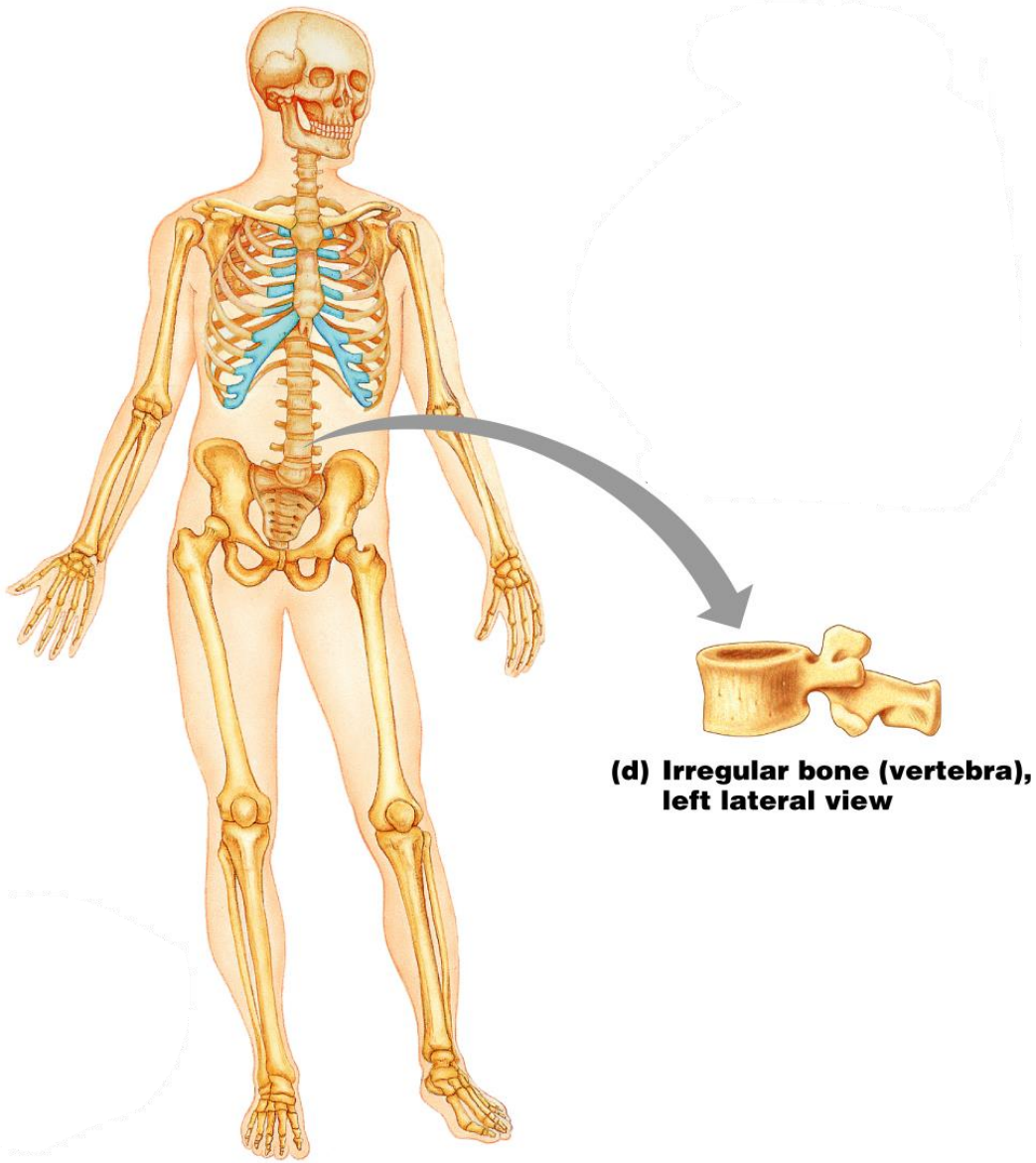
Flat bones – thin, flattened, and a bit curved (e.g., sternum, and most skull bones)



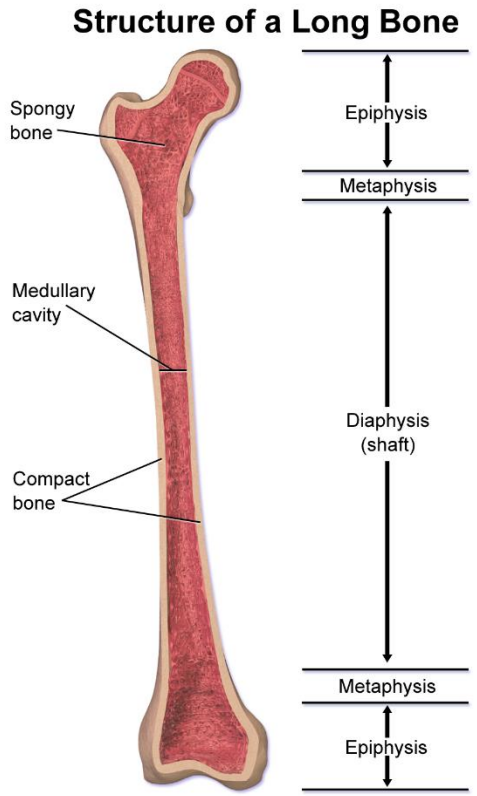

ure 6.2c

# CLASSIFICATION OF BONES: BY SHAPE

Irregular bones – bones with complicated shapes (e.g., vertebrae and hip bones)



# LONG BONES




length>breadth

Mostly present in limbs; acts as levers for muscles.

