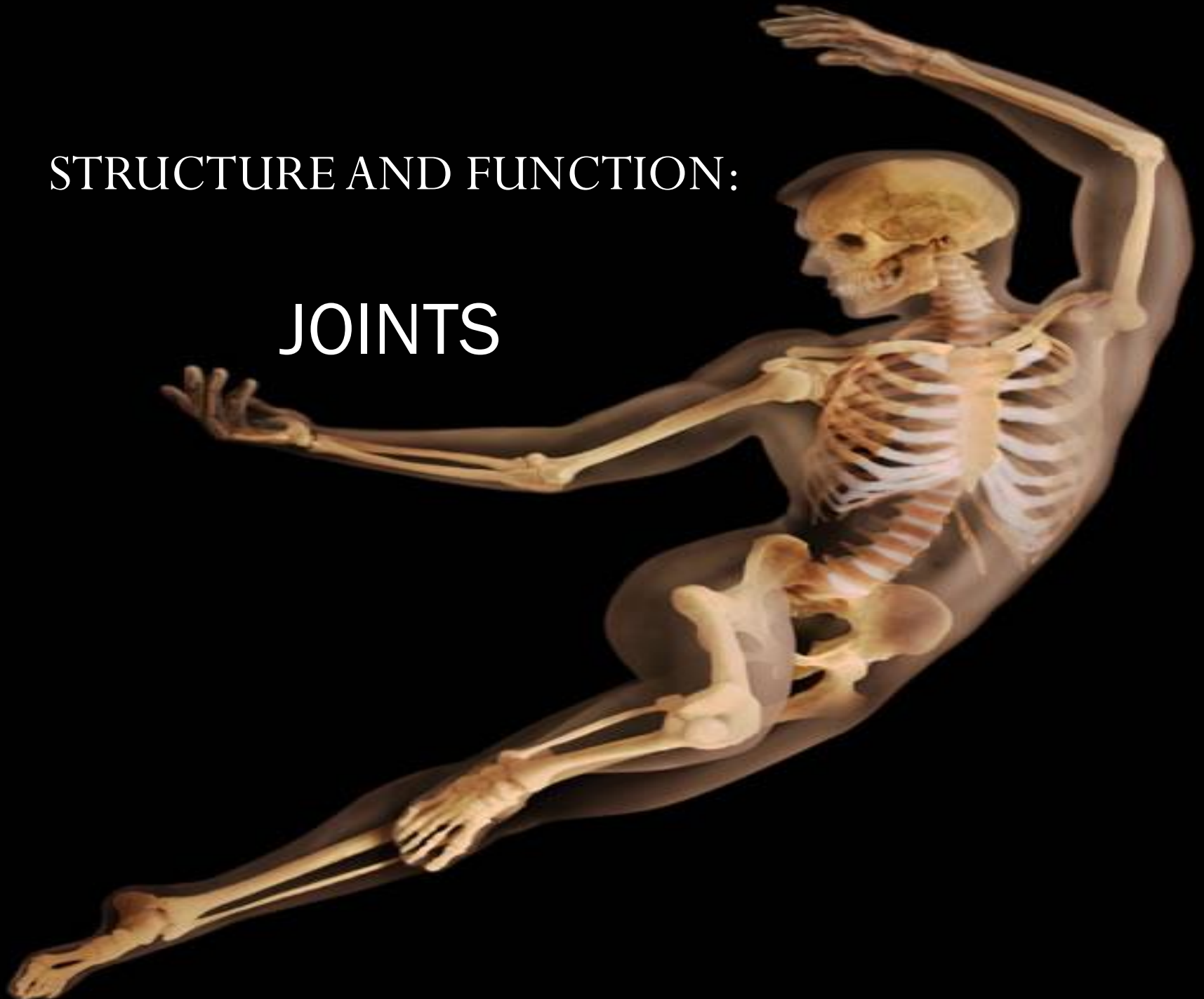
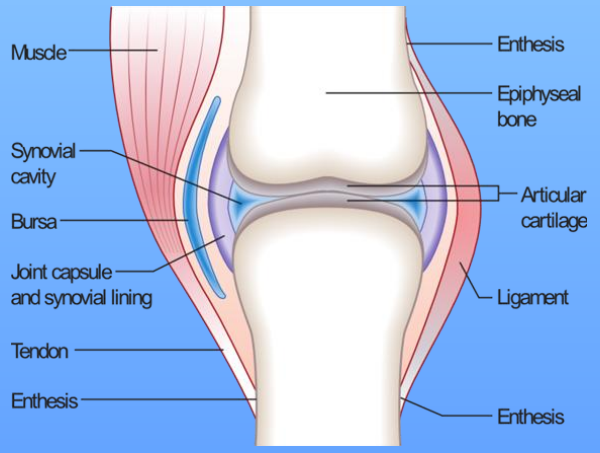
STRUCTURE AND FUNCTION:

JOINTS



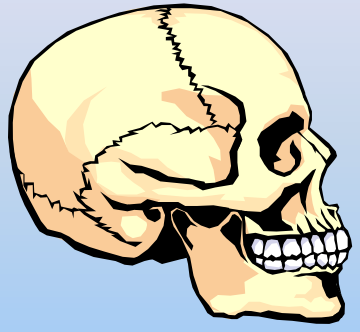
Joints

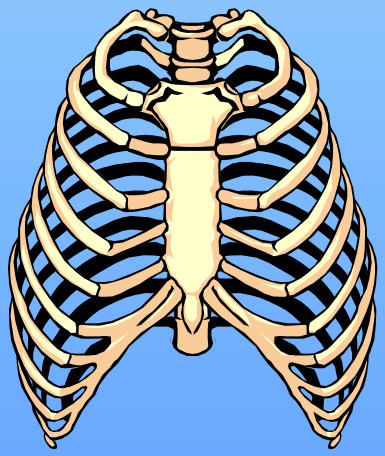
- A "connection" between 2 or more bones
- A pivot point for bony motion
- The "features" of the joint help determine
  - The ROM
  - Degrees of freedom
  - Functional potential of the joint

