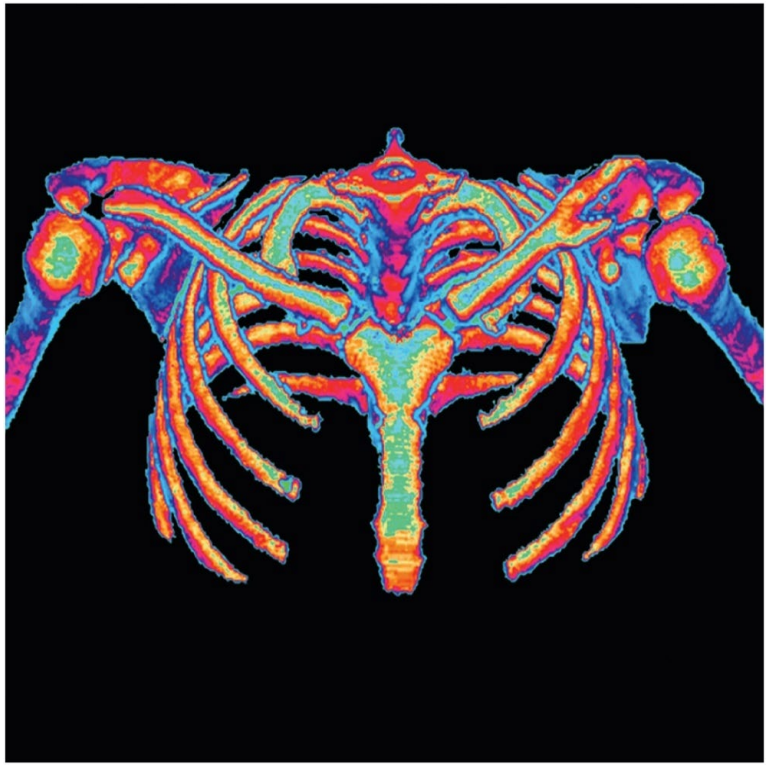
C8 Skeletal System, C9 Joints, and C10 Muscle System

Only The Essential Info

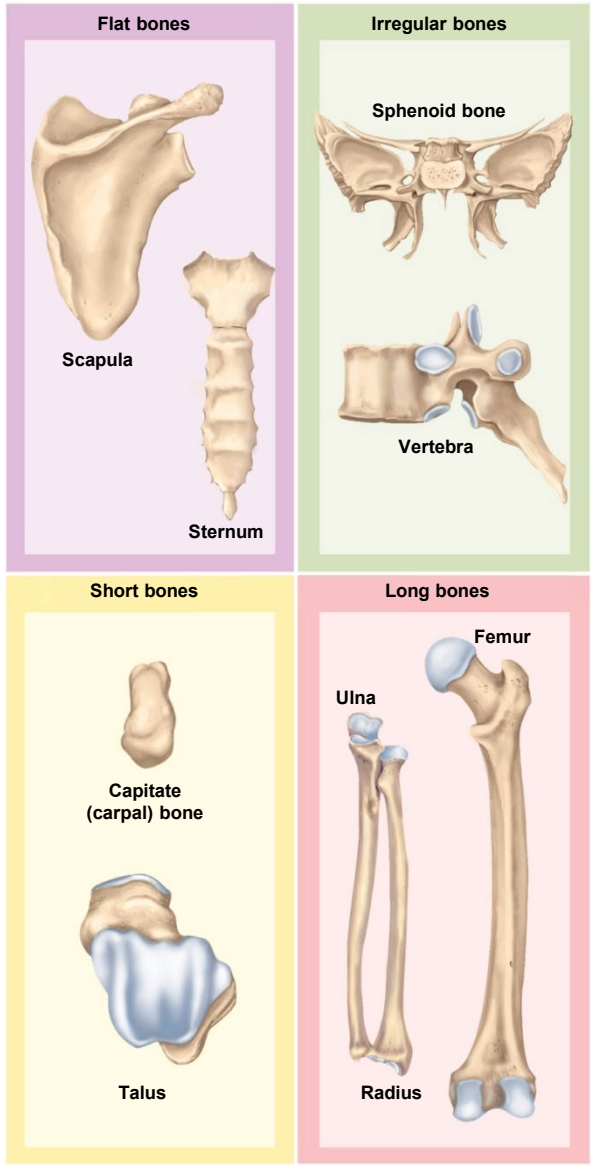
(See Special Summary Study Guide for These Slides)



C8

An Introduction to the Skeleton System

Shapes of Bones



long bones

–longer than wide

–rigid levers acted upon by muscles

short bones

–equal in length and width

–glide across one another in multiple directions

flat bones

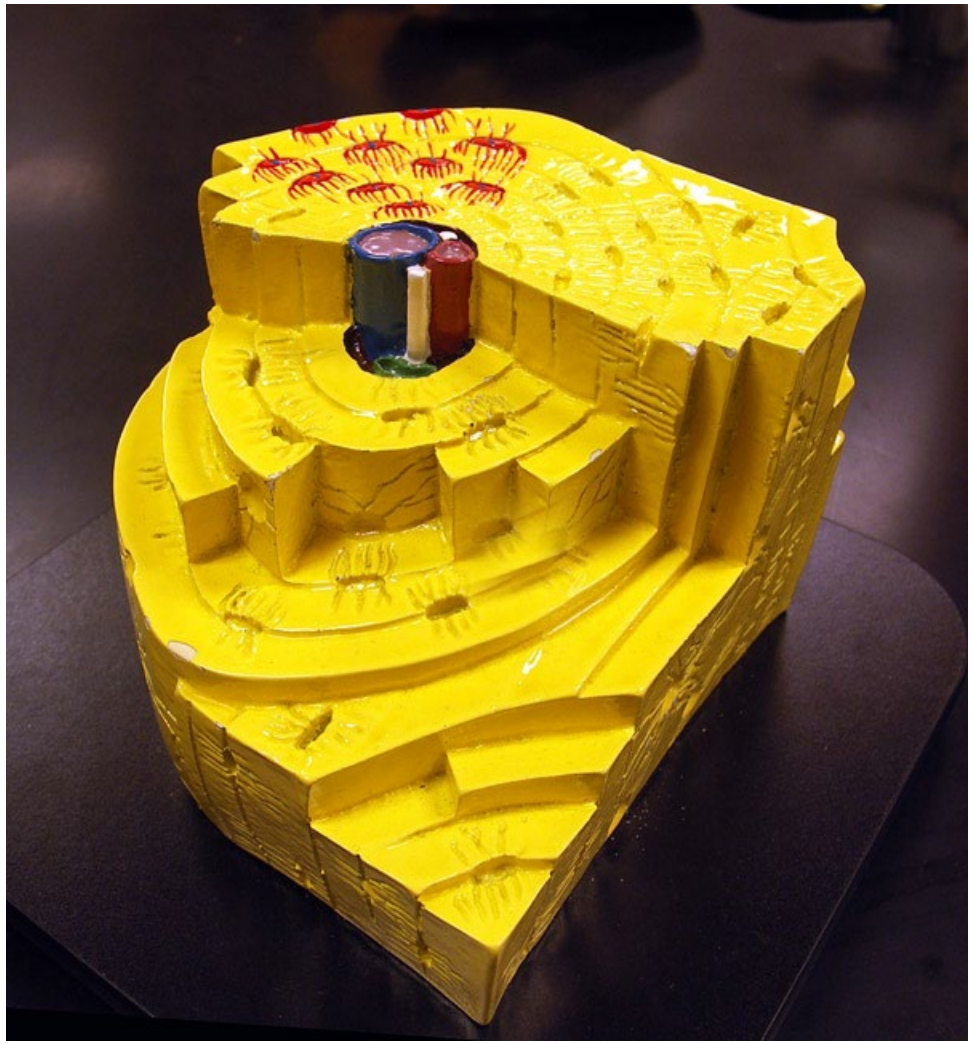
–protect soft organs

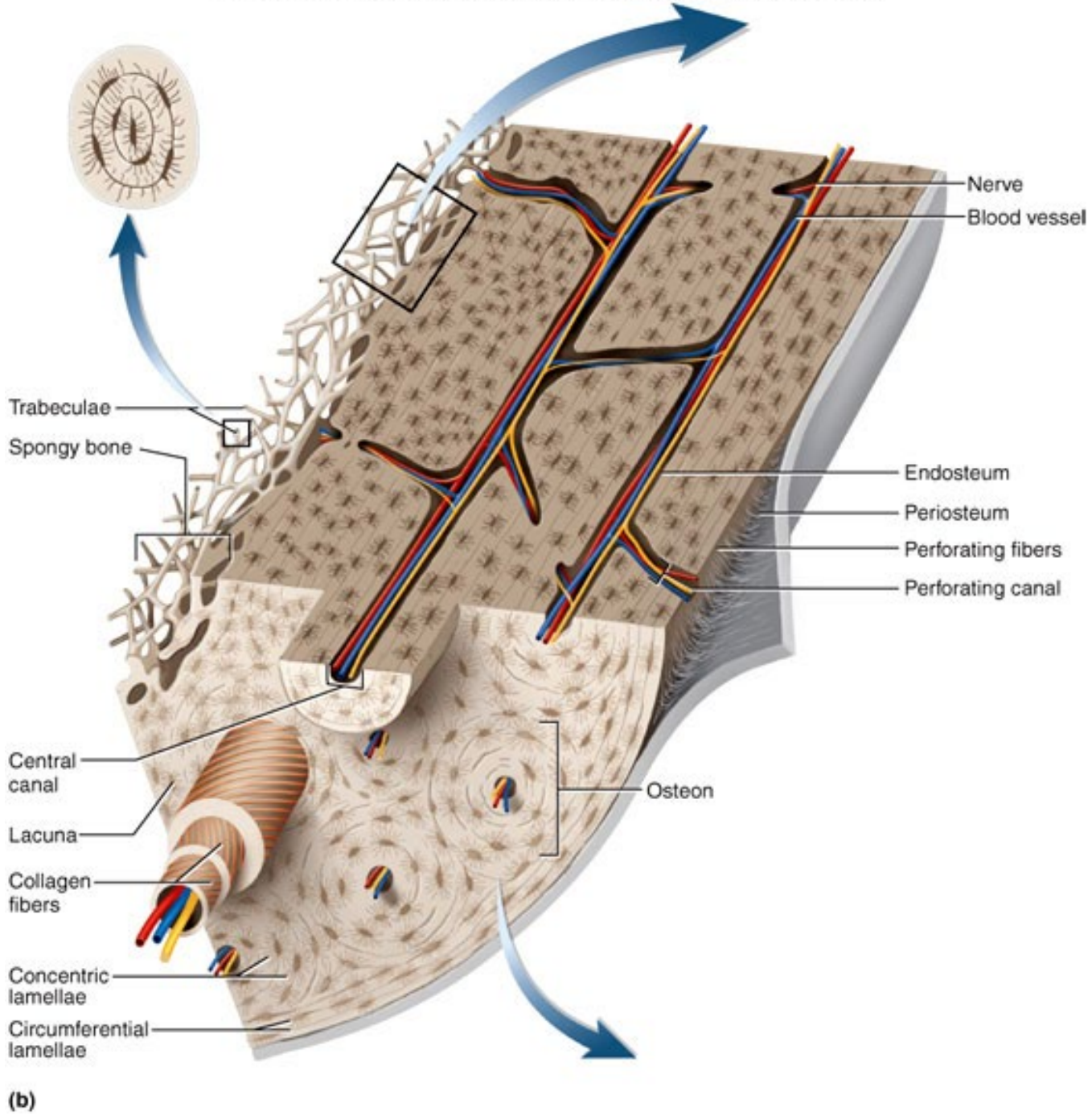
–curved but wide & thin

irregular bones

–elaborate shapes that don't fit into the other categories

The Osteon is the functional unit of bone.

