Name_____Block_____Date_____

Ch 5: Skeletal System Notes

Lisa Peck

Skeletal System: 206 bones- bones composed of osseous tissue (a type of connective tissue)
joints- where 2 bones meet
ligaments - connects bone to bone (strong, tough connective tissue)
cartilage- strong, flexible connective tissue
locations 1. articulations- movable joints (provides smooth surface on jt.)
2. need of flexibility: tip of nose
external ear
larynx (vocie box)
rib attachment

2 subdivisions: **Axial Skeleton:** bones that form the longitudinal axis of the body

Appendicular Skeleton: bones of the limbs and girdles

I. Bones: An Overview (pp. 130-139)

A. Functions of Bones

1. Supportive internal framework
bones form internal framework that supports and anchors all soft organs
bones of legs support body torso when standing erect
rib cage supports the thoracic wall

2. Protection of soft body organs
fused bones of skull protect brain
vertebrae protect the spinal cord
rib cage protects the thoracic organs (heart & lungs)

3. Movement using bones as levers
skeletal muscles attached to bones by tendons
bones used as levers to move body and its parts

4. Storage of calcium and phosphorus ect
fat is stored in the internal cavities of bones
minerals stored in bones.....
calcium - needed for 1. neural transmission
2. muscle contraction
3. blood clot formation

hormones control mvmt of Ca to & from bones and blood

phosphorus- part of ATP, nucleic acids, and proteins

5. Hematopoiesis- blood cell formation in red marrow cavities of certain bones
location: usually spongy bone

B. Classification of Bones (pp 131-132)

2 types: **Compact Bone Tissue**- dense, smooth, and homogeneous
very strong, can endure great stress & impacts

Spongy Bone Tissue- has small needle-like bone pieces within open spaces
strong yet light-weight

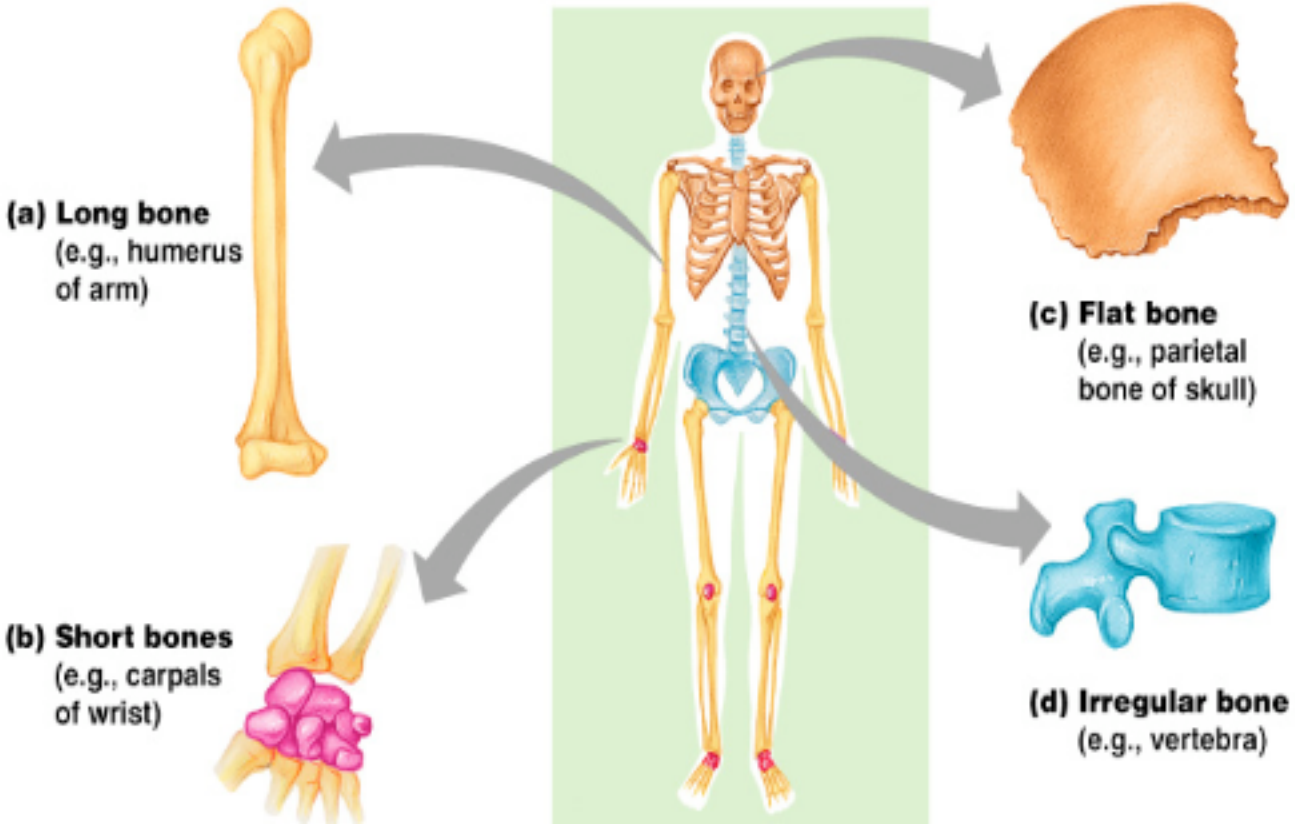
Classification According to Shape: variety of shapes related to function

Long Bones- longer than width
shaft w/ heads at both ends
mostly compact bone (except epiphyses-ends)
location: limbs (except wrist & ankle)

Short Bones- cube shape
mostly spongy bone
location: wrist and ankle
sesamoid bones: special bones formed w/ in tendons
eg. patella

Flat Bones- thin and flattened
usually curved
2 thin layers of compact bone "sandwiching" layer of spongy bone
location: skull bones, ribs, sternum

Irregular Bones- neither long, short, or flat bones
location: vertebrae and hip bones



C. Structure of a Long Bone (pp. 132-133)

Gross Anatomy

Diaphysis- shaft

Periosteum- fibrous connective tissue that covers diaphysis (f'ns: 1. protection,2. appositional growth, 3. contains collagen fibers that merge w/ those of tendons and ligaments that are attached to bone)

Sharpey's Fibers- connective tissue fibers (also known as **perforating fibers**)
connect periosteum to underlying bone

Epiphyses- ends of long bone

Articular Cartilage- covers epiphyses (instead of periosteum)
decreases friction b/ w bones of joints

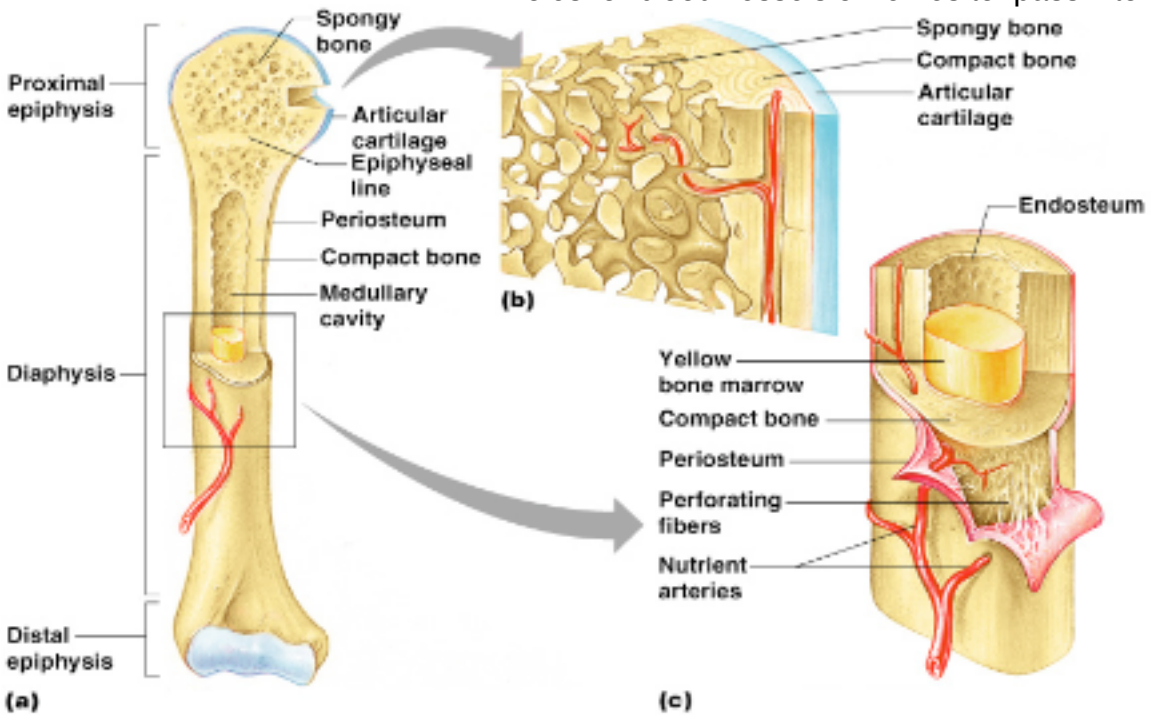
Epiphyseal Line- remnant of epiphyseal plate

Epiphyseal Plate- flat plate of hyaline cartilage
location: in young, growing bones
causes lengthwise bone growth
end of puberty: hyaline cartilage replaced with bone

Yellow Marrow- also known as **medullary cavity**
location: cavity of shafts of adult bones
storage area for adipose (fat) tissue

Red Marrow- site of erythrocyte (RBC) production (hematopoesis)
location: infant- shaft of long bone
adult- spongy layer flat bones
epiphyses

Bone Markings- bone surface is not smooth (bumps, holes, and ridges)
projections (processes), depressions (cavities), holes
indicate location of 1. muscle, tendon, or ligament attachment
2. holes for blood vessels & nerves to pass into bone



osteocytes- mature bone cells

lacunae- cavities wh/ house osteocytes

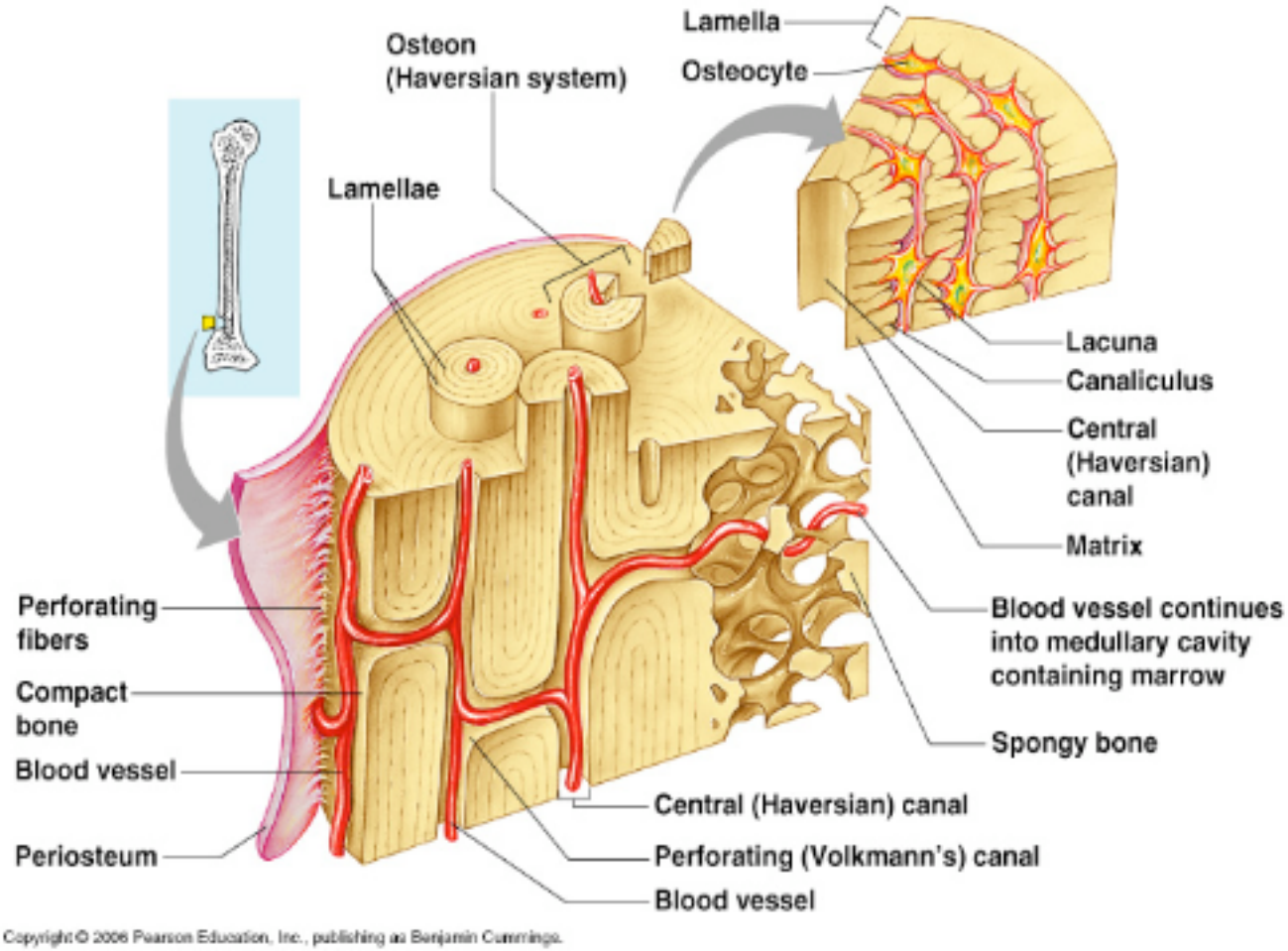
lamellae- concentric circles of lacunae

central (haversian) canals- surrounds by lamellae
run lengthwise through bony matrix
carry blood vessels and nerves to all areas of bone

canaliculi- tiny canals radiating outward from central cans to all lacunae
form transportation system that connects all bone cells to nutrient supply through hard boney matrix
bone injuries heal quickly

perforating (Volkmann's) canals- run into compact bone at right angles to shaft
aids in communication from outside bone to its interior

Haversian system- **(osteon)** bone complex consisting of central canal & matrix rings



D. Bone Formation, Growth, and Remodeling (pp. 134-138)

fetus - bones begin as cartilage
cartilage- tough, flexible connective tissue (cartilage cells & collagen fibers)
avascular- rely on diffusion of nutrients from nearby capillaries

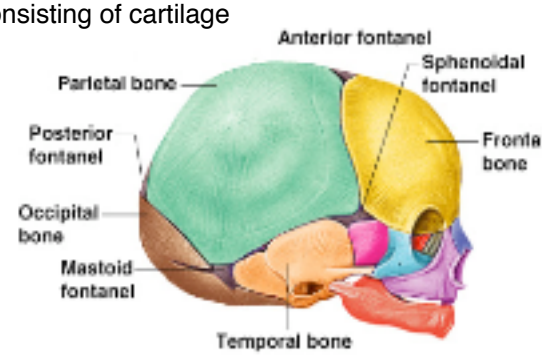
ossification- process of bone formation
process of replacing cartilage with bone tissue

ossification begins ~ 3rd month of gestation (fetus)
ends ~16-25 years old w/ closure of epiphyseal plate

fetus- 1. cartilage is covered with bone matrix produced by **osteoblasts**- bone-forming cells
2. internal cartilage is broken down.....creating **medullary cavity**- yellow marrow

infant- a few bones remain as cartilage (skull...creating fontanels "soft spots"...allow brain growth)
most bones replaced w/ bone matrix except: articular cartilage on epiphyses' ends
epiphyseal plate consisting of cartilage

