

Cartilage: is a strong, flexible connective tissue that protects joints and bones. It acts as a shock absorber throughout the body.

Functions:

- Absorbing shock
- Reducing friction
- Supporting structures in the body

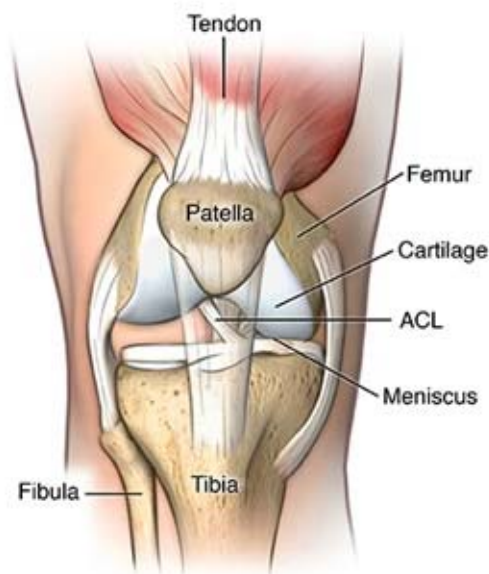
Types of cartilage:

There are three types of cartilage in the body:

- ❑ **Hyaline cartilage:** contains a resilient gel and appears in the body as a bluish-white, shiny substance
- ❖ **Location:** Most abundant cartilage in body; at ends of long bones, anterior ends of ribs, nose, parts of larynx, trachea, bronchi, bronchial tubes, embryonic and fetal skeleton.
- ❖ **Function:** Provides smooth surfaces for movement at joints, flexibility, and support; weakest type of cartilage and can be fractured
- ❑ **Fibrocartilage:** has chondrocytes among clearly visible thick bundles of collagen fibers within extracellular matrix.
- ❖ **Location:** Pubic symphysis (where hip bones join anteriorly), intervertebral discs, menisci (cartilage pads) of knee, portions of tendons that insert into cartilage.
- ❖ **Function:** Support and joining structures together. Strength and rigidity make it the strongest type of cartilage
- ❑ **Elastic cartilage:** is most flexible cartilage. It supports parts of the body that need to bend and move to function. Located in external ears

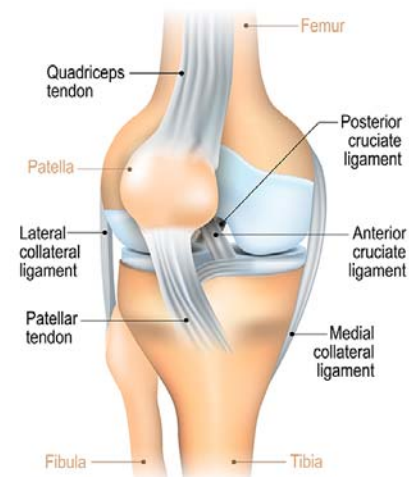
A tendon is a fibrous connective tissue that attaches muscle to bone. Tendons may also attach muscles to structures such as the eyeball. A tendon serves to move the bone or structure.

A ligament is a fibrous connective tissue that attaches bone to bone, and usually serves to hold structures together and keep them stable.



Normal knee

Ligament



A joint:

❑ Is a point of contact between two bones or more, bone and cartilage called an articulation.

Joints are classified:

A. Structurally, based on their anatomical characteristics:

The structural classification of joints is based on two criteria:

- ❖ the presence or absence of a space between the articulating bones, called a synovial cavity.
- ❖ the type of connective tissue that binds the bones together.

Classified to three following types:

- **Fibrous joints:** There is no synovial cavity, and the bones are held together by dense irregular connective tissue that is rich in collagen fibers.
- **Cartilaginous joints:** There is no synovial cavity, and the bones are held together by cartilage.
- **Synovial joints:** The bones forming the joint have a synovial cavity and are united by the dense irregular connective tissue of an articular capsule, and often by accessory ligaments.

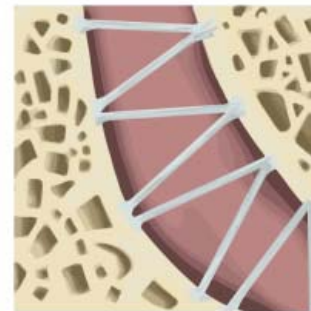
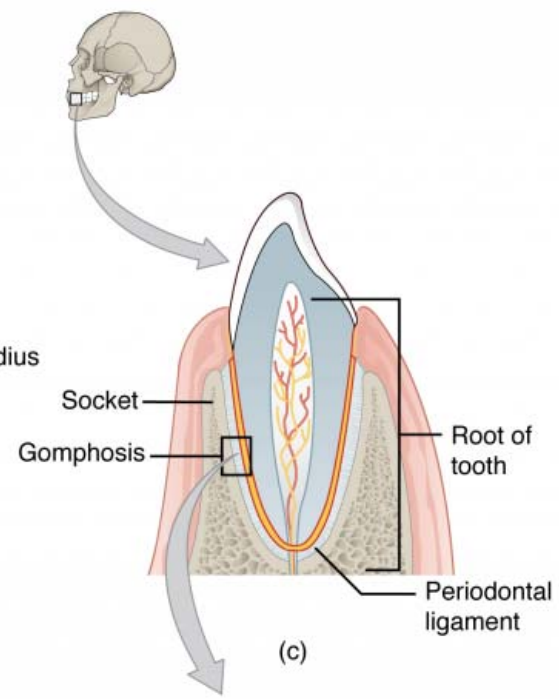
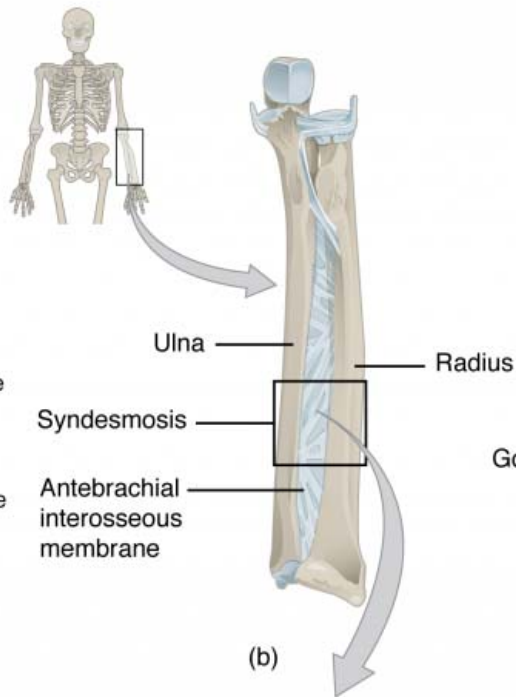
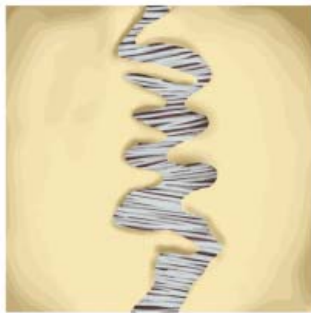
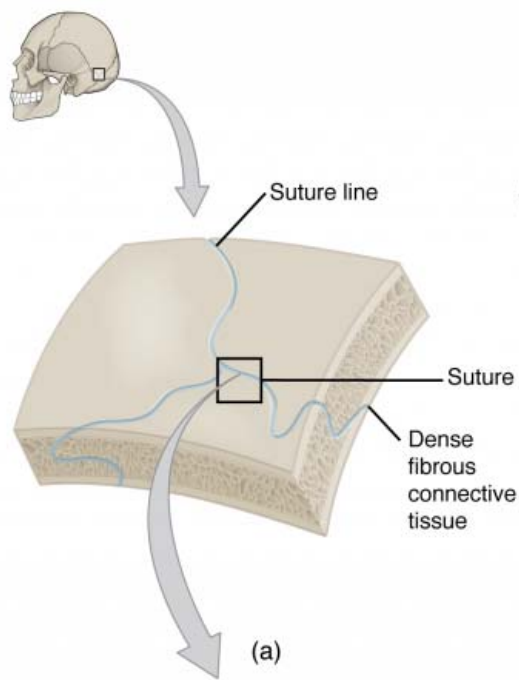
Fibrous Joints: fibrous joints **lack a synovial cavity**, and the articulating bones are **held very closely together by dense irregular connective tissue**. Fibrous joints permit **little or no movement**.