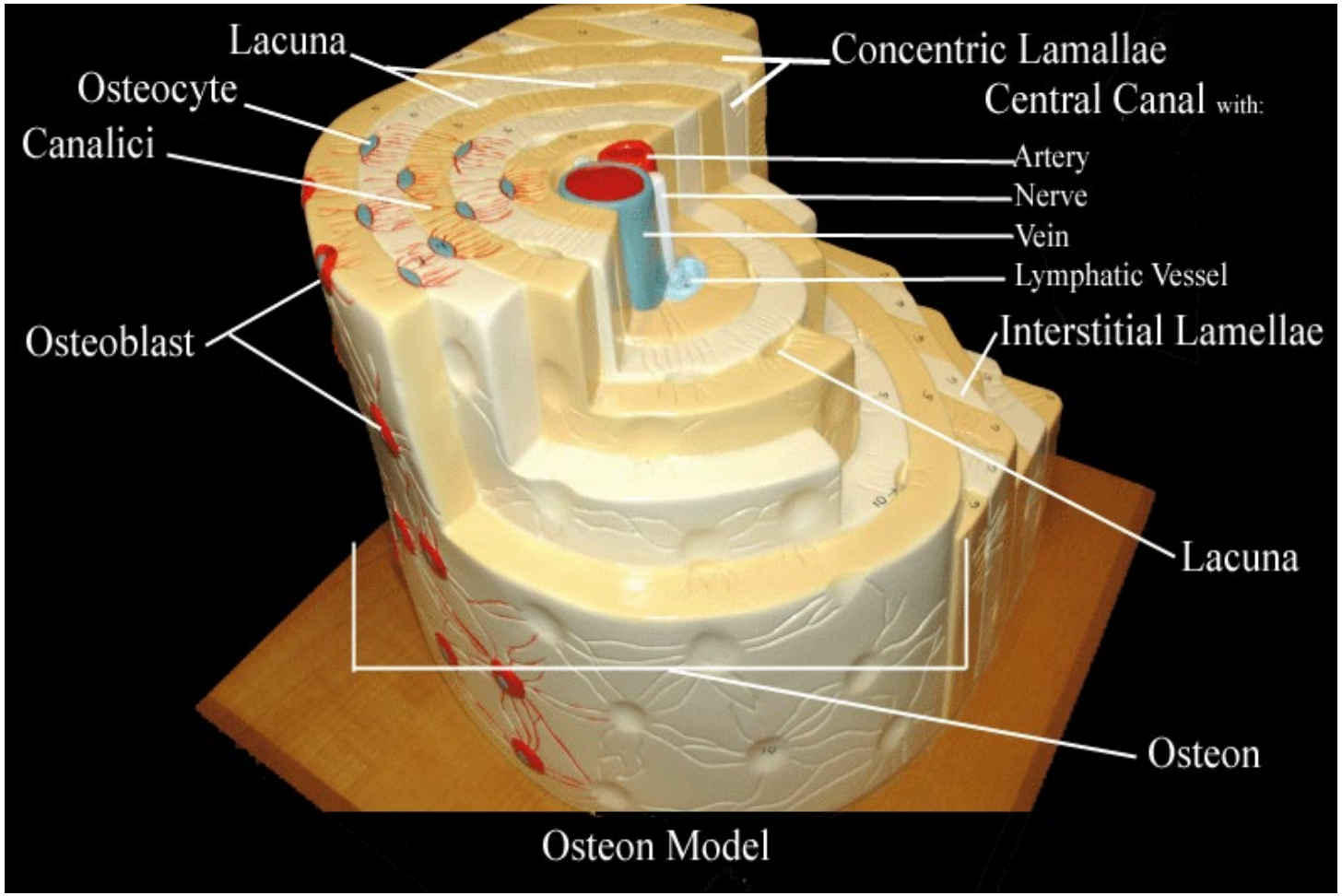


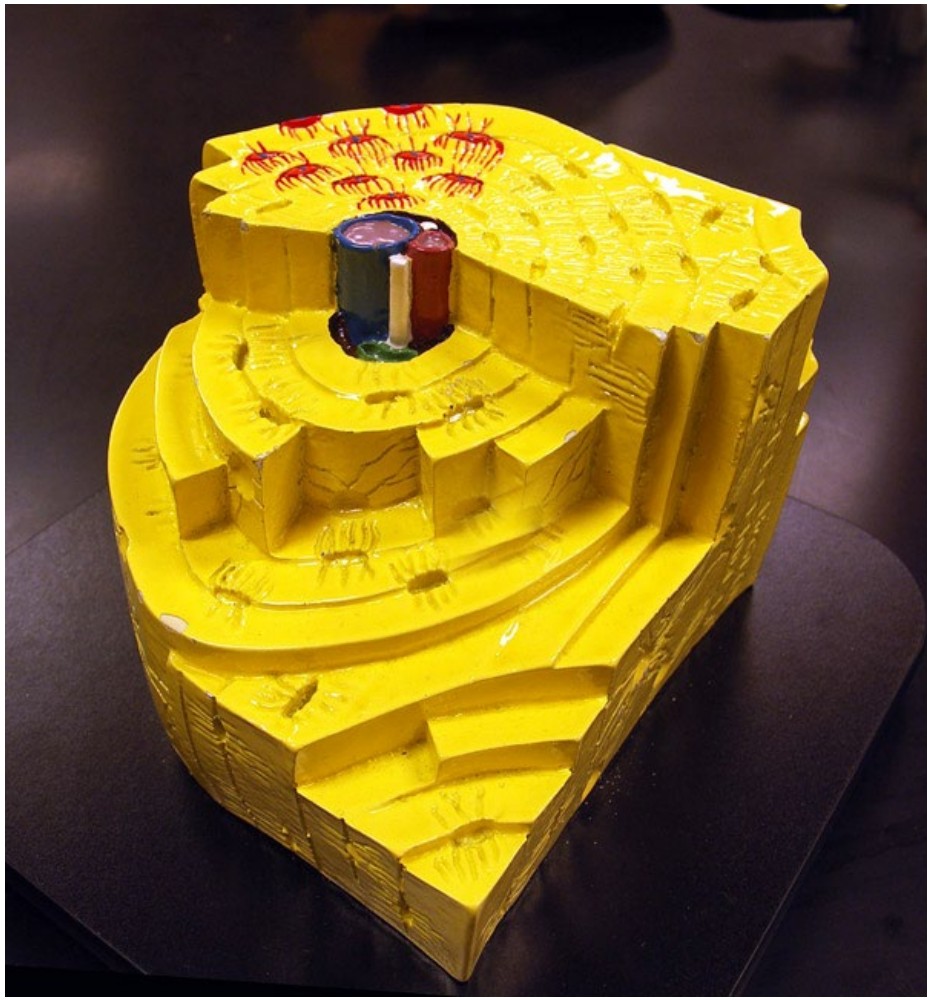


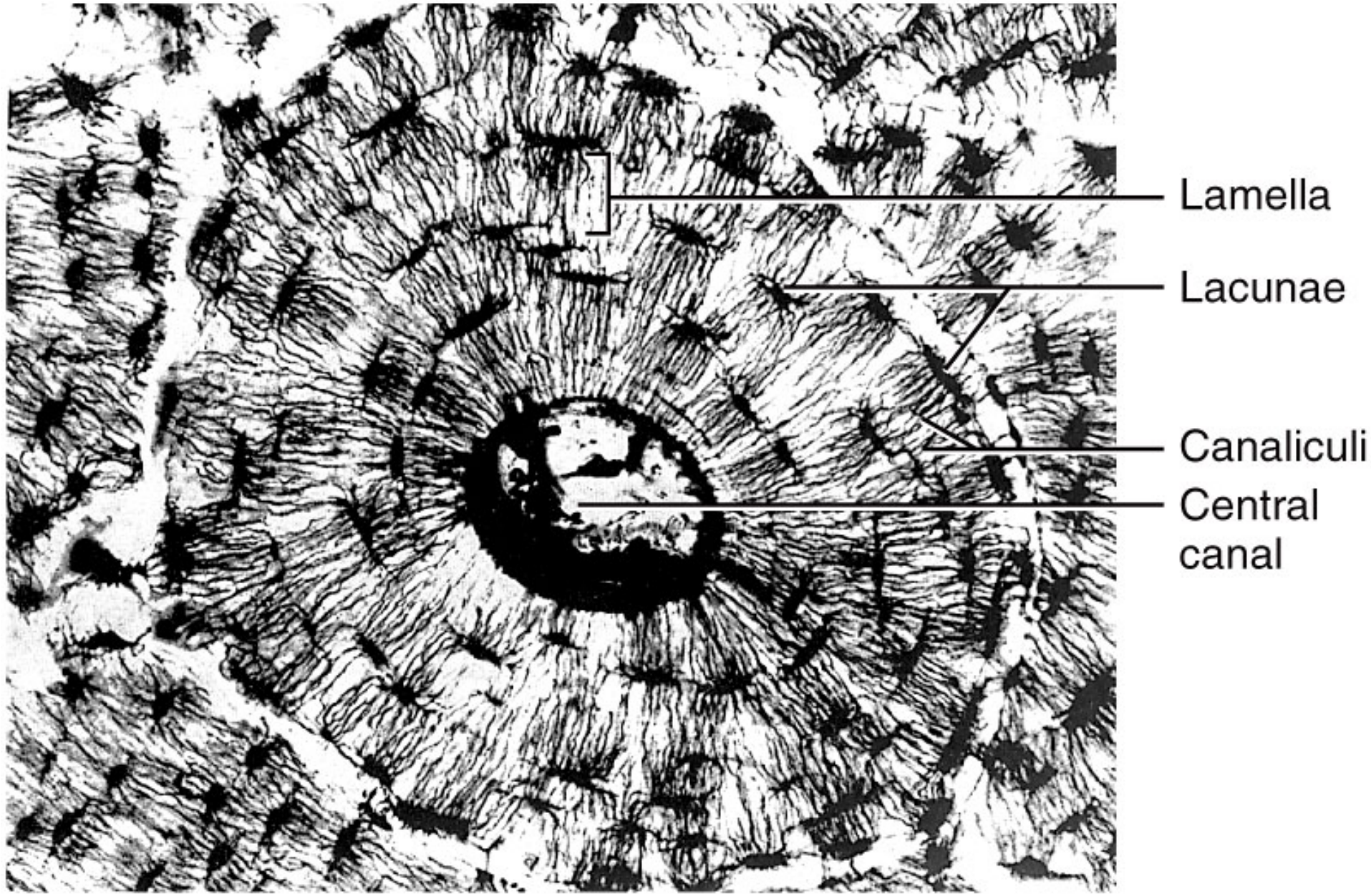
Compact Bone Structure

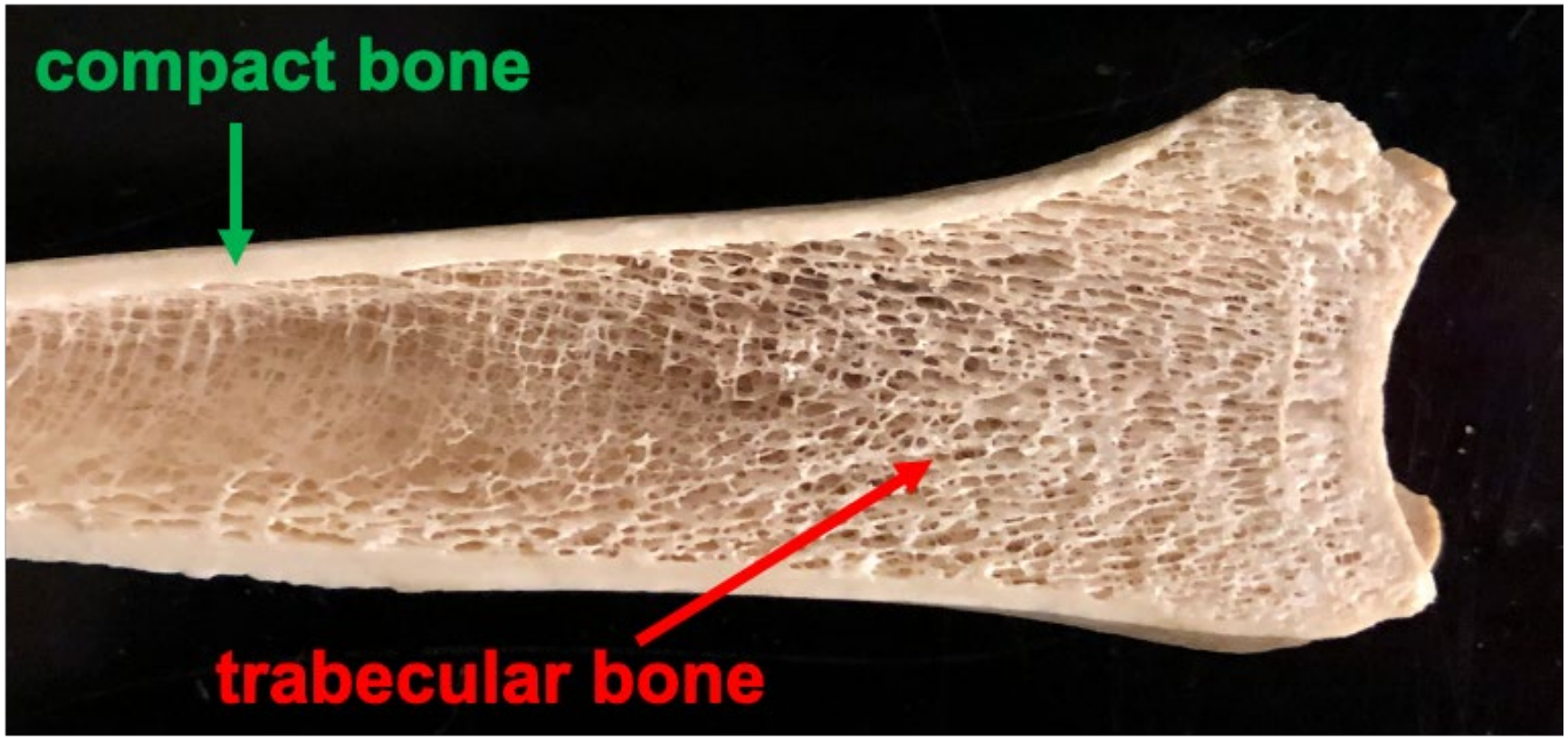
Blood Vessels of Bone

- circumferential lamellae
  - interstitial lamellae


Lacuna
Osteocyte
Canalici
Osteoblast
Concentric Lamallae
Central Canal with:
Artery
Nerve
Vein
Lymphatic Vessel
Interstitial Lamellae
Lacuna
Osteon
Osteon Model