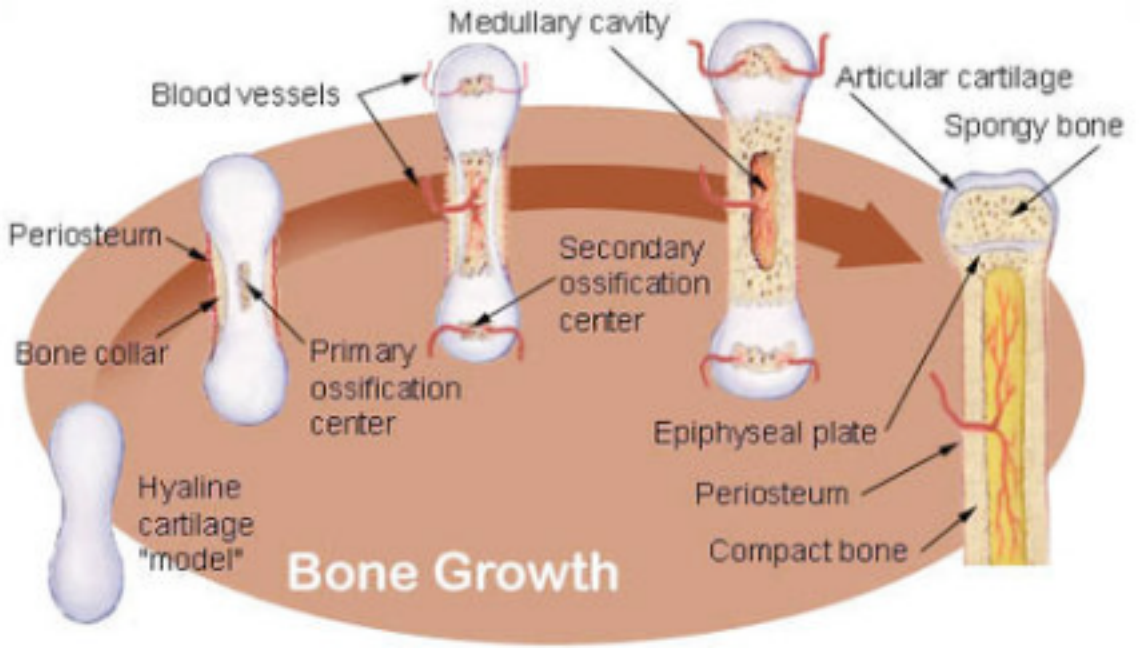
childhood- long bone growth occurs and skull is ossified
(loss of fontanels)



long bone growth:
controlled by growth hormone in childhood
sex hormones during puberty

longitudinal growth: occurs at epiphyseal plates
epiphysis end- more cartilage produced (lengthening bone)
diaphysis end- cartilage replaced by bone matrix by **osteoblasts**

appositional growth: increases diameter of bone
osteoblasts in periosteum add bone tissue to external diaphysis
periosteum- fibrous connective tissue membrane covering diaphysis
connected to bone by **Sharpey's fibers (perforating)**
contains osteoblasts (repair fractures too)



D. Bone Formation, Growth, and Remodeling (pp. 134-138)

osteoclasts- giant bone-destroying cells activated by parathyroid hormone (PTH)

osteoblasts- produce bone matrix around itself creating an **osteocyte**

osteocyte- a mature bone cell

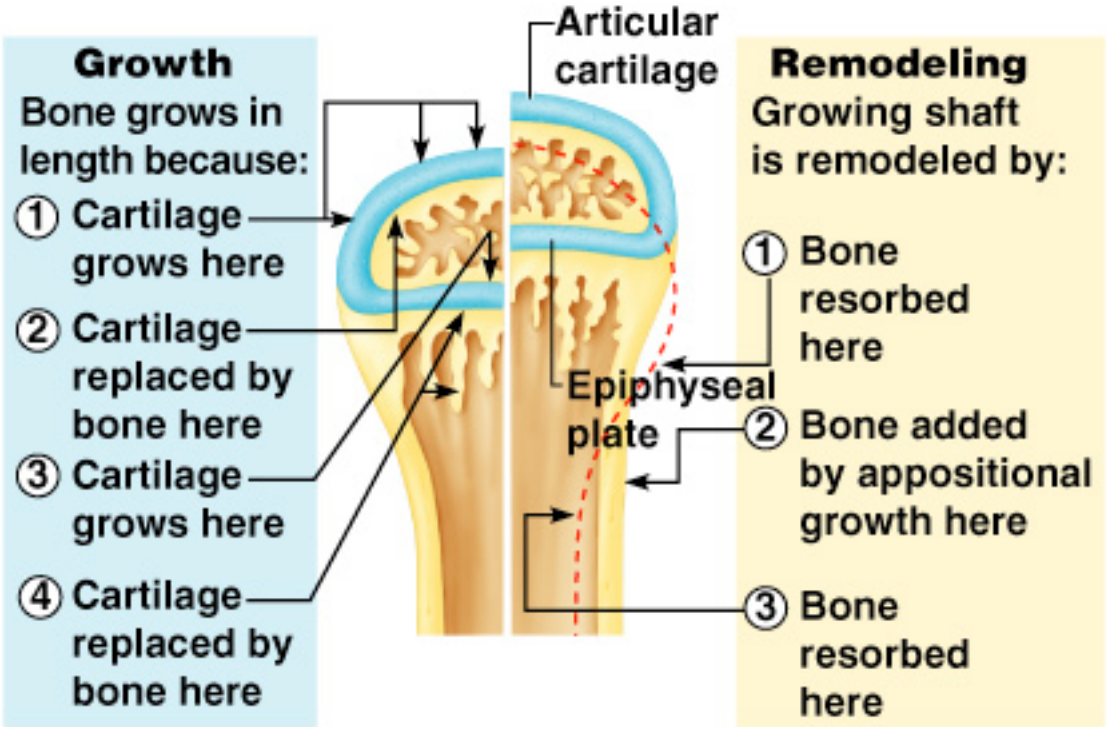
bone remodeling- necessary to maintain proportions & strength in bones as they grow
thickens bones increasing strength
creates large projections to increase strength in areas of large muscle attachment

occurs in response to 1. Δ's in the pull of gravity and muscles on skeleton
det. where bone matrix is broken down or created

2. Δ's in calcium levels in blood

<u>Ca level too low:</u> PTH stimulates osteoclasts to break down bone matrix, releasing Ca to blood

<u>Ca level too high:</u> Ca removed from flood & deposited into bone matrix as a calcium salt



E. Bone Fractures (pp. 138-139)

Types of Fractures

1. simple fracture (closed): bone does not penetrate skin
2. compound fracture (open): bone penetrates the skin

Comminuted: bone breaks into many fragments
common in elderly w/ brittle bones

Compression: bone is crushed
common in porous bones (osteoporosis)

Depressed: broken bone portion is pressed inward
skull fractures

Impacted: broken bone ends are forced into each other
common in "breaking fall w/ outstretched hands"

Spiral: ragged break occurs when excessive twisting forces are applied to a bone
common in sports fractures

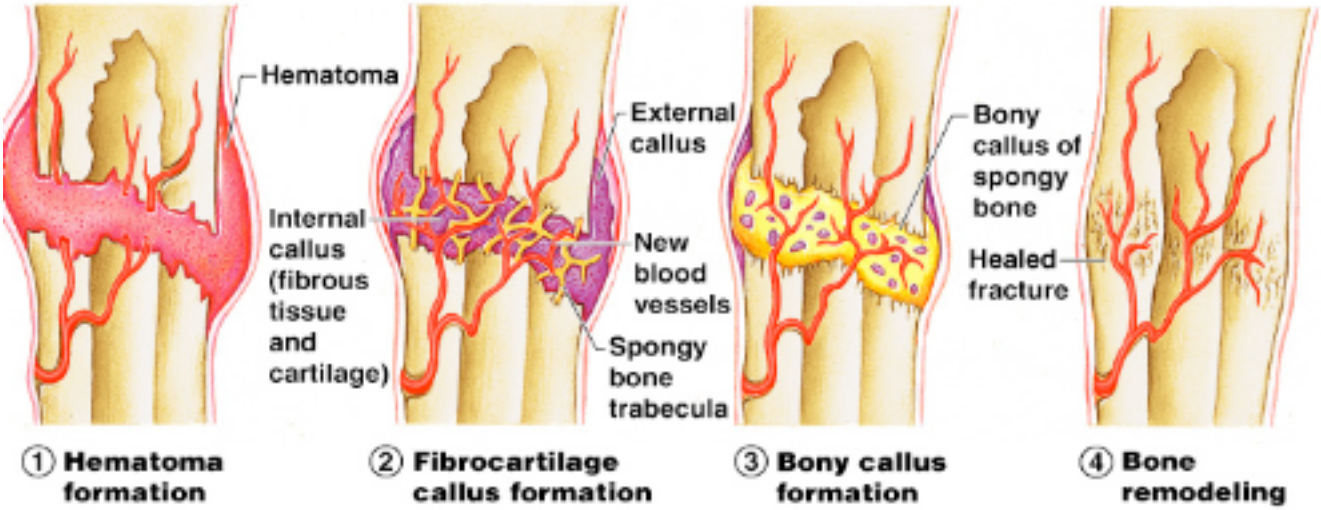
Greenstick: bone breaks incompletely (like a green twig)
common in children (bones more flexible)

Reduction- realignment of broken bone ends
closed- achieved through moving bones back into alignment with hands
open- achieved through surgery with pins, plates, or wires to secure bones tog.

Immobilization- with a cast or traction (avg 6-8 weeks)

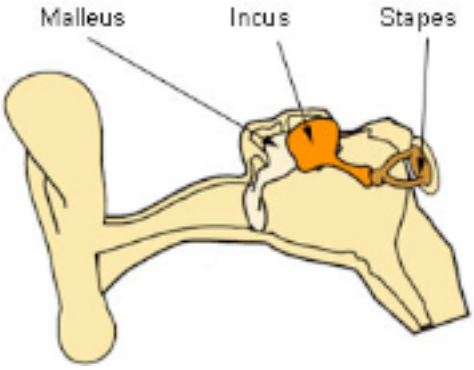
Repair of Fractures

1. Hematoma Formation- bcs vessels ruptured during break, osteocytes die (lack of nutrients)
2. Splinting of Break by Fibrocartilage Callus- consists of bony matrix, cartilage, collagen fibers
3. Bony Callus Formation- osteoblasts & osteoclasts move into area replacing callus w/ spongy bone
4. Bone Remodeling in Response to Mechanical Stress-



Skeleton: consists of **206 bones**

2 Parts: 1. **Axial**- skull, vertebral column, bony thorax — 80 total
2. **Appendicular**- limbs and girdles (pectoral & pelvic) — 126 total
206 total



Axial: 80 total

Skull:	8 cranial 14 facial	22 total
Ears:	6	6 total
Hyoid:	1	1 total
Vertebral Column:	7 cervical vertebrae 12 thoracic vertebrae 5 lumbar vertebrae 1 sacrum (5 fused vertebrae) 1 coccyx (3-5 fused vertebrae)	26 total
Bony Thorax:	24 ribs (12 pairs) 1 sternum	25 total

80 total

Appendicular: 126 total

Pectoral Girdle:	4 (2 scapula & 2 clavicles)	4 total
2 Upper Limbs:	2 upper arm (2 humerus) 4 forearm (2 radius & 2 ulna) 16 carpals (8 in each wrist) 10 metacarpals 28 phalanges (digits)	60 total
Pelvic Girdle:	2 coxal (ea. 3 fused: ilium, ischium, pubis)	2 total
2 Lower Limbs:	2 thigh (2 femur) 2 patella 4 lower leg (2 tibia & 2 fibula) 14 tarsals (7 in each ankle) 10 metatarsals 28 phalanges (digits)	60 total

126 total

II. Axial Skeleton - forms longitudinal axis of the body
3 parts: skull, vertebral column, & bony thorax

Skull (pp. 139-145)

all but 1 skull bone (mandible) are joined together by **suture**- interlocking, immovable joints
skull formed by 2 sets of bones: 1. cranial (8)
2. facial (14)

Cranium- 8 large, flat bones encloses & protects the brain

(1) Frontal Bone- forms forehead
forms bony projections under eyebrows
forms superior aspect of eye orbit

(2) Parietal Bones- paired
form superior & lateral walls of cranium
sagittal suture- joins 2 parietal bones at midline of skull
coronal suture- joins 2 parietal bones to frontal bone

(2) Temporal Bones- paired
lie inferior to parietal bones middle ear located here
squamous suture- joins 2 temporal bones to parietal bones (above them)
significant bone markings
1. External Auditory Meatus- canal leading to eardrum & middle ear

2. Styloid Process- sharp, needle-like projection
inferior to auditory meatus
point of attachment for neck muscles

3. Zygomatic Process- bony bridge joining w/ zygomatic bone anteriorly

4. Mastoid Process- rough projection post. & inf. to auditory meatus
point of attachment for neck muscles

5. Jugular Foramen- b/w occipital & temporal bones
passageway for jugular vein

6. Carotid Canal- internal carotid artery passes through
ant. to jugular foramen on inferior aspect of skull

(1) Occipital Bone- most posterior bone of cranium
forms floor & back wall of skull condyles articulate w/ atlas
lambdoid suture- joins occipital bone to parietal bones
foramen magnum- lg. hole spinal cord connects to brain
occipital condyles- rest on axis (1st cervical vertebrae)

(1) Sphenoid Bone- butterfly shaped spans width of skull
forms part of floor of skull
sella turcica holds pituitary gland

(1) Ethmoid Bone- irregular shape lies anterior to sphenoid bone
forms roof of nasal cavity & part of medial walls of eye orbits

Cranial Bones 8 total bones 2 paired & 6 single

Ear Bones- 6 total bones 3 paired ossicles malleus (hammer), incus (anvil), stapes (stirrup)
send vibration from tympanic membrane to inner ear

Hyoid Bone- 1 bone only bone of body that does not articulate w/ any other bone

midneck region: 1 inch above larynx
f'ns: movable base for tongue
attachment of muscles tht move larynx (up-down) when we speak or swallow

Facial Bones- 14 total bones: 12 paired & 2 single

(2) Maxillary Bones- paired fused to form upper jaw
keystone bone: all face bones (except mandible) join maxillae
hold upper teeth in alveolar margin
palatine processes- form ant. part of hard palate
contain **sinuses** that drain into nasal passages (lighten skull bones)
mucosa lining continuation of nasal & throat mucosa- infections: **sinusitis**

(2) Palatine Bones- paired lie post. to palatine process of maxillary bones
form posterior part of hard palate

failure of palatine bones or palatine processes to fuse medially results in **cleft palate**

(2) Zygomatic Bones- paired
form cheekbones & lateral walls of each orbit (eye socket)

(2) Lacrimal Bones- paired finger-nail size bones
form part of medial walls of each orbit bears tear ducts
each bone has a groove- serves as a passageway for tears

(2) Nasal Bones- paired small rectangular bones
form bridge of nose

(1) Vomer Bone- single bone median line of nasal cavity
forms most of nasal septum

(2) Inferior Nasal Conchae- paired thin, curved projecting from nasal cavity lateral walls

