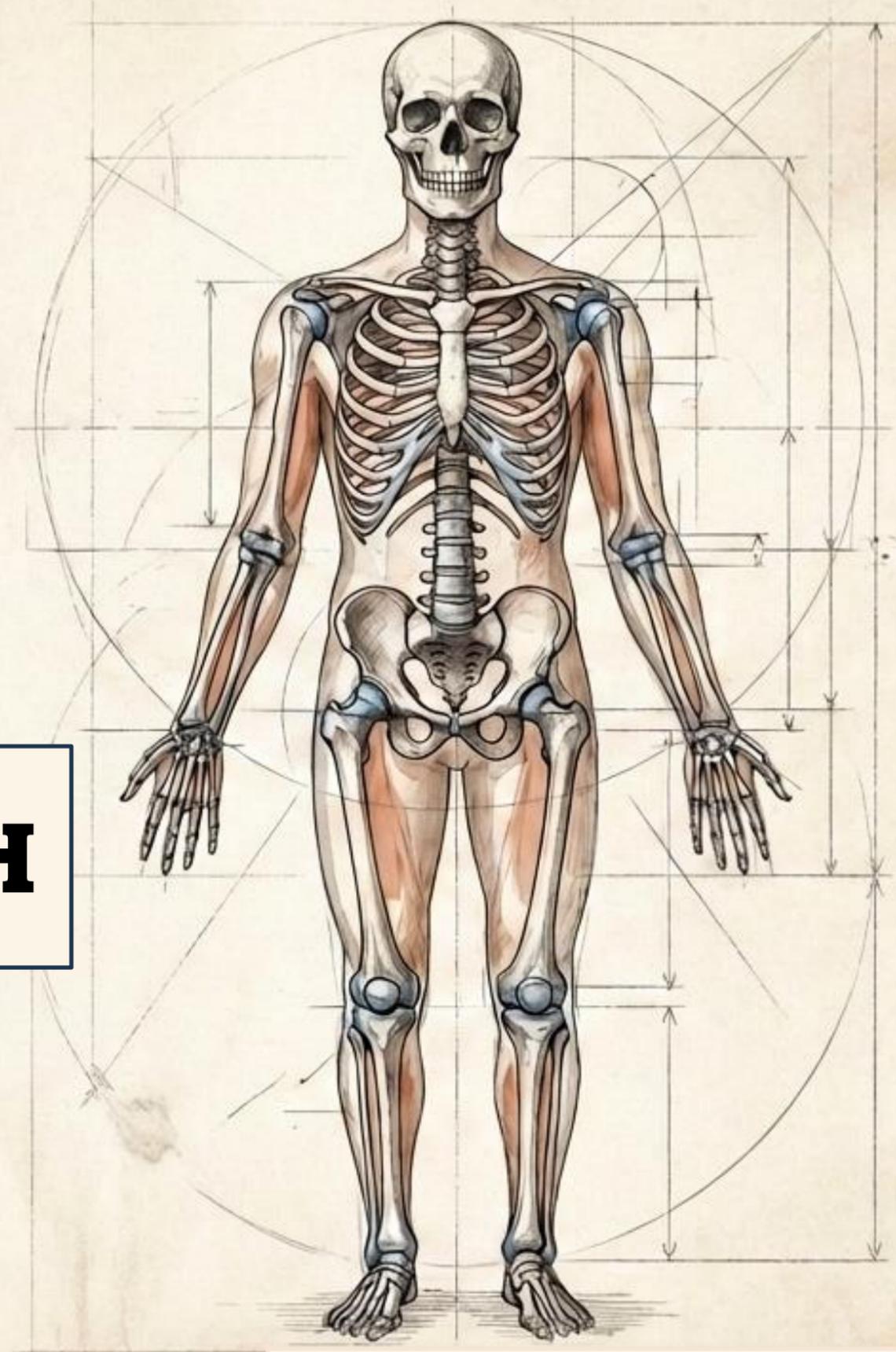


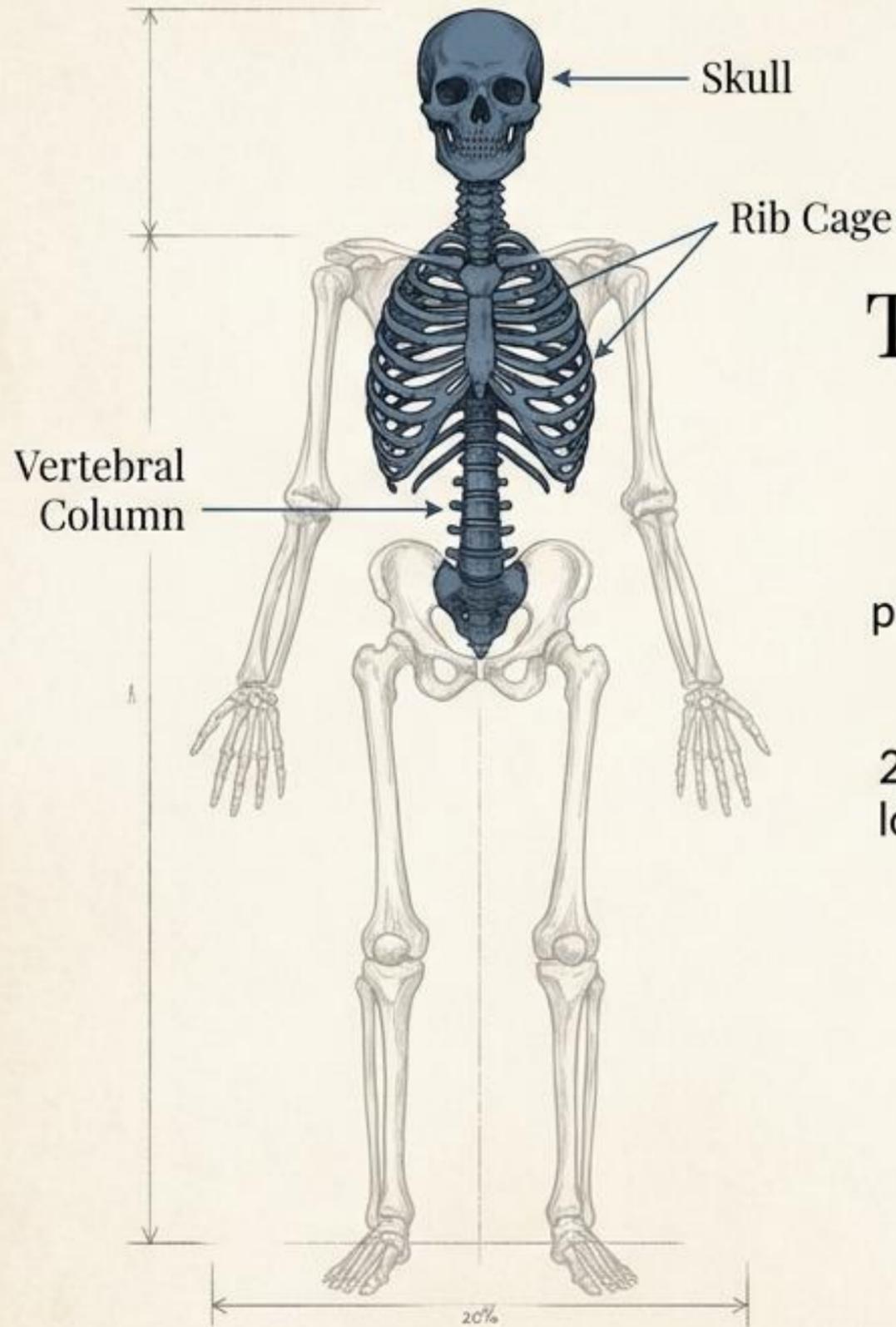
The Skeletal System & Joints

From Framework to Function:
An Anatomical Blueprint

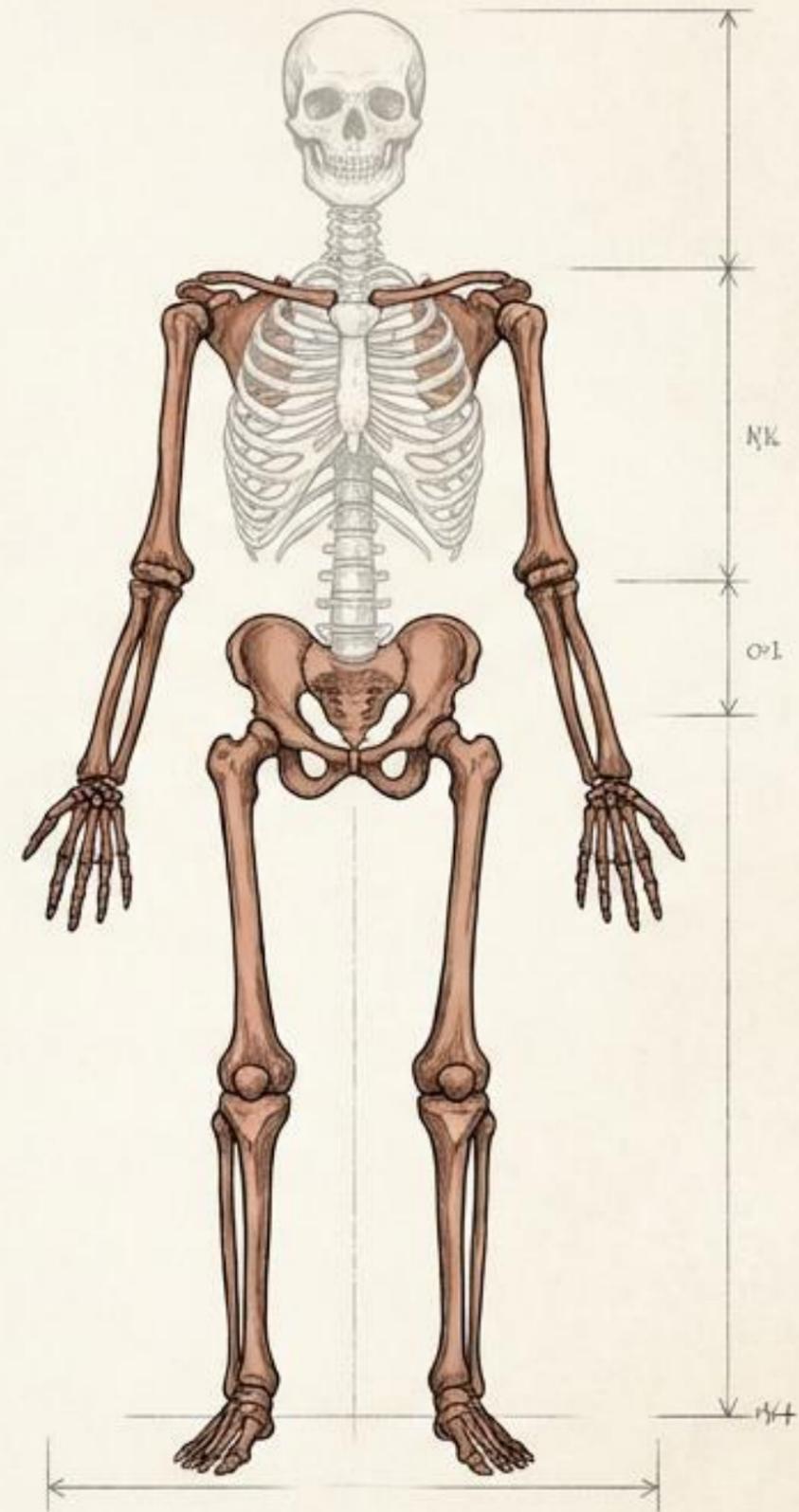
Dr AMAL AQEEL ALBTOOSH



The Axial Skeleton



The Appendicular Skeleton

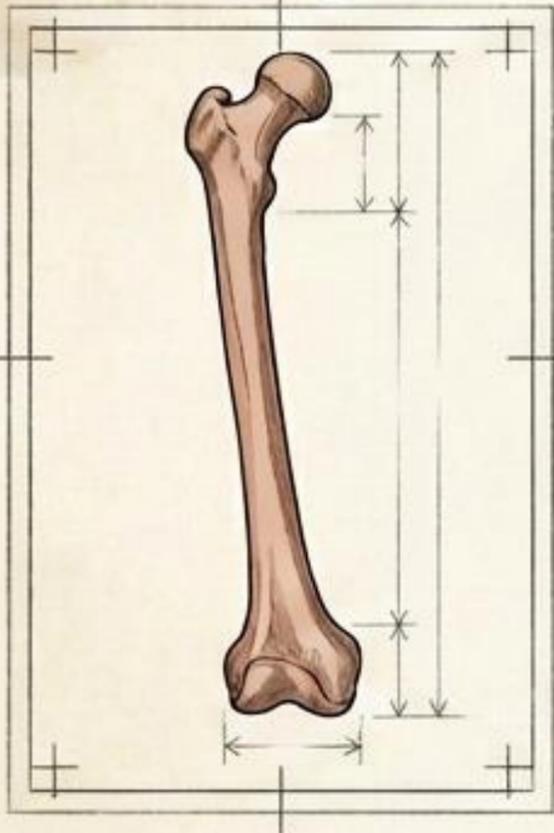


The Two Pillars of Support

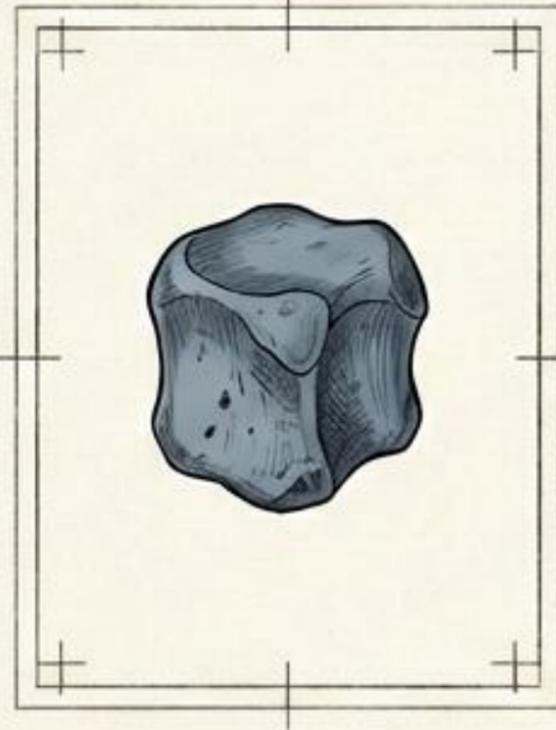
1. Axial: The central axis protecting the nervous system and vital organs.
2. Appendicular: The levers of locomotion and manipulation.

