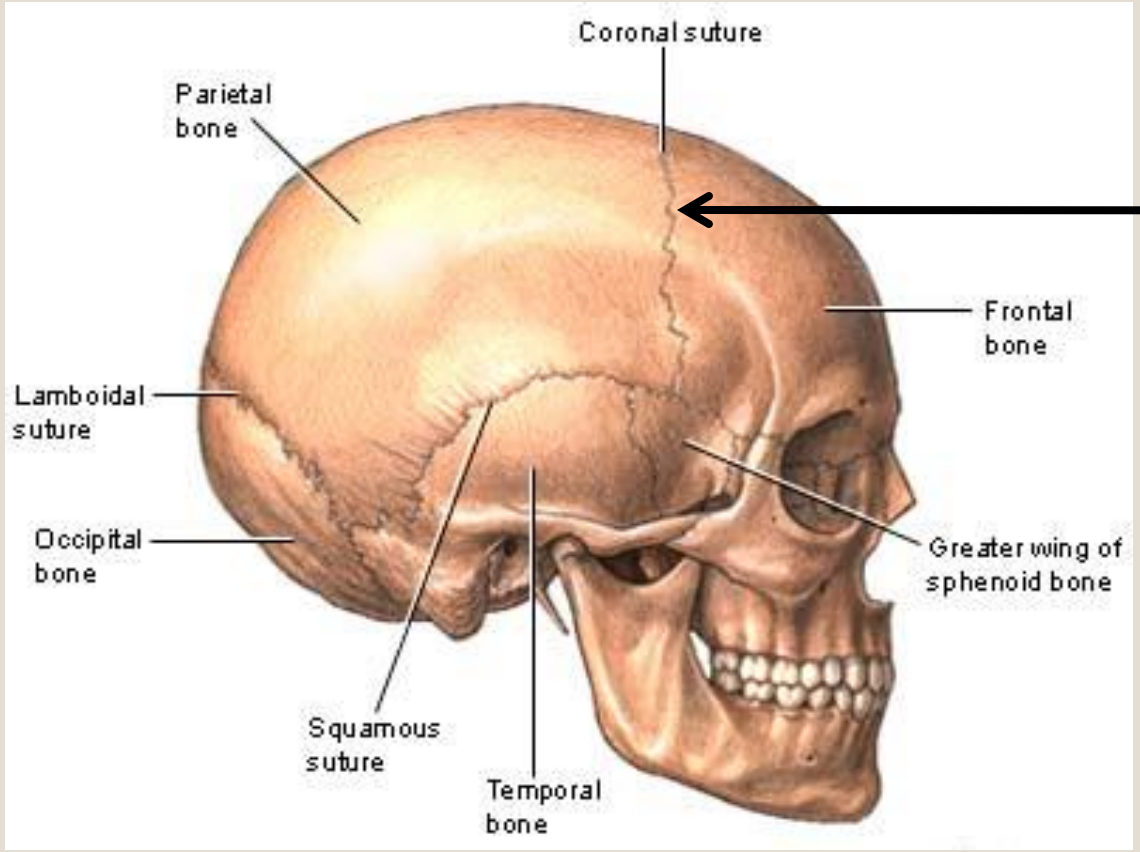
JOINTS AND ARTICULATIONS

BY M.PONPANDI

Joints…

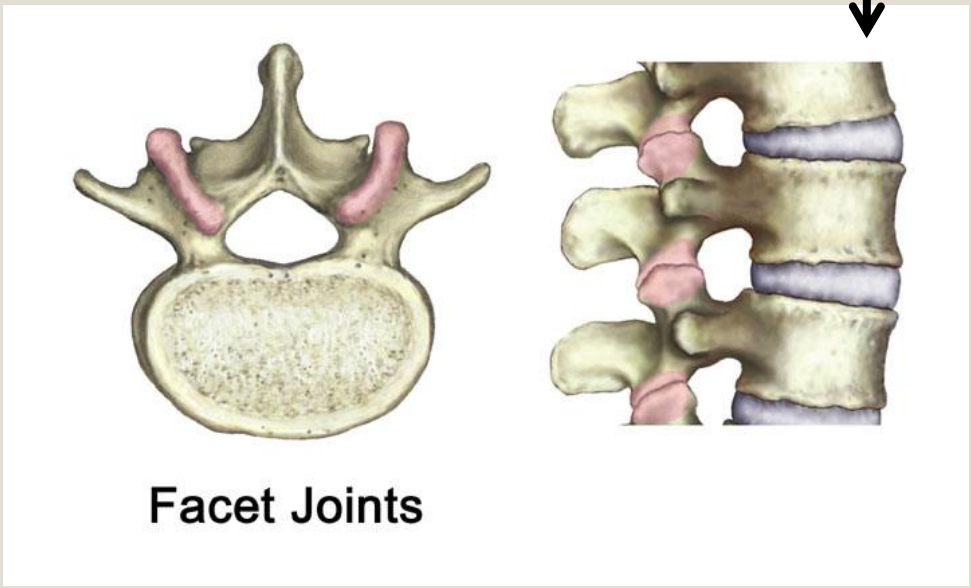
A joint is a place where two or more bones connect. The manner in which they connect determines the type of movement allowed at that joint.

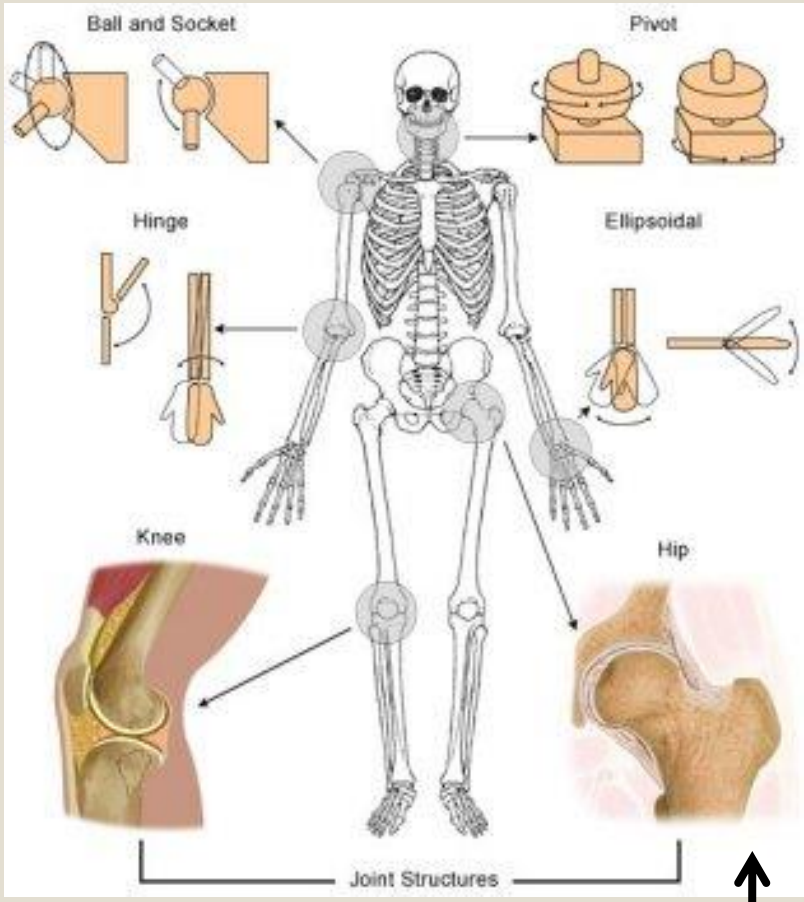


A synarthrosis (sĭn ahrTHROW siss) is a joint that allows no movement. An example would be a cranial suture.

Joints…

A amphiarthrosis (am fee ahr THROW siss) is a joint that allows slight movement. An example would be a vertebra.





A diarthrosis (dye ahr THROW siss) is a joint that allows free movement in a variety of directions, such as knee, hip, elbow, wrist, and foot.

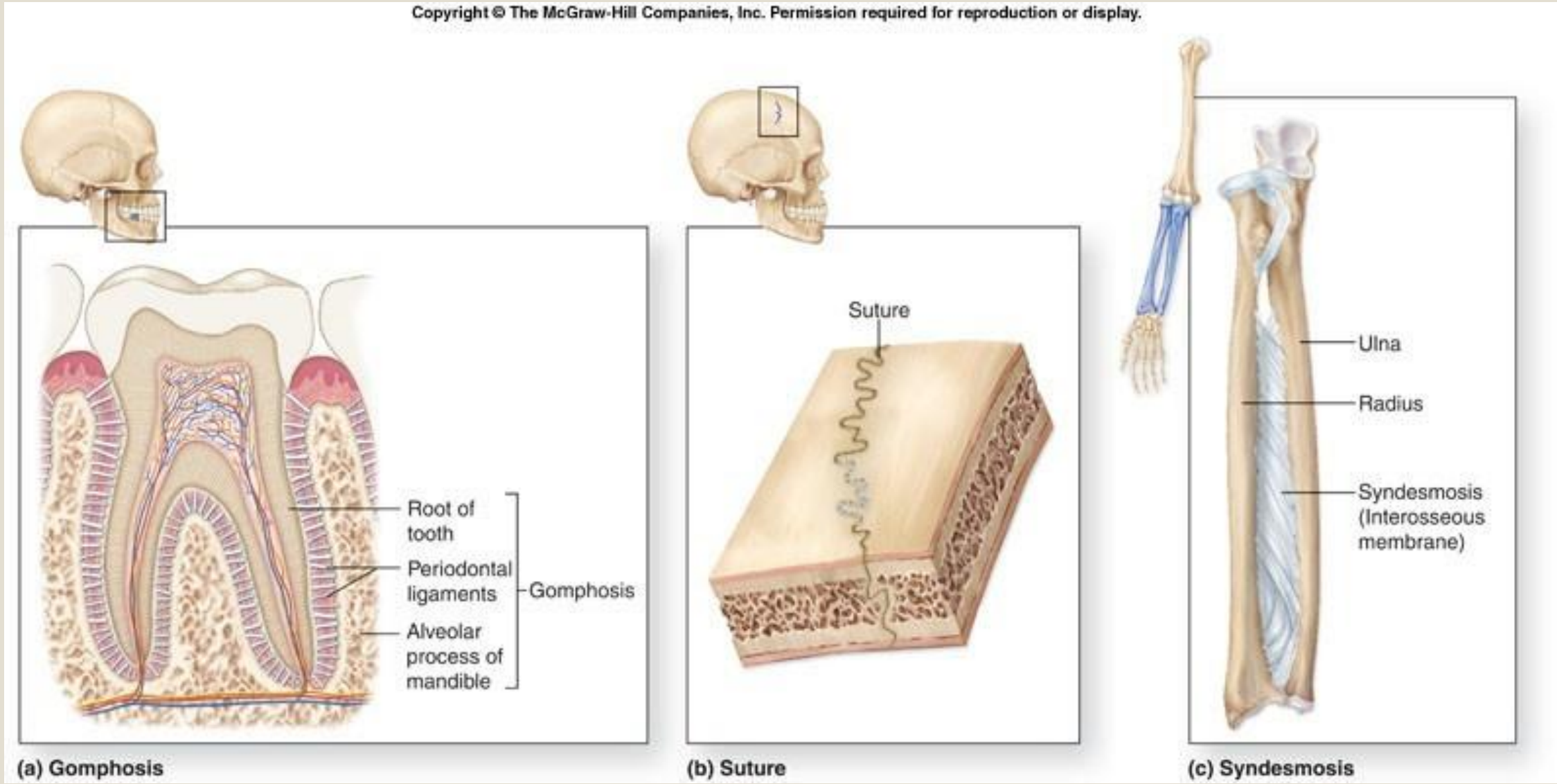
Structural classification of joints: Fibrous Joints

- Based on the type of tissue involved in formation of the joints, there are three structural joints namely: fibrous, cartilaginous, and synovial.

Fibrous Joints:

- Fibrous joints are connected by dense, tough connective tissue that is rich in collagen fibres. There are three types of fibrous joints:

1) SUTURES: joints found in the cranium(skull). These bones are connected by sharpey's fibres. The nature of cranial sutures allows for the movement in the foetus, but when grown into an individual, they become mostly immovable. Even though some cranial elasticity allows for slight movement, they are mostly referred to has synarthrodial.
2) Syndesmoses: joints found between long bones of the body, such as the radio-ulnar and tibio-fibular joints. These moveable fibrous joints are termed amphiarthrodial.
3) Gomphosis: it is a type found at the articulation between teeth and the sockets of the maxilla or mandible (dental-alveolar joint). The fibrous tissue that connects the tooth and socket is called the periodontal ligament.



Structural classification of joints: Cartilaginous Joints

- Cartilaginous joints are connected by fibrocartilage or hyaline cartilage.
- They allow more movement than fibrous joints but less than that of synovial joints. These types of joints are further subdivided into primary (synchondroses) and secondary (symphyses) cartilaginous joints.