Basically weight bearing.

Parts:

- Shaft or body
- Two ends

Shaft consists of tube of compact bone and contains medullary cavity which is filled with bone marrow.

Shaft is narrowest in the middle and gradually expands at each end.

# PARTS OF YOUNG LONG BONE

In early fetal life, a long bone is preceded by a model of hyaline cartilage.

Areas where bone ossification starts in the cartilaginous model are k/a the centres of ossification.

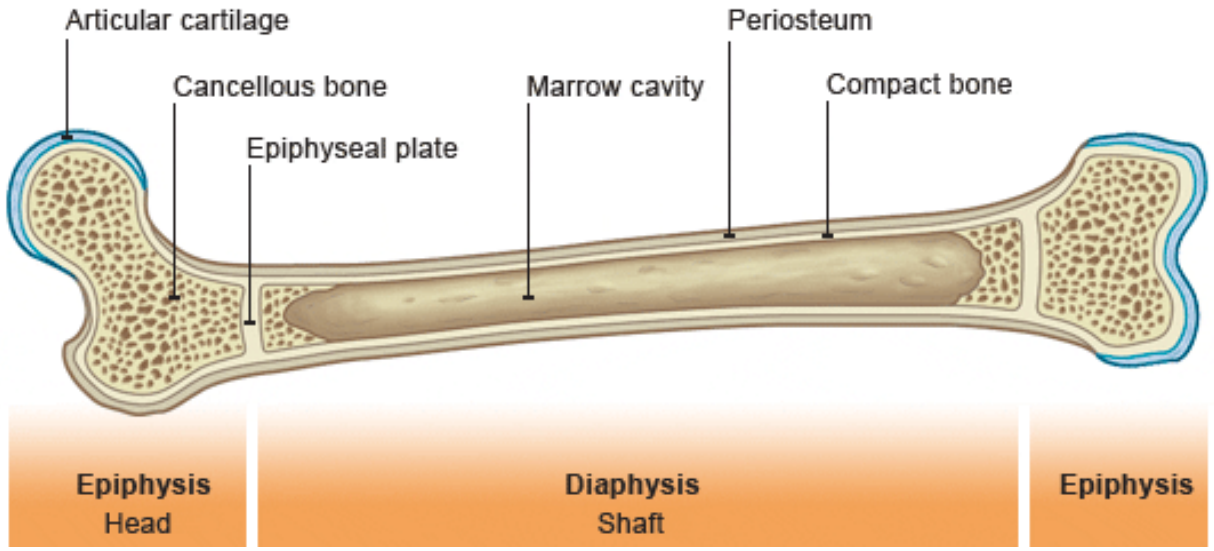
Primary centres are those in which main part of bone ossifies. They appears before birth(primary centers of tarsals and carpels appear after birth; except talus, calcaneus and cuboid bones).

Shaft of long bone is ossified from the primary centre.

Secondary centre are those from which accessory part of a bone is ossified. They appears after birth(lower end of femur and sometimes upper end of tibia appears before birth)

A young long bone presents

- Diaphysis
- Epiphysis
- Epiphyseal cartilage
- Metaphysis



# DIAPHYSIS

Part of the bone ossified from the primary centre, and forms the shaft of the bone

Elongated center part of long bone.

Lies is between two epiphyseal plate

# EPIPHYSIS

Part of bone ossified from the secondary centre

Basically of three types:

- Pressure epiphysis: Long bone that forms joints, transmits body weight and protects epiphyseal cartilage.e.g heads of femur and humerus, condyles of femur and tibia.
- Traction epiphysis: produced by pull of some muscles. Provide attachment to the tendons.  E.g trochanter of femur and tubercles of humerus.
- Atavastic epiphysis: phylogenetically an independent bone and is attached to a host bone for nutrition, grows like a parasite. E.g coracoid process of scapula and posterior tubercle of the talus.

# EPIPHYSEAL CARTILAGE

Plate of hyaline cartilage that intervenes between the epiphysis and diaphysis of a growing bone.

Separate epiphysis from metaphysis

It persists as long as the bone grows in length.

When full length is reached, they are replaced by bone.

# METAPHYSIS

End of diaphysis facing towards the epiphyseal cartilage

Importance:

- Actively growing area of long bone.
- Has profuse blood supply from nutrient, periosteal and juxta-epiphyseal arteries. These arteries forms capillary loops hence, micro-organisms from the circulation here and primarily affects this area.
- Muscles, ligaments and joint capsules are attached to this area.

# TYPES OF LONG BONES

I. Typical long bones:
- A diaphysis and at least two epiphyses, one at each end. Most of the long bones of the limbs are typical.

II. Miniature long bone:
- Single epiphysis at one end only.
- Metacarpals, metatarsals, and phalangeal bones of finger and toes.

III. Modified long bone:
- Clavicle is a modified long bone.
- It is devoid of medullary cavity and ossifies in membrane.

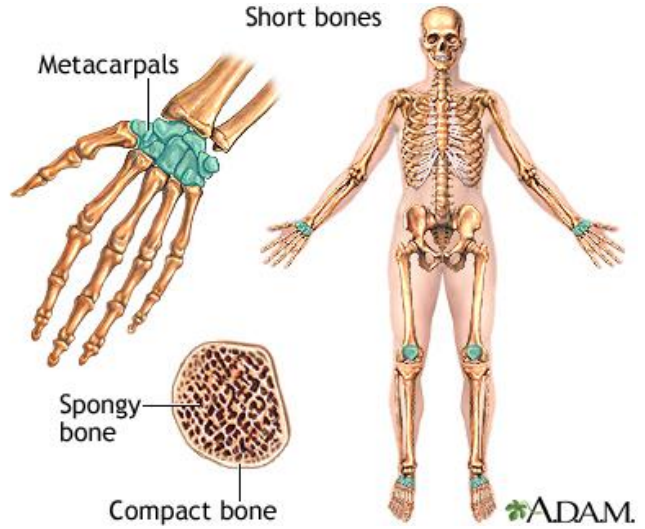
# SHORT BONES

Typically cuboid in shape with six surfaces.

