

**Topic 18: Skeletal and Muscular Systems (Ch. 49)**

- I. Uses of skeletons
  - A. protection of body structures
  - B. rigid support for body structures
  - C. allow movement by serving as a rigid surface for muscle attachment
- II. Types of skeletons
  - A. **hydrostatic skeleton** (AKA hydraulic skeleton or hydroskeleton)
    1. found in soft-bodied invertebrates (such as earthworm)
    2. body fluids enclosed in a confined, incompressible space
    3. direct force of muscle against water
  - B. **exoskeleton**
    1. opposite muscle ends attached to hard parts on outside of body
    2. arthropod muscles attached to rigid chitin exoskeleton
      - limits size
      - large muscles would require excessively thick exoskeleton
  - C. **endoskeleton**
    1. found in vertebrates and echinoderms
    2. most vertebrate muscles are attached to an internal bone scaffold
      - bone can bear more weight than chitin
      - bone is cellular, living tissue that can grow and be remodeled
    3. vertebrates have a soft, flexible exterior that stretches to accommodate movement
- III. Human skeletal system
  - A. composed of bones, cartilage, and **ligaments**
  - B. **tendons** connect muscle to bone
  - C. over 200 bones divided into two groups, **axial** and **appendicular**
    1. axial – skull, backbone, rib cage, breastbone (sternum)
      - skull: cranium, facial, middle-ear, and hyoid bones
      - vertebral column = spine = backbone
        - flexible column that protects spinal cord

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- twelve pairs of ribs protect heart and lungs (FYI, same number in both males and females)
- 2. appendicular – attached to axial at shoulders and hips
  - **pectoral girdle** = shoulders
    - clavicles connect shoulder blades to breastbone
    - arms attached at shoulders
  - **pelvic girdle** = hips
    - connects to legs
    - major limitation in childbirth

### IV. Bone

- A. recall: special type of connective tissue
- B. two types of bones: flat and long
  - 1. **flat bones** not modeled in cartilage first
  - 2. **long bones** modeled in cartilage first
- C. bones also serves as calcium and phosphate reservoir and blood cells are made in the **bone marrow** of long bones
- D. structure
  - 1. collagen fibers coated with hydroxyapatite crystals (calcium phosphate)
  - 2. result is strong but not brittle
    - hydroxyapatite crystals are strong and rigid but brittle
    - collagen matrix is flexible but relatively weak
    - collagen matrix redistributes stress that otherwise would easily fracture the crystals
  - 3. fibers run parallel to axis in long bones, parallel to end in joints; this helps prevent cracks from penetrating into the bone interior
  - 4. ends and interiors of long bones are an open lattice of spongy bone tissue
    - bone marrow found in spaces of spongy bone
    - bone marrow produces most blood cells
  - 5. compact bone surrounds spongy bone, gives long bones most of their strength
- E. formation
  - 1. **osteoblast** cells secrete collagen fibers (cartilage model in most)
  - 2. collagen fibers become calcified; osteoblasts now called **osteocytes**

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3. osteocytes are encased in **lacunae**
4. Haversian system – basic unit of structure for bone
  - **Haversian canals** – narrow channels that run parallel to length of the bone; they interconnect, and they carry blood vessels and nerve cells
  - **lamellae** – thin, concentric layers of bone surrounding the canals
  - **canaliculi** – openings in bone between osteocytes and the canals

### F. modifications

1. cartilage remains for a while at the neck of long bones, allows for continued growth until completely replaced (usually in late teens)
2. **articular cartilage** remains at ends of bones, involved in joints
3. **osteoclasts** can dissolve bone, allowing remodeling of bone
4. new bone is formed along lines of stress, when possible

### V. joints: where bones come together

#### A. sutures

1. nearly immovable, joined by connective tissue
2. some movement in early development (**fontanel**s of infants)
3. main example: cranial bones

#### B. cartilaginous joints

1. slightly movable; bones bridged entirely by cartilage
2. main example: vertebral bones in the spine
  - pads of cartilage are **intervertebral disks**
  - efficient cushioning shock absorbers that allow some flexibility

#### C. synovial joints

1. freely movable joints
2. ends of bones in **synovial capsule**, a fibrous structure strengthened by **ligaments** and filled with lubricating fluid
3. types include ball-and-socket, hinged
4. **rheumatoid arthritis**: degeneration of synovial joint connective tissue

### VI. tendons: where bones and muscles come together

- A. tendons are straps of dense regular connective tissue
- B. muscle **origin** attaches to stationary base