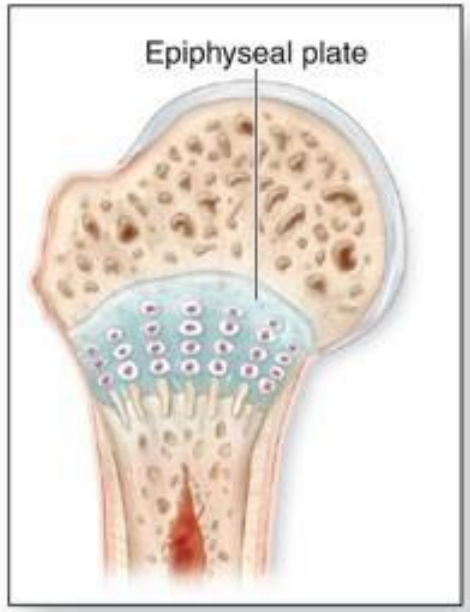
1) **Synchondrosis**

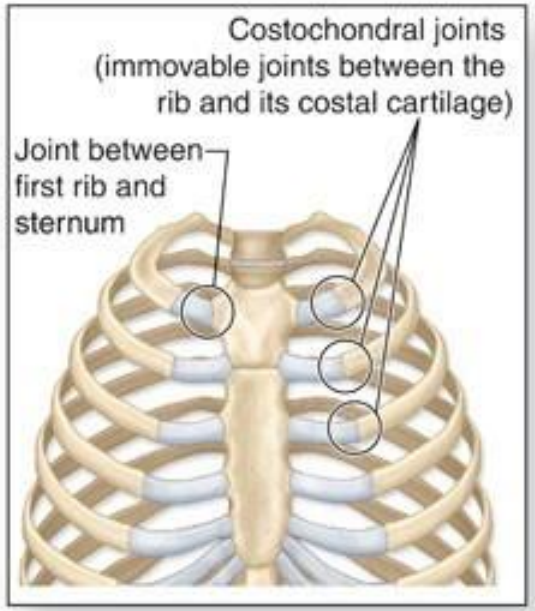
- A **synchondrosis** ("joined by cartilage") is a cartilaginous joint where bones are joined together by hyaline cartilage, or where bone is united to hyaline cartilage.
- A synchondrosis may be temporary or permanent. A temporary synchondrosis is the epiphyseal plate (growth plate) of a growing long bone. The epiphyseal plate is the region of growing hyaline cartilage that unites the diaphysis (shaft) of the bone to the epiphysis (end of the bone).

- During the late teens and early 20s, growth of the cartilage slows and eventually stops. The epiphyseal plate is then completely replaced by bone, and the diaphysis and epiphysis portions of the bone fuse together to form a single adult bone. This fusion of the diaphysis and epiphysis is a synostosis. Once this occurs, bone lengthening ceases. For this reason, the epiphyseal plate is considered to be a temporary synchondrosis. Examples of permanent synchondroses are found in the thoracic cage. One example is the first sternocostal joint, where the first rib is anchored to the manubrium by its costal cartilage.

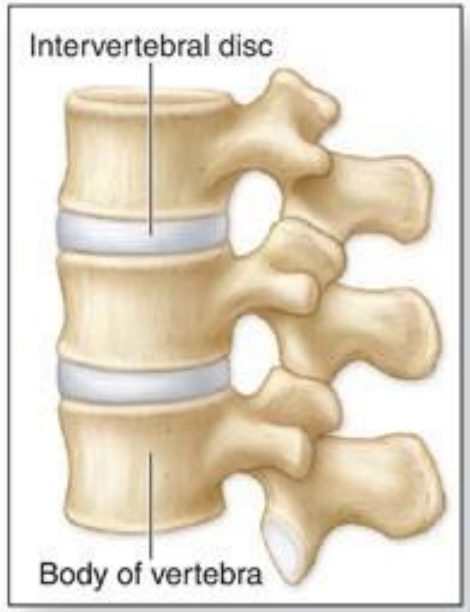
2) **Symphysis**

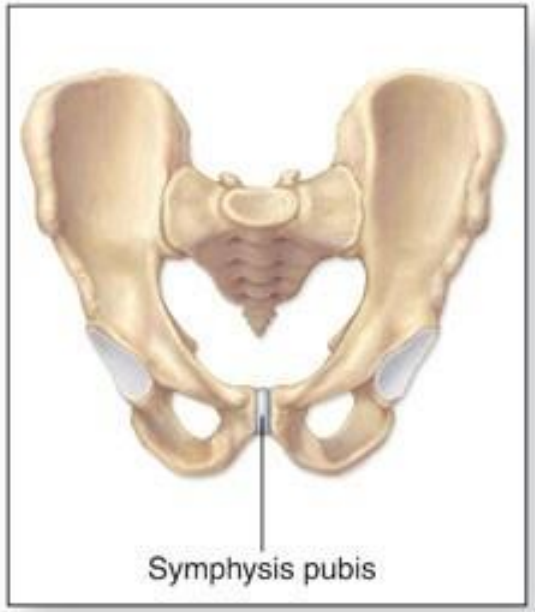
- A cartilaginous joint where the bones are joined by fibrocartilage is called a **symphysis** ("growing together").
- Fibrocartilage is very strong because it contains numerous bundles of thick collagen fibers, thus giving it a much greater ability to resist pulling and bending forces when compared with hyaline cartilage.
- This gives symphyses the ability to strongly unite the adjacent bones, but can still allow for limited movement to occur. Thus, a symphysis is functionally classified as an amphiarthrosis.





(a) Synchondroses (contain hyaline cartilage)





(b) Symphyses (contain fibrocartilage)

SYNOVIAL JOINTS

- Synovial joints are **the most common type of joint in the body .**
- presence of a **joint cavity,** contain fluid-filled space.
- unlike fibrous or cartilaginous joints, the articulating bone surfaces at a synovial joint are not directly connected to each other with fibrous connective tissue or cartilage.
- This gives the bones of a synovial joint the ability to move **smoothly against each other**, **allowing for increased joint mobility.**

Structural Features of Synovial Joints:

- Synovial joints are characterized by the presence of a **joint cavity.**
- The walls of this space are formed by the **articular capsule: a fibrous connective tissue structure that is attached to each bone just outside the area of the bone's articulating surface.**
- Friction between the bones at a synovial joint is prevented by the presence of the **articular cartilage: a thin layer of hyaline cartilage**

- Lining the inner surface of the articular capsule is a **thin synovial membrane: consists of cells that secrete synovial fluid.**
- **Synovial fluid: (synovia = "a thick fluid"), a thick, slimy fluid that provides lubrication to further reduce friction between the bones of the joint.**
- This fluid also provides **nourishment to the articular cartilage**, which does not contain blood vessels.
- The synovial joint is functionally ***classified as a diarthrosis.***

- Outside of their articulating surfaces, the bones are connected together by **ligaments: which are strong bands of fibrous connective tissue.**
- These**a) strengthen and support** the joint by anchoring the bones together and **b) preventing their separation**.
- Ligaments allow for **c) normal movements** at a joint, but **d) limit the range** of these motions, thus **e) preventing excessive or abnormal joint movements.**
- *Ligaments are classified based on their relationship to the fibrous articular capsule:*

1. **Extrinsic ligament** is located outside of the articular capsule.
2. **Intrinsic ligament** is fused to or incorporated into the wall of the articular capsule.
3. **Intracapsular ligament** is located inside of the articular capsule

- At many synovial joints, additional support is provided by the muscles and their tendons that act across the joint.
- A **tendon** is the dense connective tissue structure that attaches a muscle to bone.
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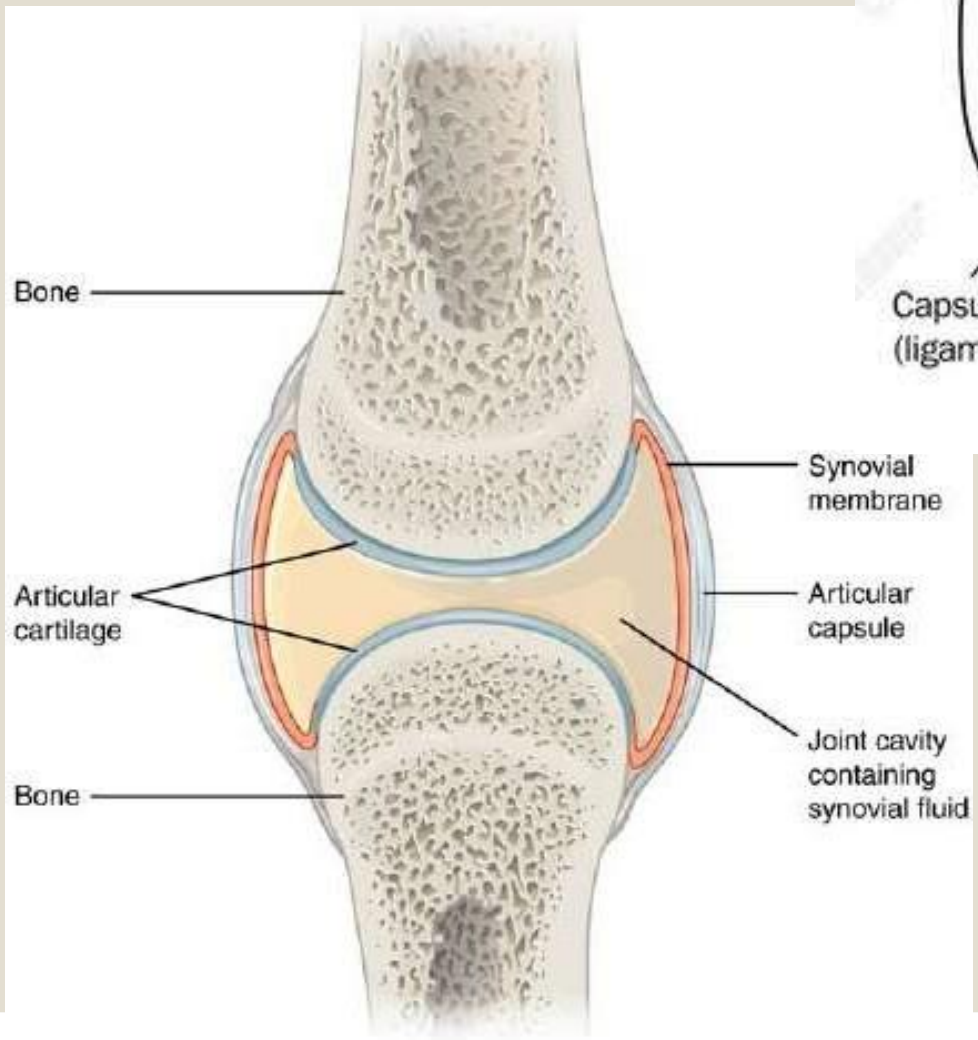
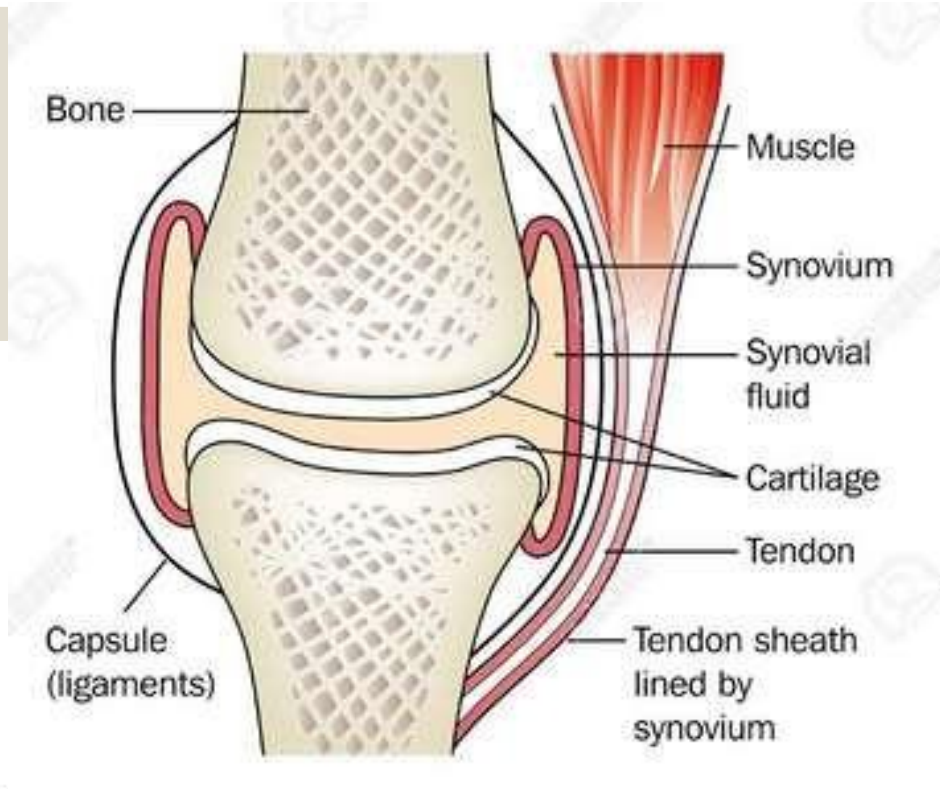

Bone
Articular cartilage
Bone
Synovial membrane
Articular capsule
Joint cavity containing synovial fluid


Bone
Muscle
Synovium
Synovial fluid
Cartilage
Tendon
Capsule (ligaments)
Tendon sheath lined by synovium

Additional Structures Associated with Synovial Joints:

- A few synovial joints of the body have a **fibrocartilage structure** located between the articulating bones.
- This is called an **articular disc: which is generally small and oval-shaped, or a meniscus, which is larger and C-shaped.**
- **These structures can** serve several functions, depending on the specific joint.

