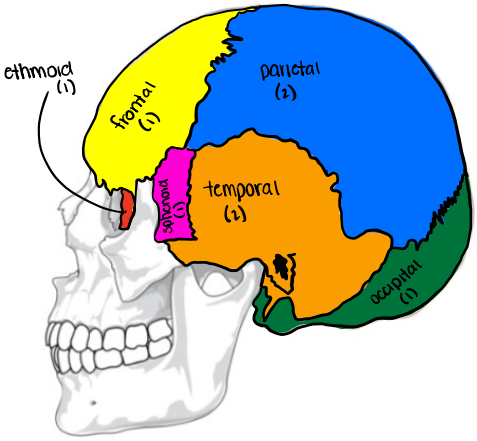
Unit 4: Skeletal system

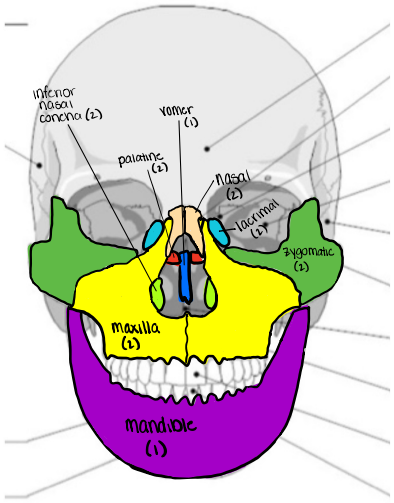
the axial skeleton

- composed of the skull, vertebrae, and ribs
  doesn't include hips or shoulder blades
- skull is divided into 2, cranial and facial bones



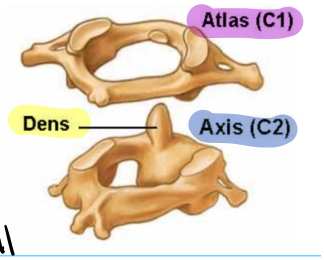
Cranium

- bones are held together by sutures
- frontal (1), parietal (2)
- temporal (2), occipital (1)
- ethmoid (1), sphenoid (1)



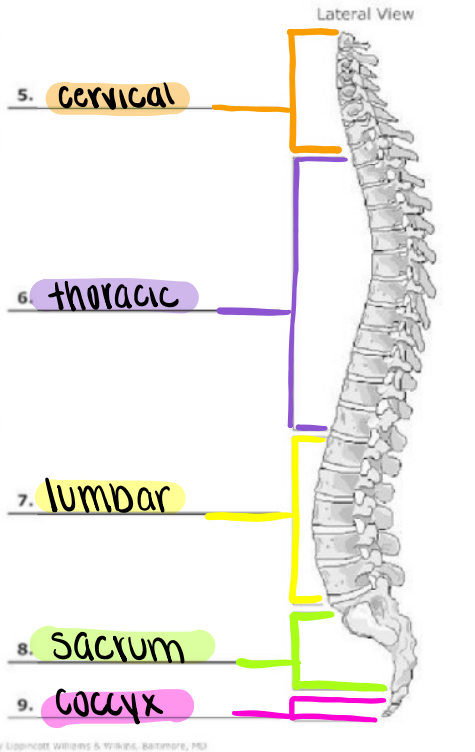
facial bones

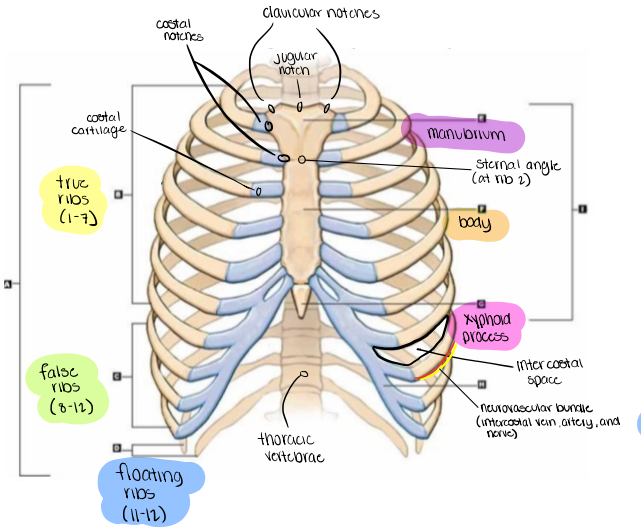
- maxillary (2), palatine (2)
- zygomatic (2), lacrimal (2)
- nasal (2), vomer (1)
- inferior nasal concha (2)
- mandible (1), hyoid (1)



Vertebrae

- cervical (7)
  - atlas → supports the skull
  - axis → dens allows for rotation
- thoracic (12)
- lumbar (5)
- sacral (5)
- coccyx (4)





thoracic cage

- manubrium (1)
- body (1)
- xiphoid process (1)
- true ribs (7 pairs)
- false ribs (3 pairs)
- floating ribs (2 pairs)

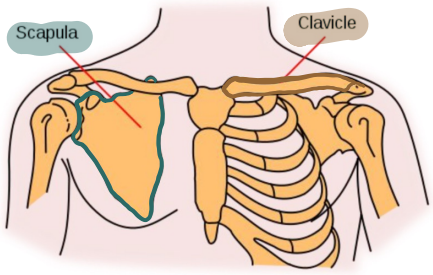
appendicular skeleton

attaches arm to shoulder

- composed of shoulder girdle, arms, hands, pelvic girdle, legs & feet

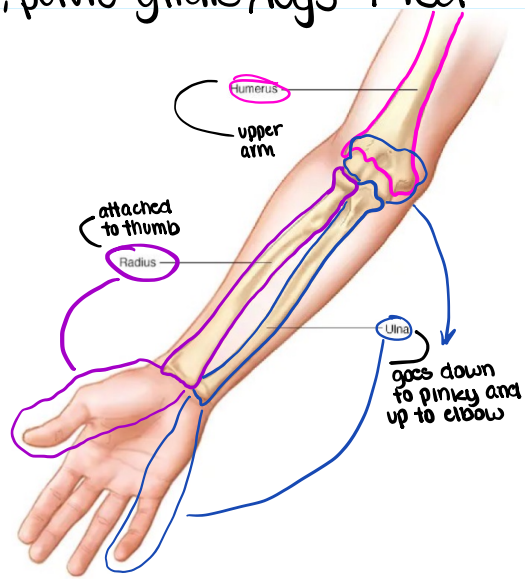
shoulder girdle

- clavicles (2)
- scapula (2)



