

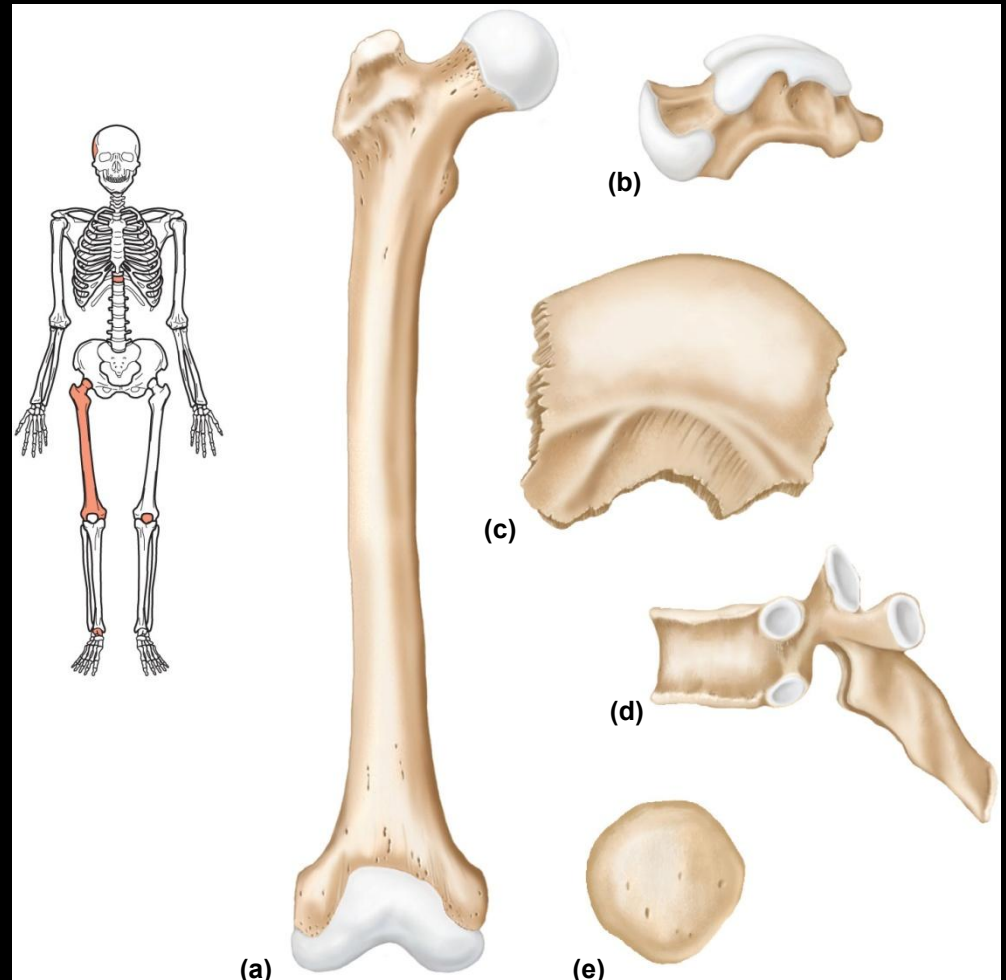
INTRODUCTION

- Human skeleton initially cartilages and fibrous membranes
- Hyaline cartilage is the most abundant cartilage
- By age 25 the skeleton is completely hardened
- 206 bones make up the adult skeleton (20% of body mass)
 - 80 bones of the axial skeleton
 - 126 bones of the appendicular skeleton

BONE CLASSIFICATION

- Bone Classification:

- Long Bones
- Short Bones
- Sesamoid Bones
- Flat Bones
- Irregular Bones
- Wormian Bones (sutural)



Classification of Bones

- Long bones
 - Typically longer than wide
 - Have a shaft with heads at both ends
 - Contain mostly compact bone
 - Examples: Femur, humerus

Classification of Bones

- Short bones
 - Generally cube-shape
 - Contain mostly spongy bone
 - Examples: Carpals, tarsals

Classification of Bones on the Basis of Shape

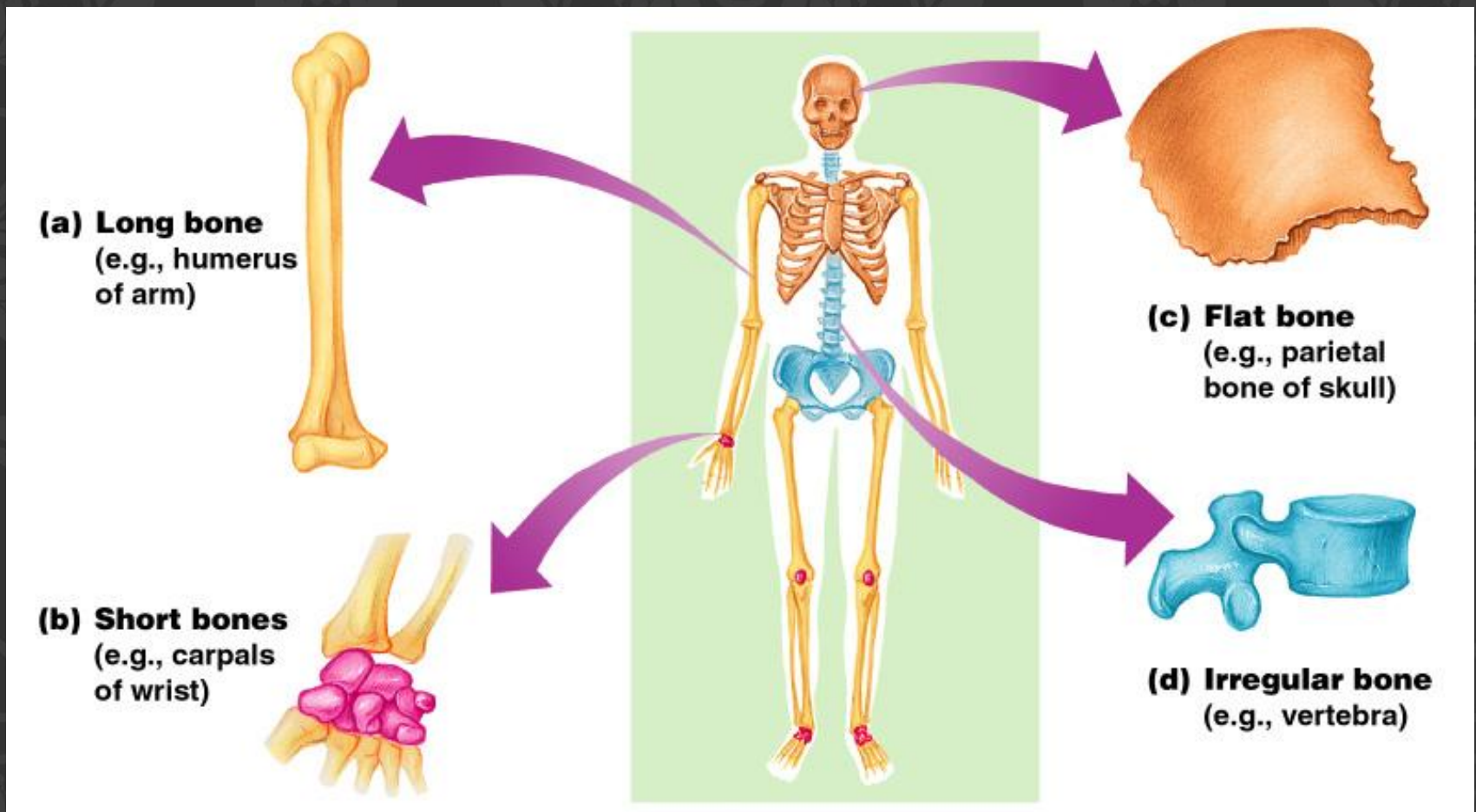


Figure 5.1

Classification of Bones

- Flat bones
 - Thin and flattened
 - Usually curved
 - Thin layers of compact bone around a layer of spongy bone
 - Examples: Skull, ribs, sternum

Classification of Bones

- Irregular bones
 - Irregular shape
 - Do not fit into other bone classification categories
 - Example: Vertebrae and hip

Classification of Bones on the Basis of Shape

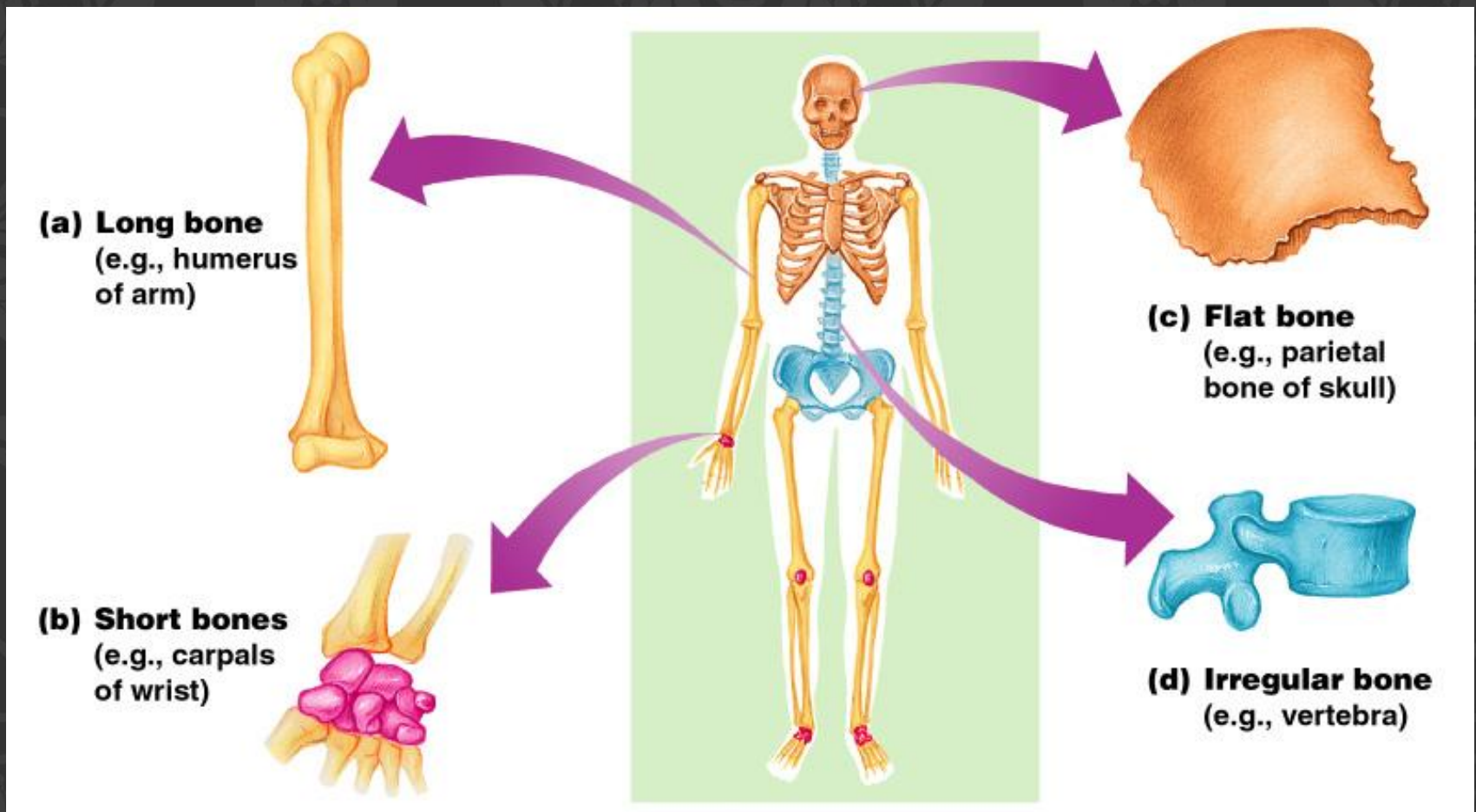
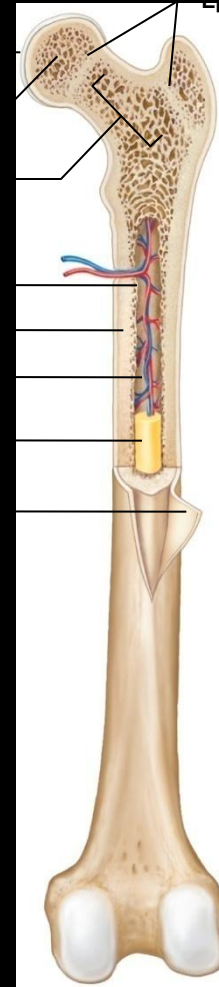


Figure 5.1

PARTS OF A LONG BONE

- Epiphysis
 - Distal
 - Proximal
- Diaphysis
- Metaphysis
- Compact bone
- Spongy bone
- Articular cartilage
- Periosteum
- Endosteum
- Medullary cavity
 - Red marrow and yellow marrow