The Catalog of Bone Shapes

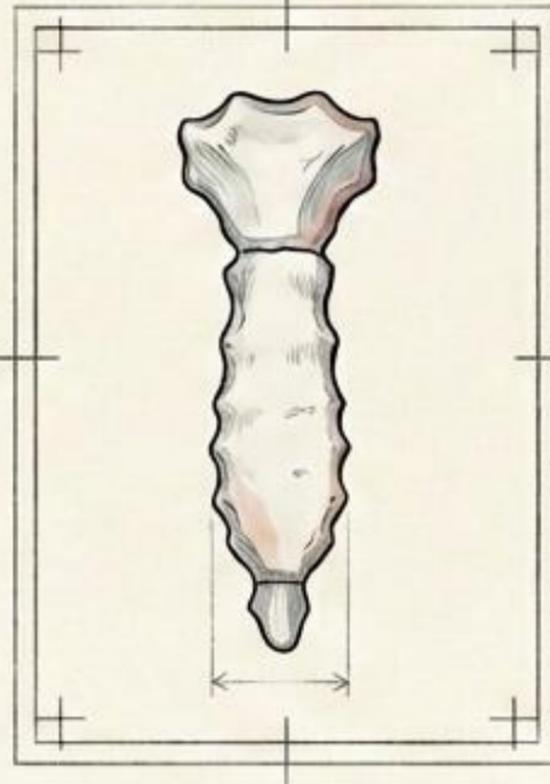
Long



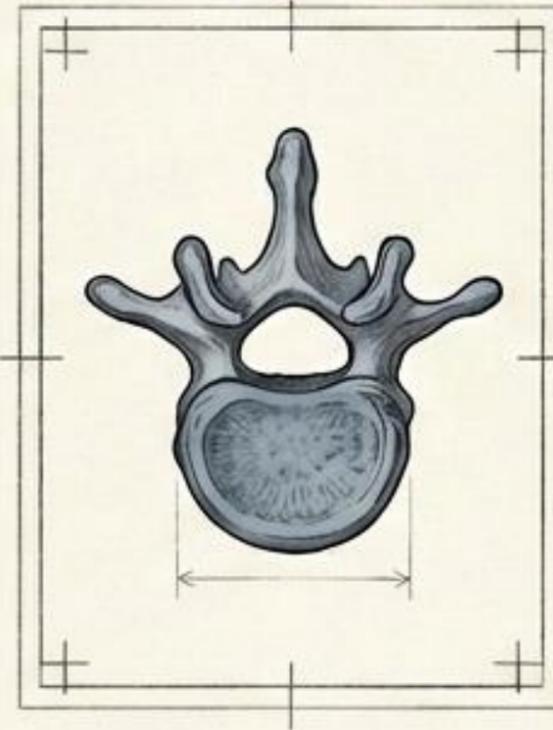
Short



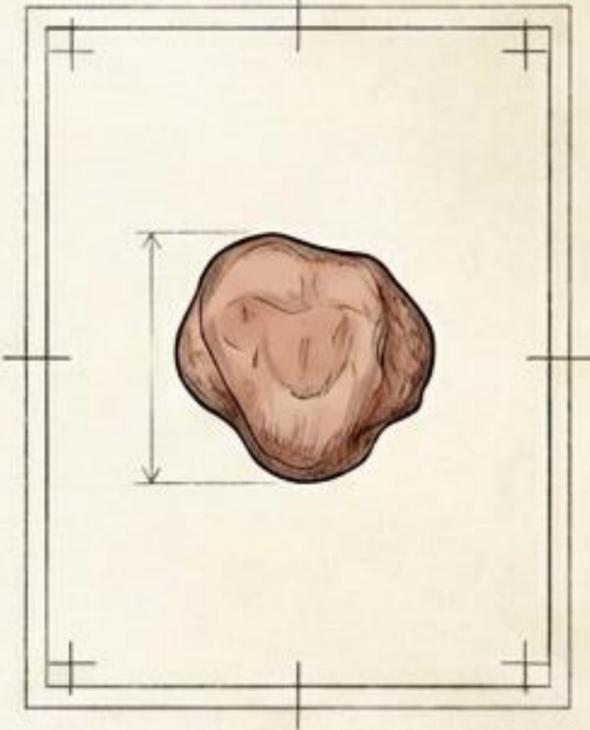
Flat



Irregular



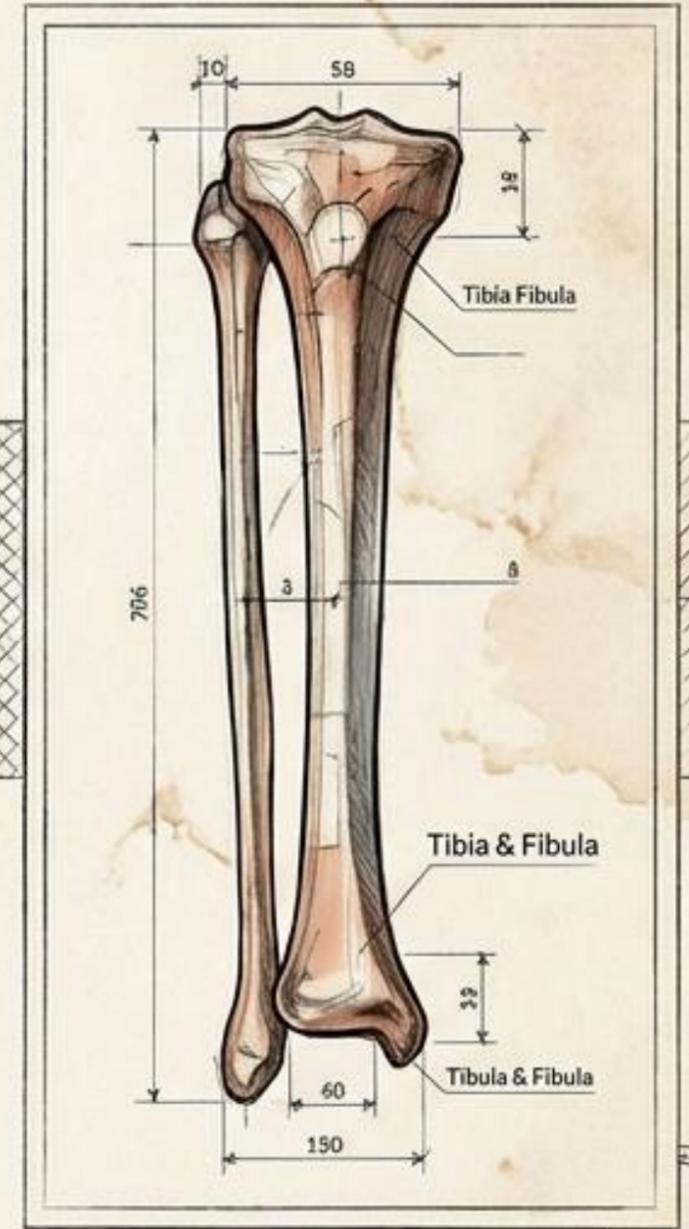
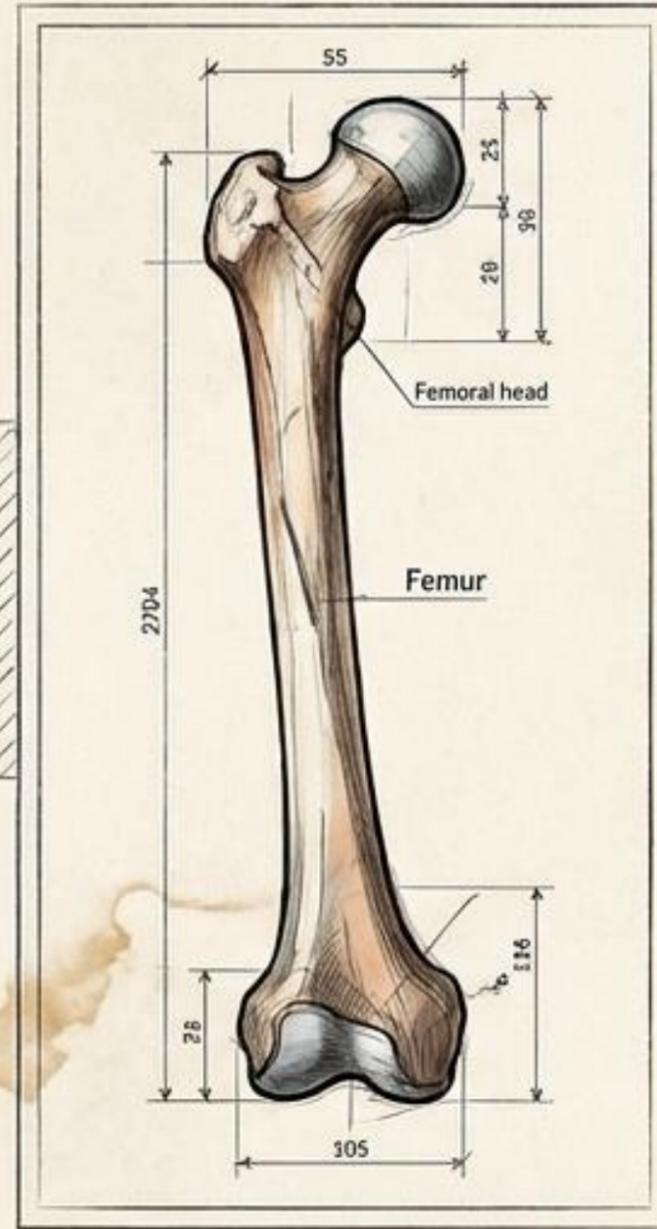
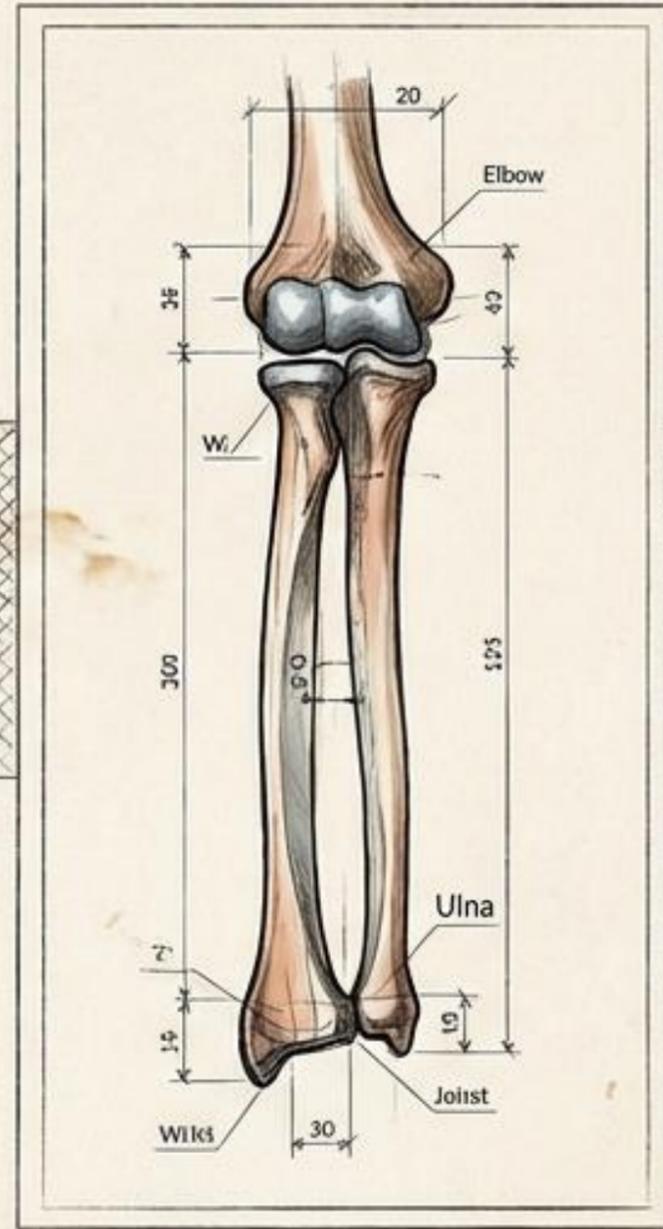
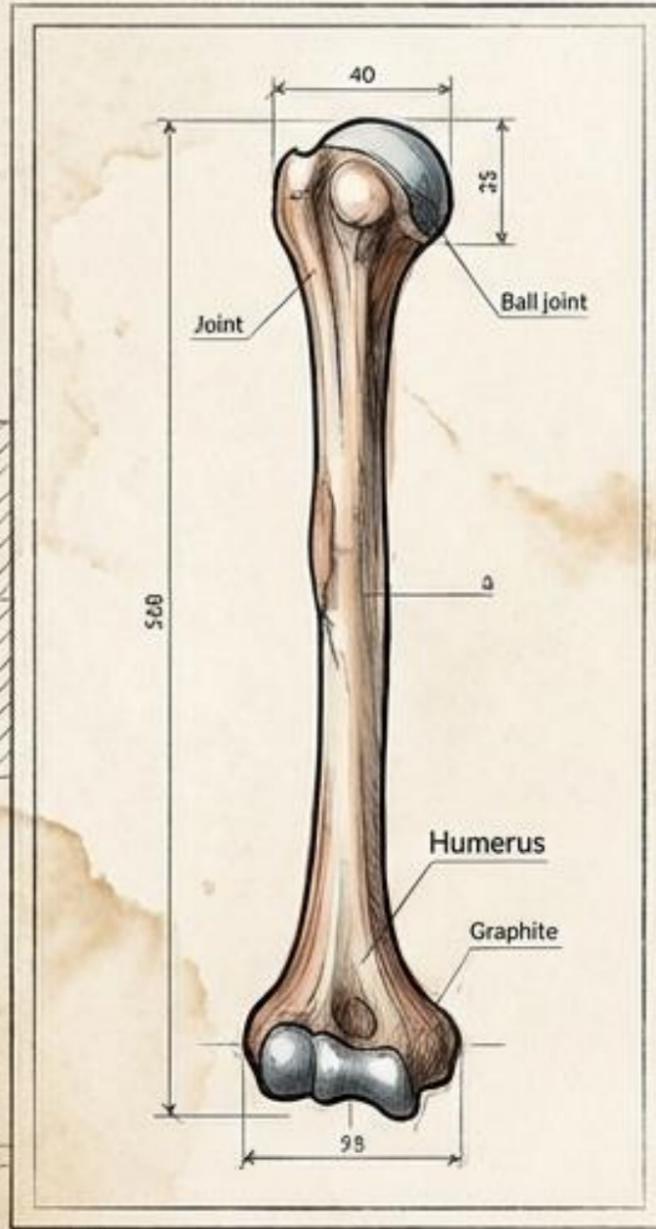
Sesamoid



