

# BONE FUNCTION AND HISTOLOGY LECTURE

## Skeletal Unit: maintain homeostasis

- I. Tissue: function, histology, growth and repair, embryology
- II. Axial Skeleton: cranial and vertebral column
- III. Appendicular
- IV. Joints, complications

## Functions of Bone and the Skeletal System:

1. 4.
2. 5.
3. 6.

## Histology: Connective Tissue

**Calcification:** a process of mineral salts (primarily: hydroxyapatite- a salt complex of Ca and P and Ca-Carbonate)salts deposit in the framework of collagen fibers and hardens

Sparsely distributed cells secrete matrix forming the intercellular materials

Bone \_\_\_\_\_: mineral salts (inorganic) = hardness

Review: matrix vs cells

Collagen fibers( organic) = strength

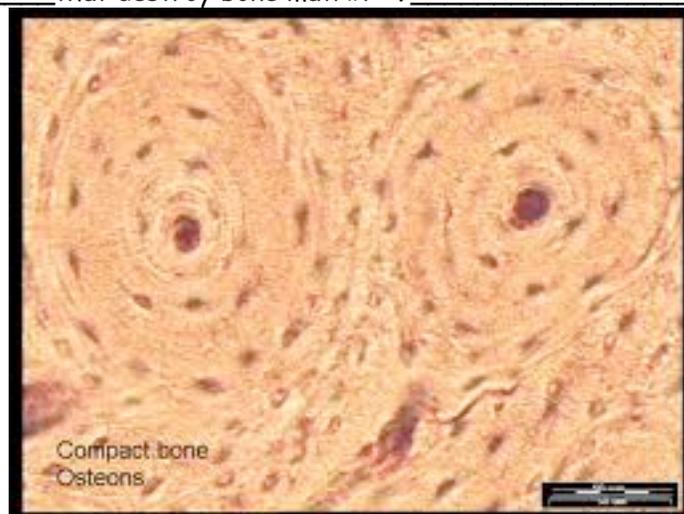
4 types of cells in bone tissue:

1. \_\_\_\_\_ cells: undergo cell division and become osteoblasts
2. \_\_\_\_\_: cells that form bone but cannot regenerate, located on the surface and secrete collagen and build bone tissue eventually trapping themselves in matrix and become osteocytes
3. \_\_\_\_\_: mature bone cells, main bone cells and maintain metabolism and exchange with blood, no regeneration

Lacunae: cavities where osteocytes reside (in circles called lamellae)

\*\*CYTES: maintain tissue

4. \_\_\_\_\_: megacell formed from 50 + monocytes with extremely powerful \_\_\_\_\_ that destroy bone matrix = r\_\_\_\_\_



## Osteon/Haversian System

Haversian canals lengthwise

Volkman's canals are perpendicular to H canals and communicate in and out of the bone