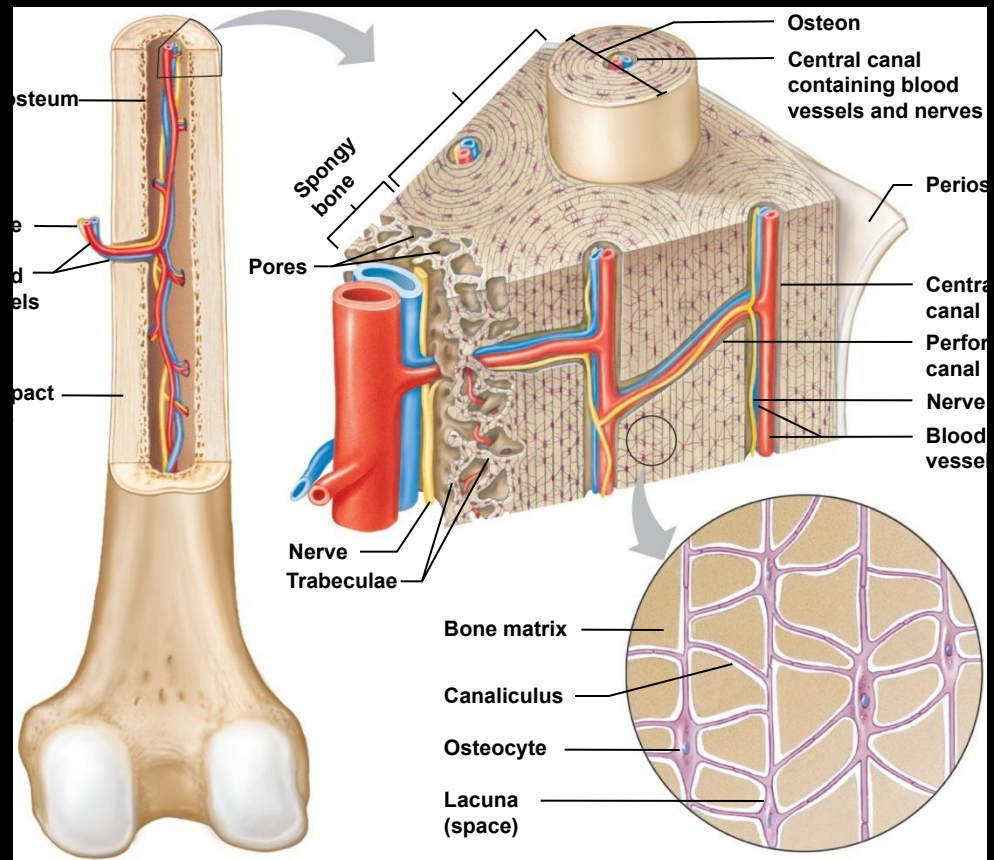


MICROSCOPIC STRUCTURE

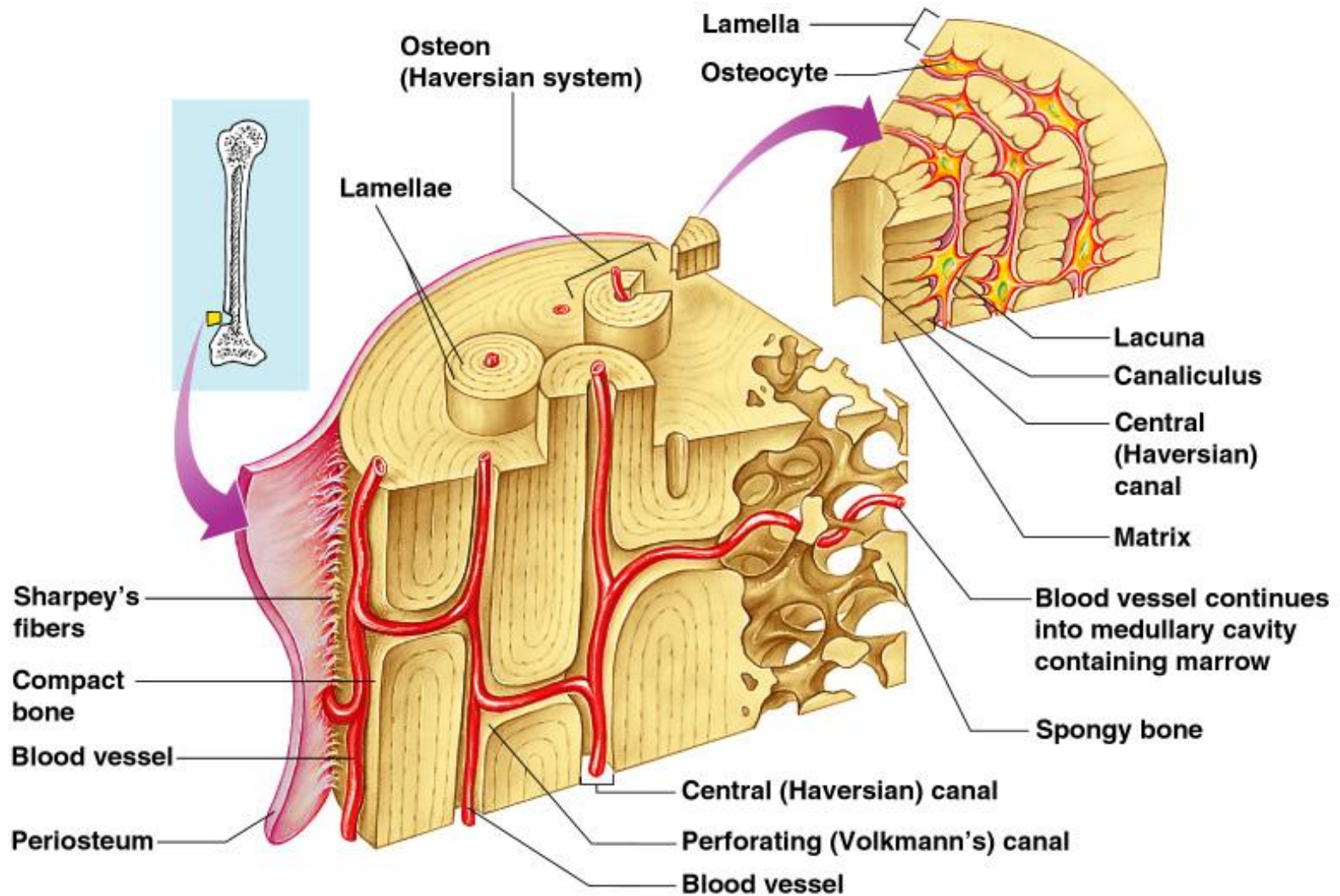
- Bone cells are called **osteocytes**
 - in a lacuna
- Osteocytes transport nutrients and wastes by cellular processes in canaliculi
- The extracellular matrix of bone is largely **collagen** and inorganic salts
 - Collagen gives bone resilience & strength
 - Inorganic salts make bone hard

COMPACT BONE

- Osteon
- Haversian System
- Central canal
- Perforating canal
- Volkmann's canal
- Osteocytes
- Lamellae
- Lacunae
- Bone matrix
- Canaliculi

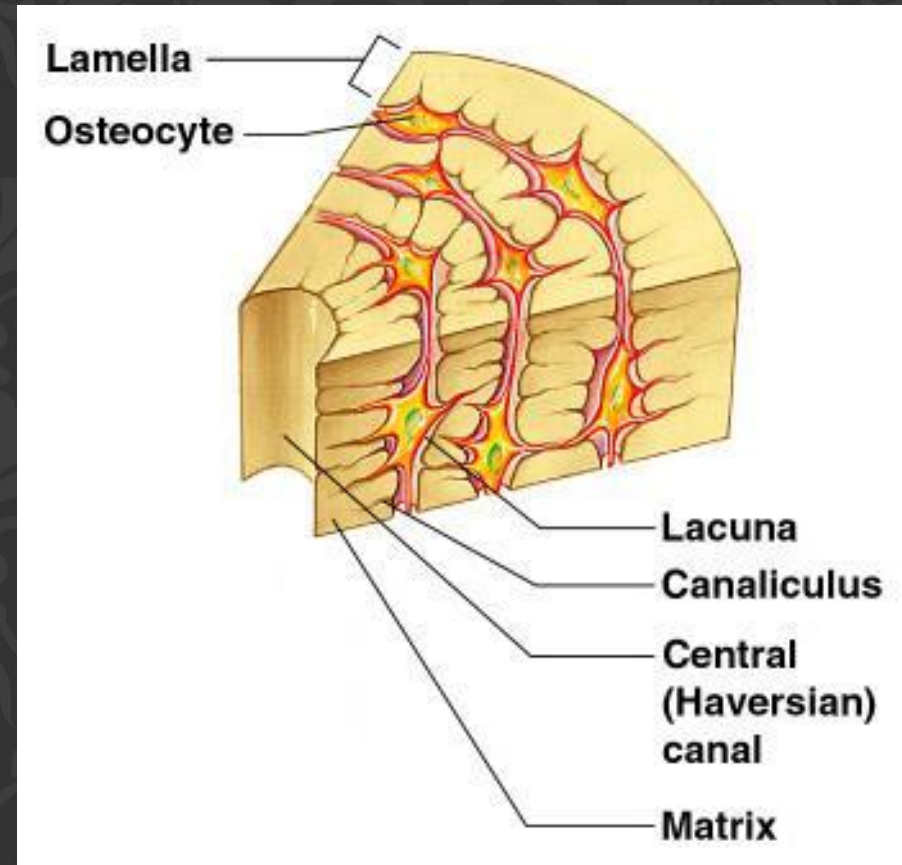


Microscopic Anatomy of Bone



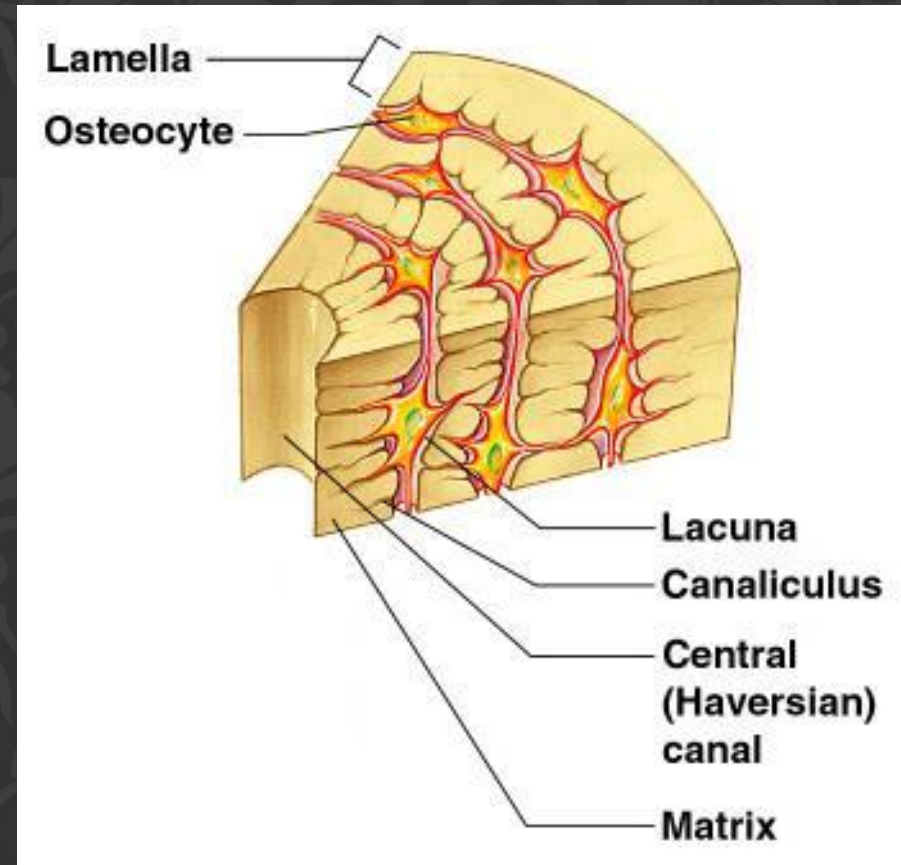
Microscopic Anatomy of Bone

- Lacunae
 - Cavities containing bone cells (osteocytes)
 - Arranged in concentric rings
- Lamellae
 - Rings around the central canal
 - Sites of lacunae



Microscopic Anatomy of Bone

- Canaliculi
 - Tiny canals
 - Radiate from the central canal to lacunae
 - Form a transport system



BONE DEVELOPMENT AND GROWTH

- Parts of the skeletal system begin to develop during the first few weeks of prenatal development
- Bones replace existing connective tissue in one of two ways:
 - As intramembranous bones
 - As endochondral bones

INTRAMEMBRANOUS BONES

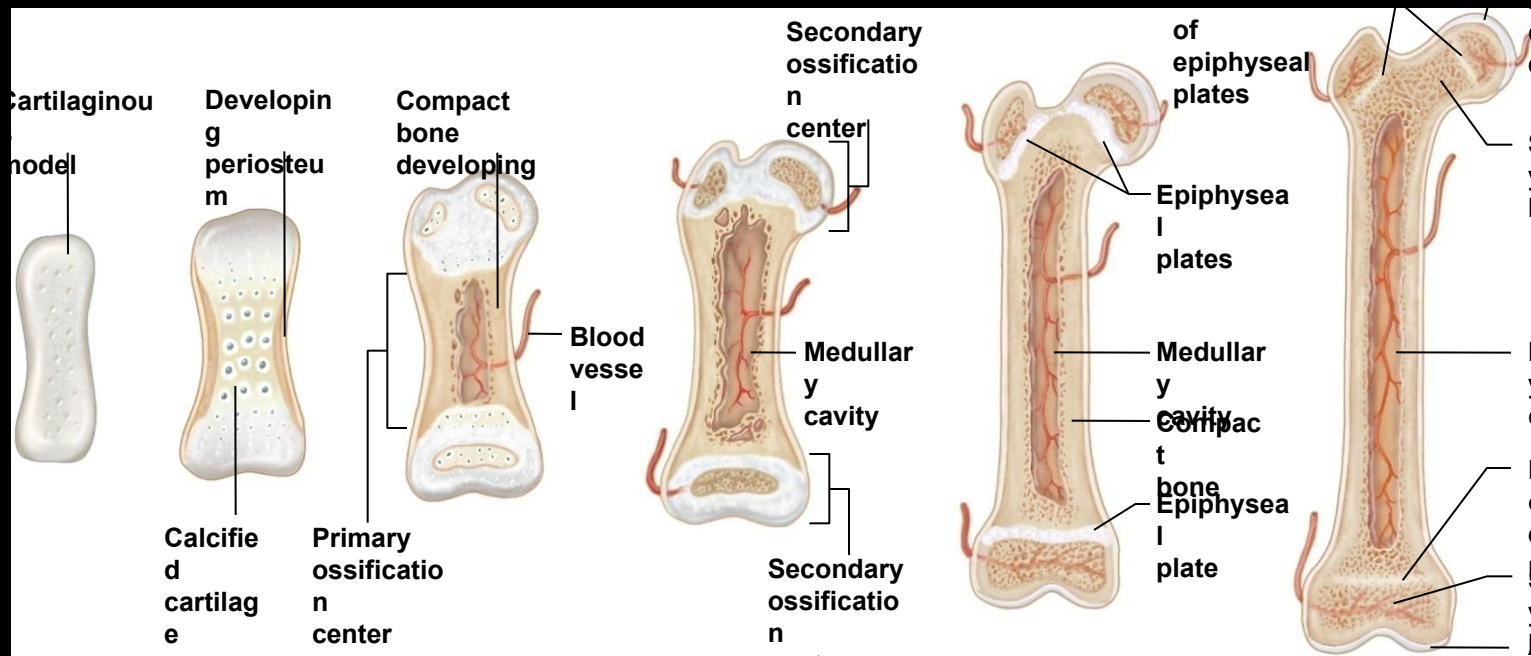
- Intramembranous Bones
 - These bones originate within sheetlike layers of connective tissues
 - They are the broad, flat bones
 - Skull bones (except mandible)
 - Are known as intramembranous bones

ENDOCHONDRAL BONES

- Endochondral Bones
 - Bones begin as hyaline cartilage
 - Form models for future bones
 - These are most bones of the skeleton
 - Are known as endochondral bones

ENDOCHONDRAL OSSIFICATION

- Hyaline cartilage model
- Primary ossification center
- Secondary ossification centers
- Epiphyseal plate
- Osteoblasts vs. osteoclasts



BONE FUNCTION

- Bones shape, support, and protect body structures

SUPPORT, PROTECTION, AND MOVEMENT

- Support, Movement & Protection
 - Gives shape to head, etc.
 - Supports body's weight
 - Protects lungs, etc.
 - Bones and muscles interact
 - When limbs or body parts move

BLOOD CELL FORMATION

- Blood Cell Formation
 - Also known as hematopoiesis
 - Occurs in the red bone marrow

INORGANIC SALT STORAGE

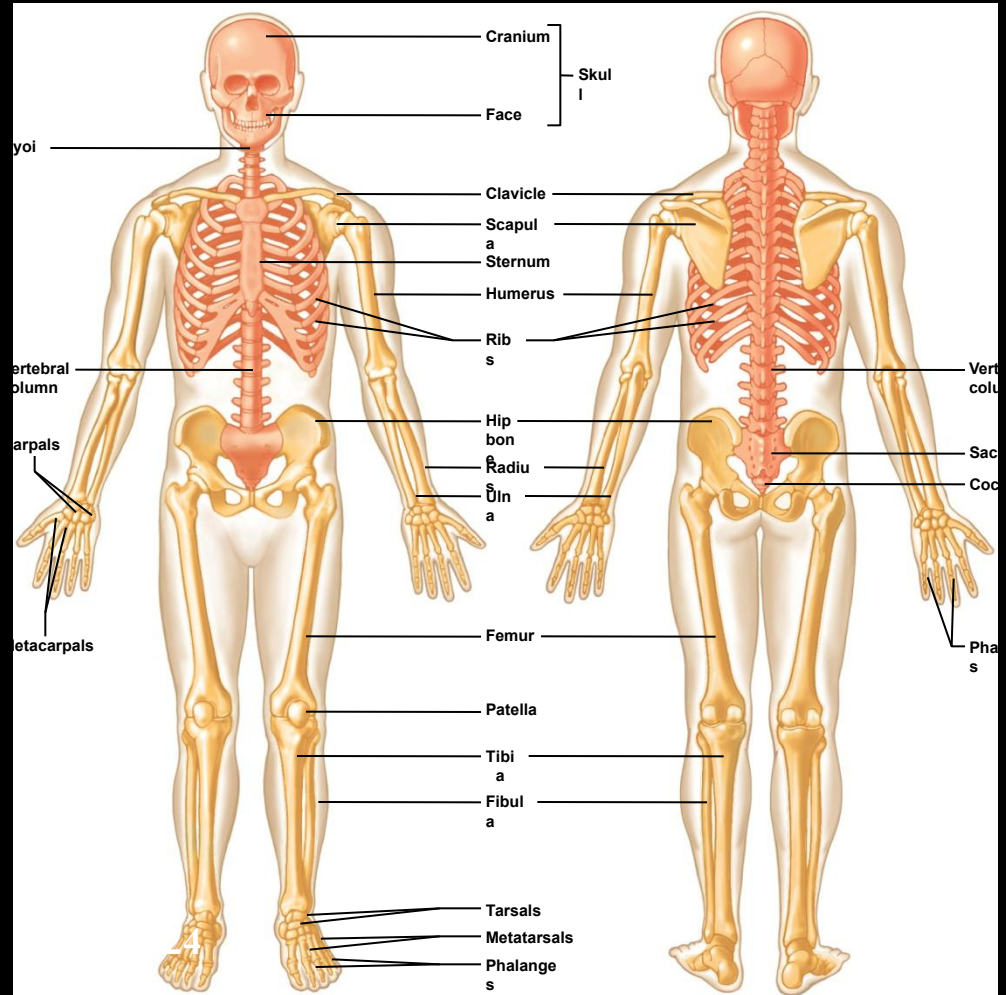
- Inorganic Salt Storage
 - Calcium
 - Phosphate
 - Magnesium
 - Sodium
 - Potassium

SKELETAL ORGANIZATION

- The actual number of bones in the human skeleton varies from person to person
- Typically there are about 206 bones
- For convenience the skeleton is divided into the:
 - Axial skeleton
 - Appendicular skeleton

DIVISIONS OF THE SKELETON

- Axial Skeleton
 - Skull
 - Spine
 - Rib cage
- Appendicular Skeleton
 - Upper limbs
 - Lower limbs
 - Shoulder girdle
 - Pelvic girdle