The three types of fibrous joints:

- ❑ **Sutures:** is a fibrous joint composed of a thin layer of dense irregular connective tissue; sutures occur only between bones of the skull. An example is the coronal suture between the parietal and frontal bones. Sutures play important roles in shock absorption in the skull.
- ❑ **Syndesmoses:** The dense irregular connective tissue is typically arranged as a bundle (ligament), allowing the joint to permit limited movement. One example distal tibiofibular joint. Another example the articulations between the roots of the teeth (cone-shaped pegs) and their sockets (dental alveoli) in the alveolar processes in the maxillae and mandibles called a gomphosis or dentoalveolar joint.
- ❑ **Interosseous Membranes:** which is a substantial sheet of dense irregular connective tissue that binds neighboring long bones and permits slight movement. One occurs between the radius and ulna in the forearm and the other occurs between the tibia and fibula in the leg.

Functions:

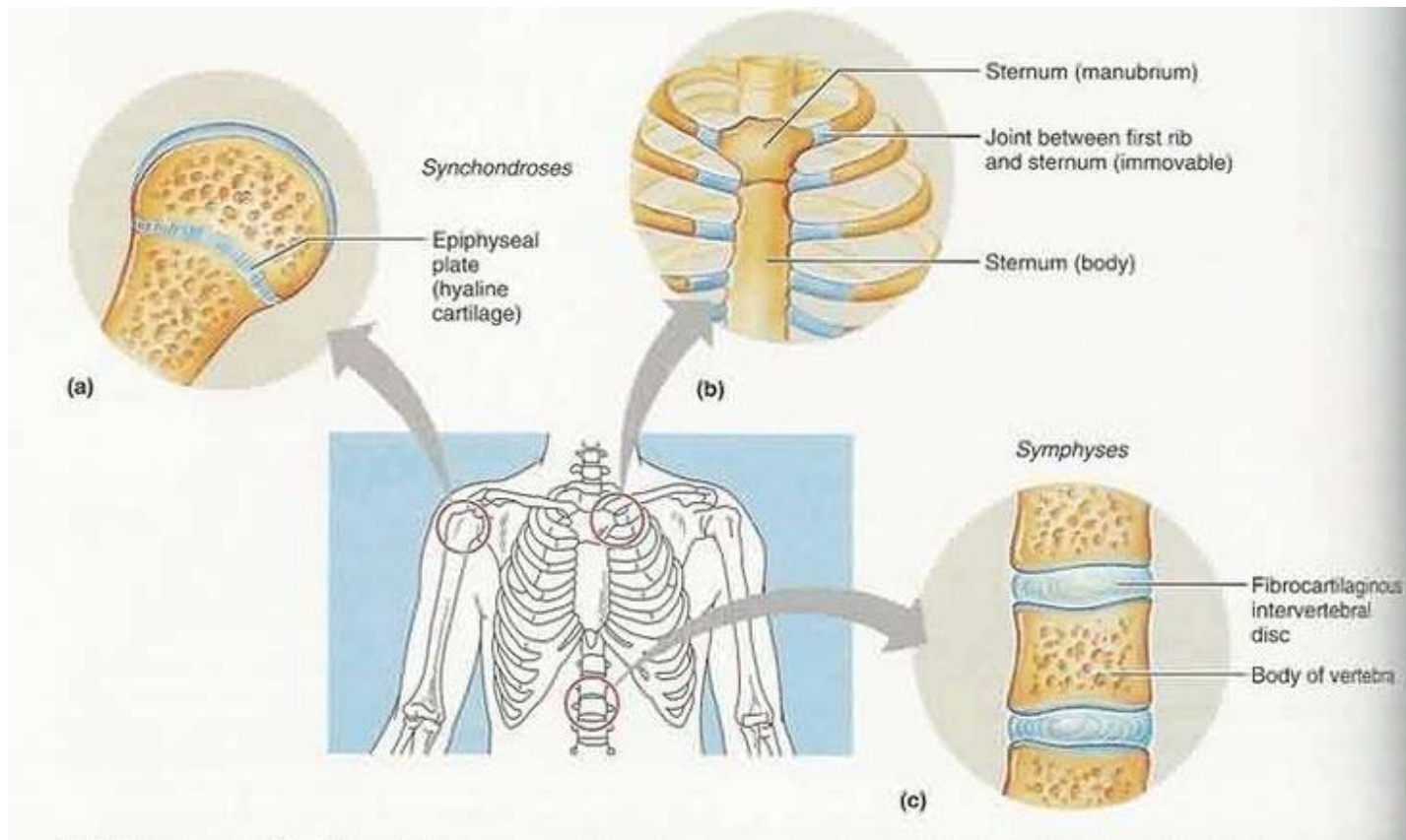
- help hold these adjacent long bones together.
- play an important role in defining the range of motion between the neighboring bones
- provide an increased attachment surface for muscles that produce movements of the digits of the hand and foot



