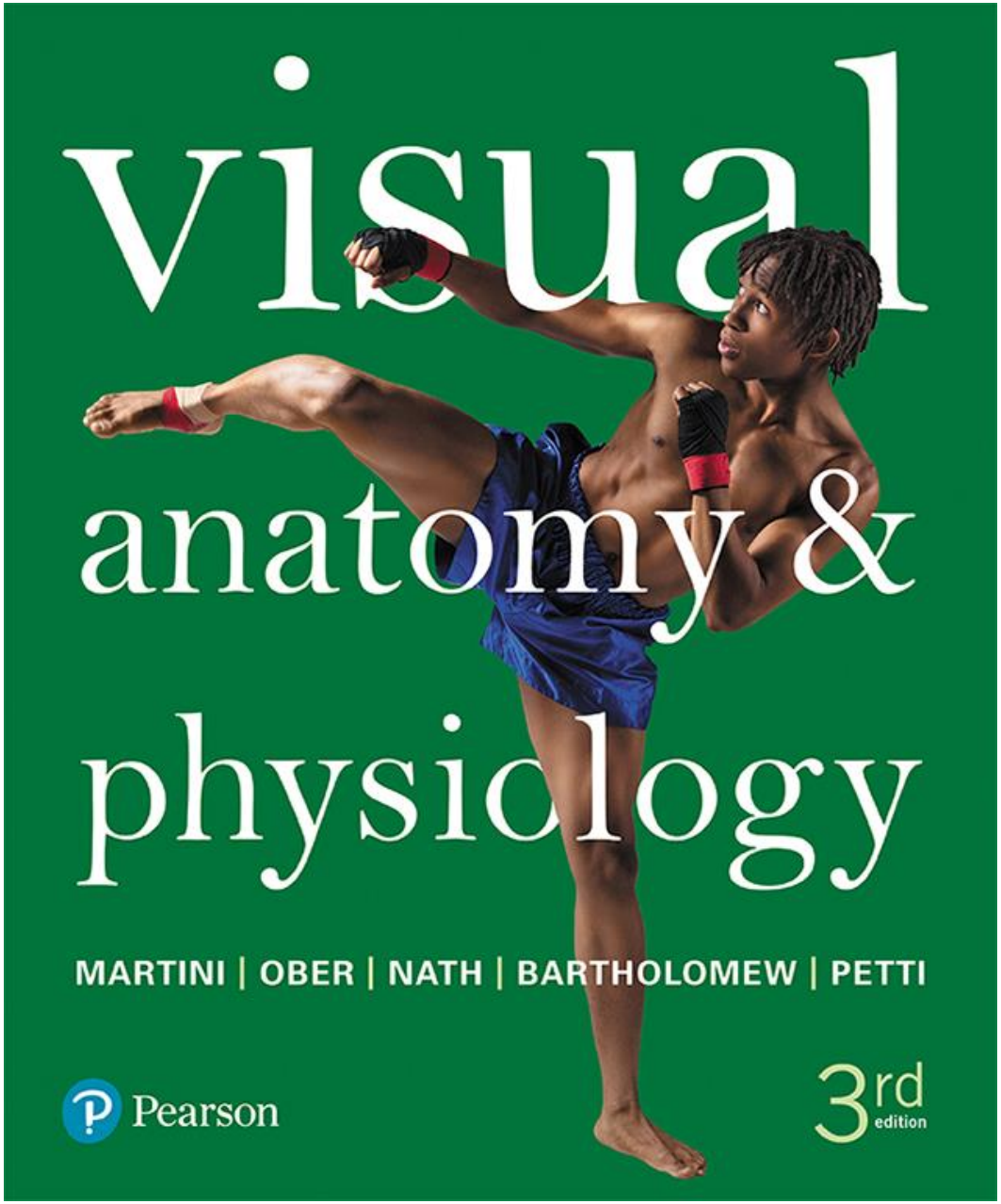


8

Joints

Lecture Presentation by
Lori Garrett

Section 1: Joint Structure and Movement

Learning Outcomes

8.1 Contrast the major categories of joints, and explain the relationship between structure and function for each category.

8.2 Describe the basic structure of a synovial joint, and describe common accessory structures and their functions.

8.3 Describe how the anatomical and functional properties of synovial joints permit movements of the skeleton.

Section 1: Joint Structure and Movement

Learning Outcomes (continued)

8.4 Describe flexion/extension, abduction/adduction, and circumduction movements of the skeleton.

8.5 Describe rotational and special movements of the skeleton.

Module 8.1: Joints are classified according to structure and movement

Joints, or articulations

- Locations where two or more bones meet
- Only points at which movements of bones can occur
  - **Joints** allow mobility while preserving bone strength
  - Amount of movement allowed is determined by anatomical structure
- Categorized
  - Functionally by amount of motion allowed, or **range of motion (ROM)**
  - Structurally by anatomical organization

Module 8.1: Joint classification

Functional classification of joints

- **Synarthrosis** (*syn-*, together + *arthrosis*, joint)
  - No movement allowed
  - Extremely strong
- **Amphiarthrosis** (*amphi-*, on both sides)
  - Little movement allowed (more than synarthrosis)
  - Much stronger than diarthrosis
  - Articulating bones connected by collagen fibers or cartilage
- **Diarthrosis** (*dia-*, through)
  - Freely movable

Module 8.1: Joint classification

Structural classification of joints

- **Fibrous**
  - **Suture** (*sutura,* a sewing together)
    - Synarthrotic joint connected by dense fibrous connective tissue
    - Located between bones of the skull
  - **Gomphosis** (*gomphos,* bolt)
    - Synarthrotic joint binding teeth to bony sockets in maxillae and mandible

Functional and Structural Classifications of Joints

Functional Category	Structural Category and Type
Synarthrosis (no movement)	**Fibrous** — **Suture** 
	Gomphosis 
	Cartilaginous — **Synchondrosis** 
	Bony — **Synostosis** 
Amphiarthrosis (little movement)	**Fibrous** — **Syndesmosis** 
	Cartilaginous — **Symphysis** 
Diarthrosis (free movement)	**Synovial** 

Module 8.1: Joint classification

Structural classification of joints (continued)

- **Fibrous** (continued)
  - **Syndesmosis** (*desmos,* a band or ligament)
    - Amphiarthrotic joint with bones connected by a ligament
    - *Example:* distal joint between tibia and fibula

Functional and Structural Classifications of Joints

Functional Category	Structural Category and Type
Synarthrosis (no movement)	**Fibrous** — **Suture** 
	Gomphosis 
	Cartilaginous — **Synchondrosis** 
	Bony — **Synostosis** 
Amphiarthrosis (little movement)	**Fibrous** — **Syndesmosis** 
	Cartilaginous — **Symphysis** 
Diarthrosis (free movement)	**Synovial** 

Module 8.1: Joint classification

Structural classification of joints (continued)

- **Cartilaginous** (held together by cartilage)
  - **Synchondrosis** (*syn,* together + *chondros,* cartilage)
    - Synarthrotic joint formed by a rigid, cartilaginous bridge between two articulating bones
    - *Example:* between ends of the first pair of ribs and the sternum

Functional and Structural Classifications of Joints

Functional Category	Structural Category and Type
Synarthrosis (no movement)	**Fibrous** — **Suture**
	Gomphosis
	Cartilaginous — **Synchondrosis**
	Bony — **Synostosis**
Amphiarthrosis (little movement)	**Fibrous** — **Syndesmosis**
	Cartilaginous — **Symphysis**
Diarthrosis (free movement)	**Synovial**

Module 8.1: Joint classification

Structural classification of joints (continued)

- **Cartilaginous** (held together by cartilage)
  - **Symphysis**
    - Amphiarthrotic joint where articulating bones separated by pad of fibrocartilage
    - *Example:* joint between the two pubic bones

Functional and Structural Classifications of Joints

Functional Category	Structural Category and Type
Synarthrosis (no movement)	**Fibrous** — **Suture**
	Gomphosis
	Cartilaginous — **Synchondrosis**
	Bony — **Synostosis**
Amphiarthrosis (little movement)	**Fibrous** — **Syndesmosis**
	Cartilaginous — **Symphysis**
Diarthrosis (free movement)	**Synovial**

Module 8.1: Joint classification

Structural classification of joints (continued)

- **Bony**
  - **Synostosis**
    - Synarthrotic, totally rigid, immovable joint
    - Formed when bones fuse
    - *Example:* frontal suture and epiphyseal lines

Functional and Structural Classifications of Joints

Functional Category	Structural Category and Type
Synarthrosis (no movement)	**Fibrous** — **Suture** 
	Gomphosis 
	Cartilaginous — **Synchondrosis** 
	Bony — **Synostosis** 
Amphiarthrosis (little movement)	**Fibrous** — **Syndesmosis** 
	Cartilaginous — **Symphysis** 
Diarthrosis (free movement)	**Synovial** 

Module 8.1: Joint classification

Structural classification of joints (continued)

- **Synovial**
  - Diarthrotic joints
  - Permit wider range of motion than any other joint type
  - Located at the ends of long bones

Functional and Structural Classifications of Joints

Functional Category	Structural Category and Type
Synarthrosis (no movement)	**Fibrous** — **Suture** 
	Gomphosis 
	Cartilaginous — **Synchondrosis** 
	Bony — **Synostosis** 
Amphiarthrosis (little movement)	**Fibrous** — **Syndesmosis** 
	Cartilaginous — **Symphysis** 
Diarthrosis (free movement)	**Synovial** 

Module 8.1: Review

A. Define *range of motion* (*ROM*).
B. Which structural category of joints allows for the greatest range of motion?

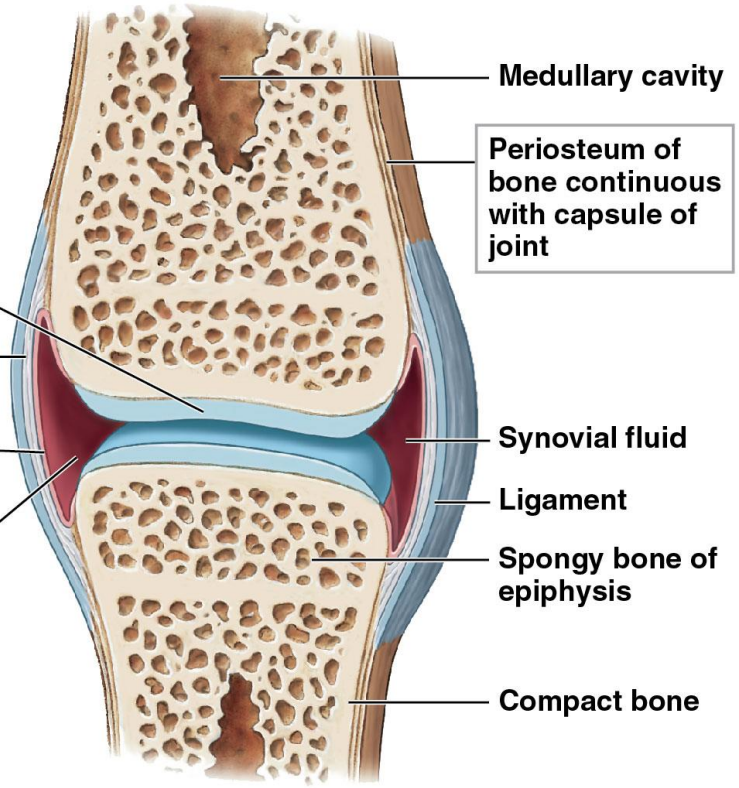
Learning Outcome: Contrast the major categories of joints, and explain the relationship between structure and function for each category.

Module 8.2: Synovial joints are freely movable and lined with a synovial membrane

Components of a synovial joint

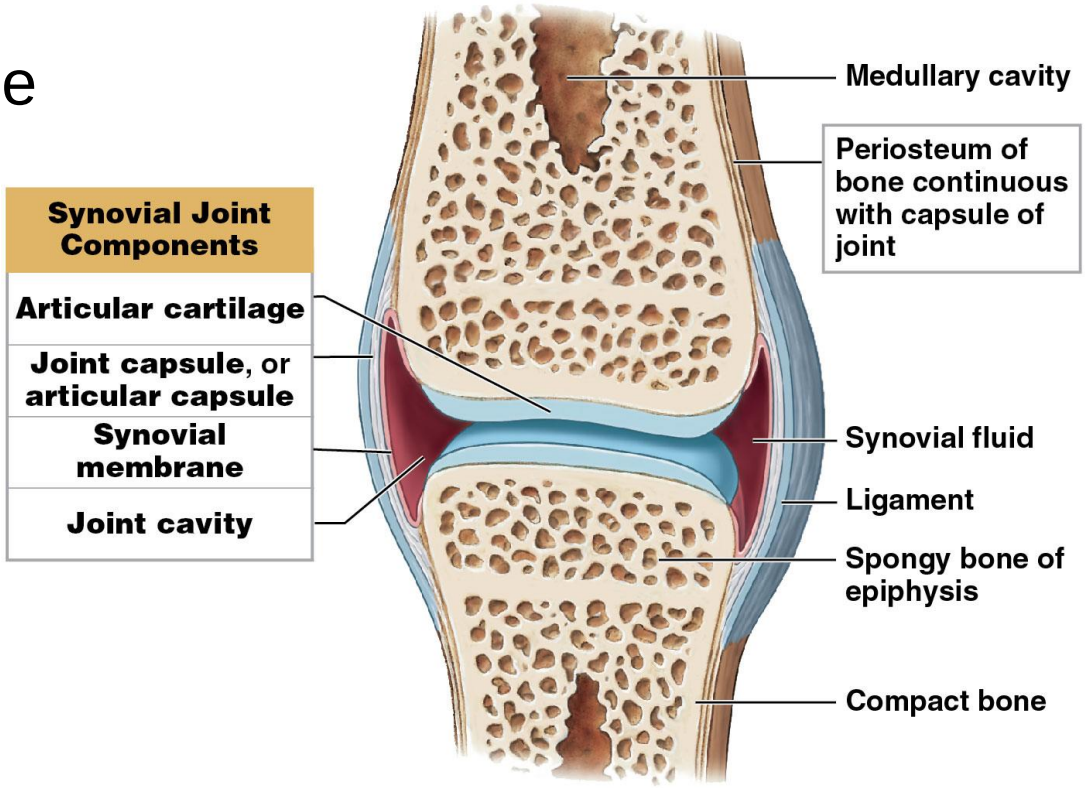
- **Articular cartilage**
  - Covers bones at joint.
  - Structure resembles hyaline cartilage but with no perichondrium
    - Matrix contains more water than other cartilages

Synovial Joint Components
Articular cartilage
Joint capsule, or articular capsule
Synovial membrane
Joint cavity



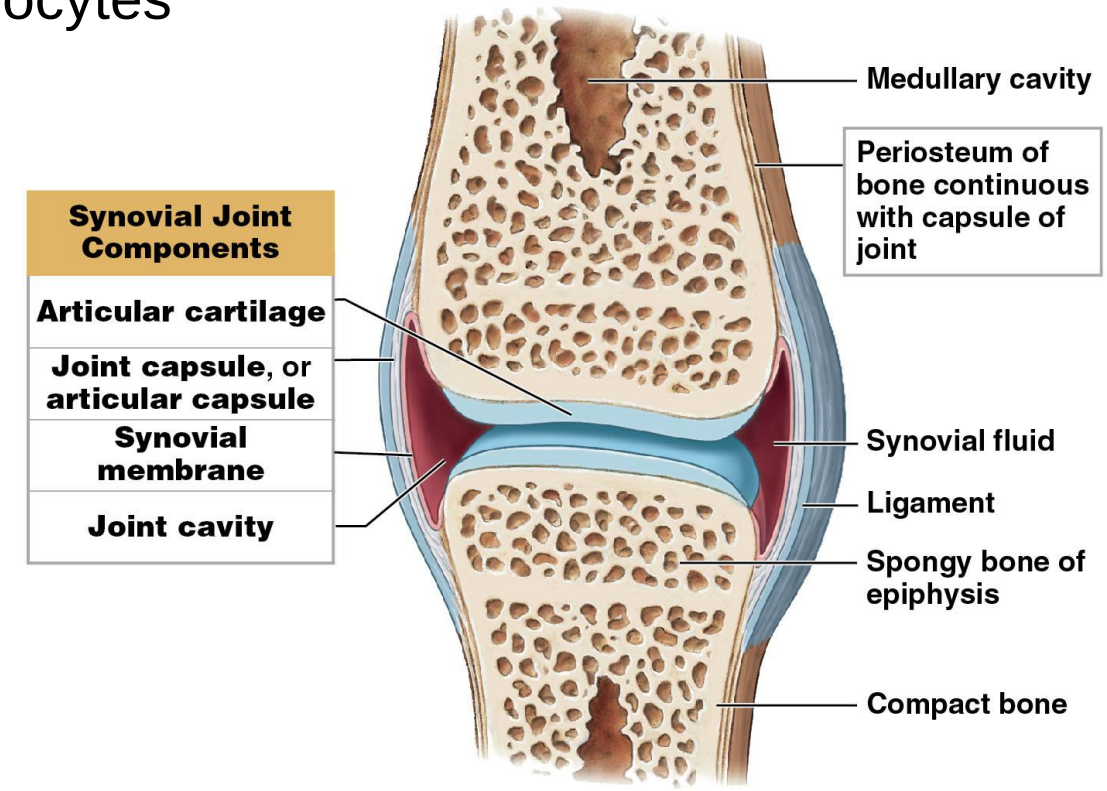
Module 8.2: Synovial joints

- **Joint capsule, or articular capsule**
  - Sac enclosing the articular ends of the bones in a joint
  - Reinforced with accessory structures (tendons, ligaments)
  - Continuous with the periosteum of each bone
    - Adds strength and mobility to the joint



Module 8.2: Synovial joints

- **Synovial membrane**
  - Lines the interior of the joint capsule
  - Secretes synovial fluid into the **joint cavity**
    - Fluid lubricates, cushions, prevents abrasion, and supports chondrocytes
    - Total quantity of synovial fluid usually less than 3 mL



Module 8.2: Synovial joints

Synovial fluid

- Clear, straw-colored, viscous fluid
- Consistency of raw egg white
  - Viscosity due to high concentration of hyaluronic acid
- Produced by the synovial membrane
  - Circulates from areolar tissue into joint cavity
  - Percolates through articular cartilage
    - Provides oxygen and nutrients to chondrocytes
    - Carries away metabolic wastes

Module 8.2: Synovial joints

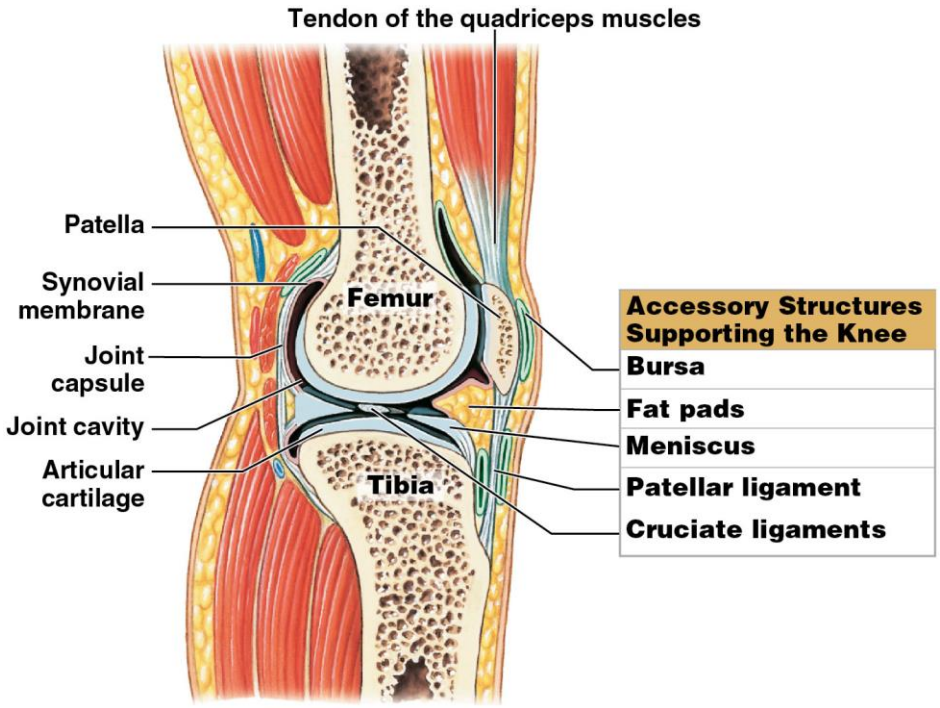
Functions of synovial fluid

- **Lubrication**
  - Under compression, fluid squeezes out of the cartilage and into space between bones
  - Layer of fluid reduces friction
- **Nutrient distribution**
  - Circulates continuously, providing nutrients and carrying away wastes
  - Compression and expansion of articular cartilage assists in circulation
- **Shock absorption**
  - Viscosity increases with increasing pressure

Module 8.2: Synovial joints

Accessory structures supporting the knee

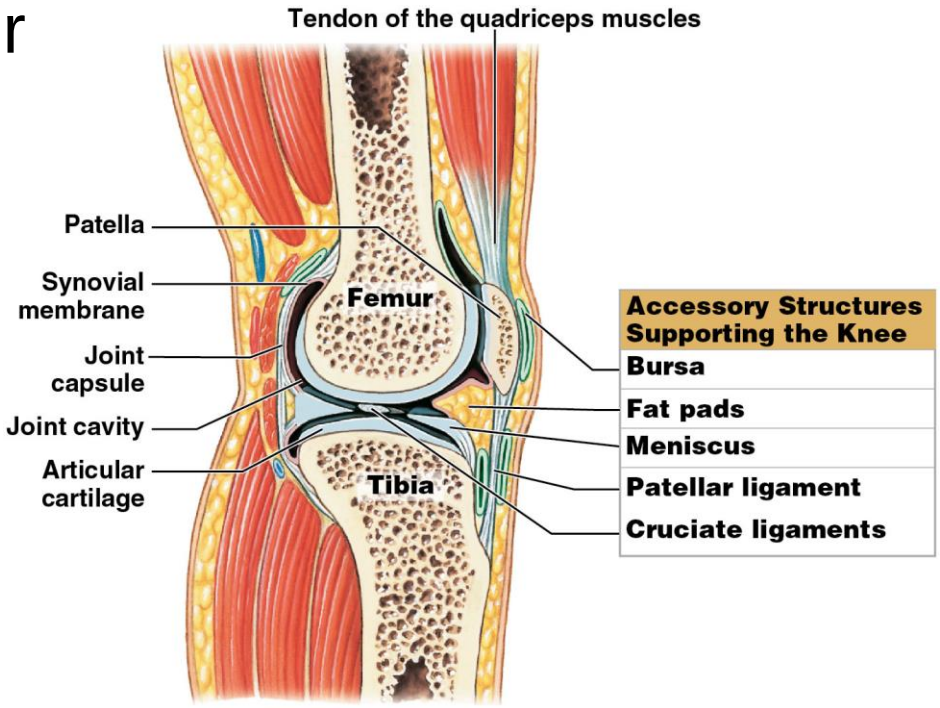
- Provide support and additional stability
- Tendon of the quadriceps muscle
  - Not part of knee joint itself
  - Limits range of motion and provides mechanical support



Module 8.2: Synovial joints

Bursa

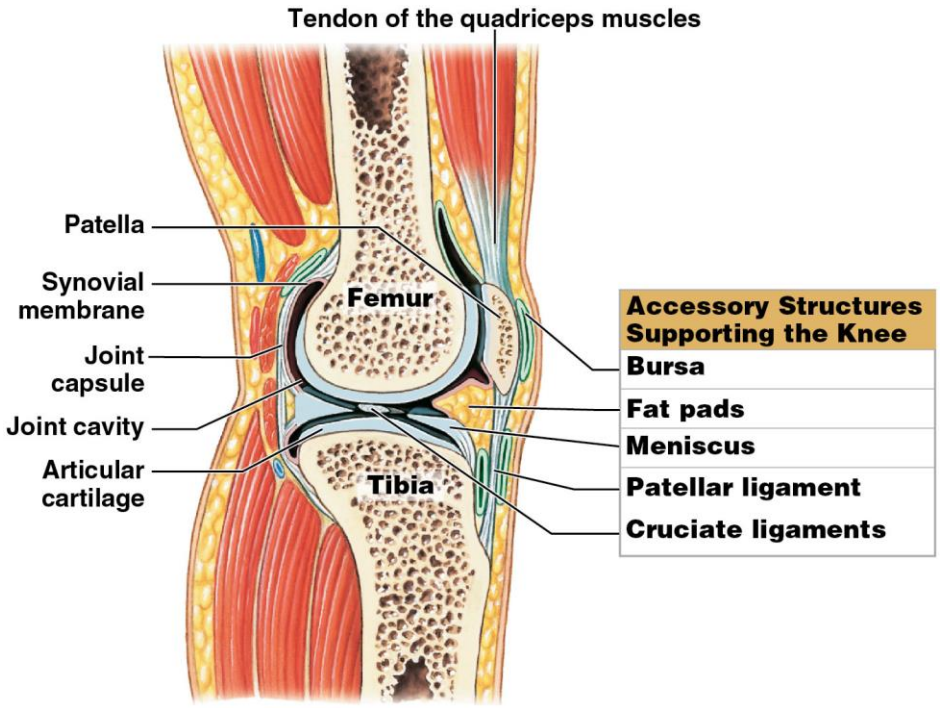
- Small, thin, fluid-filled pocket filled with synovial fluid and lined by synovial membrane
- Forms in connective tissue outside a joint capsule
- Reduces friction
- Acts as shock absorber



