

1. Overview & Functions

- **4 Parts:** Bones, Joints, Cartilages, Ligaments.
 - **2 Divisions:**
 - **Axial:** Skull, ribs, vertebrae, bony thorax, laryngeal skeleton (longitudinal axis).
 - **Appendicular:** Limbs (extremities) and girdles (pectoral & pelvic).
 - **5 Functions:**
 1. *Support:* Body framework.
 2. *Protection:* Soft organs.
 3. *Movement:* Levers for attached skeletal muscles.
 4. *Storage:* Minerals (calcium, phosphorus, magnesium) and fats (yellow marrow).
 5. *Blood cell formation:* Hematopoiesis in red marrow.
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2. Bone Basics & Anatomy

- **Total Bones:** 206 in adults.
- **Chemical Makeup:** Calcium, magnesium, phosphorus, and dense collagen.
- **2 Bone Tissues:**
 - **Compact Bone:** Homogeneous and dense.
 - **Spongy Bone:** Small, needle-like pieces (trabeculae) with open spaces.

Anatomy of a Long Bone

- **Diaphysis:** Shaft; composed of compact bone.
- **Epiphysis:** Ends; composed mostly of spongy bone.
- **Periosteum:** Fibrous connective tissue membrane covering the diaphysis.
- **Perforating (Sharpey's) Fibers:** Secure periosteum to underlying bone.
- **Articular Cartilage:** Hyaline cartilage covering epiphyses; reduces joint friction.
- **Arteries:** Supply bone cells with nutrients.
- **Medullary Cavity:**
 - *Infants:* Red marrow (blood cell formation).
 - *Adults:* Yellow marrow (fat storage).

Microscopic Anatomy (Compact Bone)

- Osteon (Haversian System): Unit of bone.
 - Central (Haversian) Canal: Carries blood vessels and nerves lengthwise.
 - Perforating (Volkmann's) Canal: Runs perpendicular to the central canal; carries blood vessels and nerves.
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3. Classification of Bones by Shape

- Long: Longer than wide; shaft + 2 ends; mostly compact bone. (*e.g., femur, humerus*)
 - Short: Cube-shaped; mostly spongy bone. (*e.g., carpals, tarsals*)
 - Flat: Thin, flattened, usually curved; compact bone layers around spongy bone. (*e.g., skull, ribs, sternum*)
 - Irregular: Do not fit other categories. (*e.g., vertebrae, hip*)
 - Sesamoid: Small, protective; found where tendons pass over joints. (*e.g., patella*)
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4. Bone Growth, Fractures, & Healing

- Embryo/Fetus: Skeleton starts as hyaline cartilage; replaced by bone except at bridge of nose, parts of ribs, and joints.
- Growth: Epiphyseal plates allow long bones to lengthen during childhood (cartilage forms, ossifies, and remodels). Bones also grow in width.

Fractures & Healing

- Closed (Simple): Does not break the skin.
- Open (Compound): Broken bone penetrates skin.
- Treatment: Reduction (realignment) and immobilization.

Fracture Type	Description & Notes
<u>Comminuted</u>	Broken into many fragments (common in aged, brittle bones).
<u>Compression</u>	Bone is crushed (common in porous/osteoporotic bones).
<u>Depressed</u>	Broken bone pressed inward (typical skull fracture).
<u>Impacted</u>	Broken ends forced into each other (e.g., breaking a fall).
<u>Spiral</u>	Ragged break from excessive twisting forces (sports injury).
<u>Greenstick</u>	Incomplete break; bends like a twig (common in children).

- 4 Healing Stages:

1. *Hematoma formation*: Blood-filled swelling.
2. *Fibrocartilage callus formation*: Connective tissue/cartilage splints the break.
3. *Bony callus formation*: Spongy bone replaces cartilage.
4. *Bone remodeling*: Permanent strong patch forms.