1. Articular disc may act to **strongly unite the bones** example: (sternoclavicular joint, distal ends of the radius and ulna bones).
2. The disc can **provide shock absorption and cushioning between the bones** example: **(** knee joint)
3. Articular disc can serve **to smooth the movements between the articulating bone**s example: (temporomandibular joint)

- A **bursa: (plural = bursae) is a thin connective tissue sac filled with lubricating liquid.**
- They are located in regions **where skin, ligaments, muscles, or muscle tendons** can rub against each other, usually near a body joint**.**
- Bursae reduce friction by separating the adjacent structures, preventing them from rubbing directly against each other.
- Bursae are **classified by their location.**

1- A **subcutaneous bursa** is located between the skin and an underlying bone.

I. It allows skin to move smoothly over the bone.

II. Examples include the ***prepatellar bursa*** located over the kneecap and the ***olecranon bursa*** at the tip of the elbow.

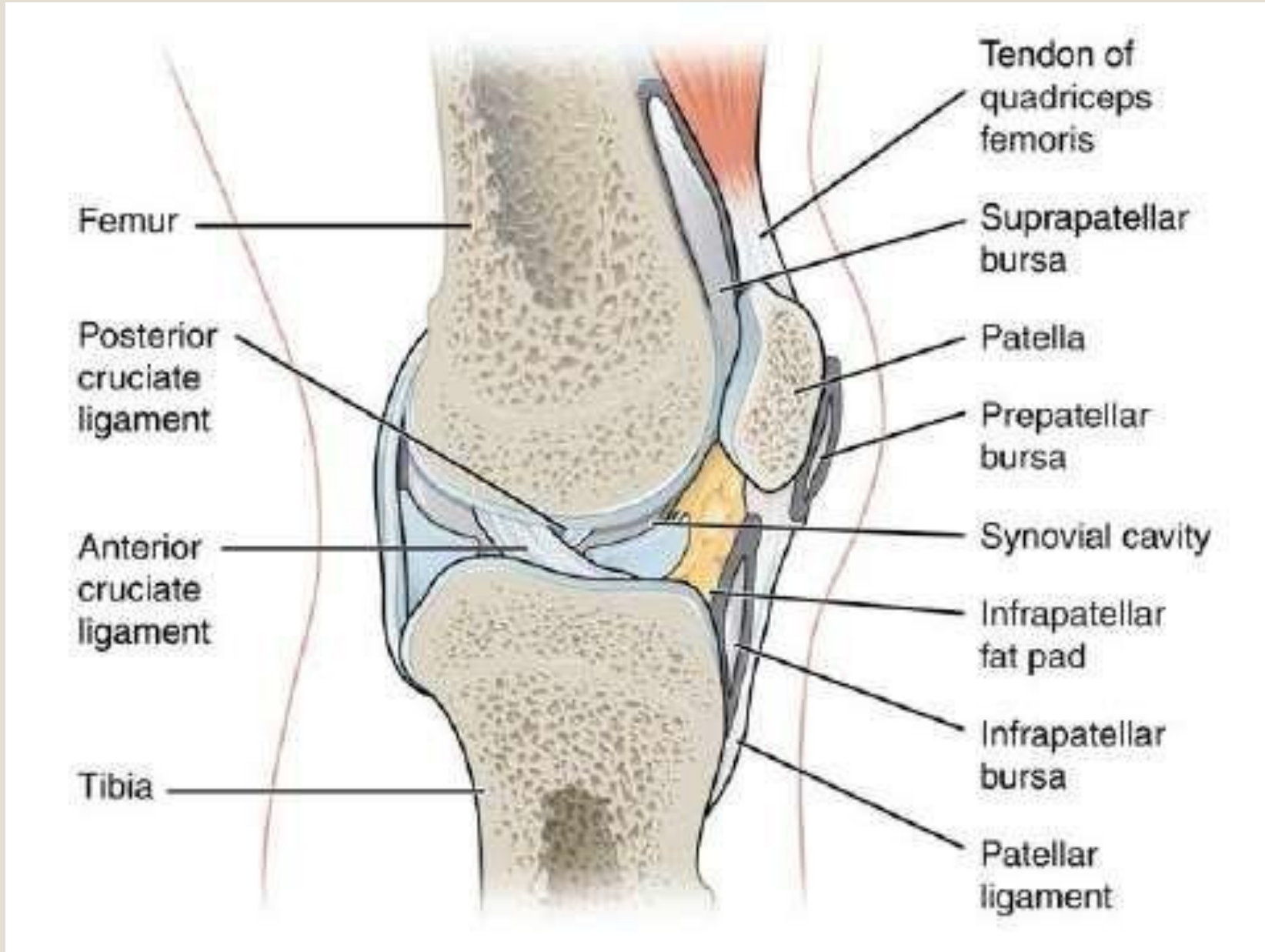
2- A **submuscular bursa** is found between a muscle and an underlying bone, or between adjacent muscles.

These prevent rubbing of the muscle during movements.

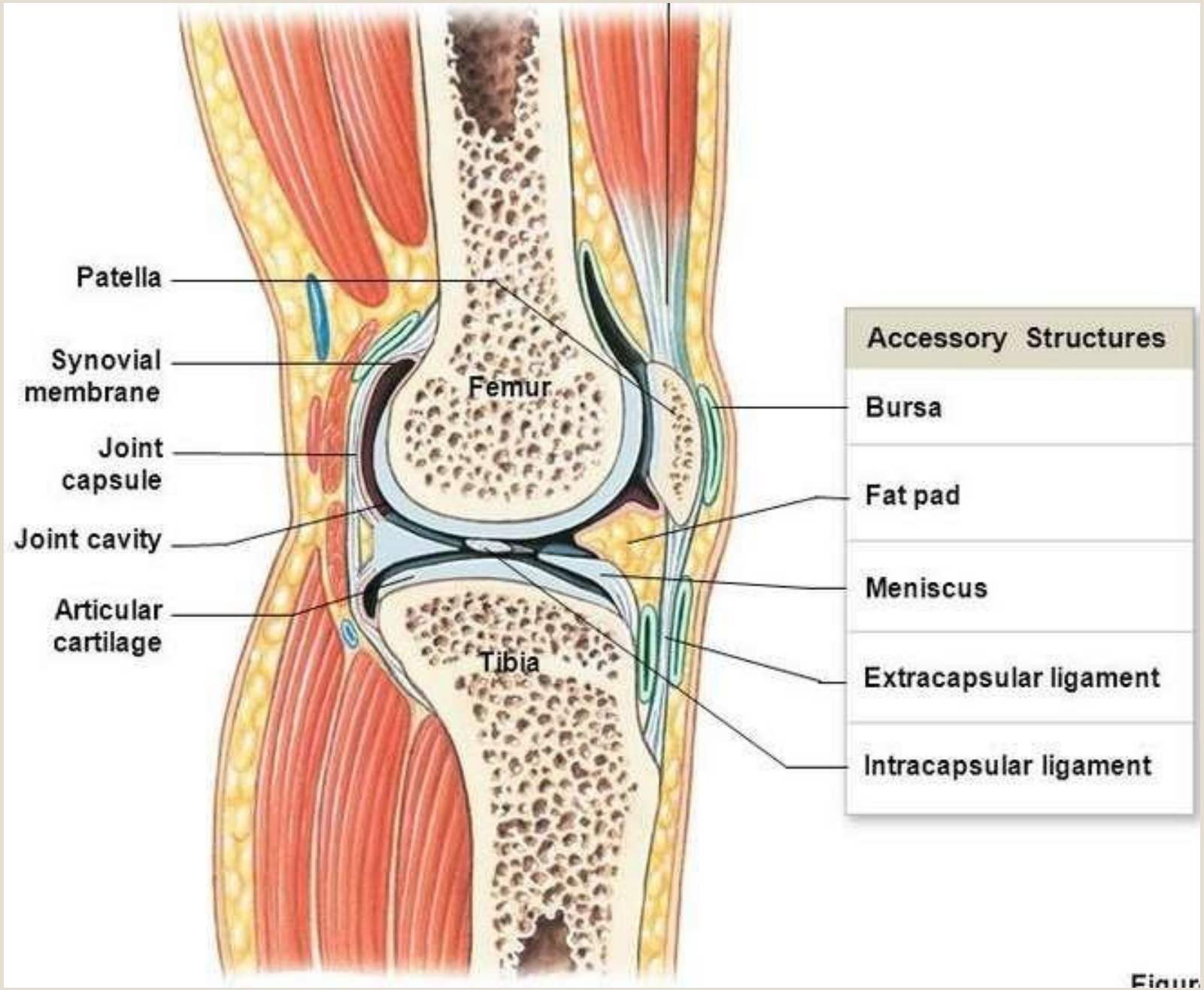
I. A large submuscular bursa, ***the trochanteric bursa***, is found at the lateral hip, between the greater trochanter of the femur and the overlying gluteus maximus muscle.

3- A **subtendinous bursa** is found between a tendon and a bone.

Examples include the ***subacromial bursa*** that protects the tendon of shoulder muscle as it passes under the acromion of the scapula, and the ***suprapatellar bursa*** that separates the tendon of the large anterior thigh muscle from the distal femur just above the


Tendon of quadriceps femoris
Femur
Suprapatellar bursa
Posterior cruciate ligament
Patella
Prepatellar bursa
Synovial cavity
Anterior cruciate ligament
Infrapatellar fat pad
Infrapatellar bursa
Tibia
Patellar ligament

- A **tendon sheath** is similar in structure to a bursa, but smaller.
- It is a connective tissue sac that surrounds a muscle tendon at places where the tendon crosses a joint.
- It contains a lubricating fluid that allows for smooth motions of the tendon during muscle contraction and joint movements.


Patella
Synovial membrane
Joint capsule
Joint cavity
Articular cartilage
Femur
Tibia
Accessory Structures
Bursa
Fat pad
Meniscus
Extracapsular ligament
Intracapsular ligament

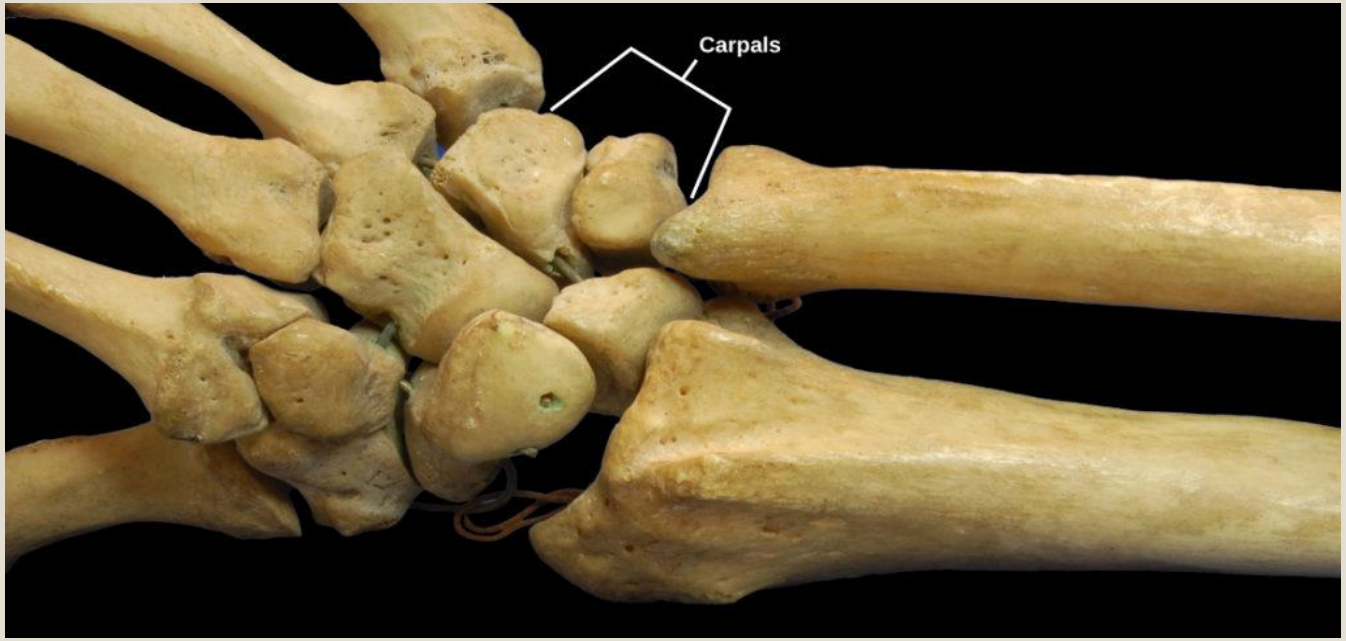
Types of Synovial Joints:

- Synovial joints are subdivided based on the shapes of the articulating surfaces of the bones that form each joint.
- *The six types of synovial joints are:*

1. **Pivot**
2. **Hinge**
3. **Condyloid**
4. **Saddle**
5. **Plane**
6. **Ball-and socket-joints.**

PLANAR JOINTS

- **Planar joints** have bones with articulating surfaces that are flat or slightly curved faces.
- These joints allow for gliding movements, and so the joints are sometimes referred to as gliding joints.
- The range of motion is limited in these joints and does not involve rotation. Planar joints are found in the carpal bones in the hand and the tarsal bones of the foot, as well as between vertebrae.

