

Introduction to Orthopedic Anatomy

Traumatology
RHS 231
Dr. Einas Al-Eisa
Lecture 2

Types of Joints

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graph TD; A[Types of Joints] --> B[Synovial]; A --> C[Cartilagenous]; A --> D[Fibrous]; B --> B1[Diarthroidal]; B --> B2[Freely movable]; C --> C1[Amphiarthroidal]; C --> C2[Slightly movable]; D --> D1[Synarthroidal]; D --> D2[Immovable];
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Synovial

Diarthroidal

Freely movable

Cartilagenous

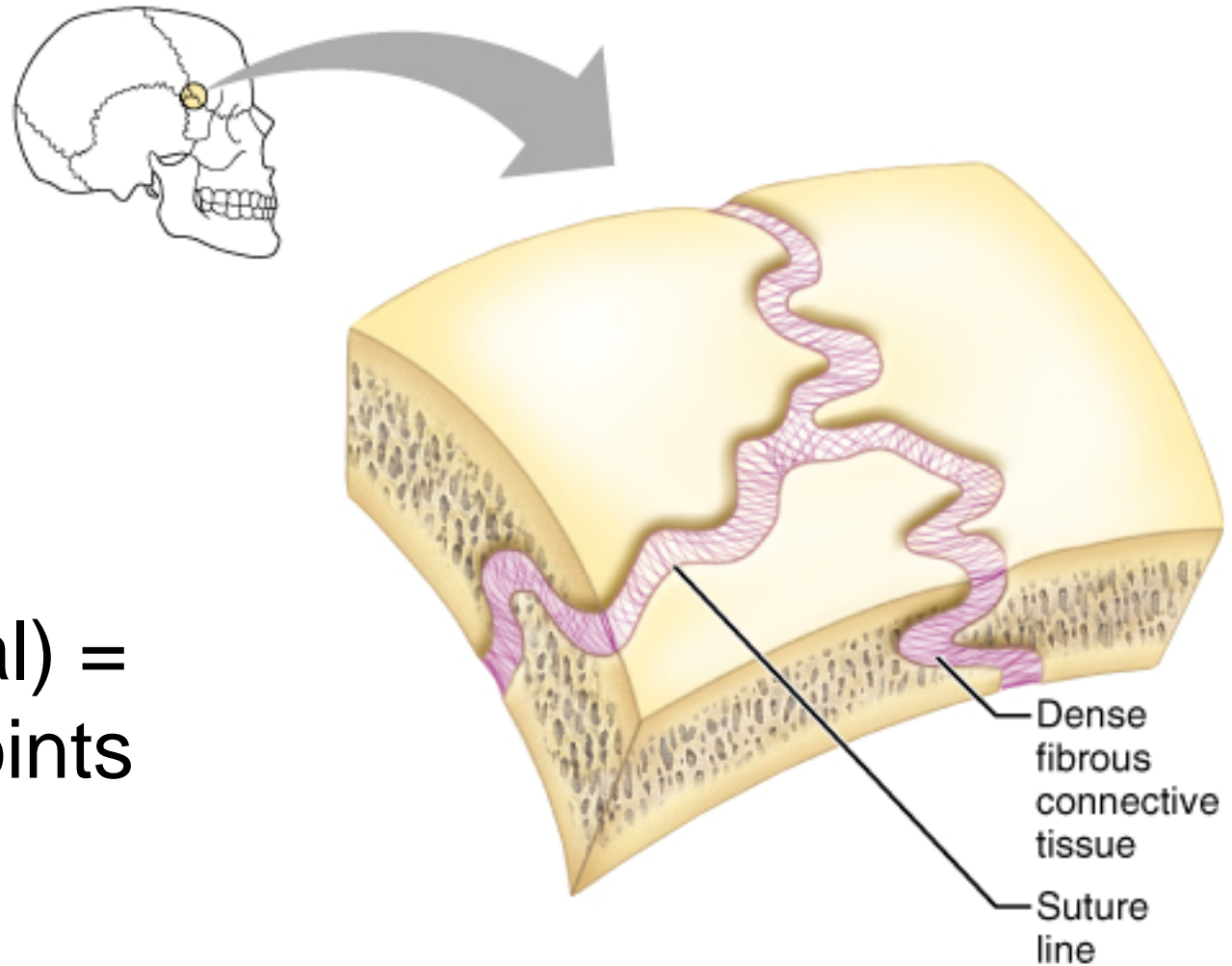
Amphiarthroidal

Slightly movable

Fibrous

Synarthroidal

Immovable

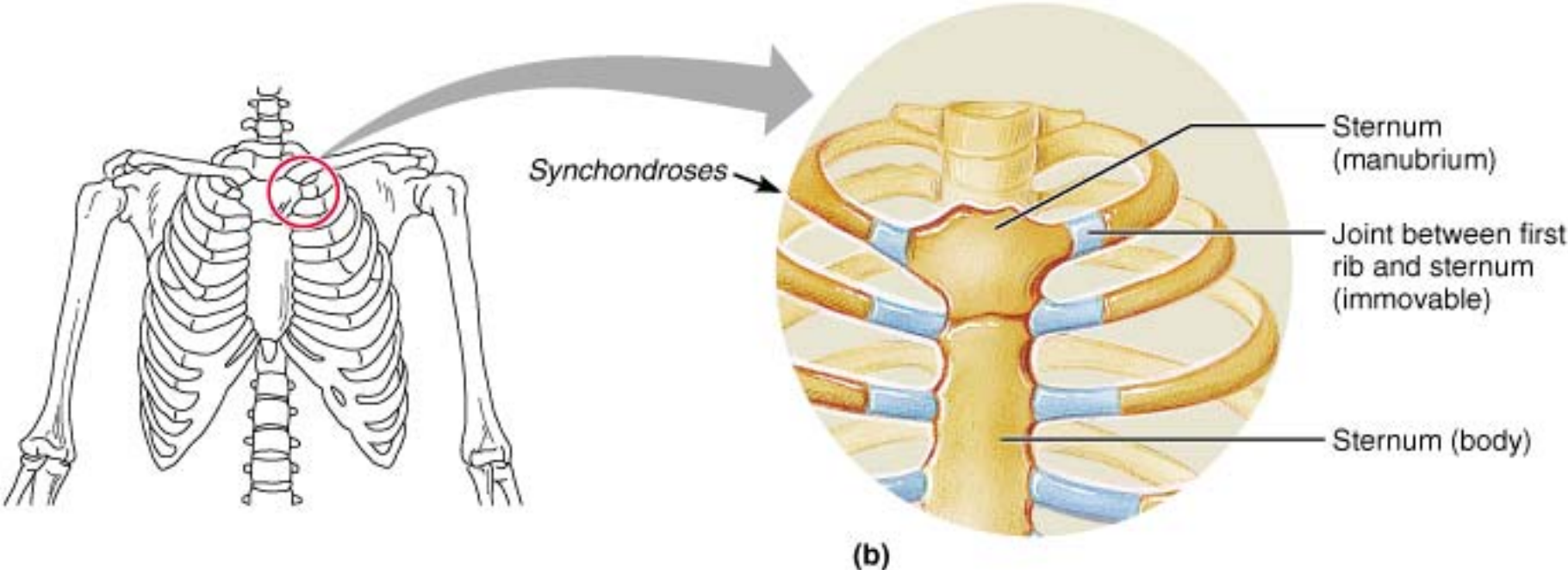


Fibrous
(Synarthroidal) =
Immovable joints

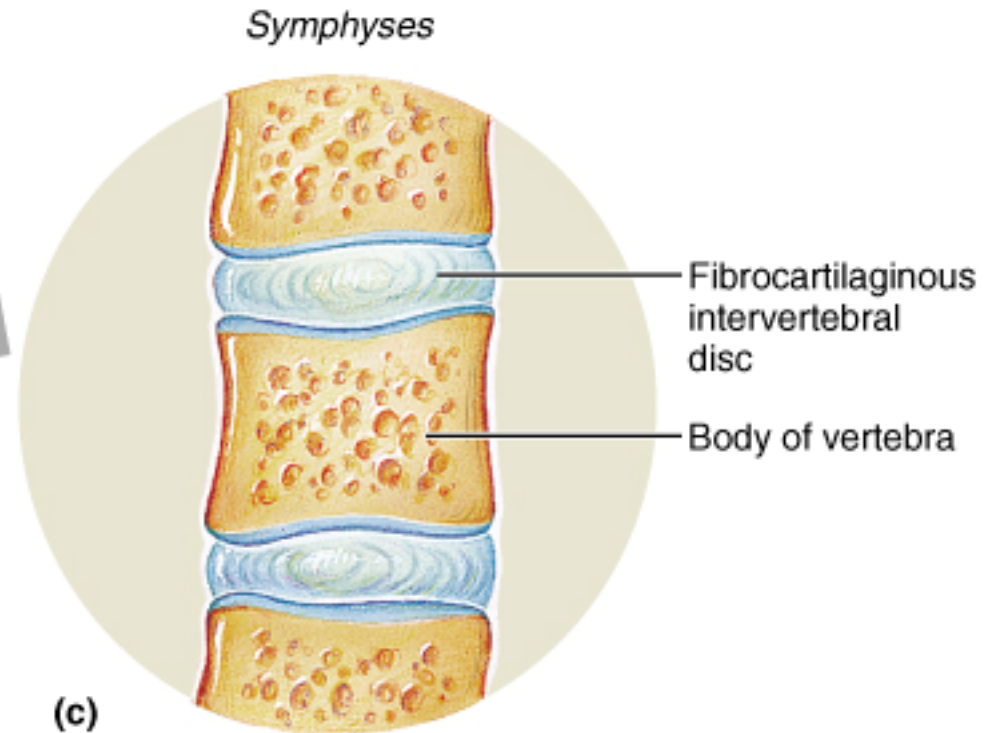
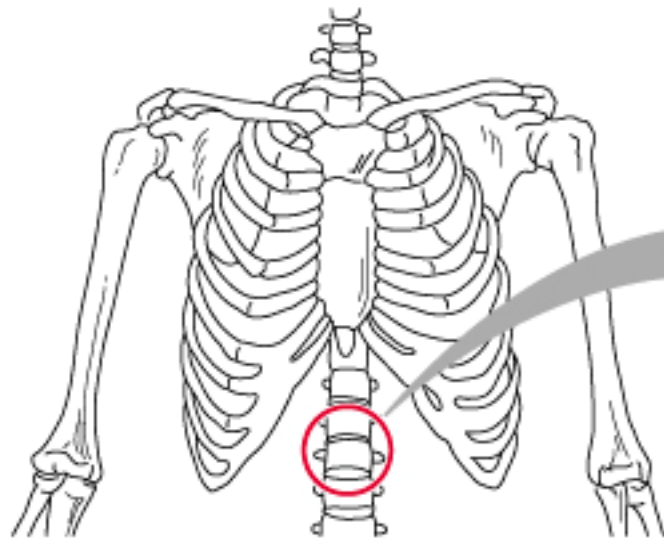
(a) Suture

