

# Bone Lec 1



HUMAN HISTOLOGY

Semester 2, Year 1

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# Learning Objectives

**At the end, The student will be able to :-**

- Describe the structure of bone.
- Recognize structure of different types of bone cells.
- Predict functions of different types of bone cells.
- Describe the external and internal coverings (membranes) of bone.
- Discuss the structure of bone matrix.



# Bone

**1-Definition.**

**2-General characters.**

**3-Functions.**

**4-Structure.**

- Periosteum

- Endosteum

- Bone cells.

- Bone matrix.

**5-Types of bone tissue.**

**A-Macroscopic Type (Anatomical types)**

- \*Compact

- \*Cancellous bone

**B- Microscopic Type**

- \*Primary bone

- \*Secondary bone: Compact and Cancellous bone



## General characters:

- Matrix: **hard**.
- BV: highly **Vascular**.

**Membranes: 2 membranes:** All bone are covered on the external surface by dense connective tissue **periosteum** and the cavities of bone are lined by a thin membrane **endosteum**.

## Functions:

- Skeleton and lever for muscles attached to it.
- Supports and protects vital organs.
- Storage site for calcium and phosphate.
- Storage site for bone marrow (Hemopoietic organ) for blood formation.



# Structure of bone tissue



**Periosteum**

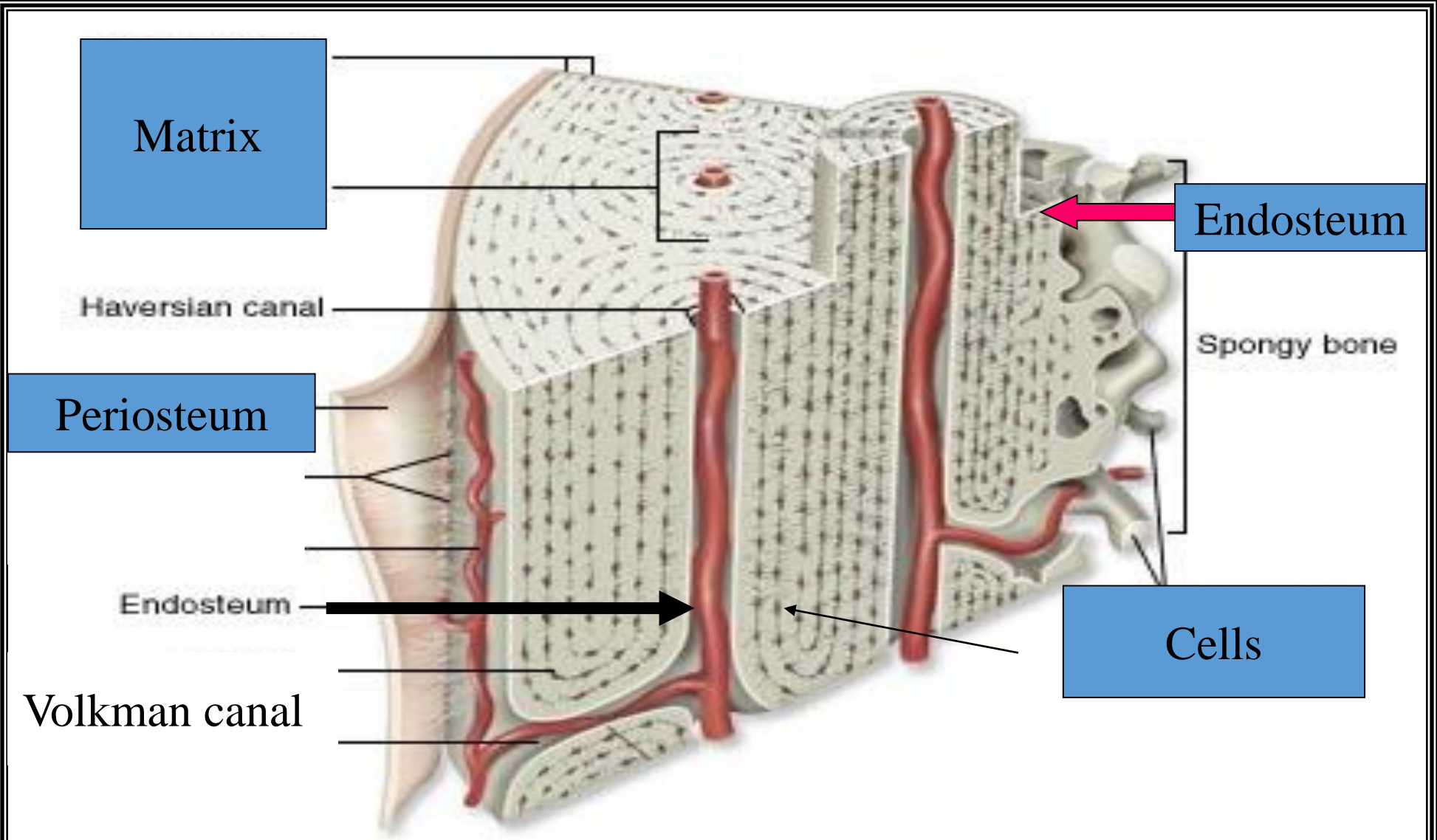
**A- Extracellular  
matrix**

**B- Bone cells**

**Endosteum**

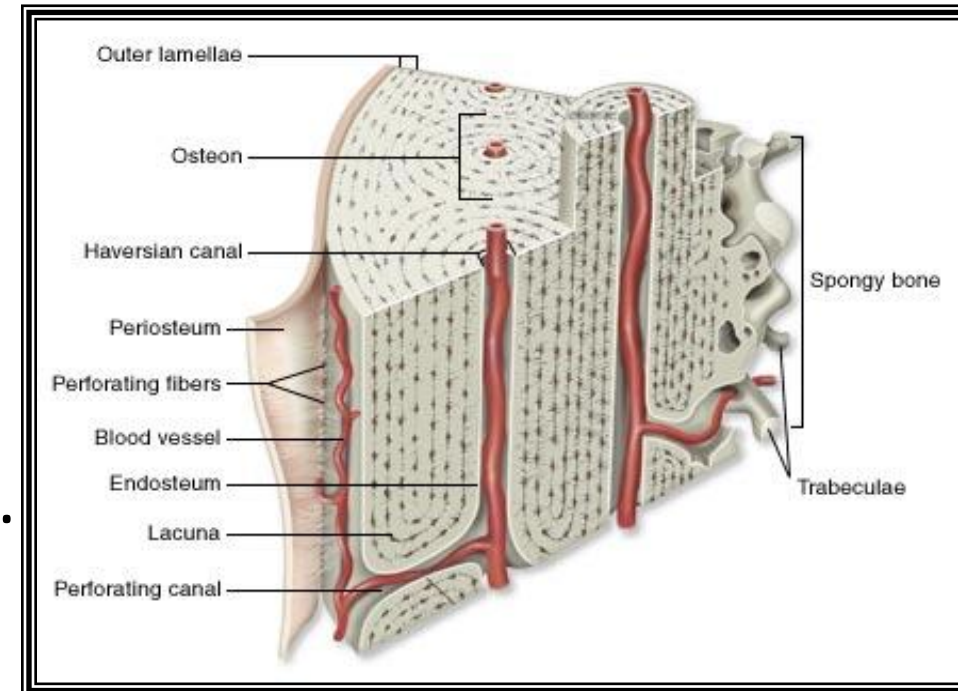
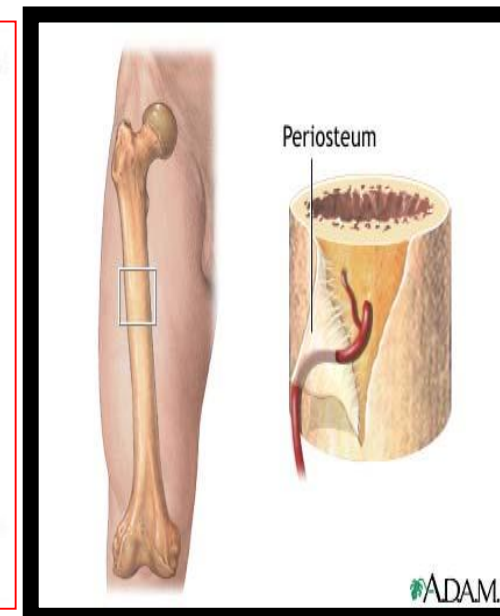
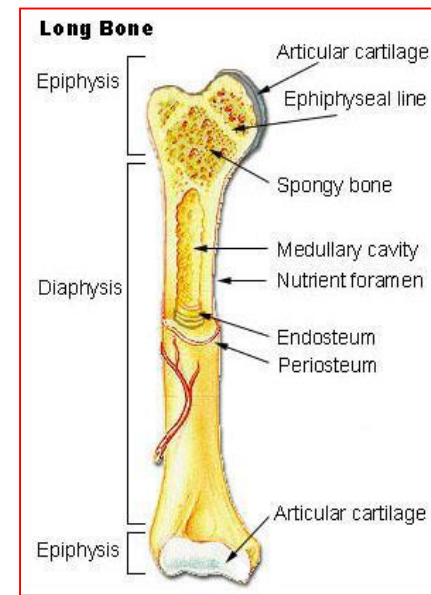