Four surfaces articular and two surfaces for the attachment of muscles, ligaments etc.

Identical in structure with the epiphysis of long bones.

Ossifies in cartilage after birth (except talus, calcaneus and cuboid)



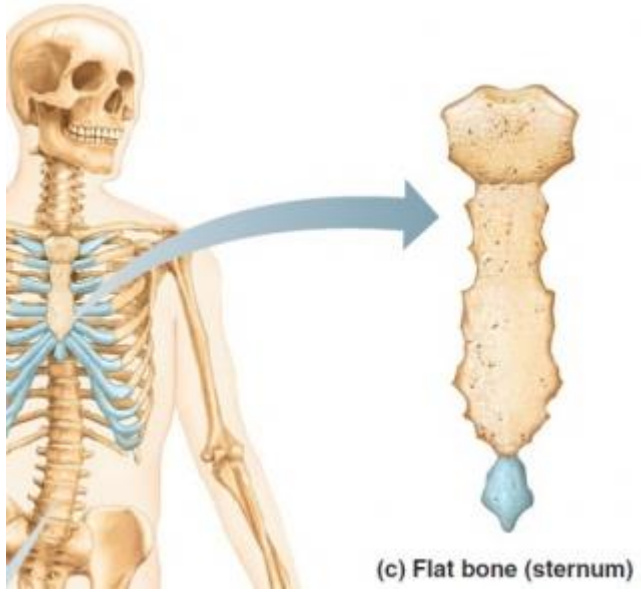

# FLAT BONES

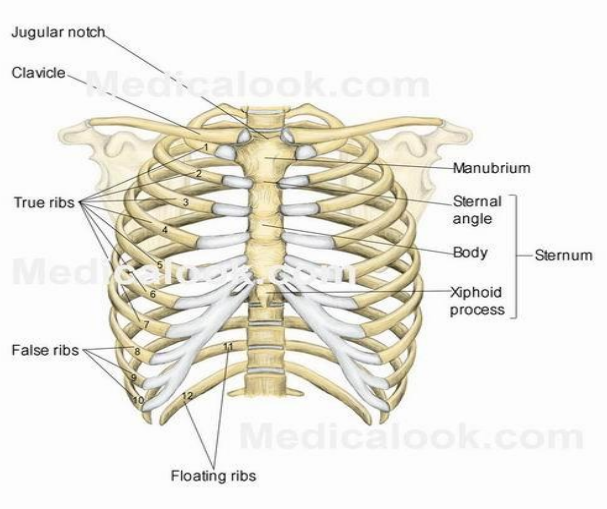
Consists two plates of compact bones with intervening spongy bone and marrow

Forms boundaries of bony cavities

Appears in areas where protection of essential organs is important.

E.g bones of vault of skull, ribs, sternum, scapula



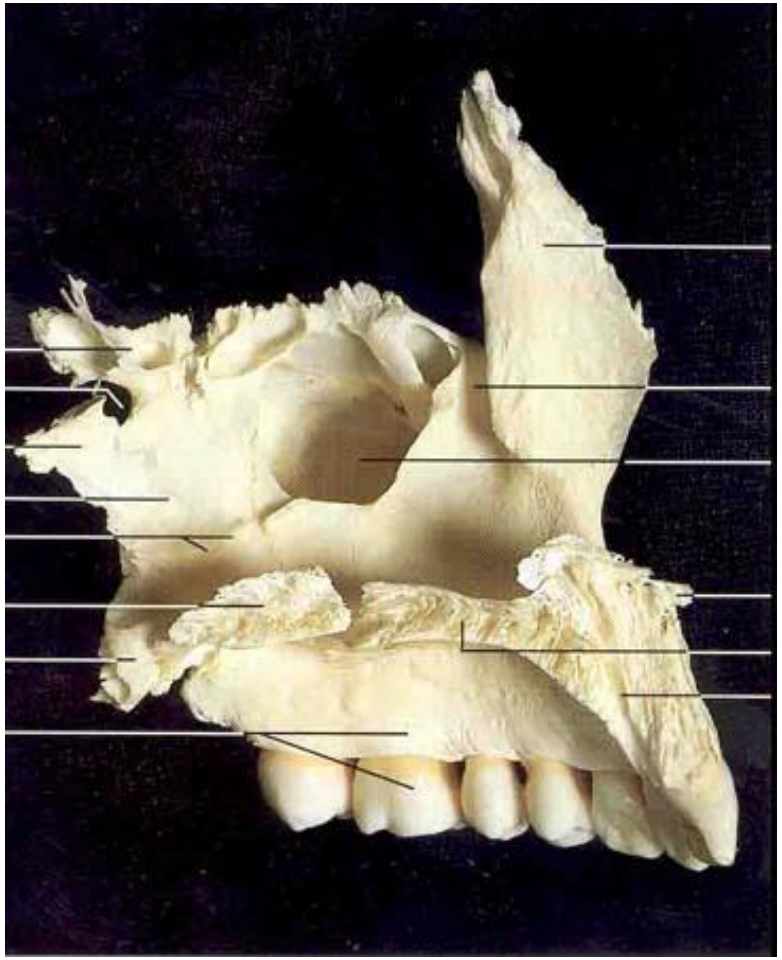
# IRREGULAR BONES

Irregular in shape and do not fit in any other classification

Bones of base of skull, vertebra and hip bones.