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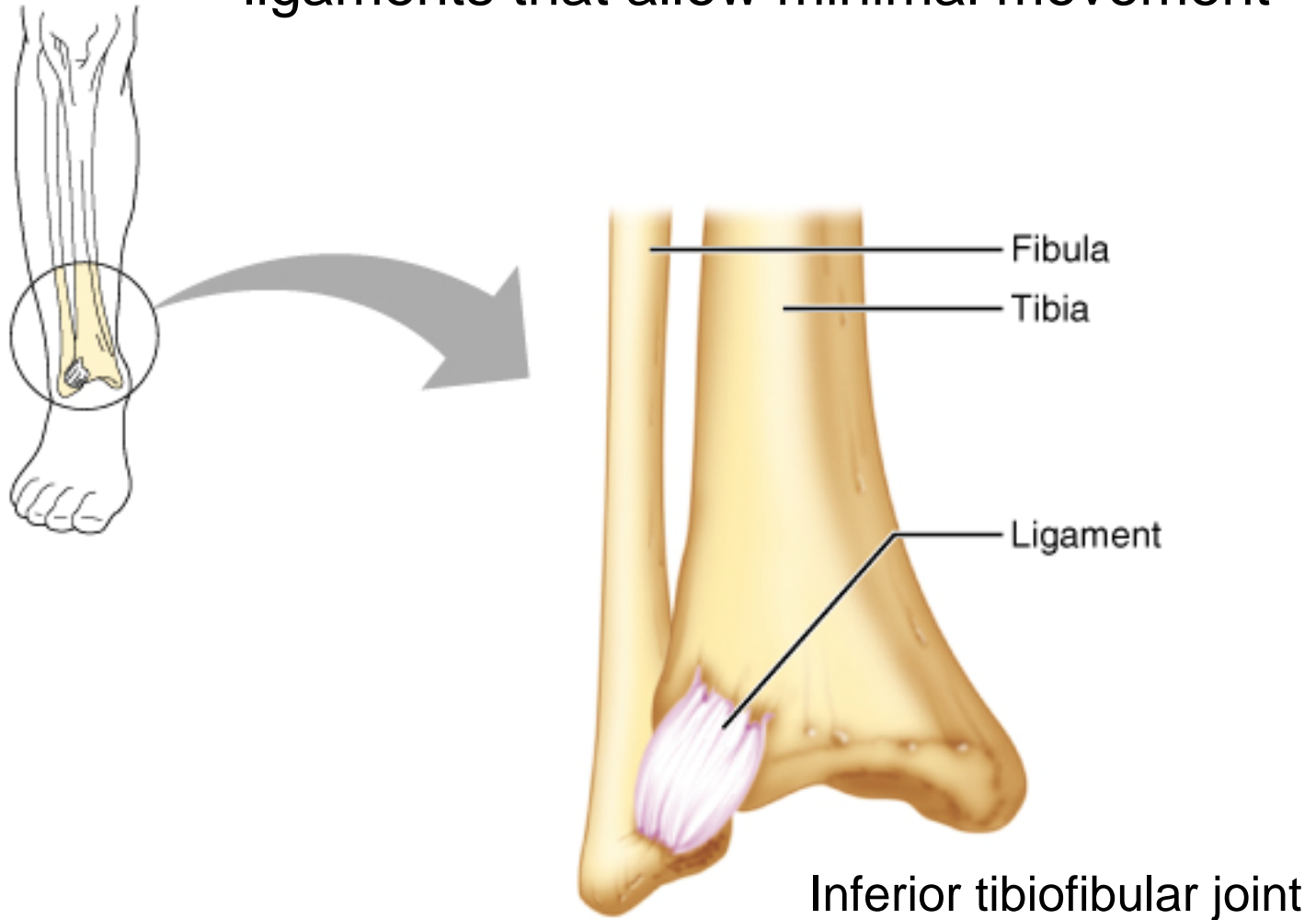
Synchondroses =
Fibrocartilagenous joint that
allows very slight movement



Fibrocartilagenous joint



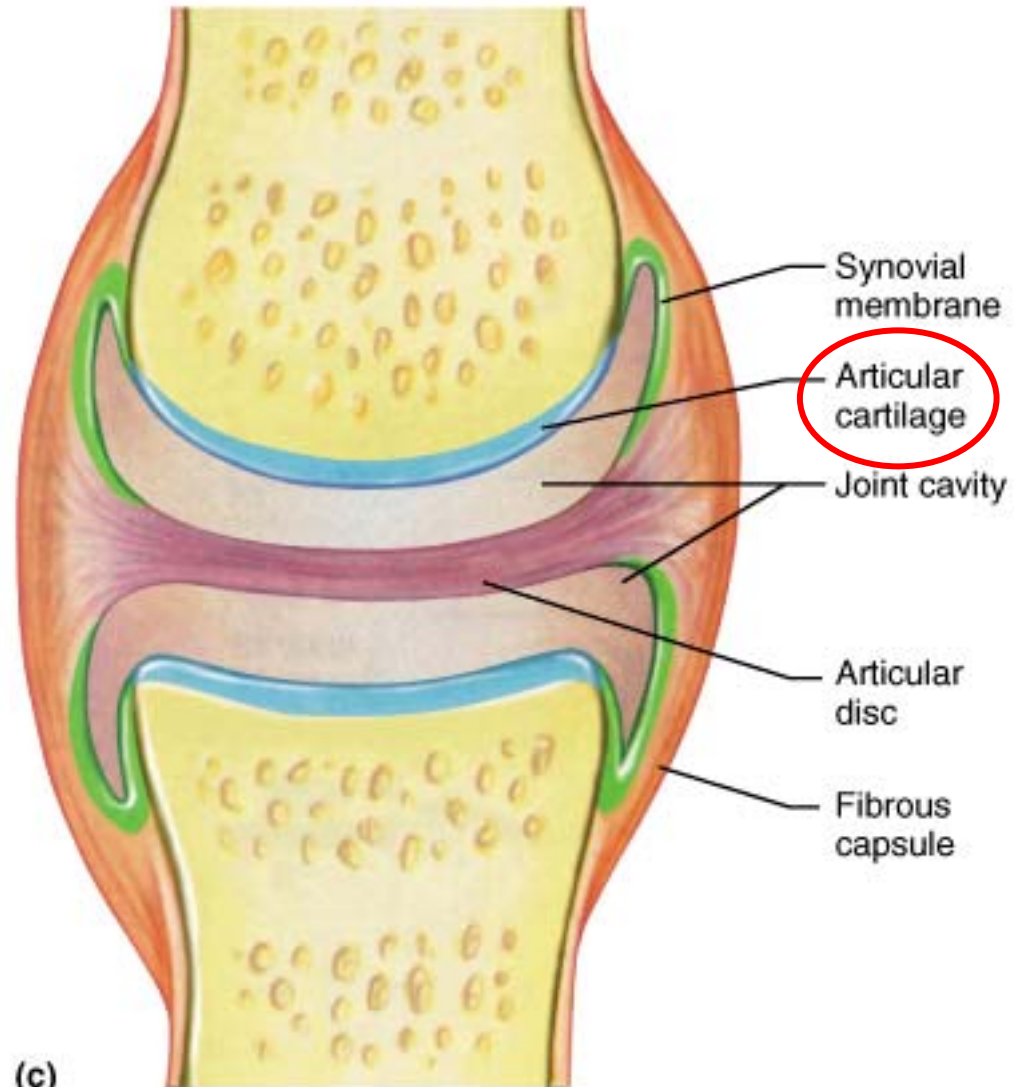
Syndesmosis = bones held together by strong ligaments that allow minimal movement



(b) Syndesmosis

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Synovial joint



(c)

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Characteristics of Synovial Joints

- **Articular end plate** = a thin layer of compact bone over the spongy bone (covering the ends of the bones)



Covered by:

- **Articular (hyaline) cartilage** for shock absorption, stability, improved fit for the surfaces, lubrication

Characteristics of Synovial Joints

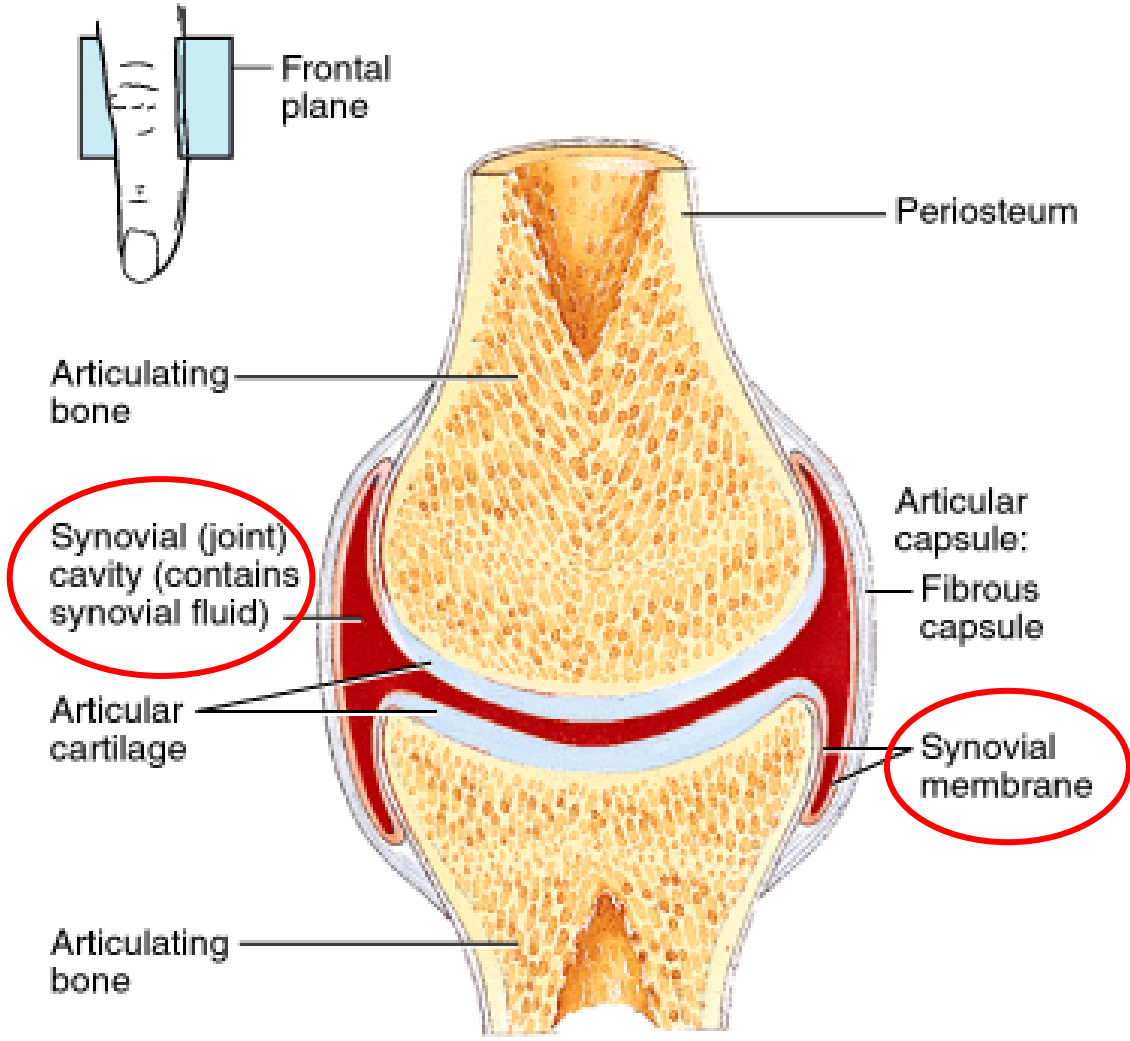
- **Joint capsule** = a fibrous connective tissue that surround the bony ends forming the joint



Lined with:

- **Synovial membrane** = loose, vascularized connective tissue that secretes **synovial fluid** into the joint cavity for lubrication

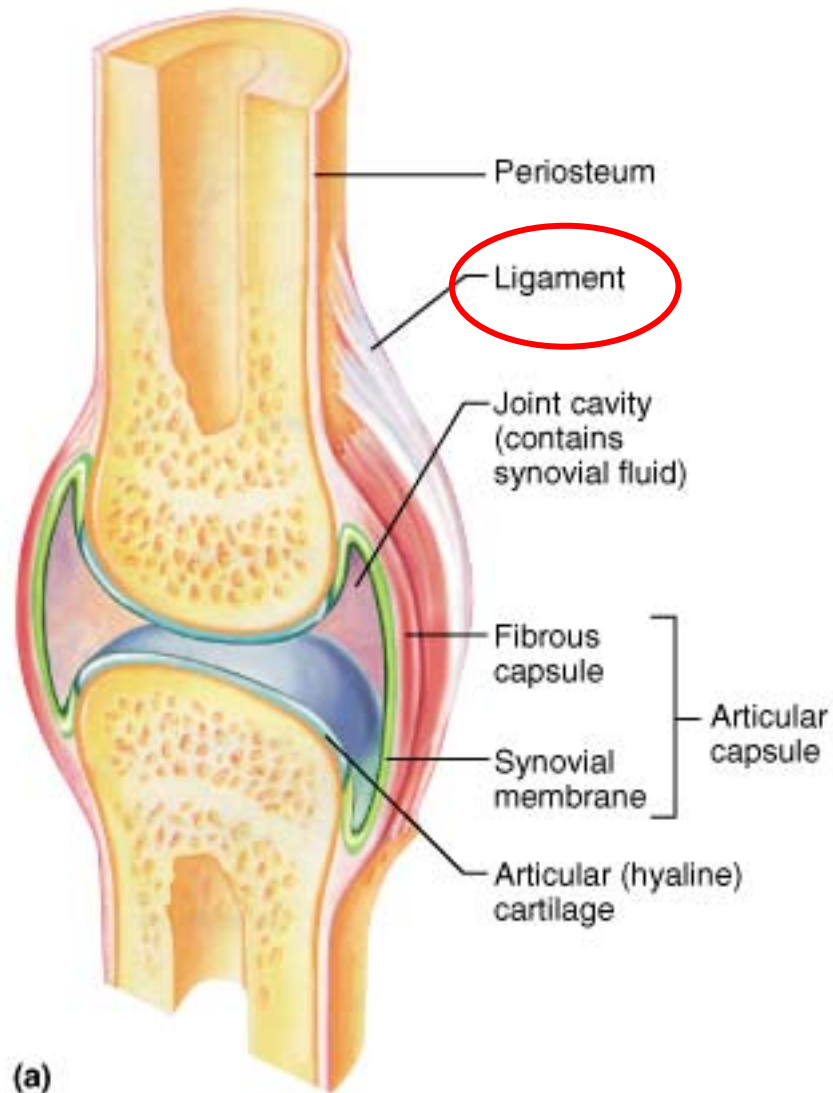
Synovial joint



(a) Diagram of frontal section of a typical synovial joint

Characteristics of Synovial Joints

- Where additional support is needed, the joint capsule is thickened to form tough, non-elastic **ligaments** to provide additional support.
- **Stability** of a synovial joint is provided by: the capsule, ligaments, muscles & tendons spanning the joint, and the *congruency* of the bone surfaces.