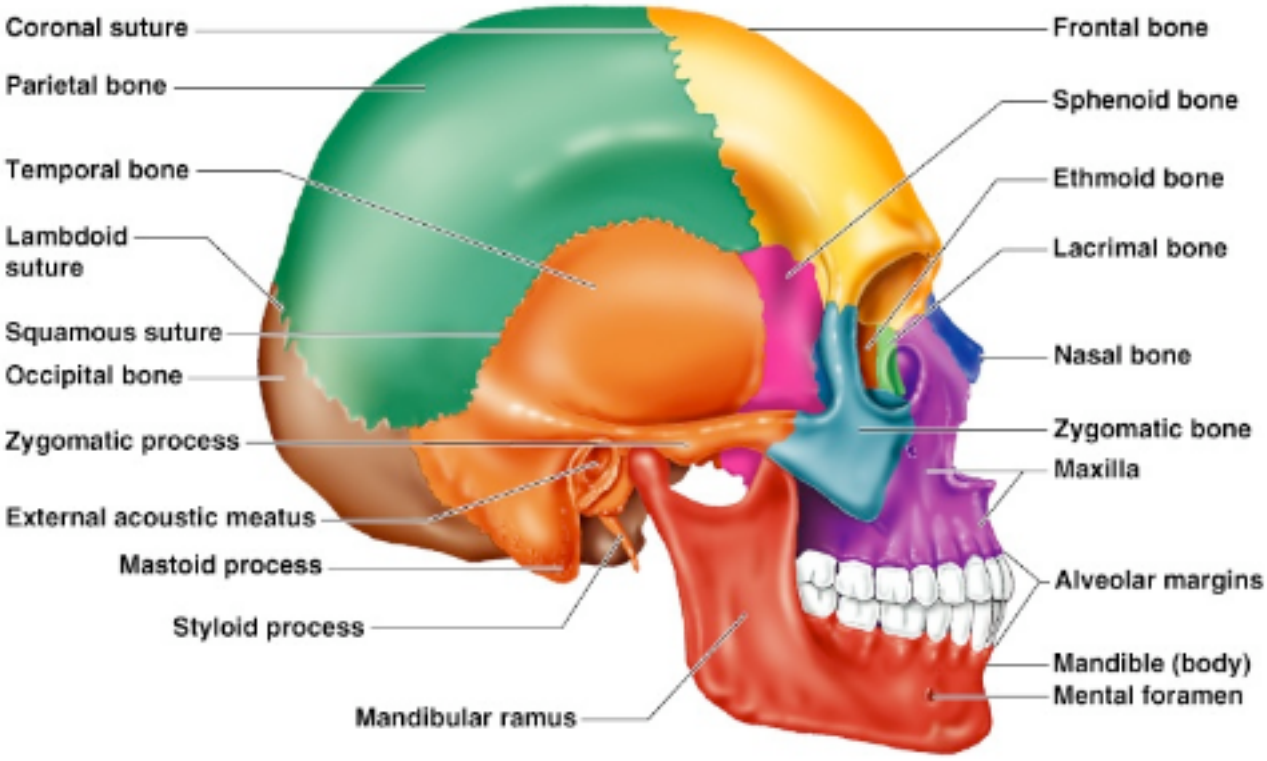
(1) Mandible- single lower jawbone
largest & strongest facial bone
parts: body- horizontal part forms chin
alveolar margin- holds lower teeth
located at superior ridge of mandible body

ramus- upright bar of bone extending from body of mandible
connects the mandible with the temporal bone

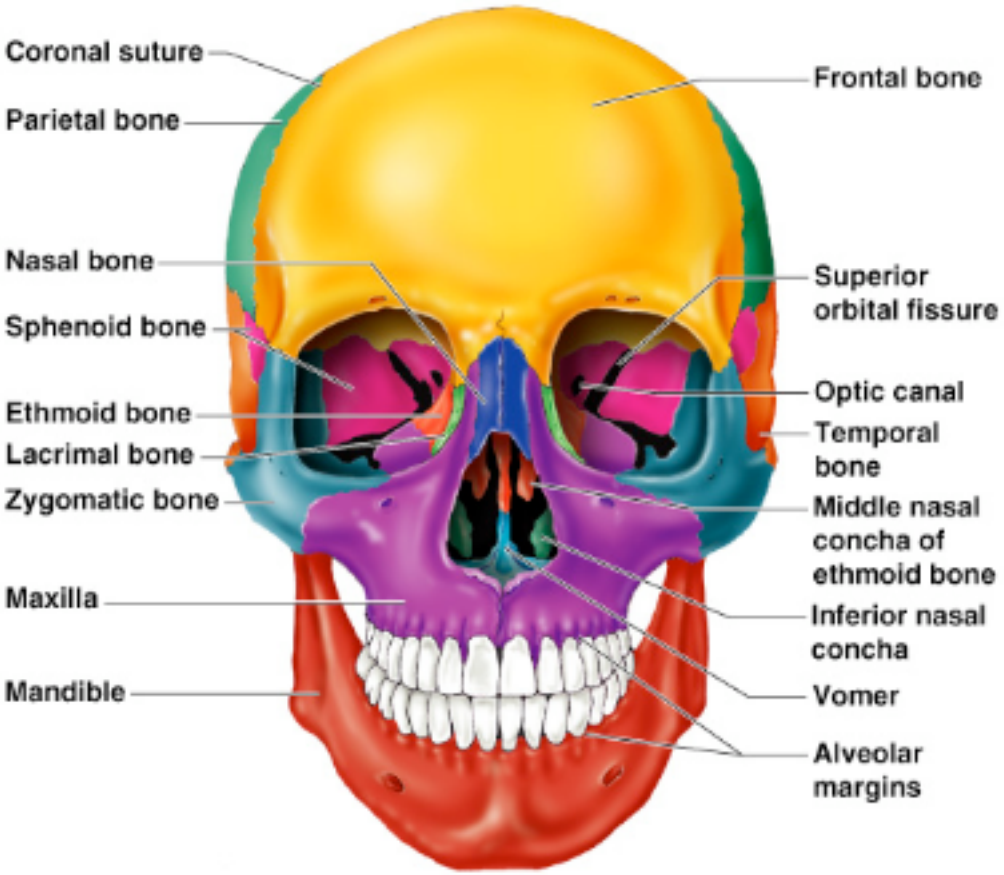
temporal-mandibular joint- only freely movable joint of skull

TMJ disorder

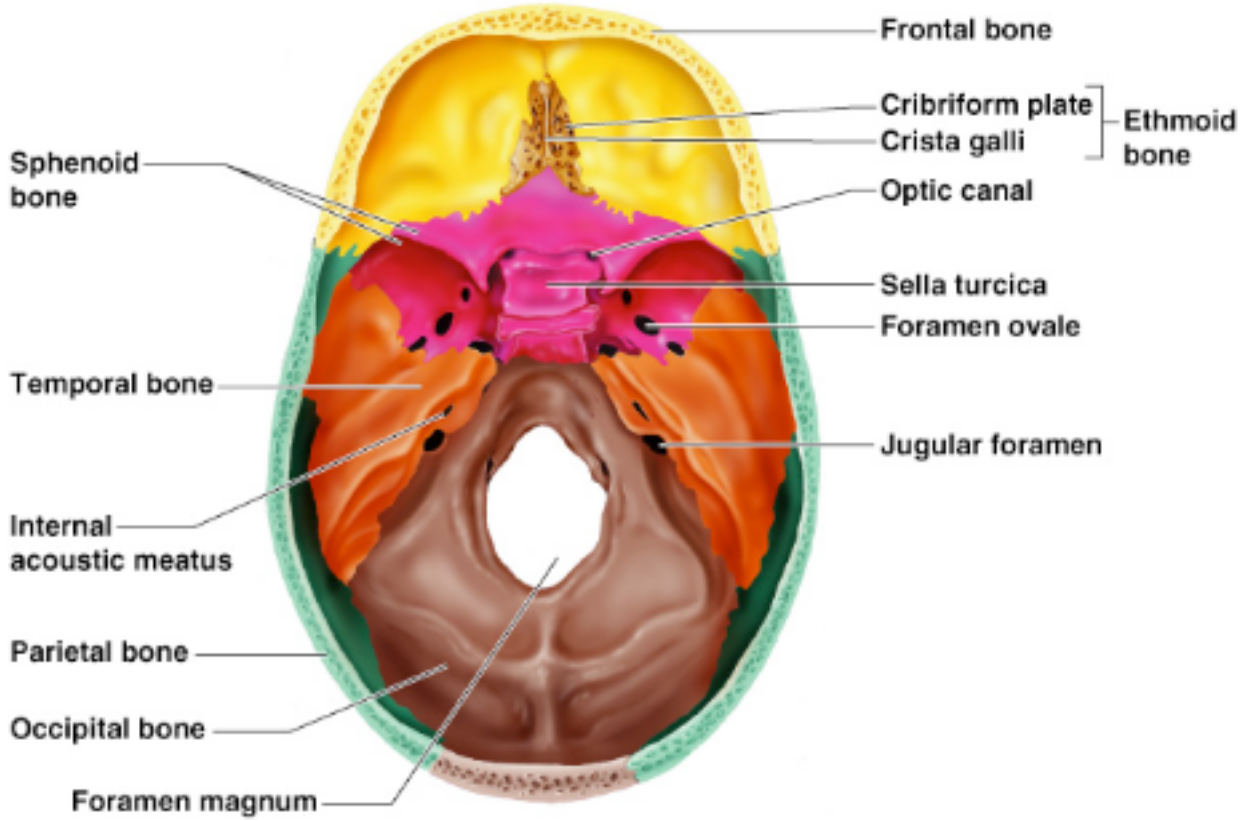
Lateral View of the Skull



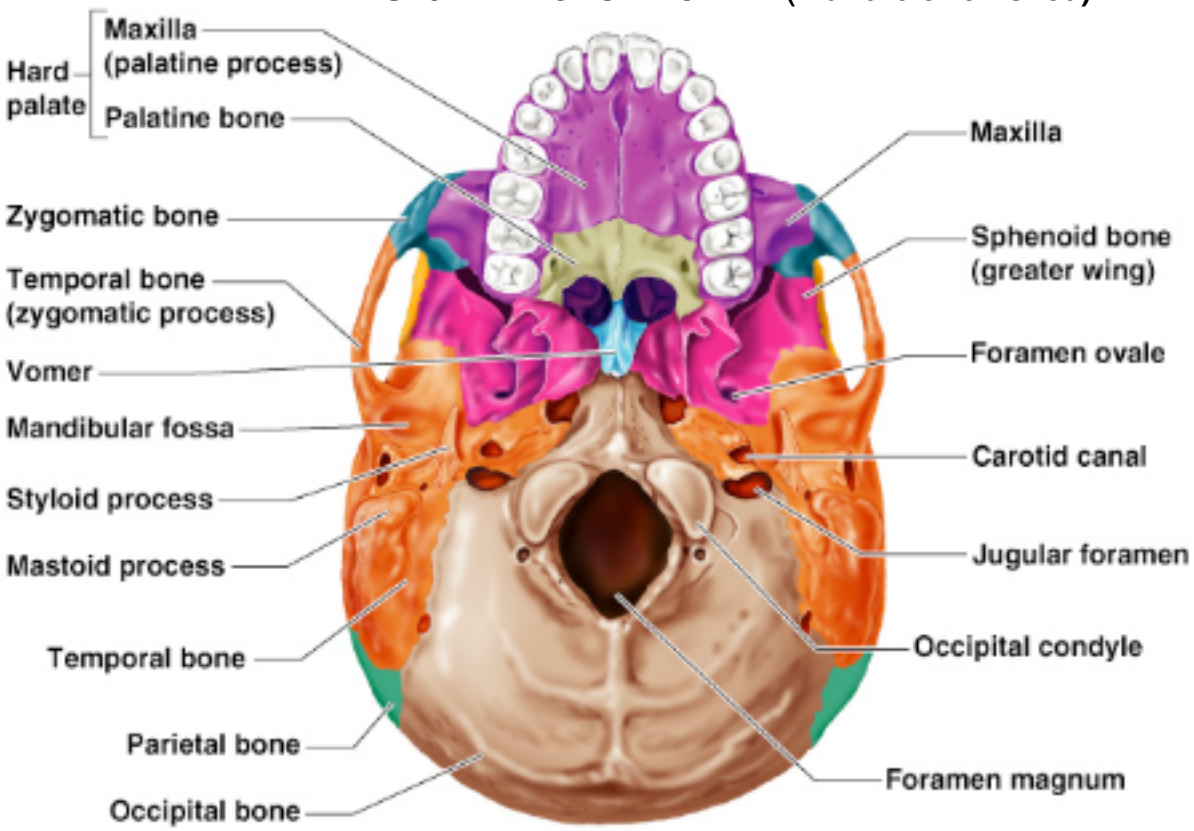
Anterior View of the Skull



skull: superior view (top of cranium removed)



skull: inferior view (mandible removed)



Vertebral Column (Spine) (pp. 145-152)- "spine" extends from skull to pelvis

transmits weight of body to lower limbs

protects spinal cord

consists of 26 irregular bones: 24 vertebrae & 1 sacrum & 1 coccyx

vertebrae separated by **intervertebral disks-** fibrocartilage, cushion & absorb shock
decreases stress to brain during normal movement

primary curvatures: thoracic region & sacral regions present during birth

secondary curvatures: cervical region- develops when baby begins to lift its head
lumbar region- develops when baby begins to walk

disks along with vertebral curvatures: 1. make spine (body trunk) flexible
2. enables spine to absorb shock & not pass shock to head

Vertebrae Common Features:

body (centrum)- disclike, weight-bearing part of vertebra facing anteriorly in vertebral column

vertebral arch- arch formed from the joining of all posterior extensions

pedicle- posterior extension from body to transverse process
concavities above & below the pedicles are named vertebral notches & when vertebrae are articulated, the notches of ea. contiguous pr. form intervertebral foramina

lamina- posterior extension from transverse process to spinous process

vertebral foramen- canal through which the spinal cord passes

transverse processes- two lateral projections from the vertebral arch

spinous process- single projection arising from the posterior aspect of the vertebral arch
(vertebral arch = fused lamina)

superior & inferior articular processes- paired projections lateral to the vertebral foramen
enables vertebra to form joints w/ adjacent vertebra
articular process covered by articular cartilage

A typical vertebrae consists of two essential parts-
an anterior segment, the body, & a post. part: vertebral arch