Cartilaginous Joints: Like a fibrous joint, a cartilaginous joint **lacks a synovial cavity** and **allows little or no movement**. Here the **articulating bones are tightly connected by either hyaline cartilage or fibrocartilage**.

The three types of cartilaginous joints are synchondroses, symphyses, and epiphyseal cartilages.

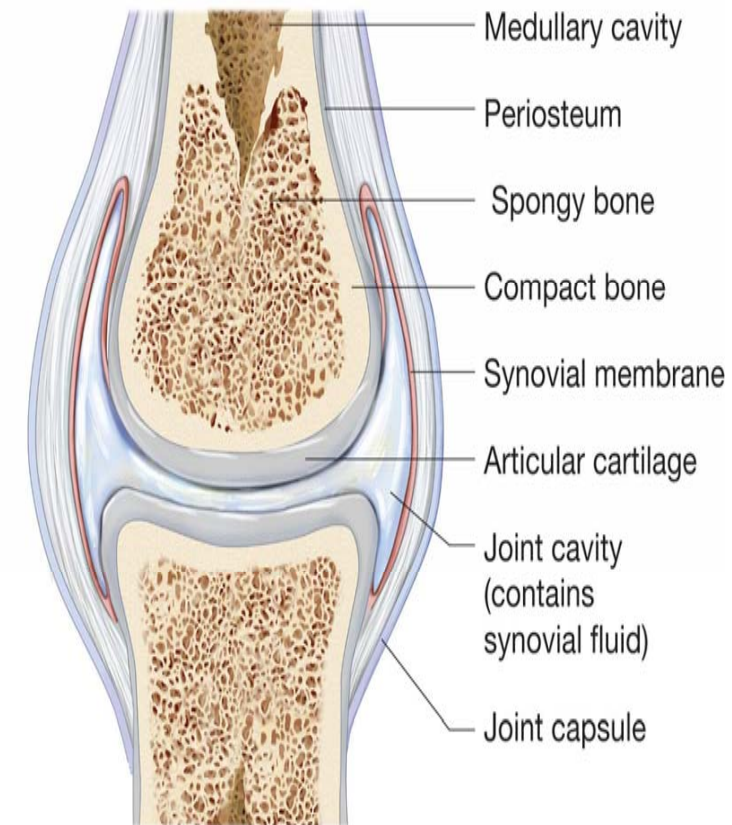
- ❑ **Synchondroses:** is a cartilaginous joint in which the connecting material is hyaline cartilage and is slightly movable to immovable. One example is the joint between the first rib and the manubrium of the sternum.
- ❑ **Symphyses:** is a cartilaginous joint in which the ends of the articulating bones are covered with hyaline cartilage, but a broad, flat disc of fibrocartilage connects the bones. For example the pubic symphysis between the anterior surfaces of the hip, at the junction of the manubrium and body of the sternum and at the intervertebral joints between the bodies of vertebrae. A symphysis is a slightly movable joint.
- ❑ **Epiphyseal Cartilages:** are actually hyaline cartilage growth centers during endochondral bone formation, not joints associated with movements. An example of epiphyseal cartilage is the epiphyseal (growth) plate that connects the epiphysis and diaphysis of a growing. Functionally, epiphyseal cartilage is an immovable joint. When bone elongation ceases, bone replaces the hyaline cartilage, and becomes a bony joint.



Synovial Joints:

Synovial joints have certain characteristics that distinguish them from other joints.

