

# BI 204 CHAP 9

## ARTICULATIONS - JOINTS

# Classification of Joints

- 2 classification schemes used for joints – 1) functional - range of motion then subdivided into anatomical structure & range of motion permitted 2) structural – anatomical organization of the joint without regard to range of motion

**TABLE 9-1 A FUNCTIONAL CLASSIFICATION OF ARTICULATIONS**

Functional Category	Structural Category	Description	Example
Synarthrosis (no movement)	Fibrous		
	Suture	Fibrous connections plus interlocking projections	Between the bones of the skull
	Gomphosis	Fibrous connections plus insertion in alveolar process	Between the teeth and jaws
	Cartilaginous		
	Synchondroses	Interposition of cartilage plate	Epiphyseal cartilages
Amphiarthrosis (little movement)	Bony fusion		
	Synostosis	Conversion of other articular form to solid mass of bone	Portions of the skull, epiphyseal lines
	Fibrous		
Diarthrosis (free movement)	Syndesmosis	Ligamentous connection	Between the tibia and fibula
	Cartilaginous		
	Symphysis	Connection by a fibrocartilage pad	Between right and left pubic bones of pelvis; between adjacent vertebral bodies along vertebral column
Diarthrosis (free movement)	Synovial		
		Complex joint bounded by joint capsule and containing synovial fluid	Numerous; subdivided by range of movement (see Figure 9-6)
	Monaxial	Permits movement in one plane	Elbow, ankle
	Biaxial	Permits movement in two planes	Ribs, wrist
	Triaxial	Permits movement in all three planes	Shoulder, hip

# Joint Classification cont.





- Functional classification - 3 types
- 1) synarthroses – immovable joint – can be fibrous or cartilagenous
- 2) amphiarthrosis - slightly movable – can be fibrous or cartilagenous
- 3) diarthrosis – freely movable or synovial joint & subdivided into range of movement permitted

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# Joint Classification cont.

- Structural classification – bony (synostosis), fibrous (suture, gomphosis, syndesmosis), cartilagenous (synchondrosis, symphysis), synovial (monaxial, biaxial, triaxial)

TABLE 9-2 A STRUCTURAL CLASSIFICATION OF ARTICULATIONS

Structure	Type	Functional Category	Example
Bony fusion	Synostosis (illustrated)	Synarthrosis	Frontal bone 
Fibrous joint	Suture (illustrated) Gomphosis Syndesmosis	Synarthrosis Synarthrosis Amphiarthrosis	Skull 
Cartilaginous joint	Synchondrosis Symphysis (illustrated)	Synarthrosis Amphiarthrosis	Palvis 
Synovial joint	Monaxial Biaxial Triaxial (illustrated)	Diarthroses	Synovial joint 

# Joint Classification cont.

- Synarthroses (immovable joints) – bony edges are very close together & may interlock – found where movement must be prevented
- 4 types – sutures, gomphoses, synchondroses, synostoses

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# Joint Classification cont.

- Sutures – located only between bones of skull – bones interlocked & bound by dense CT
- Gomphoses – binds teeth to sockets of jaw & fibrous connection is periodontal ligament

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# Joint Classification cont.

- Synchondroses – rigid cartilagenous bridge between 2 articulating bones example – epiphyseal cartilage between 2 ends of a bone
- Synostoses – totally rigid immovable joint formed when 2 separate bones fuse example – epiphyseal line

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# Joint Classification cont.

- Amphiarthroses – some movement but much stronger than freely movable joint & articulating bones connected by collagen fibers or cartilage
- 2 main types
  - 1) symphysis – articulating bones separated by pad of fibrocartilage – between vertebrae & pubic bones

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# Joint Classification cont.

- Syndesmosis – bones connected by ligament – between tibia & fibula
- Diarthroses – or synovial joints permit wider range of motion & are surrounded by fibrous articular capsule & synovial membrane lines the walls of the articular cavity & forms the fluid that fills the cavity

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# Joint Classification cont.

- Articular cartilage of synovial joint – cover ends of bones which do not touch due to thin film of fluid between if cartilage is damaged then smooth surface turns to rough network of collagen fibers

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# Joint Classification cont.

- Synovial fluid – like interstitial fluid but has high concentration of proteoglycans secreted by fibroblasts of synovial membrane – 3 primary functions – 1) lubrication – cartilages filled with synovial fluid 2) nutrient distribution – small volume circulates to provide nutrients & remove wastes

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# Joint Classification cont.