Bones are classified by their architectural shape and structural function, not merely by their size.

Long Bones: The Levers of Movement

Designed to facilitate large movements and support weight.



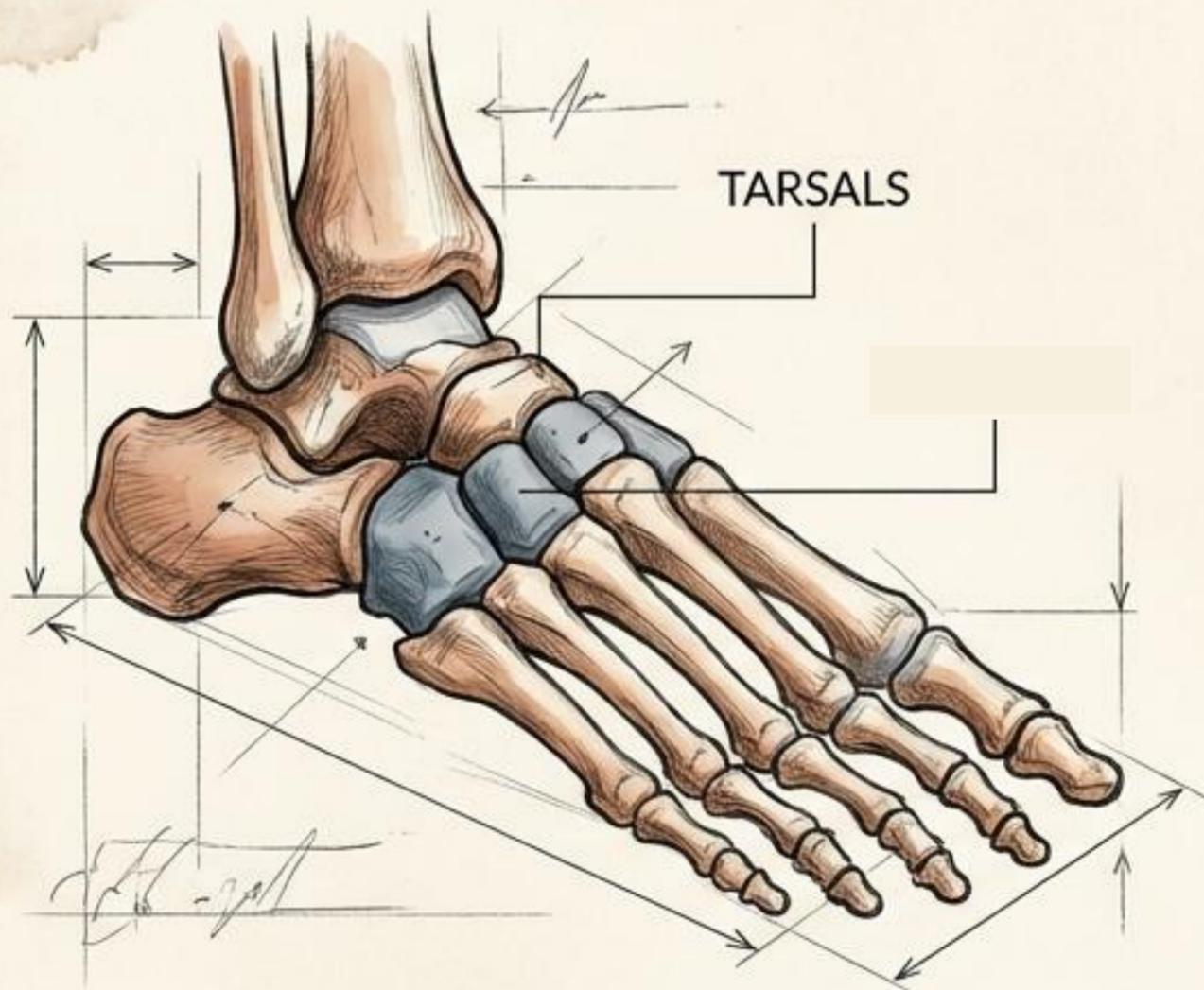
Upper Limb: Humerus, Radius, Ulna, Metacarpals, Phalanges.

Lower Limb: Femur, Tibia, Fibula, Metatarsals, Phalanges.



Short & Sesamoid: Stability and Efficiency

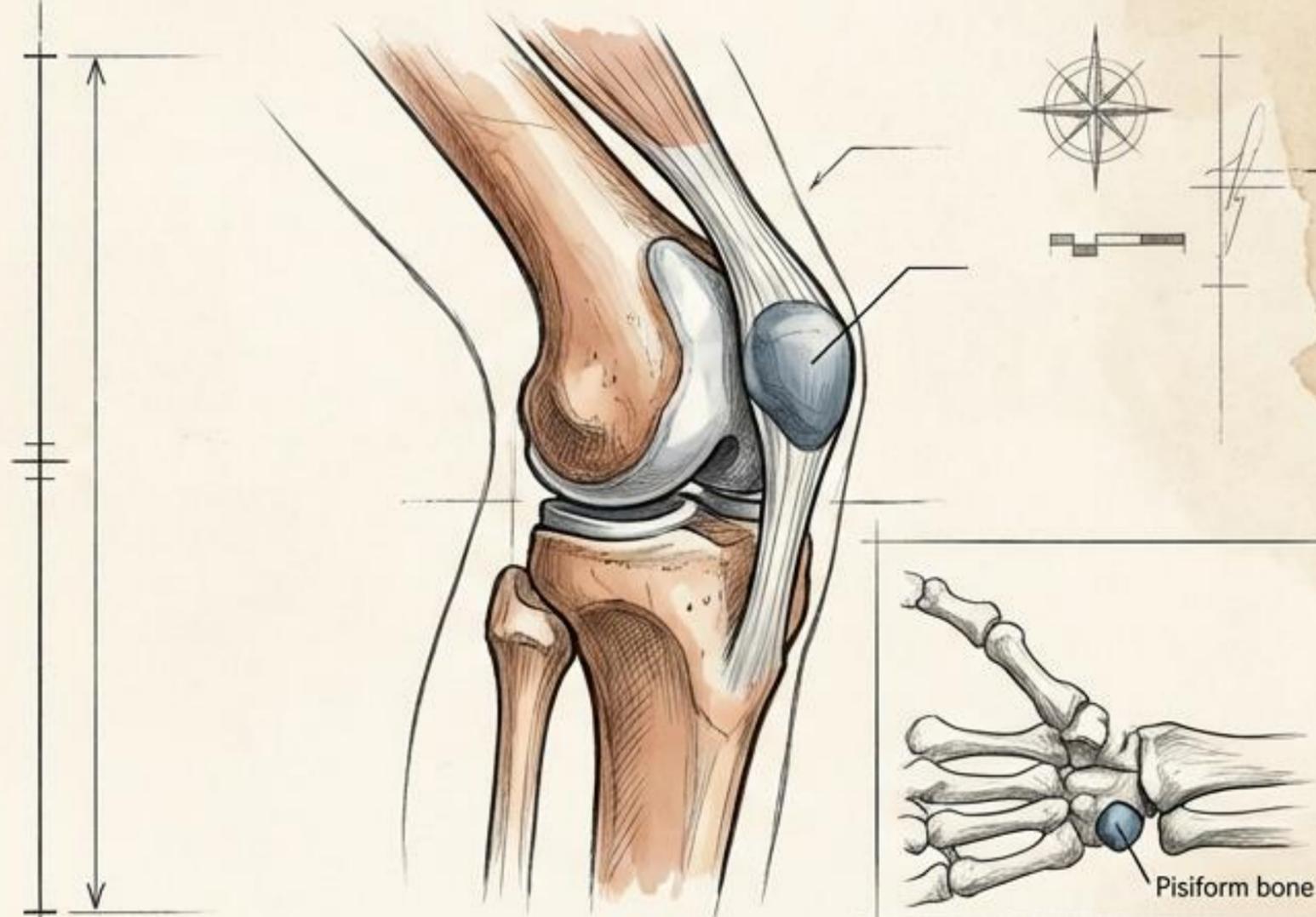
Short Bones



Provide stability with limited movement
(e.g., Carpals, Tarsals).



Sesamoid Bones



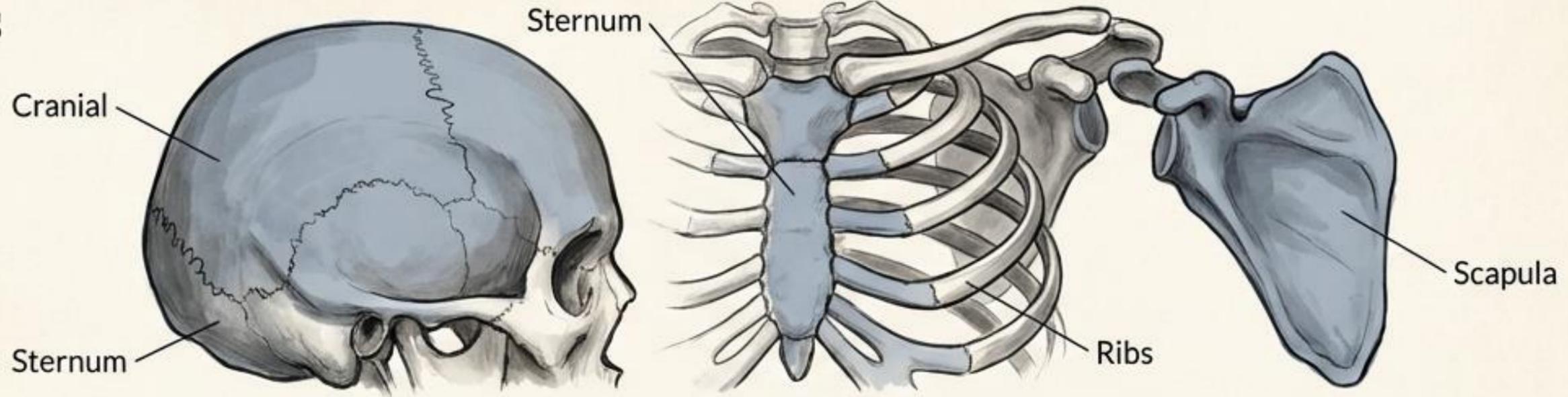
Develop inside tendons to reduce friction.
Example: The Patella (largest) and the Pisiform.