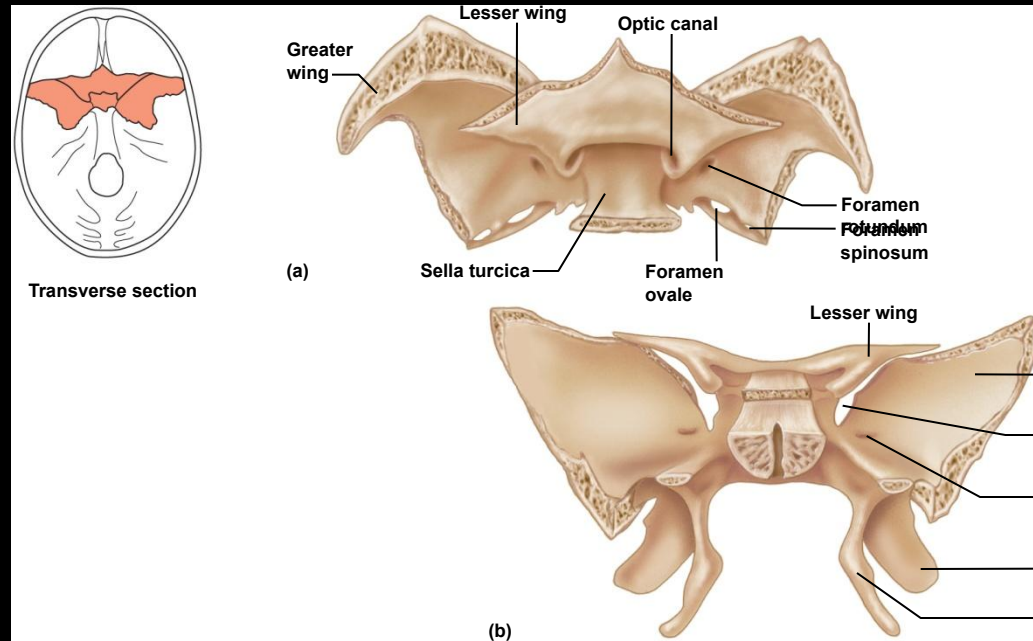
SKULL

- Is composed of the cranium (brain case) and the facial bones

CRANIUM

- Sphenoid Bone (1)

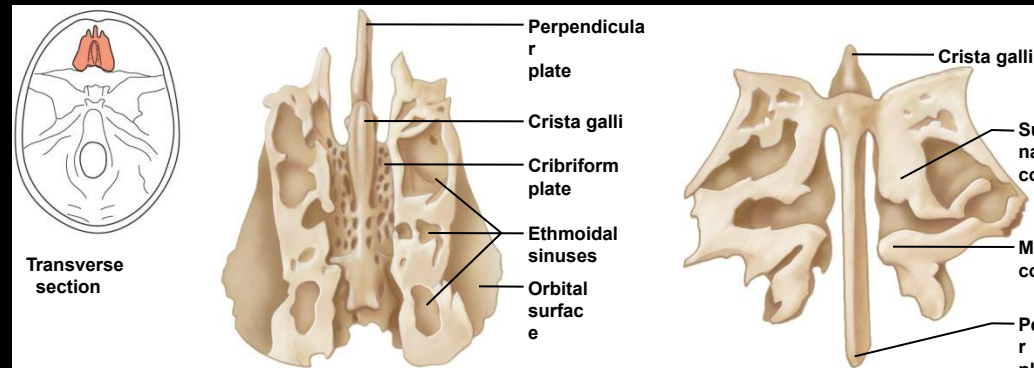
- Base of cranium
- Sides of skull
- Floors and sides of orbits
- Sella turcica
- Sphenoid sinuses



CRANIUM

• Ethmoid Bone (1)

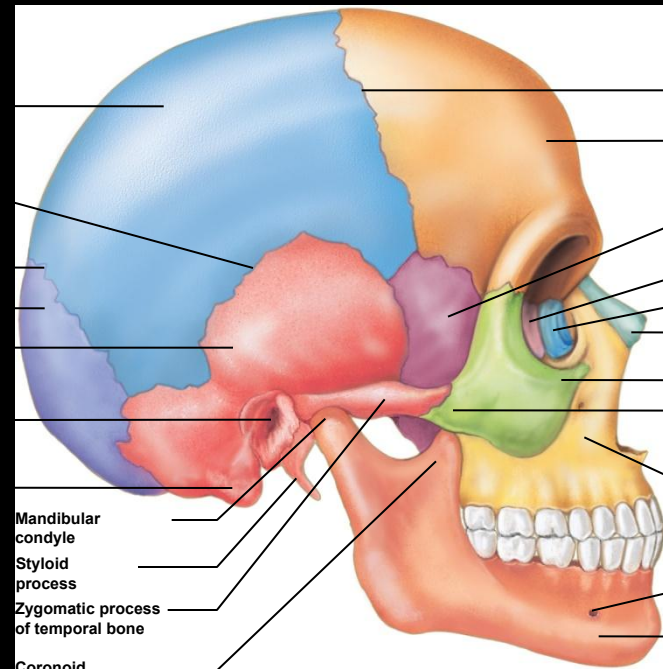
- Roof and walls of nasal cavity
- Floor of cranium
- Wall of orbits
- Cribiform plates
- Perpendicular plate
- Superior and middle nasal conchae
- Ethmoid sinuses
- Crista galli



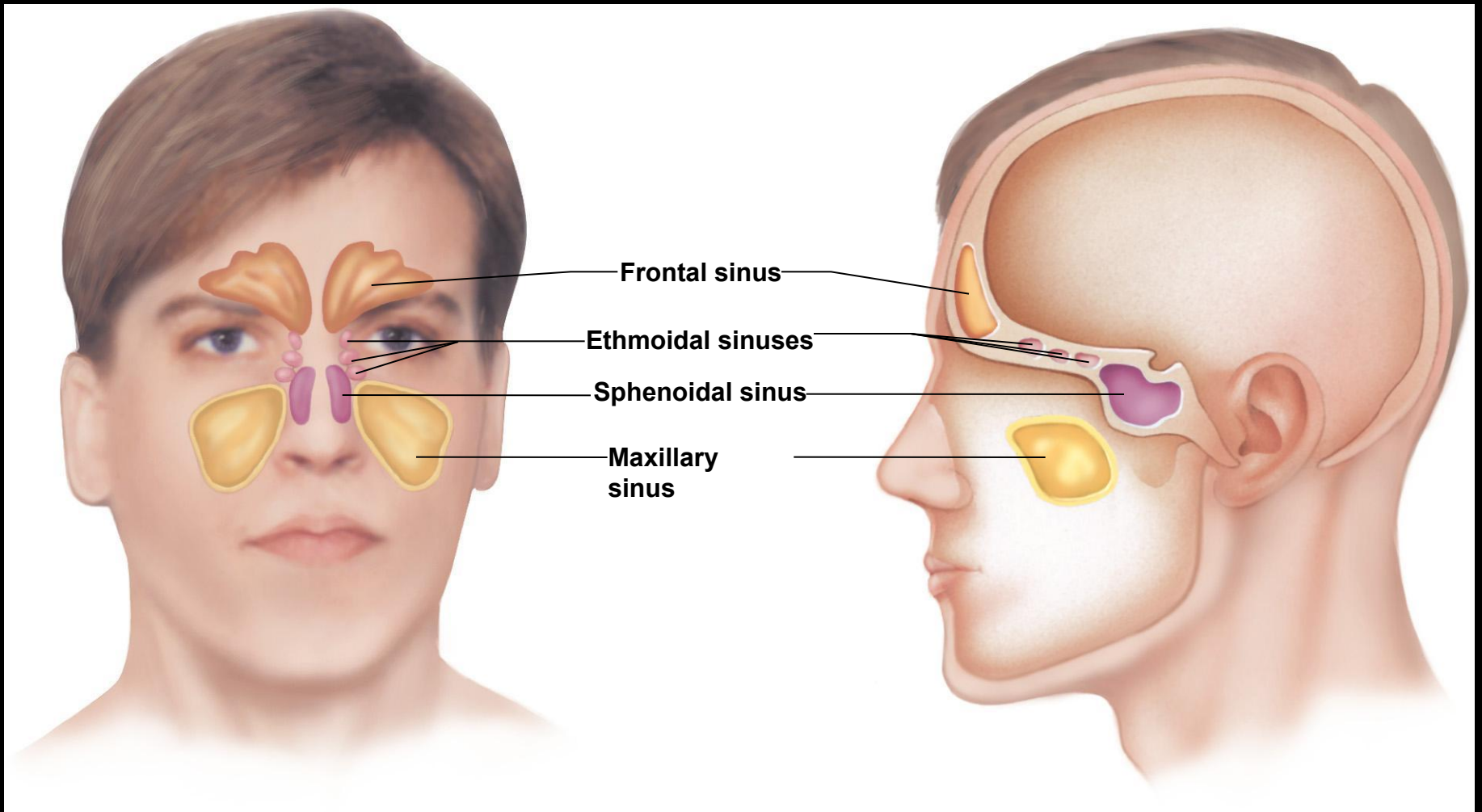
FACIAL SKELETON

- Maxillary Bones (2)

- Upper jaw
- Anterior roof of mouth
- Floors of orbits
- Sides of nasal cavity
- Floors of nasal cavity
- Alveolar processes
- Maxillary sinuses
- Palatine process



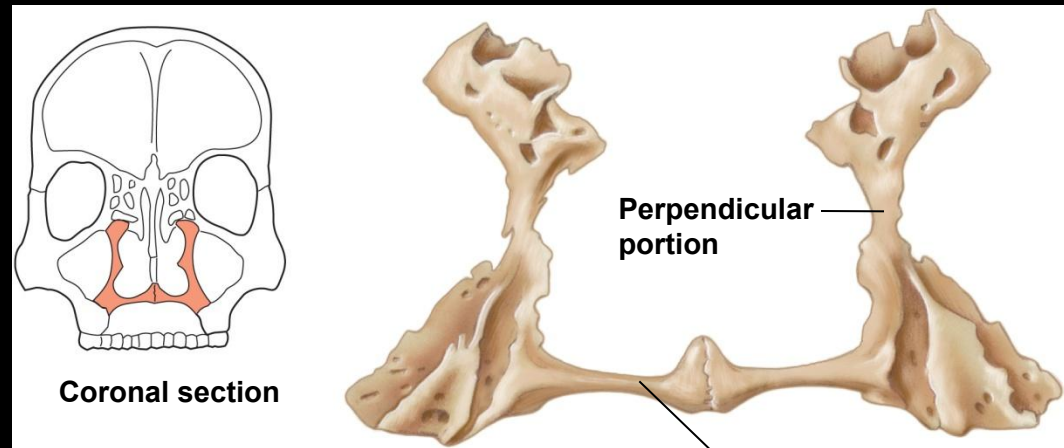
FACIAL SKELETON



FACIAL SKELETON

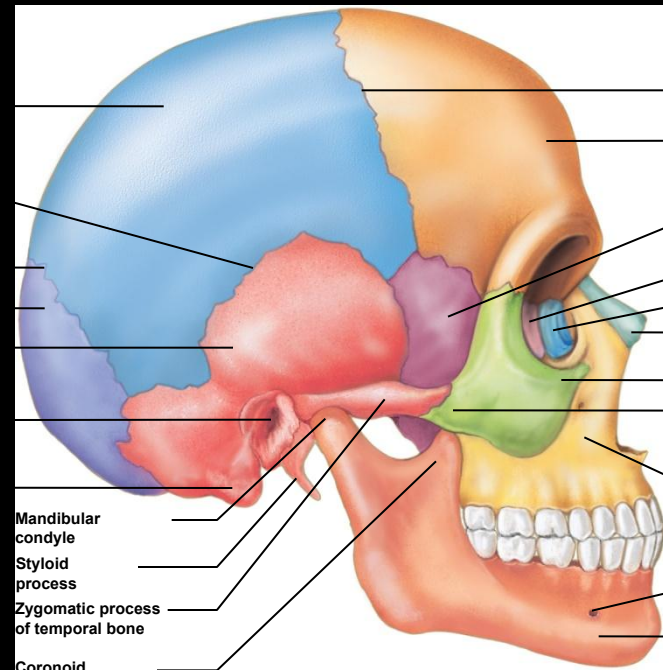
- **Palatine Bones (2)**

- 'L' shaped bones located behind the maxillae
- Posterior section of hard palate
- Floor of nasal cavity
- Lateral walls of nasal cavity



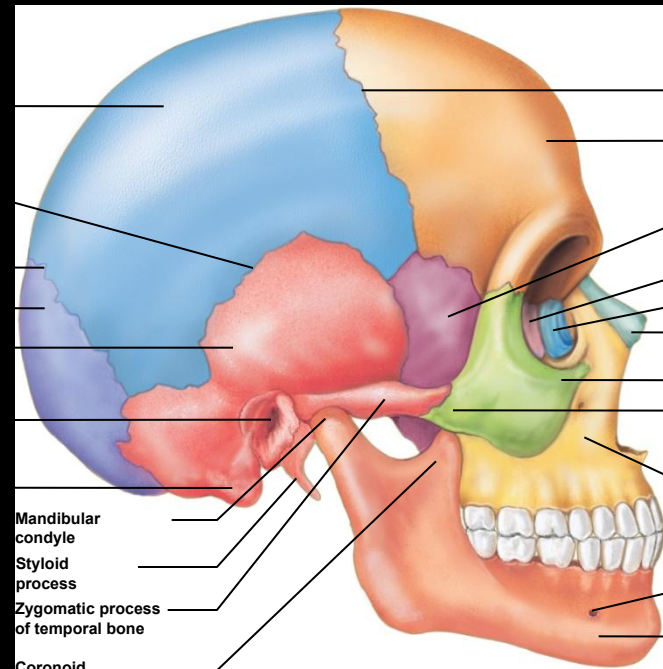
FACIAL SKELETON

- **Zygomatic Bones (2)**
 - Prominences of cheeks
 - Lateral walls of orbits
 - Floors of orbits
 - Temporal process



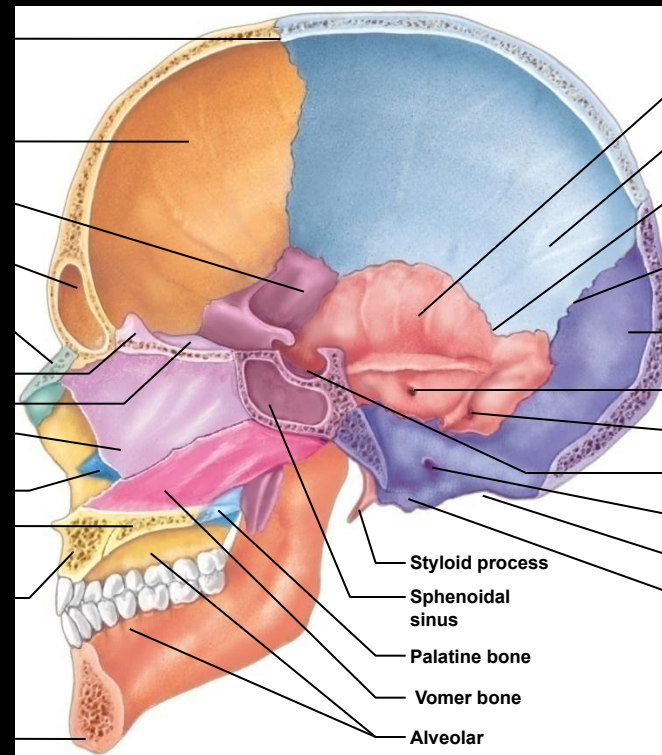
FACIAL SKELETON

- **Lacrimal Bones (2)**
 - Medial walls of orbits
 - Groove from orbit to nasal cavity
- **Nasal Bones (2)**
 - Bridge of nose