# General structure of bone



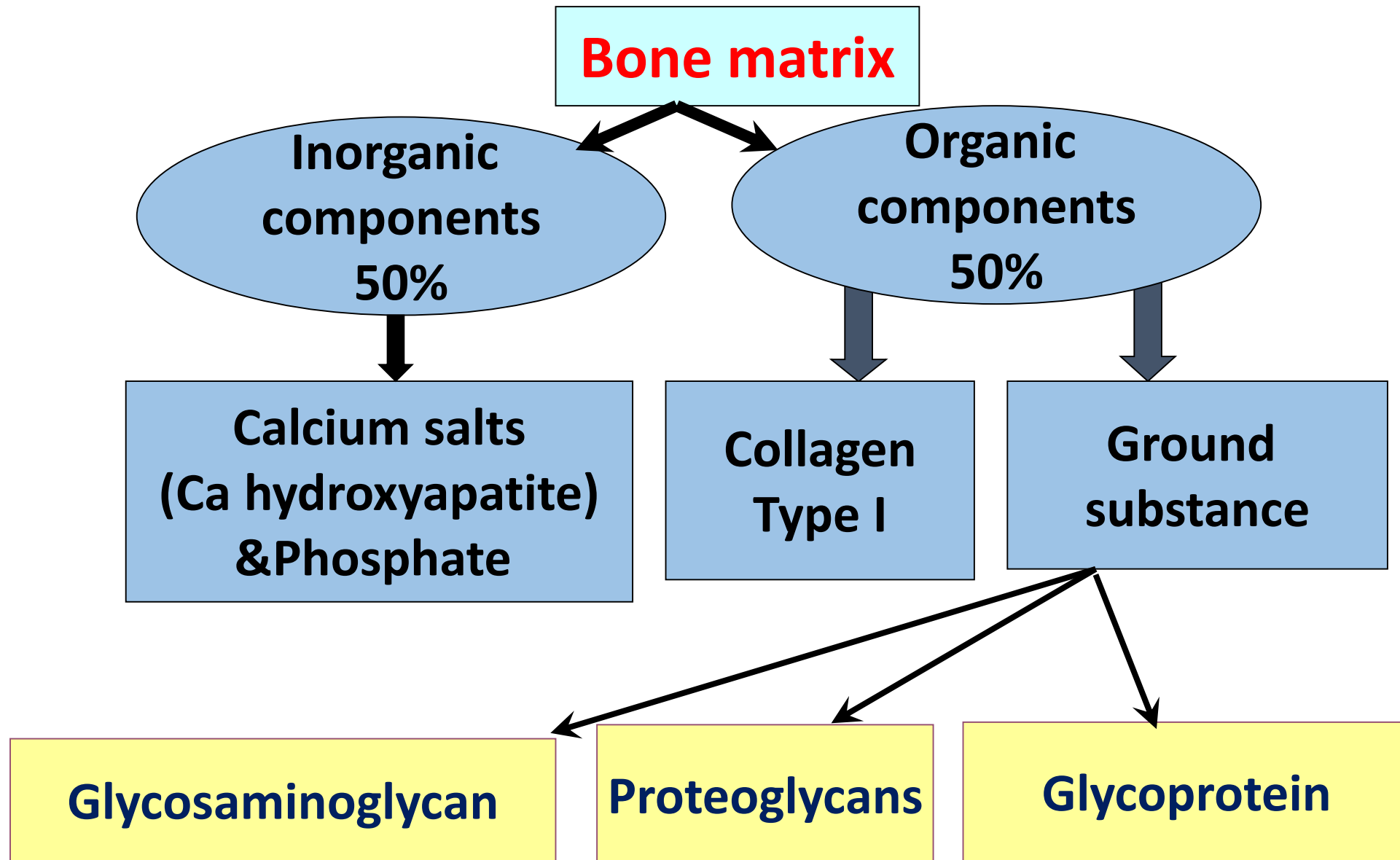
# Periosteum & Endosteum

- **Periosteum** cover bone surface by 2 layers:
  - **Outer fibrous** layer: dense C.T (collagen fibers, fibroblasts & B.V.).
  - **Inner cellular** layer: osteogenic cells and osteoblasts.
- **Endosteum** line bone cavities by 1 layer:
  - **Cellular layer**: osteogenic cells and osteoblasts.
- **Functions**: bone nutrition, growth & repair.



# A-Bone Matrix (Extracellular matrix)

- The matrix is stained **acidophilic** (*collagen*) in H & E sections.



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(a)

Without  
mineral

Without  
collagen



(b)



(c)