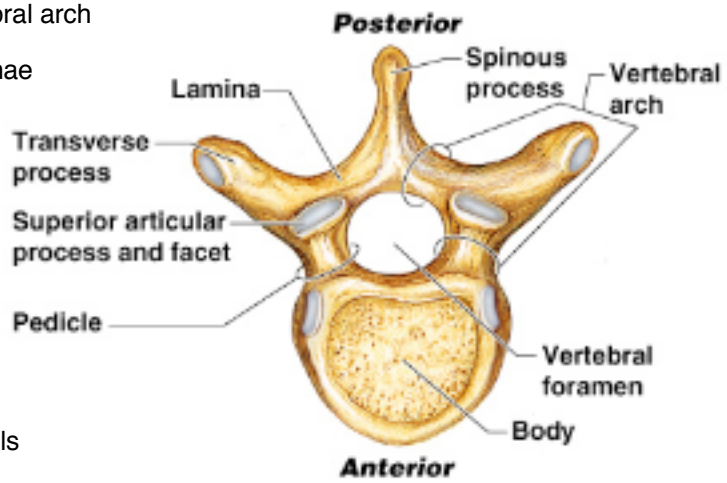
The vertebral arch consists a pair of pedicles & laminae

vertebral arch supports seven processes
4 articular, 2 transverse, 1 spinous

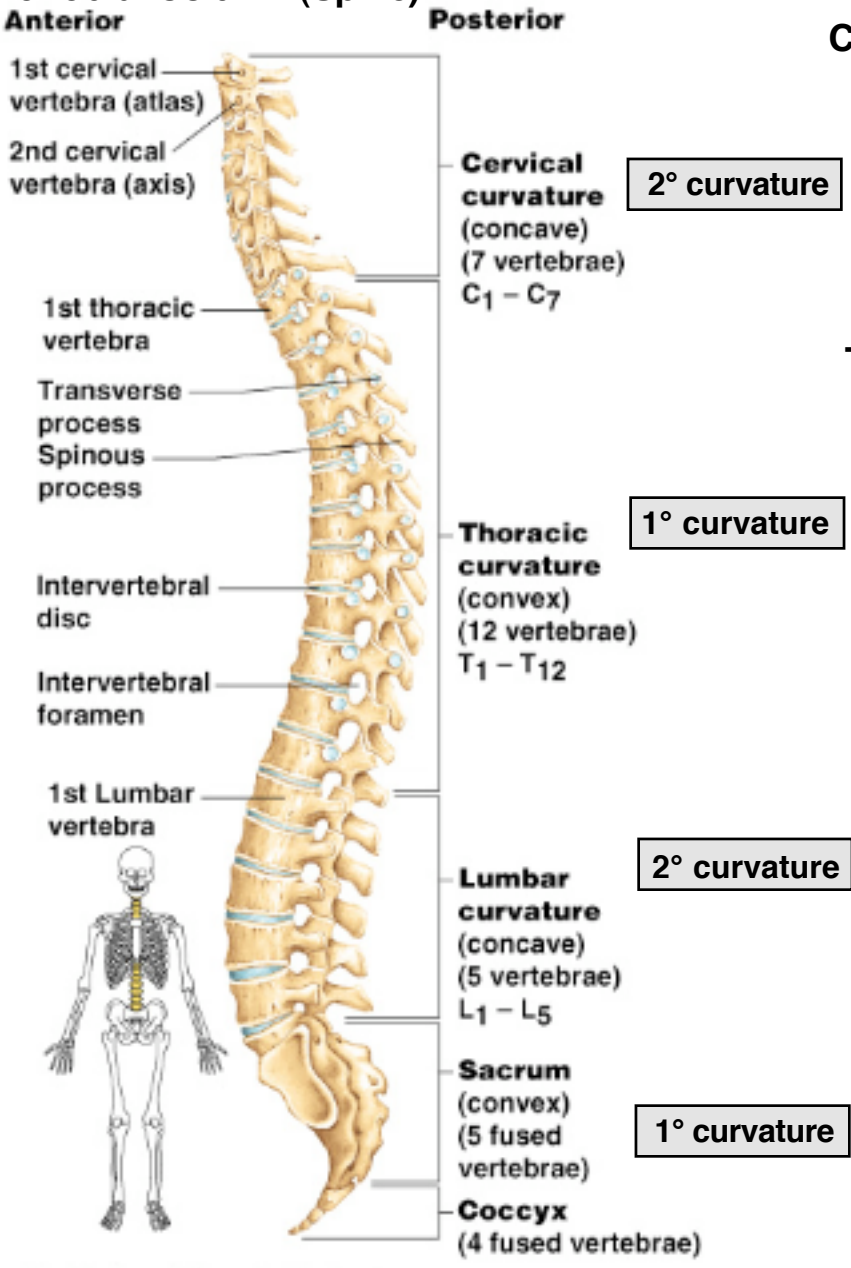
When the vertebrae are articulated w/ ea. other
the bodies form pillar of support for head & trunk

vertebral foramina form a canal for spinal cord

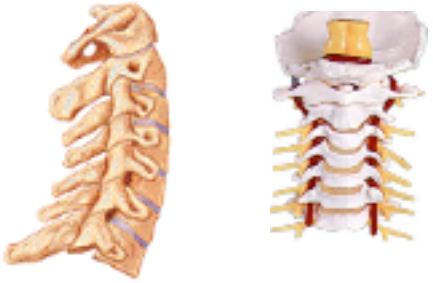
between every pair of vertebrae are 2 holes:
the intervertebral foramina, one on either side, for
the transmission of the spinal nerves & blood vessels



Vertebral Column (Spine)



Cervical Vertebrae- C_1 - C_7

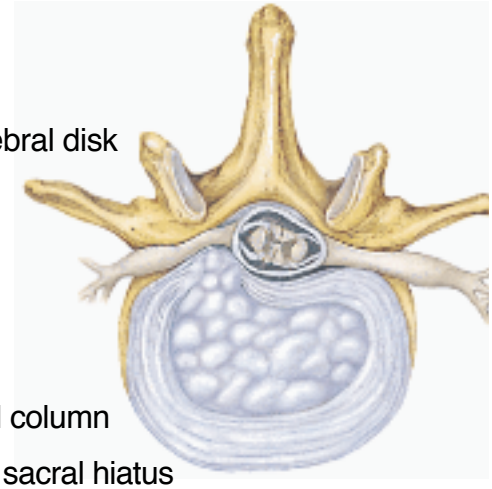


Thoracic Vertebrae- T_1 - T_{12}

Lumbar Vertebrae- L_1 - L_5

Sacrum- 5 fused vertebrae

Coccyx- 3 to 5 fused vertebrae



herniated (slipped) disk- protrusion or rupture of an intervertebral disk

Abnormal Spinal Curvatures

Scoliosis- exaggerated lateral bending of spinal column

Kyphosis- "hunchback" exaggerated thoracic curvature

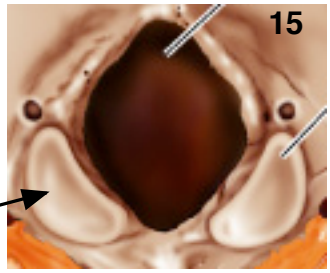
Lordosis- "swayback" exaggerated lumbar curvature

spina bifida- congenital defect- incomplete closure of vertebral column

epidural anesthesia-used in obstetrics, injected into sacrum@ sacral hiatus

lumbar puncture- "spinal tap", spinal fluid removed using a long needle b/w L3-L4 or L4-L5

Vertebral Column (Spine)
Cervical Vertebrae- C_1 - C_7



neck region of spine

1st two cervical vert. imp. f'n:

C_1 (Atlas) -has no body
- receives & articulates with occipital condyles of skull
-enables head to nod "yes"

C_2 (Axis) - has dens (odontoid process) on body & is is the pivot point for atlas & skull
- **odontoid process (dens)** act as pivot pt. enabling head to not "no"

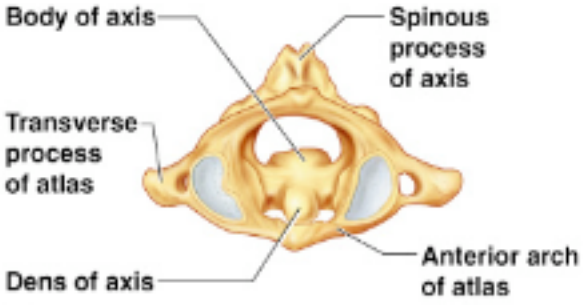
typical cervical vertebrae: (C_3 - C_7)

*smallest & lightest of all vertebrae

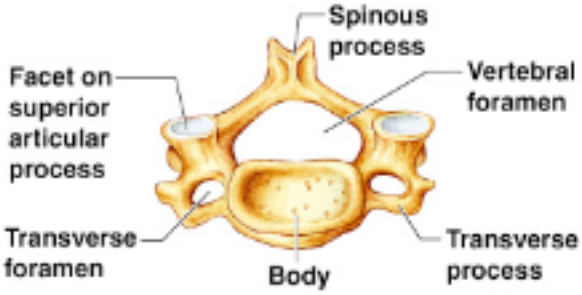
*spinous processes- short & divided into 2 branches
stick straight back

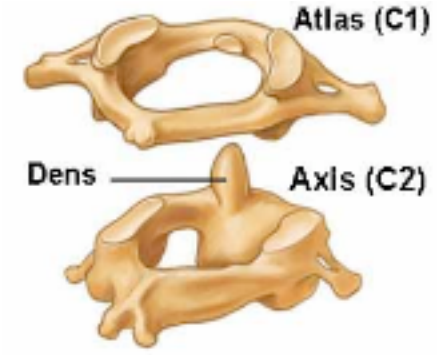
*transverse processes contain foramina (unlike thoracic & lumbar)
holes for vertebral arteries to pass up to brain

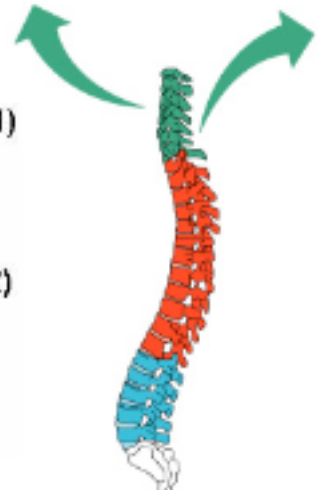
Superior view of articulated atlas & axis

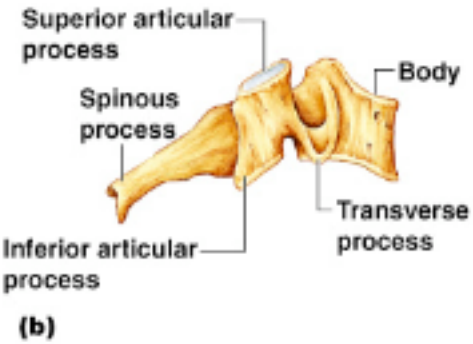


typical cervical vertebrae









Thoracic Vertebrae- T_1 - T_{12}

12 unfused vertebrae
larger than cervical vertebrae

body -somewhat heart-shaped
-has 2 **costal facets** (articulating surfaces)
receive the heads of the ribs

spinous process- longhooks sharply downward
- lever for muscle attachment

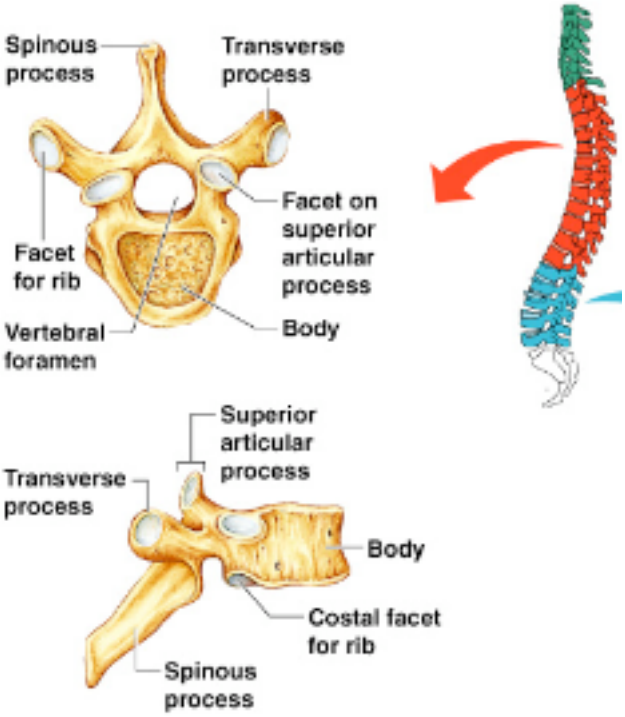
transverse process- no foramen

vertebral foramen- large circular

intervertebral foramina- larger than cervical

decreases incidence of nerve compression

range of motion- limited beccause of rib articulations
& long spinous processes



Lumbar Vertebrae- L_1 - L_5

5 unfused larger vertebrae

support most of the weight of the body

body- blocklike, massive bean shape

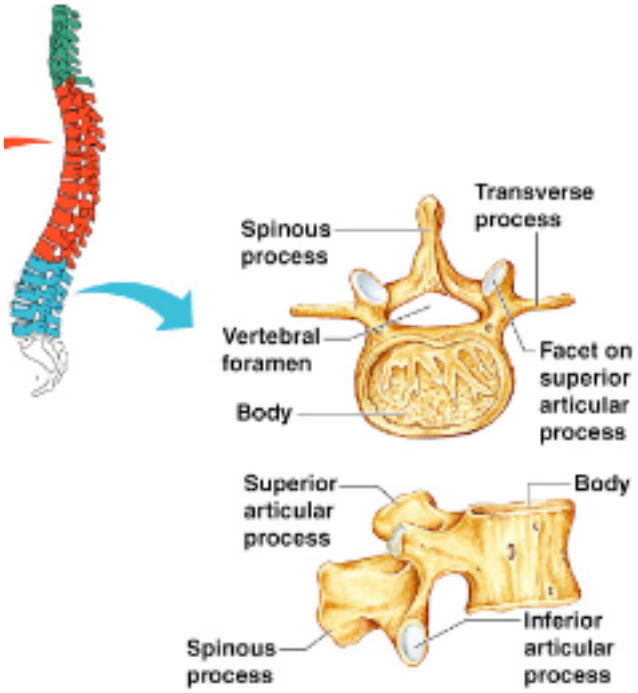
spinous process- short, hatchet-shaped
horizontal
points straight back

vertebral foramen- smaller, triangular shaped
not as many nerves passing thru

pedicles- longer & wider

intervertebral foramina- larger than cervical

nerve compression is more common than thoracic region



Sacrum- 5 fused vertebrae

articulations: 1. superiorly with L5
2. inferiorly with coccyx
3. ala with coxal bone (ilium) (sacroiliac joint)