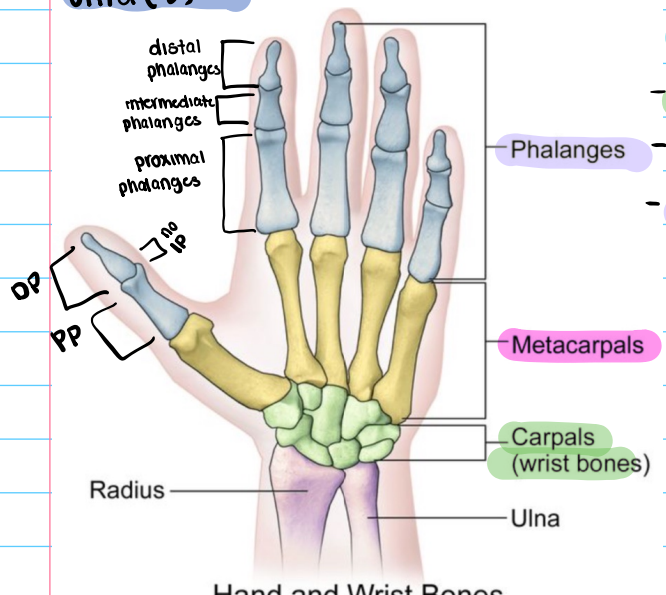
arm

- humerus (2)
- radius (2)
- ulna (2)



wrist and hand

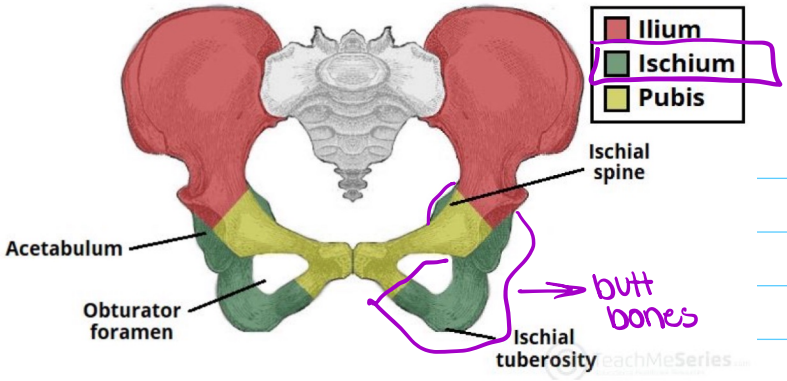
- carpals (16) * wrist bones *
- metacarpals (10)
- phalanges (14) * fingers *

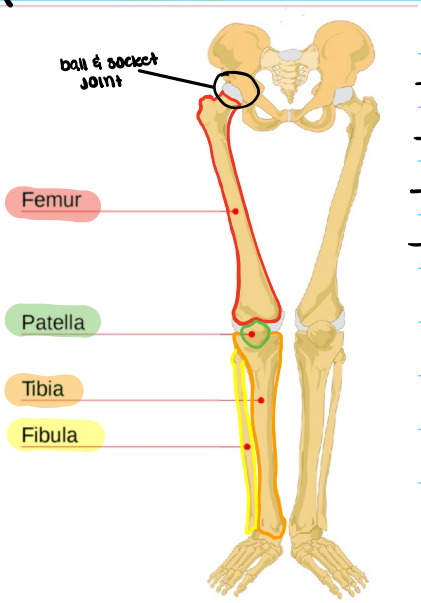


Hand and Wrist Bones

pelvic girdle (coxae)

- ileum (2)
- ischium (2)
- pubis (2)



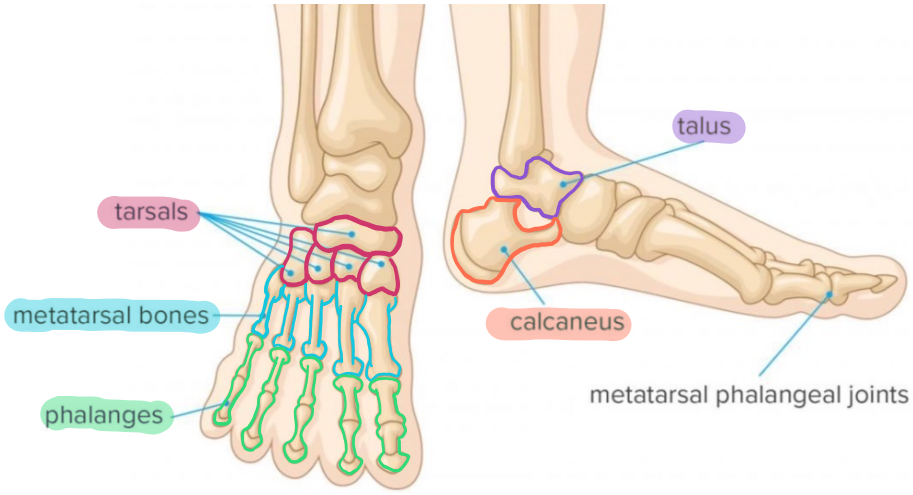


leg

- femur (2) * thigh bone → attaches to hip * (→ ball & socket joint)
- tibia (2) * shin bone → bears most of weight *
- fibula (2)
- patella (2) * knee cap *

ankle and foot

- tarsals (14)
- metatarsals (10)
- phalanges (28)
- talus (2)
- calcaneus (2)



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Term	Definition	Examples
Condyle	Rounded process that usually articulates with another bone	Occipital condyle of the occipital bone
Crest	Narrow, ridgelike projection	Iliac crest of ileum
Epicondyle	Projection above a condyle	Medial epicondyle of humerus
Facet	Small, nearly flat surface	Costal facet of thoracic vertebrae
Fontanel	Soft spot in the skull where membranes cover the space between bones	Anterior fontanel between frontal and parietal bones
Fossa	Deep pit or depression	Olecranon fossa of humerus