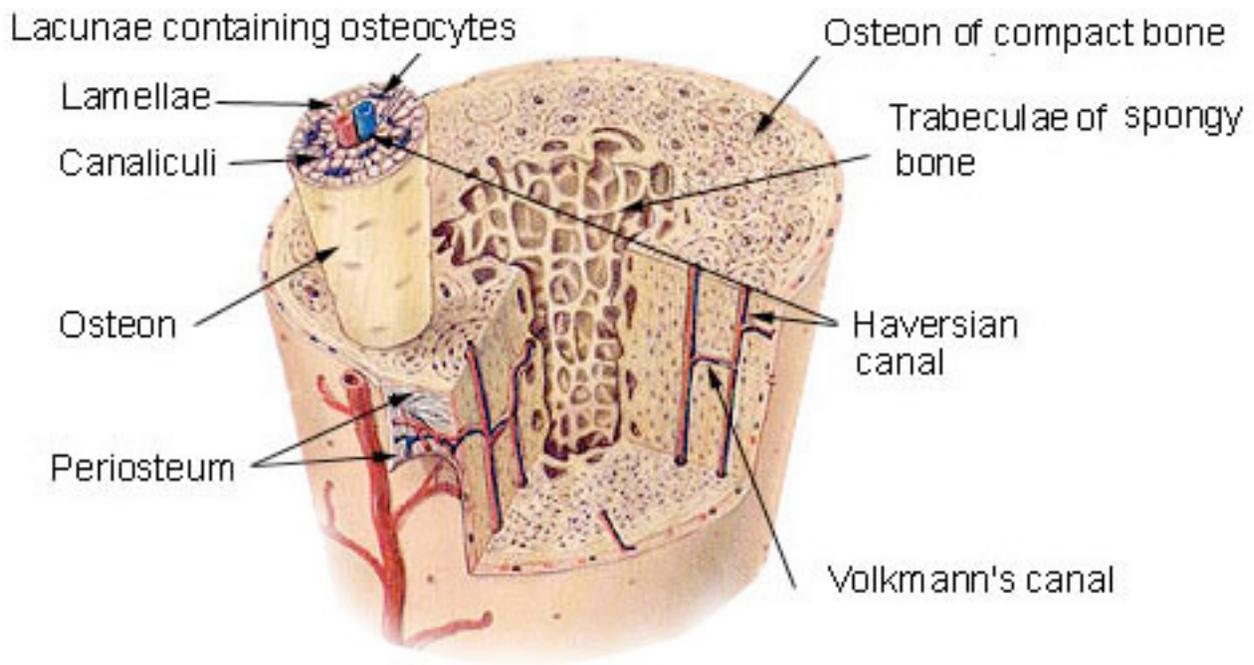
Canalliculi: tiny canals that radiate out from Lacunae Skeletal Tissue Lab: Part 1: Histology

# BONE CLASSIFICATION LECTURE

**Compact Bone:** few spaces, external layer and bulk

- Protection, support, resist stress by body's weight
- \_\_\_\_\_ (perforating canals) blood vessels, lymph vessels and nerves penetrate transversely through bone width (blood vessels and nerves connect with others in meullary cavity, periosteum and Haversian canals)
- \_\_\_\_\_: lengthwise
- \_\_\_\_\_ rings of hard calcified matrix
- \_\_\_\_\_: small spaces between concentric rings which hold osteocytes
- \_\_\_\_\_: tiny canals spreading from lacunae allowing projections of osteocytes to meet canals allowing for nutrient and waste exchange
- \_\_\_\_\_ (haversian system) a central canal with surrounding lamellae, lacunae, osteocytes and canaliculi

