



Academic year 2021-2022

2nd year S3

Musculo-Skeletal System

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The Skeletal System: Bones and Joints

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References: Moore, K.L. and Dalley, A.F. Clinically Oriented Anatomy, 8th Edition. Lipincott Williams and Wilkins, 2018.



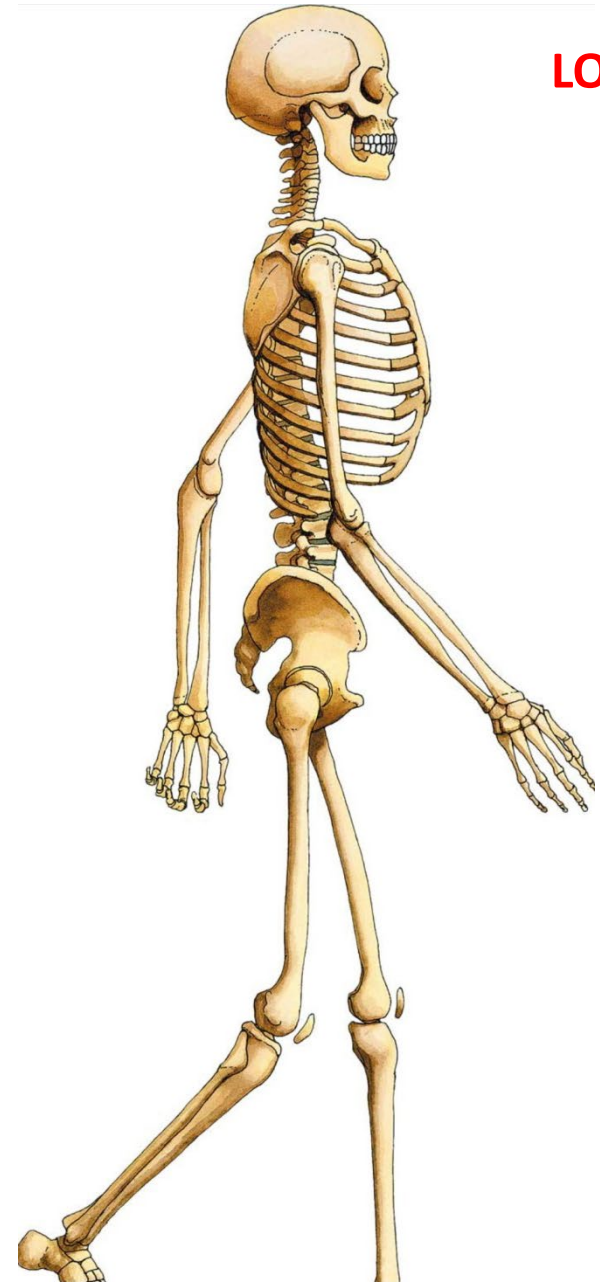


Learning Objectives (LO):

- Outline the structural, mechanical and physiological functions of the skeleton and relate the forms of bones to their function. **LO1**
- Outline the general structural and functional features of joints (particularly a synovial joint) and ***describe the structural basis and causes of joint injuries (e.g. dislocation, fractures and sprain), joint disorders (e.g. bursitis, arthritis) and pathology of joints and connective tissue which affect movement.*** **LO2**

The Skeleton – General Points

- Adult skeleton made up of 206 bones:
 - 8 (cranial), 6 (auditory ossicles), 14 (facial) , 26 (vertebral column), 26 (hyoid, sternum & ribs), 64 (upper limb) & 62 (lower limb).
- * Bones – vary in shape and size.
- * Each bone links with others to form a sturdy, flexible framework.



The Skeleton – General Points

LO1

* Structure of the skeleton designed to:

Give and maintain the shape.

Support and protect the soft tissues and vital organs of the body.

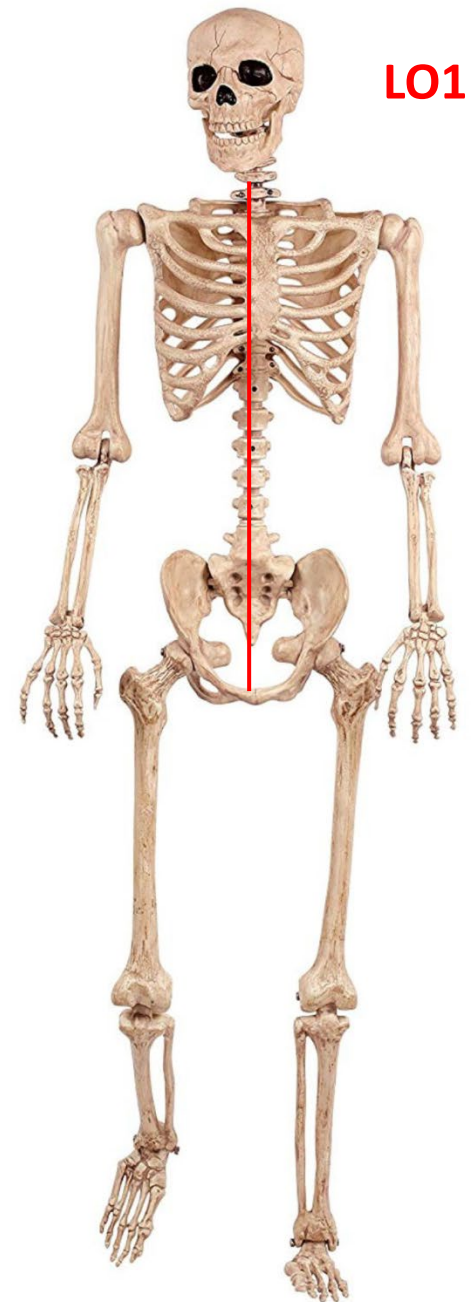
Movement.

Storage of calcium and phosphate.



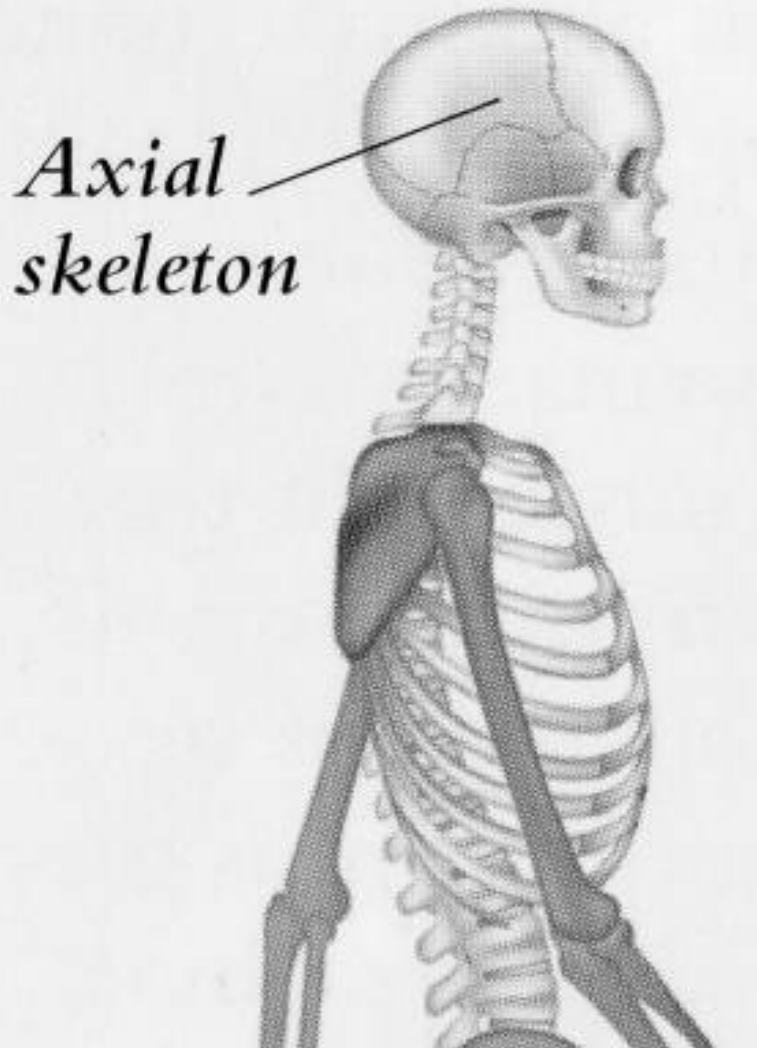
The Skeleton - Divisions

- Bilaterally symmetrical
- Two main divisions
 - **Axial** skeleton
 - **Appendicular** skeleton