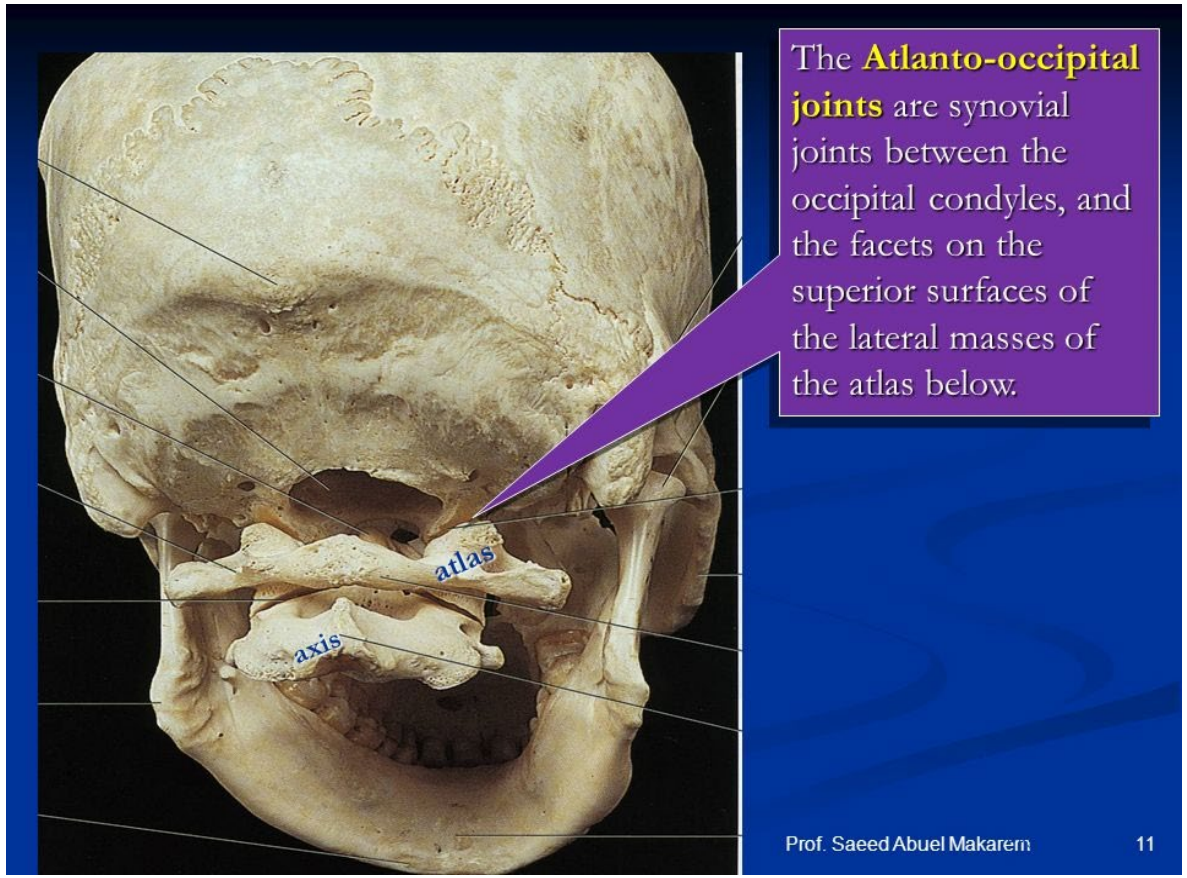


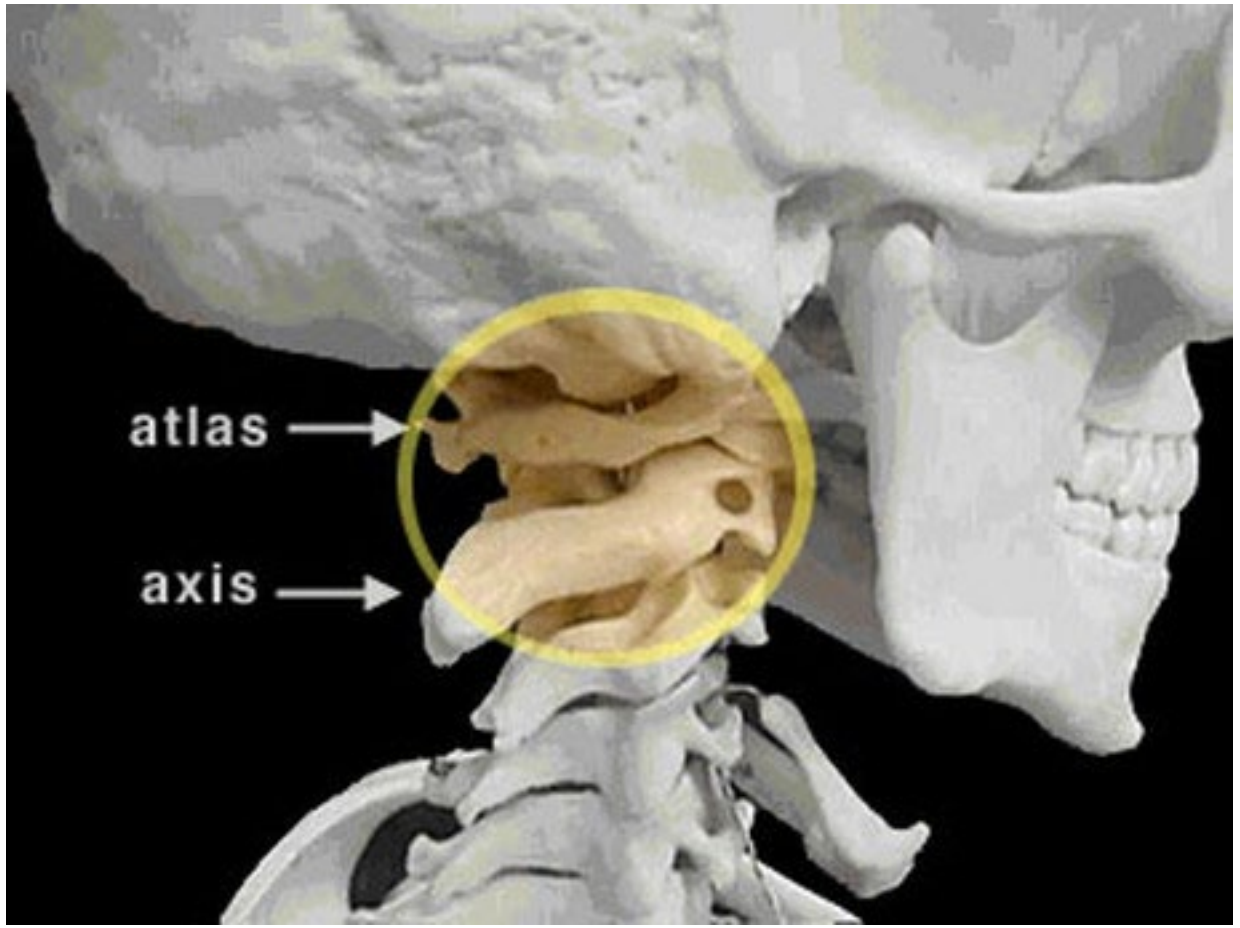


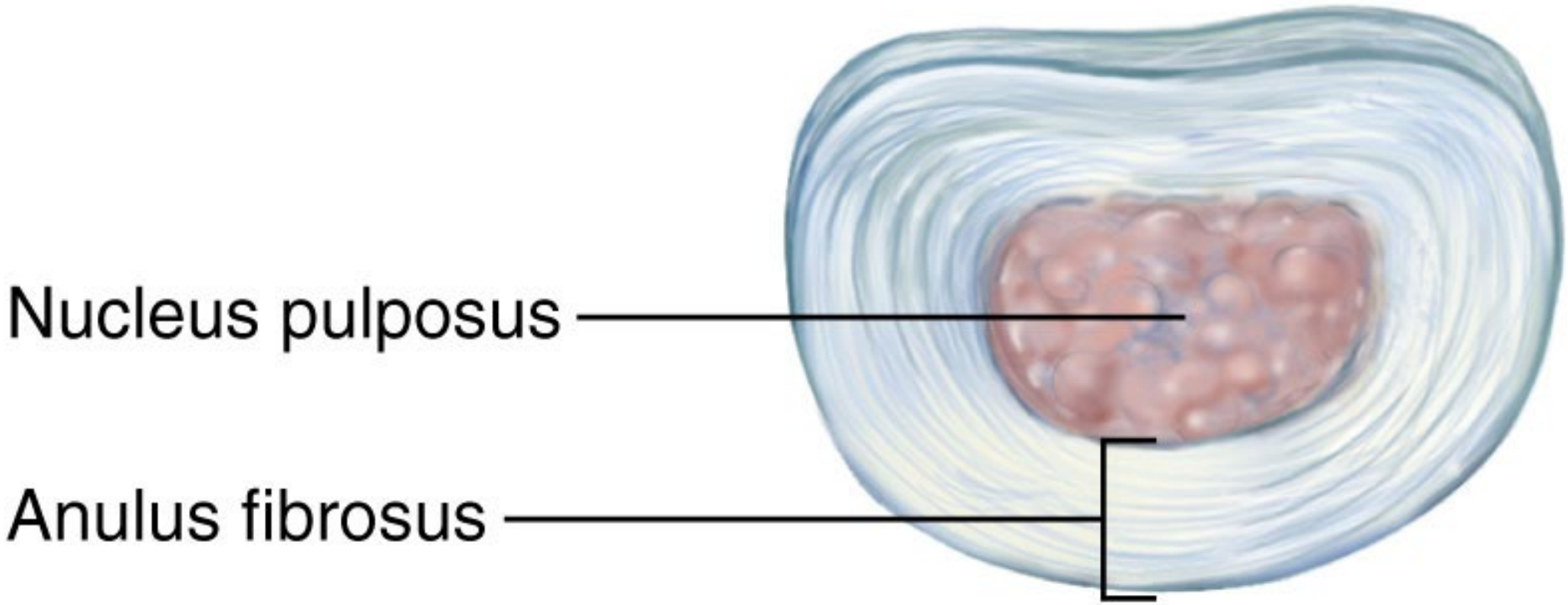


Trabecular bone is also called cancellous bone or spongy bone.

The osteon is also the structure of cancellous bone. The osteons are now arranged not parallel but in a random order.

