

The Axial Skeleton

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The Axial Skeleton

- Eighty bones segregated into three regions
 - Skull
 - Vertebral column
 - Bony thorax

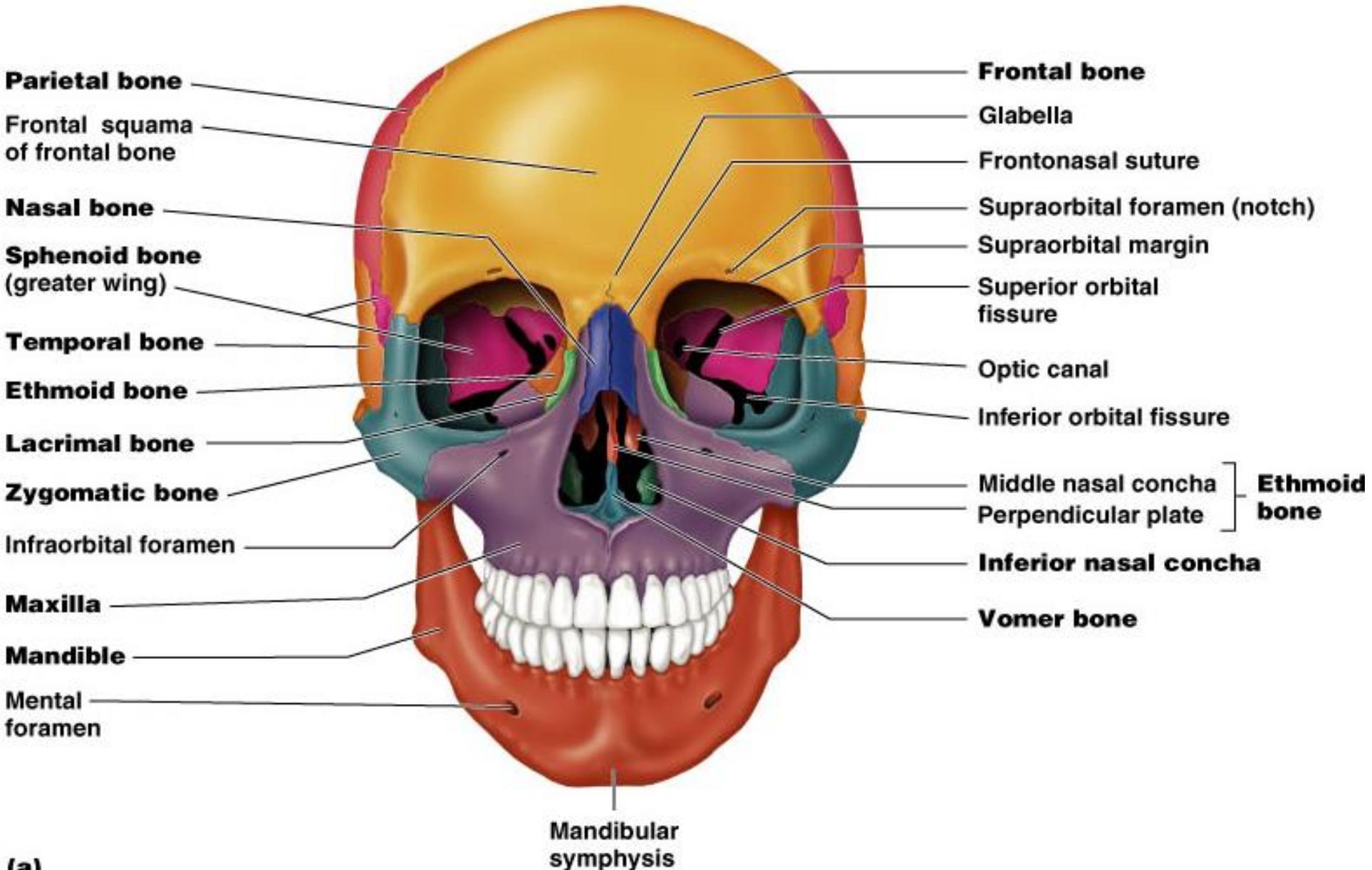
The Skull

- The skull, the body's most complex bony structure, is formed by the cranium and facial bones
- Cranium – protects the brain and is the site of attachment for head and neck muscles
- Facial bones
 - Supply the framework of the face, the sense organs, and the teeth
 - Provide openings for the passage of air and food
 - Anchor the facial muscles of expression

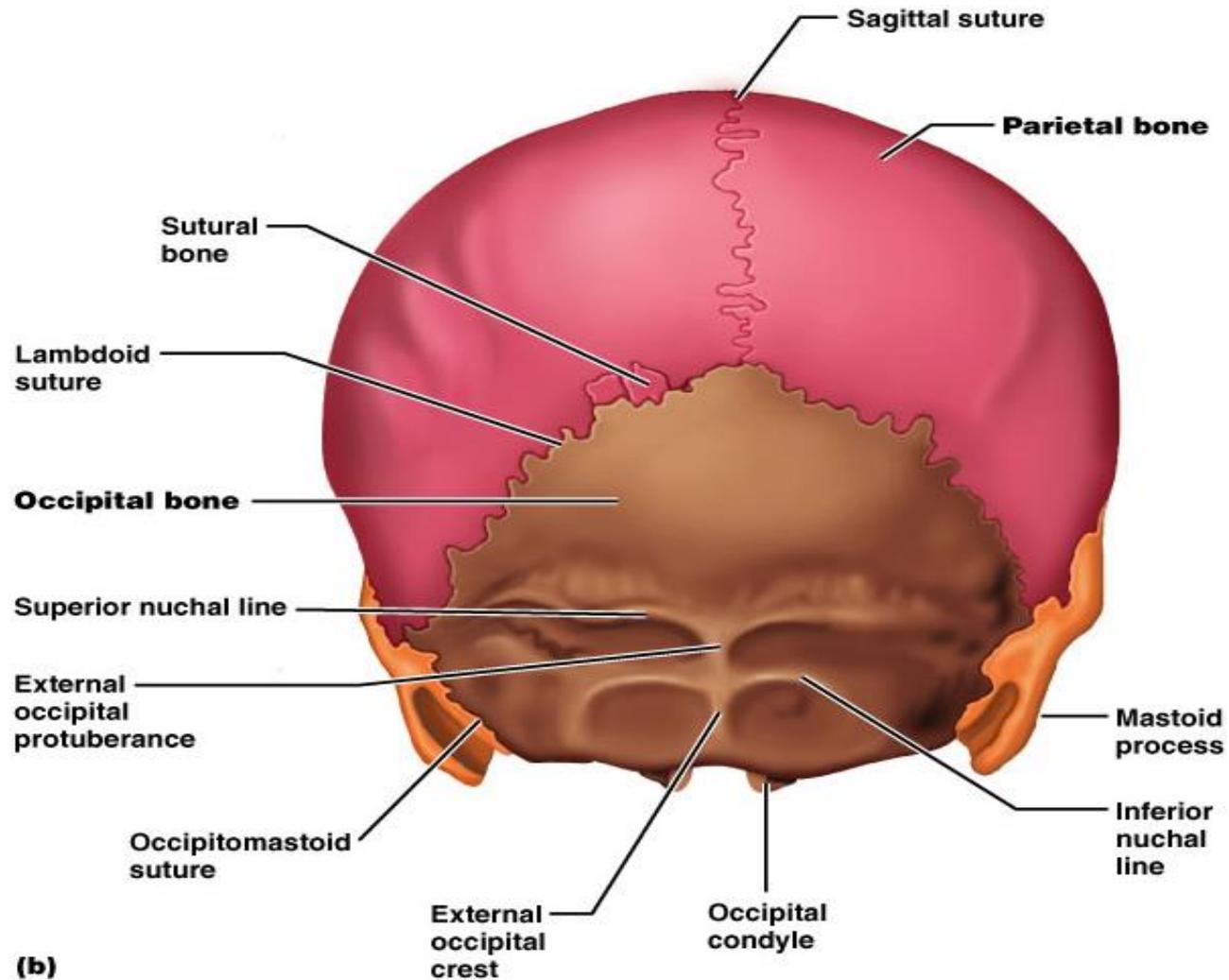
Anatomy of the Cranium

- Eight cranial bones – two parietal, two temporal, frontal, occipital, sphenoid, and ethmoid
- Cranial bones are thin and remarkably strong for their weight