LO1

The Axial Skeleton



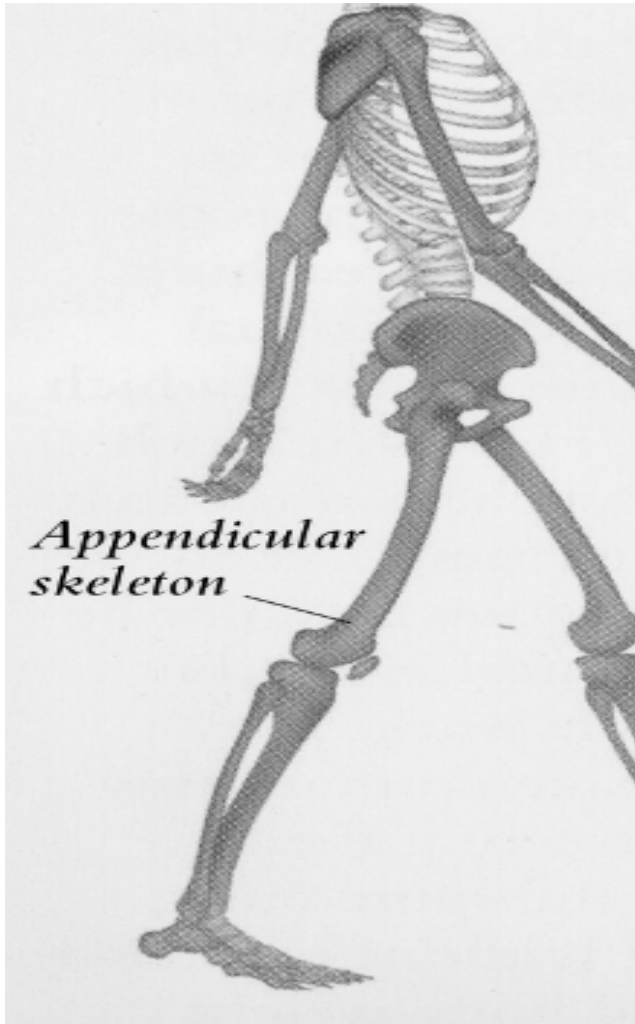
- Bones of the central part of the body:
- Skull
- Vertebral (spinal) column
- Ribs and the sternum.

The Skeleton - Divisions

- Axial skeleton (mainly) protective role for some of the body's vulnerable & vital parts:
 - Skull – brain
 - Vertebral column – the spinal cord
 - Ribs cage – the heart & lungs

The Appendicular Skeleton

LO1



- Bones of the upper and lower limbs.
- The scapulae (shoulder blades) and the pelvis – linking structures between limbs and the axial skeleton.
- Main function: mobility

Functions of Bone

Mechanical and Physiological:

- **Mechanical:**

- # Support – rigid framework

- # Protection – enclose vital structures & viscera

- # Body movement – together with attached muscles and the joints.

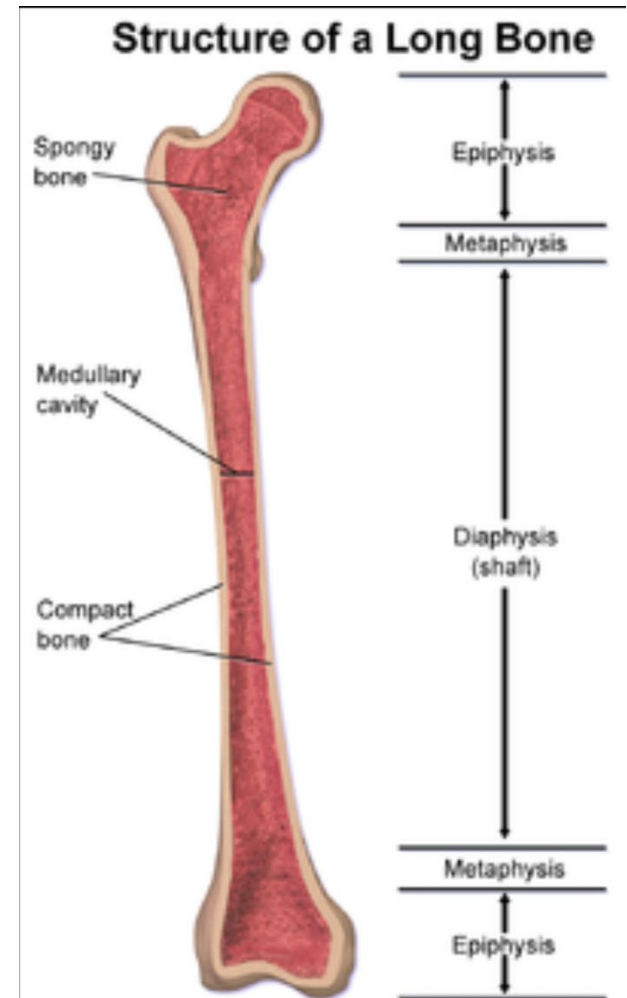
Functions of Bone

✓ **Physiological:**

- Haemopoiesis – in red marrow
- Mineral storage – in bone matrix

Types of Bones – General Shape LO1

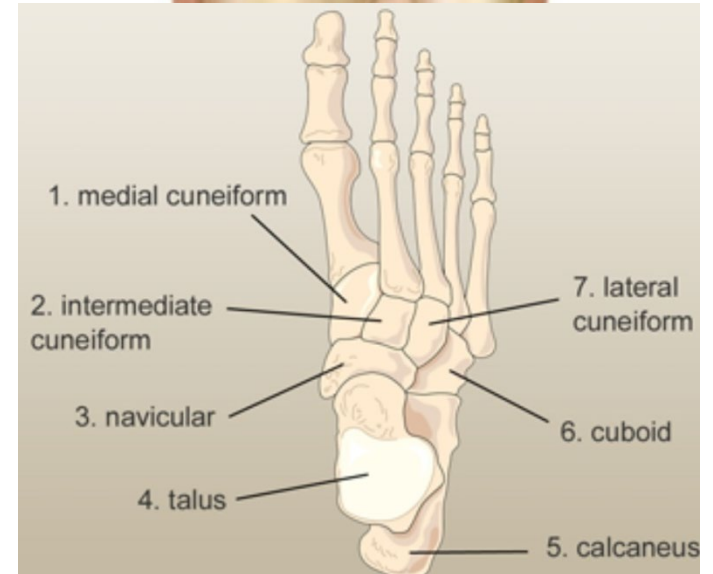
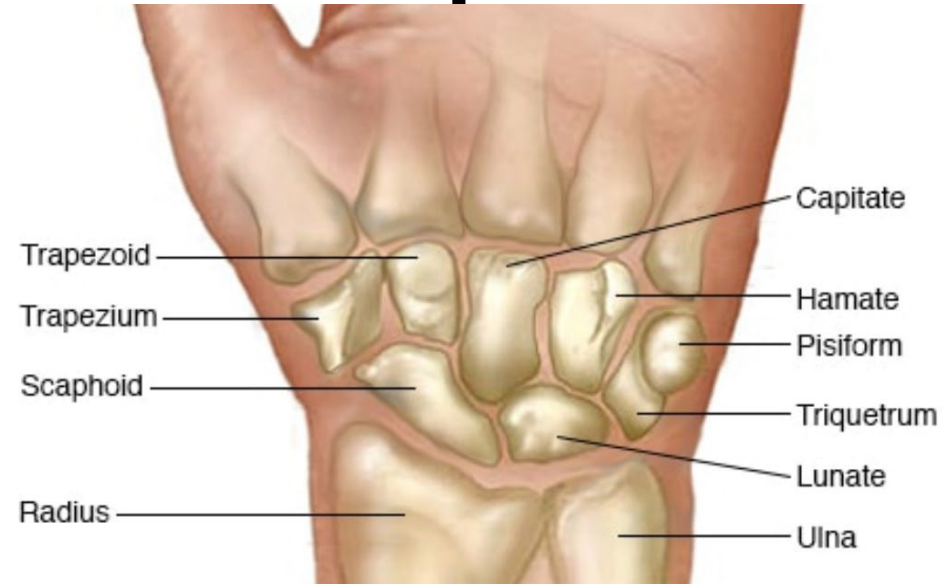
- **Long bones:** e.g. clavicle, humerus, femur, metacarpals, metatarsals & phalanges)
- The length greater than width
- Tubular shaft (**diaphysis**) & **epiphysis** at each end.



Types of Bones – General Shape

LO1

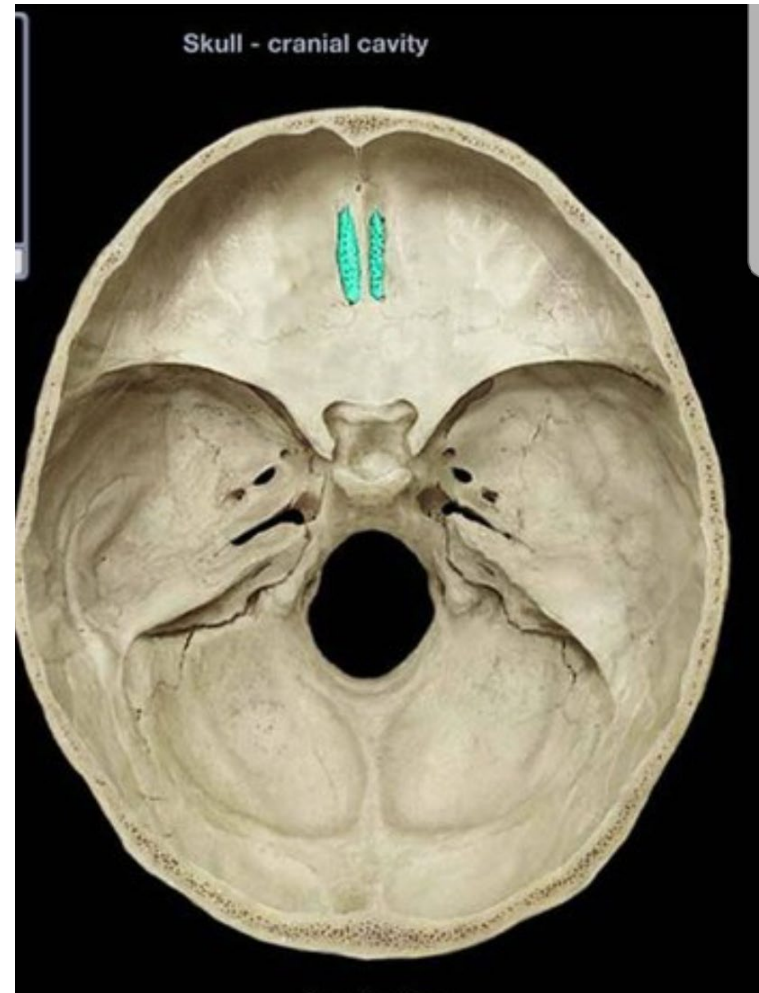
- **Short bones** – carpal bones (e.g. scaphoid, lunate) and tarsal bones (e.g. talus, calcaneum), limited movement.
- Roughly cuboidal in shape & mainly spongy with a thin compact crust



Types of Bones – General Shape

LO1

- **Flat bones** – in the vault of the skull (e.g. frontal, parietal); scapula.
- Protection &/or provision of broad surface for muscle attachment.
- Composed of two thin layers of compact bone enclosing a layer of spongy bone (diploe).