5. Axial Skeleton

- Skull: Joined by sutures; only mandible is freely movable.
 - *Cranium & Facial Bones*: Frontal, parietal, temporal, occipital, sphenoid, ethmoid, maxilla, zygomatic, nasal, lacrimal, palatine, vomer, mandible.
 - *Landmarks*: Foramen magnum, sella turcica (houses pituitary/thyroid axis path: TRH → TSH → T3/T4), foramen ovale, styloid/mastoid processes, external/internal acoustic meatus.
 - *Paranasal Sinuses*: Hollow areas in frontal, ethmoid, sphenoid, and maxillary bones.

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 - *Paranasal Sinuses:* Hollow areas in frontal, ethmoid, sphenoid, and maxillary bones.
 - *Fetal Skull:* Large; contains fibrous fontanelles (anterior, posterior, sphenoidal, mastoid).
 - *Hyoid Bone:* Only bone that does not articulate with another bone; movable base for the tongue.
- Vertebral Column:
 - 7 Cervical (C1–C7), 12 Thoracic (T1–T12), 5 Lumbar (L1–L5), Sacrum (5 fused), Coccyx (fused).
 - Separated by intervertebral discs.
- Bony Thorax:
 - Sternum: Manubrium, sternal angle, body, xiphisternal joint, xiphoid process.
 - Ribs (12 pairs): True (1–7), False (8–12), Floating (11–12).

6. Appendicular Skeleton

- Pectoral Girdle: Clavicle (collarbone) + Scapula (shoulder blade).
- Upper Limb: Humerus (arm); Ulna + Radius (forearm); Hand = Carpals (8 wrist), Metacarpals (5 palm), Phalanges (14 fingers).
- Pelvic Girdle: 3 pairs of fused bones: Ilium, Ischium, Pubis.
 - *Female Pelvis:* Broader, wider/shallower cavity, rounder brim, larger subpubic angle ($> 90^\circ$) for childbirth.
 - *Male Pelvis:* Narrower, deeper, heart-shaped inlet, smaller subpubic angle.
- Lower Limb: Femur (thigh); Tibia + Fibula (leg); Foot = Tarsals (7 ankle: calcaneus, talus, etc.), Metatarsals (5 sole), Phalanges (14 toes).
- Foot Arches: 2 longitudinal + 1 transverse.

7. Joints (Articulations) & Synovial Types

- **Functional:**

- *Synarthroses*: Immovable.
- *Amphiarthroses*: Slightly movable.
- *Diarthroses*: Freely movable (all synovial joints).

- **Structural:**

- **Fibrous**: Sutures (skull), Syndesmoses (radius-ulna membrane), Gomphosis (tooth in socket).
- **Cartilaginous**: Pubic symphysis, intervertebral joints.
- **Synovial**: Joint cavity with synovial fluid, articular cartilage, fibrous capsule, synovial membrane, ligaments.
- *Accessory structures*: **Bursae** (flattened fluid sacs) and **Tendon sheaths** (elongated bursae around tendons).

6 Types of Synovial Joints

1. **Plane**: Nonaxial; gliding (*e.g., carpals, tarsals*).
2. **Hinge**: Uniaxial; flexion/extension (*e.g., elbow*).
3. **Pivot**: Uniaxial; rotation (*e.g., C1–C2, proximal radioulnar*).
4. **Condylloid**: Biaxial; side-to-side/back-and-forth (*e.g., knuckles, wrist*).
5. **Saddle**: Biaxial; opposition (*e.g., carpometacarpal #1 of thumb*).
6. **Ball-and-Socket**: Multiaxial; universal rotation (*e.g., shoulder, hip*).

8. Complete Pathology & Disorders List

- **Ankylosing Spondylitis:** Hereditary chronic inflammatory spinal disease; fusion of vertebrae.
- **Arthritis:** ≥ 100 inflammatory/degenerative joint diseases; most widespread crippling disease.
 - *Osteoarthritis:* Most common; degenerative wear-and-tear from aging.
 - *Rheumatoid Arthritis:* Autoimmune disease; bilateral synovial thickening and deformity.
 - *Gouty Arthritis (Gout):* Deposition of **urate crystals** from high blood uric acid (**hyperuricemia**); common in great toe.
- **Avulsion Fracture:** Ligament/tendon pulls off a piece of bone.
- **Bursitis:** Inflammation of a bursa from blow or friction.
- **Tendonitis:** Inflammation of tendon sheaths.
- **Caries:** Cavities; major cause of tooth loss.
- **Carpal Tunnel Syndrome:** Compression of the **median nerve** at the wrist.
- **Dislocation:** Bone forced out of normal joint socket (shoulder/hip).
- **Subluxation:** Partial dislocation (e.g., whiplash in neck).
- **Herniated Disk:** Ruptured or slipped intervertebral disc.
- **Kyphosis:** "Hunchback"; excessive posterior thoracic curvature (osteoporosis collapse).

