MED438

King saud university
Histology team med438

CARTILAGE & BONE

Color code: Doctor notes extra Important

Editing file

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Objectives:

- describe the microscopic structure, distribution and growth of the different types of:
  - Cartilage.
  - Bone.

CARTILAGE = Chondro- * collagen type II *

- Cartilage is a specialized type of C.T. with a **rigid matrix.**
- Cartilage is usually nonvascular (avascular).
- **Types of cartilage**:
  - Hyaline cartilage.
  - Elastic cartilage.
  - Fibrocartilage.

*The main difference between bone and cartilage is the bone contain **calcium** but cartilage does not

*All contain collagen type II

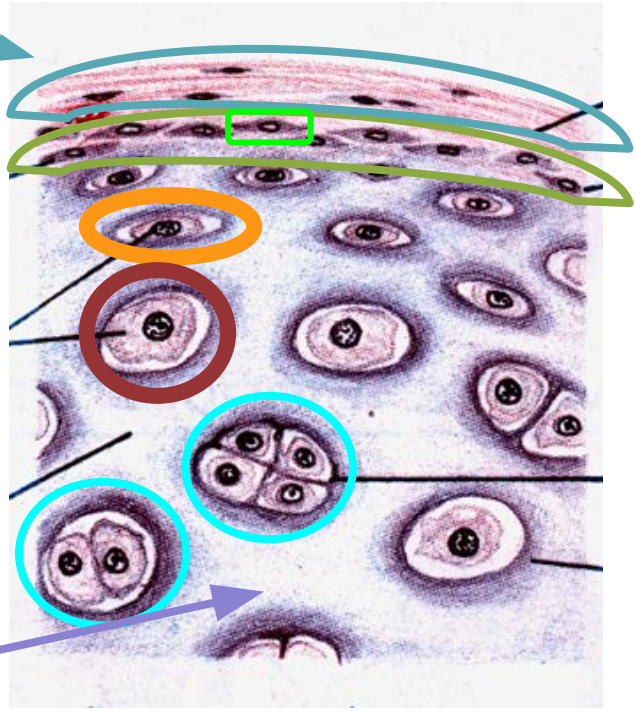
*Fibrocartilage It is the only type of cartilage that **contains type I collagen** in addition to the normal type II

*Type II in Fibrocartilage is less than 1%

1-Hyaline Cartilage

Functions of perichondrium:
a. Nutritive function (by diffusion from its blood vessels).
b. Chondrogenic function.
c. Gives attachment to muscles & tendons.

- **Perichondrium:** Vascular C.T. membrane formed of 2 layers:
  - Outer fibrous layer: dense fibrous C.T.
  - Inner chondrogenic layer: contains chondroblasts (no lacunae= space). They secrete cartilage matrix and give rise to chondrocytes.



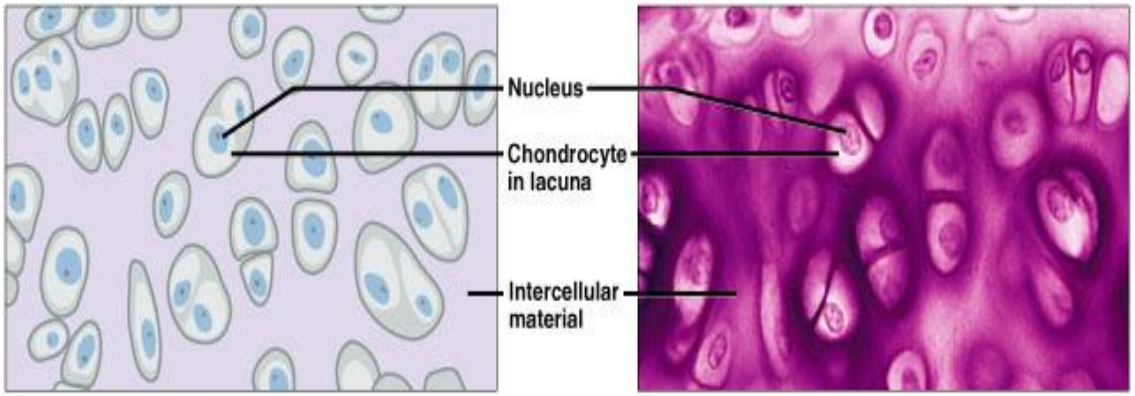
- **Cells (Chondrocytes):**
  - Found in spaces called lacunae.
  - Young chondrocytes: are small & present singly in their lacunae.
  - Mature chondrocytes: are large, and are found singly or in groups of 2, 4 or 6 cells in their lacunae (cell nests).