Module 8.2: Synovial joints

Fat pads

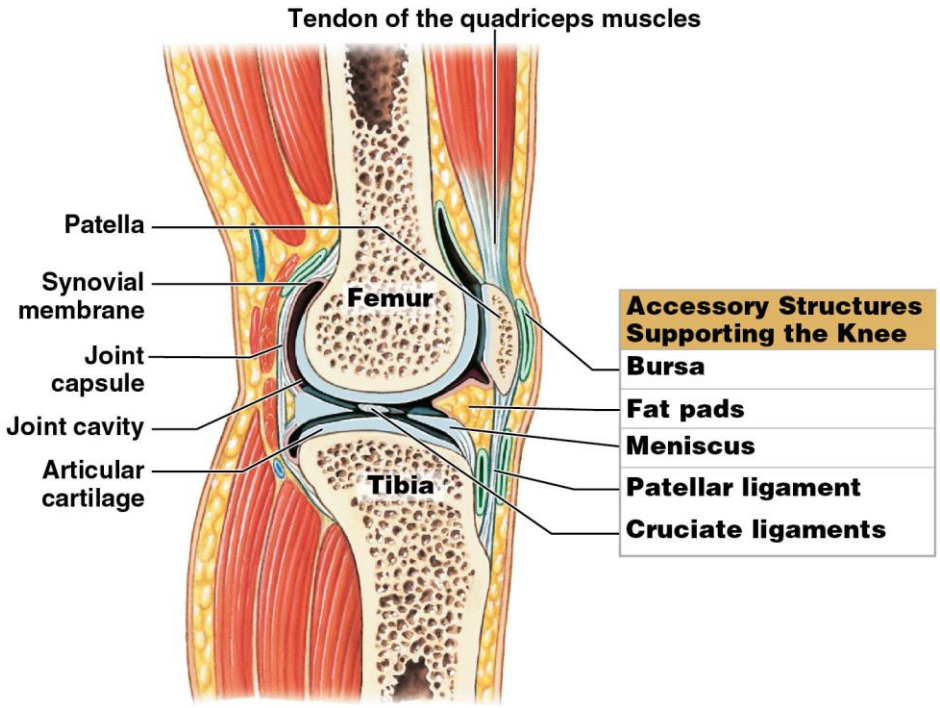
- Localized masses of adipose tissue covered by a layer of synovial membrane
- Usually superficial to joint capsule
- Protect articular cartilage
- Fill in spaces created as joint moves and joint cavity changes shape



Module 8.2: Synovial joints

Meniscus, or articular disc

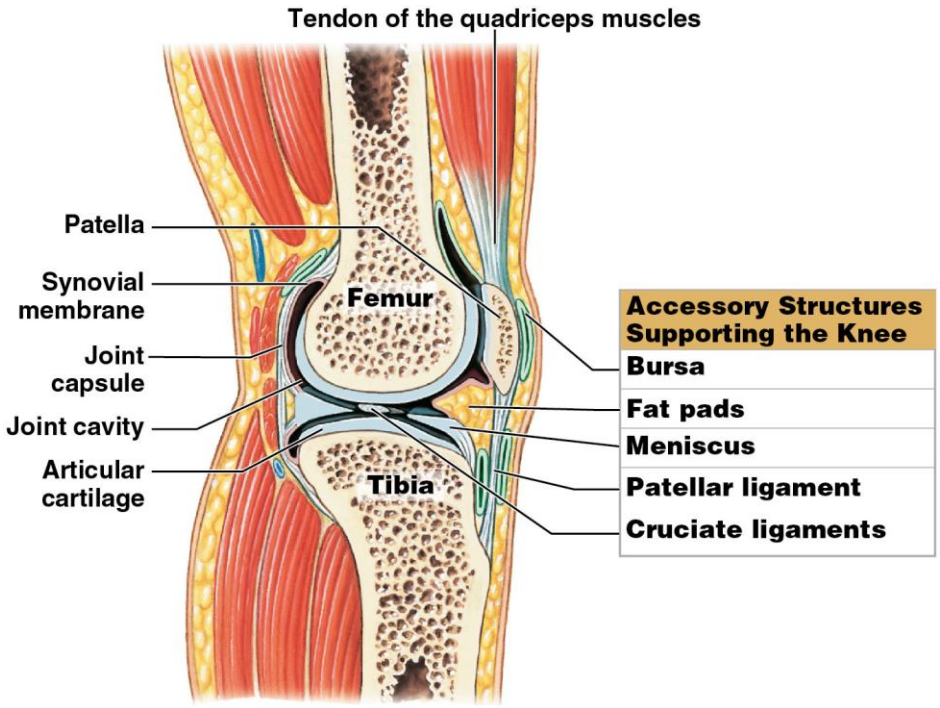
- Pad of fibrocartilage between opposing bones in a synovial joint
- May subdivide a synovial cavity
- May channel synovial fluid flow
- Allows variations in the shapes of the articular surfaces



Module 8.2: Synovial joints

Accessory ligaments

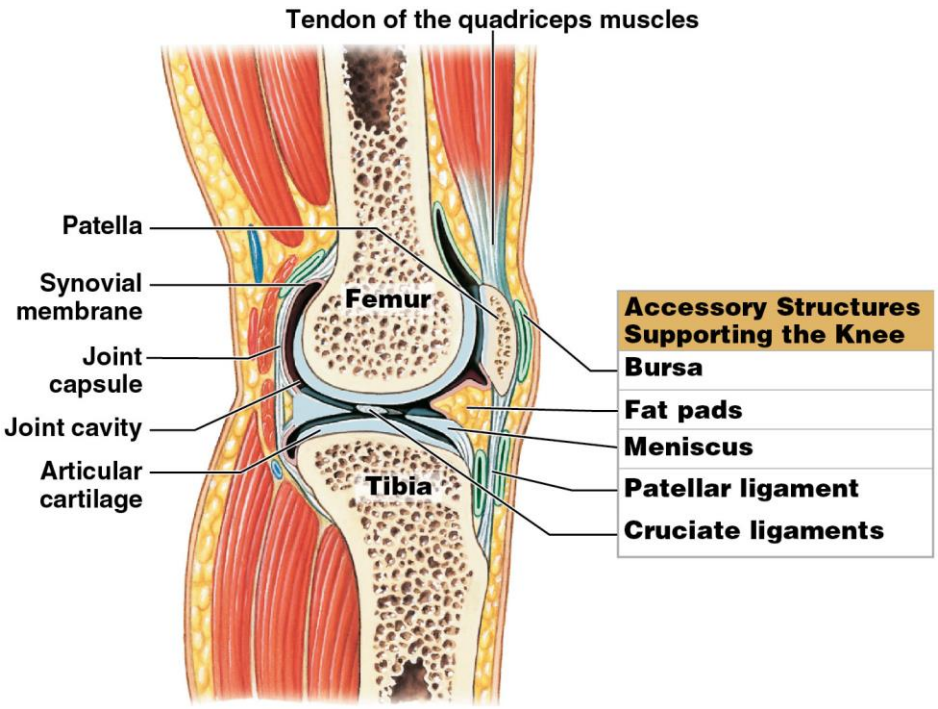
- Support, strengthen, and reinforce synovial joints
- **Capsular ligaments,** or intrinsic ligaments
  - Localized thickenings of the joint capsule



Module 8.2: Synovial joints

Accessory ligaments

- **Extrinsic ligaments**
  - Separate from the joint capsule
  - **Extracapsular ligaments** (pass outside the joint capsule)
    - *Example:* **patellar ligament**
  - **Intracapsular ligaments** (pass inside the joint capsule)
    - *Example:* **cruciate ligaments**



Module 8.2: Synovial joints

Mobility in joints

- Greater range of motion results in weaker joint
  - Synarthroses are strongest joints and have no movement
  - Diarthroses are the most mobile joints and the weakest
- **Dislocation,** or **luxation**
  - Movement beyond the normal range of motion
  - Articulating surfaces forced out of position
  - Damages joint structures
  - Pain is from nerves monitoring capsule and surrounding tissue
    - No pain receptors inside a joint

Module 8.2: Review

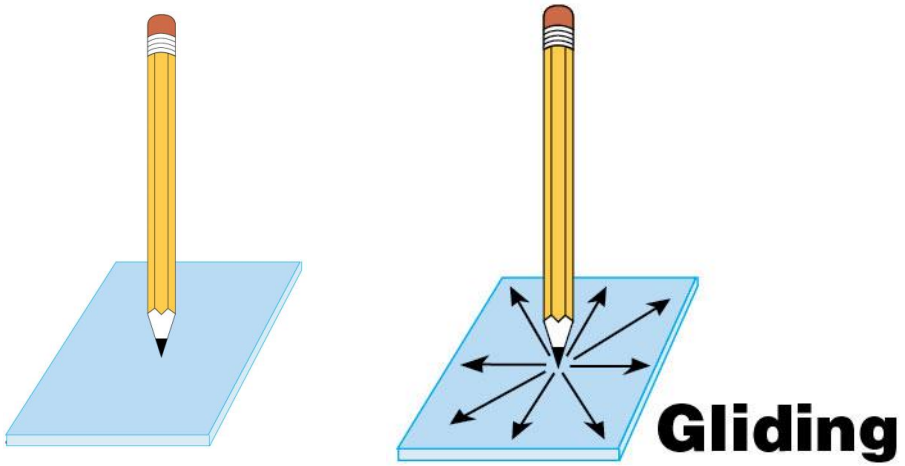
A. Describe the key components of a synovial joint, and identify their functions.
B. Describe the accessory structures of complex synovial joints and identify their functions.
C. Why would improper circulation of synovial fluid cause degeneration of articular cartilages in the affected joint?

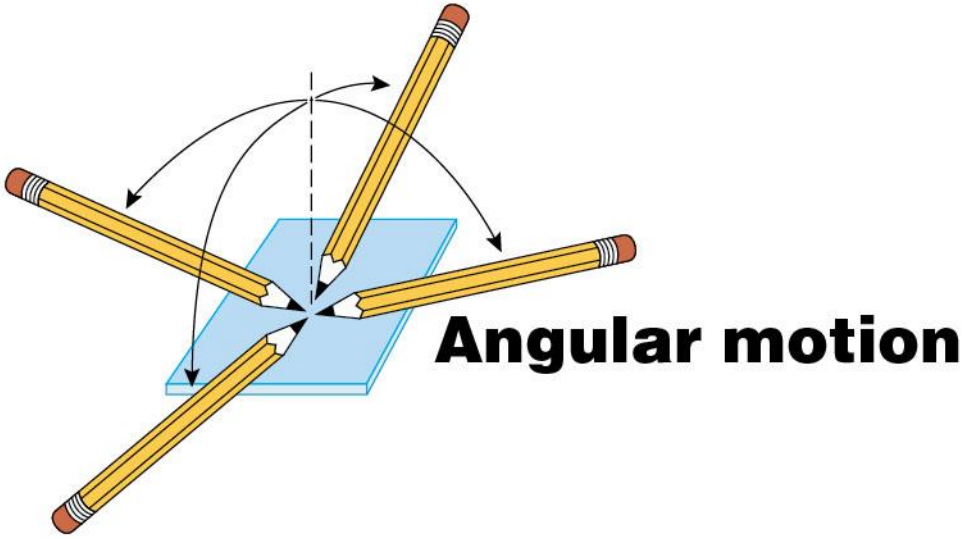
Learning Outcome: Describe the basic structure of a synovial joint, and describe common accessory structures and their functions.

Module 8.3: Anatomical organization determines the motion at synovial joints

General types of movement

- **Gliding**
  - Linear motion
  - Permits sliding motion in any direction on a relatively flat surface
- **Angular motion**
  - Movement along two axes in one plane
  - Also involves a change in angle

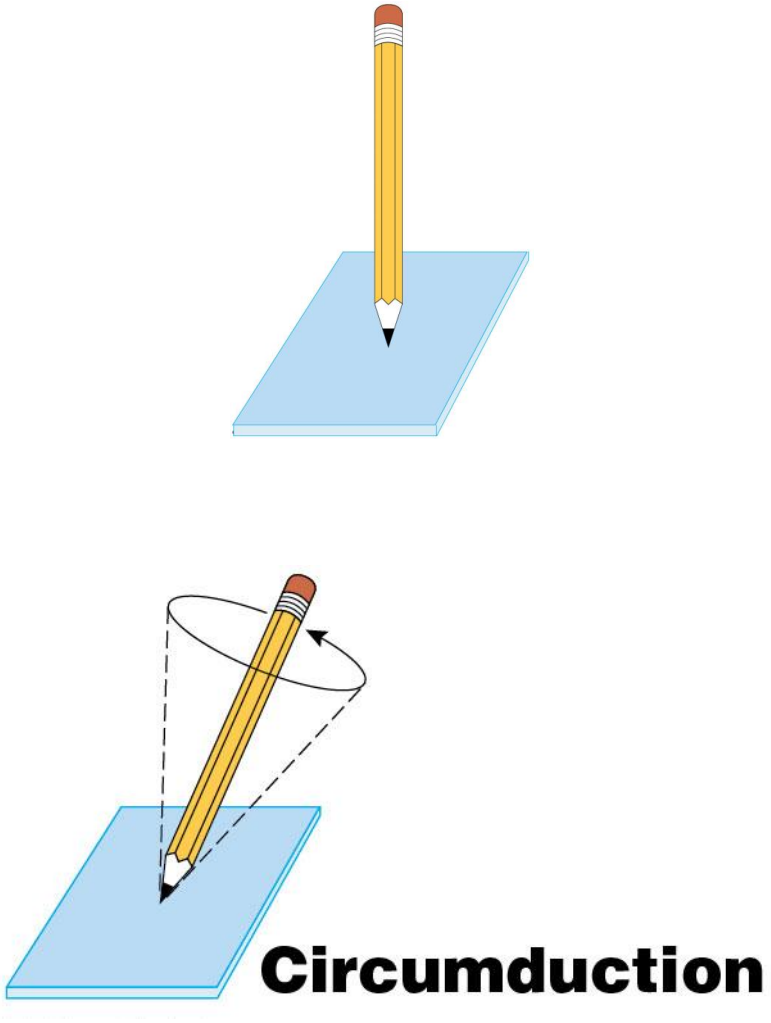




Module 8.3: Types of motion at synovial joints

General types of movement (continued)

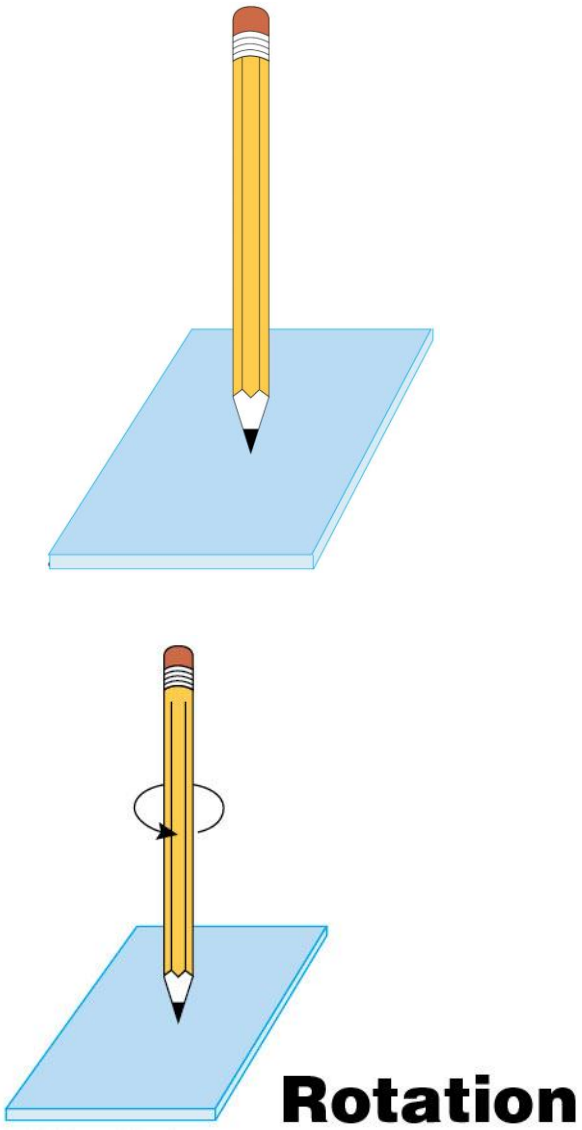
- **Circumduction**
  - Special term describing a complex angular movement
  - Proximal end of bone remains fixed while distal end moves in a path that corresponds to drawing a circle



Module 8.3: Types of motion at synovial joints

General types of movement (continued)

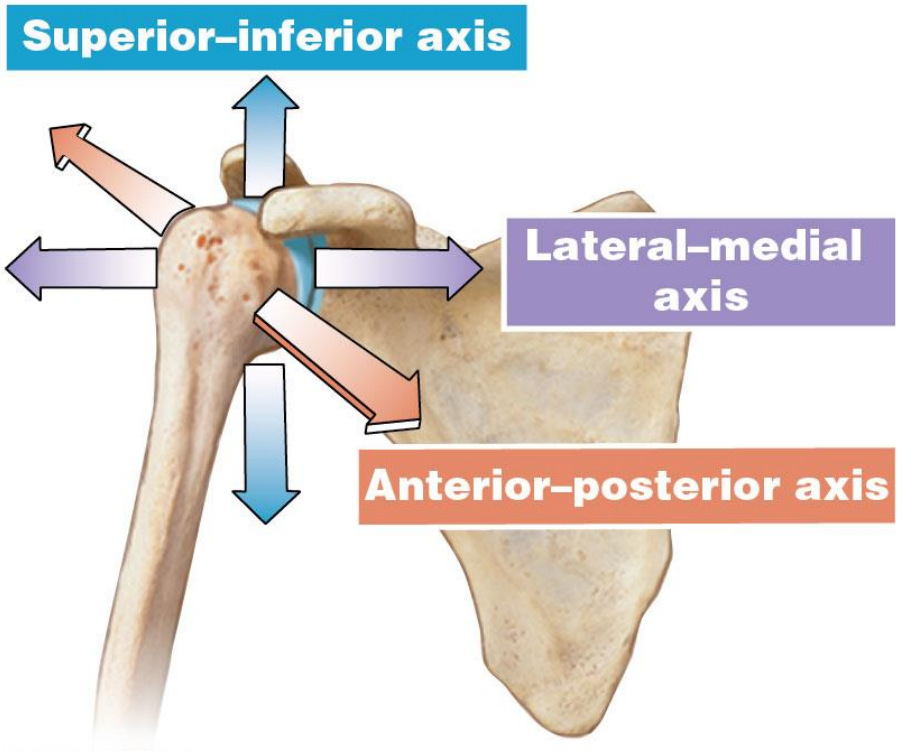
- **Rotation**
  - Movement around the longitudinal axis
  - Bone end remains fixed, and the shaft rotates



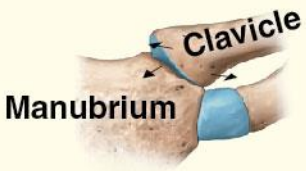
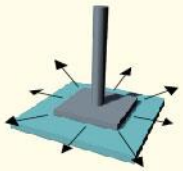
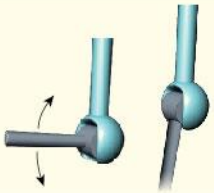
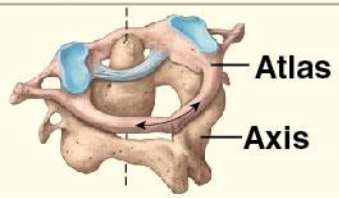
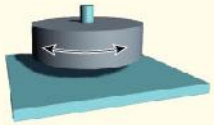
Module 8.3: Types of motion at synovial joints

Movement described by number of axes

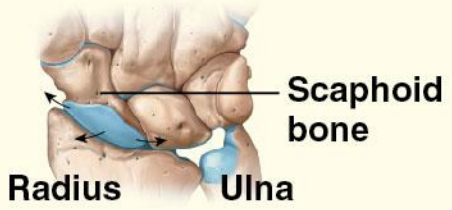
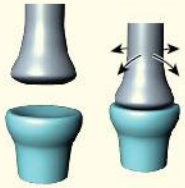
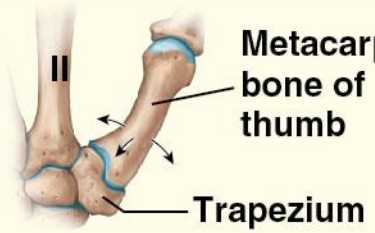
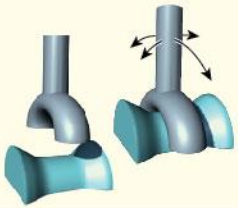
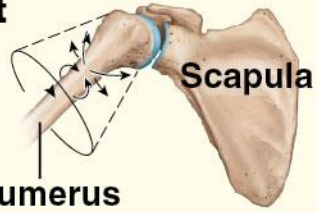
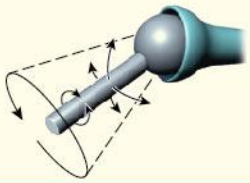
- **Monoaxial**—around one axis
- **Biaxial**—around two axes
- **Triaxial**—around three axes



Types of synovial joints

Types of Synovial Joints	Models of Joint Motion	Examples
Plane joint 		• Acromioclavicular and sternoclavicular joints • Intercarpal and intertarsal joints • Vertebrocostal joints • Sacro-iliac joints
Hinge joint 		• Elbow joints • Knee joints • Ankle joints • Interphalangeal joints
Pivot joint 		• Atlanto-axial joint • Proximal radio-ulnar joints

Types of synovial joints

Types of Synovial Joints	Models of Joint Motion	Examples
Condylar joint 		• Radiocarpal joints • Metacarpophalangeal joints II–V • Metatarsophalangeal joints
Saddle joint 		• First carpometacarpal joints
Ball-and-socket joint 		• Shoulder joints • Hip joints

Module 8.3: Review

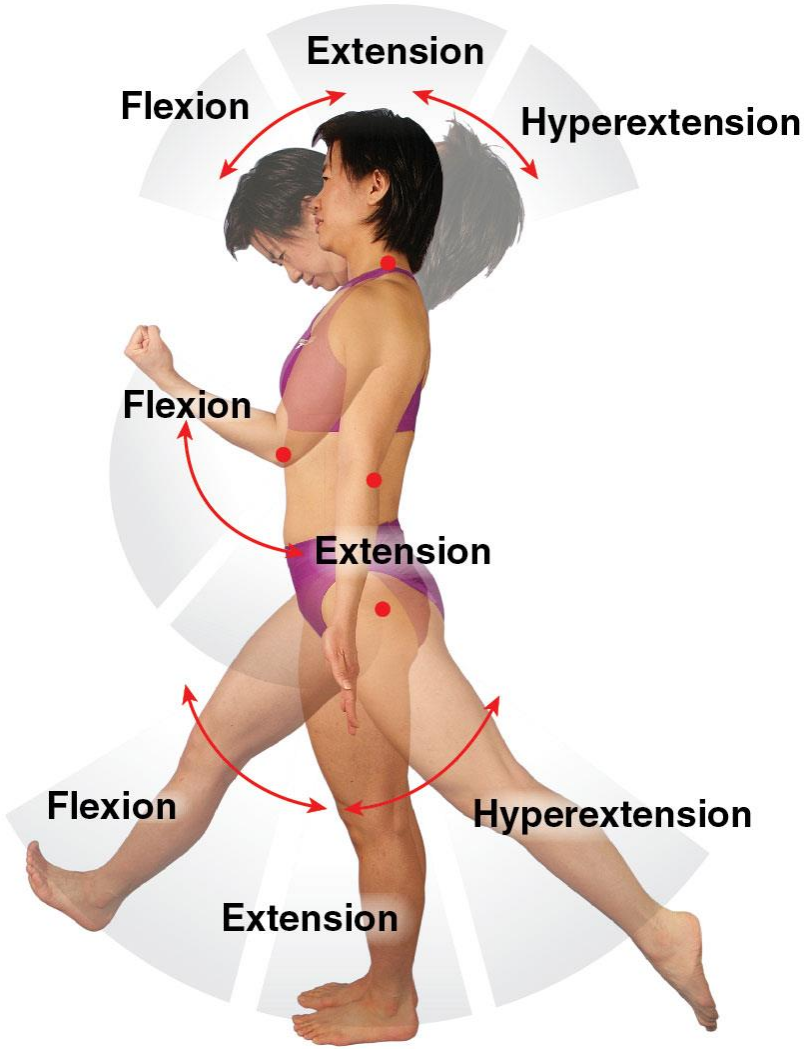
A. Describe the types of motion possible at a synovial joint.
B. Identify the types of synovial joints.
C. Which type of synovial joint permits the greatest range of motion?
D. Name the type of synovial joint for each of the following: shoulder, elbow, ankle, and thumb.

