

Introduction to Osteology



By:

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MSU

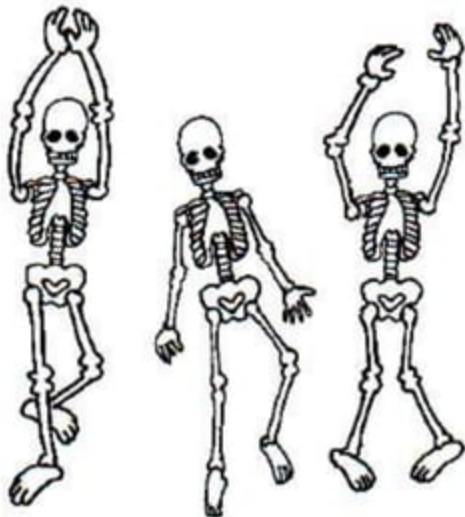
Objective of The Lecture

- **Learn about** definition of osteology
- **Learn about the classification of bones**
- **Learn about bone structure**
- **Learn about bone markings**

Osteology

Definition:

- Greek, (*osteon*= bone), (*logos*= science).
- The branch of anatomy that deals with the structure and function of bones.



Osteology

- In the skeleton of the adult there are 206 distinct bones as follows:

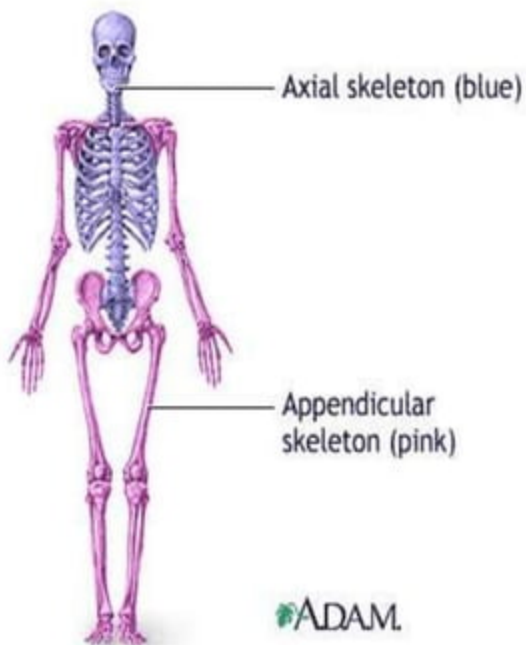
	Vertebral column	26
	Skull	22
Axial Skeleton	Hyoid bone	1
	Ribs and sternum	25
		---74
Appendicular	Upper extremities	64
Skeleton	Lower extremities	62
		---126
Auditory ossicles		6

	Total	206

Classification of bones

Bones are classified according to their position:

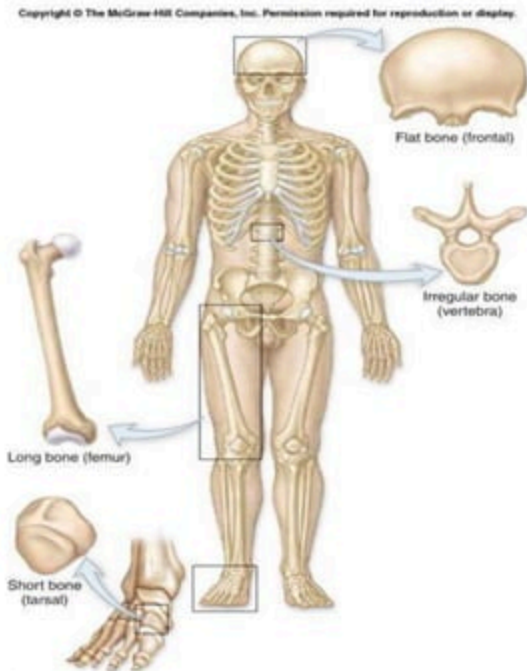
- Axial Skeleton
- Appendicular skeleton



Classification of bones

According to their shape:

- Long bones
- Short bones
- Flat bones
- Irregular bones
- Sesamoid bones



Classification of bones

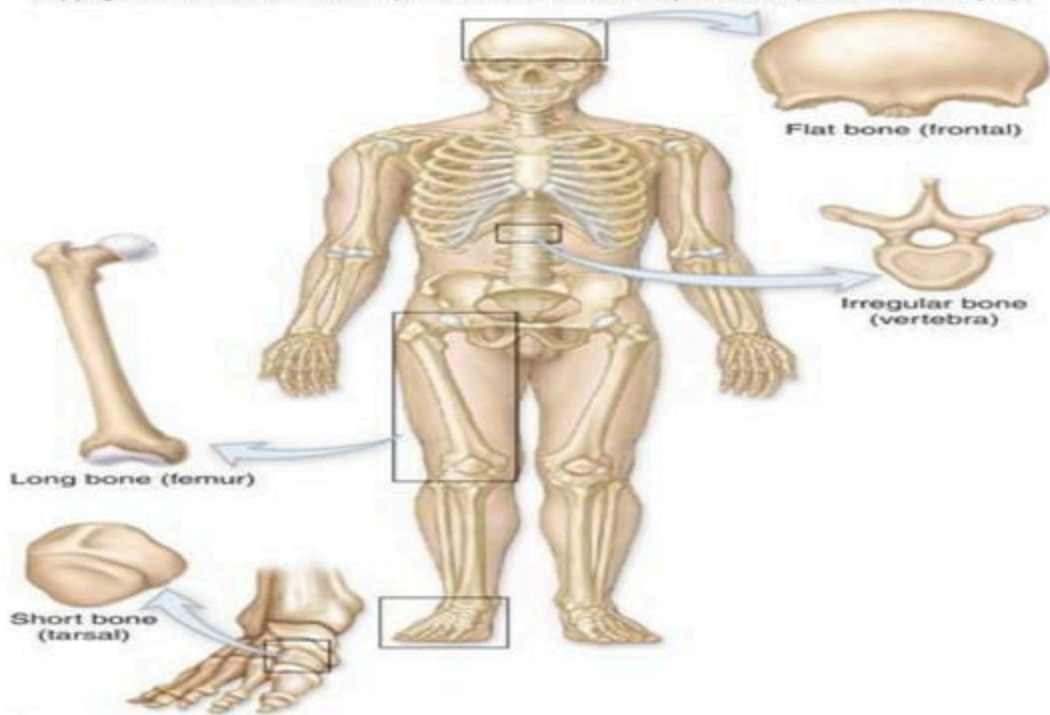
- 1. Long bones:** each long bone consist of a shaft or body and two ends or extremities
- 2. Short bones:** the short bones are roughly in cuboid shape. They distribute in wrist and foot including the carpal and tarsal bones
- 3. Flat bones:** the flat bones consist of two plates of compact bone with spongy bone and marrow between them like(occipital, parietal, frontal, nasal, lacrimal, vomer, scapula ,sternum and ribs).

