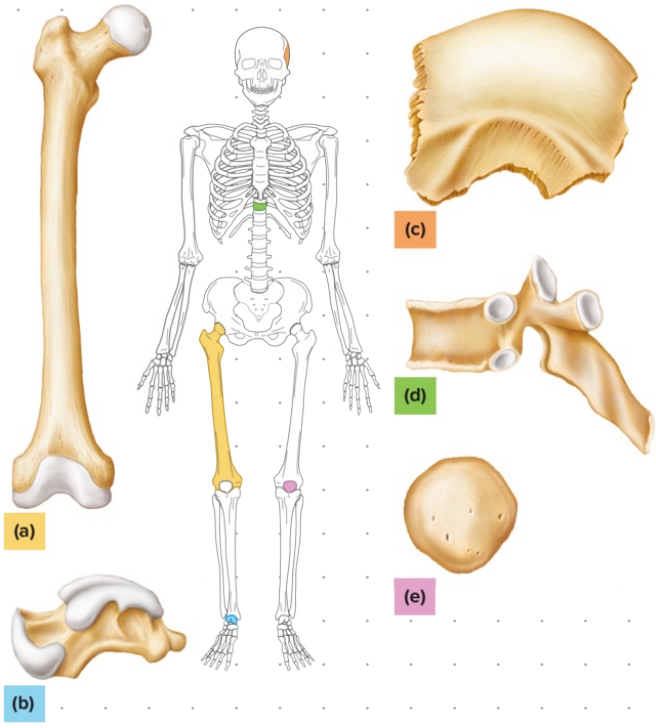
# Chapter 7.1

→ "skeleton" is greek & latin for "dried framework"
→ living bones are wrapped in connective tissues w a blood & nerve supply
→ 2 major skeletal system divisions: axial & appendicular

# CHAPTER 7.2

→ bones may be classified by shapes: long, short, flat, or irregular




→ long bones have longitudinal axes & expanded ends
ex: forearm & thigh bones (a)
→ short bones have equal length & width;
ex: wrist & ankle bones (b)
- seasmoid bone (round bone) is a special short bone: usually nodular & embedded in a tendon adjacent to a joint where tendon is compressed
ex: patella
→ flat bones are platlike w broad surfaces
ex: ribs, scapulae, some skull bones (c)
→ irregular bones have a variety of shapes, most are connected to several bones
ex: backbone vertebrae, many facial bones (d)

→ at each end of a long bone is an expanded part called: epiphysis which forms a joint w another bone
articular cartilage: hyaline cartilage that covers the ends of bones in synovial joints
diaphysis: long bone shaft
metaphysis: the widening part of bone between diaphysis & epiphysis

→ bone is enclosed by tough, vascular covering of dense connective tissue called the periosteum

→ periosteum helps form & repair bone tissue

**compact bone**: dense bone tissue in which cells are organized in osteons w/o apparent spaces; cortical bone

**spongy bone**: bone that consists of bars & plates separated by irregular spaces; cancellous bone

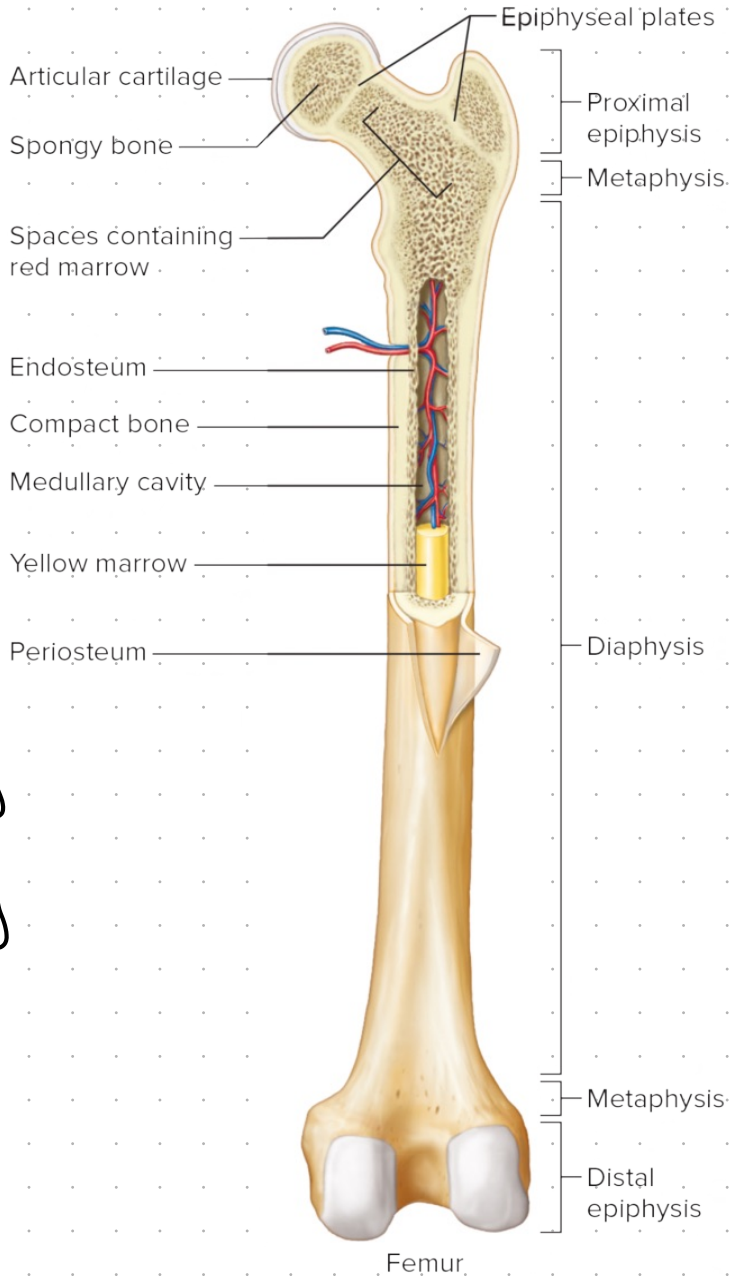
**trabecula**: branching bony plate that separates irregular spaces within spongy bone

**medullary cavity**: cavity containing red/yellow marrow w/in diaphysis of a long bone

**endosteum**: tissue lining the medullary cavity in a bone

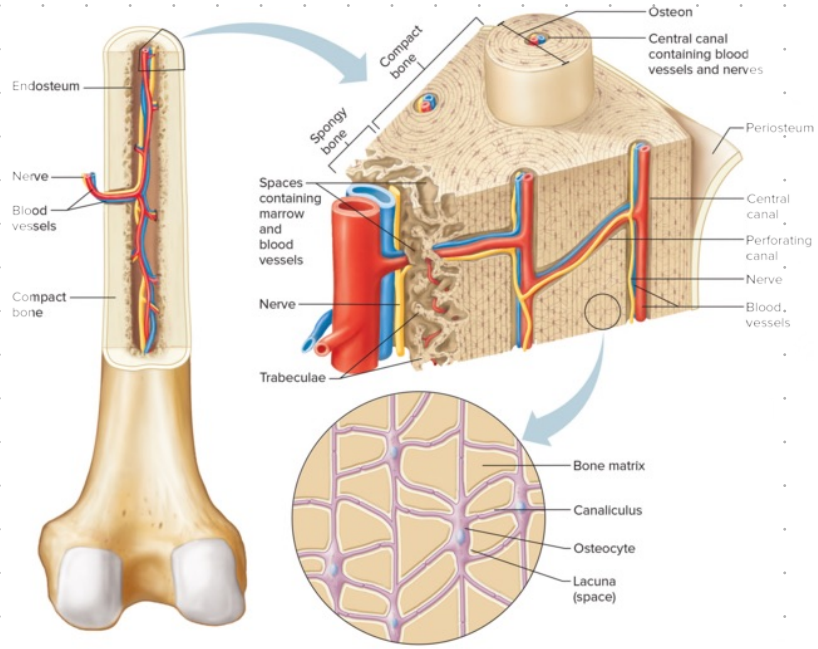
**marrow**: connective tissue w/in bone spaces that includes blood-forming stem cells

**osteocytes**: mature bone cell



Femur

→ in compact bone the osteocytes & layers of extracellular matrix called lamellae are clustered around a central canal forming a cylinder-shaped unit called an osteon




→ central canals extend longitudinally through bone tissue & transverse perforating canals connect center canals

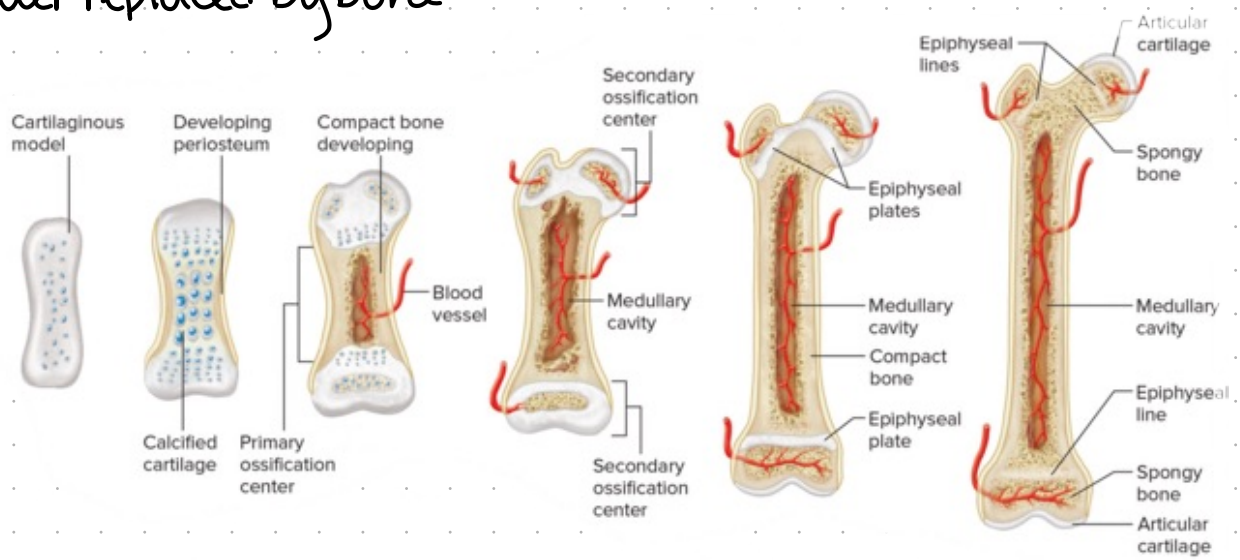
# Chapter 7.3

**hematopoises**: process of blood cell formation
→ red blood cells, white blood cells, & blood platelets form in red marrow
→ yellow marrow stores fat & does not produce blood cells

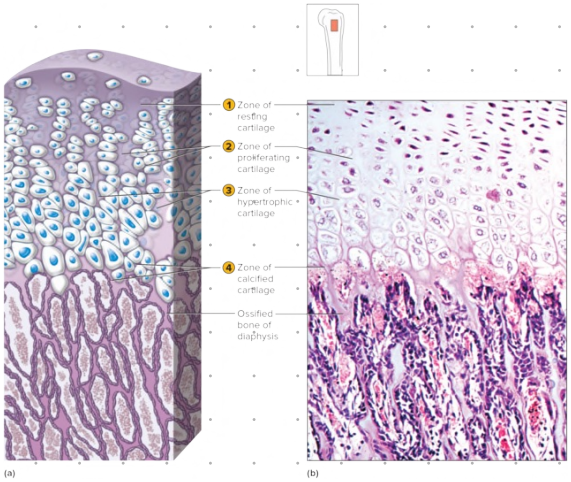
→ inorganic mineral salts in extracellular bone matrix account for ≈ 70% of the matrix by weight & are mostly small crystals of calcium phosphate called hydroxyapatite

# CHAPTER 7.4

**intramembranous bones**: bones that originate w/in sheetlike layers of connective tissues
**endochondral bones**: bones that begin as masses of hyaline cartilage & are later replaced by bone