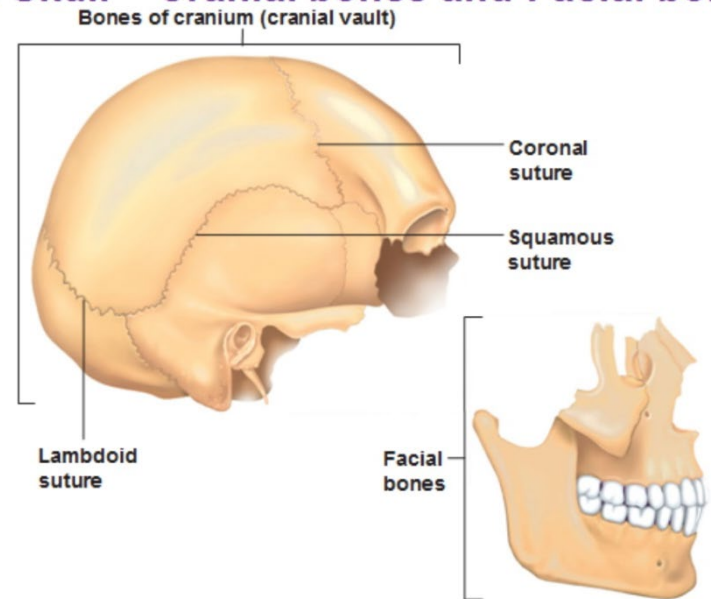


Types of Bones – General Shape

LO1

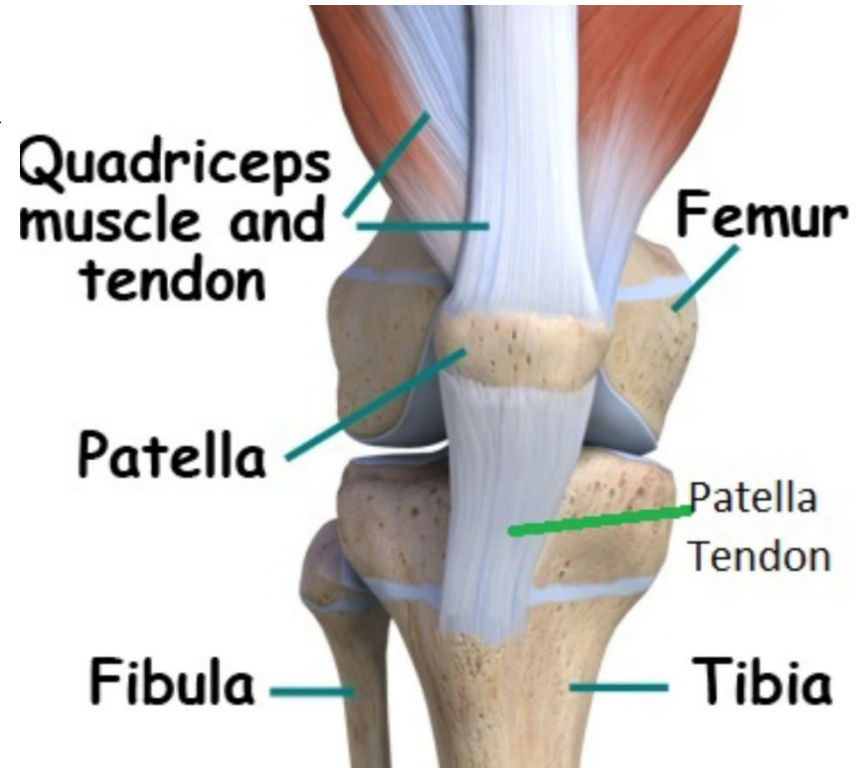
- **Irregular bones** – bones of the facial skeleton, vertebrae and pelvic bones - external layer of compact bone & spongy within.

