Bone Function and Structure

**BONE FUNCTION & STRUCTURE**

- very active tissue
- contains bone tissue, cartilage, dense connective tissue, blood, and nervous tissue
- classified based on location and shape
  - location: axial and appendicular
  - shape (p. 175): long (limb bones), short (wrist, ankle, patella), flat (sternum, scapula, ribs, most skull bones), and irregular (hip, vertebrae)

**INTRODUCTION TO BONES**

**SKELETAL CARTILAGES**

- function: provide flexibility to skeleton
- made mostly of water making it very resilient
- surrounded by perichondrium (dense connective tissue) that acts as a girdle and supplies nutrients to chondrocytes
- 3 types: hyaline, elastic, fibrocartilage

**SKELETAL CARTILAGE**

- hyaline - support with flexibility and resilience
- articular cartilage - covering ends of bones that form joints
- costal cartilage - connects ribs to sternum
- respiratory cartilage - larynx
- nasal cartilage - supports external nose
- elastic - able to withstand repeated bending
- external ear and epiglottis
- fibrocartilage - highly compressible and great tensile strength
- discs between vertebrae and knee menisci

**SUPPORT & PROTECT**

- give shape (framework)
  - head, face, thorax, limbs
- support body weight
  - lower limbs, pelvis, and backbone
- protects organs
  - skull - eyes, ears, brain
  - rib cage and shoulder girdle - heart and lungs
  - pelvic girdle - lower abs and internal reproductive organs

**BODY MOVEMENT**

- work with muscles
- levers
  - rigid rod or bar
  - fulcrum or pivot
  - object
  - energy source
- bending and extending upper arm bones of the forearm (rod)
- elbow (fulcrum)
- hand (object)
- muscles (energy source)
- biceps brachii - bends
- triceps brachii - extends
Bone Function and Structure

**Blood Cell Formation**
- a.k.a. hematopoeisis
- red marrow forms RBC, WBC, platelets found in the spongy bones of the skull, ribs, sternum, clavicles, vertebrae and hip bones
- yellow marrow stores fat found mostly in cavities of long bones can become red marrow if the body needs more blood

**Storage of Inorganic Salts**
- vital metabolic processes require calcium muscle contraction, nerve impulse conduction, blood clotting
- extracellular matrix of bone stores calcium salts mostly calcium carbonate magnesium (Mg), sodium (Na), potassium (K) and carbonate ions
- negative feedback low blood calcium, osteoclasts break bone down osteoclast = bone destroying cell high blood calcium, osteoblasts form new bone osteoblast = bone building cell

**Bone Markings**
- a bone’s shape makes possible its functions
- processes (projections) provide sites where ligaments and tendons attach
- grooves and openings form passageways for blood vessels and nerves
- depressions of one bone may articulate with a process of another

**5 Parts of a Long Bone**
- epiphysis - ends of a bone articulate (form joints) with other bones proximal epiphysis - end nearest body distal epiphysis - end farthest from body outside - compact bone inside - spongy bone covered in articular (hyaline) cartilage
- diaphysis - long axis of a bone thick collar of compact bone

**Compact vs. Spongy Bone**
- both are strong and resist bending
- compact bone - walls of diaphysis NO spaces osteons
- spongy bone - epiphyses a.k.a. cancellous bone trabeculae - honeycomb of small needle-like or flat projections along lines of stress spaces between the plates reduce the bones weight spaces filled with red or yellow bone marrow
Bone Function and Structure

**Microscopic Structure**

- 4 bone cells
  - osteogenic - bone stem cell
  - osteocytes - bone cell
  - osteoblast - bone-forming cells
  - osteoclast - bone destroying cells

- compact bone
  - osteon (Haversian system) - tiny weight-bearing pillars
  - group of hollow tubes arranged like tree rings
  - lamellae help resist twisting
  - osteocytes in lacunae (small pocket of cells) live at lamellar junctions
  - canaliculi - tiny canals that connect osteocytes

- central canals - center of osteon
  - a.k.a. Haversian canals
  - blood vessels (capillaries) and nerve fibers
- perforating canals
  - a.k.a. Volkmann's canals
  - run at right angles to central canals
  - allows the inside of bone to communicate with the outside (periosteum)

**Chemical Composition**

- organic components
  - cells - osteogenic cells, osteocytes, osteoblasts, osteoclasts
  - osteoid - organic matrix (ground substance and collagen fibers)
  - gives bone flexibility and tensile strength (resist stretch and twist)
- inorganic components
  - mineral salts - a.k.a. hydroxyapatites (calcium phosphates)
  - gives bone hardness
- right combination of organic and inorganic components makes bone strong without being brittle

**Osteomalacia & Rickets**

- osteomalacia
  - bone disorders that result in soft or weak bones
  - pain when weight is put on affected bones
- rickets
  - osteomalacia in children
  - bowed legs and deformities of the pelvis, skull, and rib cage common
  - causes - insufficient calcium in diet or a vitamin D deficiency
Bone Function and Structure

**OSTEOPOROSIS**
- Bone mass peaks at about 35 years
- Osteoclast activity greater than osteoblast
- Osteoporosis occurs when the skeletal system loses bone volume and mineral content due to increased osteoclast activity
- Bones become porous and light making them weak
- Most common in Caucasian females after menopause

**Paget’s Disease**
- Rate of bone growth and destruction becomes distorted leading to fragile or misshapen bones
- Usually localized to spine, pelvis, femur, and skull
- Characterized by pain and diagnosed through X-rays

![Normal and Osteoporotic Bone Matrix](image1)

![Normal and Paget’s Humerus](image2)