Learning Outcome: Describe how the anatomical and functional properties of synovial joints permit movements of the skeleton.

Module 8.4: Specific terms are used to describe movements with reference to the anatomical position

Flexion and extension

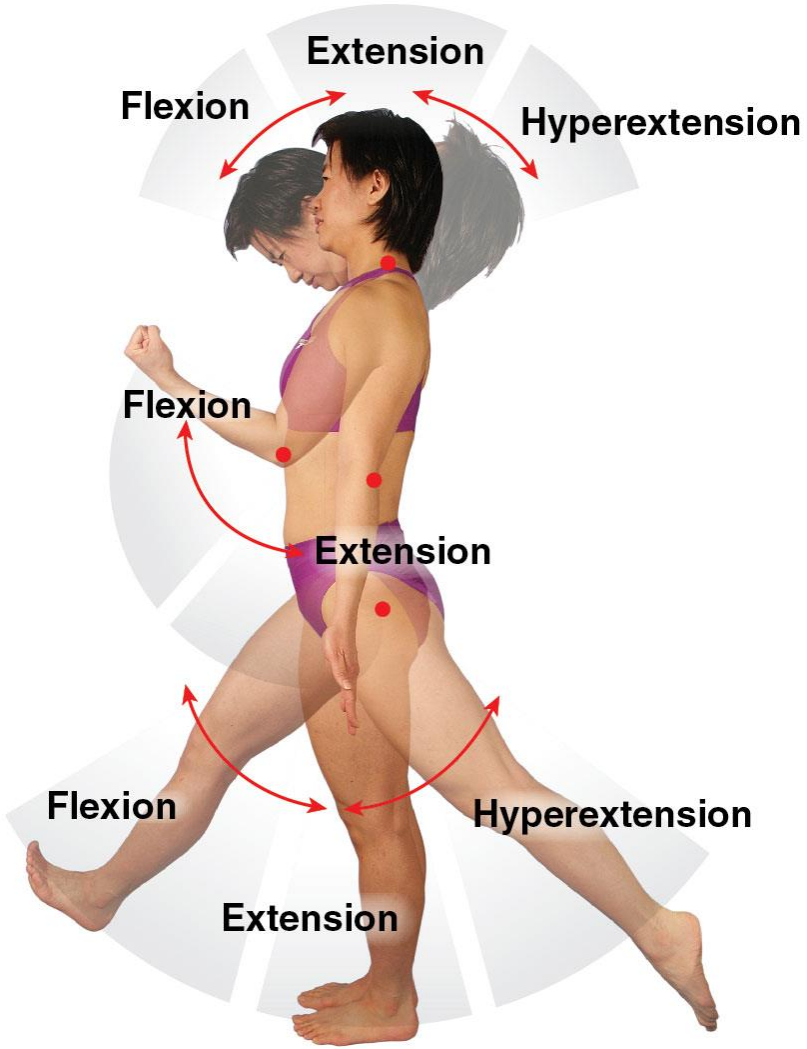
- Refer to movements at hinge joints of the long bones of the limbs
- **Flexion**
  - Decreases the angle of the joint
- **Extension**
  - Increases the angle of the joint



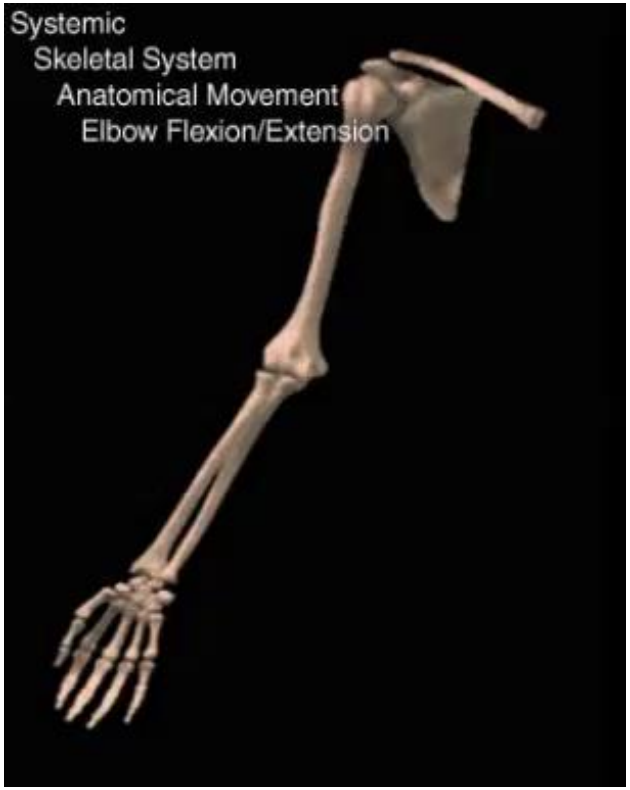
Module 8.4: Movements with reference to anatomical position

Flexion and extension (continued)

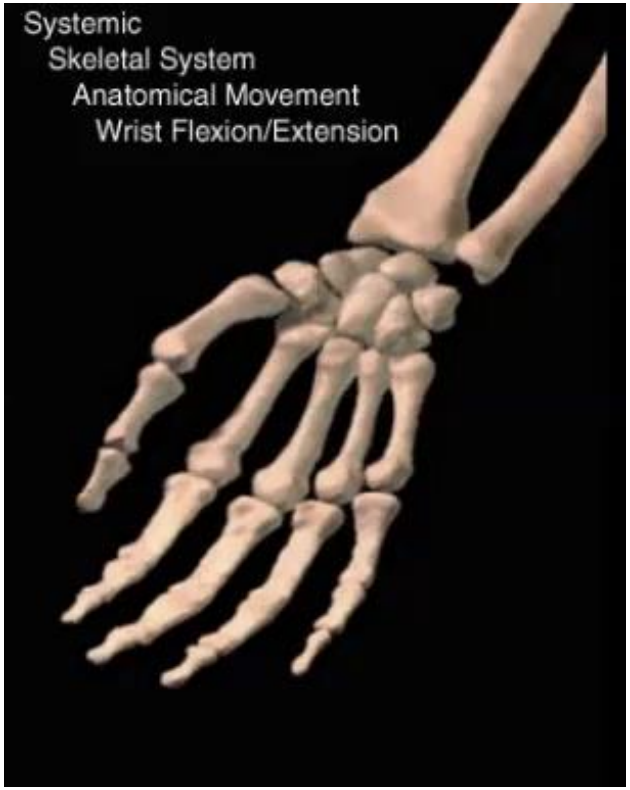
- **Hyperextension**
  - Extension past the anatomical position



Animation: Articulations: Elbow Flexion and Extension



Animation: Articulations: Wrist Flexion and Extension



Module 8.4: Movements with reference to anatomical position

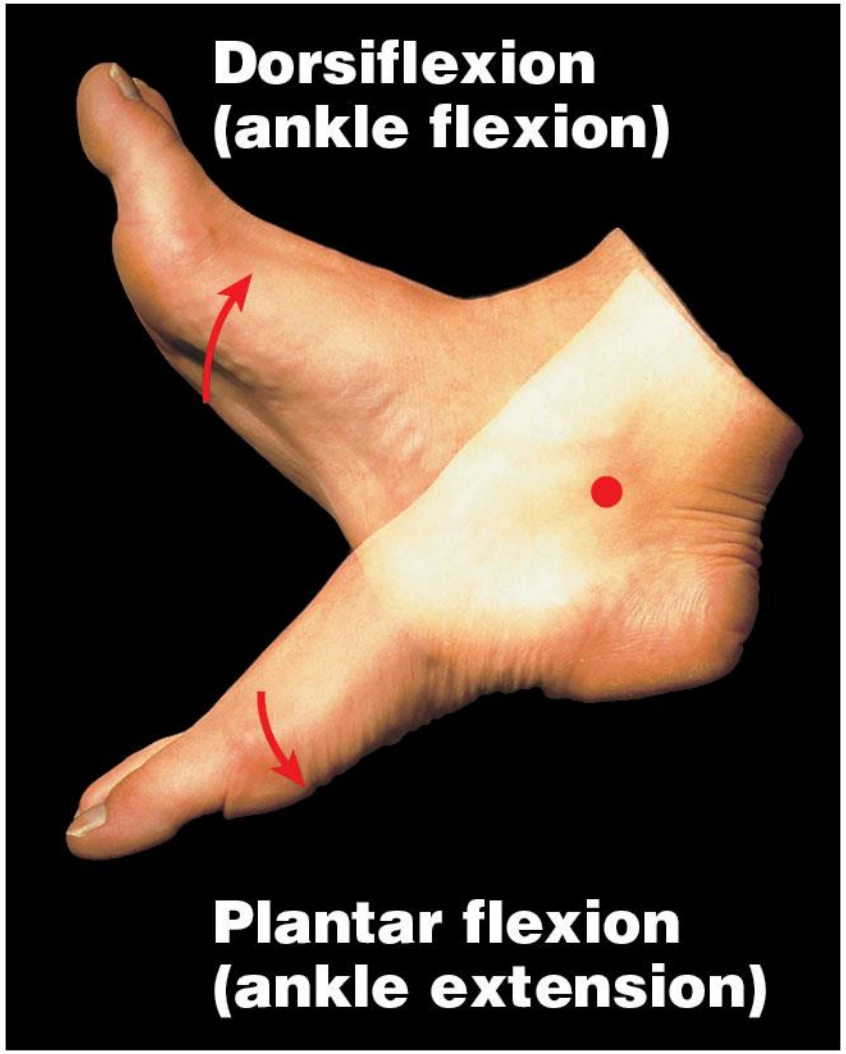
Flexion and extension (continued)

- **Lateral flexion**
  - Refers to bending the vertebral column to the side
  - Most pronounced in cervical and thoracic regions

Module 8.4: Movements with reference to anatomical position

Flexion and extension (continued)

- Movements of the foot
  - **Dorsiflexion**
    - Upward movement of the foot or toes
  - **Plantar flexion** (*planta,* sole)
    - Movement extending the ankle, as in standing on tiptoe

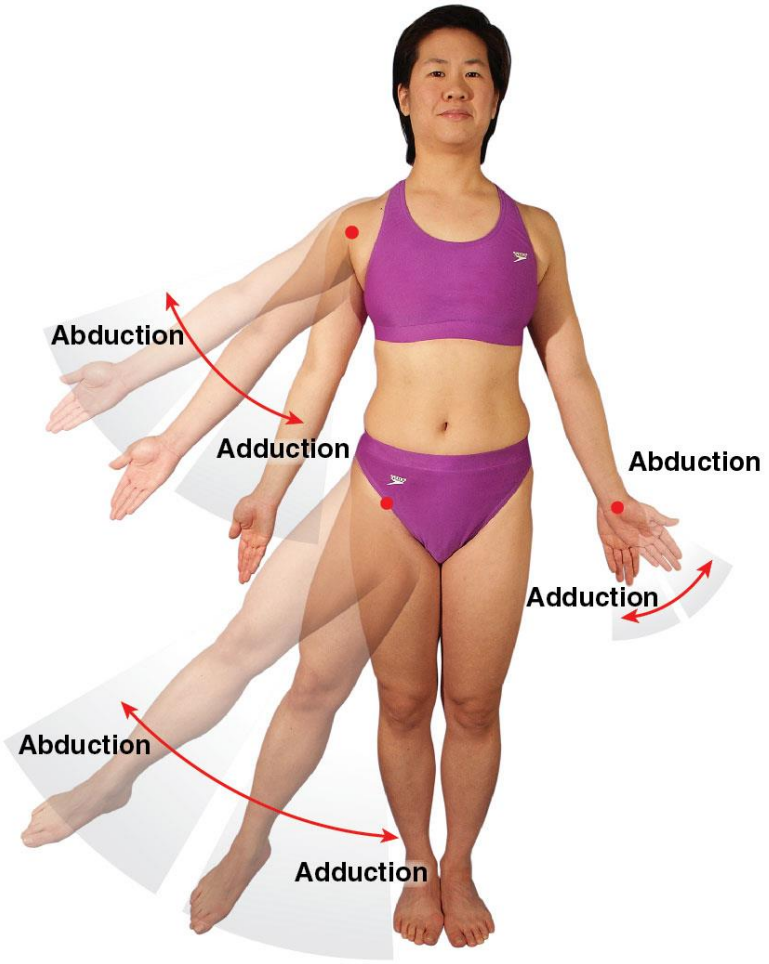


Animation: Articulations: Foot Dorsiflexion and Plantar Flexion

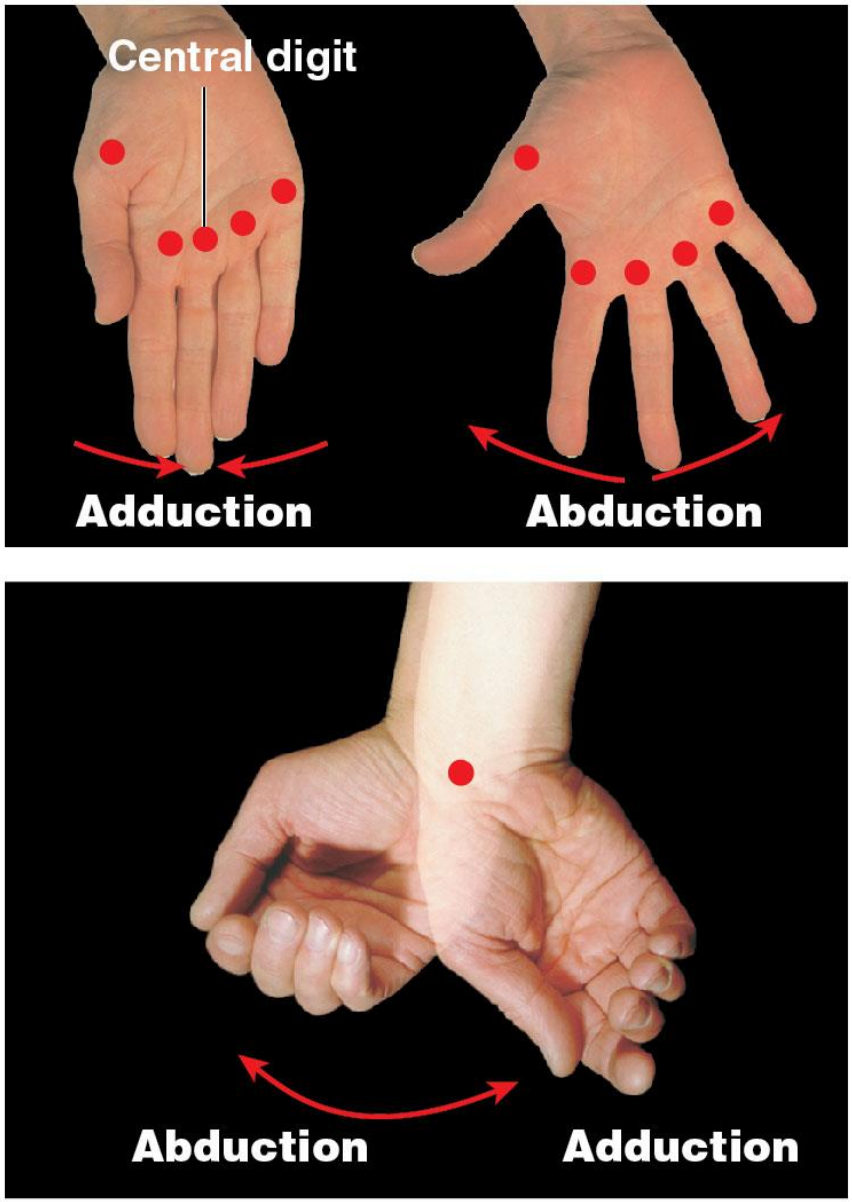
Module 8.4: Movements with reference to anatomical position

Abduction and adduction

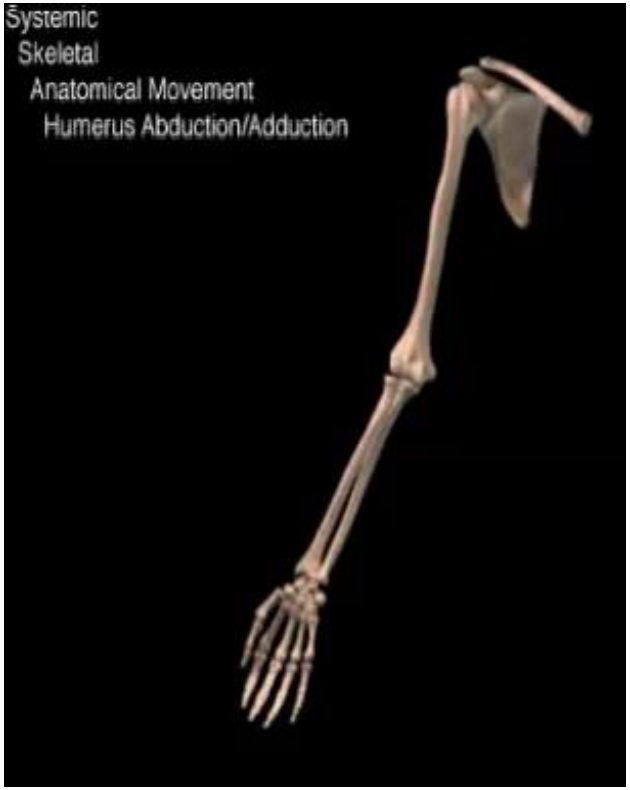
- Refer to movements of the appendicular skeleton
- **Abduction** (*ab,* from)
  - Movement away from the longitudinal axis in the frontal plane
- **Adduction** (*ad,* to)
  - Movement toward the longitudinal axis in the frontal plane



Adduction and abduction



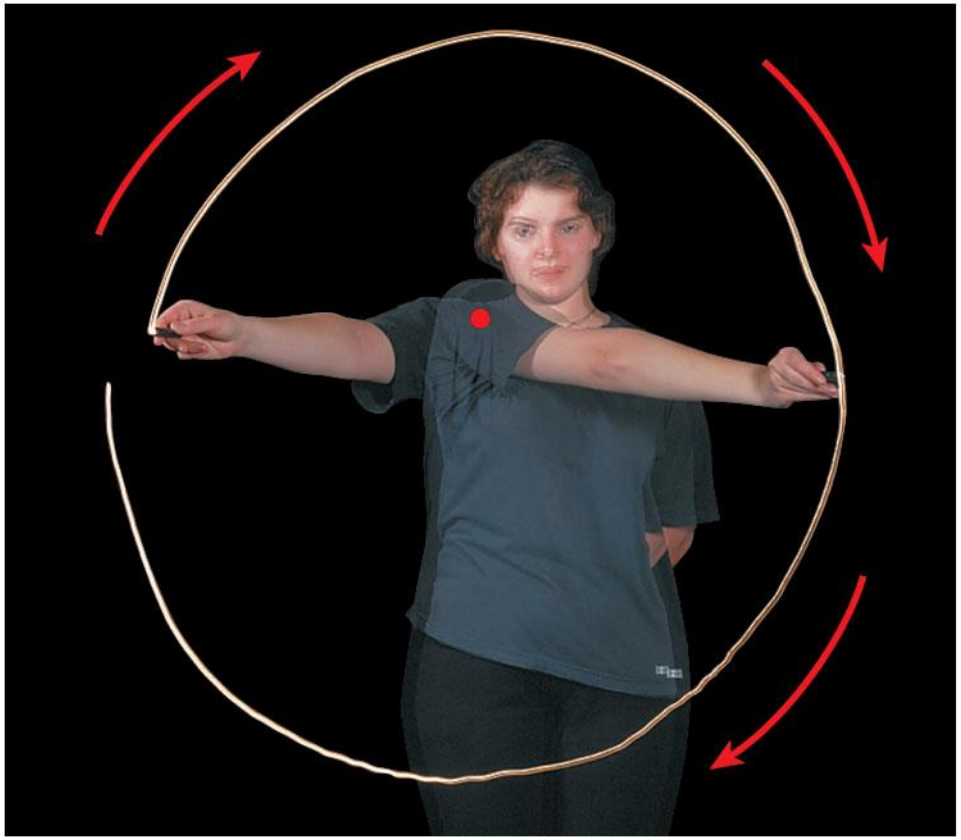
Animation: Articulations: Humerus Abduction and Adduction



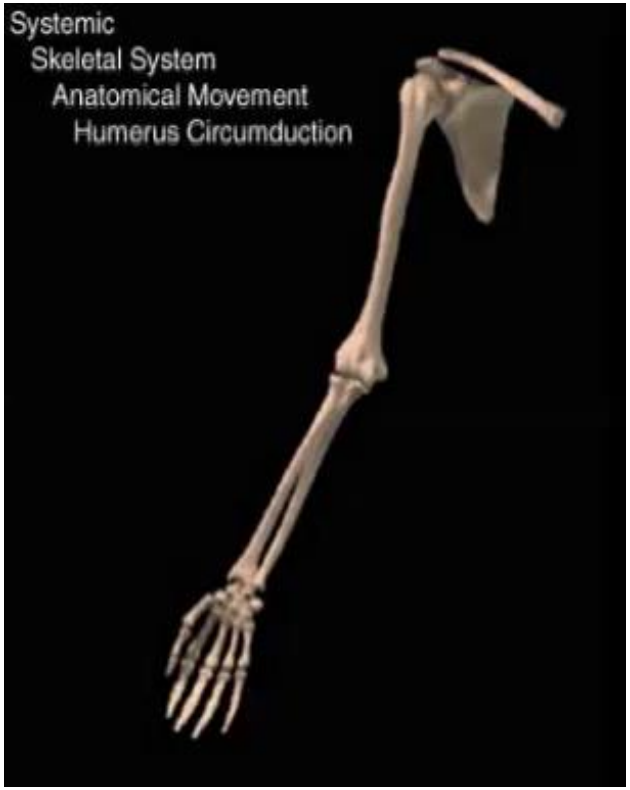
Module 8.4: Movements with reference to anatomical position

Circumduction

- Moving a body part such that the distal end traces a circle while the proximal end stays in one position



Animation: Articulations: Humerus Circumduction



Module 8.4: Review

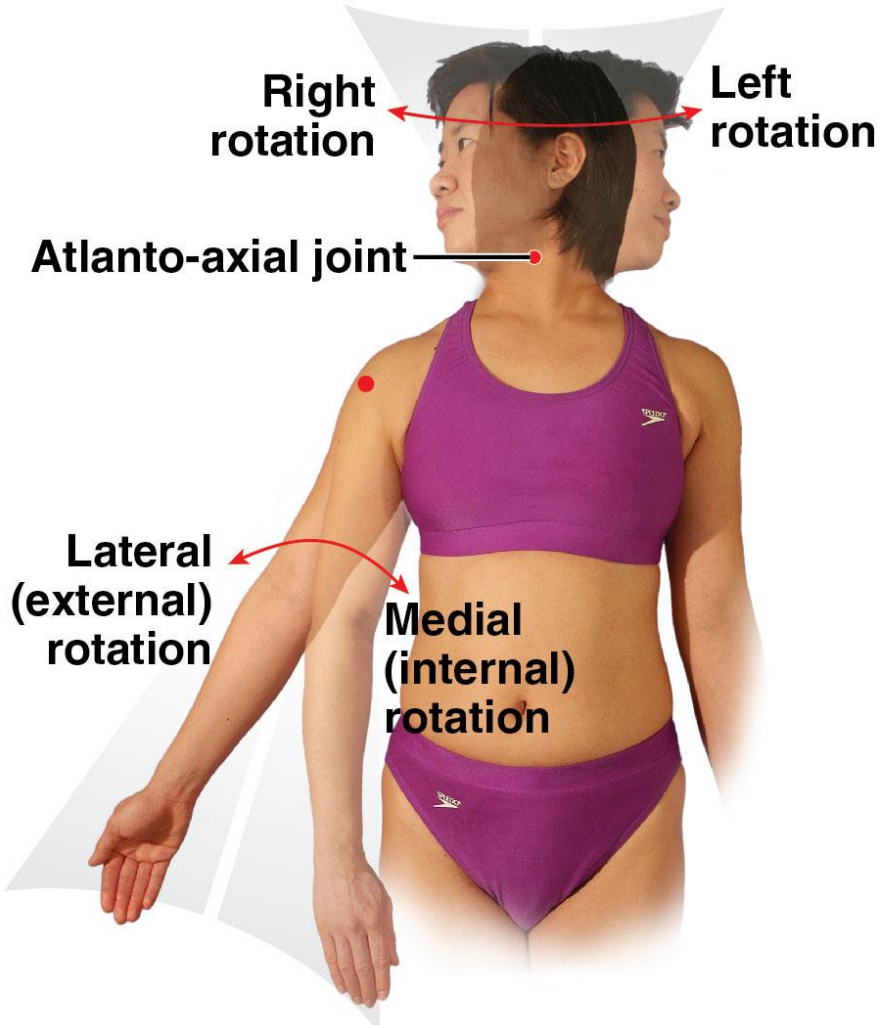
A. Which movements are possible at hinge joints?
B. Compare dorsiflexion to plantar flexion.
C. When a person does jumping jacks, which limb movements are necessary?