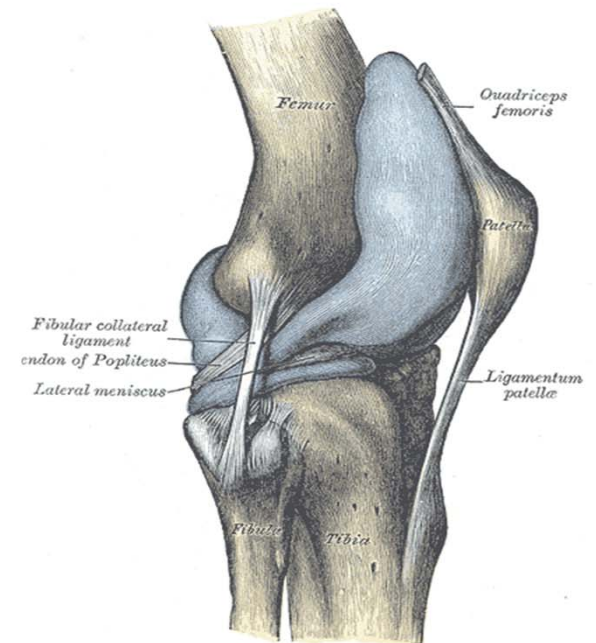
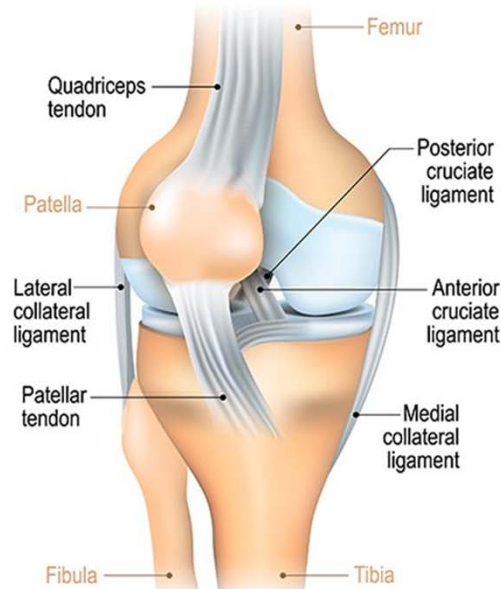
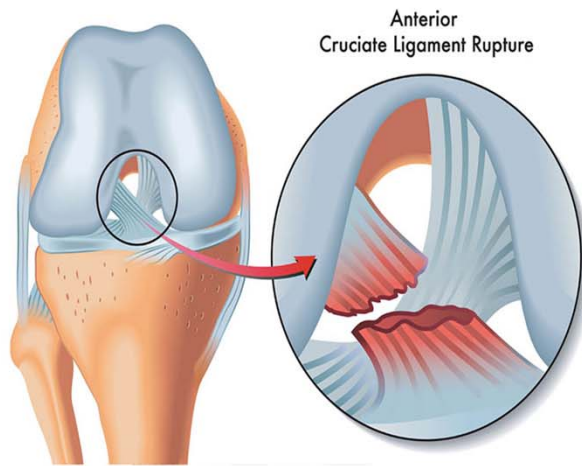
1. **Synovial cavity or joint cavity** between the articulating bones.
2. **Freely movable** (diarthroses).
3. **Articular cartilage**, A tough, elastic, fibrous connective tissue, which reduces friction between bones in the joint during movement and helps to absorb shock.
4. **Articular Capsule** A sleeve like articular capsule or joint capsule surrounds a synovial joint, encloses the synovial cavity, and unites the articulating bones. The articular capsule is composed of two layers, an outer fibrous membrane and an inner synovial membrane.
5. **Synovial Fluid** The synovial membrane secretes synovial fluid, a viscous, clear or pale yellow fluid named for its similarity in appearance and consistency to uncooked egg white. Its functions:
 - ❖ Reducing friction by lubricating the joint
 - ❖ absorbing shocks.
 - ❖ supplying oxygen and nutrients to and removing carbon dioxide and metabolic wastes.
 - ❖ contains phagocytic cells that remove microbes and the debris that results from normal wear and tear in the joint



6. Accessory Ligaments, Articular Discs, and Labra

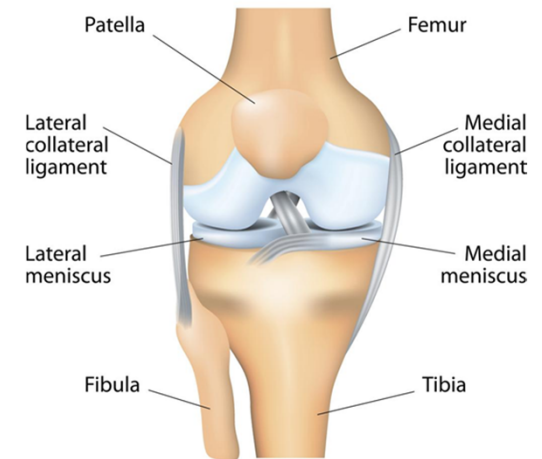
❑ Many synovial joints also contain **accessory ligaments** called:

- **Extracapsular ligaments:** lie outside the articular capsule. Examples are the fibular and tibial collateral ligaments of the knee joint.
- **Intracapsular ligaments:** occur within the articular capsule but are excluded from the synovial cavity by folds of the synovial membrane. Examples are the anterior and posterior cruciate ligaments of the knee joint providing support for knee rotational movements.

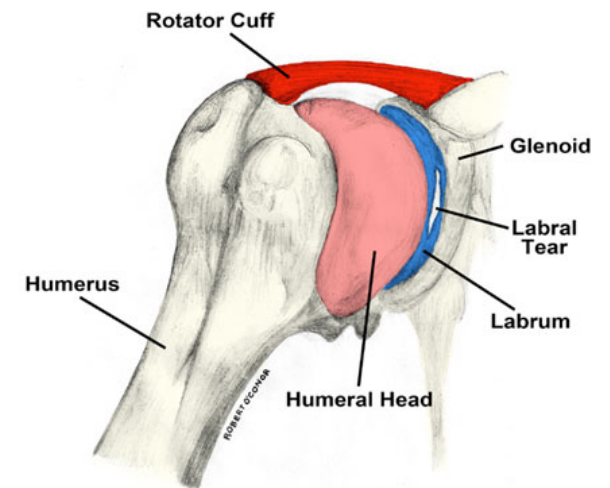


- ❑ Inside some synovial joints, such as the knee, crescent-shaped pads of fibrocartilage lie between the articular surfaces of the bones and are attached to the fibrous capsule. These pads are called **articular discs or menisci** bind strongly to the inside of the fibrous membrane and usually subdivide the synovial cavity into two spaces, allowing separate movements to occur in each space.