Classification of bones

- 4. Irregular bones:** the irregular bones are greatly varied in shape, carry out different functions, and can not be classified in the preceding like(vertebrae, sacrum, coccyx, temporal, sphenoid, ethmoid, zygomatic, maxilla, mandible, palatine, inferior nasal concha, and hyoid).
- 5. Sesamoid bones:** develop in some tendons in locations where there is considerable friction, tension, and physical stress. They may form in the palms of the hands and the soles of the feet, however their presence and quantity varies considerably from person to person. Example (the patellae)

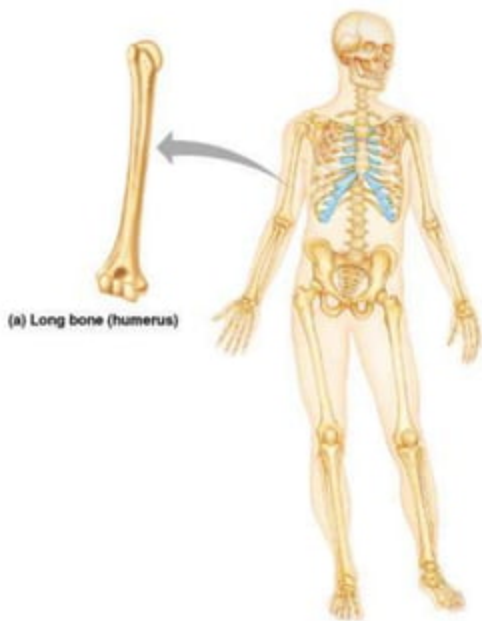
Classification of bones

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Long Bones

- **Long bones** are longer than they are wide.
- Long bones have 2 epiphyses, and a diaphysis.
- All of the bones of the limbs, except the patella, ankle, and wrist, are long bones.



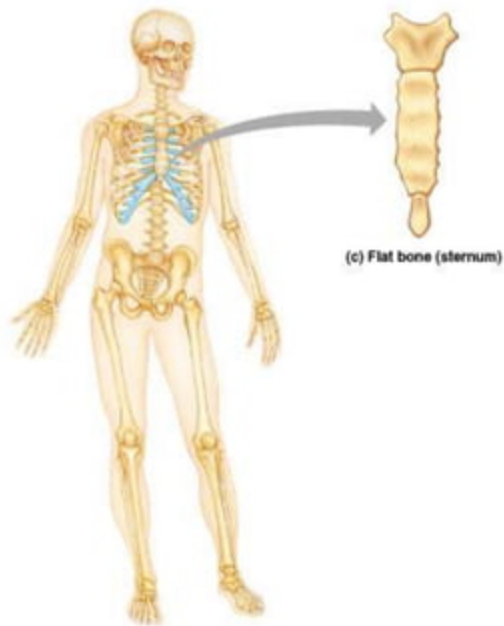
Short Bones

- **Short bones** are cube shaped, nearly equal in length and width.
- The bones of the wrist and ankle are examples of short bones.



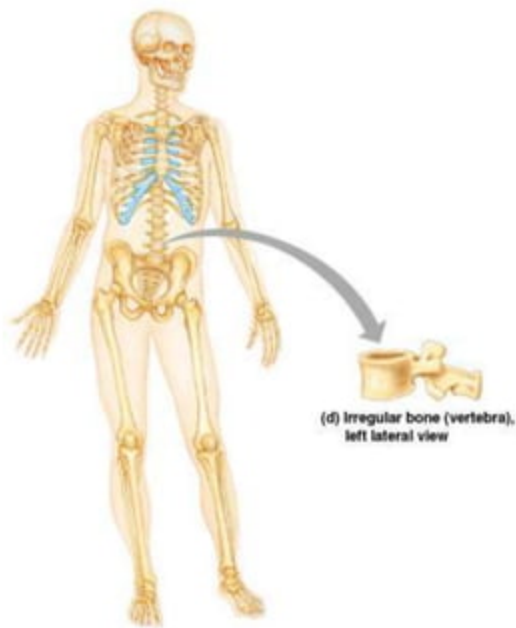
Flat Bones

- **Flat bones** are thin, flattened, and a bit curved.
- The sternum, scapulae, ribs, and most of the bones of the skull are flat bones.



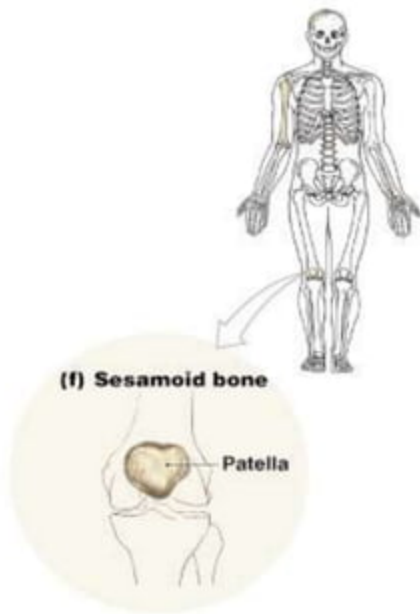
Irregular Bones

- ***Irregular bones*** have
- complicated shapes that fit none of the preceding classes.
- The vertebrae, the bones of the hip, and some facial bones.



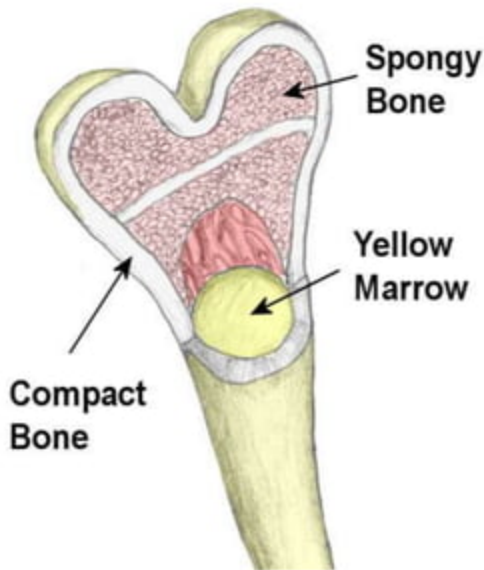
Sesamoid bones

- **Sesamoid bones** are small more or less rounded masses embedded in certain tendons and usually related to joint surfaces.
- Their functions probably are to modify pressure, to diminish friction, and occasionally to alter the direction of a muscle pull.