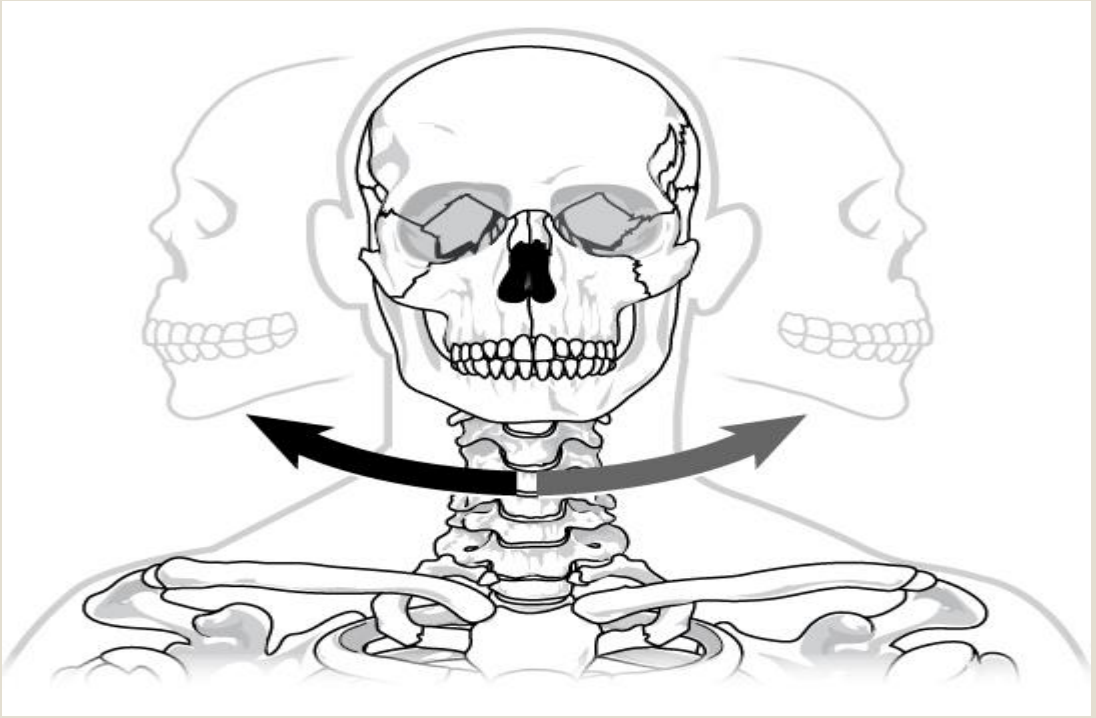


Hinge Joints

- In **hinge joints**, the slightly rounded end of one bone fits into the slightly hollow end of the other bone.
- In this way, one bone moves while the other remains stationary, like the hinge of a door. The elbow is an example of a hinge joint. The knee is sometimes classified as a modified hinge joint.

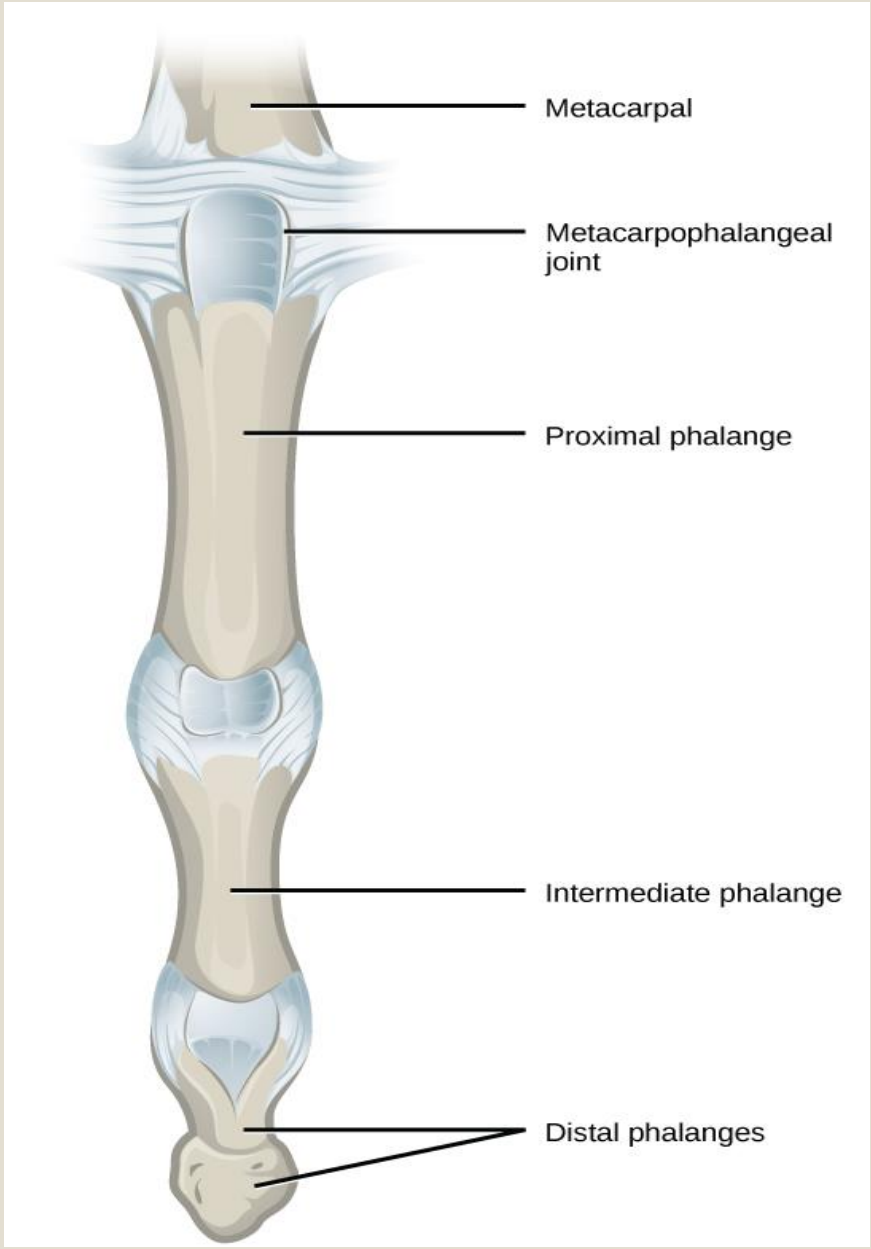
Pivot Joints

- **Pivot joints** consist of the rounded end of one bone fitting into a ring formed by the other bone. This structure allows rotational movement, as the rounded bone moves around its own axis.
- An example of a pivot joint is the joint of the first and second vertebrae of the neck that allows the head to move back and forth. The joint of the wrist that allows the palm of the hand to be turned up and down is also a pivot joint.



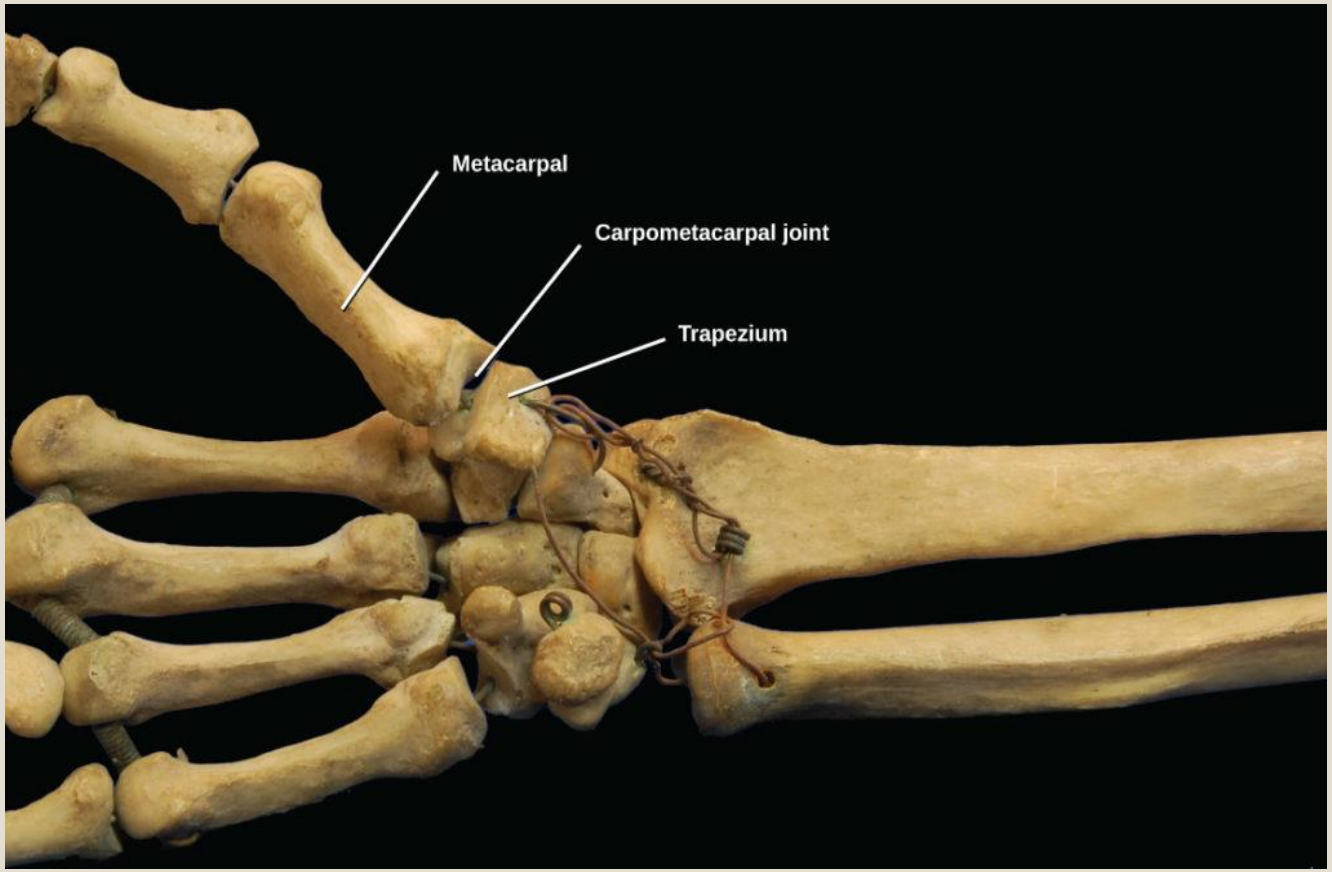
Condyloid Joints

- **Condyloid joints** consist of an oval-shaped end of one bone fitting into a similarly oval-shaped hollow of another bone. This is also sometimes called an ellipsoidal joint.
- This type of joint allows angular movement along two axes, as seen in the joints of the wrist and fingers, which can move both side to side and up and down.



