Al-Farabi Kazakh National University
Higher School of Medicine

Joint

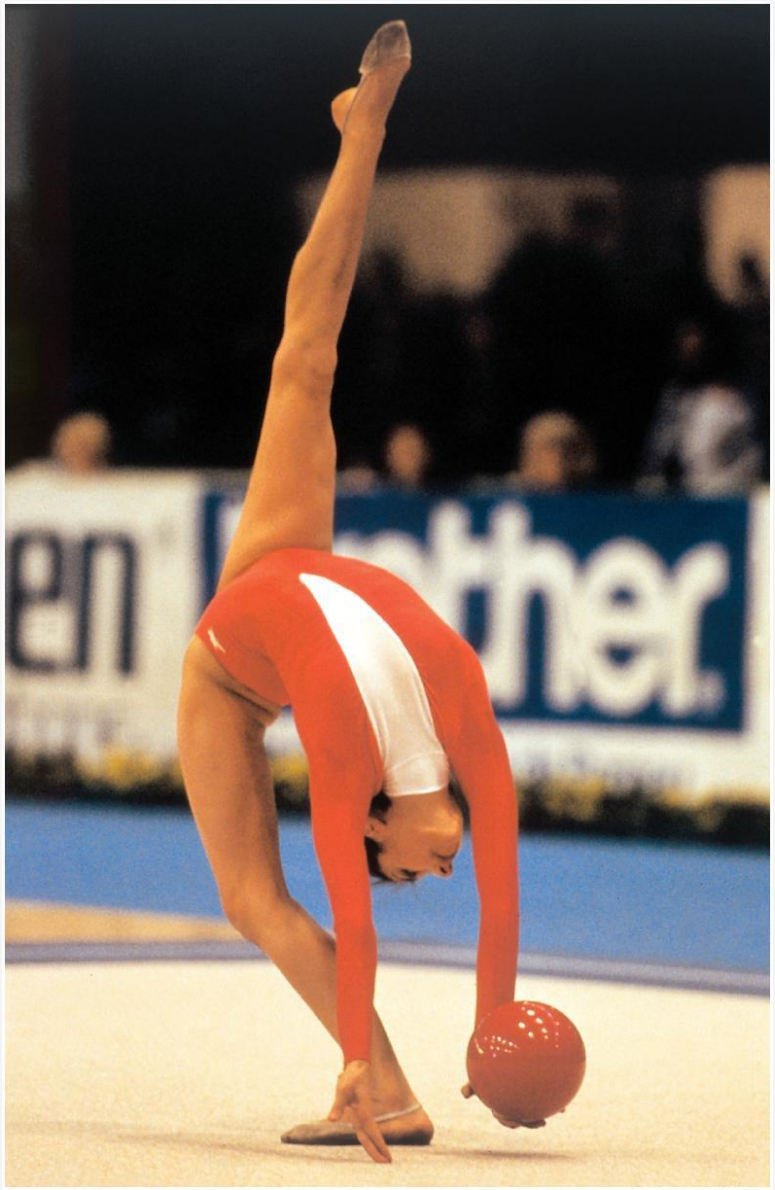
LEARNING OUTCOMES

As a result of the lesson you will be able to:

- ***E***xplain what joints are, how they are named, and what functions they serve
- *name and describe the four major categories of joints*
- *identify the anatomical components of a typical synovial joint;*

Joints

- Joint (articulation)
- – any point where two bones meet, whether or not the bones are movable at that interface

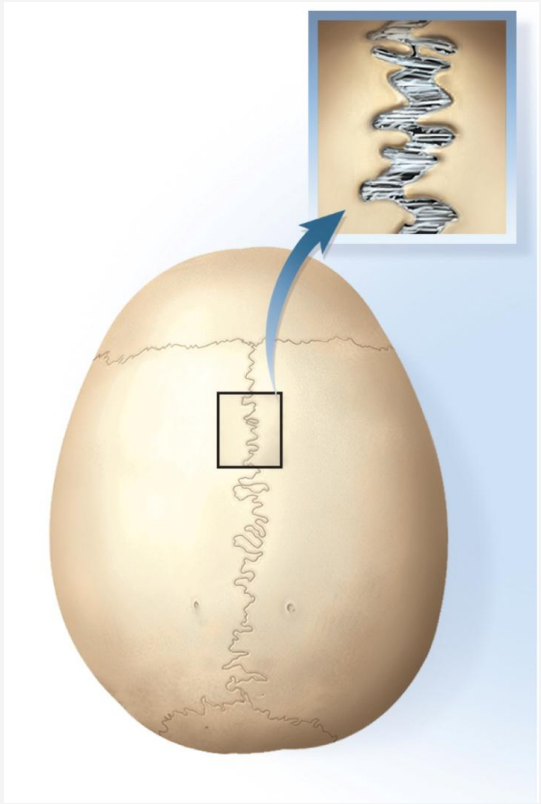


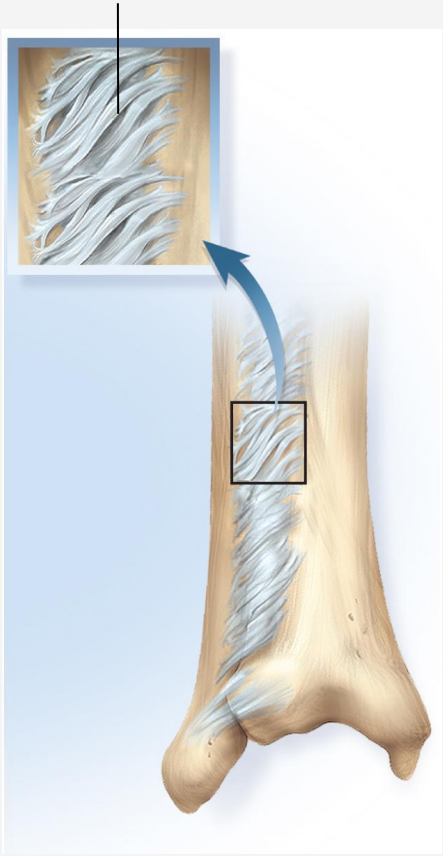
What is the difference between arthrology and kinesiology?

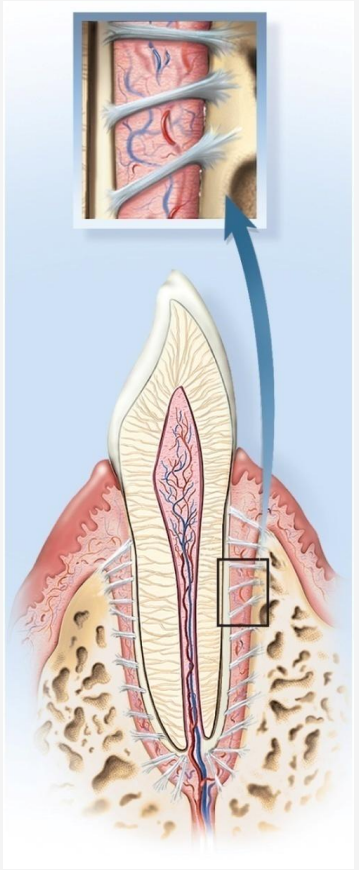
- **Arthrology** – science of joint structure, function, and dysfunction

- **Kinesiology** – the study of musculoskeletal movement
  - a branch of **biomechanics** – deals with a broad variety of movements and mechanical processes in the body, including the physics of blood circulation, respiration, and hearing

If we narrowly define a joint as an attachment of one bone to another, one of these three would not qualify. Which one and why ?