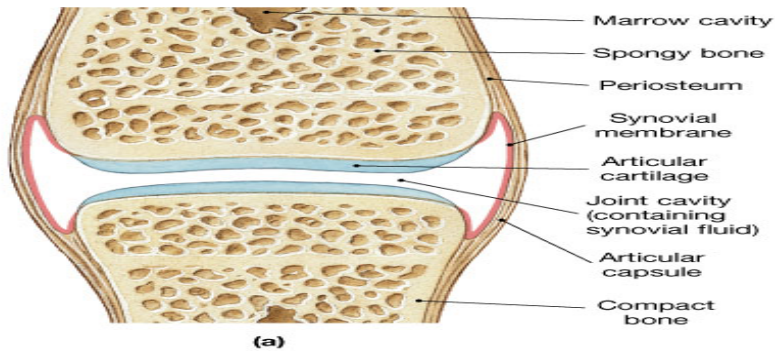
- 3) shock absorption –  
synovial fluid  
cushions shocks in  
joints subject to  
compression

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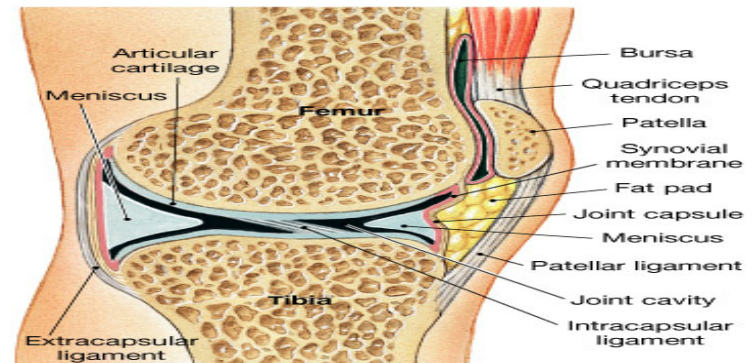
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# Accessory Structures

- Cartilage & fat pads, ligaments, tendons, bursae
- Cartilages & fat pads – meniscus is a pad of fibrocartilage between bones in a synovial joint & fat pad is a localized mass of adipose tissue covered by a layer of synovial membrane



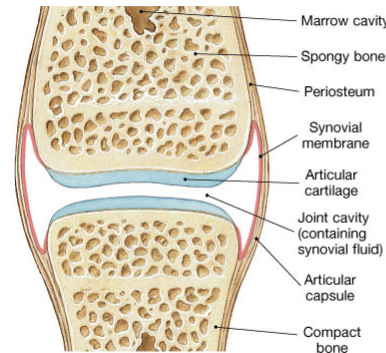
(a)



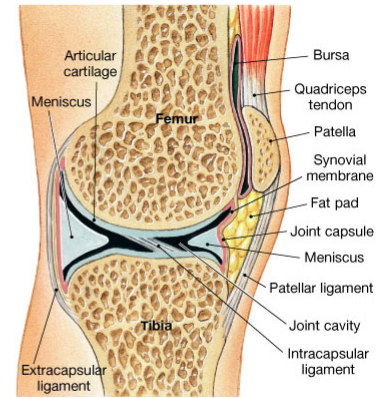
(b)

# Accessory Structures cont.

- Ligaments – capsule surrounding entire joint is continuous with periosteum of articulating bones - accessory ligaments support, strengthen, reinforce synovial joints – can be intrinsic (capsular) or extrinsic (extracapsular or intracapsular)



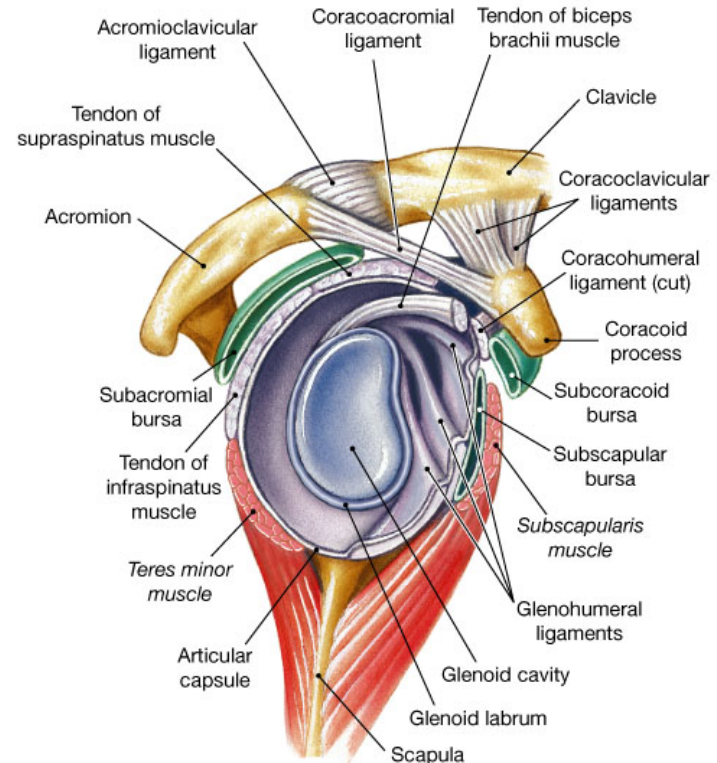
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(b)