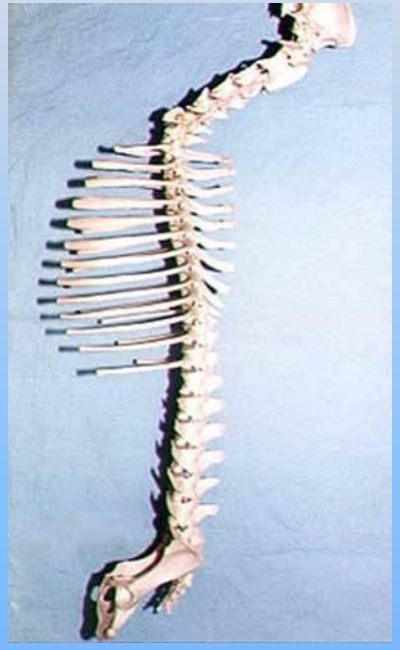


Axial Skeleton

- The Axial Skeleton makes up the central bony axis of the body and is composed of:
  - the skull
  - hyoid bone
  - sternum
  - ribs
  - vertebral column
  - sacrum
  - coccyx

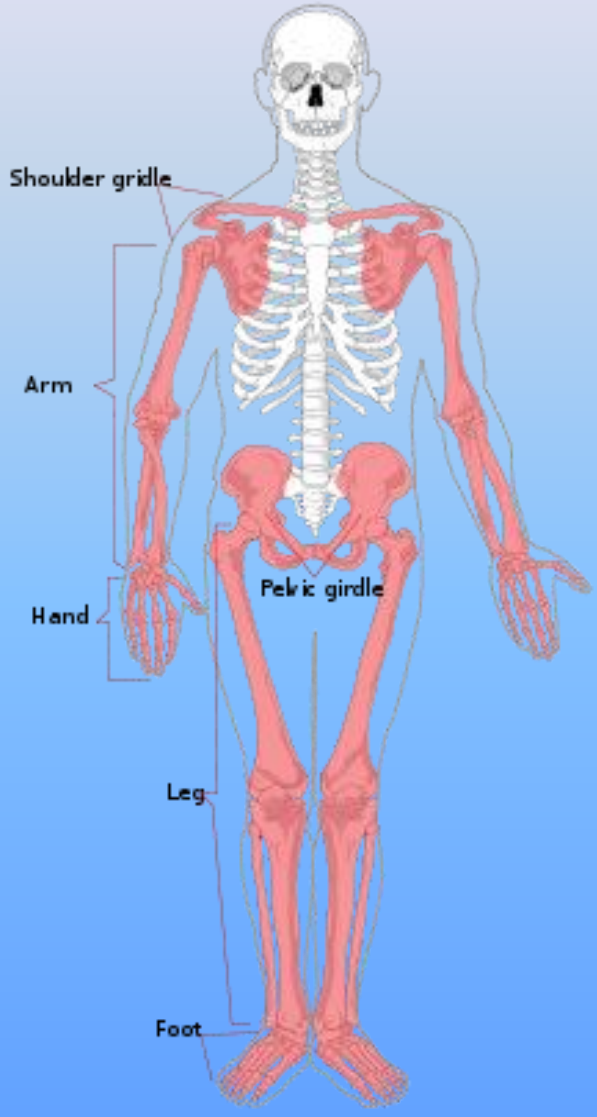






Appendicular Skeleton

- Just as the name suggests, the appendicular skeleton is composed of the appendages or extremities:
  - This includes the supporting structures