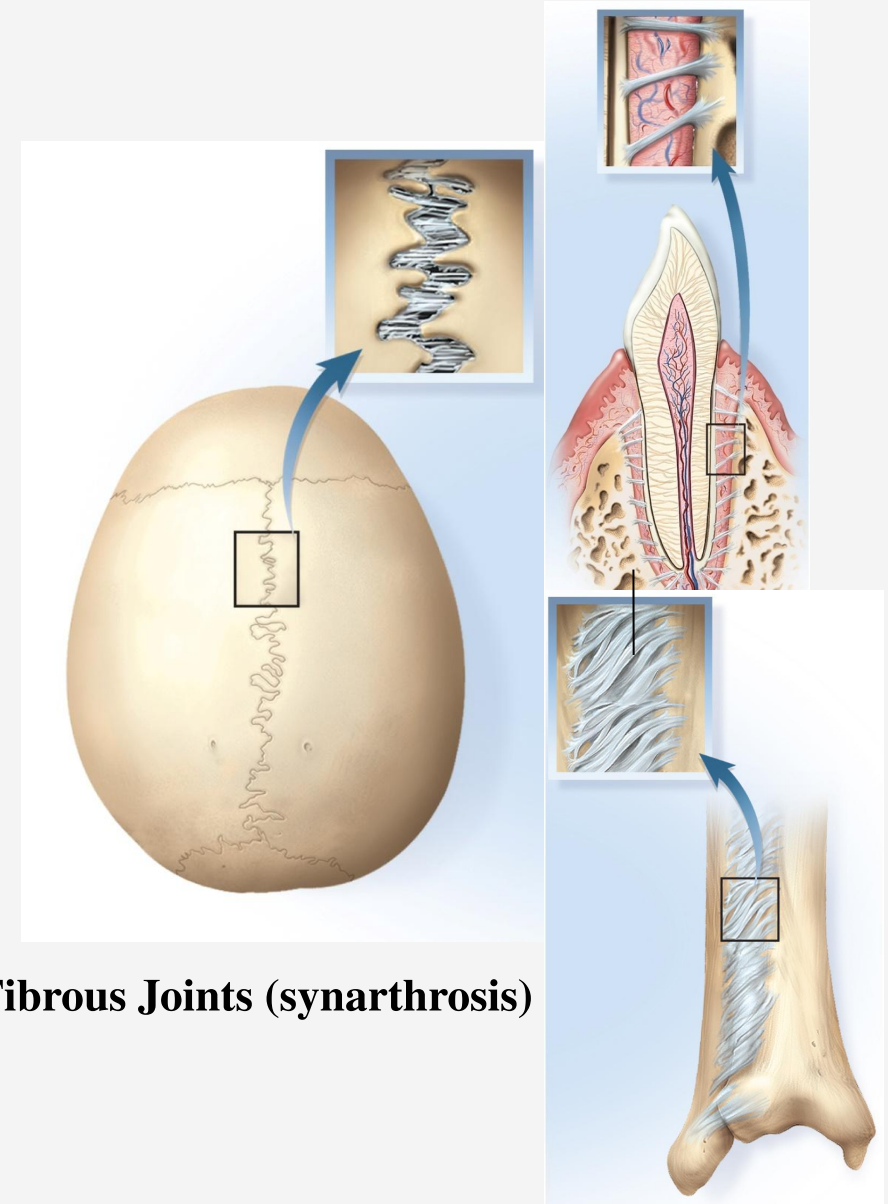




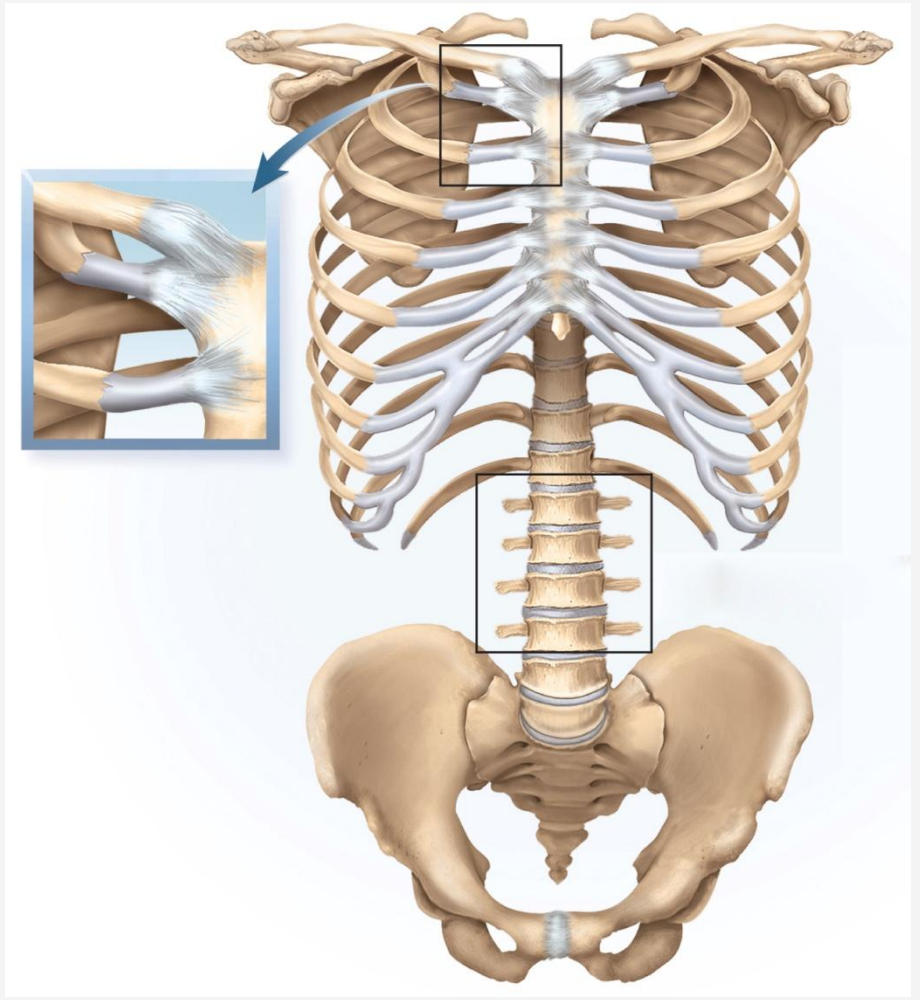


Fibrous Joints (synarthrosis)

Distinguish between a fibrous joints (synarthrosis), and cartilaginous joints (amphiarthrosis)



Fibrous Joints (synarthrosis)



Cartilaginous Joints(amphiarthrosis)

Joints and Their Classification

- **joint name** – typically derived from the names of the bones involved
  - atlanto-occipital joint, glenohumeral joint, radioulnar joint

- **joints classified** according to the manner in which the adjacent bones are bound to each other, with differences in how freely the bones can move

- **four major** joint categories:
  - **bony joints**
  - **fibrous joints**
  - **cartilaginous joints**
  - **synovial joints**

Fibrous Joints (Synarthrosis)

- **fibrous joint, synarthrosis, or synarthrodial joint** – a point at which adjacent bones are bound by collagen fibers that emerge from one bone, cross the space between them, and penetrate into the other

- **three kinds of fibrous joints**
  - **sutures**
  - **gomphoses**
  - **syndesmoses**

Fibrous Joints - Sutures

- **sutures** - immovable or slightly movable fibrous joints that closely bind the bones of the skull to each other

- sutures can be classified as:
  - **serrate** – interlocking wavy lines
    - coronal, sagittal and lambdoid sutures
  - **lap** (squamous)- overlapping beveled edges
    - temporal and parietal bones
  - **plane** (butt)- straight, nonoverlapping edges
    - palatine processes of the maxillae

