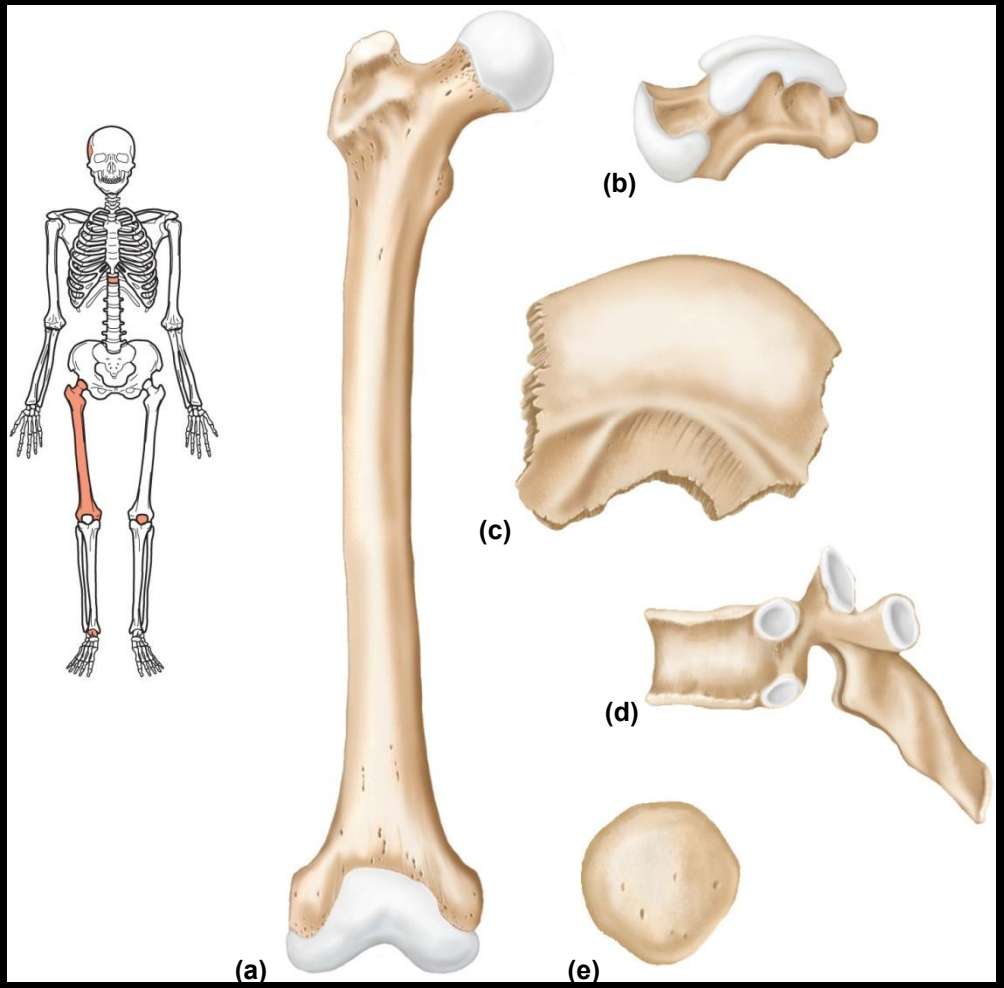
INTRODUCTION

- 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

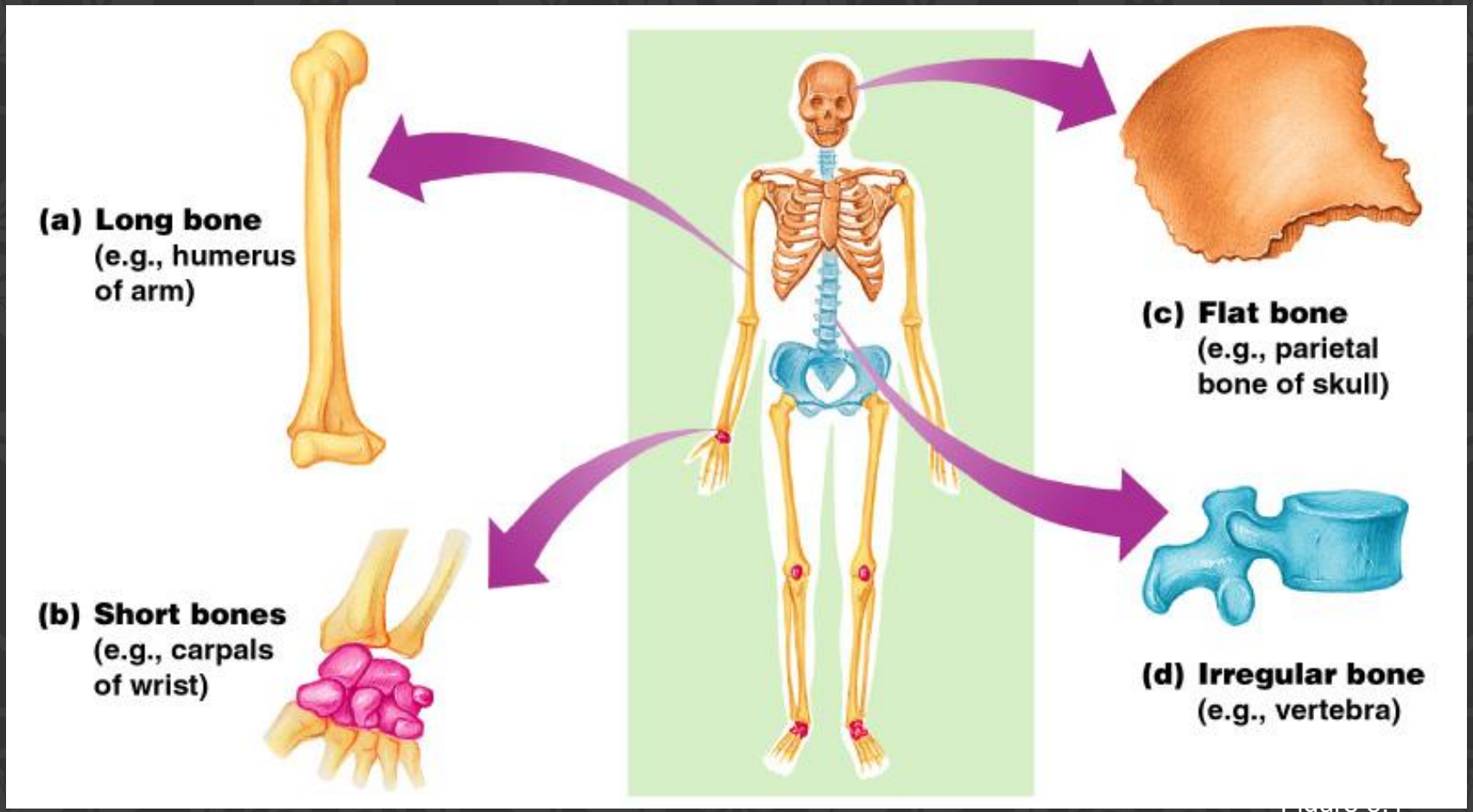


Figure 5.4

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

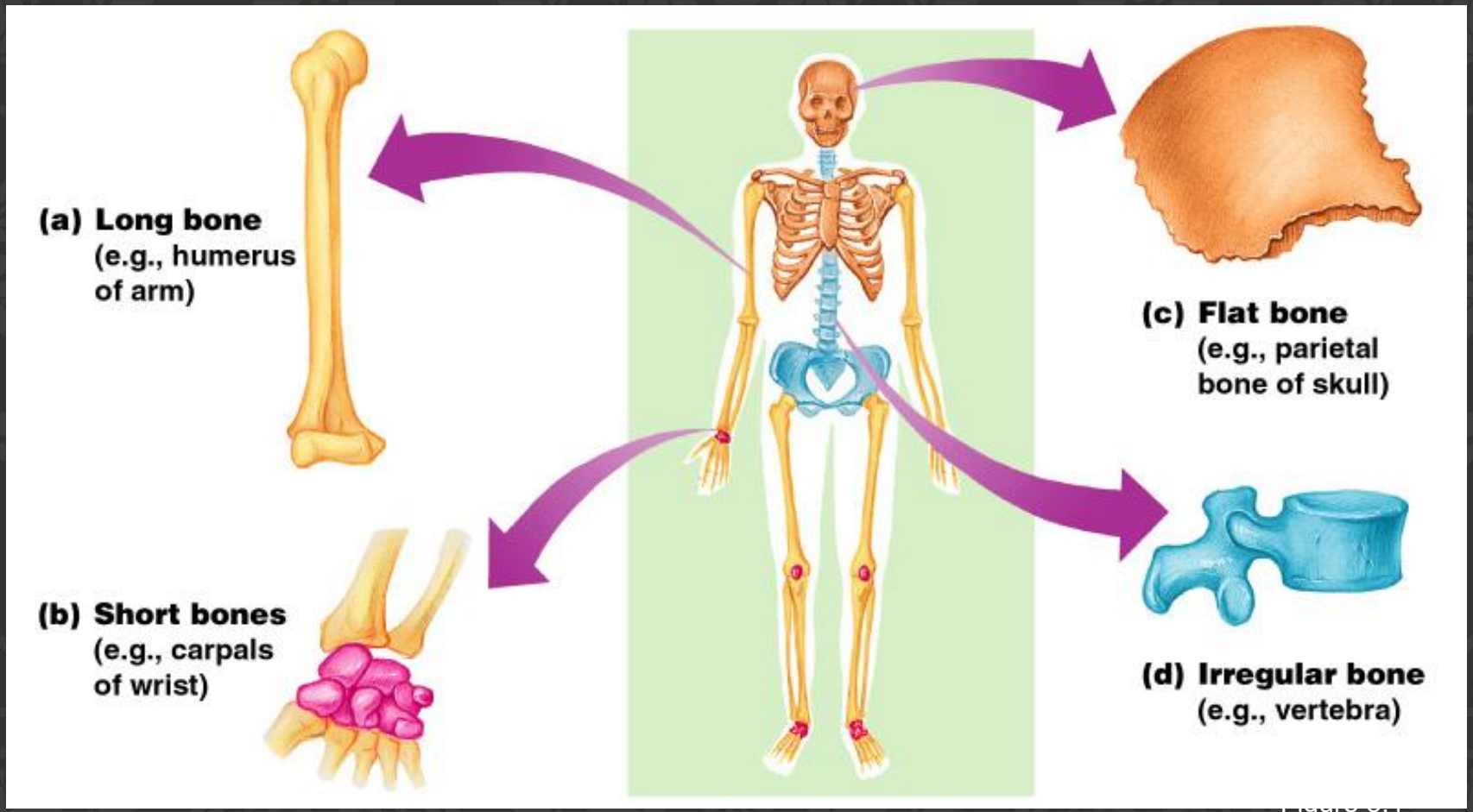
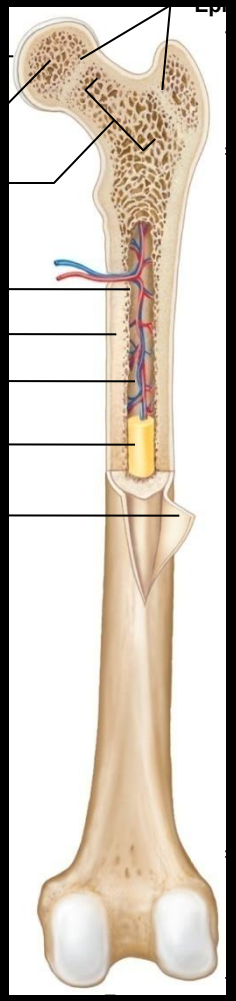


Figure 5.4

PARTS OF A LONG BONE

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

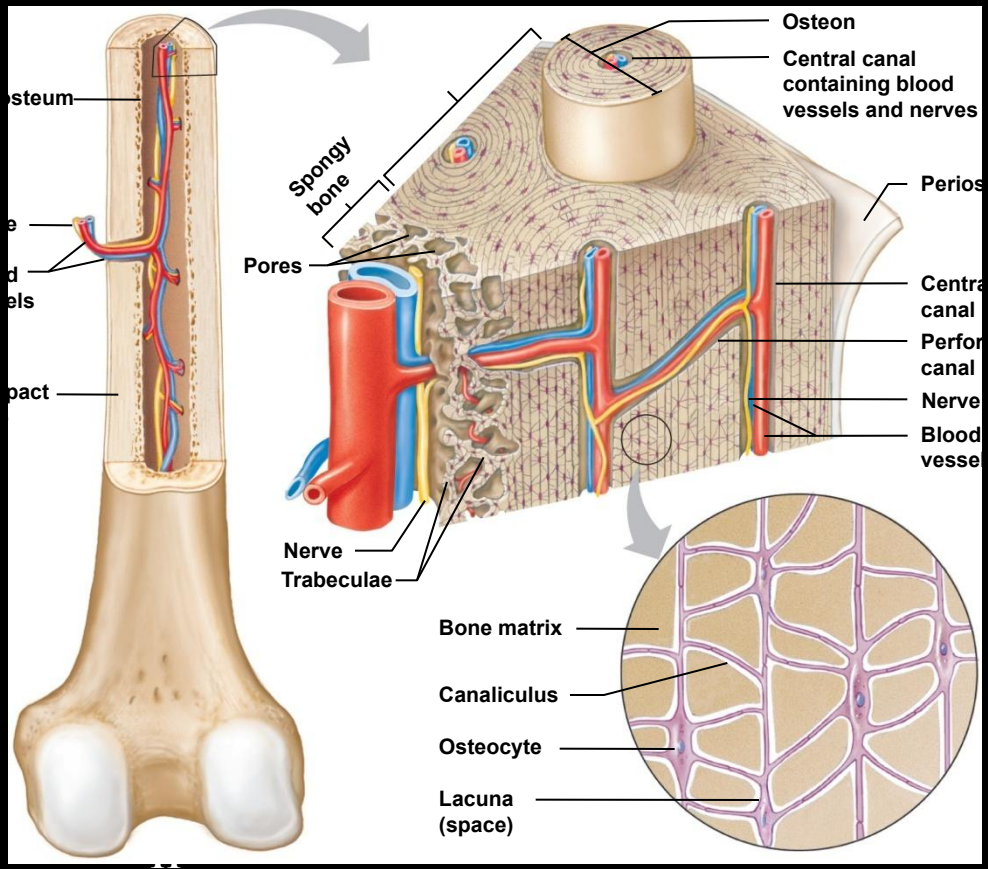


MICROSCOPIC STRUCTURE

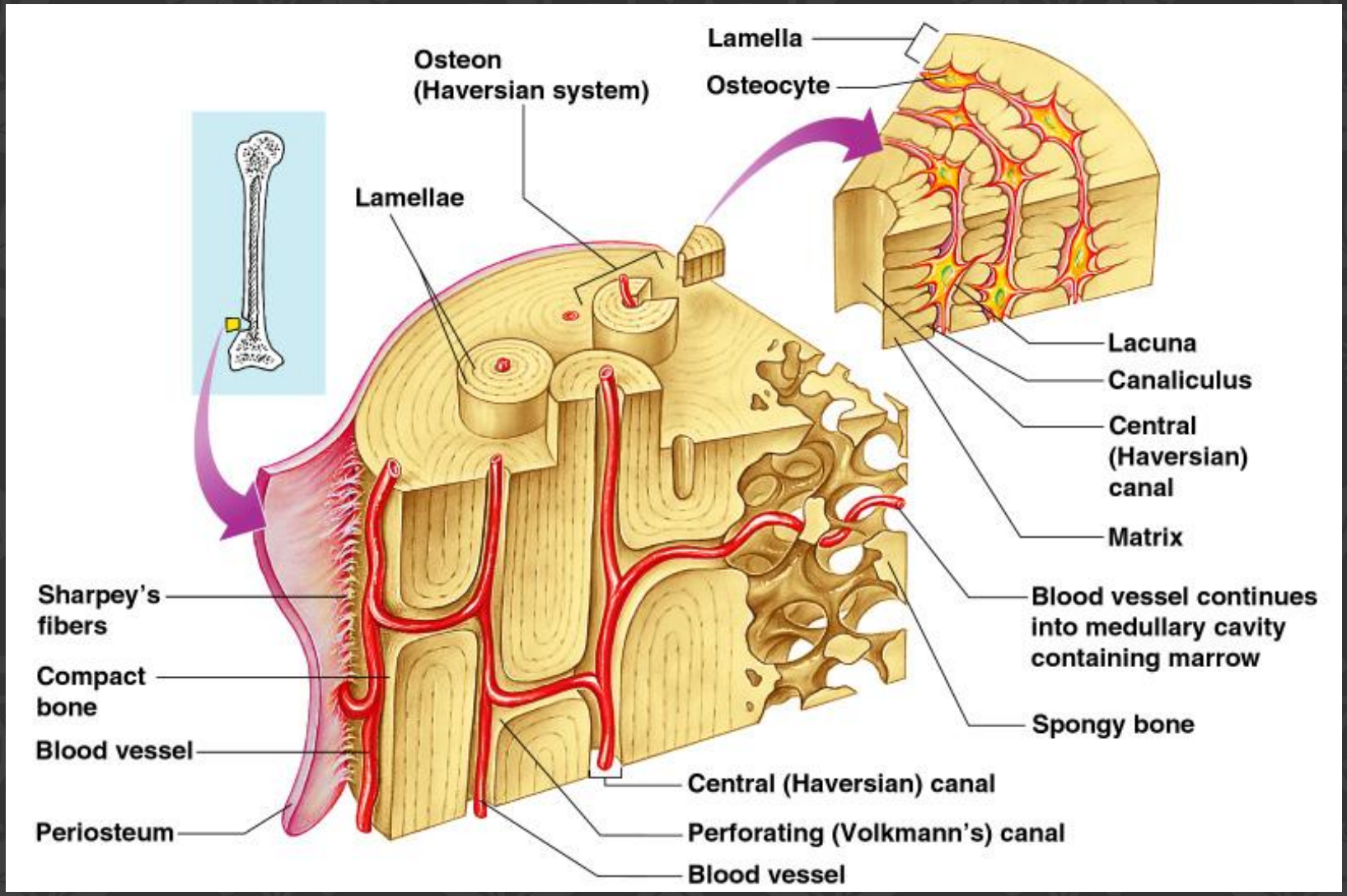
- Bone cells are called osteocytes
  - in a lacuna
- Osteocytes transport nutrients and wastes by cellular processes in canaliculi
- The extracellular matrix of bone is largely collagen and inorganic salts
  - Collagen gives bone resilience & strength
  - Inorganic salts make bone hard