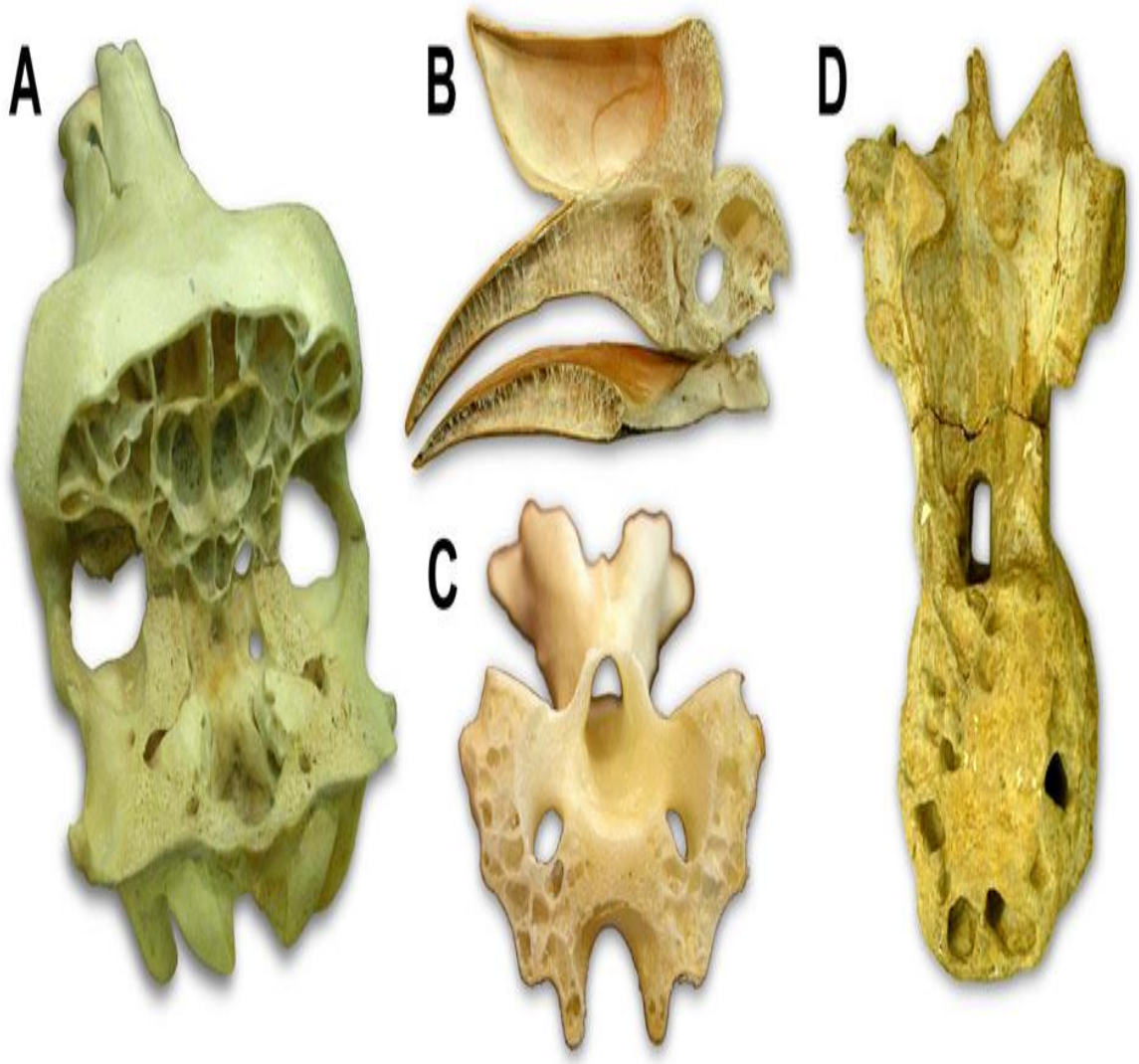
# PNEUMATIC BONES

Contains air filled spaces which are lined by mucous membrane.



Functions:

- Makes bones lighter.
- Helps in resonance of vibration of sound.
- Air-conditioning chamber for the inspired air.
- Infections from the nasal cavity extends into the air sinuses and produces ‘colds in head’.



# SESAMOID BONES

Sesamoid in Arabic means seed

Develops as seed in tendon of some muscles

Acts as pulley for muscular contraction.

Examples:

- Patella, in Quadriceps femoris
- Pisiform, in Flexor carpi ulnaris
- Fabella, in lateral head of Gastrocnemius.