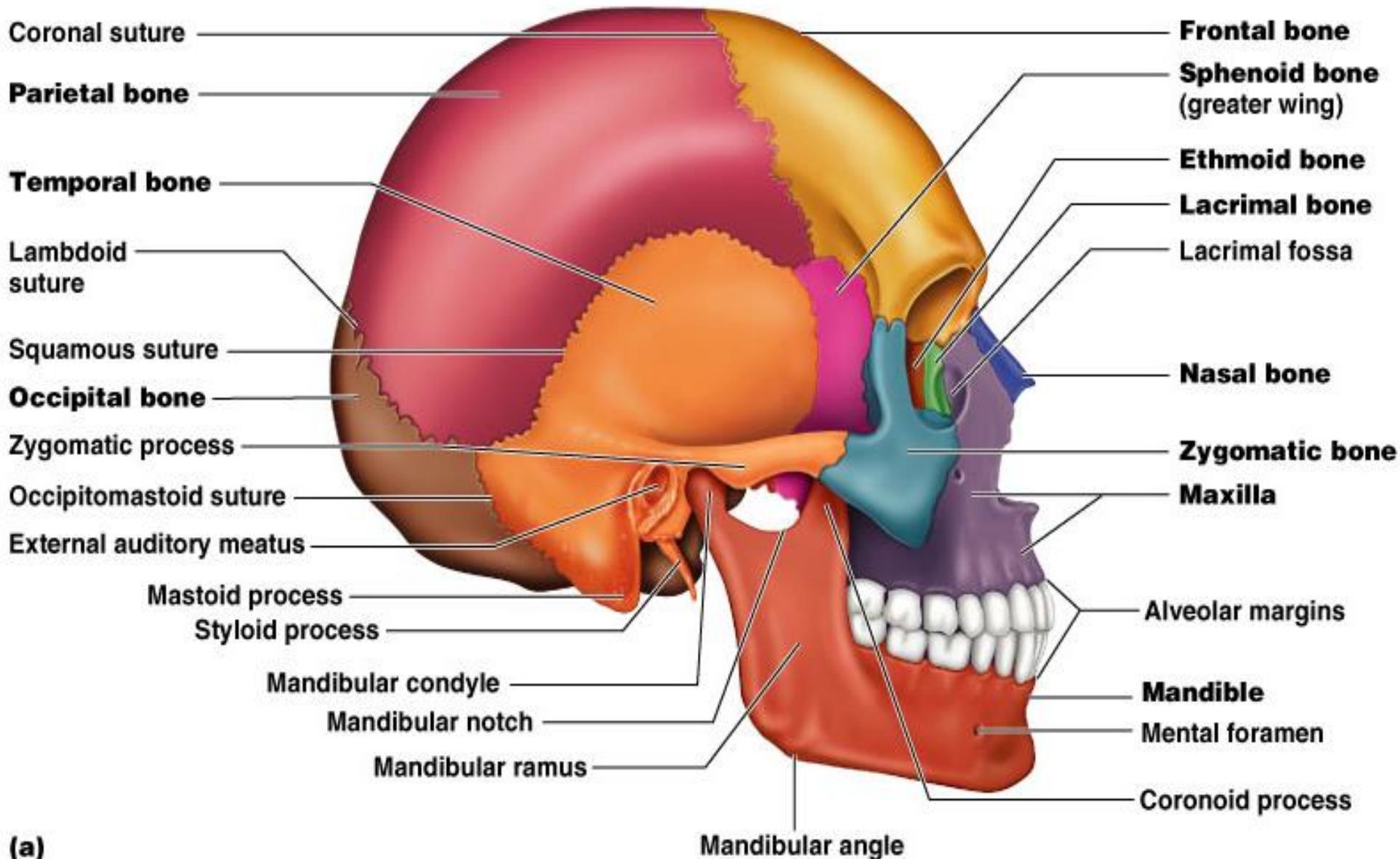
Skull: Anterior View



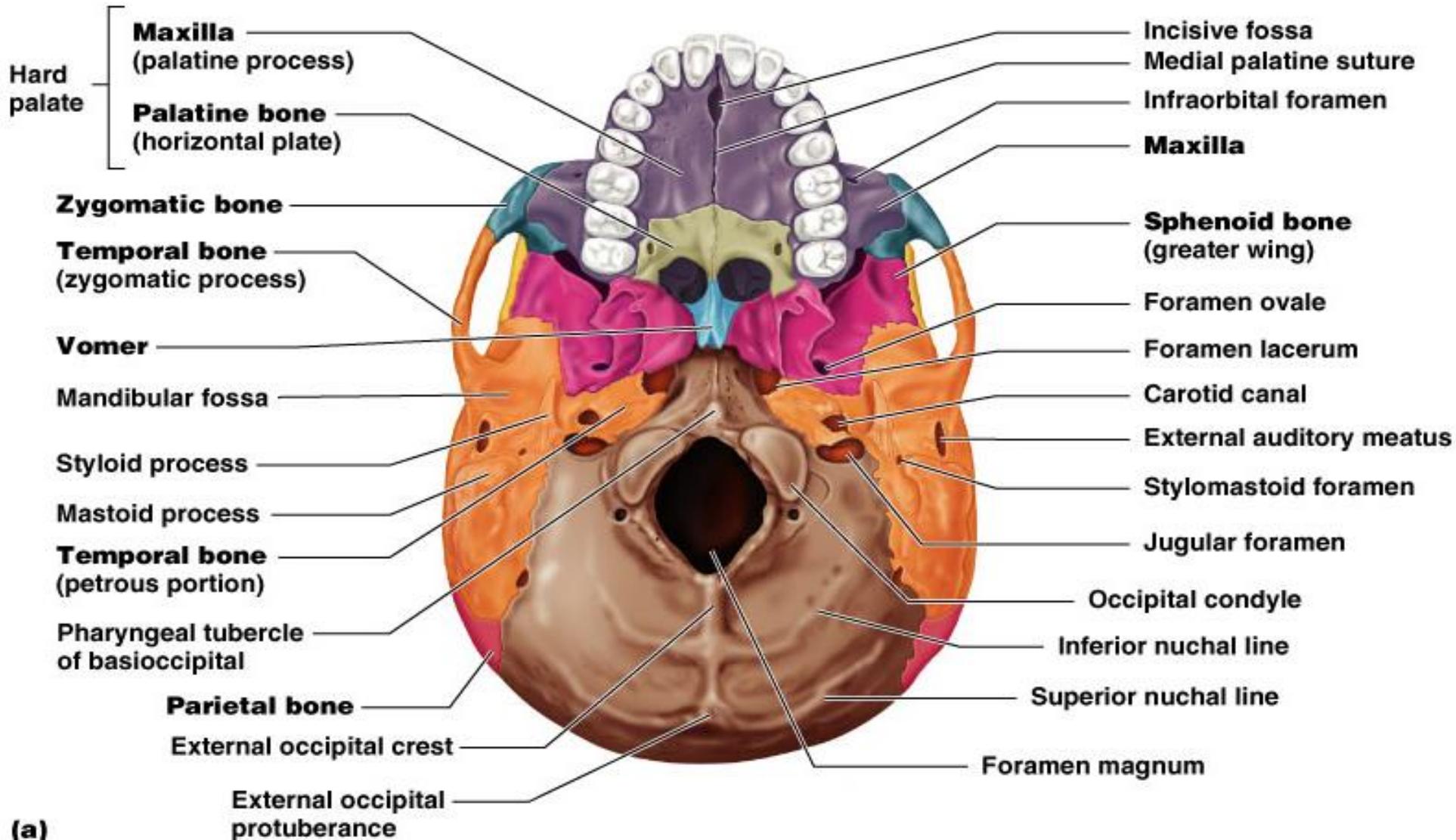
Skull: Posterior View



External Lateral Aspects of the Skull

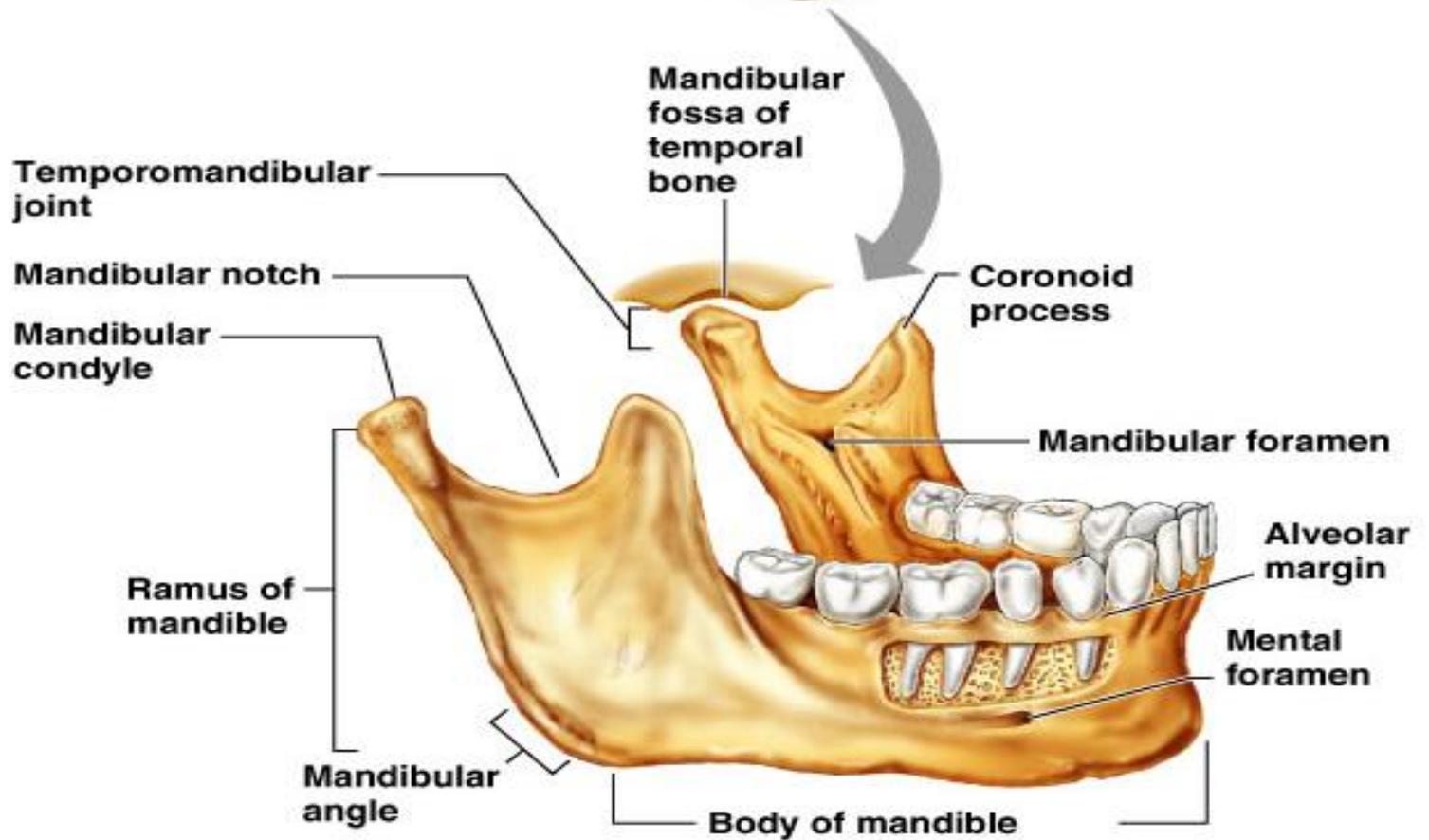
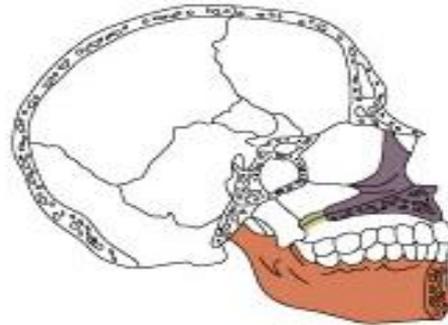


Inferior Portion of the Skull



Mandible

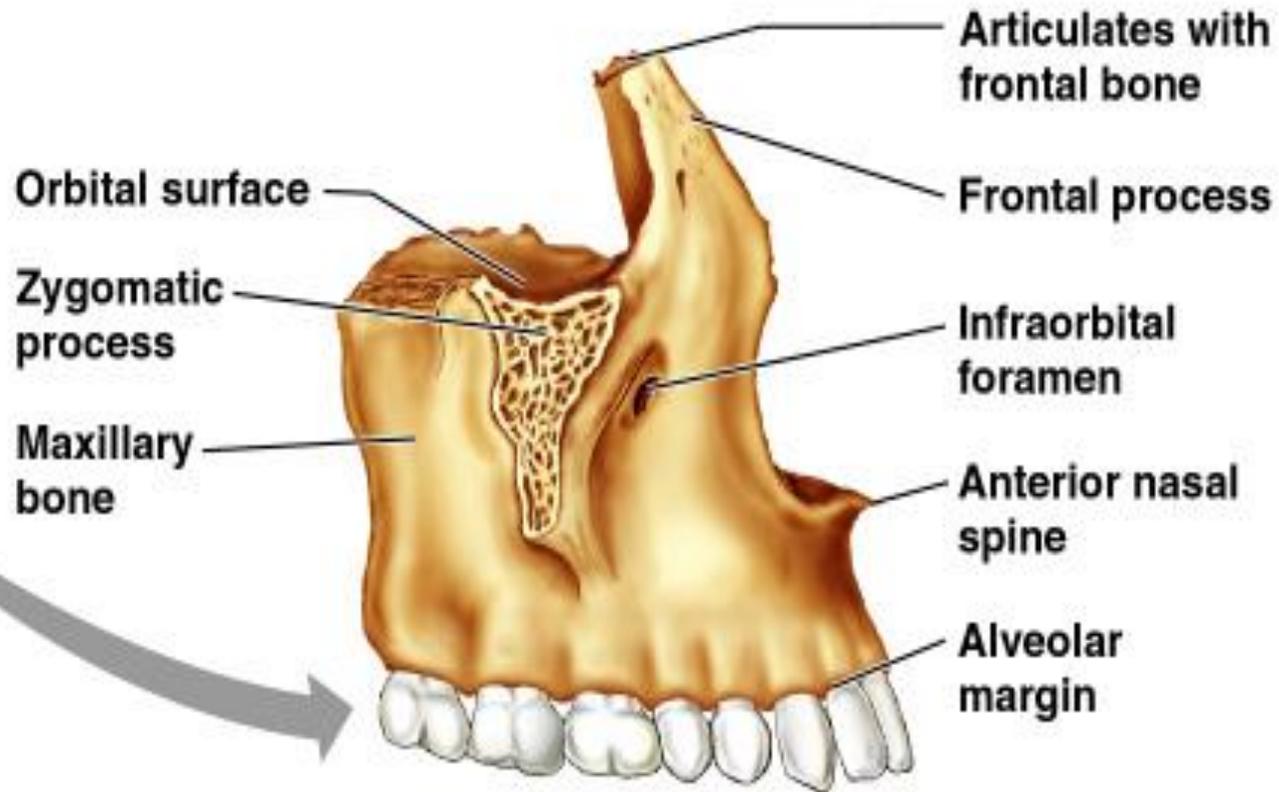
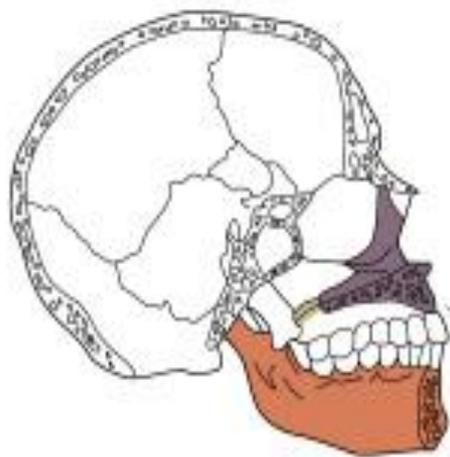
The mandible (lower jawbone) is the largest, strongest bone of the face



Maxillary Bone

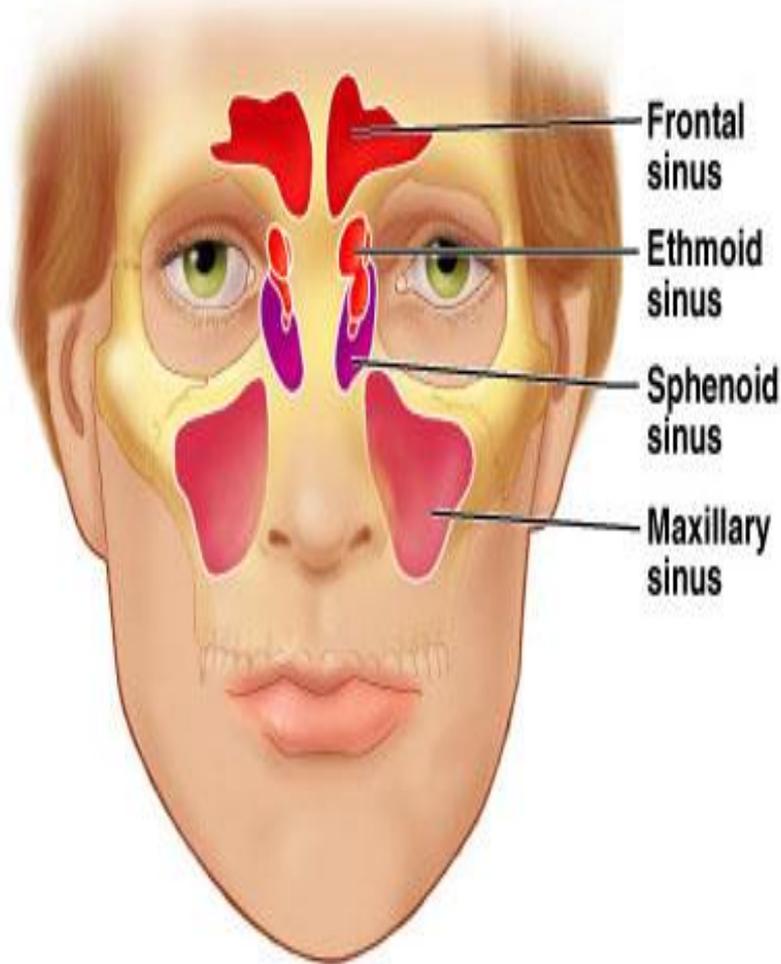
Medially fused bones that make up the upper jaw and the central portion of the facial skeleton

Facial keystone bones that articulate with all other facial bones except the mandible

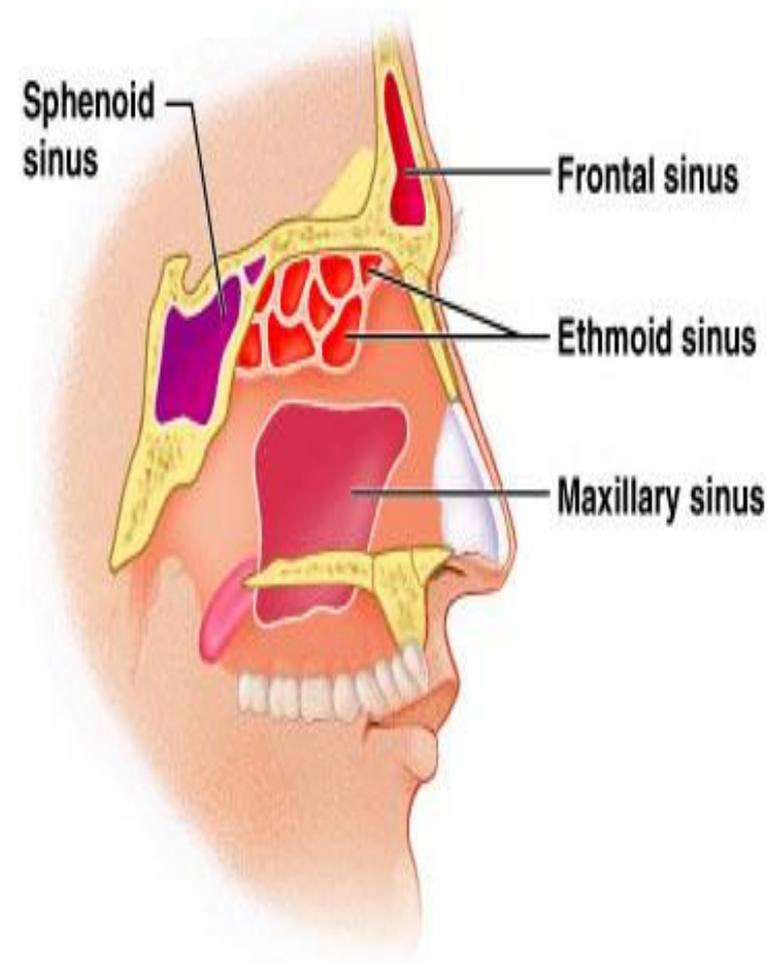


(b) Maxilla

Paranasal Sinuses



(a)



(b)

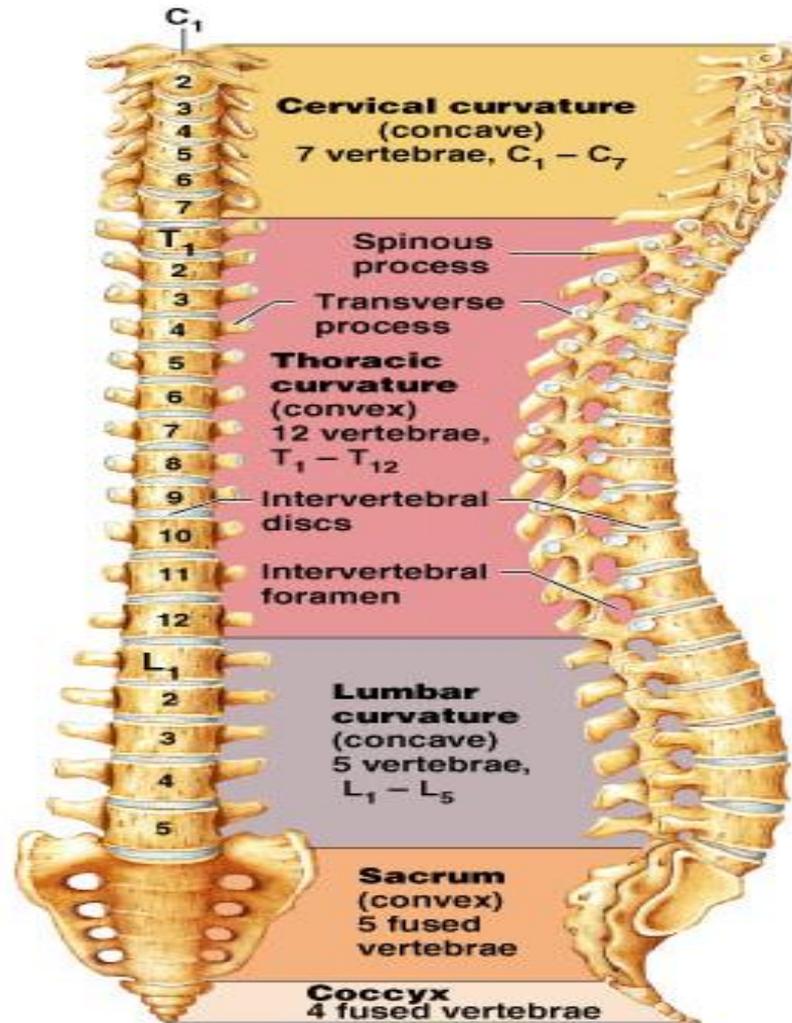
The Axial Skeleton

- Eighty bones segregated into three regions
 - Skull
 - Vertebral column
 - Bony thorax