Flat & Irregular: Protection and Complexity

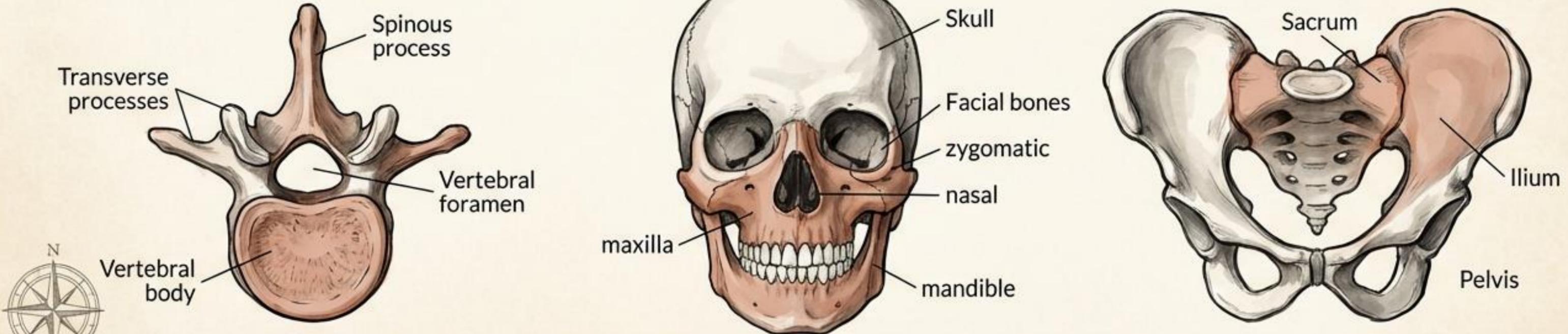


Flat Bones



"Flat bones protect internal organs." Lato

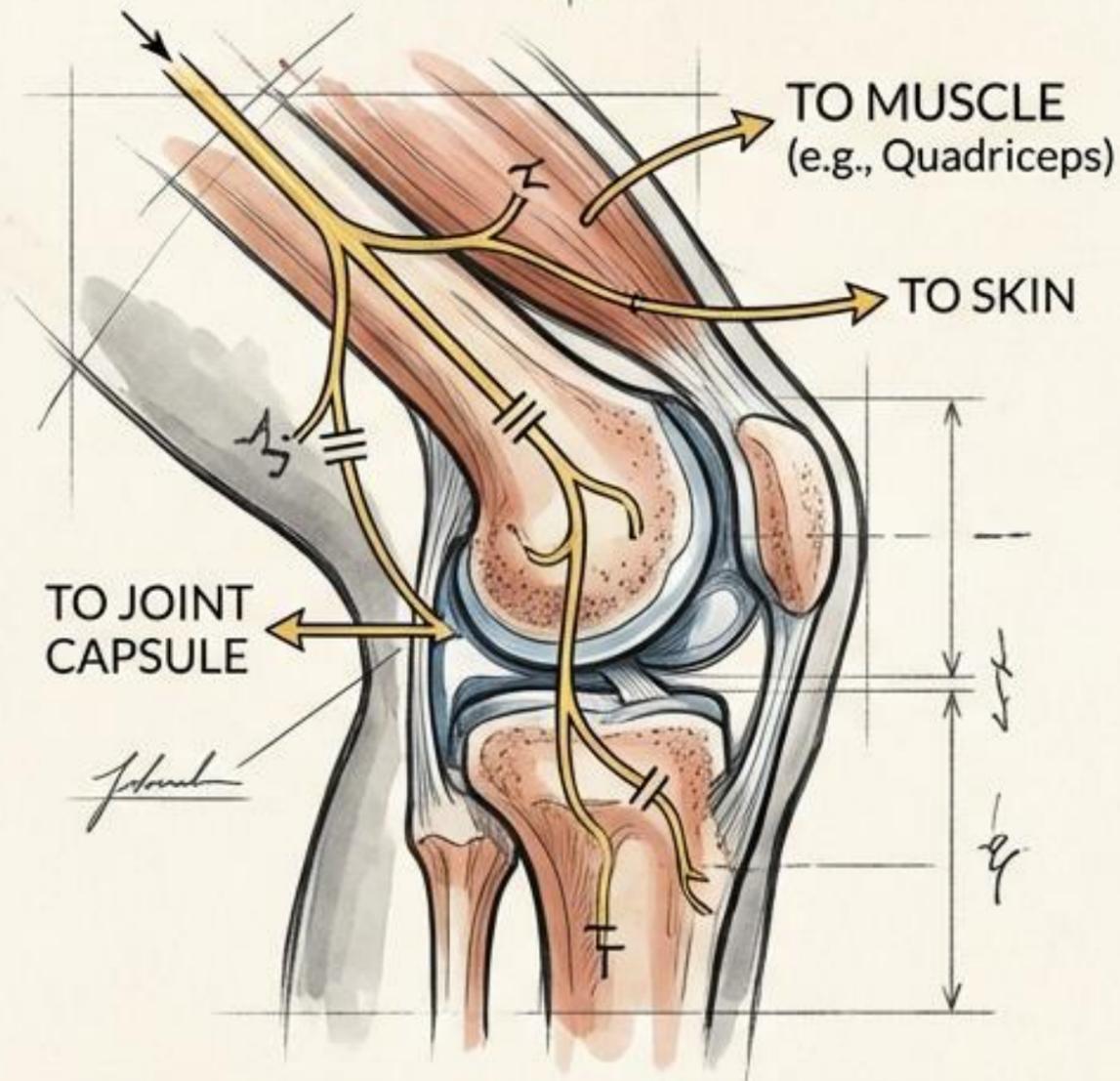
Irregular Bones



"Irregular bones have mixed shapes for complex articulation (Vertebrae, Face, Pelvis)." Lato



Joints: The Places of Union



Engineer's Field Note

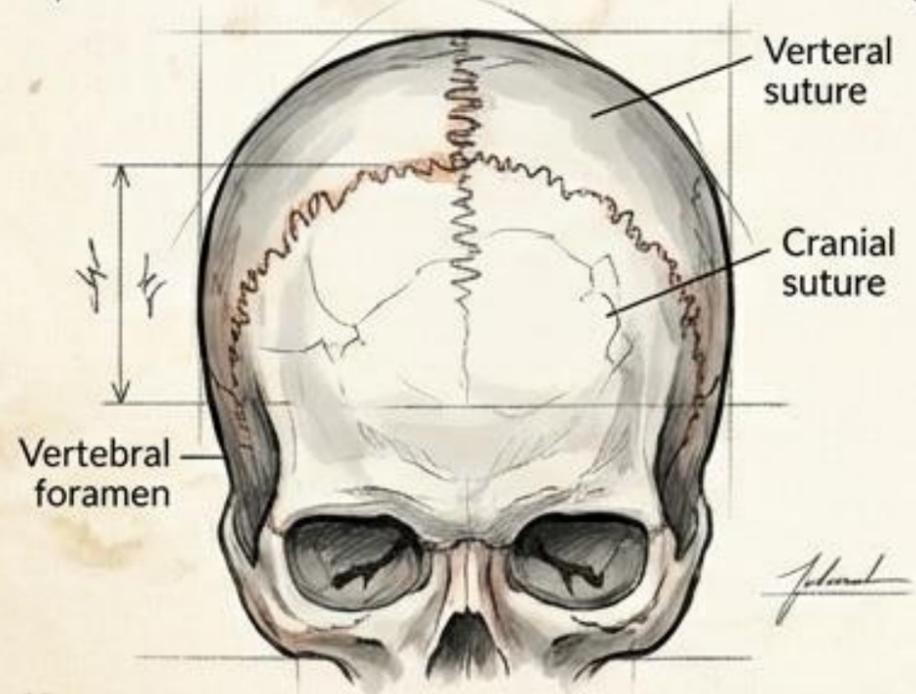
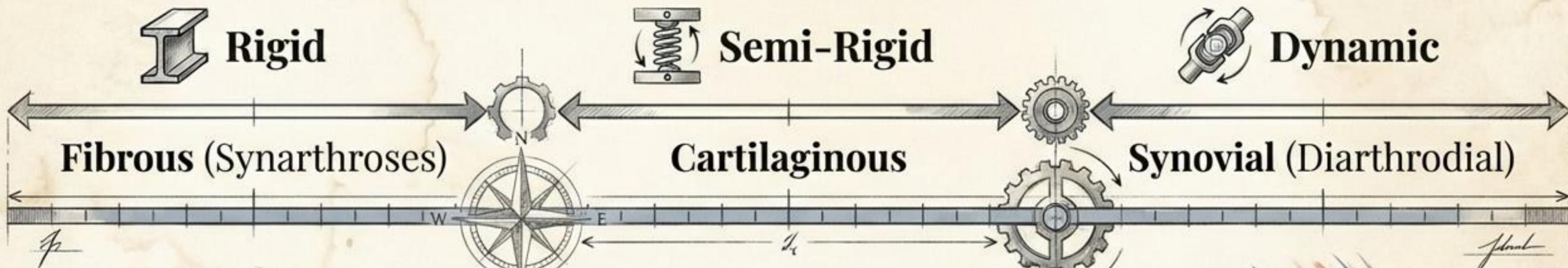
Hilton's Law

The nerve supplying a joint also supplies:

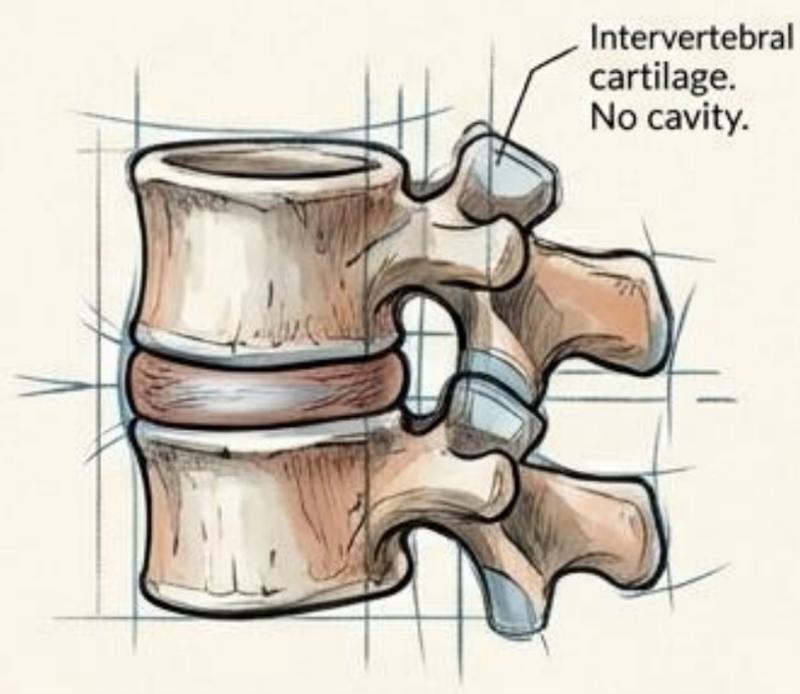
1. The muscles that move the joint.
2. The skin covering the insertion of those muscles.

A joint is the functional union between two or more bones.

The Spectrum of Mobility



Immovable.
Joined by fibrous tissue.
No cavity.



Slightly movable.
United by cartilage.
No cavity.



Freely movable.
Separated by a joint cavity.

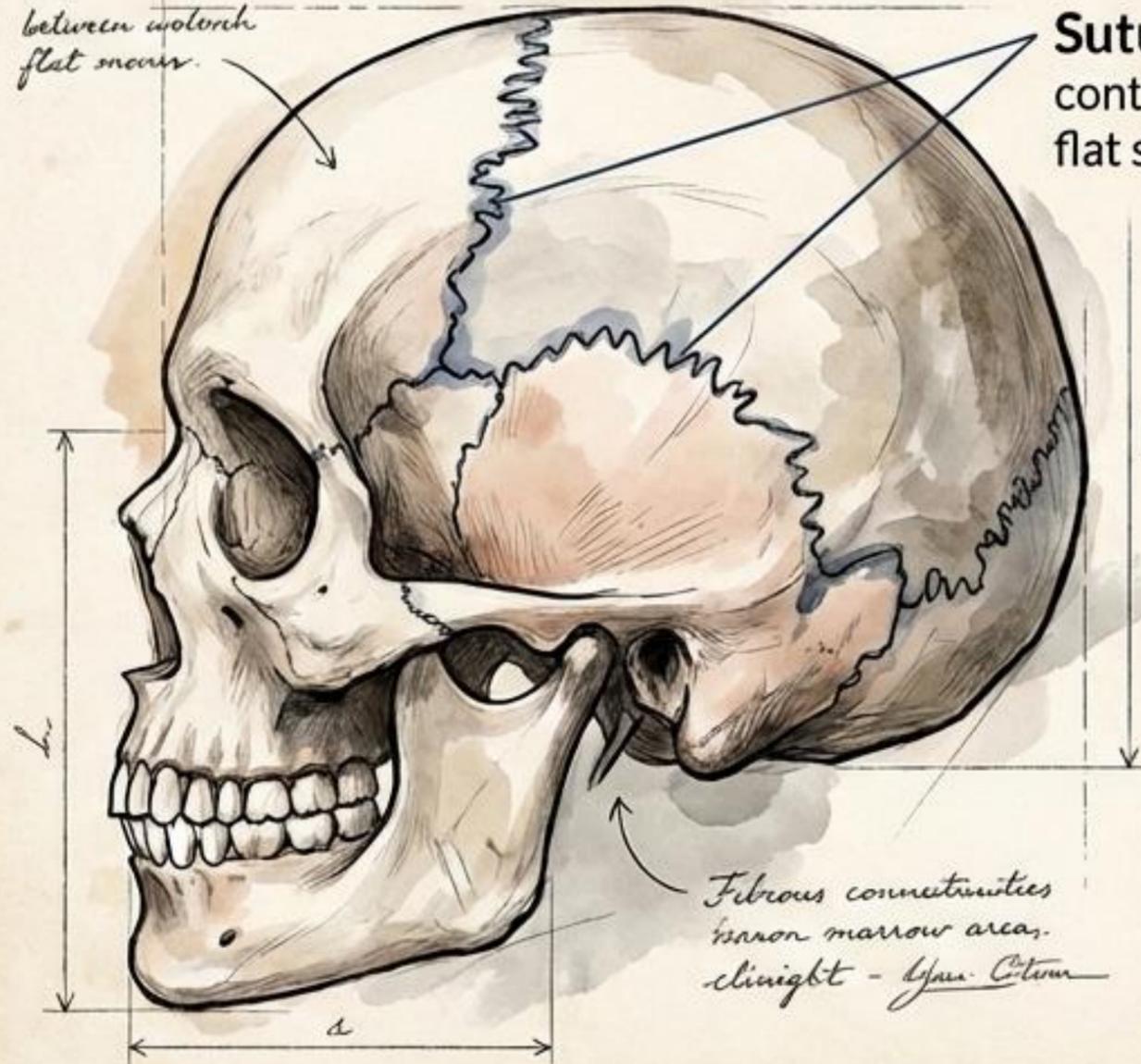


Fibrous Joints (Synarthroses)