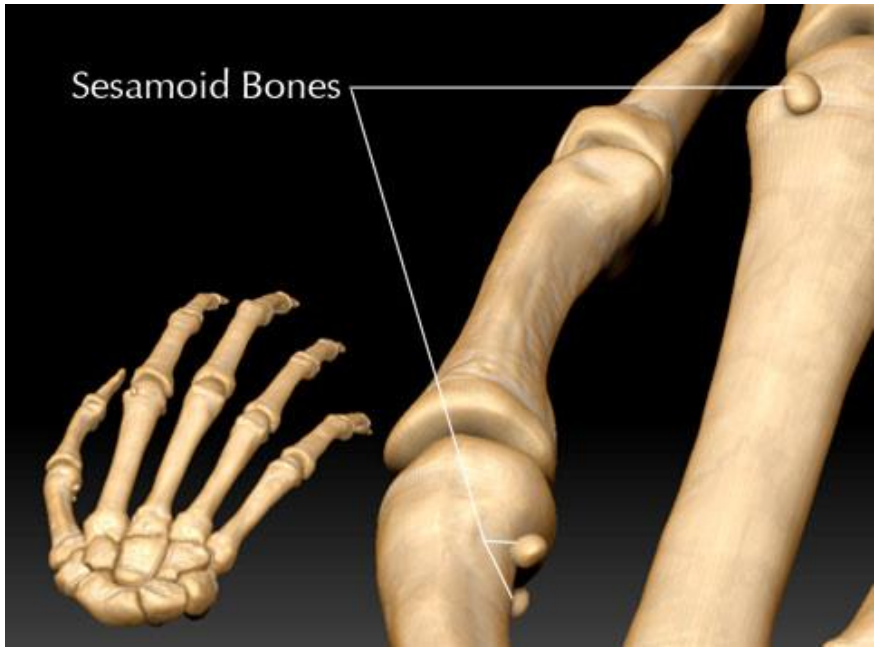
# PECULARITIES OF SESAMOID BONE


Develops in tendons of muscles

Ossify after birth

Devoid of periosteum

Haversian system absent.



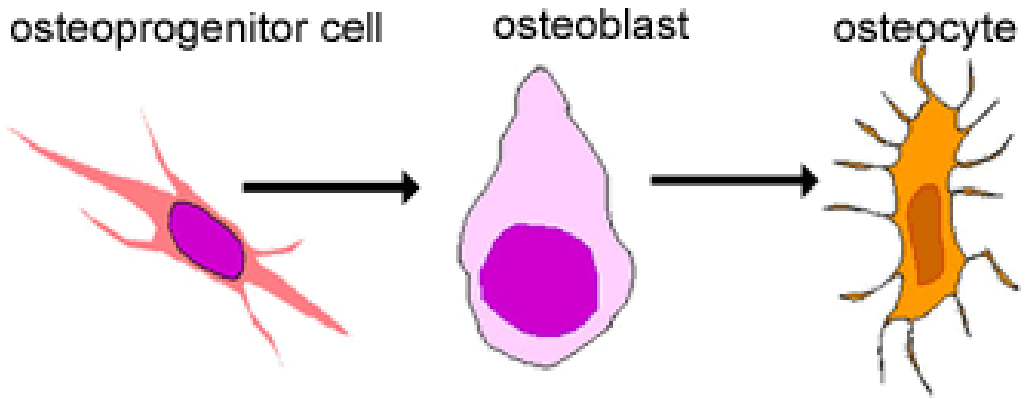
# MICROANATOMY OF BONE

Consists of cells and intercellular substances or matrix.

Matrix:

- ✓Organic
- ✓Inorganic

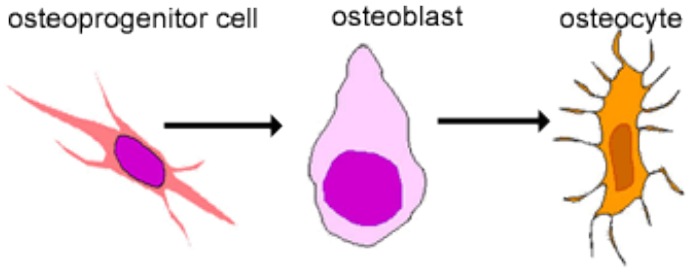
# BONE CELLS




Four types

I. Osteoprogenitor cells:
- Pleuripotent stem cells derived from the mesenchyme
- Osteoblast and osteocytes are originated from oestogenitic cells in the bone marrow
- Osteoclast do not develop from osteogenic cells( they originate from blood stem cells(hematopoietic stem cell) in the bone marrow)

# 2. OSTEOBLASTS




Precursor of osteocytes and derived from osteoprogenitor cells

Cuboidal cell arranged in a densely packed layer along the bone surface

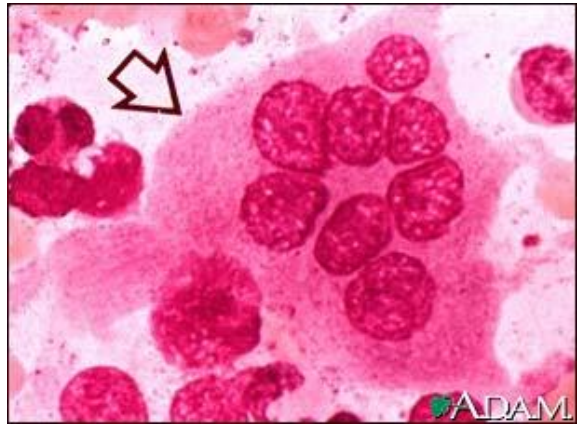
Presents with abundant cytoplasm, eccentric nuclei and numerous cytoplasmic processes.

Cytoplasm is strongly basophilic.

Functions:

- Increases surface area of bone
- Form new bone tissue
- Secretes a variety of substance including collagen, various proteins and calcium, salt

# OSTEOCLASTS




Large cells whose main function is to dissolve and reabsorb bone tissue.