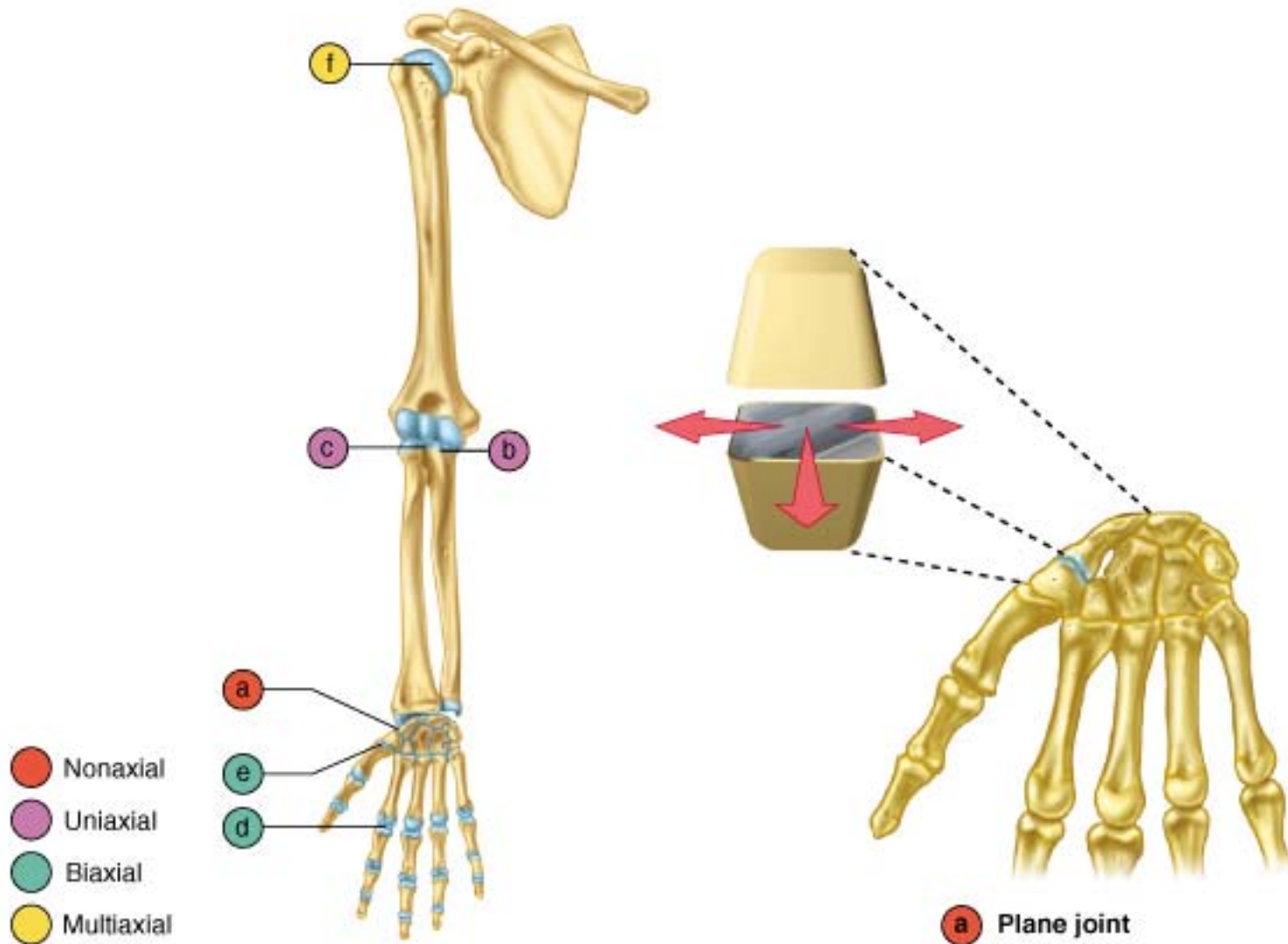


Types of synovial joints

1) Plane (gliding) joint: consists of two flat surfaces that glide over each other.

Example: carpals & tarsals

Plane (gliding) Joint

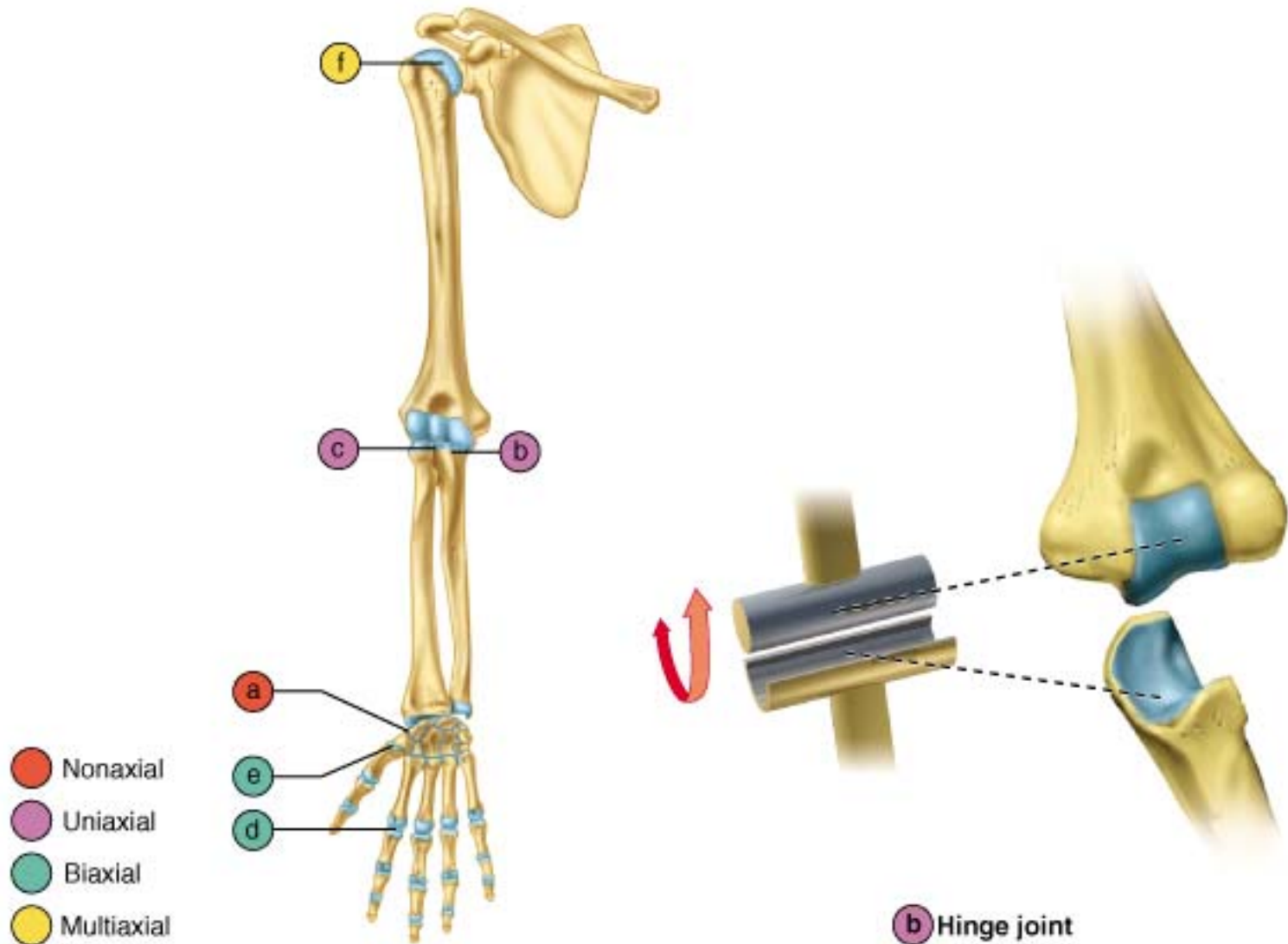


Types of synovial joints

2) Hinge joint: allow movement in one plane (flexion / extension).

Example: interphalangeal joints (hand),
ulnohumeral joint (elbow)

Hinge Joint

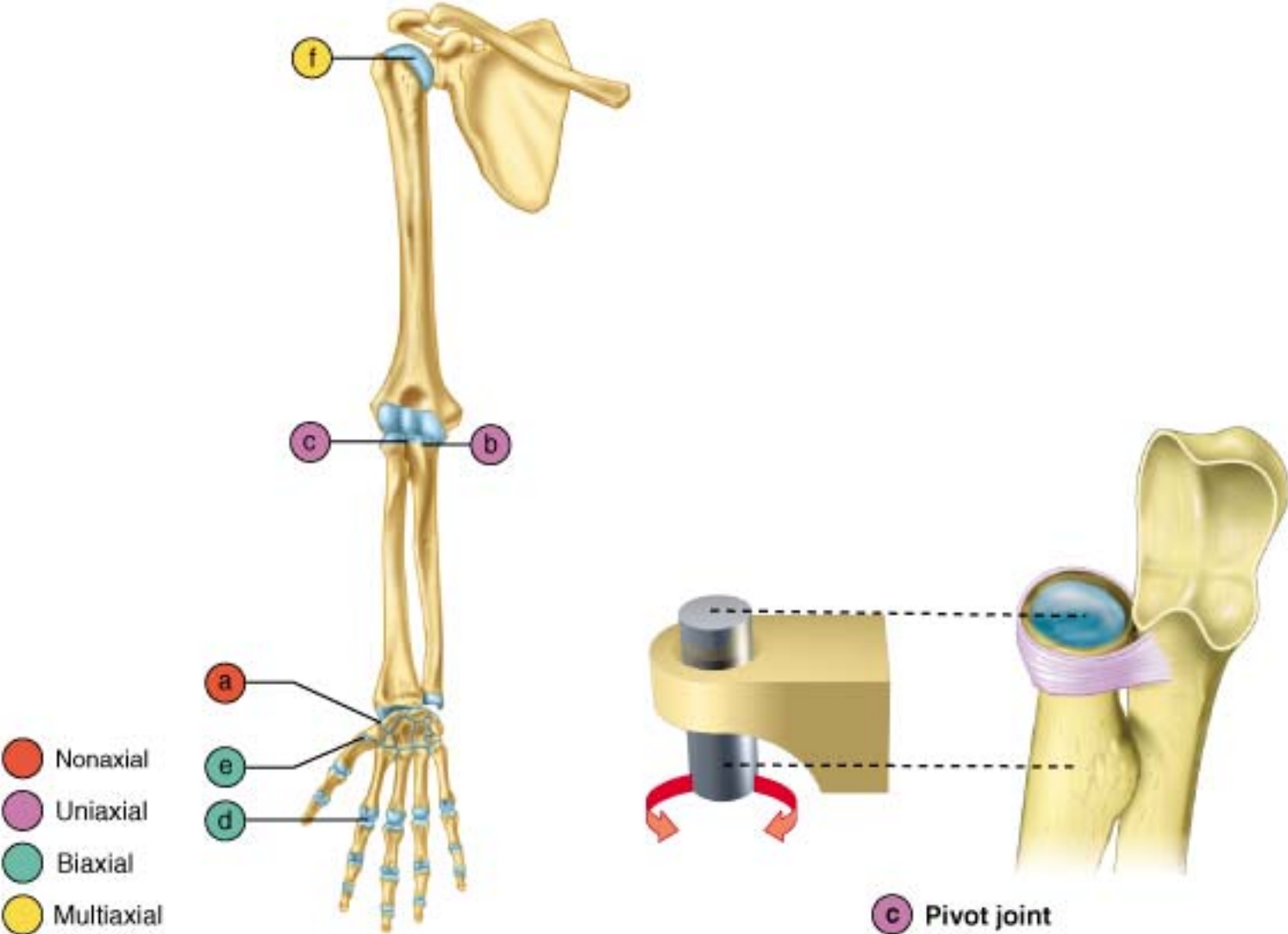


Types of synovial joints

3) Pivot Joint: allows a rotational movement around a long axis.