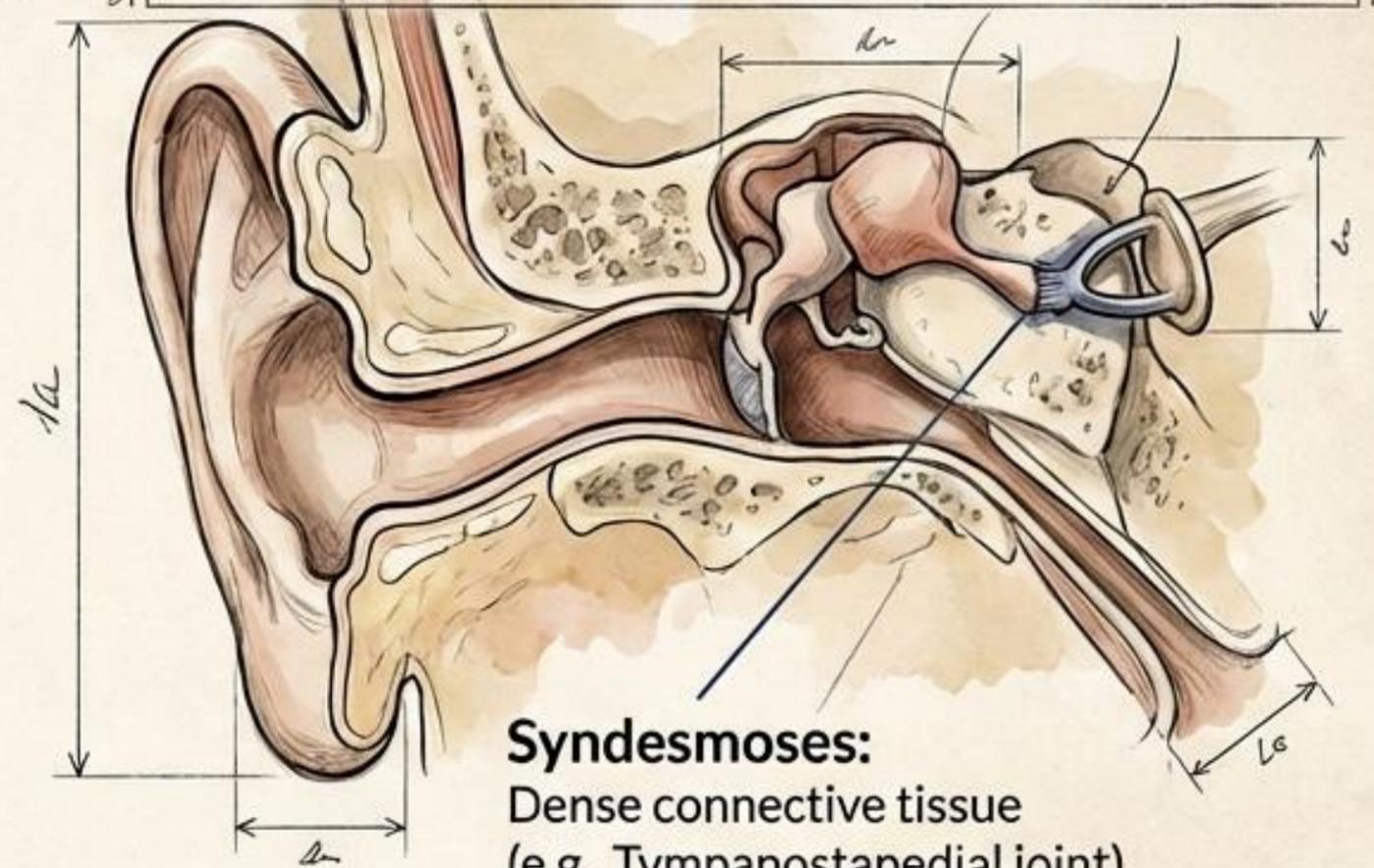
Structural welds connected by dense tissue.

*Line part of the
between each
flat skull bone.*



Sutures: Fibrous continuities between flat skull bones.

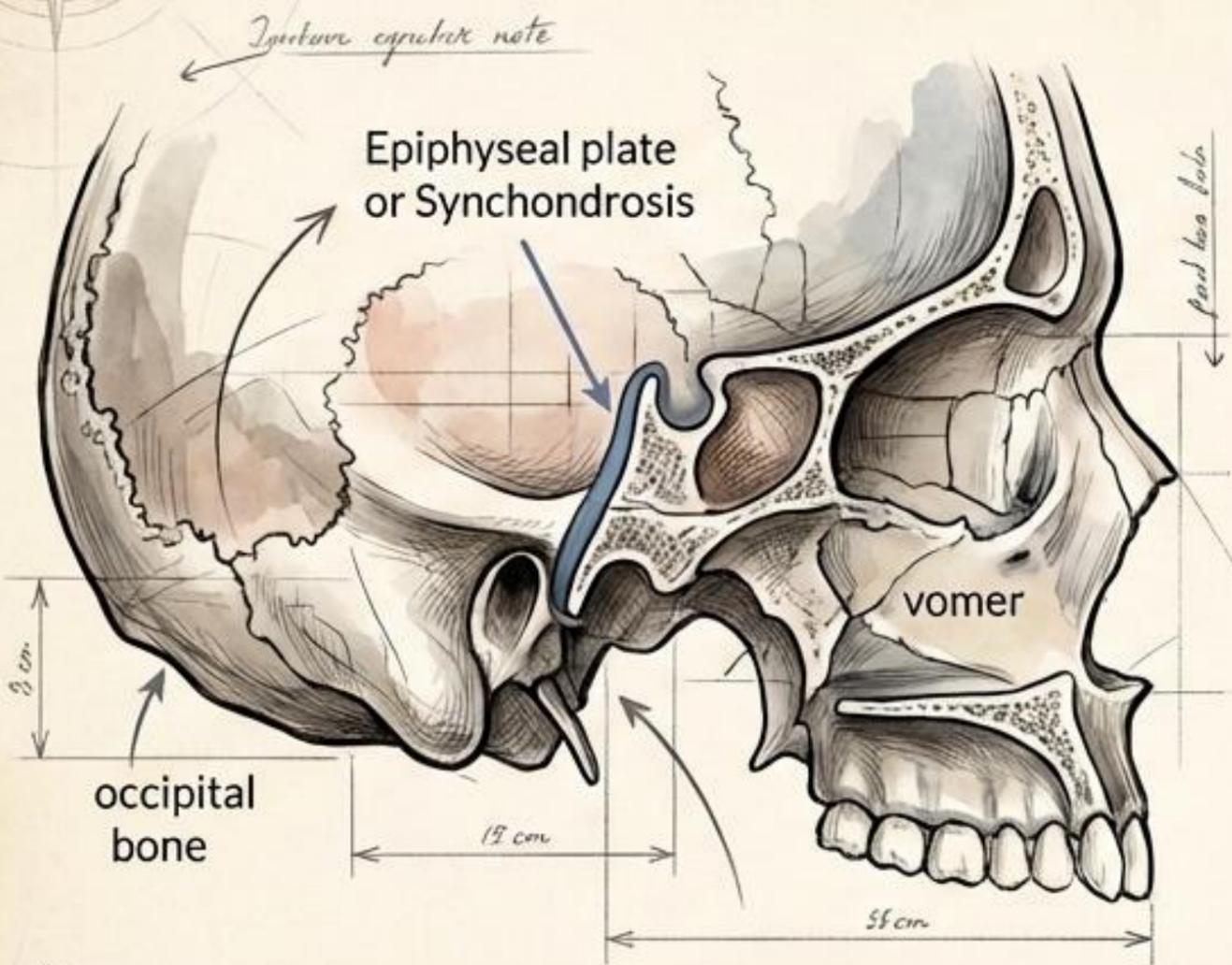
Synarthroses: A functional classification for joints that are largely immovable. Derived from Greek 'syn-' (together) and 'arthron' (joint). Their primary function is to provide strong structural union and protection, rather than movement.



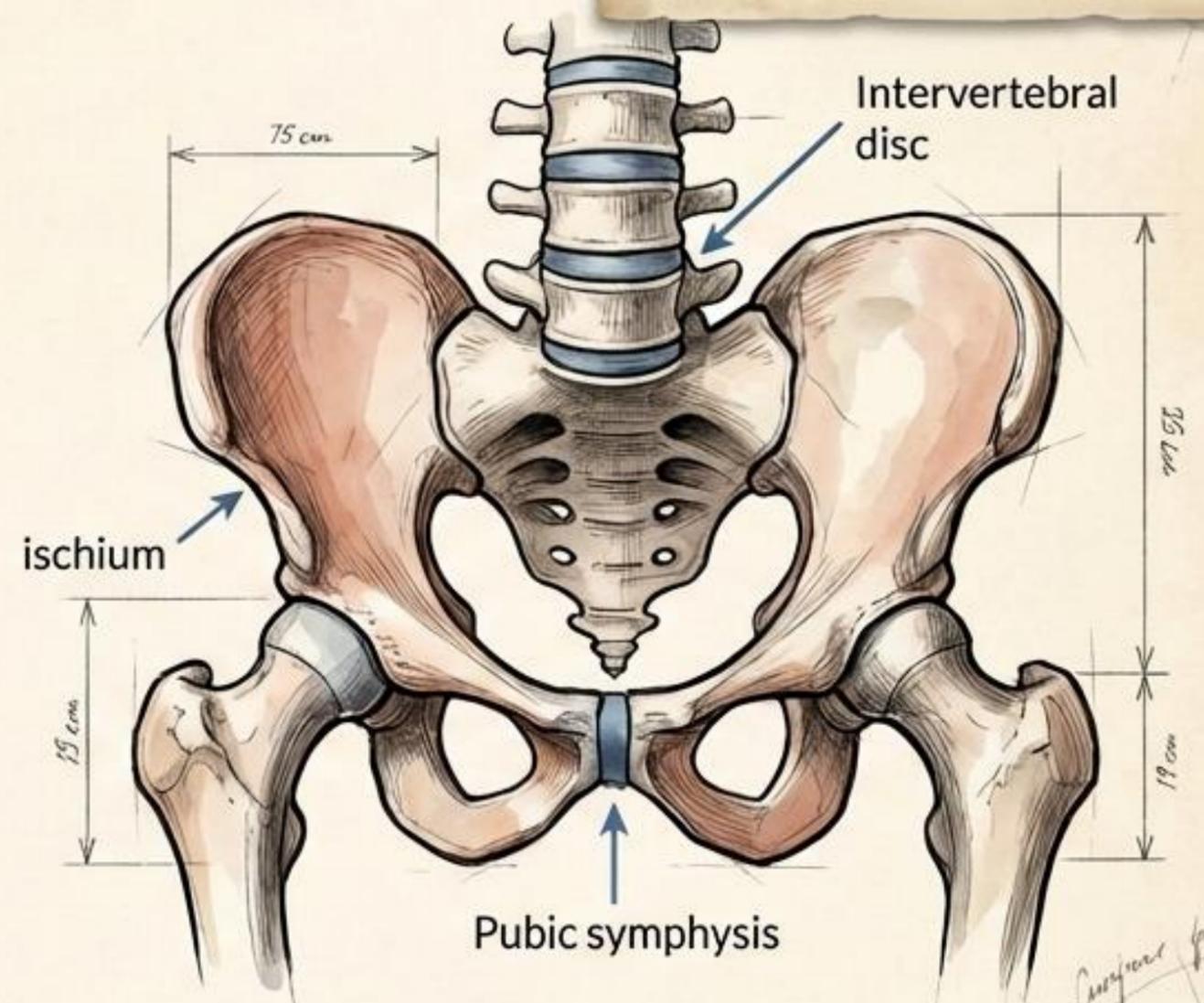
Syndesmoses:
Dense connective tissue
(e.g., Tympanostapedial joint).

Cartilaginous Joints

Linguistic Note: 'syn-' (as in synchondrosis) means 'together' or 'with'. 'sym-' (as in symphysis) also means 'together' or 'with', but is the form used before the letter p.

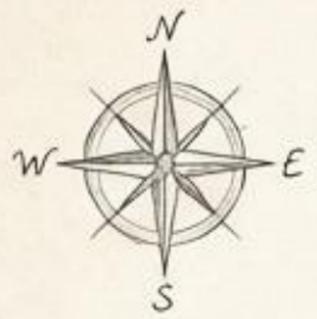


Primary (Synchondroses)
United by Hyaline cartilage.
Allows growth in length.
Immovable.