Vertebral Column

- Formed from 26 irregular bones (vertebrae) connected in such a way that a flexible curved structure results
 - Cervical vertebrae – 7 bones of the neck
 - Thoracic vertebrae – 12 bones of the torso
 - Lumbar vertebrae – 5 bones of the lower back
 - Sacrum – bone inferior to the lumbar vertebrae that articulates with the hip bones

Vertebral Column



Anterior view

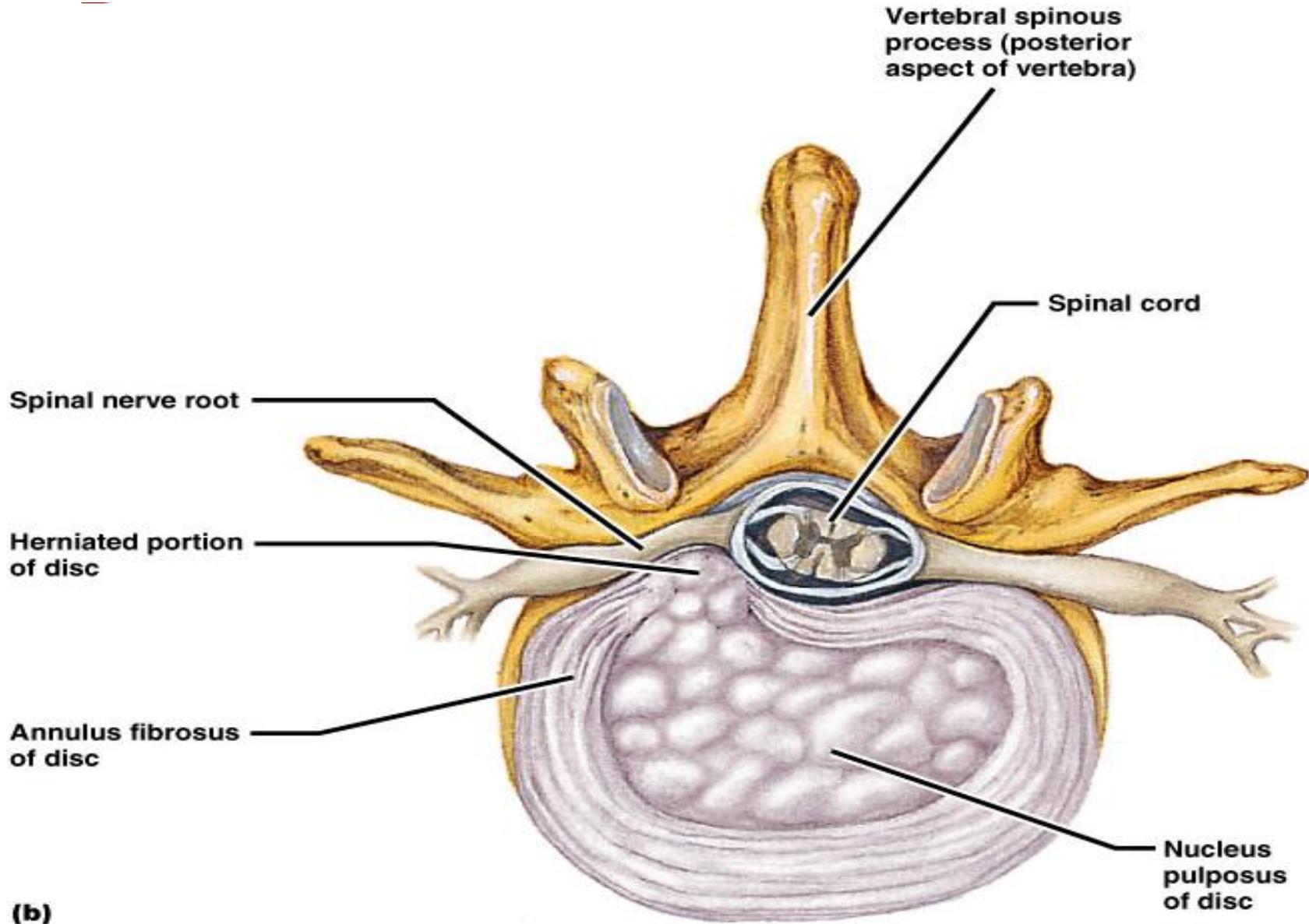
Vertebral Column: Curvatures

- Posteriorly concave curvatures – cervical and lumbar
- Posteriorly convex curvatures – thoracic and sacral
- Abnormal spine curvatures include scoliosis (abnormal lateral curve), kyphosis (hunchback), and lordosis (swayback)

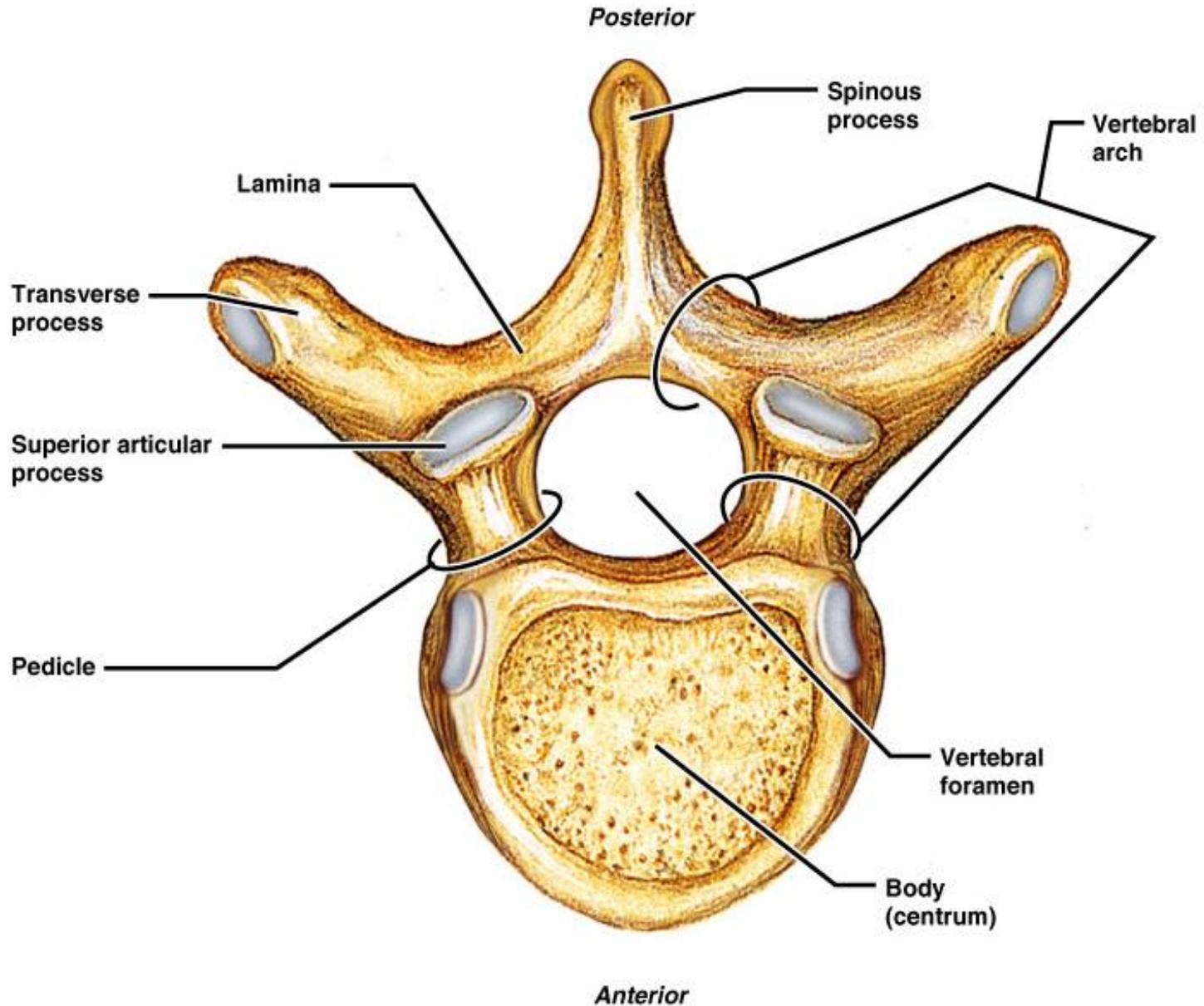
Vertebral Column: Intervertebral Discs

- Cushionlike pad composed of two parts
 - Nucleus pulposus – inner gelatinous nucleus that gives the disc its elasticity and compressibility
 - Annulus fibrosus – surrounds the nucleus pulposus with a collar composed of collagen and fibrocartilage

Vertebral Column: Intervertebral



General Structure of Vertebrae



Vertebral Column

- Formed from 26 irregular bones (vertebrae) connected in such a way that a flexible curved structure results
 - Cervical vertebrae – 7 bones of the neck
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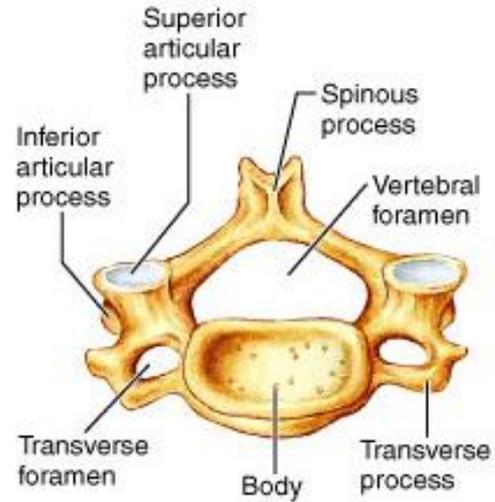
Cervical Vertebrae

- Seven vertebrae (C_1 - C_7) are the smallest, lightest vertebrae
- C_3 - C_7 are distinguished with an oval body, short spinous processes, and large, triangular vertebral foramina
- Each transverse process contains a transverse foramen

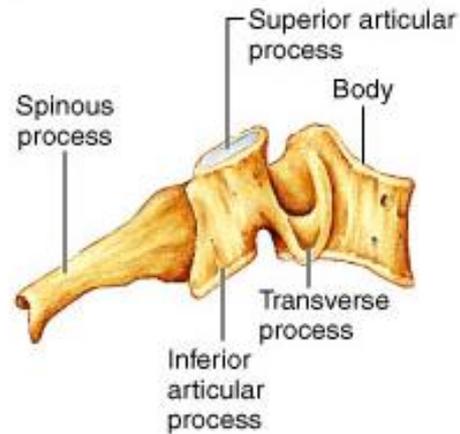
Cervical Vertebrae

Cervical (3-7)

Superior View



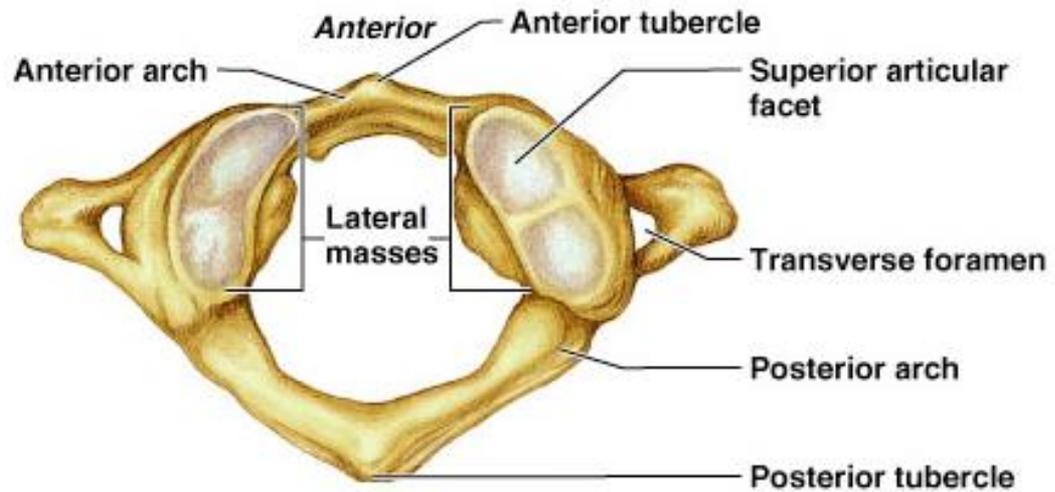
Right Lateral View



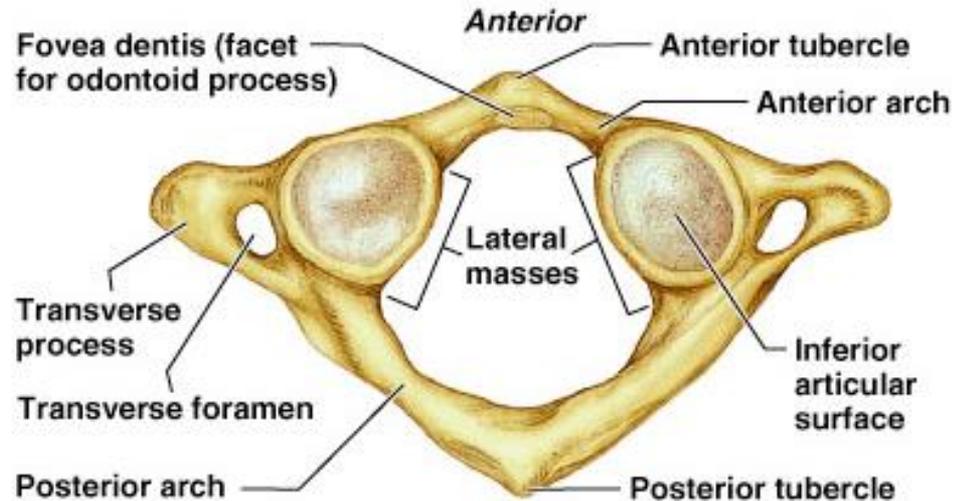
Cervical Vertebrae: The Atlas (C₁)

- The atlas has no body and no spinous process
- It consists of anterior and posterior arches, and two lateral masses
- The superior surfaces of lateral masses articulate with the occipital condyles

Cervical Vertebrae: The Atlas (C₁)



(a) Superior view of atlas (C₁)

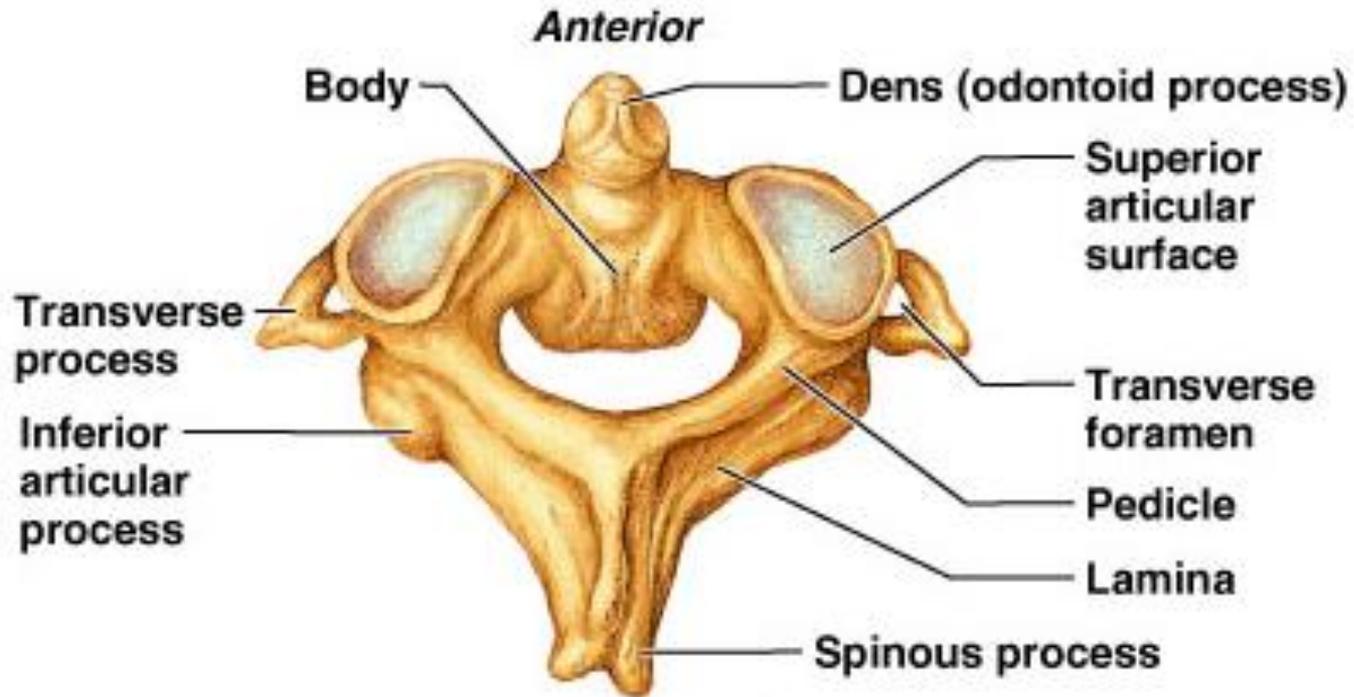


(b) Inferior view of atlas (C₁)