# Accessory Structures cont.

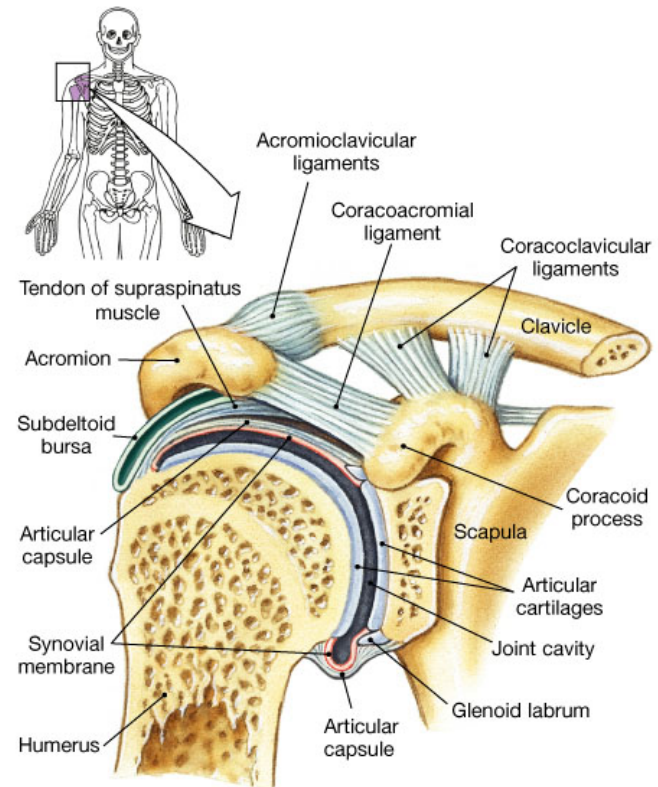
- Tendons – passing across or around a joint may limit the joint's range
- Bursae – small fluid – filled pockets of CT – contain synovial fluid & lined by synovial membrane so act as shock absorbers & reduce friction



(b) Lateral view of pectoral girdle

# Accessory Structures cont.

- Synovial tendon sheaths – tubular bursae that surround tendons where they cross bony surfaces
- Bursae become inflamed – called bursitis – too much friction



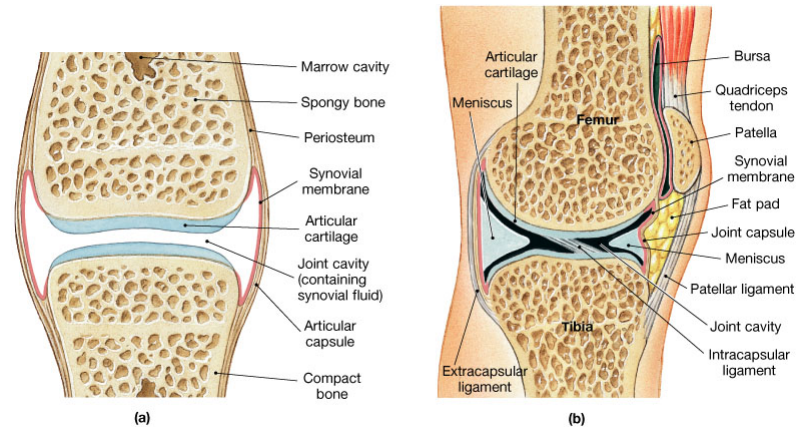
(a) Anterior view, frontal section

# Joint stabilization

- Greater the range of motion at a joint the weaker it is
- Factors responsible for limiting range of motion, stabilizing joints, reducing chance of injury
  - 1) collagen fibers of joint capsule plus accessory extra- or intracapsular ligament
  - 2) shapes of articulating surfaces & menisci which can prevent motion in particular directions
  - 3) presence of other bones, muscles, fat pads
  - 4) tension in tendons attached to articulating bones

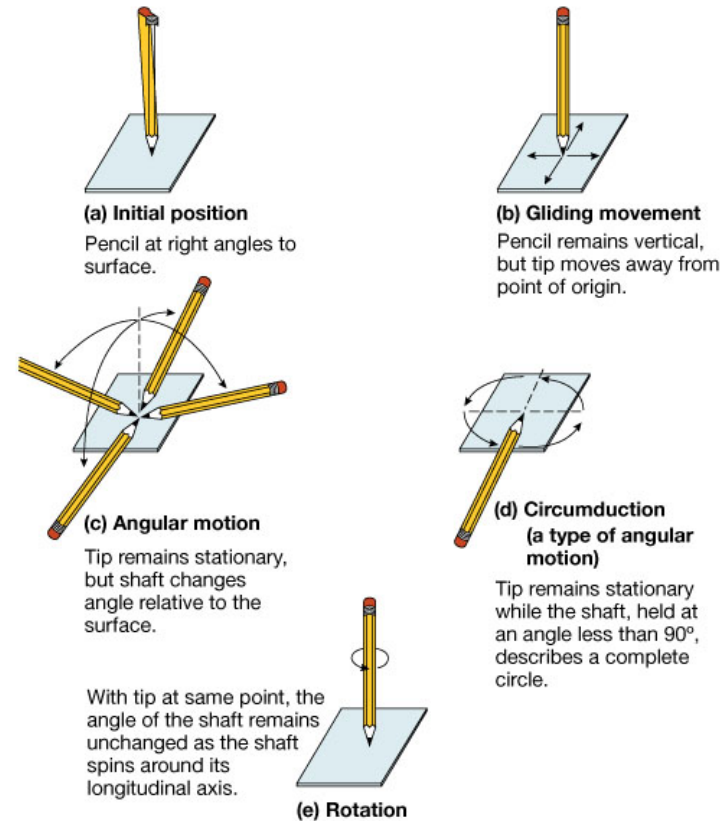
# Joint Stabilization cont.