↑ endochondral ossification ↑

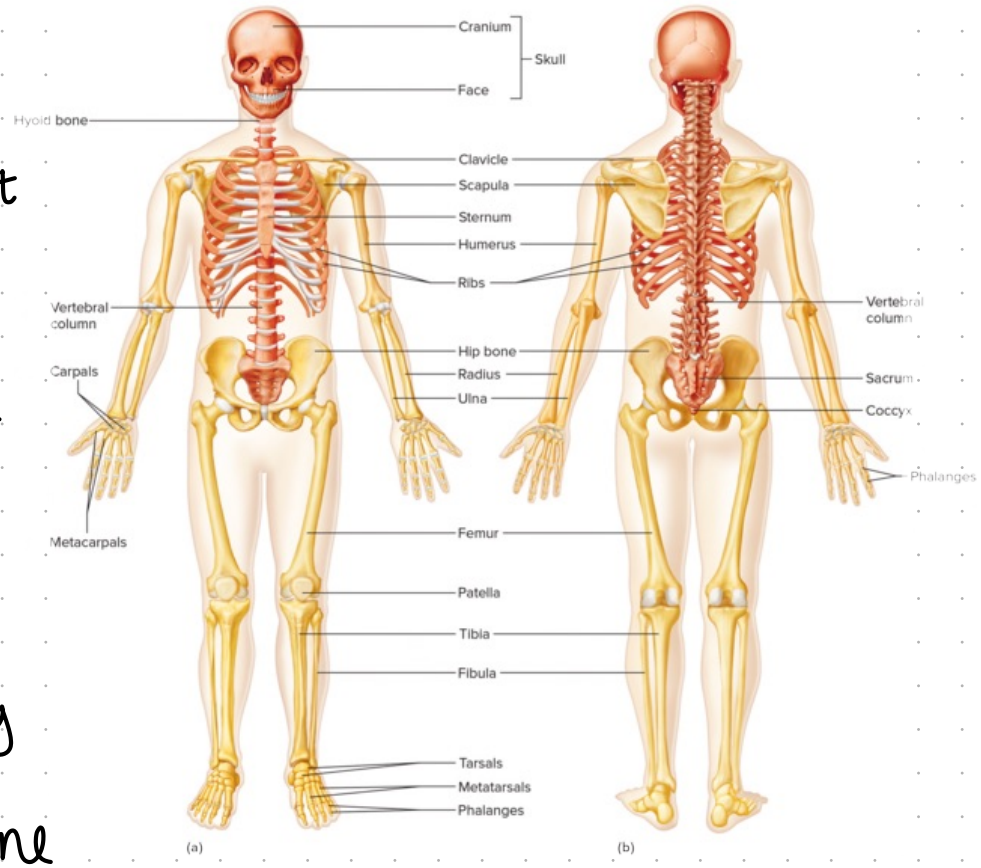


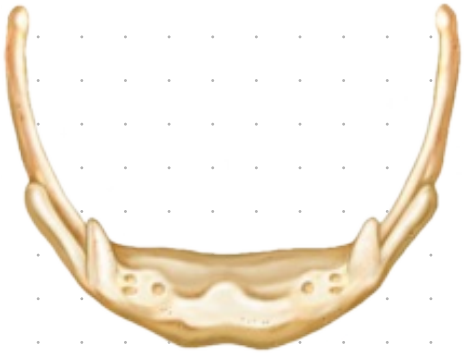

In a long bone, the diaphysis is separated from the epiphysis by an epiphyseal plate. The cartilaginous cells of the epiphyseal plate form 4 layers, each of which may be several cells thick.

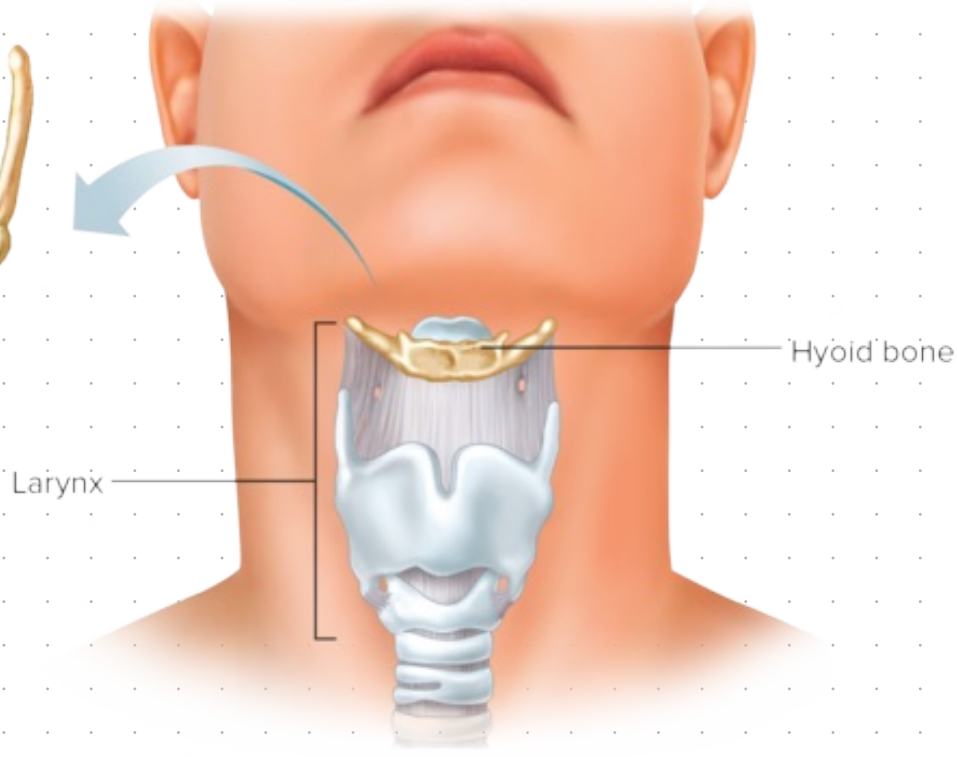
# Chapter 7.5

The axial skeleton is the bony & cartilaginous parts that support & protect the organs of the head, neck, & trunk.

- The skull is composed of the cranium & facial bones.
- The middle ear bones transfer sound vibrations to hearing receptors.
- The hyoid bone is located in the neck between the lower jaw & larynx; it does not articulate w any other bones but is in a fixed position by muscles & ligaments. The hyoid bone supports the tongue & is an attachment for certain muscles that help move the tongue during swallowing. It can be felt approximately a finger's width above the anterior prominence of the larynx.





Hyoid bone



**vertebral column**: 24 vertebrae found in the posterior side of the body that house & protect the spinal cord
→ vertebrae are separated by intervertebral discs

**pectoral girdle**: part of the skeleton that supports & attaches the upper limbs
→ pectoral girdle is formed by a scapula (shoulder blade) & a clavicle (collarbone)

**pelvic girdle**: part of skeleton to which lower limbs attach
↳ pelvic girdle formed by 2 hip bones attached to each other anteriorly & to sacrum posteriorly

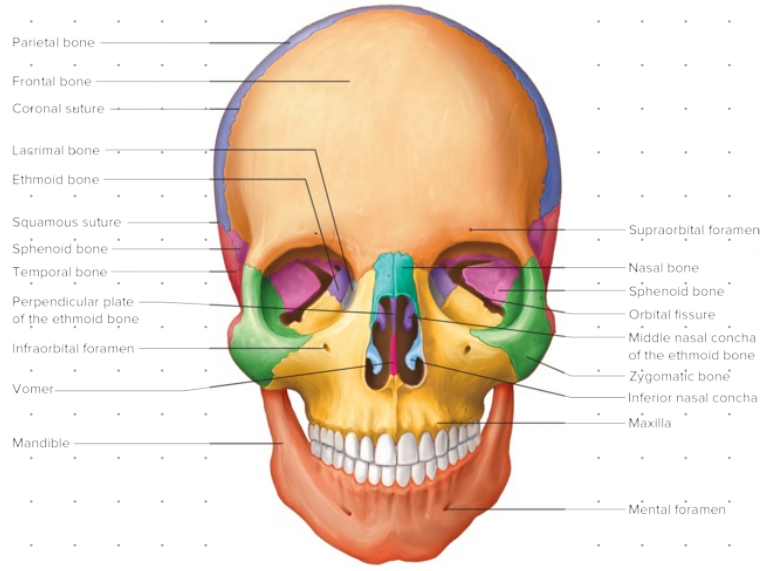
Terms used to describe skeletal structures

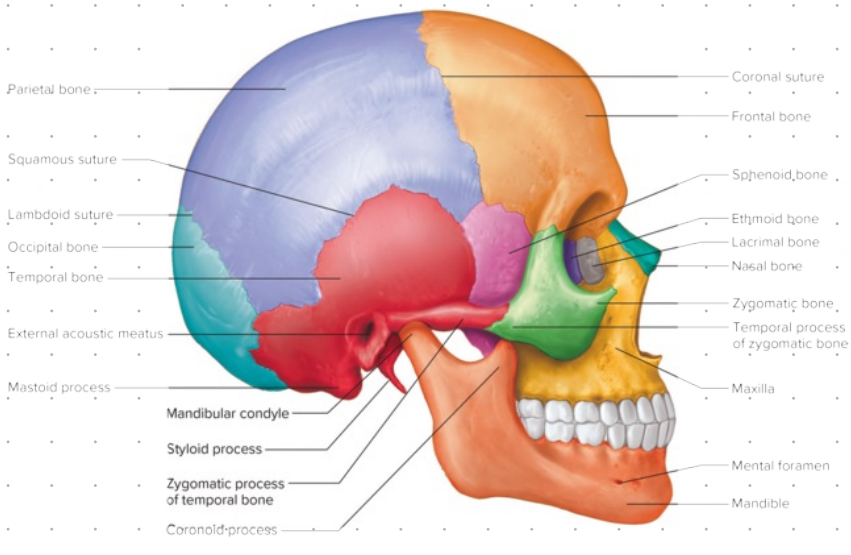
| Term | Definition | Example |
|---|---|---|
| condyle | rounded process that usually articulates w another bone | occipital condyle of the occipital bone |
| crest | narrow, ridgelike projection | iliac crest of ilium |
| epicondyle | projection situated above a condyle | medial epicondyle of the humerus |
| facet | small, nearly flat surface | costal facet of a thoracic vertebra |
| fissure | cleft/groove | inferior orbital fissure in orbit of the eye |
| fontanel | soft spot in the skull where membranes cover space between bones | anterior fontanel between frontal & parietal bones |
| foramen | opening through a bone that usually serves as a passageway for blood vessels, nerves, / ligaments | foramen magnum of the occipital bone |
| fossa | deep pit/depression | olecranon fossa of the humerus |
| fovea | tiny pit/depression | fovea capitis of femur |
| head | enlargement on the end of a bone | head of humerus |

| | | |
|---|---|---|
| linea | narrow ridge | linea aspera of femur |
| meatus | tubelike passageway w/in a bone | external acoustic meatus of the temporal bone |
| process | prominent projection on a bone | mastoid process of the temporal bone |
| ramus | branch/similar extension | ramus of the mandible |
| sinus | cavity w/in a bone | frontal sinus of the frontal bone |
| spine | thornlike projection | spine of scapula |
| sulcus | furrow/groove | intertubucular sulcus of the humerus |
| suture | interlocking line of union between bones | lambdoid suture between occipital & parietal bones |
| trochanter | relatively large process | greater trochanter of the femur |
| tubercle | knoblike process | tubercle of a rib |
| tuberosity | knoblike process usually larger than a tubercle | radial tuberosity of the radius |