Cervical Vertebrae: The Axis (C₂)

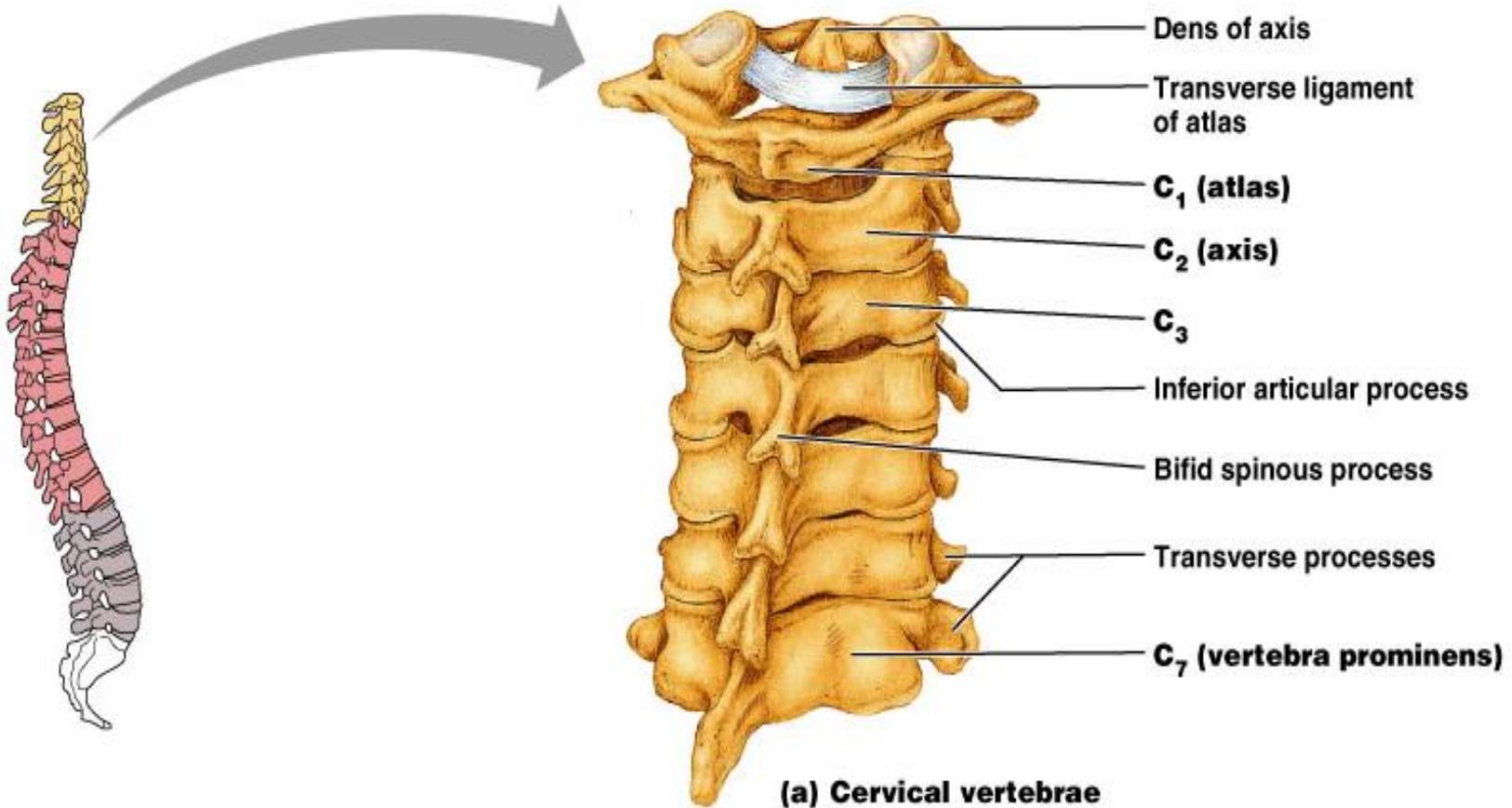
- The axis has a body, spine, and vertebral arches as do other cervical vertebrae
- Unique to the axis is the dens, or odontoid process, which projects superiorly from the body and is cradled in the anterior arch of the atlas
- The dens is a pivot for the rotation of the atlas

Cervical Vertebrae: The Axis (C₂)



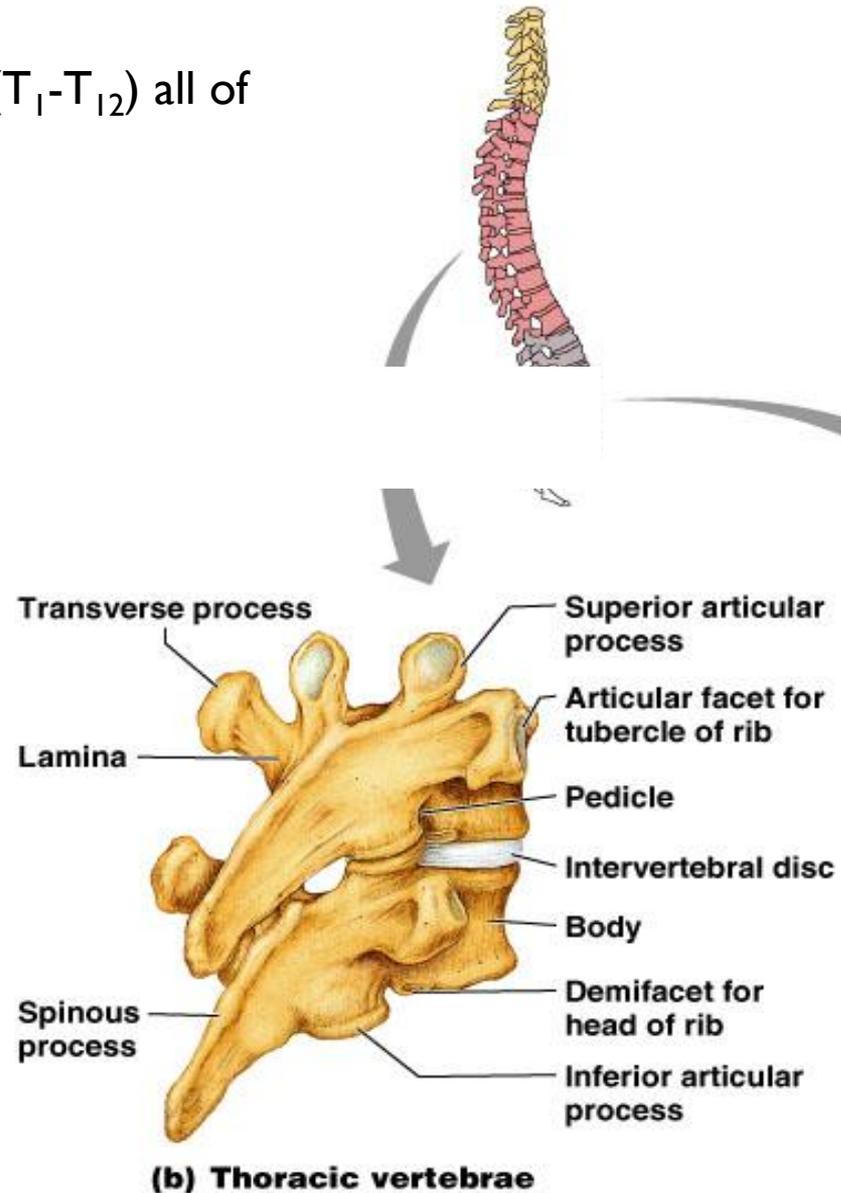
(c) Superior view of axis (C₂)

Cervical Vertebrae: The Atlas (C₂)



Thoracic Vertebrae

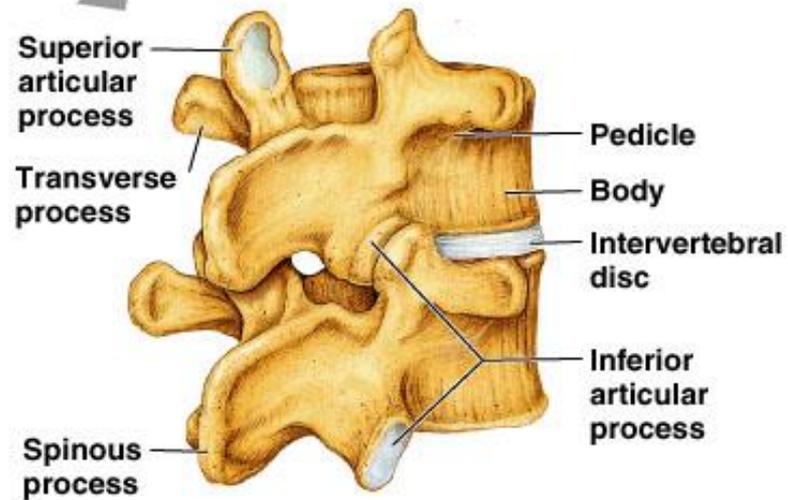
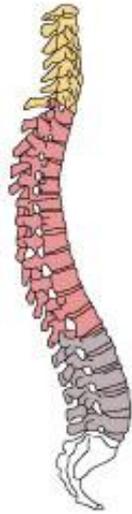
There are twelve vertebrae (T₁-T₁₂) all of which articulate with ribs



Lumbar Vertebrae

- The five lumbar vertebrae (L₁-L₅) are located in the small of the back and have an enhanced weight-bearing function
- They have short, thick pedicles and laminae, flat hatchet-shaped spinous processes, and a triangular-shaped vertebral foramen
- Orientation of articular facets locks the lumbar vertebrae together to provide stability

Lumbar Vertebrae



(c) Lumbar vertebrae

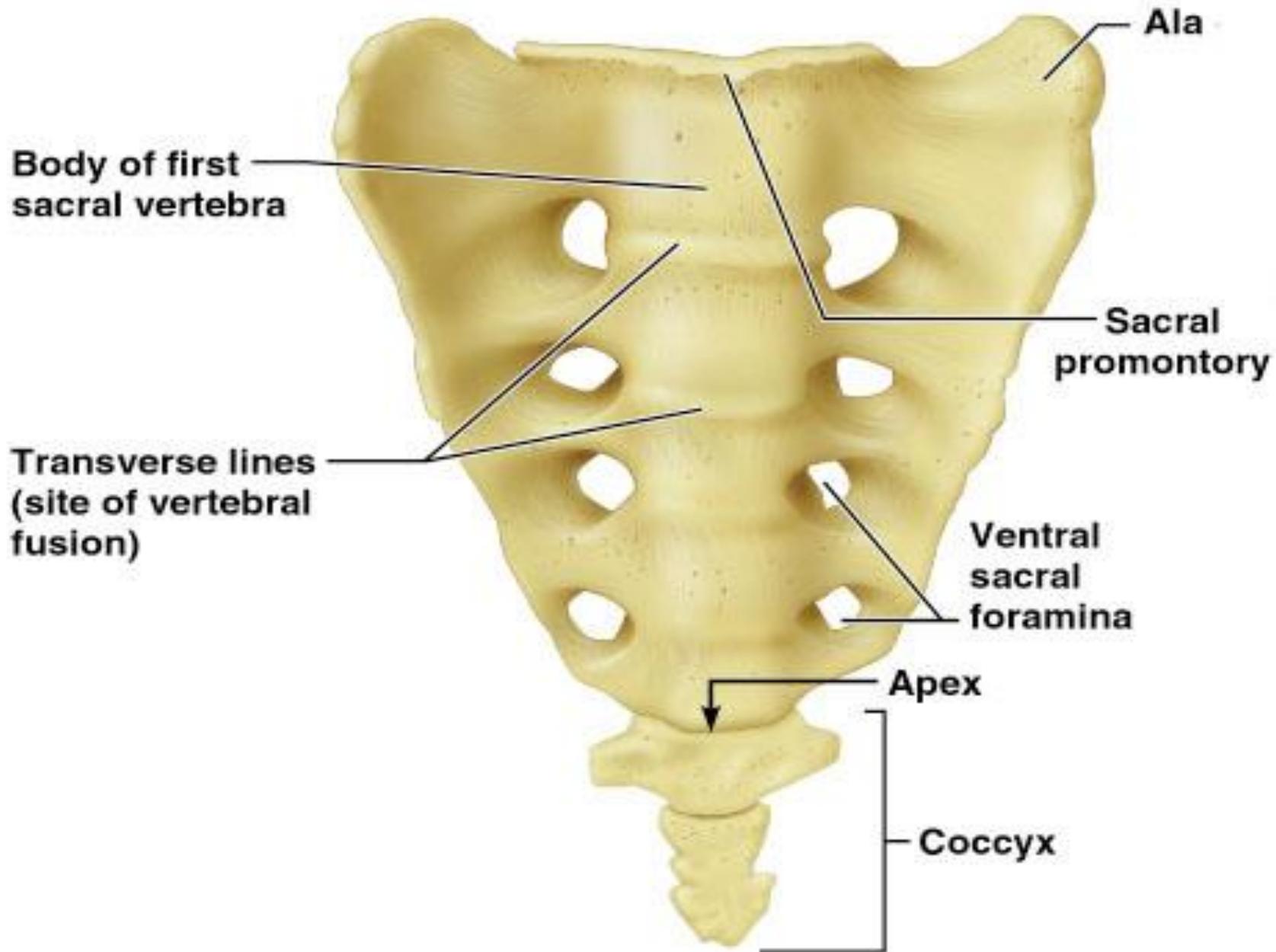
Sacrum

- Sacrum
 - Consists of five fused vertebrae (S_1 - S_5), which shape the posterior wall of the pelvis
 - It articulates with L_5 superiorly, and with the auricular surfaces of the hip bones