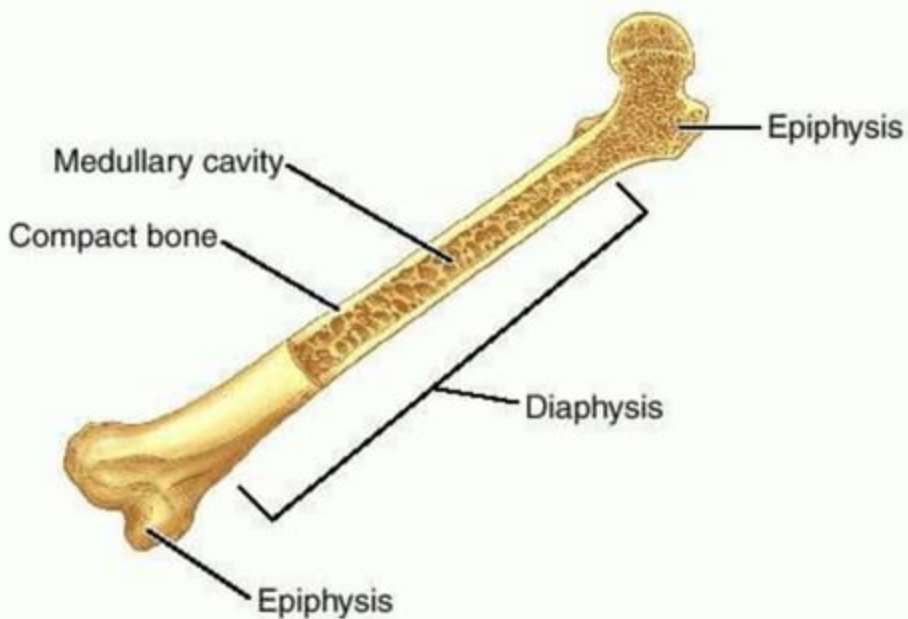


Structural Types of Bone

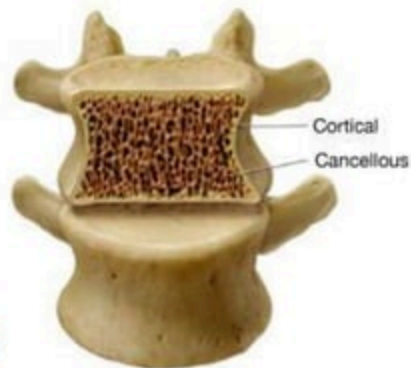
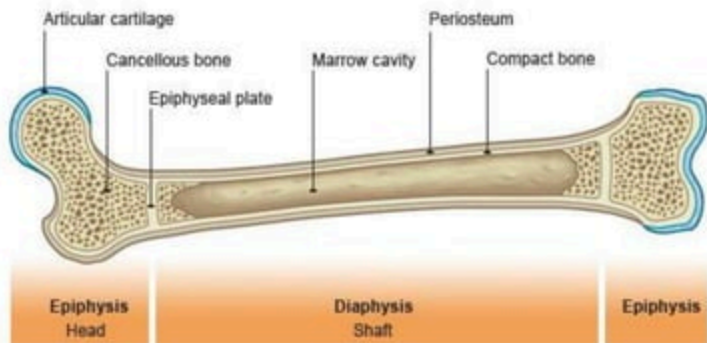
- **Cortical (compact) bone**
 - With a dense outer layer — the cortex.
 - This structure resists bending
- **Cancellous (spongy or trabecular) bone**
 - Tissue is located beneath the compact bone and consists of a meshwork of bony bars (trabeculae) with many interconnecting spaces containing bone marrow.



Compact Bone

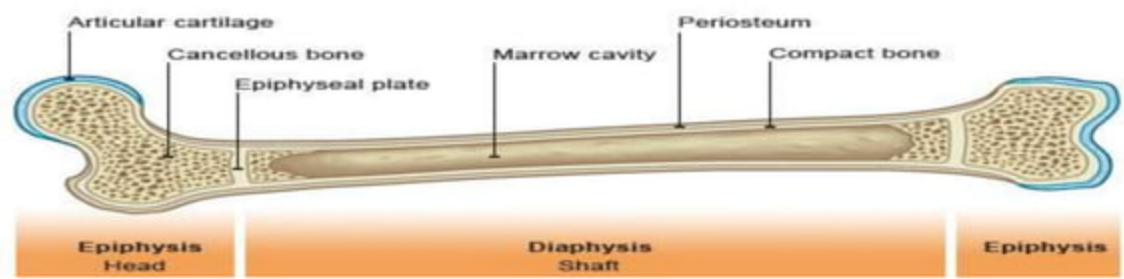


Cancellous (spongy) bone

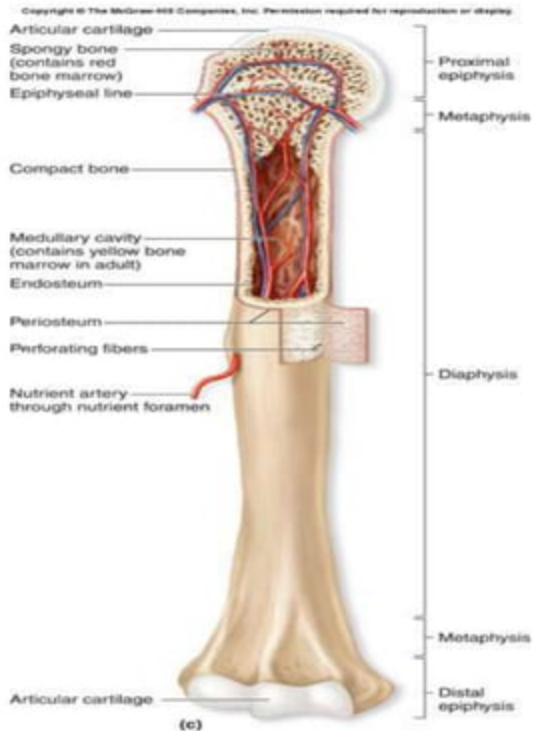


“GROSS” structure of a typical bone

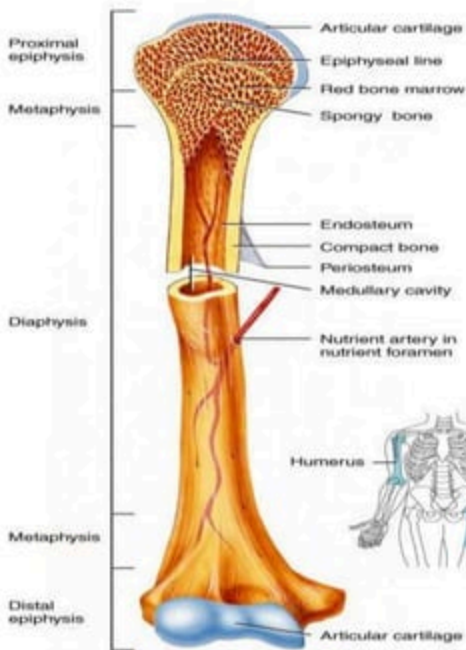
- **Articular cartilage:** Consists of Hyaline cartilage covering the end of the bone surface where it articulates with another bone, (e.g. femur and tibia, humerus and scapula). Fibrocartilage makes up the menisci of the knee joints.
- **Epiphyses:** The end of the bone. One at each end of long bones.
- **Epiphyseal line:** Remnant of the cartilaginous “growth plate” or epiphyseal plate.
- **Diaphyses:** The shaft of the bone. It Consists of a thick collar of compact bone surrounding a central marrow cavity.