# CHAPTER 7.6

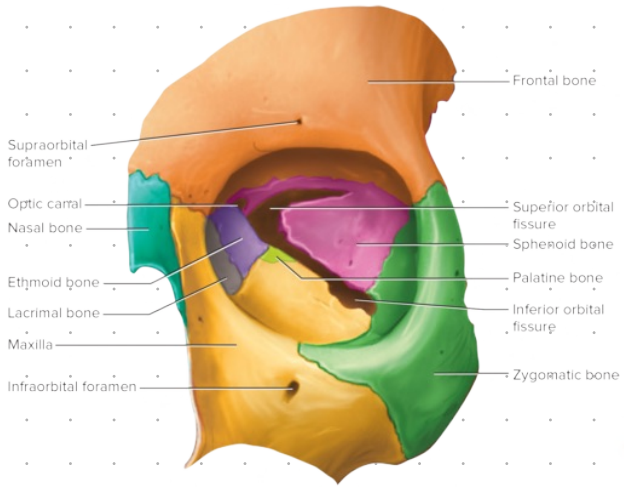
→ human skull has 22 bones

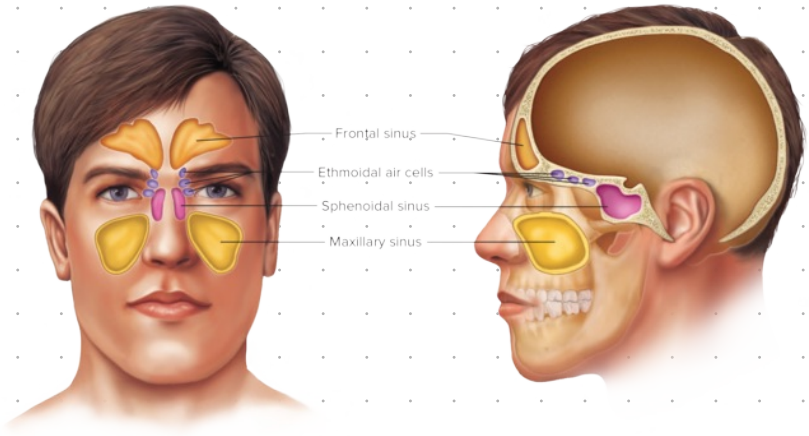


**cranium**: encloses & protects the brain, formed by 8 skull bones, brain case

**paranasal sinus**: any of the several air-filled cavities in a cranial/facial bone lined w mucous membrane & connected to nasal cavity

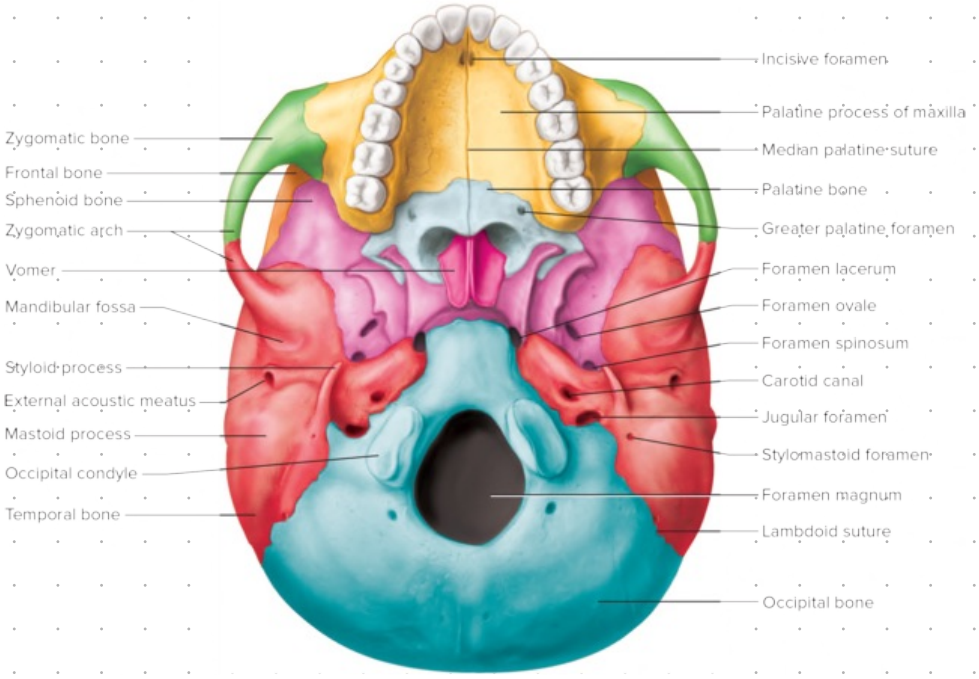


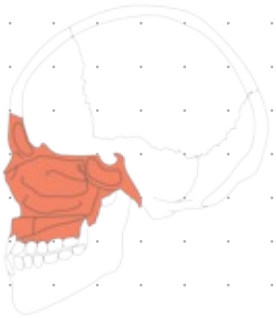

## Cranial Bones

| Name | Description | Special Features |
|---|---|---|
| Frontal (1) | forms forehead | supraorbital foramen, frontal sinuses |
| Parietal (2) | side walls & roof of cranium | fused at midline along sagittal suture |
| Occipital (1) | back of skull & base of cranium | foramen magnum, occipital condyles |
| Temporal (2) | side walls & floor of cranium | external acoustic meatus, mandibular fossa, mastoid process, styloid process, zygomatic process |
| Sphenoid (1) | parts of cranium base, sides of skull, floors & sides of orbits | sella turcica, sphenoid sinuses |
| Ethmoid (1) | parts of roof & walls of nasal cavity, cranium floor, orbit walls | cribriform plates, perpendicular plate, superior & middle nasal conchae, ethmoidal air cells, crista galli |