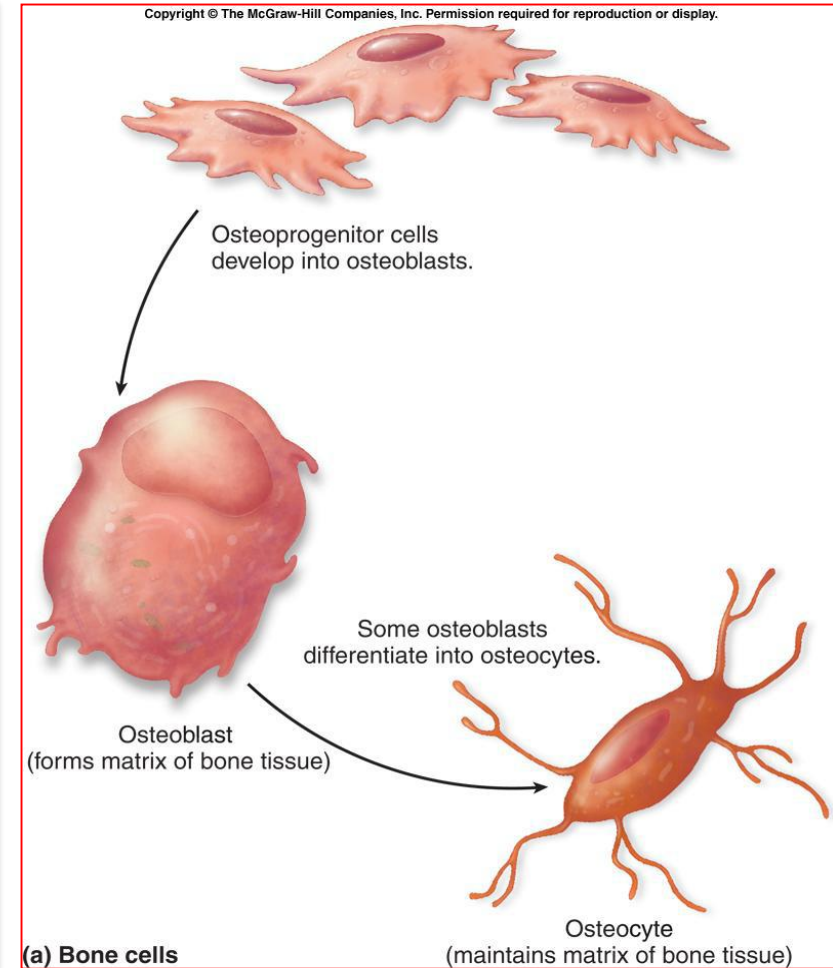
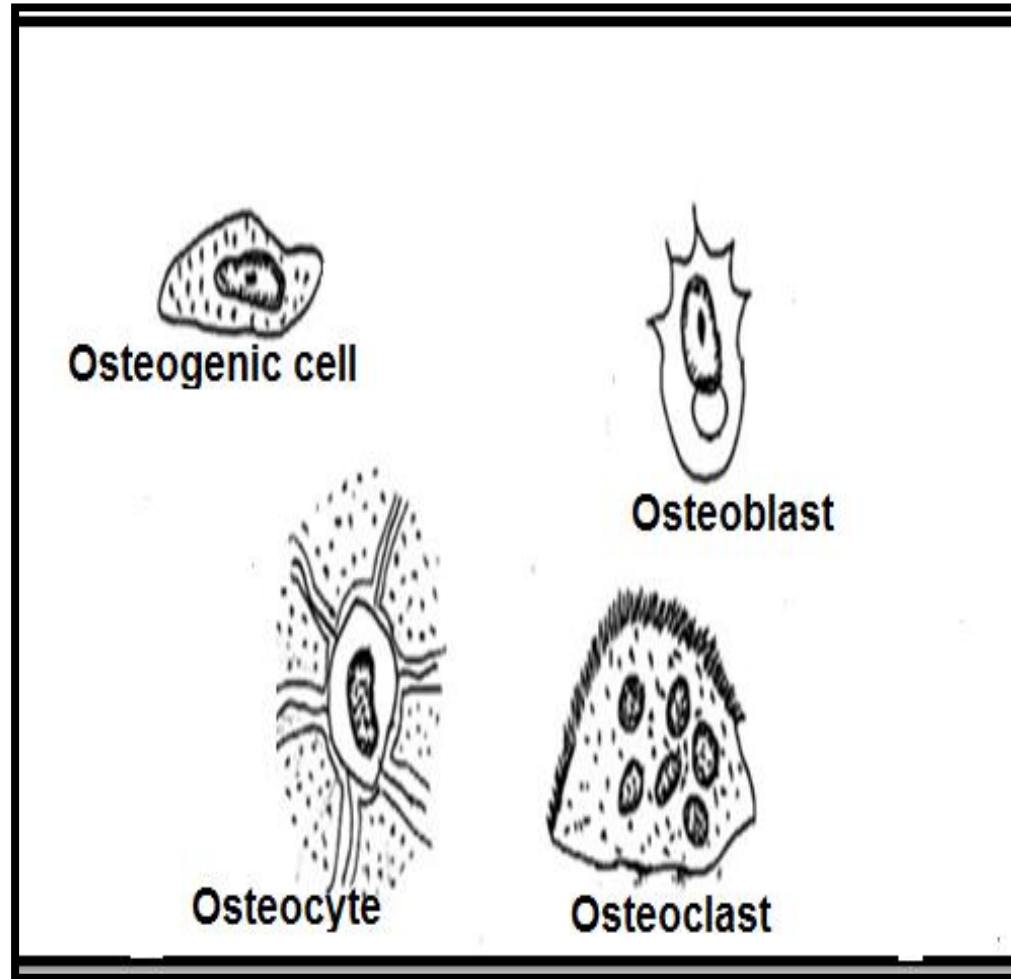
# B-BONE CELLS

1-Osteogenic.