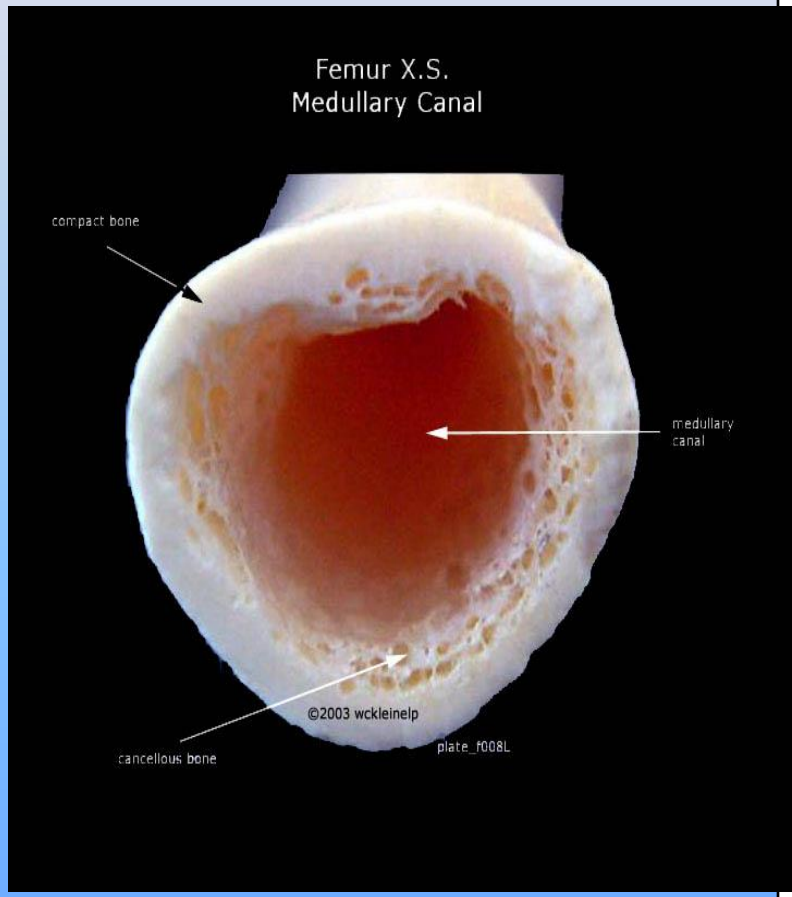


ANATOMY & FUNCTION

BONE

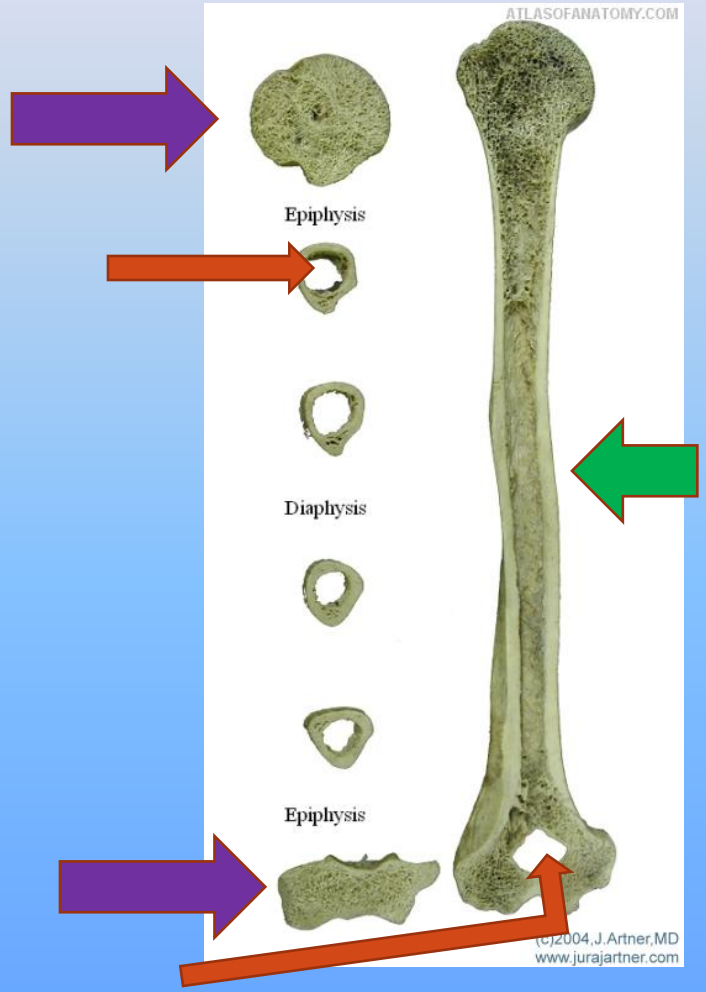
Primary Types of Tissue

- Cortical (compact) – outmost portions of bone
  - Strong
  - Dense
  - Absorptive (forces)
- Cancellous (spongy) – inner portions of bone
  - Porous
  - Lightens the bone
  - Redistributes forces & is covered by articular cartilage