Example: superior & inferior radioulnar joint (pronation / supination), atlantoaxial joint at the base of the skull (rotation)

Pivot Joint

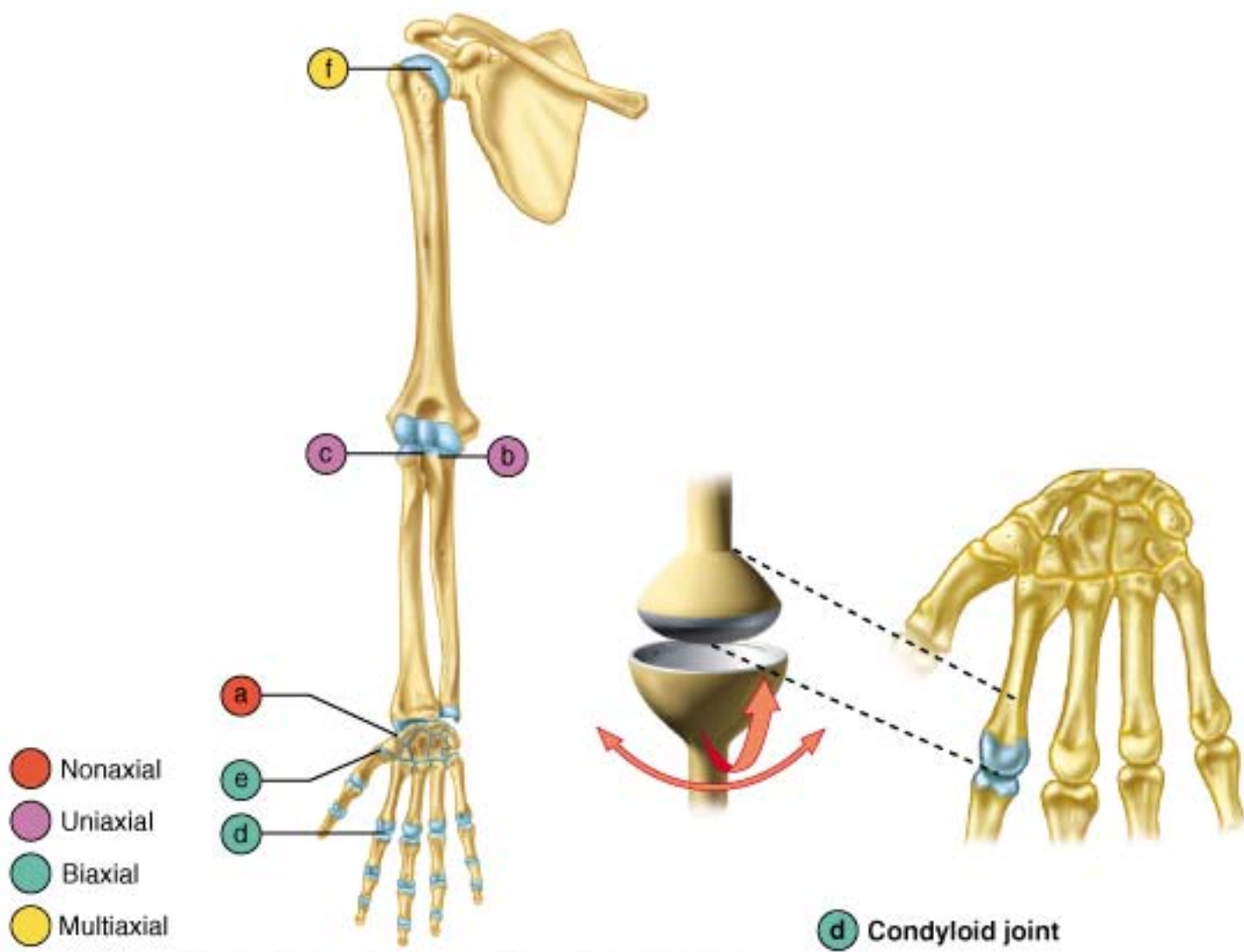


Types of synovial joints

4) Condylloid joint: allows movement in two planes (flexion / extension and abduction /adduction) without rotation.

Example: metacarpophalangeal joints

Condyloid Joint

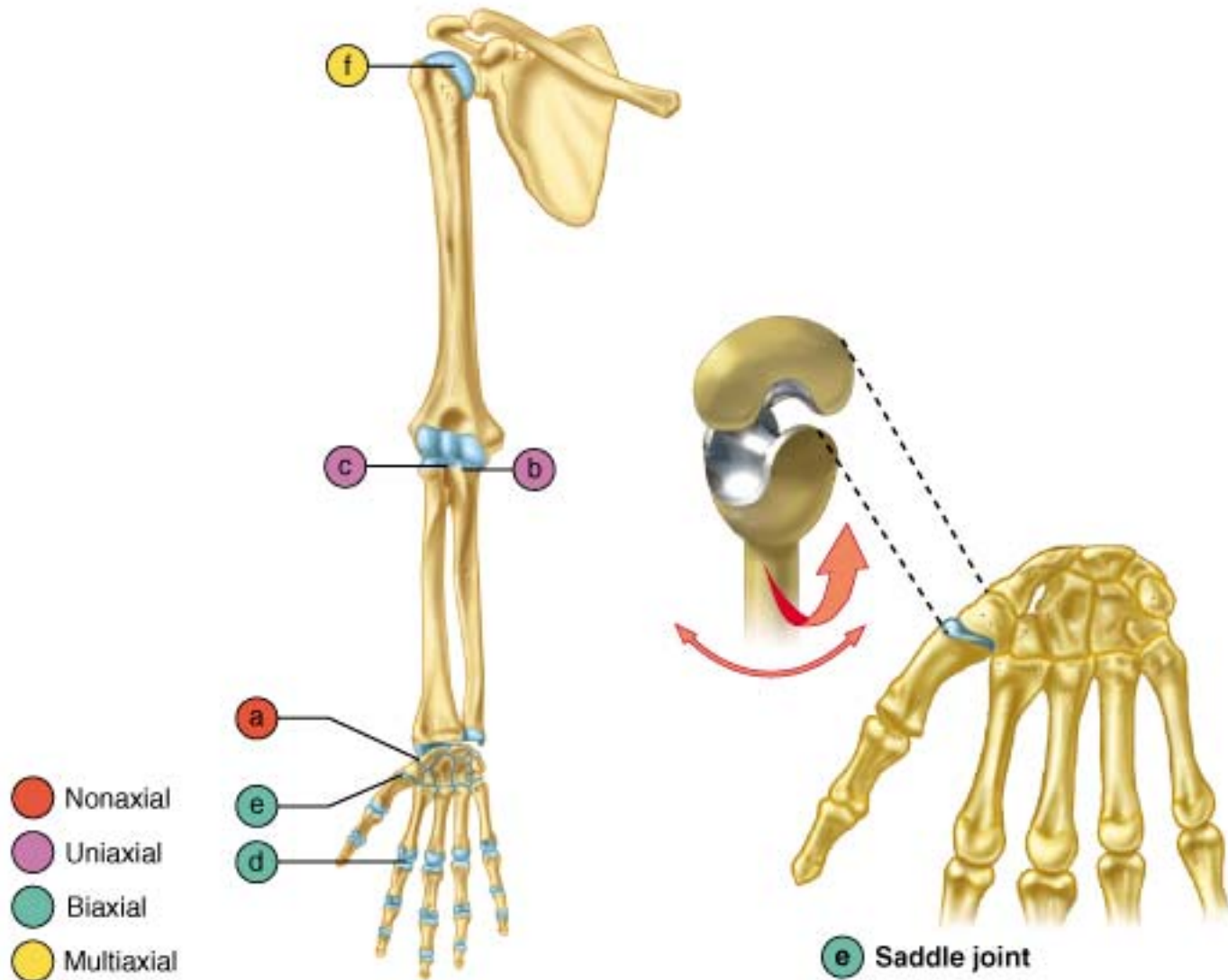


Types of synovial joints

5) Saddle joint: allows two planes of movement (flexion / extension, abduction / adduction).

Example: only found at the carpometacarpal joint of the thumb.

Saddle Joint

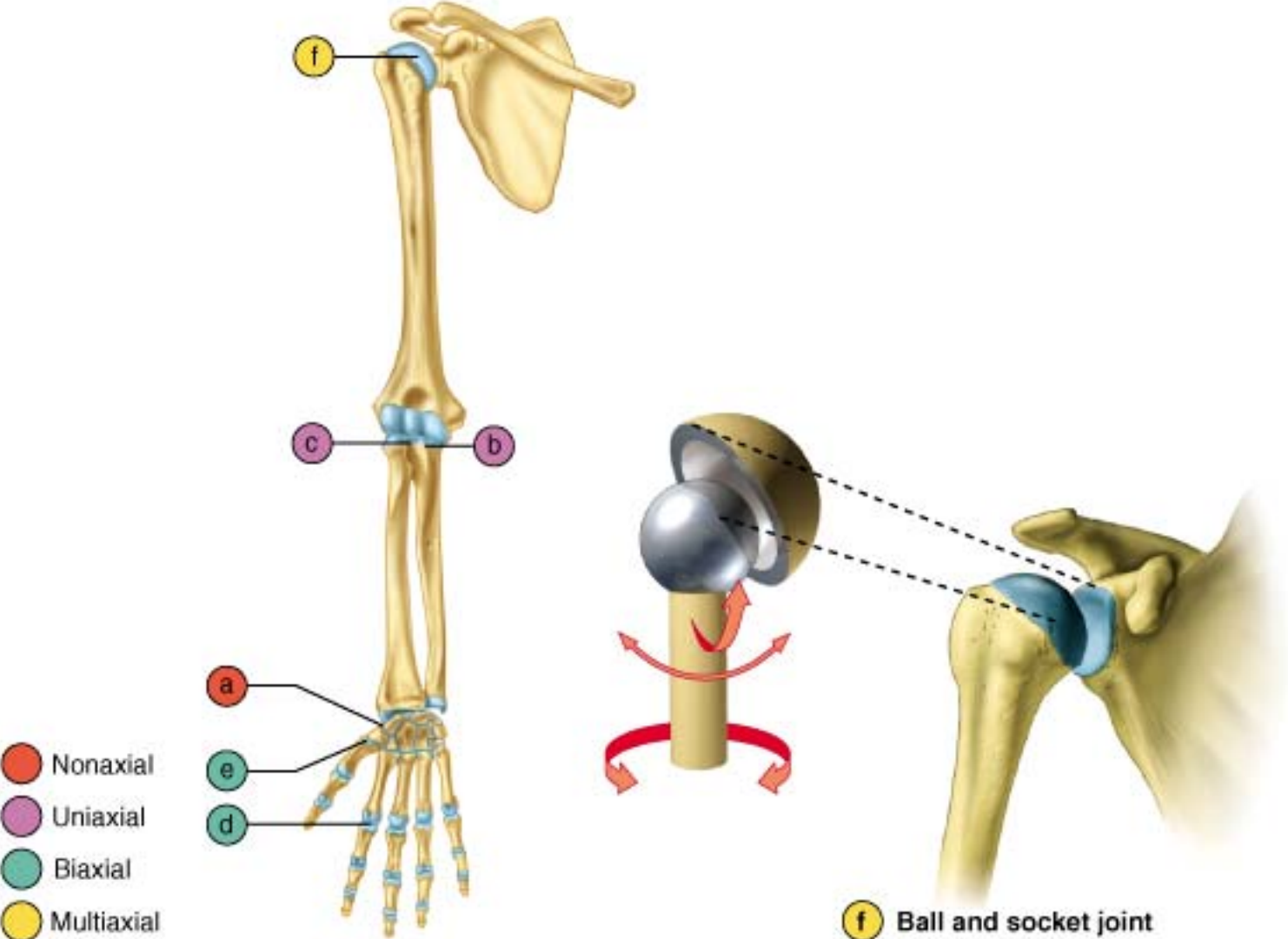


Types of synovial joints

6) Ball-and-socket joint: allows movement in all three planes (flexion/extension, abduction/adduction, & rotation)

Example: the hip and shoulder joints.