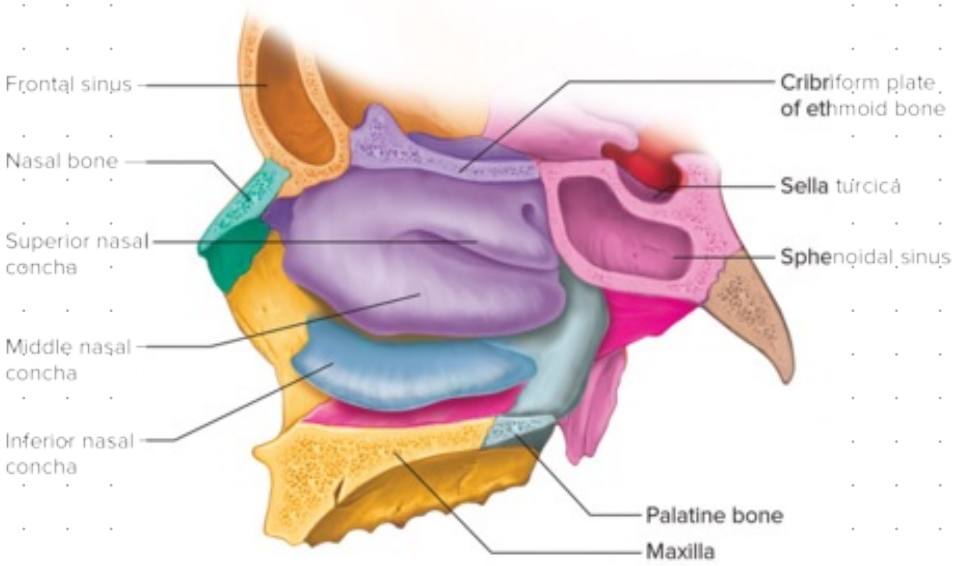
# Inferior view of the skull



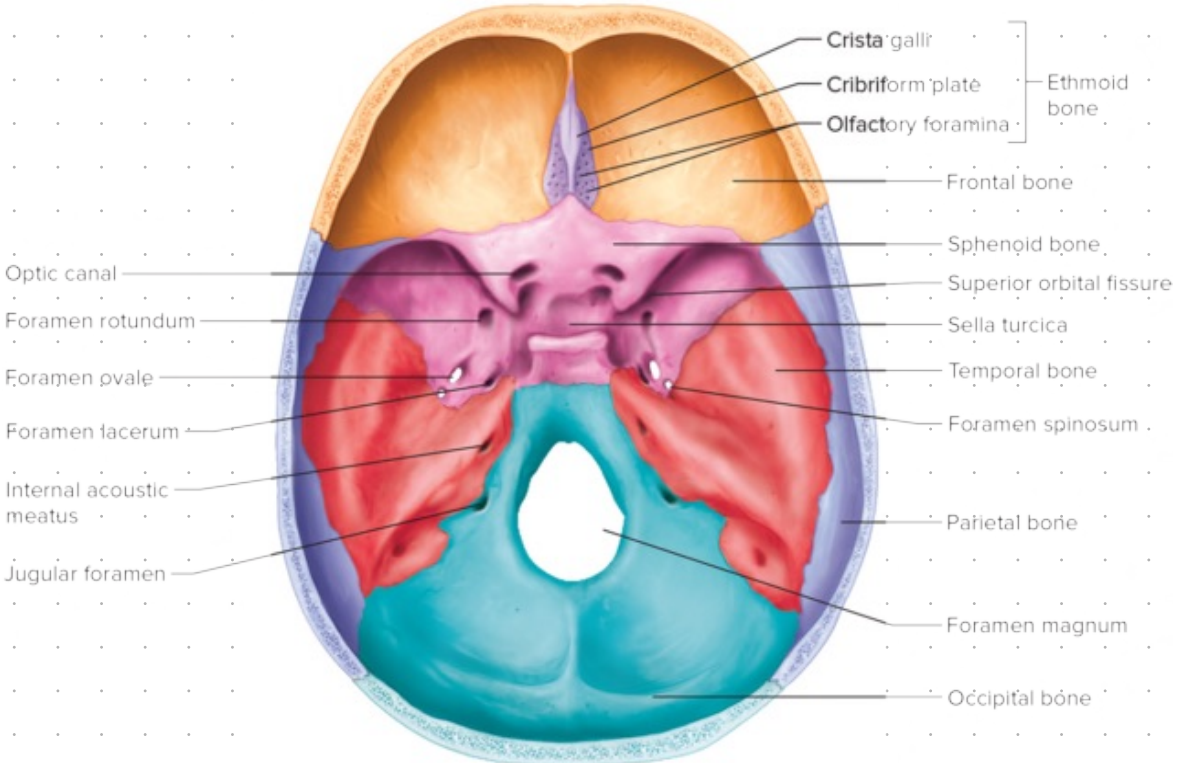

# Lateral view of the nasal cavity



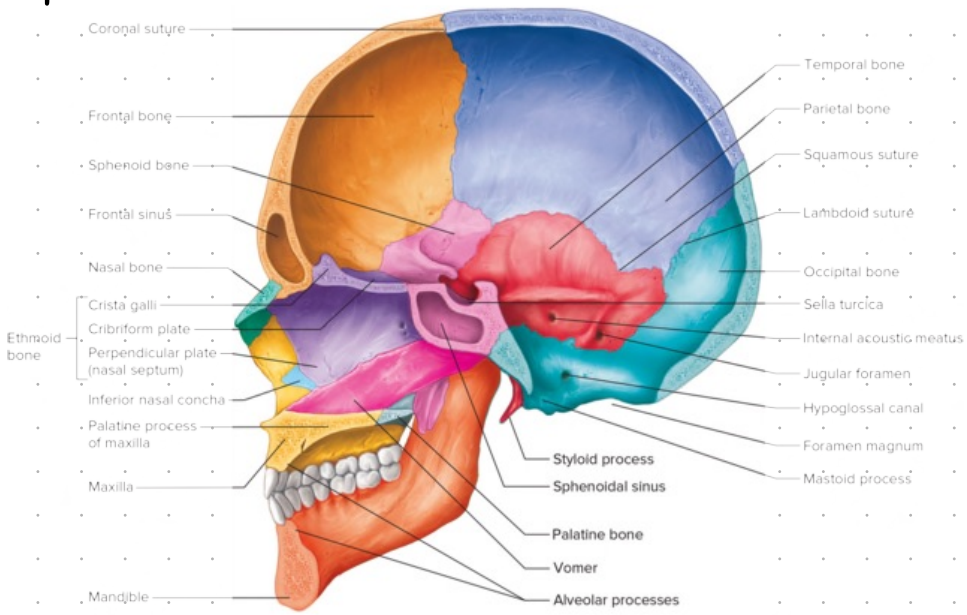
Midsagittal section



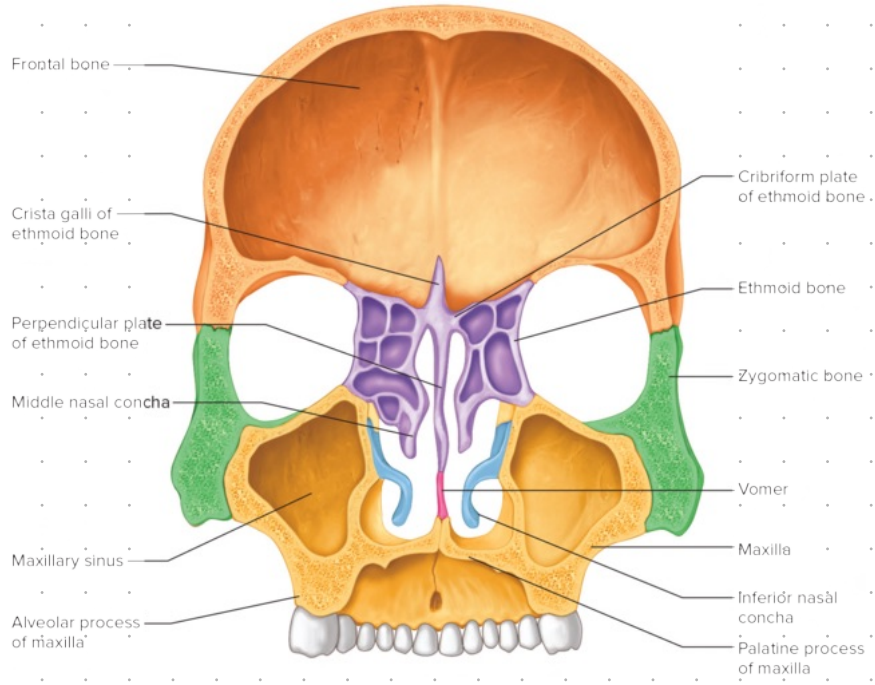

# Floor of the cranial cavity, viewed from above



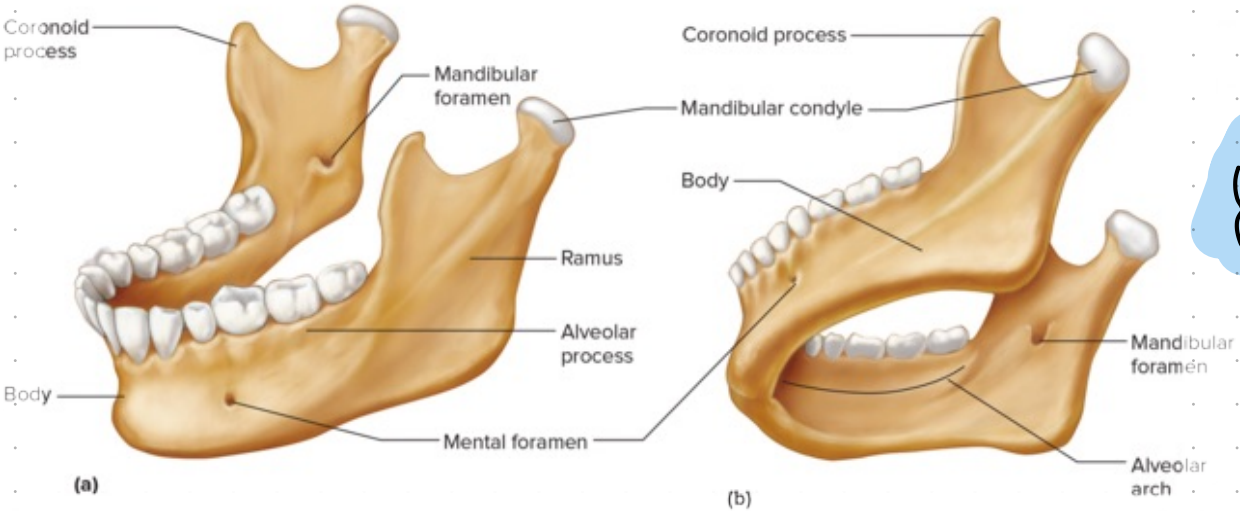
The facial skeleton consists of 13 immovable bones & a moveable lower jawbone. In addition to forming the basic face shape, these bones provide attachments for muscles that move the jaw & control facial expressions.




## Sagittal section of the skull




## Frontal section of the skull (posterior view)

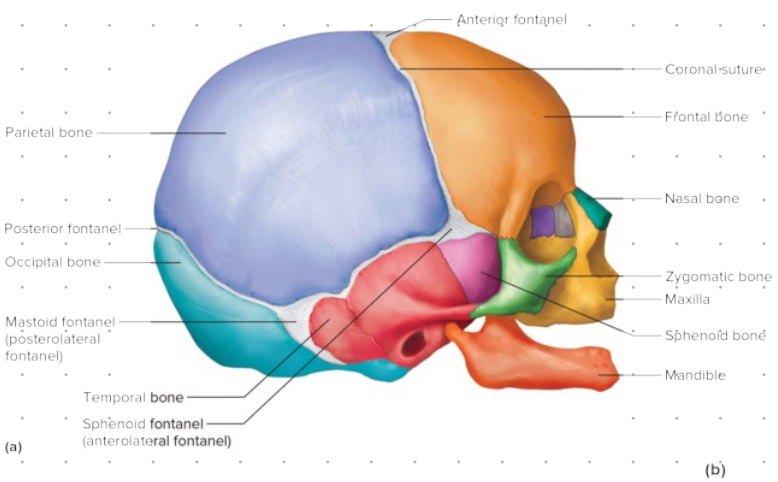


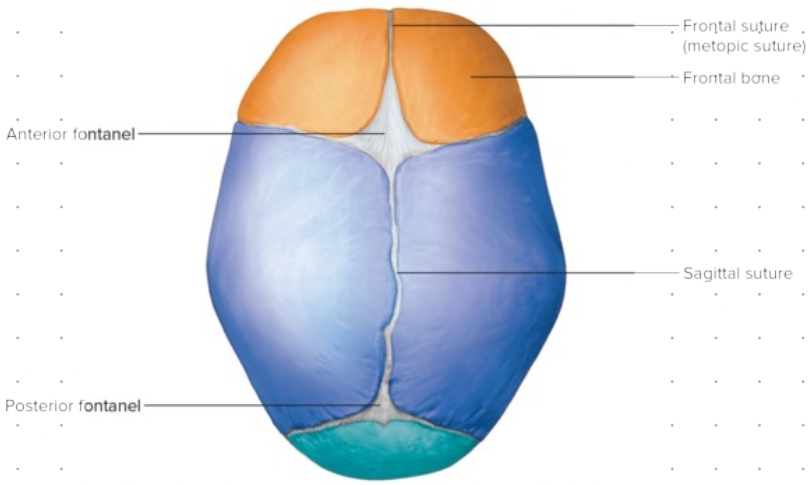

## Mandible (a) left lateral view (b) inferior view

# Bones of the facial skeleton

| Name | Description | Special features |
|---|---|---|
| Maxilla (2) | upper jaw, anterior roof of mouth, orbit floors, & sides & floor of nasal cavity | alveolar processes, maxillary sinuses, palatine process |
| Palatine (2) | posterior roof of mouth & floor & lateral walls of nasal cavity | |
| Zygomatic (2) | prominences of cheeks & lateral walls & floors of orbits | temporal process |
| Lacrimal (2) | part of medial walls of orbits | groove that leads from orbit to nasal cavity |
| Nasal (2) | bridge of nose | |
| Vomer (1) | interior portion of nasal septum | |
| Inferior nasal concha (2) | extend into nasal cavity from its lateral walls | |
| Mandible (1) | lower jaw | body, ramus, mandibular condyle, coronoid process, alveolar processes, mandibular foramen, mental foramen |

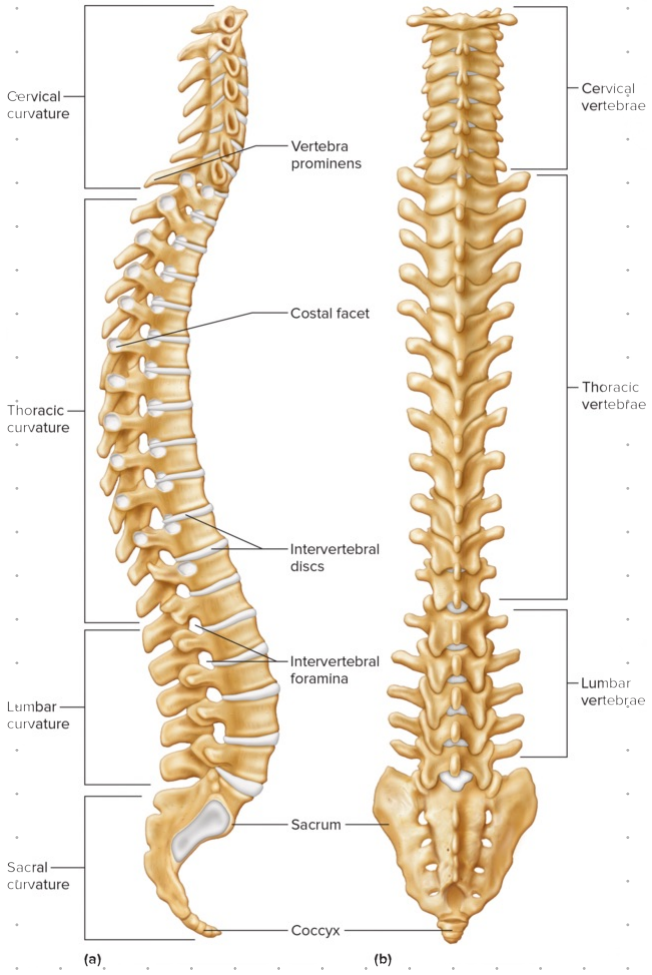
**fontanel**: membranous region between certain developing cranial bones in the skull of a fetus/infant



