The Skeletal System: The Axial Skeleton

The Skeletal System: The Axial Skeleton

- Divisions of the Skeletal System
- Types of Bones
- Bone Surface Markings
- Skull
- Hyoid Bone
- Vertebral Column
- Thorax

Divisions of the Skeletal System

- The human skeleton consists of 206 named bones
- Bones of the skeleton are grouped into two principal divisions:
  - **Axial skeleton:** the bones that lie around the longitudinal axis of the human body
    - Consists of Skull bones, auditory ossicles (ear bones), hyoid bone, ribs, sternum (breastbone), and bones of the vertebral column
  - **Appendicular skeleton**
    - Consists of the bones of the **upper** and **lower limbs (extremities),** plus the bones forming the **girdles** that connect the limbs to the axial skeleton

Divisions of the Skeletal System

TABLE 7.1

The Bones of the Adult Skeletal System

DIVISION OF THE SKELETON	STRUCTURE	NUMBER OF BONES
Axial Skeleton		
		
	Skull	
	Cranium	8
	Face	14
	Hyoid	1
	Auditory ossicles	6
	Vertebral column	26
	Thorax	
	Sternum	1
	Ribs	24
	Subtotal = 80	
Appendicular Skeleton		
		
	Pectoral (shoulder) girdles	
	Clavicle	2
	Scapula	2
	Upper limbs	
	Humerus	2
	Ulna	2
	Radius	2
	Carpals	16
	Metacarpals	10
	Phalanges	28
	Pelvic (hip) girdle	
	Hip, pelvic, or coxal bone	2
	Lower limbs	
	Femur	2
	Patella	2
	Fibula	2
	Tibia	2
	Tarsals	14
	Metatarsals	10
	Phalanges	28
	Subtotal = 126	
	Total in an adult skeleton = 206	

Table 07.01 Tortora - PAP 12/e

Divisions of the Skeletal System

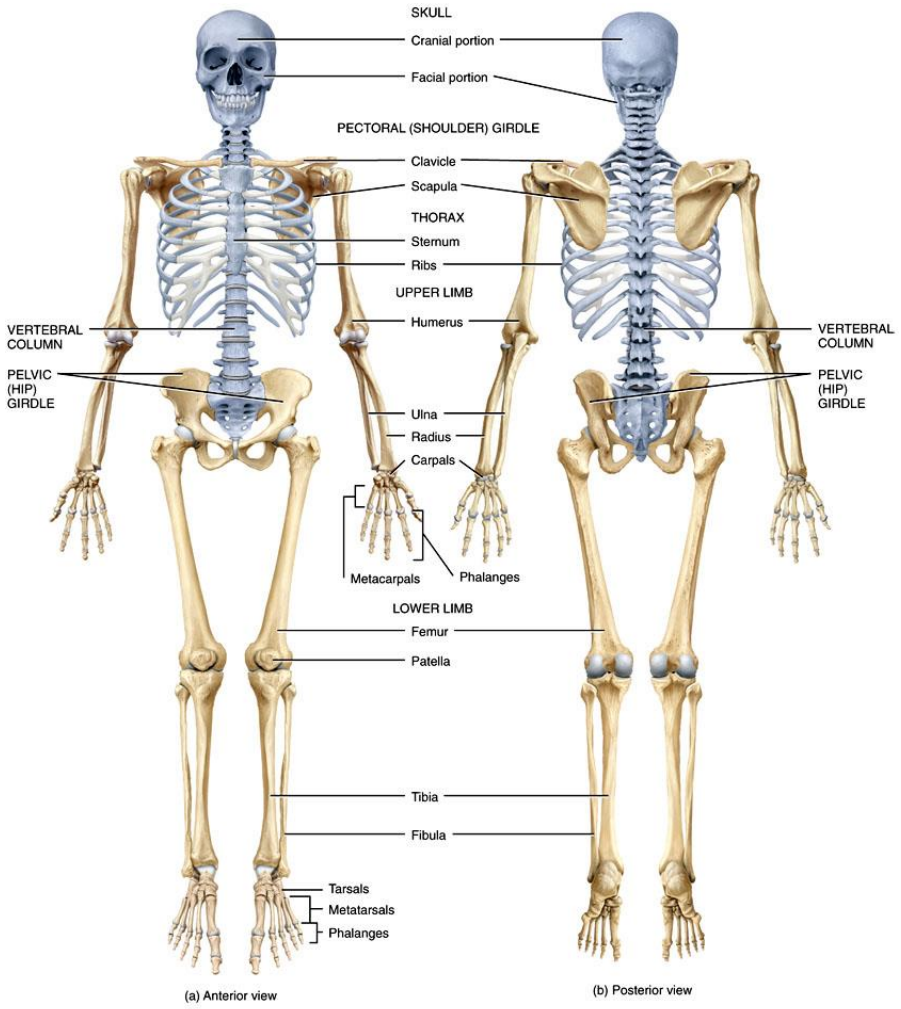


Figure 07.01 Tortora - PAP 12/e

Types of Bones

- Bones can be classified into five types based on shape:
- Long
- Short
- Flat
- Irregular
- Sesamoid

