Chapter 7

The Skeleton: Bones and Joints

1. Bone Functions

1. To store calcium salts
2. To protect delicate structures such as the brain and spinal cord
3. To serve as levers to produce movement
4. To serve as a firm framework for the body
5. To produce blood cells

S-P-L-F-B

2. Bone Structure

A. 206 bones in body
B. 2 basic groups
   - Axial skeleton (head and trunk)
   - Appendicular skeleton (extremities)

c. Four basic bone shapes:

1. Flat (ribs, skull)
2. Short (carpals, tarsals)
3. Irregular (vertebrae, face)
4. Long (most common)

D. The Long Bone

- **Diaphysis** – shaft, covered with outer membrane layer (periosteum); center hollow (medullary) cavity, lined by inner membrane (endosteum) and filled with yellow marrow, blood vessels and nerves
- **Epiphyses** – ends (proximal and distal) composed of spongy/cancellous bone, filled with red marrow
E. Bone Tissue – two types

1. Compact bone
   - Makes up the outer layer of long bone shaft
   - Cells are in rings of tissue around haversian canals
   - Each set of rings is called an osteon; osteocytes maintain bone in the lacuna

2. Spongy (cancellous) bone
   - Found in the ends of bones
   - Made of a meshwork of small bony plates
   - Contains red marrow that makes blood cells

3. Bone Growth and Repair
   - A. All bone starts as cartilage (hard connective tissue)
   - B. Ossification – the process of converting cartilage into bone, starts during 2-3rd month of embryonic development.

C. How ossification/bone growth works:
   1. Osteoblasts (bone building cells) manufacture the matrix, material between the cells made of collagen (gives strength and resilience).
   2. Calcium gets deposited in the matrix, causing it to harden. Vitamin D and calcitonin enable absorption of calcium.
   3. Osteocytes (mature osteoblasts) maintain and repair existing bone matrix throughout life.

D. Resorption – process of fixing or remodeling bone; when bone needs repair, osteoclasts breakdown bone tissue, and osteoblasts fill it in;

4. Bone Markings
   - A. Projections – allow for muscle attachments
     - Head – rounded knob-like end
     - Process – large projection of a bone
     - Crest – distinct border or edge
     - Spine – a sharp projection
   - B. Depressions or holes – allow for passage of nerves and blood vessels
     - Foramen – a hole for nerves or vessels to pass
     - Sinus – an air space in skull
     - Fossa – a depression on a surface
     - Meatus – a short channel or passageway

E. Formation of a Long Bone
   - 1. Cartilage begins to turn into bone at the shaft
   - 2. Epiphyseal plates develop across bone ends
   - 3. Bones continue to lengthen at end plates
   - 4. Bones stop lengthening in early 20’s
   - 5. Bone resorption and formation continues throughout life. It slows with age.

Animation: Bone Growth in Width
5. Bones of the Axial Skeleton

- Axial skeleton—80 bones of the head and trunk
  - Head
  - Vertebrae & sacrum
  - ribs

A. VERTEBRAE
- Cervical—7 neck bones
- Thoracic—12 chest bones; 24 ribs attach here
- Lumbar—5 bones, thick to withstand pressure
- Sacrum—5 bones fuse by adulthood
- Coccyx—4-5 fused
- Foramen—hole for spinal cord to go through
- Process—projection for muscle attachment

B. RIBS
- 12 pairs attach to T1-12 vertebrae
- #1-7 are true ribs; attach directly to sternum
- #8-12 are “false ribs” attaching indirectly to sternum (#11-12 are ‘floating ribs.’)

6. Bones of the Appendicular Skeleton

- A. Appendicular skeleton—126 bones of the extremities
  - i. 2 girdles:
    - 1. Shoulder girdle: clavicle, scapula, arm & hand bones
    - 2. Pelvic girdle: pelvis and leg and feet bones

The pelvic bones.

The skull.

Bones of the thorax, anterior view.

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ZOOMING IN • What type of joint is between bones of the skull?