- Extreme stresses can cause a dislocation of luxation – articular cartilages can be damaged
- Partial dislocation is called subluxation - less severe
- Double jointed are joints which are less stabilized & can suffer dislocation more easily



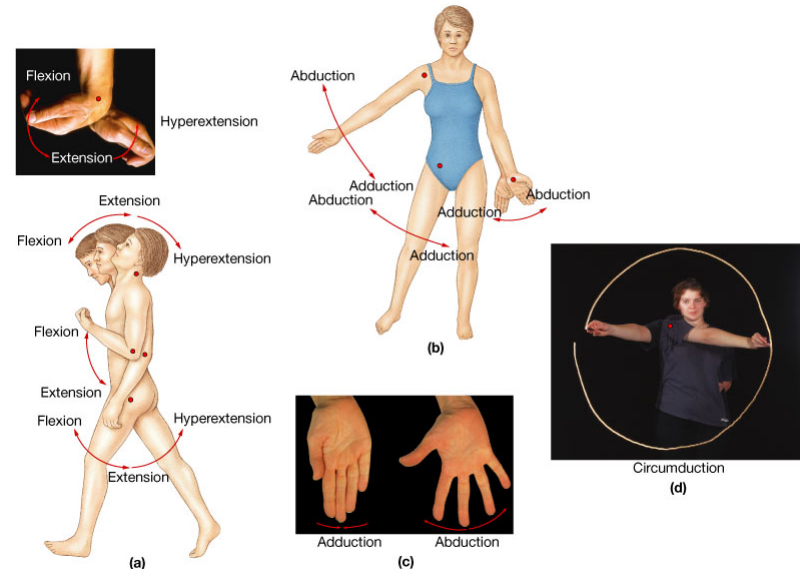
# Possible Types of Articular Motion

- 1) point of pencil can move – linear motion
- 2) shaft can change angle with surface – angular motion
- 3) shaft can rotate – rotation
- Monaxial – movement in 1 axis  
biaxial – movement in 2 axes  
triaxial – movement in 3 axes



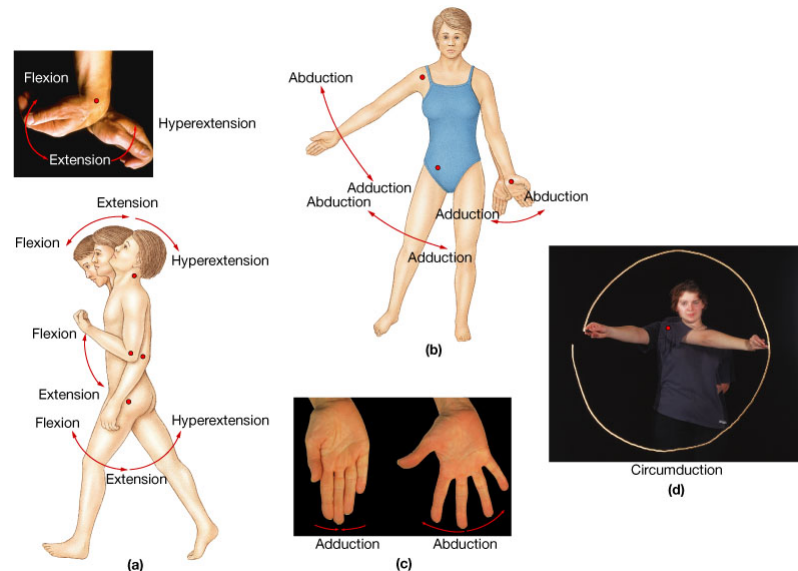
# Types of Movement

- 1) linear or gliding motion – 2 opposing surfaces slide past each other – carpal or tarsal bones
- 2) angular motion – flexion & extension – movement in anterior – posterior plane that reduces angle between articulating elements – hyperextension can occur past standard anatomical position



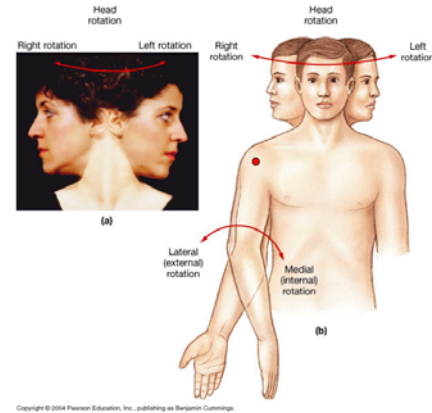
# Types of Movement cont.

- 2) angular motion cont –  
abduction & adduction –  
movement away from (ab-)  
) or toward (ad-)  
longitudinal axis of body  
in frontal plane – refer to  
appendicular not axial  
skeleton    circumduction  
– drawing a circle – hand  
moves but arm does not  
rotate

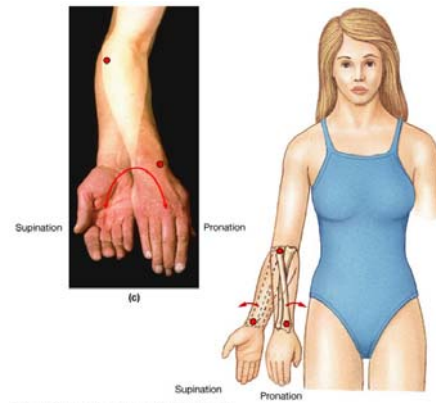


# Types of Movement cont.

- 3) rotation – refers to figure in anatomical position – can have left or right rotation (of head) or medial (internal or inward) or lateral (external or outward) rotation (of arm) or pronation supination of wrist & hand (supination during anatomical position)



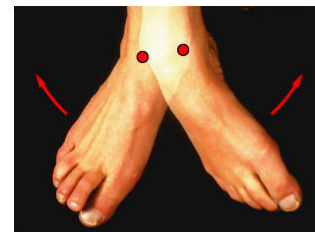
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# Types of Movement cont.