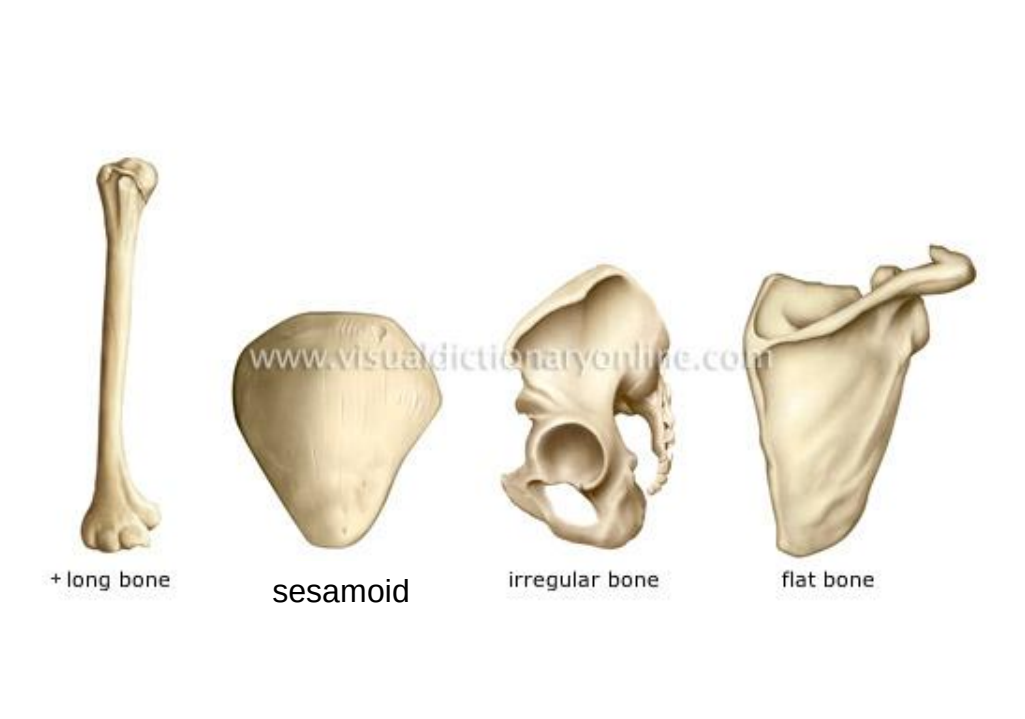
Structural Features of Bone

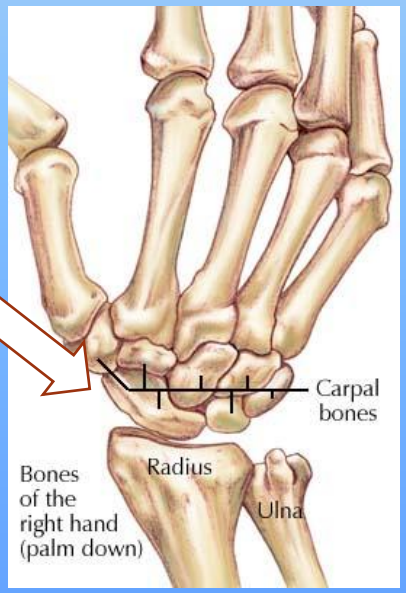
- Diaphysis
- Epiphyses (2)
  - Proximal
  - Distal
- Articular cartilage – hyaline cartilage
- Periosteum
- Medullary canal
- Endosteum



Primary Types of Bones

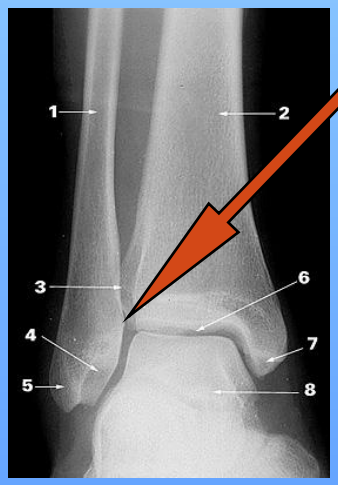
- Five categories
  - Long
  - Sesamoid
  - Irregular
  - Flat
  - Short

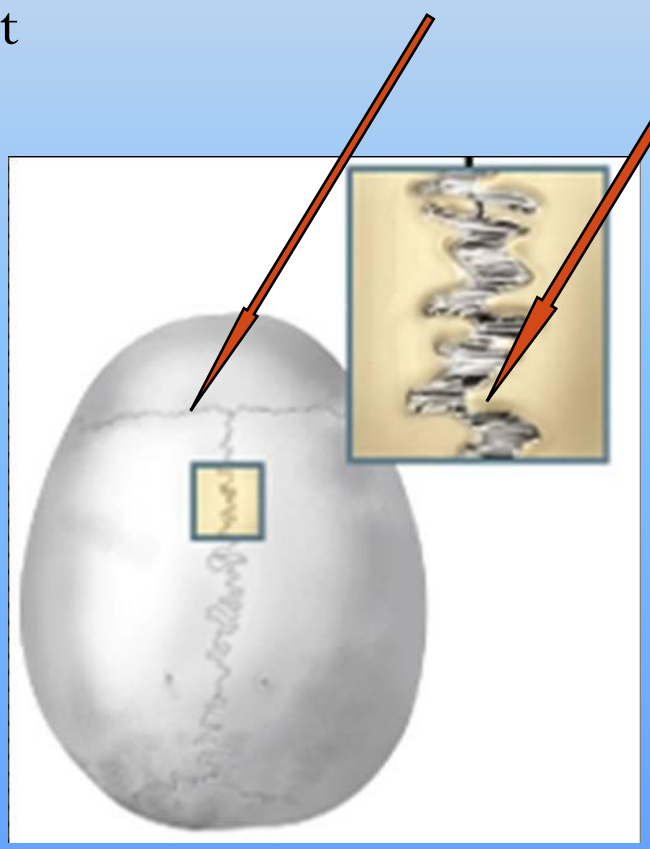




Joint Classifications

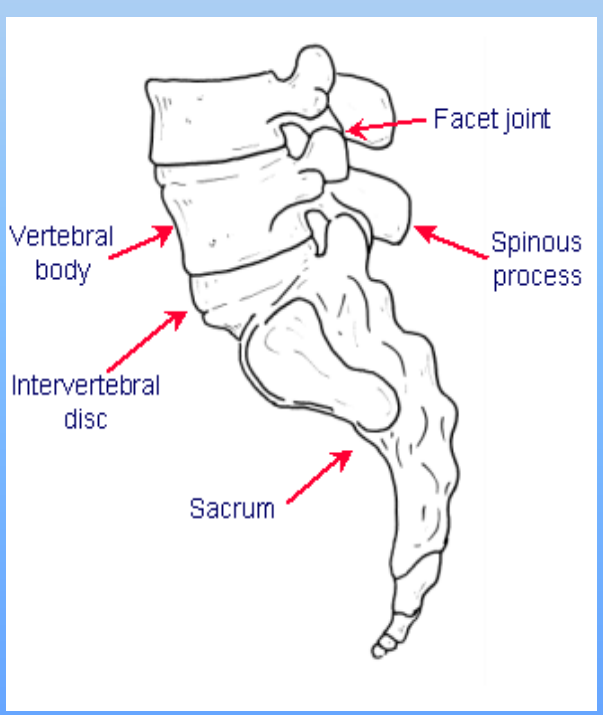
- Synarthrosis
  - Allows little to no movement
    - Sutures in the skull
    - Distal tibiofibular joint





Joint Classifications

- Amphiarthrosis
  - Formed by fibro and hyaline cartilage
  - Shock absorbers
  - Allows limited motion



Joint Classifications

- Diarthrosis (Synovial Joints)
  - Contains fluid-filled cavity between 2 or more bones
    - There are 7 categories with 7 common elements!