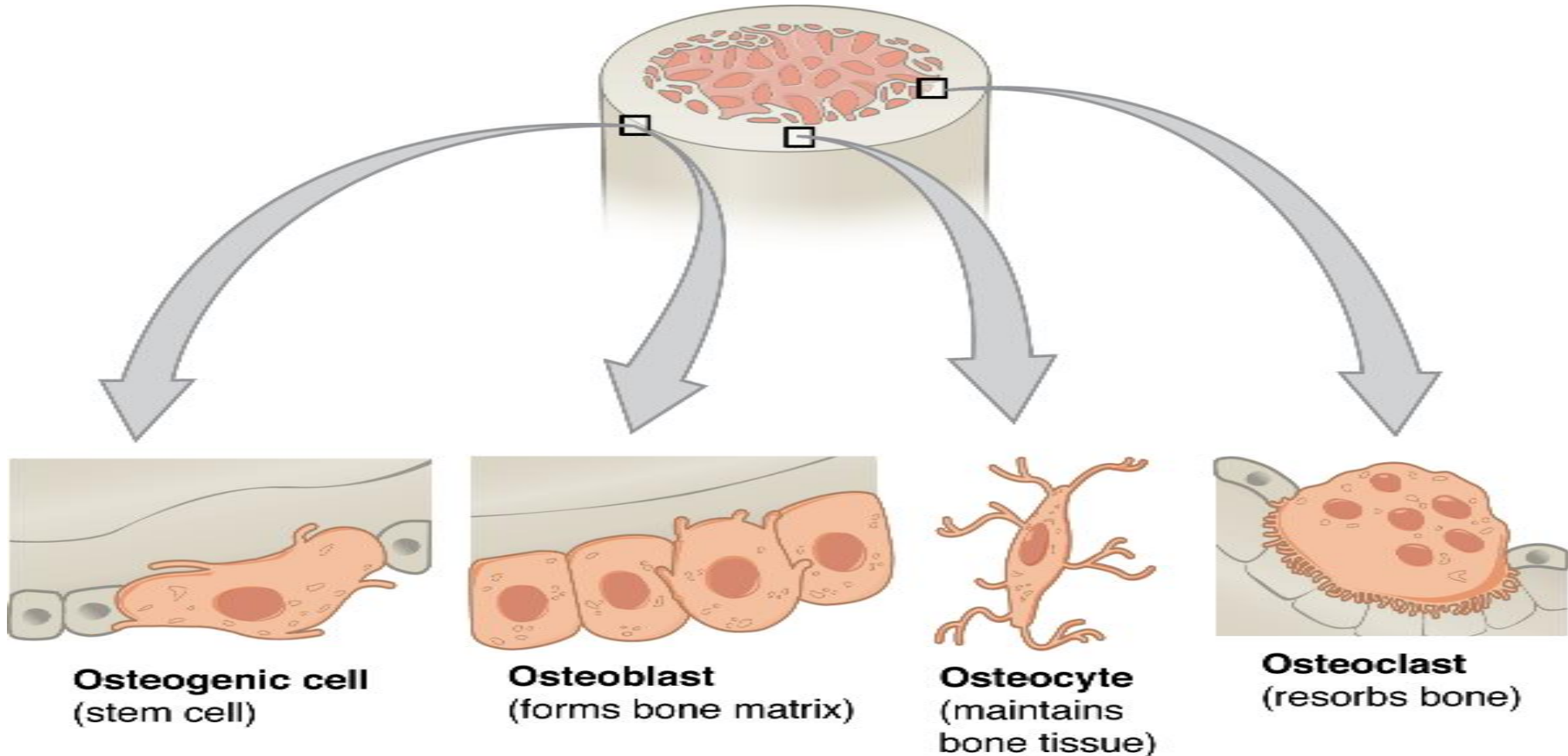
2-Osteoblast.

3-Osteocyte.

4-Osteoclast.



# B-BONE CELLS



# 1- Osteogenic cells (Osteoprogenitor cells)

- **Source (Origin):** mesenchymal cell.

- **Site:** periosteum & endosteum.

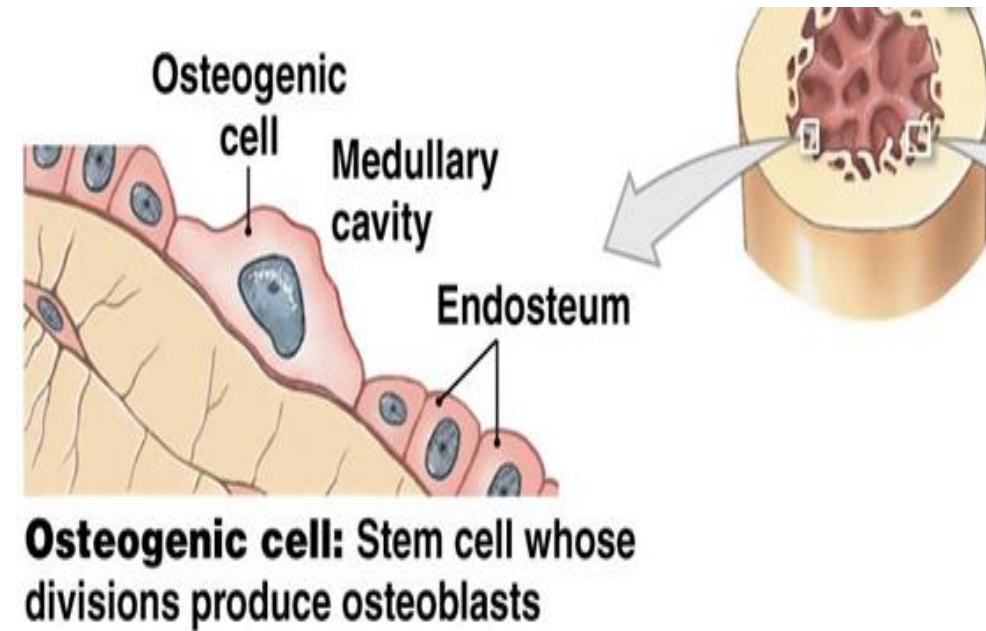
- **Shape:** spindle-shaped cells.

- **L/M:**

**Nucleus:** oval nucleus

**Cytoplasm:** Basophilic cytoplasm (↑ ribosomes)

- **Function:** when they are stimulated, they proliferate and give rise to **Osteoblasts**.