- **Lordosis**: "Swayback"; excessive anterior lumbar curvature (obesity, late pregnancy).
- **Scoliosis**: Abnormal lateral curvature and spinal twist; most common in girls.
- **Meningomyelocele (Spina Bifida)**: Congenital opening/defect of the spinal column.
- **Osteoma**: Bone tumor.
- **Osteomalacia / Rickets**: Bone softening from vitamin D and calcium deficiency (Rickets in children).
- **Osteomyelitis**: Bacterial bone infection.
- **Osteoporosis**: Weakening/thinning of bone mass.
- **Paget's Disease (Osteitis Deformans)**: Excessive destruction and chaotic remodeling of bone cells.
- **Periodontitis**: Inflammation of tissue anchoring teeth.
- **Talipes (Congenital Clubfoot)**: Foot/ankle twisted inward like a golf club (1 in 1,000 births, 2× more in males, 50% bilateral; genetic and smoking-linked, not fetal position).

Master Mnemonics for the Skeletal System

1. System Overview & Functions

Functions of Bone: "SM-P-SB" (*"Some Men Prefer Soft Beds"*)

- **S** – Support (structural framework)
- **M** – Movement (levers for skeletal muscles)
- **P** – Protection (soft organs)
- **S** – Storage (minerals & yellow marrow fat)
- **B** – Blood cell formation (hematopoiesis in red marrow)

4 Components of Skeletal System: "B-J-C-L" (*"Bones Just Can't Lie"*)

- **B** – Bones
 - **J** – Joints
 - **C** – Cartilages
 - **L** – Ligaments
-

2. Bone Classification & Microscopic Anatomy

5 Bone Shapes: "FLIRS"

- **F** – Flat (skull, ribs, sternum)
- **L** – Long (femur, humerus)
- **I** – Irregular (vertebrae, hip)
- **R** – Rounded / Short (carpals, tarsals)
- **S** – Sesamoid (patella – in tendon)

Canals of Compact Bone: "H-V"

- Haversian canal = Height (vertical / central canal along bone length)
- Volkmann's canal = Veering across (perpendicular / horizontal)

3. Fractures & Healing

⚡ 6 Fracture Types: "MD-SCIG" ("*Medical Doctors See Common Injury Groups*")

- **M** – Com**M**inuted: **M**any fragments (brittle/aged bone)
- **D** – **D**epressed: **D**ented/pressed inward (skull)
- **S** – **S**piral: **S**ports twisting injury
- **C** – **C**ompression: **C**rushed bone (osteoporosis)
- **I** – **I**mpacted: **I**nto each other (broken fall)
- **G** – **G**reenstick: **G**reen twig bending (kids)

🩹 4 Stages of Bone Repair: "H-F-B-R" ("*Healing Fractures Builds Resilience*")

1. **H** – **H**ematoma formation (blood swelling)
 2. **F** – **F**ibrocartilage callus (soft splint)
 3. **B** – **B**ony callus (spongy bone)
 4. **R** – **R**emodeling (permanent patch)
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4. Axial Skeleton

🕒 Vertebrae Meal Times: "7 – 12 – 5"

- Breakfast at 7:00 AM: 7 **C**ervical ($C_1 - C_7$)
- Lunch at 12:00 PM: 12 **T**horacic ($T_1 - T_{12}$)
- Dinner at 5:00 PM: 5 **L**umbar ($L_1 - L_5$)

📌 4 Paranasal Sinuses: "SEFM" ("*Sinuses Evaporate Fluid Mucus*")

- **S** – **S**phenoid
- **E** – **E**thmoid
- **F** – **F**rontal
- **M** – **M**axillary