The Skull – Cranial bones and Facial bones

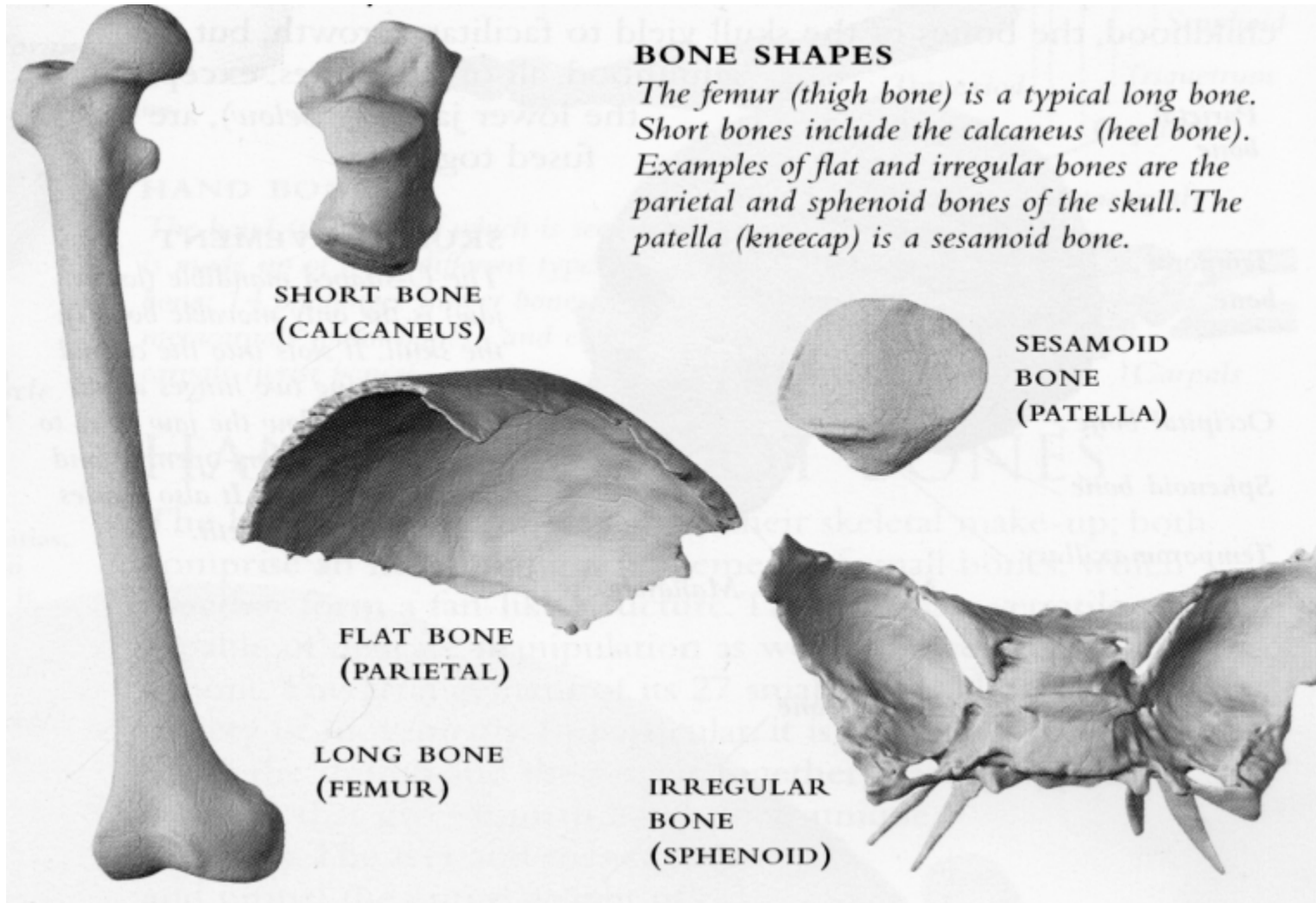


Types of Bones – General Shape ^{LO1}

- **Sesamoid bones** – found in tendons where they rub over bony surfaces



Types of Bones – General Shape

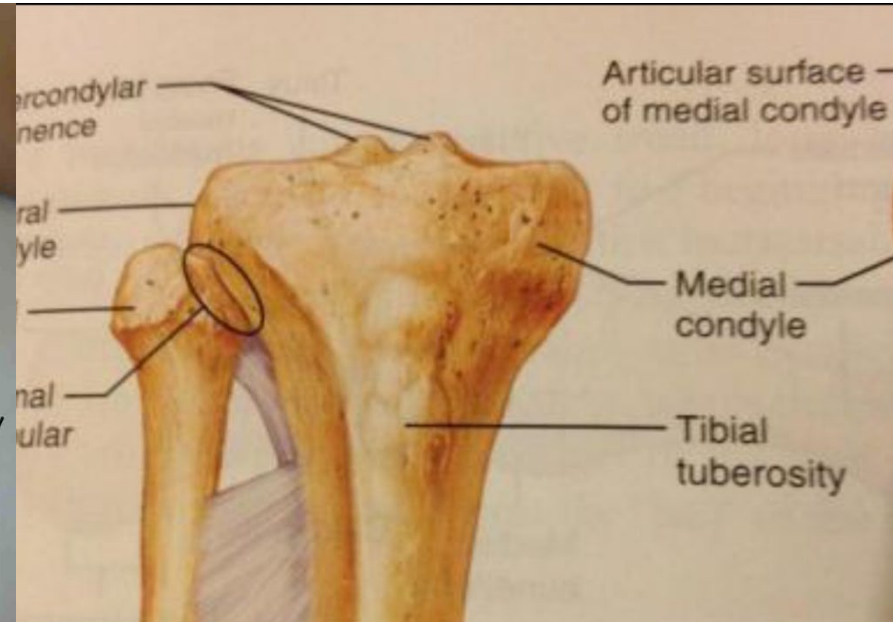
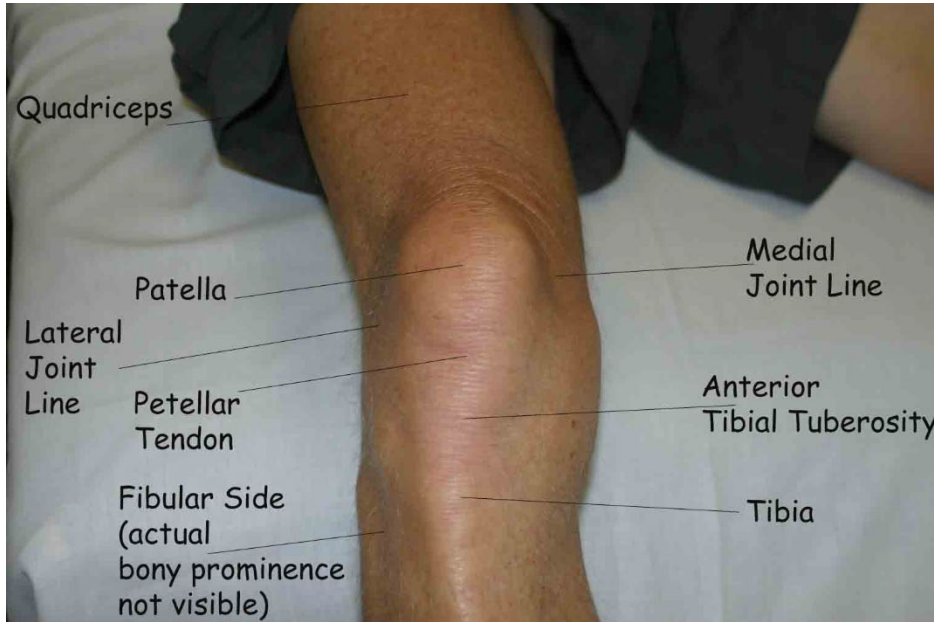


Surface Markings of Bones

- Found where fascia, ligaments, tendons or aponeuroses are attached to bone
- Not present at birth; appear at puberty & become progressively more obvious in adult life
- Pull of fibrous structures causes the periosteum to be raised and new bone is deposited beneath (tibial tuberosity by pull of patellar tendon).

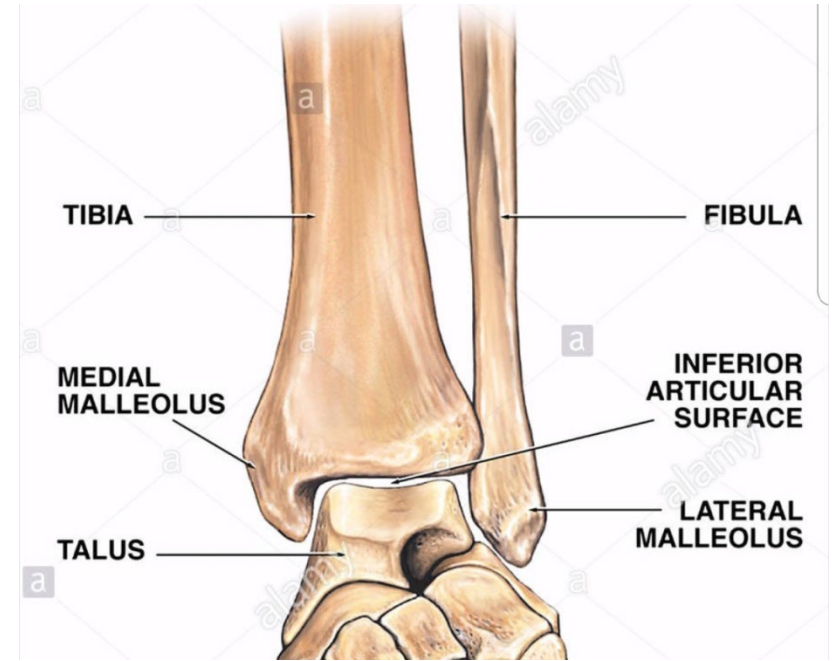
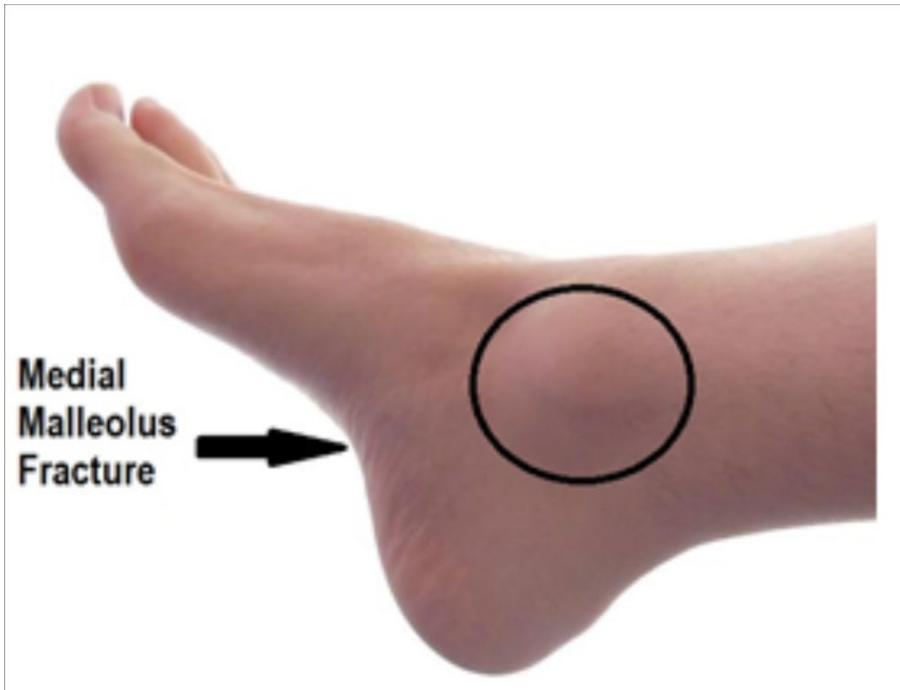
Surface Markings of Bones