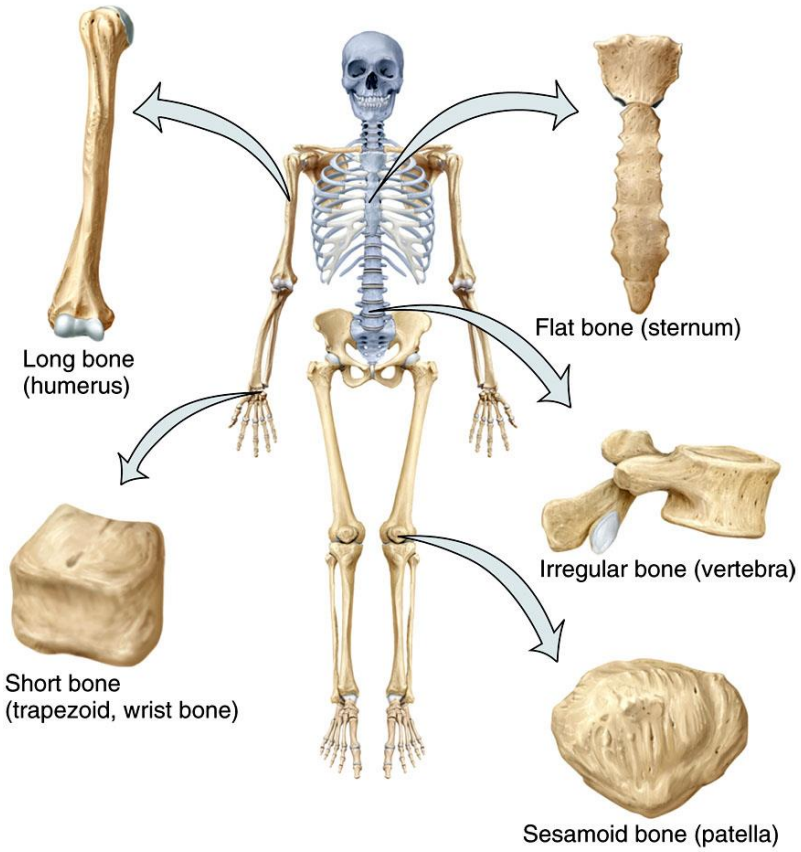


Figure 07.02 Tortora - PAP 12/e

Types of Bones

- **Long Bones**
  - Greater length than width and are slightly curved for strength
  - Femur, tibia, fibula, humerus, ulna, radius, phalanges
- **Short bones**
  - Cube-shaped and are nearly equal in length and width
  - Carpal, tarsal
- **Flat bones**
  - Thin and composed of two nearly parallel plates of compact bone tissue enclosing a layer of spongy bone tissue
  - Cranial, sternum, ribs, scapulae
- **Irregular bones**
  - Complex shapes and cannot be grouped into any of the previous categories
  - Vertebrae, hip bones, some facial bones, calcaneus
- **Sesamoid bones**
  - Protect tendons from excessive wear and tear
  - Patellae, foot, hand
- **Sutural bones**
  - Small bones located in sutures of cranial bones

Bone Surface Markings

- There are two major types of surface markings:
  - 1) Depressions and openings
    - Allow the passage of blood vessels and nerves or form joints
  - 2) Processes
    - Projections or outgrowths that form joints or serve as attachment points for ligaments and tendons

Bone Surface Markings

TABLE 7.2

Bone Surface Markings

MARKING	DESCRIPTION
Fissure (FISH-ur)	Narrow slit between adjacent parts of bones through which blood vessels or nerves pass.
Foramen (fō-RĀ-men = hole; plural is *foramina*)	Opening through which blood vessels, nerves, or ligaments pass.
Fossa (FOS-a = trench; plural is *fossae*, FOS-ē)	Shallow depression.
Sulcus (SUL-kus = groove; plural is *sulci*, SUL-sī)	Furrow along a bone surface that accommodates a blood vessel, nerve, or tendon.
Meatus (mē-Ā-tus = passageway; plural is *meati*, mē-Ā-tī)	Tubelike opening.

PROCESSES: PROJECTIONS OR OUTGROWTHS ON BONE THAT FORM JOINTS OR ATTACHMENT POINTS FOR CONNECTIVE TISSUE AND TENDONS	
Processes that form joints	
Condyle (KON-dīl; *condylus* = knuckle)	Large, round protuberance at the end of a bone.
Facet (FAS-et or fa-SET)	Smooth flat articular surface.
Head	Rounded articular projection supported on the neck (constricted portion) of a bone.
Processes that form attachment points for connective tissue	
Crest	Prominent ridge or elongated projection.
Epicondyle (*epi-* = above)	Projection above a condyle.
Line (*linea*)	Long, narrow ridge or border (less prominent than a crest).
Spinous process	Sharp, slender projection.
Trochanter (trō-KAN-ter)	Very large projection.
Tubercle (TOO-ber-kul; *tuber-* = knob)	Small, rounded projection.
Tuberosity	Large, rounded, usually roughened projection.