3 Abnormal Curvatures:

- **Kyphosis:** Kamel hump (excessive posterior thoracic curve)
 - **Lordosis:** Load in front / Lumbar / Late pregnancy (excessive anterior lumbar curve)
 - **Scoliosis:** **S**-shape (lateral sideways curve)
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5. Appendicular Skeleton



Carpals of the Wrist:

"*Some **Lovers Try Positions That They Cannot Handle"*

(Proximal row → Distal row, lateral to medial)

- **S** – Scaphoid
- L – Lunate
- **T** – Triquetrum
- **P** – Pisiform
- **T** – Trapezium (*under the *T*umb*)
- **T** – Trapezoid
- **C** – Capitate
- **H** – Hamate



Tarsals of the Ankle:

"*Tiger **Cubs Need MILC"*

- **T** – Talus
- **C** – Calcaneus (heel)
- N – Navicular
- **M** – Medial cuneiform
- I – Intermediate cuneiform
- L – Lateral cuneiform
- **C** – Cuboid

3 Fused Hip Bones: "I-I-P" ("Ill In Pubis")

- I – Ilium
- I – Ischium
- P – Pubis

6. Joints (Articulations)

Functional Joint Movement: "S-A-D" (*Least to most movement*)

- S – Synarthrosis = **S**till (immovable; sutures)
- A – Amphiarthrosis = **A** little movement (slightly movable; pubic symphysis)
- D – Diarthrosis = **D**rastic movement (freely movable; synovial)

6 Synovial Joints: "P-H-P-C-S-B"

"*Please ****Help** Pick Cute Soft Bears"*

1. P – Plane (gliding, nonaxial; carpals/tarsals)
2. H – Hinge (flex/extend, uniaxial; elbow/knee)
3. P – Pivot (rotate, uniaxial; C₁ – C₂, radioulnar)
4. C – Condyloid (biaxial; knuckles/wrist)
5. S – Saddle (opposition, biaxial; thumb base)
6. B – Ball-and-socket (all planes, multiaxial; shoulder/hip)

7. Complete Disorders Mnemonic Guide

Use these quick word associations for all disorders from your slides:

- **Ankylosing Spondylitis:** Anchored Spine (hereditary spinal fusion).
- **Avulsion Fracture:** Away violently (tendon/ligament rips a bone piece off).
- **Bursitis vs. Tendonitis:**
 - Bursitis = Bag / sac inflammation.
 - Tendonitis = Tendon sheath inflammation.
- **Carpal Tunnel Syndrome:** Median nerve pressure in the wrist (Middle of wrist).
- **Caries:** Cavities causing tooth loss.
- **Dislocation vs. Subluxation:**
 - Dislocation = Done / fully out of socket.
 - Subluxation = Slight / partial slip (whiplash).
- **Gout:** Uric acid / Urate crystals in the great toe from hyperuricemia.
- **Herniated Disk:** Hole / slipped cushion between vertebrae.
- **Meningomyelocele:** Membrane open in spine (Spina bifida).
- **Osteoma:** Bone tumOr (-oma = benign growth).
- **Osteomalacia vs. Rickets:**
 - OsteoMalacia = Mature adults (soft bones from lack of Vitamin D/Ca).
 - Rickets = childRen.
- **Osteomyelitis:** Microbes in bone (bacterial bone infection).
- **Osteoporosis:** Porous, thinning bones.
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- **Periodontitis:** Perimeter of tooth tissues inflamed.
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Complete High-Yield Skeletal System Reviewer

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- 4 Parts: Bones, Joints, Cartilages, Ligaments.
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3. Fractures & Healing

6 Fracture Types: "MD-SCIG" ("*Medical Doctors See Common Injury Groups*")

- M – ComMinuted: Many fragments (brittle/aged bone)
- D – Depressed: Dented/pressed inward (skull)
- S – Spiral: Sports twisting injury
- C – Compression: Crushed bone (osteoporosis)
- I – Impacted: Into each other (broken fall)
- G – Greenstick: Green twig bending (kids)

4 Stages of Bone Repair: "H-F-B-R" ("*Healing Fractures Builds Resilience*")

1. H – Hematoma formation (blood swelling)
 2. F – Fibrocartilage callus (soft splint)
 3. B – Bony callus (spongy bone)
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- S – Sphenoid
- E – Ethmoid
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4. *Bone remodeling:* Permanent strong patch forms.