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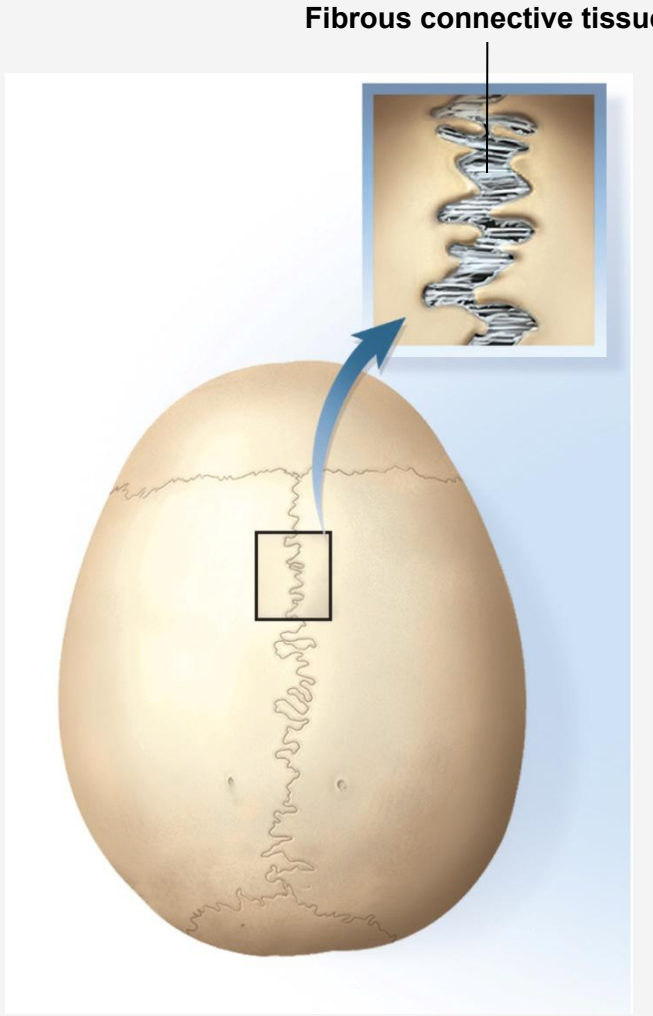

Figure 9.2a

Types of Sutures

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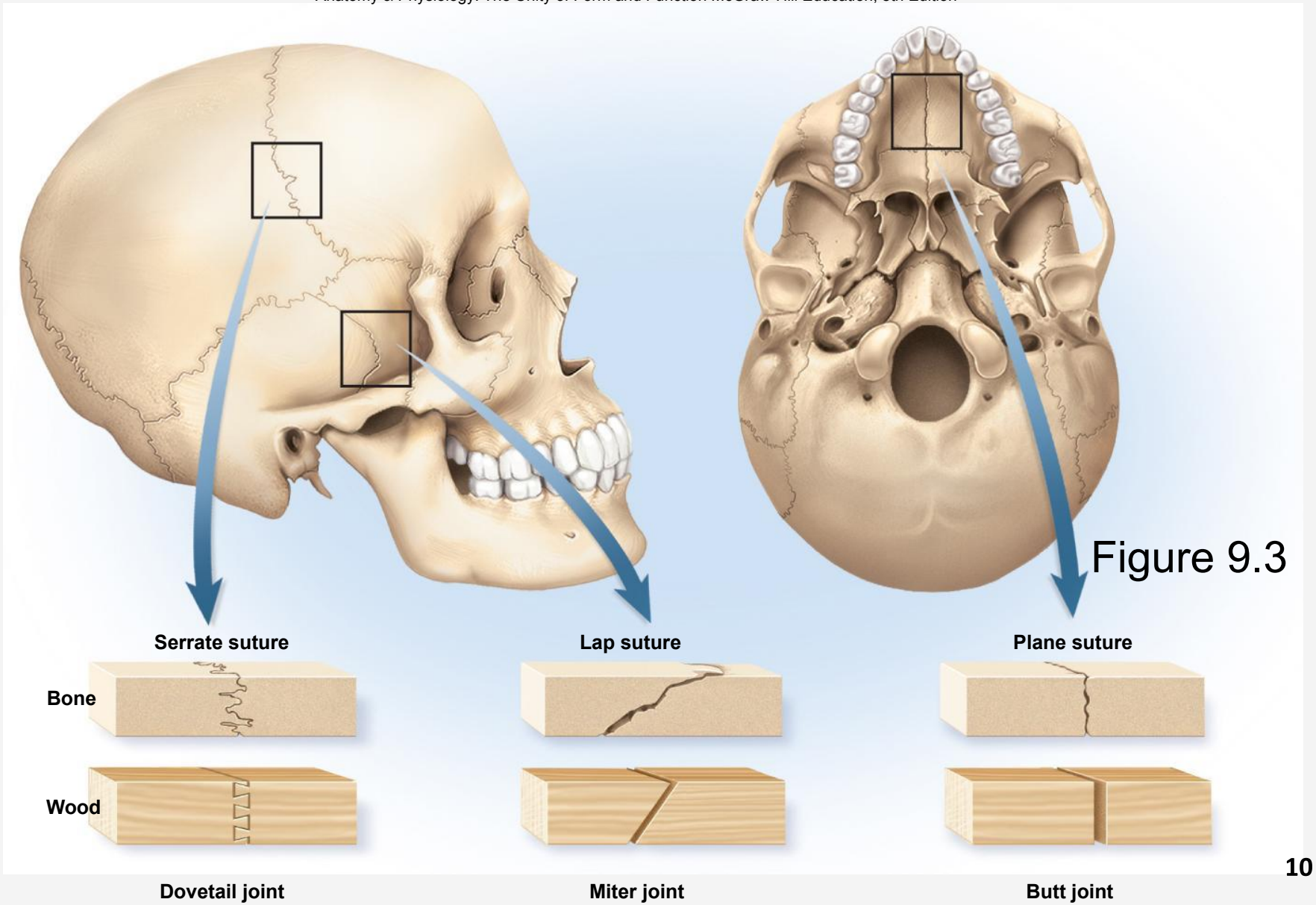

Figure 9.3

Fibrous Joint - Gomphosis

- **gomphosis** - attachment of a tooth to its socket

- held in place by fibrous **periodontal ligament**
  - collagen fibers attach tooth to jawbone
  - allows the tooth to move a little under the stress of chewing

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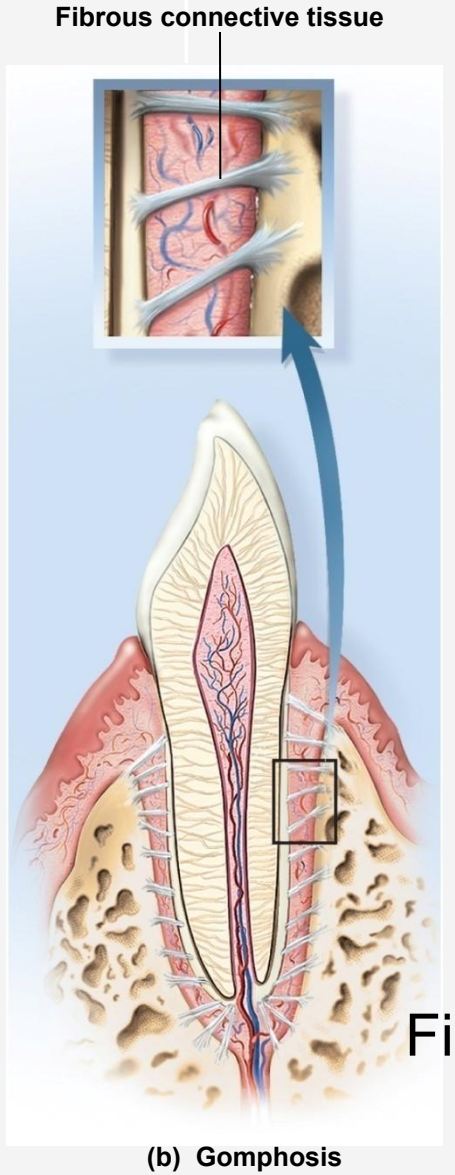