Learning Outcome: Describe flexion/extension, abduction/adduction, and circumduction movements of the skeleton.

Module 8.5: Specific terms describe rotation and special movements

Rotation

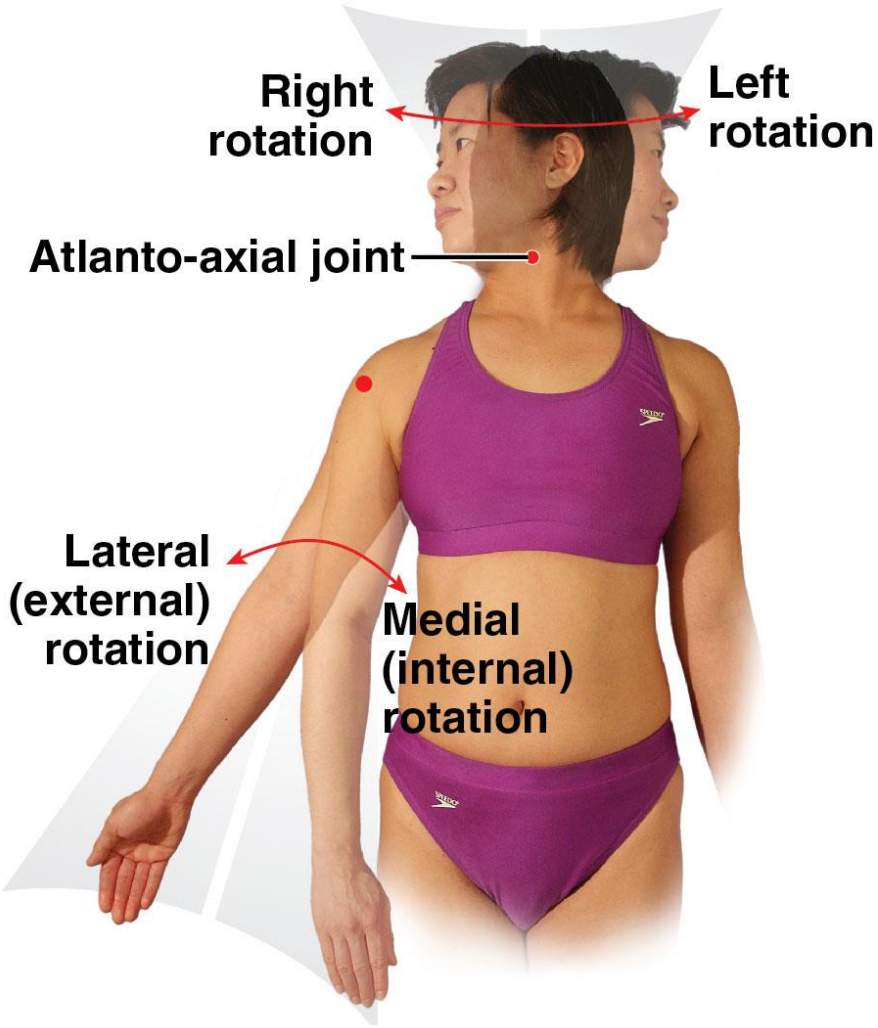
- When referring to the trunk, described as **left** and **right rotation**
  - Described in reference to anatomical position



Module 8.5: Rotation and special movements

Rotation (continued)

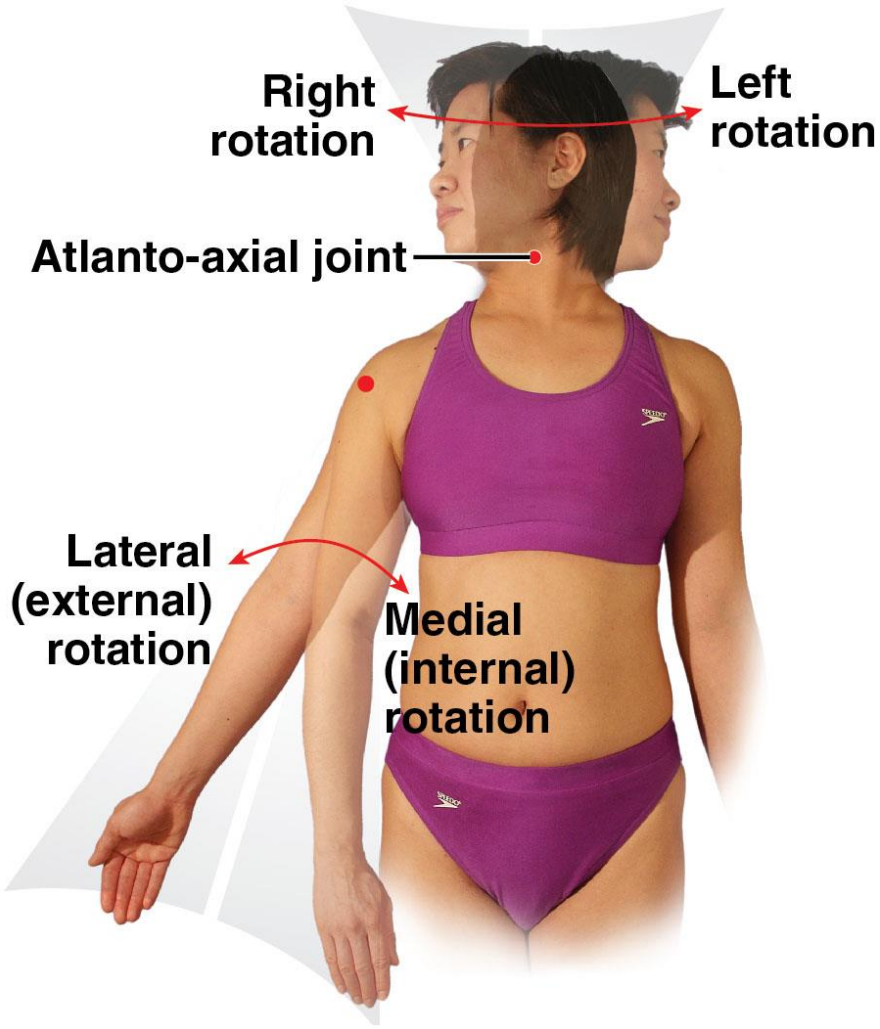
- When referring to the limbs, described as
  - **Medial rotation** (internal, or inward, rotation)
    - Anterior surface of a limb turns toward the long axis of the trunk



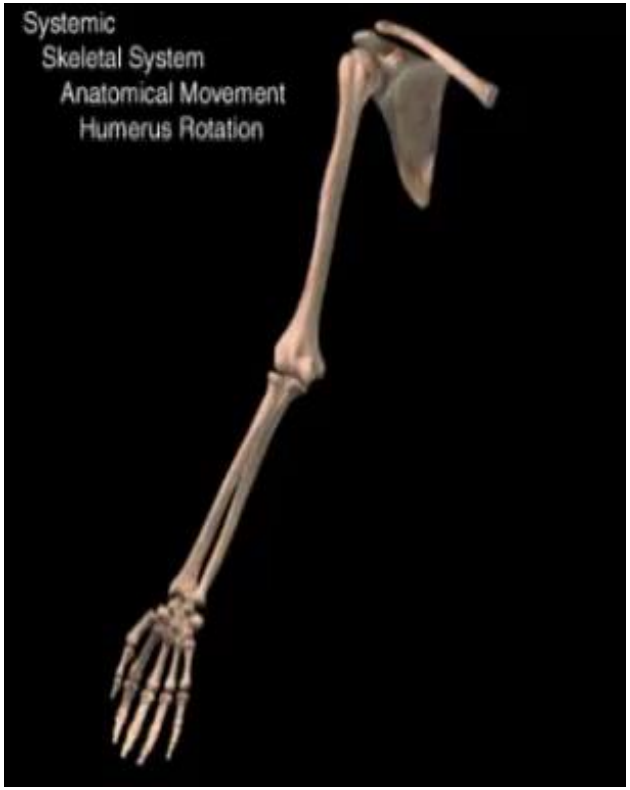
Module 8.5: Rotation and special movements

Rotation (continued)

- When referring to the limbs, described as
  - **Lateral rotation** (external, or outward, rotation)
    - Anterior surface of a limb turns away from the long axis of the trunk



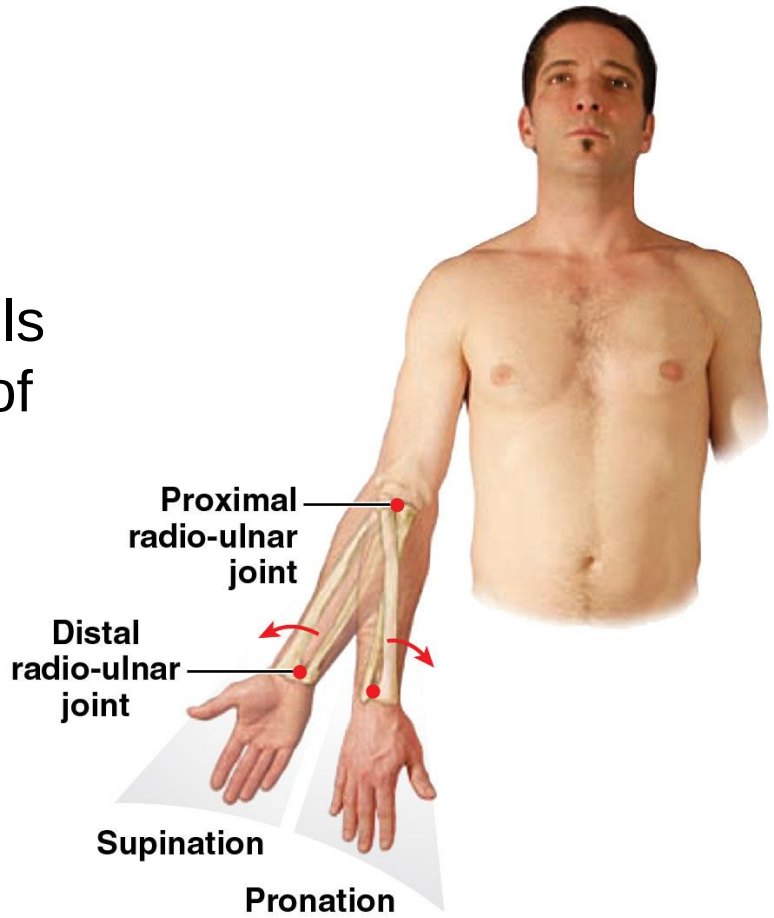
Animation: Articulations: Humerus Rotation



Module 8.5: Rotation and special movements

Rotation (continued)

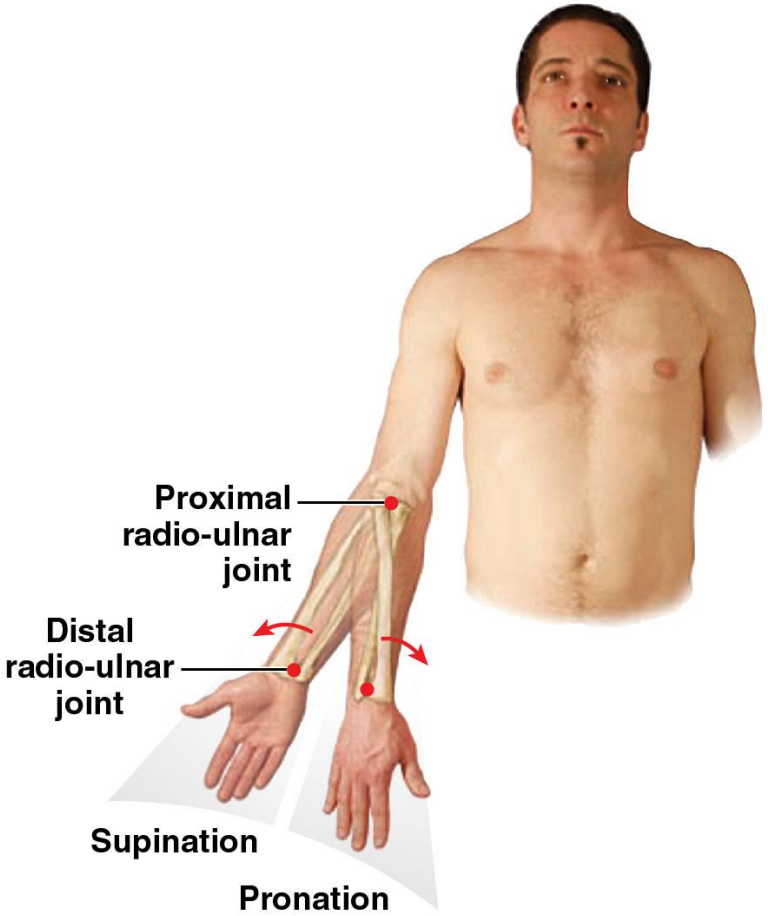
- Special terms for the rotation of the forearm
- Movement occurs at the proximal joint between radius and ulna
- Radial head rotates
  - **Pronation**
    - Distal epiphysis of radius rolls across the anterior surface of the ulna
    - Turns the wrist and hand from palm facing front to palm facing back (posteriorly)



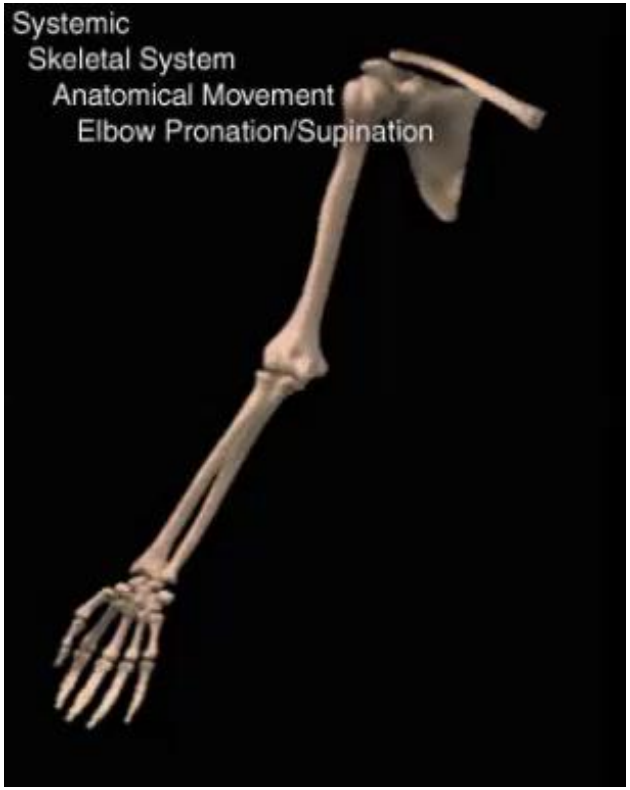
Module 8.5: Rotation and special movements

Rotation (continued)

- **Supination**
  - Opposing movement
  - Palm is turned anteriorly



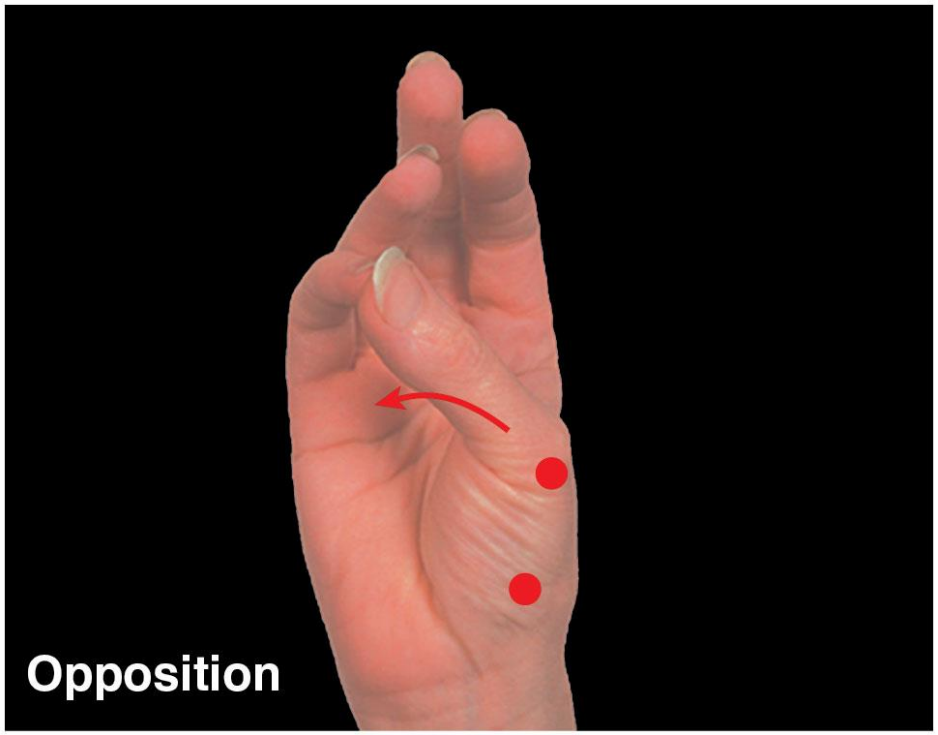
Animation: Articulations: Elbow Pronation and Supination



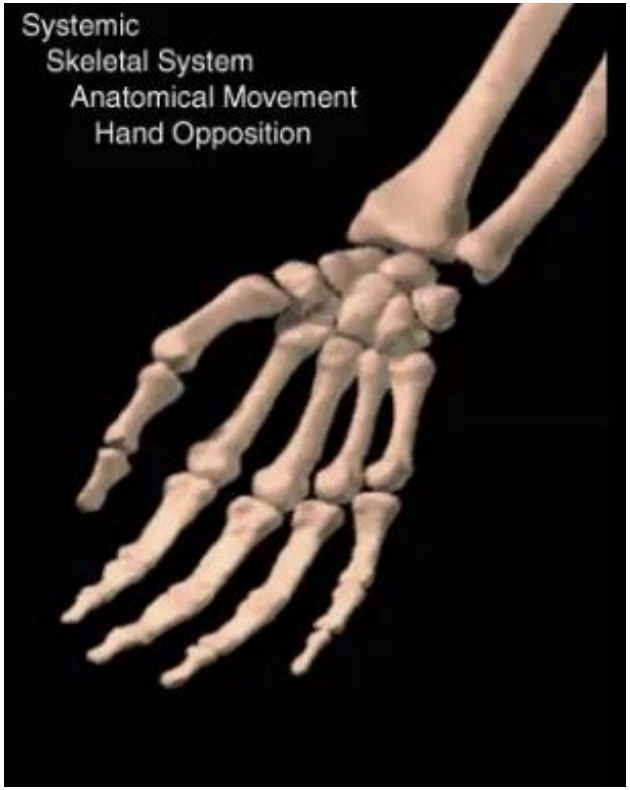
Module 8.5: Rotation and special movements

Special movements

- **Opposition**
  - Movement of the thumb toward the surface of the palm or pads of other fingers
  - Enables grasping objects



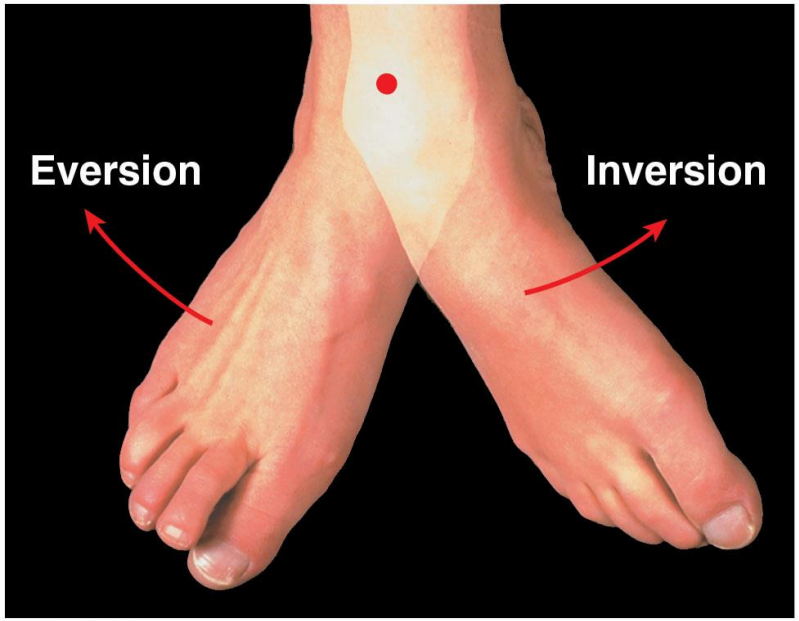
Animation: Articulations: Hand Opposition



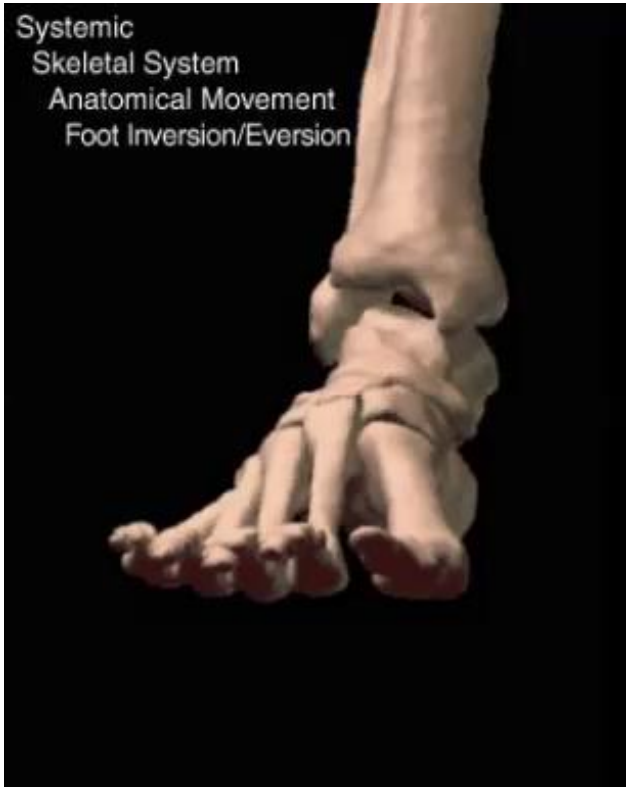
Module 8.5: Rotation and special movements

Special movements (continued)

- Movements of the foot
  - **Inversion** (*in,* into + *vertere,* to turn)
    - Twisting motion turning the sole inward
  - **Eversion**
    - Opposing motion turning the sole outward



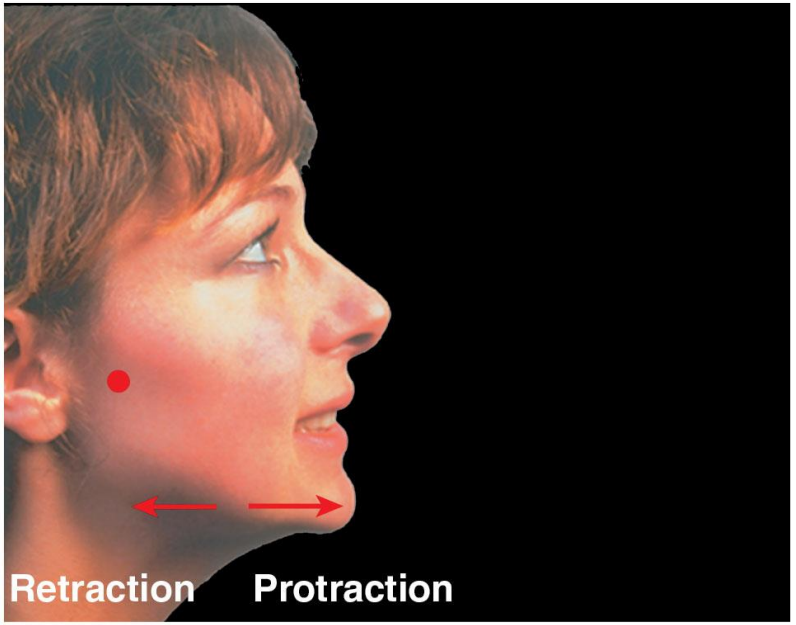
Animation: Articulations: Foot Inversion and Eversion



Module 8.5: Rotation and special movements

Special movements (continued)

- **Protraction**
  - Moving a part of the body anteriorly in the horizontal plane
- **Retraction**
  - Reverse of protraction; returning the body part to normal position



Module 8.5: Rotation and special movements

Special movements (continued)

- **Depression**
  - Moving a body part inferiorly (as in opening your jaw)
- **Elevation**
  - Moving a body part superiorly (as in closing your jaw)

Module 8.5: Review

A. What movements are made possible by the rotation of the head of the radius?
B. Snapping your fingers involves what movement of the thumb?
C. What hand movements occur when a person wriggles into tight-fitting gloves?

Learning Outcome: Describe rotational and special movements of the skeleton.

Section 2: Axial and Appendicular Joints

Learning Outcomes

8.6 Compare the general relationship between joint stability and range of motion for axial and appendicular joints.

8.7 Describe the joints between the vertebrae of the vertebral column.

8.8 **Clinical Module**: Describe intervertebral disc disease and osteoporosis.

