Lecture 1 - Bones

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> **In short:** The skeletal system is a dynamic organ system that acts as a structural framework, a reservoir for calcium, and a site for blood cell production. It is divided into an axial skeleton for protection and an appendicular skeleton for movement, with joints serving as pivot points for motion and ligaments providing necessary stability.

1. Functions of the Skeletal System

Slides 3–4

- **Bone:** Hard, mineralized connective tissue. Functions:
  - **Support & Protection:** Creates a rigid frame to protect vital organs.
  - **Metabolic:** Acts as a warehouse for calcium (calcium metabolism).
  - **Hematopoietic:** Factory for red blood cell formation.
  - **Mechanical:** Lever system for movement; attachment points for skeletal muscles.
- **Cartilage:** Tough, flexible connective tissue. Provides smooth surfaces at **articulations** (joints) to allow bone-on-bone movement without friction.

2. Skeleton Divisions

Slides 4, 18, 21

- **Axial Skeleton:** Central axis. Protects vital organs of head, neck, and trunk. Includes: Skull (cranium/mandible), vertebral column, ribs, sternum.
- **Appendicular Skeleton:** Limbs and girdles. Designed for movement and environment interaction.
  - **Pectoral Girdle:** Clavicle and Scapula. Anchors upper limbs to axial skeleton; lacks a complete bony circle to allow wider range of motion.
  - **Pelvic Girdle:** Two innominate (hip) bones and the Sacrum. Built for weight-bearing and stability. Displays **sexual dimorphism** (female pelvis is typically wider/shallower for childbirth).

3. Bone Classification and Structure

Slides 5, 7–8

3.1 Shape Categories

- **Long:** Tubular; acts as lever (e.g., femur).
- **Short:** Cuboidal; provides stability/support (e.g., tarsals).
- **Flat:** Thin plates; protection and muscle attachment (e.g., sternum).
- **Irregular:** Specialized functions/complex shapes (e.g., vertebrae).
- **Sesamoid:** Develop inside tendons; protects from wear (e.g., patella).

3.2 Internal Anatomy

- **Cortical (Compact) bone:** Dense, rigid outer shell for weight-bearing.
- **Trabecular (Spongy) bone:** Interconnected struts; lighter; manages stress from multiple directions.
- **Medullary cavity:** Hollow center containing bone marrow.
- **Coverings: Periosteum** (outer) and **Endosteum** (inner) are vital for nutrition and repair.

> **Common mistake:** Confusing bone types. Remember that the **Tibia** is a long bone (leverage), the **Talus** is a short bone (stability), and the **Parietal bone** is a flat bone (protection).

3.3 Bone Growth (Endochondral Ossification)

Bones start as hyaline cartilage "blueprints."

- **Diaphysis:** Main shaft.
- **Epiphysis:** Rounded ends.
- **Epiphyseal growth plate:** Cartilage layer between diaphysis and epiphysis. Where bone adds length.
- **Growth cessation:** Occurs when the growth plate ossifies (turns to solid bone).

> **Common mistake:** Ignoring growth plate injuries. Because the epiphyseal plate is the site of longitudinal bone growth, a fracture here in a child can permanently stop the bone from growing properly.

4. Anatomical Terminology

Slides 9–10

Category	Term	Definition
Elevations	Condyle	Smooth, rounded area forming a joint.
	Epicondyle	Bump located *above* a condyle.
	Crest	Sharp, prominent ridge.
	Trochanter	Large rounded elevation.
	Tuberosity	Large rounded elevation.
	Tubercle	Small rounded elevation.
	Process	General term for any projection.
	Facet	Smooth area.
Openings/Dips	Foramen	Hole (allows passage of nerves/vessels).
	Fossa	Wide, shallow depression.
	Sulcus/Notch	Groove or furrow (tracks for tendons/nerves).

5. Axial Skeleton Landmarks

Slides 12–17

- **Skull:** 22 bones.
  - **Neurocranium:** Protective case for the brain.
  - **Viscerocranium:** Facial skeleton.
  - **Sutures:** Immobile joints connecting 21 skull bones.
  - **Mandible:** Only movable skull bone.
  - **Cranial Fossae:** Three steps (Anterior, Middle, Posterior) housing the brain.
- **Vertebral Column (33 vertebrae):**
  - **Cervical (C1–C7):** Neck.
  - **Thoracic (T1–T12):** Mid-back; attaches to ribs.
  - **Lumbar (L1–L5):** Lower back; largest (weight-bearing).
  - **Sacral (5 fused):** Weight transfer to hips.
  - **Coccygeal (4 fused):** Tailbone.
  - *Note:* S-shaped curves provide shock absorption and flexibility.

- **Thoracic Cage:** Sternum (Manubrium, Body, Xiphoid) + 12 pairs of ribs. Ribs attach via **costal cartilages** to allow expansion/contraction for breathing.

6. Appendicular Anatomy

Slides 19–20, 22–23

- **Upper Limb Regions:**
  - **Arm:** Humerus.
  - **Forearm:** Radius (lateral) and Ulna (medial).
  - **Hand:** 27 bones (8 Carpals, 5 Metacarpals, 14 Phalanges).
- **Lower Limb Regions:**
  - **Thigh:** Femur (strongest bone).
  - **Leg:** Tibia (weight-bearing) and Fibula.
  - **Foot:** Tarsals (calcaneus is heel), Metatarsals, Phalanges. Arches act as springs for shock absorption.

> The thumb (**pollex**) is unique; it has only two phalanges (proximal and distal) rather than three, which is critical for the "opposition" (ability to touch other fingers) that defines human grip.

7. Joints (Articulations)

Slides 25–30

Joints balance **stability** vs. **mobility**.

Type	Connection	Mobility	Example
Fibrous	Tough, fibrous tissue	Little to none	Sutures (skull), Syndesmosis (radius/ulna), Gomphosis (teeth)
Cartilaginous	Cartilage (hyaline or fibrocartilage)	Limited	Epiphyseal plate (primary), Pubic symphysis/Intervertebral discs (secondary)
Synovial	Joint capsule + synovial fluid	High	Shoulder, Knee, Wrist

- **Synovial Joint Features:** Articular cavity, Articular cartilage, Joint capsule (outer fibrous layer, inner synovial membrane), Synovial fluid.
- **Synovial Types:**

- **Pivot:** Rotation (e.g., atlanto-axial joint).
- **Hinge:** Flexion/extension (e.g., elbow, knee).
- **Plane:** Sliding (e.g., acromioclavicular joint).
- **Ball and Socket:** Movement in all directions (e.g., shoulder, hip).
- **Condyloid/Saddle:** Two-plane movement (e.g., wrist, thumb).

> **Know this cold:** The trade-off between mobility and stability. Synovial joints are built for mobility; Fibrous and Cartilaginous joints are built for stability.

8. Ligaments

Slide 31

- **Definition:** Connect **bone to bone** (distinct from tendons which connect muscle to bone).
- **Structure:** Dense regular connective tissue; strong under tension.
- **Classification:**
  - **Capsular:** Thickenings of the joint capsule.
  - **Extracapsular:** Outside the capsule.
  - **Intracapsular:** Inside the capsule (e.g., ACL/PCL in the knee).

Now lock it in

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