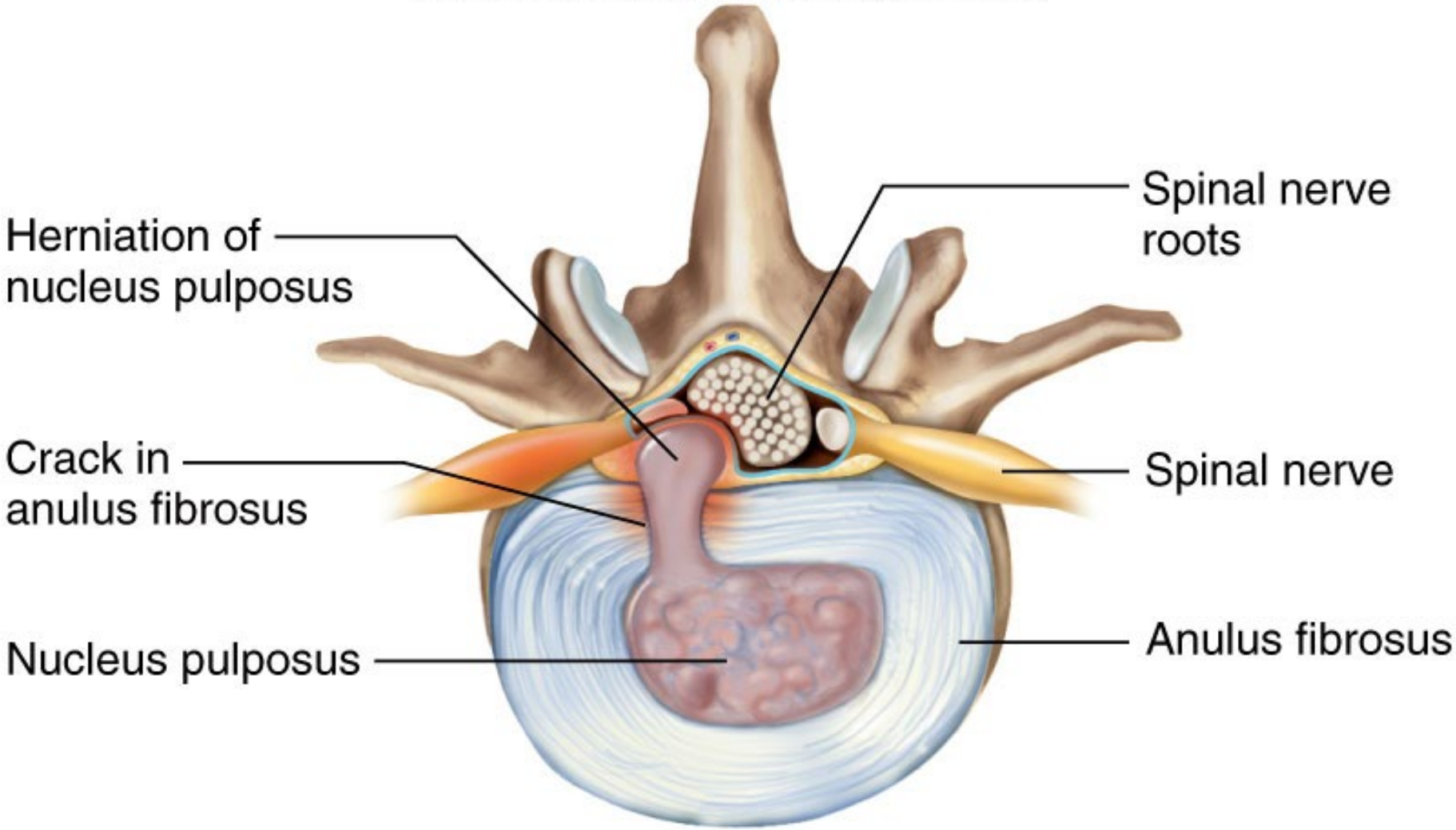

The **Atlanto-occipital joints** are synovial joints between the occipital condyles, and the facets on the superior surfaces of the lateral masses of the atlas below.
atlas
axis
Prof. Saeed Abuel Makarem
11


atlas
axis



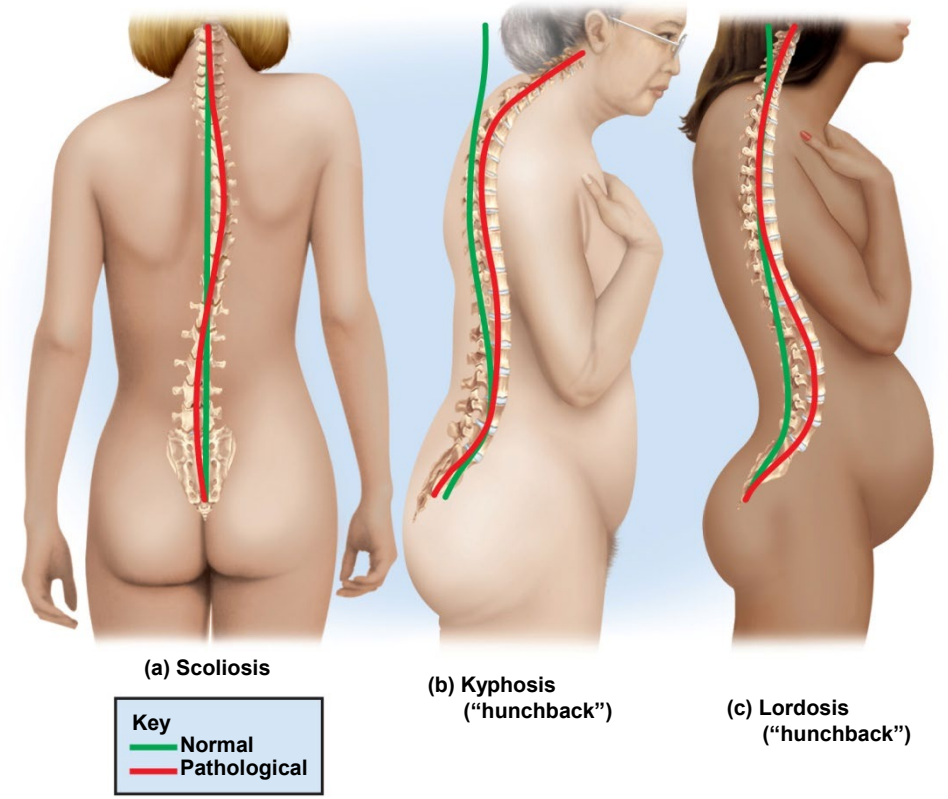
(b) Intervertebral disc

(Fibrocartilage Disc)



(c) Herniated disc

Abnormal Spinal Curvatures



Occurs from disease, paralysis of trunk muscles, poor posture, pregnancy, or congenital defect

scoliosis – abnormal lateral curvature

–most common

–usually in thoracic region

–particularly of adolescent girls

–developmental abnormality in which the body and arch fail to develop on one side of the vertebrae

kyphosis (hunchback) – exaggerated thoracic curvature

–usually from osteoporosis, also osteomalacia or spinal tuberculosis, or wrestling or weightlifting in young boys

lordosis (swayback) – exaggerated lumbar curvature

– is from pregnancy or obesity

Spinal Osteoporosis

(a)

(b)

Occurs in females after menopause. Estrogen inhibits osteoclast. When estrogen secretions lesson then osteoclast start to erode the structure of cancellous bone.

C9

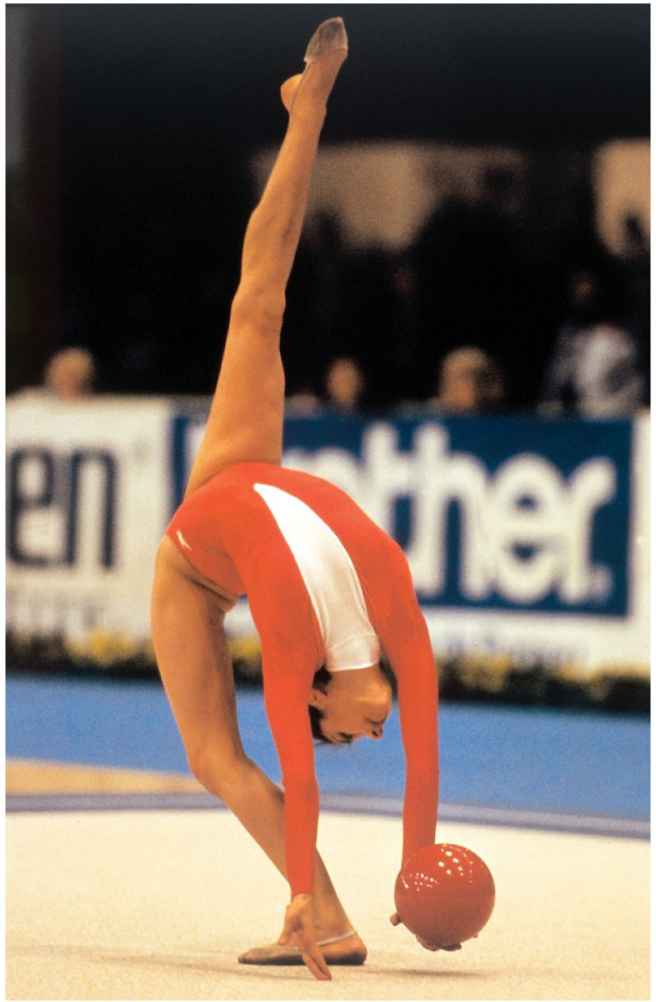
An Introduction to Articulations

Joints = Articulations

- Joints = point where two bones meet
- It is called a joint *whether or not* the bones are movable
- Functions of a joint

–Give skeleton mobility

–Hold skeleton together



Two classification used to describe articulations – based on

Function = degree of movement

Structure = type of material between bones or if there is a capsule around the joint

Functional Classification of Joints

Amount of movement = functional classification

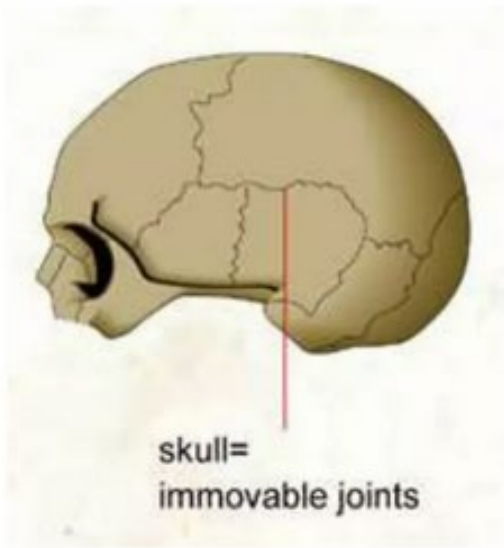
Three functional classifications: (know this!)

Synarthroses—immovable joints

Amphiarthroses—slightly movable joints

Diarthroses—freely movable joints

Functional classification



Synarthroses

Amphiarthroses

Diarthroses

Structural Classification of Joints

Based on the material that binds bones together "and/or" the presence or absence of a joint cavity

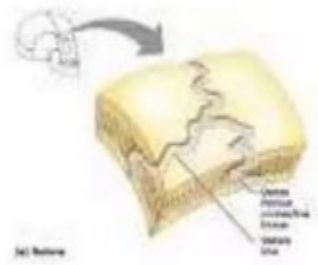
Three structural classifications (know this!)

Fibrous joints

Cartilaginous joints

Synovial joints *(cover this in detail)*

Structural classification



Fibrous

Cartilaginous

Synovial

Cartilaginous Joints (Synchondroses)

Described as a bar or plate of hyaline cartilage

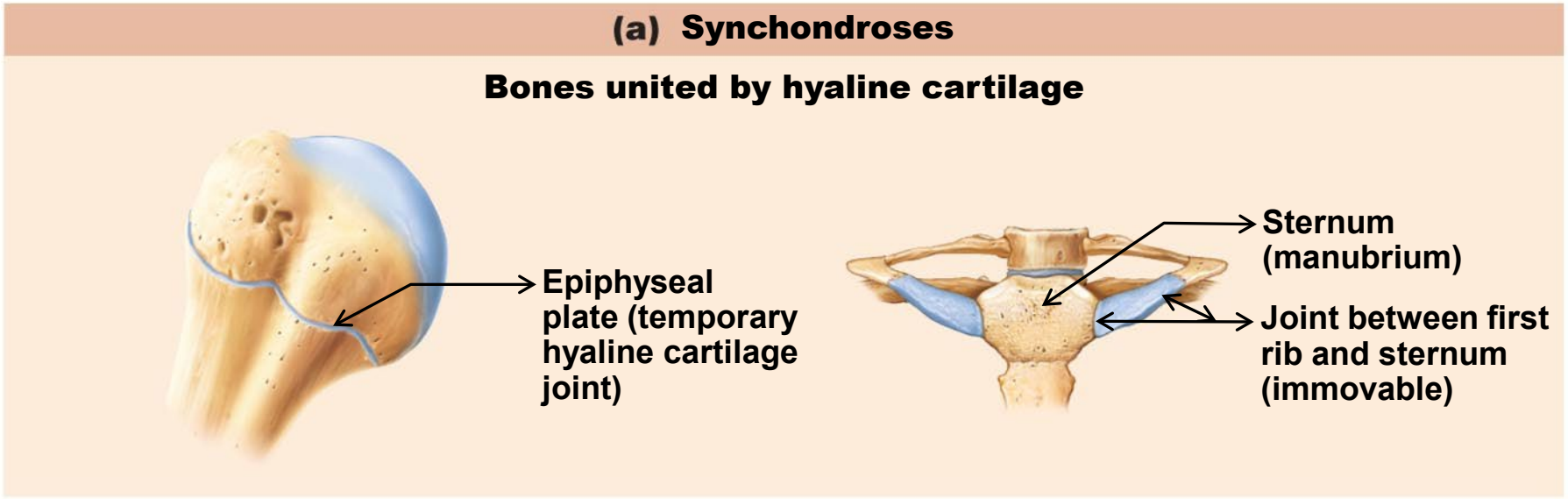
Unites two osseous tissues with hyaline cartilage, slightly moveable.

The epiphyseal plate is this type of joint. This is where the bone elongates. The growth plate.

Will become immovable after cartilage ossified, to become a synarthrosis joint and becomes the epiphyseal line (cartilage is ossified). This occurs around the age of 20 in the long bones.

