BIOLOGICAL FRAMEWORKS FOR ENGINEERS

Session #23 [m: Bone System]

General Objectives:

- ✓ Bone is a living framework that supports the organisms structure
- ✓ Biomechanical properties depend on microstructural architecture
- ✓ Composite material that is self-healing
- ✓ Biomechanics of the musculoskeletal system leads to large loads on bones and joints

Central Framework:

- ✓ Bone contains a great deal of extracellular matrix surrounding widely separated cells. It is not a completely solid substance, but instead has spaces between hard components providing channels for nutrients and cells and making bones lighter but still having needed strength.

Session Outline:

I. Introduction to Bone

Bone is a very dense, specialized form of the connective tissue, as different as could be from adipose tissue, but closely related in developmental origin. Bone is like living concrete: an anisotropic, lightweight, tissue a mixture of tough fibers (type 1 collagen) with an inorganic hydroxyapatite structure (crystalline calcium phophate) providing matrix support.

II. Bone Functions

Structural support-

Motion transmission-

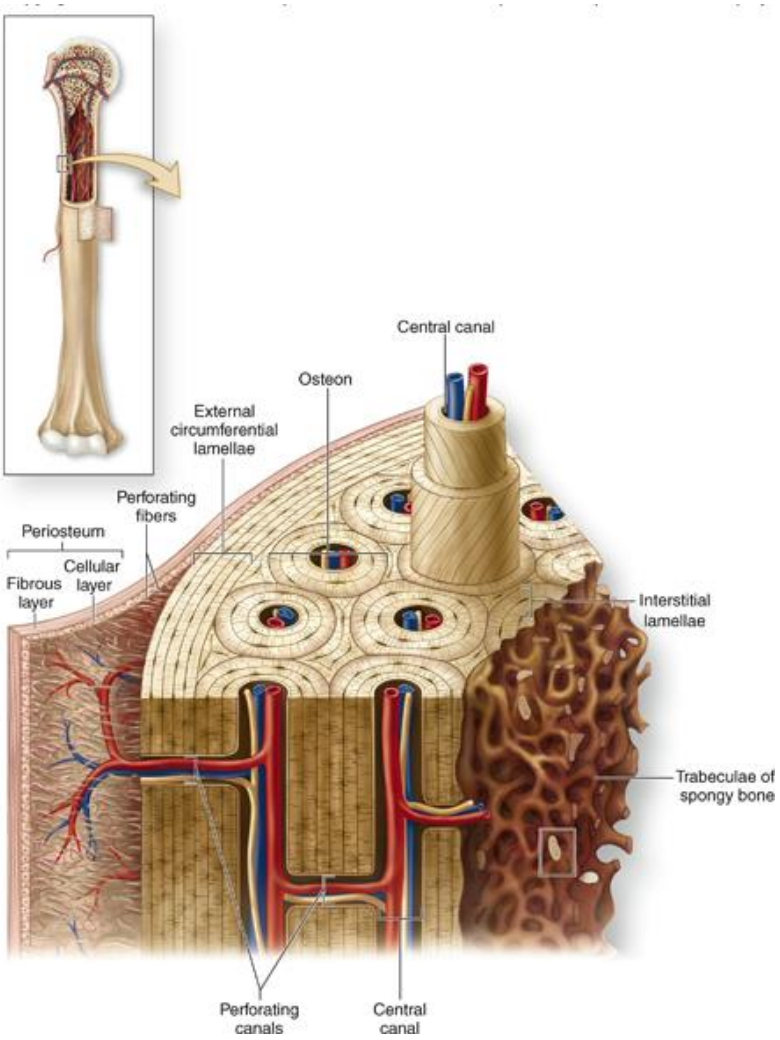
Protection-

Mineral storage-

(Cell Factory)-

III. Composition of Bone

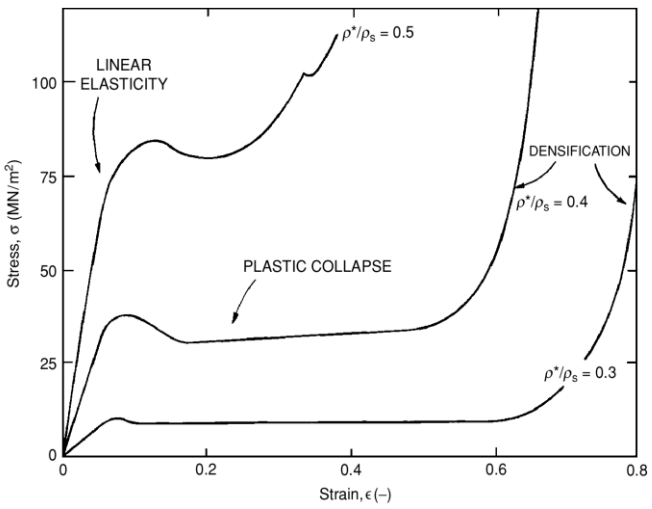
a. Cortical Bone



b. Trabecular Bone

IV. Biomechanical Properties of Bone

a. Cortical Bone



b. Trabecular Bone

V. Remodeling & Mechanobiology

a. Cell Types

b. Wolff's Law

"Every change in the form and the function of a bone or of their function alone is followed b certain definite changes in their internal architecture, and equally definite secondary alterations in their external confirmation"

VI. Bone Pathology

a. Histology

b. Osteoporosis

c. Rickets

VII. Biomechanics of the Forearm

VIII. Biomechanics of the Knee