- Special movements – most come in pairs 1) inversion – eversion – motion of foot in or out 2) dorsiflexion – plantar flexion – stand on heels or stand on toes 3) protraction – retraction - moving part of body anteriorly or posteriorly in horizontal plane



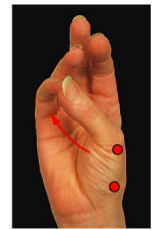
Eversion

Inversion



Dorsiflexion  
(ankle flexion)

Plantar  
flexion  
(ankle extension)



Opposition



Retraction Protraction



Depression



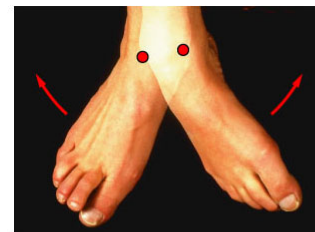
Elevation



Lateral flexion

# Types of Movement cont.

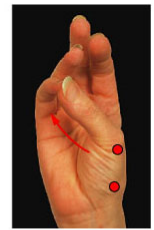
- Special movements cont.
  - 4) elevation – depression – movement in superior – inferior direction - mandible or shoulders
  - 5) opposition – movement of thumb to other fingers
  - 6) lateral flexion – movement of trunk to the side



Eversion Inversion



Dorsiflexion (ankle flexion)  
Plantar flexion (ankle extension)



Opposition



Retraction Protraction



Depression



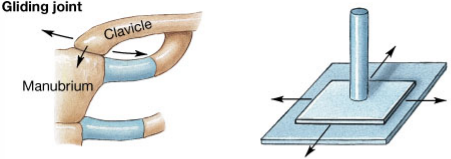
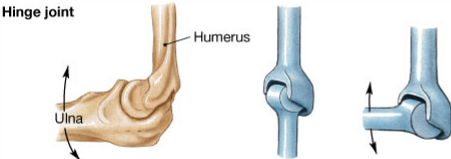
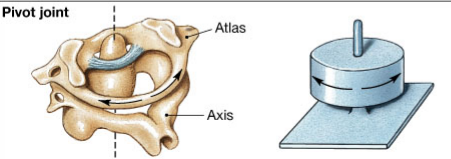
Elevation



Lateral flexion

# Structural Classification of Synovial Joints

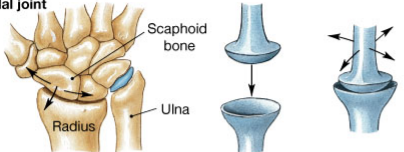
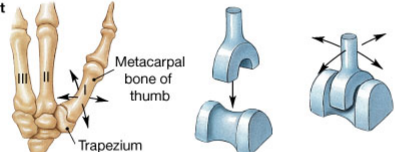
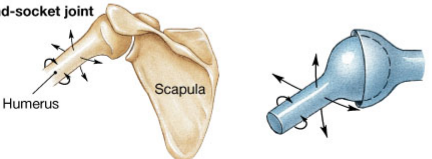
- 1) gliding – planar joints with flat surfaces which slide over each other but movement is slight
- 2) hinge joints – angular motion in a single plane
- 3) pivot joints – monaxial & permit only rotation

Types of Synovial Joints	Movement	Examples
<b>Gliding joint</b> 	Slight nonaxial or multiaxial	<ul style="list-style-type: none"> <li>• Acromioclavicular and claviculosternal joints</li> <li>• Intercarpal and intertarsal joints</li> <li>• Vertebrocostal joints</li> <li>• Sacroiliac joints</li> </ul>
<b>Hinge joint</b> 	Monaxial	<ul style="list-style-type: none"> <li>• Elbow joint</li> <li>• Knee joint</li> <li>• Ankle joint</li> <li>• Interphalangeal joint</li> </ul>
<b>Pivot joint</b> 	Monaxial (rotation)	<ul style="list-style-type: none"> <li>• Atlas/axis</li> <li>• Proximal radioulnar joint</li> </ul>

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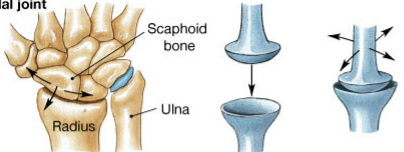
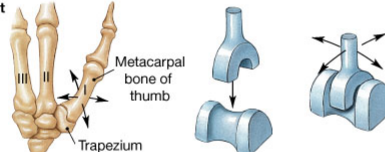
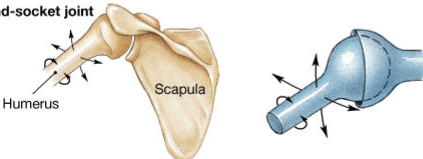
# Structural Classification of Synovial Joints cont.