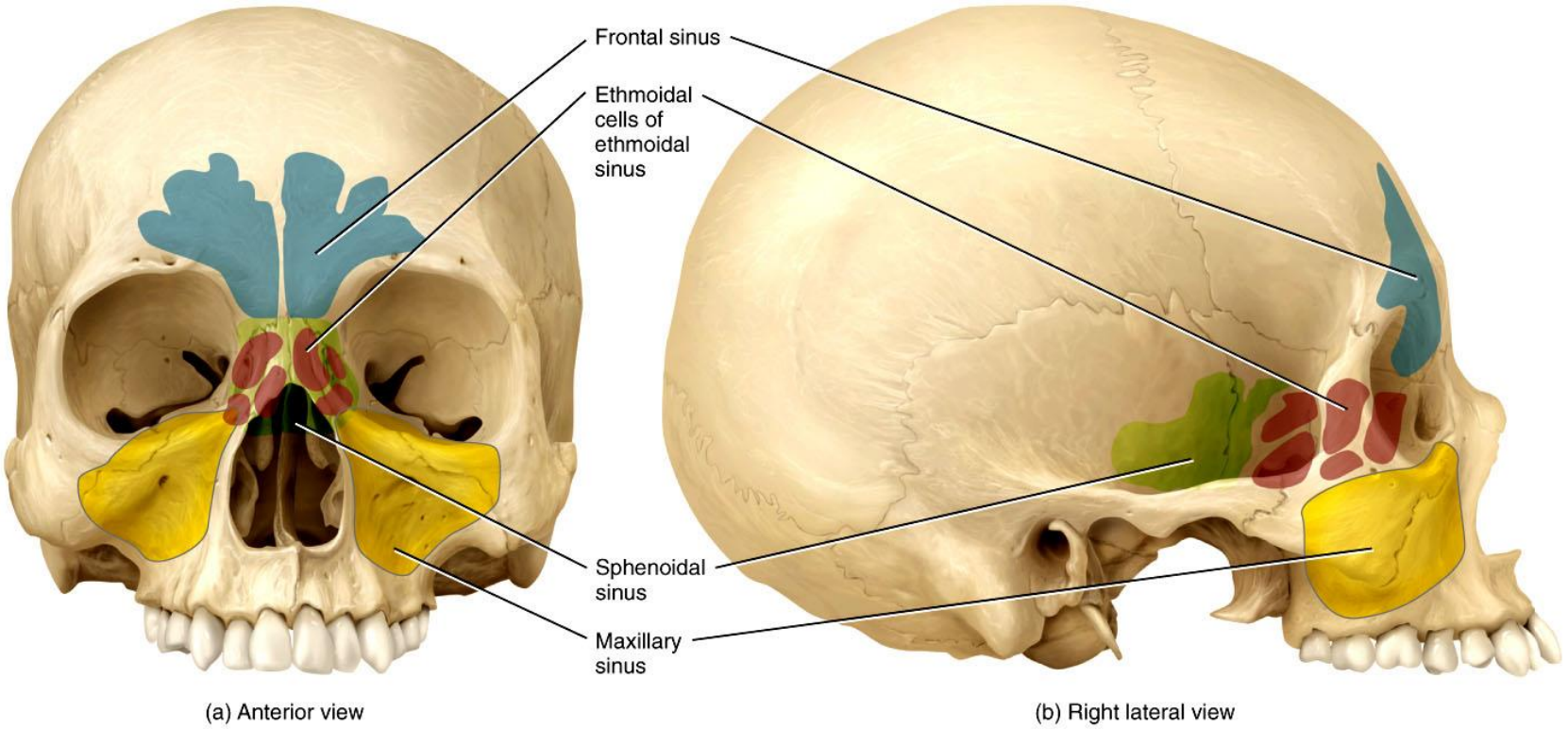
Skull

- Skull (cranium)
- Consists of 22 bones
- Bones of the skull are grouped into two categories:
  - Cranial bones
  - Facial bones

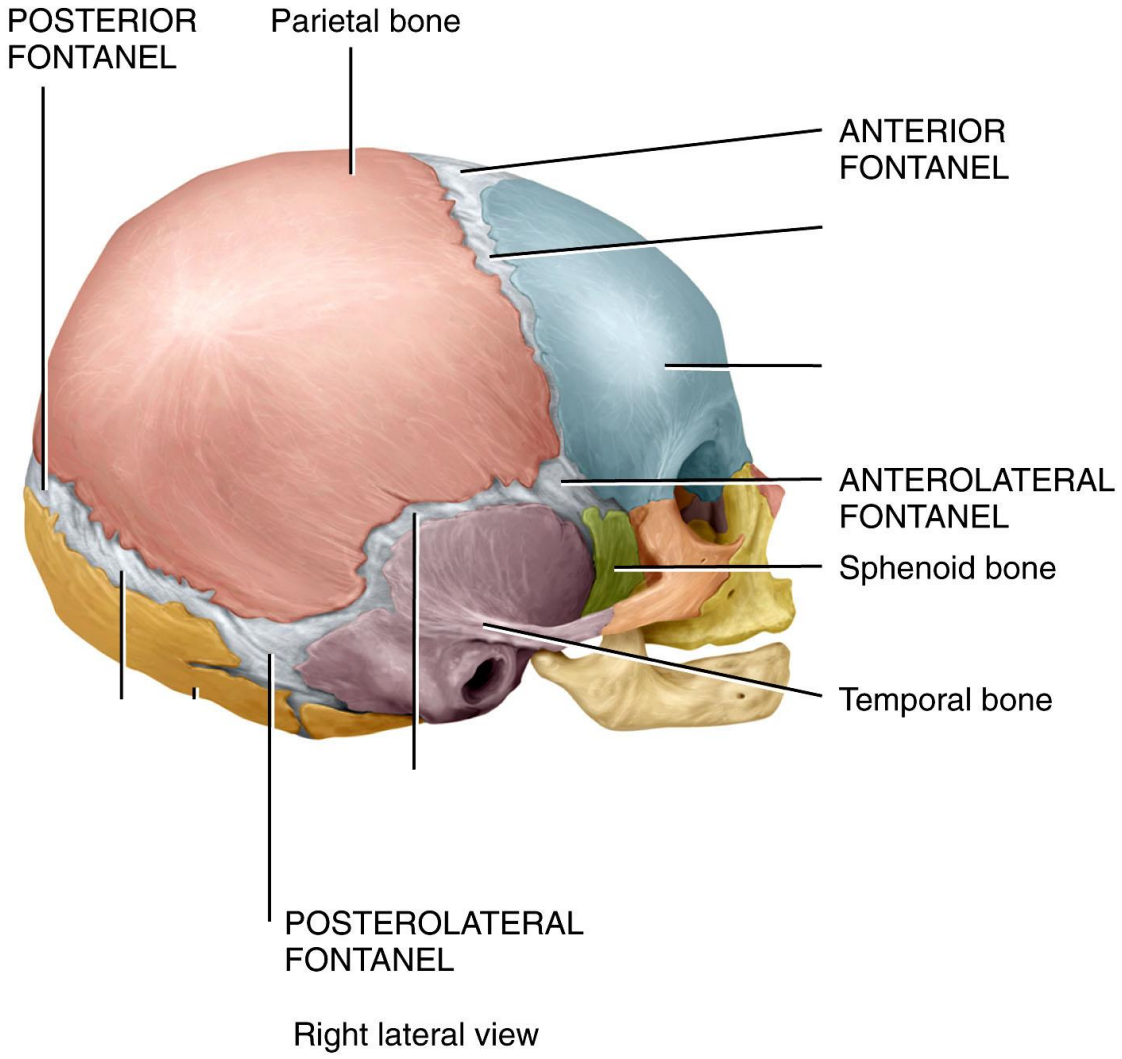
Skull

- **Unique Features of the Skull**
  - Sutures, Paranasal sinuses, Fontanels
- **Sutures**
  - an immovable joint that holds most skull bones together
- **Paranasal Sinuses**
  - Cavities within cranial and facial bones near the nasal cavity
  - Secretions produced by the mucous membranes which line the sinuses, drain into the nasal cavity
  - Serve as resonating chambers that intensify and prolong sounds
- **Fontanels**
  - Areas of unossified tissue
  - At birth, unossified tissue spaces, commonly called “soft spots” link the cranial bones
  - Eventually, they are replaced with bone to become sutures
  - Provide flexibility to the fetal skull, allowing the skull to change shape as it passes through the birth canal

Skull


Frontal sinus
Ethmoidal cells of ethmoidal sinus
Sphenoidal sinus
Maxillary sinus
(a) Anterior view
(b) Right lateral view