8.9 Describe the structure and function of the shoulder and hip joint.

Section 2: Axial and Appendicular Joints

Learning Outcomes (continued)

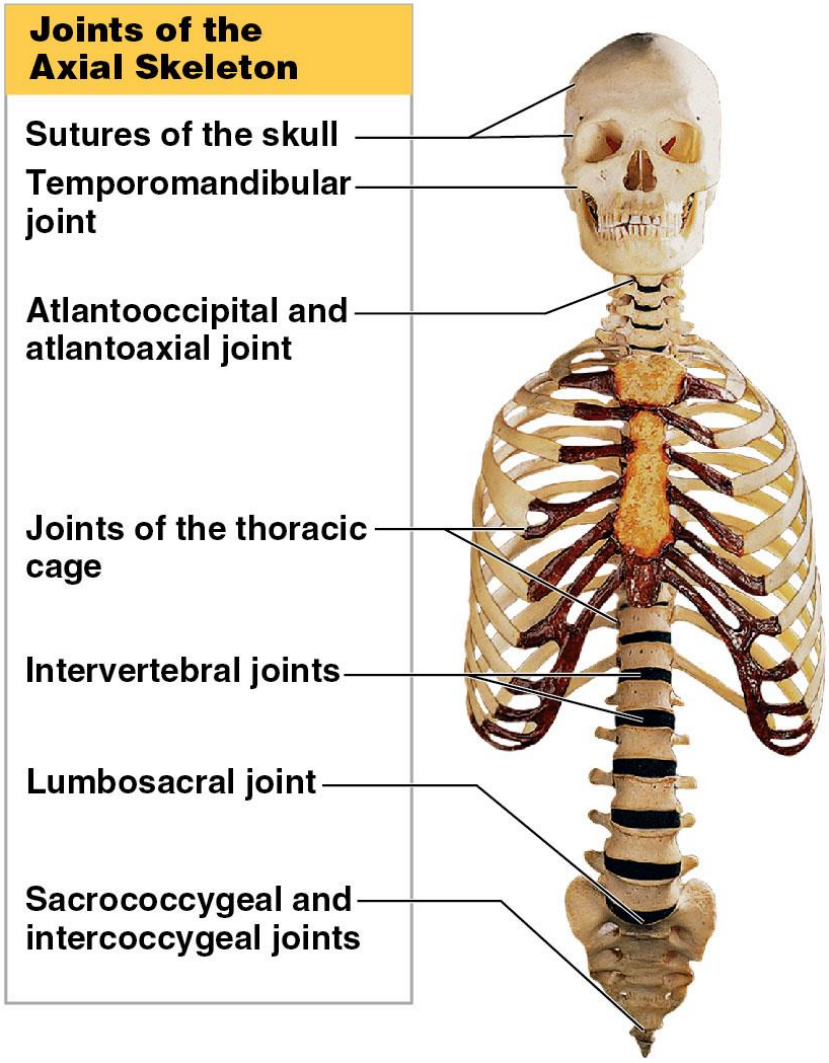
8.10 Describe the structure and function of the elbow joint and knee joint.

8.11 **Clinical Module**: Explain arthritis, and describe its effects on joint structure and function.

Module 8.6: Axial joints have less range of motion than appendicular joints

Joints of the axial skeleton

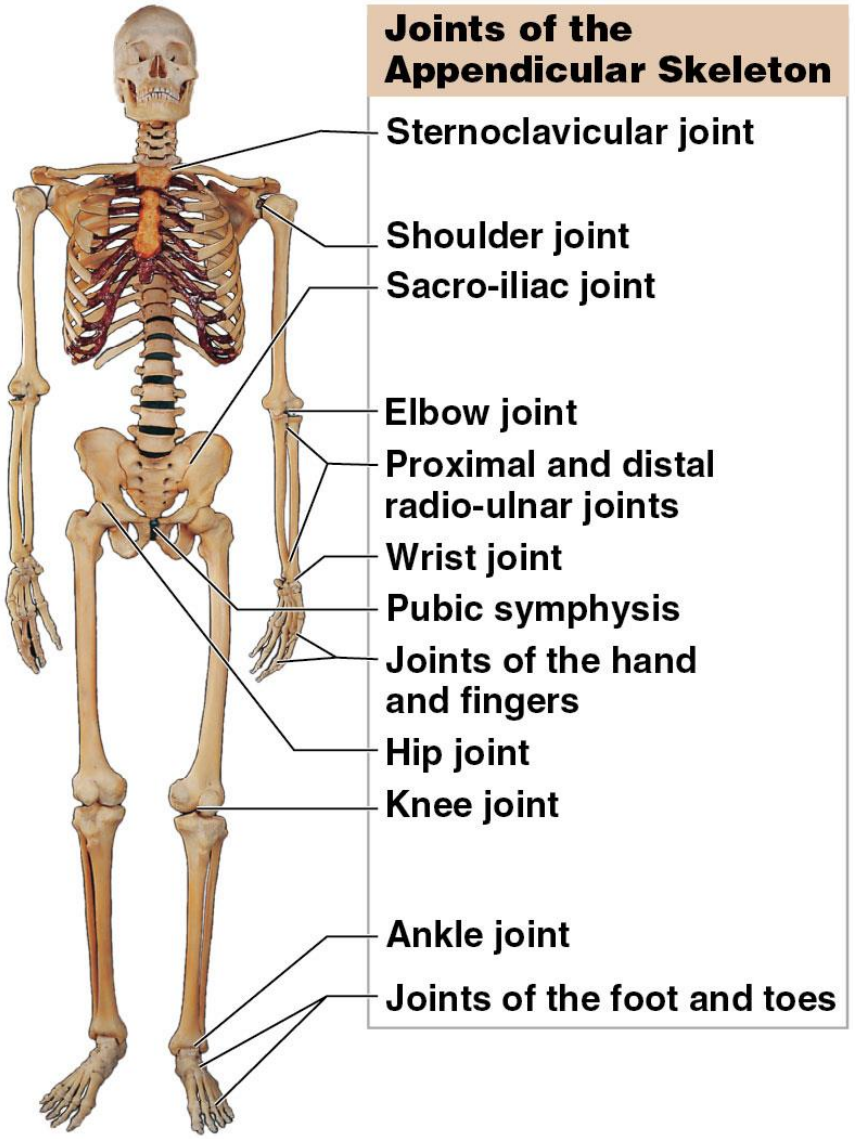
- Strong joints
- Permit very little movement
- *Examples:*
  - Atlanto-occipital joint
    - Articulation between the occipital bone and atlas
  - Atlanto-axial joint
    - Articulation between C_1 and C_2



Module 8.6: Axial and appendicular joints

Joints of the appendicular skeleton

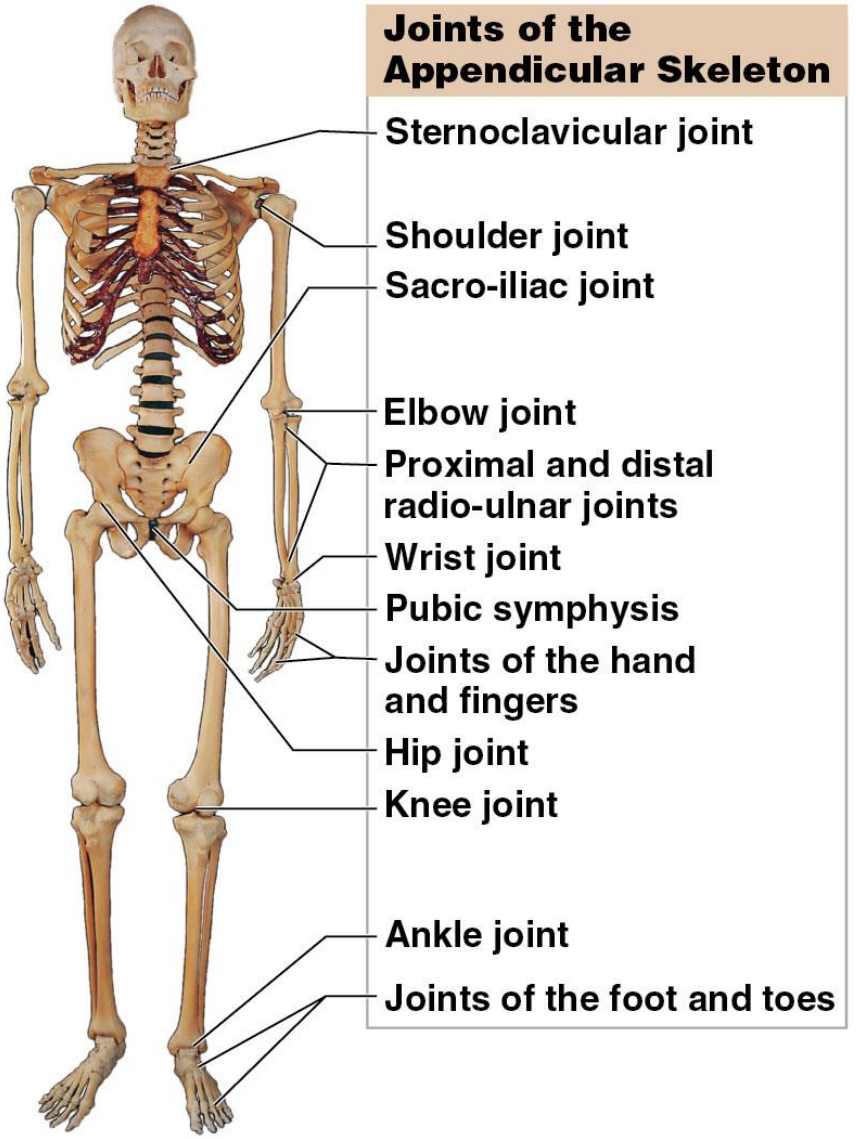
- Extensive range of motion
- Often weaker than axial skeleton joints



Module 8.6: Axial and appendicular joints

Joints of the appendicular skeleton (continued)

- *Examples:*
  - Sternoclavicular joint
    - Articulation between the axial skeleton and pectoral girdle and upper limb
  - Sacro-iliac joint
    - Attaches the sacrum of axial skeleton to the pelvic girdle



Module 8.6: Review

A. Describe the relationship between joint strength and mobility.
B. Which division of the skeleton has the greater range of motion?
C. Which joint attaches the pectoral girdle and upper limb to the axial skeleton?
D. Name the joints in which the sacrum participates.

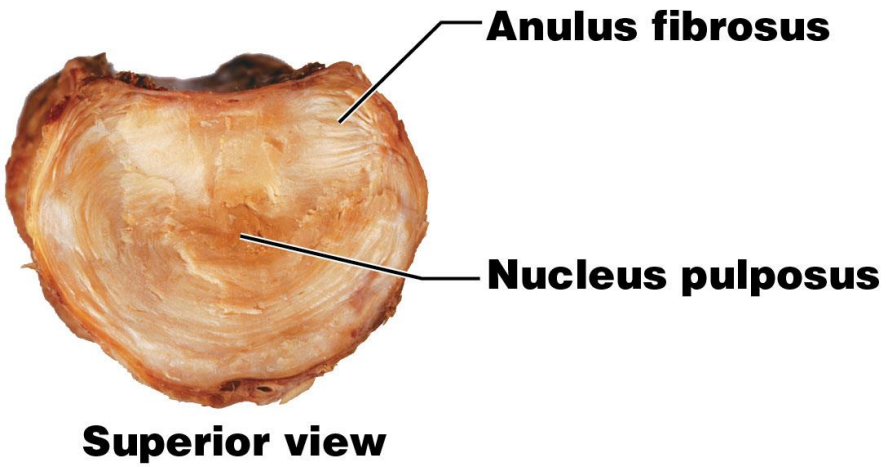
Learning Outcome: Compare the general relationship between joint stability and range of motion for axial and appendicular joints.

Module 8.7: The vertebral column includes three types of joints

Three types of joints in vertebral column

- **Syndesmoses of vertebral column**
  - Fibrous joints, including vertebral ligaments
- **Synchondroses of vertebral column**
  - Intervertebral joints, forming **intervertebral discs**
    - Account for ~1/4 length of the vertebral column
    - With increasing age, water content decreases
      - Loss of cushioning ability increases risk of vertebral injury
      - Vertebral column shortens
- **Vertebral synovial joints**
  - Joints between bony processes

Module 8.7: Vertebral articulations



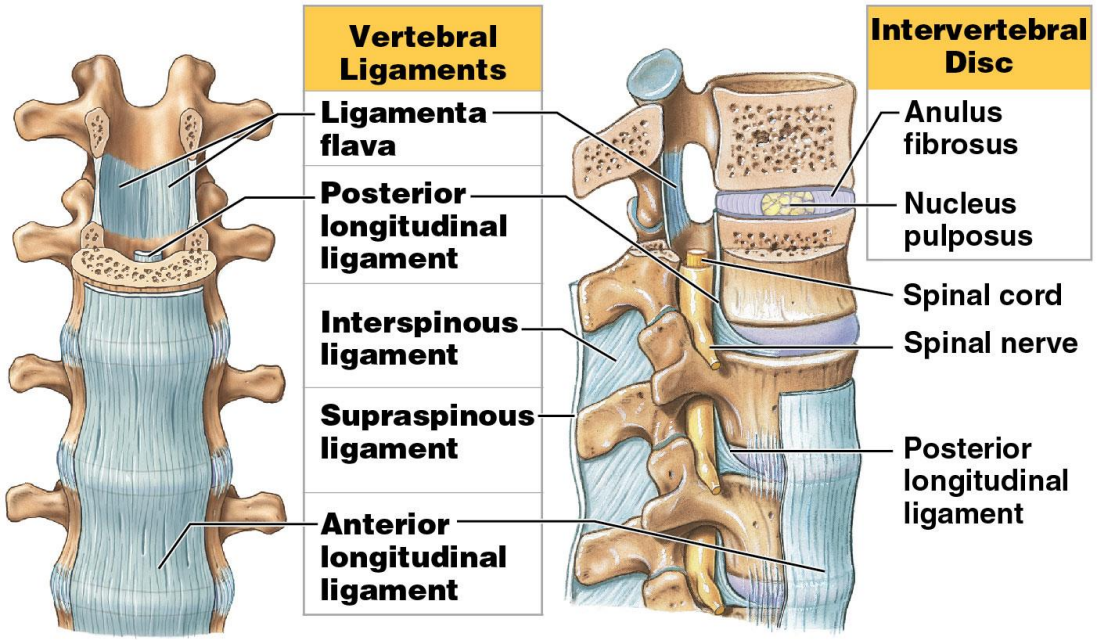
Intervertebral disc components

- **Anulus fibrosus**
  - Tough outer ring of fibrocartilage
  - Collagen fibers attach to adjacent vertebrae
- **Nucleus pulposus**
  - Soft, elastic, gelatinous core
  - Gives disc resilience and shock absorption ability

Module 8.7: Vertebral articulations

Primary vertebral ligaments

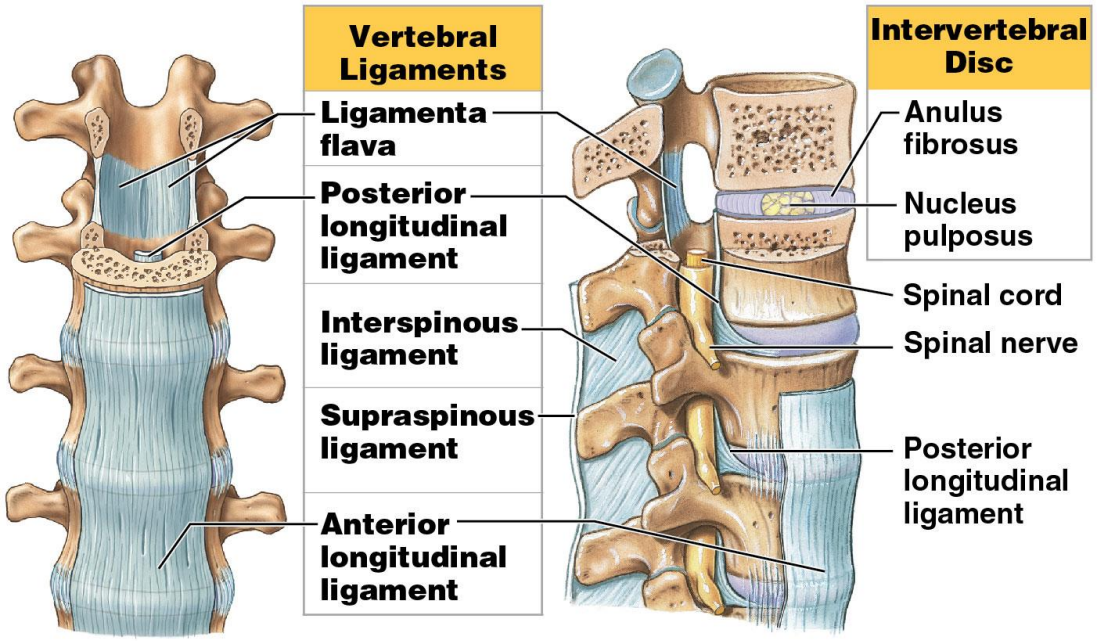
- **Ligamentum flavum**
  - Connects laminae of adjacent vertebrae
- **Posterior longitudinal ligament**
  - Connects posterior surfaces of adjacent vertebral bodies



Module 8.7: Vertebral articulations

Primary vertebral ligaments (continued)

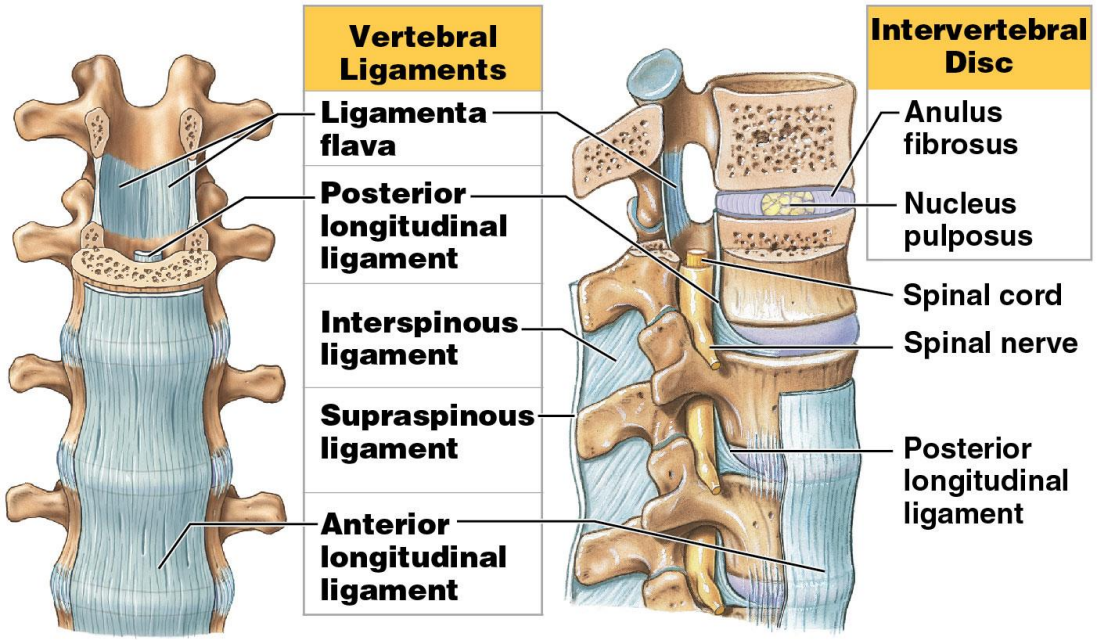
- **Interspinous ligament**
  - Connects spinous processes of adjacent vertebrae



Module 8.7: Vertebral articulations

Primary vertebral ligaments (continued)

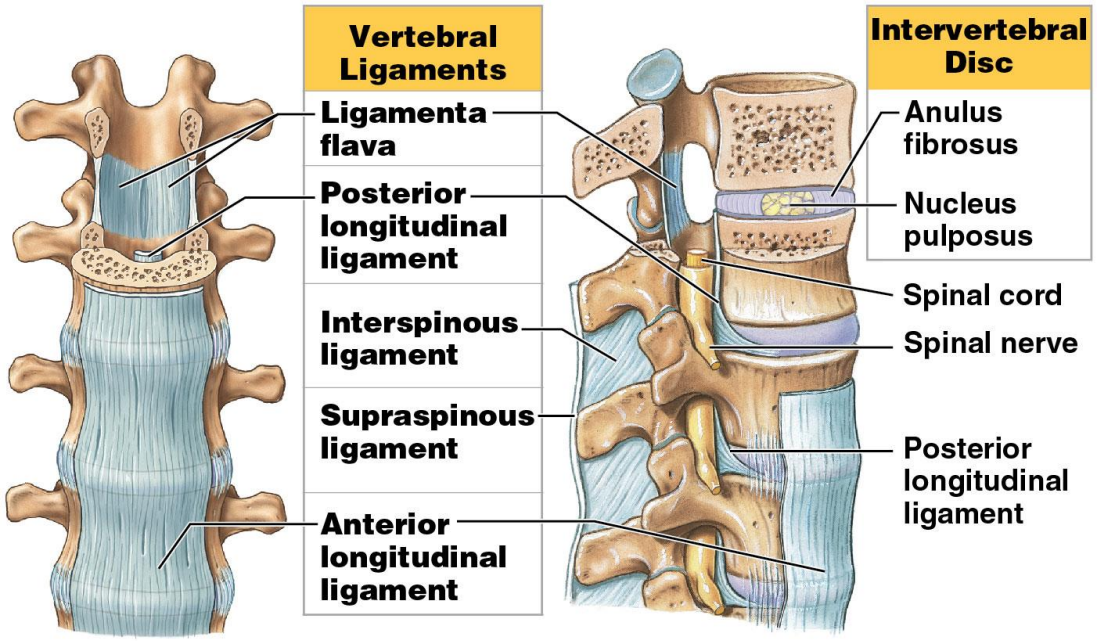
- **Supraspinous ligament**
  - Connects tips of spinous processes from the sacrum to C_7
  - Ligamentum nuchae extends from C_7 to base of the skull



Module 8.7: Vertebral articulations

Primary vertebral ligaments (continued)

- **Anterior longitudinal ligament**
  - Connects anterior surfaces of adjacent vertebral bodies



Module 8.7: Review

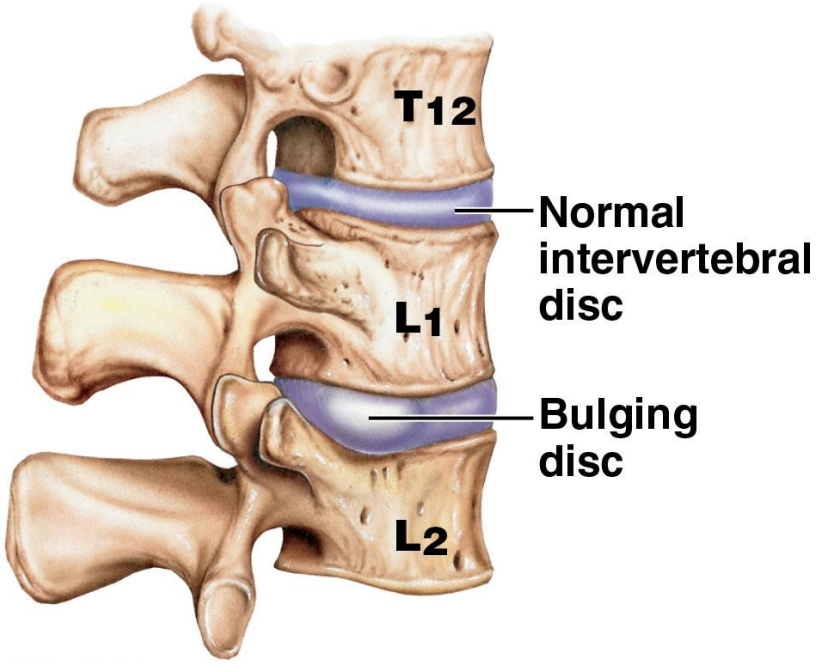
A. Describe the nucleus pulposus and anulus fibrosus of an intervertebral disc.
B. Name the primary vertebral ligaments.

Learning Outcome: Describe the joints between the vertebrae of the vertebral column.