COMPACT BONE

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

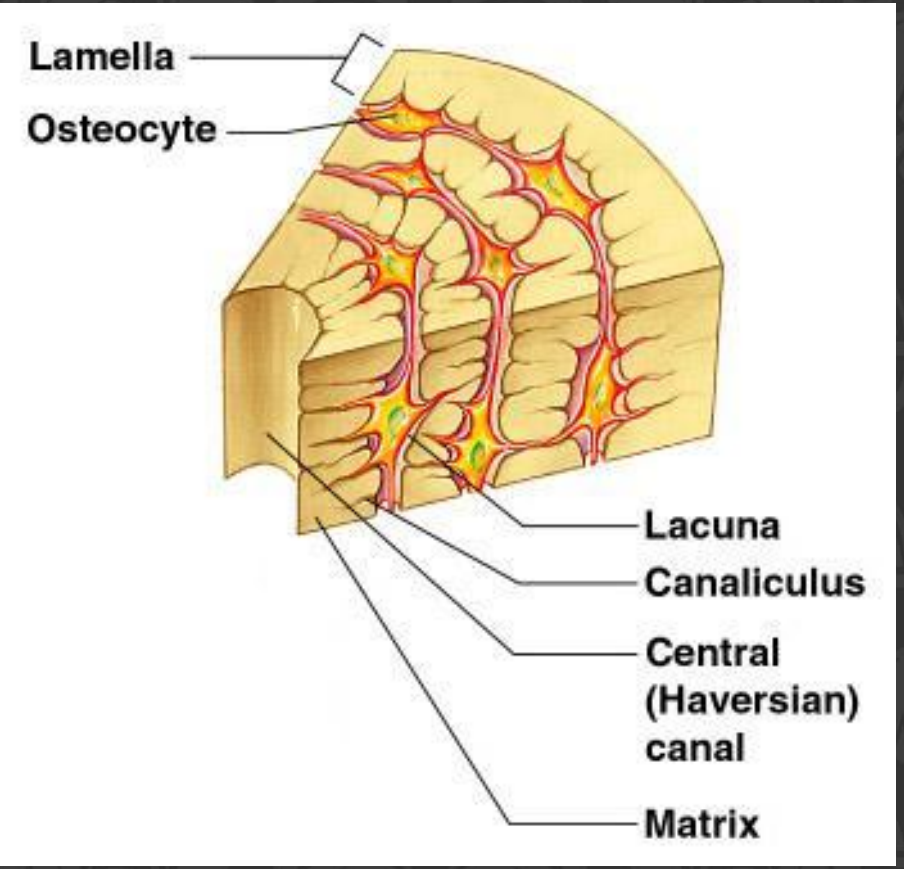


Microscopic Anatomy of Bone



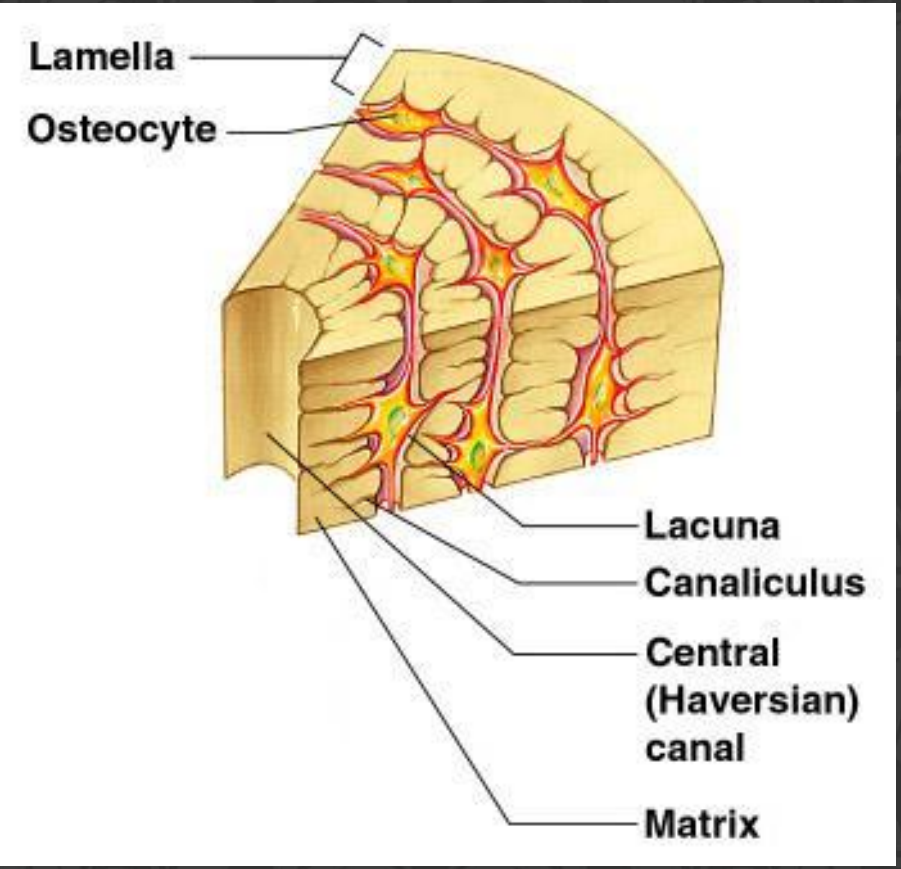
Microscopic Anatomy of Bone

- 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 endchondral bones

INTRAMEMBRANOUS BONES

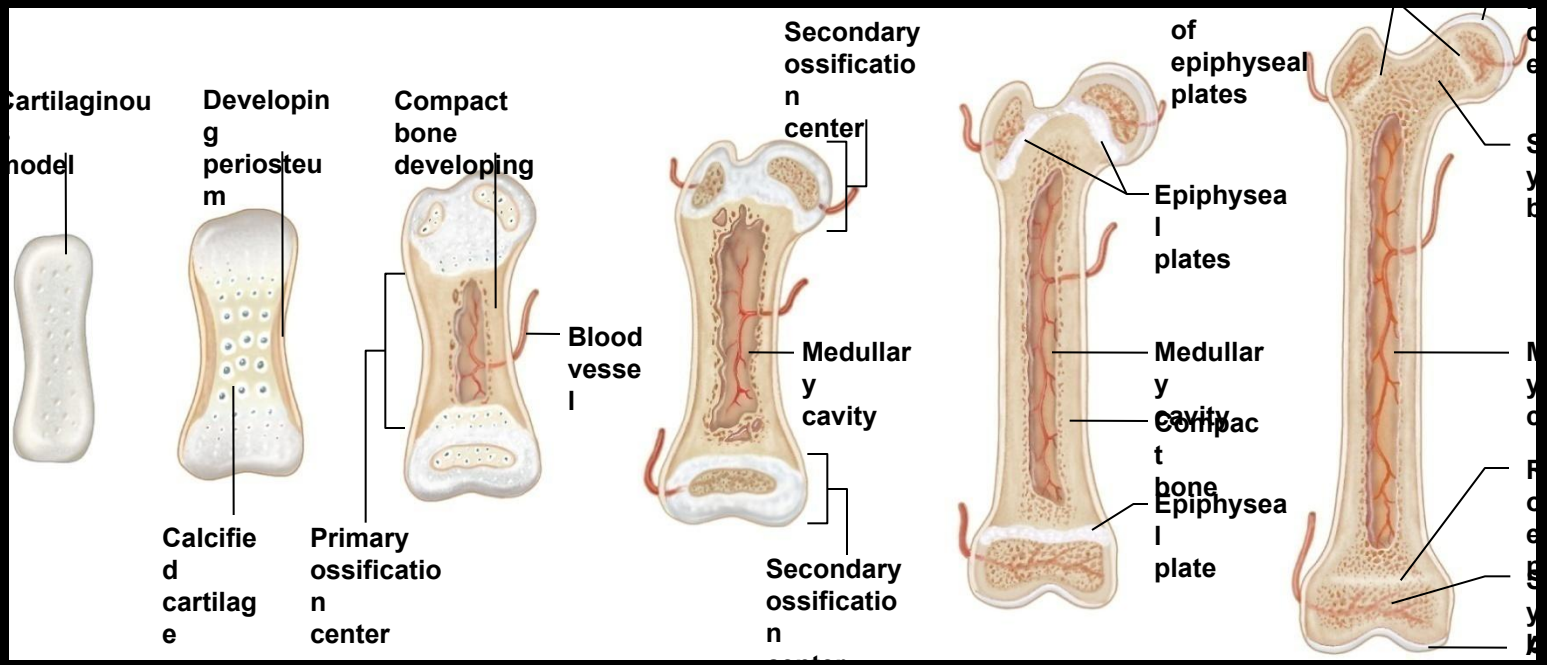
- Intramembranous Bones
  - These bones originate within sheetlike layers of connective tissues
  - They are the broad, flat bones
    - Skull bones (except mandible)
  - Are known as intramembranous bones

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

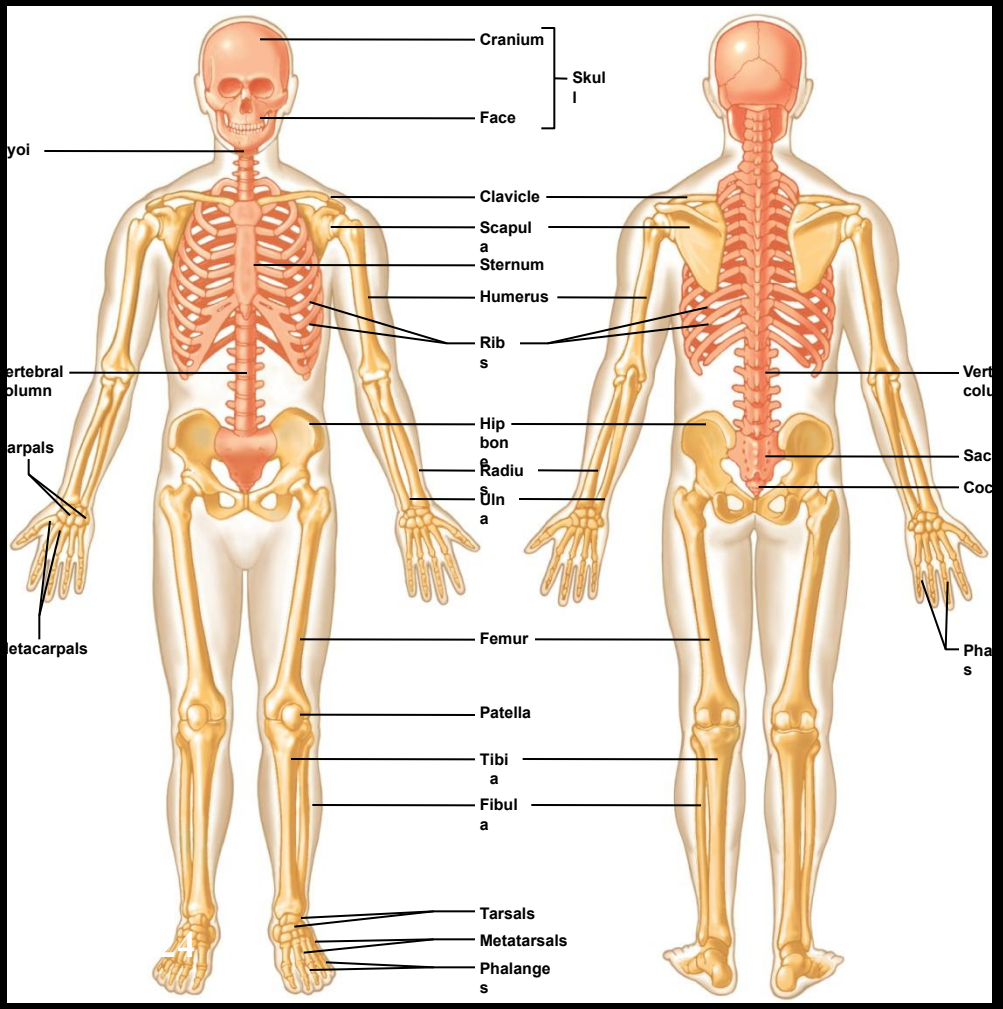
- Inorganic Salt Storage
  - Calcium
  - Phosphate
  - Magnesium
  - Sodium
  - Potassium