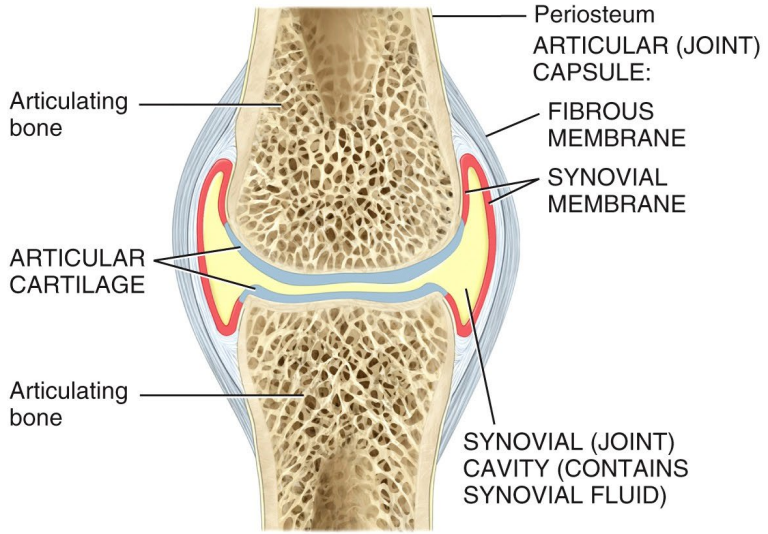
Cartilage of 1st rib with manubrium also synchondroses

Synchondroses Are Cartilaginous Joints (e.g. #1)



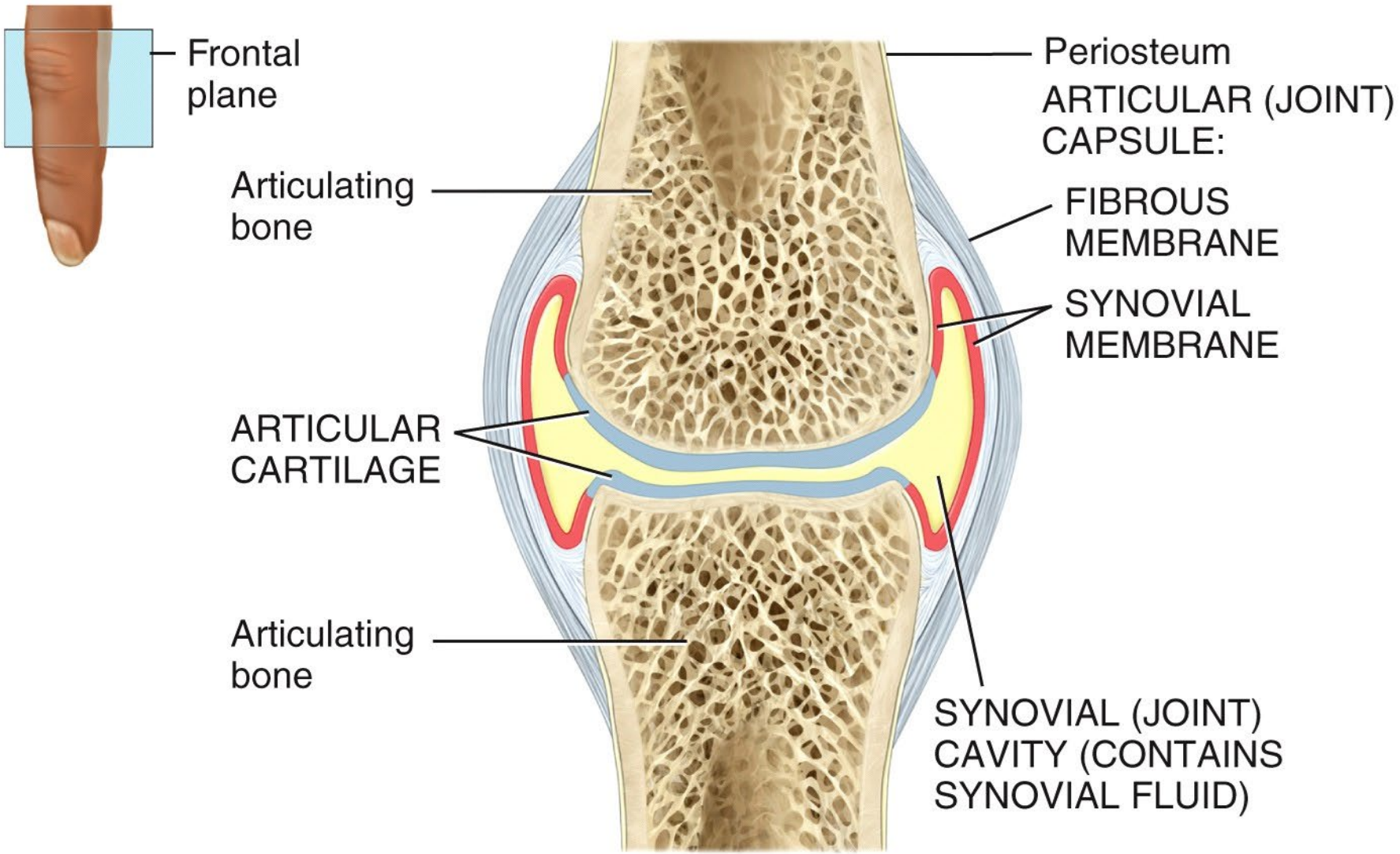
Synovial Joints – Third Type of Structural Joint

- Bones separated by fluid-filled joint cavity
- All diarthrotic joints are freely moveable
- Include // all limb joints and most common joints of body



(a) Frontal section

Synovial Joint



a) Frontal section

Other Features in Synovial Joints

Fatty pads // For cushioning between fibrous layer and synovial membrane or bone

Articular discs (menisci) // Fibrocartilage separates articular surfaces

–improve "fit" of bone ends

–stabilize joint

–reduce wear and tear

What three structures help to stabilize a synovial joint?

1) Shapes of articular surfaces (minor role)

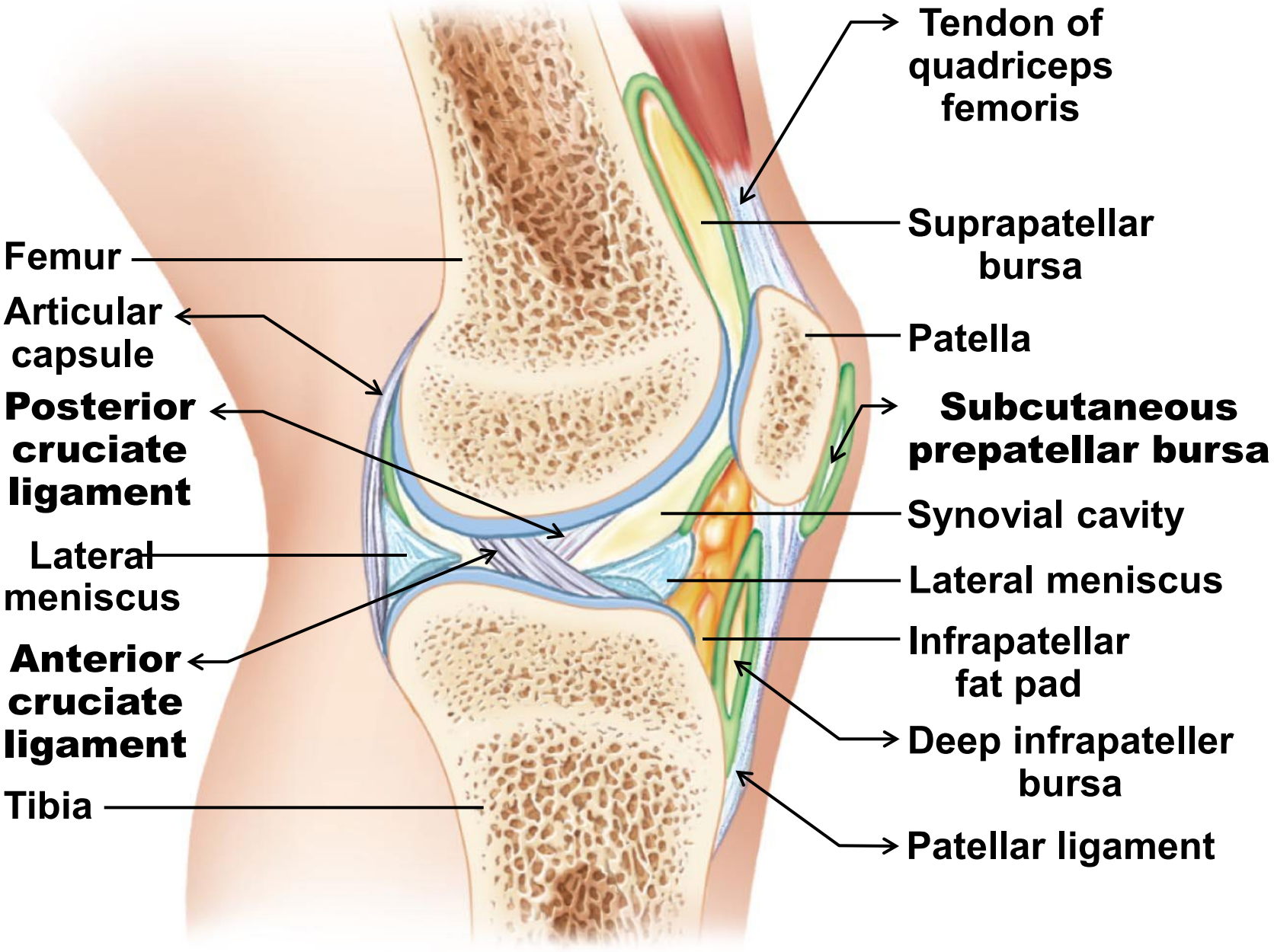
2) Ligaments /// number and location (limited role)

3) Muscle tendons that cross joint (most important)