Module 8.8: Clinical Module: Intervertebral disc disease and osteoporosis are common age-related health problems

Intervertebral disc disease (IVDD)

- **Bulging disc**
  - Caused by weakened posterior longitudinal ligaments
  - Allows compression of nucleus pulposus and distortion of anulus fibrosus
  - Tough, outer layer of cartilage bulges laterally

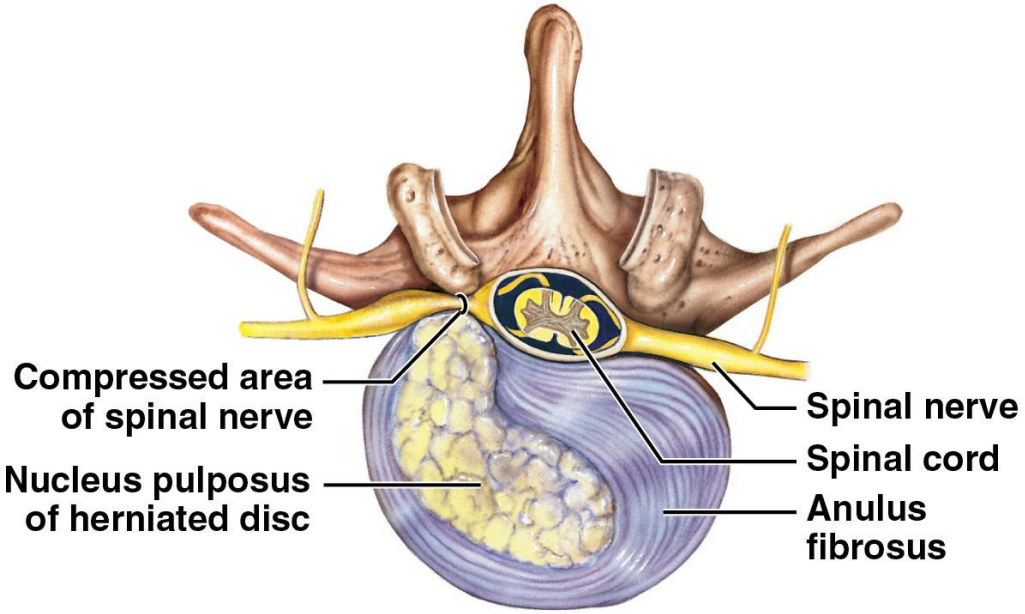


Module 8.8: Vertebral abnormalities

Intervertebral disc disease (IVDD) (continued)

Herniated disc

- Nucleus pulposus breaks through anulus fibrosus and protrudes into the vertebral canal
- Compresses spinal nerves



Module 8.8: Vertebral abnormalities

Bone changes with aging

- **Osteopenia** (*penia,* lacking)
  - Inadequate ossification leading to loss of bone mass
  - Often occurs with age, beginning between ages 30 and 40
  - More severe in women than men

Module 8.8: Vertebral abnormalities

Bone changes with aging (continued)

- **Osteoporosis** (*porosus*, porous)
  - Bone loss sufficient to affect normal function

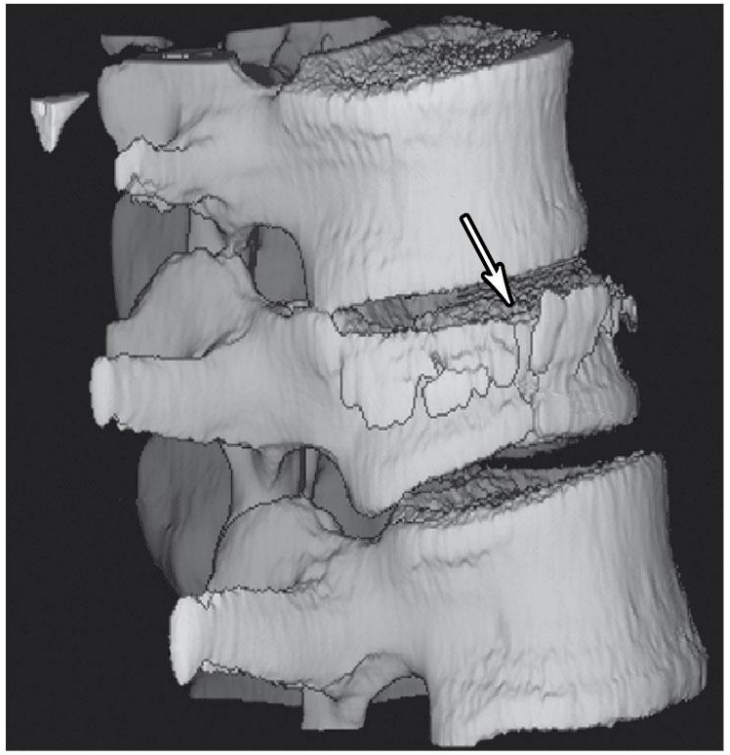
Normal spongy bone SEM × 25

Spongy bone with osteoporosis SEM × 21

Module 8.8: Vertebral abnormalities

Bone changes with aging (continued)

- Loss of bone mass, along with reduced cushioning of intervertebral discs, leads to increasing incidence of vertebral fractures in elderly



Clinical scan of a compression fracture in a lumbar vertebra

Module 8.8: Review

A. Compare a bulging disc with a herniated disc.
B. What common age-related factors contribute to vertebral fractures in the elderly?

Learning Outcome: Describe intervertebral disc disease and osteoporosis.

Module 8.9: The shoulder and hip are ball-and-socket joints

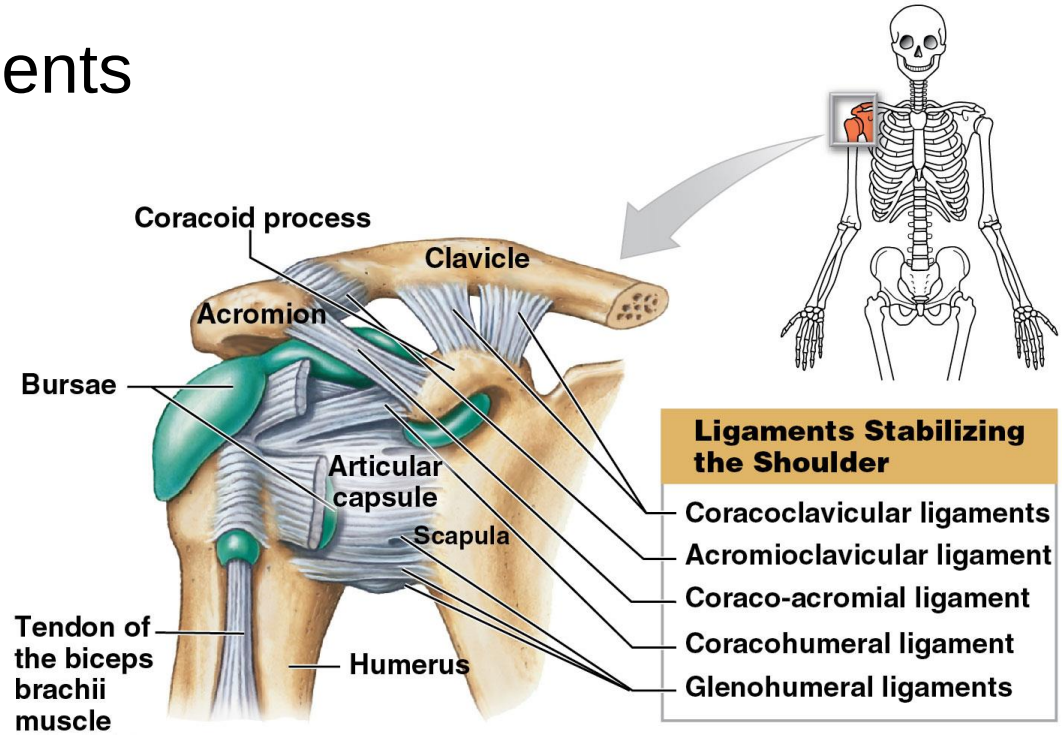
Shoulder joint, or glenohumoral joint

- Greatest range of motion of any joint
- Most frequently dislocated joint
  - Demonstrates how stability is sacrificed for mobility
- Ball-and-socket diarthrosis
  - Articulation between the head of the humerus and the glenoid cavity of the scapula
  - Stabilized by five major ligaments, surrounding muscles, and associated tendons
  - Bursae help reduce friction
    - Tendon of the biceps brachii surrounded by a tubular bursa as it passes through the articular capsule

Module 8.9: Ball-and-socket joints

Glenohumoral joint stabilizing ligaments

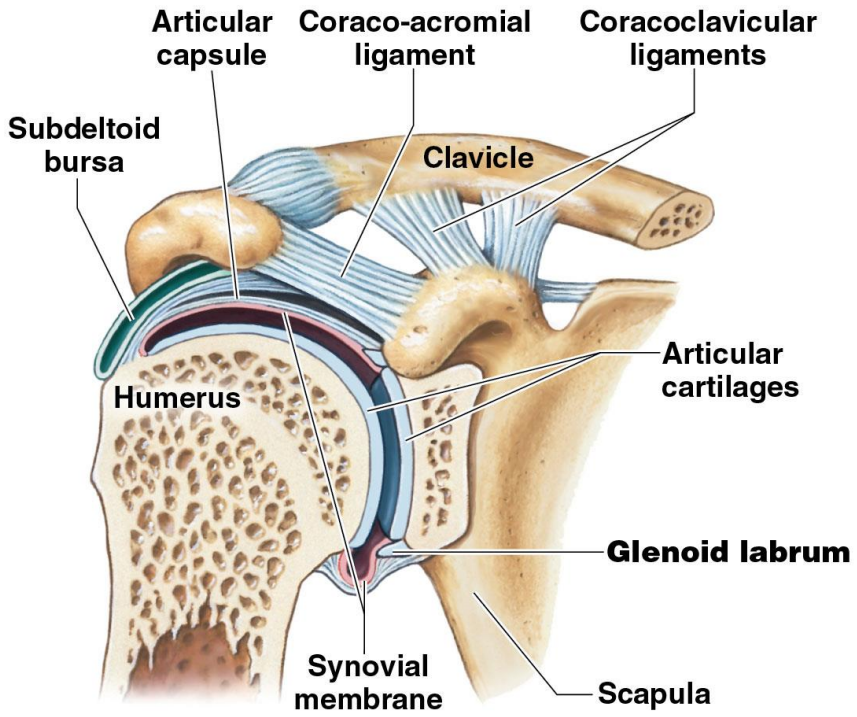
- Coracoclavicular ligaments
- Acromioclavicular ligament
- Coraco-acromial ligament
- Coracohumeral ligament
- Glenohumeral ligaments



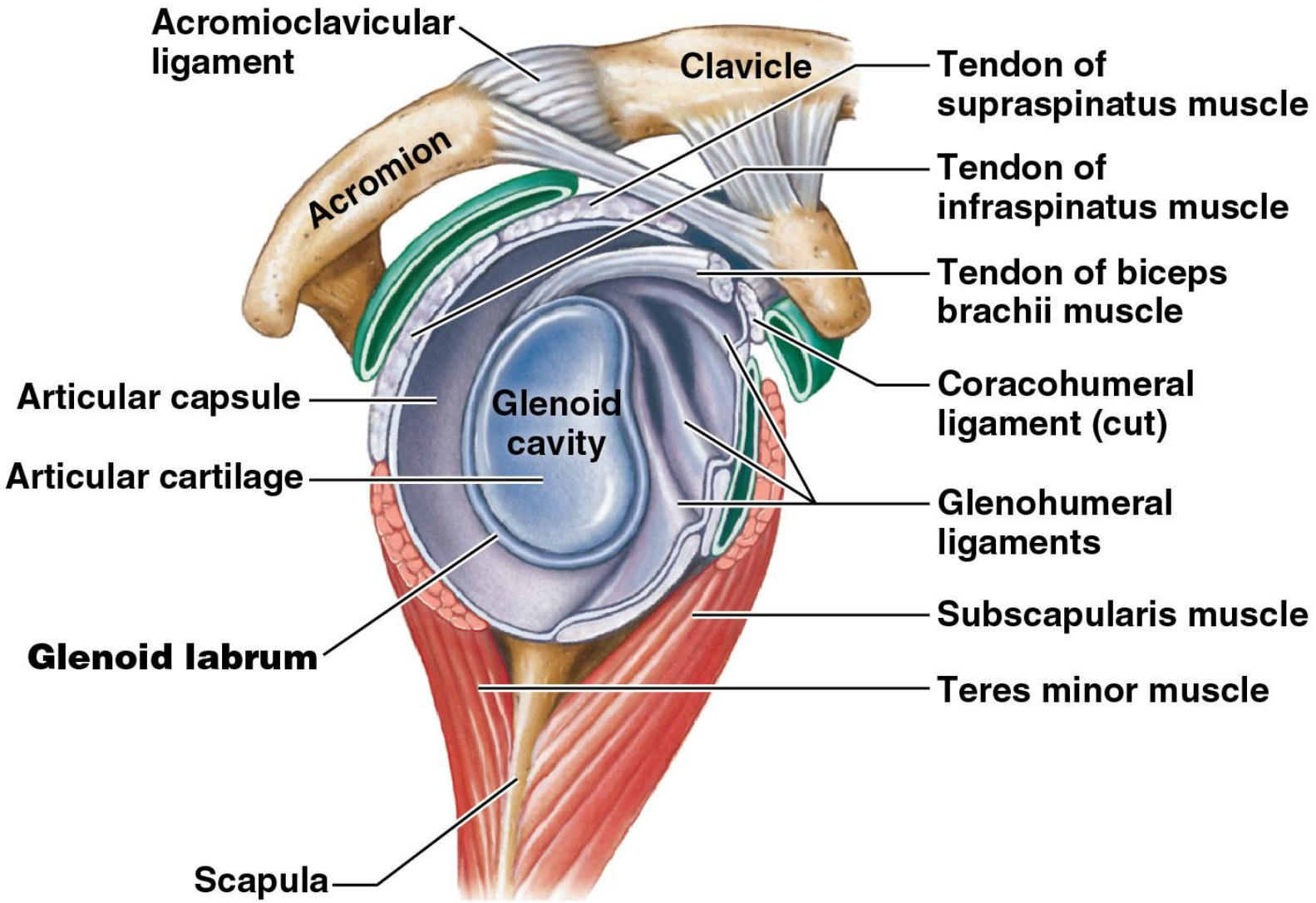
Module 8.9: Ball-and-socket joints

Glenohumoral joint features

- Articular capsule
  - Permits extensive range of motion
- Small articular cartilage
- **Glenoid labrum** (*labrum,* lip or edge)
  - Fibrocartilage rim
  - Increases area of the glenoid cavity



Glenohumoral joint



Module 8.9: Ball-and-socket joints

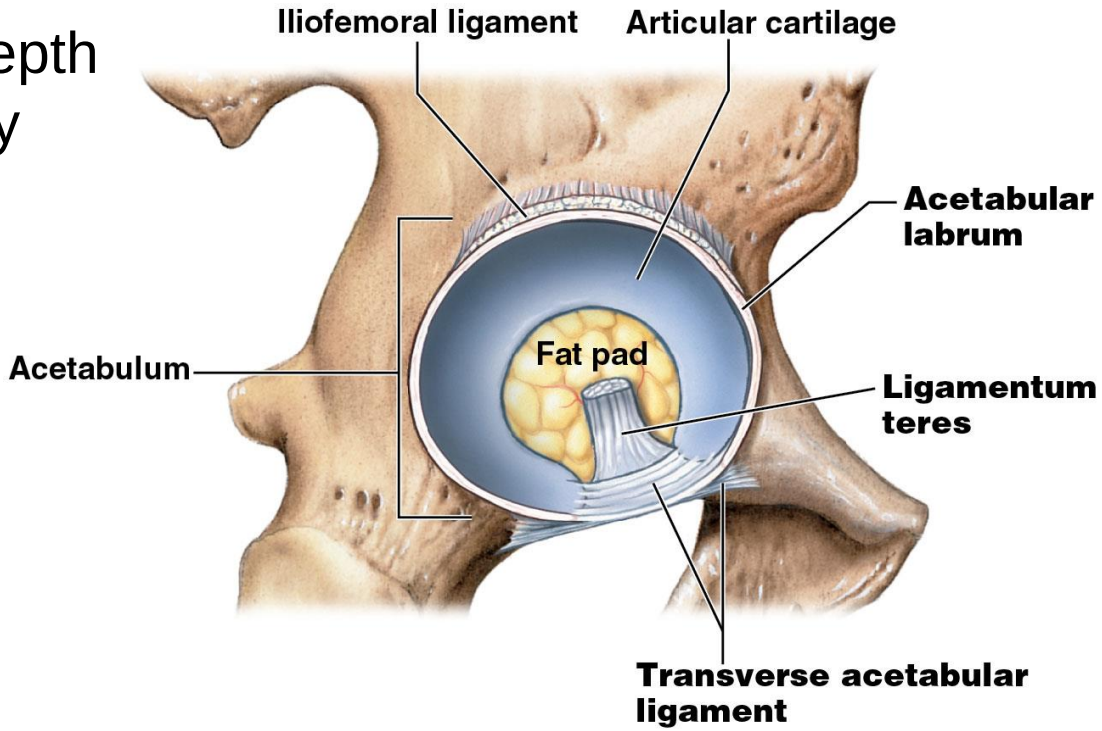
Hip joint

- Sturdy ball-and-socket diarthrosis joint
  - Permits flexion, extension, adduction, abduction, circumduction, and rotation

Module 8.9: Ball-and-socket joints

Hip joint (continued)

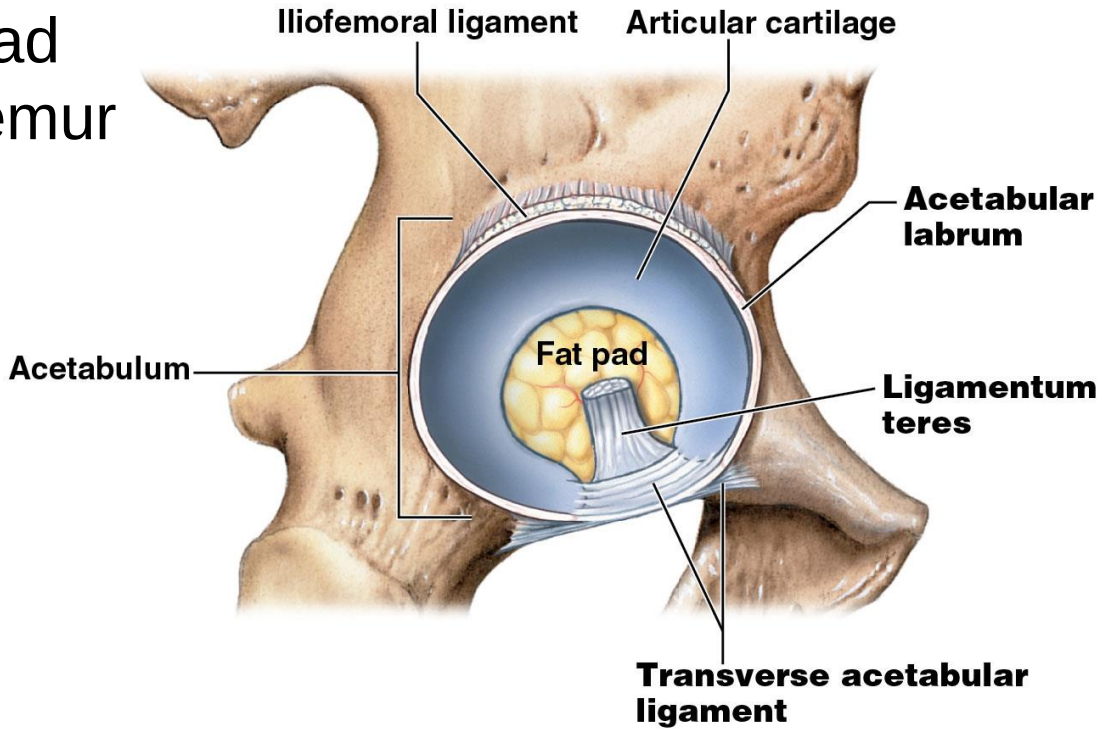
- Articulation between the head of the femur and the acetabulum (deep fossa) of the hip bone
  - **Acetabular labrum**
    - Rim of fibrocartilage
    - Increases the depth of the joint cavity
    - Helps to seal in synovial fluid



Module 8.9: Ball-and-socket joints

Hip joint (continued)

- Articular capsule of the hip
  - Extends from the lateral and inferior surfaces of the pelvic girdle to the intertrochanteric line and intertrochanteric crest of femur
  - Encloses both head and neck of the femur
  - Reinforced by five ligaments

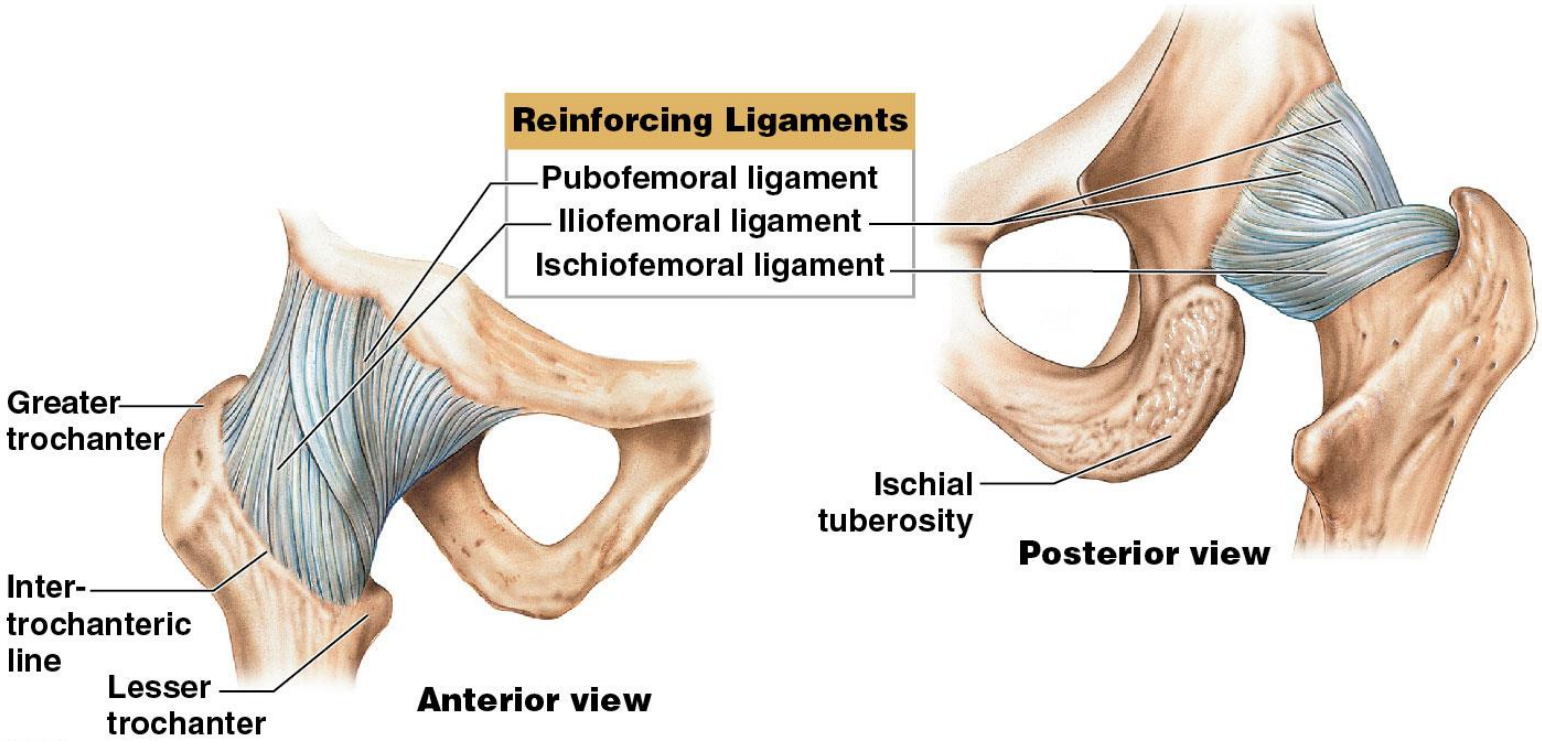


Module 8.9: Ball-and-socket joints

Hip joint reinforcing ligaments

1. Transverse acetabular ligament

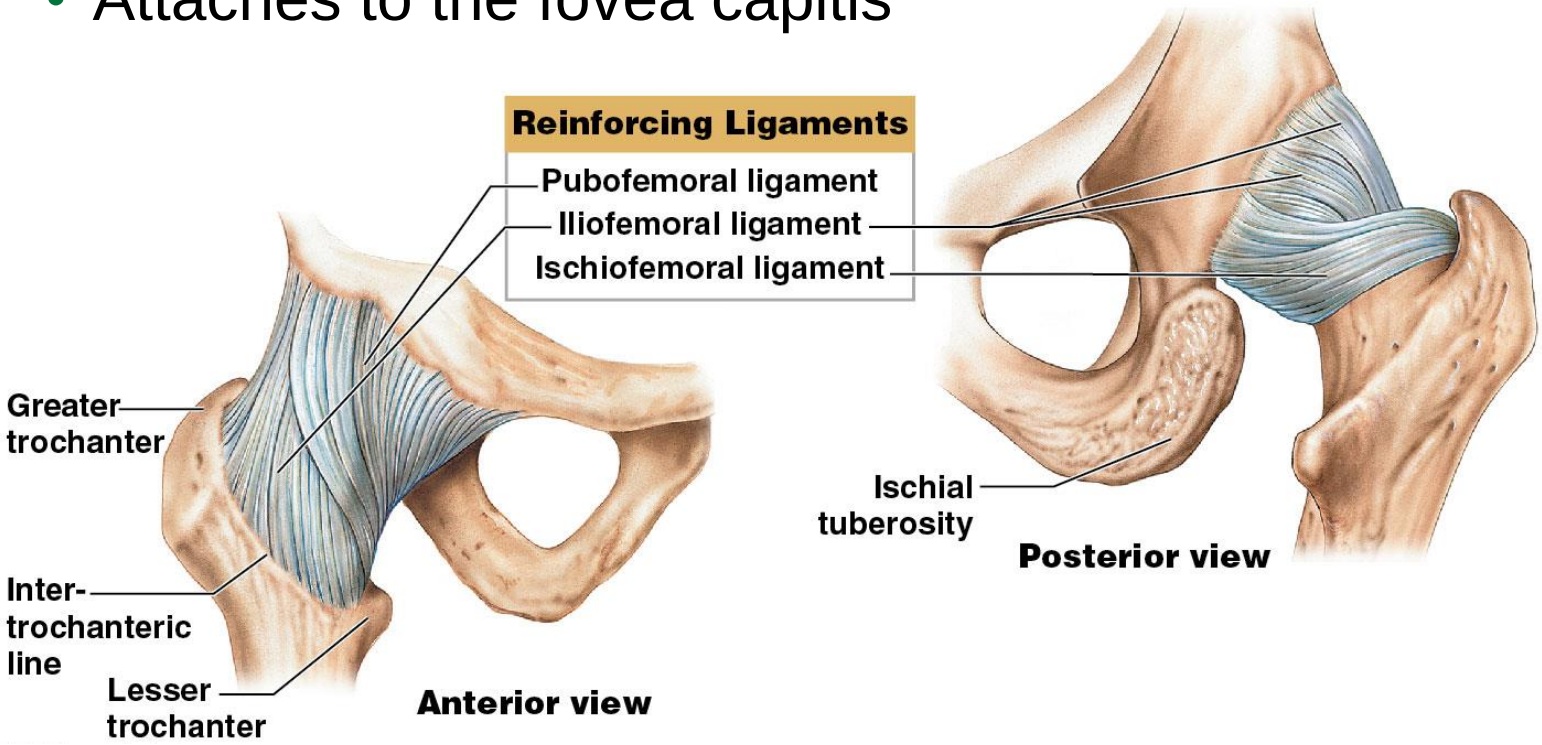
- Crosses the acetabular notch, filling gap in the inferior border of the acetabulum