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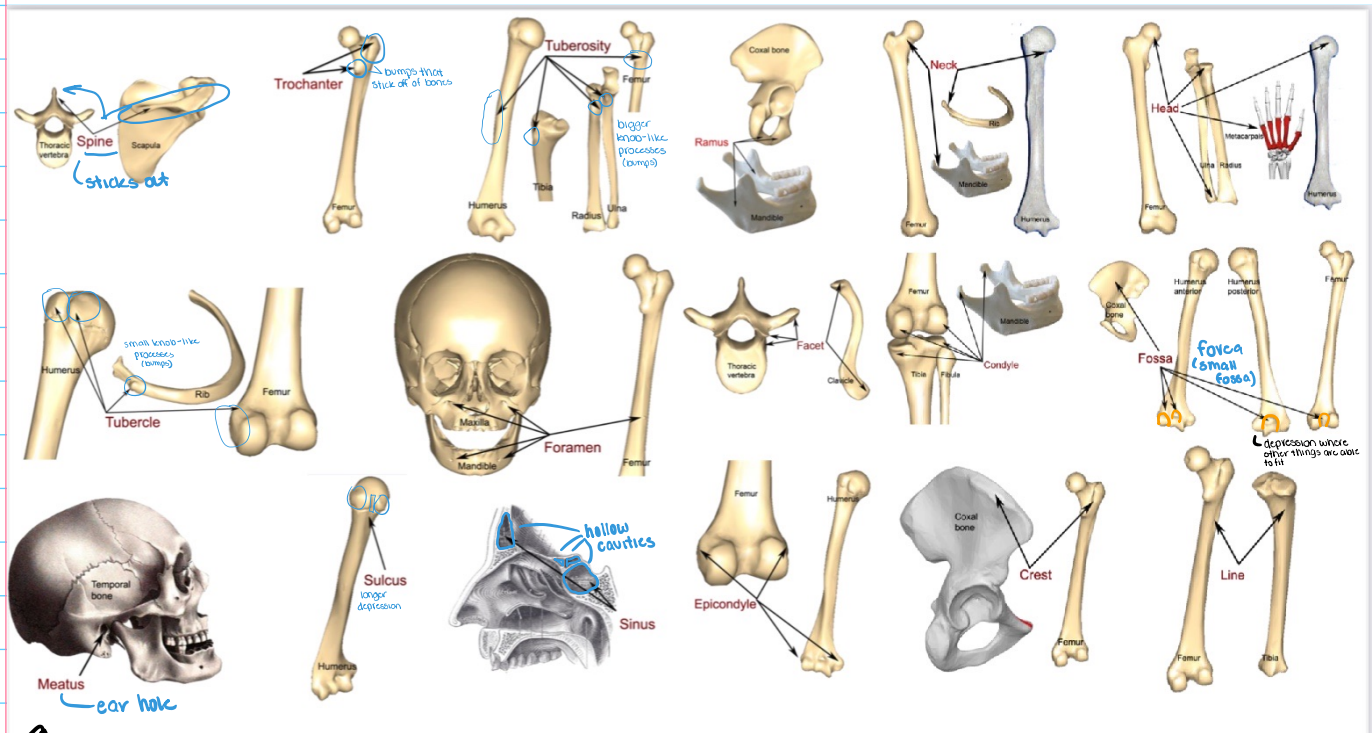
Fovea	Tiny pit or depression	Fovea capitis of femur depression little in femur
Head	Enlargement on the end of a bone	Head of humerus
Meatus	Tubelike passageway within a bone	External auditory meatus outside hearing passageway
Process	Prominent projection on a bone	Mastoid process of temporal bone
Sinus	Cavity within a bone ↳ hollow space (behind forehead, cheeks...)	Frontal sinus
Spine	Thornlike projection	Spine of scapula

NOT ON TEST!!

Sulcus	Furrow or groove ↳ like taco... long, extended depression	Intertubercular sulcus of humerus
Suture mainly found in cranium	Interlocking line of union between bones	Lambdoid suture of cranium sutures on newborns grow into each other...
Trochanter	Relatively large process	Greater trochanter of femur
Tubercle	Small, knoblike process	Greater tubercle of the humerus
Tuberosity	Knoblike process usually larger than a tubercle	Radial tuberosity

can help tell age... older=less younger=more prominent



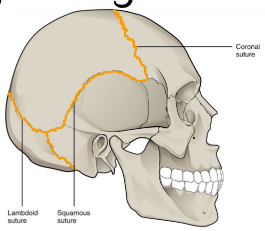
all in reference to terms above

joints

1. synarthrosis (fibrous joints)

- articulating bones are fastened together by a thin layer of connective tissue
- non moving

ex: sutures between bones of skull

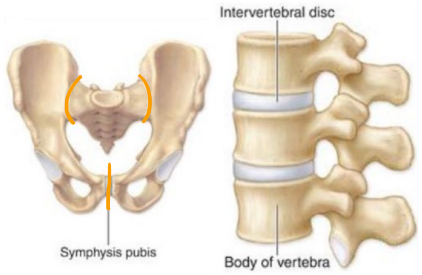


2. amphiarthrosis (cartilaginous joints) ← have cartilage

- articulating bones are connected by hyaline cartilage or fibrocartilage

ex: between the pubic symphysis

- semi-moving

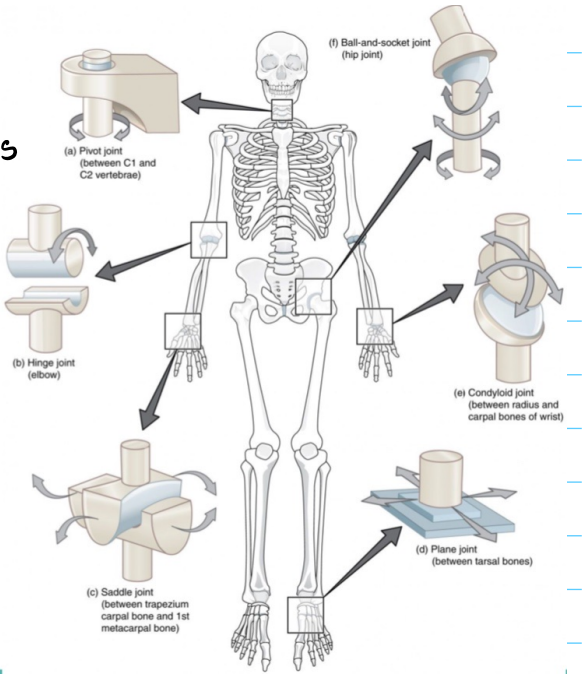


3. diarthrosis (synovial joints)