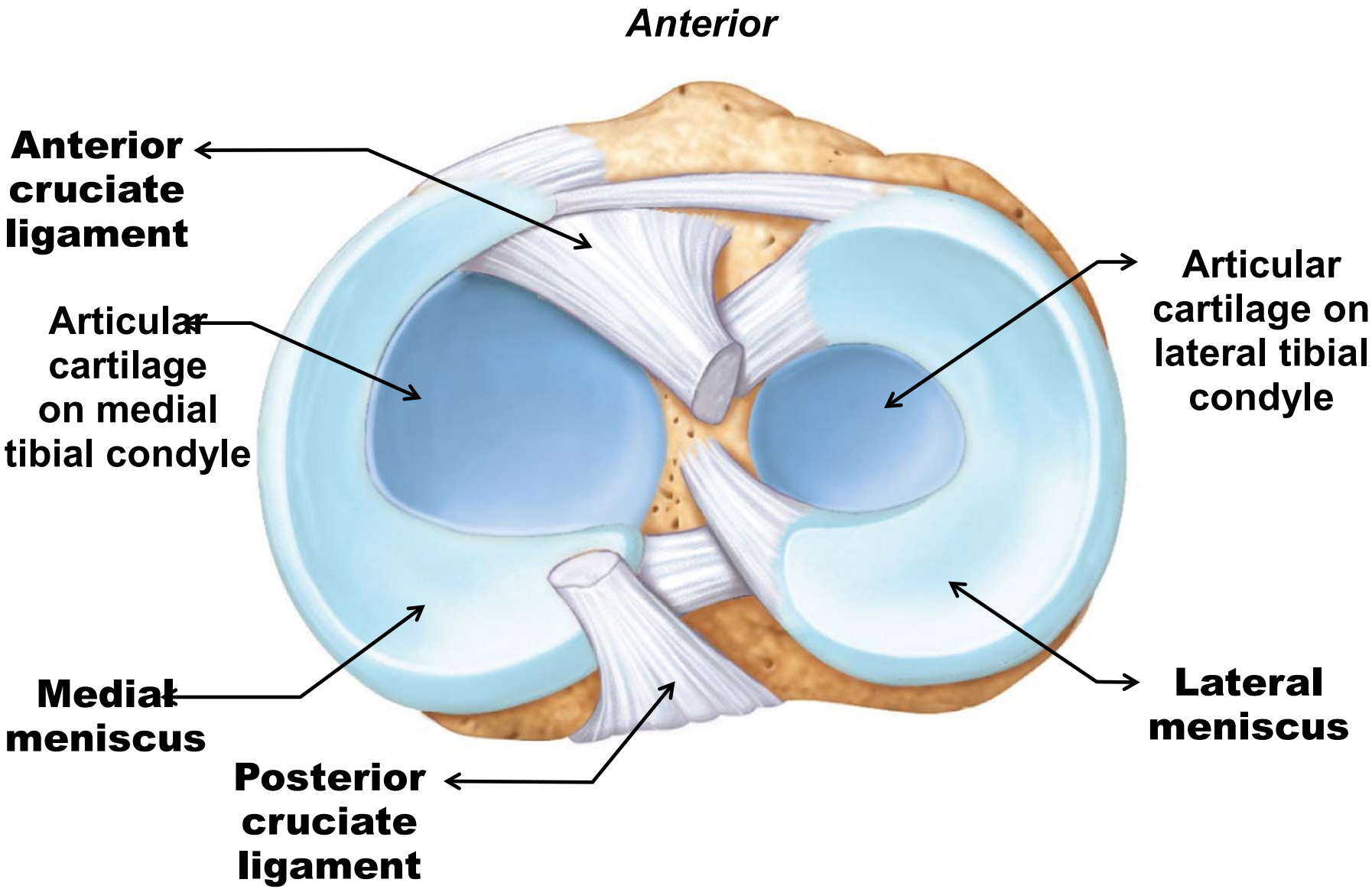
Muscle tone keeps tendons taut

Extremely important in reinforcing the shoulder and knee joints

Also help to form arches of the foot



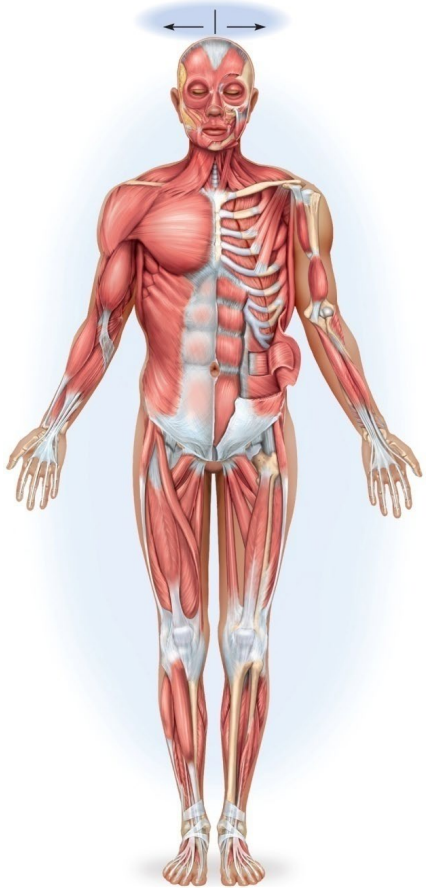
Sagittal section through the right knee joint



(b) Superior view of the right tibia in the knee joint, showing the menisci and cruciate ligaments

C10

Intro to the Muscle System



Characteristics of Muscle Tissue

responsiveness (excitability)

–to chemical signals, stretch and electrical changes across the plasma membrane

conductivity

–local electrical change triggers a wave of excitation that travels along the muscle fiber

contractility

–shortens when stimulated

extensibility

–capable of being stretched between contractions

elasticity

– returns to its original resting length after being stretched

The Functions of Muscles

- Movement // move from place to place, movement of body parts and body contents in breathing, circulation, feeding and digestion, defecation, urination, and childbirth // role in communication – speech, writing, and nonverbal communications

- Stability // maintain posture by preventing unwanted movements // antigravity muscles – resist the pull of gravity and prevent us from falling or slumping over // stabilize joints

- Control openings and passageways // sphincter muscles = internal muscular rings that control the movement of food, bile, blood, and other materials through tubular structures

- Heat production by skeletal muscles // 85% of our body heat created by skeletal muscles

Organization of Muscles

Constitute about half of our body weight

About 600 muscles

Three kinds of muscle tissue

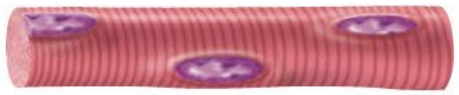
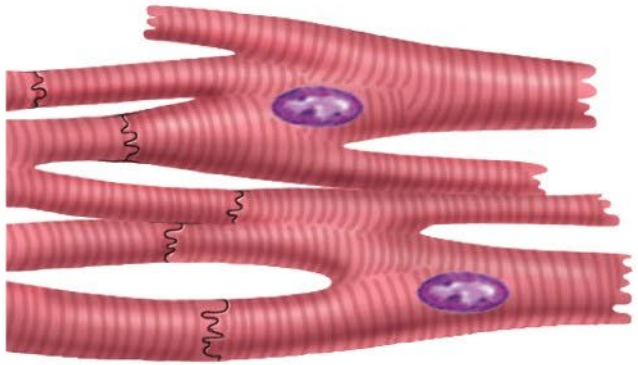
–skeletal

–cardiac

–smooth

Muscle converts the chemical energy of ATP into the mechanical energy of motion

How to Identify the Three Different Types of Muscle

Skeletal muscle	Cardiac muscle	Smooth muscle
		
Striated	Striated	No striation
Voluntary	Involuntary	Involuntary
Somatic NS	Internal pacemaker and modified by ANS	ANS

Note: This lecture will primarily cover “skeletal muscle”.

Four Connective Tissues of a Skeletal Muscle

The three layers of connective tissue covering the surface of the muscle is dense irregular. As the connective tissue moves towards the end of the muscle, the collagen fibers become parallel and transitions into regular dense connective tissue to form the tendons.

1) Endomysium

–thin sleeve of loose connective tissue surrounding each **muscle fiber**

–allows room for capillaries and nerve fibers to reach each muscle fiber

2) Perimysium

–slightly thicker layer of connective tissue

–**fascicles** – bundles of muscle fibers wrapped in perimysium

–carry larger nerves and blood vessels, and stretch receptors

Four Connective Tissues of a Skeletal Muscle

3) Epimysium

–fibrous sheath surrounding the entire muscle

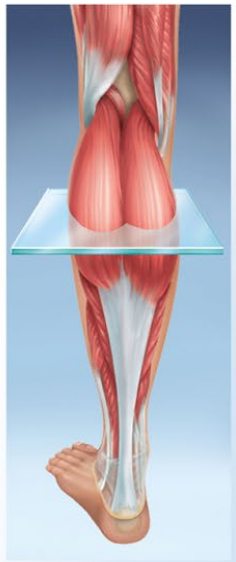
–outer surface grades into the fascia

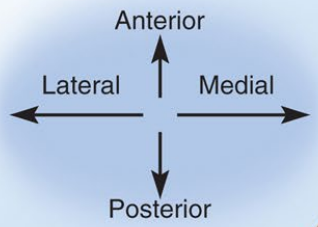
–inner surface sends projections between fascicles to form perimysium

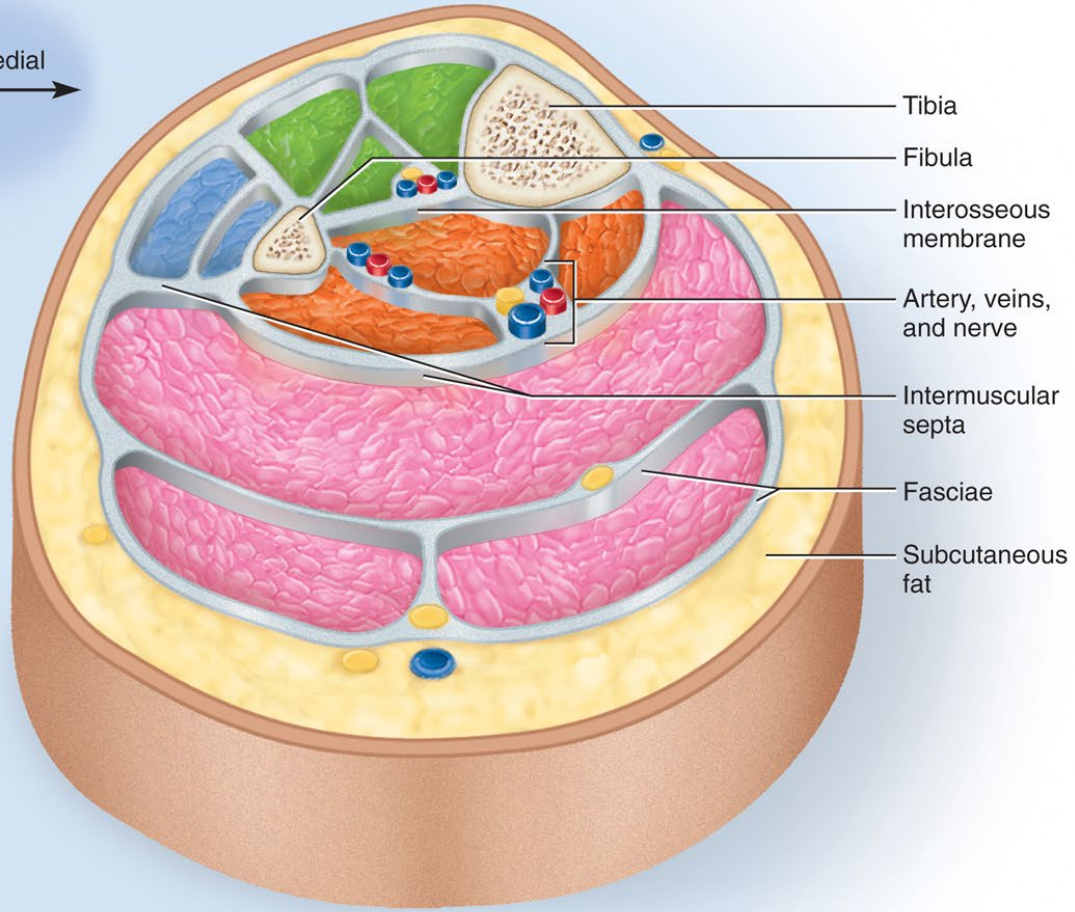
4) Fascia = sheet of connective tissue that may separate and/or connect neighboring muscles from each other /// also between all other organ systems throughout body

Compartment Syndrome /// CNN science reporter, Miles Obrien, had his arm amputated 12 hours after a heavy case “bruised his arm”.

Why? What happened?







Key

- Anterior compartment
- Lateral compartment
- Posterior compartment, deep layer
- Posterior compartment, superficial layer

What is compartment syndrome?

Muscle Indirect Attachments to Bone

Tendons bridge the gap between muscle fiber's ends and bony attachment

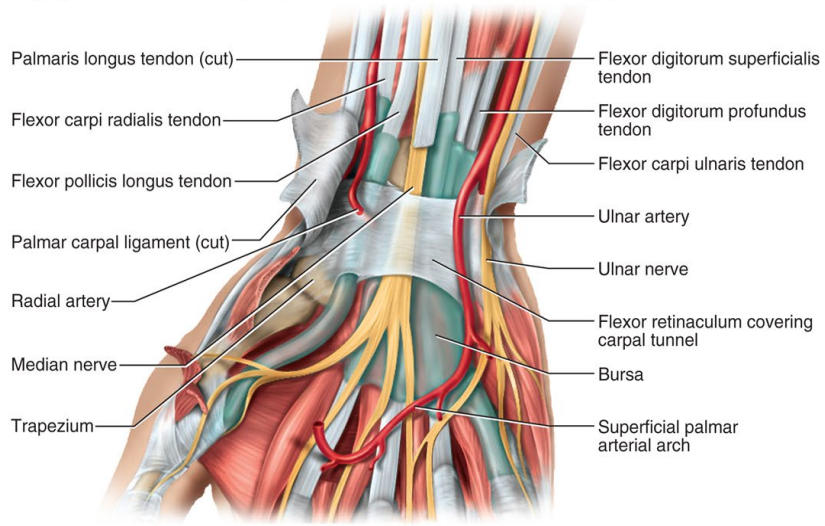
the collagen fibers of the endomysium, perimysium, and epimysium continue to become the tendon /// these fibers weave themselves into the periosteum and penetrate beyond periosteum into the matrix of bone (weaving into the collagen fibers of the bone matrix

very strong structural continuity from muscle into bone /// e.g. *biceps brachii, Achilles tendon*

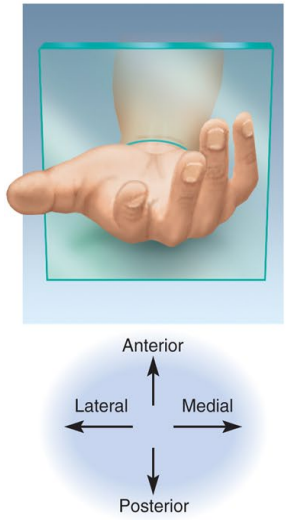
Aponeurosis – tendon is a broad, flat sheet *(palmar aponeurosis)*

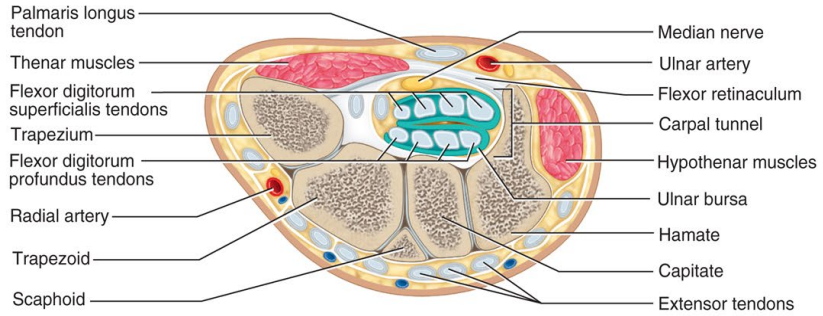
Retinaculum – connective tissue band which tendons from separate muscles pass through