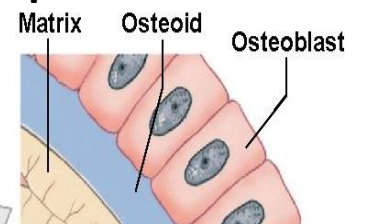
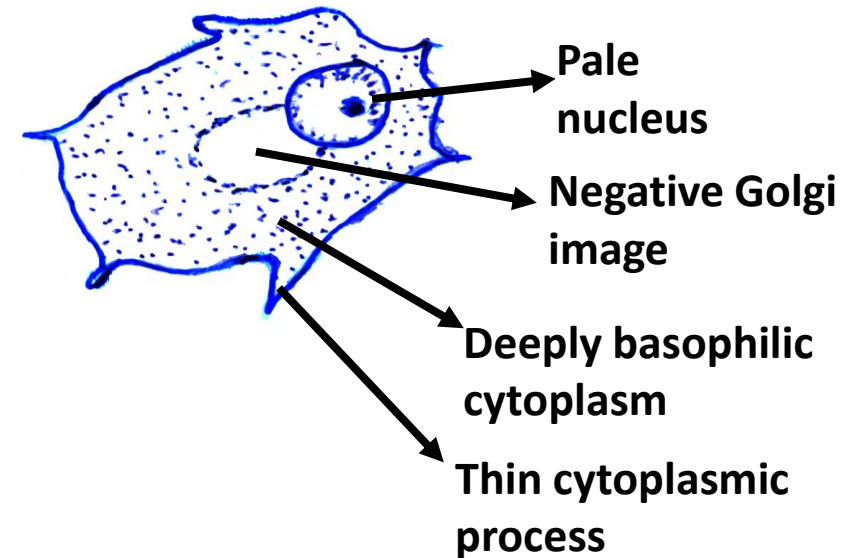
# 2- Osteoblasts

- **Source (Origin):** osteogenic cells.
- **Site:** surface of bone, side by side (sheet like arrangement).
- **Shape:** Osteoblasts are cuboidal & show very thin cytoplasmic processes
- **L/M:**

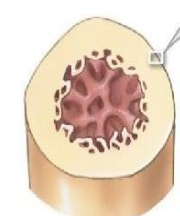
**Nucleus:** large rounded **pale** nucleus.

**Cytoplasm:** **deep basophilic** with **negative Golgi** image.

(i.e. **Rich** RER & Golgi)



**Osteoblast:** Immature bone cell that secretes osteoid, the organic component of bone matrix



## 2- Osteoblasts

**Function:** They are bone forming cells:

1- **Synthesis** of organic components of bone matrix i.e. osteoid

Osteoblasts surrounded by matrix form **osteocytes**.

2- **Deposition** of **calcium** salts by secretion of **alkaline phosphatase** enzyme.



# 3- Osteocytes

- **Source (Origin):** osteoblasts.
- **Sites:** One osteocyte (**main** & **mature** cell)

is imprisoned inside lacuna within the calcified bone matrix.

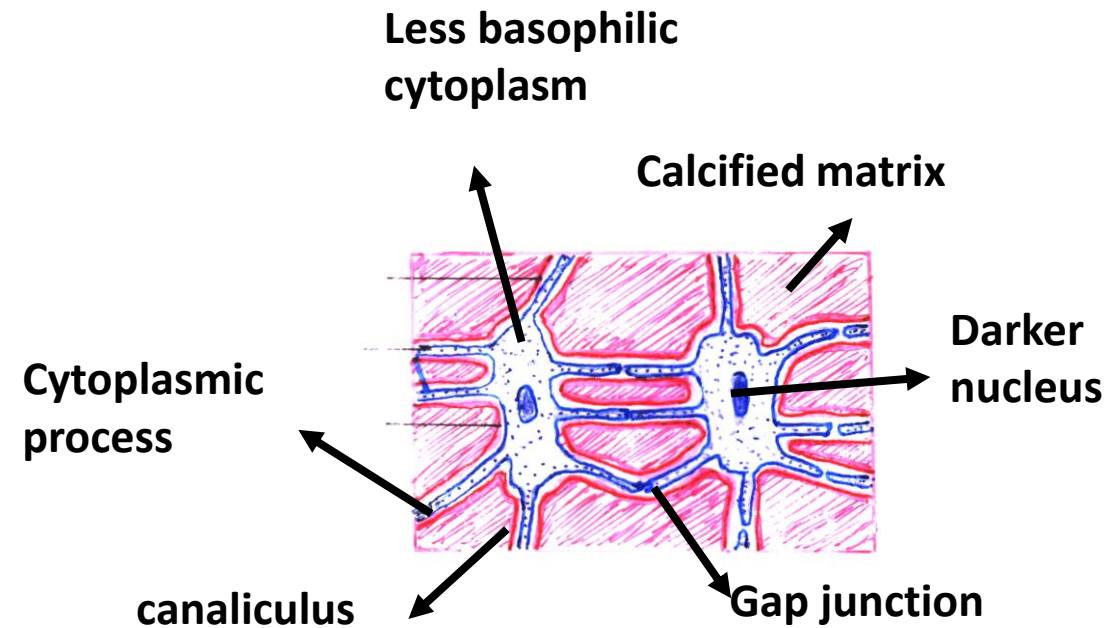
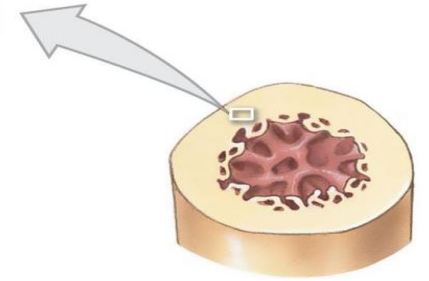
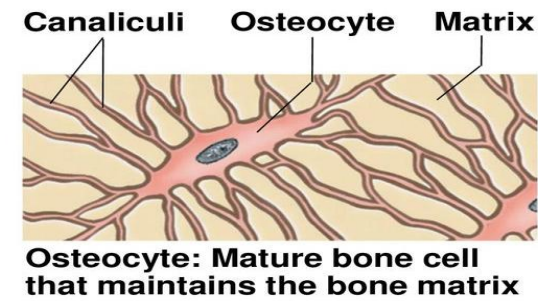
- **Shape:** **Oval**, smaller than osteoblasts & have cytoplasmic **processes** run in fine **canaliculi** in the matrix to join the processes of adjacent cells by **gap junctions** for passage of nutrients between cells.