- 4) ellipsoidal joints or condyloid joint – oval articular face nestles in depression in opposing bone so get angular motion in 2 planes
- 5) – saddle joints – concave & convex surfaces nest together – permits angular motion including circumduction

Types of Synovial Joints	Movement	Examples
<b>Ellipsoidal joint</b> 	Biaxial	<ul style="list-style-type: none"> <li>• Radiocarpal joint</li> <li>• Metacarpophalangeal joints 2-5</li> <li>• Metatarsophalangeal joints</li> </ul>
<b>Saddle joint</b> 	Biaxial	<ul style="list-style-type: none"> <li>• First carpometacarpal joint</li> </ul>
<b>Ball-and-socket joint</b> 	Triaxial	<ul style="list-style-type: none"> <li>• Shoulder joint</li> <li>• Hip joint</li> </ul>

# Structural Classification of Synovial Joints cont.

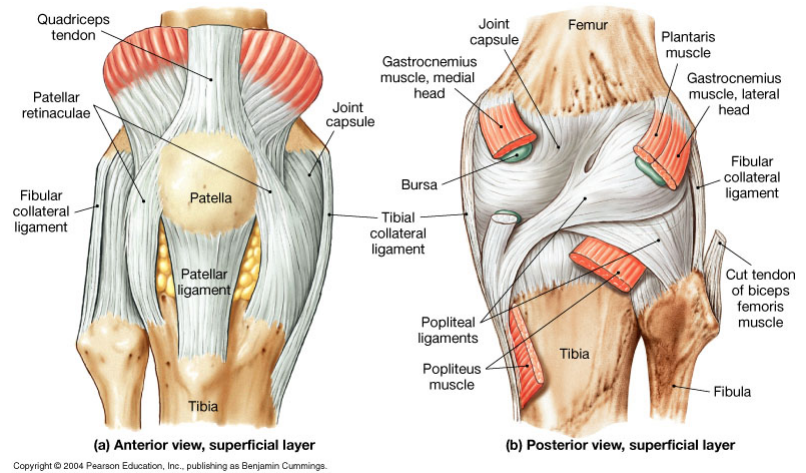
- 6) ball & socket joints
  - round head of 1 bone fits in cup shaped depression of other bone permitting all angular & rotational motions including circumduction & rotation

Types of Synovial Joints	Movement	Examples
<b>Ellipsoidal joint</b> 	Biaxial	<ul style="list-style-type: none"> <li>• Radiocarpal joint</li> <li>• Metacarpophalangeal joints 2-5</li> <li>• Metatarsophalangeal joints</li> </ul>
<b>Saddle joint</b> 	Biaxial	<ul style="list-style-type: none"> <li>• First carpometacarpal joint</li> </ul>
<b>Ball-and-socket joint</b> 	Triaxial	<ul style="list-style-type: none"> <li>• Shoulder joint</li> <li>• Hip joint</li> </ul>

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# Knee Joint

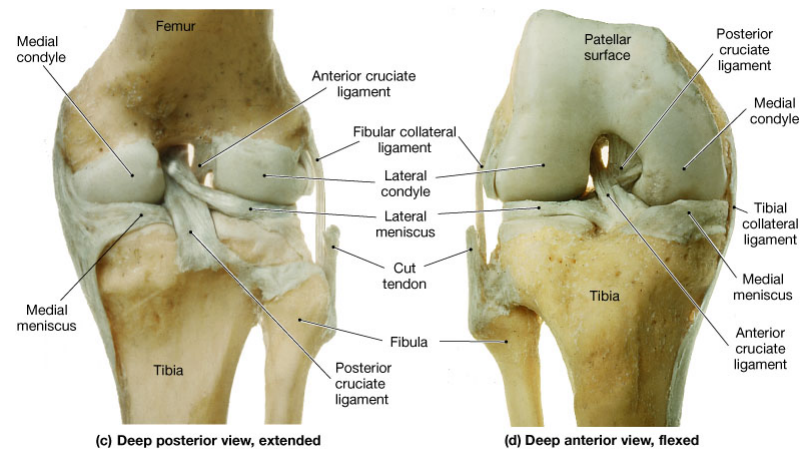
- Knee functions as a hinge joint but is more complicated & permits flexion, extension, & very limited rotation
- Structurally knee resembles 3 joints – 2 between femur & tibia (medial condyle to medial condyle & lateral condyle to lateral condyle) and 1 between patella & patellar surface of femur



# Knee Joint cont.

articular capsule thin &  
incomplete but  
strengthened by ligaments  
& tendons