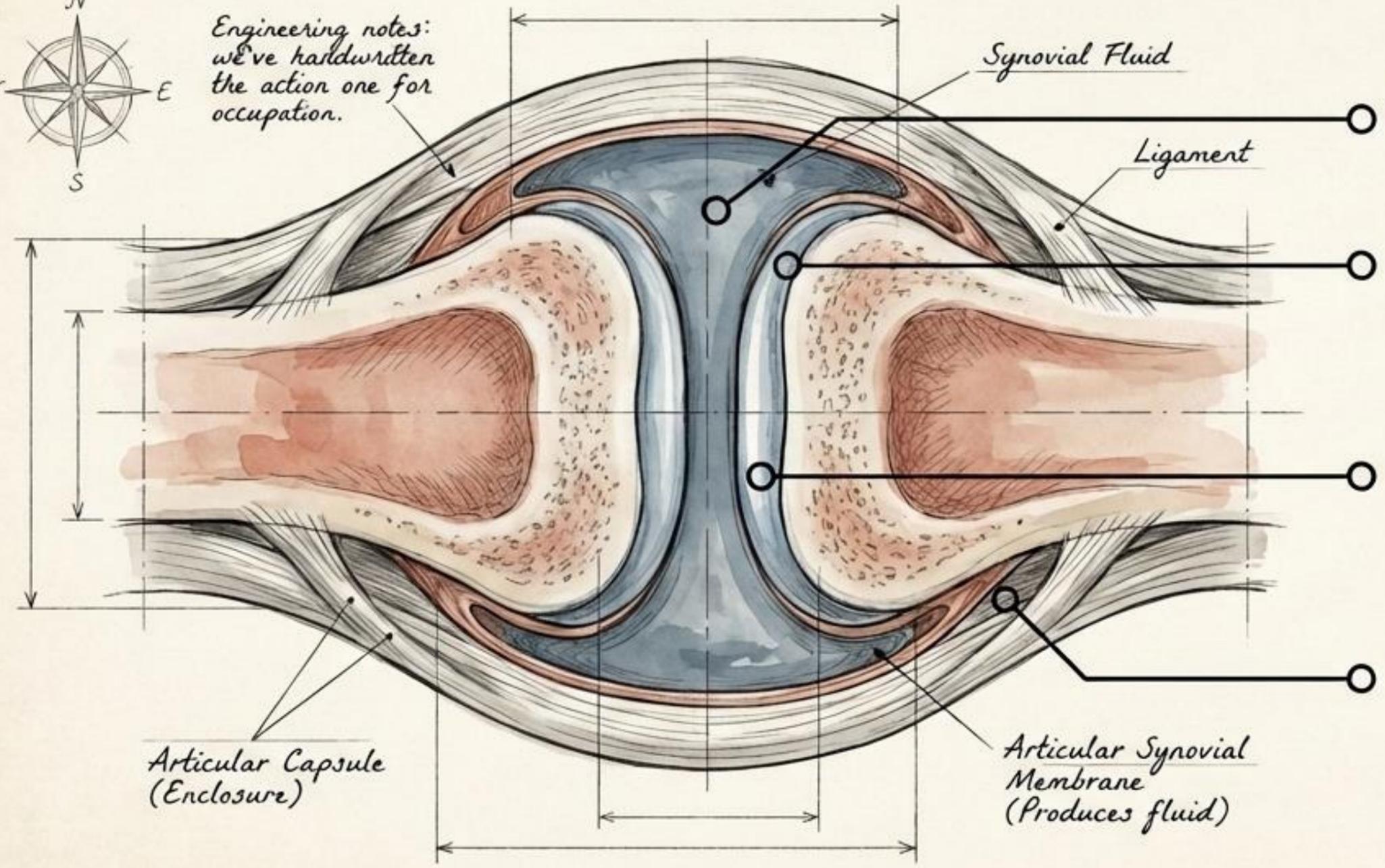


Secondary (Symphyses)
United by Fibrocartilage.
Located in the median plane.
Slightly movable.

The Synovial Joint: A Blueprint for Motion



*Engineering notes:
we've hand-drawn
the action one for
occupation.*

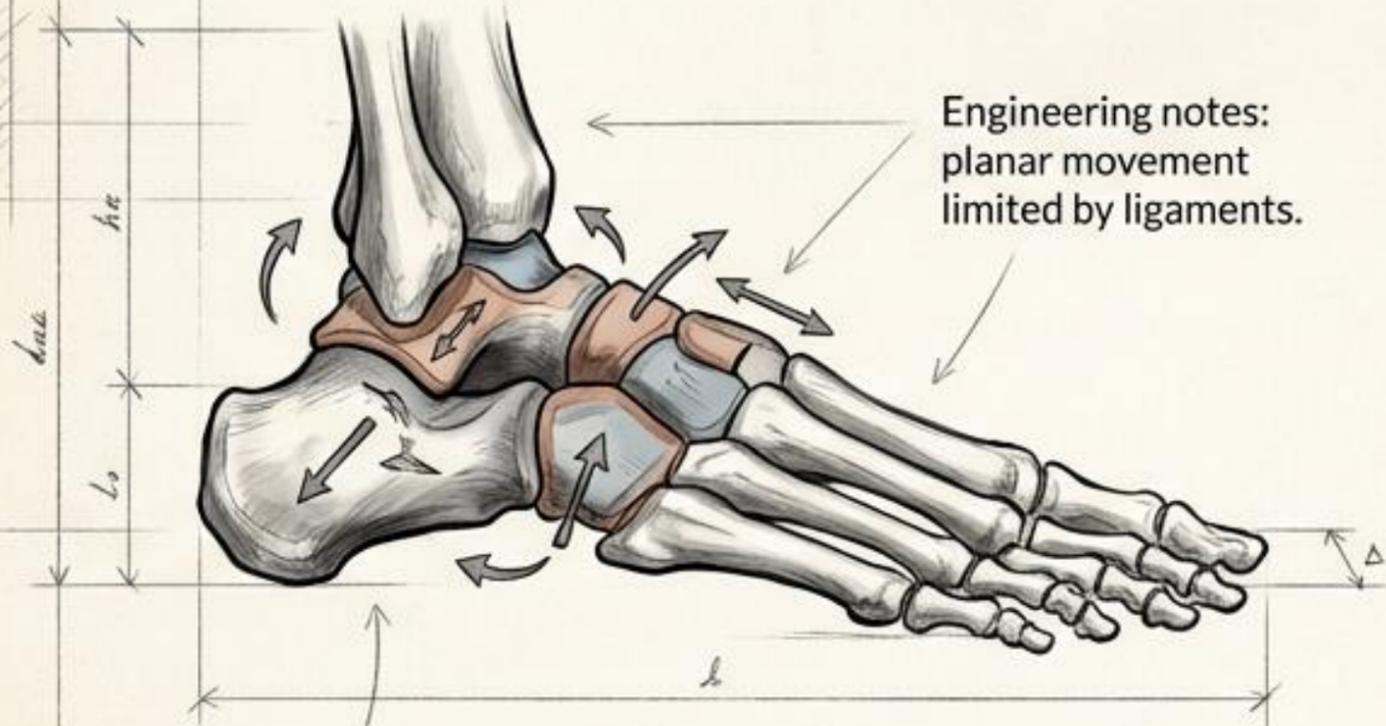


- Joint Cavity (Space)
- Articular Cartilage (Hyaline coating)
- Synovial Membrane (Produces fluid)
- Articular Capsule (Enclosure)

Synovial Mechanics I: Slide & Swing

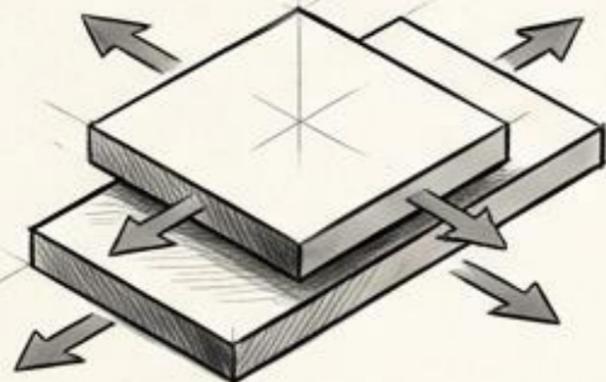


Gliding (Plane) Joints



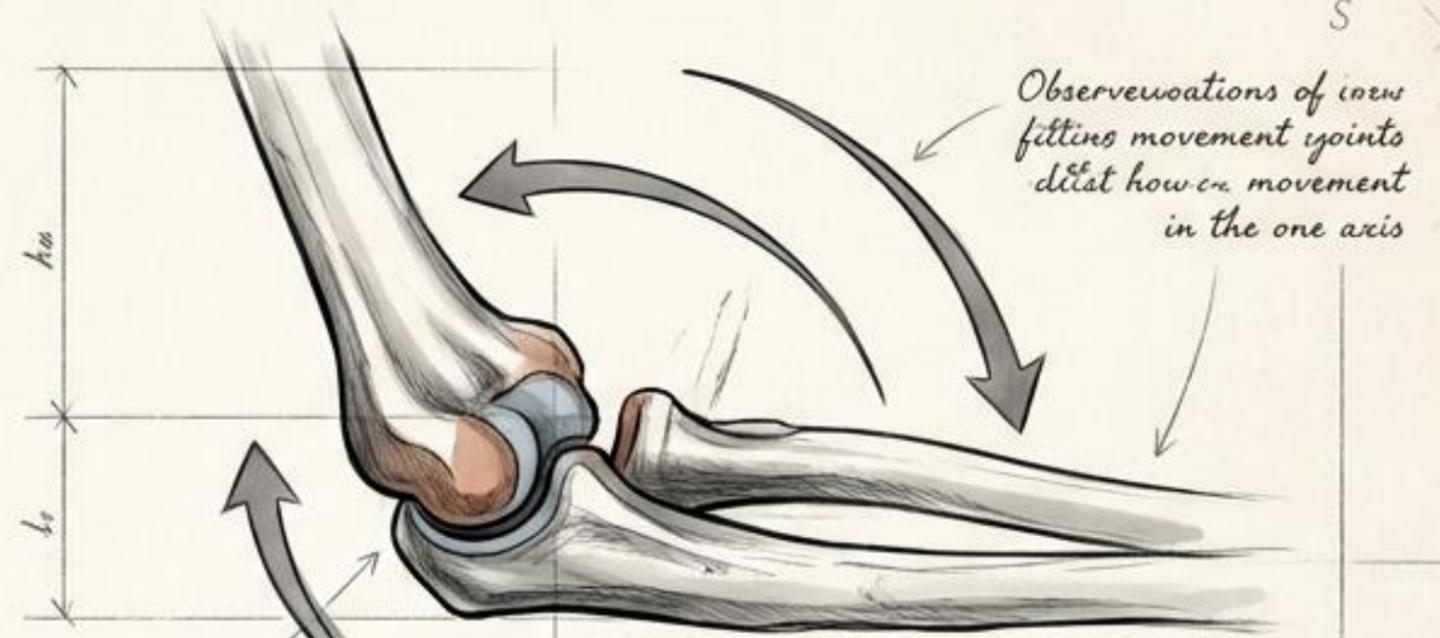
Engineering notes:
planar movement
limited by ligaments.

*Faux-handwritten
observations on planar
movements limited by
planar plane.*



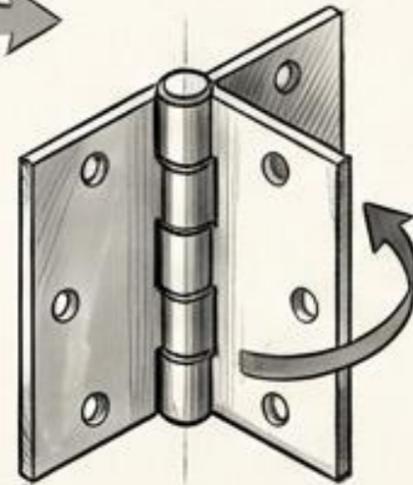
Planar sliding in any direction
Examples: Intercarpal, Intertarsal.