What	Why
Synovial fluid-	for joint lubrication & nutrition
Articular cartilage-	to spread out and absorb forces
Articular capsule-	to contain the joint
Synovial membrane-to	produce the fluid for the joint
Capsular ligaments-	to limit excessive joint motion
Blood vessels-	to provide nutrients, permit healing to occur!
Sensory nerves-	transmit pain and awareness of position (proprioception)

Synovial Joint Classifications

The structure of the joint determines the functional potential for the joint. Most of the names intentionally resemble functional structures!

Hinge

Pivot

Ellipsoid

Condyloid

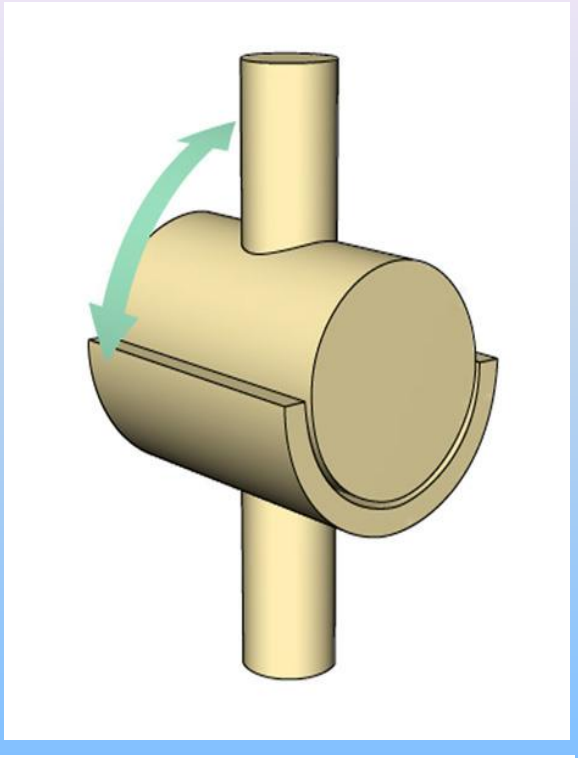
Saddle

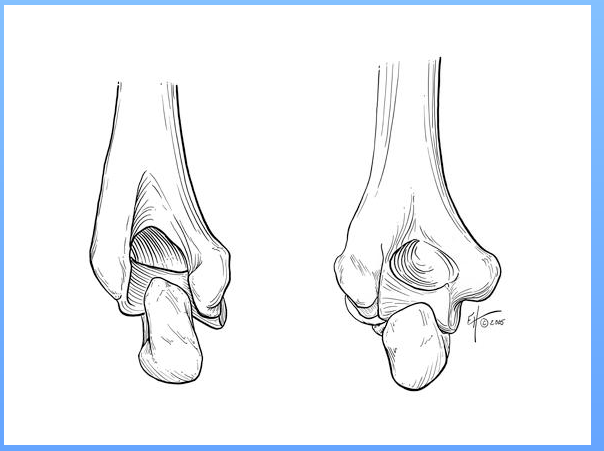
Plane

Ball-and-Socket

Hinge Joint

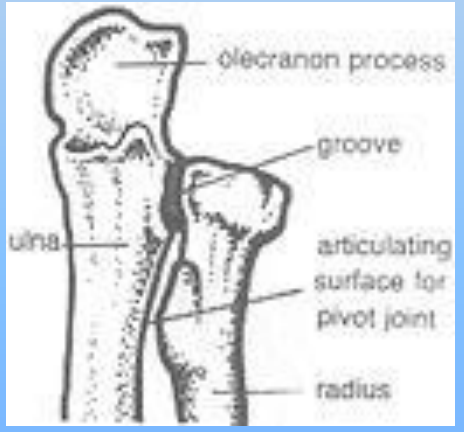
Degrees of Freedom	1
Primary Motions	Flexion and extension
Mechanical Analogy	Door hinge
Anatomic Examples	Humero-ulnar joint, interphalangeal joints





Pivot Joint

Degrees of Freedom	1
Primary Motions	Spinning one member on an axis
Mechanical Analogy	Door knob
Anatomic Examples	Proximal radioulnar joint

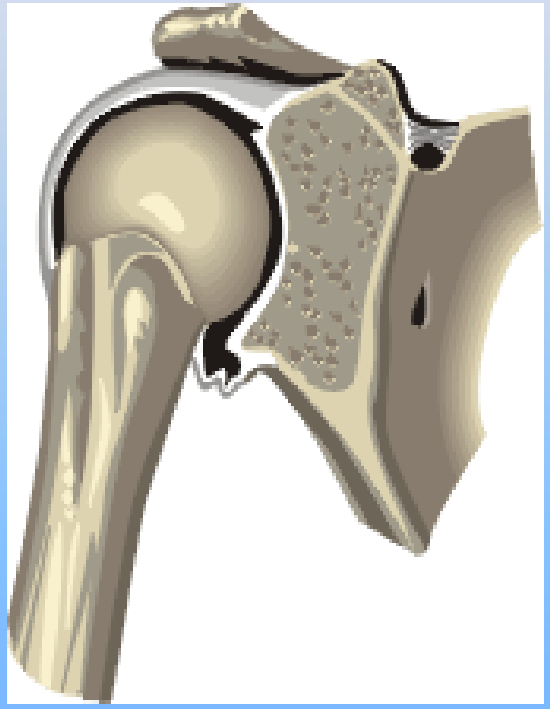


Elipsoid Joint

Degrees of Freedom	2
Primary Motions	Flex & Ext, ABD & ADD
Mechanical Analogy	Flattened convex with concave trough
Anatomic Examples	Radiocarpal joint