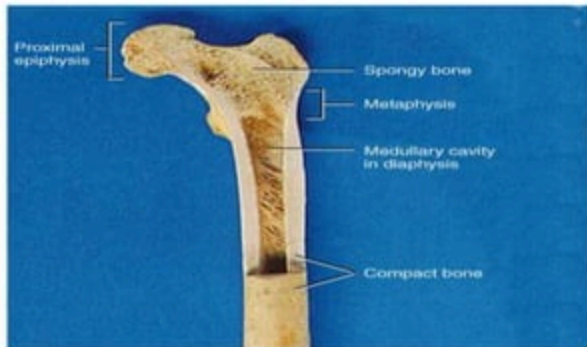
Typical bone structure



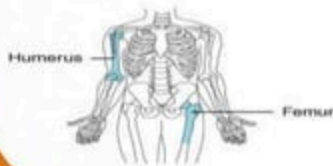
Typical bone structure



(a) Partially sectioned humerus (arm bone)

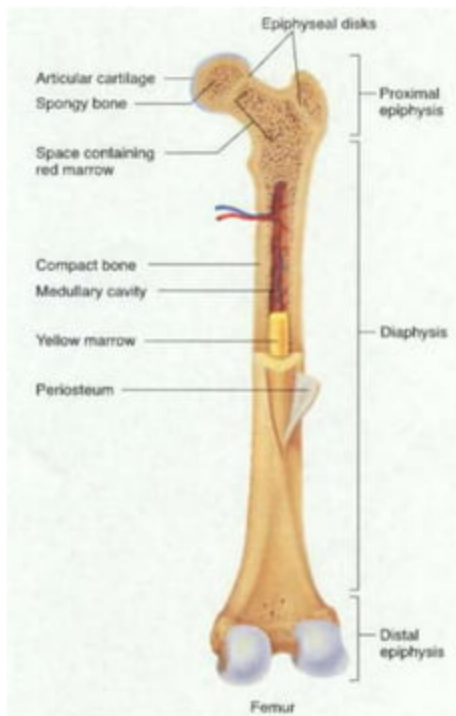


(b) Partially sectioned femur (thigh bone)



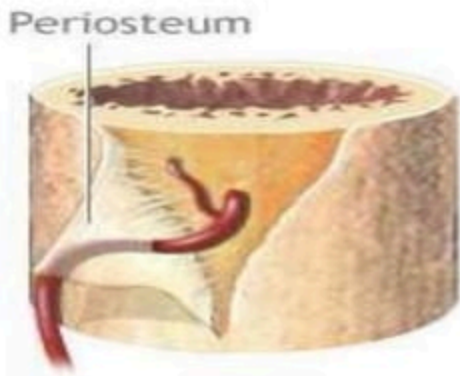
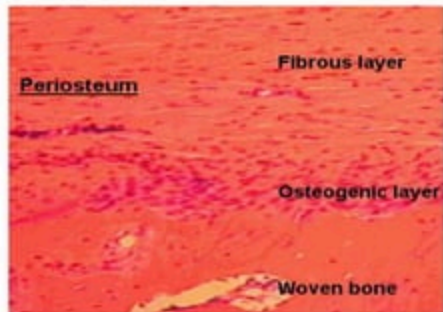
Long Bone Structure

- Shaft plus 2 expanded ends.
- Shaft is known as the **diaphysis**.
 - Consists of a thick collar of compact bone surrounding a central marrow cavity
 - In adults, the marrow cavity contains fat - yellow bone marrow.
- Expanded ends are **epiphyses**
 - Thin layer of compact bone covering an interior of spongy bone.
 - Joint surface of each epiphysis is covered w/ a type of hyaline cartilage known as **articular cartilage**. It cushions the bone ends and reduces friction during movement.



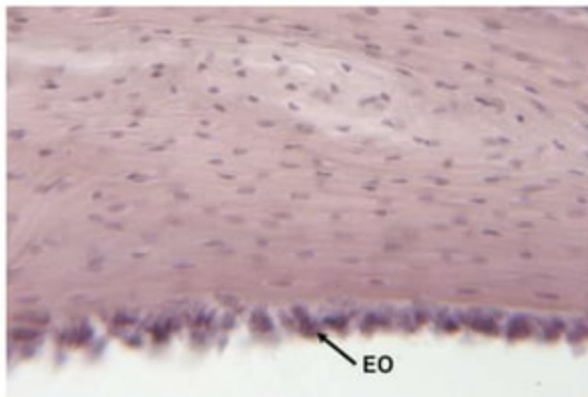
Long Bone Structure

- The external surface of the entire bone except for the joint surfaces of the epiphyses is covered by a double-layered membrane known as the **periosteum**.
 - Outer fibrous layer is dense irregular connective tissue.
 - Inner cellular layer contains osteoprogenitor cells and osteoblasts.
 - Periosteum is richly supplied with nerve fibers, lymphatic vessels and blood vessels.
 - These enter the bone of the shaft via a **nutrient foramen**.
 - Periosteum is connected to the bone matrix via strong strands of collagen.