Skull



Right lateral view

Skull

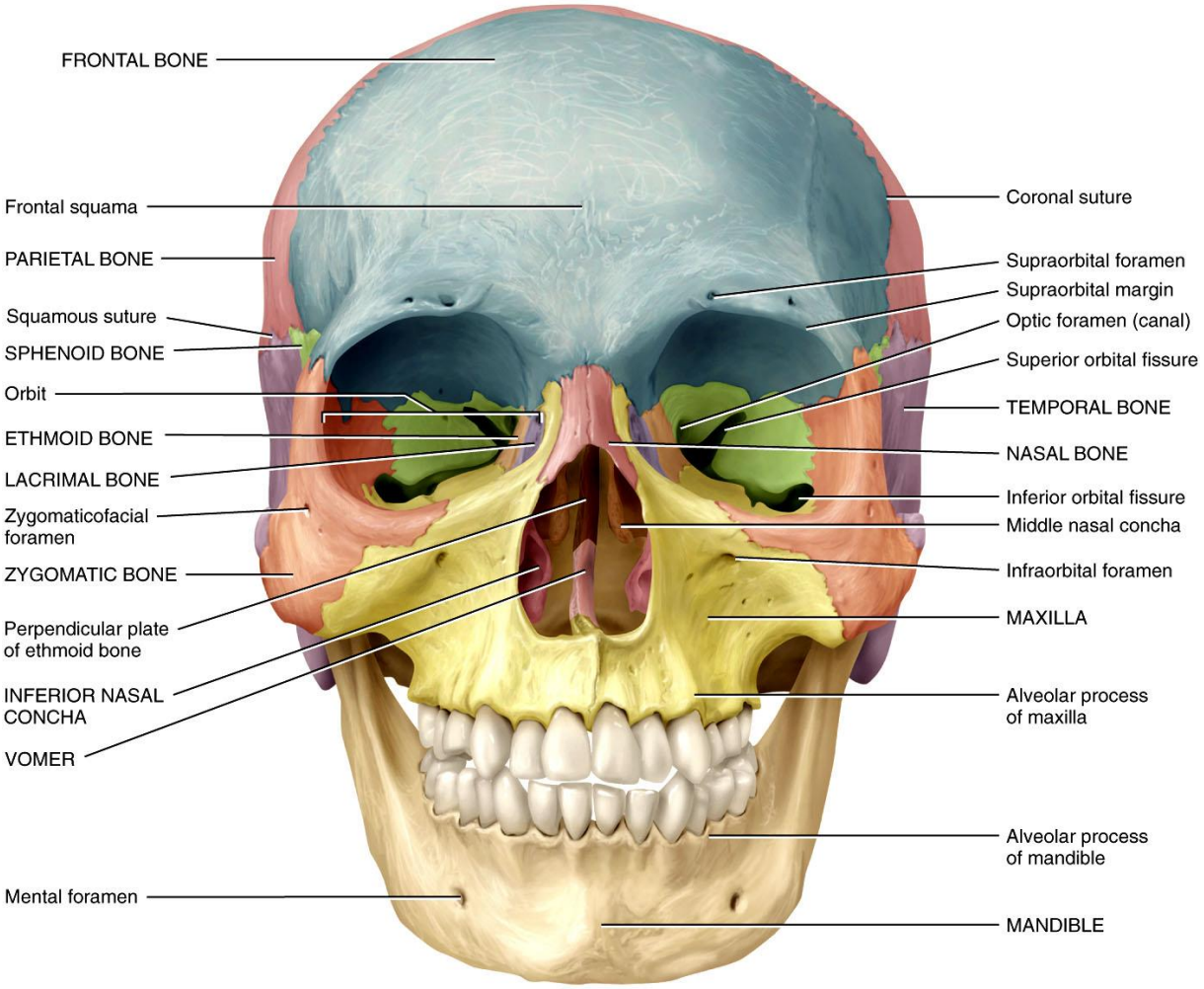


Figure 07.03 Tortora - PAP 12/e

Skull

- Immovable joints called sutures fuse most of the skull bones together
- Skull and facial bones provide attachment for muscles that produce facial expressions
- The facial bones form the framework of the face and provide support for the entrances to the digestive and respiratory systems

Skull

- The cranial and facial bones protect and support special sense organs and the brain
- Besides forming the large cranial cavity, the skull also forms several smaller cavities
  - Nasal cavity
  - Orbits (eye sockets)
  - Paranasal sinuses
  - Small cavities which house organs involved in hearing and equilibrium

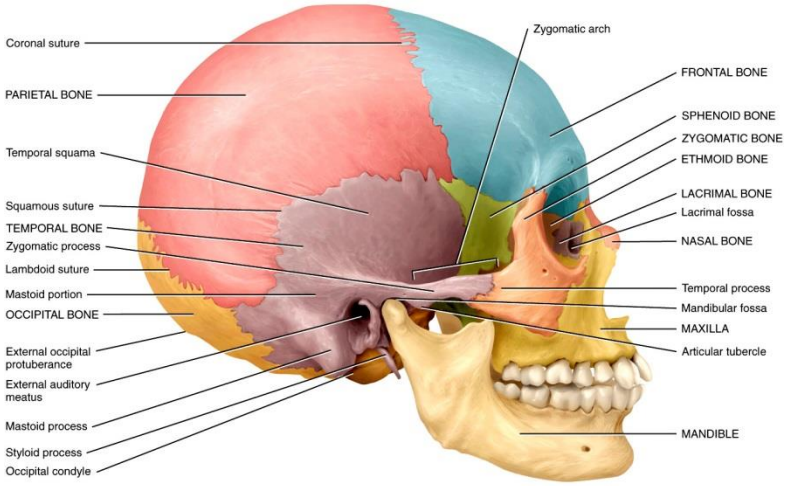
Skull

- Cranial bones
  - Eight cranial bones form the cranial cavity
    - Frontal bone, two parietal bones, two temporal bones, the occipital bone, the sphenoid bone, ethmoid bone
- Facial bones
  - Fourteen facial bones form the face
    - Two nasal bones, two maxillae, two zygomatic bones, the mandible, two lacrimal bones, two palatine bones, two inferior nasal conchae, vomer

Skull (Cranial Bones)