ZOOMING IN • To what bones do the costal cartilages attach?

ZOOMING IN • What bone is nicknamed the “sit bone”?
7. Disorders of Bone

- Metabolic diseases - osteoporosis
- Infections – Osteomyelitis, tuberculosis
- Structural problems – curvature of the spine, cleft palate, flat foot

A. Osteoporosis

B. 3 Irregular spinal curvatures
  - Kyphosis – exaggerated thoracic curve
  - Lordosis – exaggerated lumbar curve
  - Scoliosis – spine curves laterally rather than straight

C. Cleft palate— the hard palate (mouth roof) does not fuse before birth

D. Flat feet— tendons and ligaments are weak, causing arch to fall

E. Fractures – break in the bone usually caused by trauma
F. Skeletal Changes in the Aging

Bones undergo significant changes:
- 1. Loss of calcium salts causes bone brittleness
- 2. Decrease in protein being formed
- 3. Reduction in collagen causes stiffness in joints
- 4. Loss of height as discs get thinner
- 5. Decrease in chest diameter as cartilage calcifies

Part 2 - The Joints

A. Classified by material between adjoining bones and by degree of movement permitted:
- 1. Fibrous (immovable)
- 2. Cartilaginous (slightly movable)
- 3. Synovial (freely movable)

B. Types of Synovial Joints

Classified by types of movement they allow:
- Gliding – wrist, feet
- Hinge – elbow, knee
- Pivot – head on neck
- Condyloid – finger and metacarpal joint
- Saddle – wrist and thumb
- Ball-and-socket – shoulder, hip

Movement at Synovial Joints

- Flexion/Extension
- Abduction/Adduction
- Circumduction
- Rotation

Movements characteristic of forearm and ankle
- Supination/Pronation
- Inversion/Eversion
- Dorsiflexion/Plantar flexion

Disorders of Joints

- Mechanical disorders
- Dislocation
- Sprain
- Herniated disk
- Arthritis
- Osteoarthritis (degenerative joint disease [DJD])
- Rheumatoid arthritis
- Septic (infectious) arthritis
- Gout
- Backache
- Vertebral diseases
- Intervertebral disk disorders
- Supporting structure abnormalities
- Abdominopelvic disorders
- Lumbosacral joint strains

Arthroscopic examination of the knee.
**Checkpoint 7-1:** A long bone has a long narrow shaft and two irregular ends. What are the scientific names for the shaft and the ends of a long bone?

Shaft – diaphysis; ends – epiphysis(es)

**Checkpoint 7-2:** What are the two types of osseous (bone) tissue and where is each type found?

Compact bone, found in the shaft
Spongy bone, found in the ends

**Checkpoint 7-3:** What are the three types of cells found in bone and what is the role of each?

- **Osteoblasts** – form new bone when needed
- **Osteoclasts** – break down bone tissue (resorption)
- **Osteocytes** – bone maintenance cells (locked in the matrix)

**Checkpoint 7-4:** As the embryonic skeleton is converted from cartilage to bone, the intercellular matrix becomes hardened. What compounds are deposited in the matrix to harden it?

Calcium

**Checkpoint 7-5:** After birth, long bones continue to grow in length at secondary centers. What are these centers called?

Epiphyseal plates

**Checkpoint 7-6:** Bones have a number of projections, depressions, and holes. What are some functions of these markings?

**Checkpoint 7-7:** The axial skeleton consists of the bones of the skull and the trunk. What bones make up the skeleton of the trunk?

The vertebral column and ribs

**Checkpoint 7-8:** What are the five regions of the vertebral column?

Cervical, thoracic, lumbar, sacral, coccygeal

**Checkpoint 7-9:** What division of the skeleton consists of the bones of the shoulder girdle, hip, and extremities?

Appendicular
Checkpoint 7-10: What are the three types of joints classified according to the type of material between the adjoining bones?

Checkpoint 7-11: What is the most freely movable type of joint?
Ball and socket joint

Checkpoint 7-12: What is the most common type of joint disorder?
arthritis