LO1



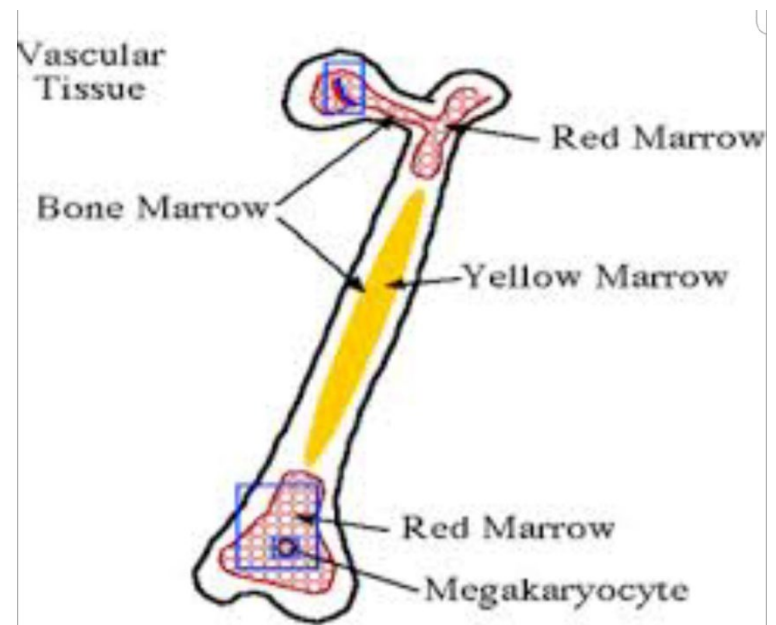
Surface Markings of Bones

LO1



Bone Marrow

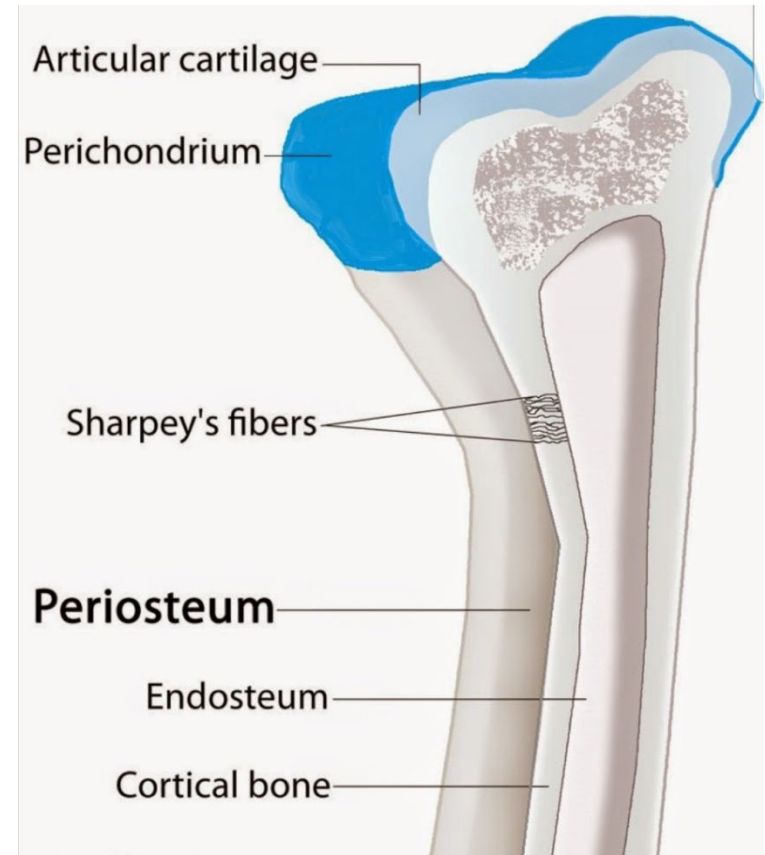
- Found in marrow cavities of long & short bones and in between bony trabaculae of cancellous bone in flat & irregular bones.
- At birth, marrow is red (haemopoiesis); blood forming activities gradually lessens with age – red marrow replaced by yellow (fatty) marrow.
- In the adults, red marrow restricted to the flat bones, irregular bones, and at both ends of long bones.



Periosteum

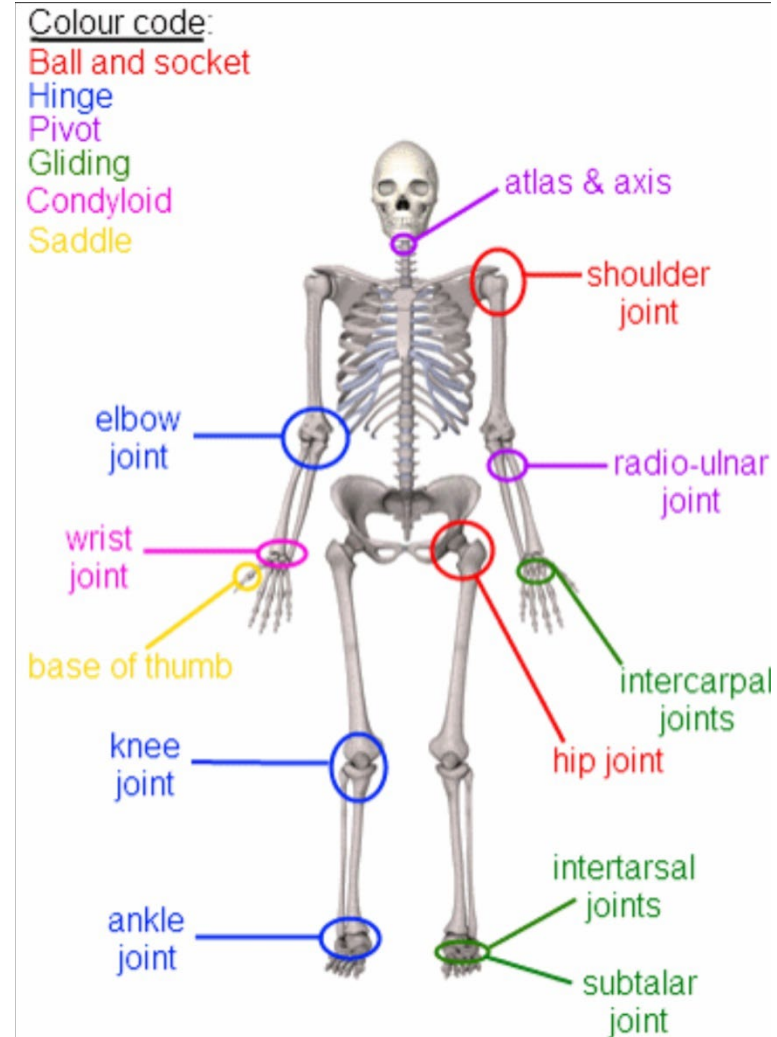
LO 1

- Periosteum covers all bone surfaces, except at joints; has abundant vascular and nerve supply & the deep layer is osteogenic.
- Sensitive (pain when traumatised)
- It is firmly fixed at sites where muscles, tendons and ligaments are attached to bone; Sharpey's fiber.



Joints

- **Joint** – point at which two bones meet (**articulation**), with or without movement between them.



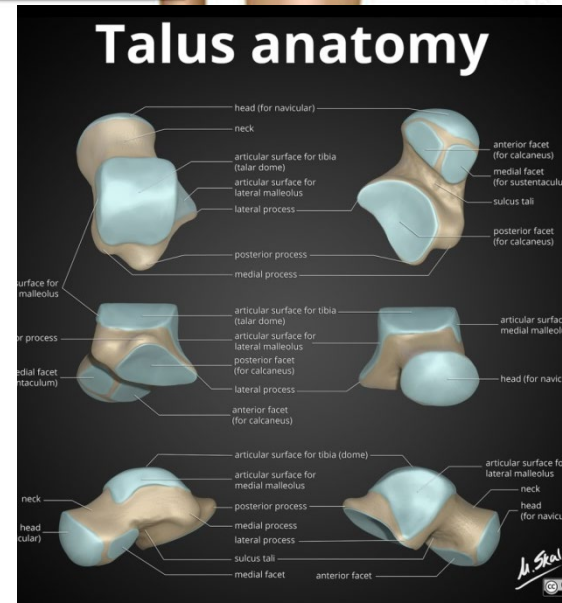
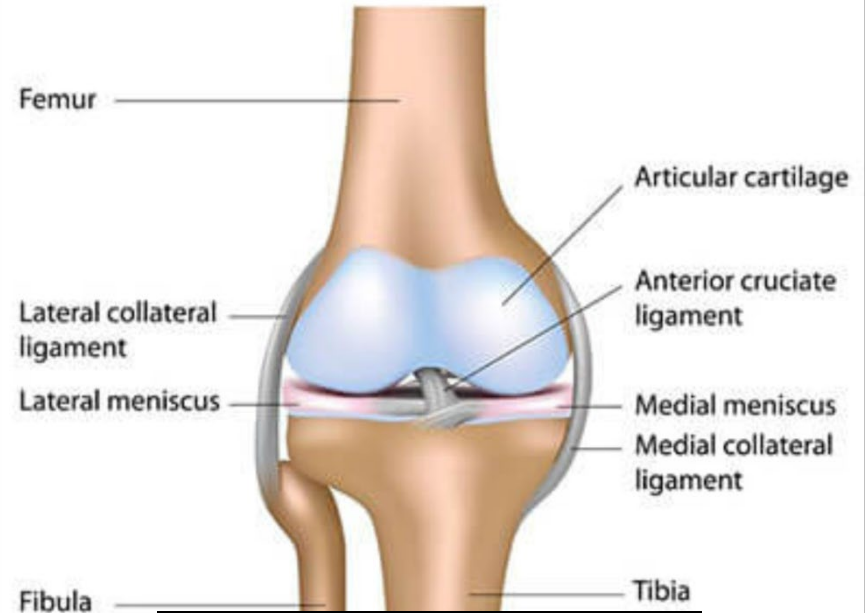
Classification of Joints

- Joints are classified according to the tissues that lie between them (by **structure**) or by the way they move.
- Various types of joints:
 - Fibrous joints (no movement)
 - Cartilaginous joints (primary & secondary)
 - Synovial joints (freely moveable)