Figure 9.2b

Fibrous Joint - Syndesmosis

- **syndesmosis** – a fibrous joint at which two bones are bound by longer collagenous fibers than in a suture or gomphosis giving the bones more mobility
  - **interosseus membrane**

- most movable syndesmosis
  - interosseus membranes unite radius to ulna allowing supination and pronation

- less movable syndesmosis
  - tibia to fibula

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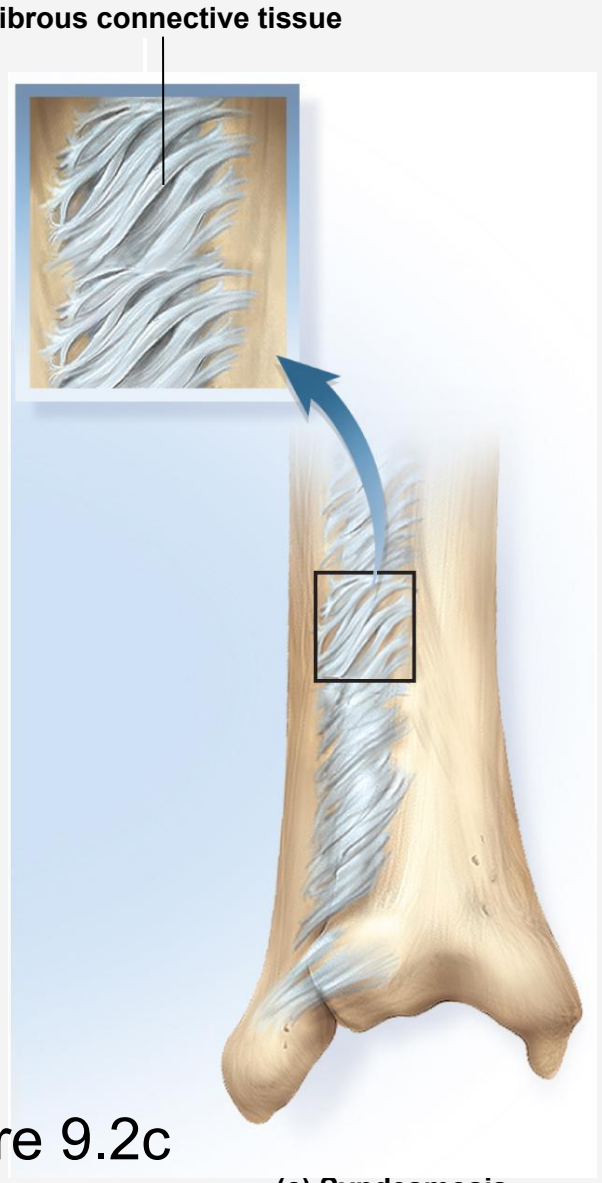

Figure 9.2c

Cartilaginous Joints

- **cartilaginous joint, amphiarthrosis** or **amphiarthrodial joint** – two bones are linked by cartilage

- **two types** of cartilaginous joints
  - **synchondroses**
  - **symphyses**

Cartilaginous Joint - Synchondrosis

- **synchrondrosis** - bones are bound by **hyaline cartilage**
  - temporary joint in the epiphyseal plate in children
    - binds epiphysis and diaphysis
  - first rib attachment to sternum
    - other costal cartilages are joined to sternum by synovial joints

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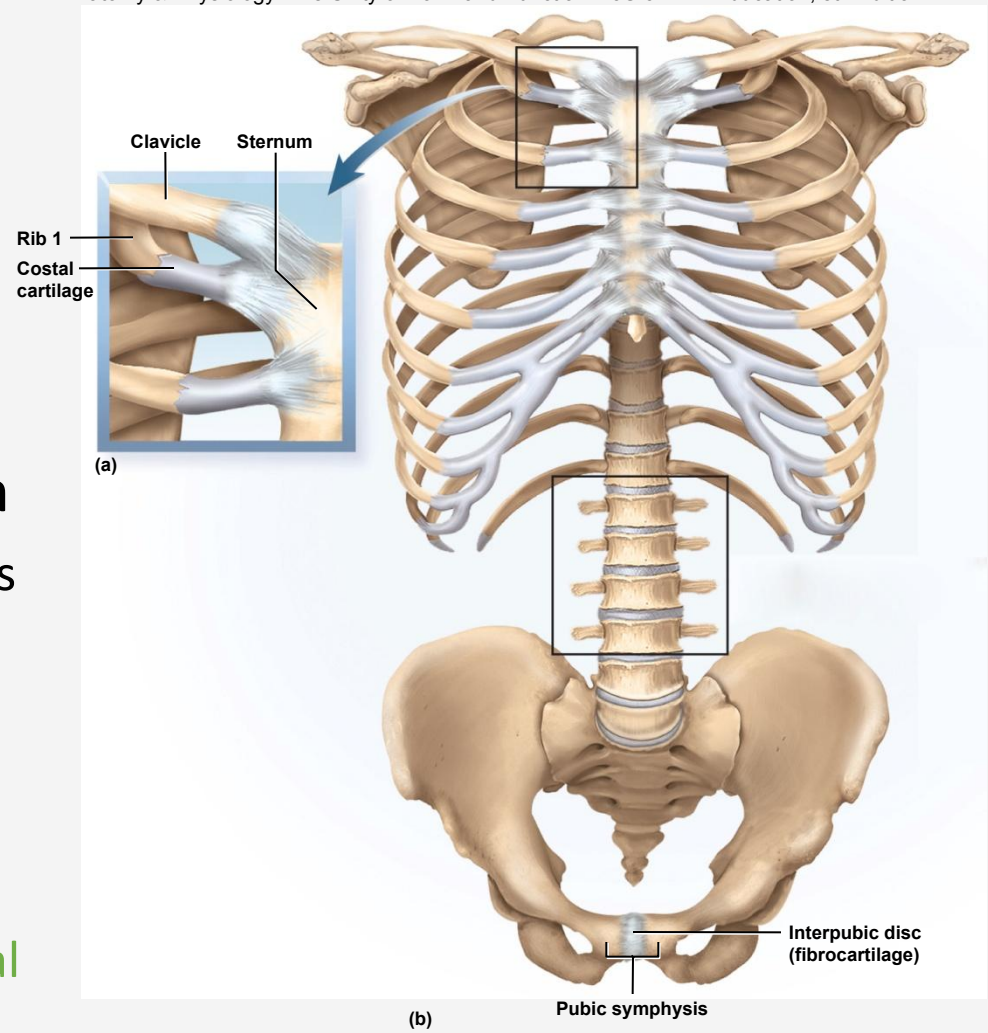
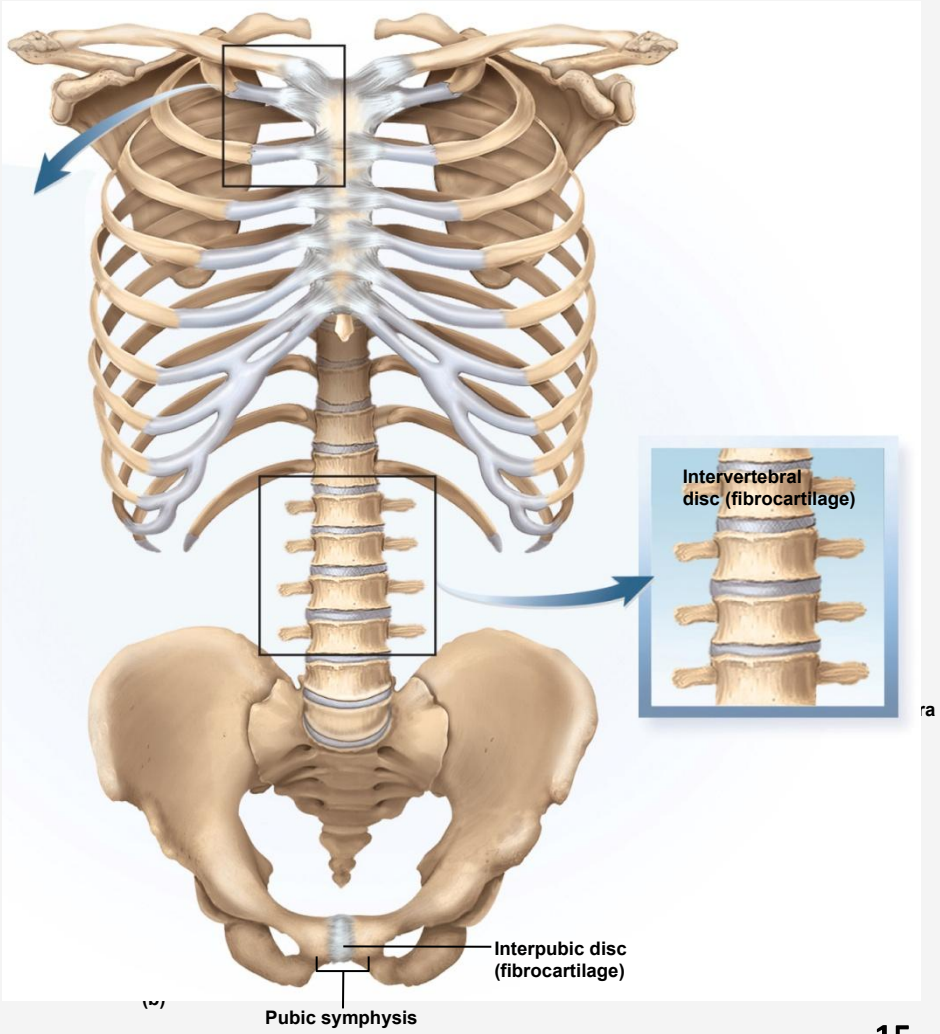