Ball-and-socket Joint

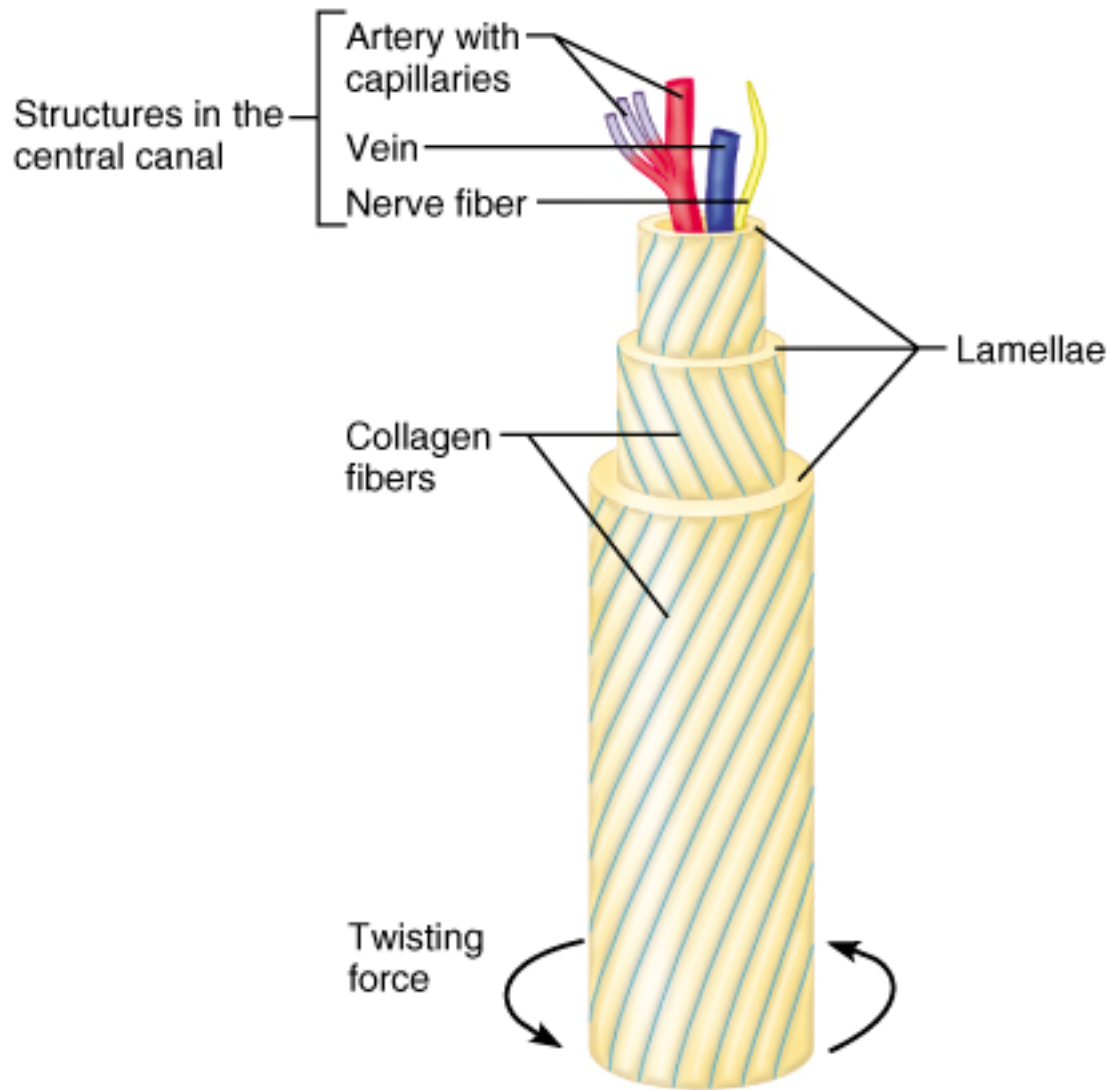


Architecture of bone (osseous tissue)

1. **Cortical (compact) bone:**

- the exterior dense layer of the bone
- consists of hollow tubes called **lamellae** (collagen fibers that are arranged in layers and run in different directions)
- A series of lamellae form an **osteon** or **haversian system** (weight-bearing pillars)
- Provides strength for weight bearing & stiffness in response to muscle tension

Osteon

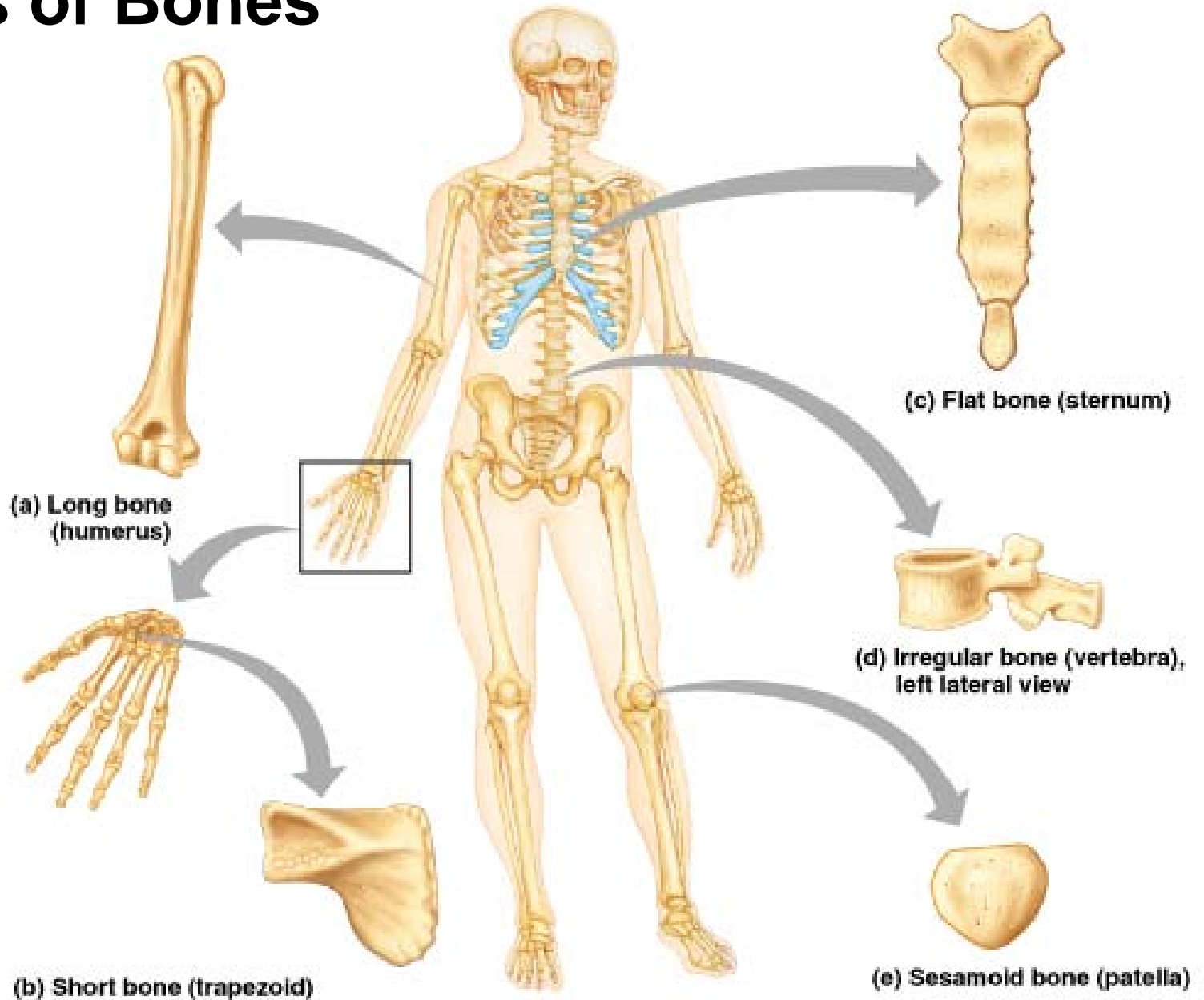


Architecture of bone (osseous tissue)

2. **Cancellous (spongy) bone** :

- interior to cortical bone
- consists of flat pieces of bone called **trabeculae** (collagen runs along the axis of the trabeculae)
- Provides energy absorption & stress distribution in response to loads
- Not as strong as cortical bone (risk of fracture in the elderly)

Types of Bones



(a) Long bone (humerus)

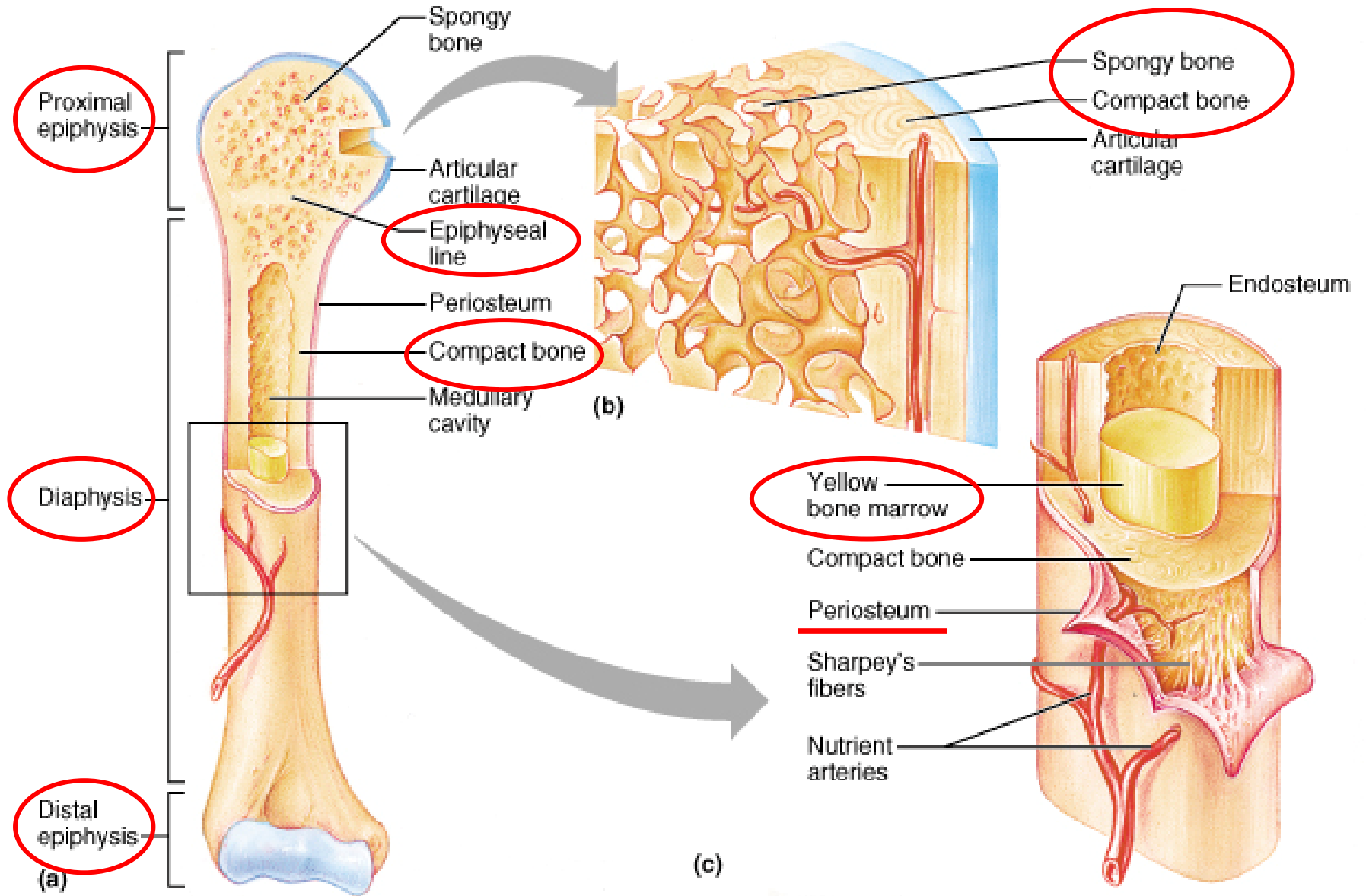
(c) Flat bone (sternum)

(d) Irregular bone (vertebra),
left lateral view

(b) Short bone (trapezoid)

(e) Sesamoid bone (patella)