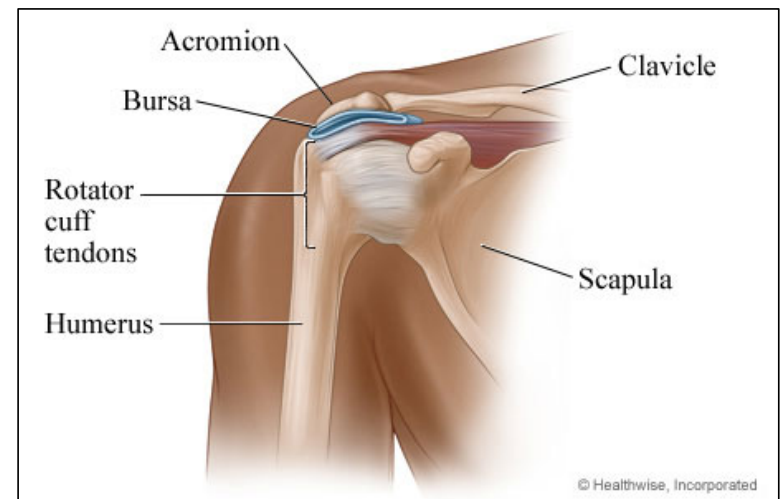
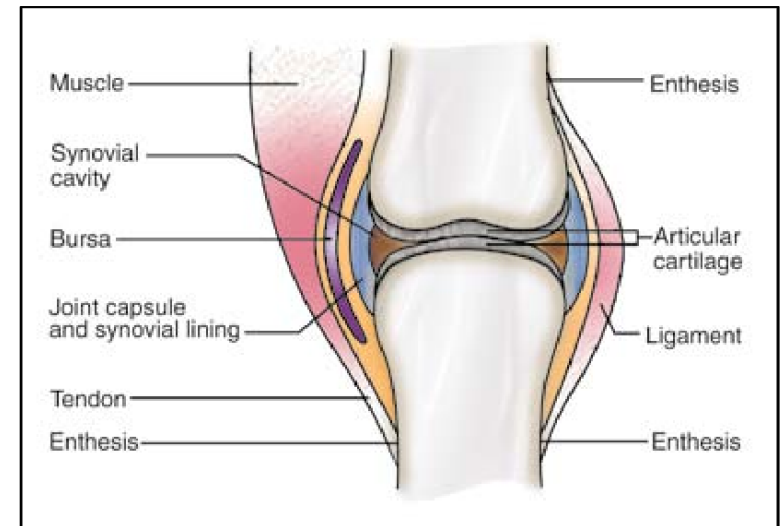
THE HUMAN KNEE



- ❑ A **labrum (plural is labra)**: prominent in the ball-and socket joints of the shoulder and hip, is the fibrocartilaginous lip that extends from the edge of the joint socket. The labrum helps deepen the joint socket and increases the area of contact between the socket and the ball-like surface of the head of the humerus or femur.



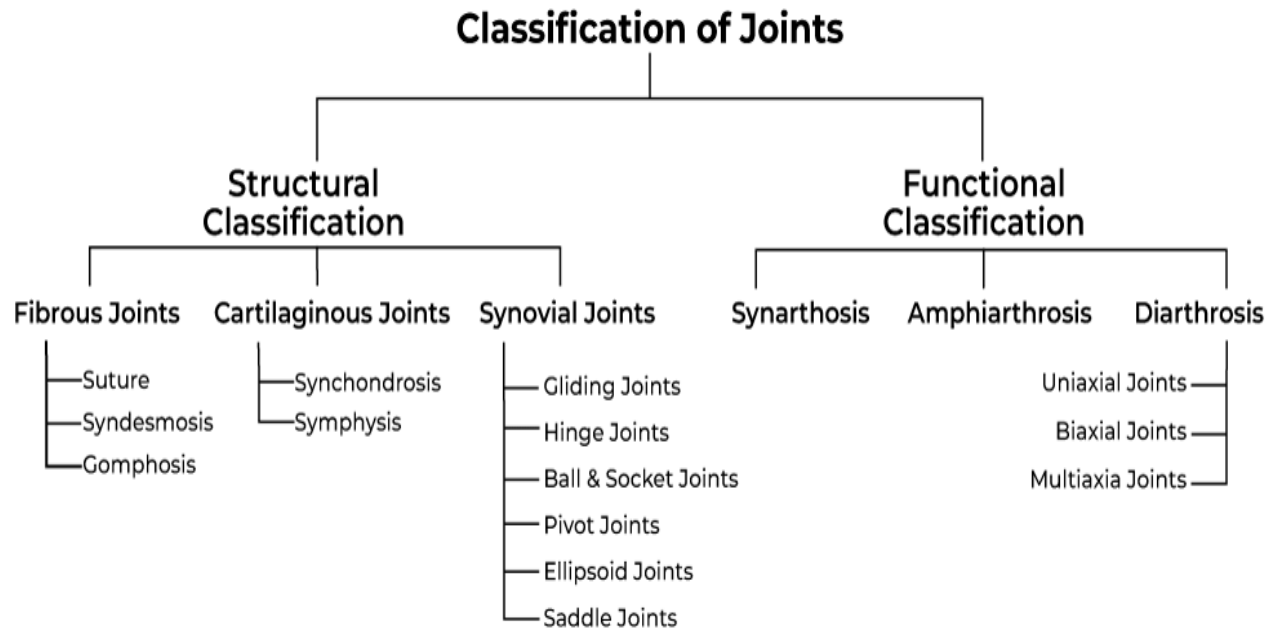
- ❖ In some joints little sacs are present, **Bursae** are not strictly part of synovial joints.
- ❖ They do resemble joint capsules because their walls consist of an outer fibrous membrane of thin, dense connective tissue lined by a synovial membrane.
- ❖ They are filled with a small amount of fluid that is similar to synovial fluid.
- ❖ Bursae can be located between the skin and bones, tendons and bones, muscles and bones, or ligaments and bones.
- ❖ The fluid-filled bursal sacs cushion the movement of these body parts against one another.
- ❖ they act as cushions to prevent friction between a bone and a ligament or tendon, or skin where a bone in a joint is near the surface



B. The functional classification of joints relates to the degree of movement they permit.

Functionally, joints are classified as one of the following types:

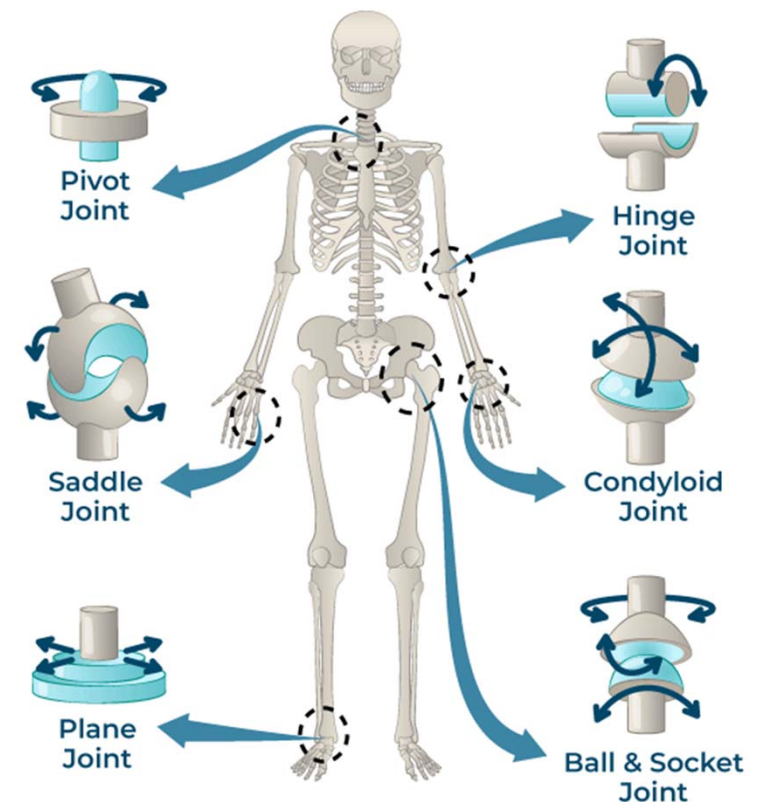
- **Synarthrosis:** An immovable joint.
- **Amphiarthrosis** (on both sides): A slightly movable joint.
- **Diarthrosis** (movable joint): A freely movable joint. All diarthroses are synovial joints, they have a variety of shapes and permit several different types of movements.



