

Biology 47 – Human Anatomy

West Valley College - Norris

Lecture Outline - Skeletal System: Bone Structure

I. There are 206 bones in the skeletal organ system. Each bone is made up of several tissue types, primarily connective tissues (ie. bone, cartilage, fibrous, blood) as well as epithelial tissue (endothelium) and nervous tissue (neurons), thus each bone is an organ.

II. Bones are the functional unit of the skeletal system. As a whole the skeletal organ system has several functions:

- A. Support
- B. Protection
- C. Hematopoiesis
- D. Mineral Reservoir
- E. Leverage / Movement

III. Histology

A. Cells

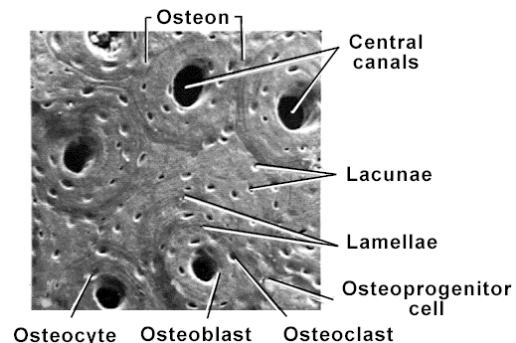
- 1. osteoprogenitor cells
- 2. osteoblasts
- 3. osteocytes
- 4. osteoclasts

B. Matrix (extracellular matrix)

- 1. Ground Substance
- 2. Protein
- 3. Minerals

C. Microscopic Structure

- 1. **Compact Bone** - The very dense matrix of compact bone is arranged in a regular pattern around blood vessels supplying nutrients. Each unit is composed of concentric rings of bone matrix and the cells that produce it around a central canal (aka haversian canal). Many of these units called osteons (or haversian systems) make up the structure of compact bone and tend to parallel the long axis of the bone.



Blood vessels in the central (haversian) canal supply the cells of the osteon while communicating (volkmans) canals provide communication between osteons.

- 2. **Spongy Bone** - Honey comb of bony plates called trabeculae make up the structure of spongy bone, the spaces (filled with red bone marrow) reduce the weight of the bone yet provide tremendous strength. The osteocytes that produce the bone matrix are found within the trabeculae and receive nutrients by diffusion along cellular processes that extend to the trabeculae surface. Although ring like lamellae may be present there are no true osteons (no central canals)

In both spongy and compact bone the osteocytes produce a matrix composed of protein fibers (primarily collagen - which give bone much of its strength) and a high concentration of inorganic salts (primarily calcium phosphate - which gives bone its hardness)

IV. Gross Structure of bones making up the skeletal system:

A. Structurally all bones are similar - they are composed of a honey comb of spongy bone (spongy or cancellous bone) enclosed by a dense hard shell of compact bone (compact or cortical bone). The structure of long bones is representative of all bones (with some specialized features).

1. Gross Structure of a Long Bone

- a. Epiphysis
- b. Epiphyseal Line (plate)
- c. Metaphysis
- d. Diaphysis
- e. Medullary Cavity

2. Structural Elements

- a. Periosteum
- b. Endosteum
- c. Articular Cartilage (hyaline)

B. Blood Supply

1. Nutrient Vessels
2. Metaphyseal Vessels
3. Periosteal Vessels

C. Bones are classified based on shape (shape and function are closely related)

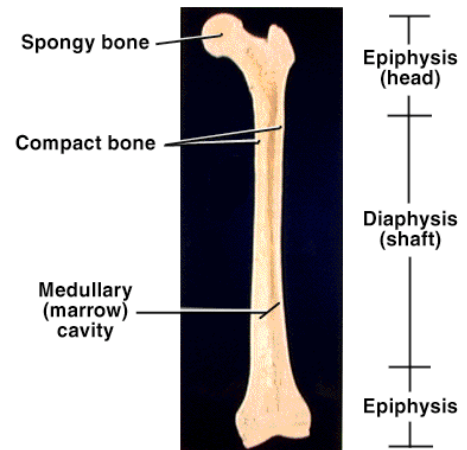
1. long bones
2. short bones
3. flat bones
4. irregular bones
5. sesamoid & wormian bones

V. Bone Development

A. Bones form by replacing existing connective tissue in one of two ways:

1. Intramembranous Ossification – i.e flat bones in skull

2. Endochondral Ossification - within cartilage



VI. Factors Affecting Bone Development:

A. Physical Stress

B. Hormonal Influences

1. growth hormone (pituitary)
2. calcitonin (thyroid)
3. sex hormones (gonads, adrenal gland)
4. parathyroid hormone

C. Vitamin D / Nutrition

VII. Clinical Significance

A. Osteoporosis

B. Rickets / Osteomalacia

- ### C. Fractures
- traumatic
 - spontaneous or physiological
 - simple
 - compound

- ### D. Healing
- formation of a blood clot (hematoma)
 - penetration by new blood vessels (with phagocytes, fibroblasts, osteoblasts...)
 - phagocytes carry away debris
 - fibroblasts fill spaces with fibrocartilage (callus)
 - osteoblasts initiate bone formation, replace callus with bone tissue

VIII. Additional Key Terms

calcitonin hydroxyapatite osteoblast osteoclast parathyroid hormone (PTH)