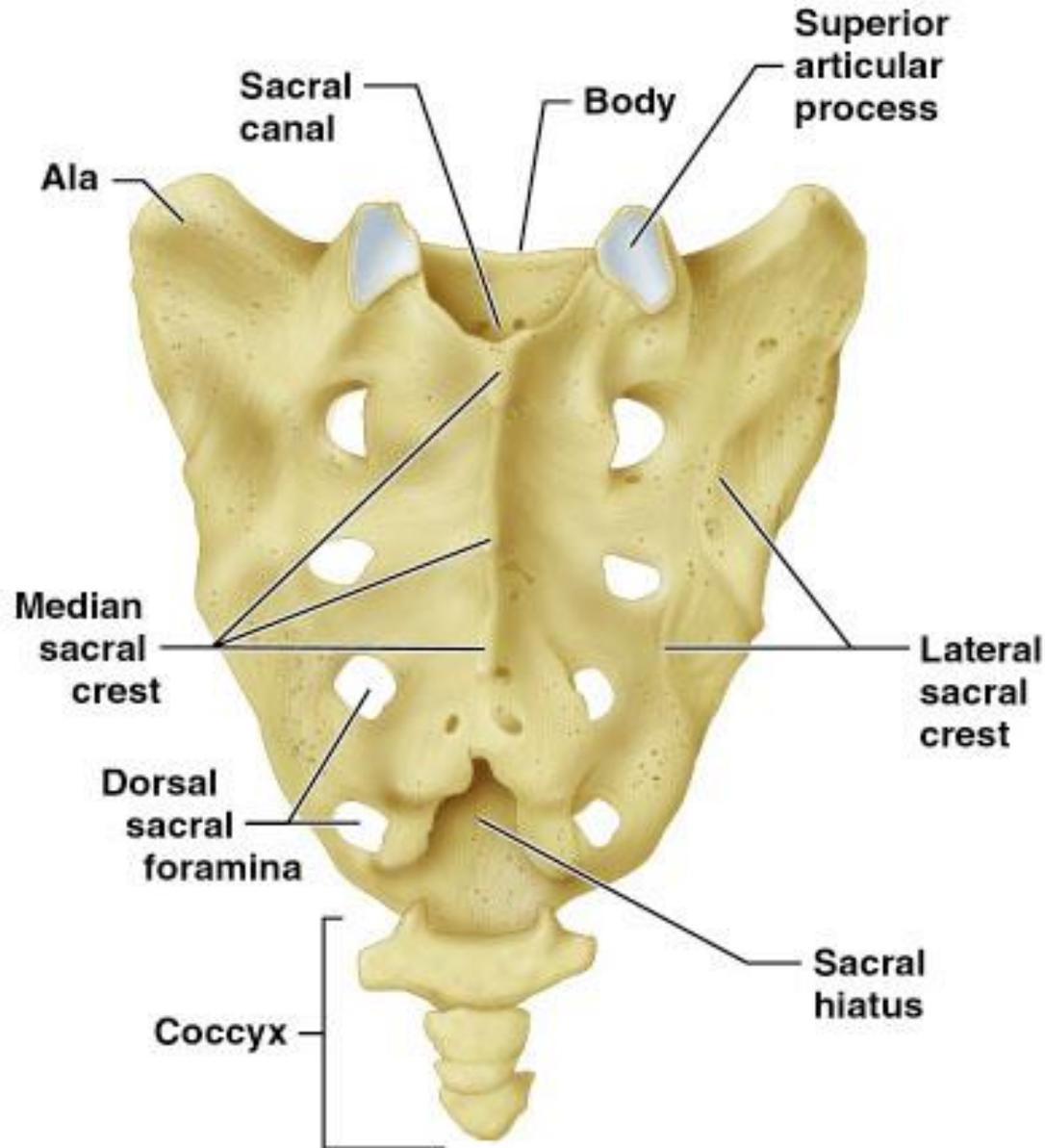
Coccyx

- Coccyx (Tailbone)
 - The coccyx is made up of four (in some cases three to five) fused vertebrae that articulate superiorly with the sacrum

Sacrum and Coccyx: Anterior View



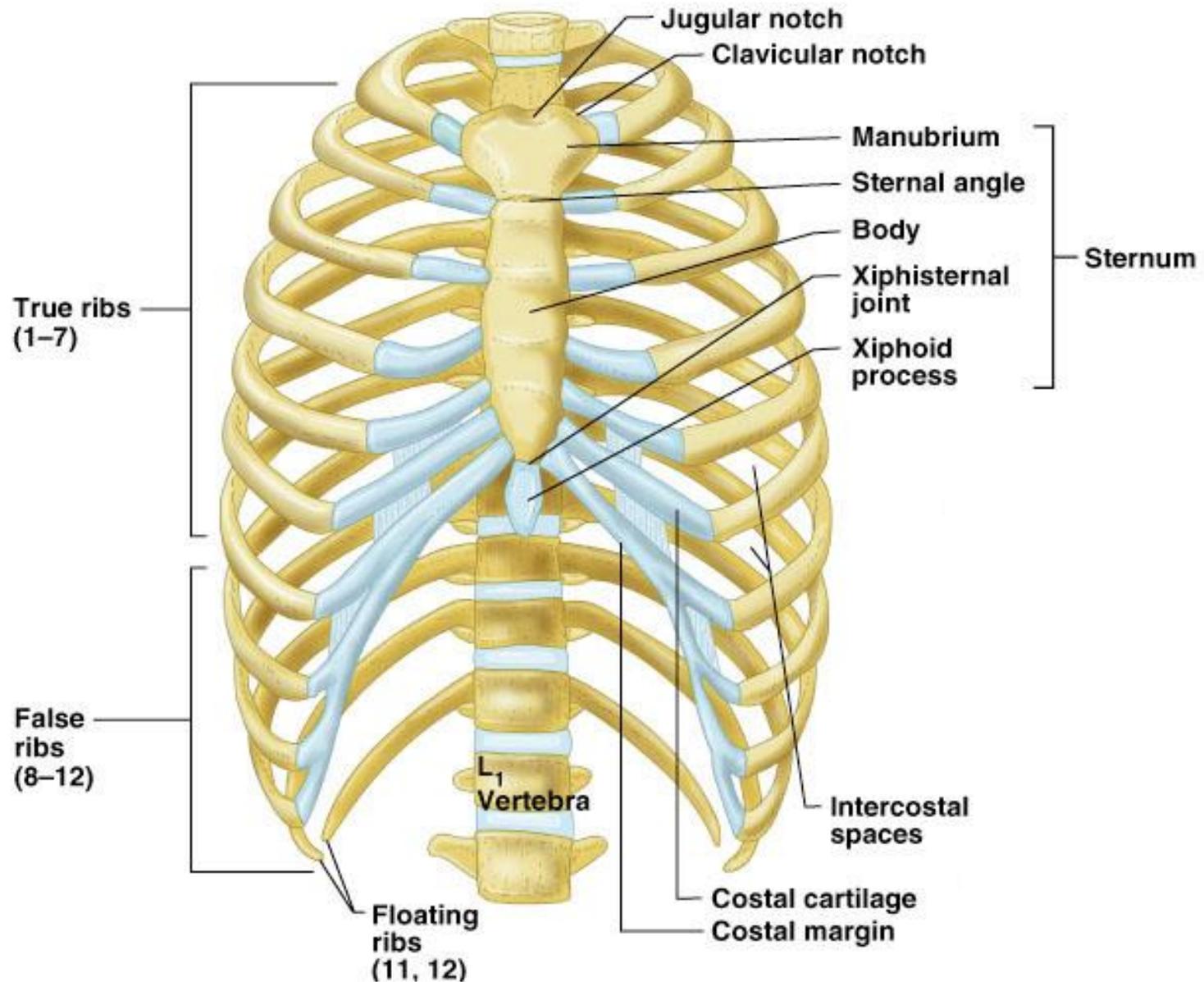
Sacrum and Coccyx: Posterior View



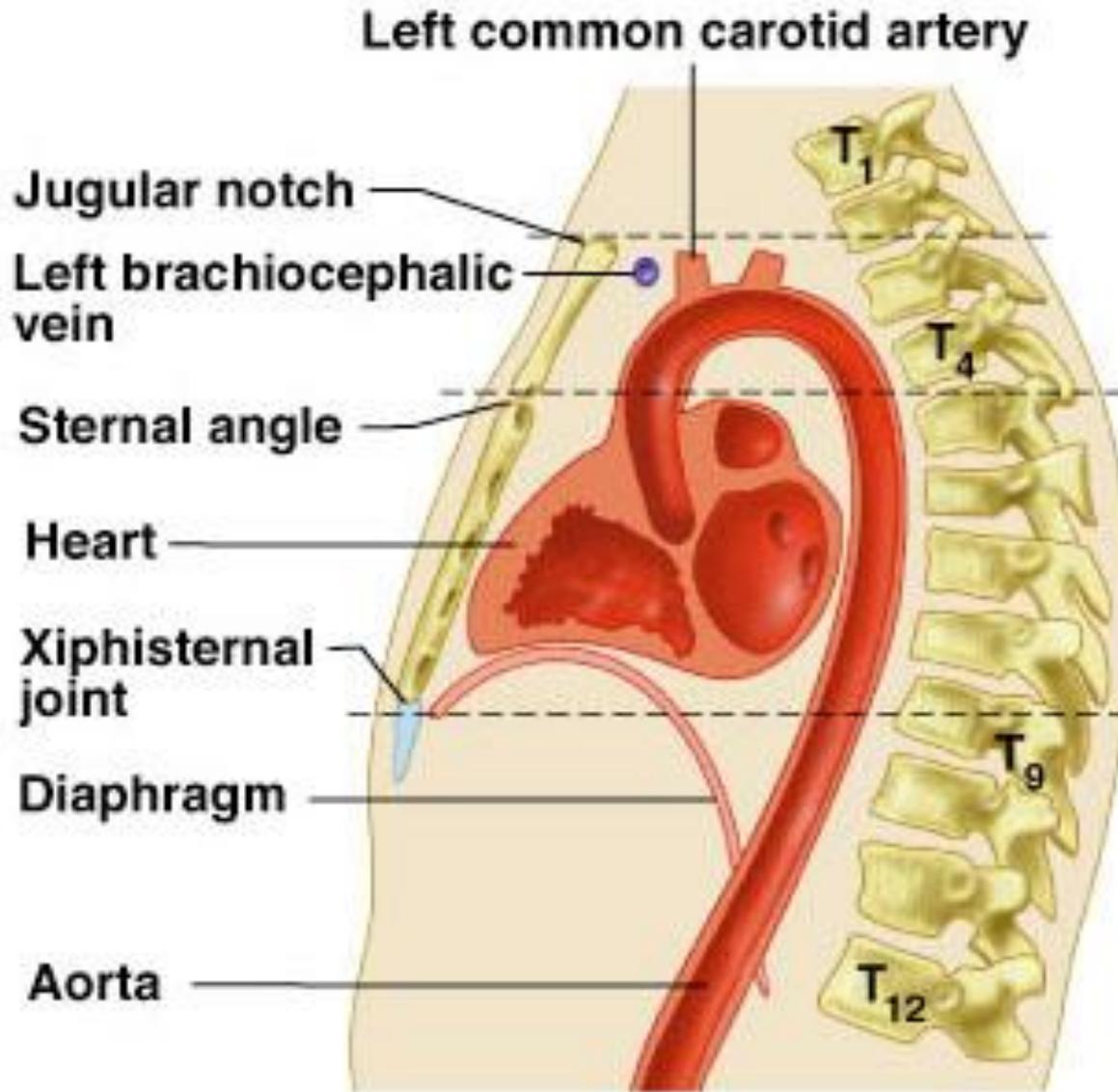
Bony Thorax (Thoracic Cage)

- The thoracic cage is composed of the thoracic vertebrae dorsally, the ribs laterally, and the sternum and costal cartilages anteriorly
- Functions
 - Forms a protective cage around the heart, lungs, and great blood vessels
 - Supports the shoulder girdles and upper limbs
 - Provides attachment for many neck, back, chest, and shoulder muscles
 - Uses intercostal muscles to lift and depress the thorax during breathing

Bony Thorax (Thoracic Cage)



Bony Thorax (Thoracic Cage)



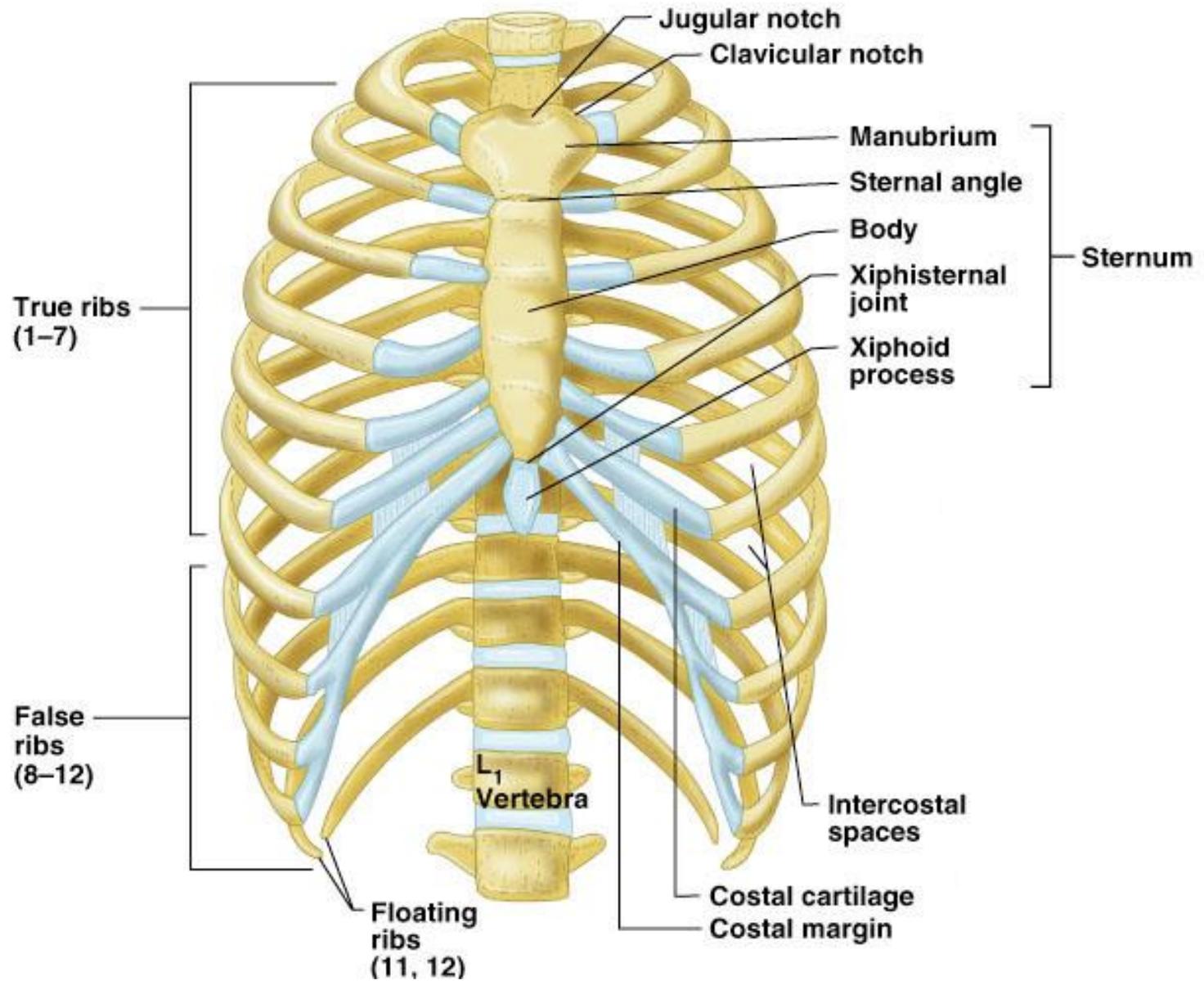
Sternum (Breastbone)

- A dagger-shaped, flat bone that lies in the anterior midline of the thorax
- Anatomical landmarks include the jugular (suprasternal) notch, the sternal angle, and the xiphisternal joint

Ribs

- There are twelve pair of ribs forming the flaring sides of the thoracic cage
- All ribs attach posteriorly to the thoracic vertebrae
- The superior 7 pair (true, or vertebrosteral ribs) attach directly to the sternum via costal cartilages
- Ribs 8-10 (false, or vertebrocondral ribs) attach indirectly to the sternum via costal cartilage
- Ribs 11-12 (floating, or vertebral ribs) have no anterior attachment