## Compact Bone & Spongy (Cancellous Bone)



**Spongy Bone:**

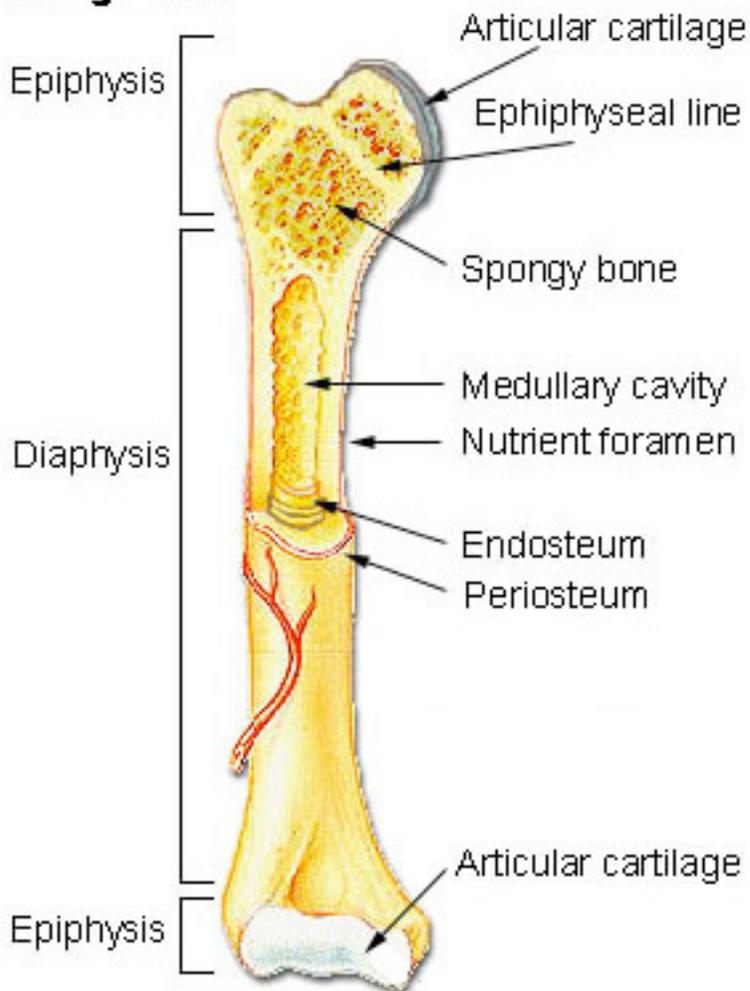
- No true osteons
- Trabeculae: irregular lattice work of thin columns of bone
- Red bone marrow may fill spaces
- Within trabeculae are osteocytes in lacunae
- Blood vessels from the periosteum to spongy bone directly nourishing osteocytes
- Short, flat, irregular bones, long bone epiphyses and around the diaphysis
- Hemopoiesis in skull, hip bones, ribs, sternum, vertebrae, ends of long bones

## Types of Bones:

Should be able to classify on shape and location

1. \_\_\_\_\_ : curved shaft with heads at both ends (femur, tibia, fibula, humerus, ulna, radius, phalanges)
  - a. both compact and spongy bone
2. \_\_\_\_\_ cube shaped, equal width and length, mostly spongy bone (carpals/wrist and ankle bones)
3. \_\_\_\_\_ : thin, give lots of protection, extensive areas for muscle attachment (cranial, sternum, ribs, scapulae)
  - a. thin, curved, compact layer with spongy bone in between
4. \_\_\_\_\_ : vertebrae and some facial bones, hip
5. \_\_\_\_\_ : develop in certain tendons where there is considerable friction, tension, physical stress (palms, soles, vary) patella  
Function: protect tendons from excessive wear and tear, change direction of pull on a tendon therefore increasing efficiency of joint movement
6. \_\_\_\_\_ are in joints in the cranium

## **Long Bone**



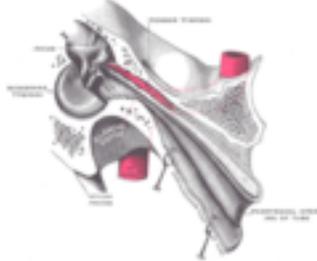
## Long Bone Anatomy:

Functions above

**Bone Markings:**

**(indentations)**

- a. foramen: a hole for blood vessels, nerves and ligaments
  - 1. ex. Foramen magnum
- b. meatus: a tubelike channel in a bone
  - a. ex. External auditory meatus of the temporal bone
- c. fossa: a shallow depression in/ on a bone
  - a. ex. Mandibular fossa on temporal bone



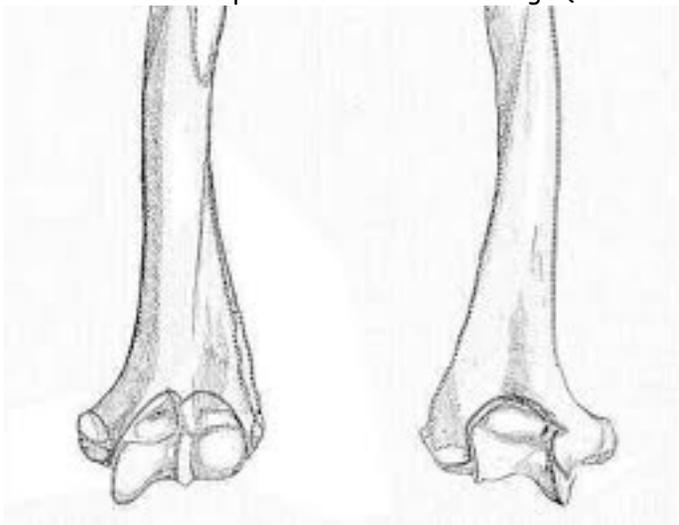
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- a. condyle : knuckle like , large rounded prominence
  - i. ex. Condyle
- b. head: a rounded prominence that forms a joint on the neck of a bone
  - ex. Head of the femur
- c. facet: smooth, flat articulated surface
  - ex. Facet on vertebrae

