

# **Chapter 7**

# **Skeletal System**

## **Introduction:**

- A. Bones are very active, living tissues
- B. Each bone is made up of several types of tissues and so is an organ.
- C. Bone functions include: muscle attachment, protection and support of soft materials, blood cell production and storage of minerals

## **Bone Structure**

A. Bones differ in size and shape, yet are similar in several ways.

### **B. Classification of Bones**

Bones are classified according shape:

- Long
- Short
- Flat
- Irregular
- Sesamoid

## C. Parts of a Long Bone

1. Expanded ends of bones that form joints with adjacent bones are called epiphyses.
2. Articular cartilages (hyaline cartilage) cover the epiphyses.
3. The shaft of the bone is the diaphysis.
4. A tough layer of vascular connective tissue, called the periosteum, covers the bone and is continuous with ligaments and tendons.

5. A bone's shape makes possible its function; *bony processes* or grooves indicate places of attachment for muscles.
6. Compact bone makes up the wall of the diaphysis; the epiphyses are filled with spongy bone to reduce the weight of the skeleton.
7. Spongy bone has many branching bony plates called trabeculae.
8. The diaphysis contains a hollow medullary cavity that is lined with endosteum and filled with marrow.

## D. Microscopic Structure

1. Bone cells (osteocytes) are located within *lacunae* that lie in concentric circles around *central* (Haversian) *canals*.
2. Osteocytes pass nutrients and gasses in the matrix via *canaliculi*.
3. Extracellular matrix of bone consists mainly of collagen and inorganic salts.

4. In compact bone, osteocytes and extracellular matrix layers are organized into *osteons* (Haversian systems) that are cemented together.
5. Central canals contain blood vessels and nerve fibers, and extend longitudinally through bone.
6. Central canals are interconnected by transverse *perforating* (Volkmann's) *canals*.
7. Unlike compact bone, spongy bone is made of osteocytes and extracellular matrix that lie within *trabeculae*.

# Bone Development and Growth

- A. Bones form by replacing connective tissues in the fetus.
- B. Some form within sheetlike layers of connective tissue (intramembranous bones), while others replace masses of cartilage (endochondral bones).
- C. Intramembranous Bones
  1. The broad, flat bones of the skull form as intramembranous bones
  2. Osteoblasts deposit a bony matrix around themselves.

3. Once the deposited bony matrix completely surrounds the osteoblasts, they are then called osteocytes.
4. Cells of the membranous tissue that lie outside the developing bone give rise to the periosteum.
5. The formation of bone is referred to as ossification.

## D. Endochondral Bones

1. Most of the bones of the skeleton fall into this category.
2. They first develop as hyaline cartilage models and are then replaced with bone.
3. Cartilage is broken down in the diaphysis and progressively replaced with bone while the periosteum develops on the outside.
4. Disintegrating cartilage is invaded by blood vessels and osteoblasts that first form spongy bone at the *primary ossification center* in the diaphysis.

5. Osteoblasts from the periosteum lay down compact bone around the *primary ossification center*.
6. *Secondary ossification centers* appear later in the epiphyses.
7. A band of hyaline cartilage, the epiphyseal plate, forms between the two ossification centers.
8. Layers of cartilage cells undergoing mitosis make up the epiphyseal plate.
9. Osteoclasts break down the calcified matrix and are replaced with bone-building osteoblasts that deposit bone in place of calcified cartilage.

10. Increases in thickness are due to intramembranous ossification underneath the periosteum, while epiphyseal plates are responsible for lengthening bones.
11. The medullary cavity forms in the diaphysis due to the activity of osteoclasts.

## E. Homeostasis of Bone Tissue

1. Osteoclasts tear down and osteoblasts build bone throughout the lifespan with the processes of *resorption* and *deposition*, with an average of 3% to 5% of bone calcium exchanged each year.

# Bone Function

## A. Support and Protection

1. Bones give shape to the head, face, thorax, and limbs.
2. Bones such as the pelvis and lower limbs provide support for the body's weight.
3. Bones of the skull protect the eyes, ears, and brain.