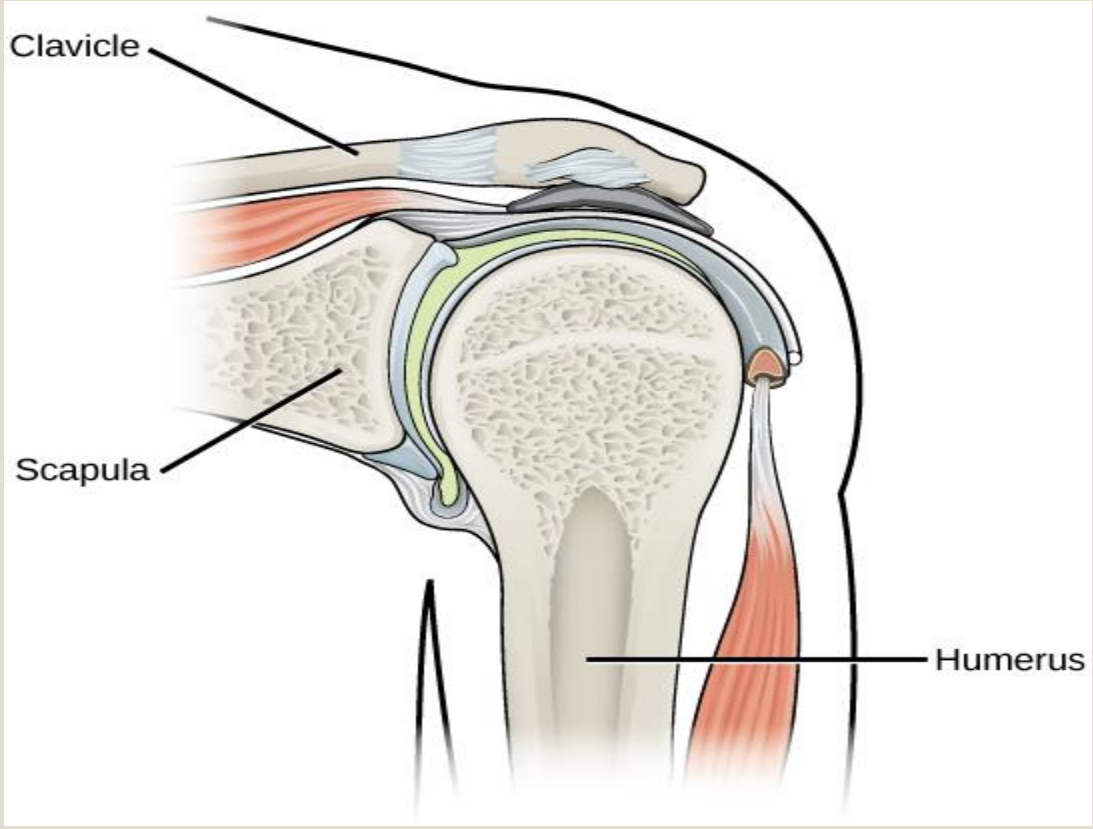
Saddle Joints

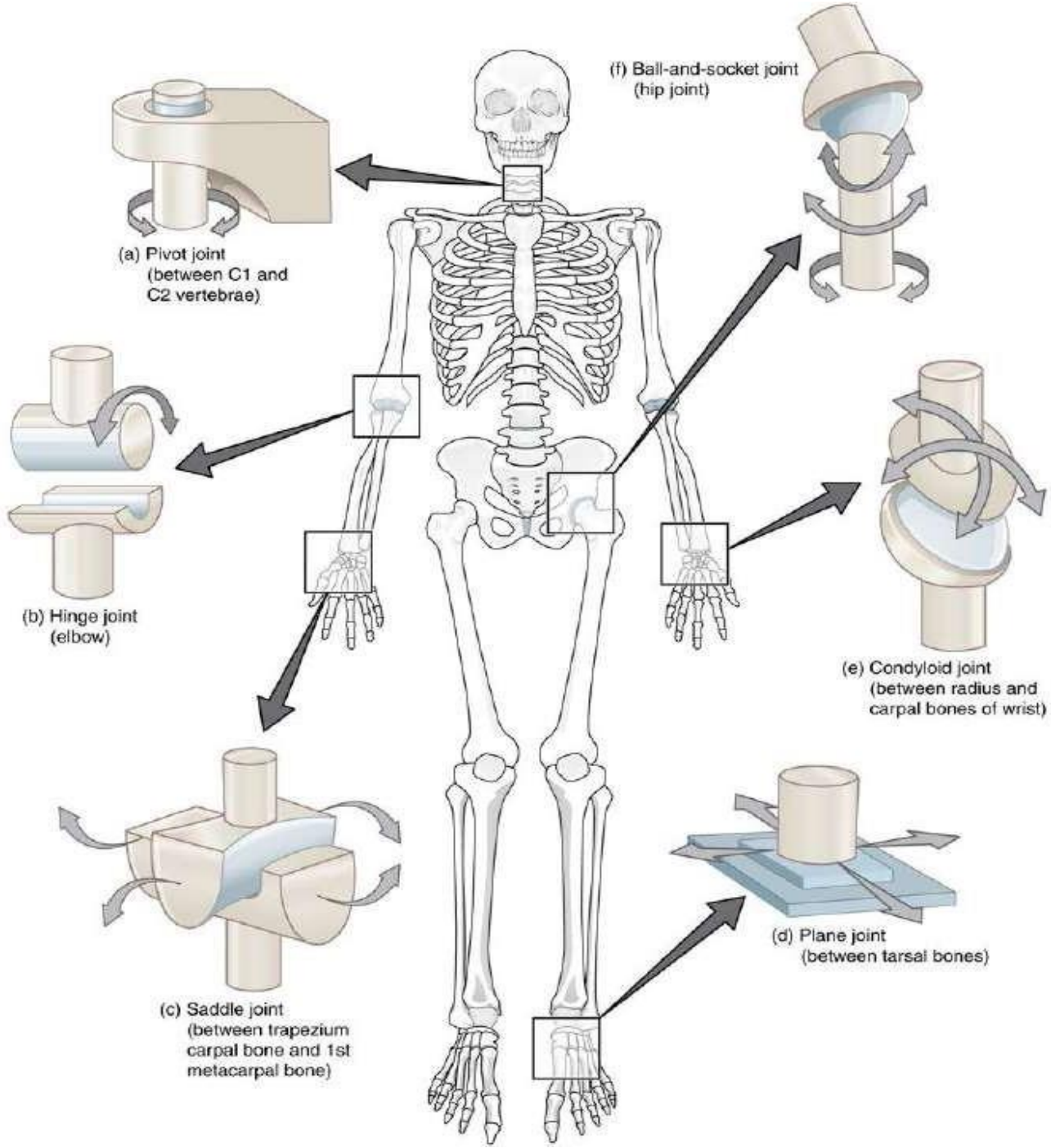
- **Saddle joints** are so named because the ends of each bone resemble a saddle, with concave and convex portions that fit together. Saddle joints allow angular movements similar to condyloid joints but with a greater range of motion. An example of a saddle joint is the thumb joint, which can move back and forth and up and down, but more freely than the wrist or fingers.



Ball-and-Socket Joints

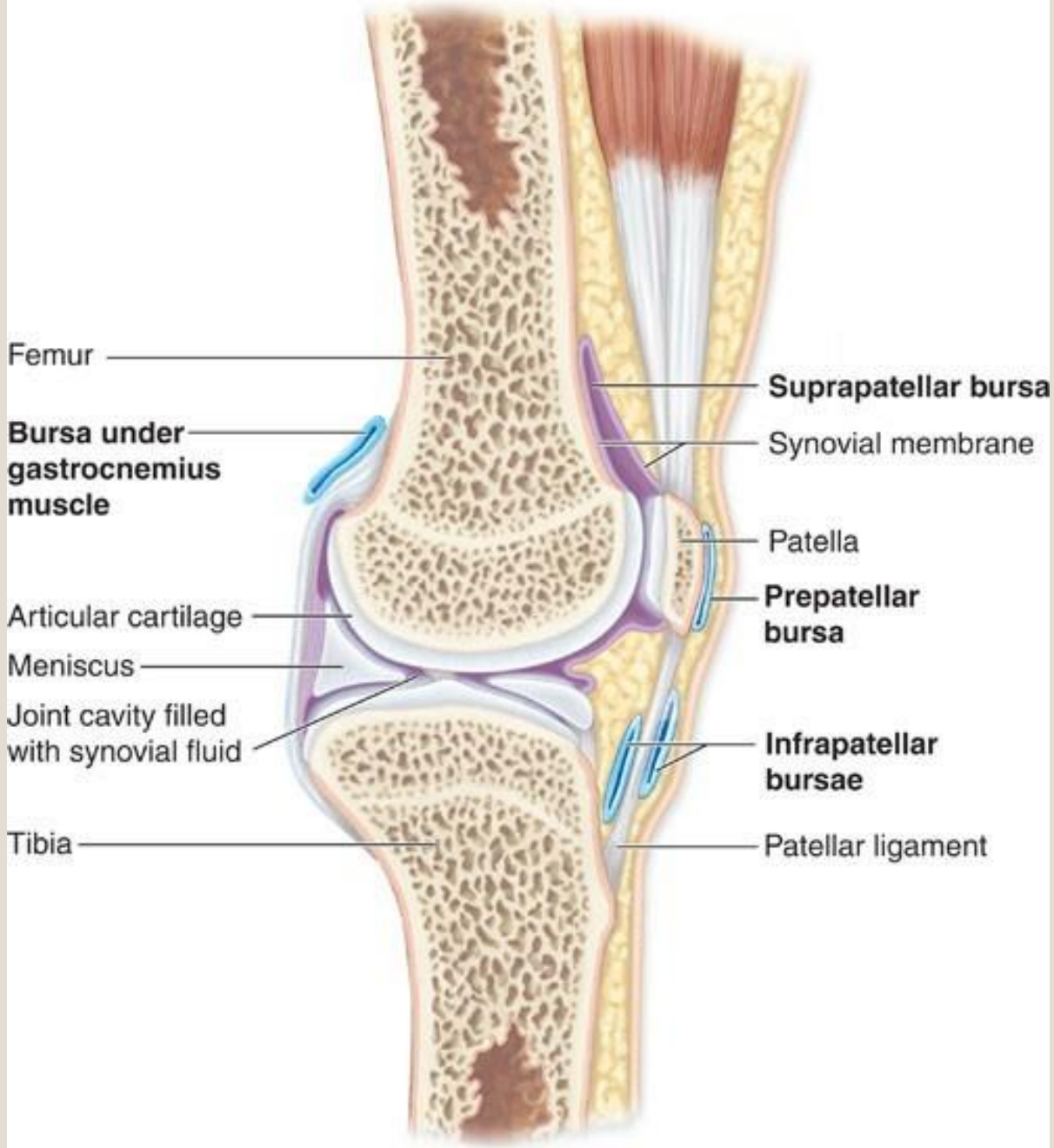
- **Ball-and-socket joints** possess a rounded, ball-like end of one bone fitting into a cuplike socket of another bone. This organization allows the greatest range of motion, as all movement types are possible in all directions. Examples of ball-and-socket joints are the shoulder and hip joints.




(f) Ball-and-socket joint
(hip joint)
(a) Pivot joint
(between C1 and
C2 vertebrae)
(b) Hinge joint
(elbow)
(e) Condyloid joint
(between radius and
carpal bones of wrist)
(c) Saddle joint
(between trapezium
carpal bone and 1st
metacarpal bone)
(d) Plane joint
(between tarsal bones)

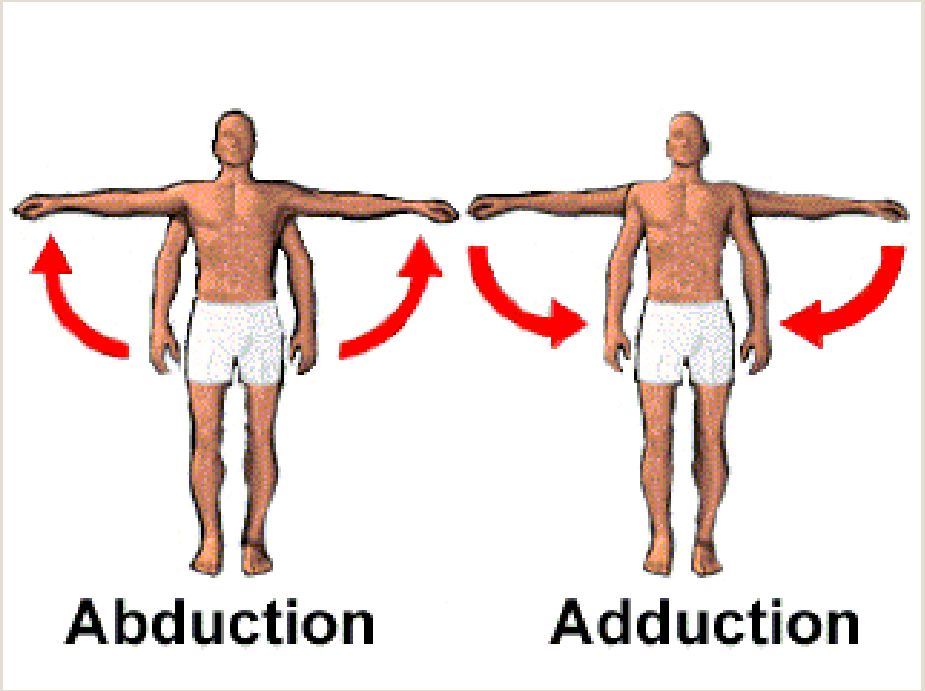
Anatomy of Selected Synovial Joints:

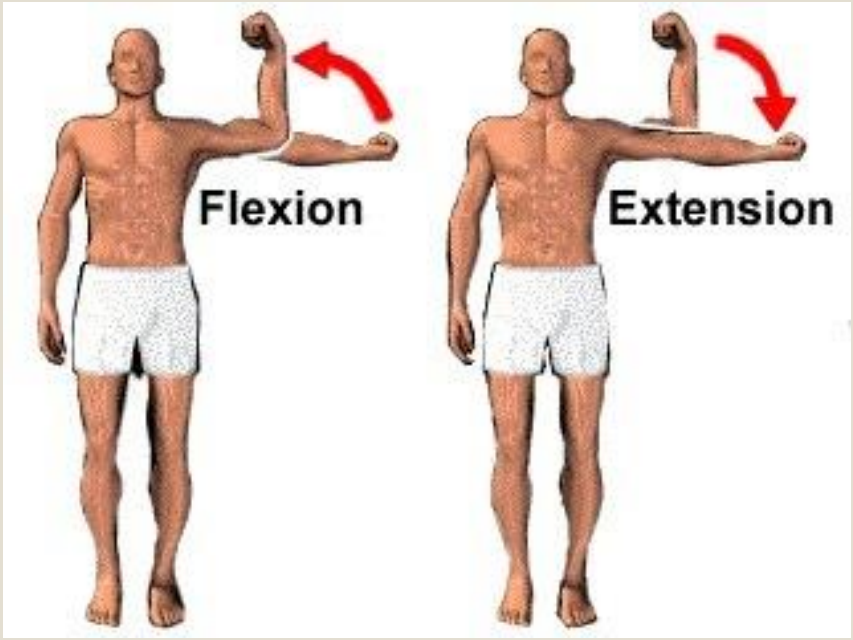
a) Articulations of the Vertebral Column: (zygapophysial joints, atlanto-occipital joint, atlantoaxial joint).
b) Temporomandibular Joint.
c) Shoulder Joint: (glenohumeral joint).
d) Elbow Joint: (humeroulnar joint, humeroradial joint).
e) Hip Joint.
f) Knee Joint: (femoropatellar Joint, medial tibiofemoral joint and lateral tibiofemoral joint).
g) Ankle and Foot Joints: (talocrural joint, subtalar joint).



(a) Bursae of the knee joint, sagittal section

Types of body movements at diarthrotic joints…

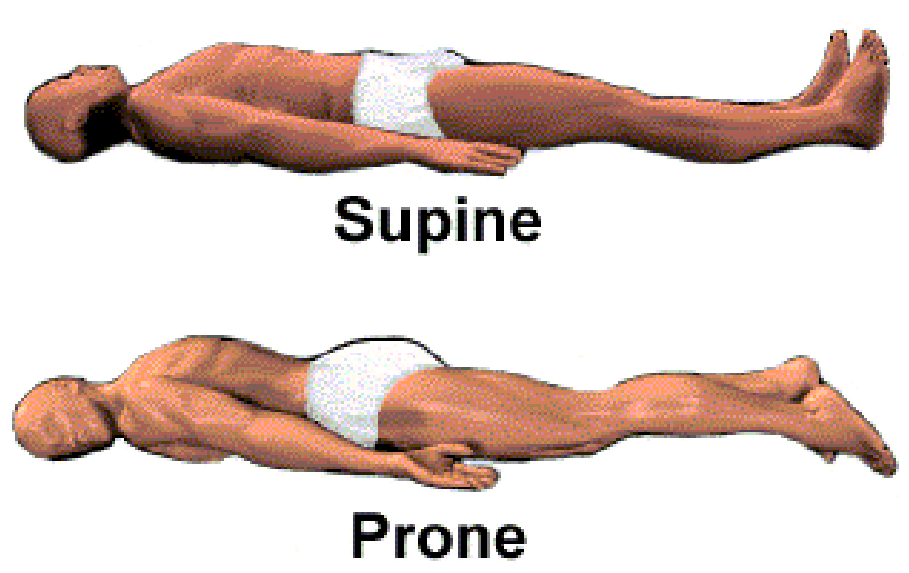


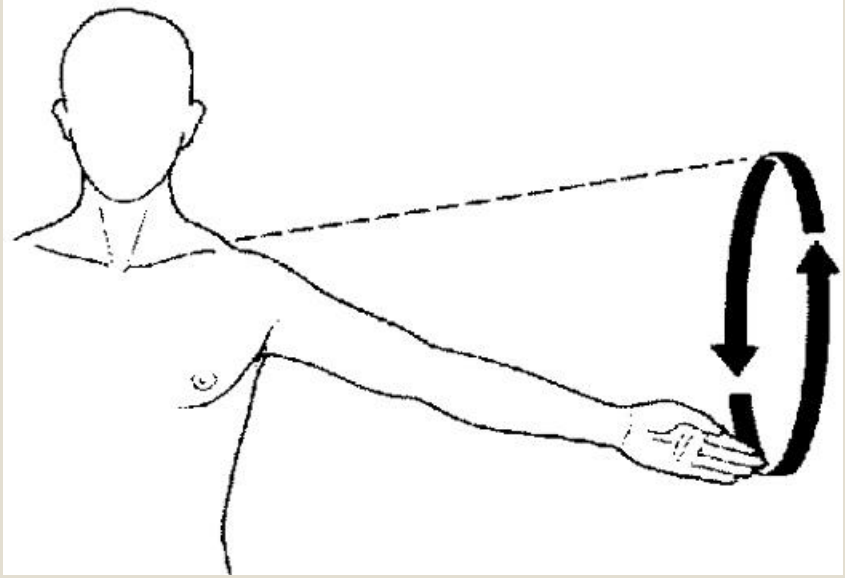


<u>Abduction:</u> moving a body part away from the middle.
<u>Adduction:</u> moving a body part toward the middle.

<u>Flexion</u>: bending a limb
<u>Extension</u>: straightening a flexed limb

Types of body movements at diarthrotic joints…



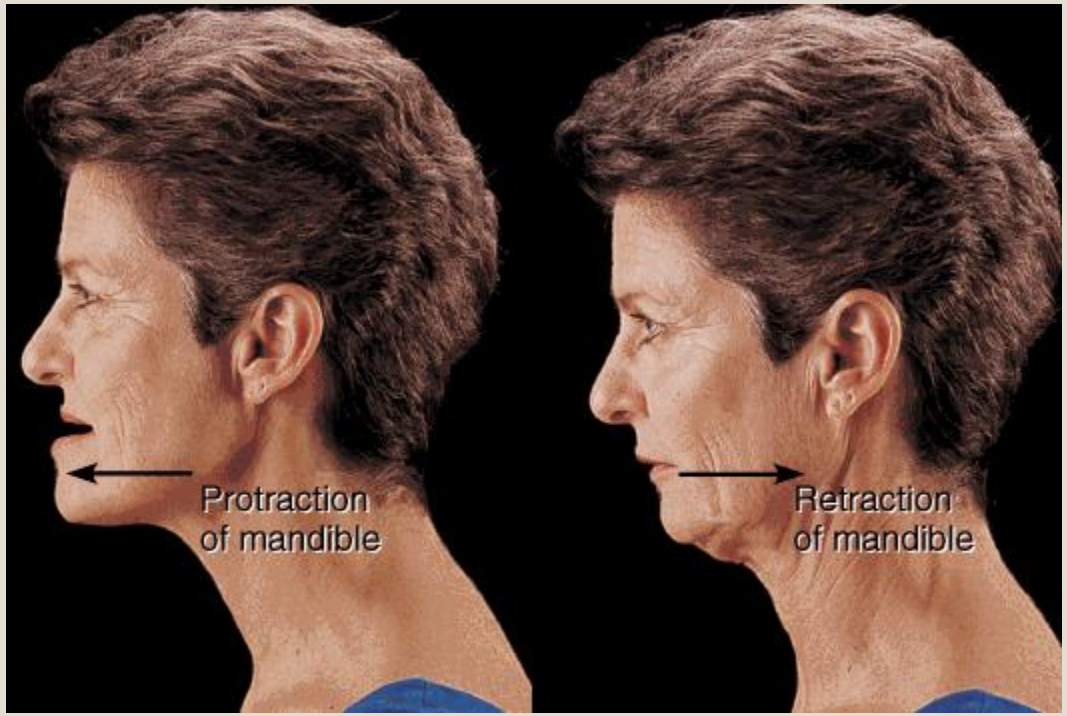


<u>Supination:</u> lying supine or face upward; or turning the palm or foot upward.

<u>Pronation:</u> lying prone or face downward; or turning the palm downward.

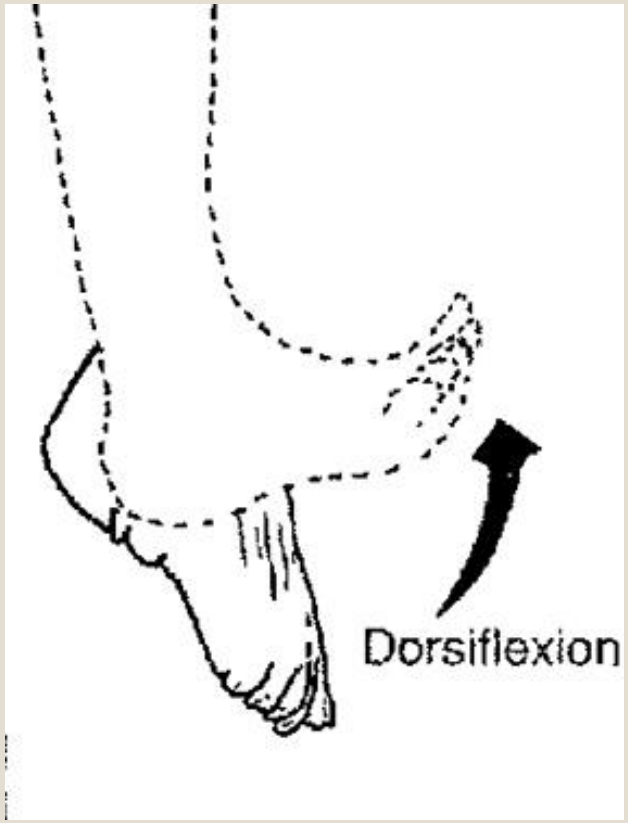
<u>Circumduction:</u> moving a body part in a circular motion

Types of body movements at diarthrotic joints…



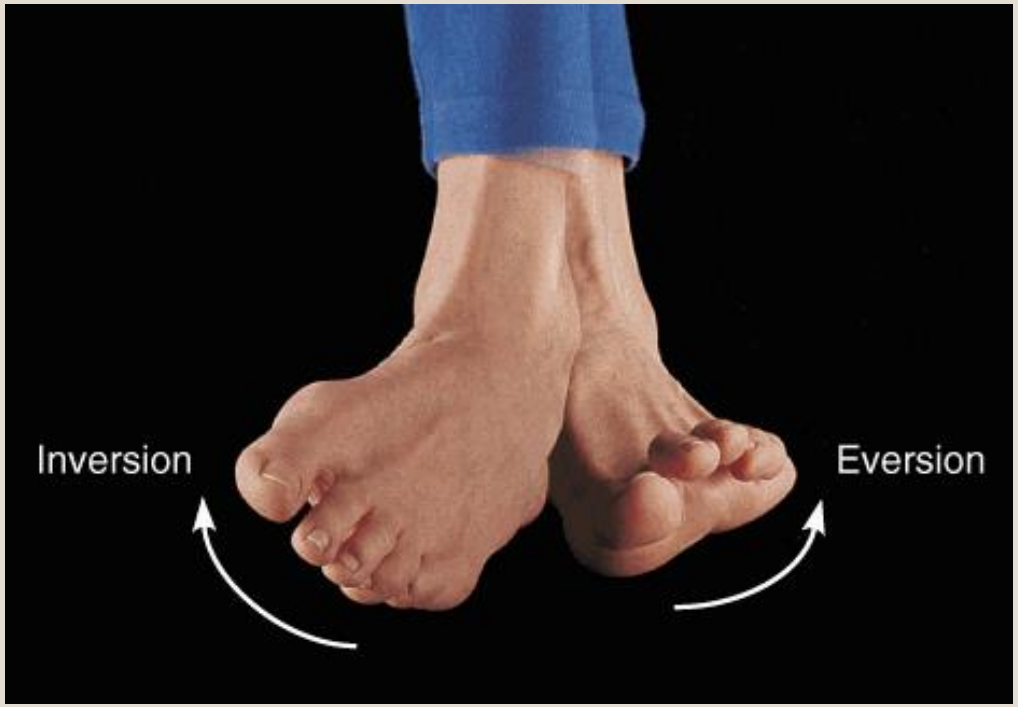
<u>Protraction:</u> moving a body forward.