- articulating ends of bones are surrounded by a joint capsule of ligaments and synovial membrane
- moving

types

- ball and socket: movement in all directions; shoulder, hip
- condylar: two planes of movement, between metacarpals and phalanges
- plane: bones slide past each other, wrist and ankle
- hinge: bending and straightening in a single axis, elbow
- pivot: rotation around a single axis, between atlas and axis
- saddle: movement in two planes, between carpal



functions of the skeletal system

- 206 bones that support the weight of the body
- protect organs like brain and lungs
- create movement by acting as levers
- store minerals like calcium and phosphates
- site of hematopoiesis

→ hematopoiesis: blood cell formation (red, white and platelets)

- stores triglycerides (fats & lipids)

* as adults we mostly make blood from hips and skull *
* fats and lipids stored in places like shoulder and femur *

structure and classification of bone

- composition of bones

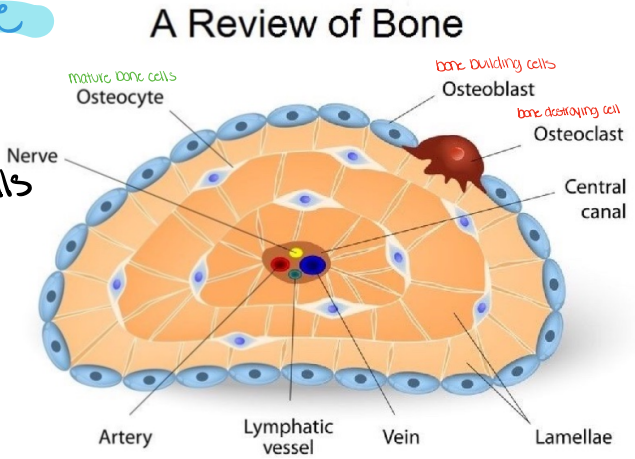
make bones squishy

osteoid: living portion of bone made of ground substance, collagen fibers, and cells

osteocytes: mature bone cells

osteoblasts: create new bone (builder)

osteoclasts: breaks down bone (destroyer)



minerals (non-living portion)

calcium carbonate: $CaCO_3$

calcium phosphate: $Ca_3(PO_3)_2$

collagen: children have more than adults

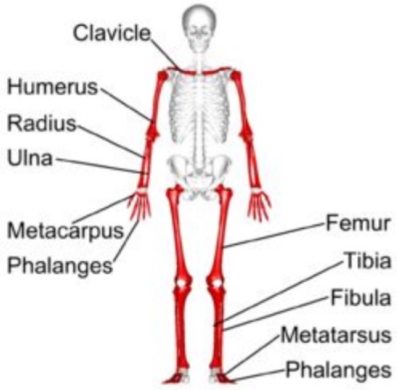
make bones hard

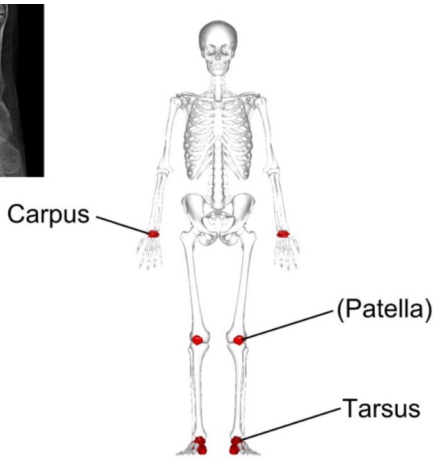
types of bones

1. long bones

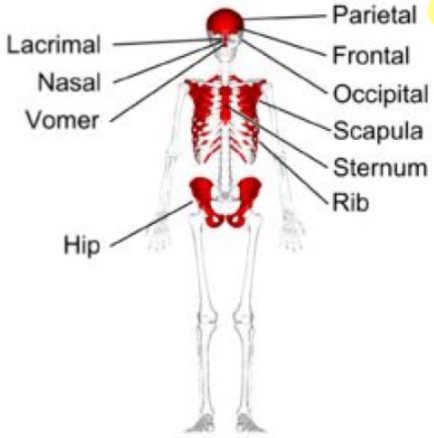
- longer than they are wide

ex: humerus, femur, radius, ulna, tibia, fibula,



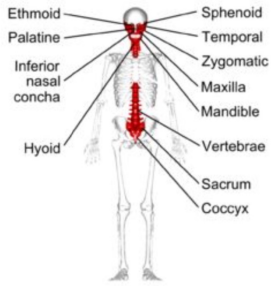


2. short bones
- roughly cube shaped
sesamoid bones: formed within a tendon
ex: carpals, tarsals, patella



3. flat bones
- thin, flat, somewhat curved
ex: sternum, scapula, skull, ribs, and hip

4. irregular bones
- none of the above
ex: vertebrae, sacrum, hyoid
(only really need to remember these 3)