## B. Body Movement

1. Bones can act as levers.

- a. A lever has four components:  
*a rigid bar or rod, a pivot or fulcrum, an object that is moved against resistance, and a force that supplies energy.*

## C. Blood Cell Formation

1. Blood cells begin to form through hematopoieses in the *yolk sac*; they are later manufactured in the liver and spleen and then finally formed in the bone marrow.

2. Two kinds of marrow occupy the medullary cavities and the larger central canals of bone.
  - a. *Red marrow* occupies the spongy bone of the skull, ribs, sternum, clavicles, vertebrae, and pelvis in adults. Its function is the formation of red blood cells, white blood cells, and platelets. Its color comes from the  $O_2$  carrying pigment [hemoglobin](#).
  - b. *Yellow marrow* stores fat and occupies most cavities of bone in adults.

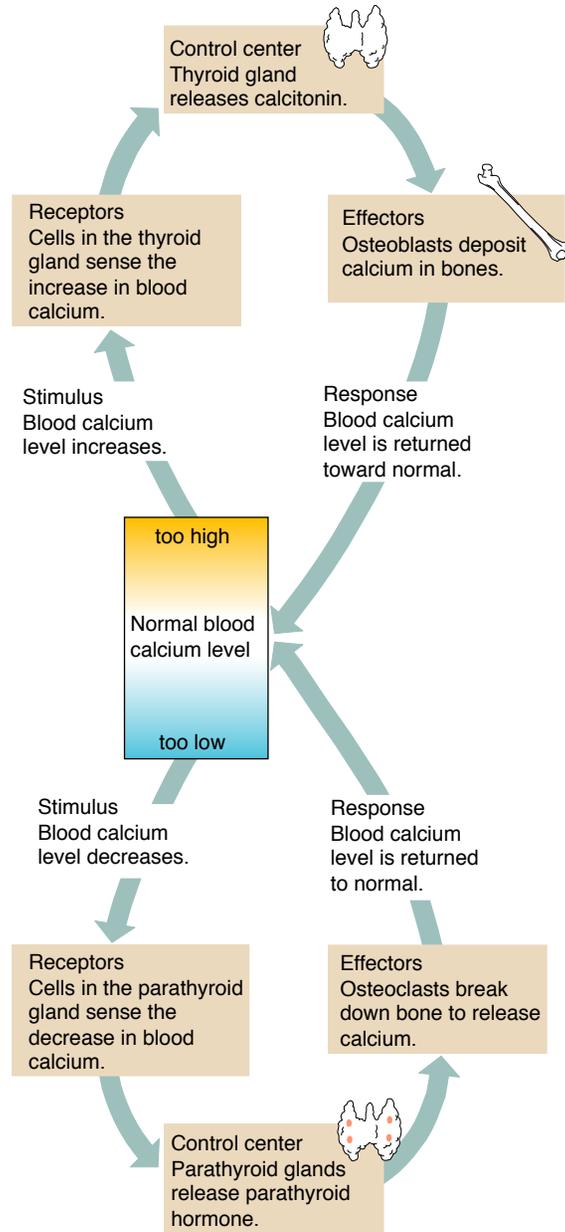
## D. Storage of Inorganic Salts

1. The extracellular matrix of bone is rich in calcium salts mainly in the form of calcium phosphate that is important in many metabolic processes.
2. Calcium in bone is a reservoir for body calcium; when blood levels are low, osteoclasts release calcium from bone under the influence of the parathyroid hormone.

3. Calcium is stored in bone under the influence of calcitonin when blood levels of calcium are high.
4. Bone also stores *magnesium, sodium, potassium, and carbonate ions*.
5. Bones can also accumulate harmful metallic elements, such as lead, radium, and strontium.

Fig07.08

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



# Skeletal Organization

A. The axial skeleton consists of the bony and cartilaginous parts that support the and protect the head, neck and trunk. (Skull, hyoid bone, vertebral column, & thoracic cage)

B. The appendicular skeleton consists of the bones of the upper and lower limbs and the bones that anchor the limbs to the axial skeleton. (pectoral girdle, upper limbs, pelvic girdle, & lower limbs)