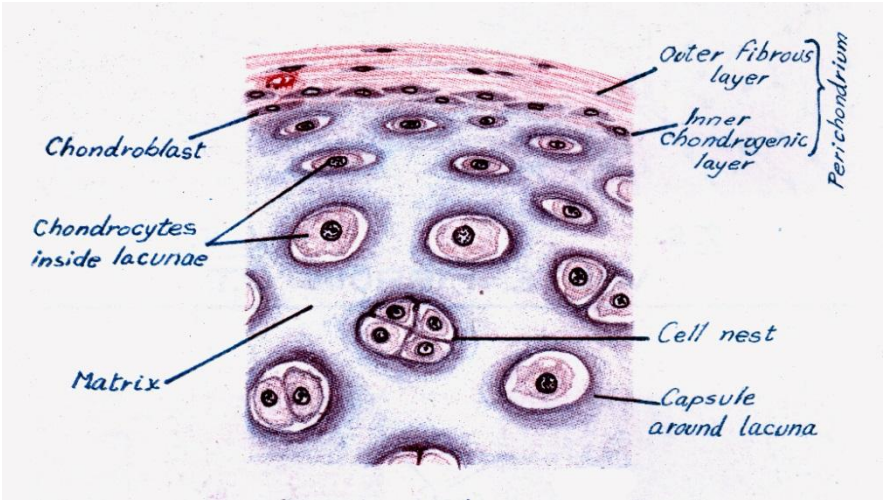
*chondroblasts → young chondrocytes → mature chondrocytes

- **Matrix:**
  - **Homogeneous** and **basophilic.**
  - Contains **collagen type II**.

*Basophilic matrix caused by chondroitin sulphate

Note: Colors are only for explanation





Sites of hyaline cartilage :

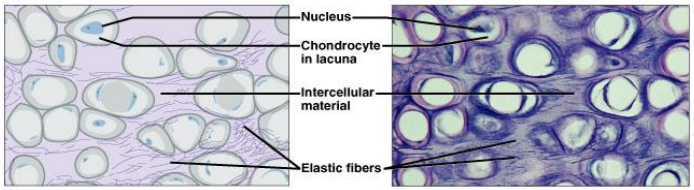
- Most of Foetal skeleton
- Costal cartilages
- Articular surfaces of bones
- Nose, trachea & bronchi
- Adam's apple

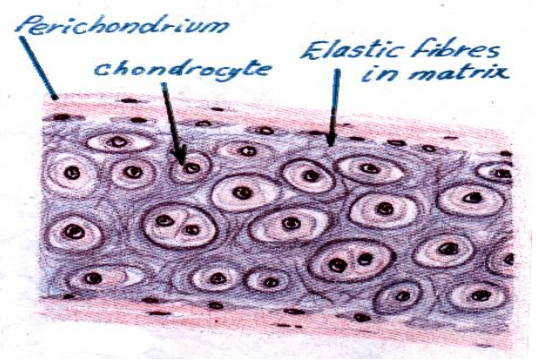
Functions:

- Forms the skeleton of the foetus.
- Protection of bony surfaces, at joints.
- Keeps the respiratory tract open.

2- Elastic Cartilage **Contain collagen type II ,Rich in elastic fibers**

- Similar to hyaline cartilage + **elastic fibres** in the matrix.
- Sites:
  - External ear.
  - Epiglottis. (لسان المزمار)

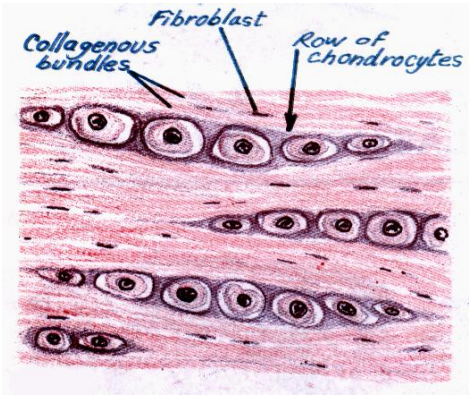




3-Fibrocartilage

Contain very little amount of collagen type II < 1% , Rich in collagen type I

- **No perichondrium.**
- Rows of chondrocytes in lacunae separated by parallel **bundles of collagen fibers (type I).**
- Sites:
  - e.g. Intervertebral disks.