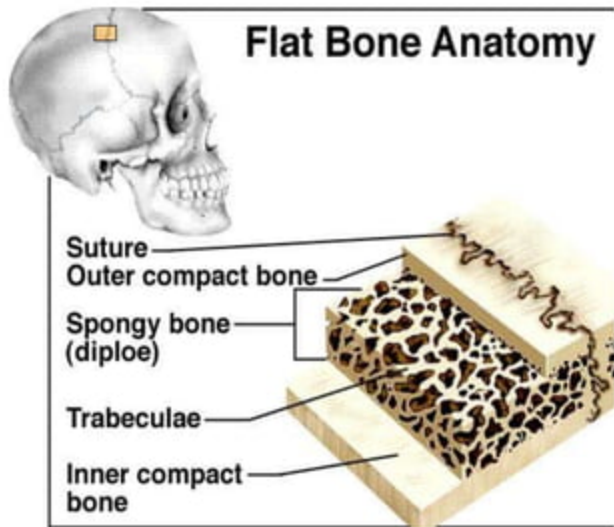
Long Bone Structure

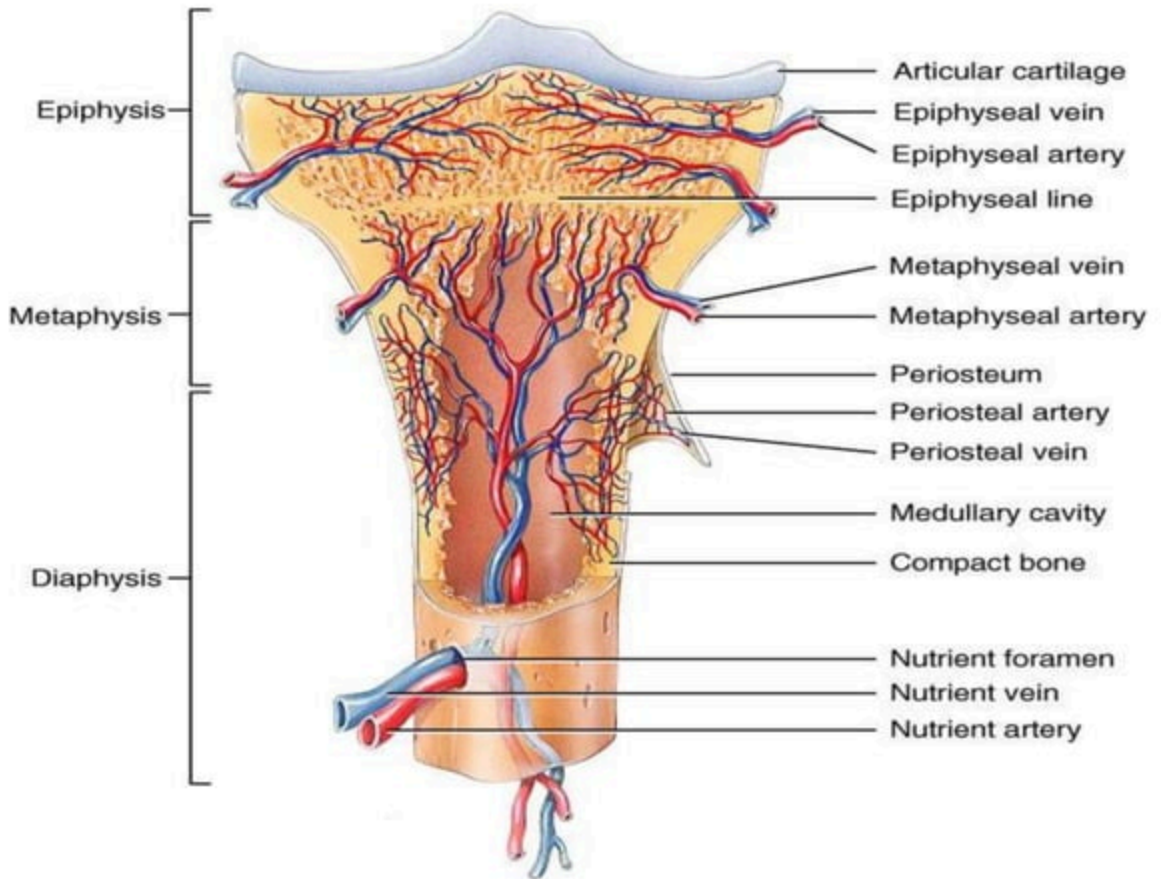
- Internal bone surfaces are covered with a delicate connective tissue membrane known as the ***endosteum***.
 - Covers the trabeculae of spongy bone in the marrow cavities and lines the canals that pass through compact bone.
 - Contains both osteoblasts and osteoclasts.



Structure of Short, Irregular, and Flat Bones

- Thin plates of periosteum-covered compact bone on the outside and endosteum-covered spongy bone within.
- Have no diaphysis or epiphysis because they are not cylindrical.
- Contain bone marrow between their trabeculae, but no marrow cavity.
- In flat bones, the internal spongy bone layer is known as the *diploë*, and the whole arrangement resembles a stiffened sandwich.





Bone matrix

- The matrix of bone is made up of organic and inorganic matter.
- The organic portion is composed of collagen fibers and various proteoglycans, glycosaminoglycans and glycoproteins.
- The collagen fibers form the framework of the matrix of bones and allows for elasticity and flexibility.



Bone matrix

- The majority of the matrix of bone is composed of inorganic crystals called *hydroxyapatite* and are composed of *calcium phosphate* and *calcium carbonate*.
- **Hydroxyapatite** forms a cement-like material that gives bone its hardness and strength.
- The combination of collagen and hydroxyapatite allows bone to be strong and hard, yet somewhat flexible and elastic.

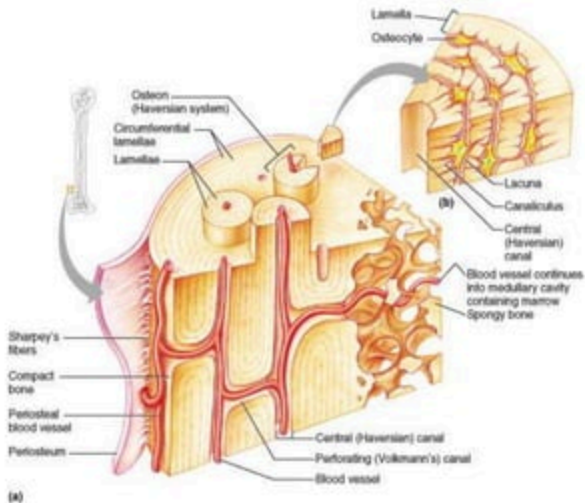


Microscopic structure of compact bone

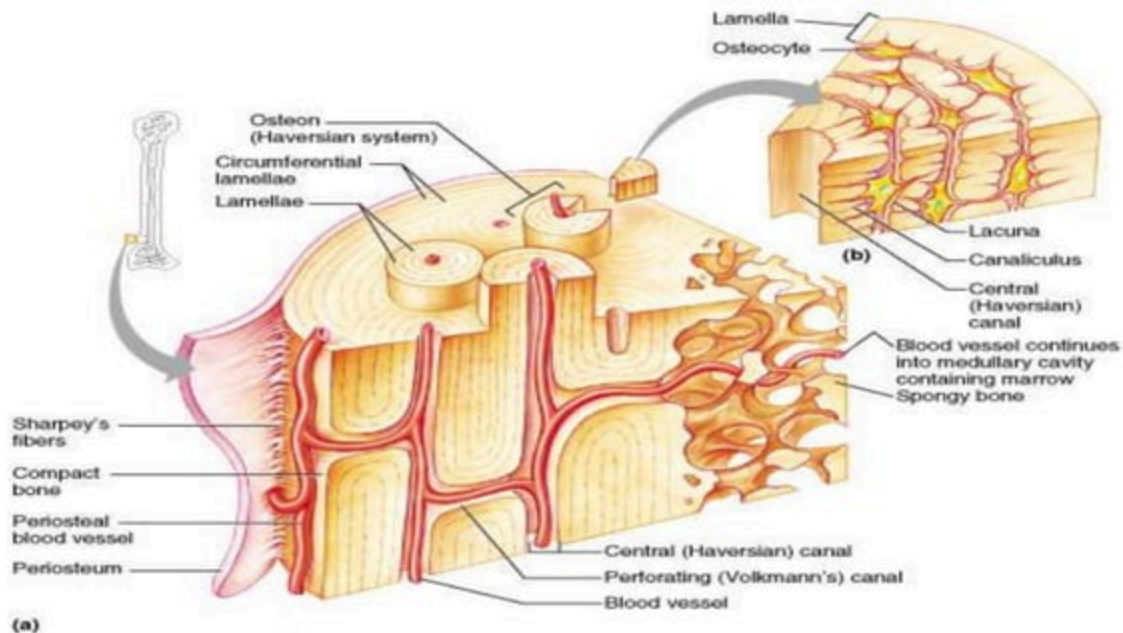
- The structural unit of Compact bone is the ***osteon, or haversian system.***

Each osteon

- Is an elongated cylinder
- Oriented parallel to the
- Long axis of the bone.