Ball & Socket Joint

Degrees of Freedom	3
Primary Motions	Flex & Ext, ABD & ADD, IR & ER
Mechanical Analogy	Spherical convex surface & concave cup
Anatomic Examples	Glenohumoral joint and hip

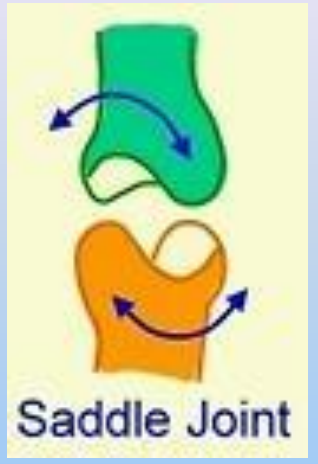


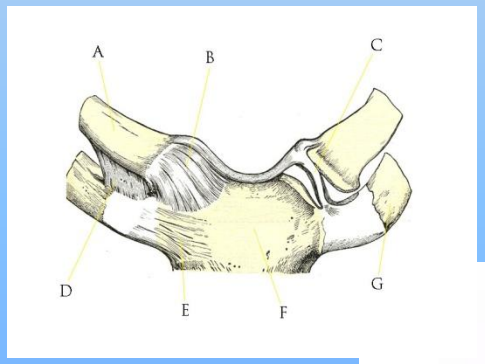
Plane Joints

Degrees of Freedom	Variable
Primary Motions	Slide &/or rotation
Mechanical Analogy	Book sliding or spinning on a table
Anatomic Examples	Intercarpal joints intertarsal joints

Saddle Joints

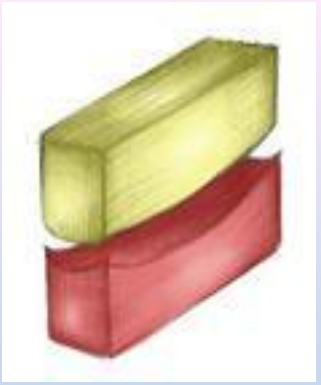
Degrees of Freedom	2
Primary Motions	Bilpanar, excluding spin
Mechanical Analogy	Horseback rider on a saddle
Anatomic Examples	CMC joint of the thumb Sternoclavicular joint

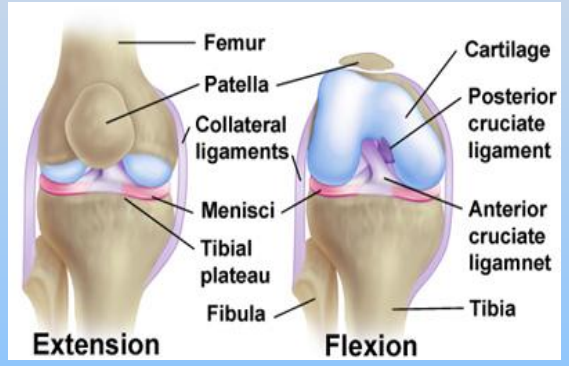




Condyloid Joint

Degrees of Freedom	2
Primary Motions	Biplanar Motion
Mechanical Analogy	Spherical convex surface & concave cup
Anatomic Example	Tibiofemoral joint MCP joint





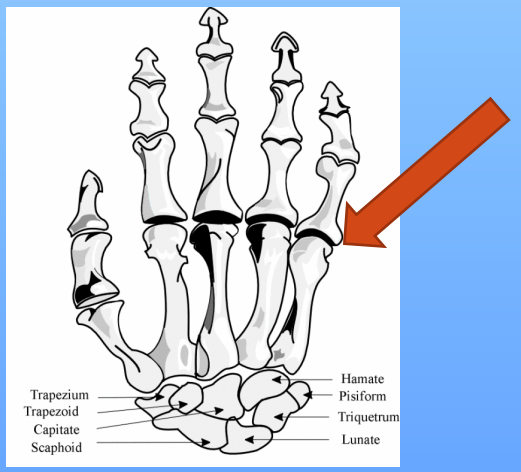


TABLE 2-1 TYPES OF SYNOVIAL JOINTS

Joint	Degrees of Freedom	Primary Motions	Mechanical Analogy	Anatomic Examples
Hinge	1	Flexion and extension	Door hinge	Humeroulnar joint Interphalangeal joint
Pivot	1	Spinning of one member about a single axis of rotation	Door knob	Proximal radioulnar joint Atlantoaxial joint
Ellipsoid	2	Flexion-extension and abduction-adduction	Flattened convex ellipsoid paired with a concave trough	Radiocarpal joint
Ball-and-socket	3	Flexion-extension, abduction-adduction, internal and external rotation	Spherical convex surface paired with a concave cup	Glenohumeral (shoulder) joint Hip joint
Plane	Variable	Typical motions include a slide or rotation, or both	Book sliding or spinning on a table	Intercarpal joints Intertarsal joints
Saddle	2	Biplanar motion; generally excluding a spin	Horseback rider on a saddle	Carpometacarpal joint of the thumb Sternoclavicular joint
Condyloid	2	Biplanar motion	Spherical convex surface paired with a shallow concave cup	Tibiofemoral (knee) joint Metacarpophalangeal joint

TABLE 2-1 TYPES OF SYNOVIAL JOINTS.