Osteoclasts constantly break down and reabsorb old bone tissue , while osteoblasts form new bone tissue. Together these two cells control the gradual reshaping of the bones

# OSTEOCYTES

Majority of bone cells

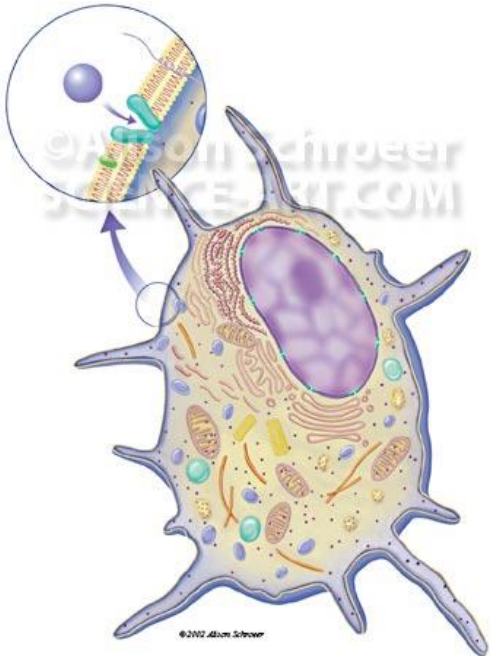
Flattened cells with centrally placed nuclei.

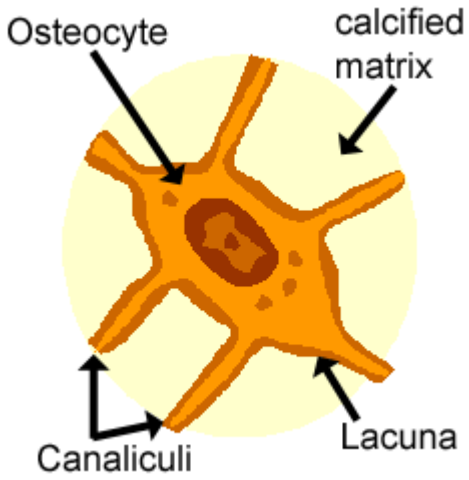
Derived from osteoblasts and occupy spaces known as lacunae.

Oestocytes account for 90 to 95% of cells in bone tissue

Maintain the minerals composition of bone tissue

Plays a central role in bone remodeling.(Regulate the activity of osteoblasts and osteoclasts and manage the bone's calcium reservoir)



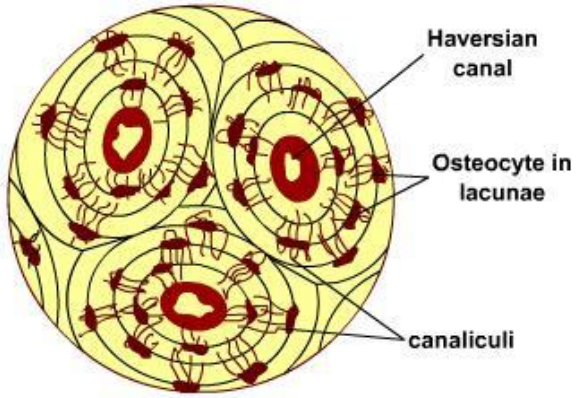


# INTERCELLULAR SUBSTANCE

A. Organic matrix: 35%
   - They consists
     a. Type I collagen fibres
     b. The cement substance i.e proteoglycan, chondroitin sulfate, structural glycoproteins etc.

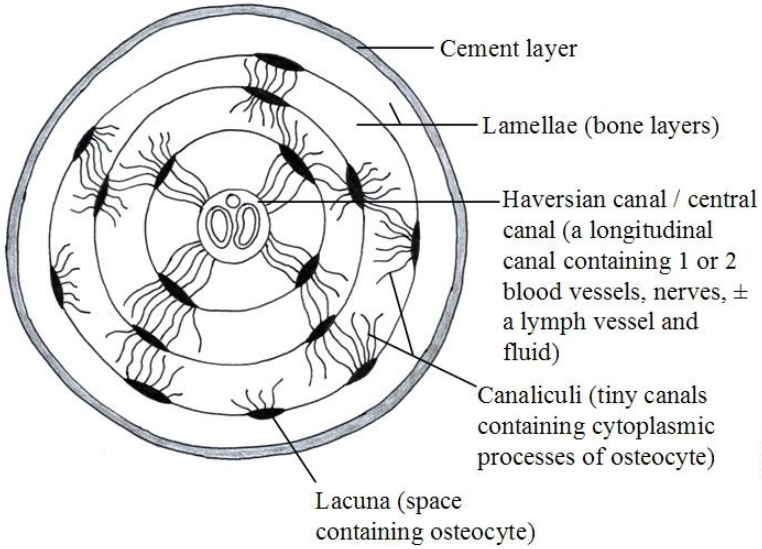
B. Inorganic matrix: 65%
   - Calcium
   - Magnesium
   - Phosphate
   - Carbonate chloride
   - Floride
   - citrate