Hinge (Ginglymus) Joints



*Observations of how
fitting movement joints
dictate how movement
in the one axis*

Axis of rotation



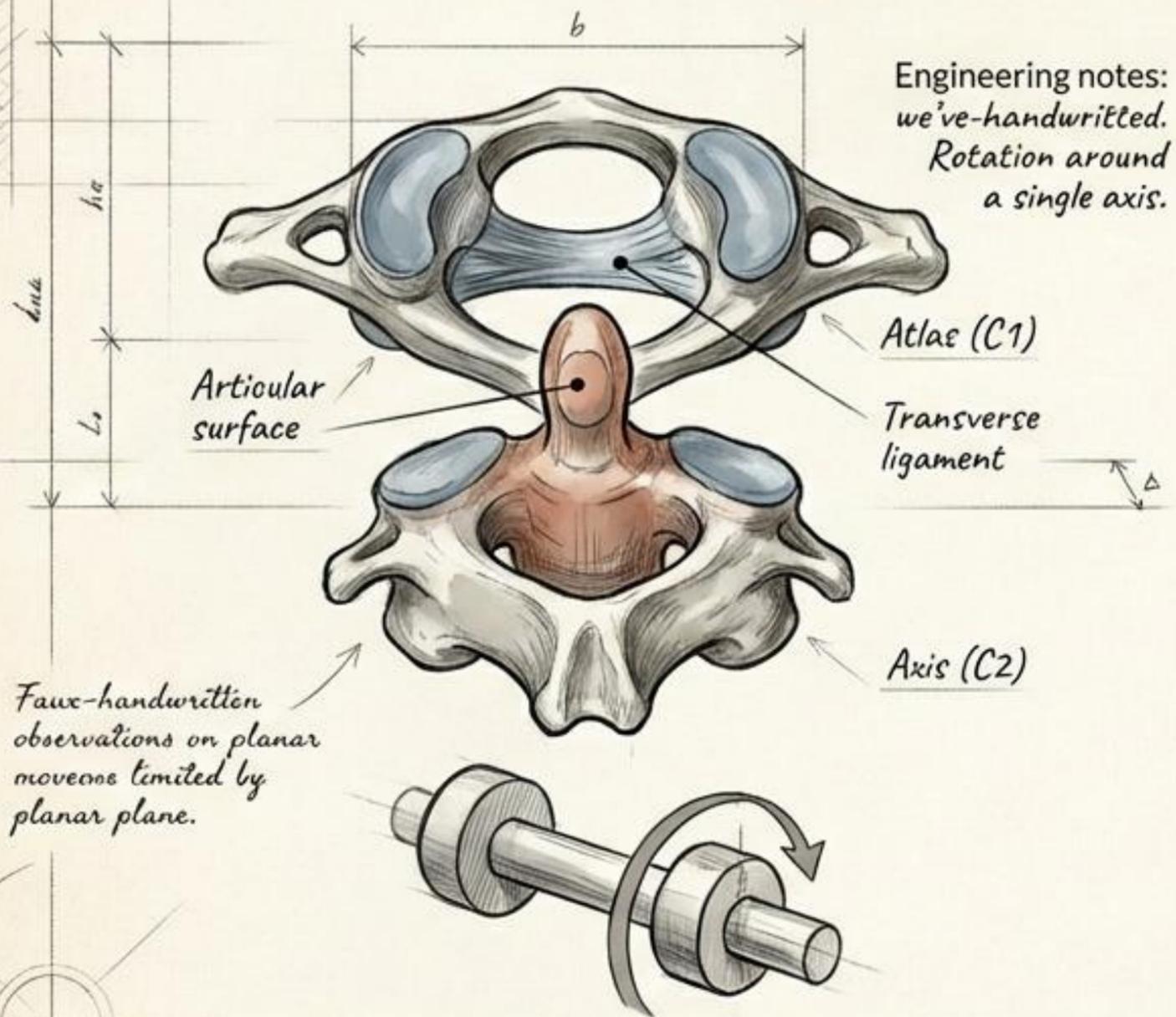
*Observation: Da Vinci
displays the ligaments
measurement, using all
joint to rotate around
axes of copper inos.*

Flexion and Extension only.
Examples: Elbow, Ankle, Interphalangeal

Synovial Mechanics II: Rotate & Rock

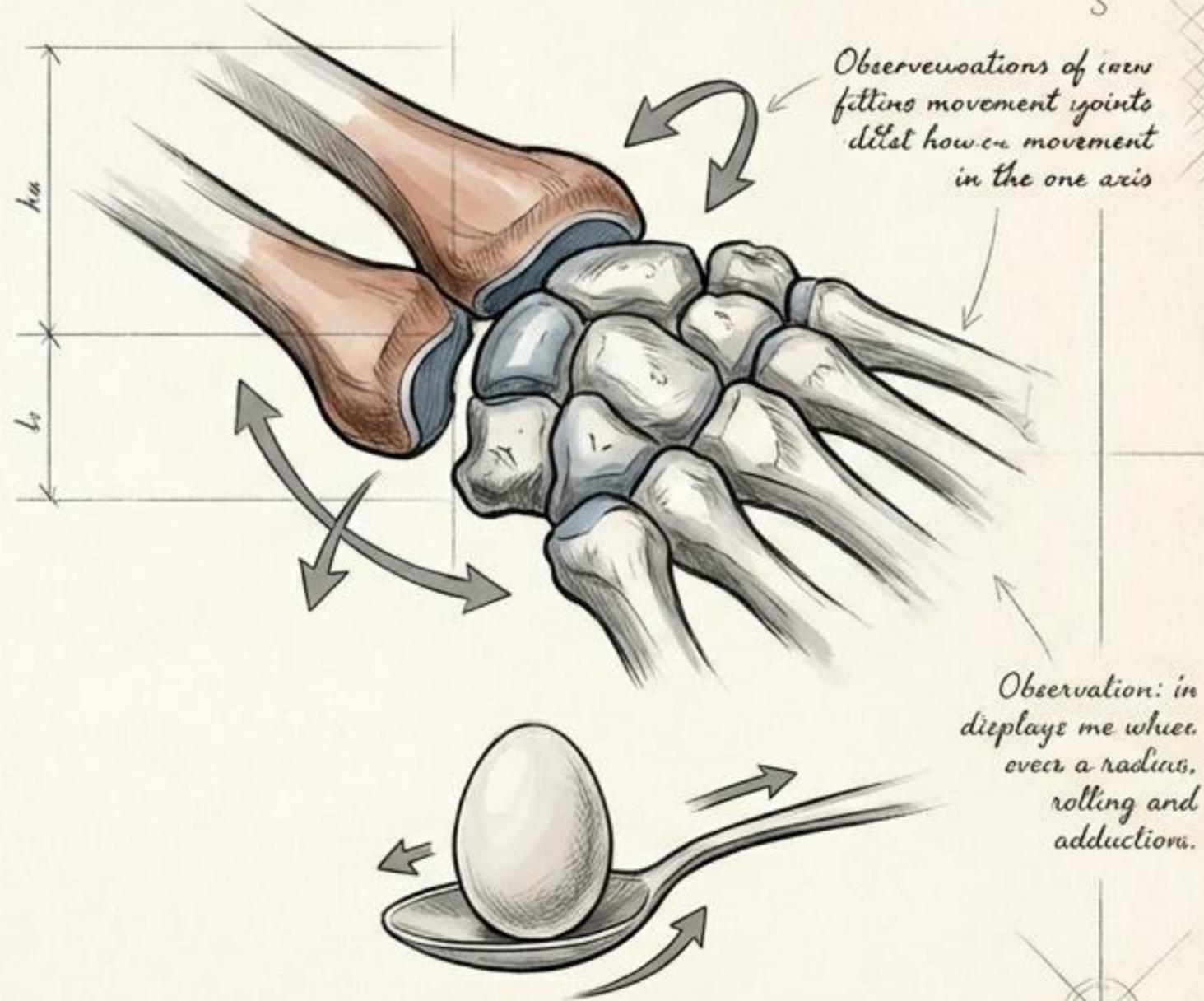


Pivot (Trochoid) Joints



Rotation around a single axis.
Examples: Atlantoaxial joint, Radio-ulnar.

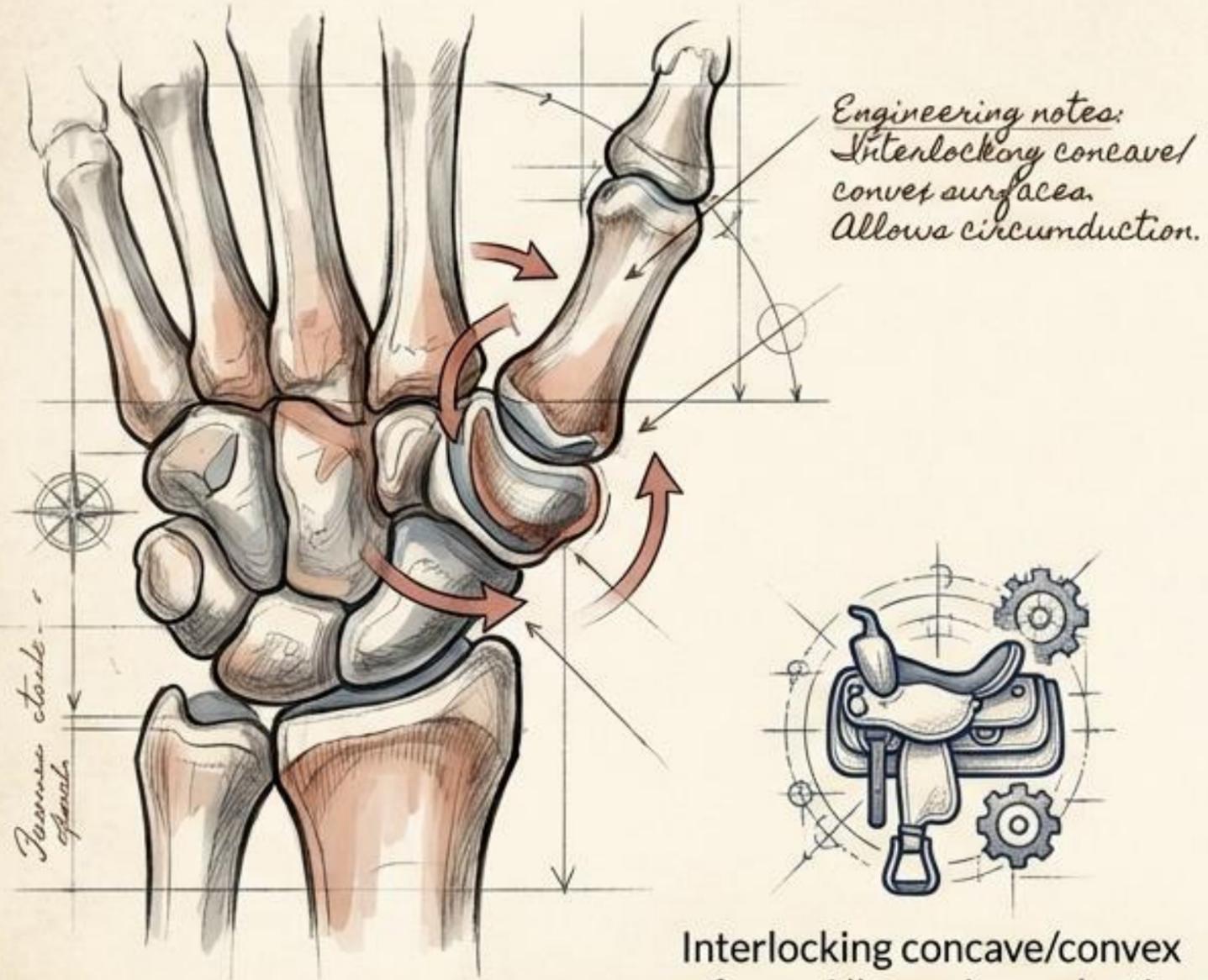
Condylar (Ellipsoidal) Joints



Elliptical movement (Flexion/Extension).
Examples: Wrist (radiocarpal), Knee.

Synovial Mechanics III: Complex Freedom

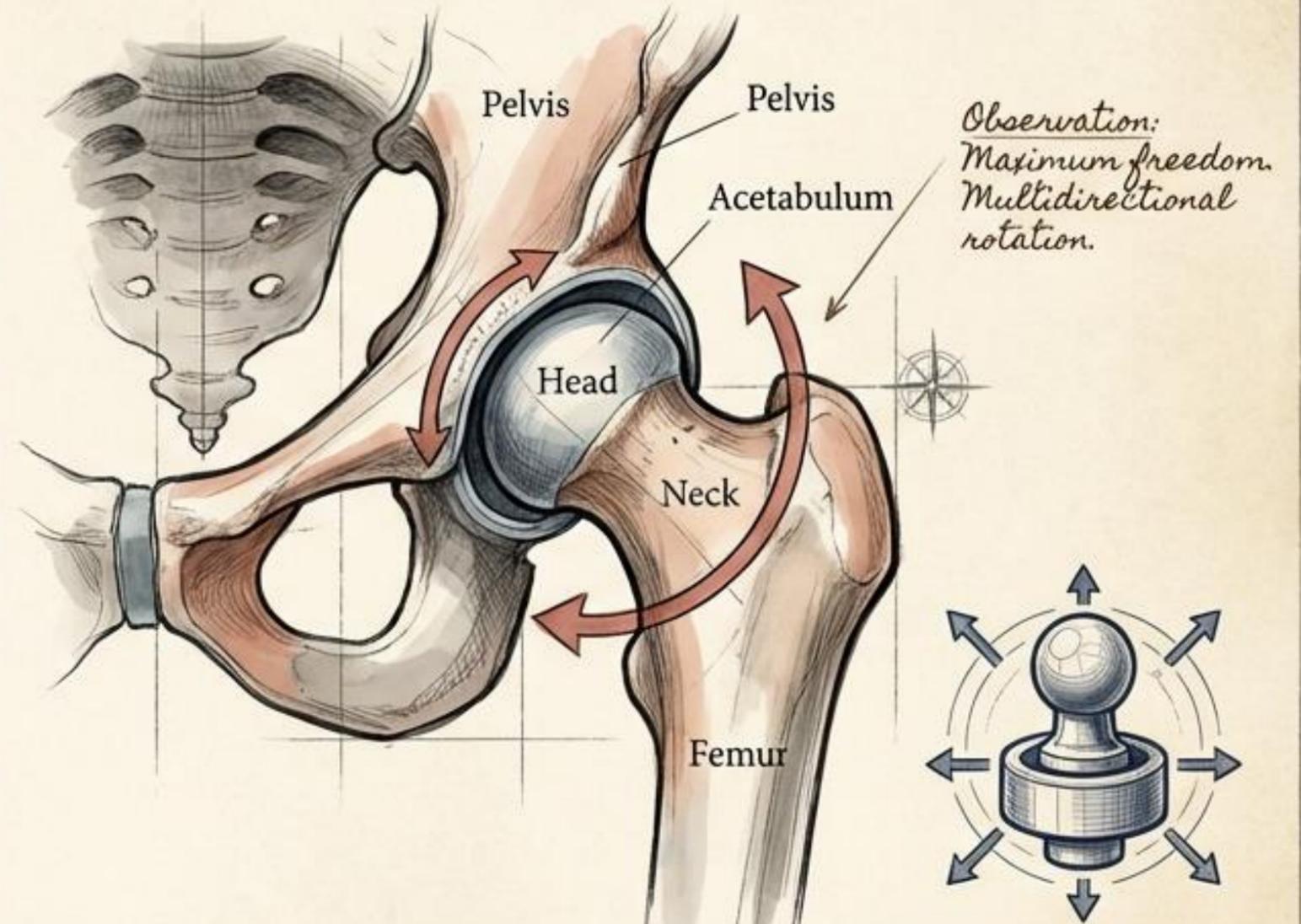
Saddle (Sellar) Joints



Engineering notes:
Interlocking concave/convex surfaces.
Allows circumduction.