What is a retinaculum? Clinical significance? – connective tissue band /// tendons from separate muscles may pass through the retinaculum /// inflammation swells tissue but retinaculum unable to expand which results in pain (carpal tunnel syndrome)



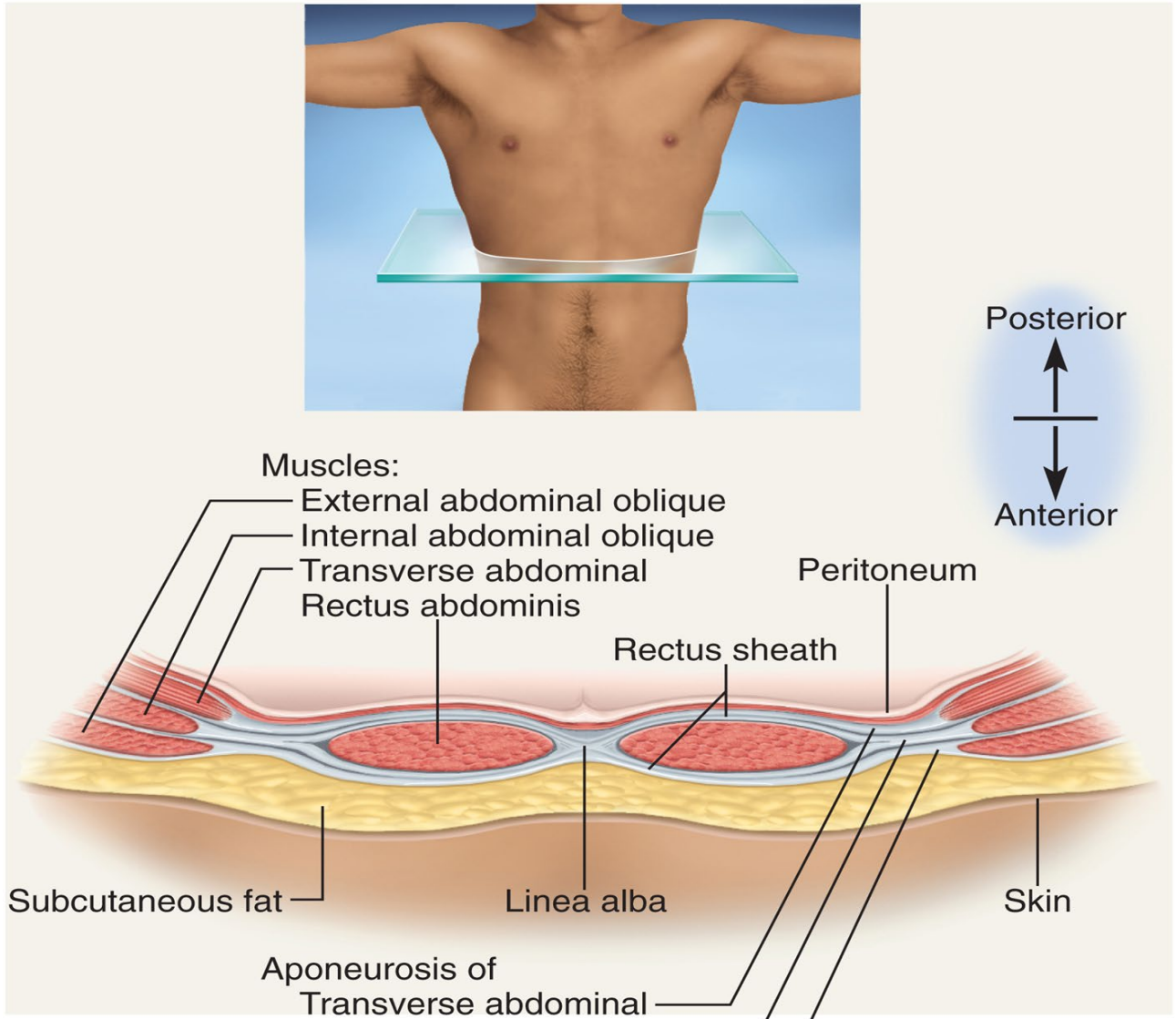
(a) Anterior view



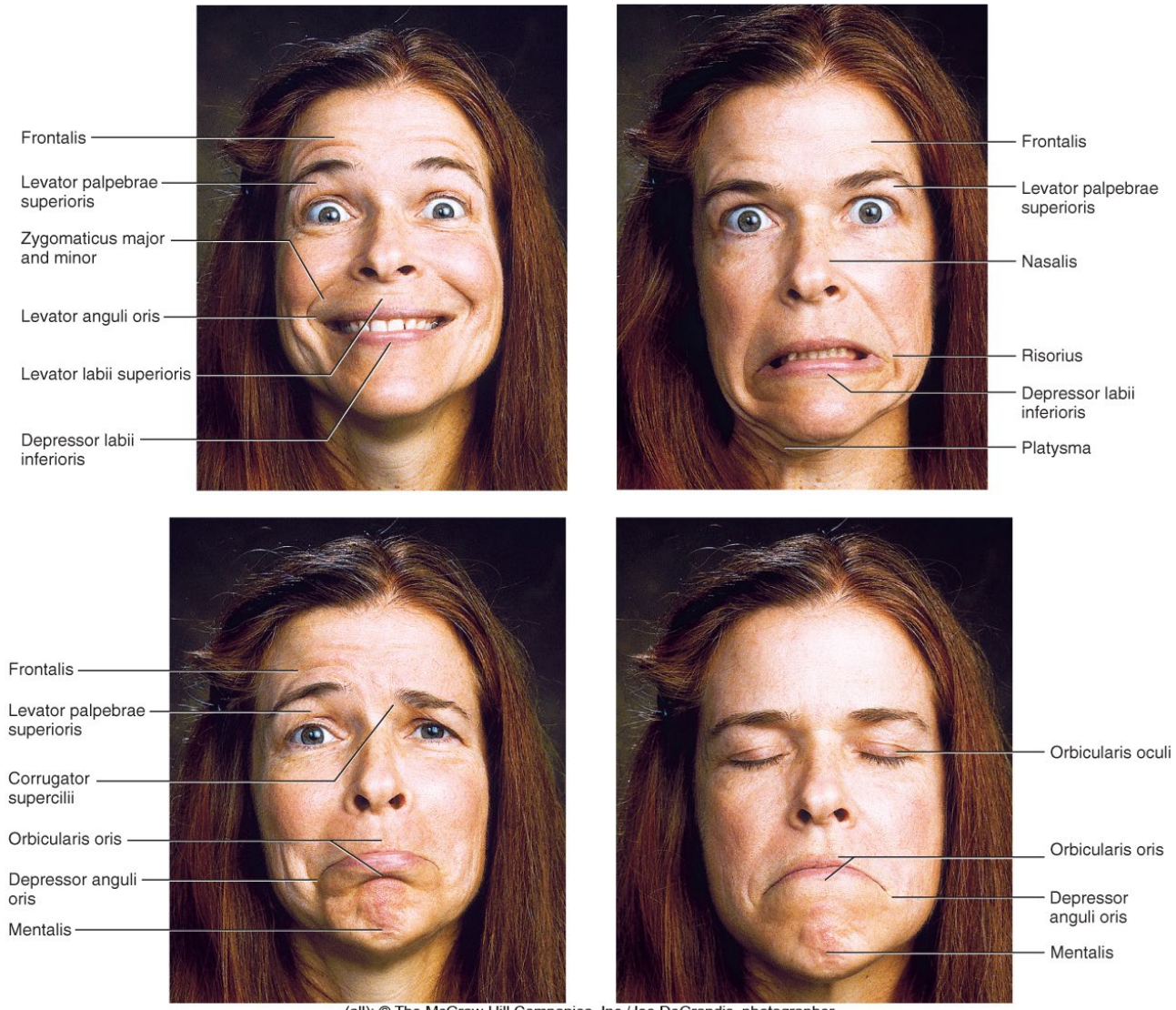


(b) Cross section

Muscles May Also Be Arranged in Layers



Some skeletal muscles do not insert onto the periosteum/bone but attach to the dermis of the skin or to the tendons of another muscle – e.g. muscles of facial expression (see next slide)



Classify Muslces by Their A Function

Action

– the effects produced by a muscle

–to produce or prevent movement

Prime mover (agonist)

–muscle that produces most of force during a joint action

Synergist

–muscle that aids the prime mover

–stabilizes the nearby joint

–modifies the direction of movement

Functional Groups of Muscles

Antagonist

–opposes the prime mover

–relaxes to give prime mover control over an action

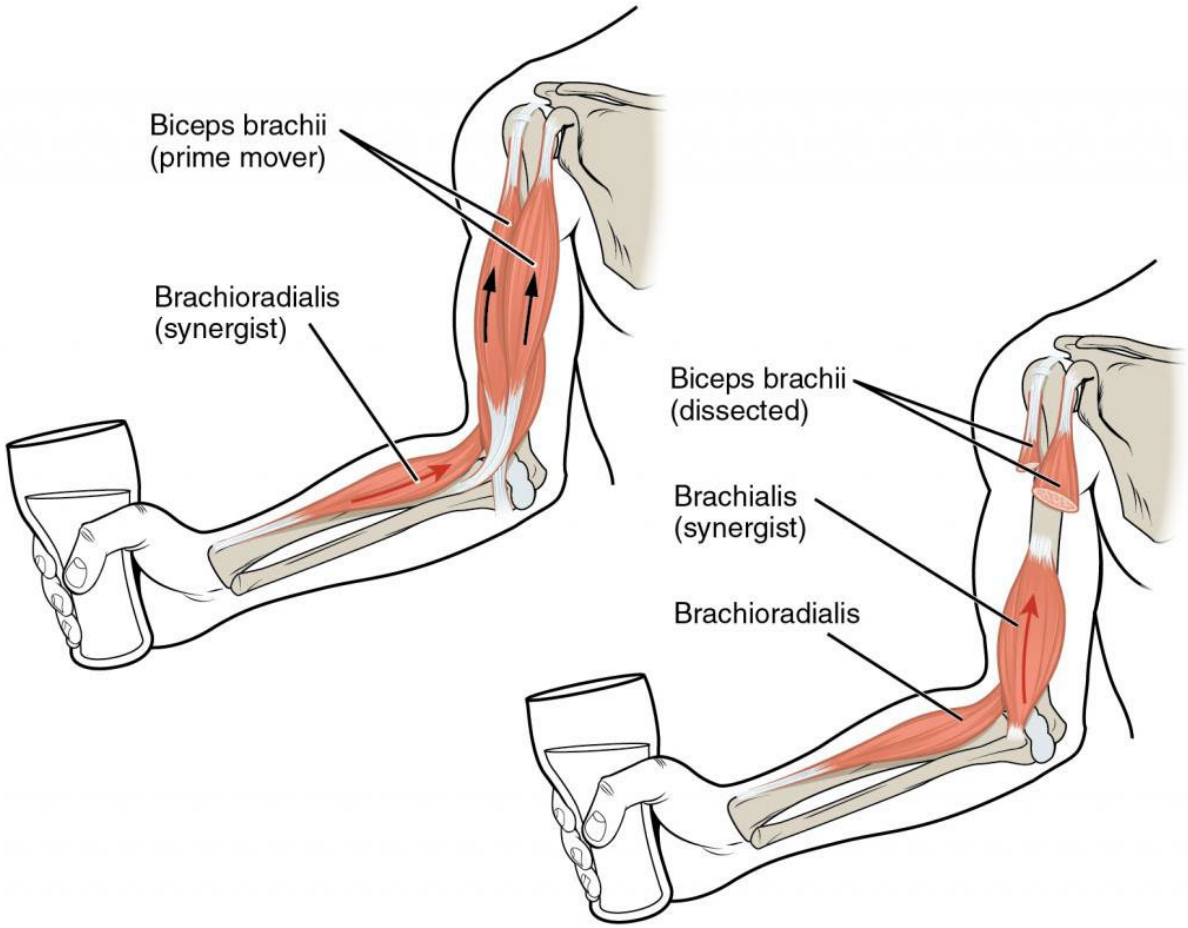
–preventing excessive movement and injury