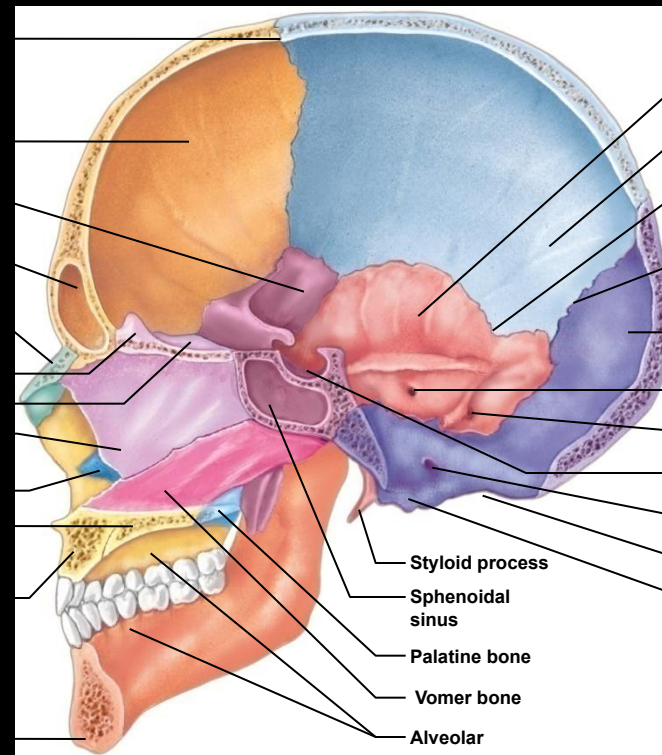
FACIAL SKELETON

- Vomer Bone (1)
 - Inferior portion of nasal septum



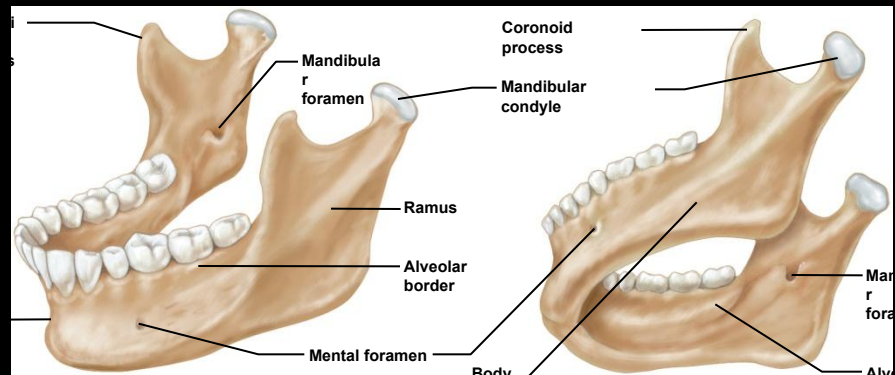
FACIAL SKELETON

- Inferior Nasal Conchae (2)
 - Extend from lateral walls of nasal cavity



FACIAL SKELETON

- Mandible Bone (1)
 - Lower jaw
 - Body
 - Ramus
 - Mandibular condyle
 - Coronoid process
 - Alveolar process
 - Mandibular foramen
 - Mental foramen

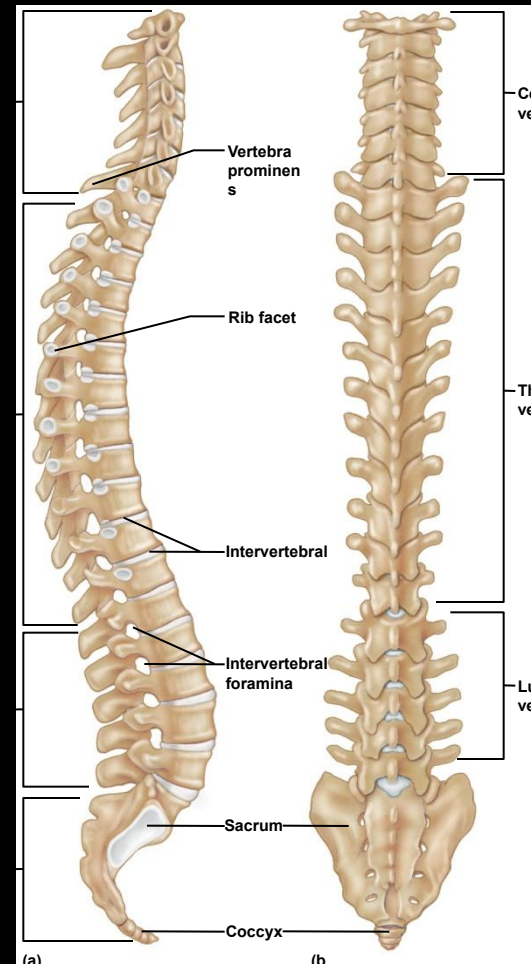


VERTEBRAL COLUMN

- The vertebral column, or spinal column, consists of many vertebrae separated by cartilaginous **intervertebral discs**.

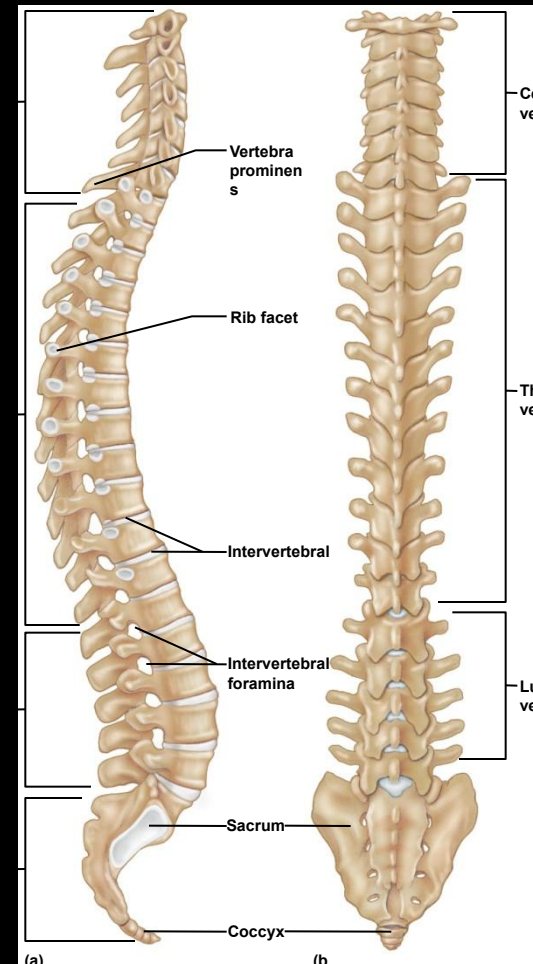
VERTEBRAL COLUMN

- Cervical vertebrae (7)
- Thoracic vertebrae (12)
- Lumbar vertebrae (5)
- Sacral (4-5 fused segments)
 - Sacrum is fused bone
- Coccygeal (3-4 fused segments)
 - Coccyx is fused bone



VERTEBRAL COLUMN

- Cervical curvature
- Thoracic curvature
- Lumbar curvature
- Sacral curvature
- Rib facets
- Vertebral prominens
- Intervertebral discs (IVD)
- Intervertebral foramina (IVF)



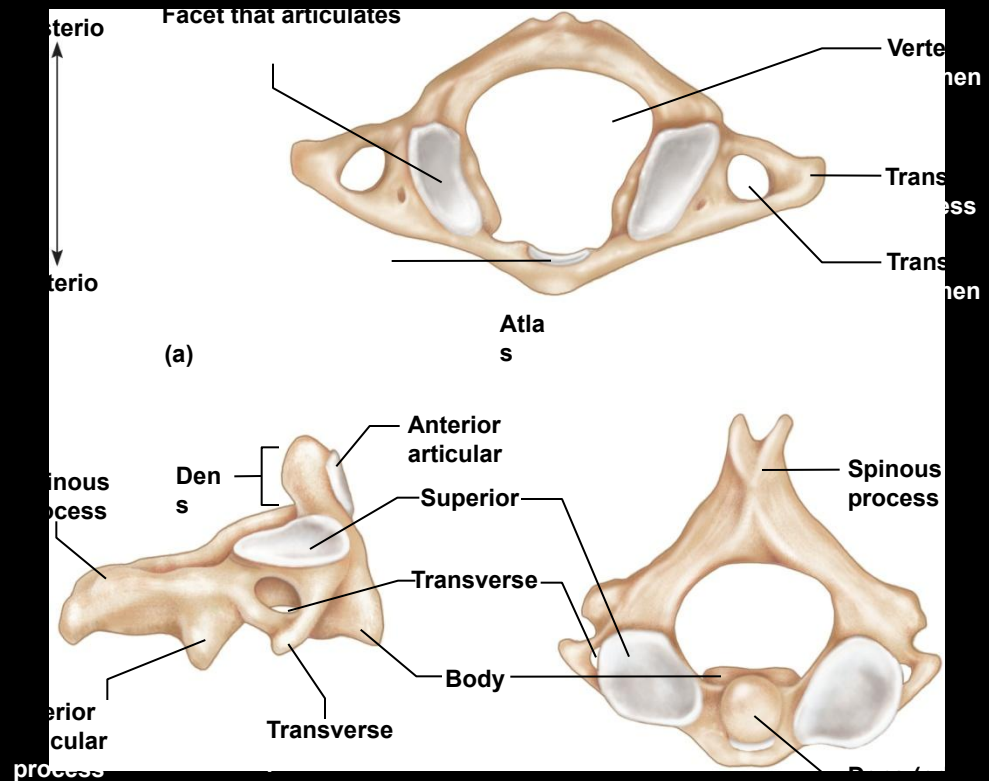
TYPICAL VERTEBRAE

- Includes the following parts:
 - Vertebral body
 - Pedicles
 - Lamina
 - Spinous process
 - Transverse processes
 - Vertebral foramen
 - Facets

CERVICAL VERTEBRAE

- **Atlas** – 1st; supports head
- **Axis** – 2nd; dens pivots to turn head
- Transverse foramina
- Bifid spinous processes
- Vertebral prominens – useful landmark

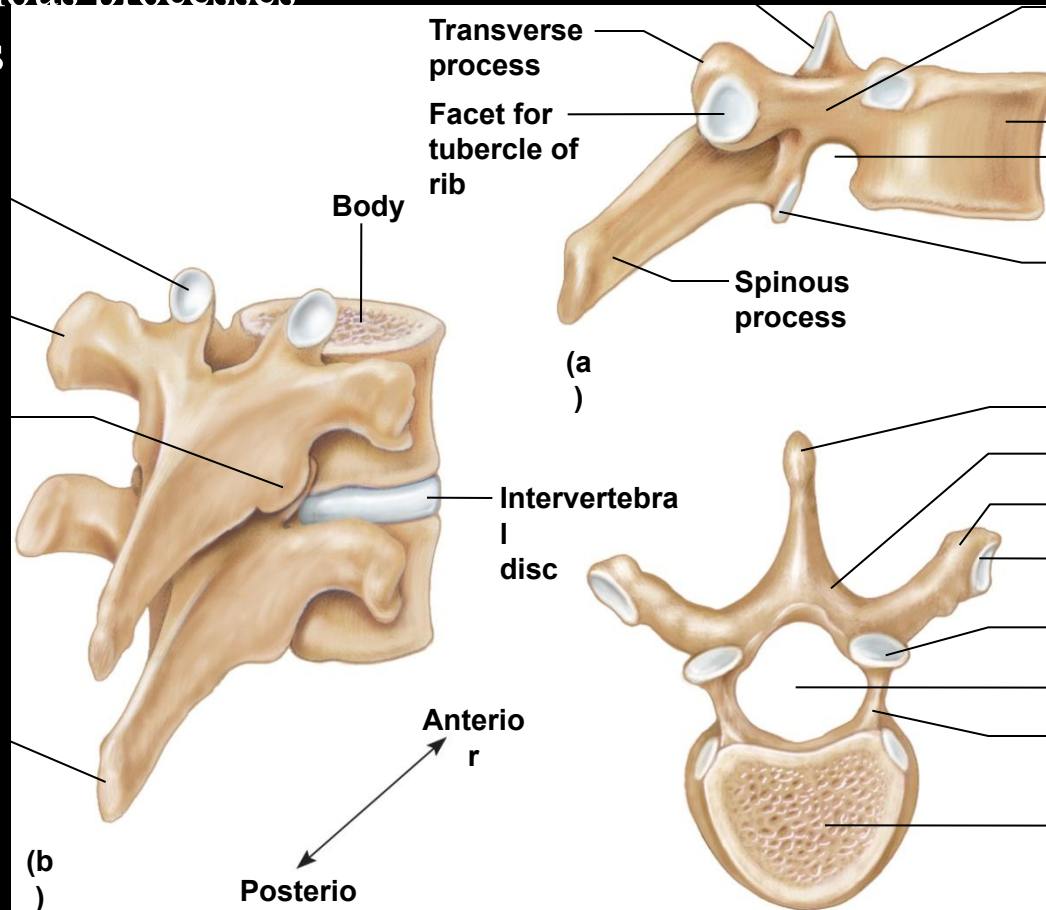
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THORACIC VERTEBRAE

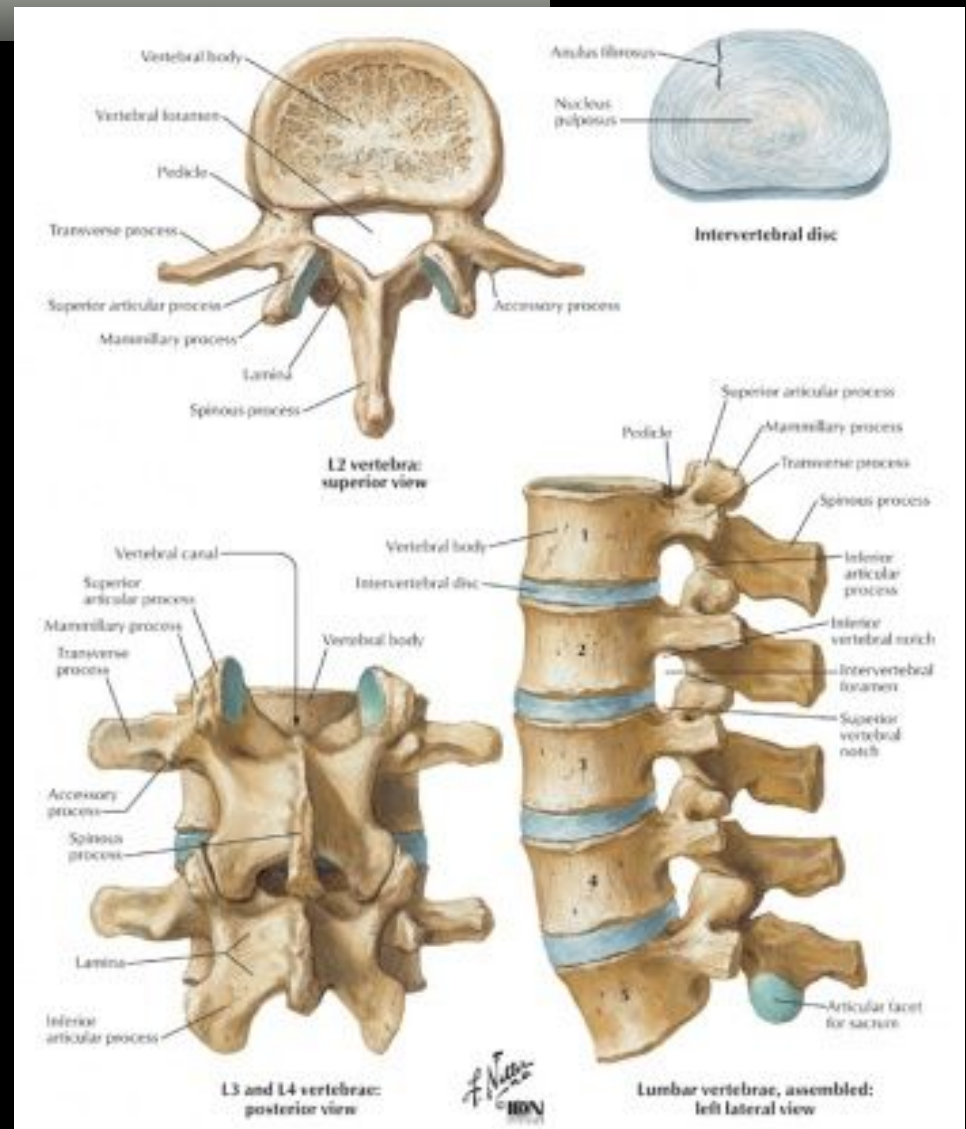
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- Long spinous processes
- Rib facets