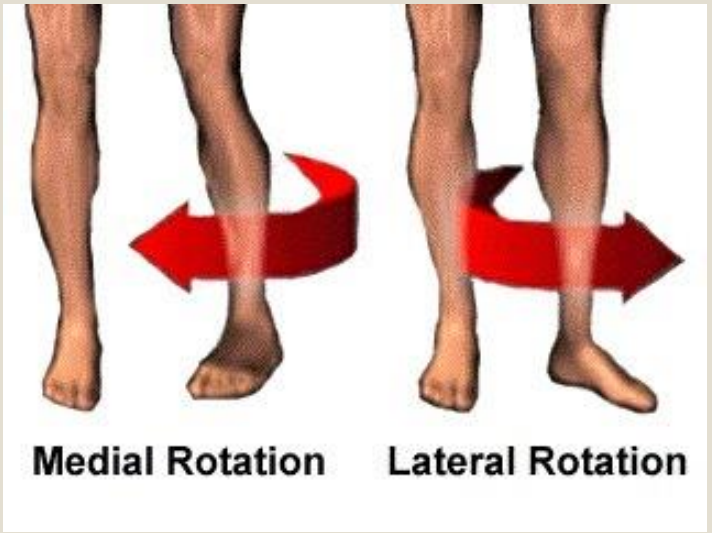
<u>Retraction:</u> moving a body part backward.



<u>Dorsiflexion:</u> bending a body part backwards.

Types of body movements at diarthrotic joints…

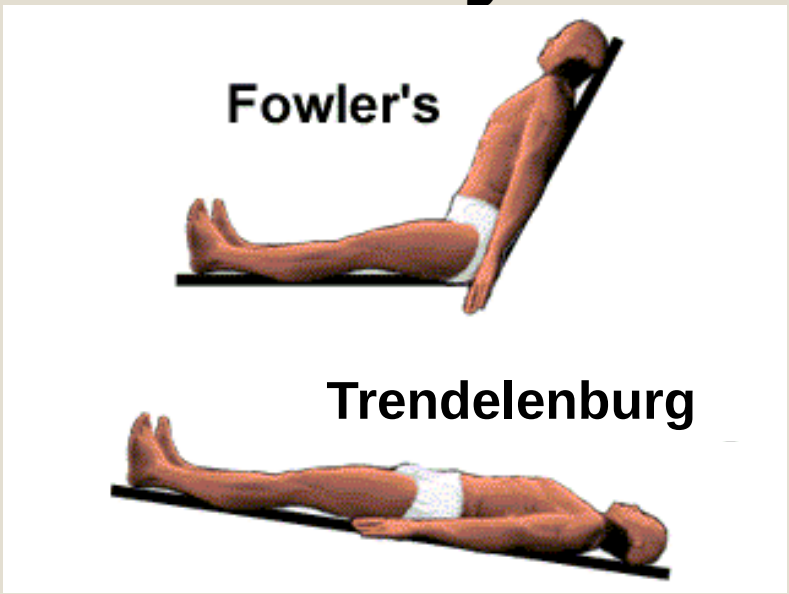


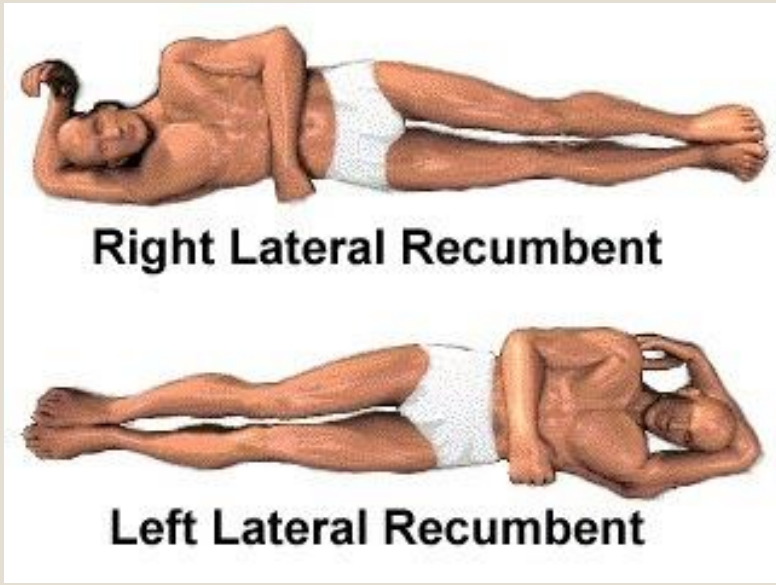


Inversion: turning inward.
Eversion: turning outward.

Rotation: moving a body part around a central axis

Types of body movements at diarthrotic joints…





<u>Fowler's position:</u> **sitting straight up or reclining slightly; legs straight or bent.**

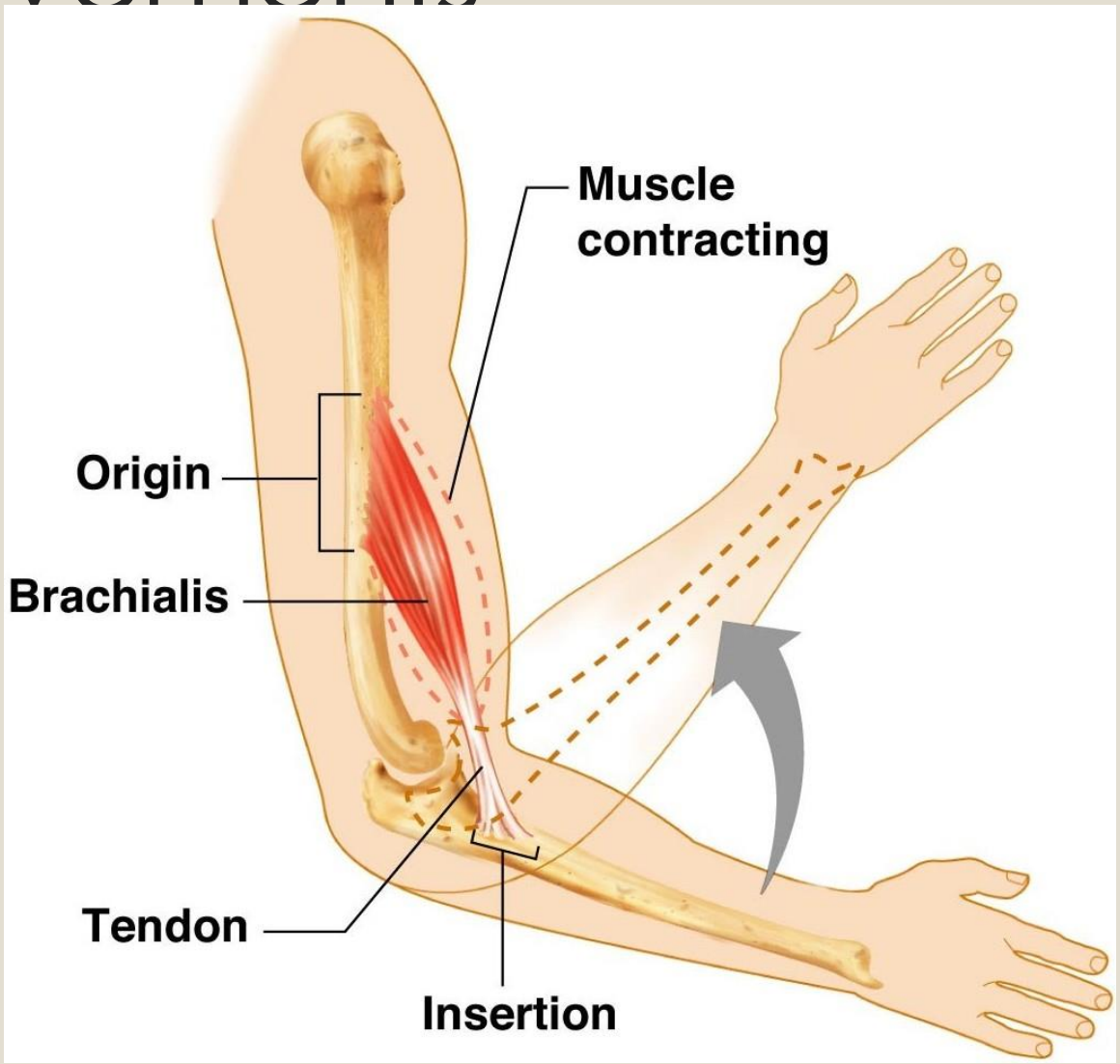
<u>Trendelenburg position:</u> **(TREN duh len burg) lying supine with head lower than feet.**

<u>Lateral recumbent:</u> **lying on your left or right side**

Muscles and Body Movements

- Movement results when a muscle moves an attached bone
- Muscles are attached to at least two points
  - Origin
    - Attachment to a immoveable bone
  - Insertion
    - Attachment to an movable bone