# ARRANGEMENT OF BONY LAMELLAE

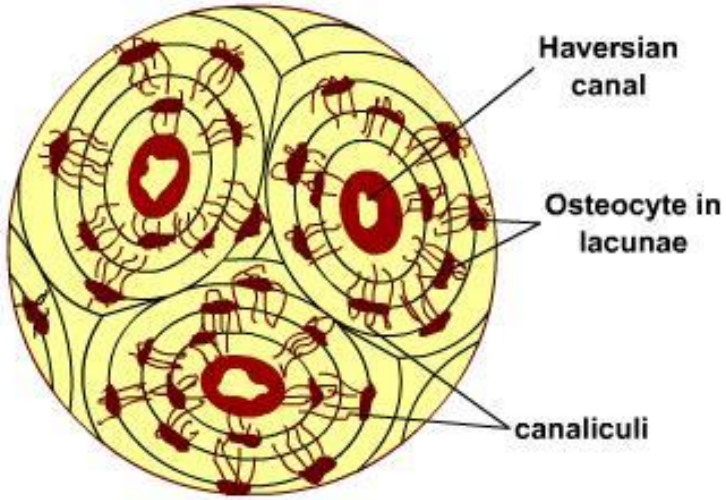



HAVERSIAN SYSTEM IN COMPACT BONE

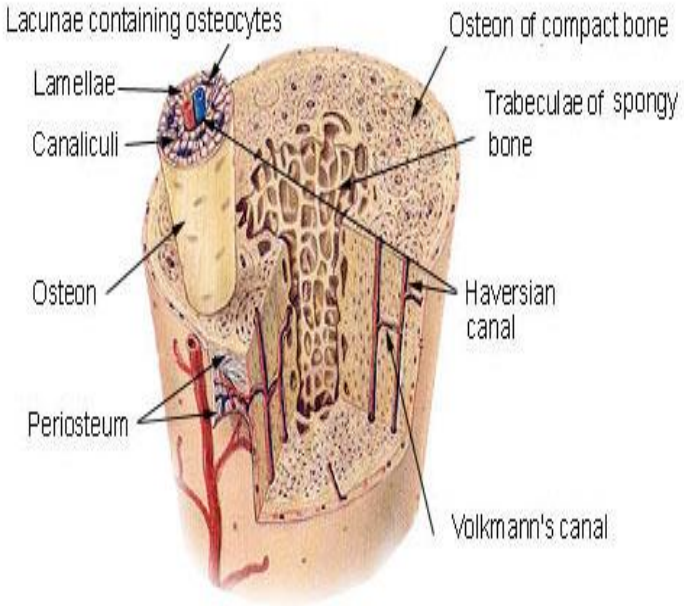
- Bones arranged in a number of cylindrical units k/a osteons or harversian sytem.
- Each system consists a central Haversian canal, surrounded by concentric lamellae of bony tissue
- Between the lamellae there are numerous lacunae which communicate with one another and with the central canal by numerous radiating canaliculi.
- Central canal contains small vessels, and lacunae are filled with Osteocytes.
- They run longitudinally in bones.