Interlocking concave/convex surfaces. Allows circumduction.
Example: Thumb base.

Ball-and-Socket (Spheroidal) Joints



Observation:
Maximum freedom.
Multidirectional rotation.

Maximum freedom.
Multidirectional rotation.
Examples: Shoulder, Hip.

MEDICAL TERMINOLOGY DECODED

(Shape-Based Synovial Joints)

Dr Amal AlBtoosh



Dr Amal AlBtoosh

TEMPOROMANDIBULAR JOINT



Opening

Closing

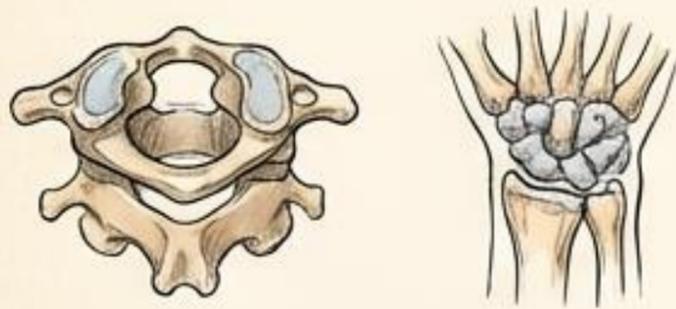
Protrusion

Lateral movement

Essential for
occlusion &
mastication.

Synovial Mechanics: Summary

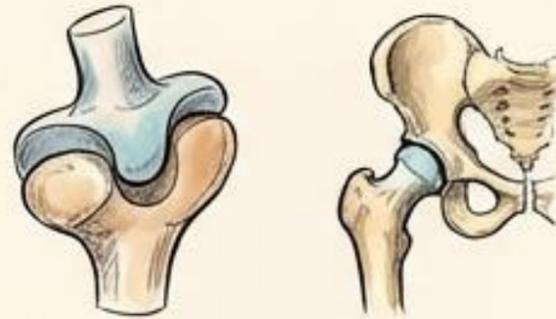
Rotate & Rock



Pivot (Trochoid): Single axis rotation (e.g., C1-C2).

Condylar (Ellipsoidal): Elliptical movement (e.g., Wrist, Knee).

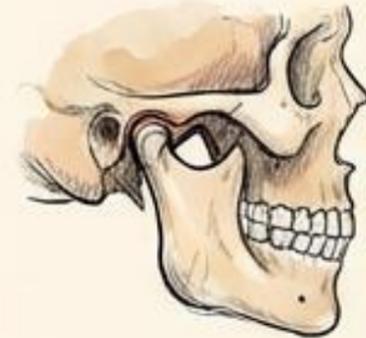
Complex Freedom



Saddle (Sellar): Interlocking surfaces, circumduction (e.g., Thumb base).

Ball-and-Socket (Spheroidal): Multidirectional rotation, max freedom (e.g., Shoulder, Hip).

Specialized Joint

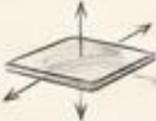


TMJ: Complex hinge & gliding for occlusion & mastication.

Opening, Closing, Protrusion, Lateral.

Key Principle: Joint structure dictates its function and range of motion.

Anatomical Summary

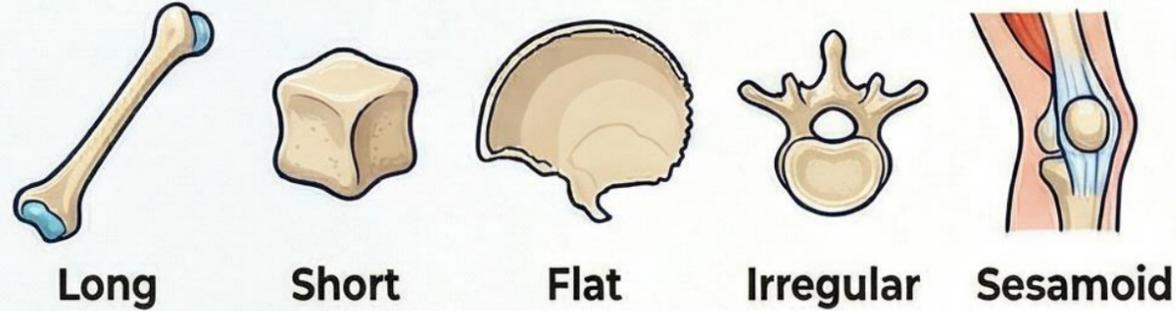
Joint Type	Primary Action	Key Example
Pivot 	Rotation	Atlas/Axis 
Hinge 	Flexion/Extension	Elbow 
Saddle 	Multi-axial/Thumb Opposition	Thumb 
Plane 	Gliding	Tarsals 
Condylloid 	Flexion/Extension	Wrist 
Ball-and-Socket 	All directions	Hip/Shoulder 

Structure dictates function: The architectural shape of the bone determines the freedom of the joint.

Anatomy of the Human Skeletal System: Bones and Joints

Bone Classification

Five Primary Bone Categories



The Unique Role of Sesamoid Bones

Develop in tendons to reduce friction; the patella is the largest example.

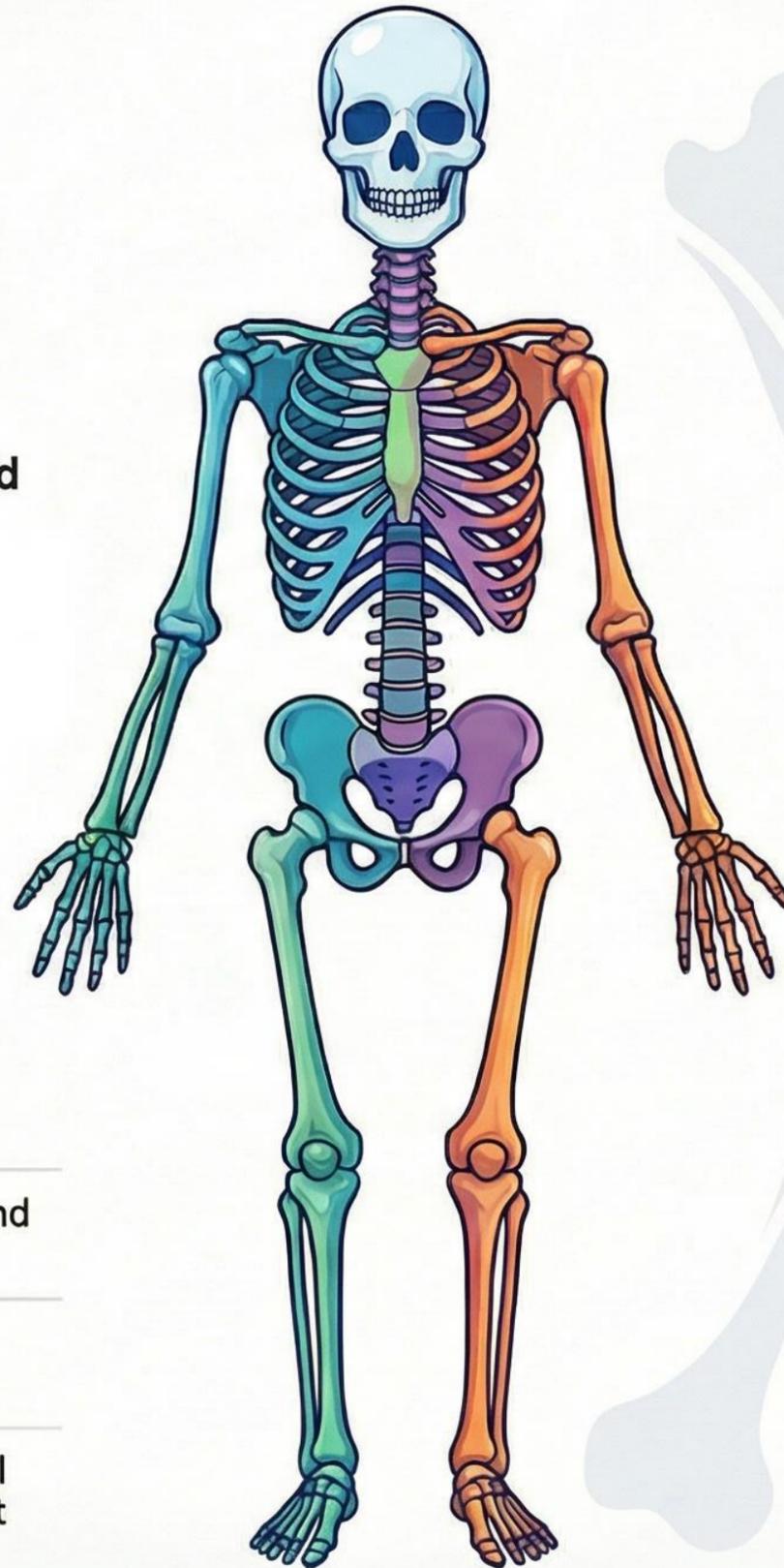
Structural Diversity in the Skeleton

Examples include long humerus, short carpals, flat cranial bones, and irregular vertebrae.

Joint Mechanics

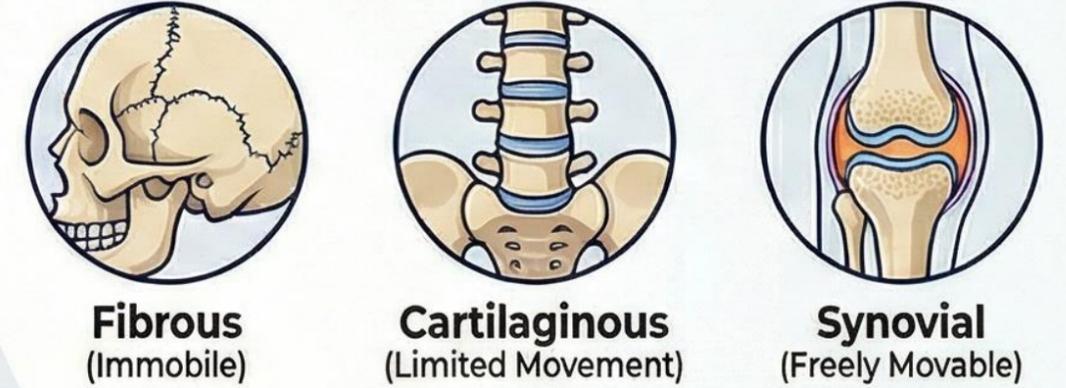
Common Synovial Joint Mechanics & Locations

Joint Type	Primary Movement	Example Location
 Ball-and-Socket	Multi-directional	 Shoulder and Hip Joints
 Hinge	Flexion and Extension	 Elbow and Knee
 Pivot	Rotation Only	 Atlantoaxial (Neck) Joint

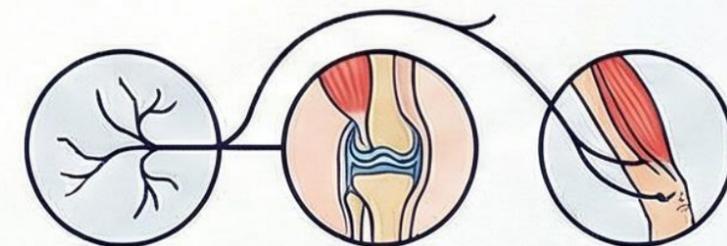
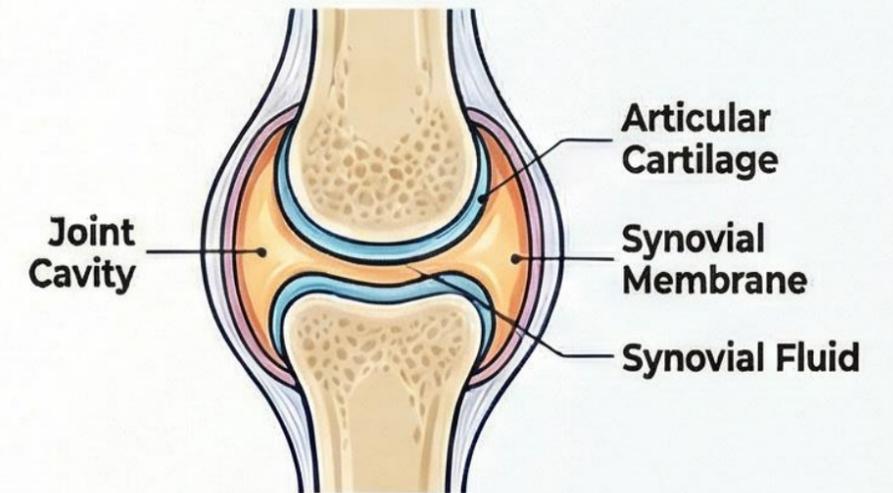


Joint Classification & Mechanics

Three Structural Joint Types



The Anatomy of Synovial Joints



Hilton's Law of Innervation

The nerve supplying a joint also supplies the muscles and skin nearby.