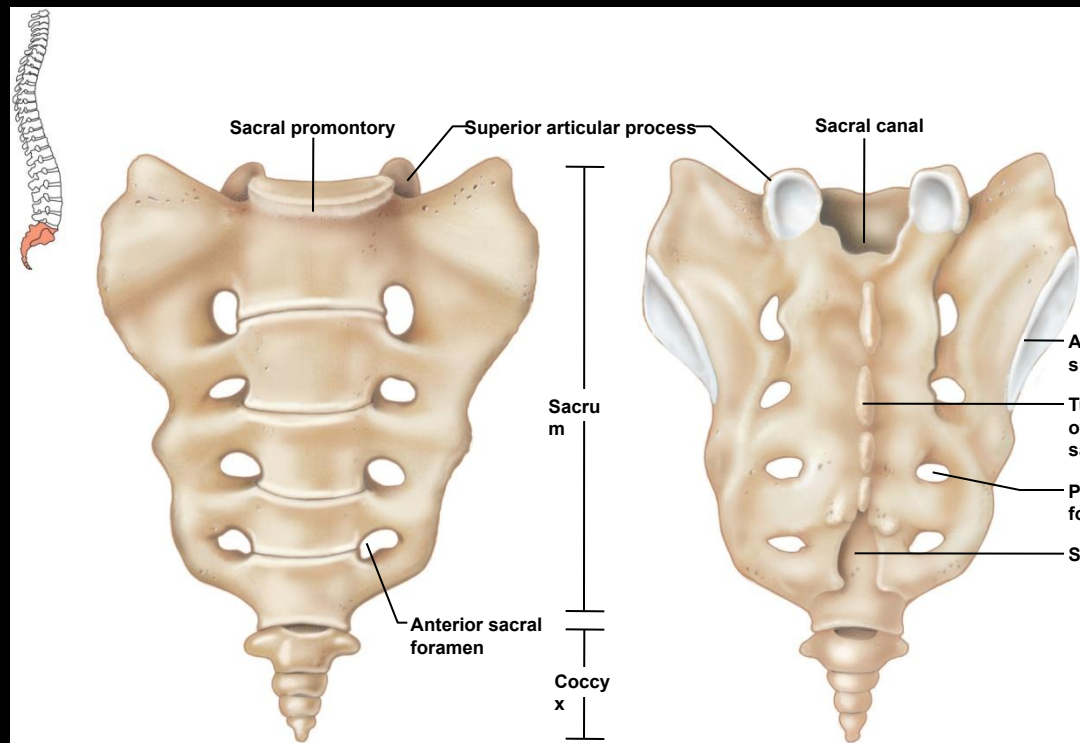
LUMBAR VERTEBRAE

- Large bodies
- Thick, short spinous processes



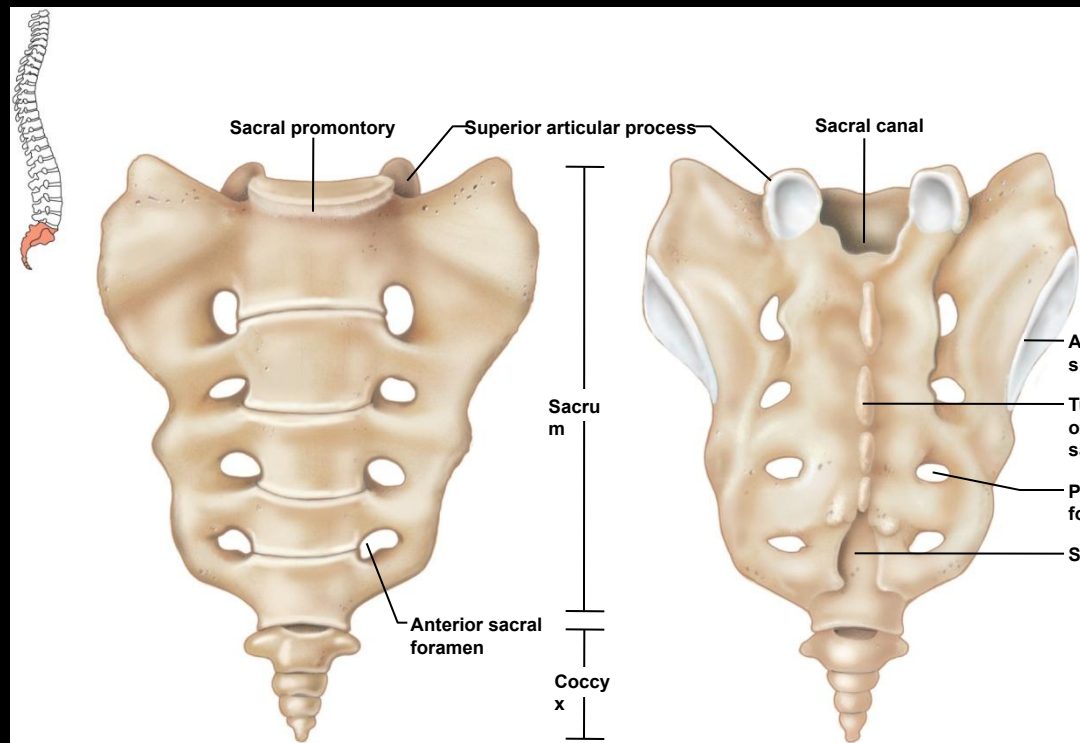
SACRUM

- 4-5 fused segments
- Median sacral crest
- Posterior sacral foramina
- Posterior wall of pelvic cavity
- Sacral promontory aka base
- Area toward coccyx is the apex



COCCYX

- 3-4 fused segments

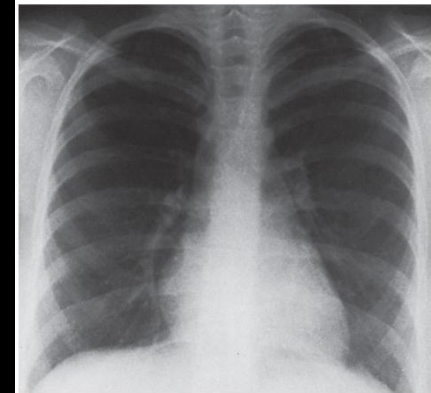
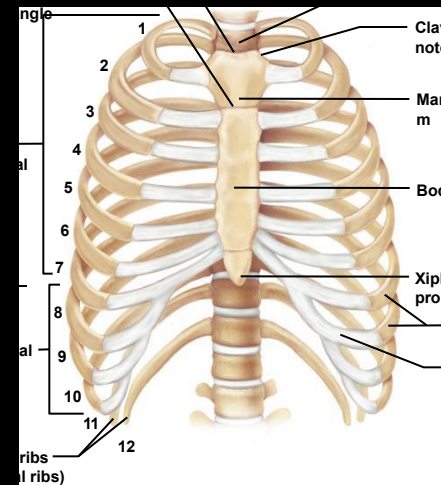


THORACIC CAGE

- The thoracic cage includes the ribs, the thoracic vertebrae, the sternum, and the costal cartilages that attach the ribs to the sternum.

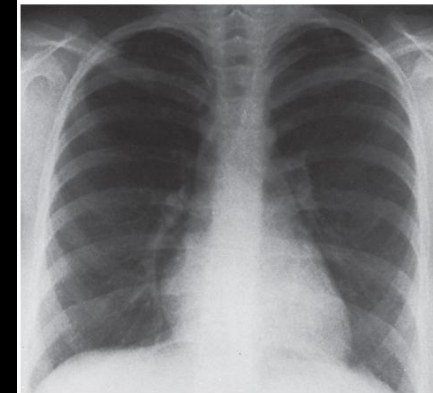
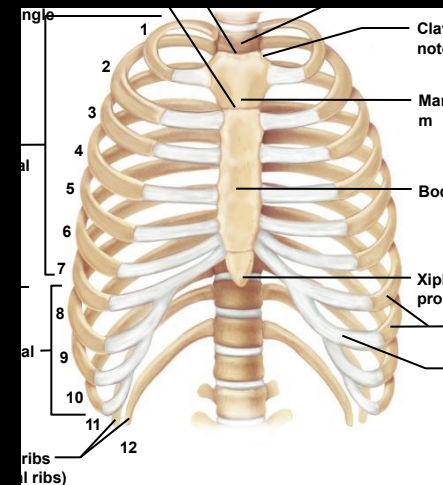
THORACIC CAGE

- Ribs (12)
- Sternum
- Thoracic vertebrae (12)
- Costal cartilages
- Supports shoulder girdle and upper limbs
- Protects viscera
- Role in breathing



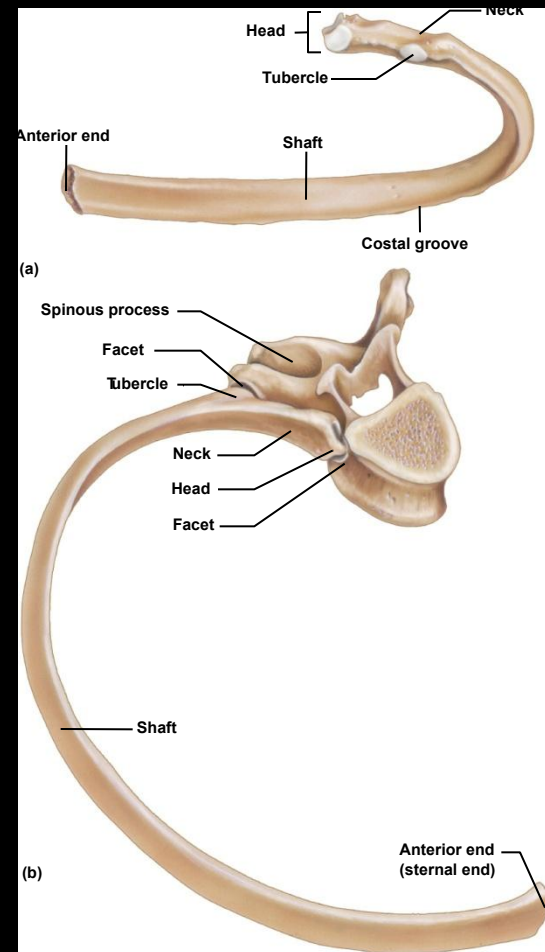
RIBS

- Humans have 12 pairs of ribs:
 - True ribs (7)
 - False ribs (5), of which:
 - Floating (2)
- There are some anomalies:
 - Cervical ribs
 - Lumbar ribs



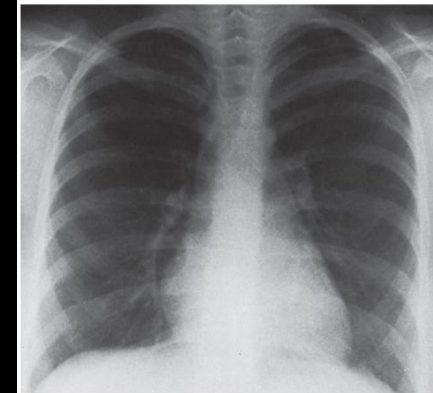
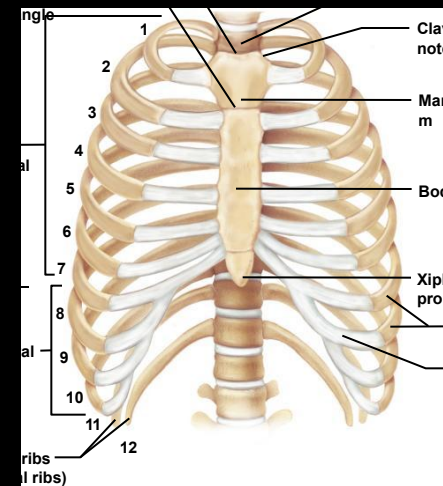
RIB STRUCTURE

- Shaft
- Head – posterior end; articulates with vertebrae
- Tubercle – articulates with vertebrae
- Costal cartilage – hyaline cartilage



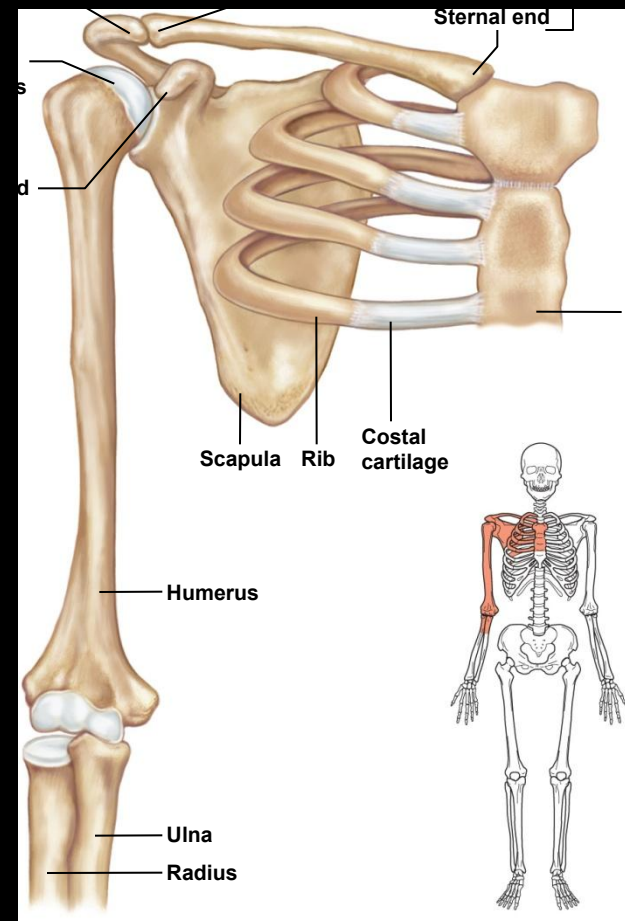
STERNUM

- Three (3) parts of the sternum:
 - Manubrium
 - Body
 - Xiphoid process



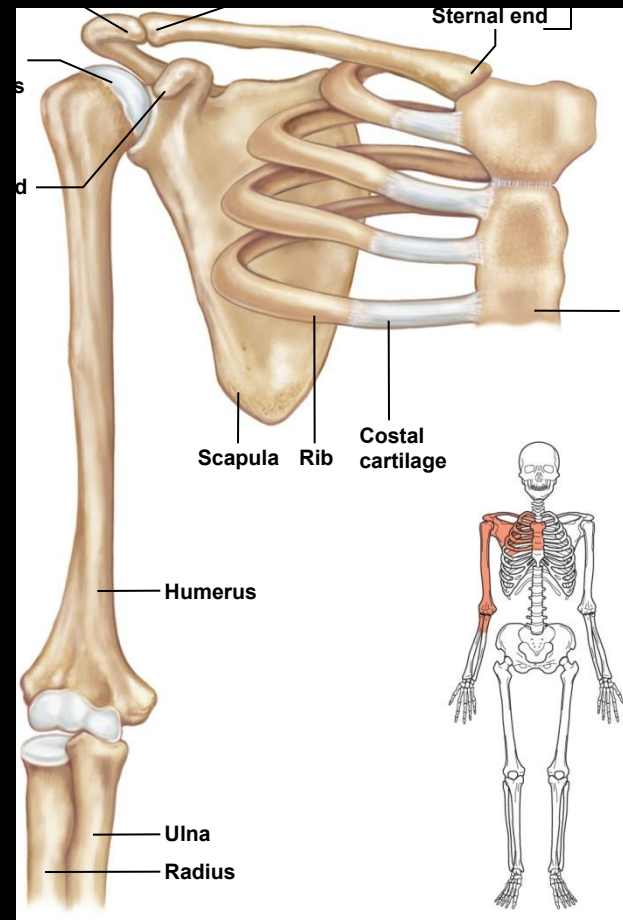
PECTORAL GIRDLE

- Also known as the shoulder girdle
- Clavicles
- Scapulae
- Supports upper limbs
- True shoulder joint is simply the articulation of the humerus and scapula



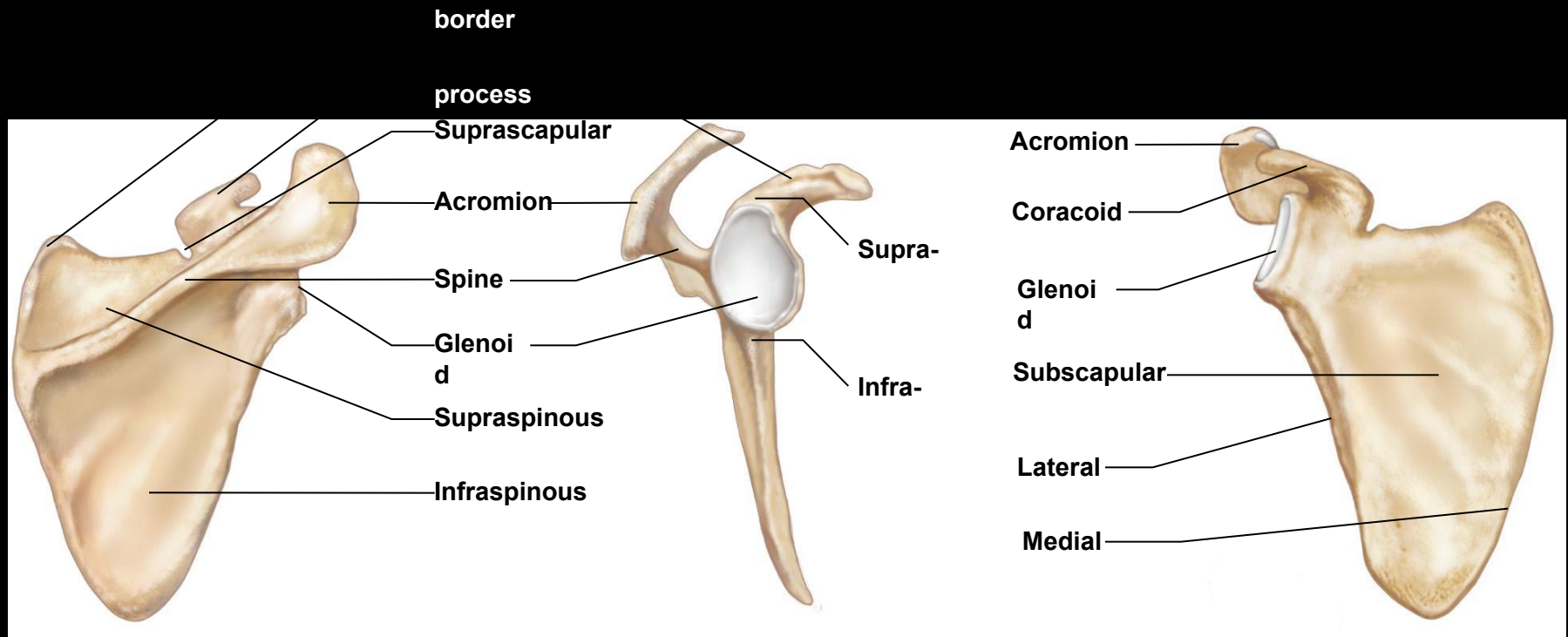
CLAVICLES

- Articulate with manubrium
- Articulate with scapulae (acromion process)
- A-C joint