a. tuberosity: a large rounded projection with a rough surface

ex. deltoid tuberosity of humerus

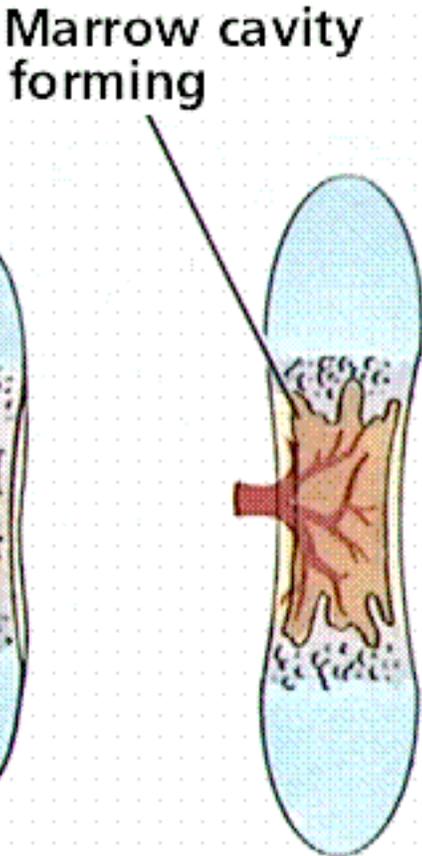
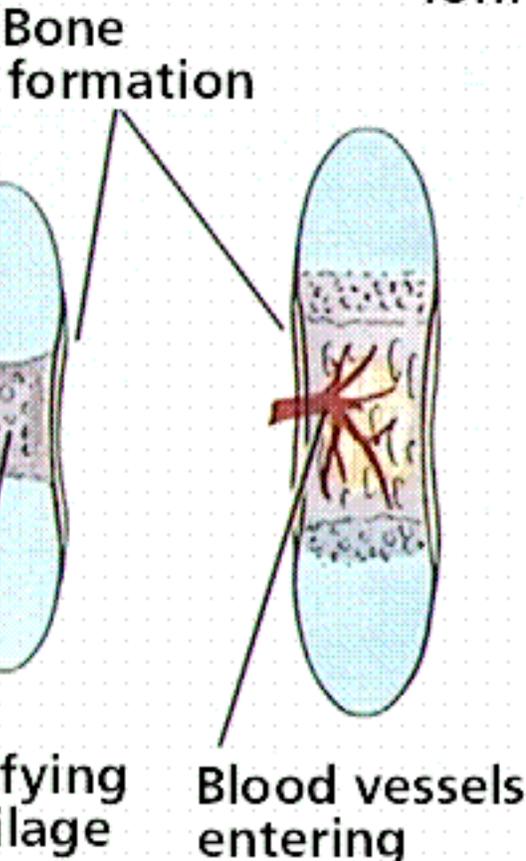
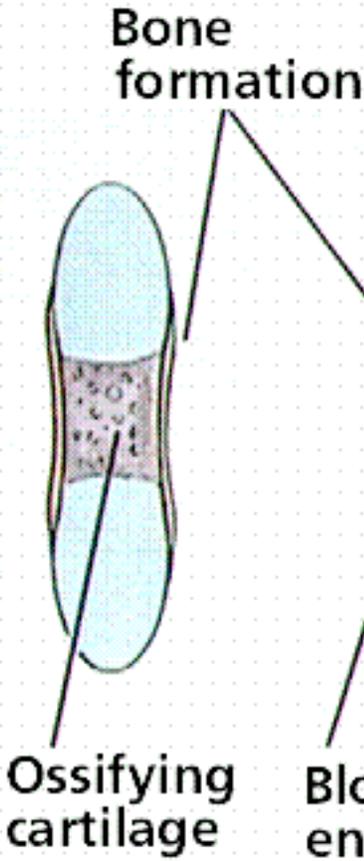
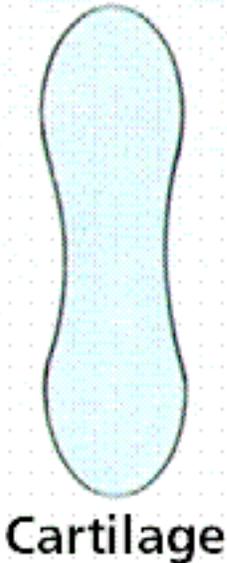
- b. spinous process or spine: sharp, slender projection
  - ex. Spinous process on vertebrae
- c. trochanter: large blunt projection only on femur (greater trochanter)
- d. crest: a prominent border or ridge (iliac crest of pelvis)

