Bones: Tissue and Organ

• Bones can be referred to as either a tissue (osseous) or an organ
  – Bone referred to as a connective tissue consists of:
    • cells
    • extracellular matrix (ground substance + fibers)
    • this living/dynamic tissue is capable of growth and repair
  – Bone referred to as an organ (particular bones of the body) consists of:
    • osseous tissue
    • nervous tissue
    • epithelial and muscle tissue (blood vessels)
    • Ex. femur, humerus, clavicle, sternum…
Skeletal System
Function of Bones

• **Support**
  – form the framework that supports the body

• **Protection**
  – provide a protective cavity for the brain (skull), spinal cord (vertebrae), and vital organs (rib cage)

• **Movement**
  – provide attachment points for skeletal muscles and are used as levers

• **Mineral storage**
  – reservoir for calcium and phosphorus

• **Blood cell formation** (hemopoiesis)
  – occurs within the **red bone marrow** of bones
Shapes of Bones
Gross Anatomy of Bones: Bone Textures

- **Compact bone**
  - dense and heavy bone

- **Spongy bone**
  - porous and light bone
  - formed by rods and plates of bone called *trabeculae*
  - spaces filled with *red bone marrow*
  - provides strength with little weight

- **The bones of the body contain both bone textures**
  - the outer layer is made of compact bone
  - the inner portion of bones is made of spongy bone
Compact and Spongy bone
Structure of Long Bones

- Articular cartilage
- Red bone marrow
- Epiphyseal line
- Marrow cavity
- Yellow bone marrow
- Periosteum
- Nutrient foramen
- Site of endosteum
- Compact bone
- Spongy bone
- Epiphyseal line
- Articular cartilage

(a) Living
(b) Dried
Structure of Long Bones

- **Diaphysis**
  - tubular shaft of *compact bone* that surrounds the *medullary cavity*
  - during growth periods contains *red bone marrow*
  - in adults, contains *yellow bone marrow* (fat)

- **Epiphyses**
  - expanded ends of long bones
  - exterior is *compact bone*, and the *interior* is *spongy bone*
  - superficial surface covered in *articular* (joint) cartilage
  - *epiphyseal plate* (line) separates the diaphysis from the epiphyses and represents location of bone lengthening (growth)
Cells of Osseous Tissue

• **Osteoblasts**
  – found in periosteum and endosteum
  – cells that make *(deposit)* the matrix of osseous tissue
  – increase bone density

• **Osteoclasts**
  – found in periosteum and endosteum
  – cells that break down *(resorb)* the matrix of osseous tissue
  – decrease bone density

• **Osteocytes**
  – cells that are surrounded by matrix *(located in a lacunae)* that are not depositing or resorbing matrix
Composition of Bone (Extracellular) Matrix

- Inorganic components
  - hydroxyapatites
    - calcium and phosphate deposits
    - 65% of bone by mass
    - responsible for bone hardness
- Fibers
  - collagen
    - provides an ability of bone to flex slightly without fracturing
Histology of Bone
Bone Histology

• The basic structural unit of bone is called the osteon (haversian system)
  – a central canal holding blood vessels and nerves that are parallel to the longest dimension of the bone is surrounded concentric cylinders of bone called lamellae
  – osteocytes found between lamellae are connected to each other by tiny cracks in the lamellae called canaliculi

• Perforating canals
  – canals that are perpendicular to the central canals joining them to the blood and nerve supply at the superficial surface of the bone
Osteon of Compact Bone

- Lamella
- Lacunae
- Canaliculi
- Central canal
Coverings of Bone

- There are 2 surfaces of a bone that are covered with a thin layer of connective tissue
  - the most superficial surface is covered by the **periosteum**
  - the internal surface of the central and perforating canals is covered with **endosteum**
- Both the periosteum and the endosteum contain osteoblasts and osteoclasts which are capable of increasing and decreasing the amount of bone tissue
  - bone remodeling
Joints (Articulations)

- Site where two or more bones meet
- Weakest parts of the skeleton
- Functions include:
  - provide mobility for the skeleton
    - bones move in relation to one another where the joints serve as a **fulcrum** (pivot point) and the associated bones serve as **levers**
  - hold the skeleton together
Classification of Joints

• The three **functional** classes of joints are:
  – Synarthroses
    • immovable
  – Amphiarthroses
    • slightly movable
  – Diarthroses
    • freely movable

• The three **structural** classifications are:
  – Synovial
  – Fibrous
  – Cartilaginous
Synovial Joints

- Those joints in which the articulating bones are separated by a joint capsule filled with synovial fluid – all are freely movable (diarthroses) – found mainly in arm and legs
Cartilaginous Joints

- Articulating bones are united by cartilage
  - most are slightly movable (amphiarthroses)
  - include intervertebral discs
Fibrous Joints

- The bones are joined by dense connective tissue containing a high amount of collagen
  - most are immovable (synarthroses)
  - include the bones of the skull