- **L/M:** **Less active** than osteoblasts

**Nucleus:** flattened **Darker**

**Cytoplasm:** less basophilic (i.e. less RER).

- **Function:** maintaining the bone matrix.



# 4- Osteoclasts

- **Origin:** blood monocytes(fusion).
- **Site:** Surface of bone in shallow depressions (Howship's lacunae).

• **Structure:** Giant motile cells

• **L/M:**

**Nucleus:** Multinucleated (5 -50 nuclei).

**Cytoplasm:** Acidophilic cytoplasm ( many lysosomes ). Lysosomal enzymes are secreted to digest the bone, like acid phosphatase and collagenase

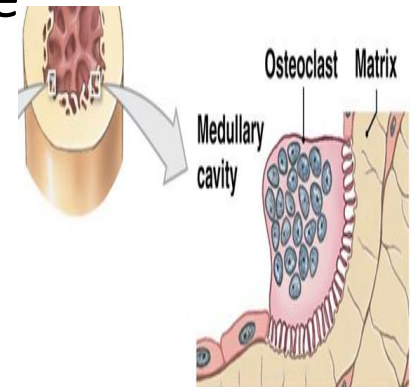
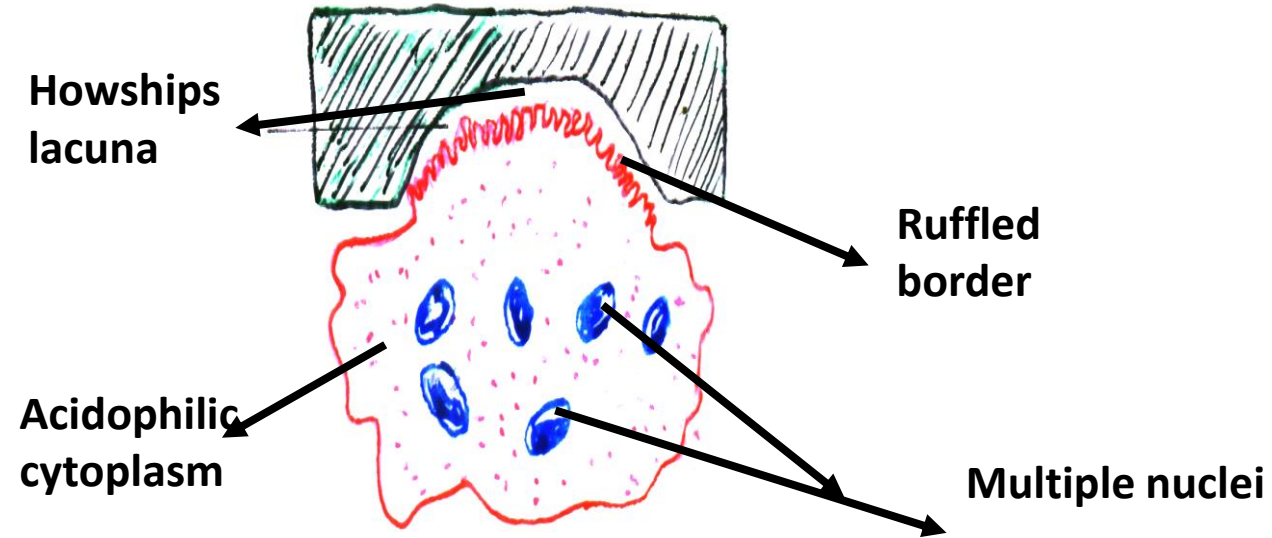
Surface facing bone is irregular (ruffled border).

• **Function: 2R**

*1-bone resorption* (break down or erode bone matrix).

*2-bone remodeling* (continuous destruction and rebuilding of bone

(Haversian systems).