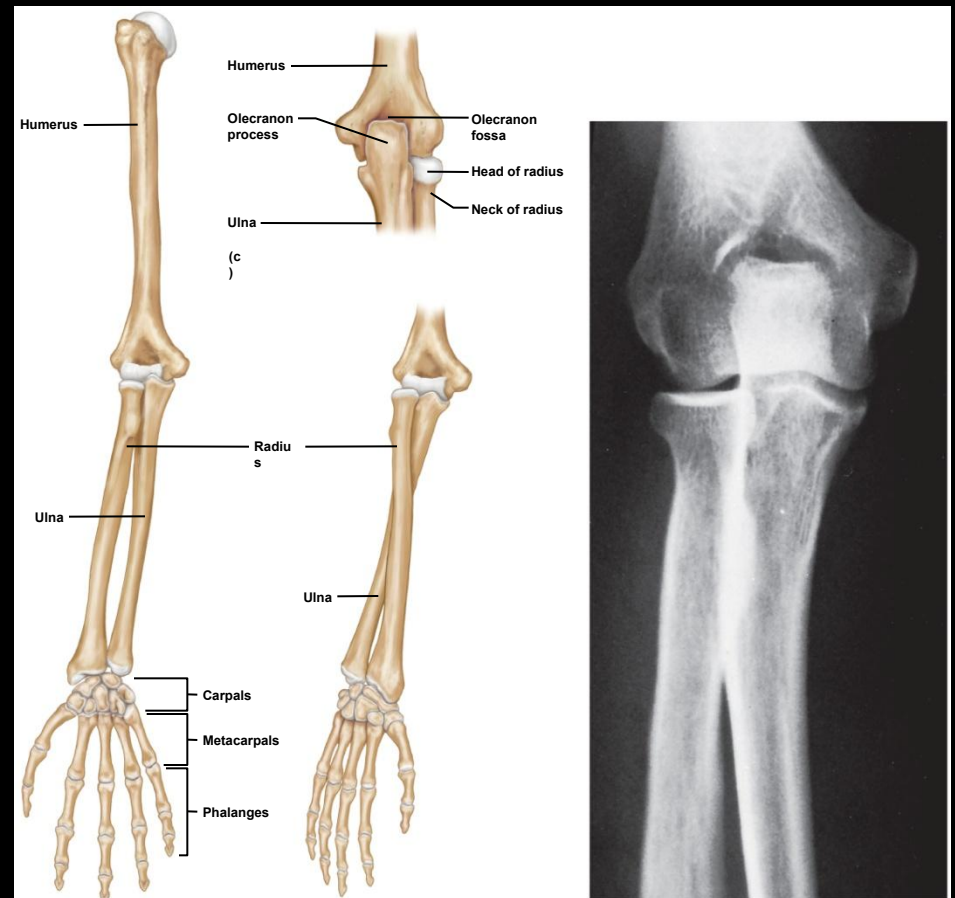
SCAPULAE

- Spine
- Supraspinous fossa
- Infraspinous fossa
- Acromion process
- Coracoid process
- Glenoid fossa or cavity



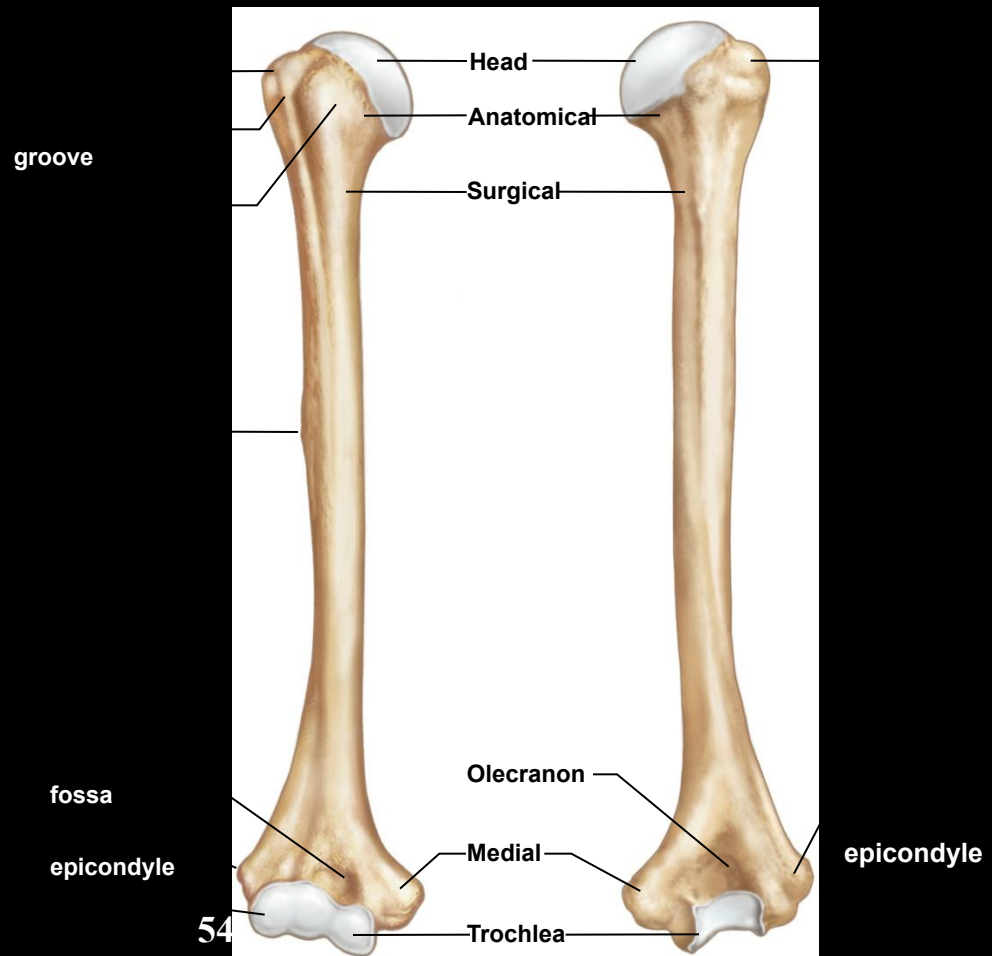
UPPER LIMB

- Humerus
- Radius
- Ulna
(Interosseous membrane)
- Carpals
- Metacarpals
- Phalanges



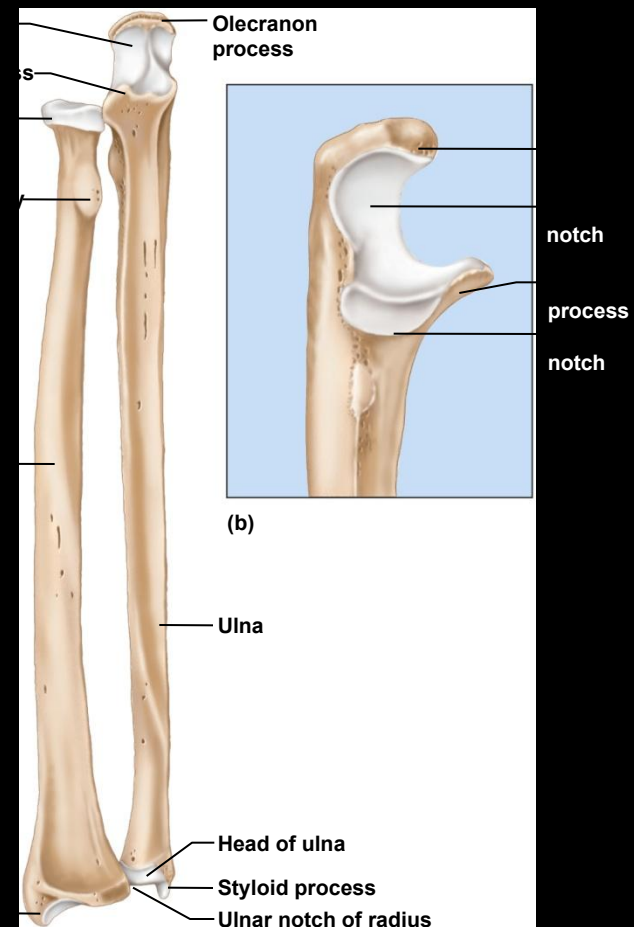
HUMERUS

- Head
- Greater tubercle
- Lesser tubercle
- Anatomical neck
- Surgical neck
- Deltoid tuberosity
- Capitulum
- Trochlea
- Coronoid fossa
- Olecranon fossa



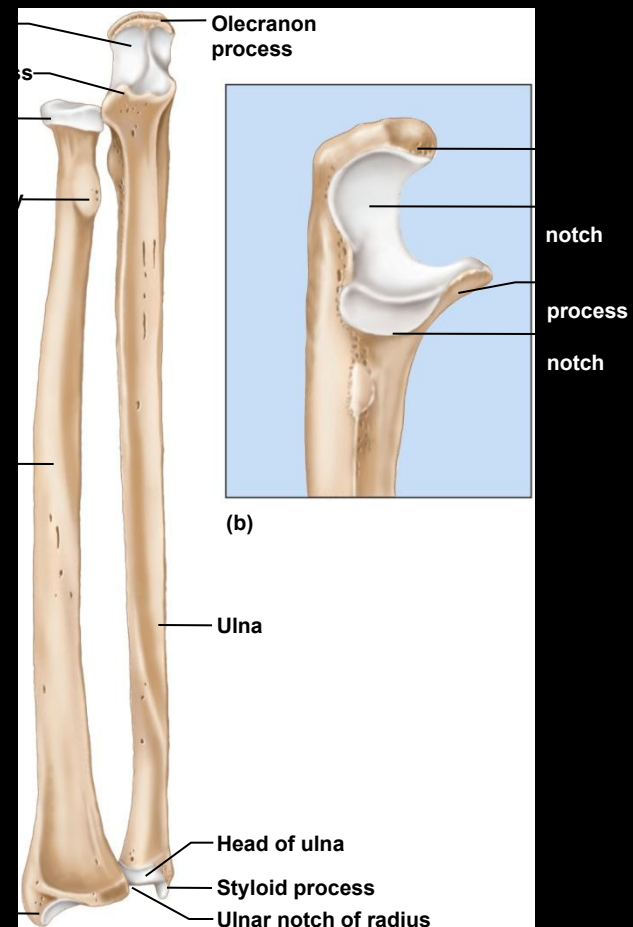
RADIUS

- Lateral forearm bone
- Head
- Radial tuberosity
- Styloid process



ULNA

- Medial forearm bone
- Trochlear notch
- Olecranon process
- Coronoid process
- Styloid process



WRIST AND HAND

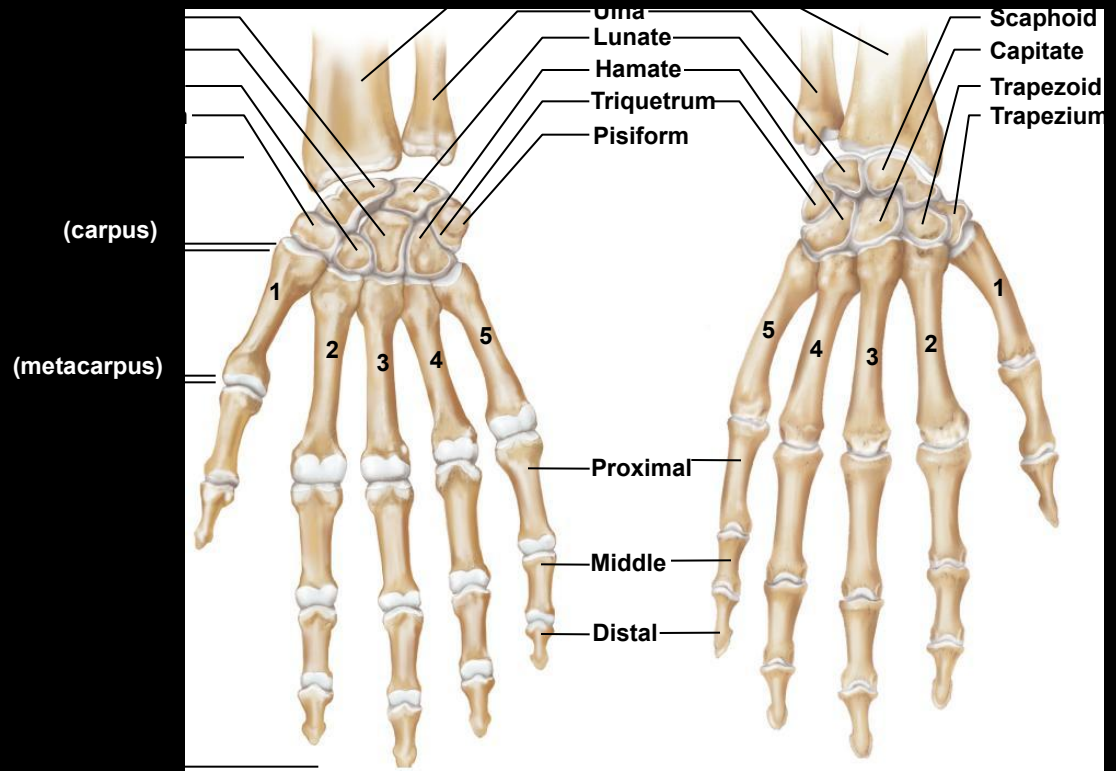
- **Carpal Bones** (16 total bones)

- Scaphoid
- Lunate
- Triquetral
- Pisiform
- Hamate
- Capitate
- Trapezoid
- Trapezium

- **Metacarpal Bones** (10)

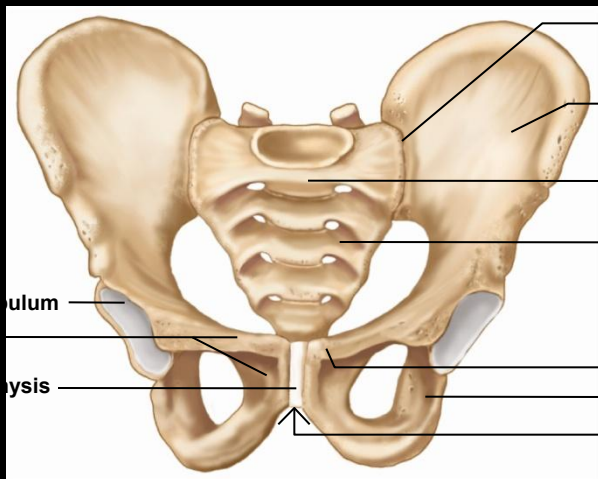
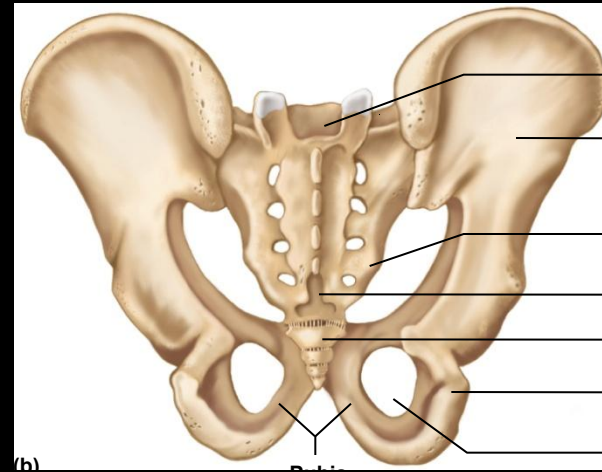
- **Phalangeal Bones** (28)

- Proximal phalanx
- Middle phalanx
- Distal phalanx



PELVIC GIRDLE

- Coxal Bones (2)
 - Supports trunk of body
 - Protects viscera
 - Forms pelvic cavity



HIP BONES

- Also known as the coxae:
 - Acetabulum
 - There are three (3) bones:

1. Ilium

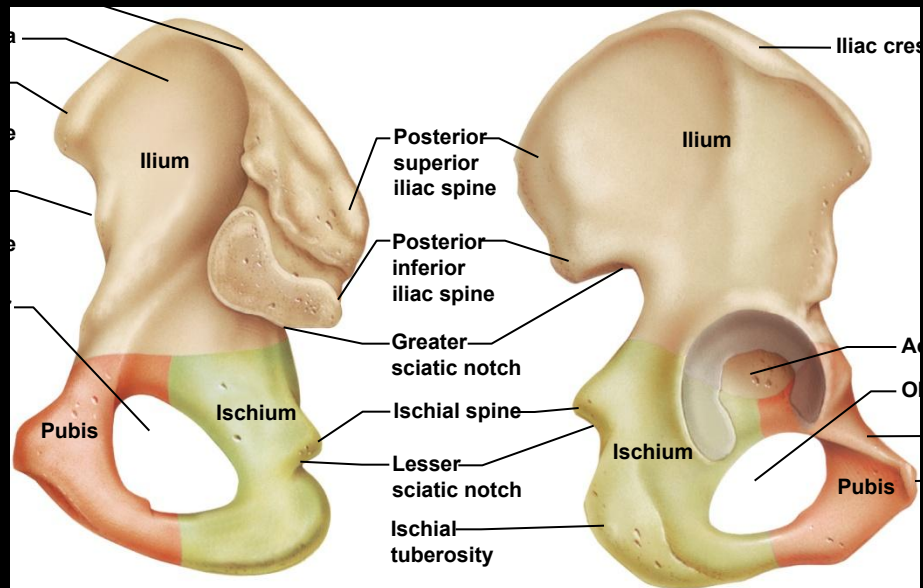
- Iliac crest
- Iliac spines
- Greater sciatic notch

2. Ischium

- Ischial spines
- Lesser sciatic notch
- Ischial tuberosity

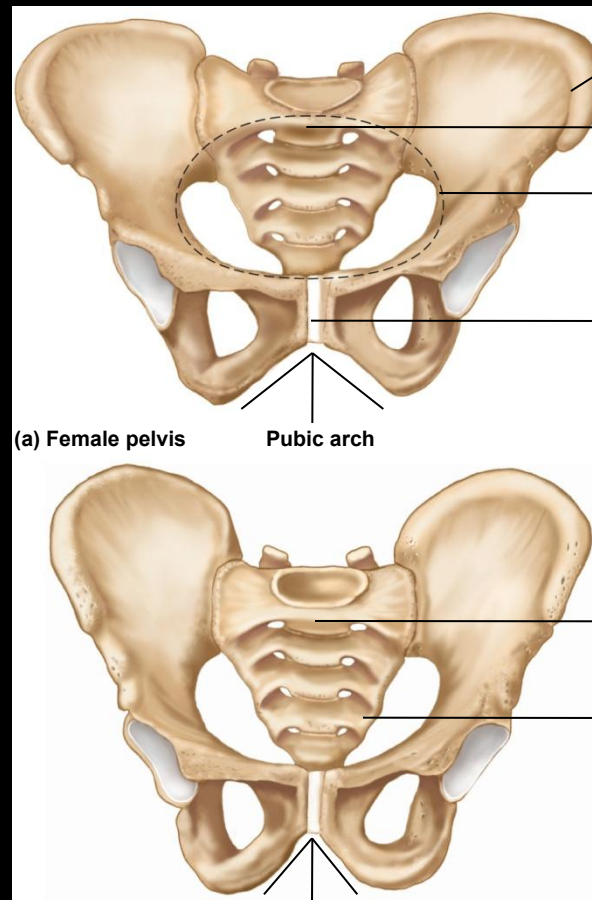
3. Pubis

- Obturator foramen
- Symphysis pubis
- Pubic arch



GREATER AND LESSER PELVES

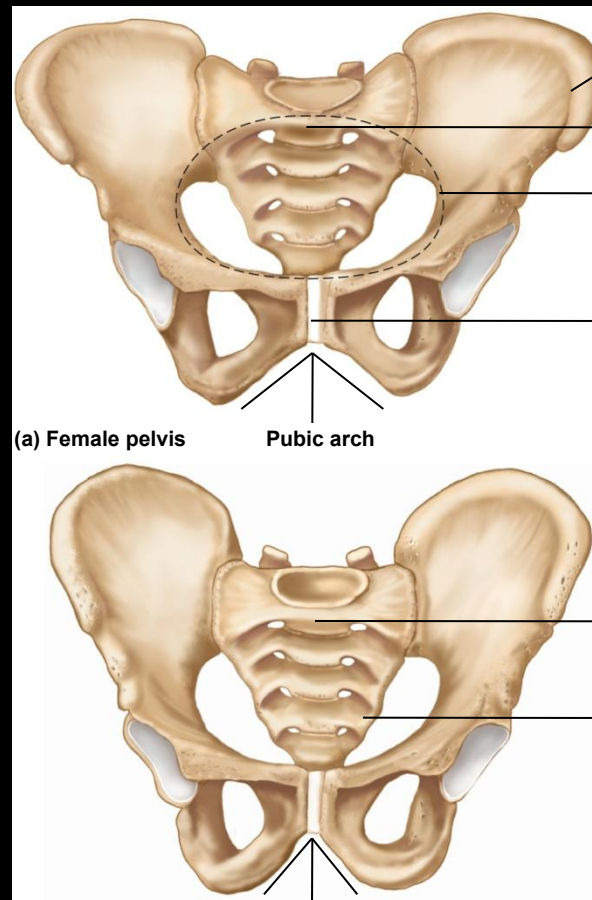
- **Greater Pelvis**
 - Lumbar vertebrae posteriorly
 - Iliac bones laterally
 - Abdominal wall anteriorly
- **Lesser Pelvis**
 - Sacrum and coccyx posteriorly
 - Lower ilium, ischium, and pubic bones laterally and anteriorly



DIFFERENCES BETWEEN MALE FEMALE PELTS

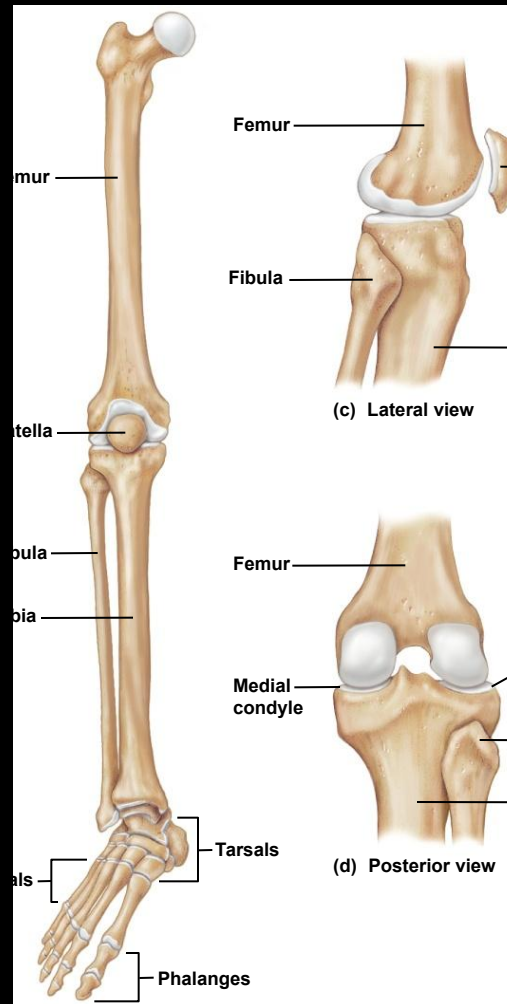
- Female pelvis

- Iliac bones more flared
- Broader hips
- Pubic arch angle greater
- More distance between ischial spines and ischial tuberosities
- Sacral curvature shorter and flatter
- Lighter bones
- Why?



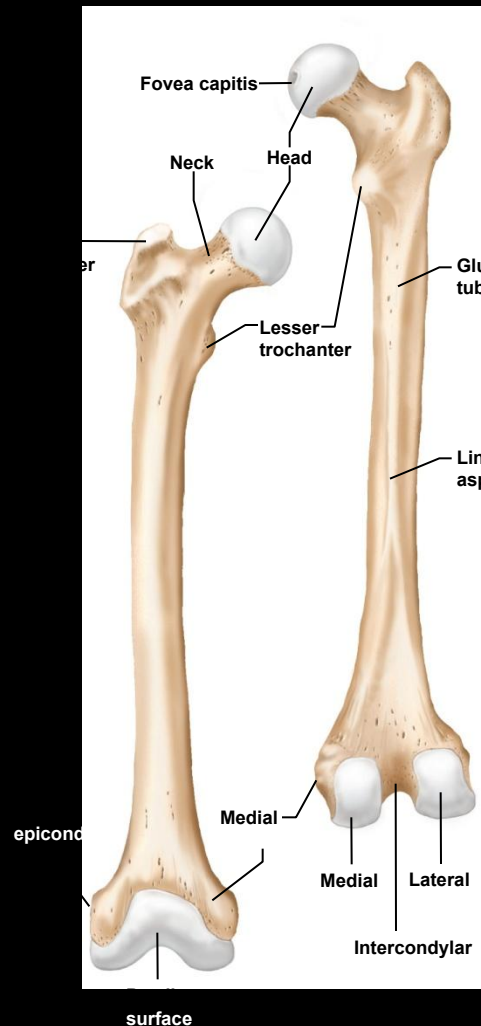
LOWER LIMB

- Femur
- Patella
- Tibia
- Fibula
- Tarsals
- Metatarsals
- Phalanges



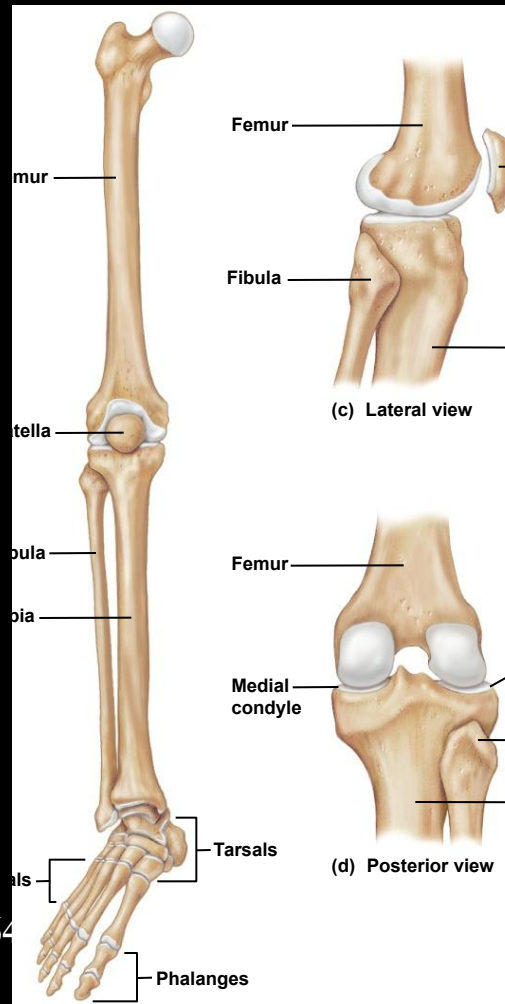
FEMUR

- Longest bone of body
- Head
- Fovea capitis
- Neck
- Greater trochanter
- Lesser trochanter
- Linea aspera
- Condyles
- Epicondyles



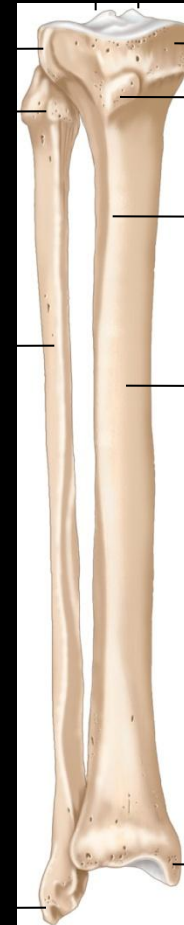
PATELLA

- Anterior surface of the knee joint
- Flat sesamoid bone located in the quadriceps tendon



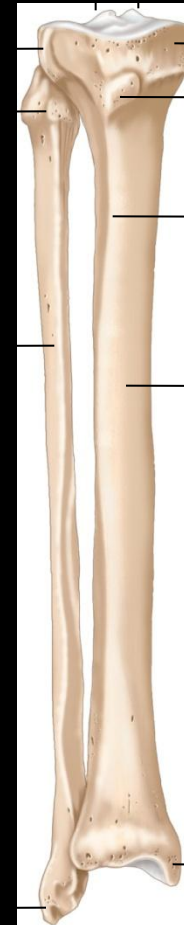
TIBIA

- Medial to fibula
- Condyles
- Tibial tuberosity
- Makes the medial malleolus



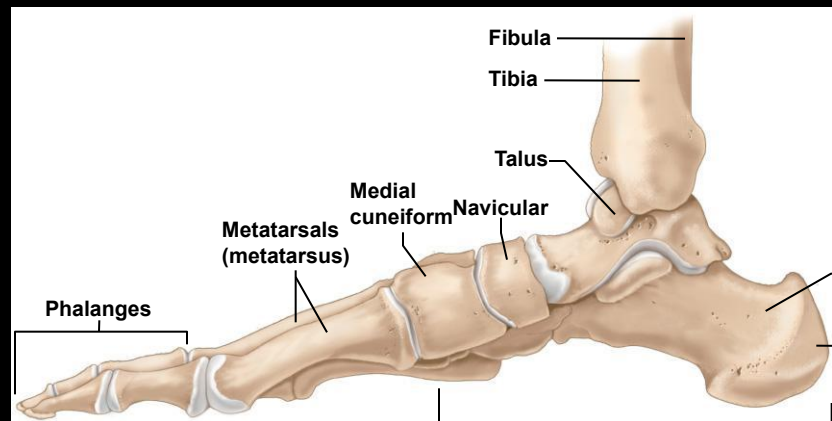
FIBULA

- Lateral to tibia
- Long, slender
- Head
- Makes the lateral malleolus
- Non-weight bearing

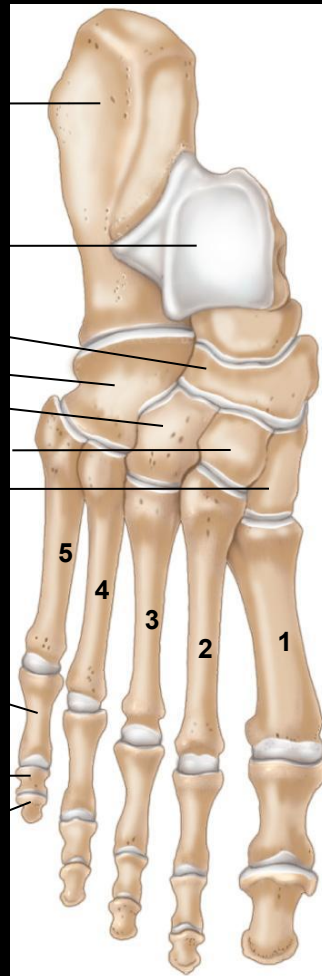


FOOT

- Tarsal Bones (14)
 - Calcaneus
 - Talus
 - Navicular
 - Cuboid
 - Lateral (3rd) cuneiform
 - Intermediate (2nd) cuneiform
 - Medial (1st) cuneiform
- Metatarsal Bones (10)
- Phalanges (28)
 - Proximal
 - Middle
 - Distal



FOOT



LIFESPAN CHANGES

- Decrease in height at about age 30
- Calcium levels fall
- Bones become brittle
- Osteoclasts outnumber osteoblasts
- Spongy bone weakens before compact bone
- Bone loss rapid in menopausal women
- Hip fractures common
- Vertebral compression fractures common

Joints

- Articulations of bones
- Functions of joints
 - Hold bones together
 - Allow for mobility
- Ways joints are classified
 - Functionally
 - Structurally