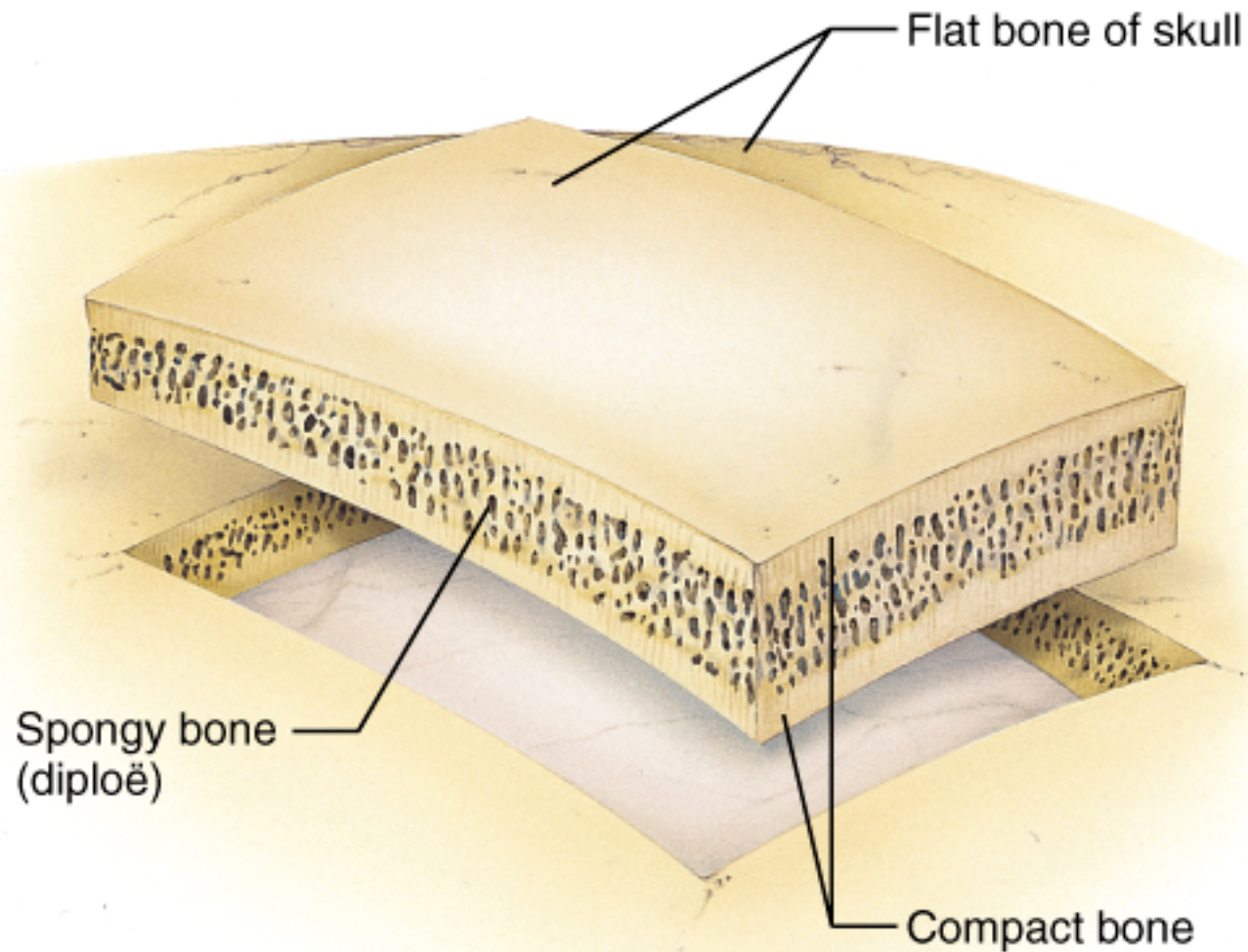
Long Bones



Long Bones

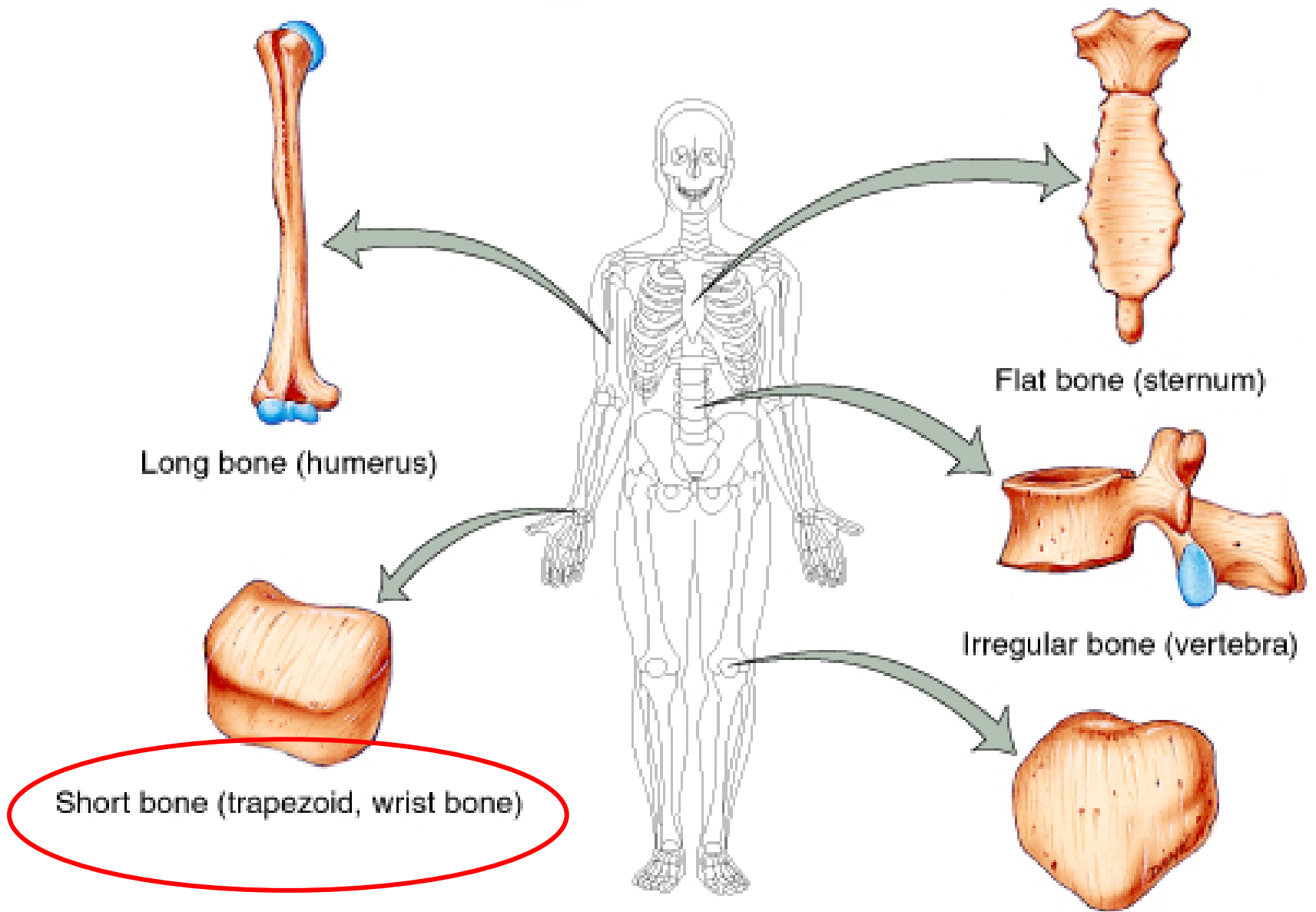
- Consist of a shaft called **diaphysis** (made of compact bone), which broadens out into the **epiphysis** (made up of spongy bone inside a thin layer of compact bone)
- Offer support and leverage
- Example: humerus, radius, ulna, femur, tibia, fibula, metacarpals, metatarsals

Flat Bones



Flat Bones

- Consist of two layers of compact bone with spongy bone in between
- Protect internal structures and offer broad surfaces for muscle attachments
- Example: ribs, illium, sternum, scapula



Long bone (humerus)

Flat bone (sternum)

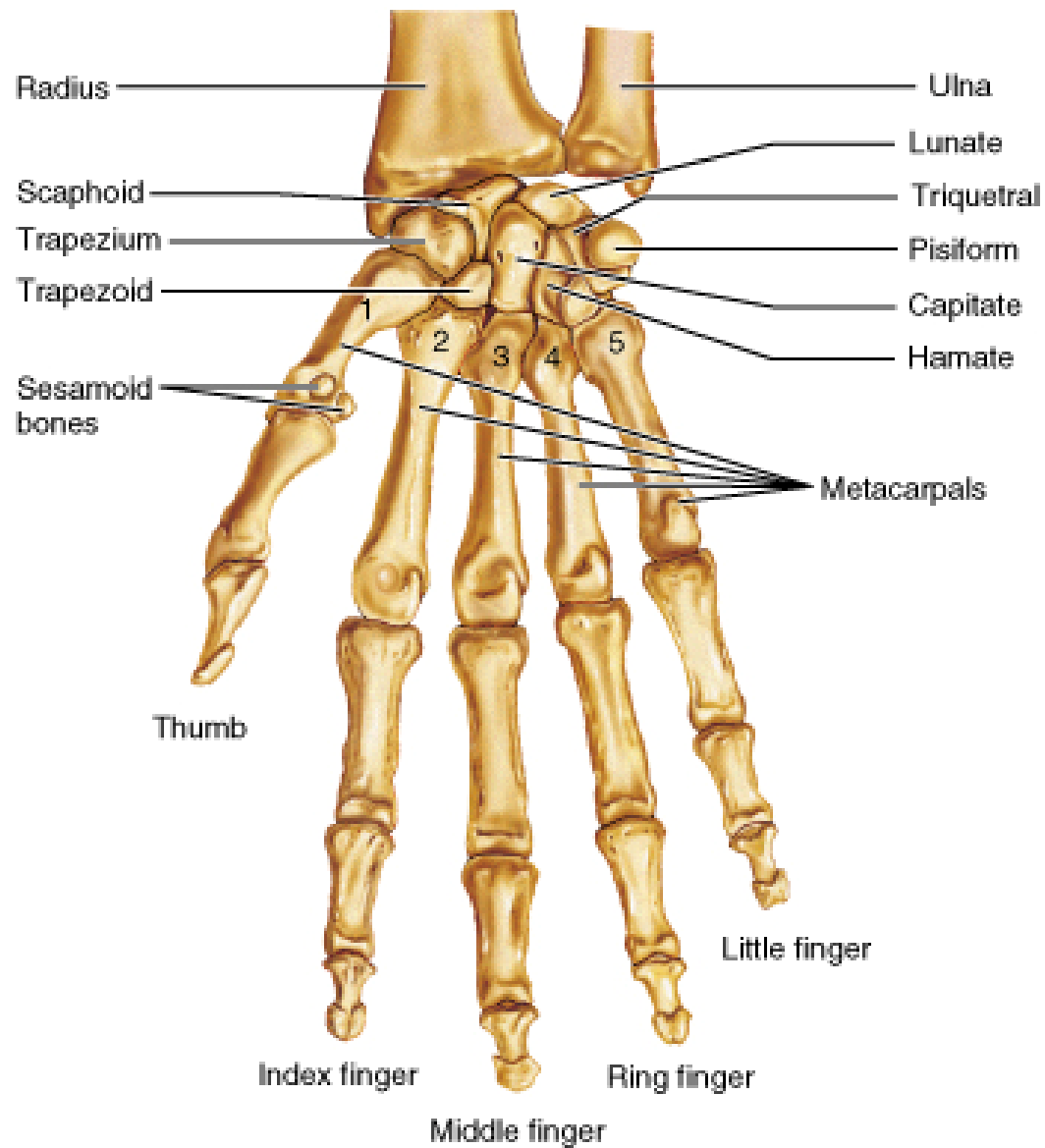
Irregular bone (vertebra)

Sesamoid bone (patella)

Short bone (trapezoid, wrist bone)

Short Bones

- Consist of spongy bone covered with a thin layer of compact bone
- Play an important role in shock absorption and transmission of forces
- Example: carpals of the hand and the tarsals of the foot