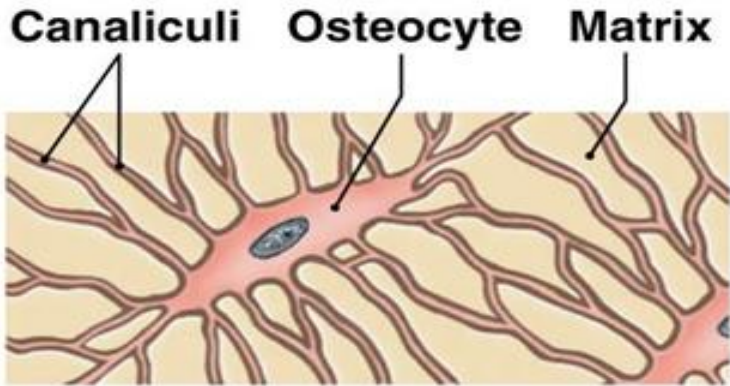


**Osteoclast:** Multinucleate cell that secretes acids and enzymes to dissolve bone matrix

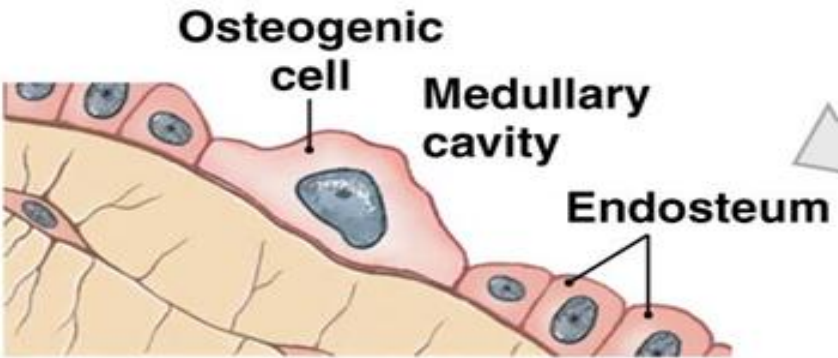
# Bone cells

	<b>Osteogenic</b>	<b>Osteoblast</b>	<b>Osteocytes</b>	<b>Osteoclast</b>
<b>Origin</b>	Mesenchymal cells	Osteogenic cells	Osteoblast cells	Blood monocytes
<b>Site</b>	Periosteum Endosteum	Bone surface	In lacunae	Bone surface In (Howship's lacunae).
<b>Structure LM</b>	-Pale N -Basophilic cytoplasm	-Pale N -Basophilic cytoplasm	-Dark N -Less basophilic cytoplasm	-Many nuclei -Acidophilic cytoplasm -Ruffled border
<b>Function</b>	Stem cell	Bone forming (Osteoblasts surrounded by matrix form osteocytes)	4M -Main -Mature -Maintain Matrix	2R Resorption & Remodling

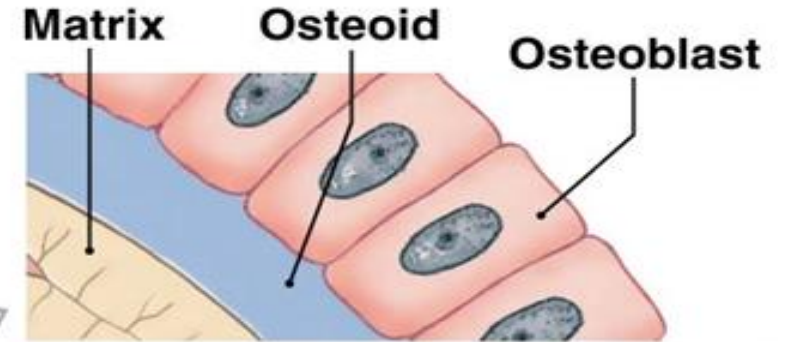




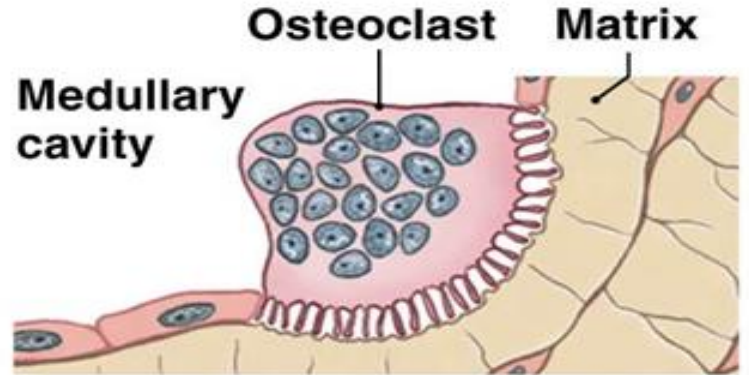
**Osteocyte:** Mature bone cell that maintains the bone matrix



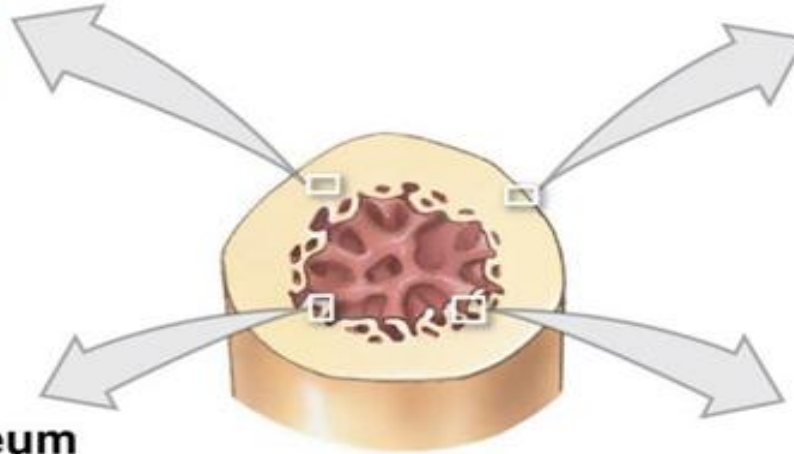
**Osteogenic cell:** Stem cell whose divisions produce osteoblasts



**Osteoblast:** Immature bone cell that secretes osteoid, the organic component of bone matrix



**Osteoclast:** Multinucleate cell that secretes acids and enzymes to dissolve bone matrix



## 2-Microscopic types

	<b>Primary (Woven) bone</b>	<b>Secondary (Lamellar) bone</b>
<b>Maturation</b>	<b>Immature</b>	<b>Mature</b> compact or cancellous
<b>Time</b>	First bone to appear in development & during fracture repair	Replace 1ry bone in adults
<b>Duration</b>	Temporary	Permanent
<b>Cells (osteocytes)</b>	↑ (more)	↓ (less)
<b>Calcium</b>	↓ (radio-translucent)	↑ (radio-opaque)
<b>Collagen</b>	Irregular	Regular ( <b>Parallel</b> to each other)

Thank You

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