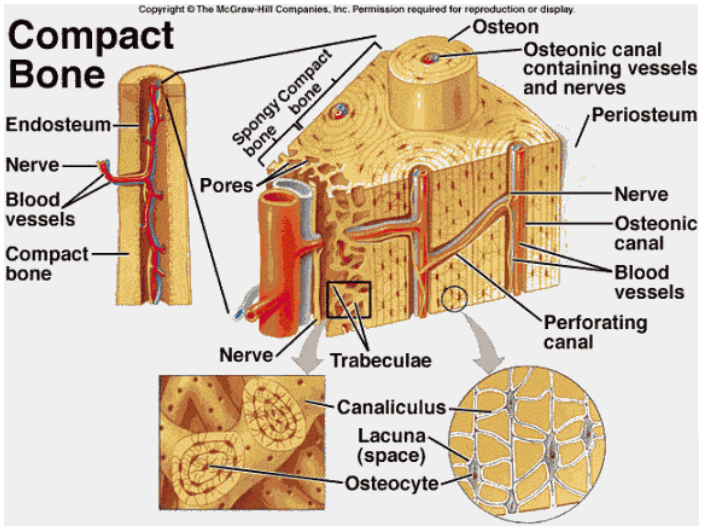


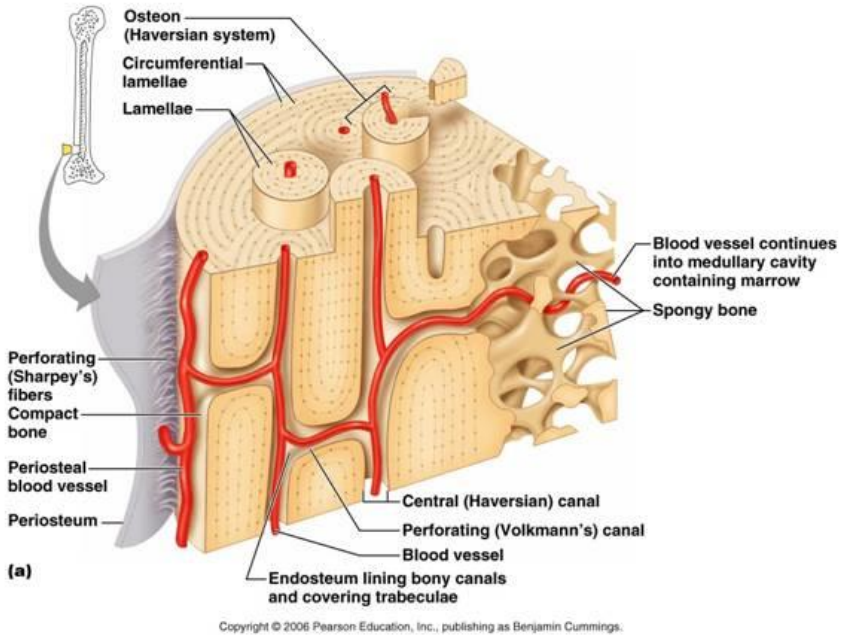

**A single osteon in cross-section**



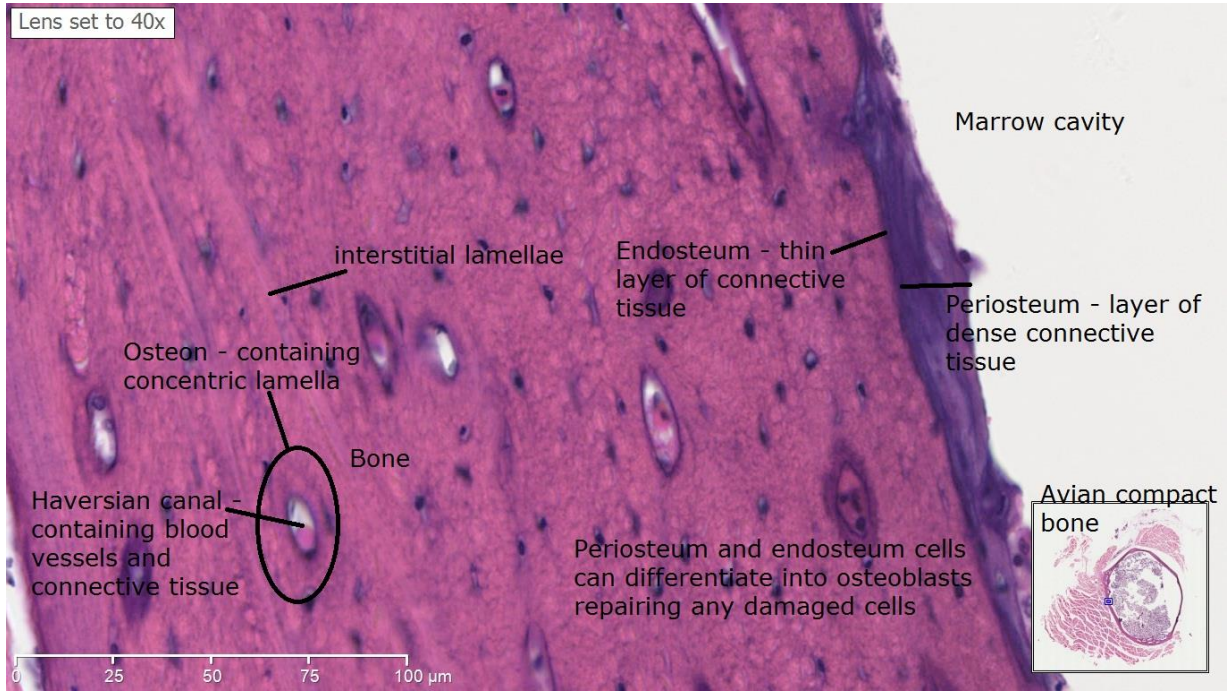

**Compact Bone & Spongy (Cancellous Bone)**



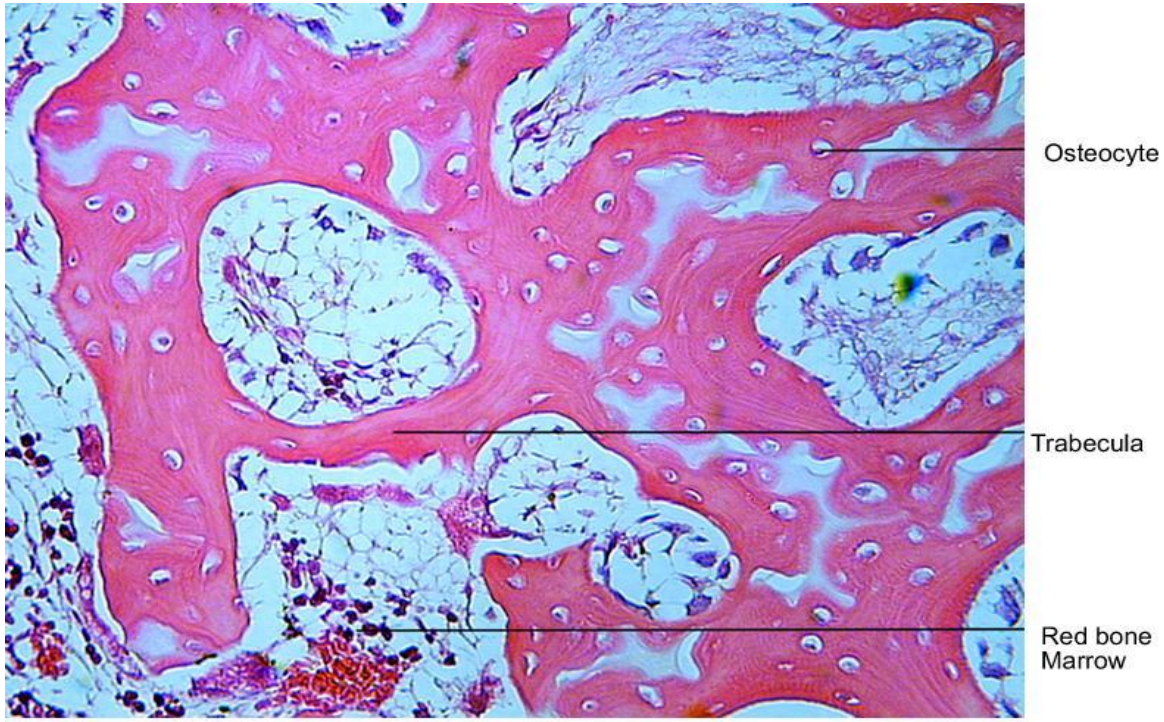



# HISTOLOGY OF BONE




T.S of compact bane




Cancellous (Spongy) Bone (400x)