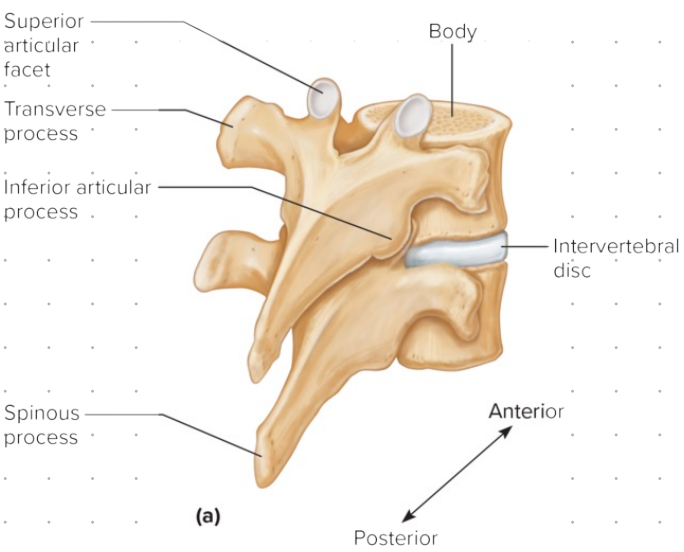



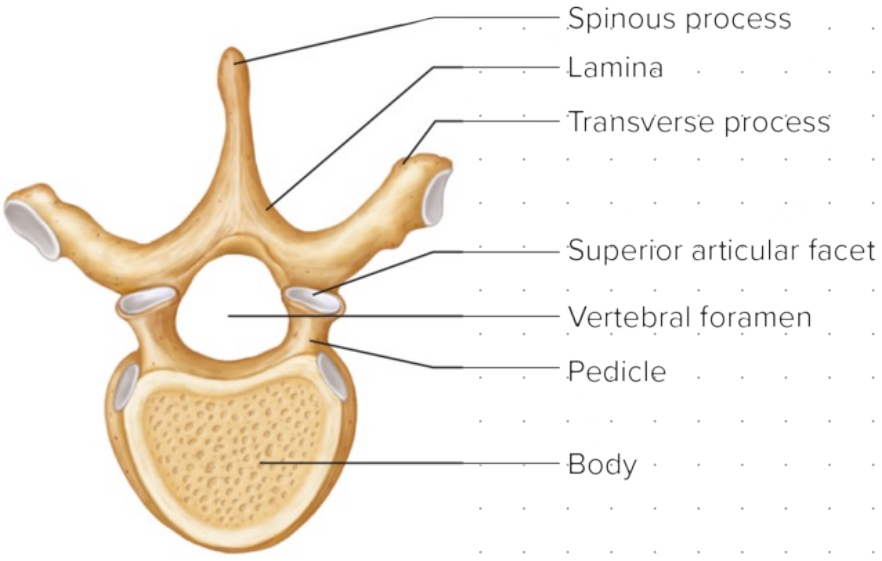
# CHAPTER 7.7

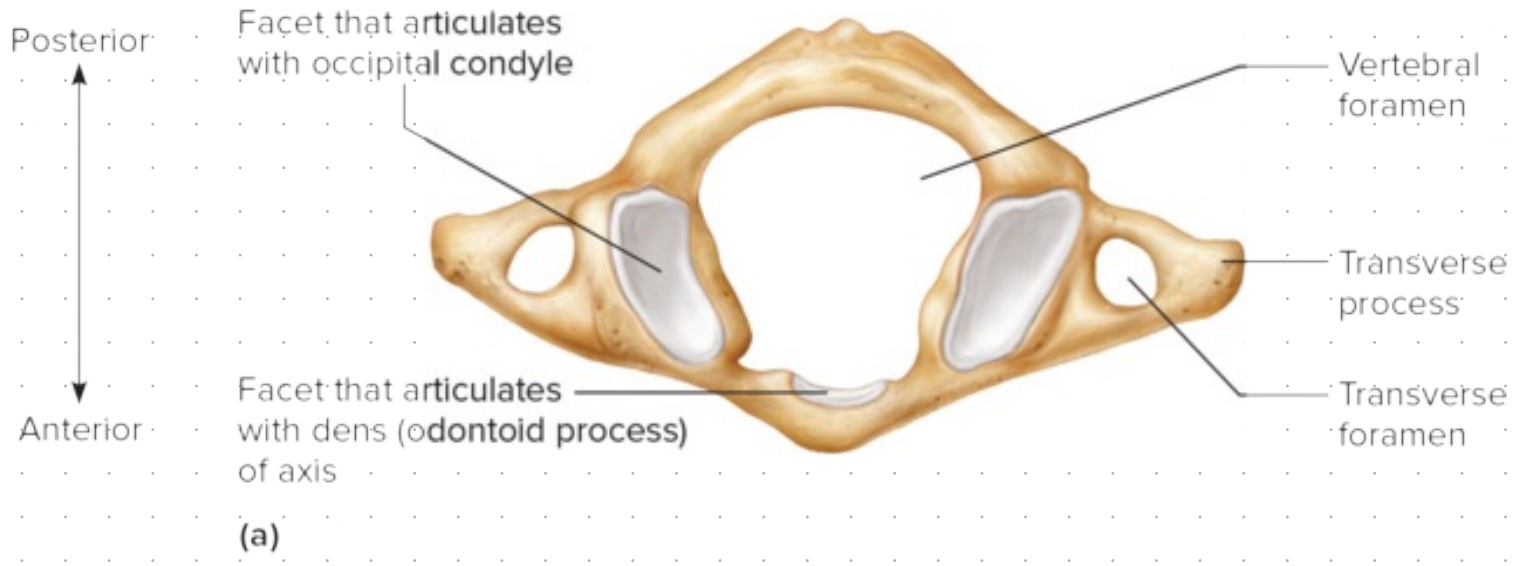
The vertebral column extends from the skull to the pelvis & forms the vertical axis of the skeleton. It is composed of many bony parts called vertebrae separated by masses of fibrocartilage called intervertebral discs & connected to one another by ligaments. The vertebral column supports the head & the trunk of the body, yet is flexible enough to permit movements, such as bending forward, backward, or to the side & turning or rotating on the central axis. It also protects the spinal cord.

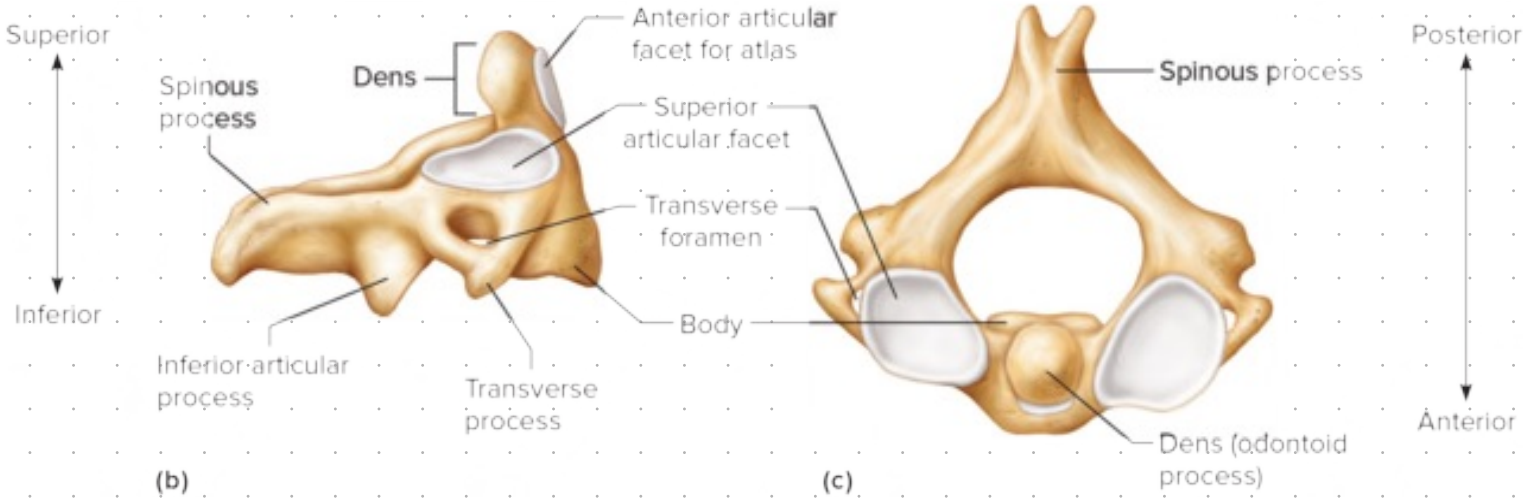



- → infants have 33 bones in the vertebral column
- → adults have 26 bones in the vertebral column
- → the thoracic & sacral curvatures are concave anteriorly & are are called primary curves
- → the cervical curvature in neck & lumbar curvature in lower back are convex anteriorly & are called secondary curves



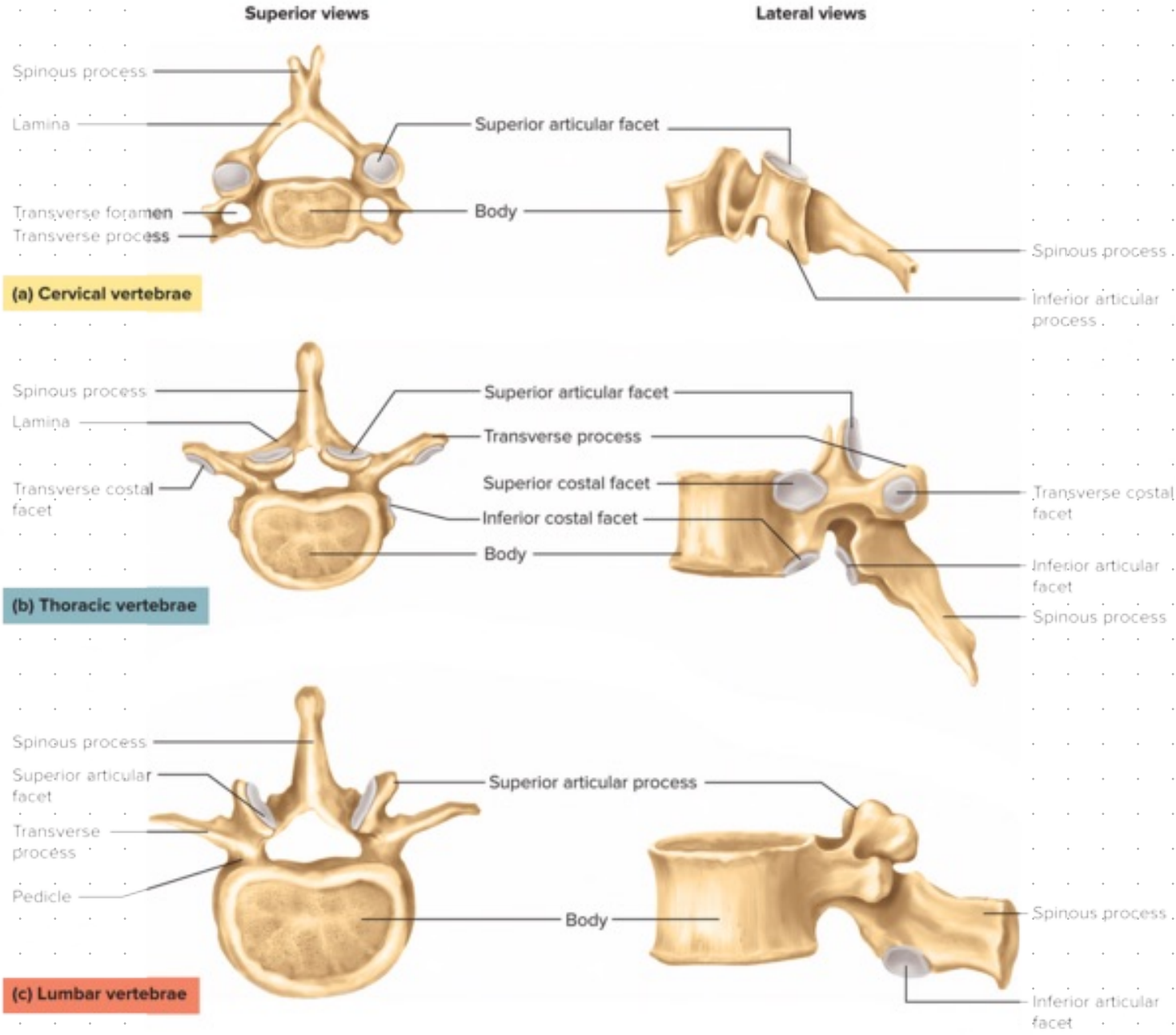





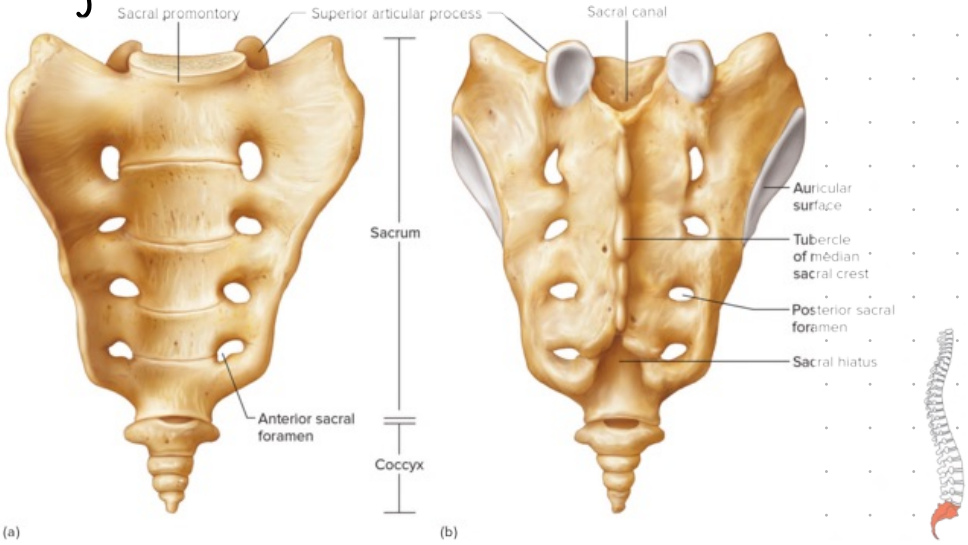




(a) superior view of the atlas
(b) right lateral view
(c) superior view of the axis

→ 12 thoracic vertebrae are larger than those in the cervical region
→ thoracic vertebrae, except for T11-T12, have 2 costal facets that articulate w ribs
→ one costal facet articulates w the rib tubercle, second articulates w the rib head