LO 5

Structures that form Joints

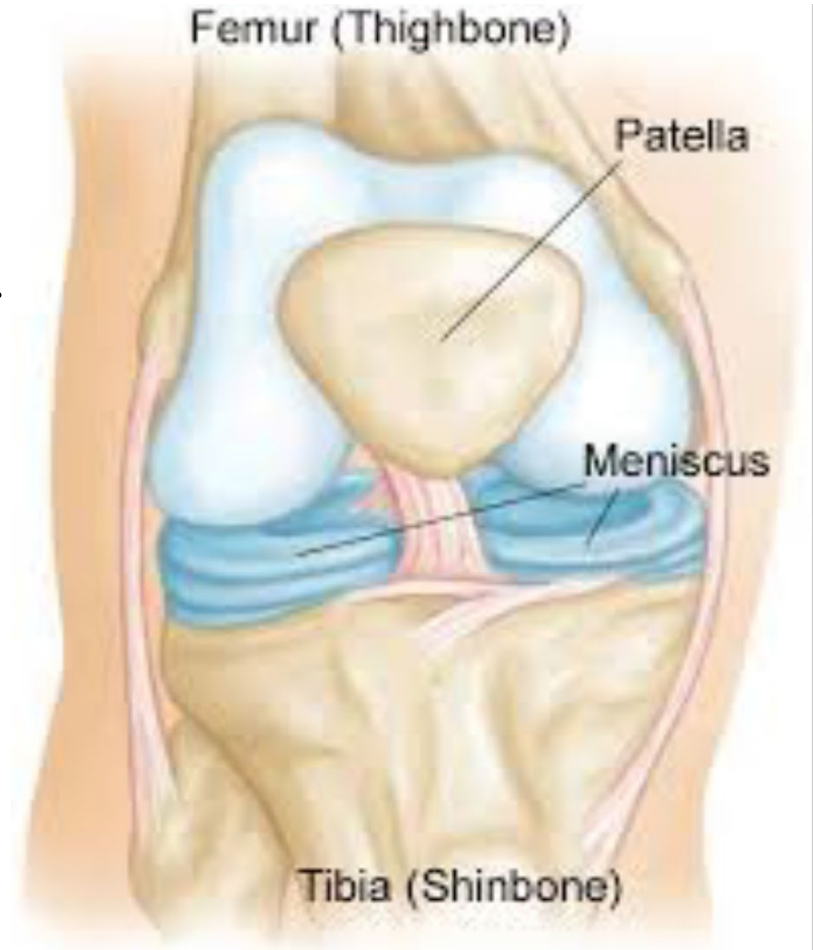
- **Bone** – fundamental element of all joints.
- **Cartilage** – at the articular surfaces in long bones; all around the surfaces of short bones.



Structures that form Joints

LO5

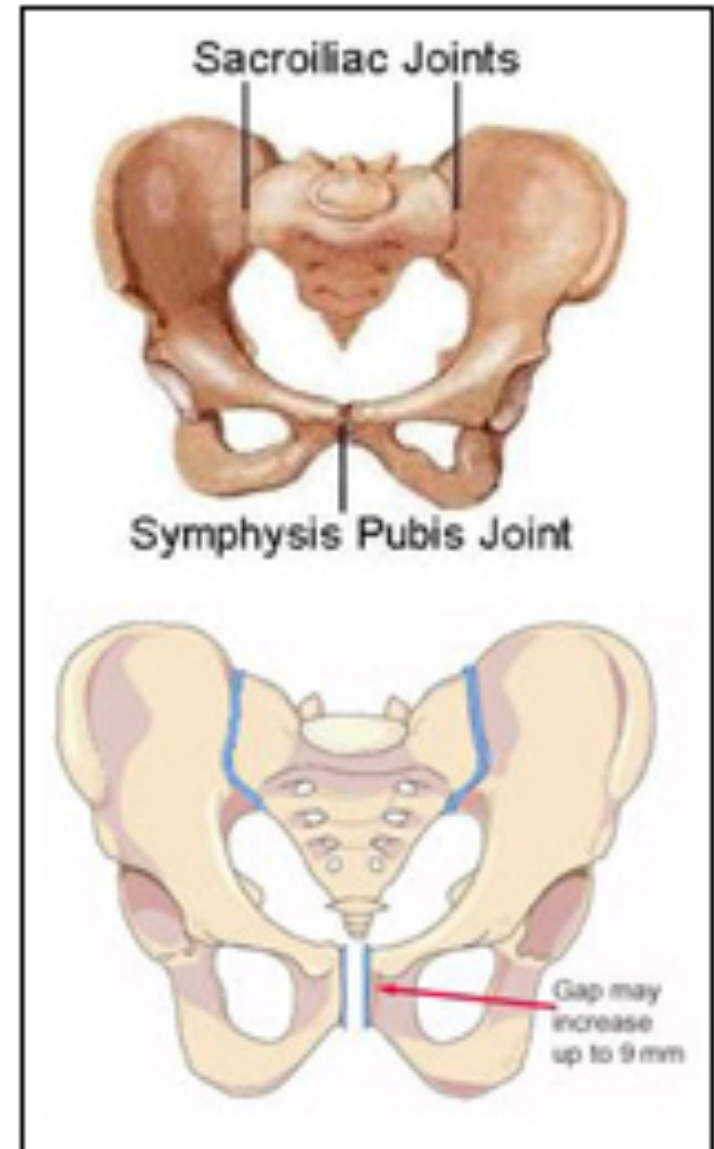
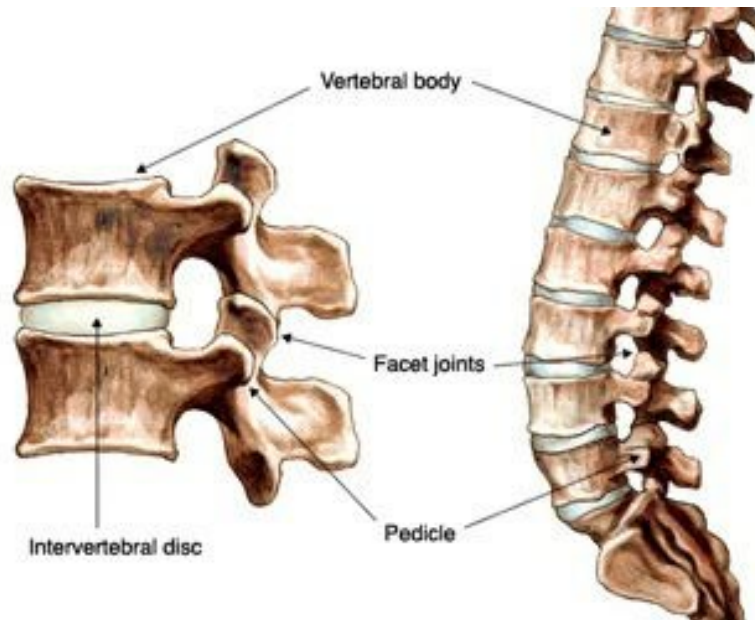
- **Fibrocartilage** – white fibrous (collagen for strength & toughness) & cartilaginous (elasticity).
- Arrangement varies – interarticular (menisci)



Structures that form Joints

LO5

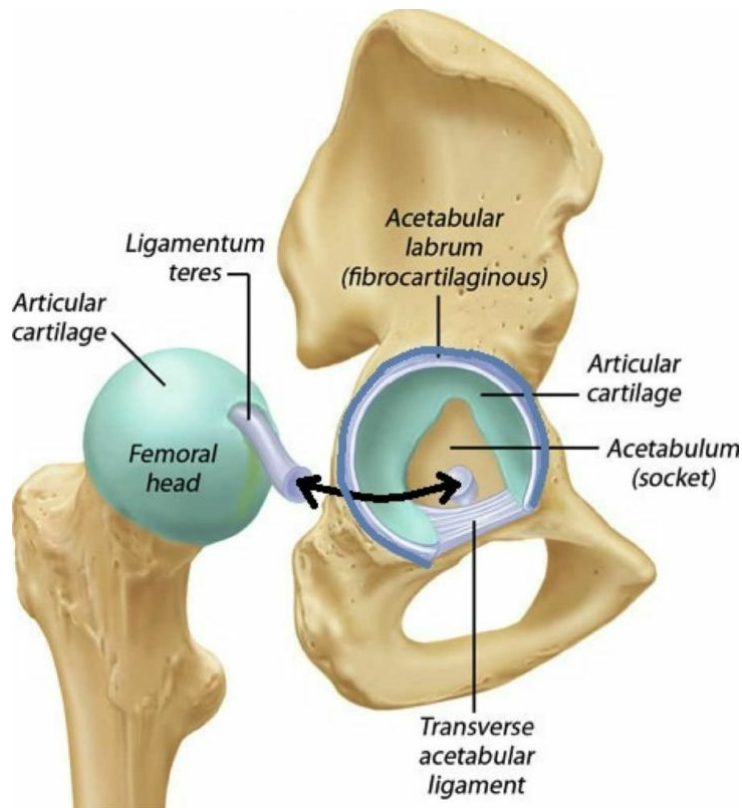
- **Fibrocartilage** –
- Arrangement varies – interosseous (occur as discs at joints with slight mobility – intervertebral joints & symphysis pubis).