Growth of cartilage:

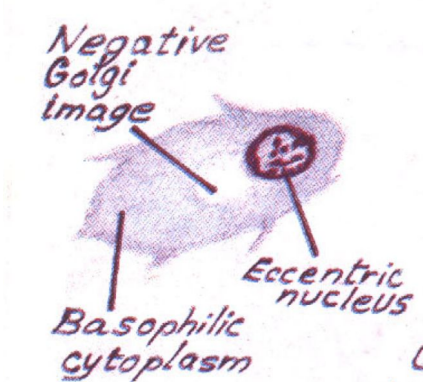
	Appositional growth	Interstitial growth
produced by:	the activity of **Chondroblasts** in the inner chondrogenic layer.	division and activity of **mature chondrocytes.**
It leads to:	increase in width	increase in length

BONE = Osteo- * collagen type I *

Bone is a specialized type of C.T. with a **hard matrix.**

- **Types:**
  - Compact bone.
  - spongy (cancellous) bone.
- **Components:**
  - **Bone Cells**: 4 types.
  - **Bone Matrix** (calcified osteoid tissue):
    - hard because it is calcified (Calcium salts).
    - It contains type I collagen fibers.
    - It forms bone lamellae and trabeculae.
  - **Periosteum**.
  - **Endosteum**.
- **Functions:**
  - body support.
  - protection of vital organs as brain & bone marrow.
  - calcium store.

Bone cells (1)



1- Osteogenic cells = osteoprogenitor cells

- in periosteum & endosteum.
- **Fate: give rise to osteoblasts.**

*Basophilic cytoplasm

2- Osteoblasts

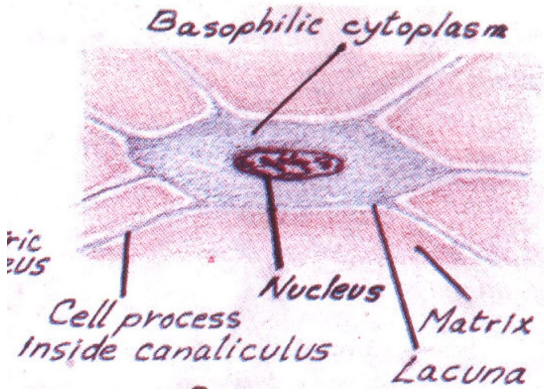
- in periosteum & endosteum.
- **Origin:** osteogenic cells.
- **Fate:** change to osteocytes.
- **Function:** They secrete the bone matrix & deposit Ca salts in it.

*Basophilic cytoplasm

3- Osteocytes (important)

- Branched cells.
- Present singly in lacunae.
- Their branches run in the canaliculi.
- **Origin:** osteoblasts.
- **Function**: They maintain the bone matrix.

*Basophilic cytoplasm



Extensions of cytoplasm goes through canaliculi (plural of canaliculus) to connect to the blood vessel, bone marrow, and each other(osteocytes) as well to get nutrients, because diffusion can't happen since the matrix is hard.

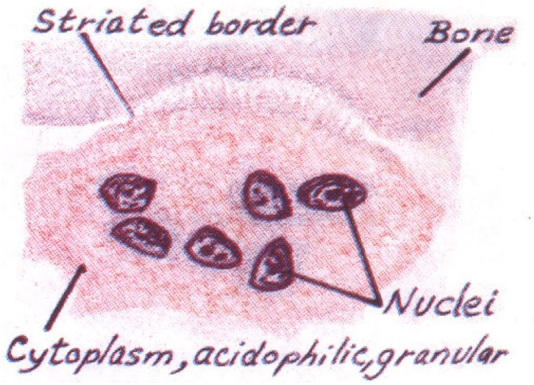
Osteocytes maintain the bone matrix, by continuous deposition of calcium salts

Bone cells (2)

4- Osteoclasts

- Large multinucleated cells on bony surfaces, in Howship's lacunae.
- They have striated or ruffled border.
- Cytoplasm is rich in lysosomes.
- **Origin:** blood monocytes.
- **Function:** bone resorption.