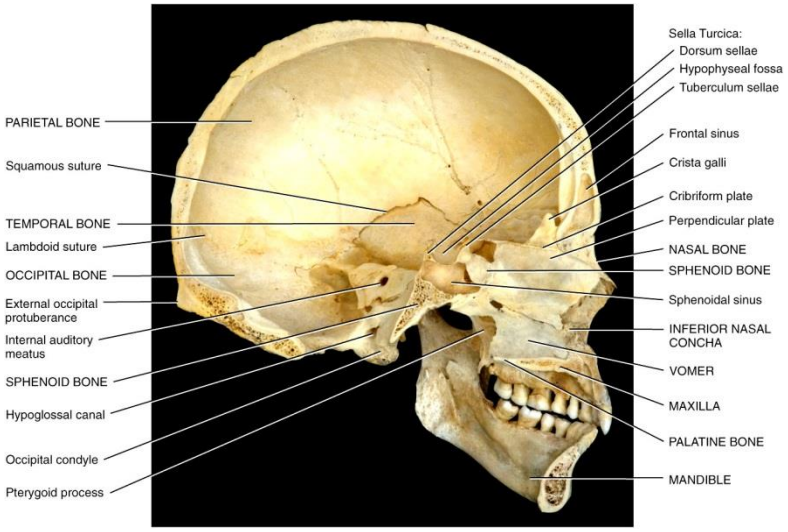
- **Frontal Bone**
  - Forms the forehead
- **Parietal Bones**
  - Form the sides and roof of the cranial cavity
- **Temporal Bones**
  - Form the lateral aspects and floor of the cranium
- **Occipital Bone**
  - Forms the posterior part and most of the base of the cranium
- **Sphenoid Bone**
  - Lies at the middle part of the base of the skull
- **Ethmoid Bone**
  - Located on the midline in the anterior part of the cranial floor medial to the orbits
  - A major superior supporting structure of the nasal cavity
  - Contain thin projections called conchae which are lined by mucous membranes
  - Increased surface area in the nasal cavity helps to humidify inhaled air trapping inhaled particles