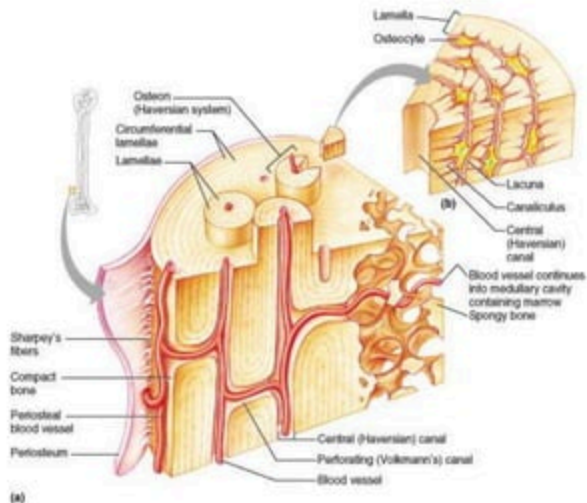


Microscopic structure of compact bone



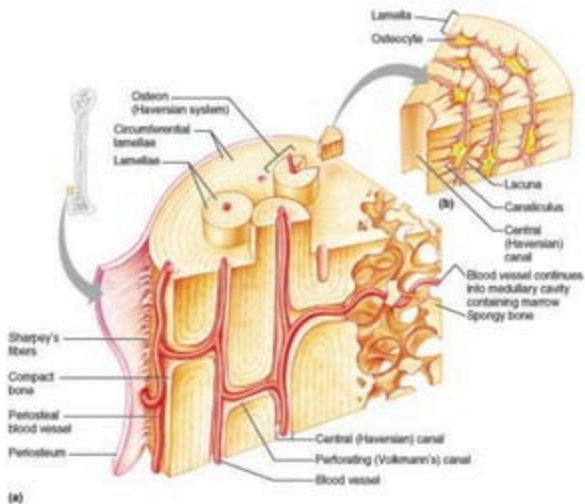
Microscopic structure of compact bone

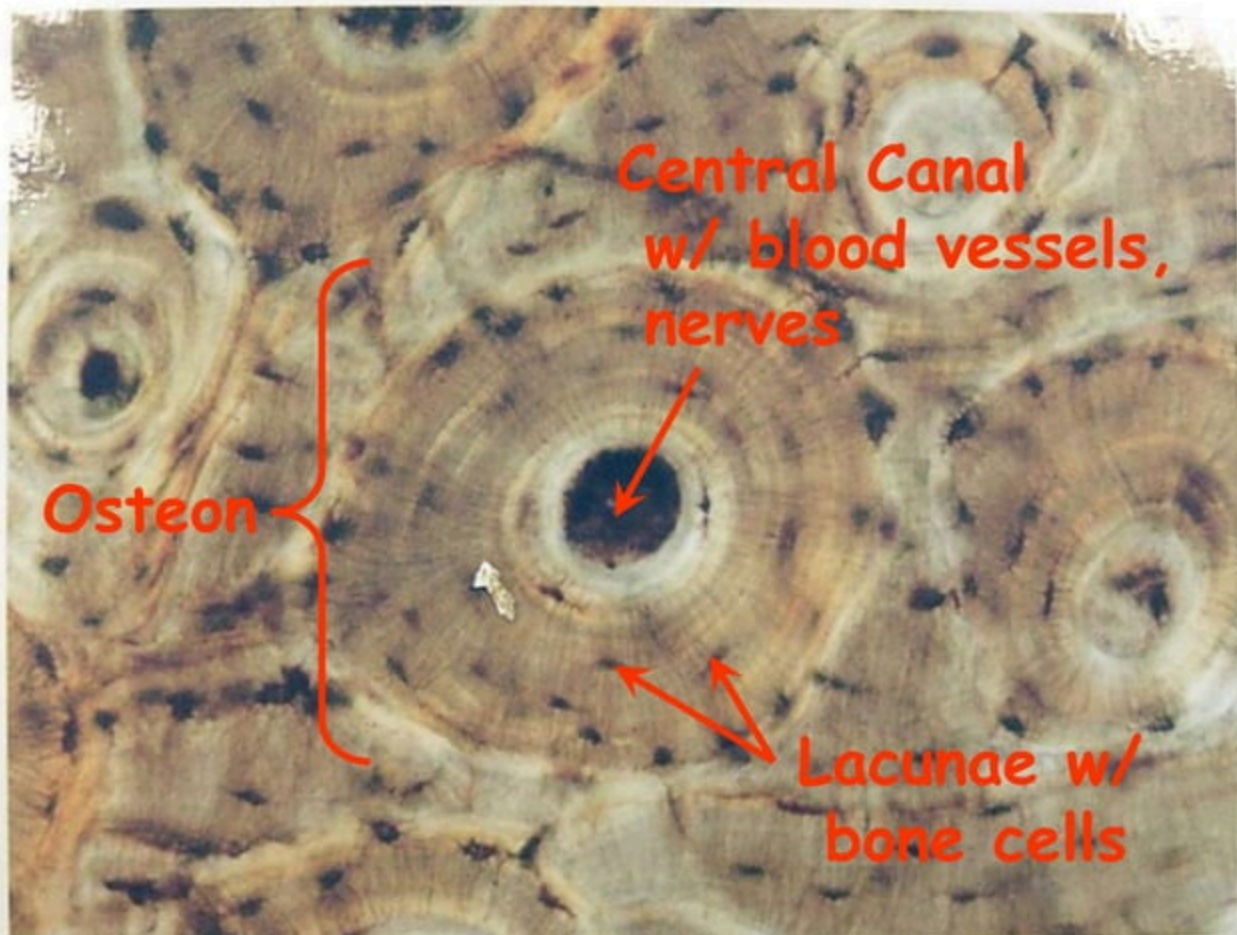
- An osteon is a group of hollow tubes of bone matrix, one placed outside the next like the growth rings of a tree trunk.
- Each of the matrix tubes is a **lamella**.
- The collagen fibers in a particular lamella run in a single direction.