Module 8.9: Ball-and-socket joints

Hip joint reinforcing ligaments (continued)

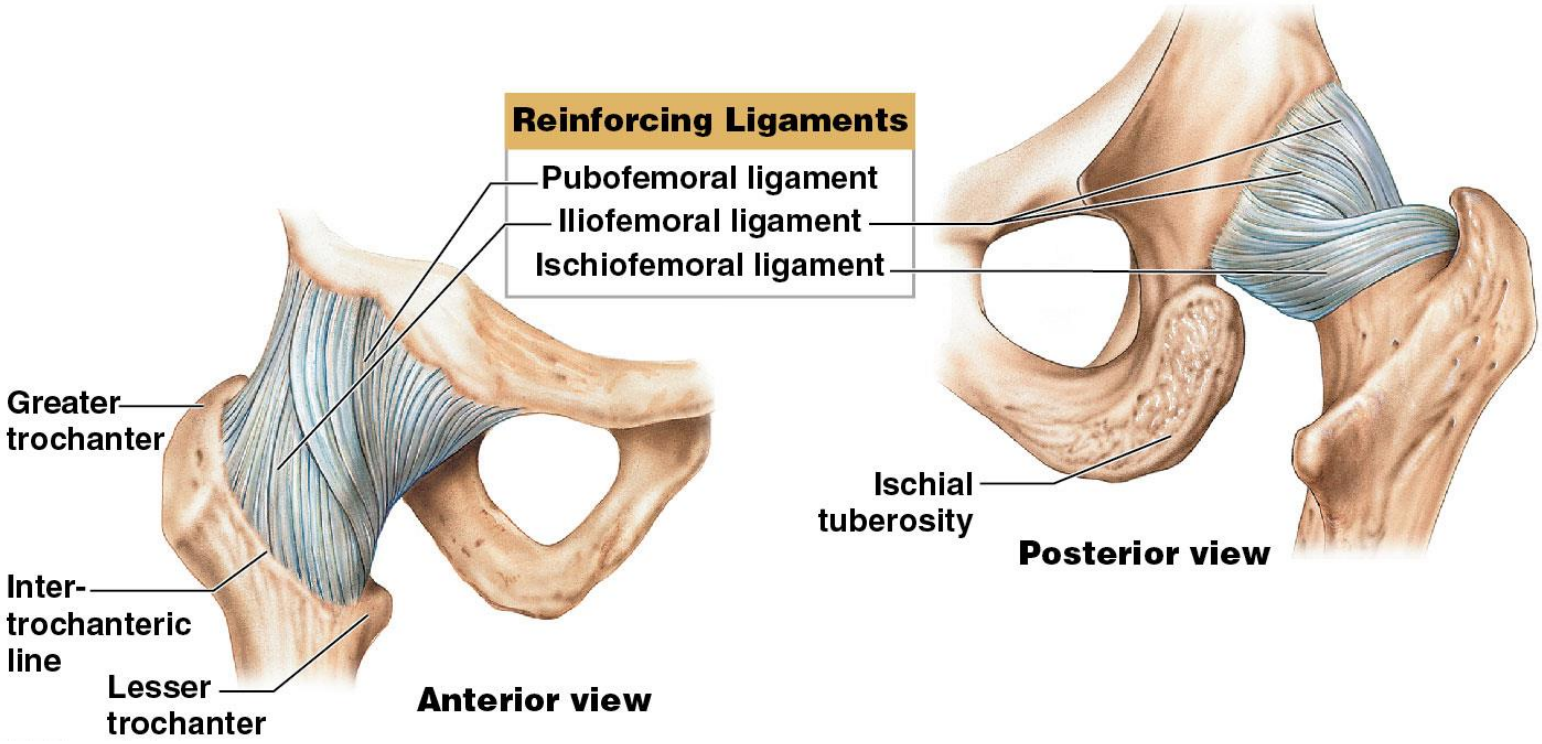
2. **Ligamentum teres** (*teres*, long and round)
   - Also called **ligament of the femoral head**
   - Originates along the transverse acetabular ligament
   - Attaches to the fovea capitis



Module 8.9: Ball-and-socket joints

Hip joint reinforcing ligaments (continued)

3. **Pubofemoral ligament**
4. **Iliofemoral ligament**
5. **Ischiofemoral ligament**



Module 8.9: Review

A. Which structures provide most of the stability for the shoulder joint?
B. At what site are the iliofemoral ligament, pubofemoral ligament, and ischiofemoral ligament located?
C. A football player is pushed out of bounds from behind. He falls onto his outstretched hand, pushing the humeral head forcefully upward. Which joints and ligaments are affected?

Learning Outcome: Describe the structure and function of the shoulder joint and hip joint.

Module 8.10: The elbow and knee are hinge joints

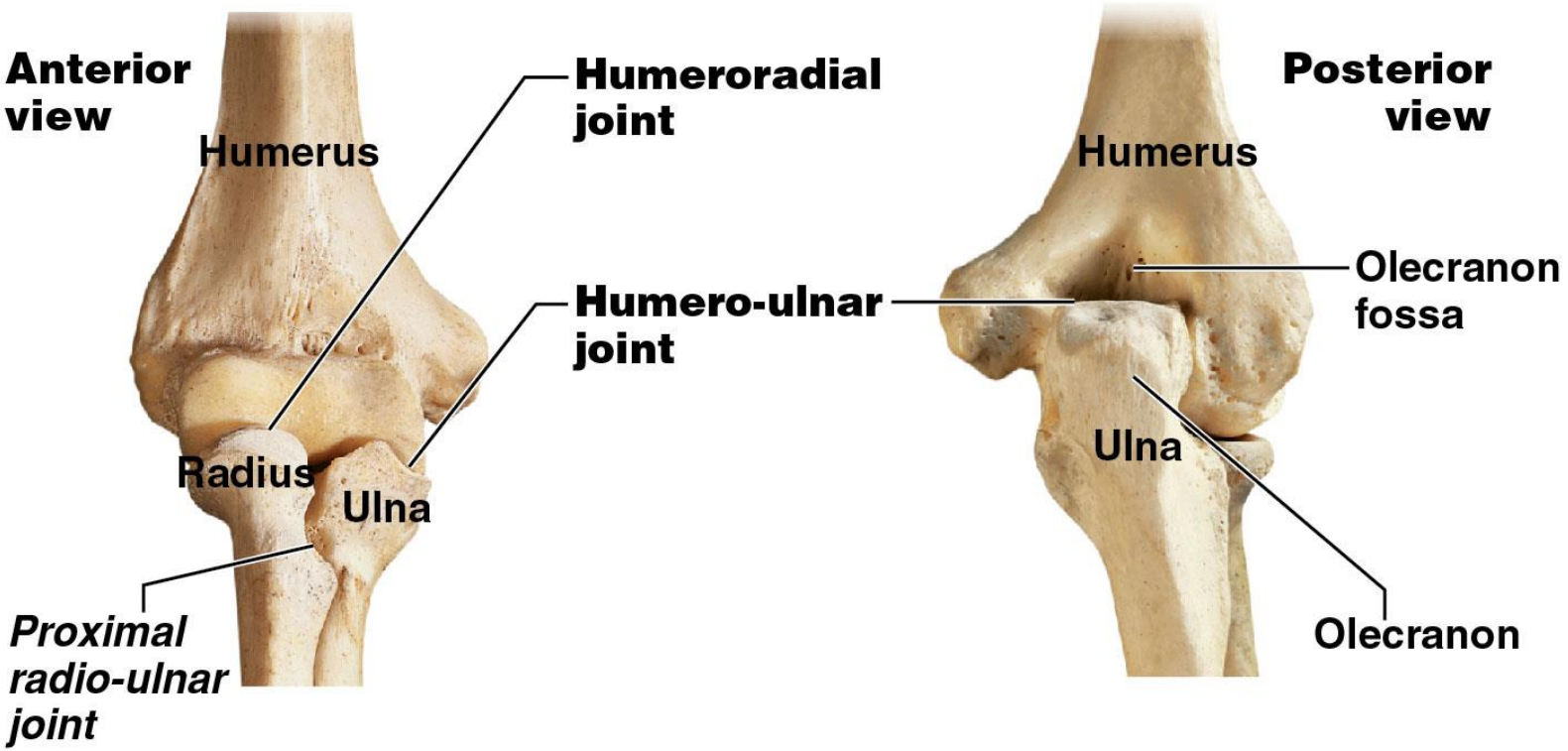
Elbow joint

- Complex hinge joint involving humerus, radius, and ulna
- Extremely stable because:
  1. The bony surfaces of the humerus and ulna interlock
  2. A single, thick articular capsule surrounds both the humero-ulnar and proximal radio-ulnar joints
  3. Strong ligaments reinforce the articular capsule

Module 8.10: Hinge joints

Specific joints of the elbow

- **Humeroradial joint**
  - Capitulum of humerus articulates with head of radius

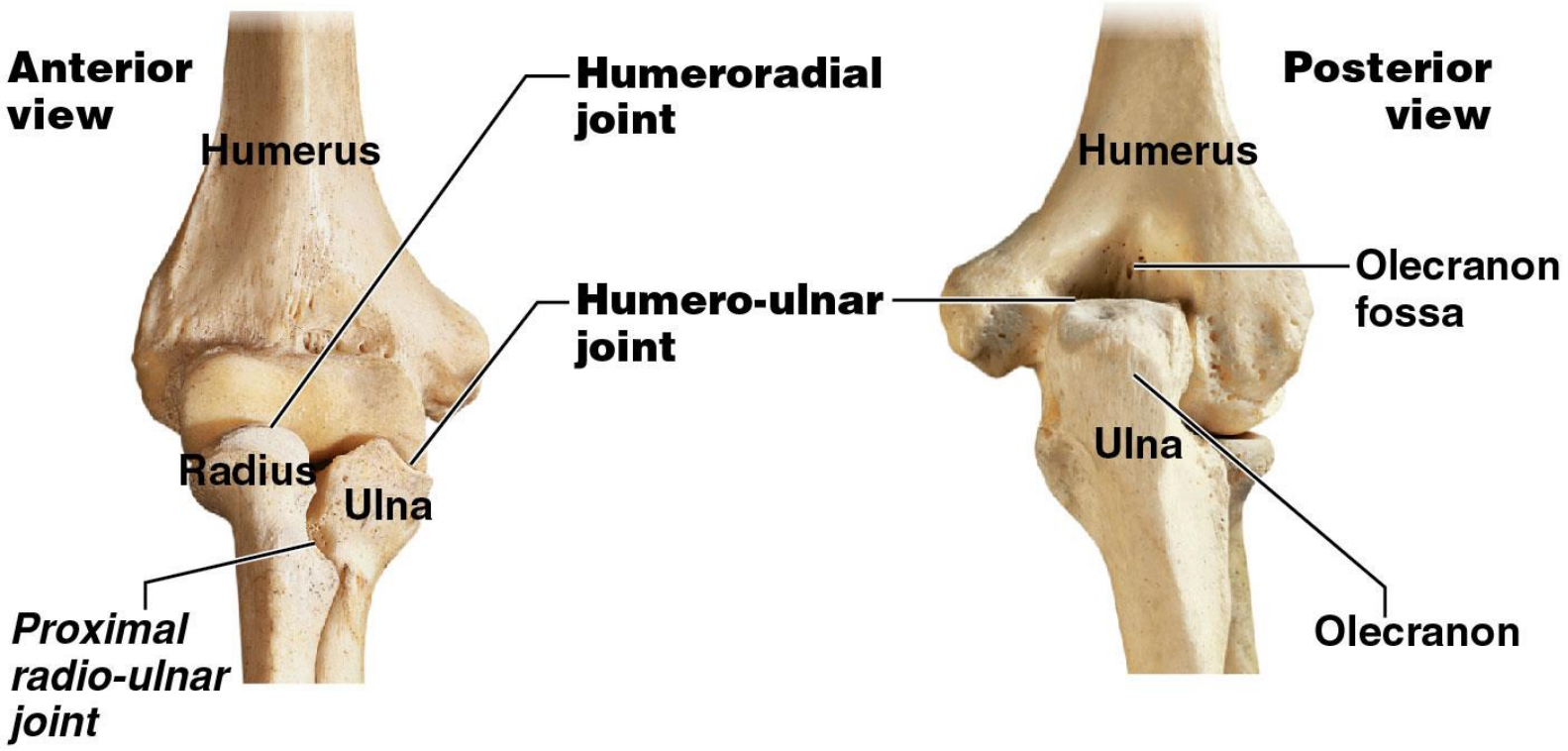


Module 8.10: Hinge joints

Specific joints of the elbow (continued)

- **Humero-ulnar joint**
  - Largest and strongest articulation
  - Works like a door hinge, where trochlea of humerus articulates with the trochlear notch of the ulna
    - Shape of the trochlear notch determines the plane of movement
    - Shapes of the olecranon fossa and olecranon limit the degree of extension

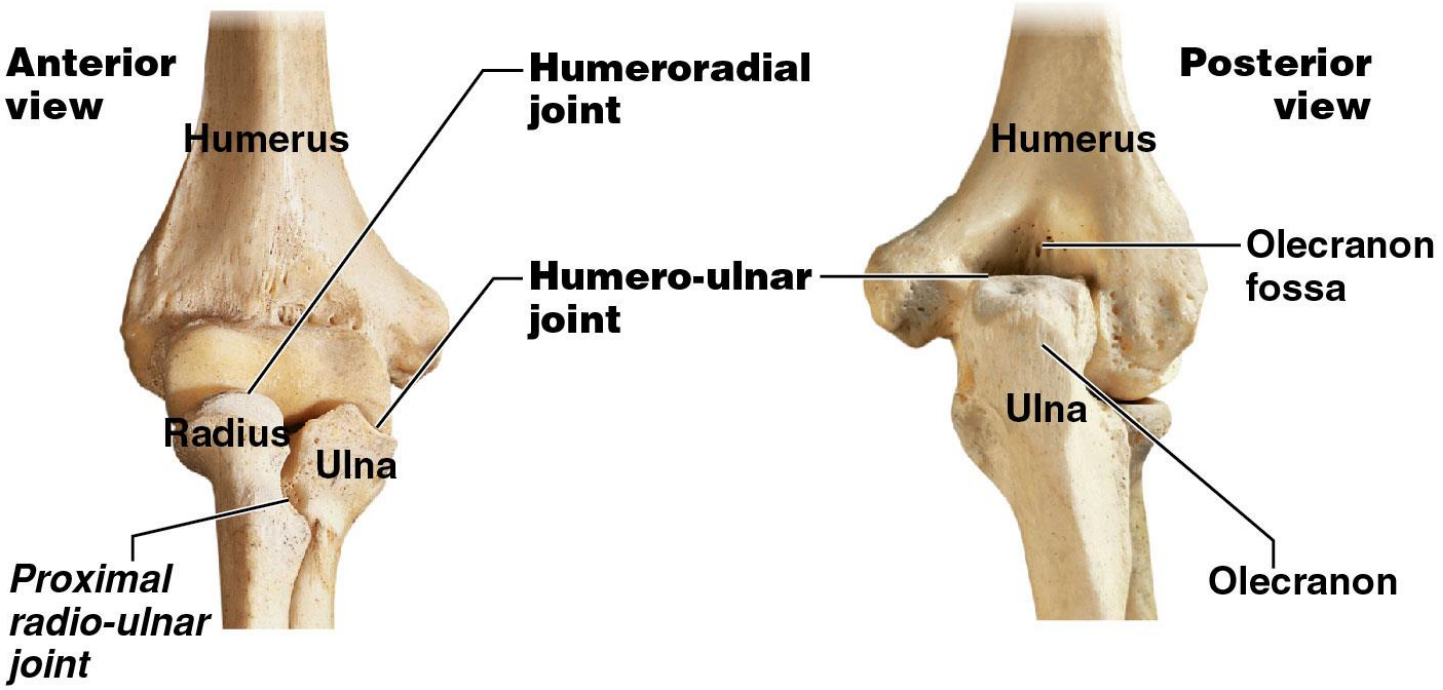
Humeroulnar joint



Module 8.10: Hinge joints

Elbow joint (continued)

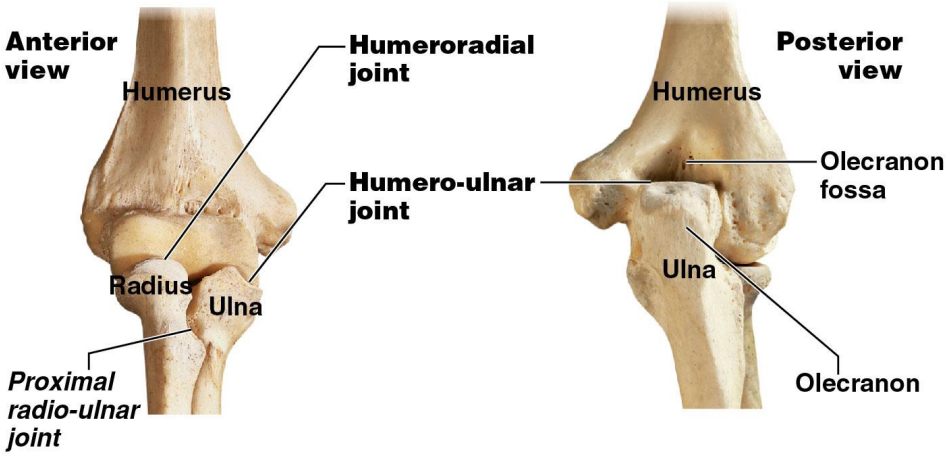
- *Proximal radio-ulnar joint* is not part of the elbow joint
  - Capsule and ligaments help hold the humerus, ulna, and radius in position



Module 8.10: Hinge joints

Elbow joint (continued)

- Muscle attachments
  - Muscles that extend the elbow attach on the olecranon on the posterior surface
    - Controlled by the radial nerve
  - Tendon of the biceps brachii attaches at the radial tuberosity
    - Contraction produces supination of forearm and flexion at the elbow



Module 8.10: Hinge joints

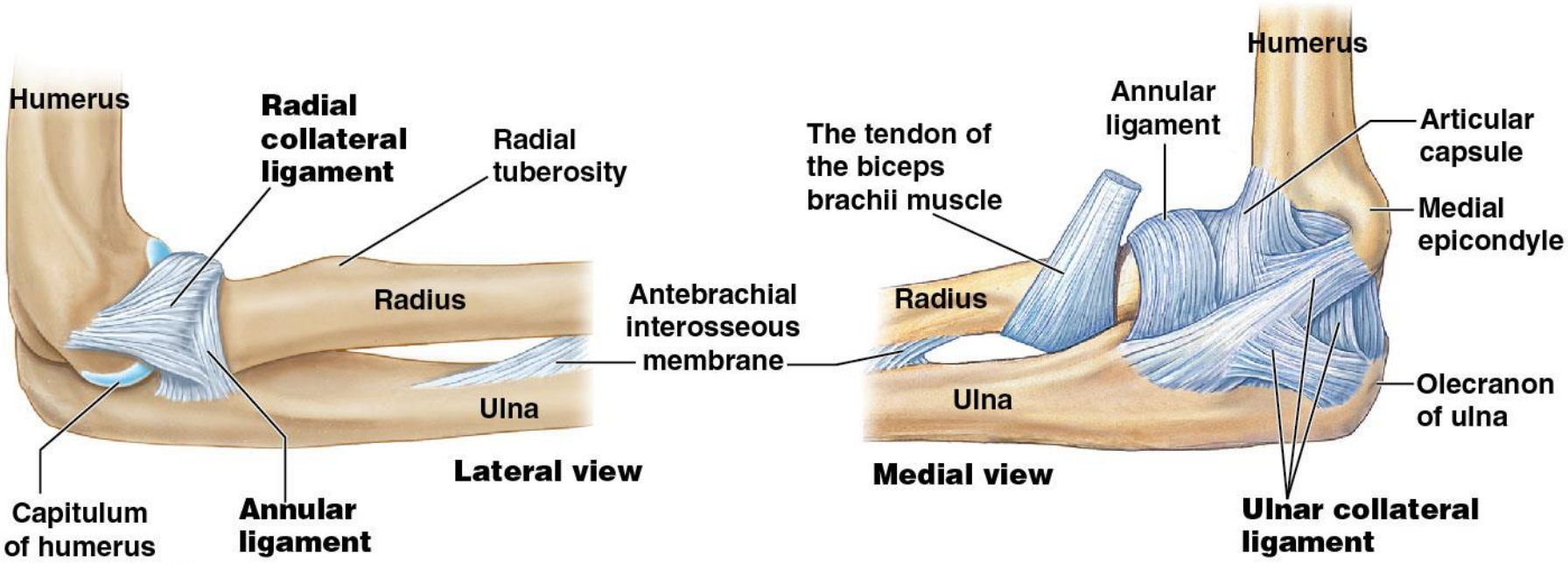
Elbow joint (continued)

- Severe stresses can still produce dislocations or other injuries, especially when epiphyseal growth is not complete
  - *Example:* **nursemaid's elbow**
    - Partial dislocation of the radial head from annular ligament

Module 8.10: Hinge joints

Elbow joint reinforcing ligaments

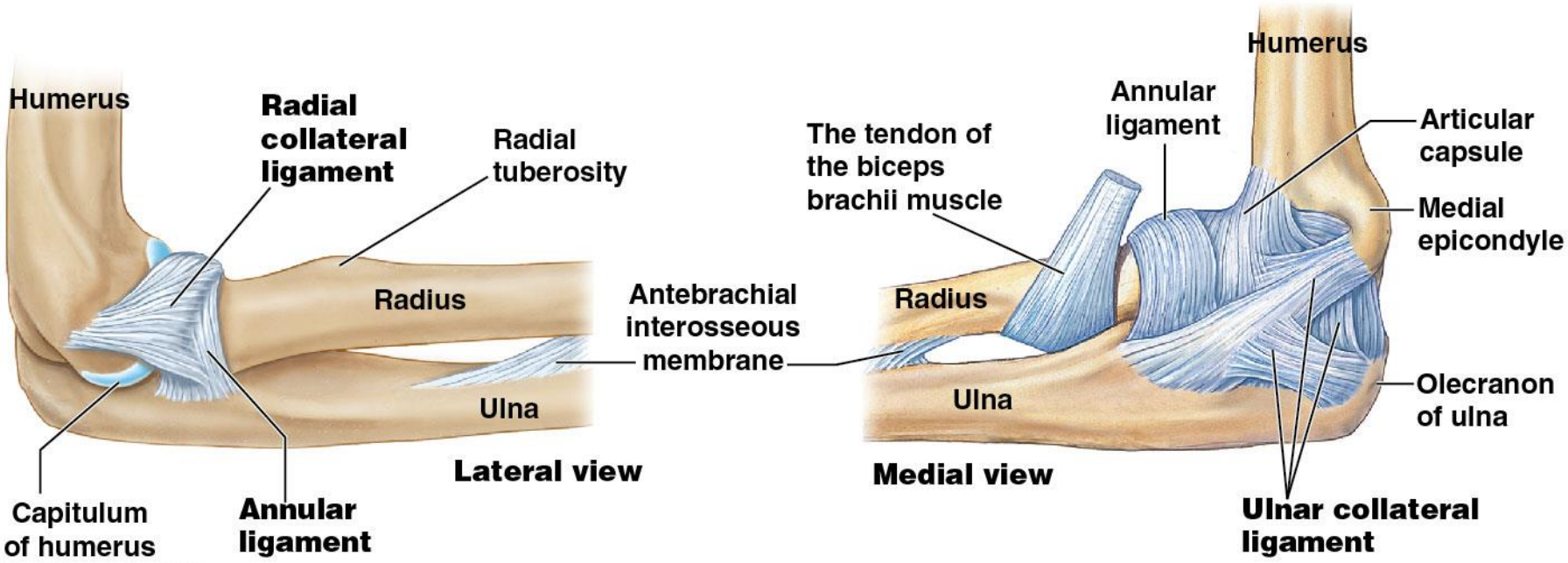
- **Radial collateral ligament**
  - Stabilizes the lateral surface of the elbow joint
- **Annular ligament**
  - Binds the head of the radius to the ulna