Structures that form Joints

LO5

- **Fibrocartilage** –
- Arrangement varies – circumferential rims (occur as rims around some articular cavities; shoulder & hip joints)



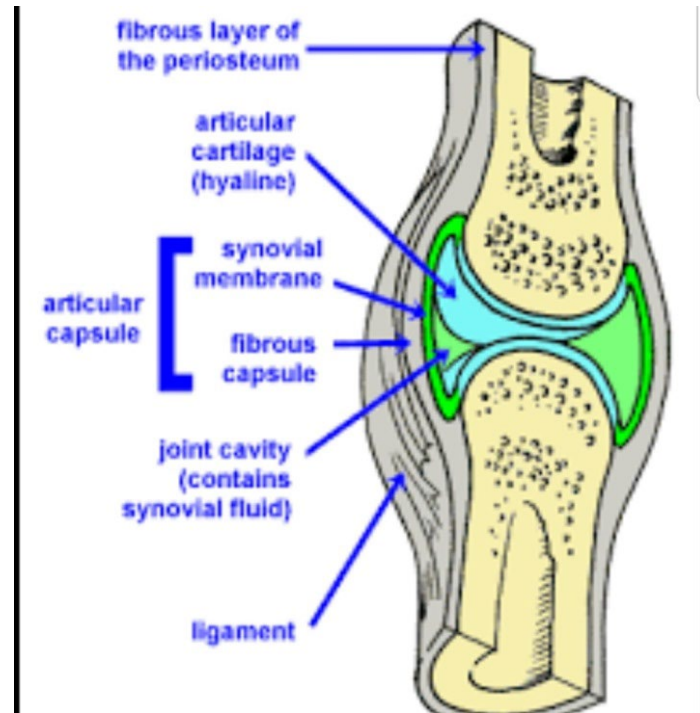
Structures that form Joints

- **Ligament** – found in nearly all moveable joints; bundles of collagen fibers; pliable & flexible but strong.



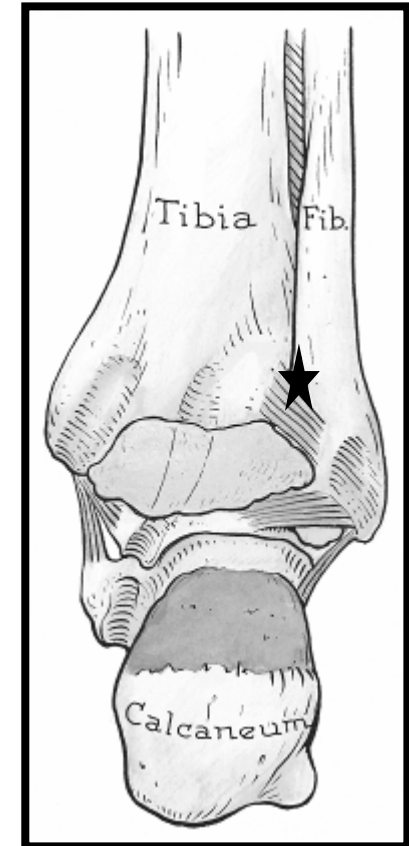
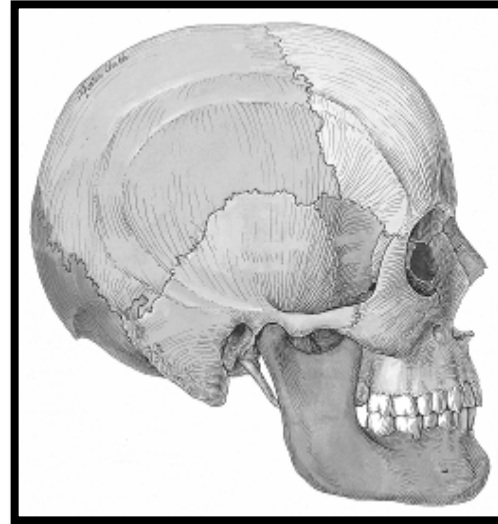
Structures that form Joints

- **Synovial membrane** – thin secretory membrane: –in freely moveable joints.



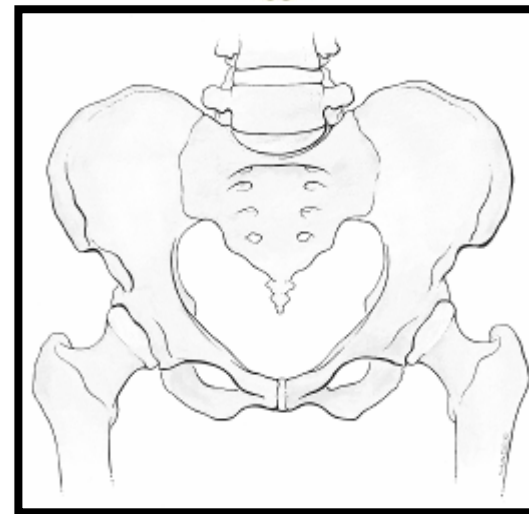
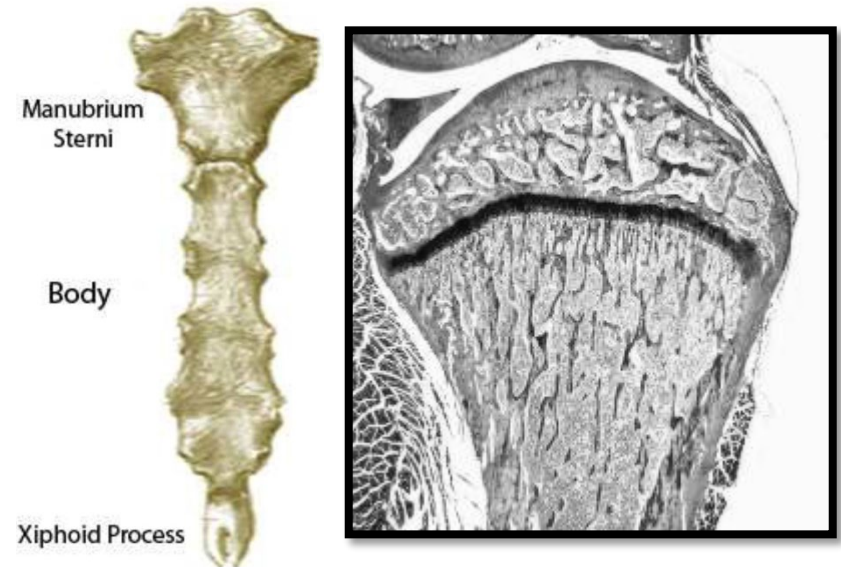
Fibrous Joints - Features

- Articulating surfaces joined by fibrous tissue
- Degree of movement depends upon the length of collagen fibers between the bones.
- E.g. Sutures of the vault of skull; inferior tibiofibular joint.



Cartilaginous Joints - Features

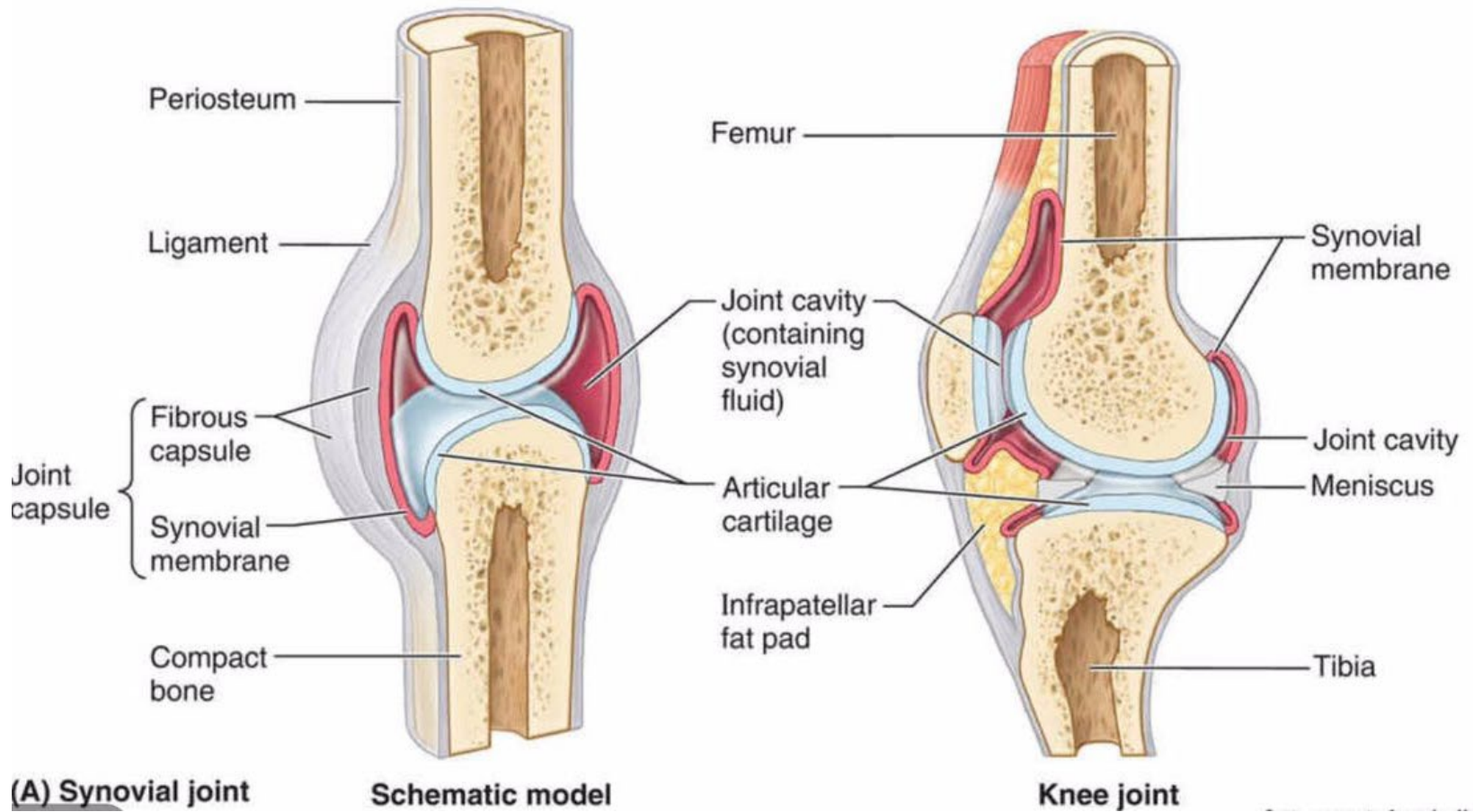
- Two types - 1° & 2°
- **1° (Primary)** – bones united by a plate of hyaline cartilage (e.g. epiphyseal plate of a growing bone & 1st rib & manubrium sterni); no movement
- **2° (Secondary)** – bones united by a plate/disc of fibrocartilage & joint surfaces covered by hyaline cartilage (e.g. inter-vertebral joints(IVJ) symphysis pubis); small amount of movement