Microscopic structure of compact bone

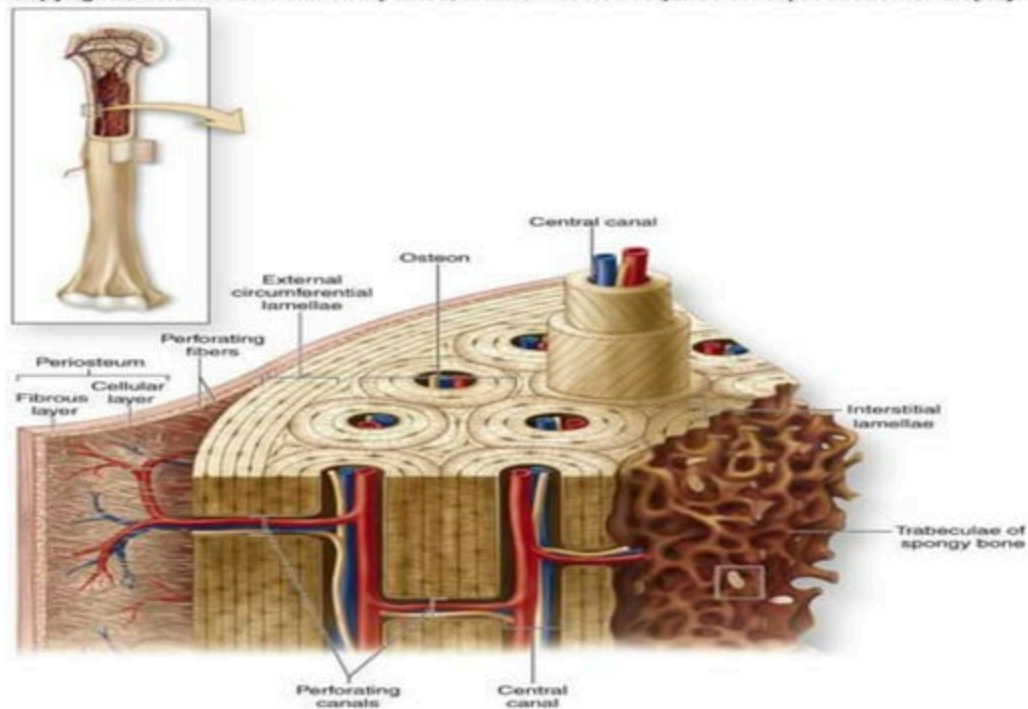
- Running through the core of each osteon is the **central, or Haversian canal**.
- The canal contains small blood vessels and nerve fibers that serve the needs of the osteon's cells.





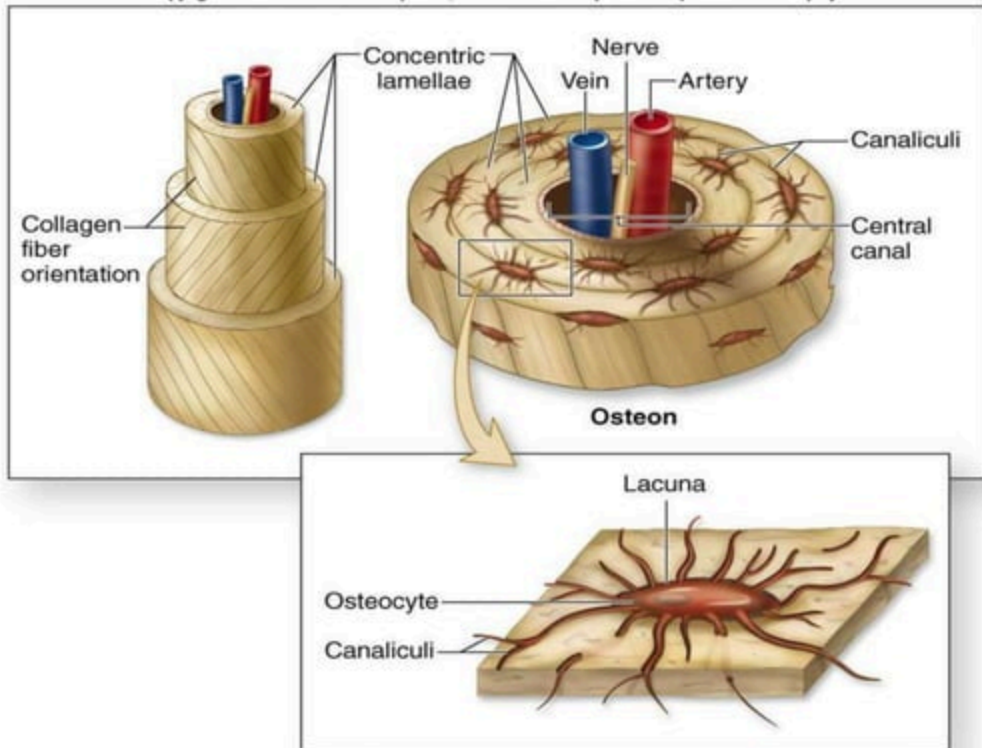
Compact bone structure

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Compact bone structure

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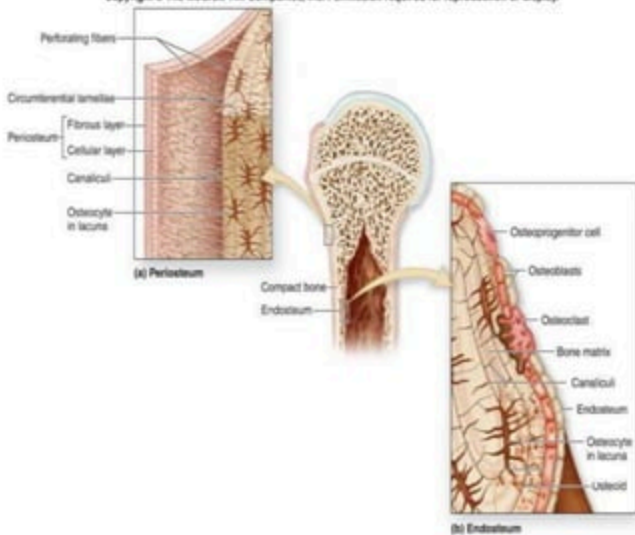


Spongy Bone

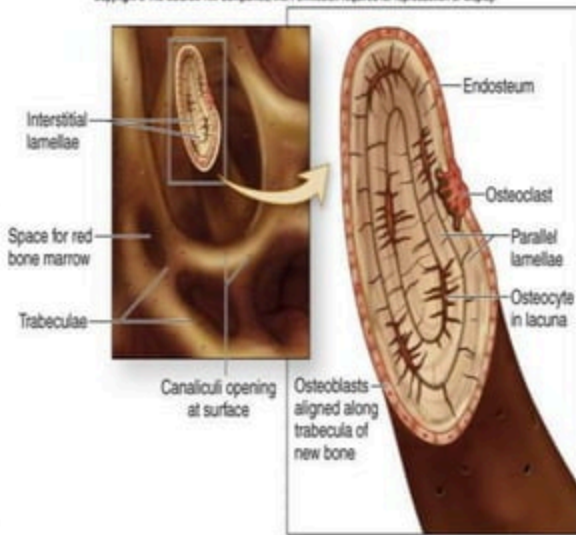
- **Spongy bone** composes the *inner portion* of the bone lining the marrow cavity. It contains trabeculae and spicules giving it a honeycomb appearance . Although it looks poorly organized it is designed to withstand the specific stresses put on each bone because of their trabeculae.
- **Trabeculae** are tiny bone struts or plates that form very strong support structure for the spongy bones.
- Trabeculae are irregularly arranged and contain lamellae and osteocytes, but contain no osteons as they receive nutrients from the marrow tissue.