Cartilaginous Joint - Symphysis

- **symphysis** - two bones joined by **fibrocartilage**
  - **pubic symphysis** in which right and left pubic bones joined by **interpubic disc**
  - **bodies of vertebrae** and **intervertebral discs**
    - only slight amount of movement between adjacent vertebrae
    - collective effect of all discs gives spine considerable flexibility



Bony Joint (Synostosis)

- **bony joint,** or **synostosis** – an immovable joint formed when the gap between two bones ossify, and they become in effect, a single bone
  - frontal and mandibular bones in infants
  - cranial sutures in elderly
  - attachment of first rib and sternum with old age

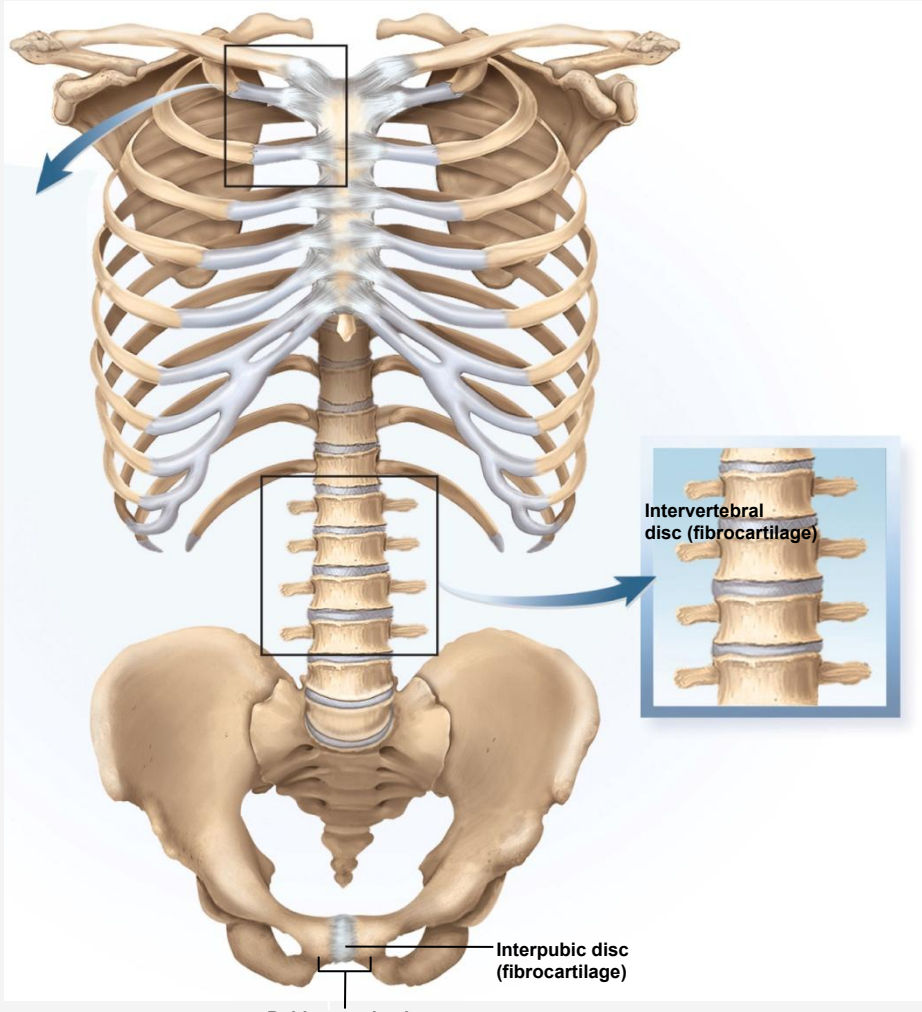
- can occur in either fibrous or cartilaginous joint

Cartilaginous Joint - Symphysis

- What is the difference between the pubic symphysis and the interpubic disc

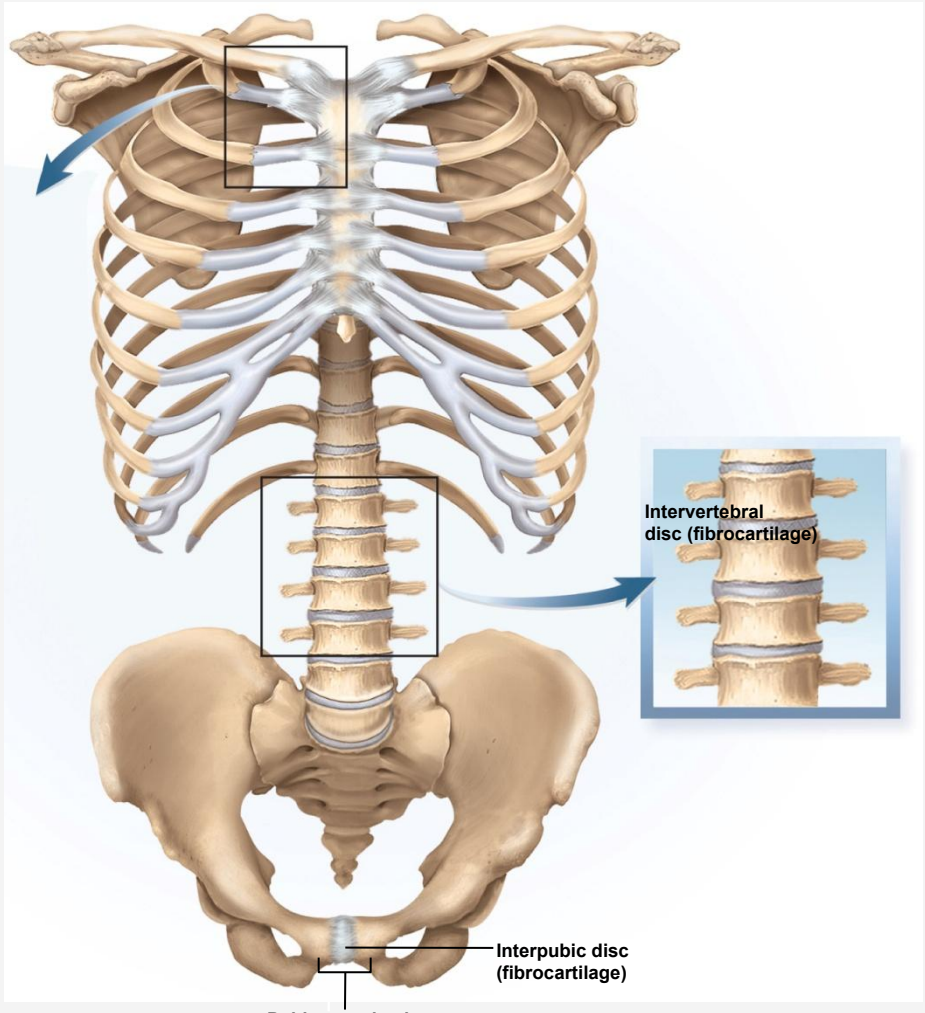
- The intervertebral joints are symphyses only in the cervical through the lumbar region. How would you classify the intervertebral joints of the sacrum and coccyx in a middle-aged adult?