Ribs



The Appendicular Skeleton



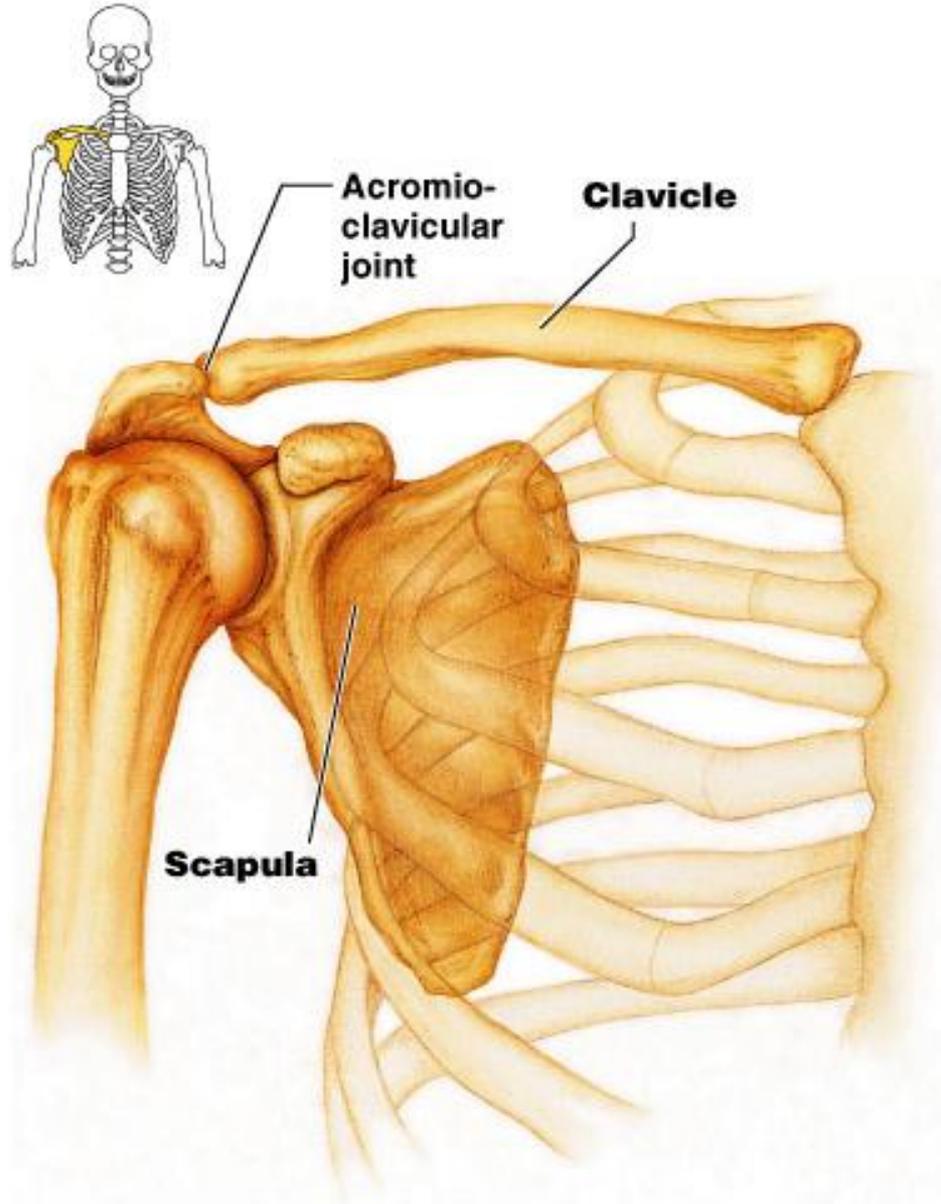
Appendicular Skeleton

- The appendicular skeleton is made up of the bones of the limbs and their girdles
- Pectoral girdles attach the upper limbs to the body trunk
- Pelvic girdle secures the lower limbs

Pectoral Girdles (Shoulder Girdles)

- The pectoral girdles consist of the anterior clavicles and the posterior scapulae
- They attach the upper limbs to the axial skeleton in a manner that allows for maximum movement
- They provide attachment points for muscles that move the upper limbs

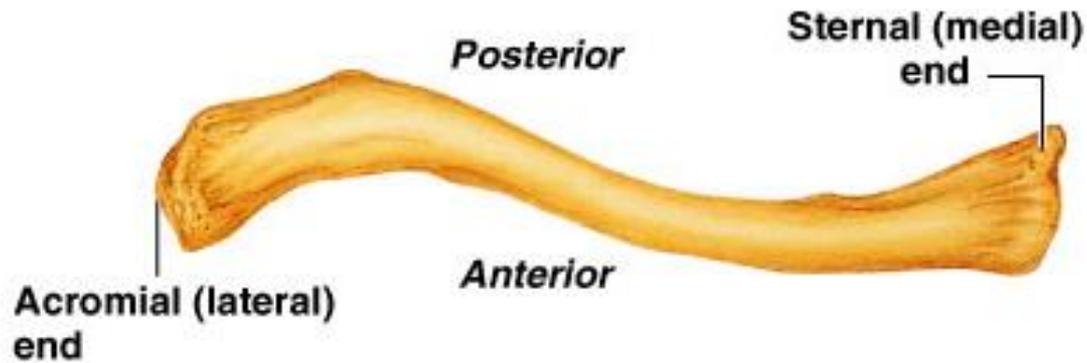
Pectoral Girdles (Shoulder Girdles)



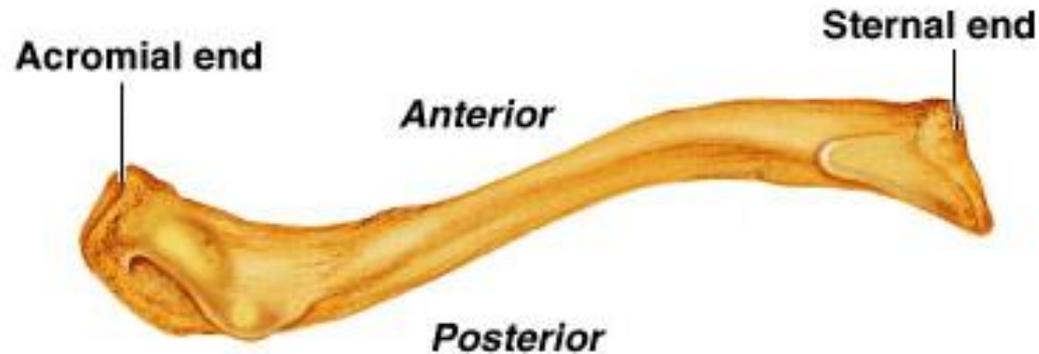
Clavicles (Collarbones)

- The clavicles are slender, doubly curved long bones lying across the superior thorax
- The acromial (lateral) end articulates with the scapula, and the sternal (medial) end articulates with the sternum
- They provide attachment points for numerous muscles, and act as braces to hold the scapulae and arms out laterally away from the body

Clavicles (Collarbones)



(b) Right clavicle, superior view

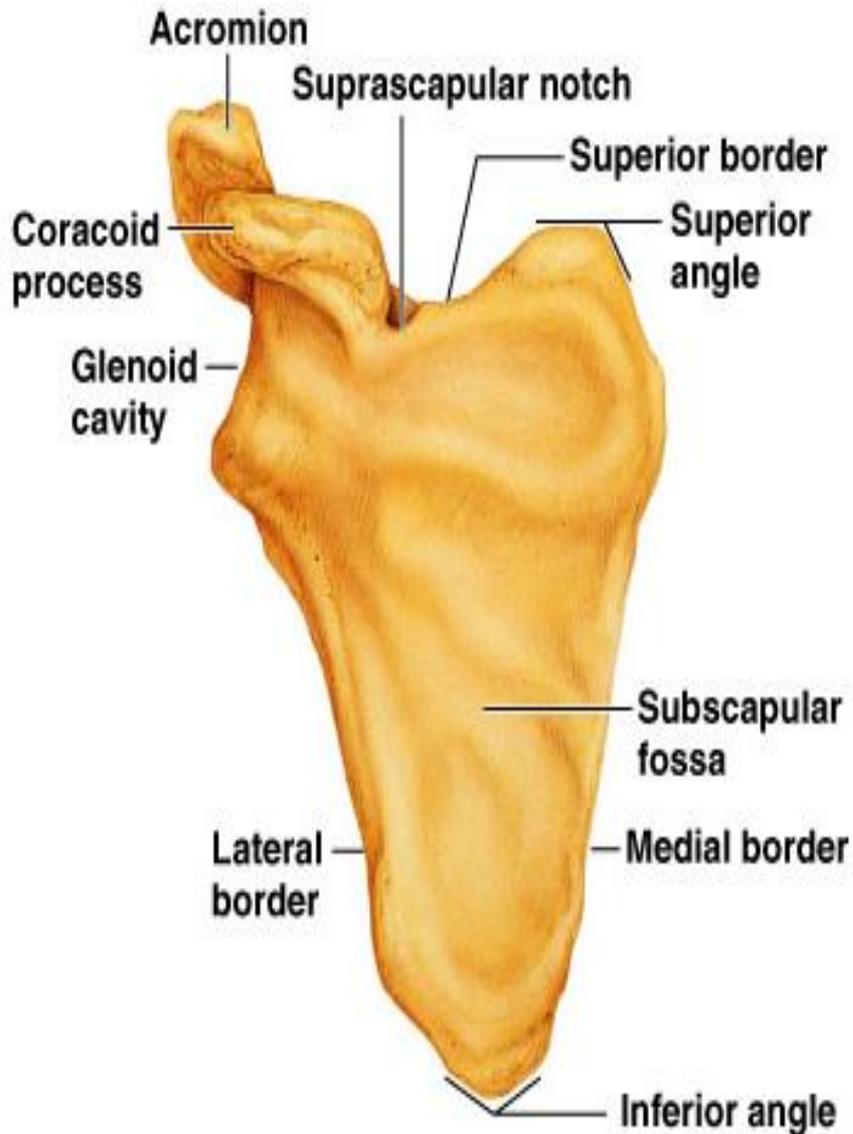


(c) Right clavicle, inferior view

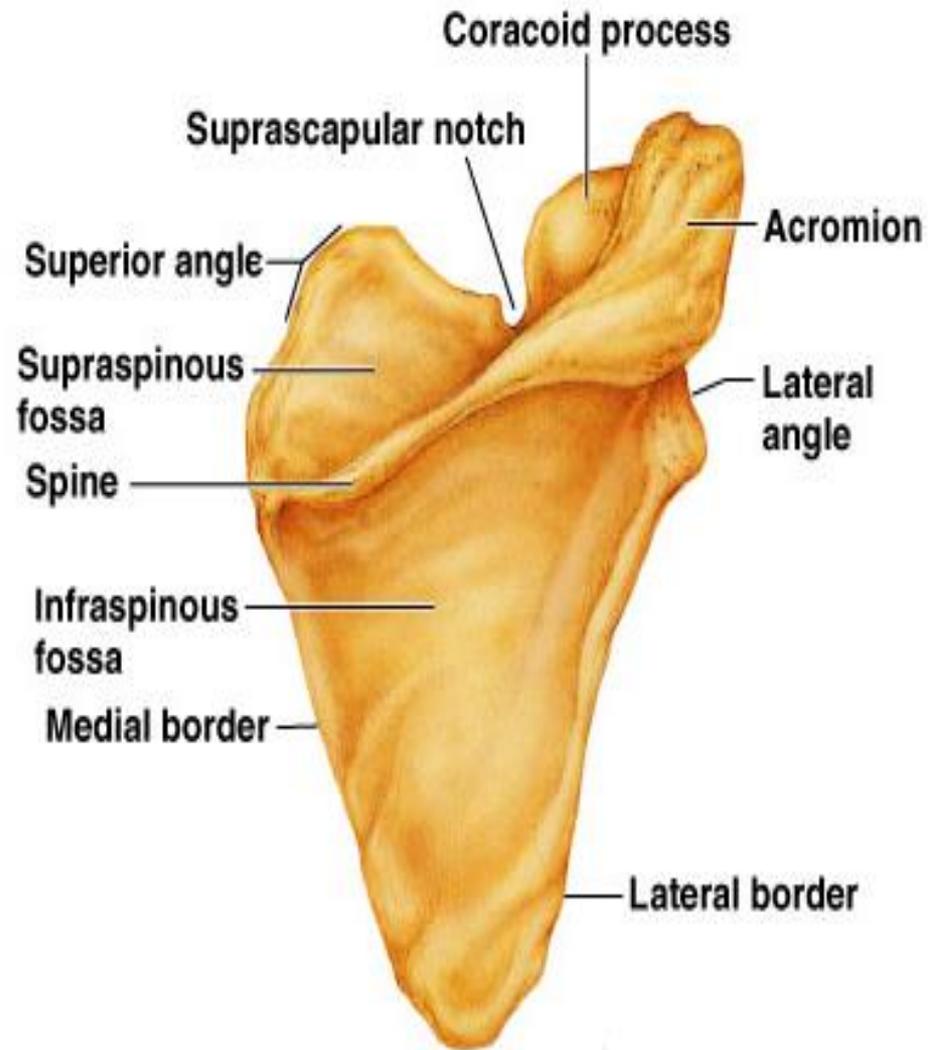
Scapulae (Shoulder Blades)

- The scapulae are triangular, flat bones lying on the dorsal surface of the rib cage, between the second and seventh ribs
- Scapulae have three borders and three angles
- Major markings include the suprascapular notch, the supraspinous and infraspinous fossae, the spine, the acromion, and the coracoid process

Scapulae (Shoulder Blades)



(d) Right scapula, anterior aspect



(e) Right scapula, posterior aspect

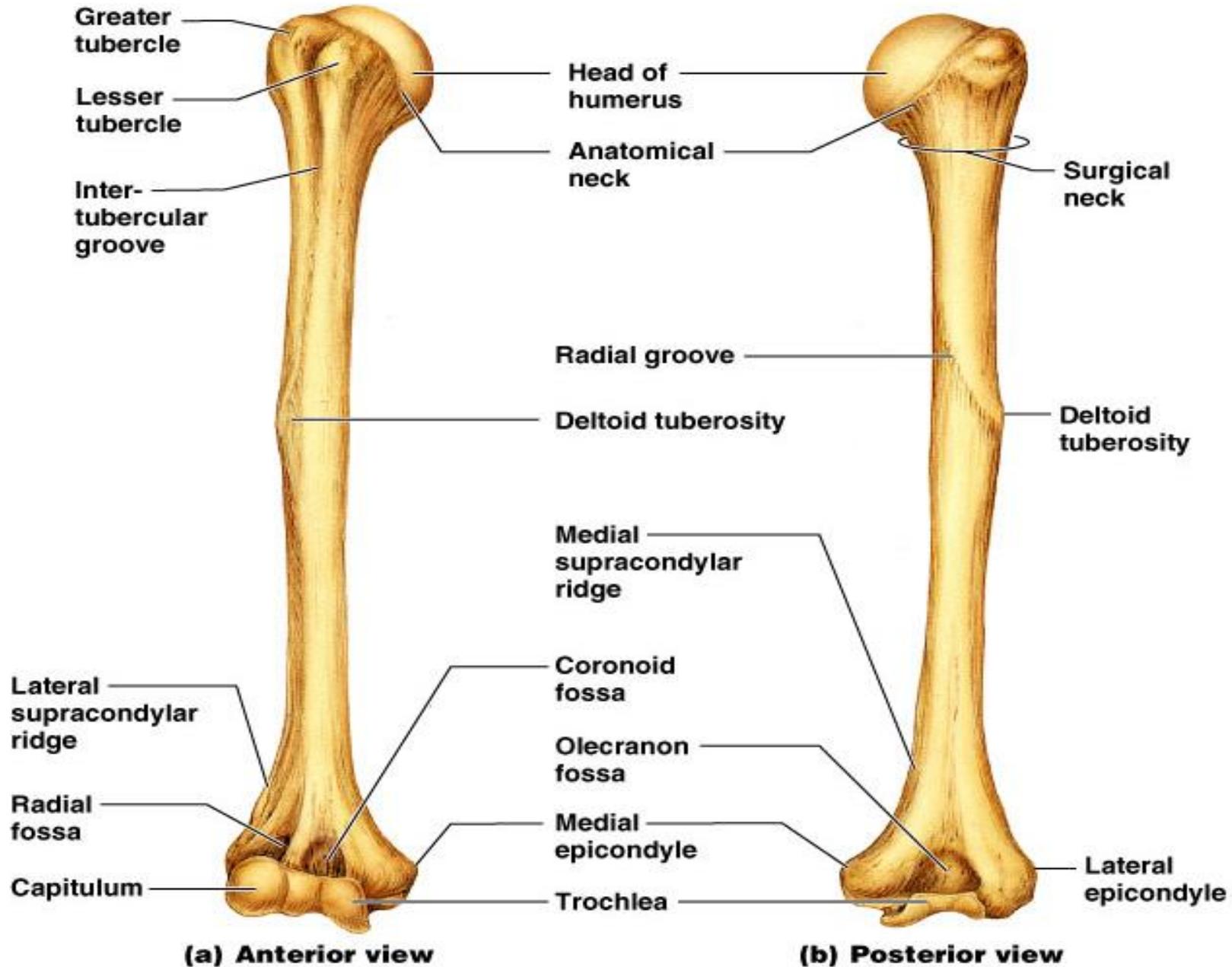
The Upper Limb

- The upper limb consists of the arm (brachium), forearm (antebrachium), and hand (manus)
- Thirty-seven bones form the skeletal framework of each upper limb