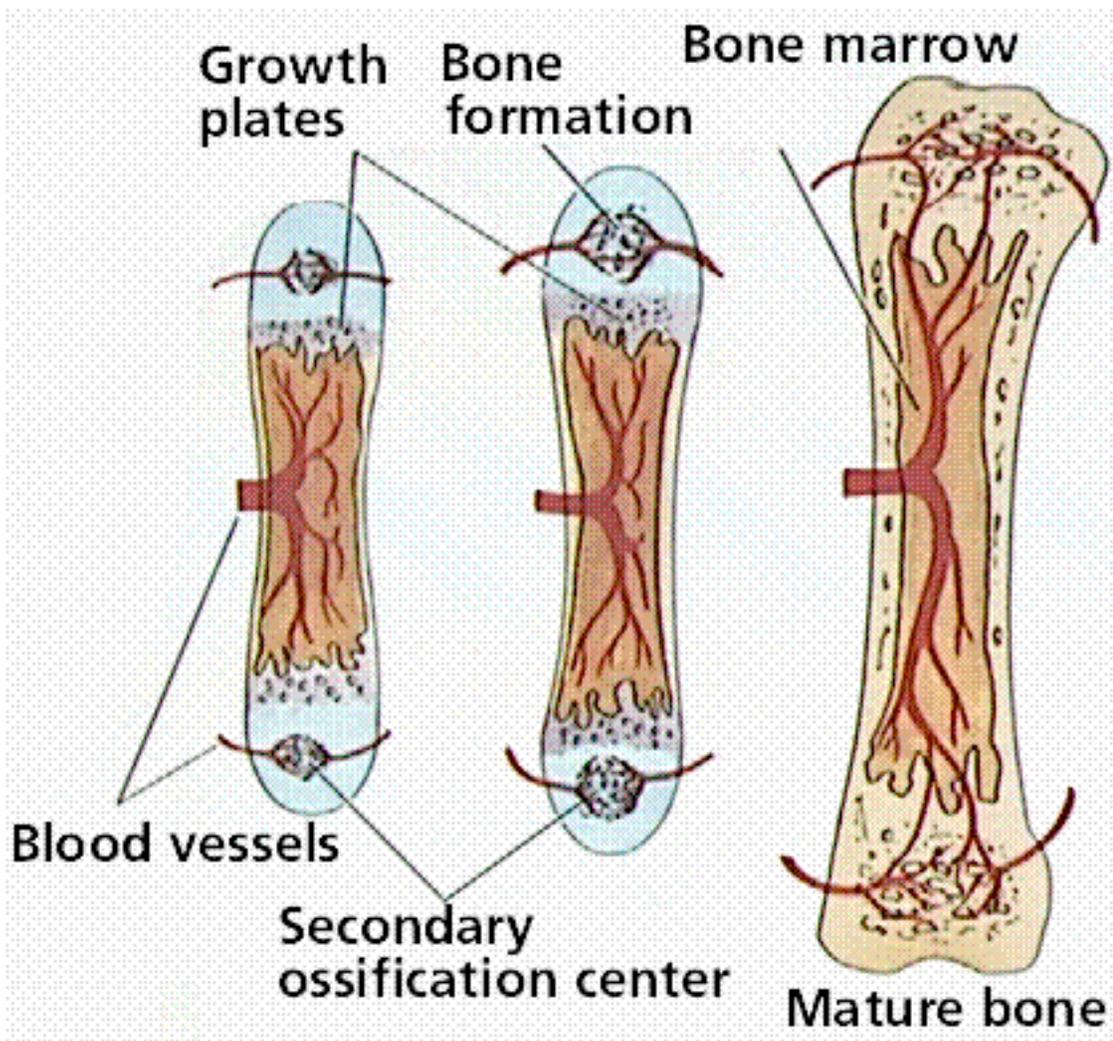


**Describe bone formation in the fetus and the process of bone remodeling:**

1. Fetal skeleton is primarily composed of hyaline cartilage and fibrous CT
2. This cartilage "model" is covered with bone matrix by osteoblasts (secrete matrix) and the cartilage is digested (begins 6<sup>th</sup>/7<sup>th</sup> week)
3. Two methods of bone formation involve replacing CT with bone
  1. intramembranous ossification : bone form on/in fibrous CT
    - a. simpler method: used for flat bones of skull and mandible and sealing sutures after birth
    - b. mesenchymal cells (tissue all CT comes from ) differentiate into osteogenic cells that become osteoblasts secreting matrix
    - c. once trapped in their lacunae the osteocytes extend pm into canaliculi; salts are deposited and matrix hardens
    - d. formation of trabeculae: as matrix forms it becomes trabeculae that fuse to form spongy bone; blood vessels grow in between trabeculae spaces and mesenchyme along newly formed bone; CT with blood vessels becomes red bone marrow
    - e. development of periosteum: peripheral mesenchyme becomes periosteum, surface layers of spongy bone become compact bone
    - f. much of the new bone is reshaped into its adult size
  2. endochondral ossification: form bone within hyaline cartilage
    - a. most bones made this way