- Give some examples of joints that become synostoses with age.



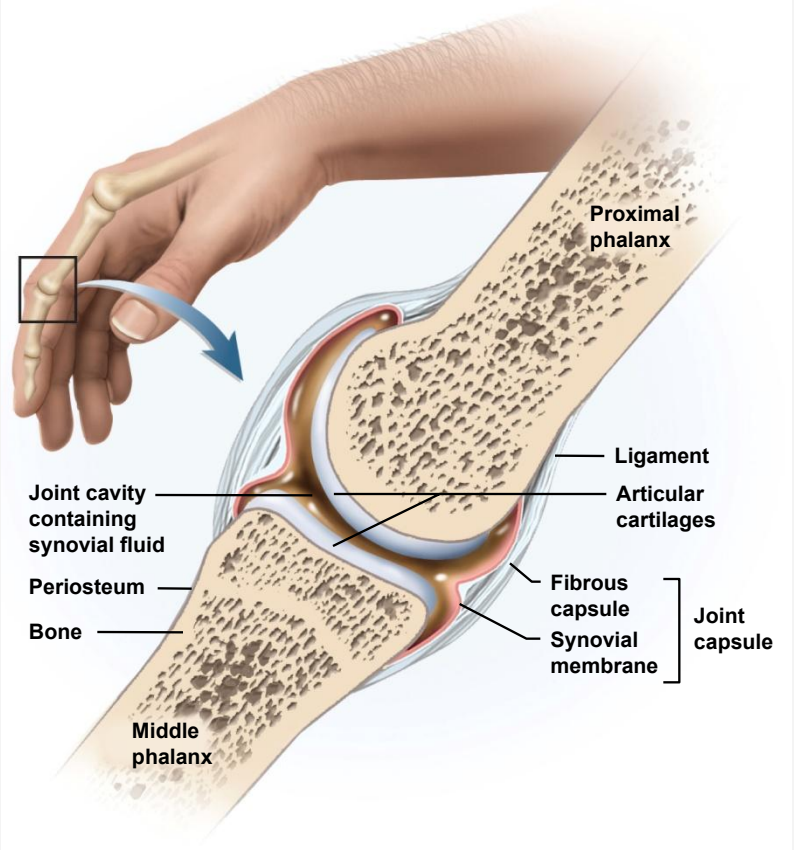
Cartilaginous Joint - Symphysis

- the pubic symphysis consists of the cartilaginous interpubic disc and the adjacent parts of the two pubic bones.
- In the sacrum and coccyx, the vertebrae fuse together by adulthood, thus becoming synostoses
- obliterated by ossification; therefore the adjacent cranial bones such as the parietal bones fuse together. Cartilaginous joints join the epiphysis and diaphysis of the long bones in childhood and with age they become synostosis in early adulthood. Lastly, the attachment of the first rib to the sternum becomes synostosis with age.



Synovial Joint

- **synovial joint, diarthrosis** or **diarthrodial joint** – joint in which two bones are separated by a space called a **joint cavity**
- most familiar type of joint
- most are freely movable
- most structurally complex type of joint
- most likely to develop painful dysfunction
- most important joints for physical and occupational therapists, athletic coaches, nurses, and fitness trainers
- their mobility make them important to quality of life



Synovial Joint

- **Describe the roles of articular cartilage and synovial fluid in joint mobility**

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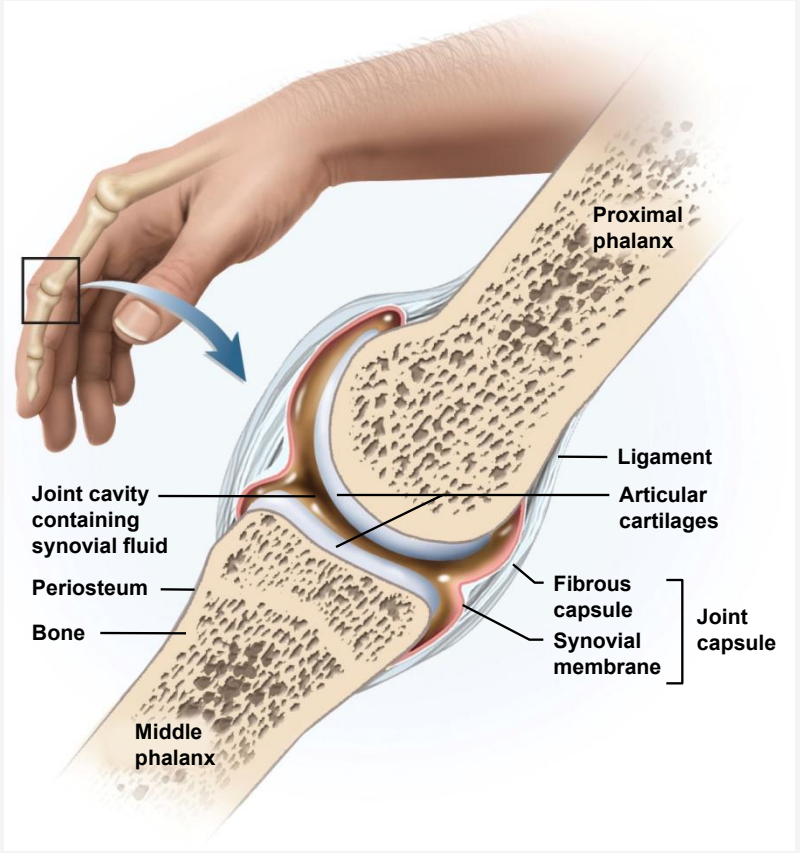
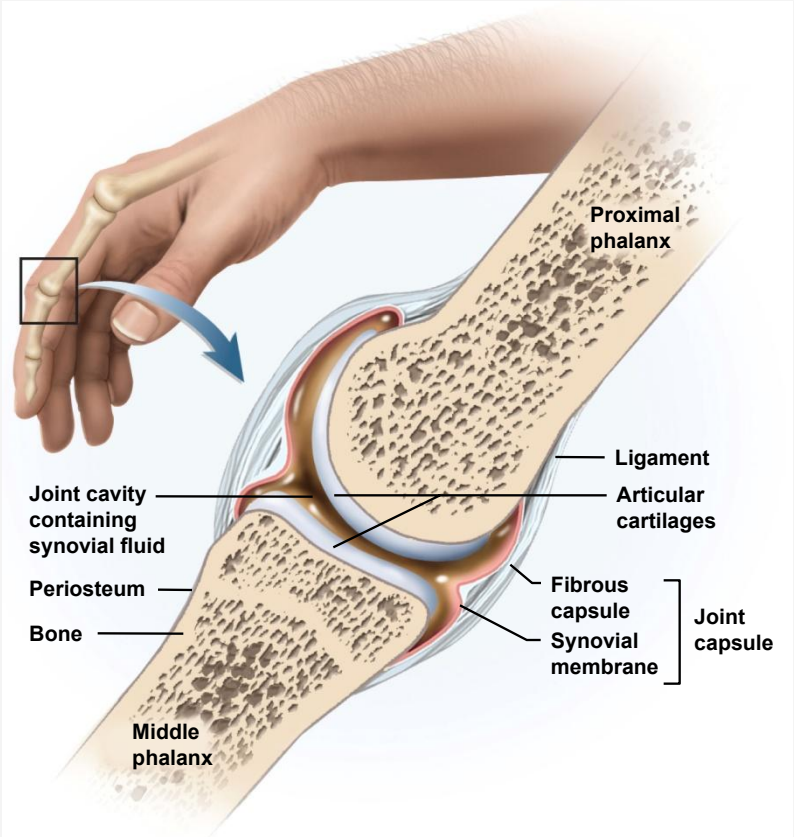