Synovial Joints - Features

- Also called freely movable joints: most movable joint found in human body.
- Articular surfaces covered by **hyaline cartilage** separated by a **joint cavity**; this arrangement permits a great degree of freedom of movement
- Cavity lined by **synovial membrane** that extends from the margin of the one articular surface to that of the other
- Protected on the outside by a tough fibrous tissue – **capsule**
- Joint surfaces are lubricated by viscous **synovial fluid**; produced by the synovial membrane

Synovial Joints - Features



(A) Synovial joint

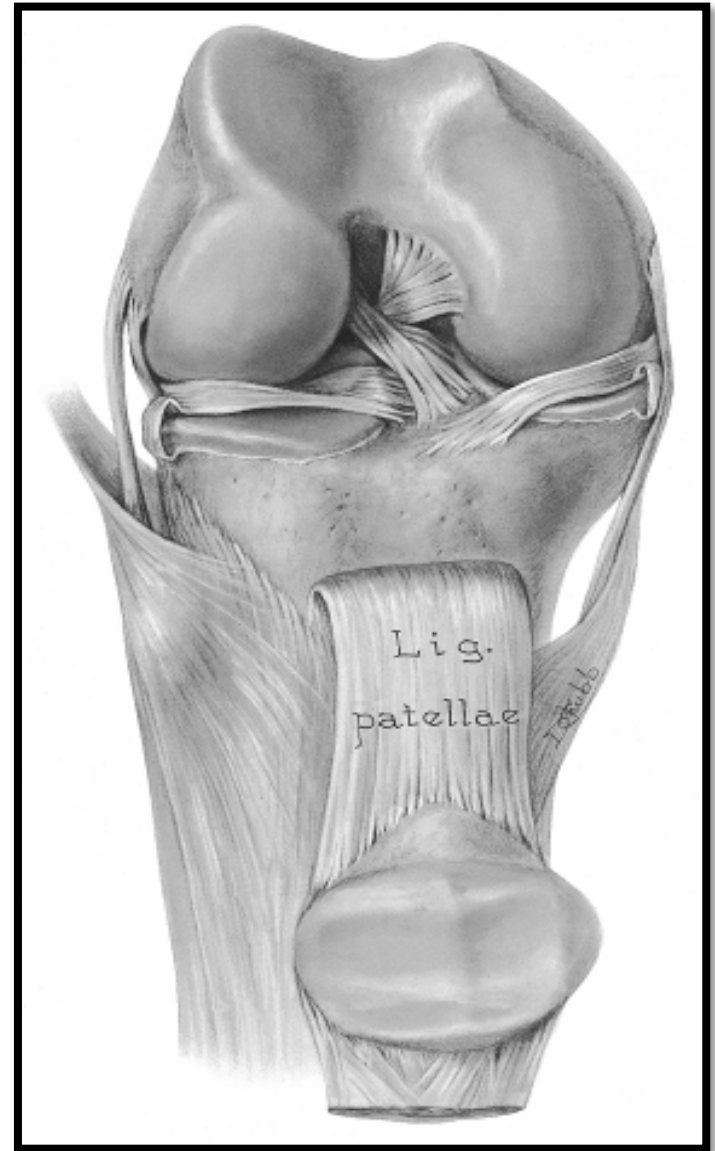
Schematic model

Knee joint

Degree of Joint movement

Limited by:

- The shape of the bones.
- Coming together of adjacent anatomical structures (e.g. flexion of the thigh against the anterior abdominal wall)
- Presence of **ligaments** uniting the bones – e.g. extra- & intra-capsular ligaments.

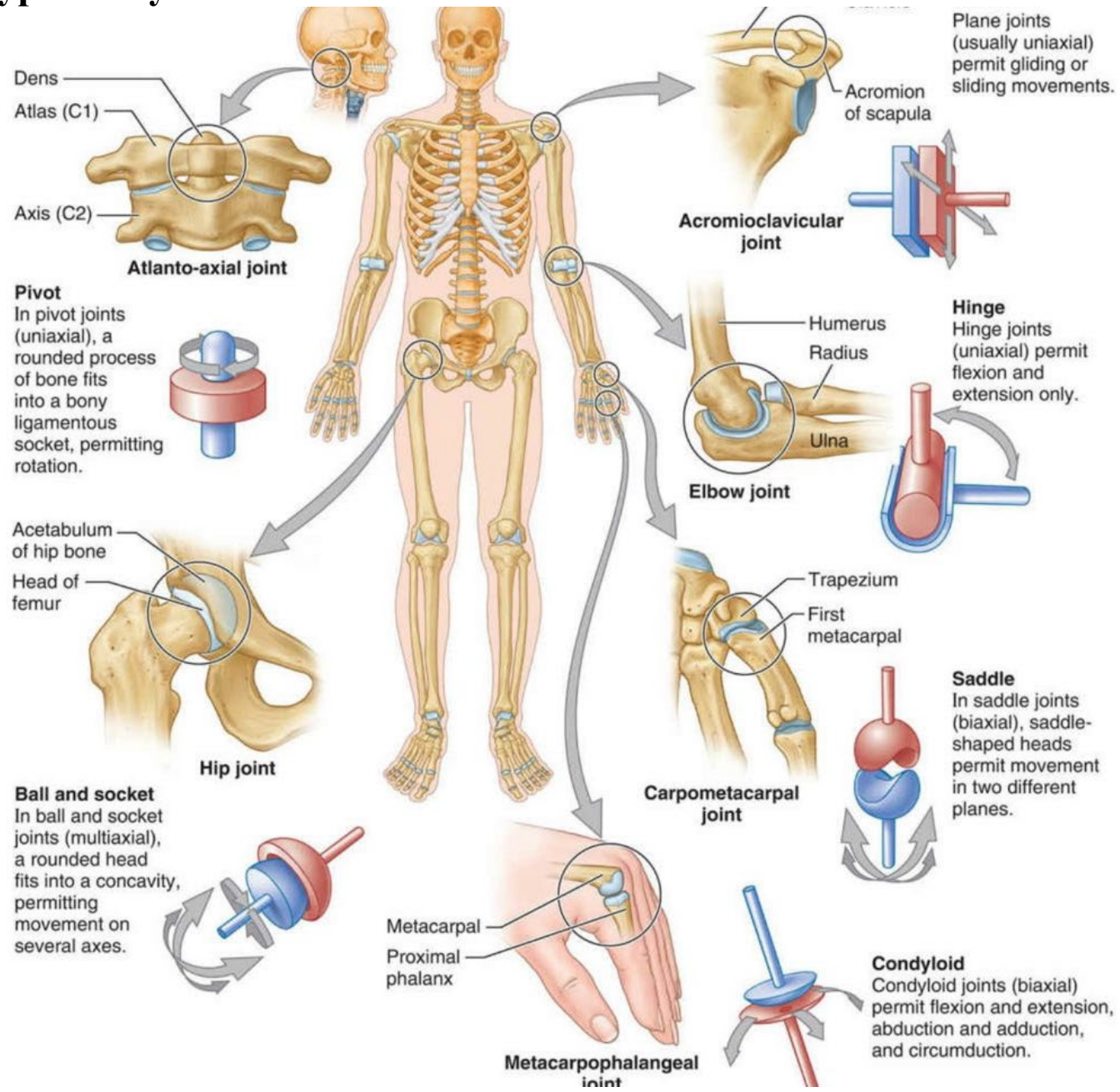


Types of Synovial Joints

(by arrangement of articular surfaces & types of movement)

- **Hinge** – permit flexion & extension only (e.g. elbow joint)
- **Saddle** – concave & convex joint surfaces (e.g. 1st metacarpophalangeal joint)
- **Plane** – permit gliding or sliding movements (acromioclavicular joint)
- **Pivot** – allow rotation; a round bony process fits into a bony ligamentous socket (e.g. atlantoaxial joint & proximal Radio-ulnar joint)
- **Condylloid** – permit flexion & extension, adduction, adduction & circumduction (e.g. MPJ)
- **Ball & Socket** – permit movement in several axes; a rounded head fits into a concavity (e.g. shoulder & hip joints)

Types of Synovial Joints







Thank You