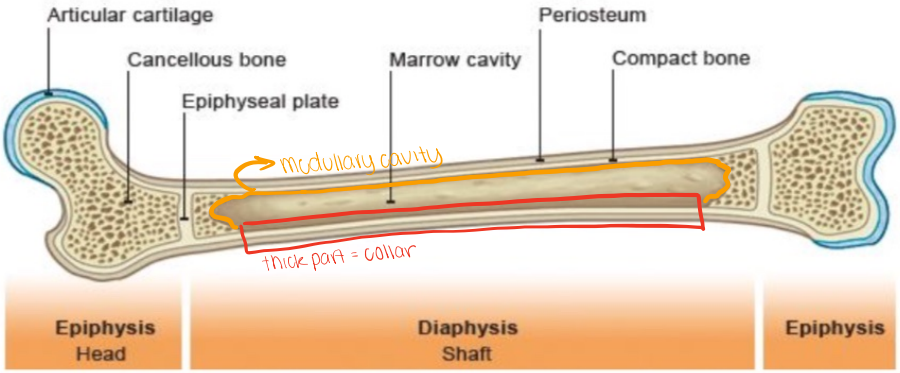
long bone structure

diaphysis: shaft of bone

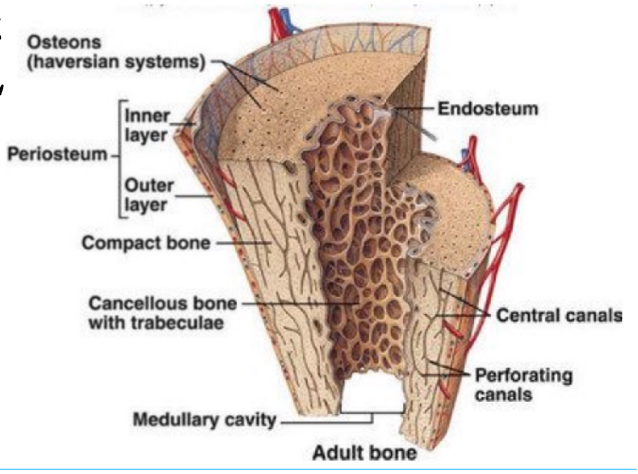
collar: compact bone around diaphysis

compact bone: tightly packed bone
aka = cortical or lamellar bone

medullary cavity: hollow cavity filled with yellow marrow (fat)
↳ when born, filled with red marrow. as you get older it turns to yellow fat

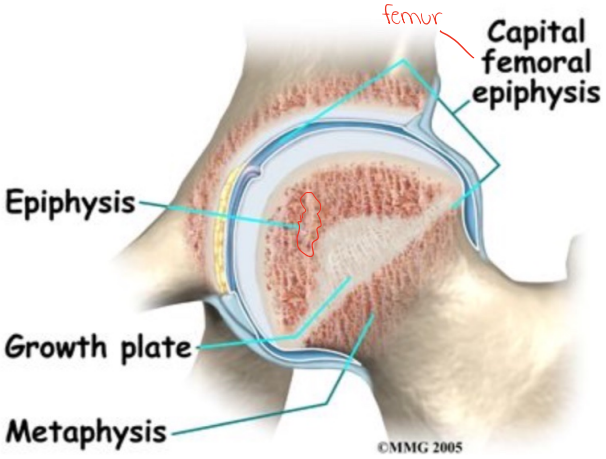


periosteum: dense irregular CT that surrounds the diaphysis, contains blood, lymph, and nerve vessels



sharpey's fibers: tufts of collagen that tightly attaches periosteum to bone
like glue that holds muscle to bone

endosteum: CT that lines the inside of the diaphysis



epiphysis: expanded ends of bone made of spongy bone filled with red marrow (site of hematopoiesis)

↑

spongy bone: bone filled with lots of arches

aka: cancellous bone, trabecular bone

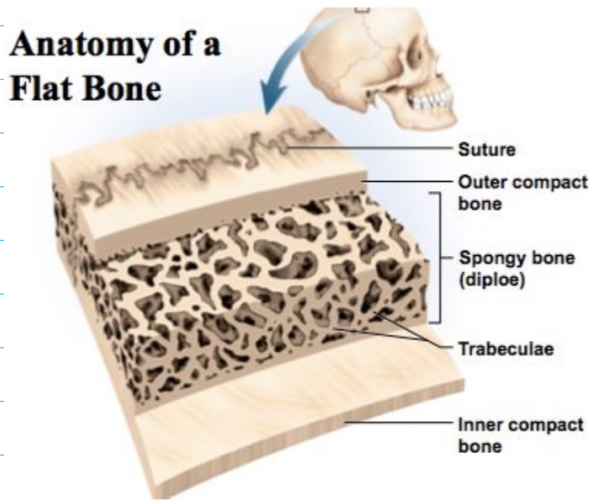
articular cartilage: hyaline cartilage that covers epiphyses

epiphyseal plate: region of hyaline cartilage that grows to lengthen the bone (growth plate)

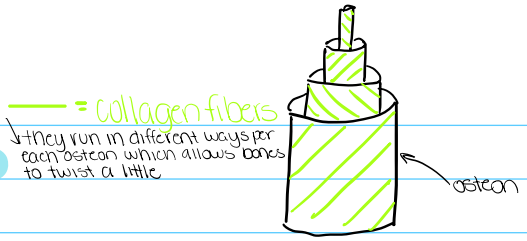
epiphyseal line: where the epiphysis and diaphysis fuse at the end of bone growth (growth plate line)

flat bone structure
- compact bone on the outside
- diploe (spongy bone) on the inside

no hollow inside

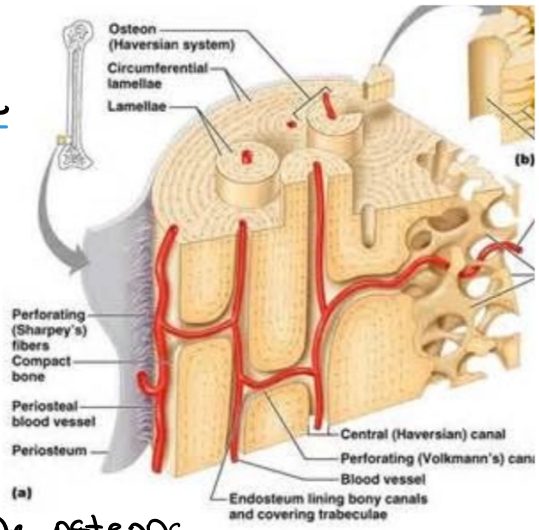


Microscopic anatomy of compact bone



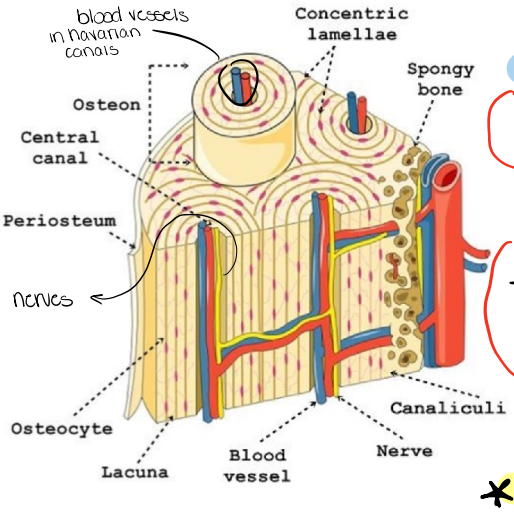
osteon (Haversian system): functional unit of compact bone oriented with the long axis of the bone