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

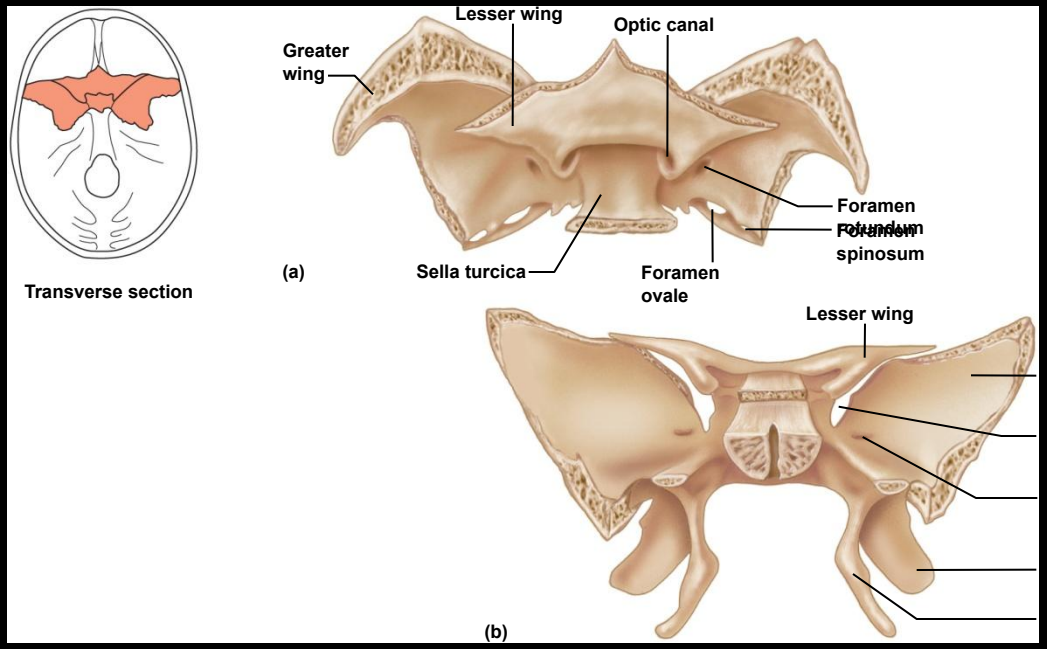


SKULL

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

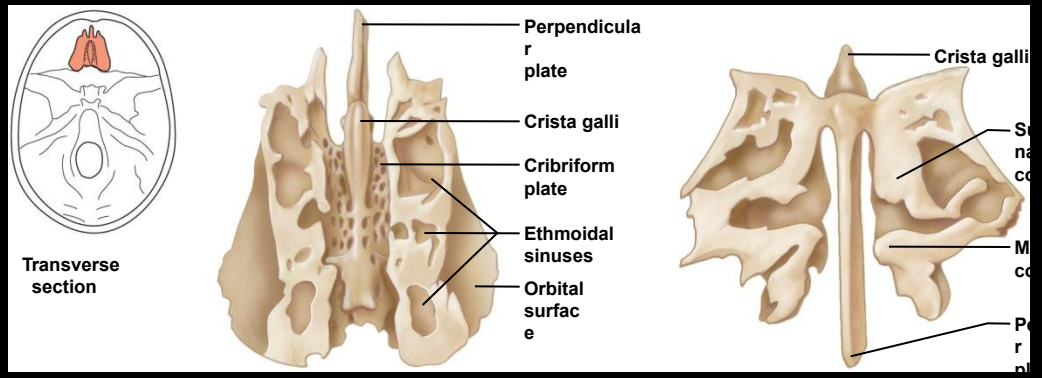
CRANIUM

- Sphenoid Bone (1)
  - Base of cranium
  - Sides of skull
  - Floors and sides of orbits
  - Sella turcica
  - Sphenoid sinuses



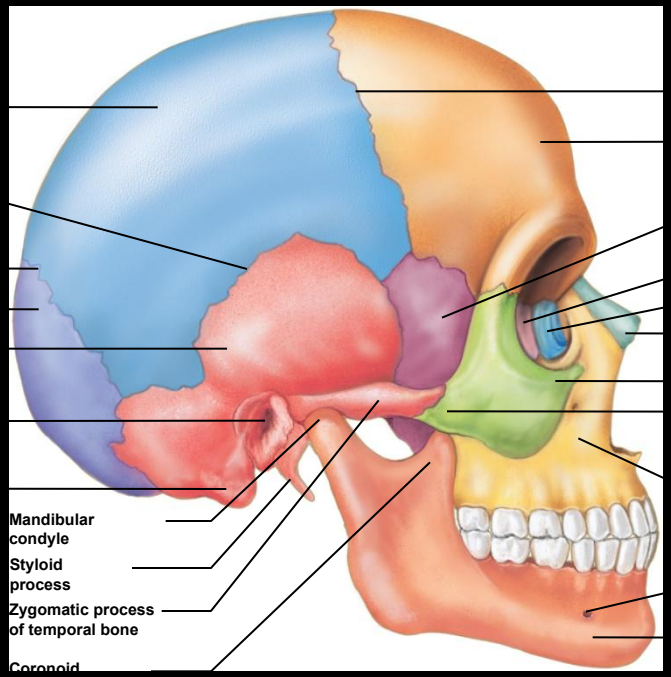
CRANIUM

- 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

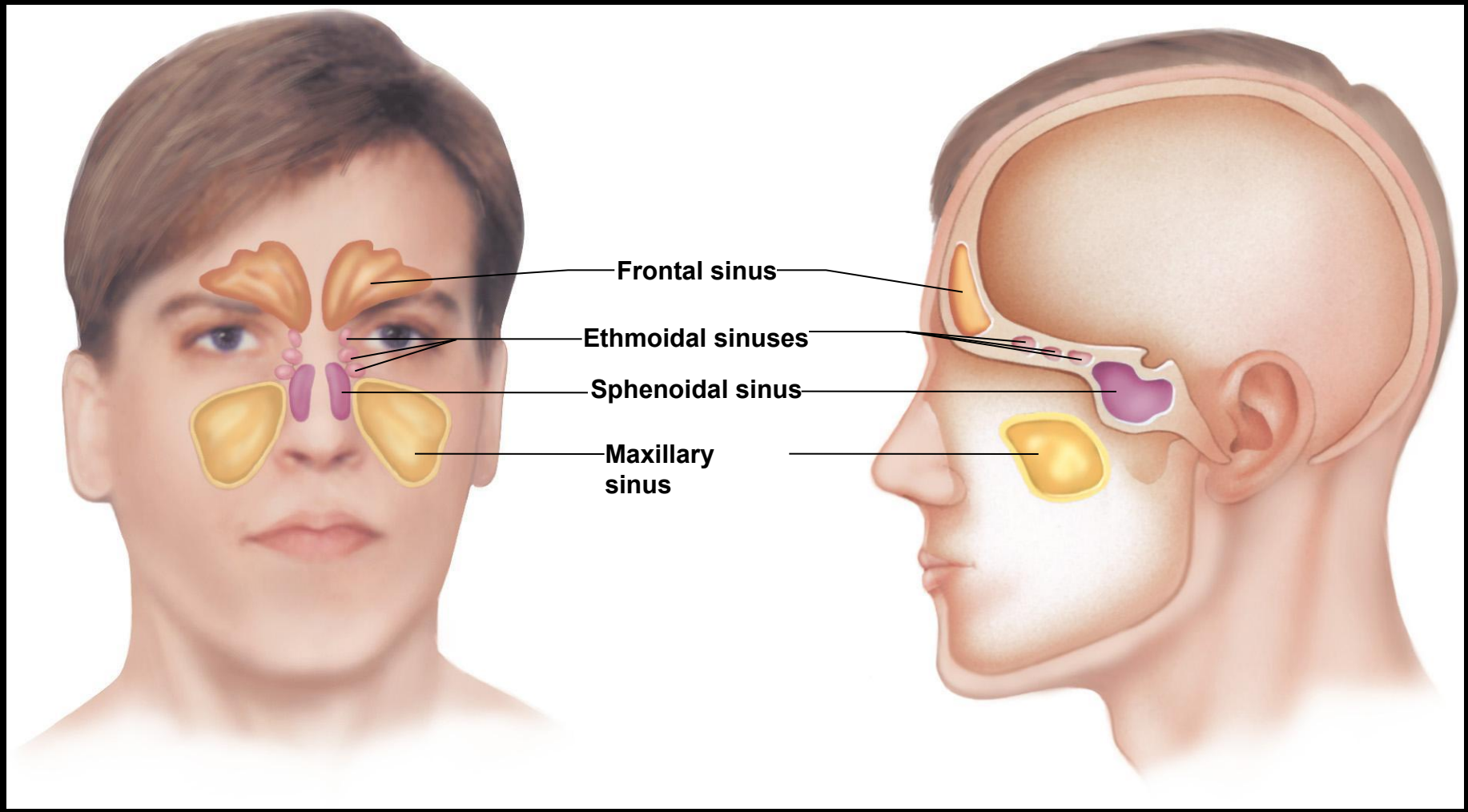


FACIAL SKELETON

- 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

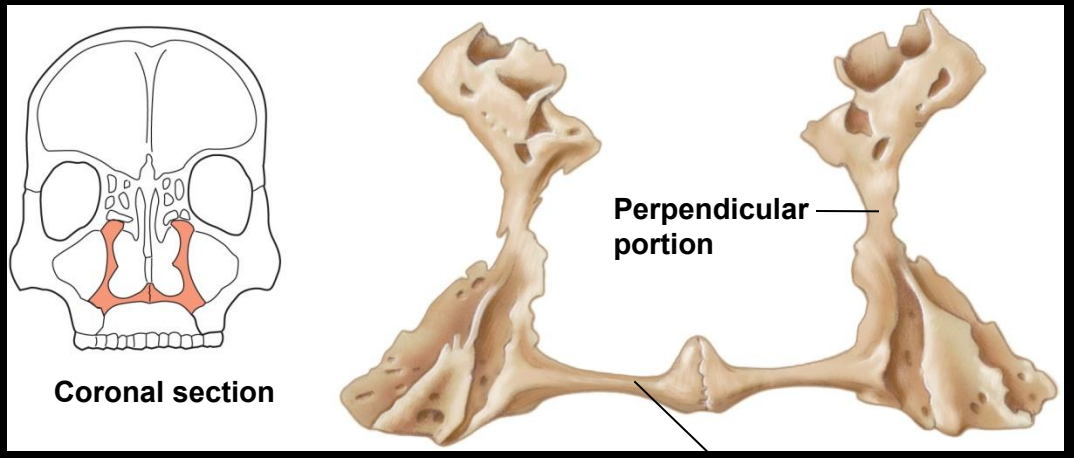


FACIAL SKELETON



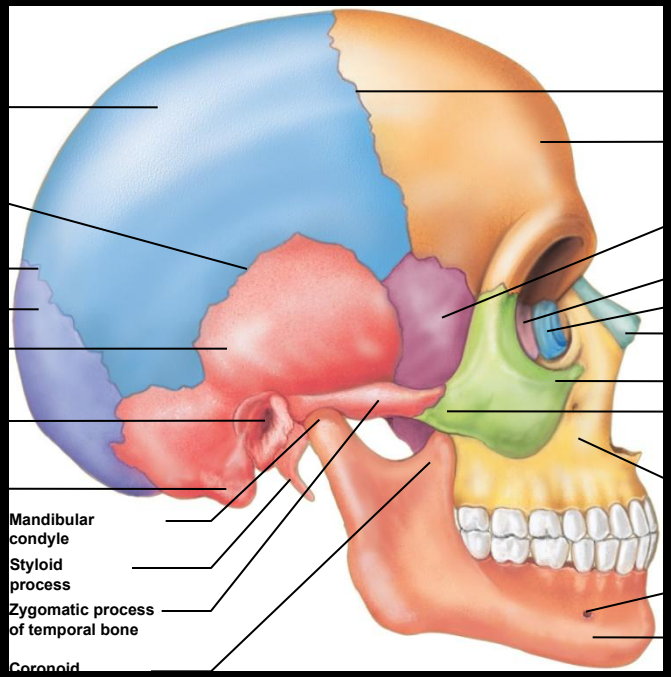
FACIAL SKELETON

- Palatine Bones (2)
  - 'L' shaped bones located behind the maxillae
  - Posterior section of hard palate
  - Floor of nasal cavity
  - Lateral walls of nasal cavity