General Anatomy

- **articular cartilage** – layer of hyaline cartilage that covers the facing surfaces of two bones
  - usually 2 or 3 mm thick
- **joint (articular) cavity** – separates articular surfaces
- **synovial fluid** – slippery lubricant in joint cavity
  - rich in albumin and hyaluronic acid
  - gives it a viscous, slippery texture like raw egg whites
  - nourishes articular cartilage and removes waste
  - makes movement of synovial joints almost friction free



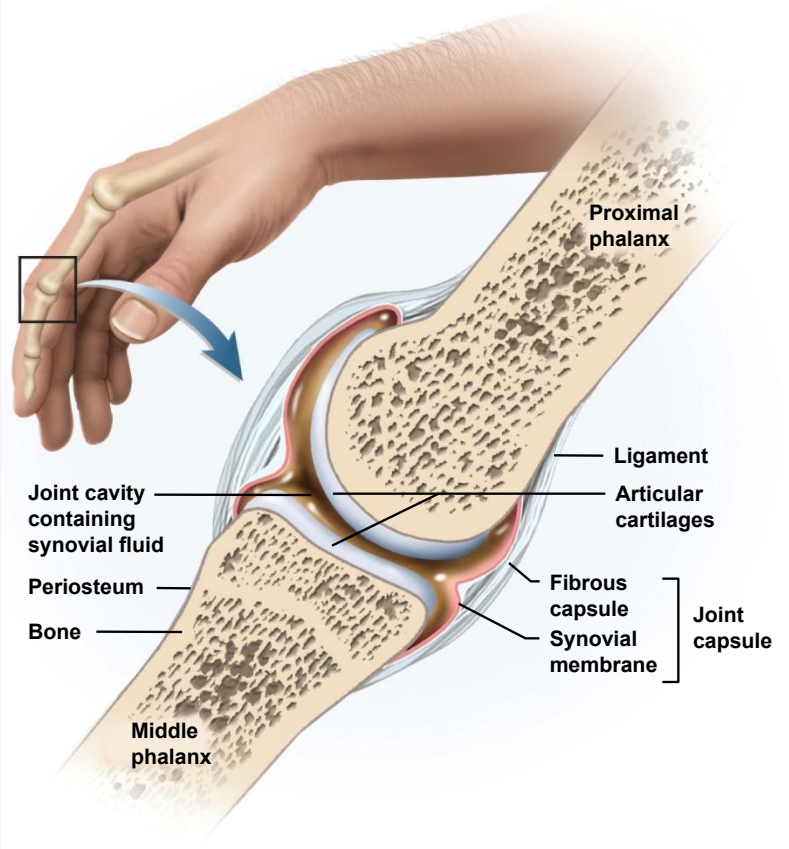
- **joint (articular) capsule – connective tissue that encloses the cavity and retains the fluid**
  - **outer fibrous capsule – continuous with periosteum of adjoining bones**
  - **inner, cellular, synovial membrane – composed mainly of fibroblast-like cells that secrete synovial fluid and macrophages that remove debris from the joint cavity**

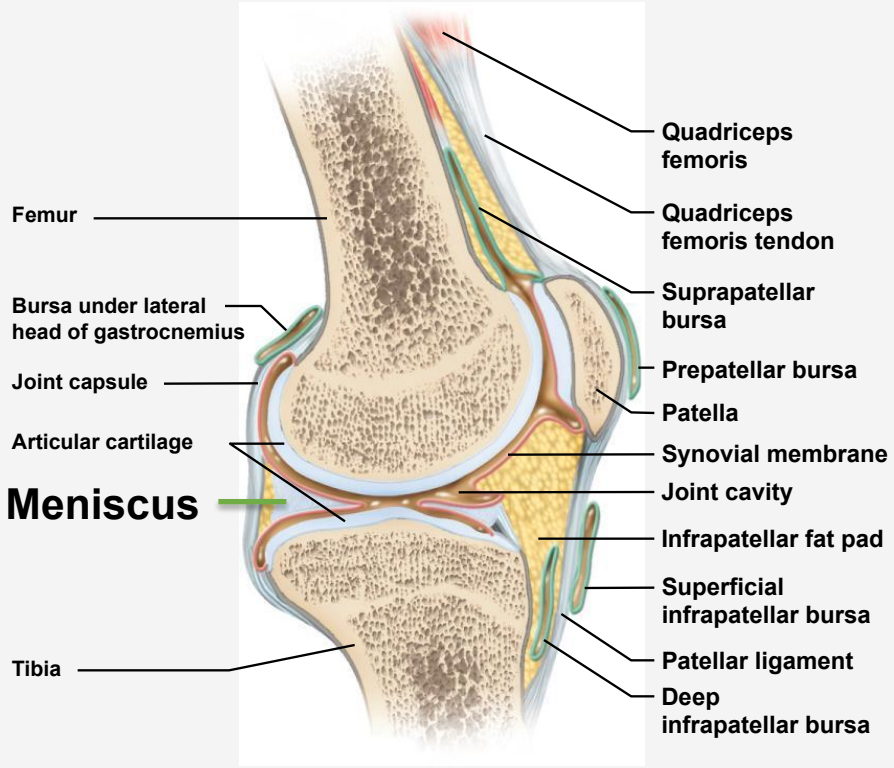
General Anatomy

- in a few synovial joints, **fibrocartilage** grows inward from the joint capsule
  - **articular disc** forms a pad between articulating bones that crosses the entire joint capsule
    - temporomandibular joint, distal radioulnar joints, sternoclavicular and acromioclavicular joints
  - **meniscus** – in the knee, two cartilages extend inward from the left and right but do not entirely cross the joint
    - these cartilages absorb shock and pressure
    - guide bones across each other
    - improve the fit between bones
    - stabilize the joints, reducing the chance of dislocation

- **accessory structures** associated with synovial joints
  - **tendon** – a strip or sheet of tough collagenous connective tissue that attaches muscle to bone
    - the most important structures in stabilizing a joint
  - **ligament** – similar tissue that attaches one bone to another
  - **bursa** – a fibrous sac filled with synovial fluid, located between adjacent muscles, where tendon passes over bone, or between bone and skin
    - cushion muscles, helps tendons slide more easily over joints, modify direction of tendon pull
  - **tendon sheaths** – elongated cylindrical bursae wrapped around a tendon
    - in hand and foot