Skull



Right lateral view

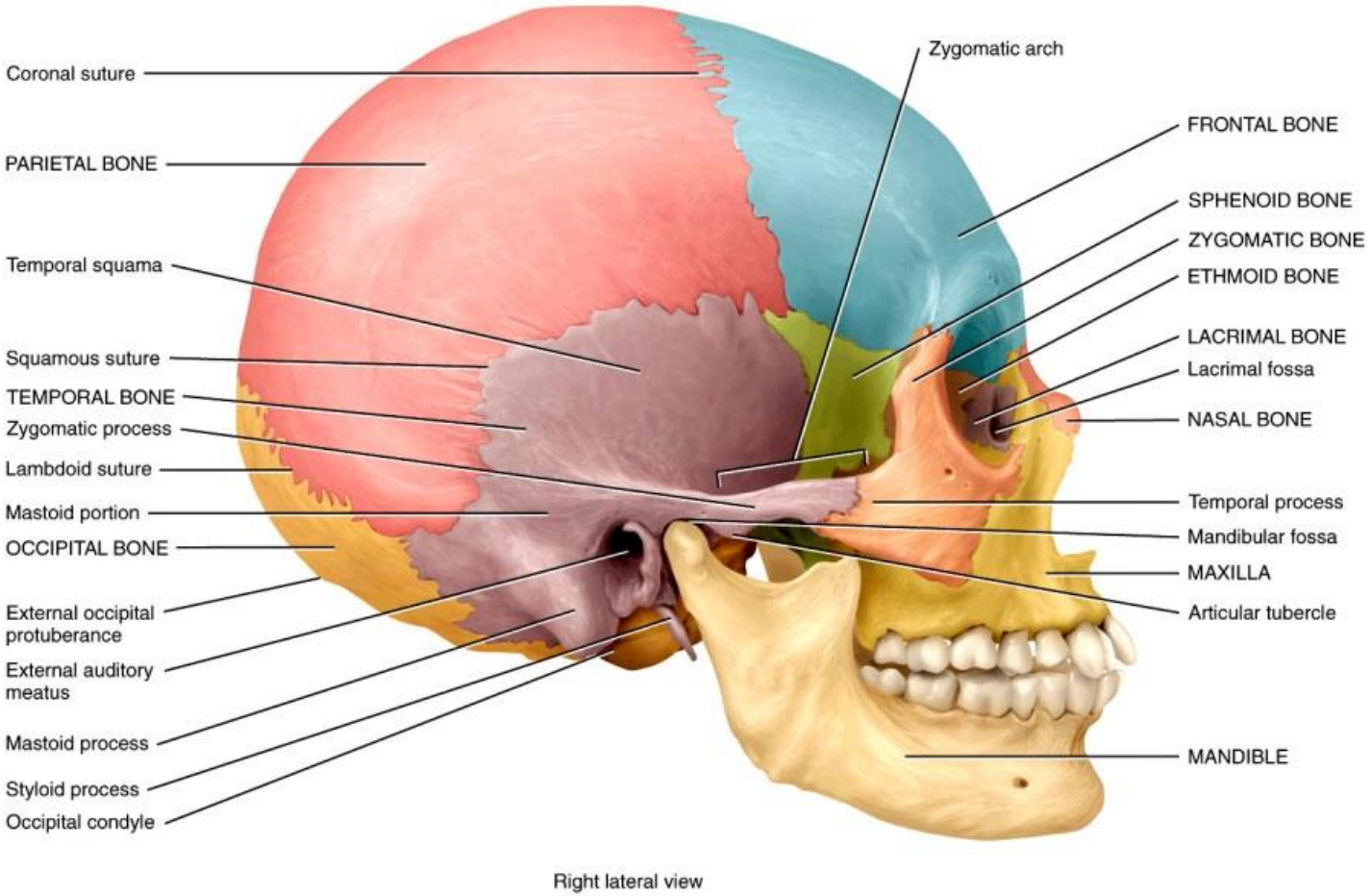
Figure 07.04a Tortora - PAP 12/e



(b) Medial view of sagittal section

Figure 07.04b Tortora - PAP 12/e

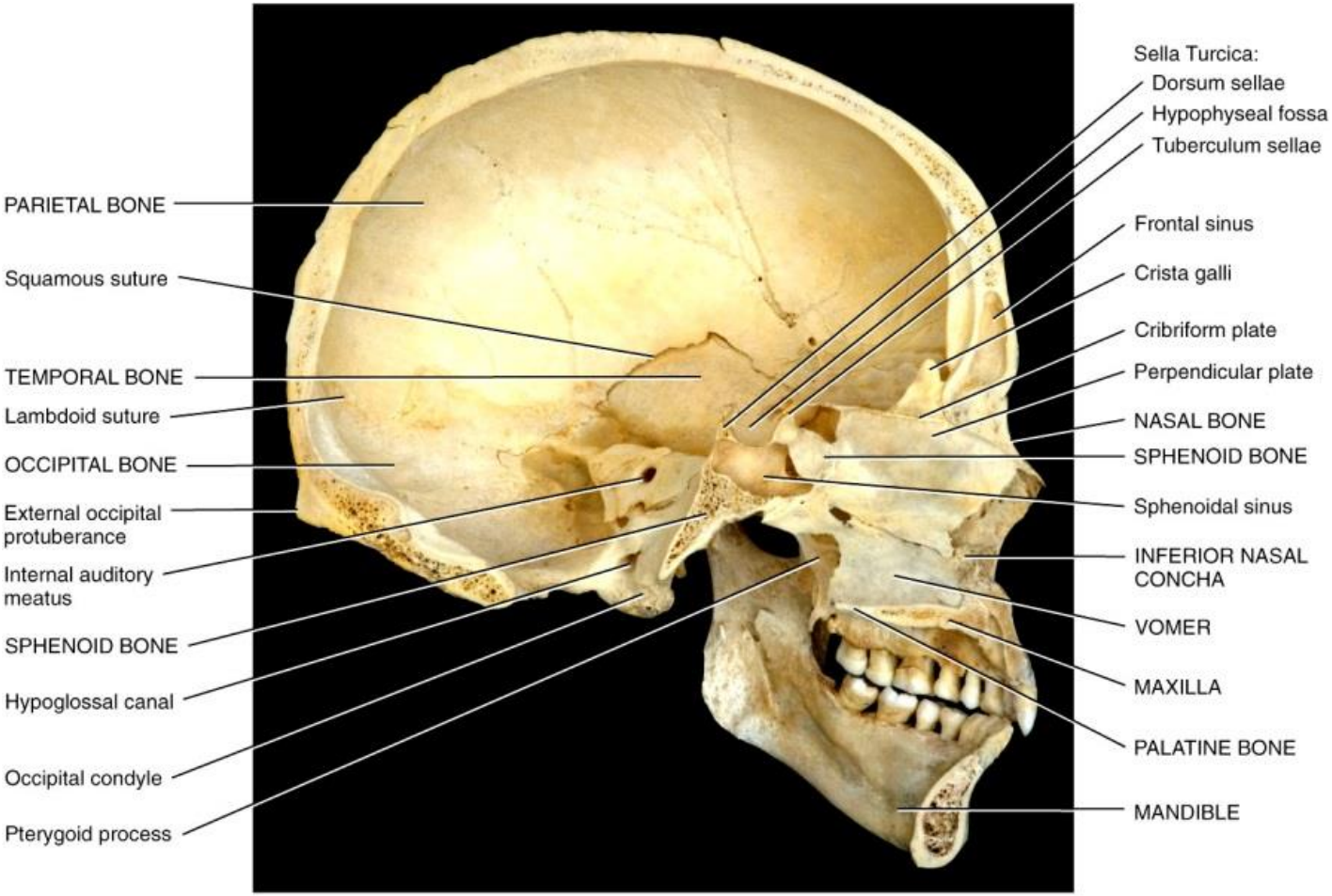
Skull



Right lateral view

Figure 07.04a Tortora - PAP 12/e

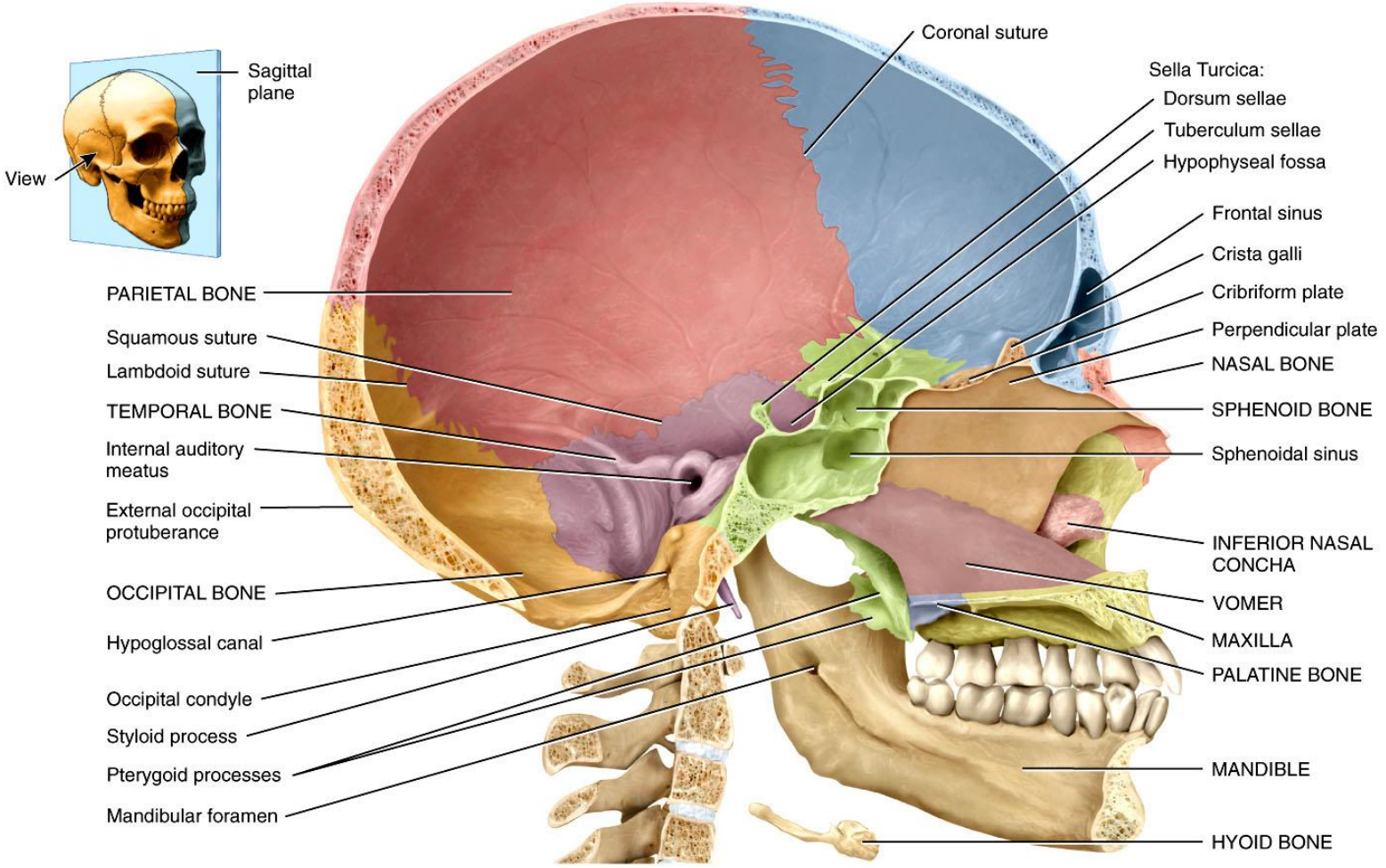
Skull



(b) Medial view of sagittal section

Figure 07.04b Tortora - PAP 12/e

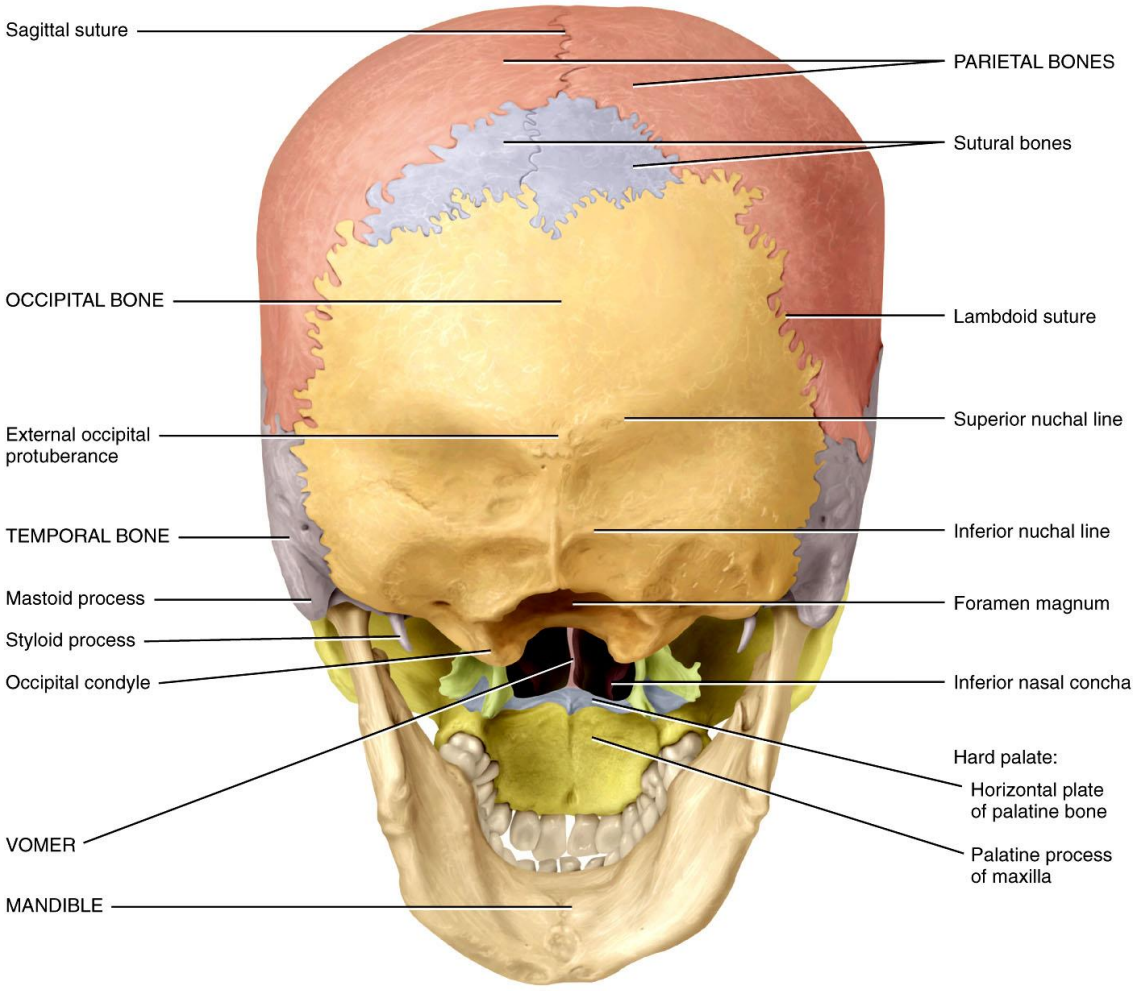
Skull



(a) Medial view of sagittal section

Figure 07.05 Tortora - PAP 12/e

Skull



Posteroinferior view

Figure 07.06 Tortora - PAP 12/e

Skull (Facial Bones)

- **Nasal Bones**
  - Form the bridge of the nose
- **Maxillae**
  - Form the upper jawbone
  - Form most of the hard palate
    - Separates the nasal cavity from the oral cavity
- **Zygomatic Bones**
  - commonly called cheekbones, form the prominences of the cheeks
- **Lacrimal Bones**
  - Form a part of the medial wall of each orbit
- **Palatine Bones**
  - Form the posterior portion of the hard palate
- **Inferior Nasal Conchae**
  - Form a part of the inferior lateral wall of the nasal cavity

Skull (Facial Bones)

- **Vomer**
  - Forms the inferior portion of the nasal septum
- **Mandible**
  - Lower jawbone
  - The largest, strongest facial bone
  - The only movable skull bone
- **Nasal Septum**
  - Divides the interior of the nasal cavity into right and left sides
  - “Broken nose,” in most cases, refers to septal damage rather than the nasal bones themselves
- **Orbits**
  - Eye socket
- **Foramina**
  - Openings for blood vessels , nerves , or ligaments of the skull