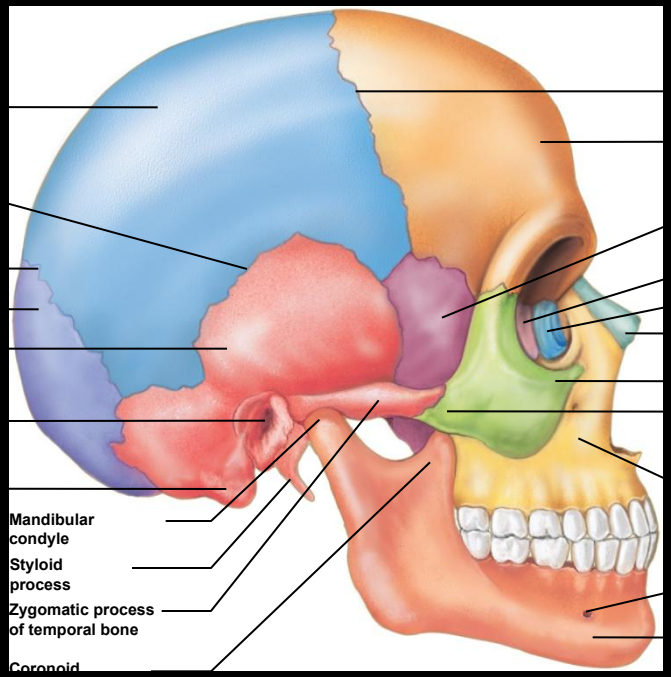
FACIAL SKELETON

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



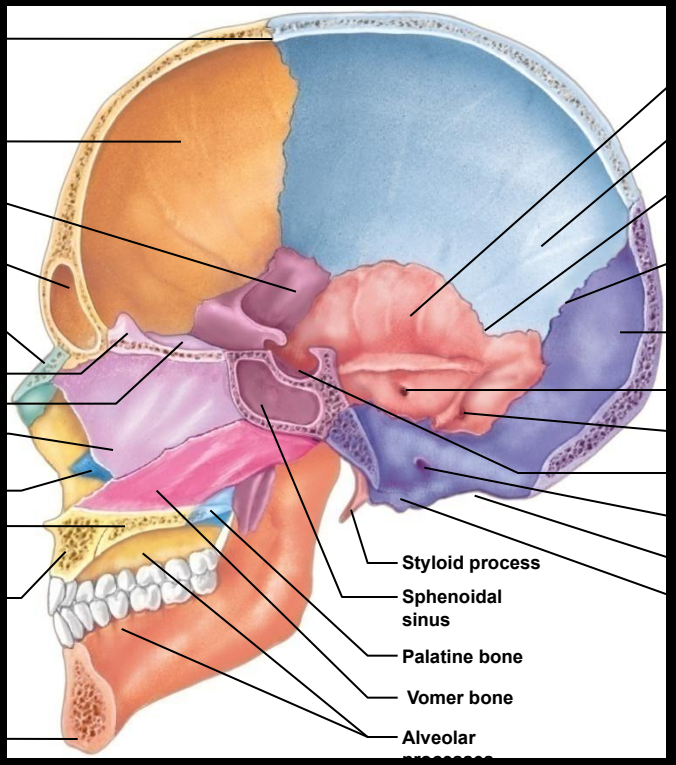
FACIAL SKELETON

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



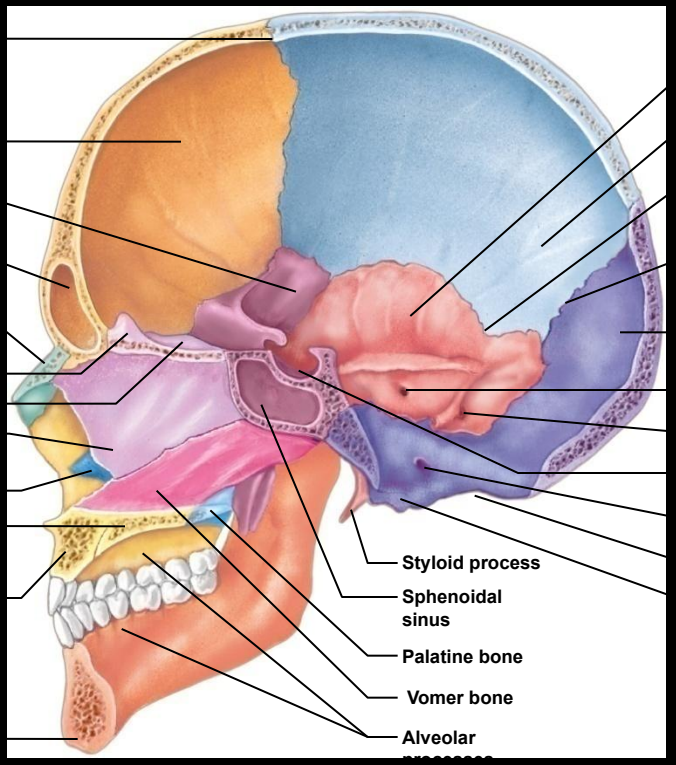
FACIAL SKELETON

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



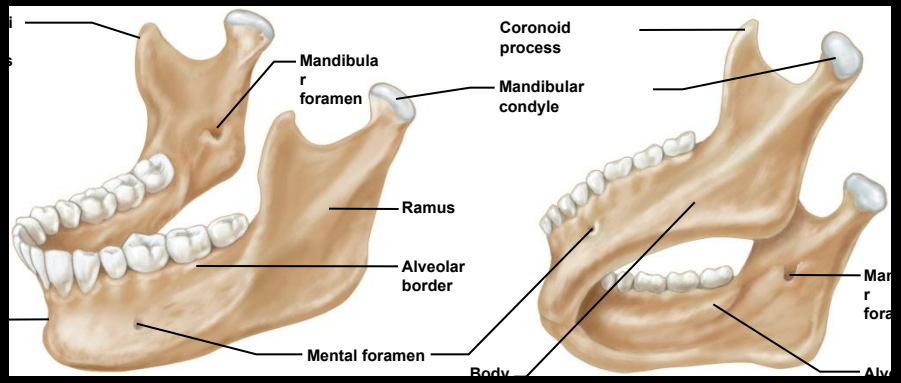
FACIAL SKELETON

- 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

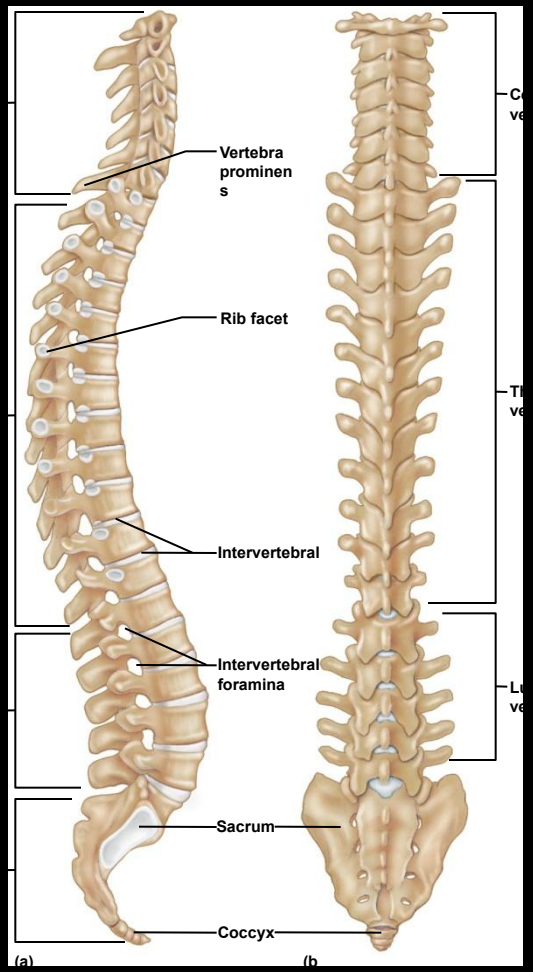


VERTEBRAL COLUMN

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

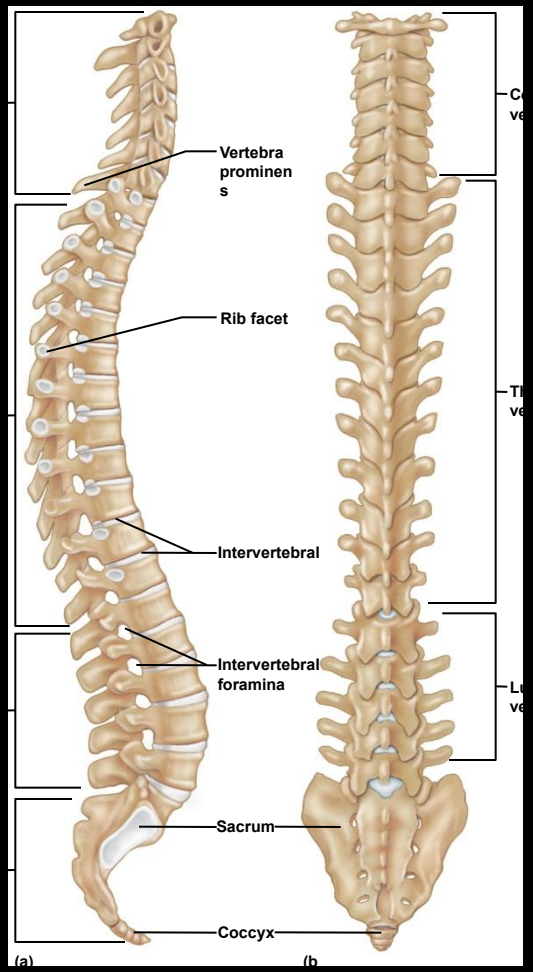
VERTEBRAL COLUMN

- 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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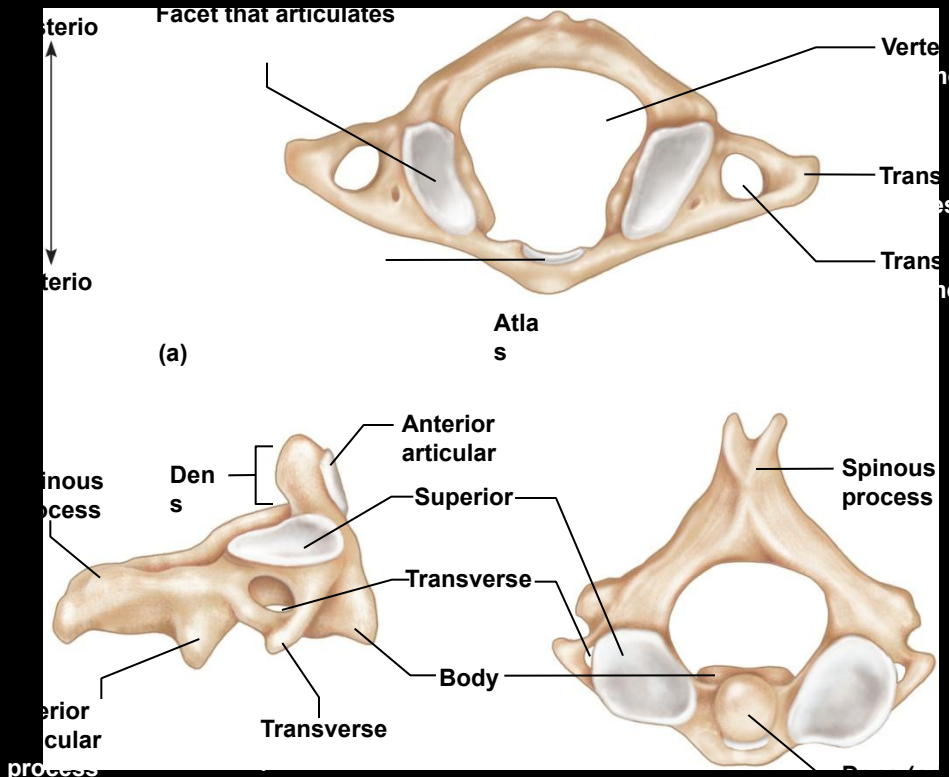

THORACIC VERTEBRAE

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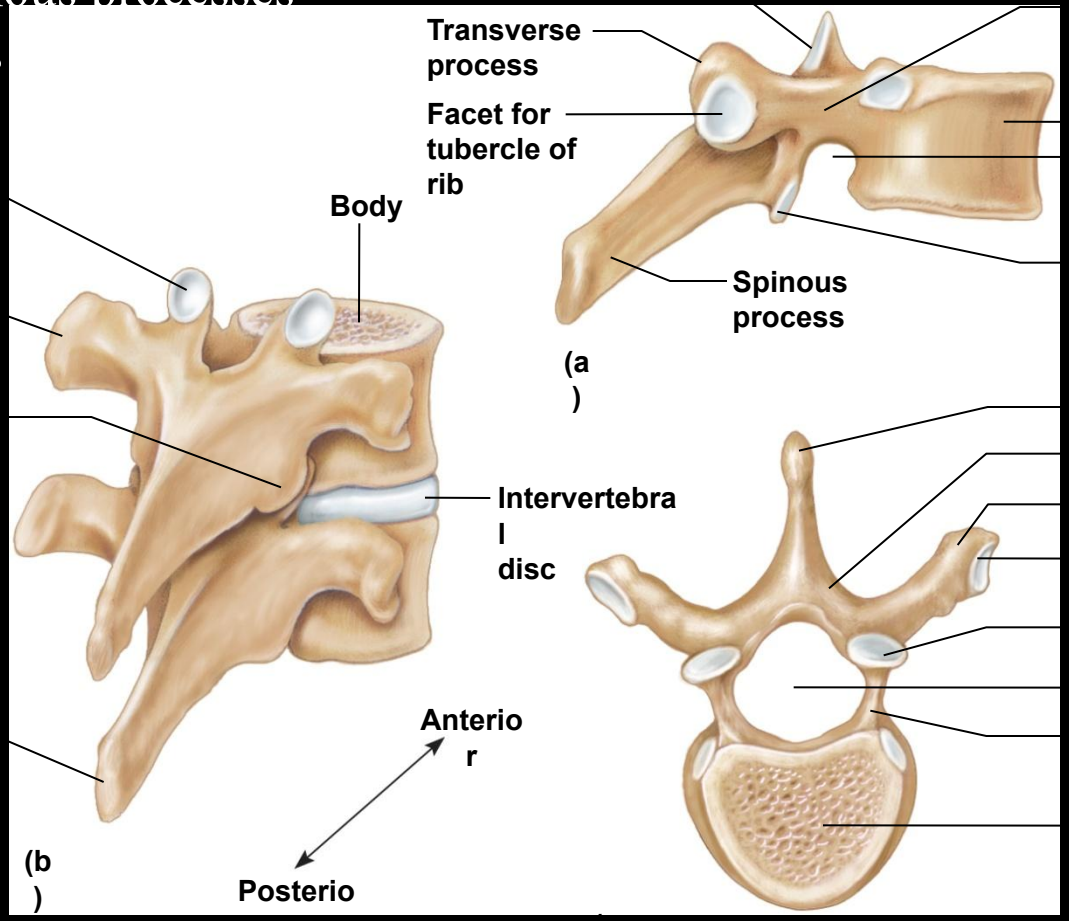
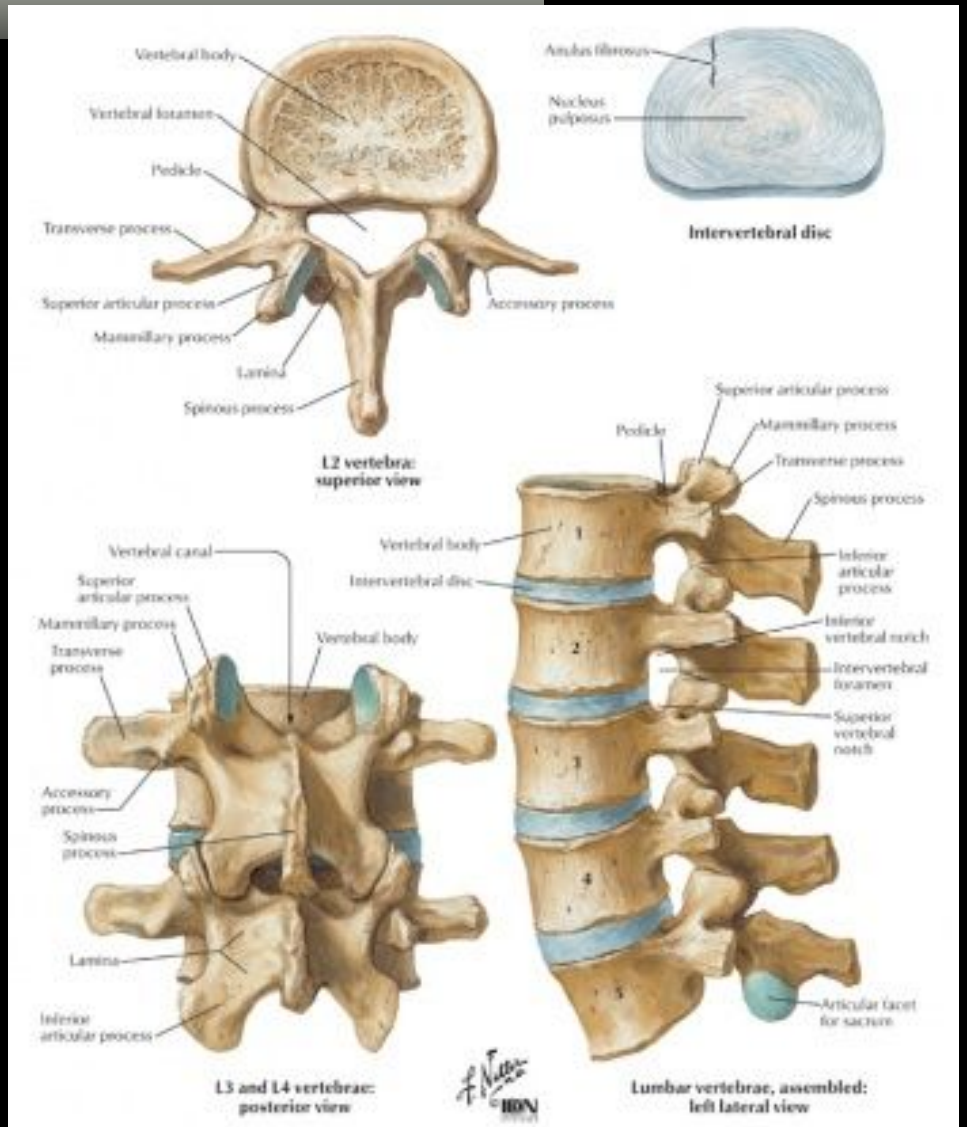
- Long spinous processes
- Rib facets