Spongy bone histology

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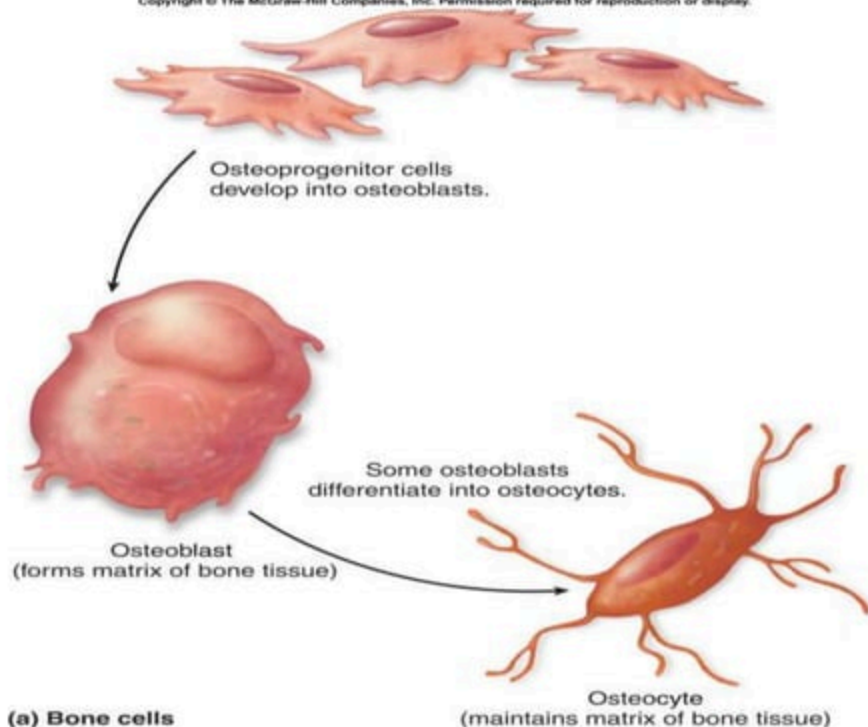
Types of Bones cells

Bone is formed and metabolized by specific cells and is in constant state of remodeling.

- 1. *Osteoclasts*:** Bone destroying cells
“C” means chewing
- 2. *Osteoblasts*:** Bone generating cells
“B” means building
- 3. *Osteocytes*:** Mature bone cells, spider shaped and maintain bone tissue

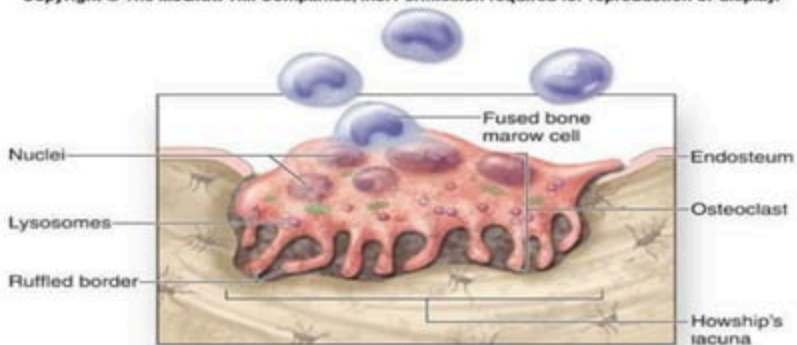
Bone Cells

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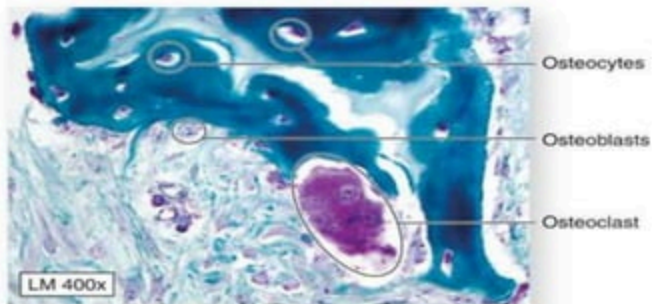


Bone Cells

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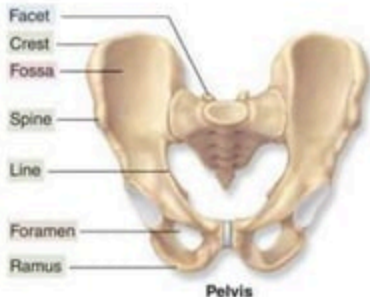
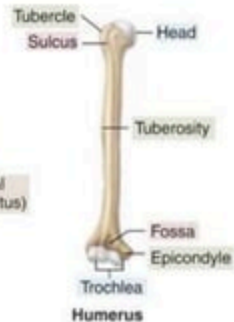
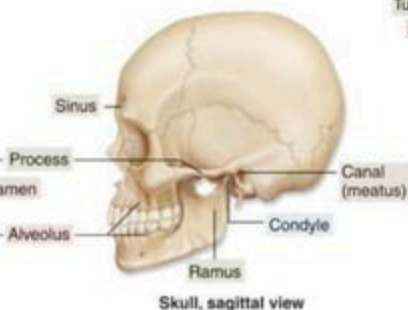
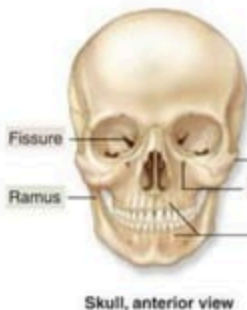
(b) Osteoclast



(c) Bone tissue

Bone markings and landmarks

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Bone markings and landmarks

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General Structure	Anatomical Term	Description
Articulating surfaces	Condyle	Large, smooth, rounded articulating oval structure
	Facet	Small, flat, shallow articulating surface
	Head	Prominent, rounded epiphysis
	Trochlea	Smooth, grooved, pulley-like articular process
Depressions	Alveolus	Deep pit or socket in the maxillae or mandible
	Fossa	Flattened or shallow depression
	Sulcus	Narrow groove
Projections for tendon and ligament attachment	Crest	Narrow, prominent, ridgelike projection
	Epicondyle	Projection adjacent to a condyle
	Line	Low ridge
	Process	Any marked bony prominence
	Ramus	Angular extension of a bone relative to the rest of the structure
	Spine	Pointed, slender process
	Trochanter	Massive, rough projection found only on the femur
	Tubercle	Small, round projection
	Tuberosity	Large, rough projection
Openings and spaces	Canal (meatus)	Passageway through a bone
	Fissure	Narrow, slitlike opening through a bone
	Foramen	Rounded passageway through a bone
	Sinus	Cavity or hollow space in a bone

Thank You!