    - b. development of the cartilage model: bone site: mesenchymal cells form the shape of the future bone and develop into chondroblasts secreting cartilage matrix making a hyaline model.
4. Long bone growth at epiphyseal plate is controlled by GH

# The Growth of Long Bones





#### Bone Remodeling in life is due to

1.  $Ca^{+}$  in the blood
  - a.  $Ca^{+}$  low: parathyroid glands release PTH which activates osteoclasts which destroy bone releasing  $Ca^{+}$  back into the bloodstream
  - b.  $Ca^{+}$  high (hypercalcemia)  $Ca$  should be deposited into bone
2. pull of gravity and muscles
  - a. muscles attach to "bulky" bone and osteoblasts lay down new matrix and get trapped = osteocytes
  - b. ie. Gymnasts, equestrians
  - c. physical therapy
  - d.

#### Types of Bone Fractures:

1. Closed and open (compound) fractures

#### Bone Repair:

1. Hematoma forms
2. fibrocartilage callus : grow new capillaries into clotted blood= granulation tissue
  - a. dispose of dead tissue by phagocytes
  - b. CT forms a mass = fibrocartilage callus
    - i. Cartilage matrix
    - ii. Bony matrix
    - iii. Collagen fibers
  - c. splint closes the gap

3. bony callus: spongy bone replaces fibrocartilage callus

**Ossification: the making of bone**

bones does not harden until growth stops, even then it is constantly being rebuilt  
embryonic skeleton is