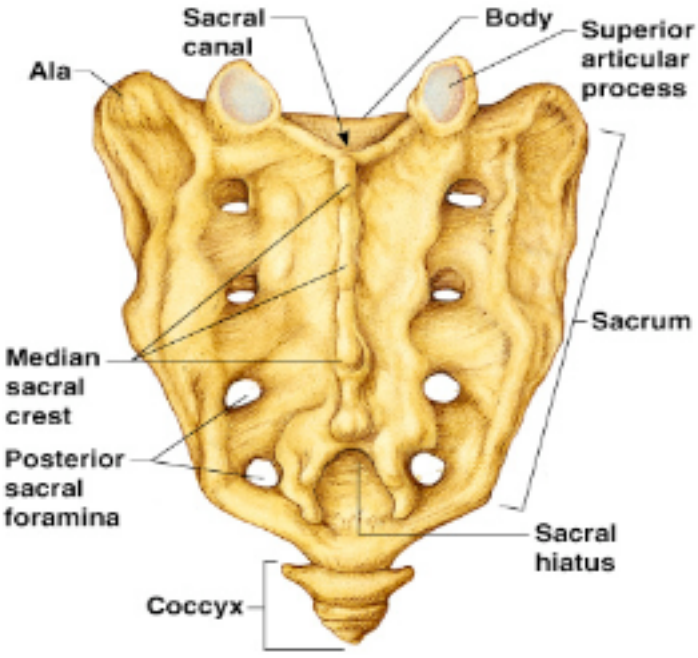
forms posterior wall of pelvis

median sacral crest- formed by fused spinous processes

sacral canal- canal continues inside

vertebral canal terminates via a larger opening-
sacral hiatus-large opening vertebral canal

posterior sacral foramina- nerves pass thru



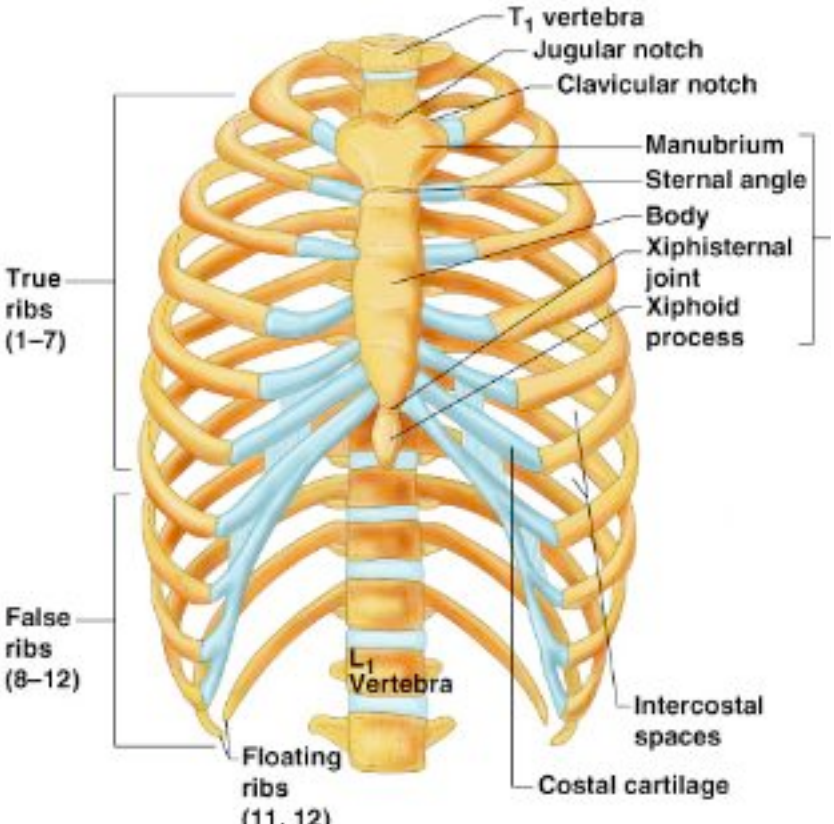
Coccyx
3-5 fused vertebrae
"tailbone"
vestigal- no longer functions

Bony Thorax (pp. 152-153)
protects thoracic cavity: heart & lungs

Sternum- breastbone

flat bone- contains red marrow

Manubrium
Body
Xiphoid Process



Ribs- 12 pairs
"typical ribs" #3-9

head- 2 facets sep. by a crest articulates with:
- thoracic vertebrae
- verterbra superior to it

neck- connects head to shaft

shaft- thin, flat, curved
interior concave w/ groove for intercostal nerves & vessels

Bony Thorax

Ribs-

articulations- posteriorly w/ thoracic vertebrae
anteriorly w/ sternum

True Ribs- superior seven rib pairs
- attach directly to sternum by costal cartilage

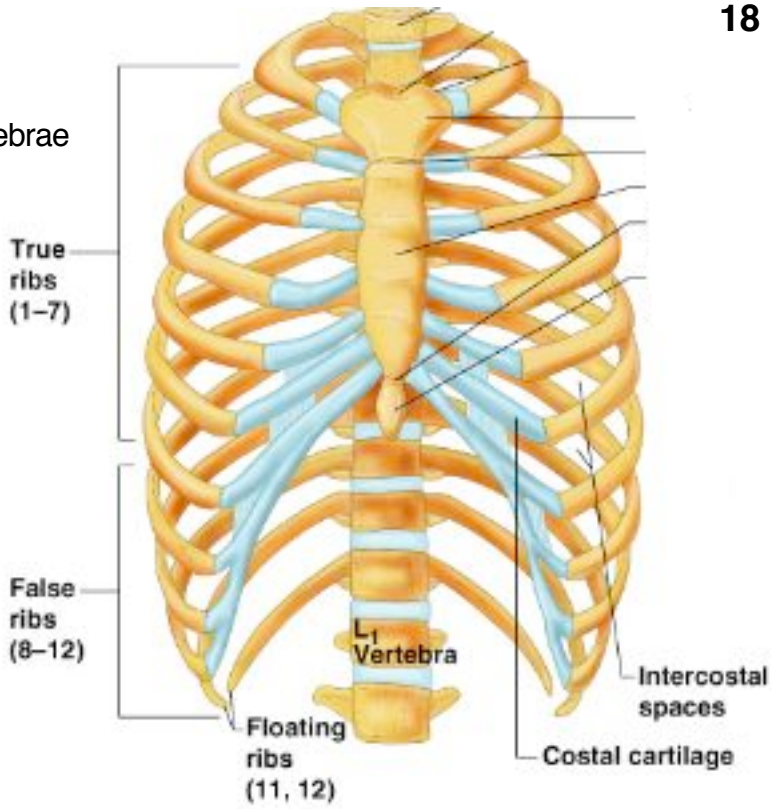
#1-7 ribs

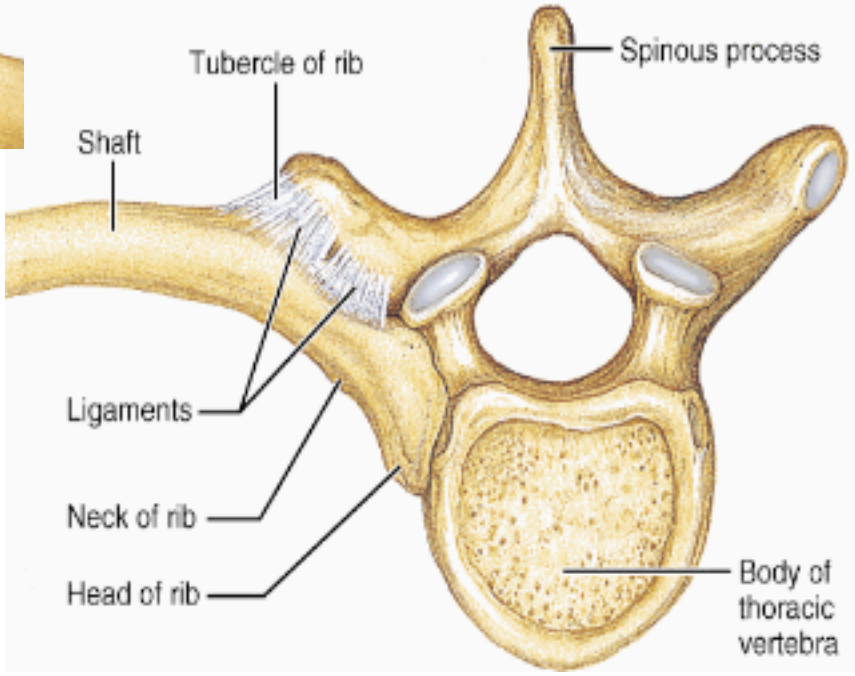
False Ribs- inferior five rib pairs
-attach indirectly to sternum or not attached at all

8-12 ribs

Floating Ribs- inferior two rib pairs
- no sternal attachment

11, 12 ribs



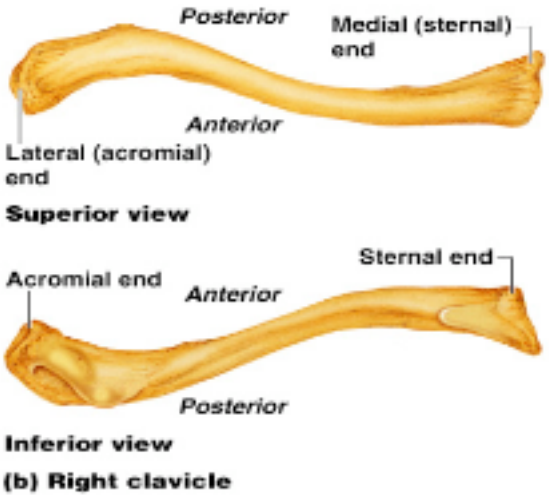


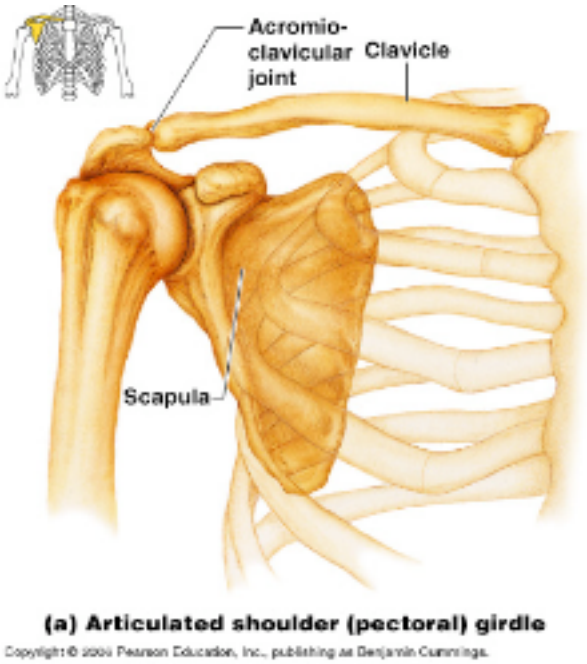
Appendicular Skeleton (pp. 153-163)

Shoulder Girdle- clavicle & scapula

PRO: very light & creates a flexible freely movable joint with arm because
1. pectoral girdle attaches in only 1 place w/ axial skeleton:**sternoclavicular jt**
2. scapula is loosely attached enabling it to slide back & forth against the thorax as muscles act
3. glenoid cavity is shallow, & shoulder joint is poorly reinforced by ligaments

CON: prone to dislocation





Clavicles (Collarbones)

articulations: 1. manubrium of sternum medially
2. acromion process of scapula laterally

clavicle braces arm away from top of thorax & prevents shoulder location

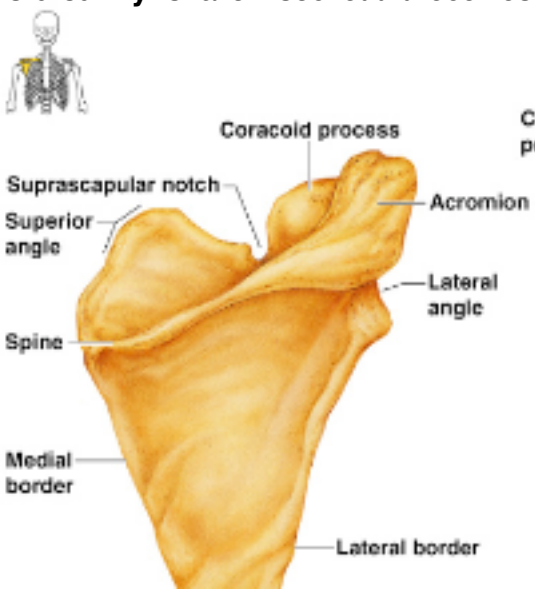
Scapula (Shoulder Blades)

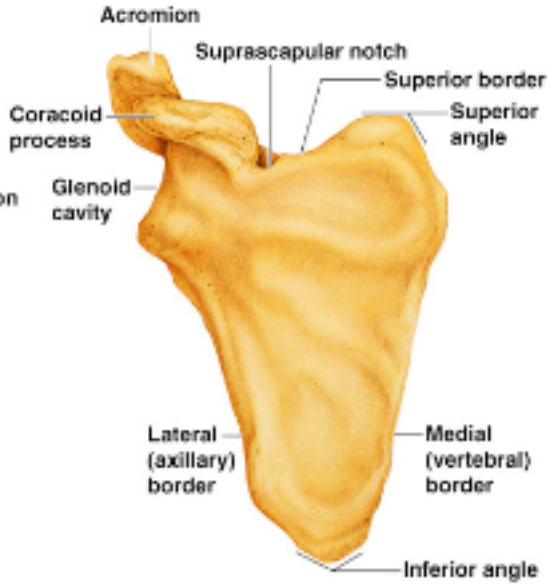
triangular, flat bone with 2 large processes
not directly attached to axial skeleton- loosely held in place by trunk muscles

acromion process- enlarge end of the spoine of the scapula
articulates with the lateral end of the clavicle: **acromioclavicular joint**

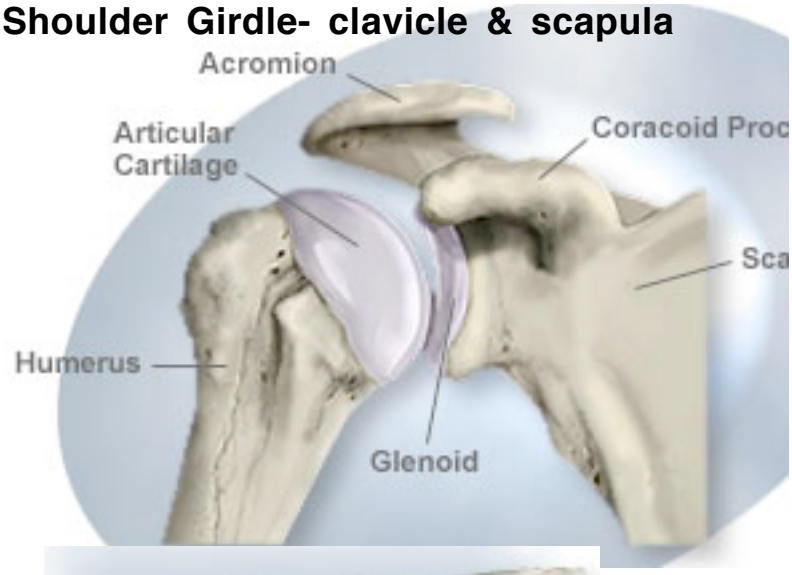
coracoid process- points over top shoulder & anchors some arm muscles

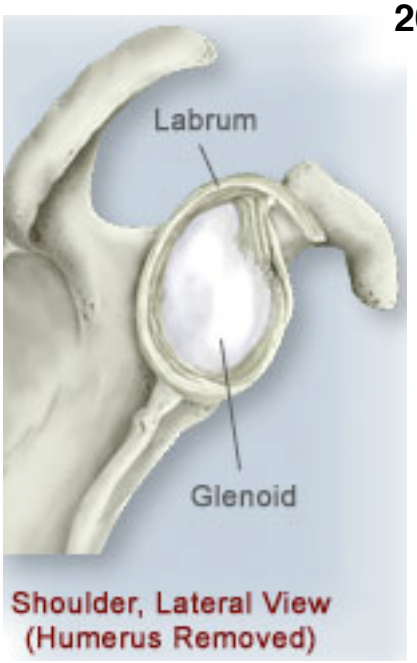
glenoid cavity- shallow socket tht receives the head of the humerus