- made of **lamella**, or **concentric rings in the osteon**
  - collagen fibers run alternately in each lamella



circumferential lamellae: bundles all the osteons together

interstitial lamellae: incomplete, between the osteons



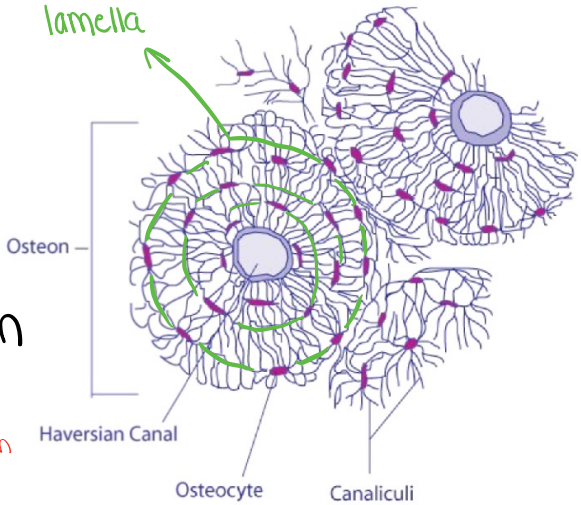
haversian (central canals): hole in the middle of each osteon where blood vessels and nerves are found
→ run parallel to osteon

volkmann's (perforating) canals: smaller holes that run perpendicular to the length of the bone, connects Haversian canals
→ runs perpendicular to osteon
connects to haversian to be able to communicate

* nerves & blood vessels run through middle of haversian

osteocytes: mature bone cells that live in lacunae, small houses, found between the lamellae
→ make little indentations in your bone where they stay they will end up coming together and 'holding hands'

canaliculi: hair-like canals that connect lacunae to each other and to the Haversian canal
→ all osteocytes are in communication with each other and the veins within the haversian by canaliculi



long bone growth

osteoblasts: cells that create new bone tissue

osteoclasts: cells that resorb or eliminate weakened or damaged bone tissue

ossification/osteogenesis: formation of bone, begins at 8 weeks in the fetus

intramembranous ossification

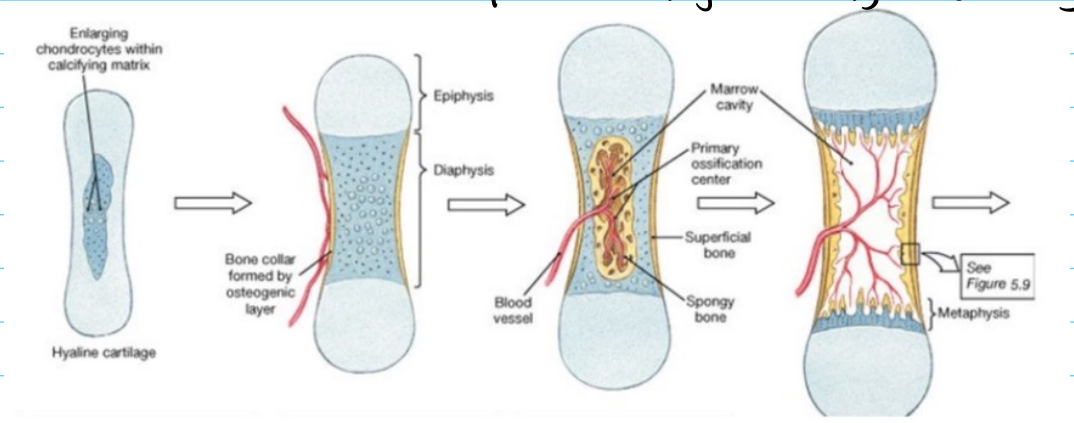
intramembranous ossification: bones develop within a fibrous membranes
- forms the flat bones of the skull and scapula

endochondral ossification

- in a fetus, long bones develop from replacing a hyaline cartilage model

PHASE 1: osteoblasts create a bone matrix shell covering a hyaline cartilage model

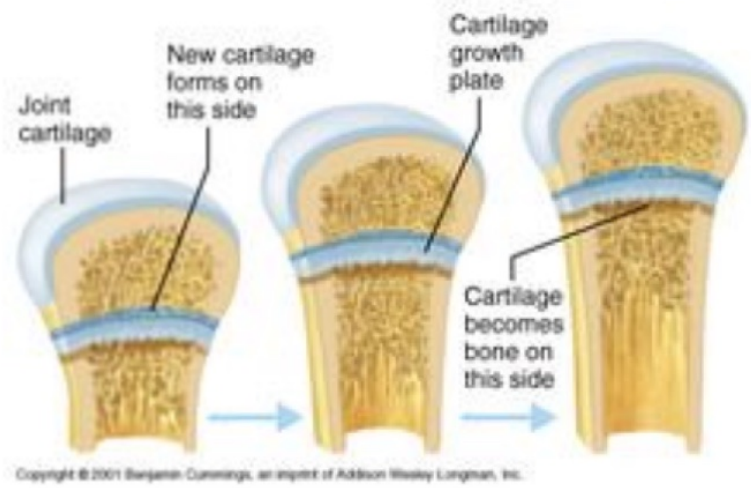
PHASE 2: osteoclasts resorb the hyaline cartilage creating a medullary cavity



interstitial growth (longitudinal)

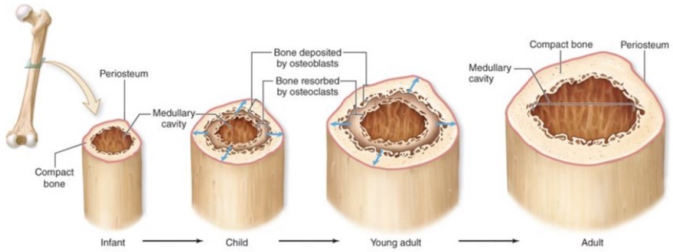
- grow in length
- osteoblasts create new bone cells, pushing epiphyses outward
- epiphyseal plate dissolves, calcifies, turning into epiphyseal line when done growing

growth plate line



appositional growth (circumferential)

- growth in thickness
- osteoblasts beneath the periosteum create bone matrix
- osteoclasts on the endosteal surface break down bone