Arm

- The humerus is the sole bone of the arm
- It articulates with the scapula at the shoulder, and the radius and ulna at the elbow

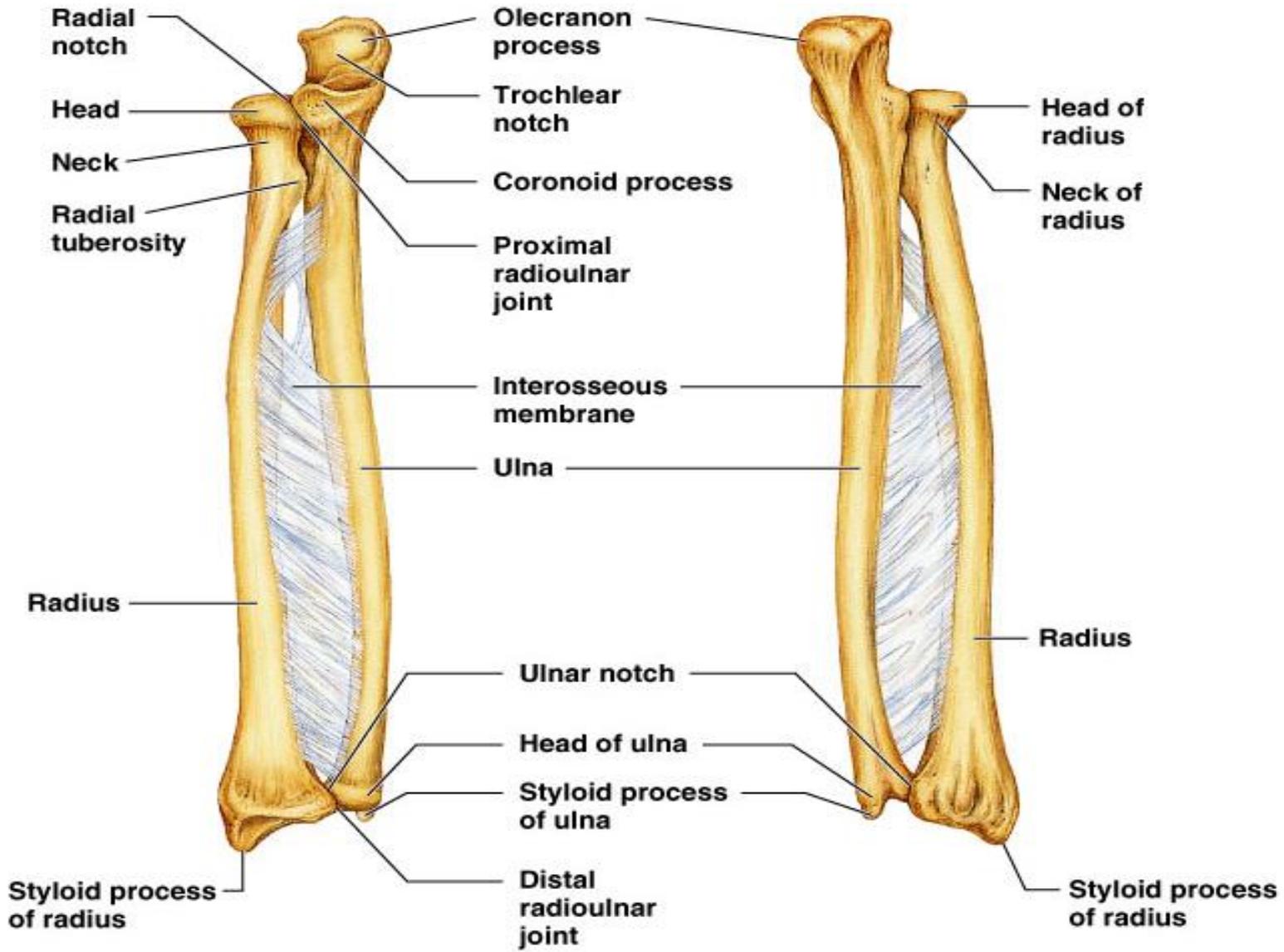
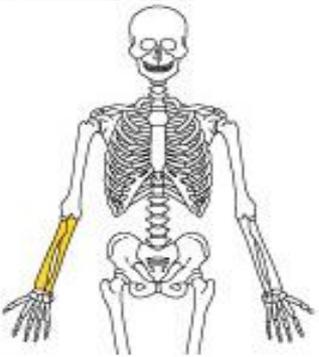
Humerus of the Arm



Forearm

- The bones of the forearm are the radius and ulna
- They articulate proximally with the humerus and distally with the wrist bones
- They also articulate with each other proximally and distally at small radioulnar joints
- Interosseous membrane connects the two bones along their entire length

Bones of the Forearm



(a) Anterior view

(b) Posterior view

Radius and Ulna

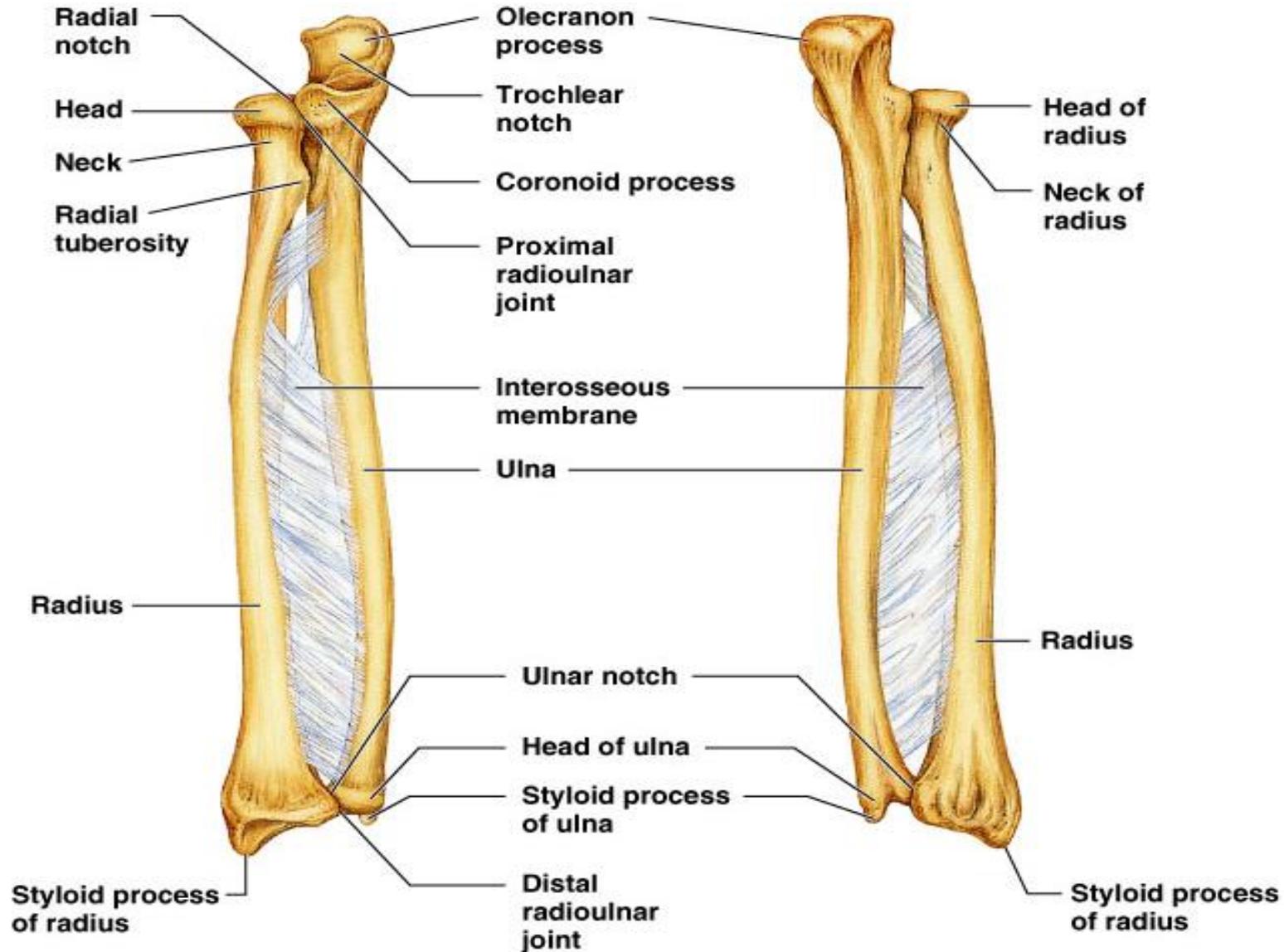
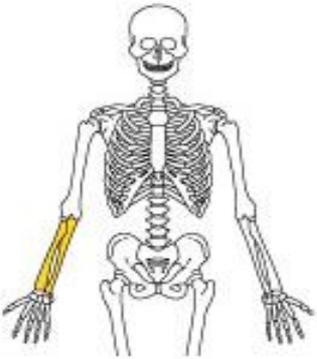
Ulna

- The ulna lies medially in the forearm and is slightly longer than the radius (non thumb side)
- Forms the major portion of the elbow joint with the humerus

Radius

- The radius lies opposite the ulna and is thin at its proximal end, widened distally (thumb side)
- The superior surface of the head articulates with the humerus

Radius and Ulna

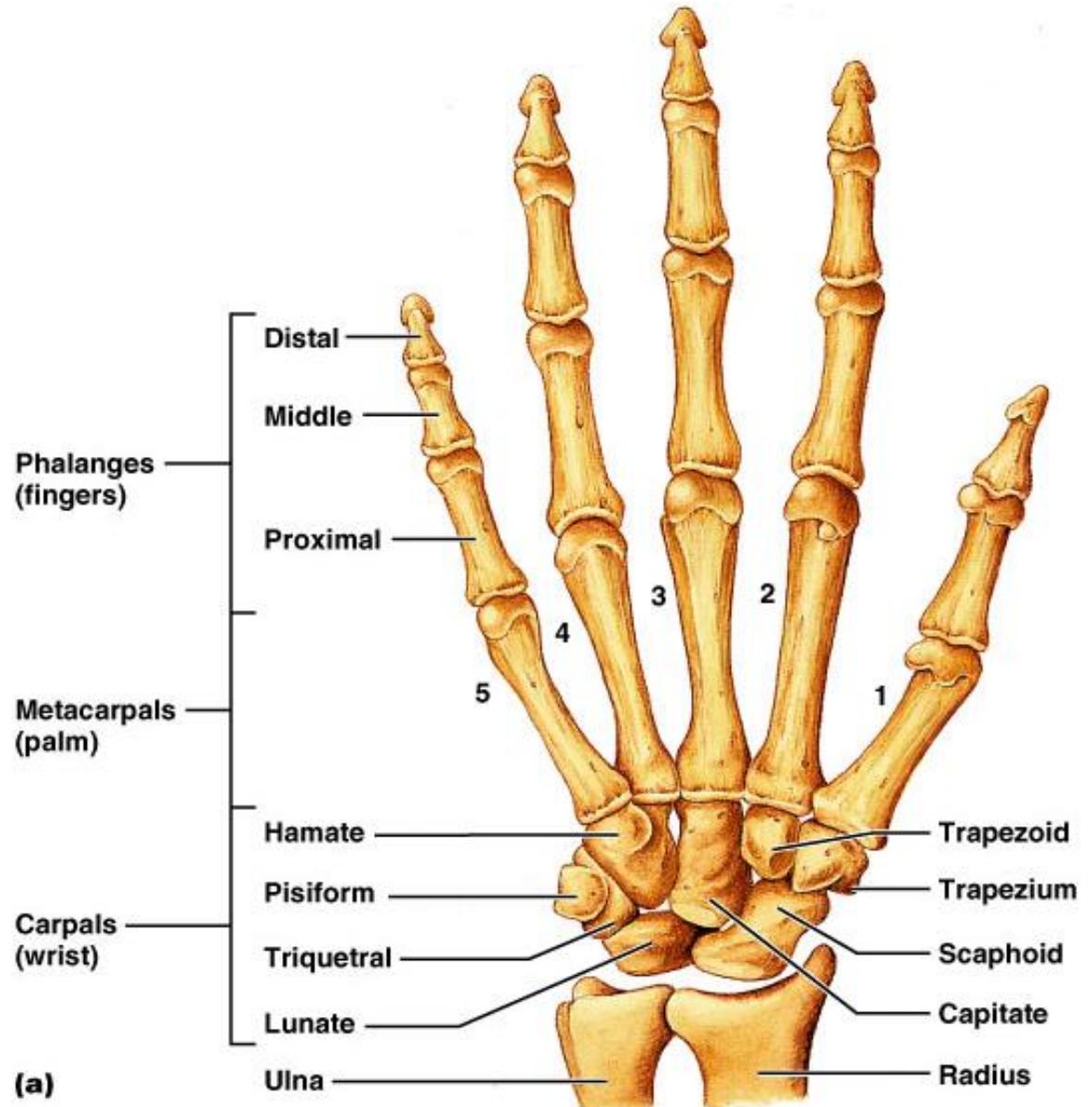


(a) Anterior view

(b) Posterior view

Hand

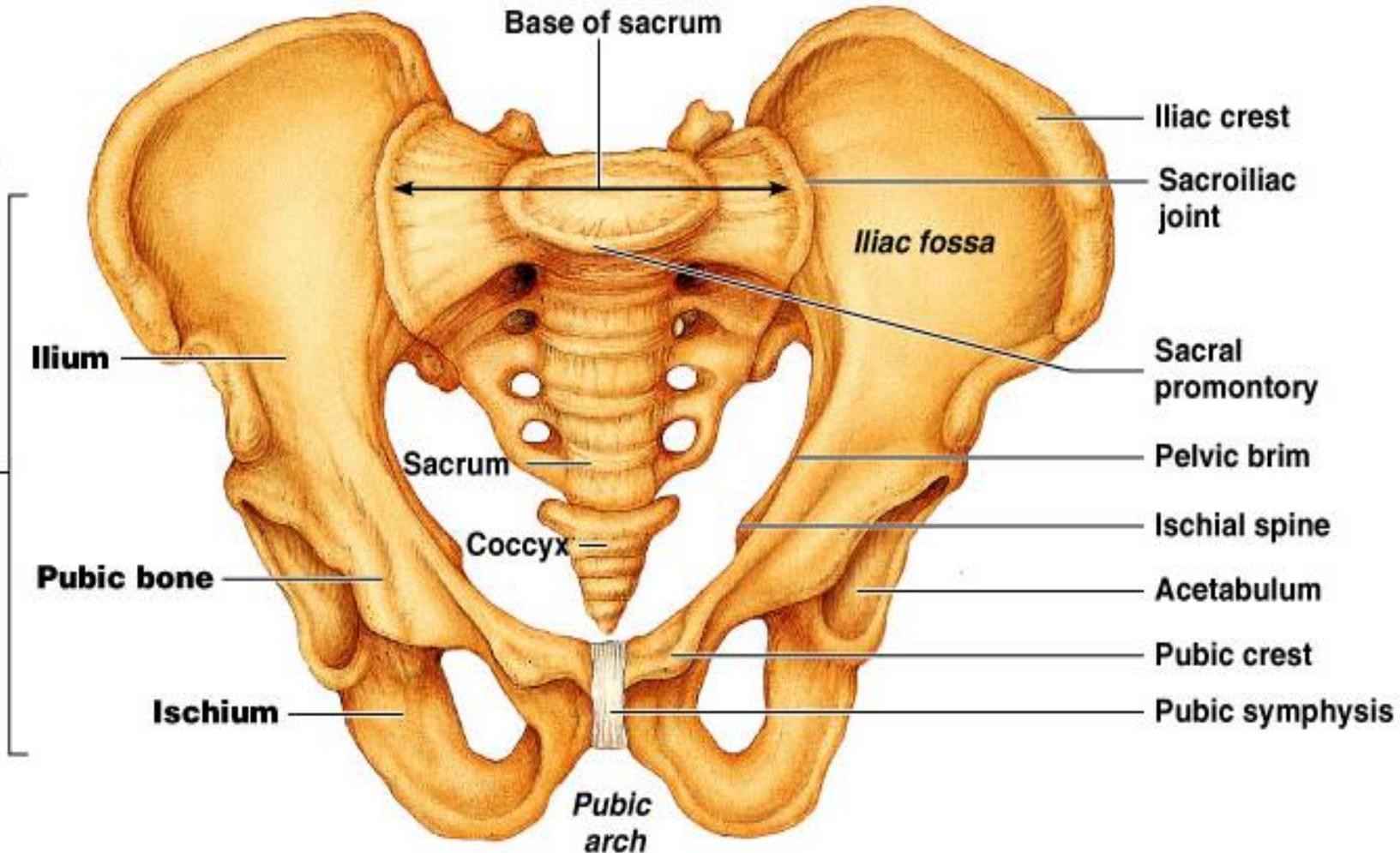
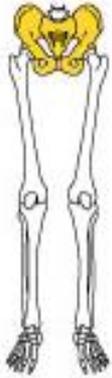
- Carpals
 - Wrist bones
- Metacarpals
 - Palm
- Phalanges
 - Fingers