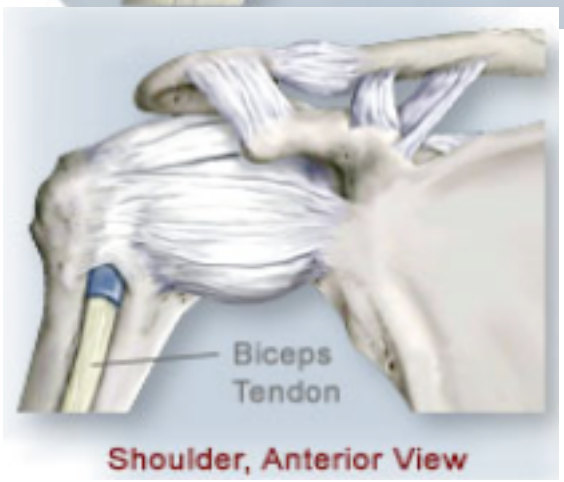




Shoulder Girdle- clavicle & scapula



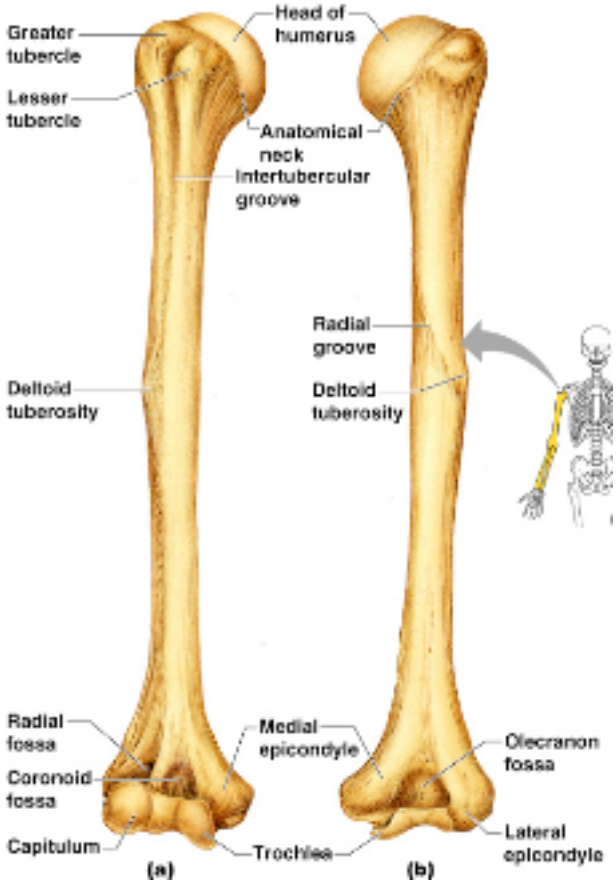




Bones of the Upper Limbs (pp. 155-156)

Arm

Humerus

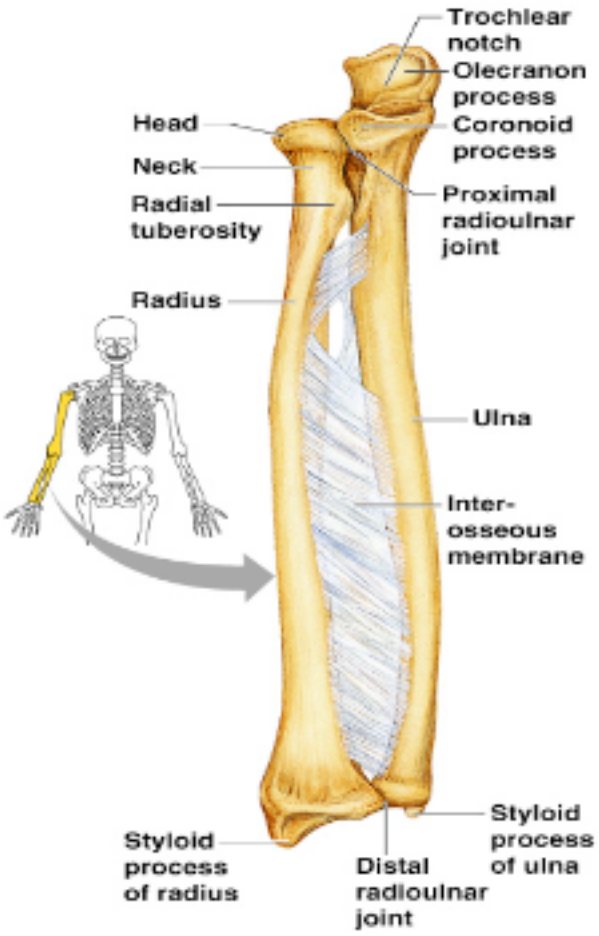


Bones of the Upper Limbs (pp. 155-156)

Forearm

Radius- lateral bone which follows thumb

Ulna- medial bone



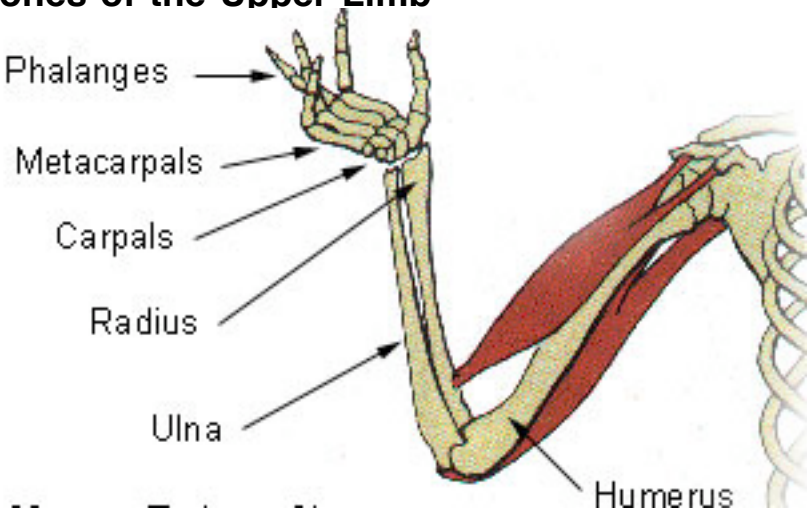
Hand

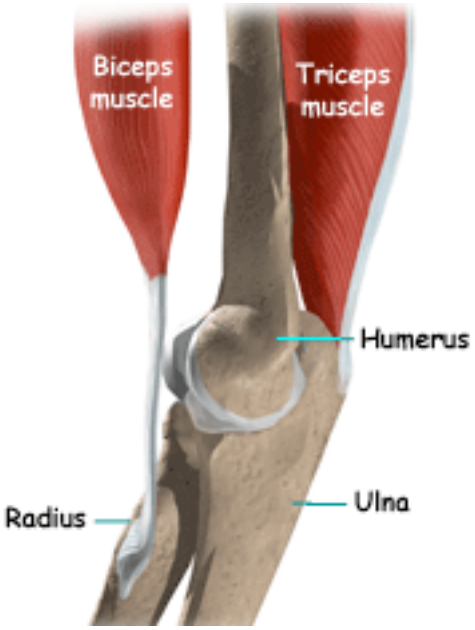
Carpals- two irregular rows of four bones each

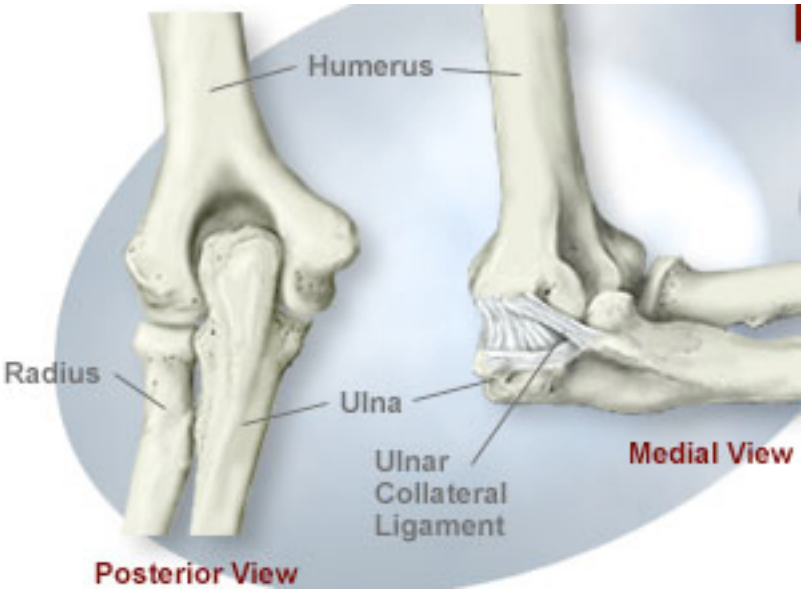
Metacarpals- palm bones
numbered 1to 5 beginning w/ thumb

Phalanges

Bones of the Upper Limb







Bones of the Pelvic Girdle (pp. 157-159)

Coxal (Hip) bones (2)

3 fused bones

Ilium

Ischium

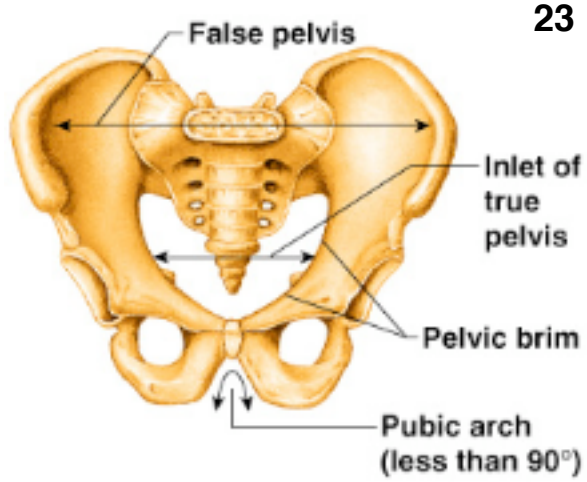
Pubis

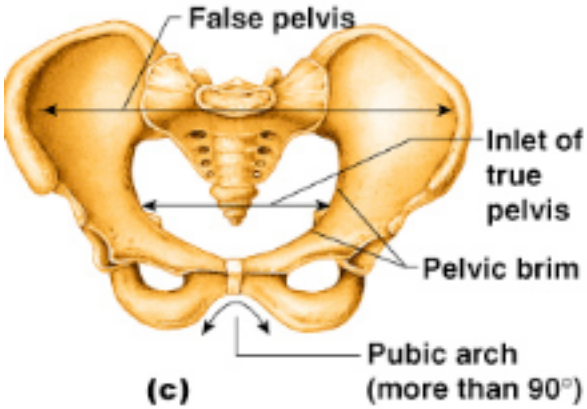
Sacroiliac (SI) Joint

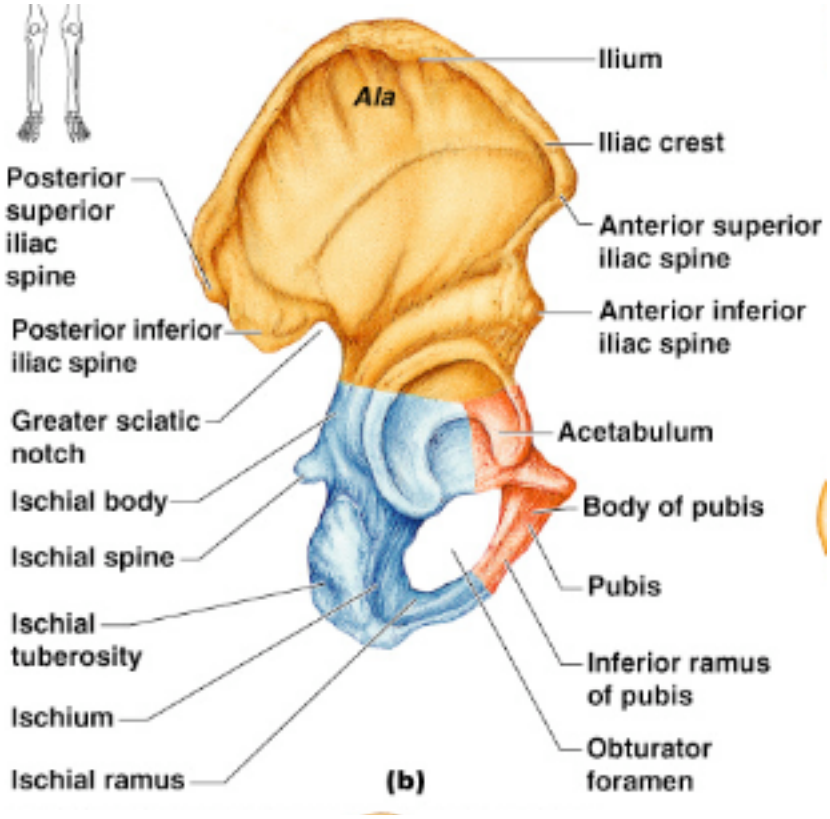
Bones of the Pelvic Girdle (pp. 157-159)

Coxal (Hip) bones

Difference b/ w male and female pelvic girdles



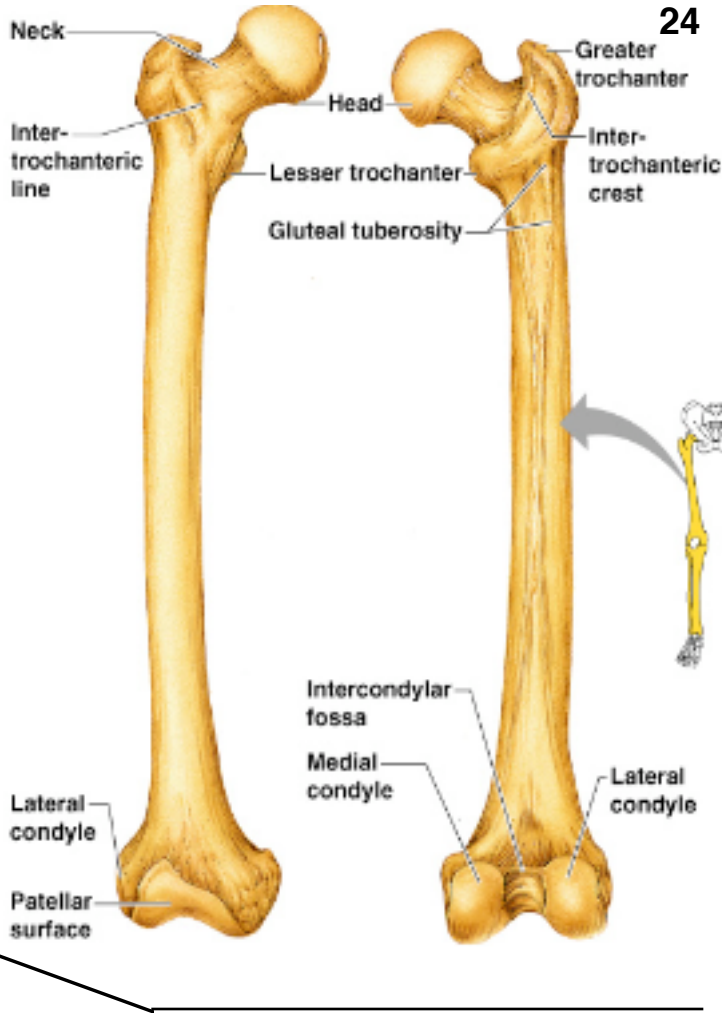


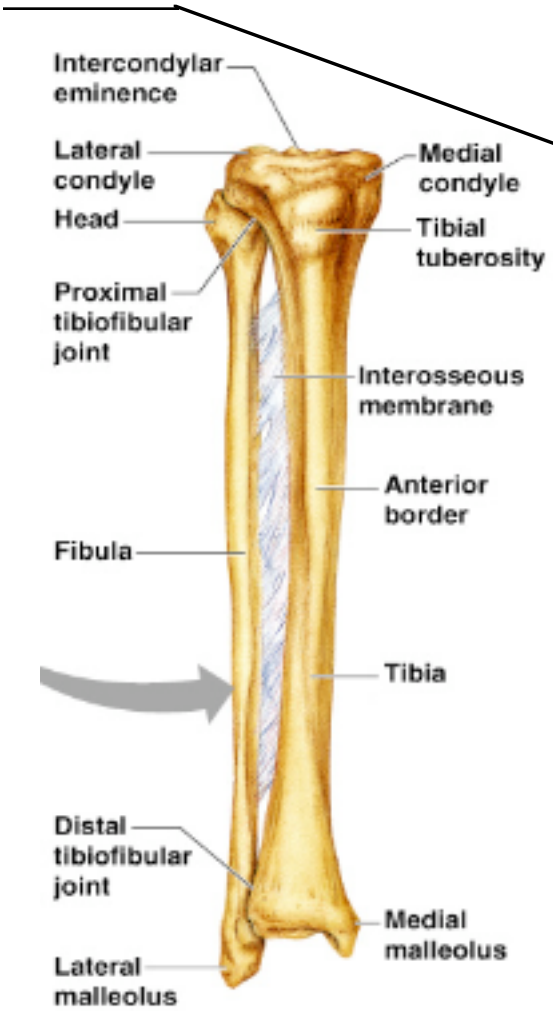


Lower Limb Bones (pp.159 - 63)