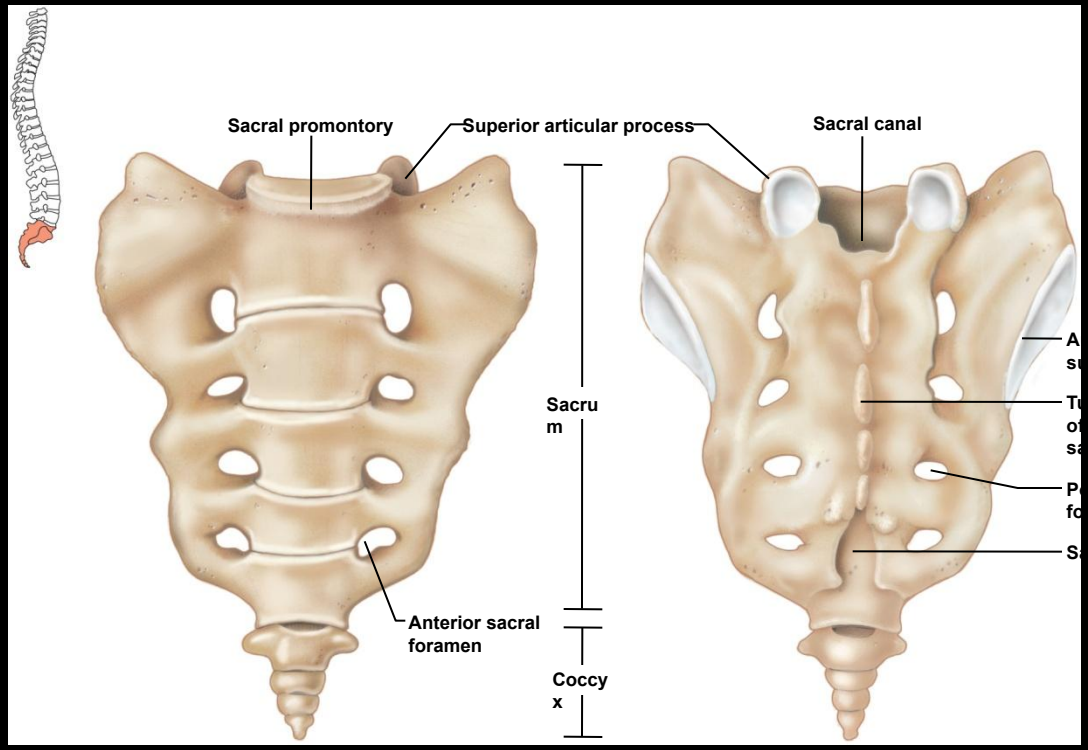
LUMBAR VERTEBRAE

- Large bodies
- Thick, short spinous processes



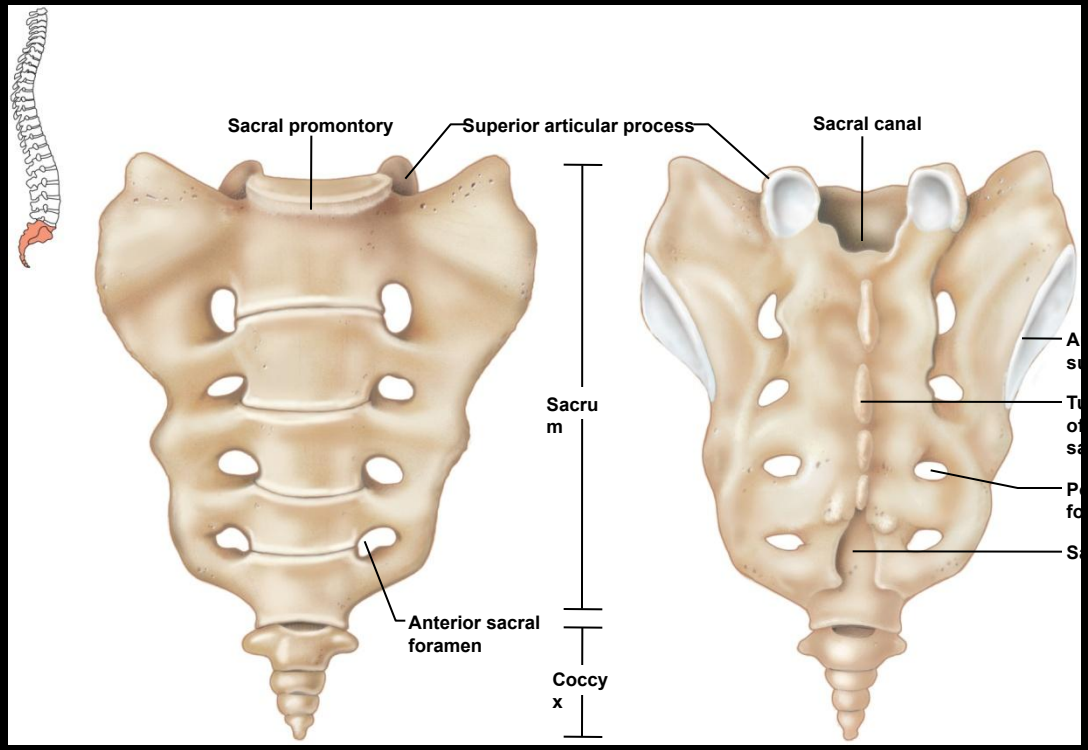
SACRUM

- 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

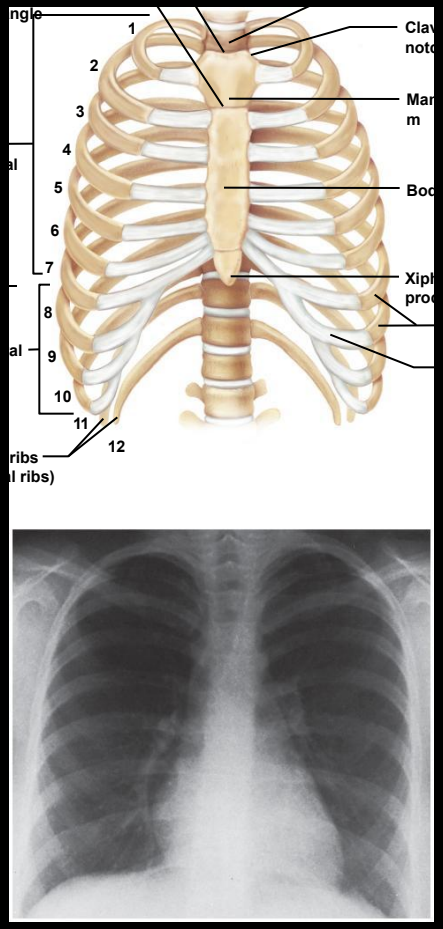


THORACIC CAGE

- 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



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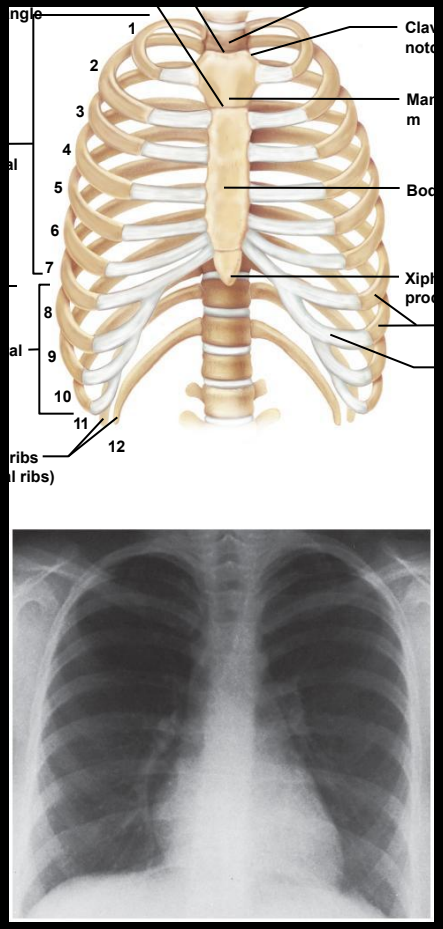
RIBS

- Humans have 12 pairs of ribs:
  - True ribs (7)
  - False ribs (5), of which:
    - Floating (2)

- There are some anomalies:
  - Cervical ribs
  - Lumbar ribs



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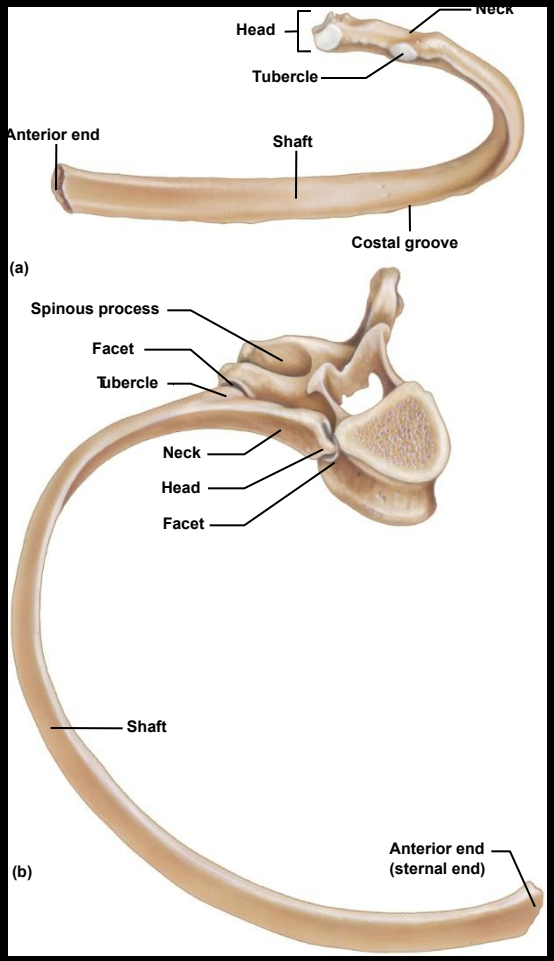
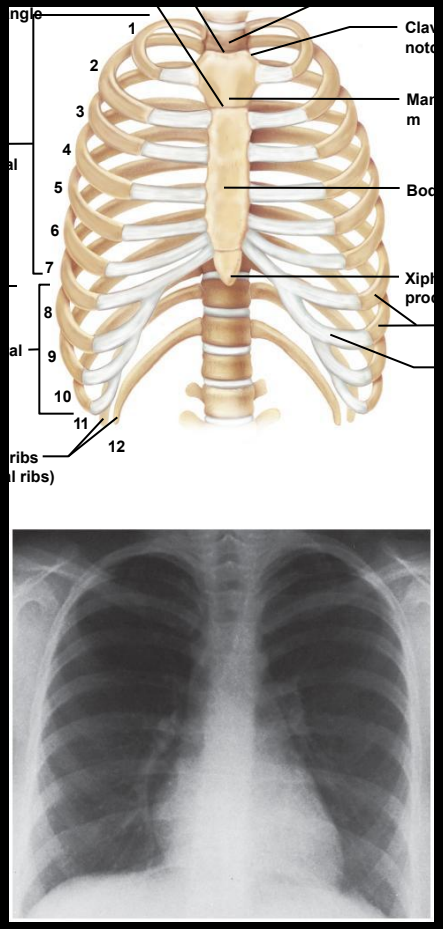
RIB STRUCTURE

- 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



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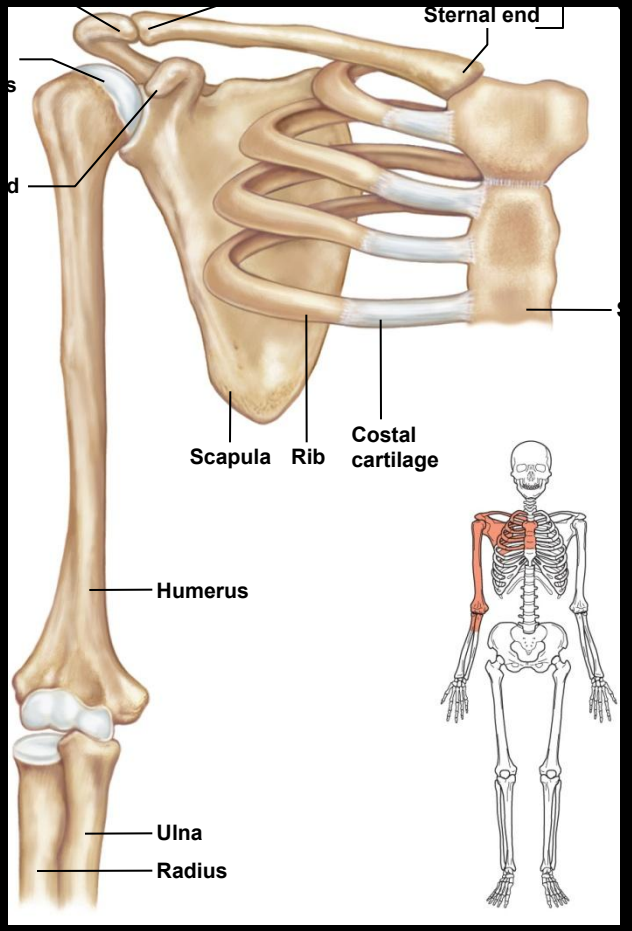
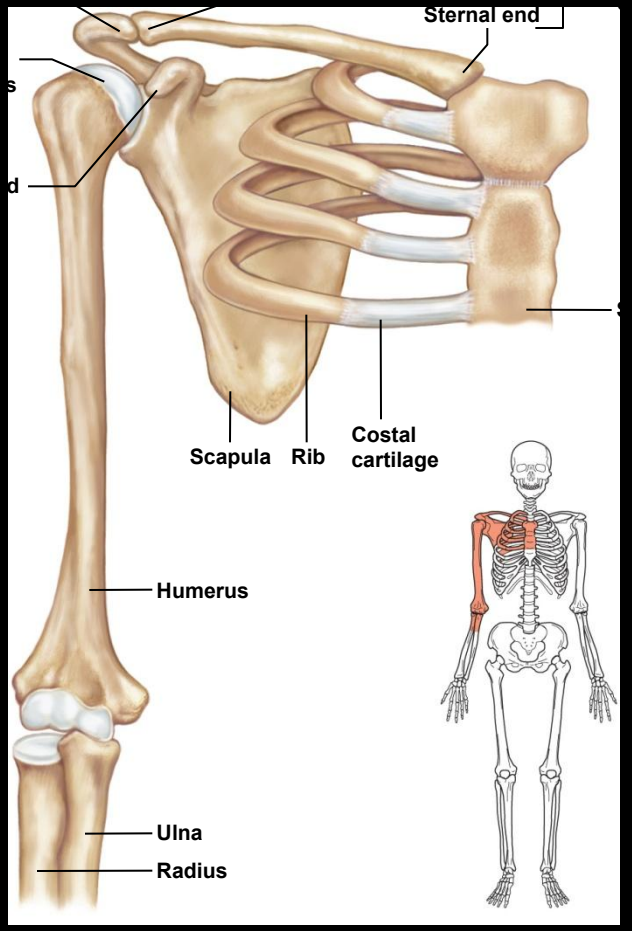
PECTORAL GIRDLE