  * acidophilic cytoplasm

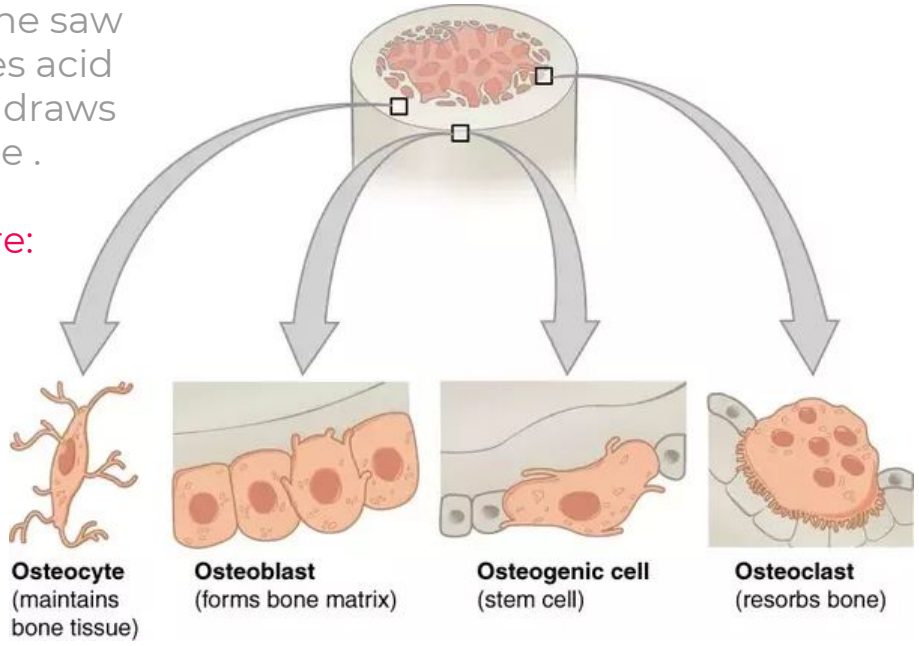


Osteoclasts have one smooth border and one saw like border (because of microvilli). It secretes acid (carbonic acid-carbonate+hydrogen) it withdraws calcium so it remodels and shapes the bone .

Note: the bone cells that contain lacunae are: Osteoblasts, osteocytes and osteoclasts

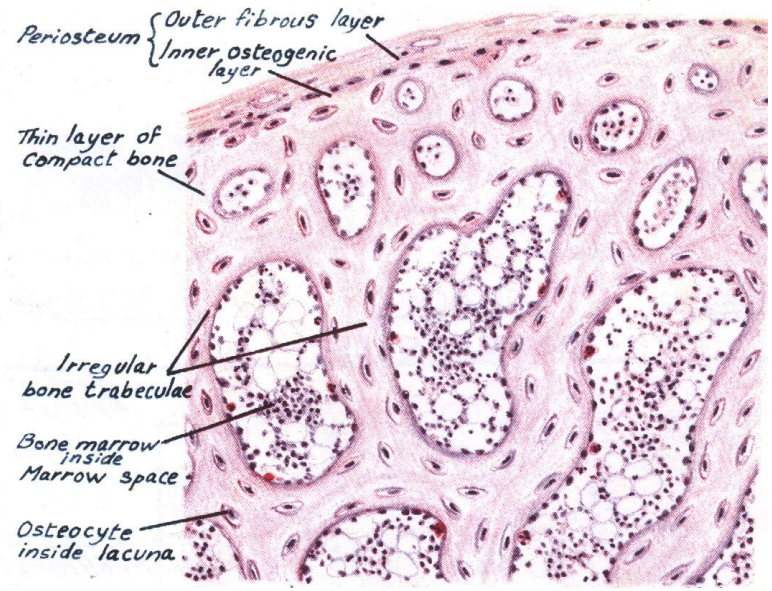
Osteogenic cells → Osteoblasts → Osteocytes