Thigh

Femur



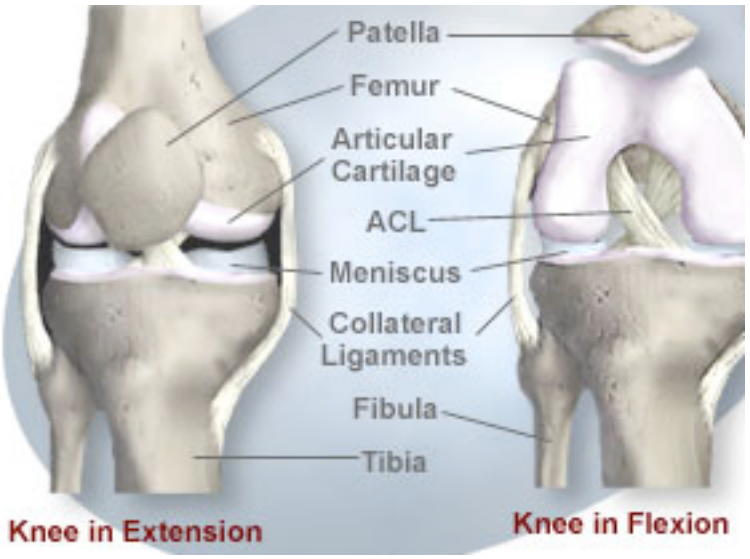


Leg

Tibia- weight-bearing shinbone

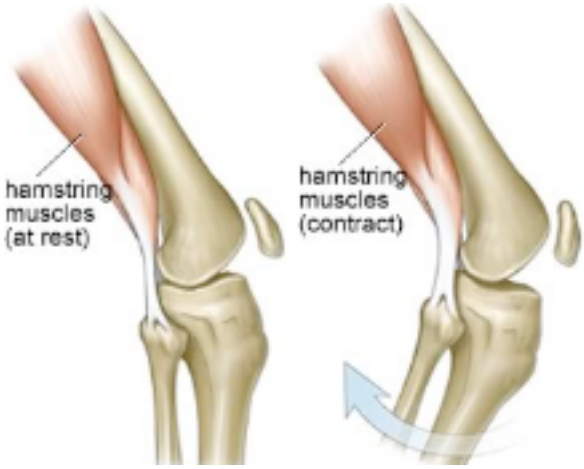
Fibula


femur
(thigh bone)
patella
(knee cap
patellar
tendon
fibula
tibia
(shin bone)


Patella
Femur
Articular
Cartilage
ACL
Meniscus
Collateral
Ligaments
Fibula
Tibia
Knee in Extension
Knee in Flexion


patella
(knee cap)
articular
cartilage
lateral
collateral
ligaments
lateral
meniscus
medial
meniscus
medial
collateral
ligaments


posterior
cruciate
ligament
(PCL)
anterior
cruciate
ligament
(ACL)
lateral
meniscus
medial
meniscus


hamstring
muscles
(at rest)
hamstring
muscles
(contract)

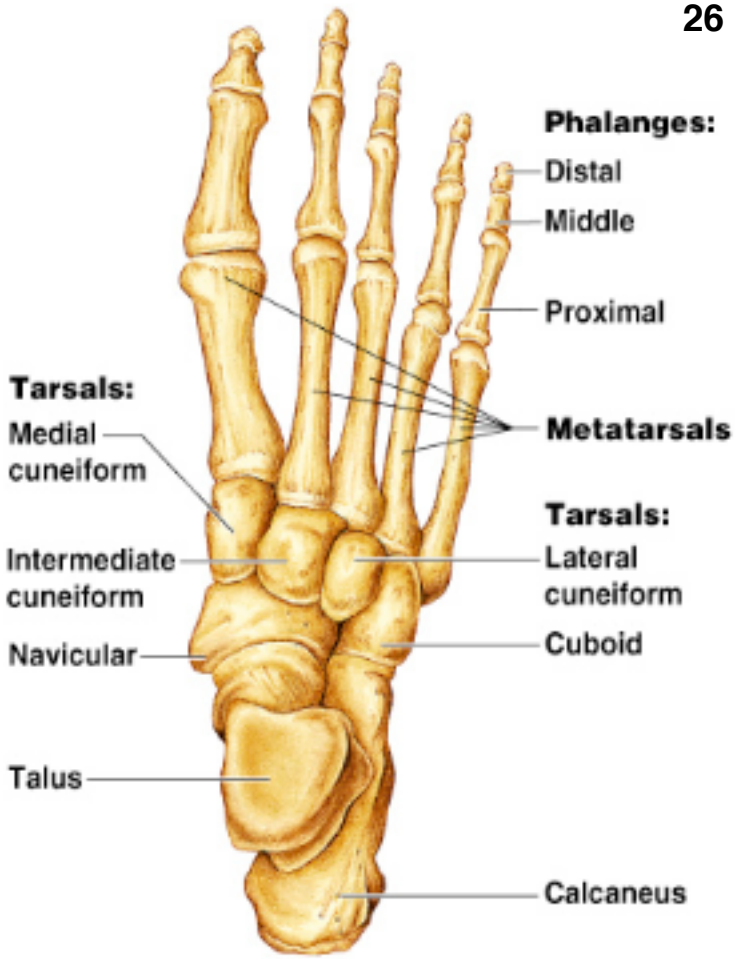

quadricep
muscles
(at rest)
quadricep
muscles
(contract)
patella
(knee cap)
patellar
tendon
tibia
(shin bone)

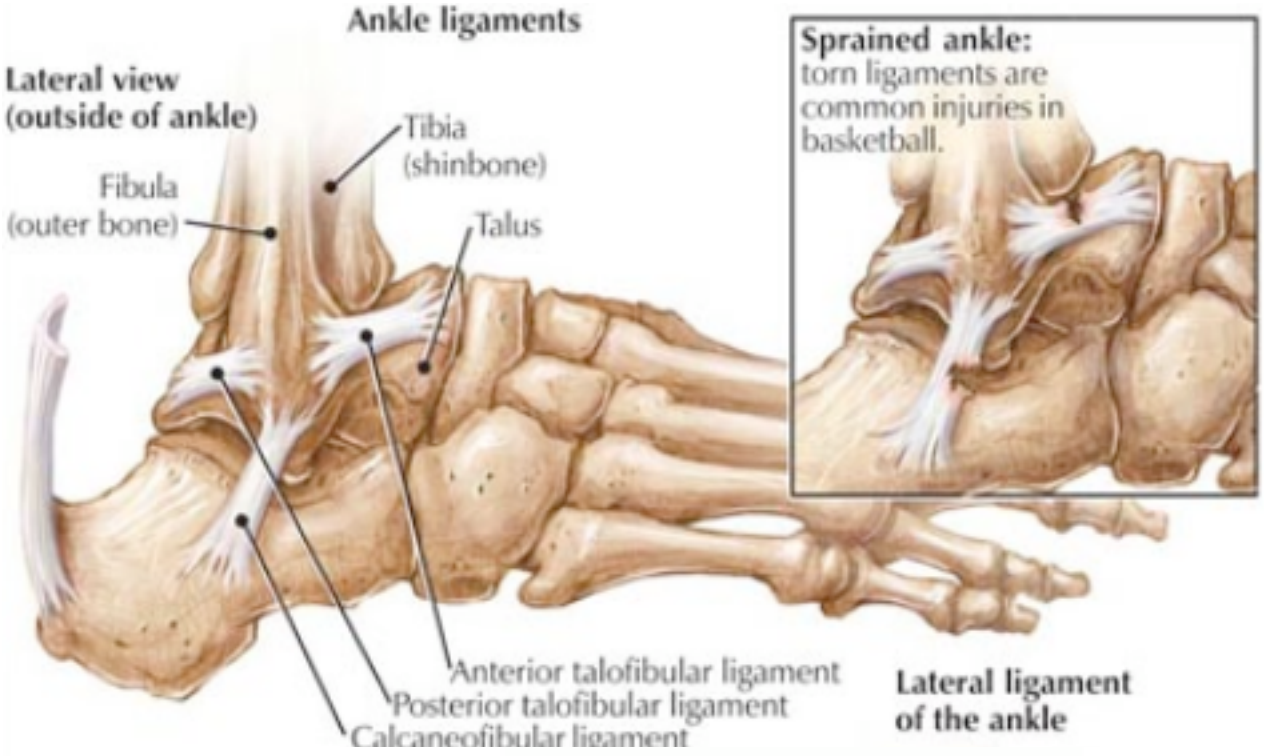
Foot

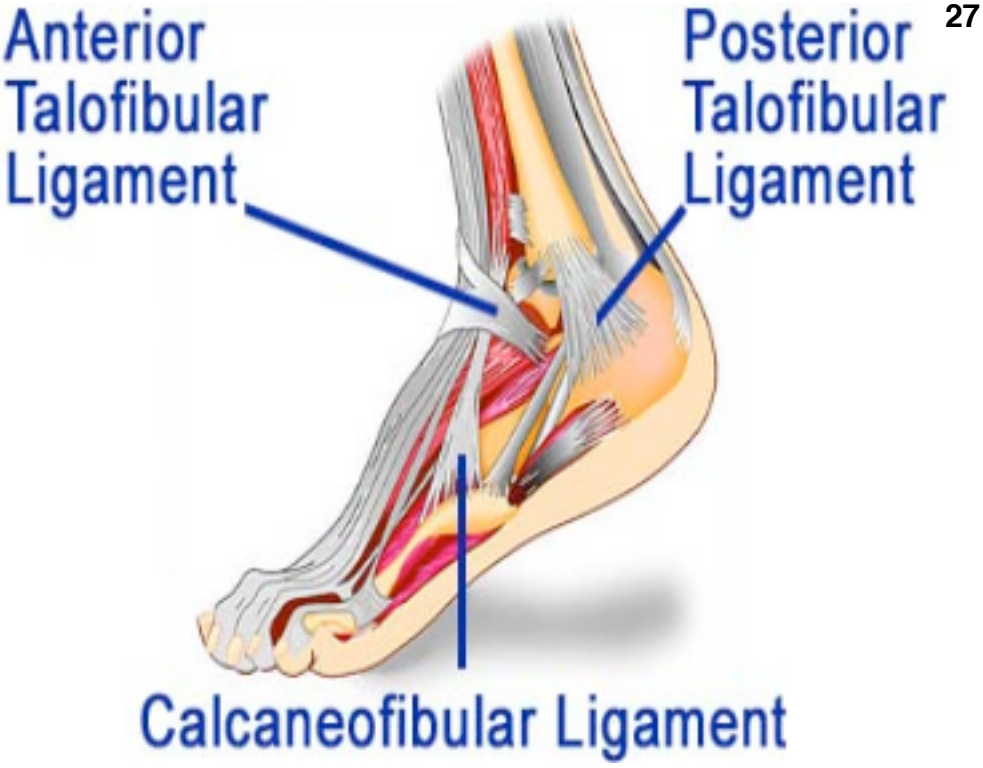
Tarsal Bones- consist of 7 bones

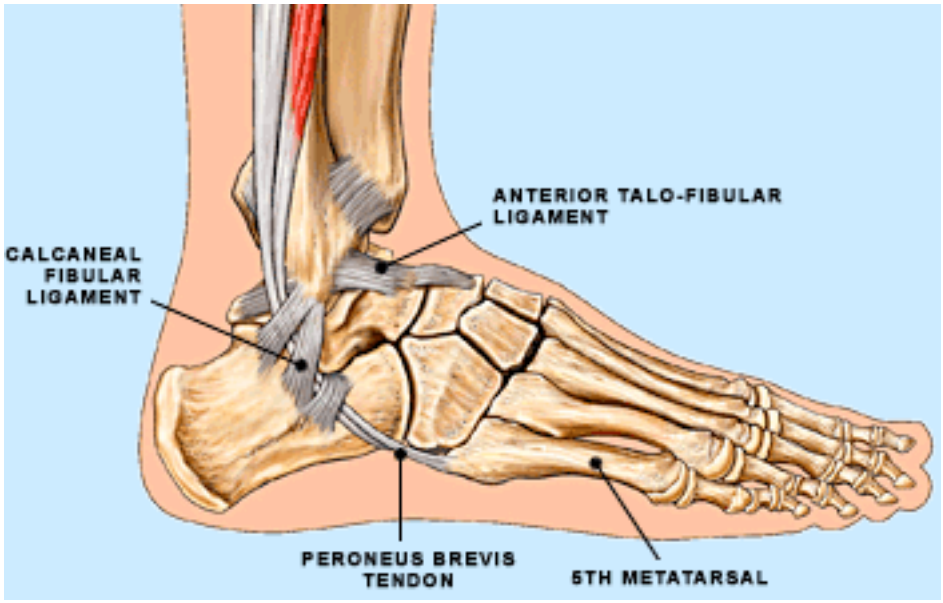
Metatarsals- 5 long bones

Phalanges- bones of toes






Anterior
Talofibular
Ligament
Posterior
Talofibular
Ligament
Calcaneofibular Ligament


ANTERIOR TALO-FIBULAR
LIGAMENT
CALCANEAL
FIBULAR
LIGAMENT
PERONEUS BREVIS
TENDON
5TH METATARSAL

Joints (pp. 163 - 168)

Functional Categories of Joints (p. 163)

Synarthroses- immovable

Amphiarthroses- slightly movable

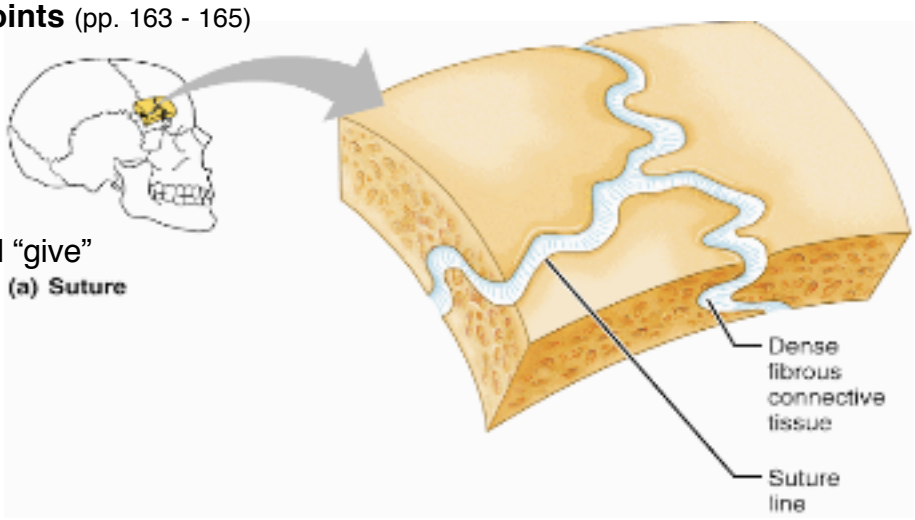
Diarthroses- freely movable

Structural Categories of Joints (pp. 163 - 165)