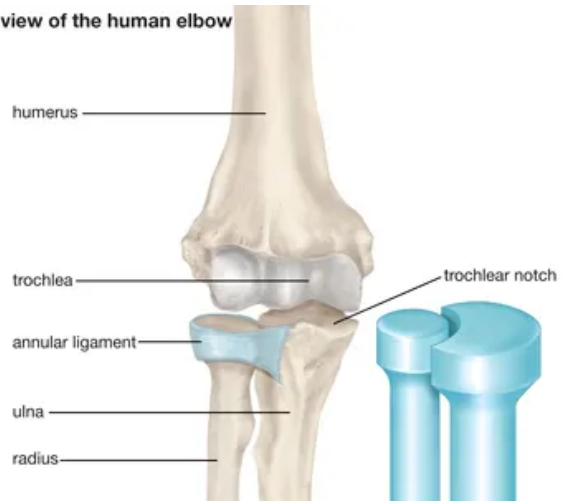
Types of Synovial Joints: Although all synovial joints have many characteristics in common, the shapes of the articulating surfaces vary; thus, many types of movements are possible. Synovial joints are divided into six categories based on type of movement: plane, hinge, pivot, condyloid, saddle, and ball-and-socket.

- ❖ **plane joint** the articulating surfaces are flat, and the bones primarily glide back and forth and side to side (many are biaxial), they may also permit rotation (triaxial). Examples are joints between carpals and tarsals, sternoclavicular and acromioclavicular joints
- ❖ **hinge joint**, the convex surface of one bone fits into the concave surface of another, and the motion is angular around one axis (uniaxial); examples are the elbow, knee (a modified hinge joint), and ankle joints.
- ❖ **pivot joint**, a round or pointed surface of one bone fits into a ring formed by another bone and a ligament, and movement is rotational (uniaxial). Examples are the atlanto-axial and radioulnar joints.

