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Chapter 7: Bone Tissue

Osteology: The study of bone

- Skeletal System: Includes bones, cartilage, ligaments, and tendons
    - Bone and teeth are the most durable materials in the body
        - Survive for 100s of years after death, unlike soft tissues
    - Living Skeleton: Accompanied by dynamic, mitotically active tissue
        - Skeleton that we normally thing of is dead

Functions of the Skeleton

- Support: Frame for the body
    - Ligaments help attach bone to bone and cartilage help attach muscle to bone
    - Ex: Mandible and maxilla—Support teeth
- Protection: Bones enclose many important organs
    - Ex: Rib cage—protects thoracic organs
    - Ex: Cranium—protects brain
    - Ex: Spinal column—protects spinal cord
- Movement: Bones act as levers to provide movement
- Electrolyte balance: Calcium and phosphorus are stored in bone (very important electrolytes) and released into the tissue fluid and blood according to the body's physiological needs
- Acid-Base Balance: Acts to produce buffers to help resist changes in pH
    - Ex: Absorb or release alkaline phosphate and carbonate salts
- Blood Formation: Red bone marrow is responsible for blood cell production, including both red and white (immune) blood cells

Bones and Osseous Tissue

- Osseous Tissue: Bone; Connective tissue in which the matrix is hardened by the deposition of calcium phosphate and other minerals
    - Mineralization/Calcification: Hardening of the bone
    - Hardest substance in the body—Tooth enamel (NOT bone)
- Dynamic nature of bones allows it to be metabolically active, constantly remodeling and interacting with other structures
    - Ex: Release or absorb calcium

- Sensitivity and Metabolic Activity (nerves)
- Tissues that make up bone:
    - Osseous tissue
    - Blood
    - Bone marrow
    - Cartilage
    - Adipose tissue
    - Nervous tissue
    - Fibrous connective tissue

General Features of Bones

- Flat bones: Thin curved plates
    - Ex: Cranial bones, sternum, scapula, ribs, hip bones
- Long bones: Most important bones in body movement; Serve as rigid levers that are acted upon by skeletal muscles to produce major body movements
    - Ex: Limbs—humerus, radius, ulna, femur, tibia, fibula, metacarpals, metatarsals, phalanges
- Short bones: Approximately equal in length and width and produce relatively limited gliding movement
    - Ex: Wrist, ankle, patella
- Irregular bones: Bones that do not fit any other structural category
    - Ex: Sphenoid bone (butterfly), vertebrae, 3 tiny ear bones

General Anatomy of Bones

- Compact (Dense) Bone: Covering of bone made of dense white osseous tissue
    - About ¾ of bone weight
    - Made up of parallel osteons that are tightly packed together
    - Cover the surface of most bones
    - Forms most of the diaphysis (shaft) of long bones
- Spongy (Cancellous) Bone: Loosely organized form of osseous tissue
    - Found in the central space of the end of each bone, just inside the compact bone of the shaft, and in the middle of most flat/long/short bones
    - Trabeculae: Thin plates forming spongy bone tissue

        - Spaces between trabeculae are filled with bone marrow (red in epiphyses, yellow in diaphysis)
    - Spicules: Slivers of bone in spongy bone tissue
    - Always enclosed by compact bone
    - About ¼ of bone weight

General Features of Long Bones

- Epiphyses: Ends of bone; Expanded heads off of shaft
    - Contains spongy bone
    - Enlarged to strengthen joint and add surface area for the attachment of tendons and ligaments
- Diaphysis: Shaft of long bone
    - Between compact bone and medullary cavity in the diaphysis, spongy bone is found
    - Provides leverage for movement
- Medullary Cavity: AKA marrow cavity; Bone marrow cavity along the shaft of the bone
    - In young people, mostly red (prevalence of red blood cells)
    - In older people, mostly white (prevalence of white blood cells)
    - Very soft in all people
- Hyaline Cartilage: AKA articular cartilage (joint cartilage) that is located on the ends of bones where two bones meet
    - Combined with a lubricating fluid, allows joints to move much more easily than bone on bone
    - Classified by a relatively clear matrix, fine collagen fibers, and no conspicuous elastic fibers
    - Perichondrium: Hyaline cartilage (dense connective tissue) found covering and surrounding the surface of the cartilage model during ossification
- Nutrient Foramina: Openings for nutrients to leave/enter bones
    - Ex: Blood vessels, nerves, lymphatics
- Periosteum: Sheath that covers outside of bone with a tough, outer fibrous layer of collagen and an inner osteogenic layer of bone-forming cells
    - Outer fibrous layer: Outermost layer
        - Mostly collagen
        - Important for healing for fractures and growth of bone