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



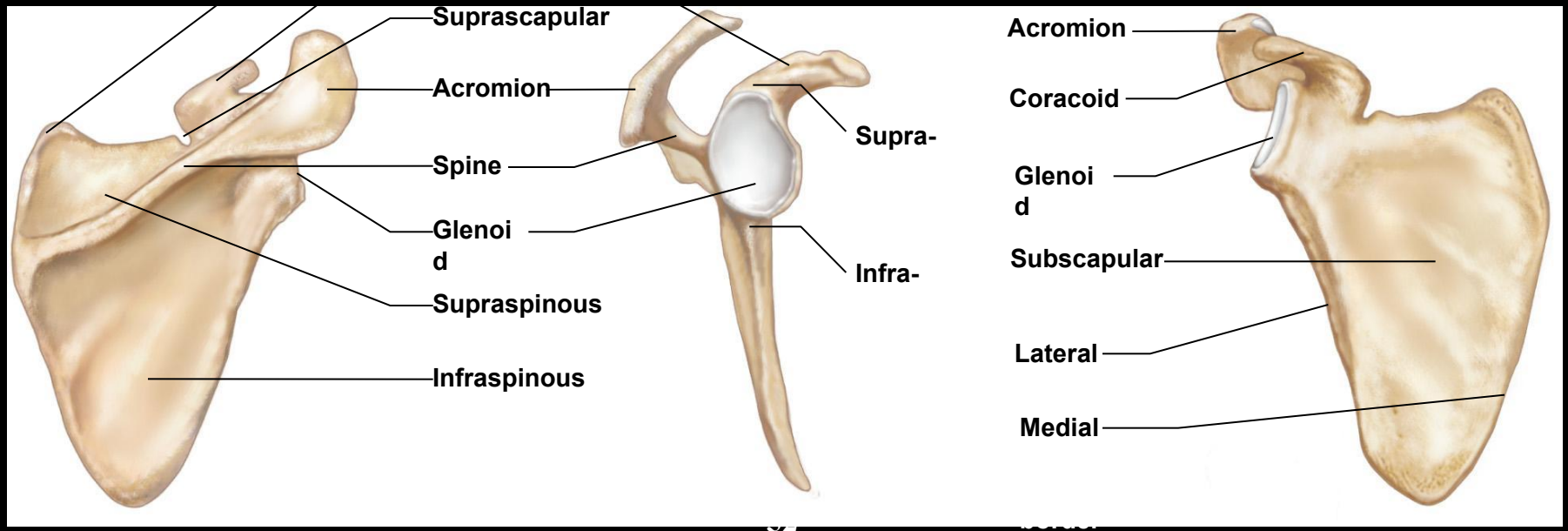
CLAVICLES

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



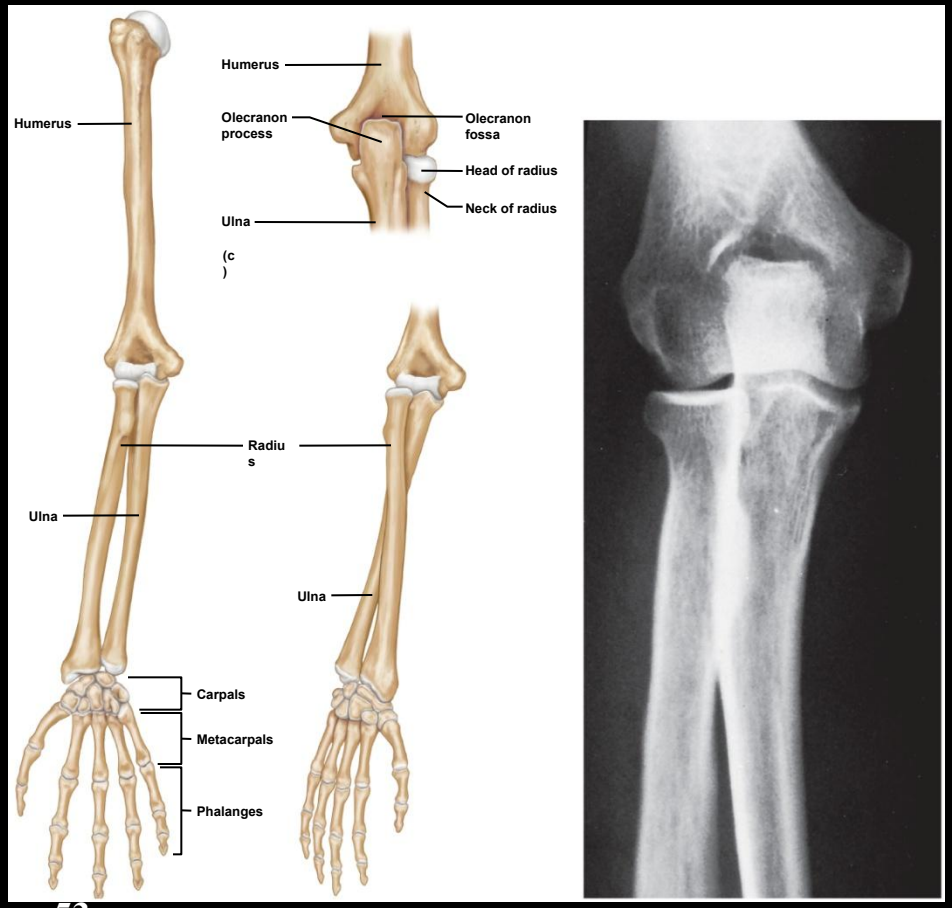
SCAPULAE

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



UPPER LIMB

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



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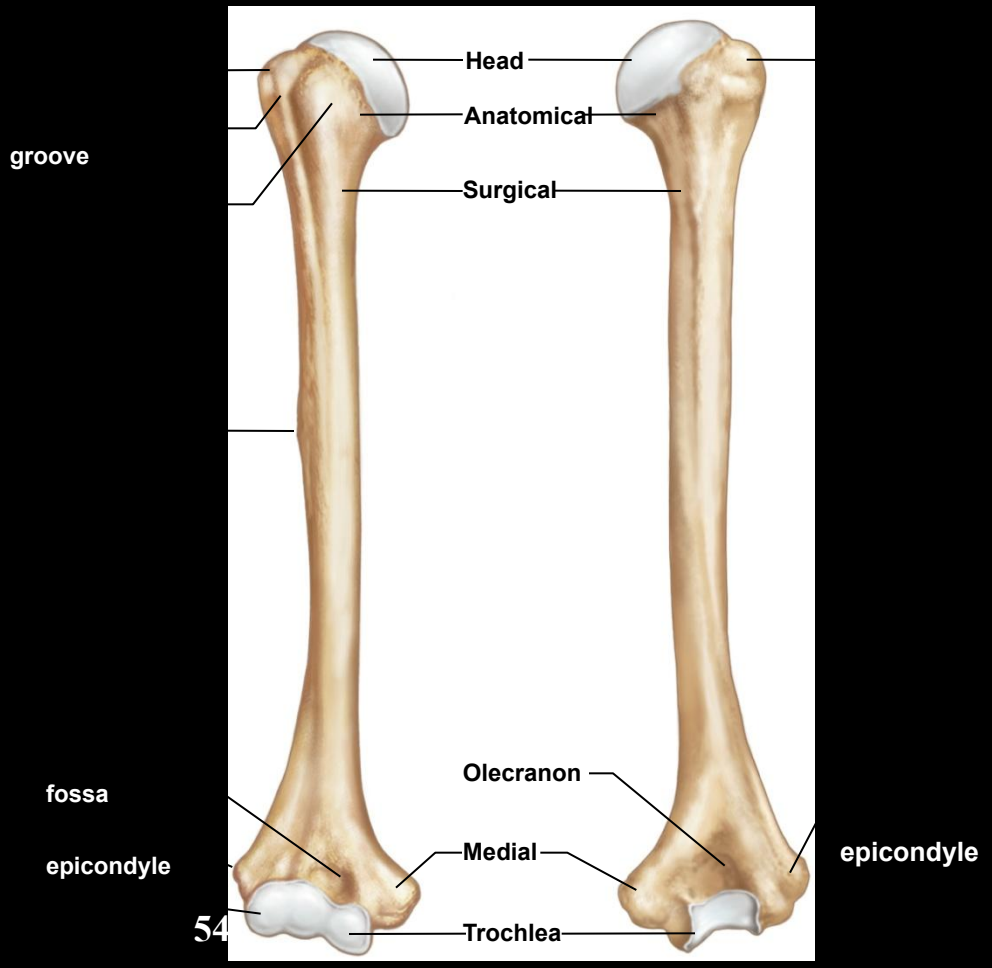
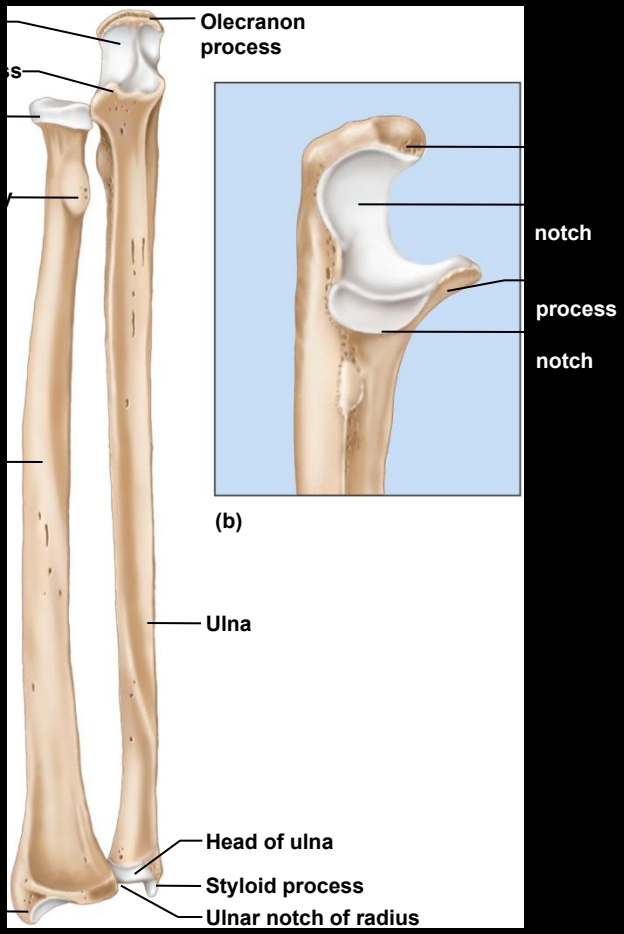
HUMERUS

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



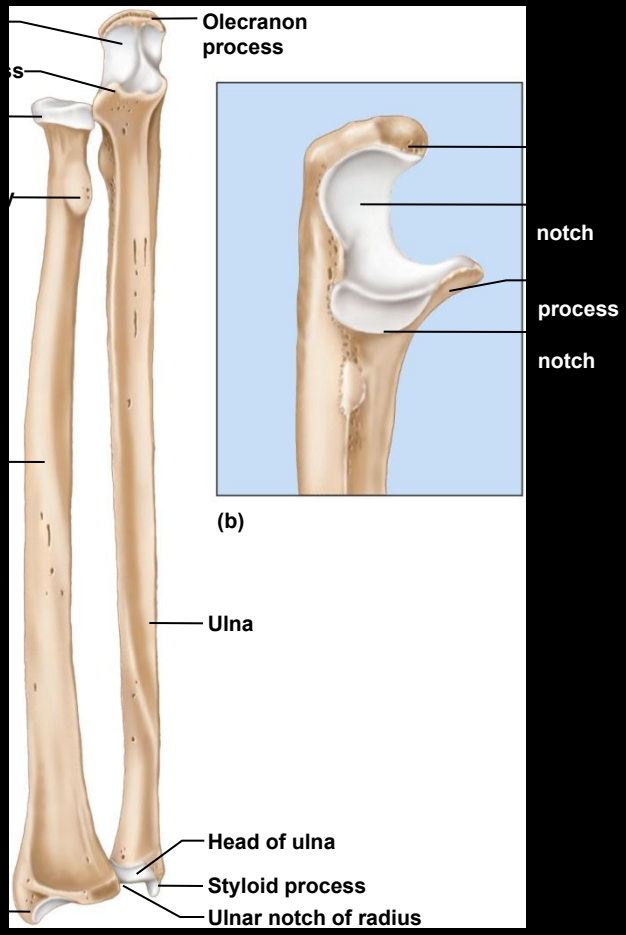
RADIUS

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



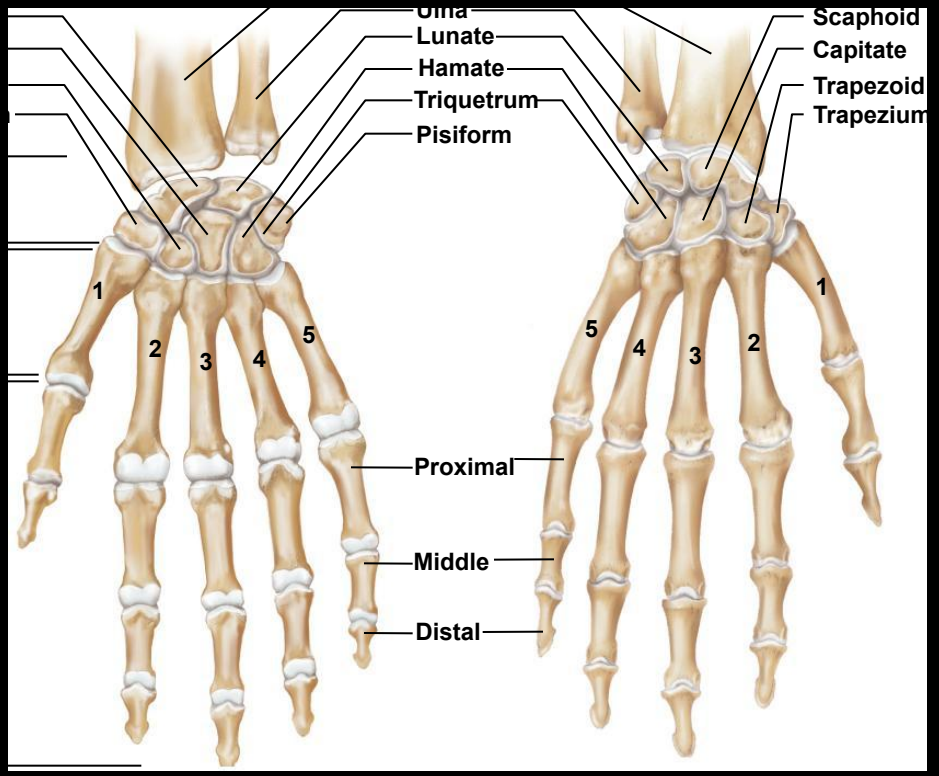
ULNA

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



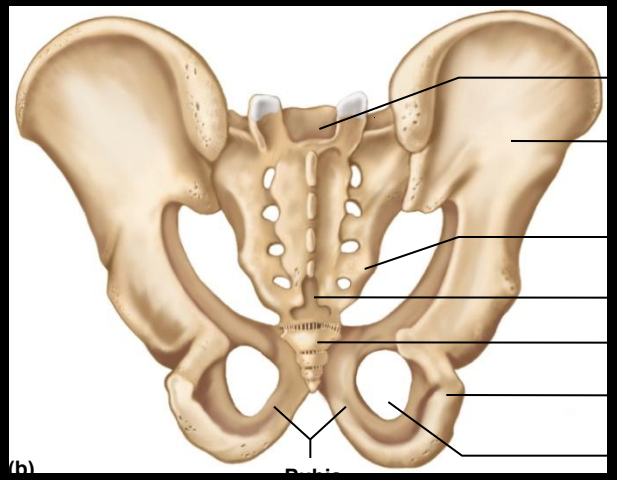
WRIST AND HAND

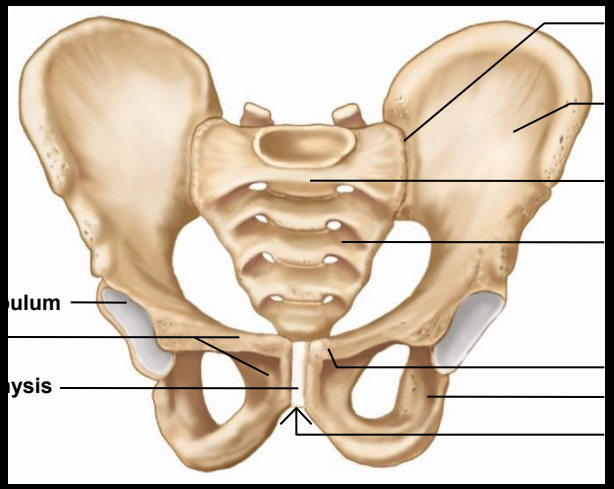
- Carpal Bones (16 total bones)
  - Scaphoid
  - Lunate
  - Triquetral
  - Pisiform
  - Hamate
  - Capitate
  - Trapezoid
  - Trapezium
- Metacarpal Bones (10)
- Phalangeal Bones (28)
  - Proximal phalanx
  - Middle phalanx
  - Distal phalanx



PELVIC GIRDLE

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

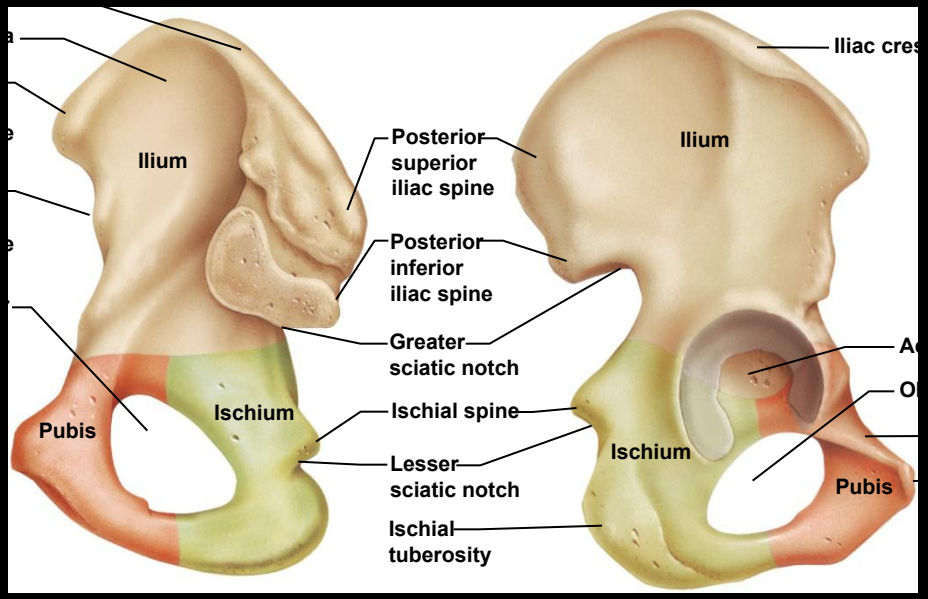




HIP BONES

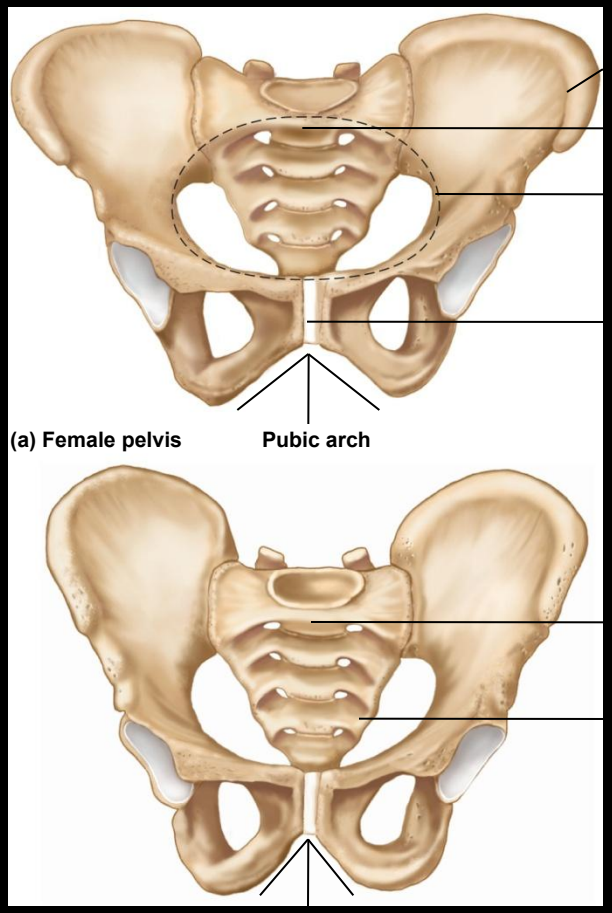
- Also known as the coxae:
  - Acetabulum
  - There are three (3) bones:

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



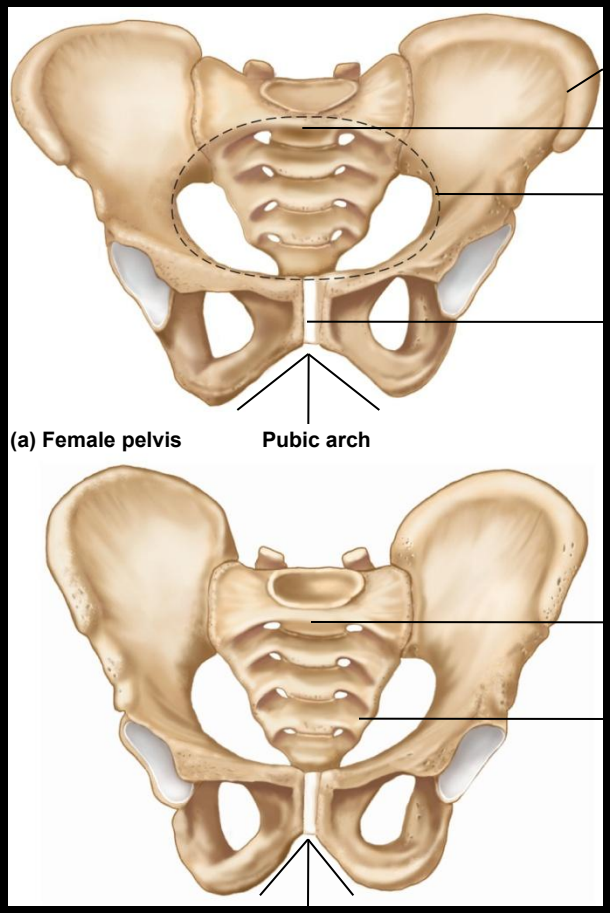
GREATER AND LESSER PELVES

- 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



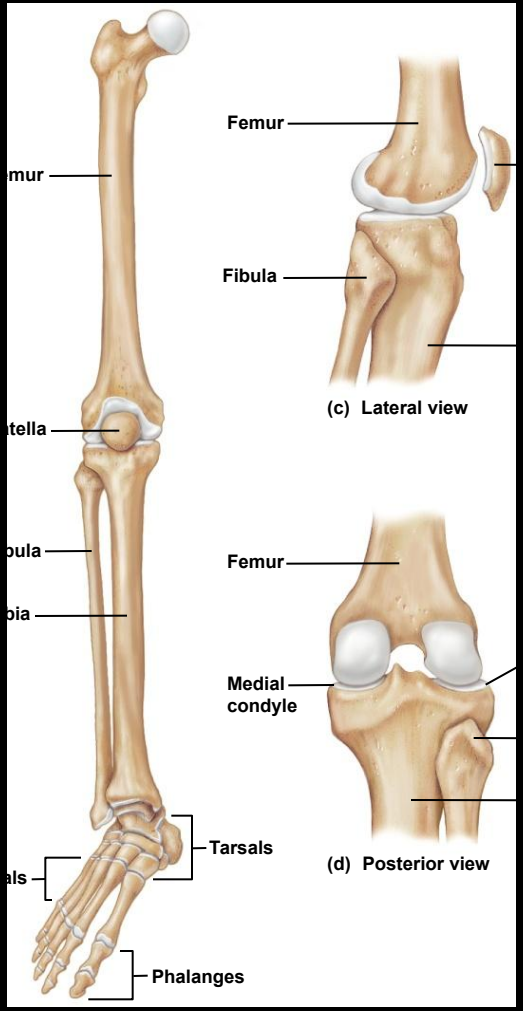
DIFFERENCES BETWEEN MALE FEMALE PELVES

- 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?



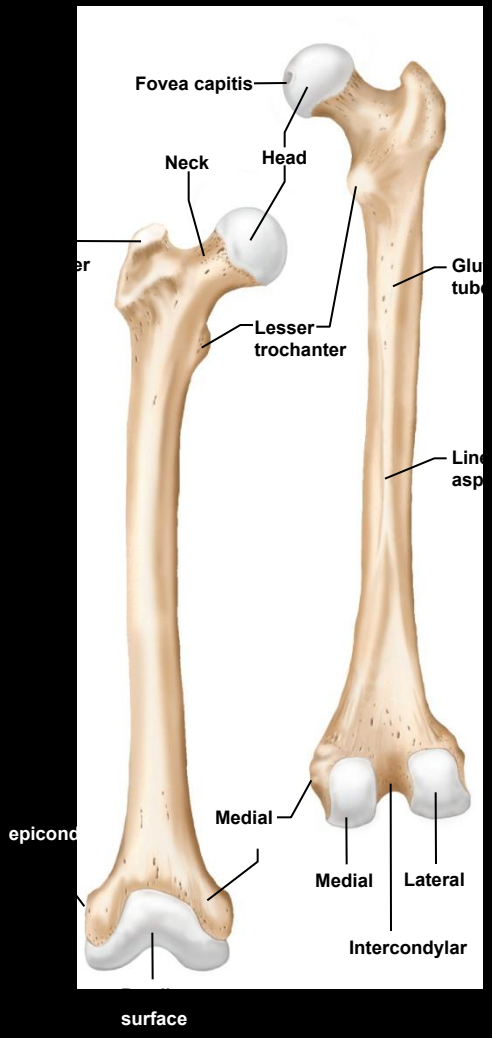
LOWER LIMB

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



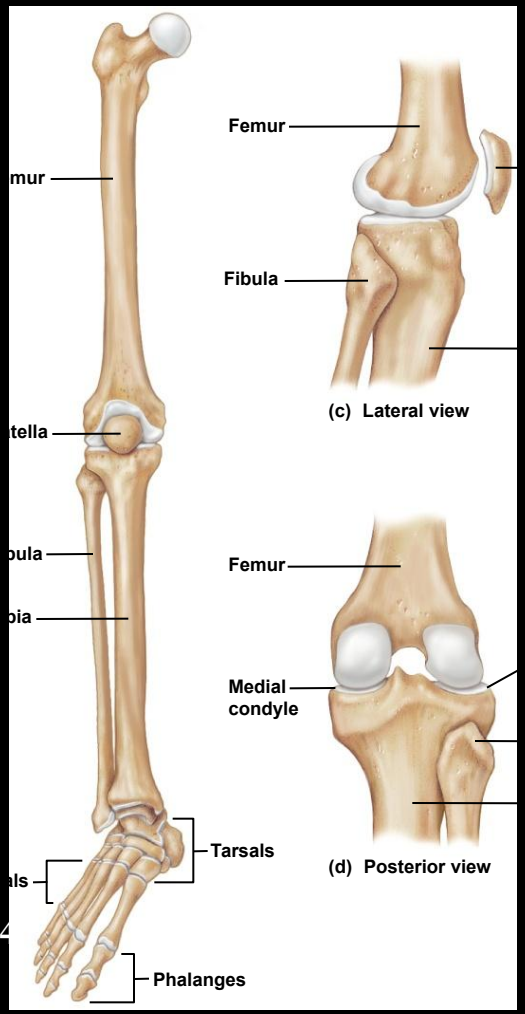
FEMUR

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



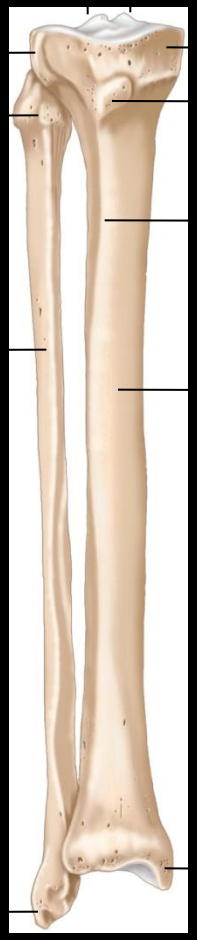
PATELLA

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



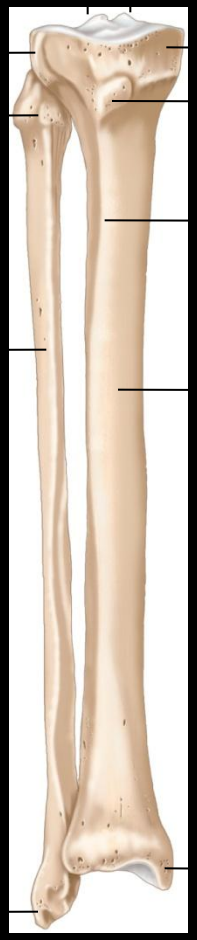
TIBIA

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



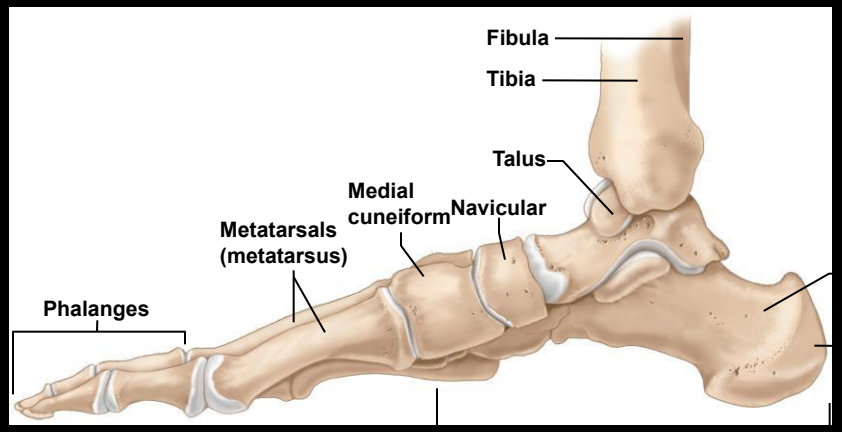
FIBULA

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

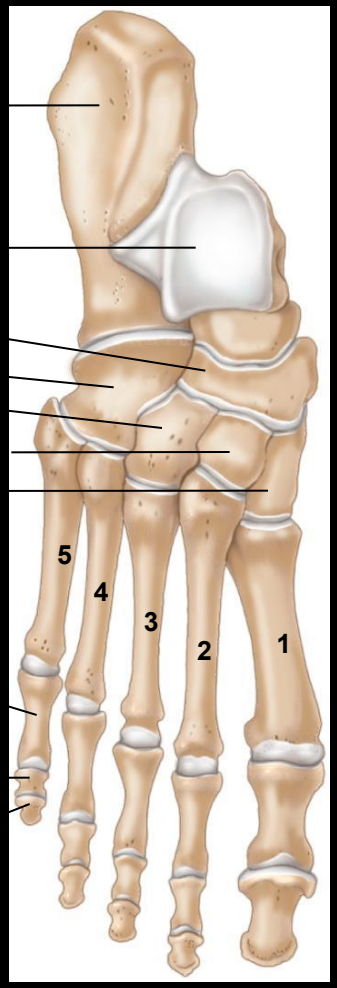


FOOT

- 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

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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

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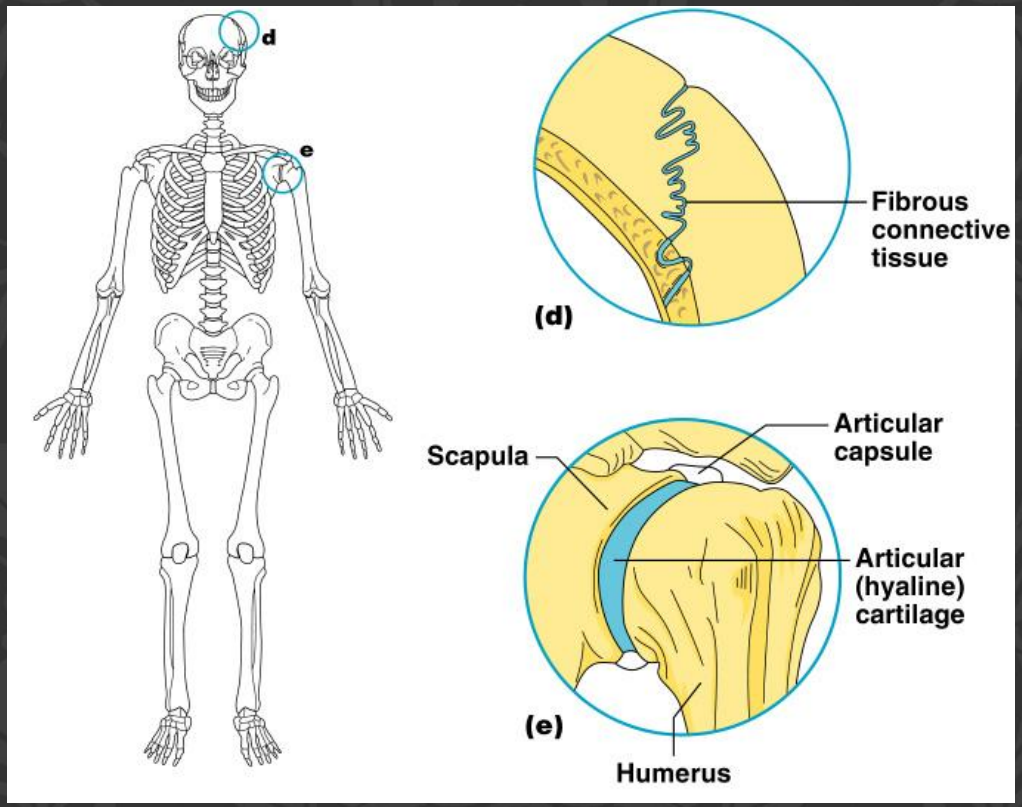
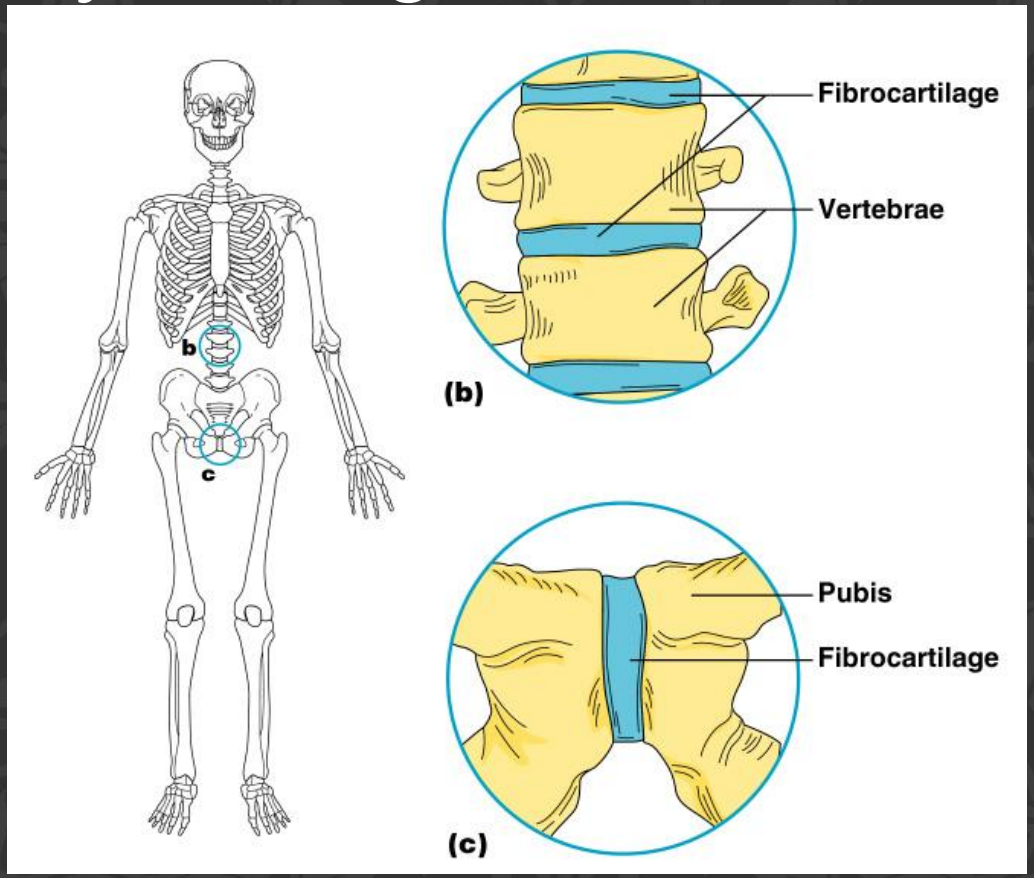
Fibrous Joints