Types of Joints



Anterior view of the human elbow



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Plane Joint



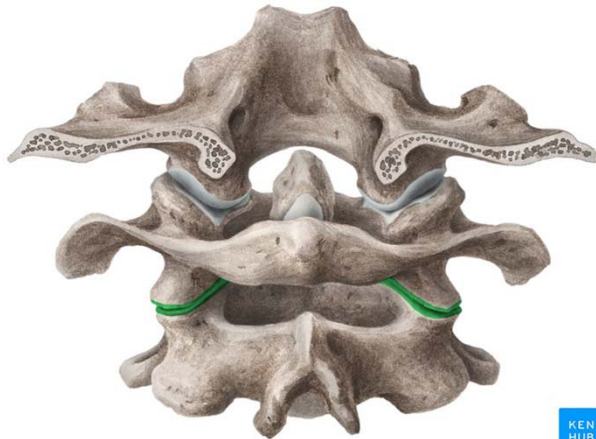
Saddle Joint



Hinge Joint



Pivot Joint



Ball-and-Socket Joint

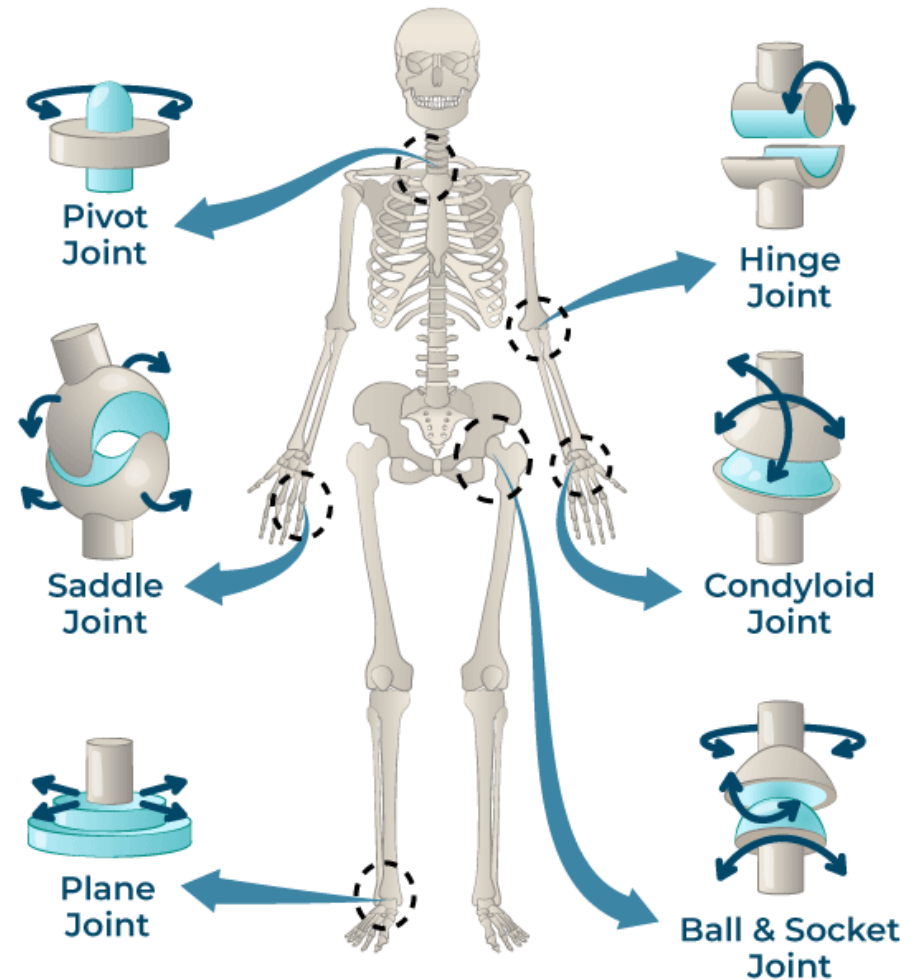


Ellipsoid Joint



Types of Joints

- ❖ **condyloid joint (ellipsoidal):** an oval projection of one bone fits into an oval cavity of another, and motion is angular around two axes (biaxial). Examples include the wrist joint and metacarpophalangeal joints of the second through fifth digits.
- ❖ **saddle joint**, the articular surface of one bone is shaped like a saddle and the other bone fits into the saddle like a sitting rider; movement is biaxial. An example is the carpometacarpal joint between the trapezium and the metacarpal of the thumb.
- ❖ **ball-and-socket joint**, the ball-shaped surface of one bone fits into the cuplike depression of another; motion is around three axes (triaxial). Examples include the shoulder and hip joints

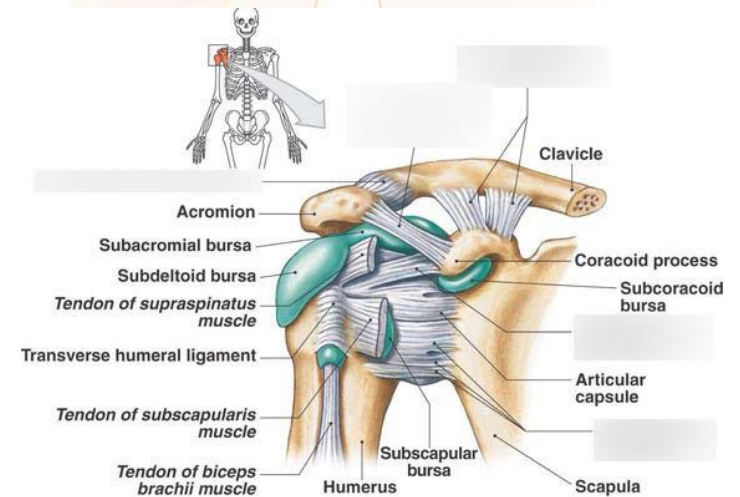
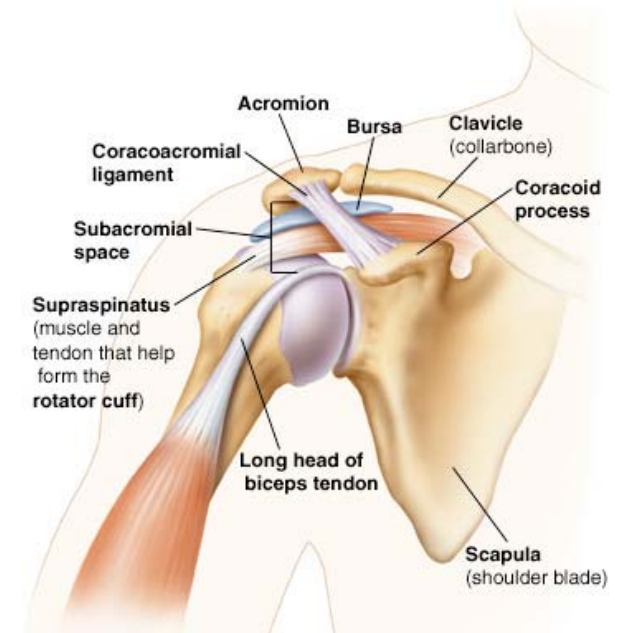


Joints of the upper limb:

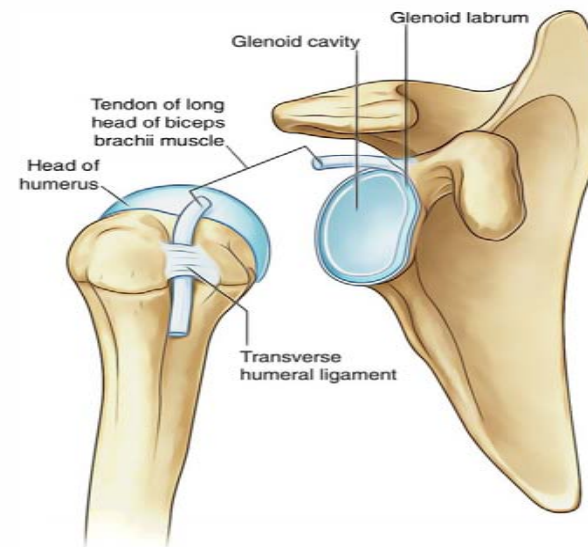
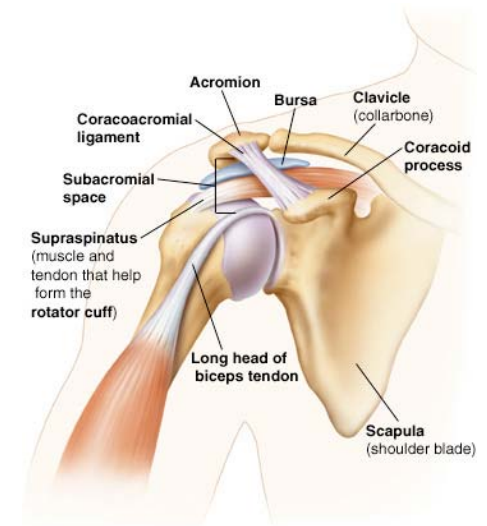
❑ **Shoulder Joint:** The shoulder joint is a ball-and-socket joint formed by the head of the humerus and the glenoid cavity of the scapula. It is also referred to as the humeroscapular or glenohumeral joint

❑ Anatomical Components:

1. **Articular capsule.** Thin, loose sac that completely envelops the joint and extends from the glenoid cavity to the anatomical neck of the humerus. The inferior part of the capsule is its weakest area
2. **Glenoid labrum.** Narrow rim of fibrocartilage around the edge of the glenoid cavity that slightly deepens and enlarges the glenoid cavity.
3. **Bursae.** Four bursae are associated with the shoulder joint. They are the subscapular bursa, subdeltoid bursa, subacromial bursa and subcoracoid bursa.