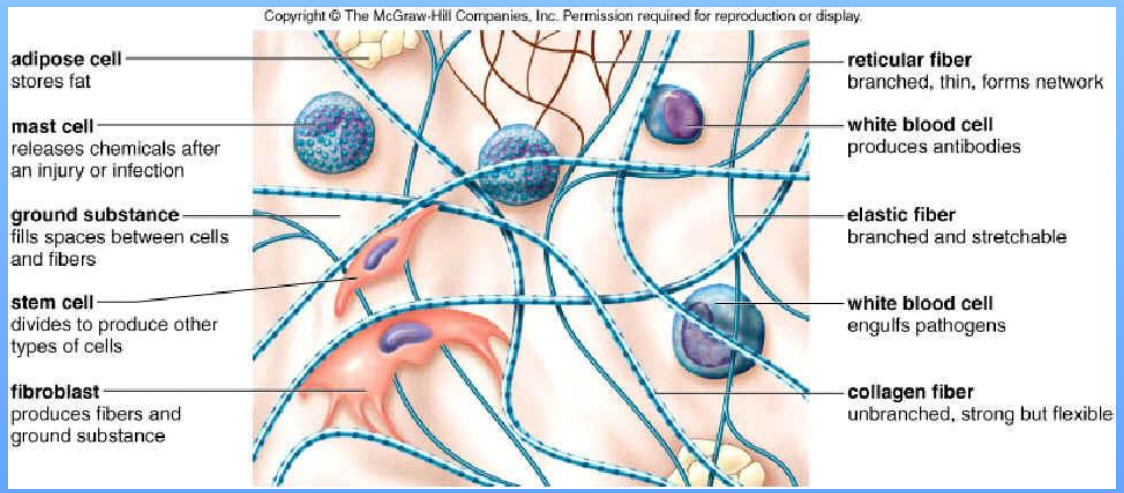
(Modified from Neumann DA: *Kinesiology of the musculoskeletal system: foundations for physical rehabilitation*, St Louis, 2002, Mosby, Table 2-3. Some items previously published.)

Connective Tissue

- All connective tissues that support the joints of the body are composed of:
  - Fibers
    - There are 3 types of fibers
      - Type I collagen
        - Thick and resist stretching
        - Ligaments, tendons & fibrous capsules
      - Type II collegen
        - Thinner and less stiff
        - Provide a flexible framework to maintain the shape & consistency of the structures such as hyaline cartilage
      - Elastin
        - Elastic and help prevent injury due to ability to "give" and not break

Connective Tissue

- All connective tissues that support the joints of the body are composed of:
  - Ground substance
    - Collagen & elastin within a water saturated matrix
  - Cells
    - Responsible for maintenance & repair



Connective Tissue: Joint “support”

Ground substance

Disperses repetitive forces

- Water
- Glycosaminoglycans
- Solutes

Cells – “cytes”

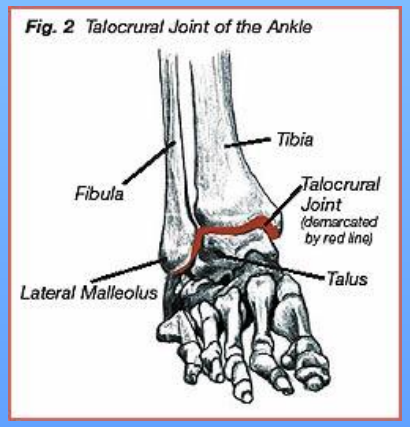
Cells for maintenance and repair.

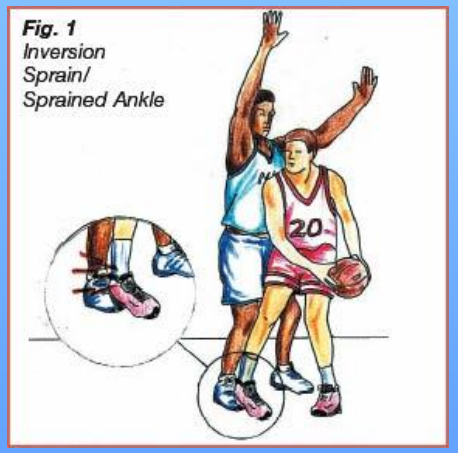
- Blastocytes,
- phagocytes

Why do bones need maintenance & repair?