Fibrous Joints

Sutures- no movement

Syndesmoses- allow minimal "give"



Cartilaginous Joints

Hyaline cartilage connection at bone ends

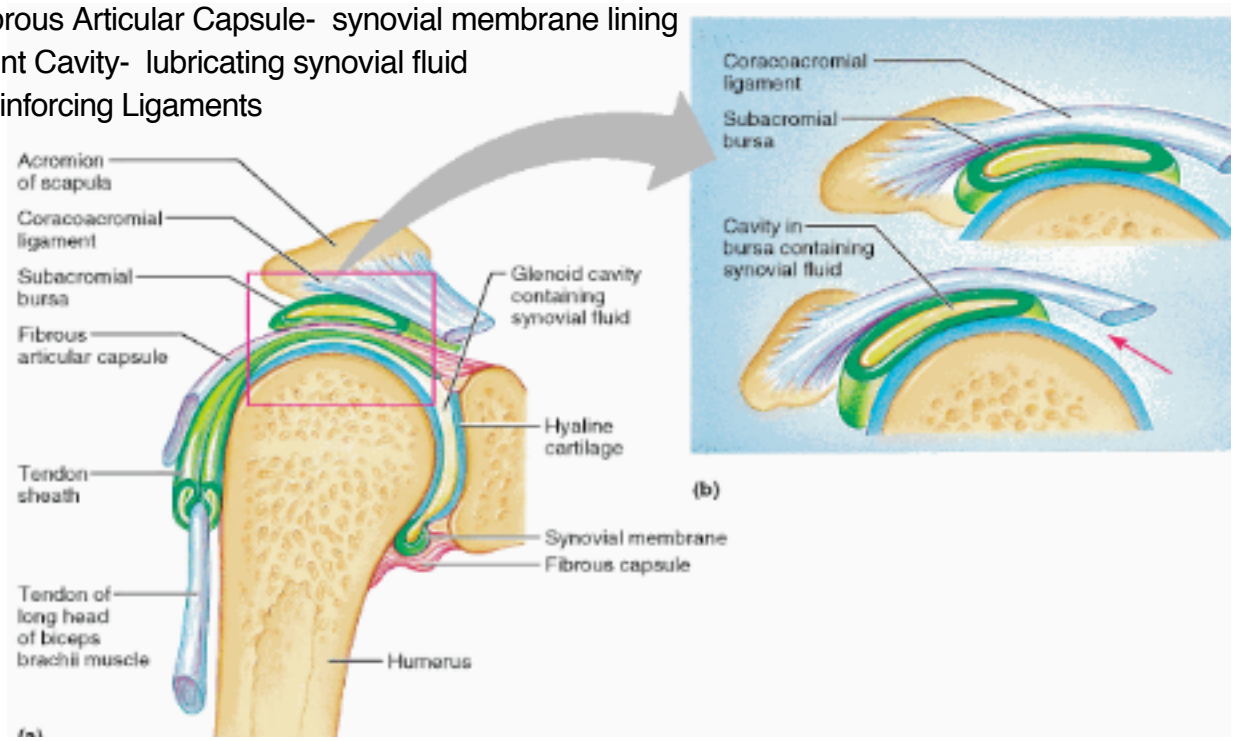
Synovial Joints

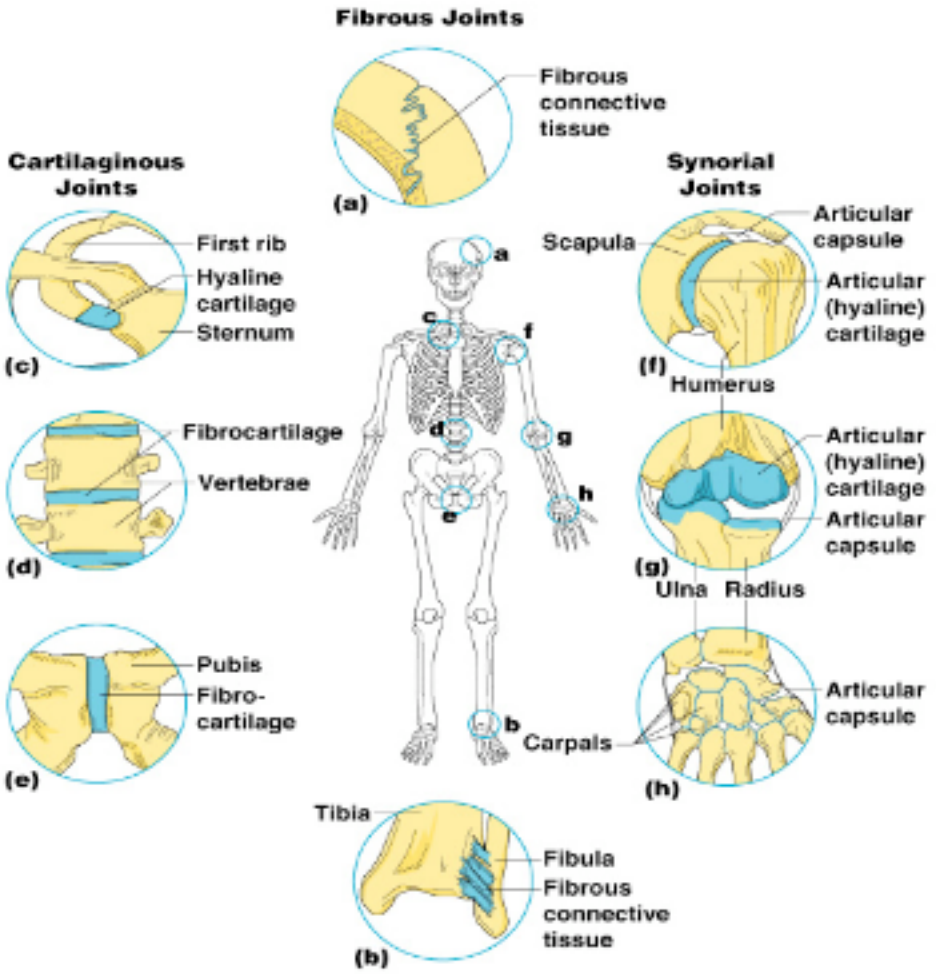
Articular Cartilage- covers bone ends

Fibrous Articular Capsule- synovial membrane lining

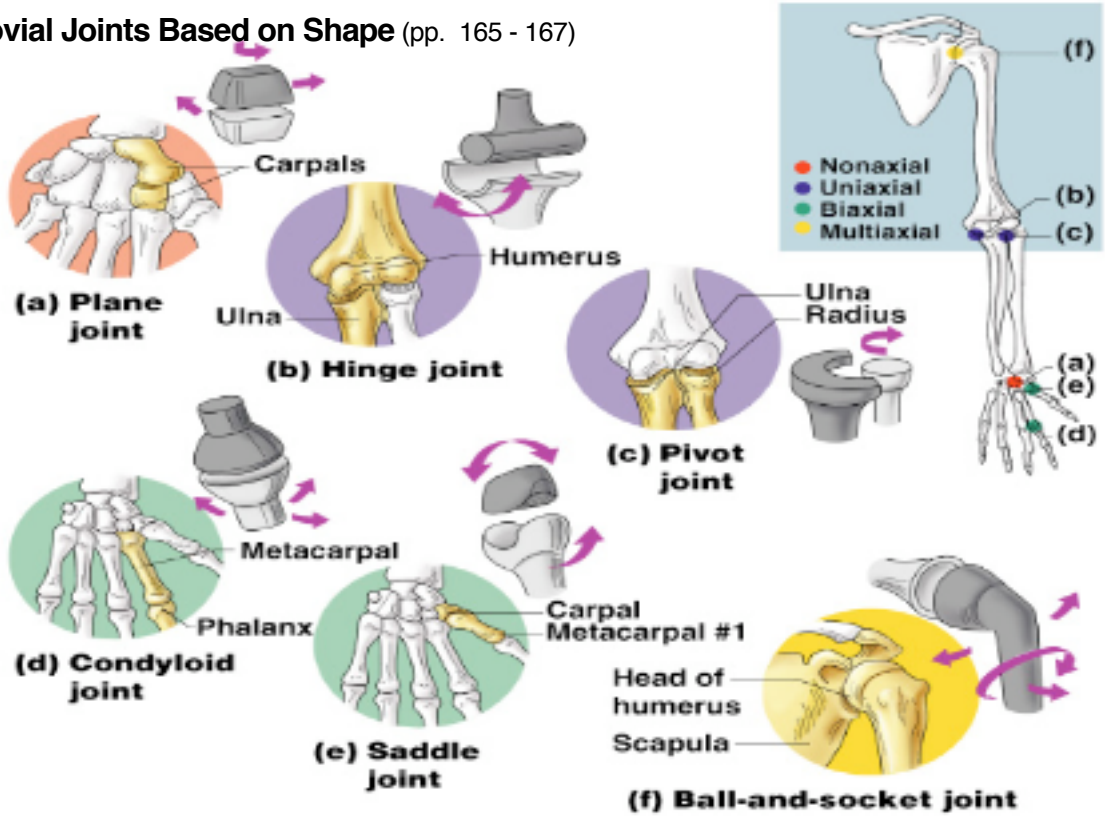
Joint Cavity- lubricating synovial fluid

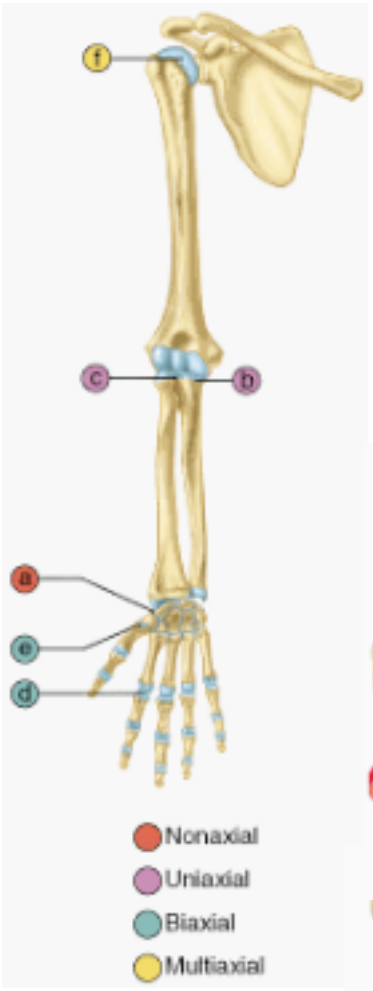
Reinforcing Ligaments

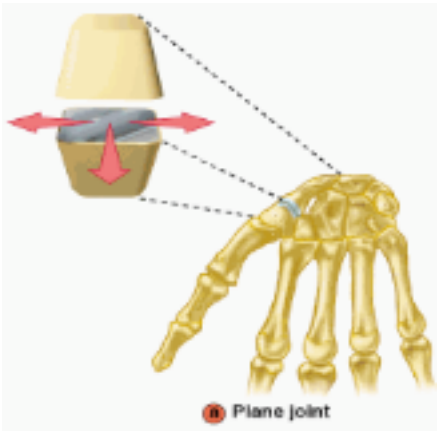


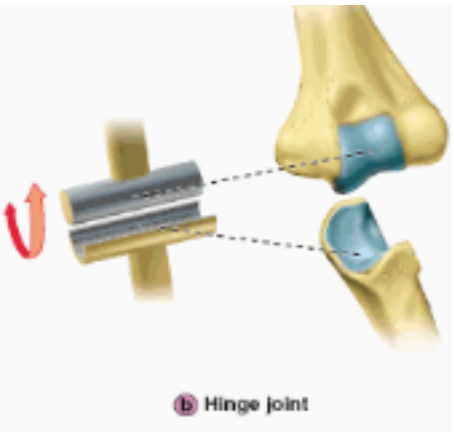


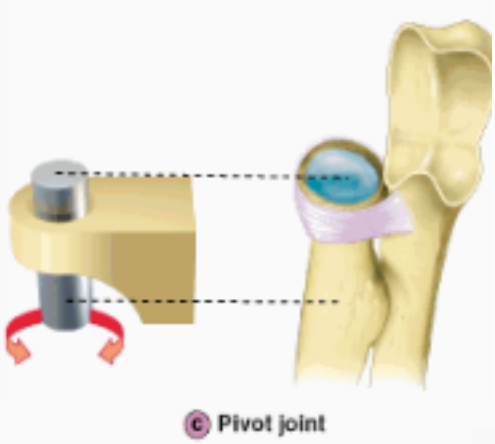
Types of Synovial Joints Based on Shape (pp. 165 - 167)

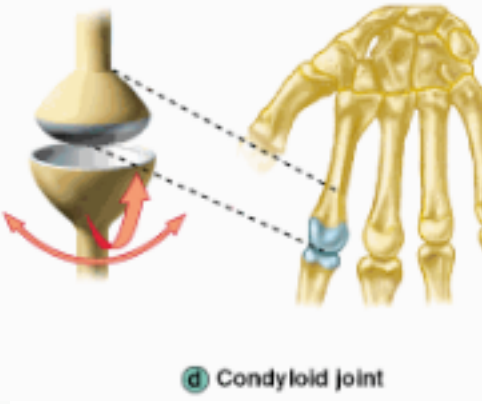


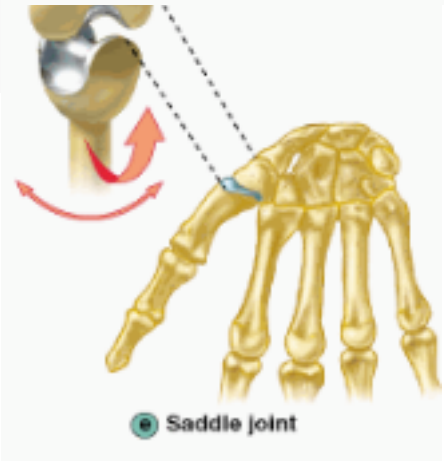


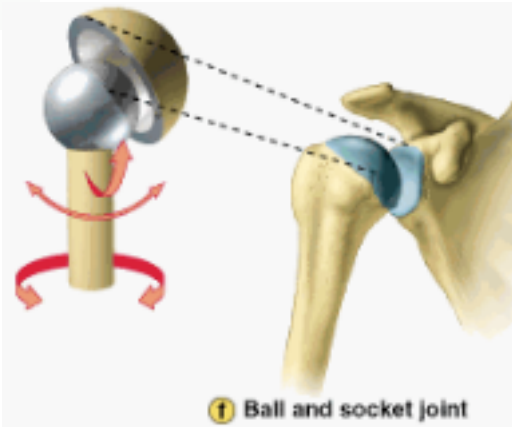












Plane Joint

Hinge Joint

Pivot Joint

Condyloid Joint

Saddle Joint

Ball-and-Socket Joint

Inflammatory Disorders of Joints (pp. 167 - 168)

Osteoarthritis (OA)- degenerative “wear and tear”

Rheumatoid Arthritis (RA)- autoimmune-related and most crippling

Gouty Arthritis- painful uric acid crystals in joints