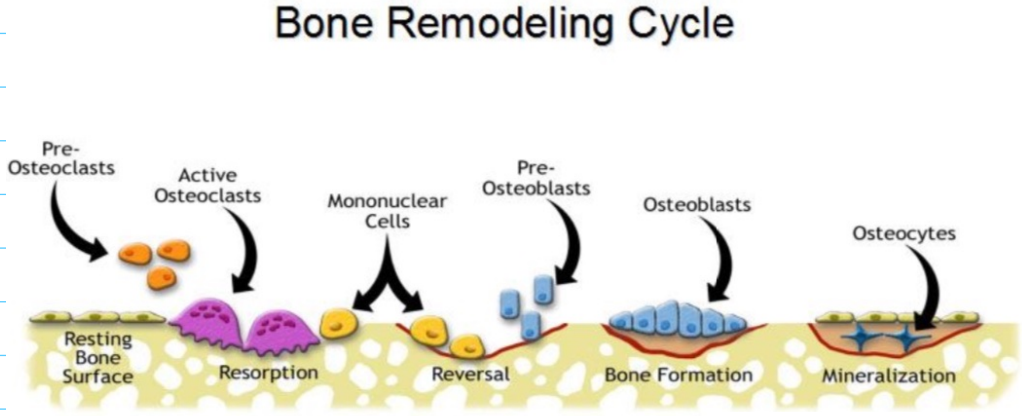
★ growth is affected by testosterone, estrogen, and growth hormones ★

bone homeostasis

bone remodeling: concurrent process of bone growth and bone reabsorption

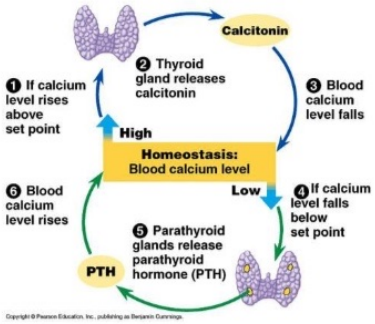
bone deposit: osteoblasts deposit new bone where bone is injured or strength is needed

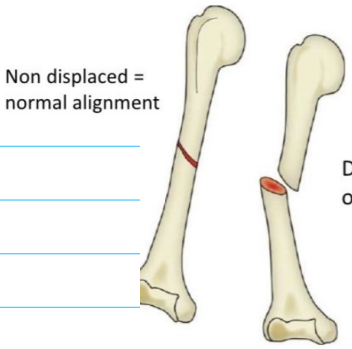
bone resorption: osteoclasts break down bone on periosteal and endosteal sides



- control of remodeling
- thyroid releases **calcitonin** to stimulate calcium deposit in the bone
- parathyroid releases **PTH** to break down bone and release calcium into blood

PTH = parathyroid hormones

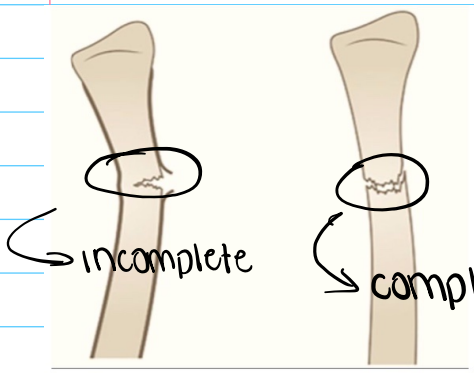




common bone injury

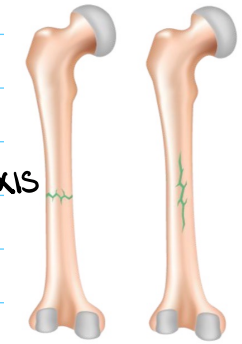
non-displaced: bones in original position

displaced: bone ends are out of alignment



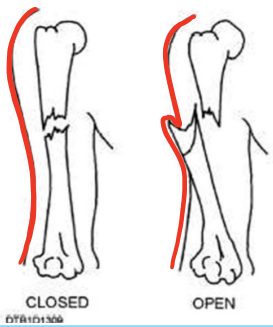
complete: bone broken all the way through

incomplete: bone not broken all the way through



linear: break parallel to long axis of the bone

transverse: break is perpendicular to long axis



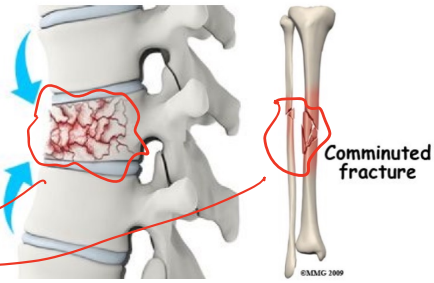
open (compound): bone breaks through skin

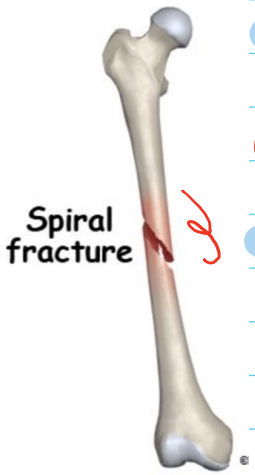
closed (simple): bone doesn't break through skin

comminuted: bone is broken in three or more places

compression: bone is crushed

multiple spots broken





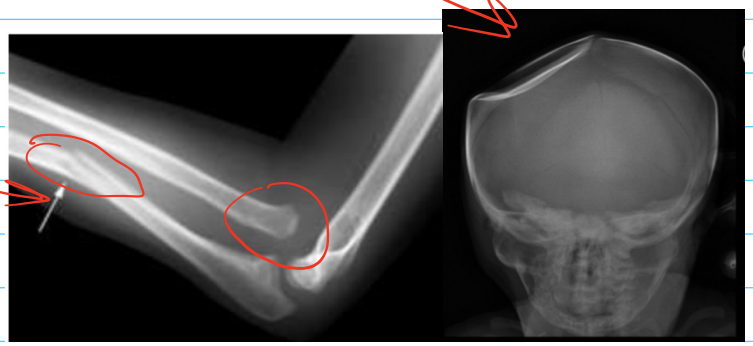
spiral: bone is twisted

commonly seen in soccer & football players, also sign of child abuse

epiphyseal: epiphysis separates from diaphysis

depressed: bone is pushed inwards
also sign of child abuse

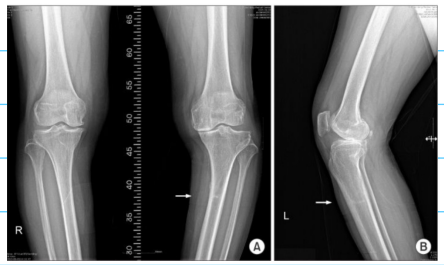
greenstick: bone breaks on one side but bends on the other
sign of child abuse as well