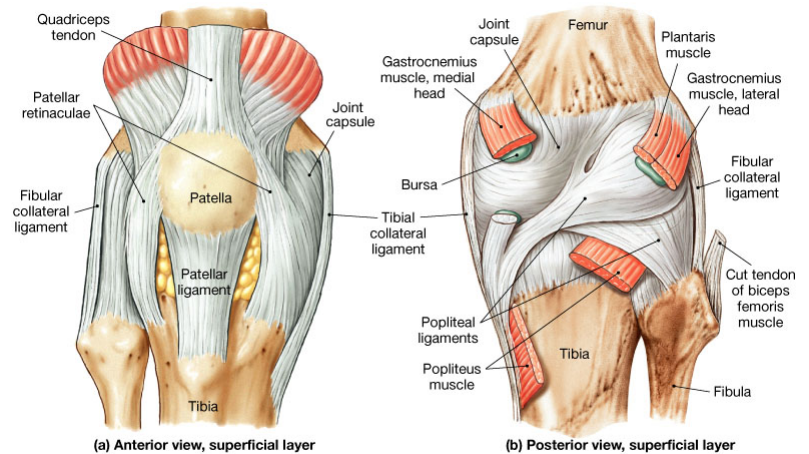
Medial & lateral menisci lie  
between femoral & tibial  
surfaces & 1) act as  
cushions 2) conform to  
shape of articulating  
surfaces 3) provide  
stability to the joint



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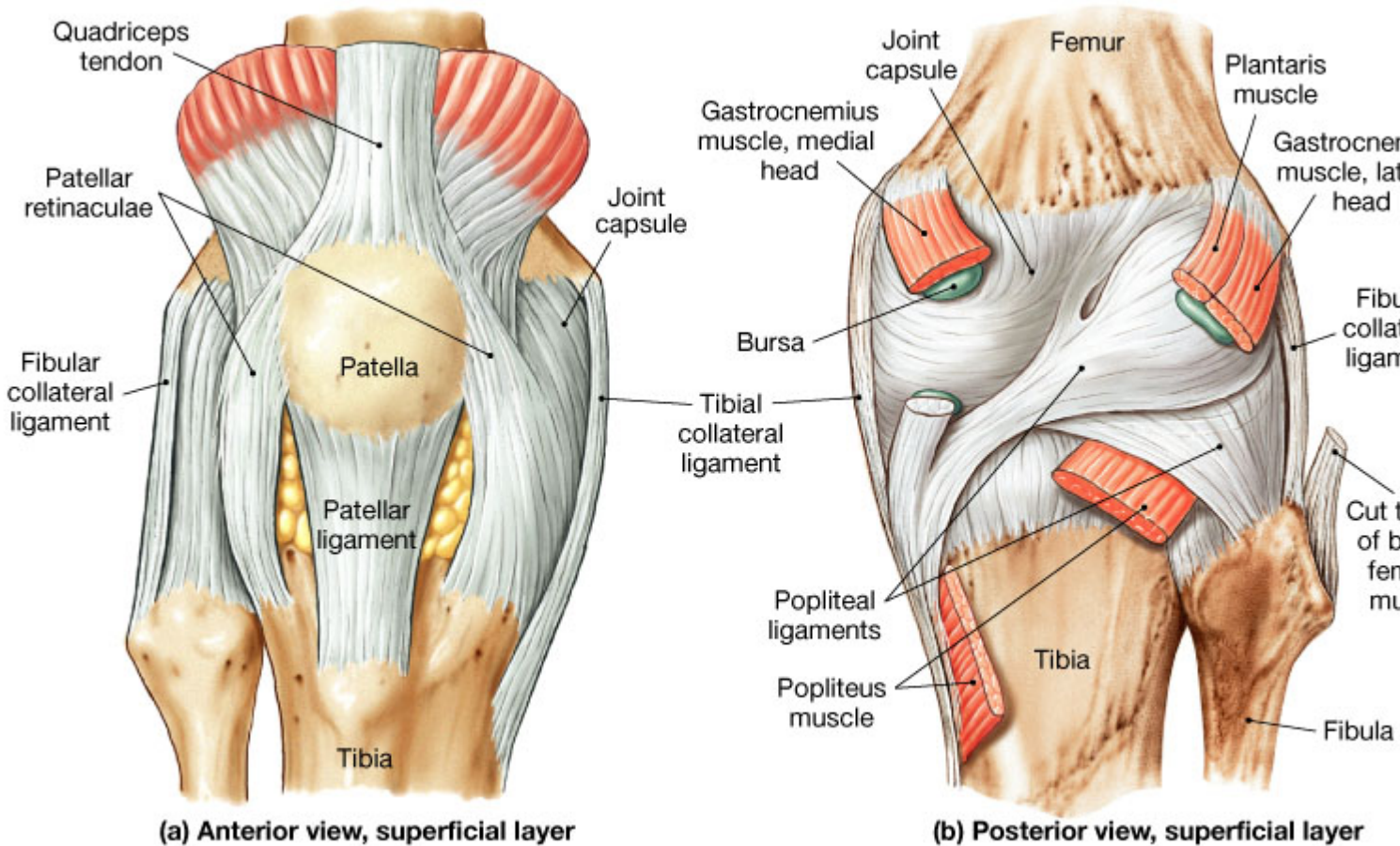
# Knee Joint cont.