(a) Anterior view

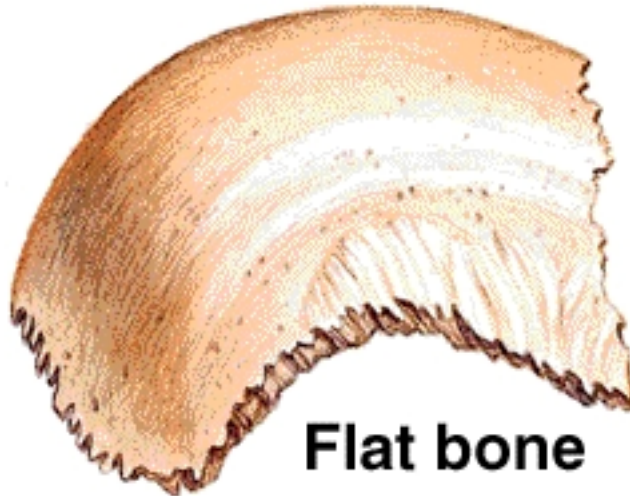
Bone Types



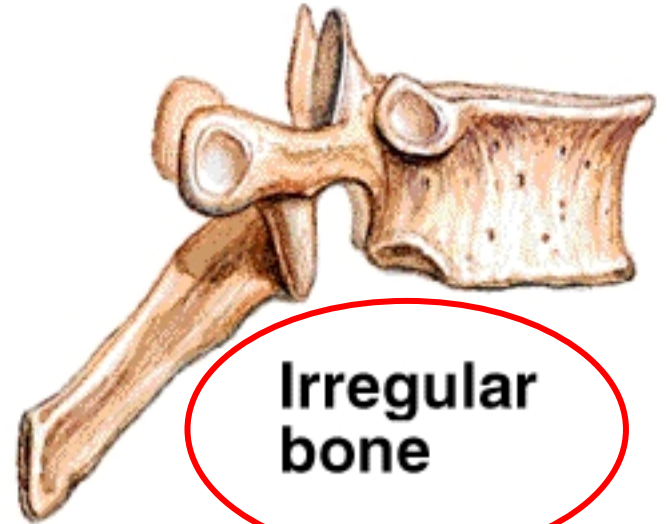
Long bone



Short bone



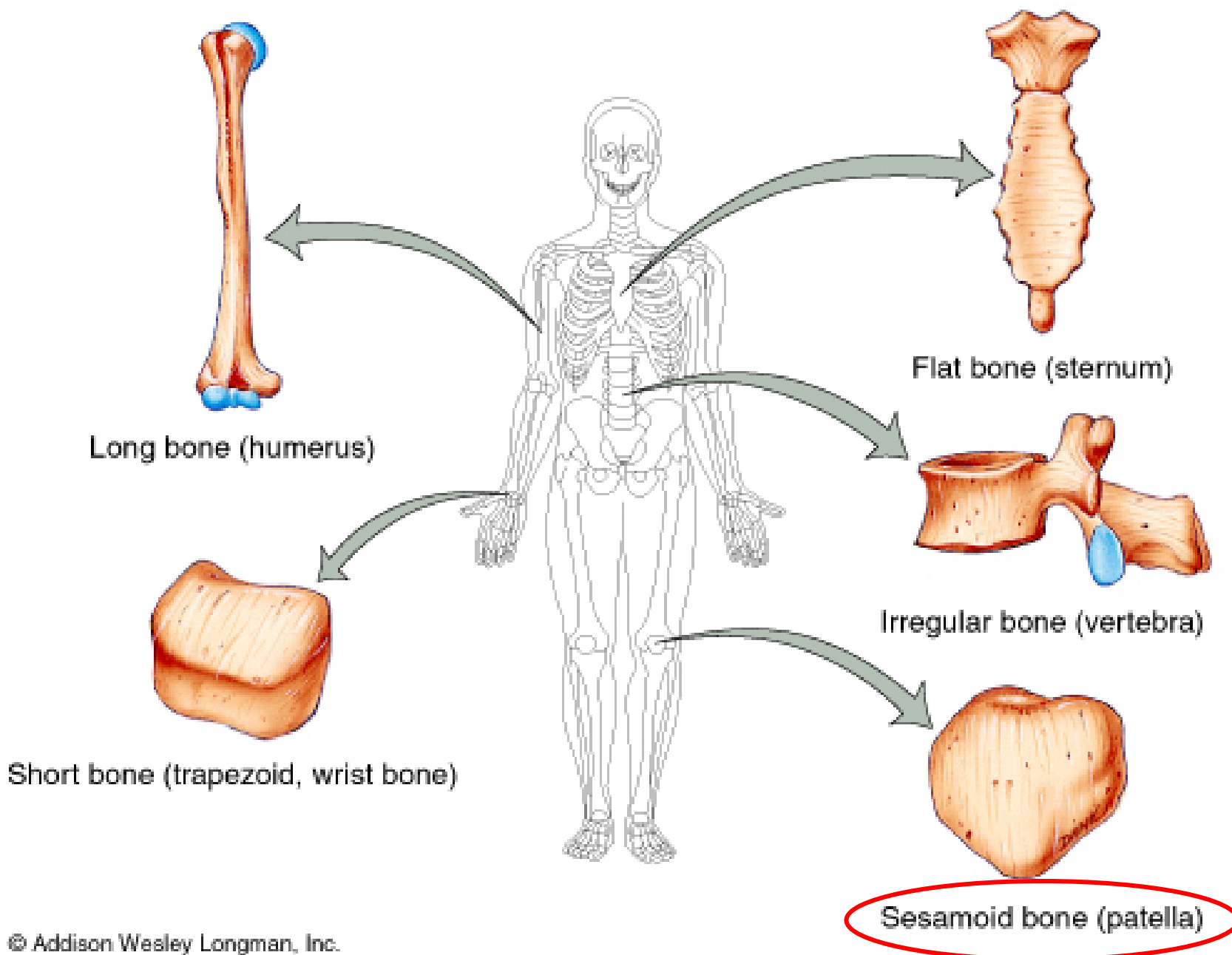
Flat bone



**Irregular
bone**

Irregular Bones

- Consist of spongy bone and thin exterior layer of compact bone
- Specialized functions such as supporting the weight, protecting the spinal cord, dissipating loads
- Example: vertebrae, ischium, pubis



Long bone (humerus)

Flat bone (sternum)

Irregular bone (vertebra)

Short bone (trapezoid, wrist bone)

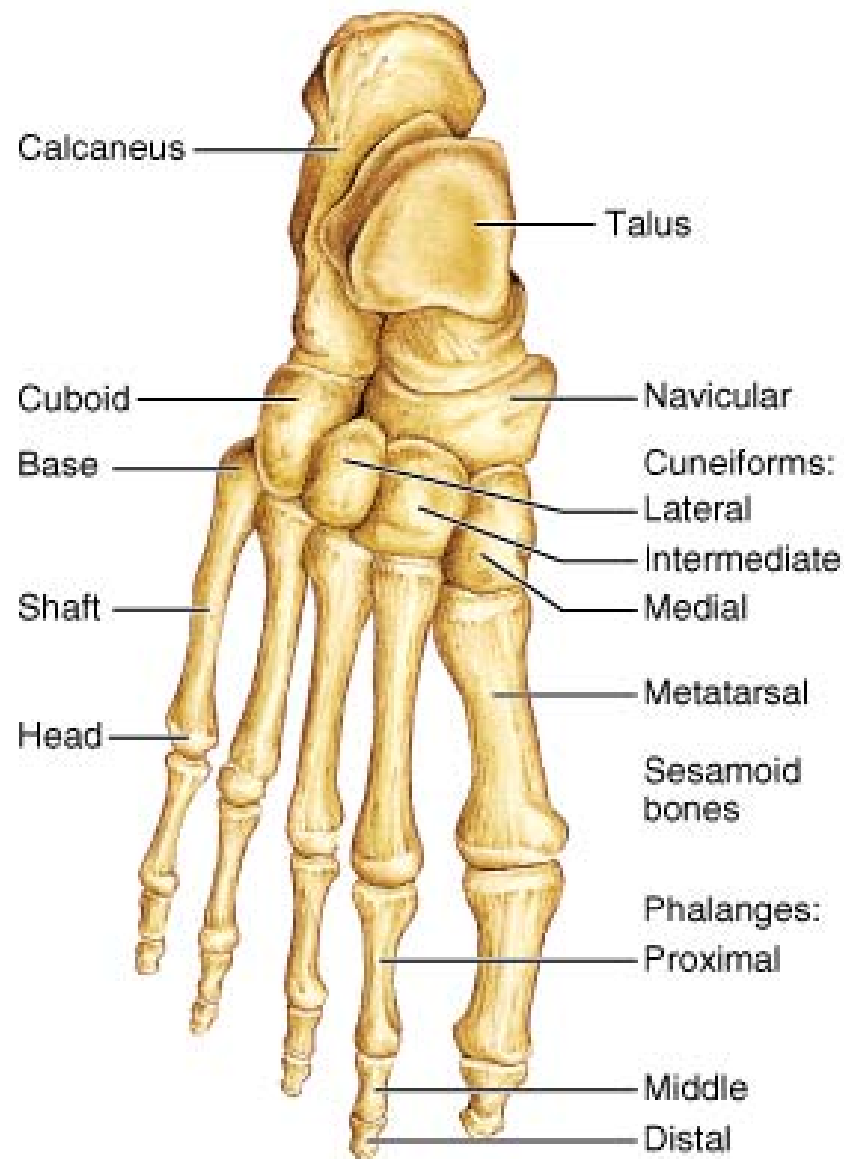
Sesamoid bone (patella)

Sesamoid Bones

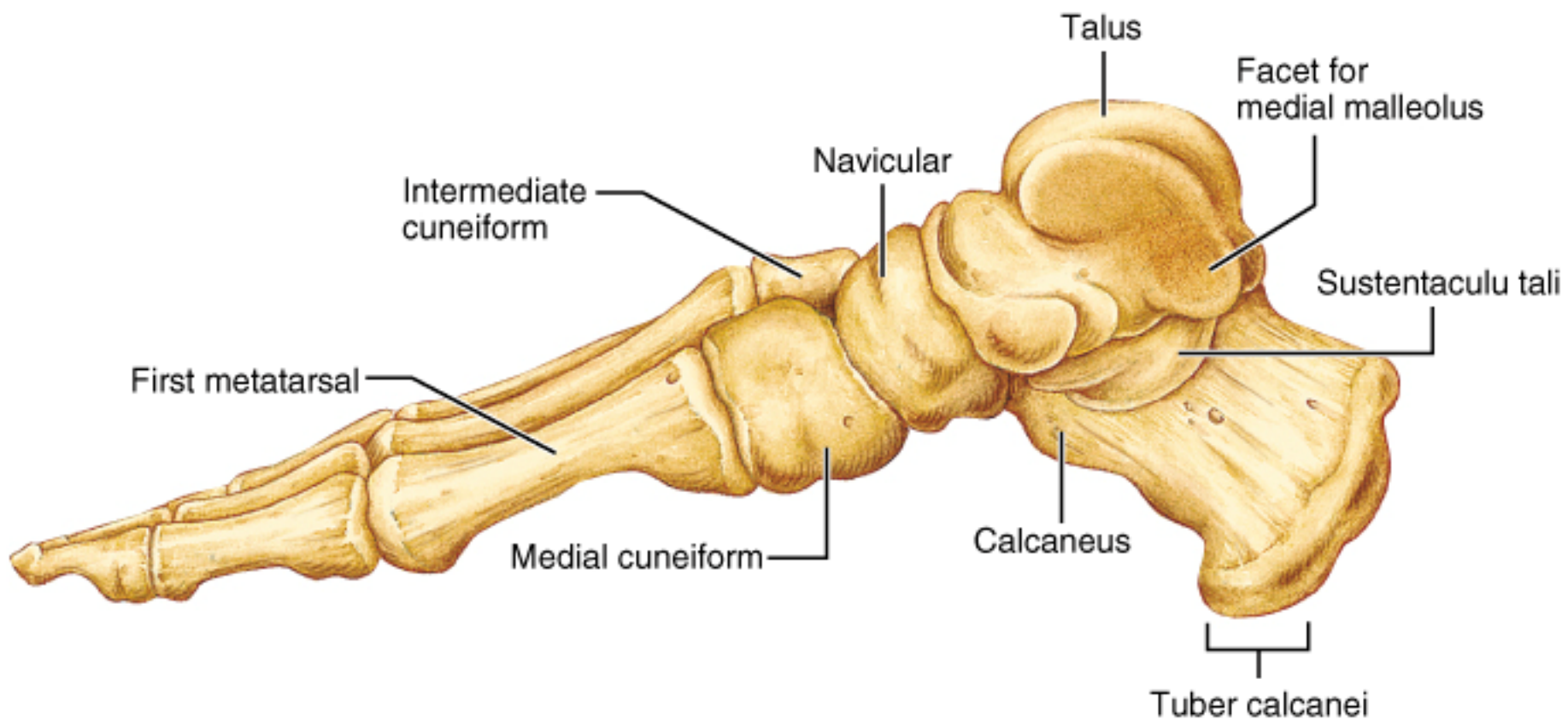
- Short type of bone embedded in a tendon or joint capsule
- Alter the angle of muscle insertion to increase its mechanical advantage
- Example: the patella embedded in the quadriceps tendon, sesamoid bones within the flexor tendons of the great toe & thumb

Accessory ossicles

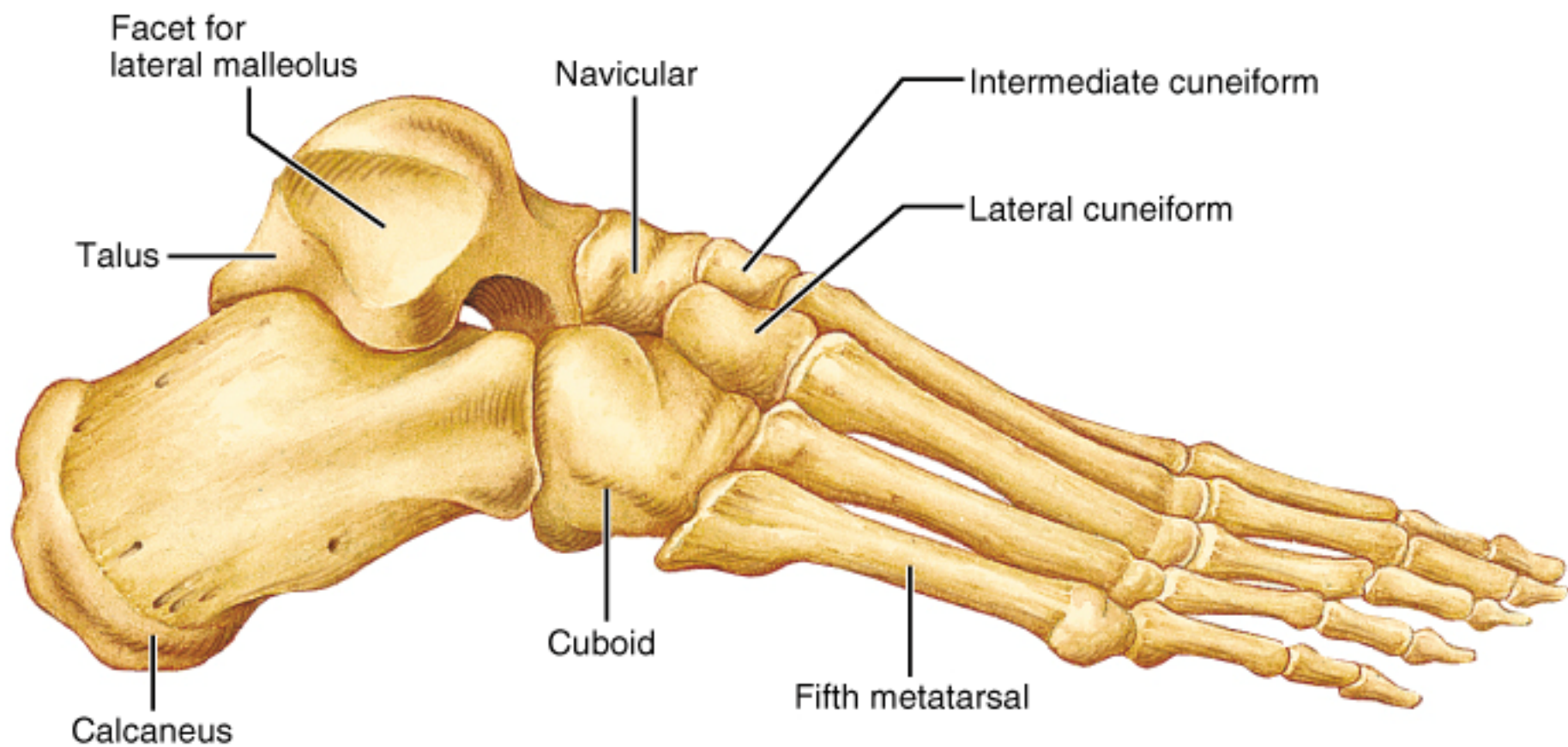
- Occur as variants of normal (only in few individuals, in addition to the normal bones).
- Can be mistaken as fractures, but are harmless.
- Example: the os trigonum behind the talus, the accessory navicular.