Types of Connective Tissue in Joints

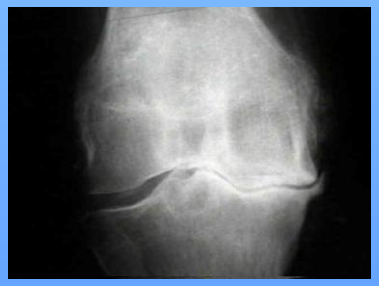
- Dense Irregular Connective Tissue
  - Binds bones together
  - Makes up ligaments & external joint capsule
  - Type I collagen
- Injuries-
  - Ruptured Lateral Collateral ligaments in the ankle, instability in the talocrural ligament





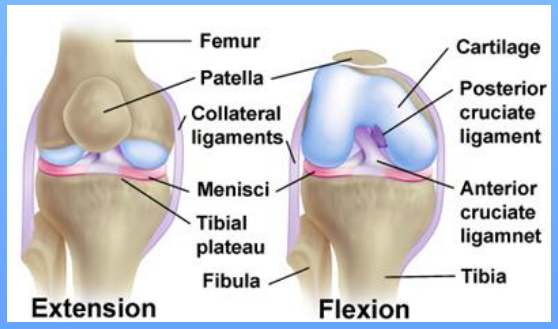
Types of Connective Tissue in Joints

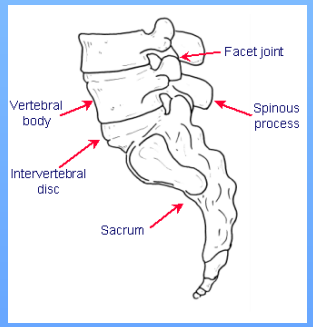
- Articular Cartilage
  - Resists compressive and shear forces in articular surfaces
  - Covers the ends of articulating surfaces of bones in synovial joints
  - High % type II collagen content which helps to anchor the cartilage to the bone
- Injuries
  - Wear & tear decreases it's effectiveness in reducing compression leading to OA and joint pain & inflammation.



Types of Connective Tissue in Joints

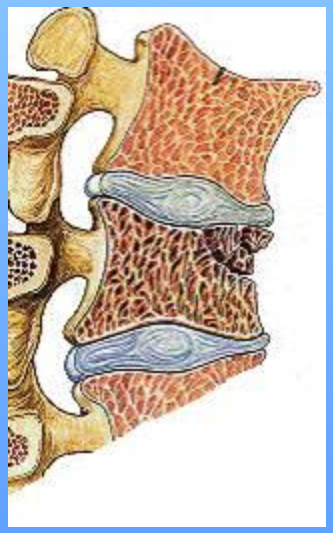
- Fibrocartilage
  - Provides support & stabilization to joints, resists compression & shear forces
  - Makes up the intervertebral discs and menisci of the knees
  - Multidirectional bundles of type I collagen
- Injuries
  - Tearing can cause disruption of the integrity of the structure and pain with loss of function





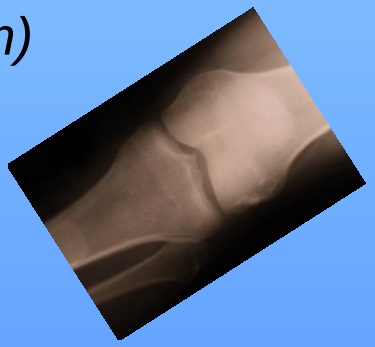
Types of Connective Tissue in Joints

- Bone
  - Forms primary supporting structure of the body & a rigid level to transmit the force of muscle to move & stabilize the body
  - Forms internal levers of musculoskeletal system
  - Specialized arrangement of Type I collagen & framework for hard mineral salts
- Injuries
  - osteoporosis



Types of Connective tissue

1. *Dense irregular (attachment points)*
   a. Ligaments
   b. Joint capsule
2. *Articular cartilage (ease of movement)*
   a. Covering at the end of bones of synovial joints
3. *Fibrocartilage (the shock absorbers)*
   a. Menisci ***pleural of "meniscus"***
   b. Intervertebral discs
4. *Bone – (the levers in the musculoskeletal system)*



Dancing Bones

http://www.youtube.com/watch?v=GJMwq_BZ53k

Skully

http://www.youtube.com/watch?v=gpmnxvA2Zf8

Sleight of Hand

http://www.youtube.com/watch?v=NNrqedPg6_Q

TABLE 2-2 TYPES OF CONNECTIVE TISSUE THAT FORM THE STRUCTURE OF JOINTS

	Mechanical Specialization	Anatomic Location	Fiber Types	Clinical Correlation
Dense irregular connective tissue	Binds bones together and restrains unwanted movement of joints	Composes ligaments and the tough external layer of joint capsules	Primarily type I collagen fibers; low elastin fiber content	Rupture of the lateral collateral ligaments of the ankle can lead to medial-lateral instability of the talocrural joint
Articular cartilage	Resists and distributes compressive and shear forces transferred through articular surfaces	Covers the ends of articulating bones in synovial joints	High type II collagen fiber content; fibers help anchor the cartilage to bone	Wear and tear of articular cartilage often decreases its effectiveness in dispersing joint compression forces, often leading to osteoarthritis and joint pain
Fibrocartilage	Provides support and stabilization to joints; primarily functions to provide shock absorption by resisting and dispersing compressive and shear forces	Composes the intervertebral discs of the spine, and the menisci of the knee	Multidirectional bundles of type I collagen	Tearing of the intervertebral disc within the vertebral column can allow the central nucleus pulposus (gel) to escape and press on a spinal nerve or nerve root
Bone	Forms the primary supporting structure of the body and provides a rigid lever to transmit muscle force to move and stabilize the body	Forms the internal levers of the musculoskeletal system	Specialized arrangement of type I collagen that provides a framework for hard mineral salts	Osteoporosis of the spine results in loss of mineral and bone content; may result in fractures of the vertebral body

TABLE 2-2 TYPES OF CONNECTIVE TISSUE THAT FORM THE STRUCTURE OF JOINTS.

(Modified from Neumann DA: *Kinesiology of the musculoskeletal system: foundations for physical rehabilitation*, St Louis, 2002, Mosby, Table 2-2. Some items previously published.)