- Prominent fat pads cushion the margins of the joint & assist the many bursae in reducing friction between patella & other tissues



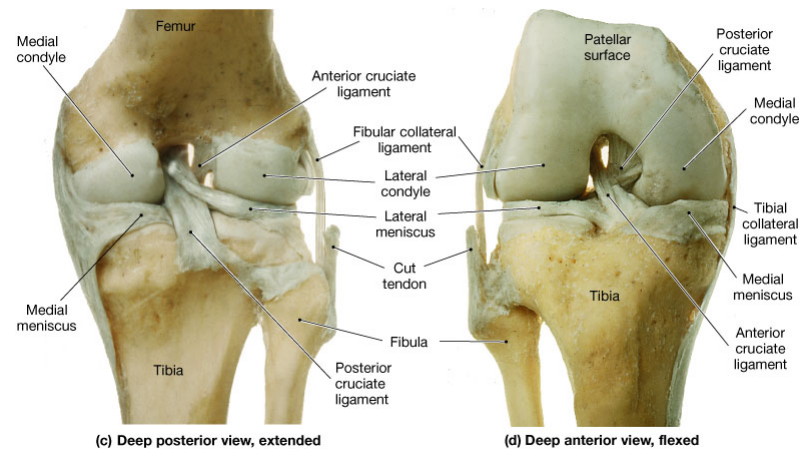
# Knee Joint cont.

- Support major the joint complex
- 1) patellar ligament patella support surface



# Knee Joint cont.

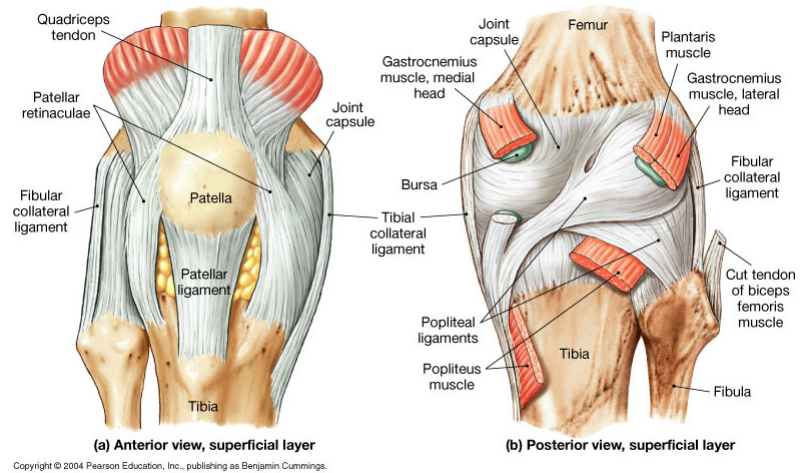
- 2&3) 2 popliteal ligaments extend between femur & heads of tibia & fibula – reinforcing the posterior surface of knee 4&5) anterior & posterior cruciate ligaments – attach intercondylar area of tibia to condyles of femur ( anterior & posterior refer to sites of origin on tibia – cross over on way to femur



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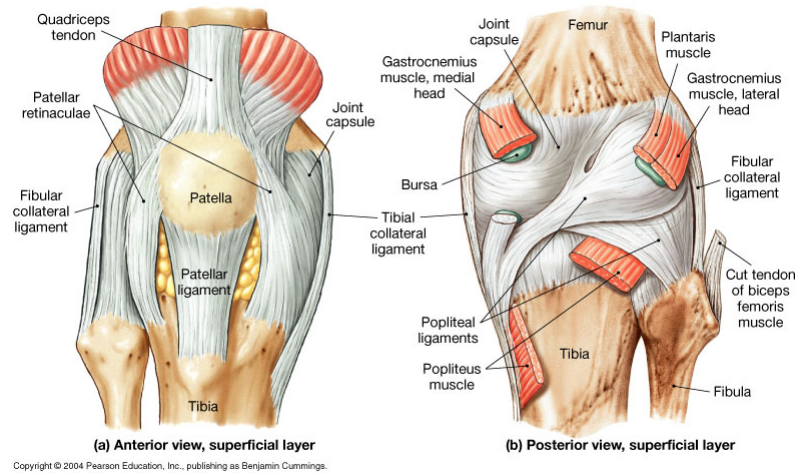
# Knee Joint cont.

- ACL & PCL limit anterior and posterior movement of femur & maintain alignment of femoral and tibial condyles
- 6&7) tibial collateral ligament reinforces medial surface of knee joint & fibular collateral ligament reinforces the lateral surface of knee - tighten only at full extension where stabilize knee



# Knee Joint cont.

- At full extension slight lateral rotation of tibia tightens ACL & jams lateral meniscus between tibia and femur locking knee in extended position



# Aging & Articulations

- Rheumatism – general term for pain & stiffness affecting skeletal, muscular or both systems
- Arthritis – covers all rheumatic diseases that affect synovial joints – always involving damage to articular cartilages – causes vary from infection, injury, metabolic problems, severe physical stresses
- Osteoarthritis – degenerative joint disease affects population over 60 caused by wear & tear or from genetic factors affecting collagen formation

# Aging & Articulations cont.

- Rheumatoid arthritis – inflammatory condition where immune system attacks joint tissues (called autoimmune disease) causes include allergies, infections, genetic factors
- Gouty arthritis – crystals of uric acid, a metabolic waste product, form in synovial joint fluid & over time interfere with normal movement –metatarsal – phalangeal joint of big toe most often affected

# Aging & Articulations

- Bone mass decreases with age so risk of fractures increases with hip fractures among most dangerous fractures seen in elderly with or without osteoporosis