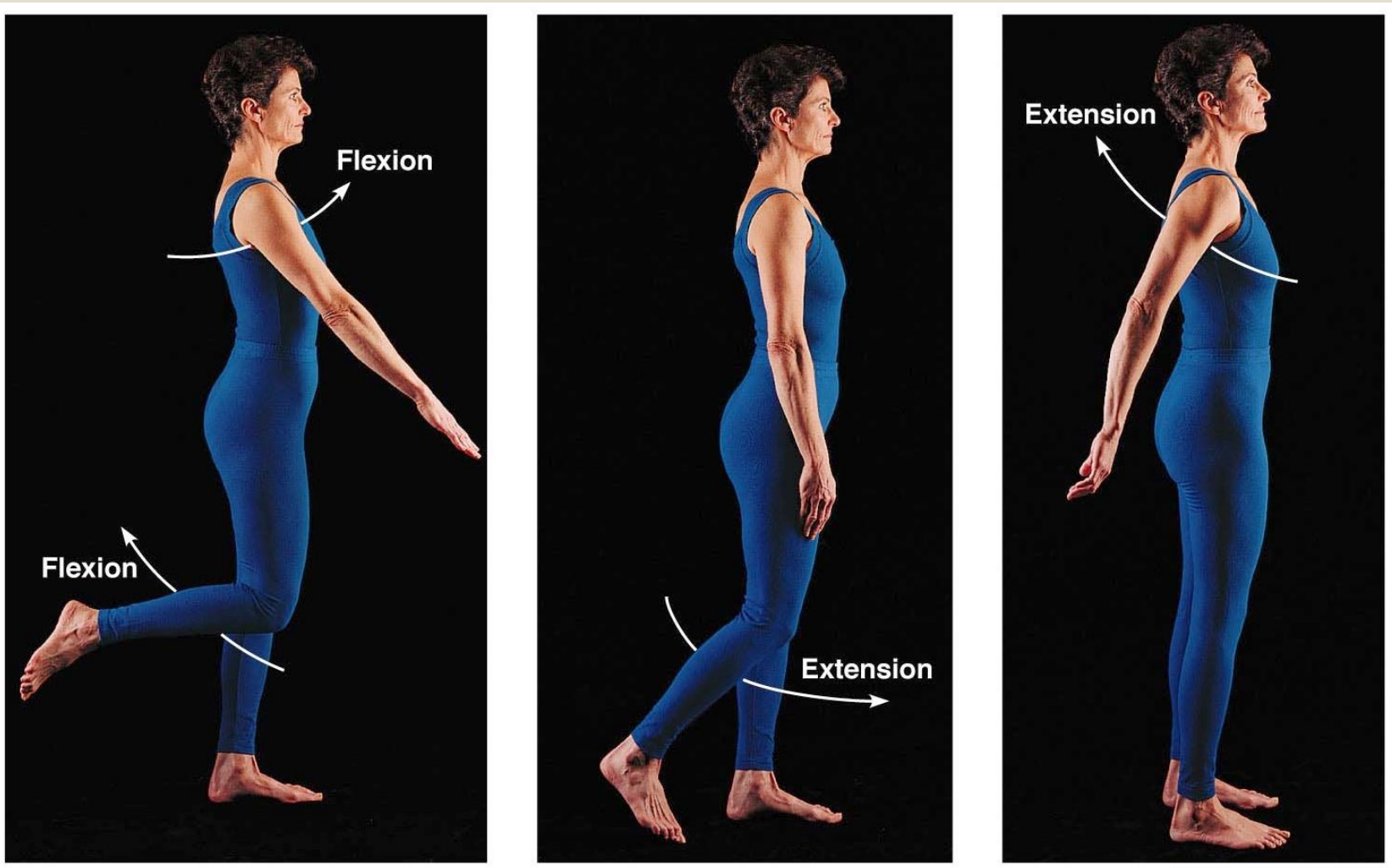
Muscles and Body Movements



Types of Ordinary Body Movements

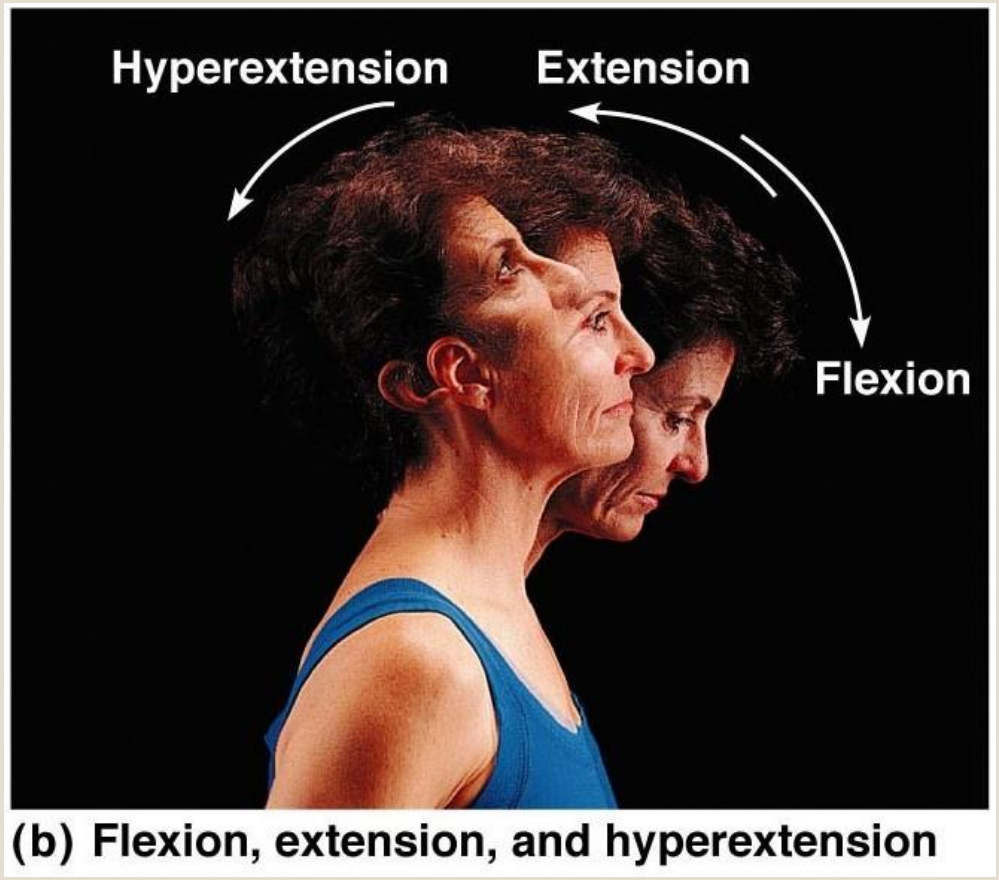
- Flexion
  - Decreases the angle of the joint
  - Brings two bones closer together
  - Typical of hinge joints like knee and elbow
- Extension
  - Opposite of flexion
  - Increases angle between two bones

Types of Ordinary Body Movements



(a) Flexion and extension of the shoulder and knee

Types of Ordinary Body Movements

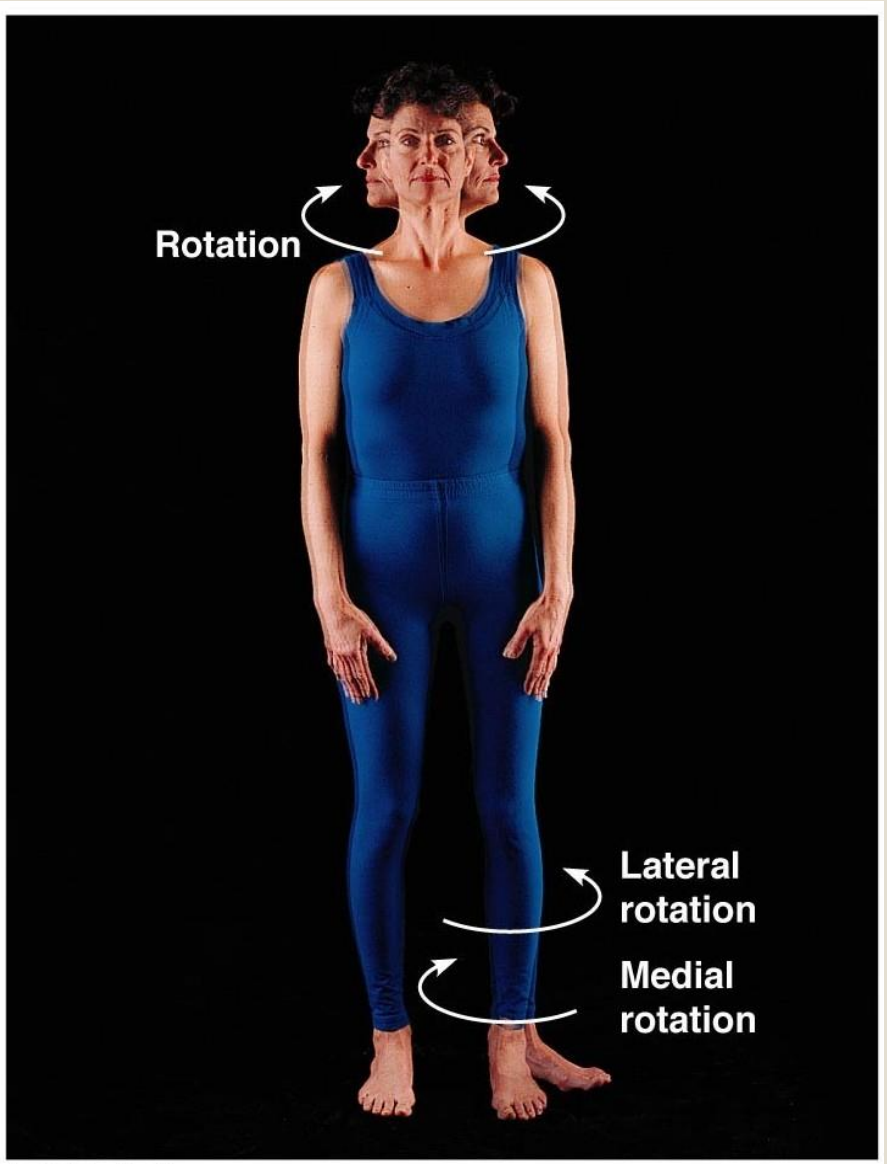


(b) Flexion, extension, and hyperextension

Hyperextension: results when angle is > 180

Types of Ordinary Body Movements

- Rotation
  - Movement of a bone around its longitudinal axis
  - Common in ball-and-socket joints
  - Example is when you move atlas around the axis vertebra (shake your head "no")



(c) Rotation

Types of Ordinary Body Movements

- Abduction
  - Movement of a limb away from the midline
- Adduction
  - Opposite of abduction
  - Movement of a limb toward the midline

(d) Abduction, adduction, and circumduction

Types of Ordinary Body Movements

- Circumduction
  - Combination of flexion, extension, abduction, and adduction
  - Common in ball-and-socket joints

(d) Abduction, adduction, and circumduction

Special Movements

- Dorsiflexion
  - Lifting the foot so that the superior surface approaches the shin
- Plantar flexion
  - Depressing the foot (pointing the toes)

(e) Dorsiflexion and plantar flexion

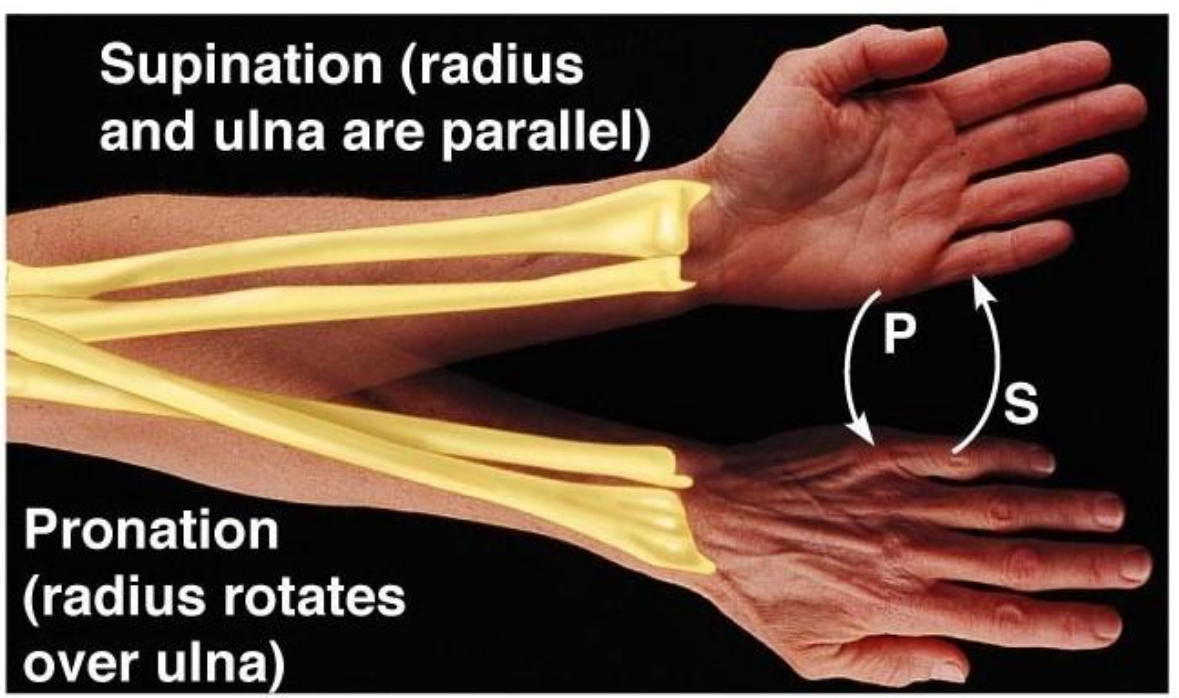
Special Movements

- Inversion
  - Turn sole of foot medially
- Eversion
  - Turn sole of foot laterally

(f) Inversion and eversion

Special Movements

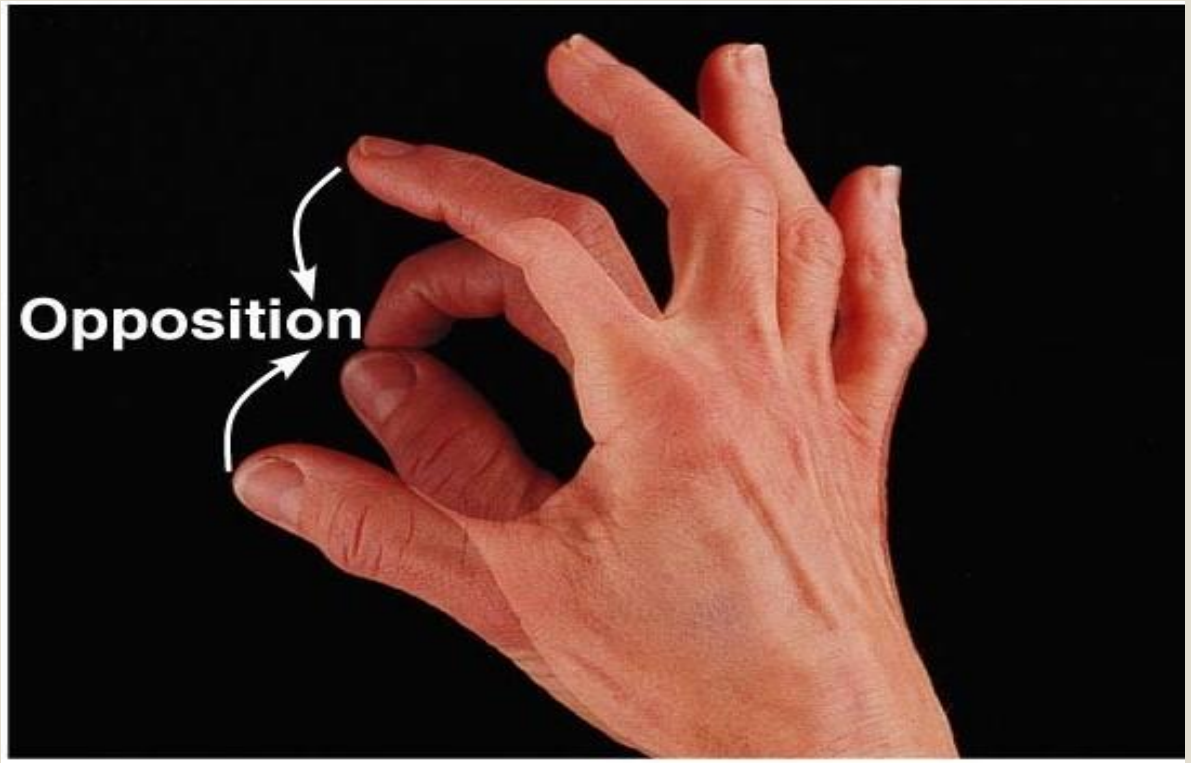
- Supination
  - Forearm rotates laterally so palm faces up (anterior)
- Pronation
  - Forearm rotates medially so palm faces down (posterior)



(g) Supination (S) and pronation (P)

Special Movements

- Opposition
  - Move thumb to touch the tips of other fingers on the same hand



(h) Opposition

THE END