Pelvic Girdle (Hip)

- The hip is formed by a pair of hip bones
- Together with the sacrum and the coccyx, these bones form the bony pelvis
- The pelvis
 - Attaches the lower limbs to the axial skeleton with the strongest ligaments of the body
 - Transmits weight of the upper body to the lower limbs
 - Supports the visceral organs of the pelvis

Pelvic Girdle (Hip)



(a)

Ilium and Ischium

Ilium

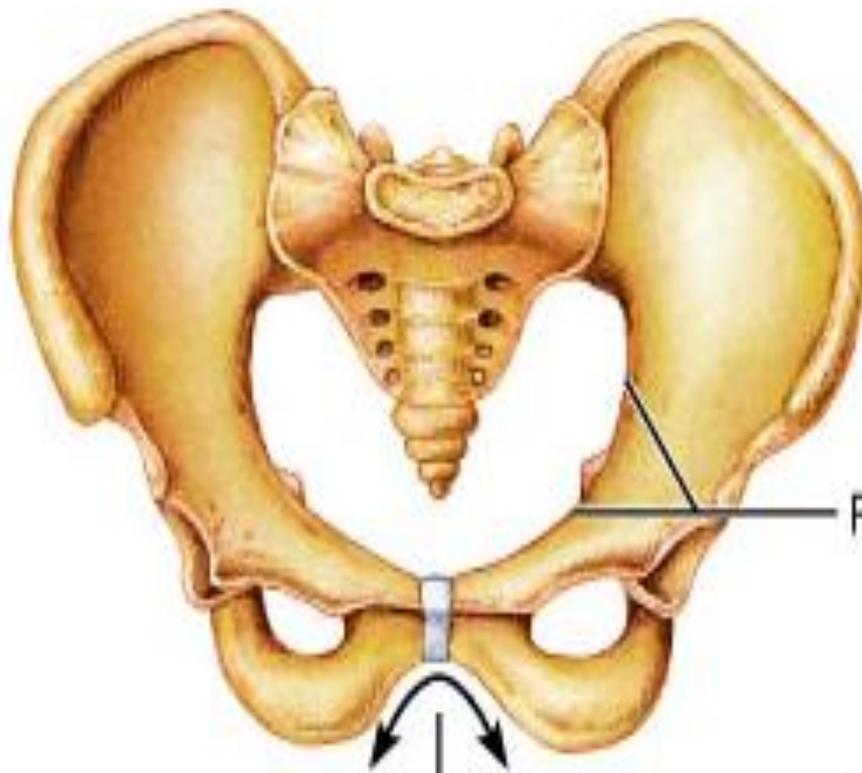
- The ilium is a large flaring bone that forms the superior region of the hip bone
 - It consists of a body and a superior winglike portion called the ala
 - The broad posterolateral surface is called the gluteal surface
- The auricular surface articulates with the sacrum (sacroiliac joint)

Ischium

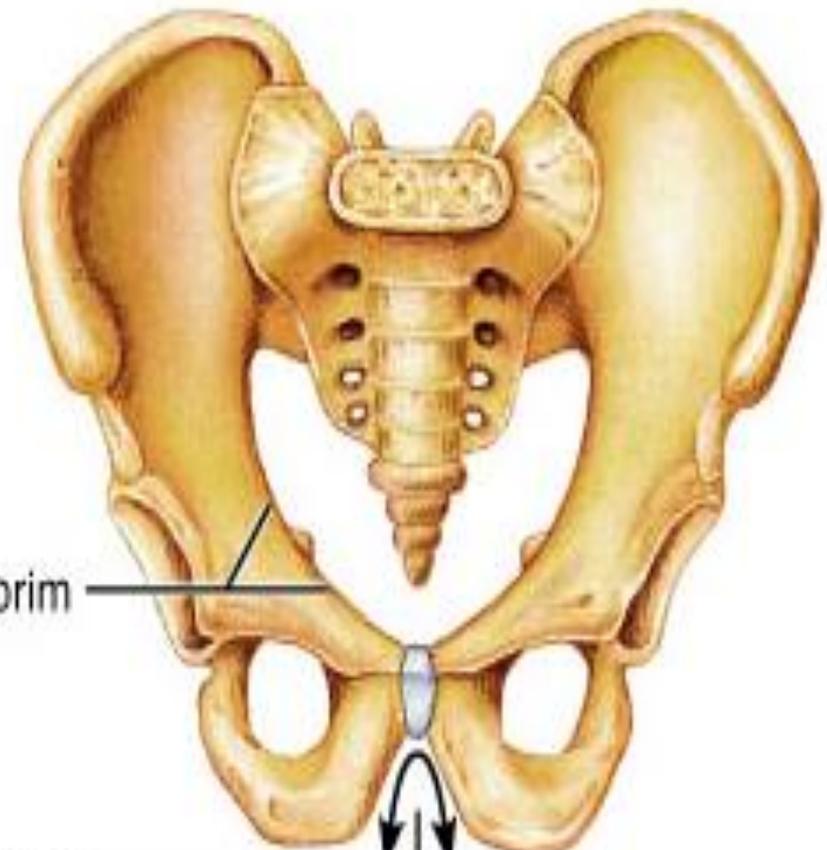
- The ischium forms the posteroinferior part of the hip bone

Comparison of Male and Female Pelvic Structure

For childbearing



For support of heavier male build and stronger muscles



Pelvic brim

Pubic arch

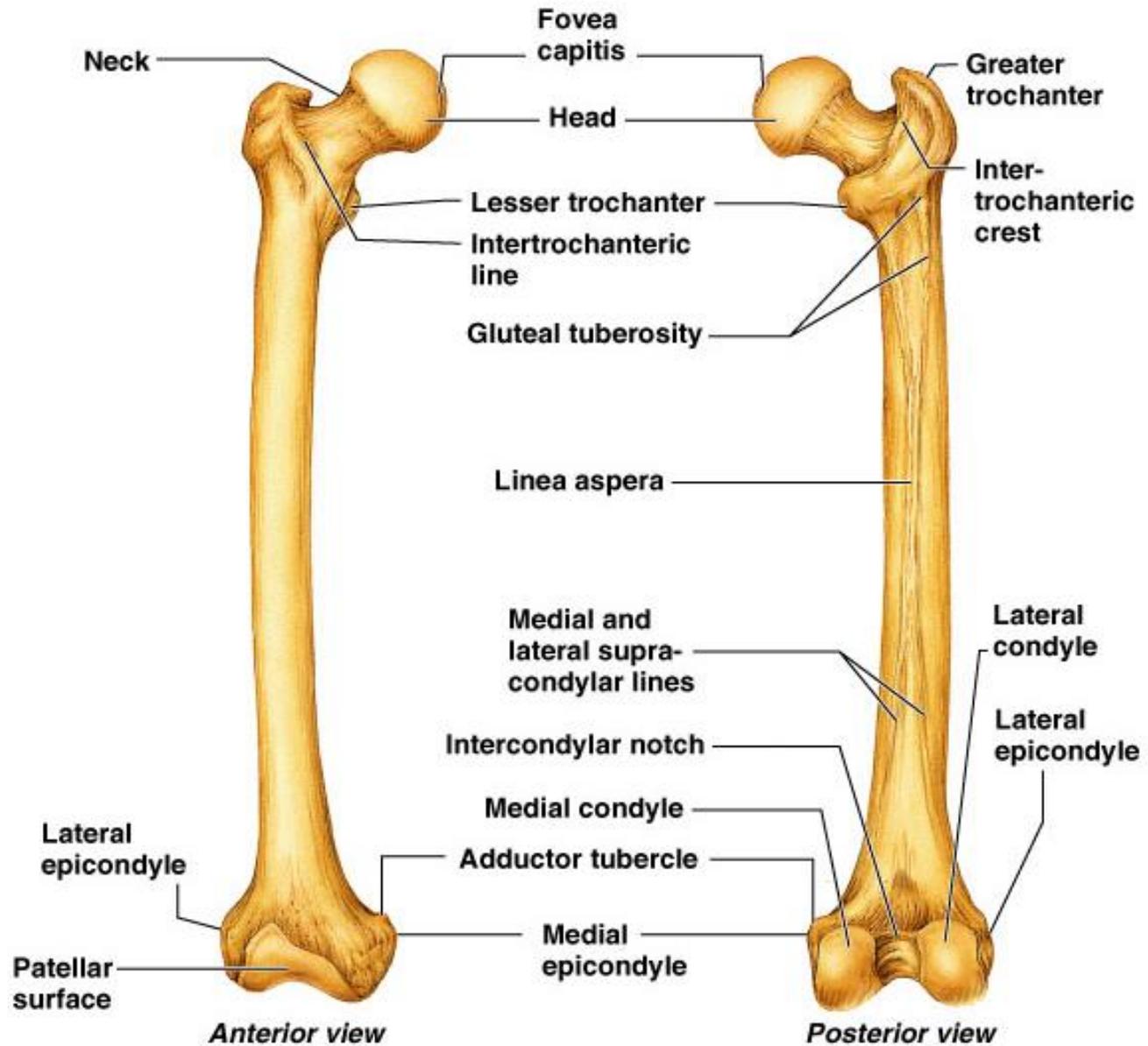
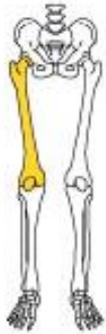
The Lower Limb

- The three segments of the lower limb are the thigh, leg, and foot
- They carry the weight of the erect body, and are subjected to exceptional forces when one jumps or runs

Femur

- The sole bone of the thigh is the femur, the largest and strongest bone in the body
- It articulates proximally with the hip and distally with the tibia and fibula

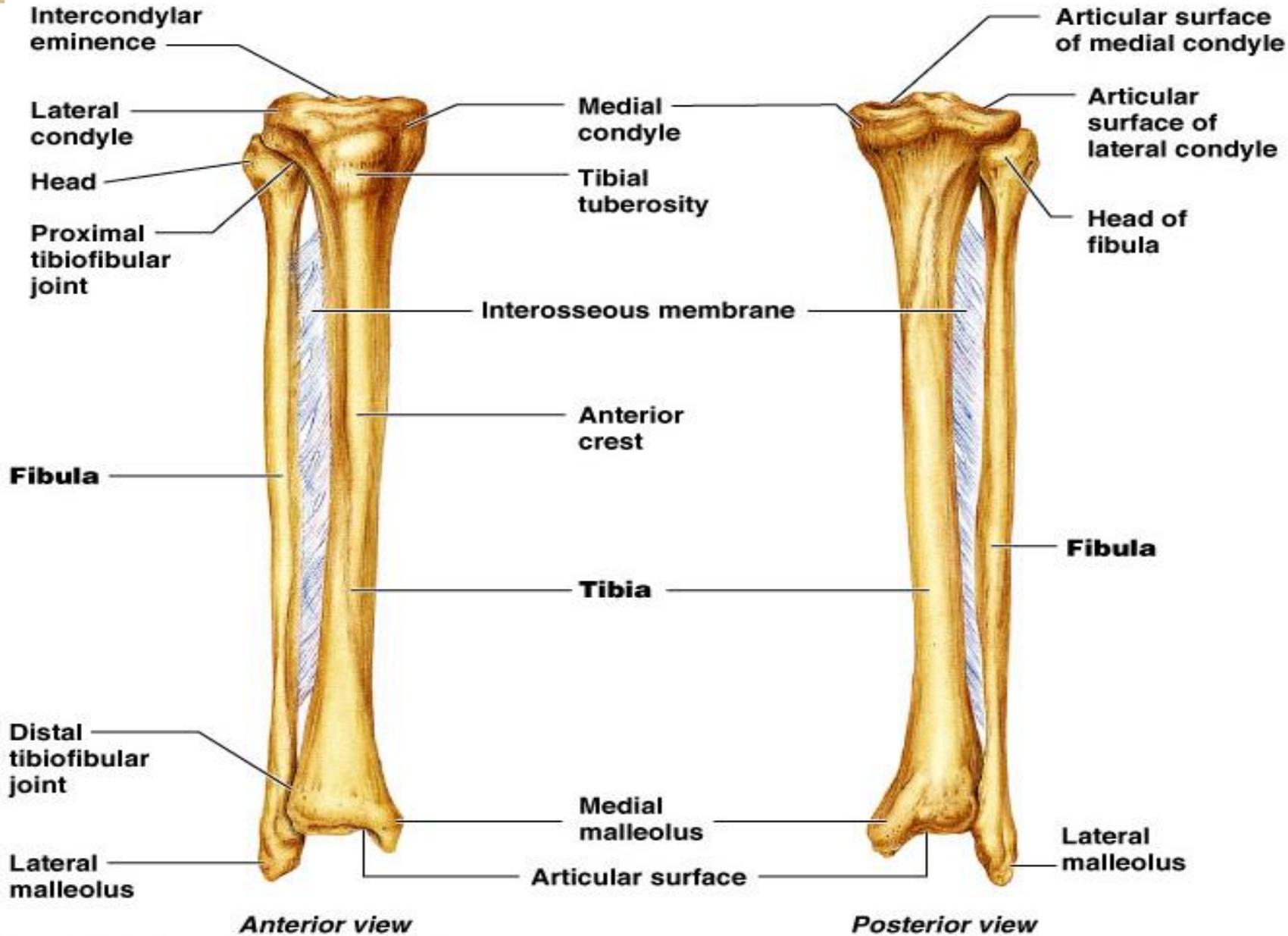
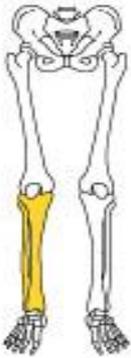
Femur



Leg

- The tibia and fibula form the skeleton of the leg
- They are connected to each other by the interosseous membrane
- They articulate with the femur proximally and with the ankle bones distally

Tibia and Fibula



Metatarsus and Phalanges



(a) Superior view