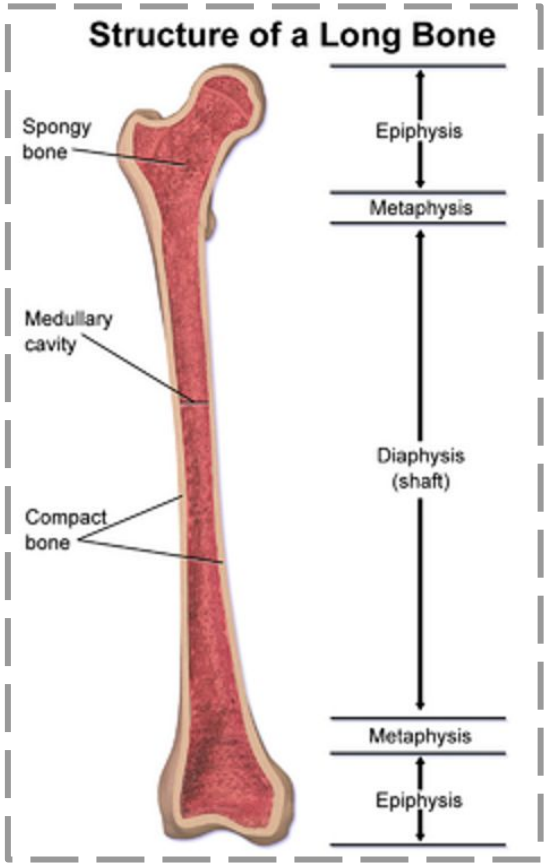
blood monocytes → Osteoclasts



Spongy Bone (Cancellous bone) = (Trabecular bone)

- In **flat bones** & **epiphysis of long bones.**
- **Consists of** :
  - Periosteum.
  - Endosteum.
  - Irregular bone trabeculae. (are formed of irregular bone lamellae separated by osteocytes inside the lacunae).
  - Many irregular red bone marrow spaces.
  - Bone Cells.
- **No Haversian systems (no osteons).**





Extra

Compact Bone = (Cortical bone)

It is found in the **diaphysis of long bones.** Consists of:

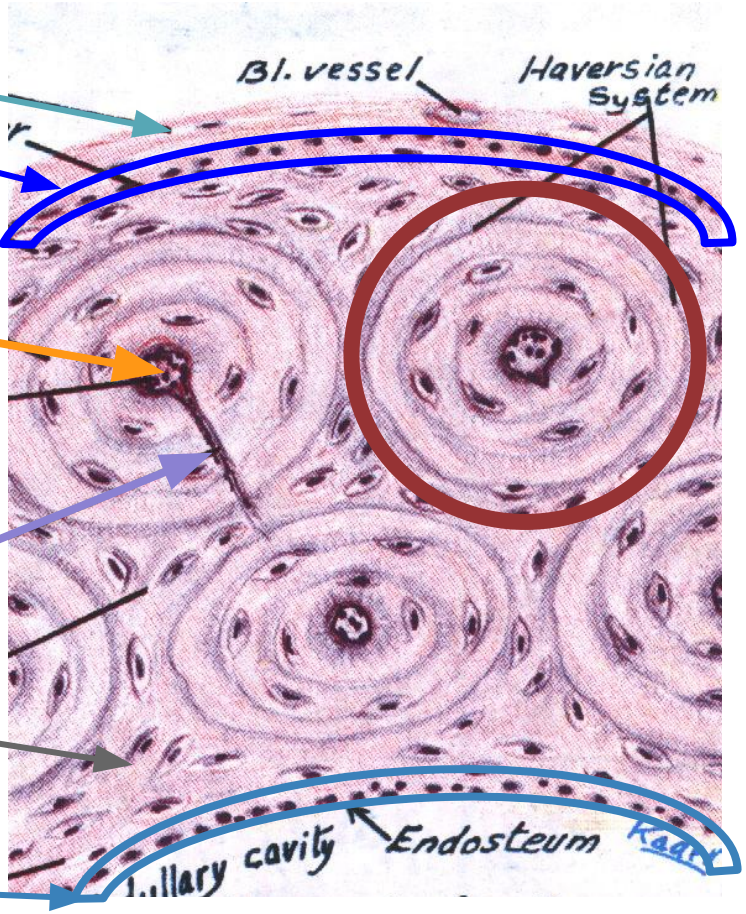
1- Periosteum:

- Outer fibrous layer.
- Inner osteogenic layer.

2- Bone Lamellae.