4. **Coracohumeral ligament:** extends from the coracoid process of the scapula to the greater tubercle of the humerus.
5. **Glenohumeral ligaments:** extend from the glenoid cavity to the lesser tubercle and anatomical neck of the humerus.
6. **Transverse humeral ligament:** Narrow sheet extending from the greater tubercle to the lesser tubercle of the humerus.



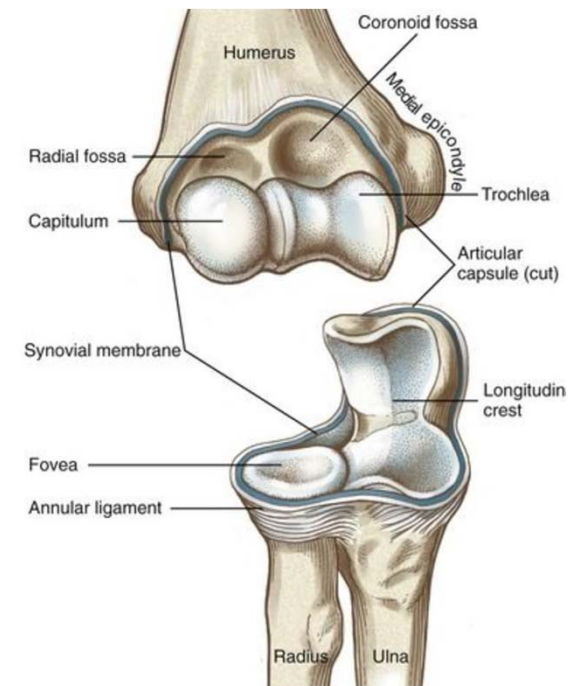
Elbow Joint:

Is hinge joint made up of three distinct articulations, which are:

- the humeroulnar, between the trochlea of the humerus and the trochlear notch of the ulna (a hinge-joint).
- the humeroradial, between the capitulum and the upper concave surface of the radial head (a ball and socket joint).
- the superior radio-ulnar, between the head of the radius and the radial notch of the ulna, the head being held in place by the tough annular ligament (a pivot joint).

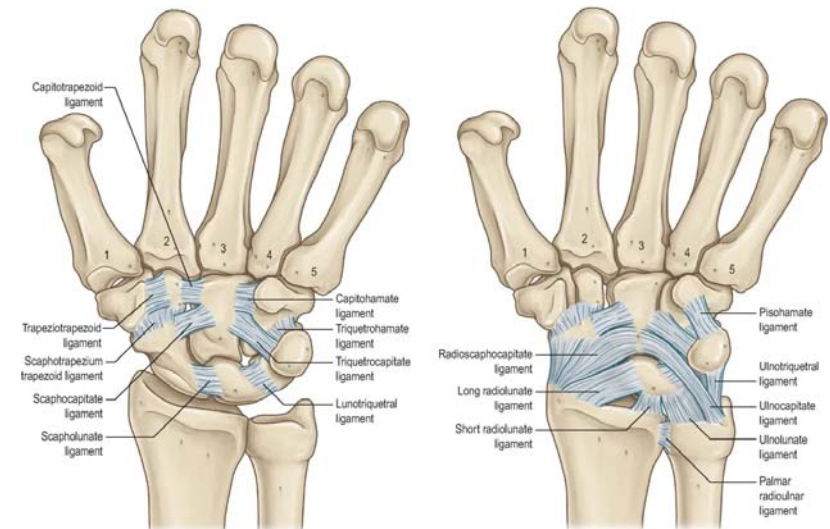
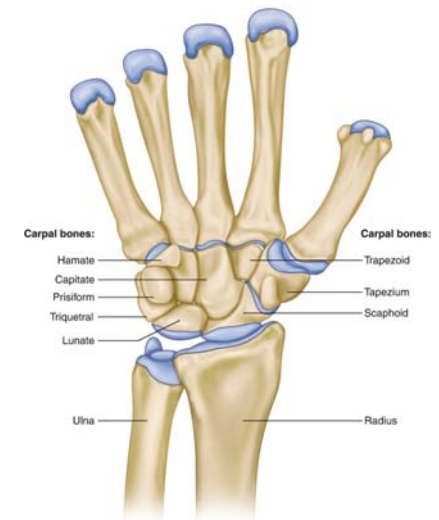
Anatomical Components:

1. **Articular capsule:** The capsule is thin and loose anteriorly and posteriorly to allow flexion and extension, whereas it is strongly thickened on either side to form the medial and lateral collateral ligaments.
2. **Ulnar collateral ligament.** Thick, triangular ligament that extends from the medial epicondyle of the humerus to the coronoid process and olecranon of the ulna. Part of this ligament deepens the socket for the trochlea of the humerus.
3. **Radial collateral ligament.** Strong, triangular ligament that extends from the lateral epicondyle of the humerus to the annular ligament of the radius and the radial notch of the ulna.
4. **Annular ligament of the radius.** Strong band that encircles the head of the radius. It holds the head of the radius in the radial notch of the ulna



Wrist joint:

- ❑ Is a condyloid joint, between the distal end of the radius and the proximal ends of the scaphoid, lunate and triquetral.
- ❑ A **disc** of white fibrocartilage separates the ulna from the joint cavity and articulates with the carpal bones. It also separates the inferior radioulnar joint from the wrist joint.
- ❑ Extracapsular structures consist of medial and lateral ligaments and anterior and posterior radiocarpal ligaments.
- ❑ **Movements:** flexion, extension, abduction, adduction



The joints of the hand

- ❑ There are synovial joints between the carpal bones, between the carpal and metacarpal bones, between the metacarpal bones and proximal phalanges and between the phalanges.
- ❑ The carpometacarpal joint of the thumb is saddle-shaped and permits flexion, extension, abduction adduction and opposition, in which the thumb is brought across in contact with the 5th finger.