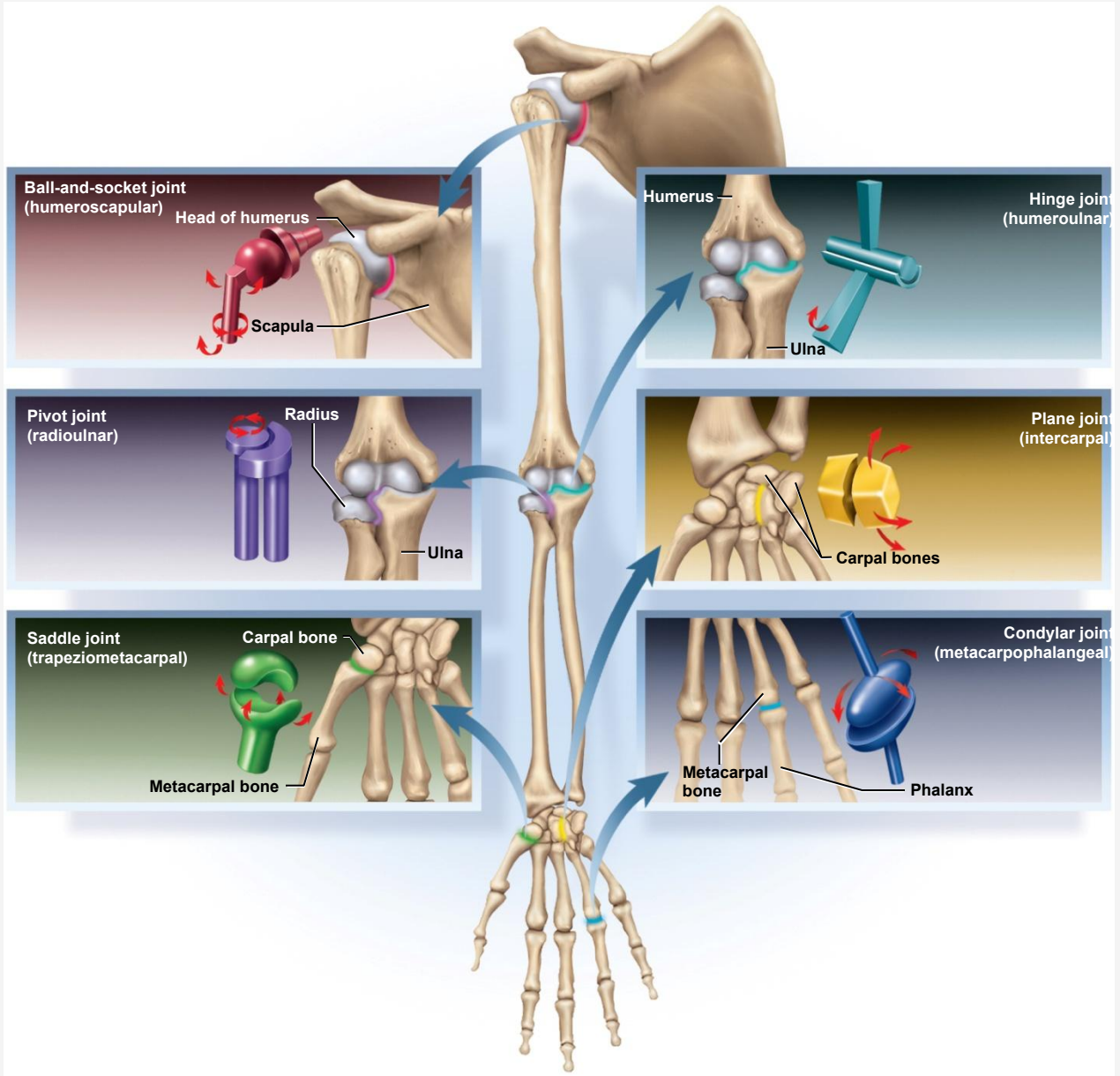
Why is a meniscus unnecessary in an interphalangeal joint?





(c) Sagittal section

List the six types of synovial joints, and for each one, if possible, identify a joint in the upper limb and a joint in the lower limb that fall into each category. Which of these six joints has/have no examples in the lower limb?



Ball-and-Socket Joints

- smooth, hemispherical head fits within a cuplike socket
  - **shoulder joint** - head of humerus into glenoid cavity of scapula
  - **hip joint** - head of femur into acetabulum of hip bone

- the **only multiaxial joints** in the body

Condyloid (ellipsoid) Joints

- oval convex surface on one bone fits into a complementary shaped depression on the other
  - **radiocarpal joint** of the wrist
  - **metacarpophalangeal joints** at the bases of the fingers

- **biaxial joints** – movement in two planes

Saddle Joints

- both bones have an articular surface that is shaped like a saddle, concave in one direction and convex in the other
  - **trapeziometacarpal** joint at the base of the thumb
  - **sternoclavicular joint** – clavicle articulates with sternum

- **biaxial joint**
  - more movable than a condyloid or hinge joint forming the primate **opposable thumb**

Plane (gliding) Joints

- flat articular surfaces in which bones slide over each other with relatively limited movement

- usually **biaxial** joint
  - carpal bones of wrist
  - tarsal bones of ankle
  - articular processes of vertebrae

- although any one joint moves only slightly, the combined action of the many joints in wrist, ankle, and vertebral column allows for considerable movement

Hinge Joints

- one bone with convex surface that fits into a concave depression on other bone
  - elbow joint - ulna and humerus
  - knee joint - femur and tibia
  - finger and toe joints

- **monoaxial** joint – move freely in one plane

Pivot Joints

- one bone has a projection that is held in place by a ring-like ligament

- bone spins on its longitudinal axis
  - atlantoaxial joint (dens of axis and atlas)
    - transverse ligament
  - proximal radioulnar joint allows the radius to rotate during pronation and supination
    - anular ligament

- **monoaxial** joint

DEEPER INSIGHT 9.1
CLINICAL APPLICATION

Exercise and Articular Cartilage

When synovial fluid is warmed by exercise, it becomes thinner (less viscous), like warm oil, and more easily absorbed by the articular cartilage. The cartilage then swells and provides a more effective cushion against compression. For this reason, a warm-up period before vigorous exercise helps protect the articular cartilage from undue wear and tear.

Because cartilage is nonvascular, repetitive compression during exercise is important to its nutrition and waste removal. Each time a cartilage is compressed, fluid and metabolic wastes are squeezed out of it. When weight is taken off the joint, the cartilage absorbs synovial fluid like a sponge, and the fluid carries oxygen and nutrients to the chondrocytes. Without exercise, articular cartilages deterio- rate more rapidly from inadequate nutrition, oxygenation, and waste removal.

Weight-bearing exercise builds bone mass and strengthens the muscles that stabilize many of the joints, thus reducing the risk of joint dislocations. Excessive joint stress, however, can hasten the progression of osteoarthritis by damaging the articular cartilage (see Deeper Insight 9.5). Swimming and bicycling are good ways of exercising the joints with minimal damage.

Exercise and Articular Cartilage

- exercise warms synovial fluid
- becomes less viscous and more easily absorbed by articular cartilage
- cartilage then swells and provides a more effective cushion against compression
- warm-up period before vigorous exercise helps protect cartilage from undue wear and tear
- repetitive compression of nonvascular cartilage during exercise squeezes fluid and metabolic waste out of the cartilage
- when weight removed, cartilage absorbs synovial fluid like a sponge taking in oxygen and nutrients to the chondrocytes
- without exercise, cartilage deteriorates more rapidly from inadequate nutrition and waste removal