3 Abnormal Curvatures:

- **Kyphosis:** **K**amel hump (excessive **posterior** thoracic curve)
- **Lordosis:** **L**oad in front / **L**umbar / **L**ate pregnancy (excessive **anterior** lumbar curve)
- **Scoliosis:** **S**-shape (**lateral** sideways curve)

5. Appendicular Skeleton



Carpals of the Wrist:

"***S**ome ****L**overs **T**ry **P**ositions **T**hat **T**hey **C**annot **H**andle"*

(Proximal row → Distal row, lateral to medial)

- **S** – **S**caphoid
- **L** – **L**unate
- **T** – **T**riquetrum
- **P** – **P**isiform
- **T** – **T**rapezium (*under the *T*humb*)
- **T** – **T**rapezoid
- **C** – **C**apitate
- **H** – **H**amate



Tarsals of the Ankle:

"***T**iger ****C**ubs **N**eed **MILC**"*

- **T** – **T**alus
- **C** – **C**alcaneus (heel)
- **N** – **N**avicular
- **M** – **M**edial cuneiform
- **I** – **I**ntermediate cuneiform
- **L** – **L**ateral cuneiform
- **C** – **C**uboid

3 Fused Hip Bones: "I-I-P" ("Ill In Pubis")

- I – Ilium
 - I – Ischium
 - P – Pubis
-

6. Joints (Articulations)

Functional Joint Movement: "S-A-D" (*Least to most movement*)

- S – Synarthrosis = Still (immovable; sutures)
- A – Amphiarthrosis = A little movement (slightly movable; pubic symphysis)
- D – Diarthrosis = Drastic movement (freely movable; synovial)

6 Synovial Joints: "P-H-P-C-S-B"

"*Please **Help Pick Cute Soft Bears"*

1. P – Plane (gliding, nonaxial; carpals/tarsals)
2. H – Hinge (flex/extend, uniaxial; elbow/knee)
3. P – Pivot (rotate, uniaxial; C₁ – C₂, radioulnar)
4. C – Condyloid (biaxial; knuckles/wrist)
5. S – Saddle (opposition, biaxial; thumb base)
6. B – Ball-and-socket (all planes, multiaxial; shoulder/hip)

7. Complete Disorders Mnemonic Guide

Use these quick word associations for all disorders from your slides:

- **Ankylosing Spondylitis:** Anchored Spine (hereditary spinal fusion).
- **Avulsion Fracture:** Away violently (tendon/ligament rips a bone piece off).
- **Bursitis vs. Tendonitis:**
 - Bursitis = Bag / sac inflammation.
 - Tendonitis = Tendon sheath inflammation.
- **Carpal Tunnel Syndrome:** Median nerve pressure in the wrist (Middle of wrist).
- **Caries:** Cavities causing tooth loss.
- **Dislocation vs. Subluxation:**
 - Dislocation = Done / fully out of socket.
 - Subluxation = Slight / partial slip (whiplash).
- **Gout:** Uric acid / Urate crystals in the great toe from hyperuricemia.
- **Herniated Disk:** Hole / slipped cushion between vertebrae.
- **Meningomyelocele:** Membrane open in spine (Spina bifida).
- **Osteoma:** Bone tumOr (-oma = benign growth).
- **Osteomalacia vs. Rickets:**
 - OsteoMalacia = Mature adults (soft bones from lack of Vitamin D/Ca).
 - Rickets = childRen.
- **Osteomyelitis:** Microbes in bone (bacterial bone infection).
- **Osteoporosis:** Porous, thinning bones.
- **Paget's Disease (Osteitis Deformans):** Prolific bone cell destruction and messy remodeling.
- **Periodontitis:** Perimeter of tooth tissues inflamed.
- **Talipes (Clubfoot):** Twisted like a golf club (1 in 1,000; 2× in males; 50% bilateral; smoking/genetic link, not womb position).