Module 8.10: Hinge joints

Elbow joint reinforcing ligaments (continued)

- **Ulnar collateral ligament**
  - Stabilizes the medial surface of the elbow joint



Module 8.10: Hinge joints

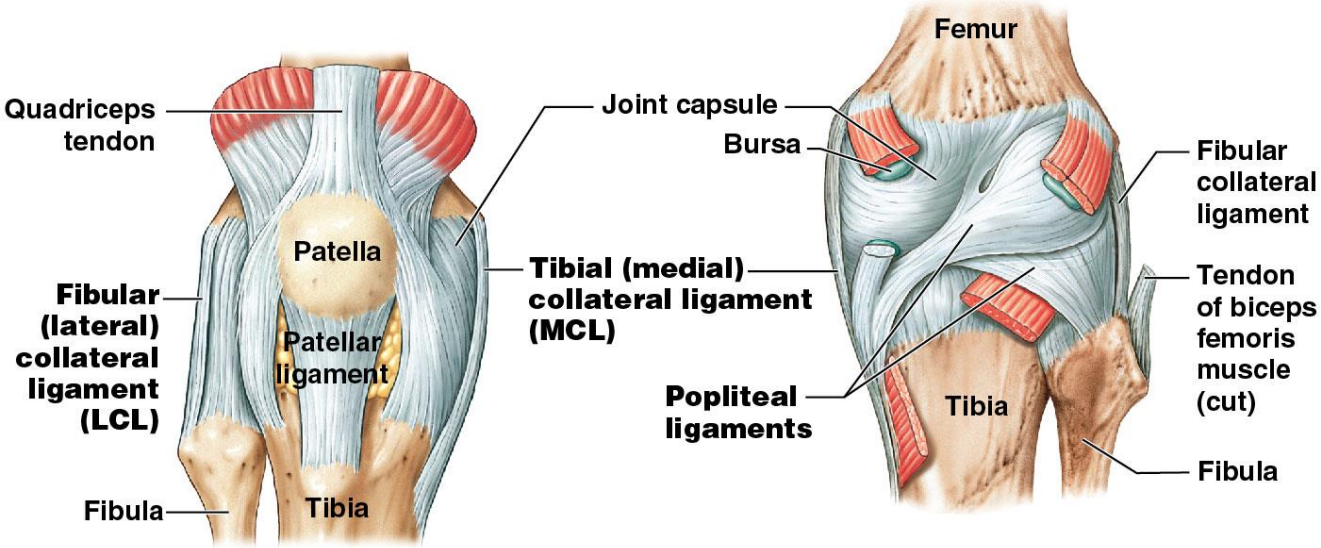
Knee joint

- Contains three separate articulations
  - Two between the femur and tibia
    1. Medial condyle of tibia to medial condyle of femur
    2. Lateral condyle of tibia to lateral condyle of femur
  - One between the patella and patellar surface of the femur
- These articulations permit flexion, extension, and very limited rotation
- Fibula is not part of the knee joint

Module 8.10: Hinge joints

Knee joint supporting structures

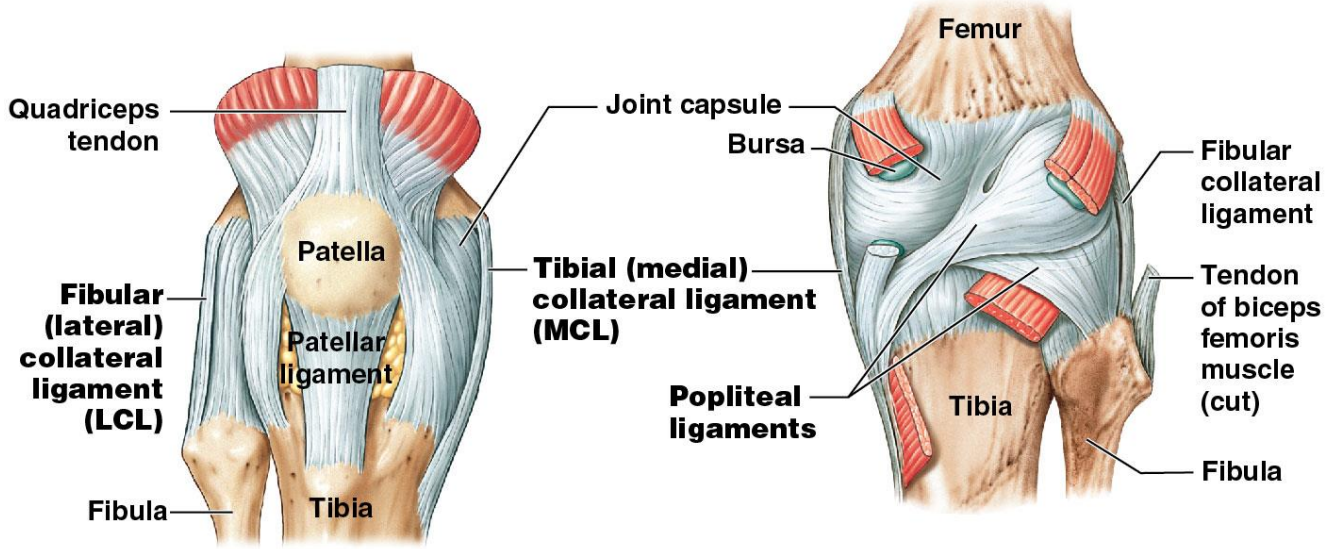
- Quadriceps tendon
  - Continues as patellar ligament to anterior tibial surface
- **Fibular collateral ligament**, or **lateral collateral ligament (LCL)**
  - Provides lateral support



Module 8.10: Hinge joints

Knee joint supporting structures (continued)

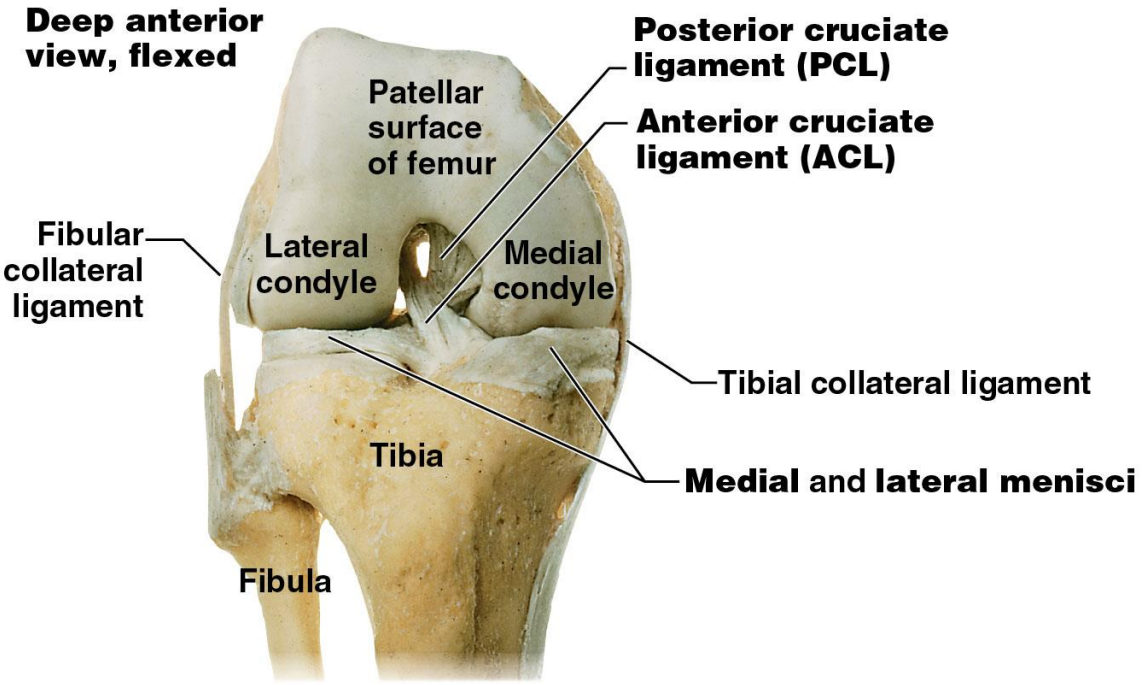
- **Tibial collateral ligament**, or **medial collateral ligament (MCL)**
  - Provides medial support
- **Popliteal ligaments**
  - Run between femur and heads of the tibia and fibula



Module 8.10: Hinge joints

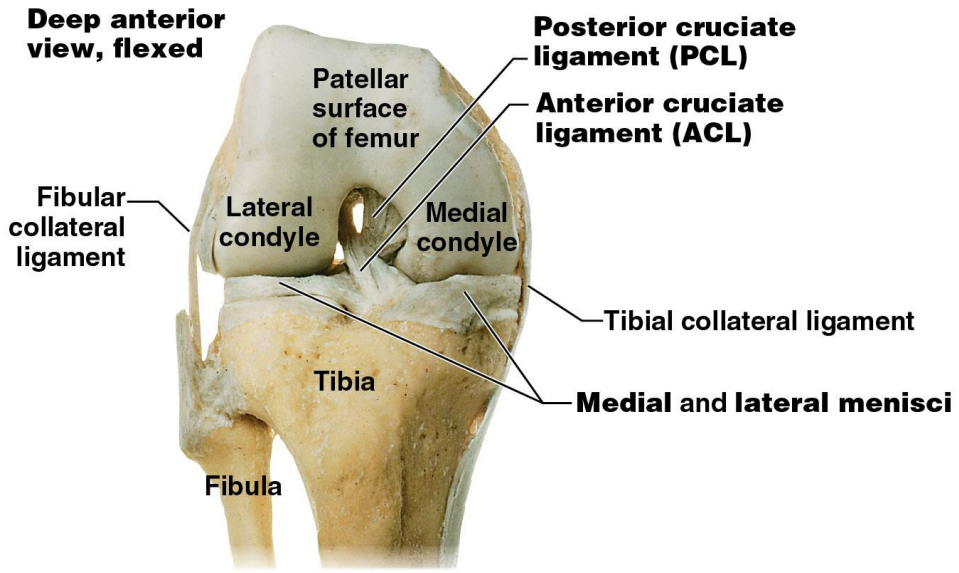
Knee joint supporting structures (continued)

- **Medial and lateral menisci**
  - Pair of fibrocartilage pads
  - Located between femoral and tibial surfaces
  - Act as cushions and provide lateral stability



Module 8.10: Hinge joints

- **Anterior cruciate ligament (ACL)**
  - At full extension, slight lateral rotation of tibia tightens ACL and forces lateral meniscus between tibia and femur
  - This “locks” knee in extended position
  - Opposite motion is required to “unlock”
- **Posterior cruciate ligament (PCL)**



Module 8.10: Review

A. Which ligaments stabilize the medial and lateral surfaces of the elbow joint?
B. What signs and symptoms would you expect in a person who has damaged the menisci of the knee joint?
C. Which ligament is a severely hyperextended knee more likely to damage: the ACL or the PCL?

Learning Outcome: Describe the structure and function of the elbow joint and knee joint.

Module 8.11: Clinical module: Arthritis can disrupt normal joint structure and function

Terminology

- **Rheumatism**
  - General term indicating pain and stiffness in the bones and/or muscles
- **Arthritis** (*arthro,* joint + *itis,* inflammation)
  - All rheumatic diseases that affect synovial joints
  - Always involves damage to the articular cartilage
  - Causes vary
  - Three types: **osteoarthritis**, **rheumatoid arthritis**, **gouty arthritis**

Module 8.11: Disruptions in joint structure and function

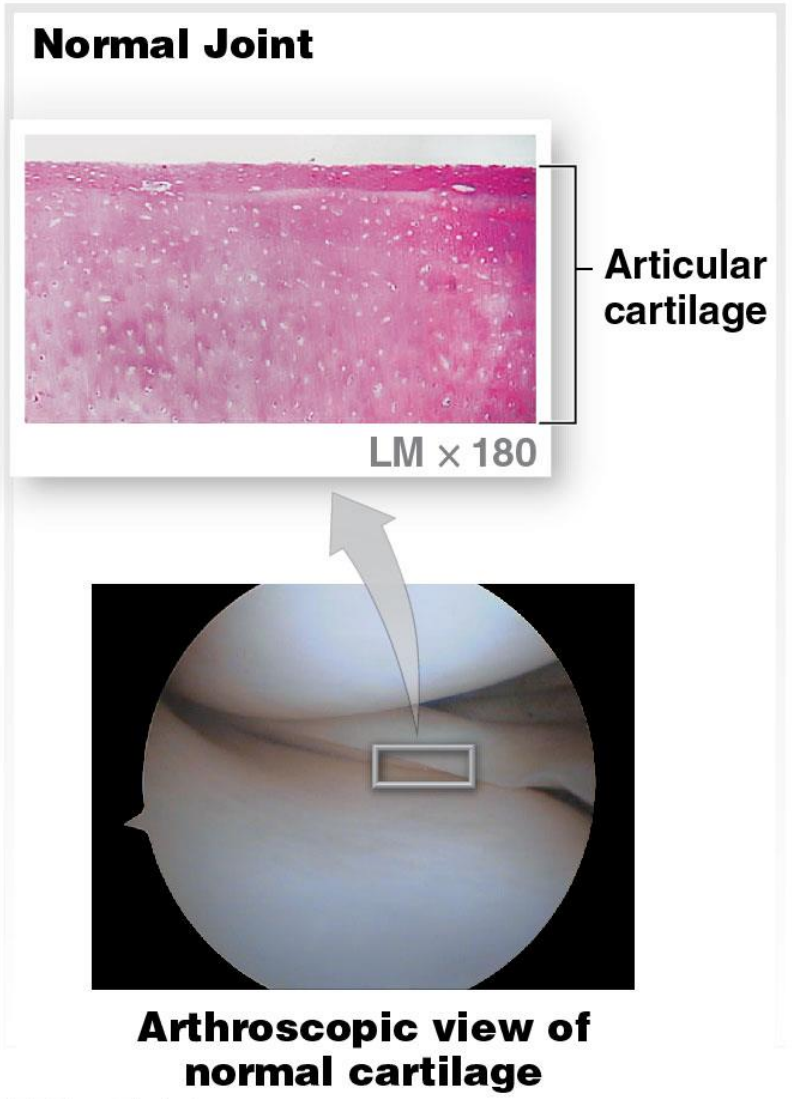
Osteoarthritis

- Also known as *degenerative arthritis* or *degenerative joint disease* (*DJD*)
- Most common form of arthritis
- Generally affects individuals age 60 or older
  - In the United States, affects 25 percent of women and 15 percent of men over age 60
- Caused by:
  - Cumulative effects of wear and tear on joints
  - Genetic factors affecting collagen formation

Module 8.11: Disruptions in joint structure and function

Joint changes with arthritis

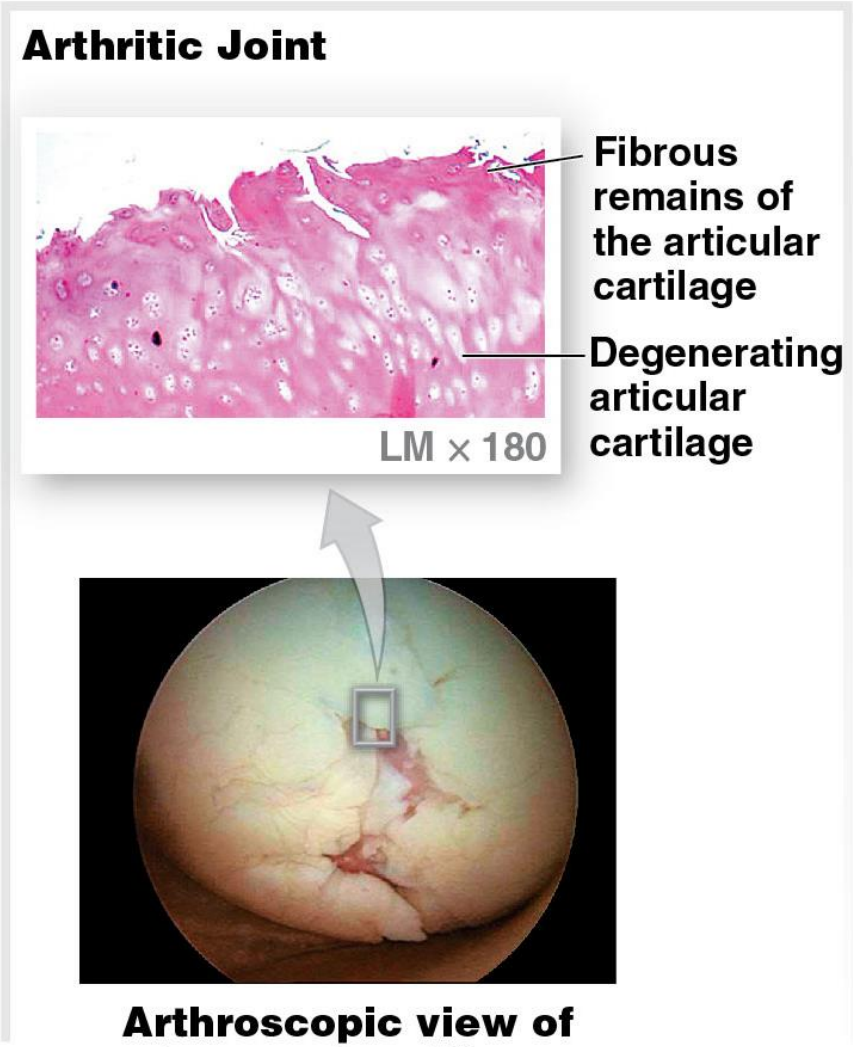
- Normal articular cartilage
  - Smooth, slick surface
  - Thick cartilage with homogeneous matrix



Module 8.11: Disruptions in joint structure and function

Joint changes with arthritis (continued)

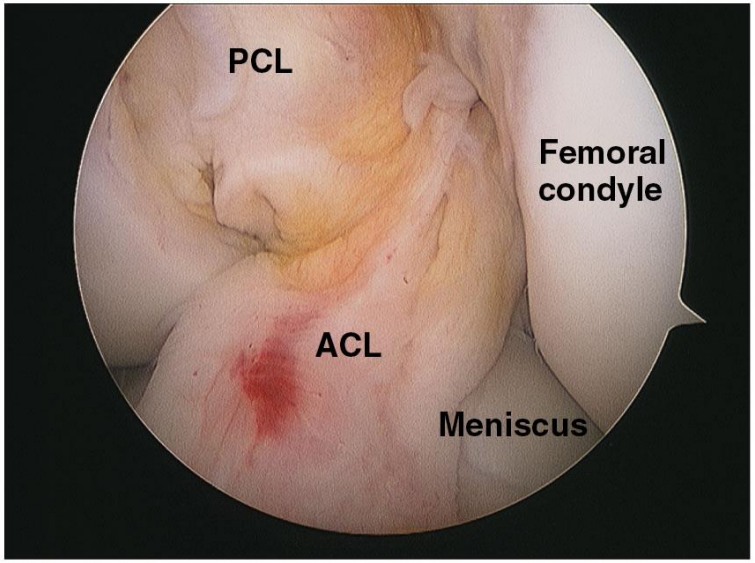
- Articular cartilage damaged by osteoarthritis
  - Rough, bristly collagen fibers on the surface
  - Increases friction at the joint
    - Promotes further degeneration



Module 8.11: Disruptions in joint structure and function

Visualization of problematic joints

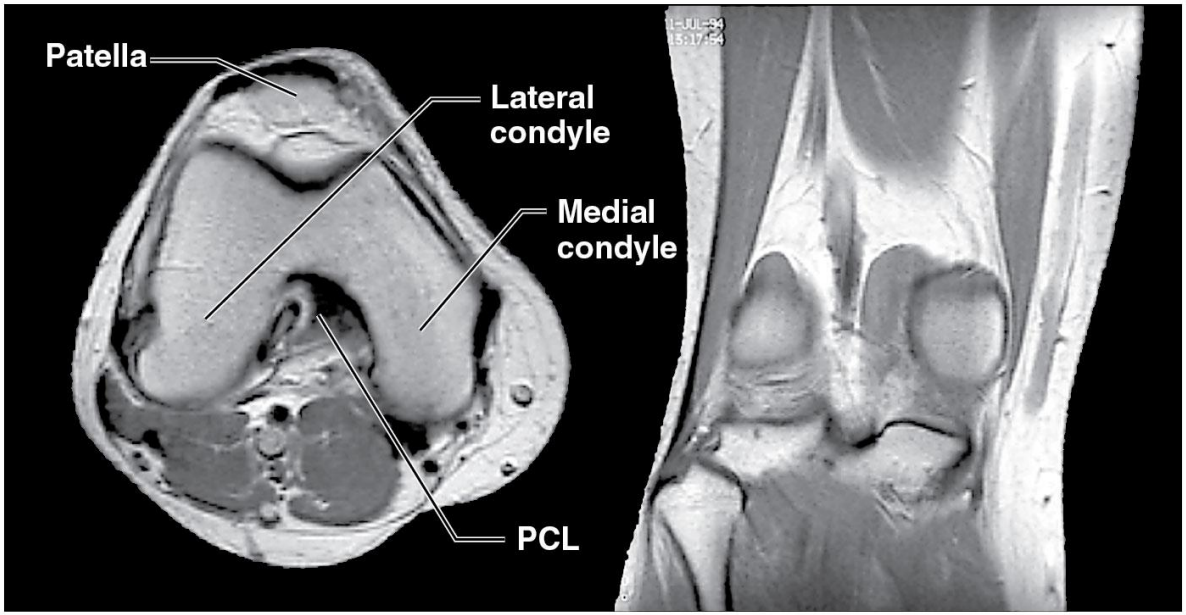
- **Arthroscope**
  - Narrow, flexible fiberoptic tube with tiny camera
  - Allows exploration of a joint without major surgery
  - May be used in combination with other flexible instruments inserted through additional incisions to conduct surgery
    - Called **arthroscopic surgery**



Module 8.11: Disruptions in joint structure and function

Visualization of problematic joints (continued)

- Magnetic resonance imaging (MRI)
  - Allows visualization of soft tissue outside the joint cavity, not visible with arthroscope
  - Cost-effective
  - Noninvasive



Module 8.11: Disruptions in joint structure and function

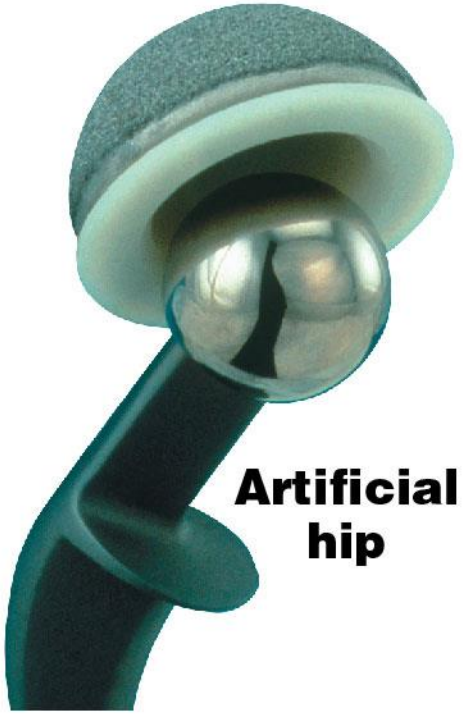
Artificial joints

- May be method of last resort for arthritis treatment if other methods fail to slow disease progression
  - Other methods include regular exercise, physical therapy, anti-inflammatory drugs
- Can restore mobility and relieve pain
- High-impact activities are restricted after replacement
- New joints (hips/knees) can last more than 15 years

Artificial joints

Artificial shoulder

Artificial knee



Module 8.11: Review

A. Compare rheumatism with osteoarthritis.
B. What can a person do to slow the progression of arthritis?

Learning Outcome: Explain arthritis, and describe its effects on joint structure and function.