Functional Classification of Joints

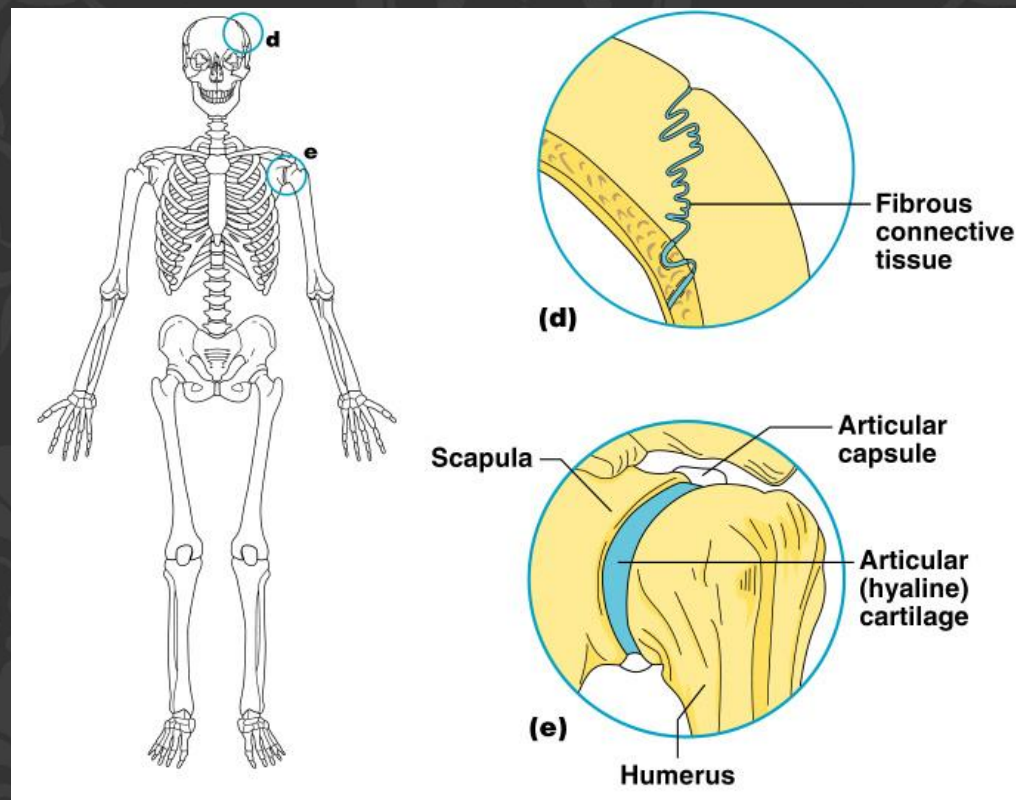
- Synarthroses – immovable joints
- Amphiarthroses – slightly moveable joints
- Diarthroses – freely moveable joints

Structural Classification of Joints

- Fibrous joints
 - Generally immovable
- Cartilaginous joints
 - Immovable or slightly moveable
- Synovial joints
 - Freely moveable

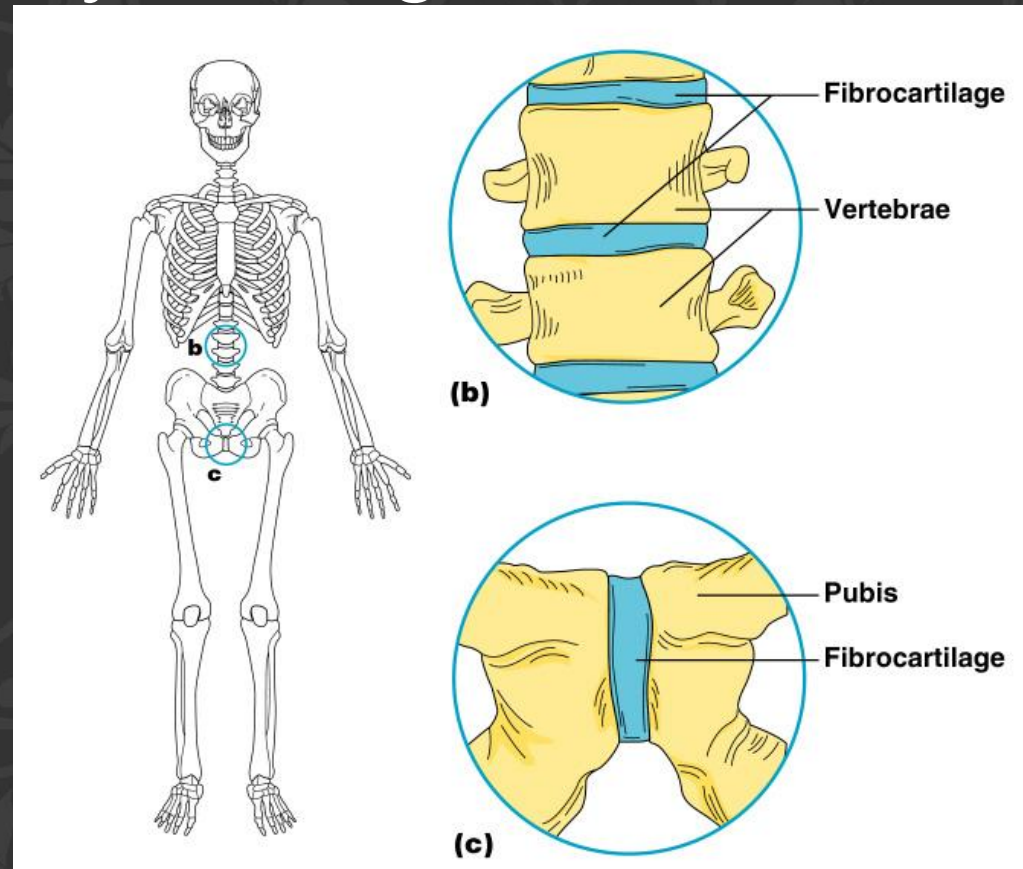
Fibrous Joints

- Bones united by fibrous tissue – synarthrosis or largely immovable.



Cartilaginous Joints – mostly amphiarthrosis

- Bones connected by cartilage
- Examples
 - Pubic symphysis
 - Intervertebral joints



Synovial Joints

- Articulating bones are separated by a joint cavity
- Synovial fluid is found in the joint cavity

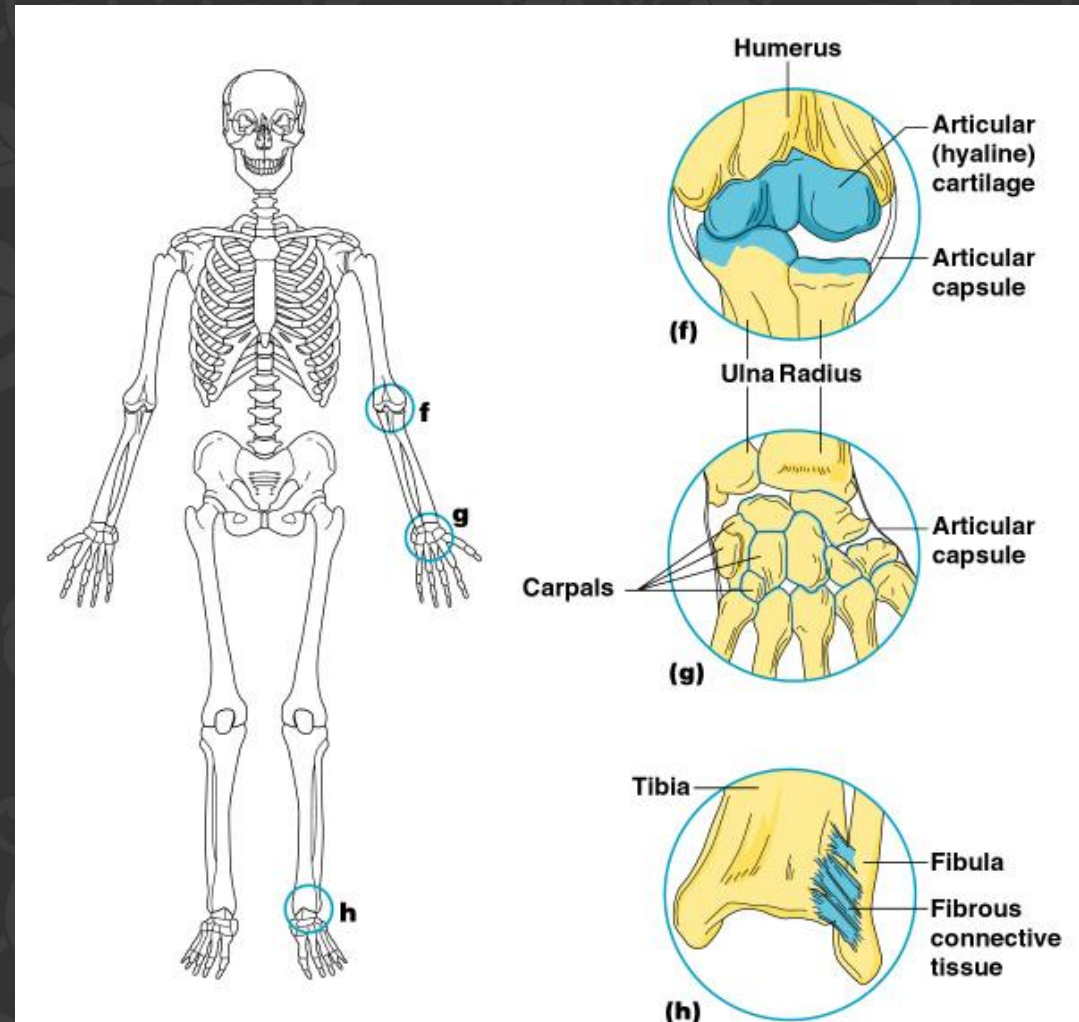


Figure 5.27f-h

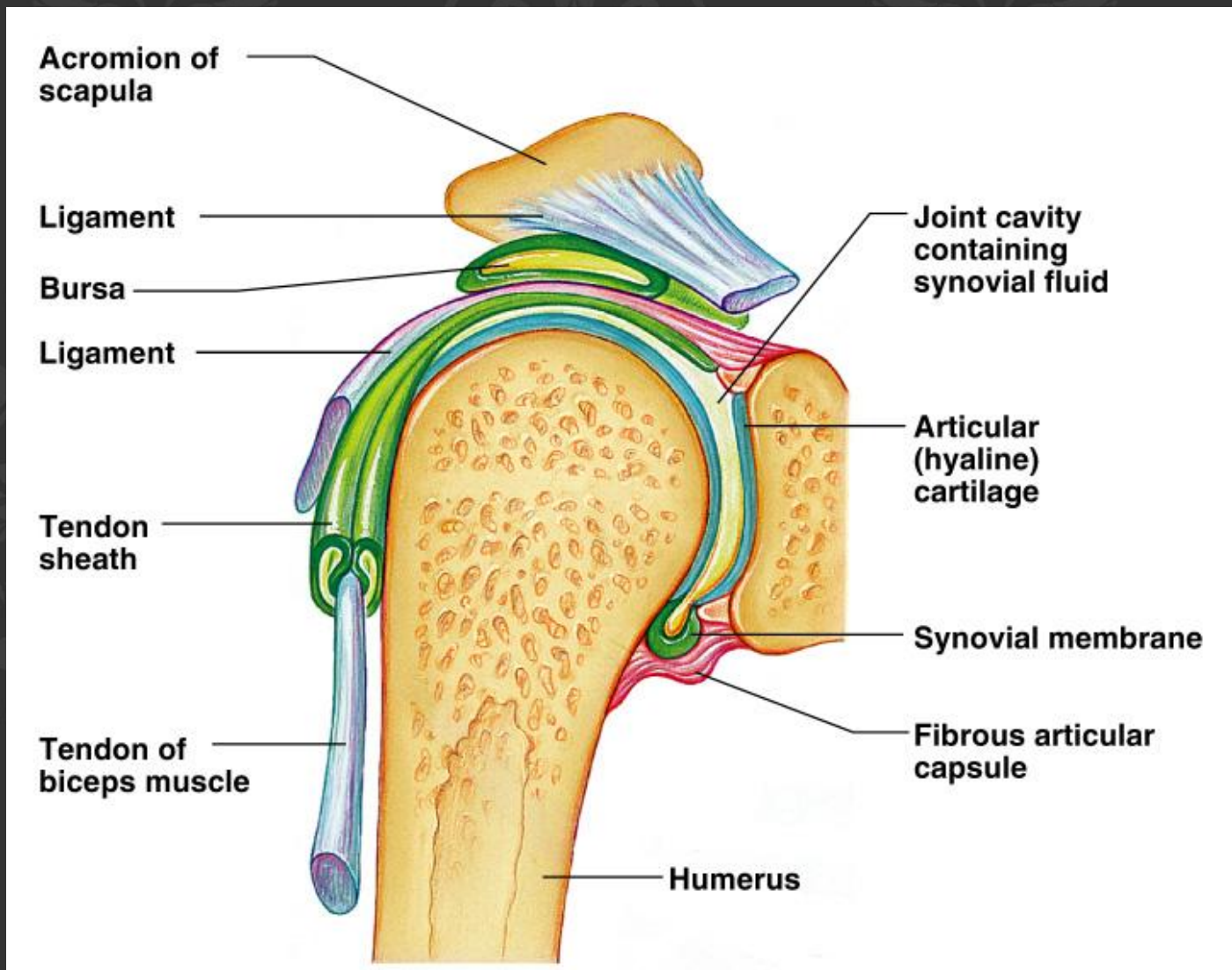
Features of Synovial Joints- Diarthroses

- Articular cartilage (hyaline cartilage) covers the ends of bones
- Joint surfaces are enclosed by a fibrous articular capsule
- Have a joint cavity filled with synovial fluid
- Ligaments reinforce the joint

Structures Associated with the Synovial Joint

- Bursae – flattened fibrous sacs
 - Lined with synovial membranes
 - Filled with synovial fluid
 - Not actually part of the joint
- Tendon sheath
 - Elongated bursa that wraps around a tendon

The Synovial Joint



Types of Synovial Joints Based on Shape

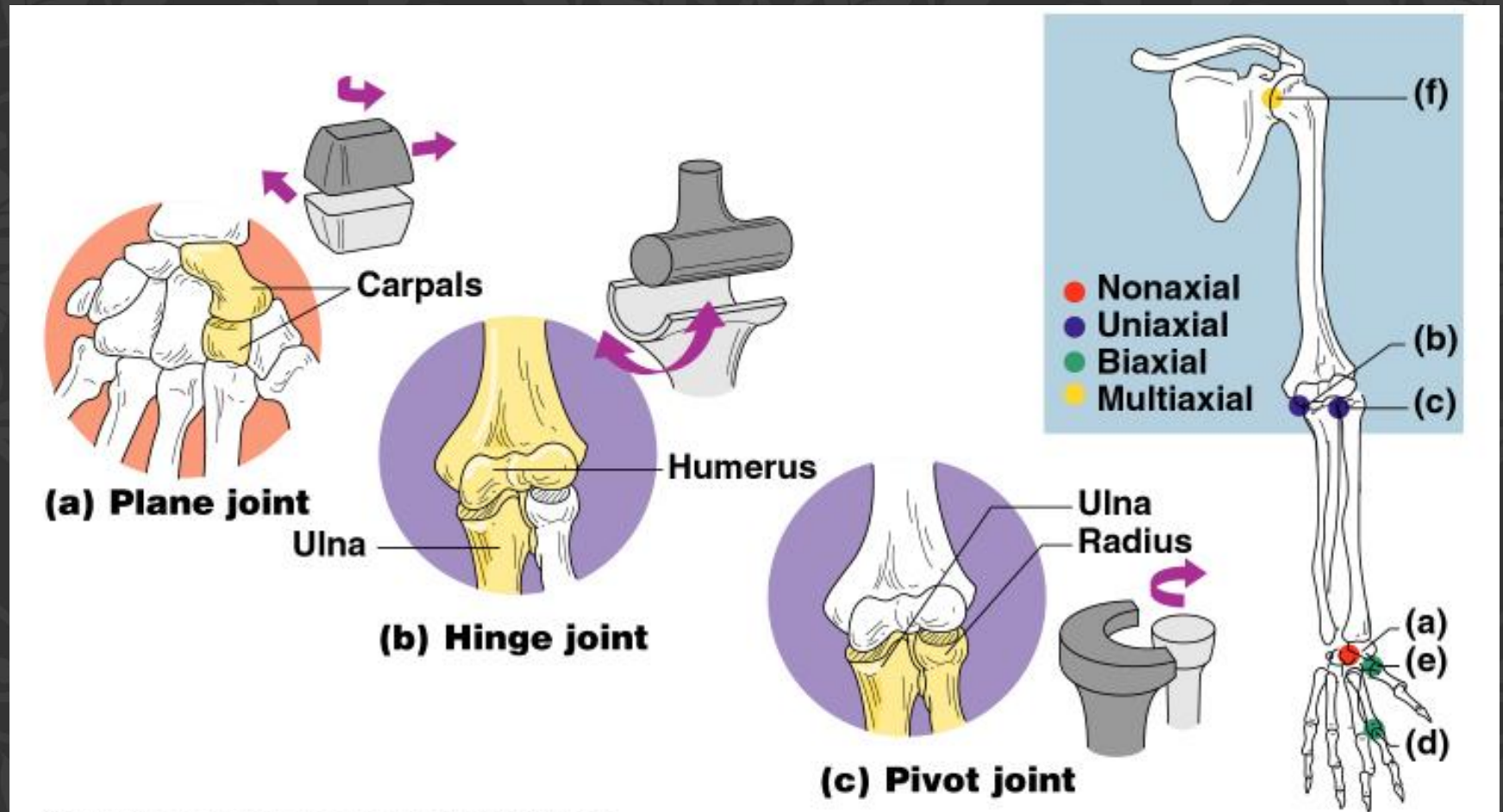


Figure 5.29a-c

Types of Synovial Joints Based on Shape