dislocation: when a bone slips out of a joint

sprain: stretching or tearing of a ligament

stress fracture: tiny cracks caused by overuse



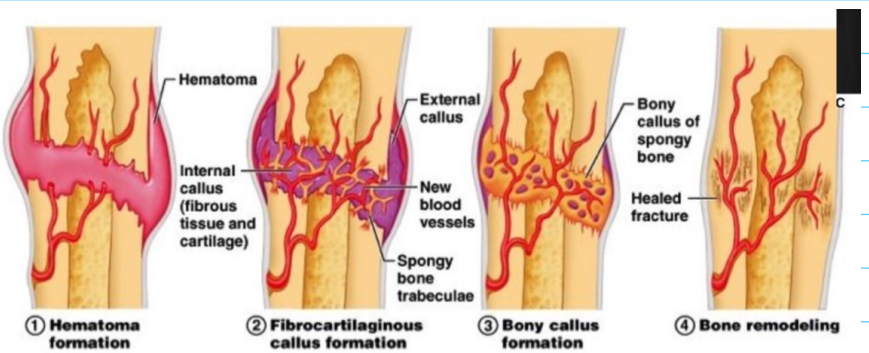
fixing bone injuries

closed reduction: bones are aligned and set in cast without surgery

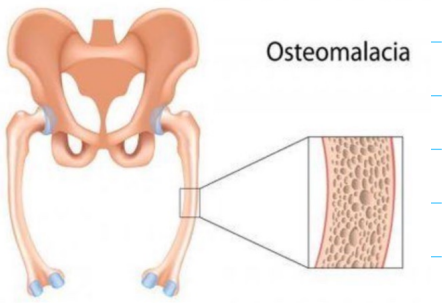
open reduction: bones are surgically repaired

4 stages of bone healing

1) hematoma formation
2) fibrocartilaginous callus
3) bony callus
4) bone remodeling

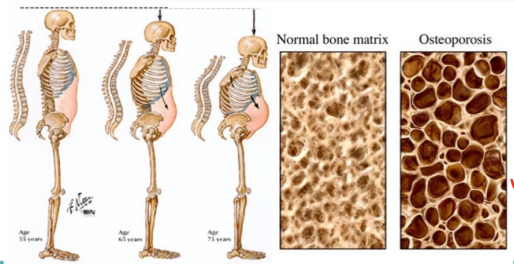


bone disorders

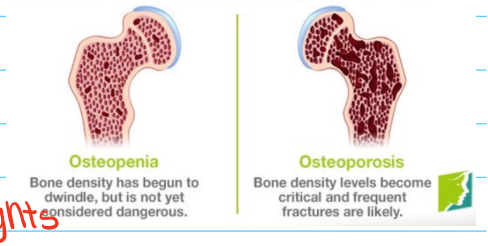


osteomalacia: bones are not properly mineralized
- bones are soft
- can be bow-legged & commonly short

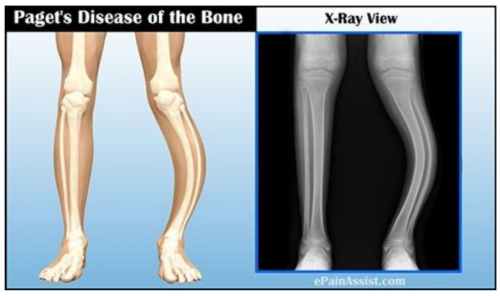
rickets: in children, epiphyseal plates don't calcify causing malformations
- caused by lack of vitamin D and calcium (vitamin D helps guide calcium to bone)



osteoporosis: bones become porous and break easily, due to a lack of estrogen
- old lady syndrome
  - all the holes contribute to compression fractures
  - holes start to flatten and causes spine to hunch over

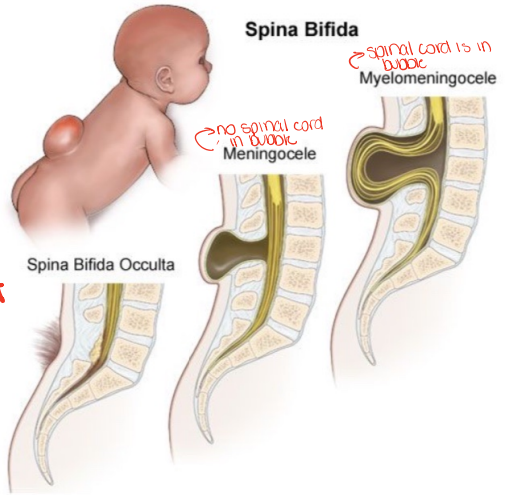


osteopenia: reduced bone mass without a fracture
- small amounts of bone lost (starting to thin)
- pre-cursor to osteoporosis → drink milk!!
- fix by vitamin D & calcium injections, lift small weights



Paget's disease: excessive bone deposit and reabsorption, too much spongy bone
- causes bowing and bending of bone
- too much bone making on 1 side and not enough on other side

spina bifida: spinal column fails to close during development (formation)
- ppl with spina bifida are commonly seen in wheelchairs because the spinal cord can get pinched off and paralyze them from the defect down



↳ without cartilage

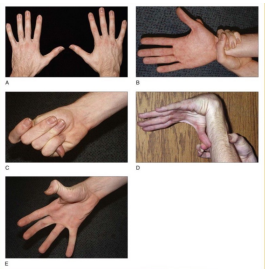
achondroplasia: abnormal epiphyseal activity (little people)

- commonly in long bones

cartilage just stops

gigantism: overproduction of growth hormone caused by tumors

- bones never stop growing



marfan syndrome: affects the collagen

- makes collagen very loose

acromegaly: extra growth hormones after the fusion of bones

- makes people look like

fibrodysplasia ossificans progressiva: muscle tissue turns to bone

- people get stuck in whatever position

arthritis: joint inflammation (starts in hands)

rheumatoid arthritis: immune system attacks your own joints (auto immune disease)

osteoarthritis: degeneration of the articular cartilage (cartilage disappears and bones fuse)