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



Cartilaginous Joints – mostly amphiarthrosis

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



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Synovial Joints

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

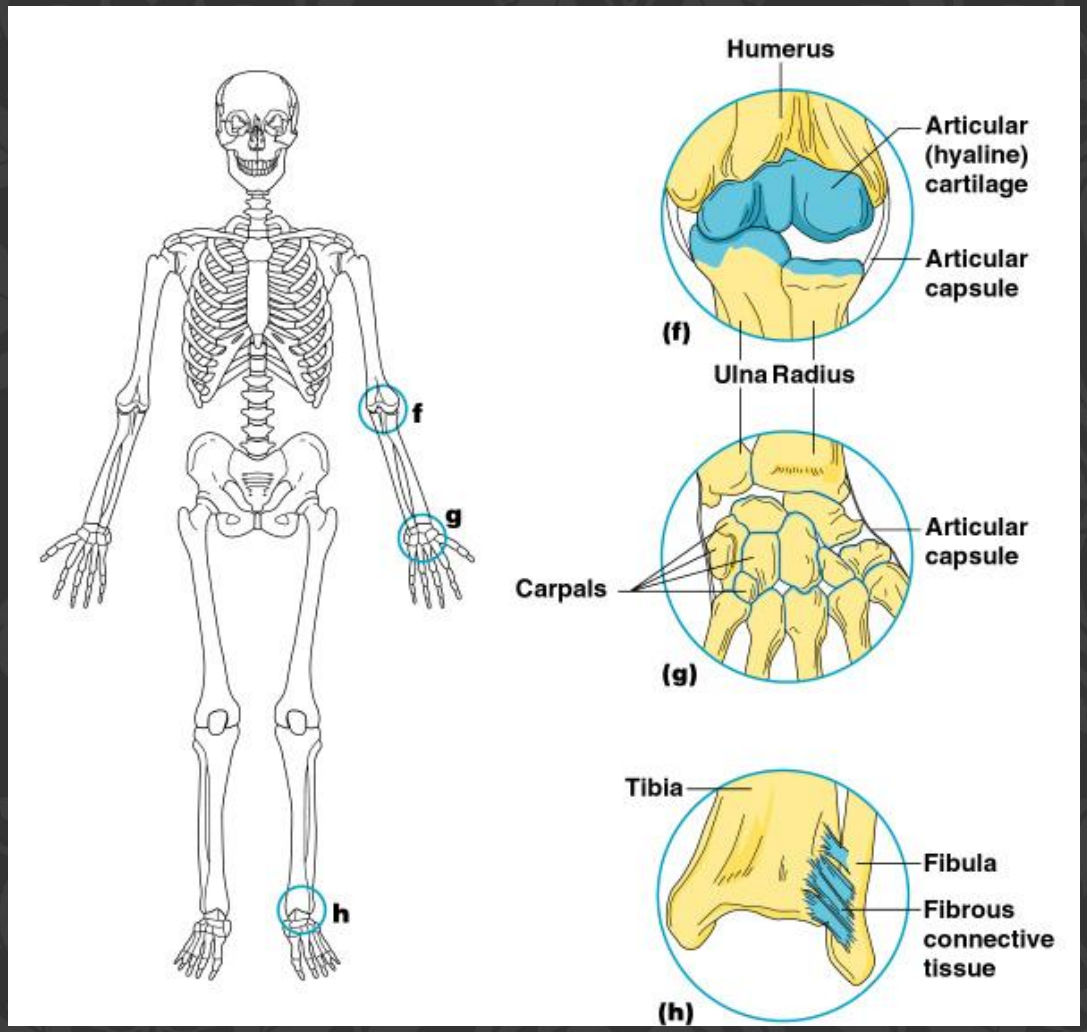

Figure 5.27f–h

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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

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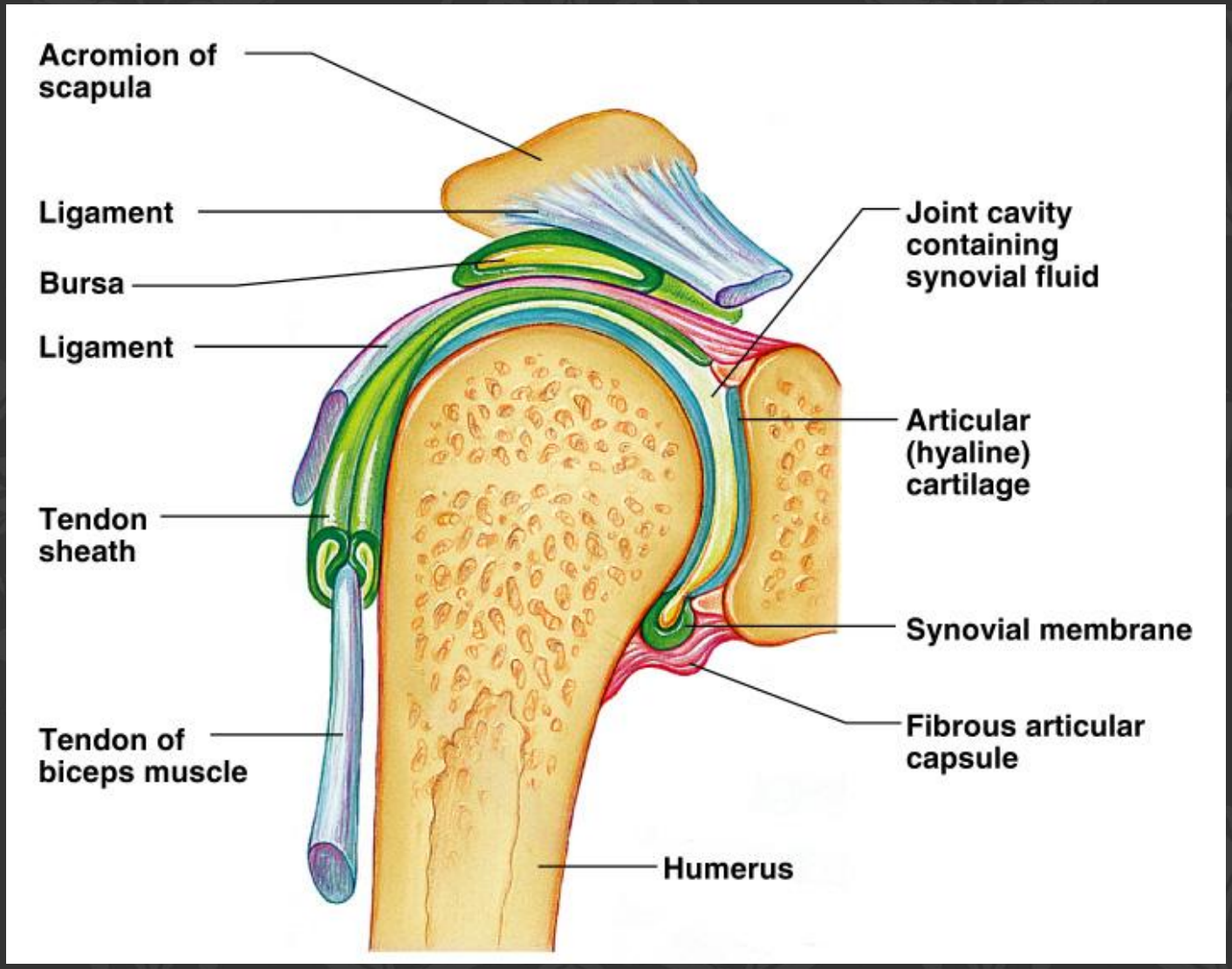
The Synovial Joint



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Types of Synovial Joints Based on Shape

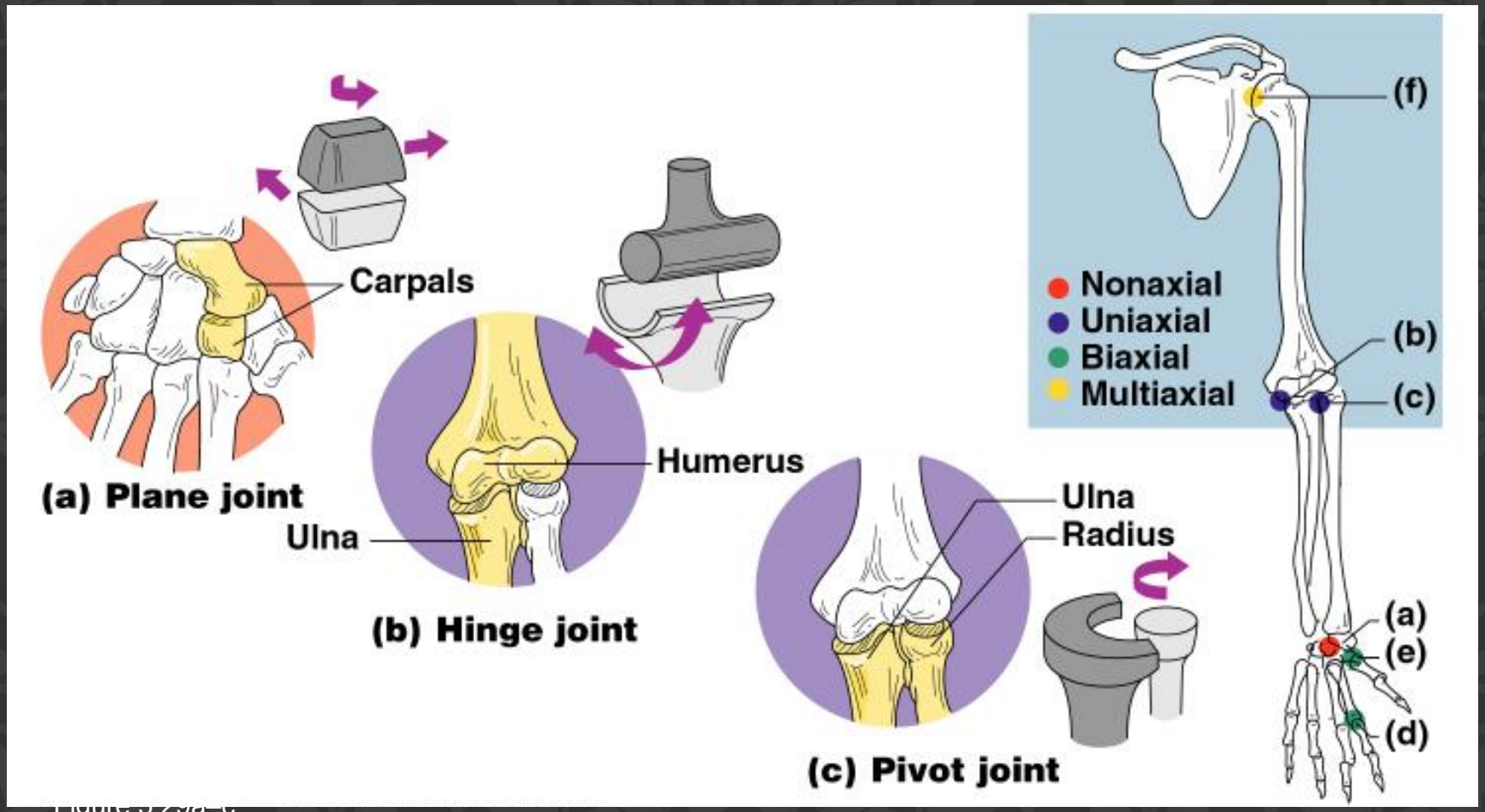

Figure 5.25a–c

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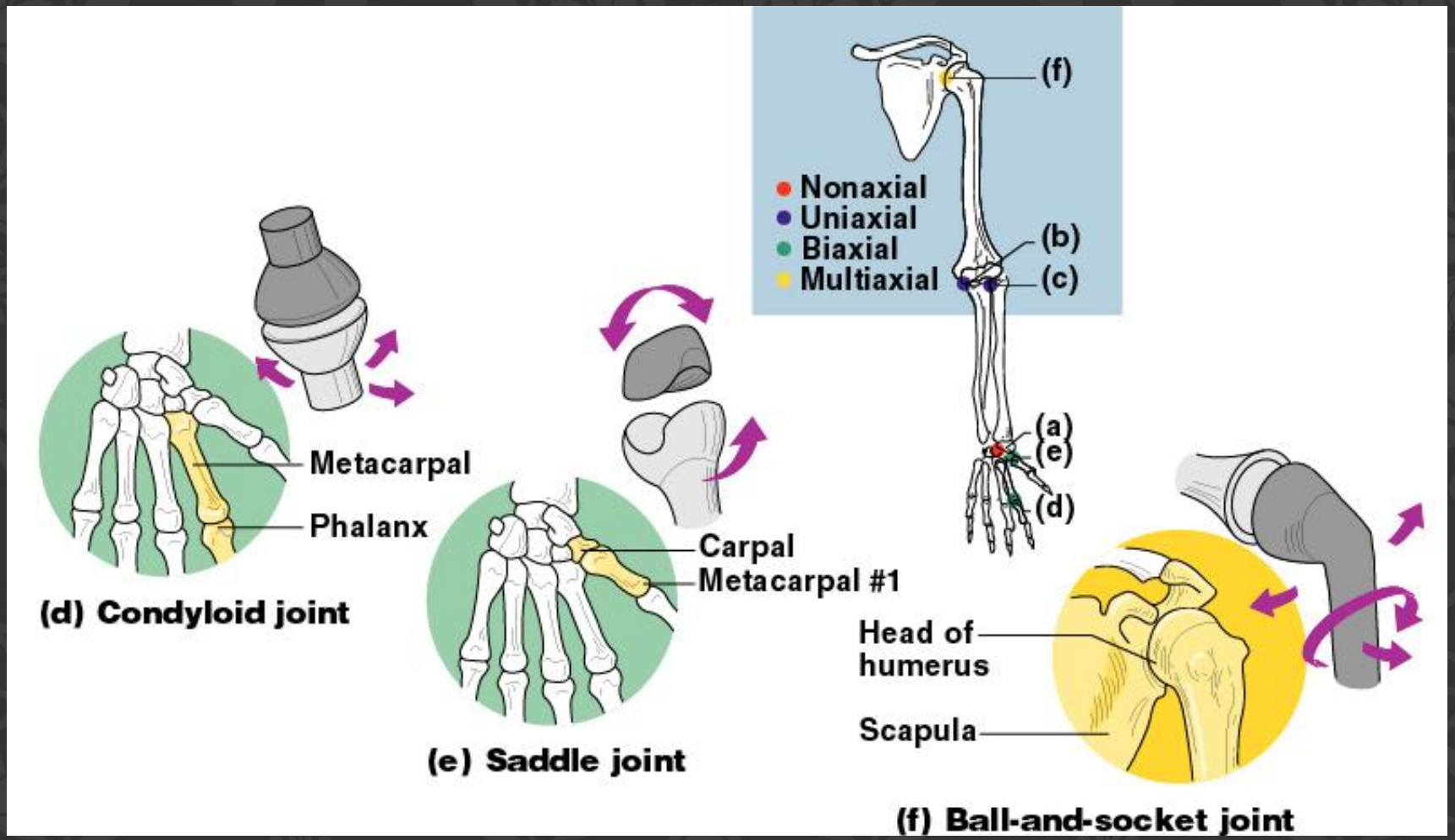
Types of Synovial Joints Based on Shape



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