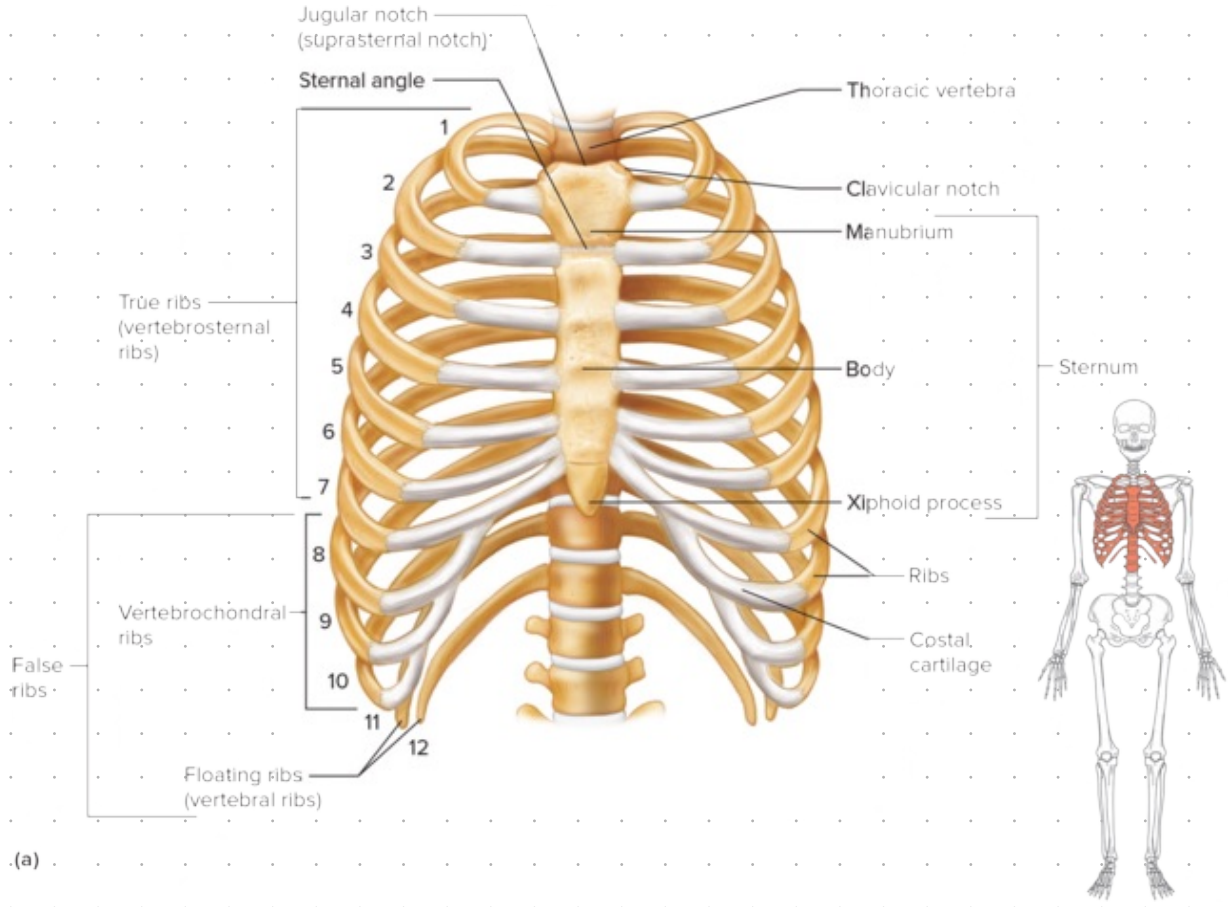

→ 5 lumbar vertebrae in the small of the back (loin) support more weight than the superior vertebrae & have larger, stronger bodies
→ sacrum is a triangular structure at the base of vertebral column



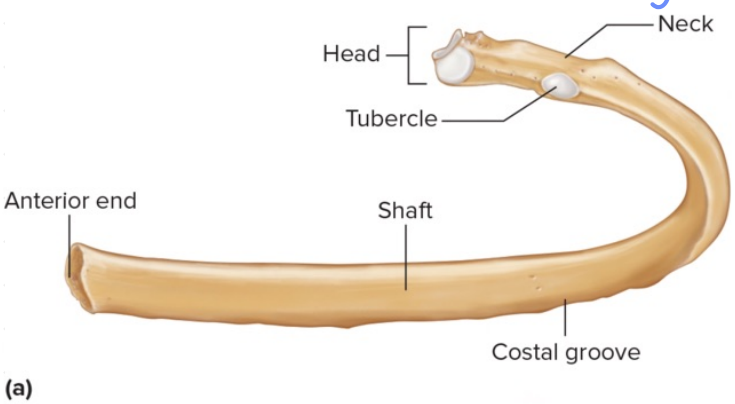
→ spinous processes of fused bones form a ridge of tubercles called the median sacral crest
→ nerves & blood vessels pass through rows of openings called posterior sacral formina, located to sides of tubercles

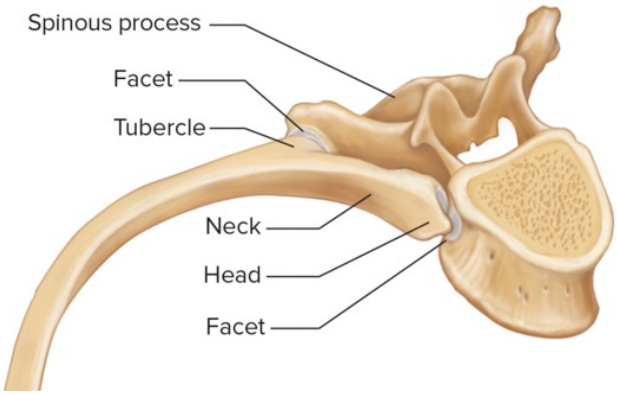
→ coccyx is typically composed of 4 vertebrae that fuse between 25-30
→ in older adults the coccyx may fuse to the sacrum

# Chapter 7.8

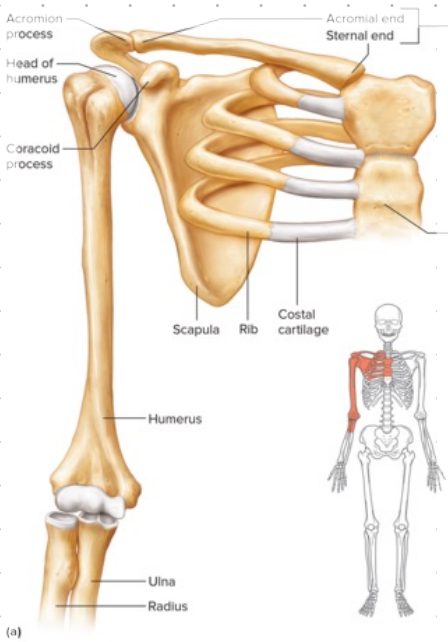



→ usually 24 ribs, some people may have more
→ first 7 rib pairs: true ribs, joined to sternum by costal cartilage
→ last 5 pairs of ribs: false ribs, their cartilage does not reach sternum
→ lower 2/3 pairs are floating ribs



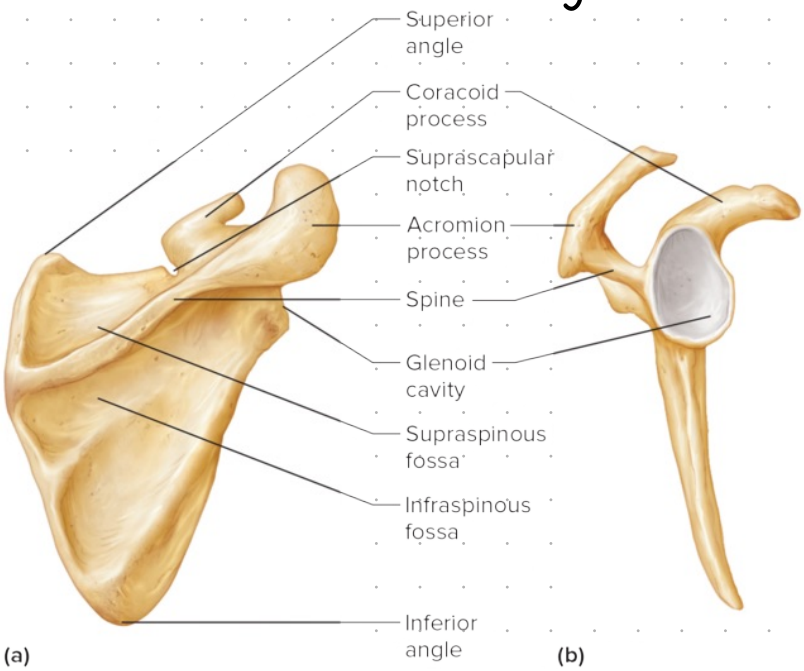
# Chapter 7.9

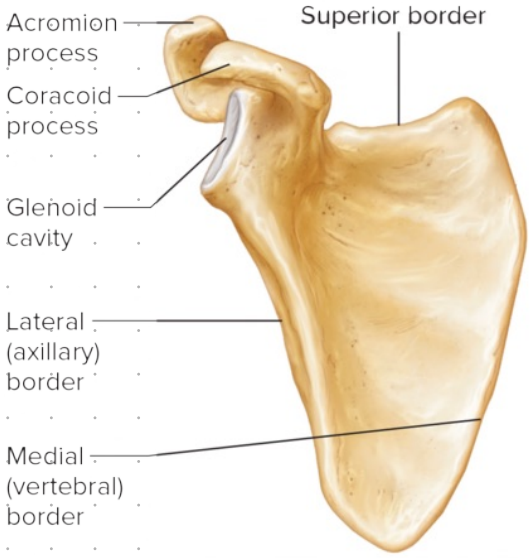


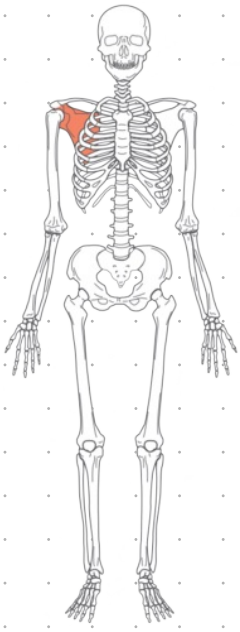


Each pectoral girdle, (shoulder girdle) is 2 parts- an anterior bone called the clavicle, & a scapula on the posterior portion. Although the word girdle suggests a ring-shaped structure, the pectoral girdle is an incomplete ring. It is open in the back between the scapulae, & the sternum separates its bones in front. The pectoral girdle supports the upper limbs & is an attachment for several muscles that move them.