- **Haversian Systems (Osteons)**:
  - Longitudinal cylinders. **Each is formed of:**
    - a Haversian canal in the center,
    - surrounded by concentrically arranged bone lamellae separated by osteocytes in lacunae.
  - Volkmann's canals: connect the Haversian canals together. They run obliquely or transversely.
- **External Circumferential Lamellae.**
- **Internal Circumferential Lamellae.**
- **Interstitial Lamellae: between osteons.**

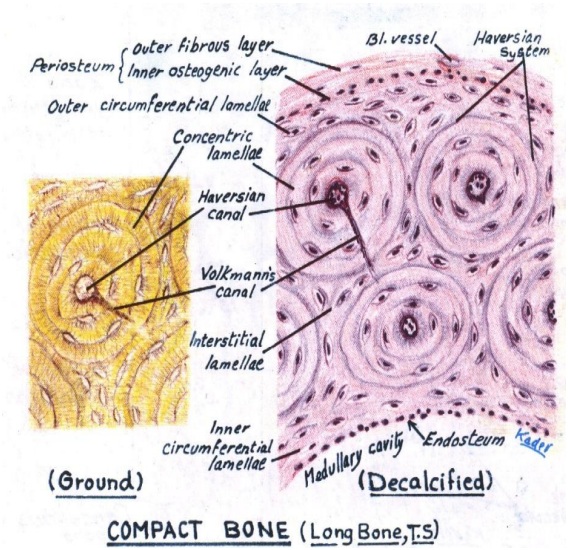
3- Bone Cells.



4- Endosteum. "Same as periosteum but without fibrous layer (outer layer)"

Note: Colors are only for explanation

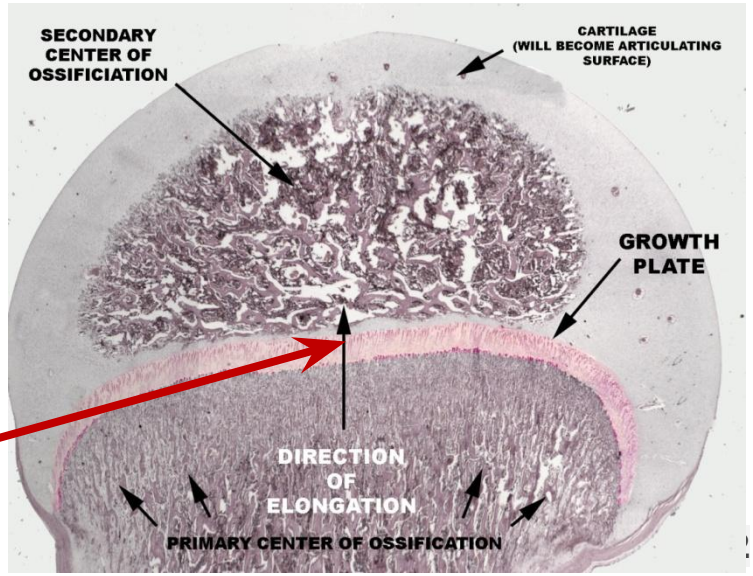
Compact Bone .. cont



Osteon of compact bone

Growth of Bone:

- **Appositional growth:**
  - Is produced by the activity of **osteoblasts**.
  - It leads to **increase in width.**
- **Growth in length:**
  - Is produced by the activity of **epiphyseal plate of cartilage**.



Quiz

1. - All Cartilage types contain which one of these fibers?
   a. collagen fiber type I
   b. collagen fiber type II
   c. collagen fiber type III
   d. All

2. - Increase of the bone length is produced by the activity of ...
   a. mature chondrocytes
   b. osteoblasts
   c. epiphyseal plate
   d. Chondroblasts

3. - The matrix of Hyaline cartilage is
   a. Heterogeneous and basophilic
   b. Homogeneous and basophilic
   c. Homogeneous and eosinophilic
   d. Heterogeneous and eosinophilic

4. - One of the site of Elastic cartilage is ...
   a. Intervertebral disc
   b. Costal cartilages
   c. Foetal skeleton
   d. Epiglottis

5. - The Origin of osteoclasts is ...
   a. Monocytes
   b. Mast cells
   c. Osteoblasts
   d. Basophils

6. - In Spongy bone irregular bone lamellae separated by ....
   a. Osteocyte
   b. Osteogenic
   c. Osteoclast
   d. Osteoblast

1-b 2-c 3-b 4-d 5-a 6-a

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