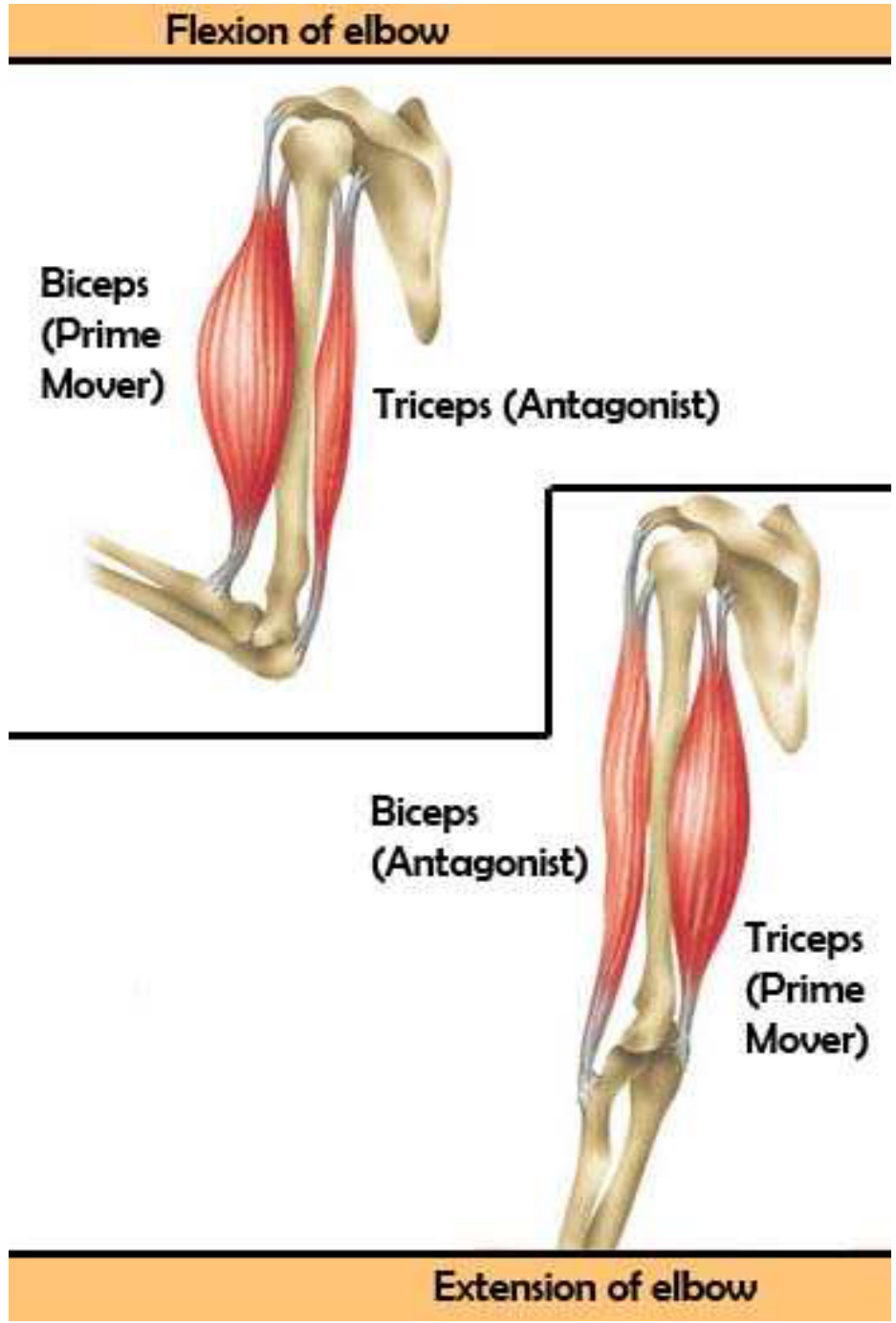
–**antagonistic pairs** – muscles that act on opposite sides of a joint

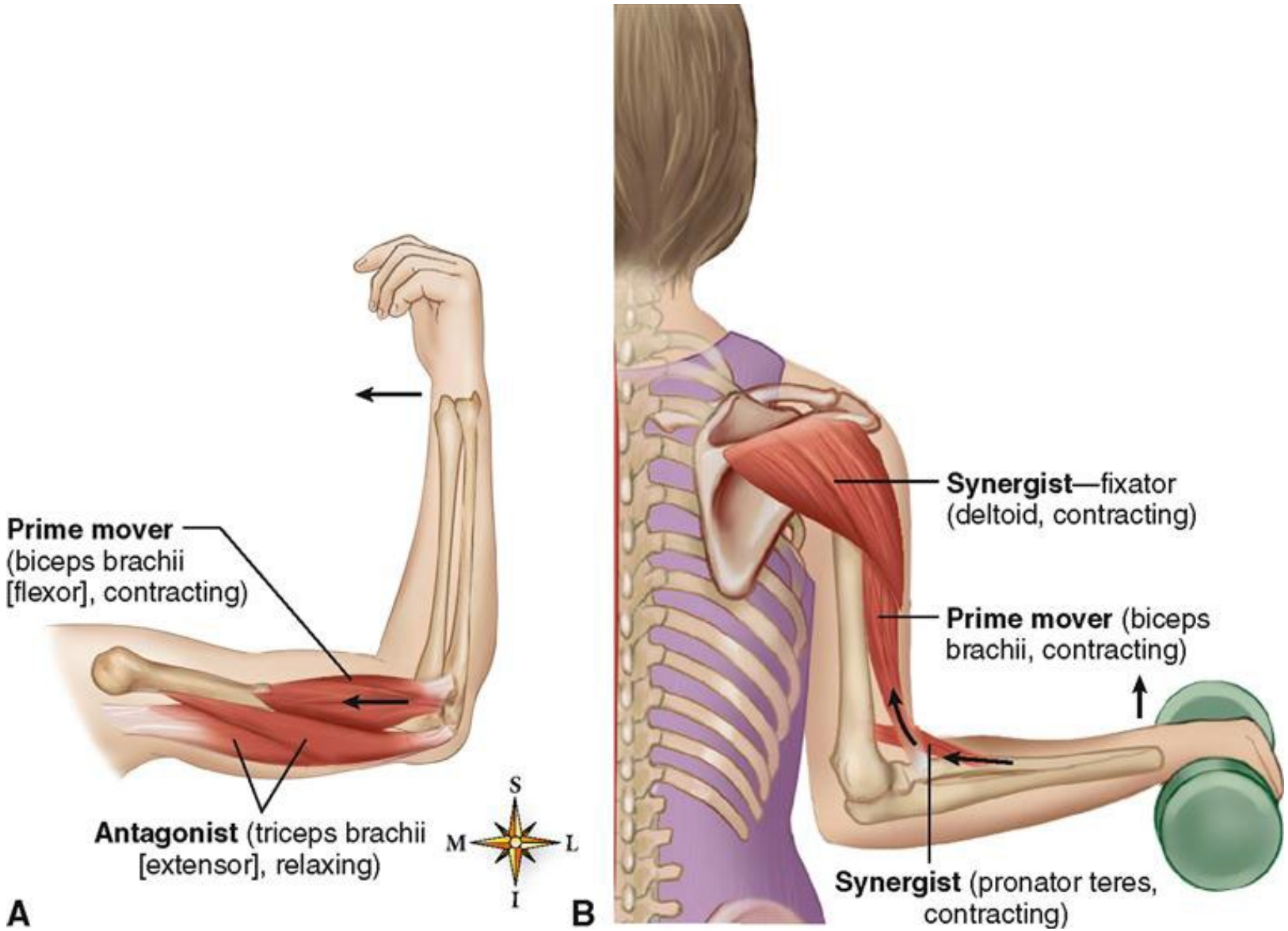
Fixator

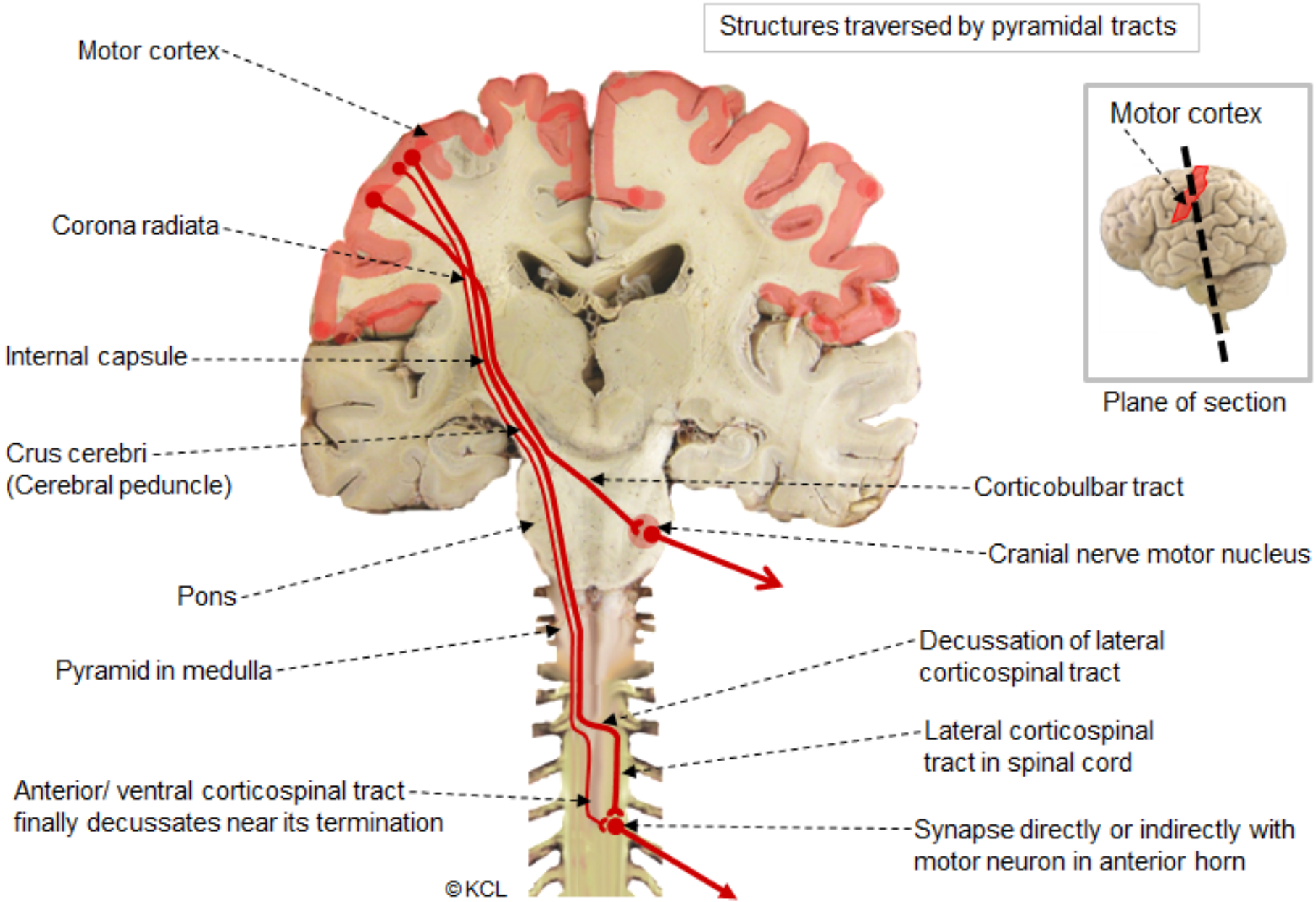
–muscle that prevents movement of bone

–allows other muscles to exert force to produce movement.


Biceps brachii
(prime mover)
Brachioradialis
(synergist)
Biceps brachii
(dissected)
Brachialis
(synergist)
Brachioradialis


Flexion of elbow
Biceps
(Prime
Mover)
Triceps (Antagonist)
Biceps
(Antagonist)
Triceps
(Prime
Mover)
Extension of elbow


Prime mover
(biceps brachii
[flexor], contracting)
Antagonist (triceps brachii
[extensor], relaxing)
S
M
L
I
A
Synergist—fixator
(deltoid, contracting)
Prime mover (biceps
brachii, contracting)
Synergist (pronator teres,
contracting)
B


Structures traversed by pyramidal tracts
Motor cortex
Corona radiata
Internal capsule
Crus cerebri
(Cerebral peduncle)
Pons
Pyramid in medulla
Anterior/ ventral corticospinal tract
finally decussates near its termination
Motor cortex
Plane of section
Corticobulbar tract
Cranial nerve motor nucleus
Decussation of lateral
corticospinal tract
Lateral corticospinal
tract in spinal cord
Synapse directly or indirectly with
motor neuron in anterior horn
©KCL

Skeletal Muscle Innervation

Corticospinal tracts

–upper motor neuron
–Originate in precentral gyrus
–Transits into spinal cord and synapse on lower motor neuron in the anterior horn
–Lower motor neurons are common pathway to skeletal muscle below head and neck

Corticobulbar

–upper motor neuron
–Originate in precentral gyrus
–Transits to brainstem and synapse on cranial nerves
–Cranial are common pathway to skeletal muscles above head and neck

Skeletal Muscle Innervation

Spinal nerves (i.e. lower motor neuron)

–arise from the spinal cord

–emerge through intervertebral foramina

–immediately branch into a posterior and anterior ramus

–innervate muscles below the neck

–**plexus** – weblike network of spinal nerves adjacent to the vertebral column

Cranial nerves (i.e. lower motor neuron)

–arise from the base of the brain

–emerge through skull foramina

–innervate the muscles of the head and neck

–numbered I to XII