→ scapula is broad, triangular, & located on each side of upper back

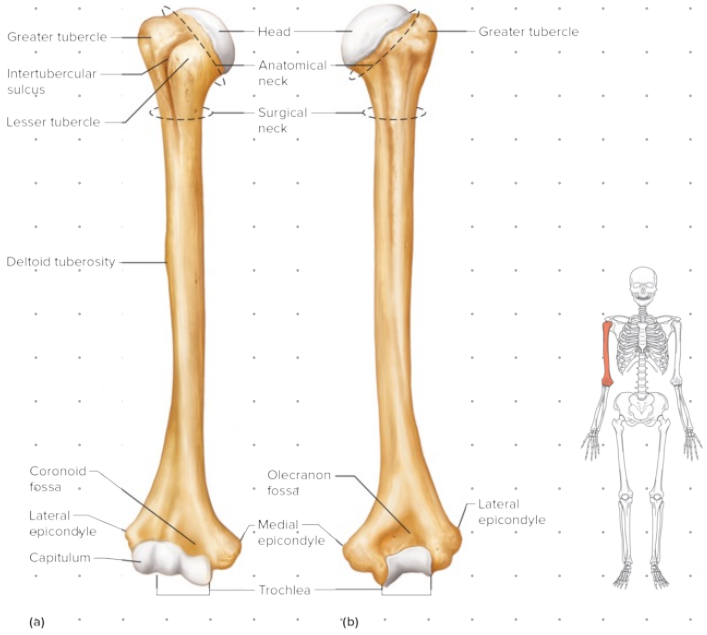


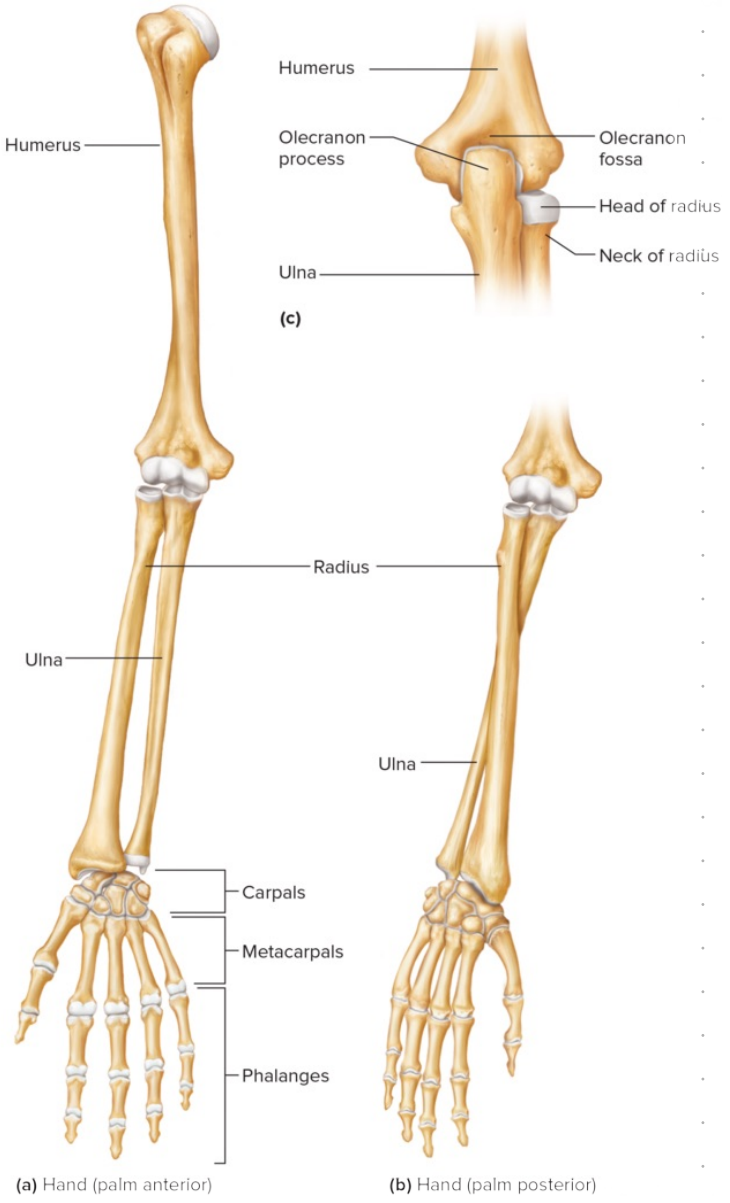



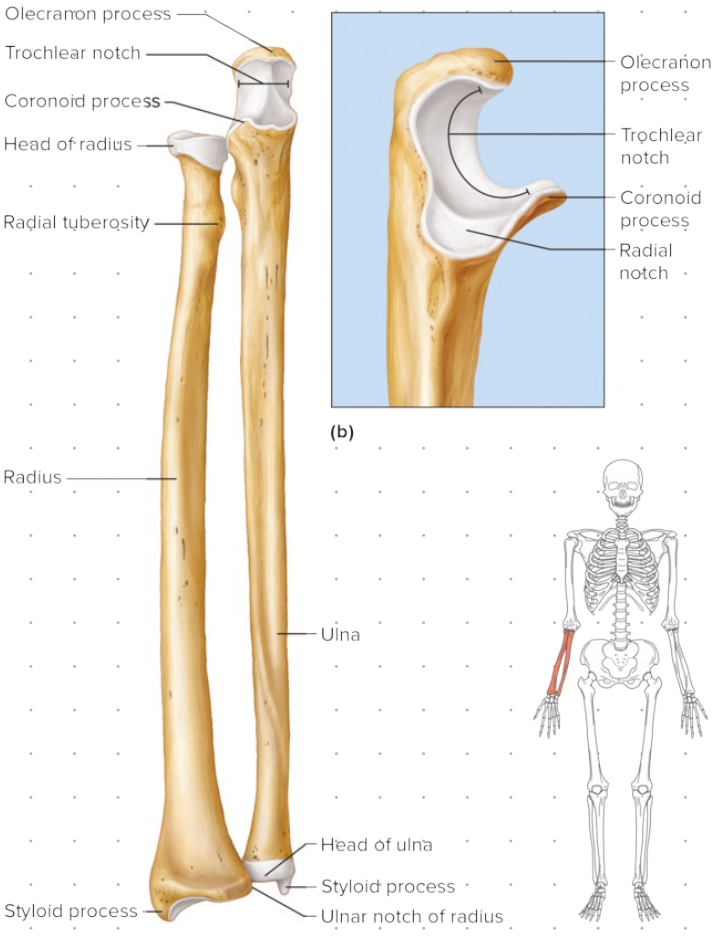
The scapula has 3 borders. The superior border is on the superior edge The axillary, or lateral, border is directed toward the upper limb. The vertebral, or medial, border, is closest to the vertebral column, about 5 cm away.

# CHAPTER 7.10



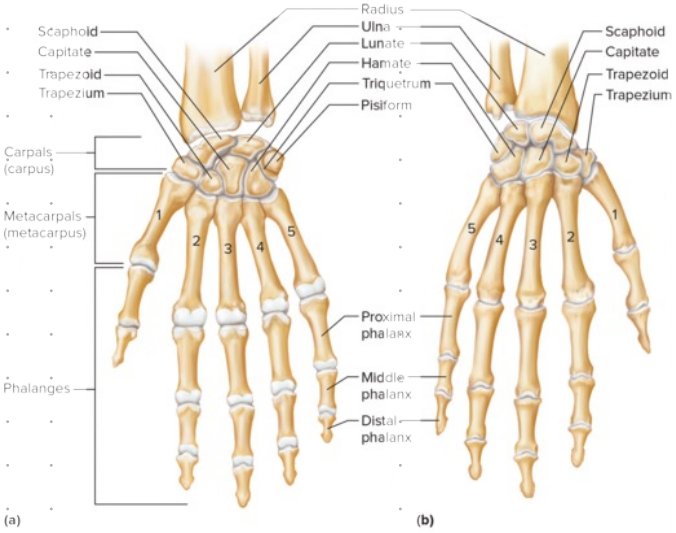

→ humerus is a long bone that extends from scapula to elbow







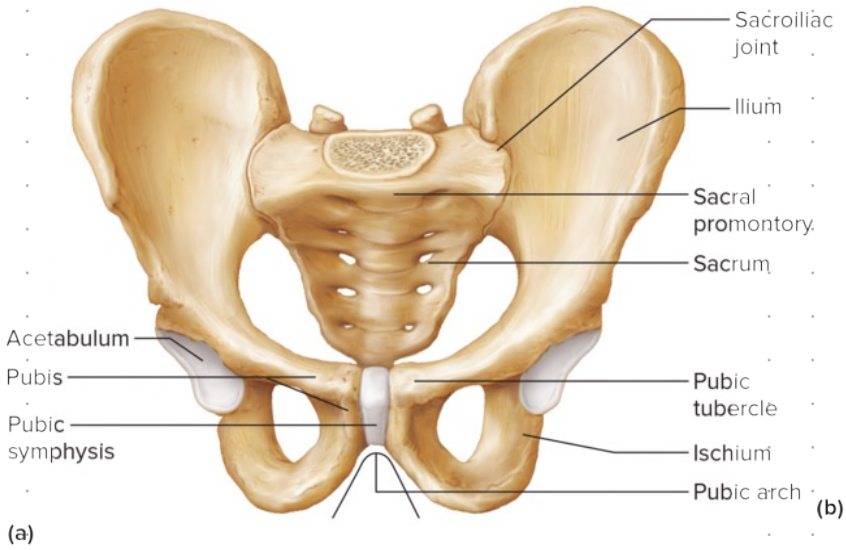



## Bones of the Pectoral Girdle & Upper Limbs

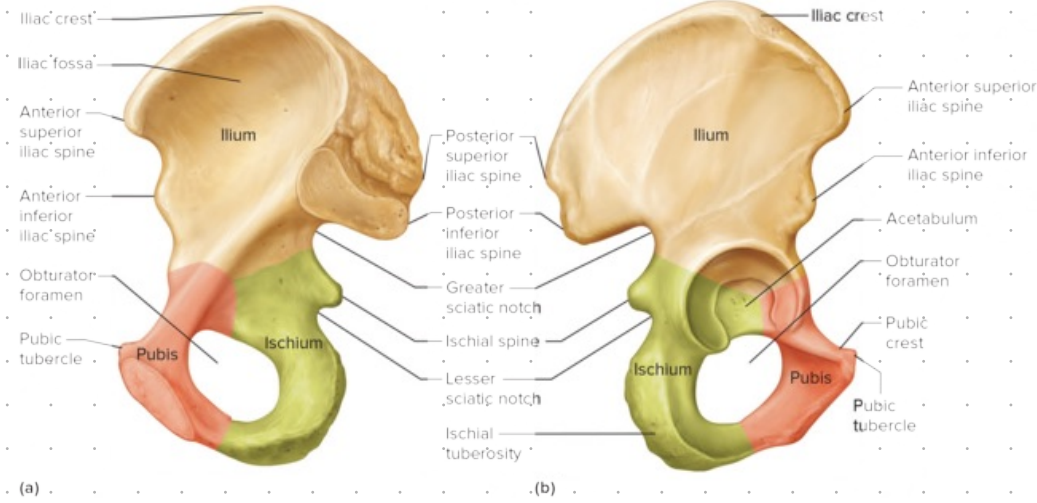
| Name | Location | Special Features |
|---|---|---|
| Clavicle (2) | base of neck between sternum & scapula | sternal end, acromial end |
| Scapula (2) | upper back, forms part of shoulder | body, spine, acromion process, coracoid process, glenoid cavity |
| Humerus (2) | arm, between scapula & elbow | head, greater & lesser tubercle, intertubercle sulcus, anatomical neck, surgical neck, deltoid tuberosity, capitulum, trochlea, medial epicondyle, coronoid & olecranon fossa |
| Radius (2) | lateral side of forearm, between elbow & wrist | head, radial tuberosity, styloid process, ulnar notch |
| Ulna (2) | medial side of forearm, between elbow & wrist | trochlear notch, olecranon & coronoid process, head, styloid process, radial notch |
| Carpal (16) | wrist | 2 rows of 4 bones each |
| Metacarpal (10) | palm | 1 bone in line w each finger & thumb |
| Phalanx (28) | finger | 3 phalanges in each finger; 2 phalanges in each thumb |

# Chapter 7.11

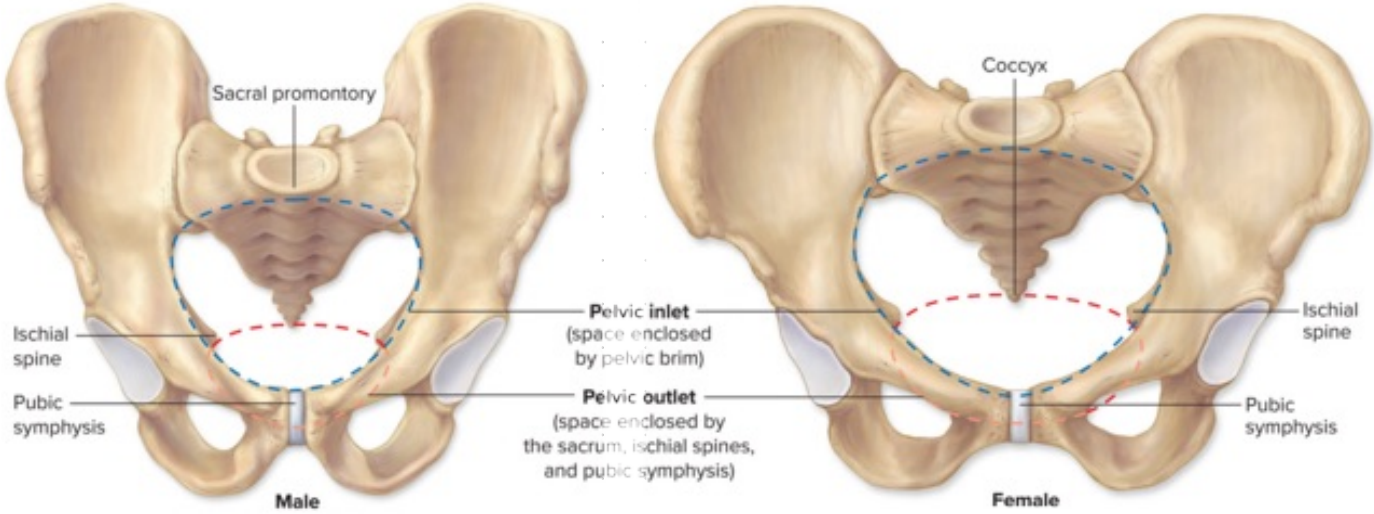
The pelvic girdle consists of 2 hip bones, also known as coxal bones (ossa coxae), or innominate bones. They articulate w each other anteriorly & w the sacrum posteriorly. The sacrum, coccyx, & pelvic girdle form the bowl-shaped pelvis. The pelvic girdle supports the trunk; provides attachments for lower limbs; & protects the urinary bladder, the distal end of the large intestine, & the internal reproductive organs. The body's weight is transmitted through the pelvic girdle to the lower limbs.




