

## Bone

1. Approaches to bone
  1. descriptive anatomy
  2. bone as a dynamic, living tissue with unique properties and capacities for growth, development, and repair.
2. Cartilage
  1. components
    1. perichondrium
    2. chondrocytes
    3. lacunae
    4. extracellular matrix
  2. types
    1. hyaline
      1. articular
      2. costal
      3. laryngeal
      4. tracheal & bronchial
      5. nasal
    2. elastic
      1. ears
      2. epiglottis
    3. fibrocartilage
      1. knee meniscus
      2. intervertebral discs
    4. figure
3. Functions of bone
  1. support
  2. protection
  3. struts & levers for muscles
  4. supply
    1. red blood cells
    2. calcium ( $\text{Ca}^{++}$ )
4. Bone as a material
  1. composition
    1. protein fiber collagen 30%
    2. calcium salts hydroxyapatite 70%
5. Forces as structural problems and a solution
  1. compression & tension
  2. biphasic materials
    1. bone
    2. reinforced concrete
    3. fiberglass
  3. physical properties of bone
    1. Strength (psi)
 

Component	Compression	Tension
Bone Matrix	6,820	845
Bone Protein	17	1,010
Whole Bone	21,400	14,300
6. Types of bone
  1. compact bone
    1. forms outer layer of all bones
    2. forms the shaft of long bones
    3. primary unit is the osteon
      1. lacunae
      2. osteocytes
      3. canaliculi
      4. Haversian canals (central)
      5. Volkmann's canals (perforating)
      6. concentric lamellae
      7. hierarchy
  2. spongy bone
    1. found in ends of long bones & inside flat bones
    2. composed of an irregular latticework of bony struts: "trabeculae"
    3. not as strong, yet lighter than compact bone
    4. contains red marrow for red blood cell production
7. Bone formation
  1. intramembranous or dermal bone
    1. forms skull and collar bones
    2. process
      1. osteoblasts (from embryonic mesenchyme) cluster at center of ossification
  2. secrete a collagenous framework which calcifies
  3. become osteocytes as they are trapped in lacunae
  4. membrane into periosteum
2. endochondral
  1. forms all other bones
  2. process
    1. cartilage model covered with perichondrium
    2. blood vessels invade and cells change into osteoblasts
    3. collar forms primary ossification center
    4. cartilage cell death
    5. creation of marrow cavity
8. Growth in length
  1. secondary ossification centers form epiphyseal plates
  2. fusion stops growth
9. Growth in diameter
  1. apposition by osteoblasts in periosteum
  2. resorption by osteoclasts in endosteum
10. Remodeling
  1. old bone into new bone
  2. spongy bone into compact bone
  3. response to wear, stress, & injury
  4. hormonal regulation
11. Cellular level
12. Health applications
  1. vitamin & mineral deficiencies
    1. rickets- vitamin D or calcium deficiency
  2. aging- osteoporosis
  3. fractures and their repair
    1. hematoma- clot, cell death, pain
    2. fibrocartilaginous callus formation
      1. granulation tissue formation
      2. vessel invasion, fibroblast & osteoblast migration
    3. bony callus formation
      1. begins 3-4 weeks after break
      2. ends 2-3 months
    4. remodeling
      1. compact bone deposited
13. Anthropological applications
  1. age
  2. sex
  3. disease
  4. physical condition