(a) Superior view



(b) Medial view



(c) Lateral view

Growth of bone

- Long bones grow from the epiphyseal plate (growth plate) at each end.
- Both ends grow, but generally one end will grow faster than the other.
- Example: distal epiphysis of the femur & proximal epiphysis of the tibia contribute roughly 60% of limb length, but proximal epiphysis of the humerus contribute 80% of humeral length.

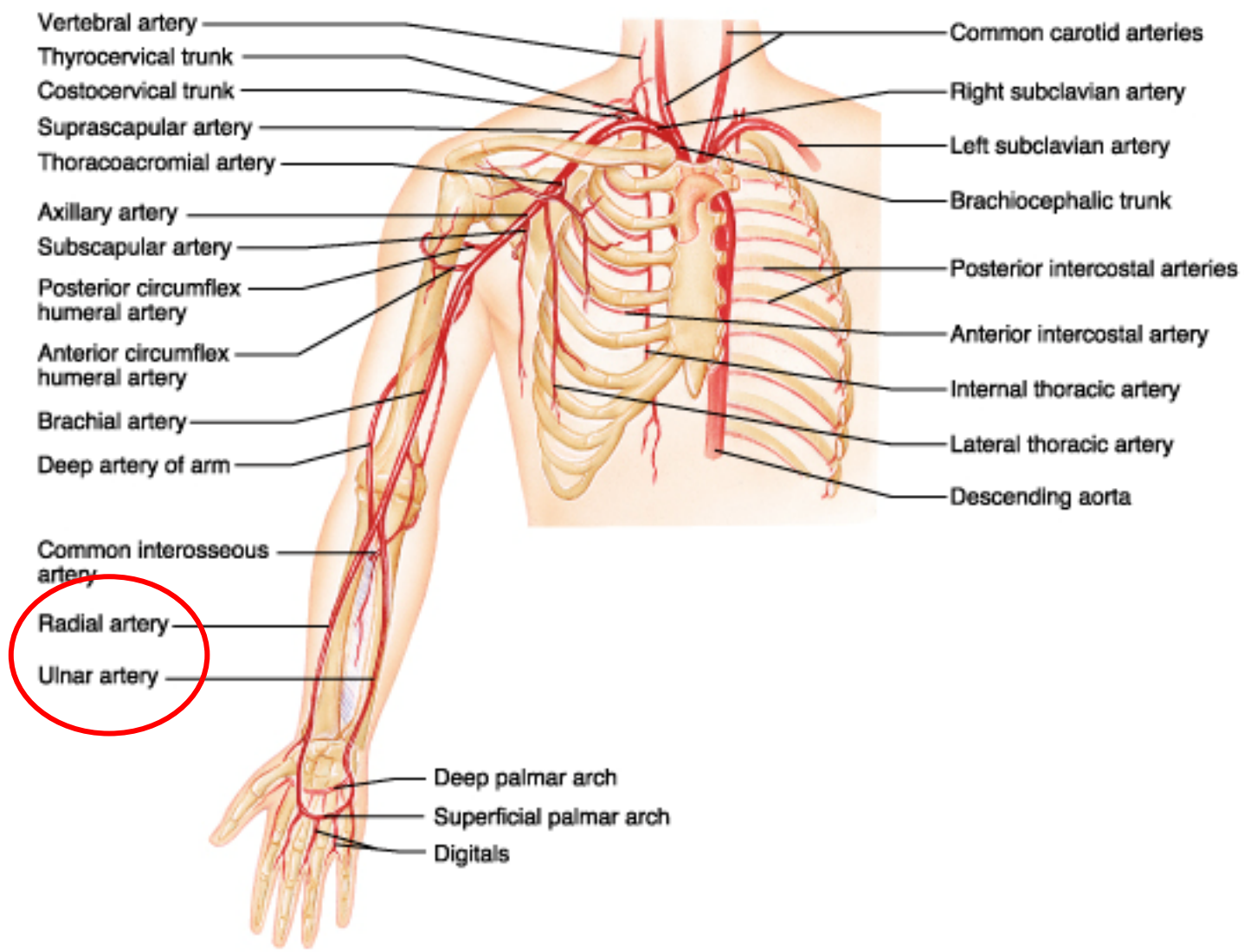
Muscles

- Agonists and antagonists oppose each other, but still work as balanced groups.
- Muscles are contained within Fascial **Compartments**.
- Swelling →
compartment pressure →
ischaemic pain

Forearm compartments

- Ventral compartment:
 - median & ulnar nerves
 - Radial & ulnar arteries

- Dorsal compartment:
 - Less common and less serious
 - Posterior interosseous nerve




Lower limb compartments

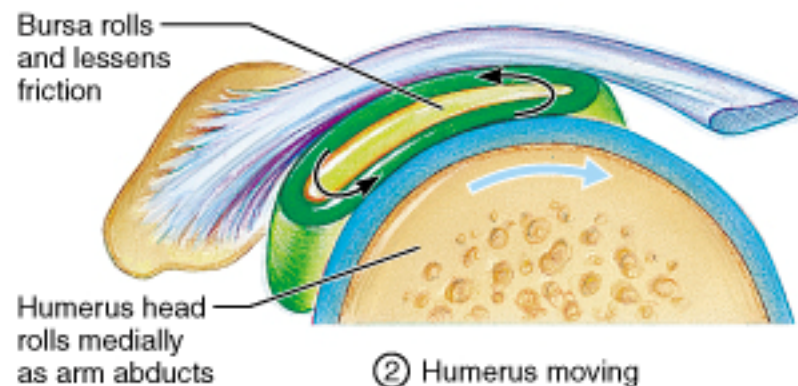
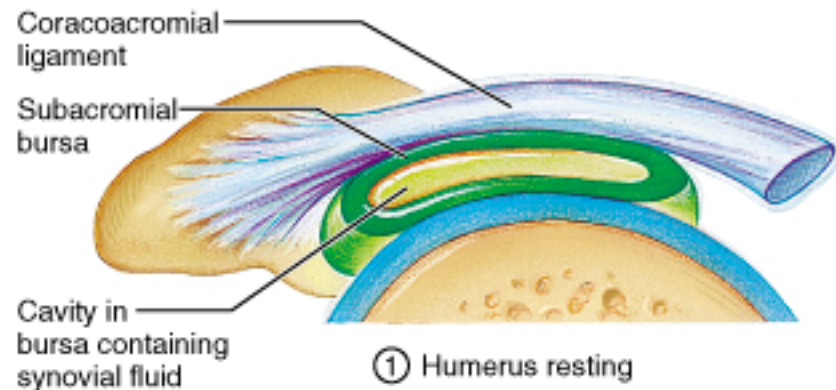
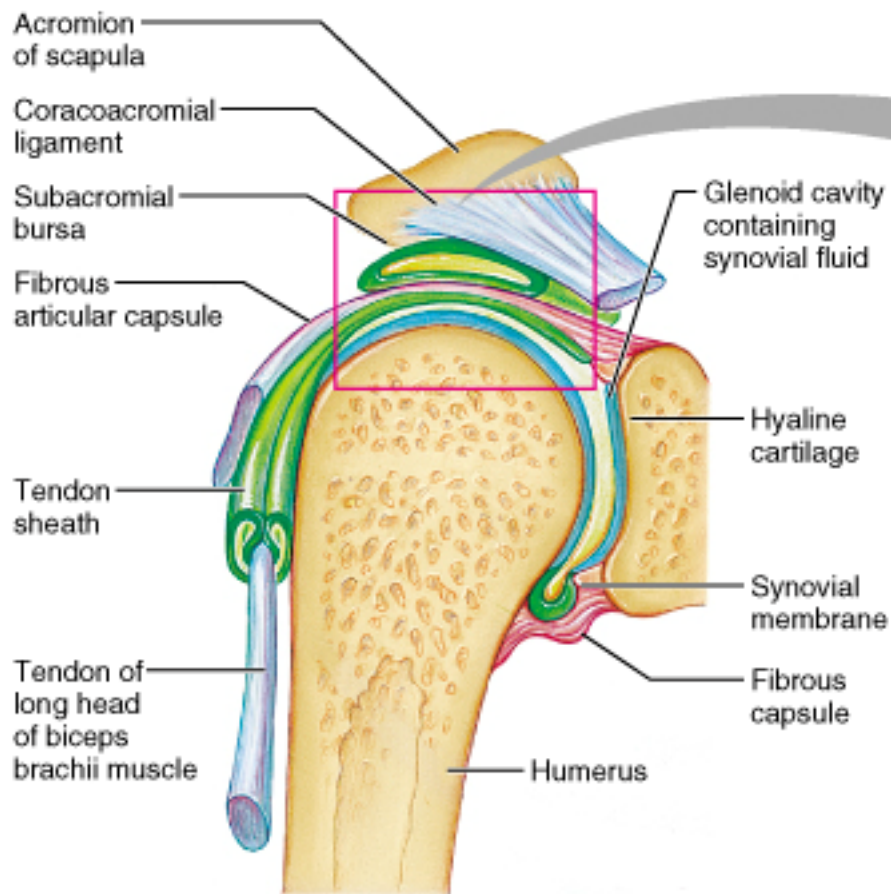
- Anterior (tibial) compartment:
 - Deep peroneal nerve
 - Anterior tibial artery
- Lateral (peroneal) compartment:
 - Superficial peroneal nerve
 - Rarely affected by compression

Lower limb compartments

- Superficial posterior compartment:
 - Gastrocnemius & soleus muscles
 - No important nerves or vessels
- Deep posterior compartment:
 - Posterior tibial vessels and nerves
 - Peroneal artery
 - Serious consequences if damaged

Tendons

- Muscle action depends on the direction of its tendon.
- Tendons do not tolerate friction  protected by bursae or synovial sheets



(a)

(b)

Nerves

```
graph TD; Nerves --> RootLesions["Root lesions  
(e.g., disc prolapse,  
spinal injury)"]; Nerves --> PeripheralNerves["Peripheral nerves  
(e.g., ulnar neuritis,  
median nerve compression)"];
```

Root lesions

(e.g., disc prolapse,
spinal injury)

Peripheral nerves

(e.g., ulnar neuritis,
median nerve compression)

Vulnerable peripheral nerves

Upper limb

- Median nerve
 - Most common: compression at the wrist (carpal tunnel)
 - Fluid retention in pregnancy
 - Repetitive movement (flexor tenosynovitis)
 - Sensory distribution: thumb, index, and middle fingers, half the ring finger

Vulnerable peripheral nerves

Upper limb

- Ulnar nerve:
 - Most common: irritation at the elbow
 - Sensory distribution: little finger & ulnar half of the ring finger
- Radial nerve:
 - Vulnerable in the medial side of the upper arm (e.g., axillary crutches)
 - Drop wrist (few sensory symptoms)

Vulnerable peripheral nerves

Lower limb

- Sciatic nerve:
 - Posterior dislocation of the hip
- Common peroneal nerve:
 - Trauma causing lesion as the nerve crosses the neck of fibula
- Lumbar nerve roots
 - Prolapsed intervertebral discs