Each hip bone develops from 3 parts - an ilium, ischium, & a pubis. These parts fuse in the region of a cup-shaped cavity called a acetabulum. This depression, on the lateral surface of the hip bone, receives the rounded head of the femur/ thigh bone.




The ilium, the largest & most superior portion of the hip bone, flares outward, forming the prominence of the hip. The margin of this prominence is the iliac crest. The smooth, concave surface on the anterior aspect of the ilium is the iliac fossa. The ischium forms the posterior & inferior region of the hip bone. The pubis constitutes the anterior & inferior region of the hip bone.

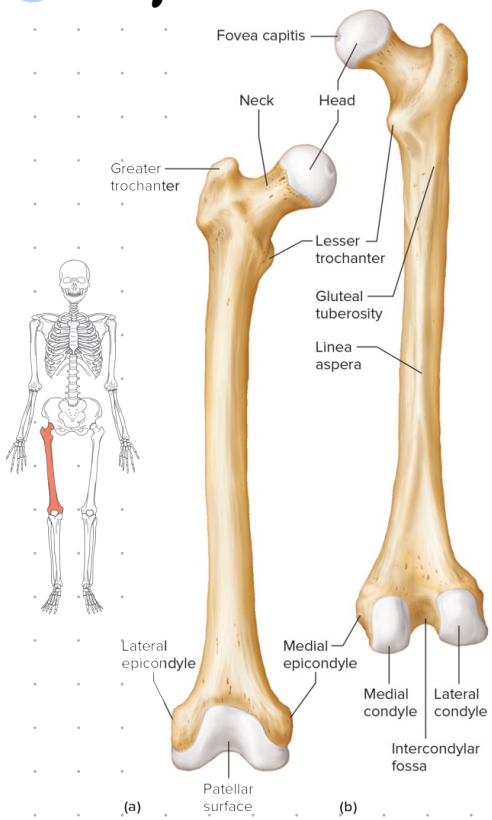


→ if a line was drawn on each side of the pelvis from sacral promontory down & anteriorly to upper margin of the symphasis pubis: the pelvic brim
→ false pelvis is bounded posteriorly by lumbar vertebrae
→ false pelvis helps support abdominal organs
→ true pelvis bounded posteriorly by sacrum & coccyx & laterally & anteriorly by lower ilium, ischium, & pubis bones

## Differences Between Male & Female Skeletons

| Part | Male | Female |
|---|---|---|
| Skull | larger, heavier, more conspicuous muscle attachment | smaller, more delicate, less evidence of muscle attachment |
| Mastoid process | larger | smaller |
| Supraorbital ridge | more prominent | less prominent |
| chin | more square | more pointed |
| jaw angle | angle of ramus about 90° | angle of ramus >125° |
| forehead | shorter | taller |
| orbit | superior border thicker, blunt edge | superior border thinner, sharp edge |
| parietal bones | less bulbous | more bulbous |
| Pelvis | hip bones heavier, thicker, more evidence of muscle attachment | hip bones lighter, less evidence of muscle attachment |
| obturator foramen | more oval | more triangular |
| acetabulum | larger | smaller |
| pubic arch | narrow, sharper angle | broader, flatter angle |
| sacrum | narrow, sacral promontory projects more forward, sacral curvature bends less sharply posteriorly | wide, sacral curvature bends sharply posteriorly |
| coccyx | less movable | more movable |
| cavity | narrow, long, more funnel-shaped | wide, distance between ischial spines & ischial tuberosities is greater |

# Chapter 7.12

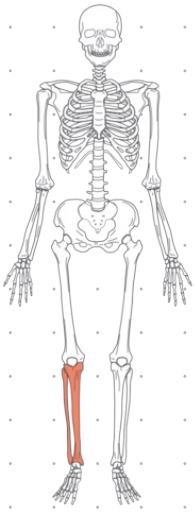


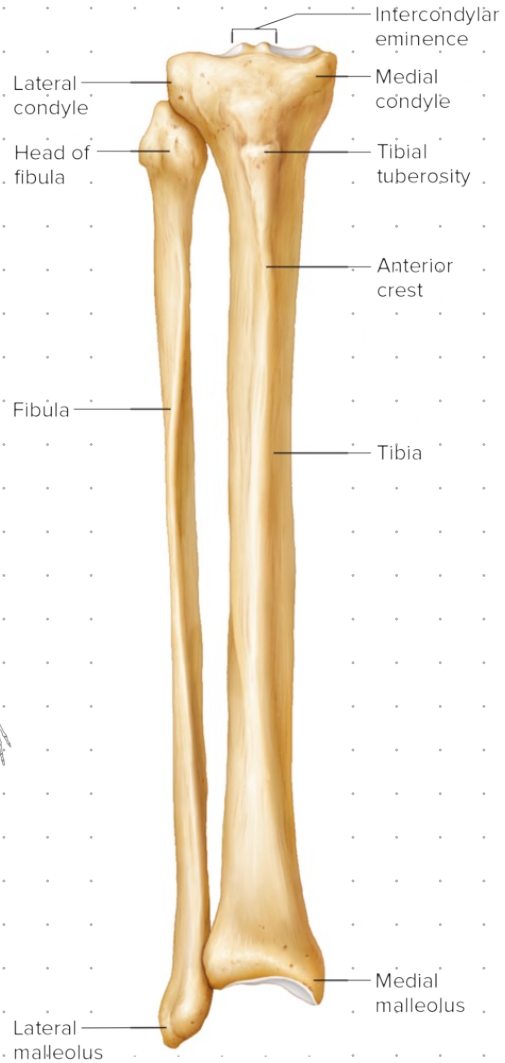

## Femur
- → thigh bone
- → longest bone in the body
- → extends from hip to knee

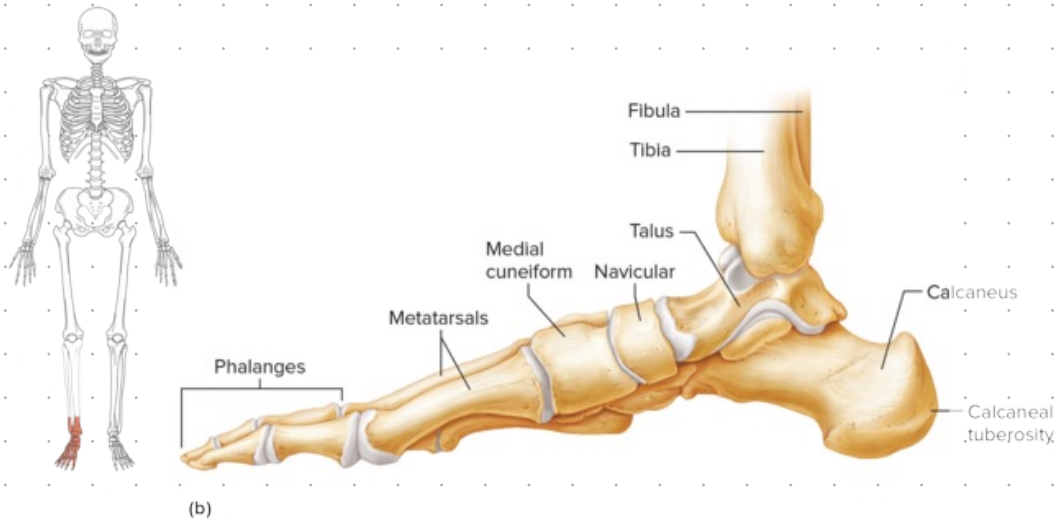
## Patella
- → kneecap
- → controls the angle at which the tendon continues toward the tibia

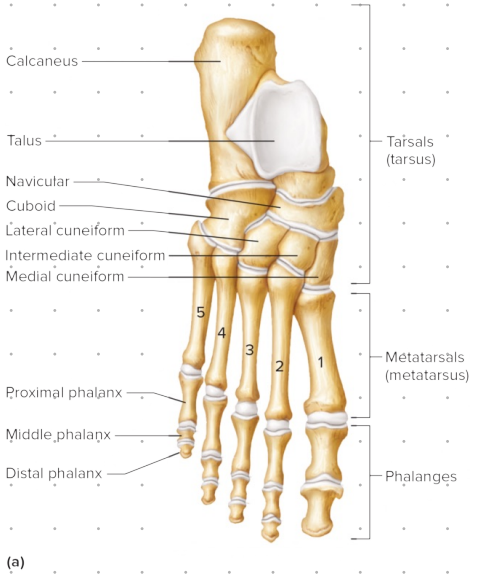
## Tibia
- → shin bone
- → larger of 2 leg bones
- → on medial side

## Fibula
- → long & slender
- → located on lateral side of tibia
- → does not enter knee joint
- → does not bear any weight








→ calcaneus is largest tarsal/heel bone
→ calcaneus supports body weight & provides attachment for muscles to move the foot

## Bones of the Pelvic Girdle & Lower Limbs

| Name | Location | Special Features |
|---|---|---|
| Hip bone (2) | Hip, articulating w other hip bone anteriorly & w the sacrum posteriorly | ilium, iliac crest, ant. sup. iliac spine, ischium, ischial tuberosity, ischial spine, obturator foramen, acetabulum, pubis |
| Femur (2) | thigh, between hip & knee | head, fovea capitis, neck, greater trochanter, lesser trochanter, linea aspera, lateral condyle, medial condyle, gluteal tub., intercondylar fossa |
| Patella (2) | ant. knee surface | flat sesamoid bone w/in tendon |
| Tibia (2) | medial leg side, between knee & ankle | medial con., lateral con., tibial tub., ant. crest, medial malleolus, intercondylar fossa |
| Fibula (2) | lat. leg side, between knee & ankle | head, lat. malleolus |
| Tarsal (14) | ankle | freely movable talus articulates w leg bones, calcaneus forms heel base, 5 other tarsals bound toget. |
| Metatarsal (10) | instep | 1 bone aligned w each toe, bound by ligaments to form arches |
| Phalanx (28) | toe | 3 phalanges in each toe, 2 phal. in great toe |

# CHAPTER 7.13

→ around age 30, the body begins to shorten at ≈ 1/16" per year
→ osteoclasts begin to outnumber osteoblasts. the bone is eaten away in the remodeling process faster than it's being replaced
→ around age 35, we begin to lose bone mass
→ compact bone loss begins around age 40
→ bone loss is slow & steady in males but females' is linked to hormones
→ first decade of menopause females lose 15-20% of trabecular bone. 2-3x the rate loss than males

## Possible reasons for falls among older adults

→ overall fragility
→ decreased muscle strength
→ decreased coordination
→ medication side effects
→ slowed reaction time due to joint stiffening
→ poor vision &/or hearing
→ disease (cancer, infection, arthritis)