Skull

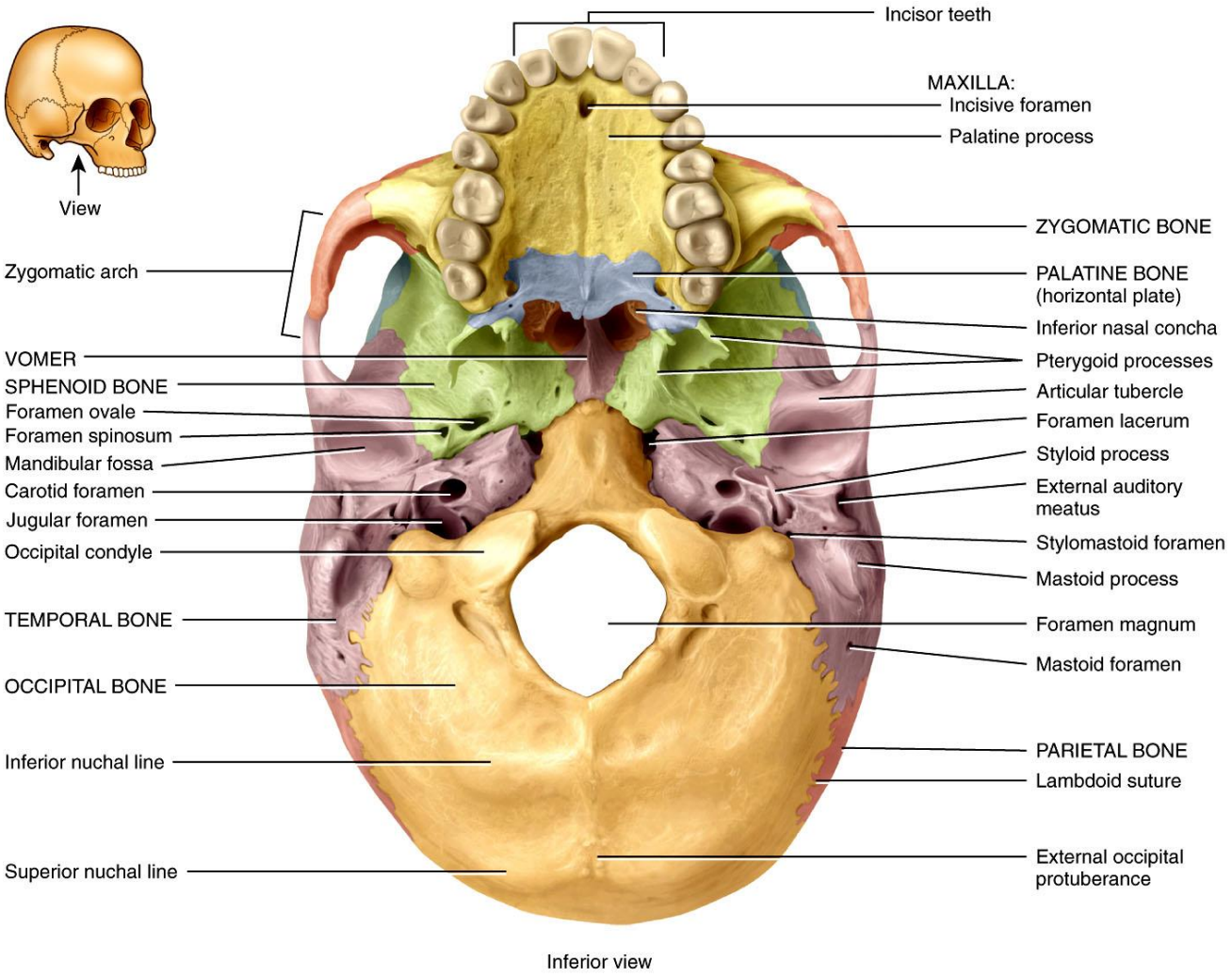
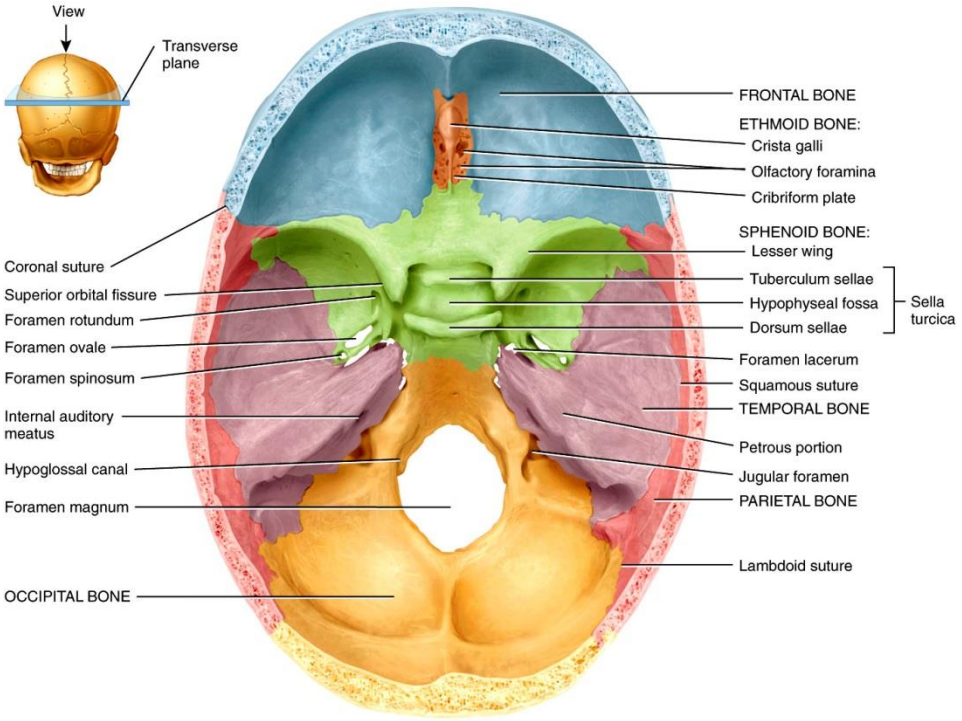


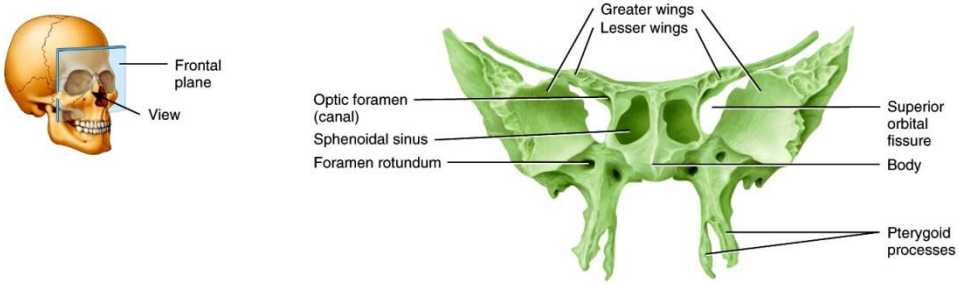
Figure 07.07 Tortora - PAP 12/e

Skull



(a) Superior view of sphenoid bone in floor of cranium

Figure 07.08a Tortora - PAP 12/e



(b) Anterior view of sphenoid bone

Figure 07.08b Tortora - PAP 12/e

Skull

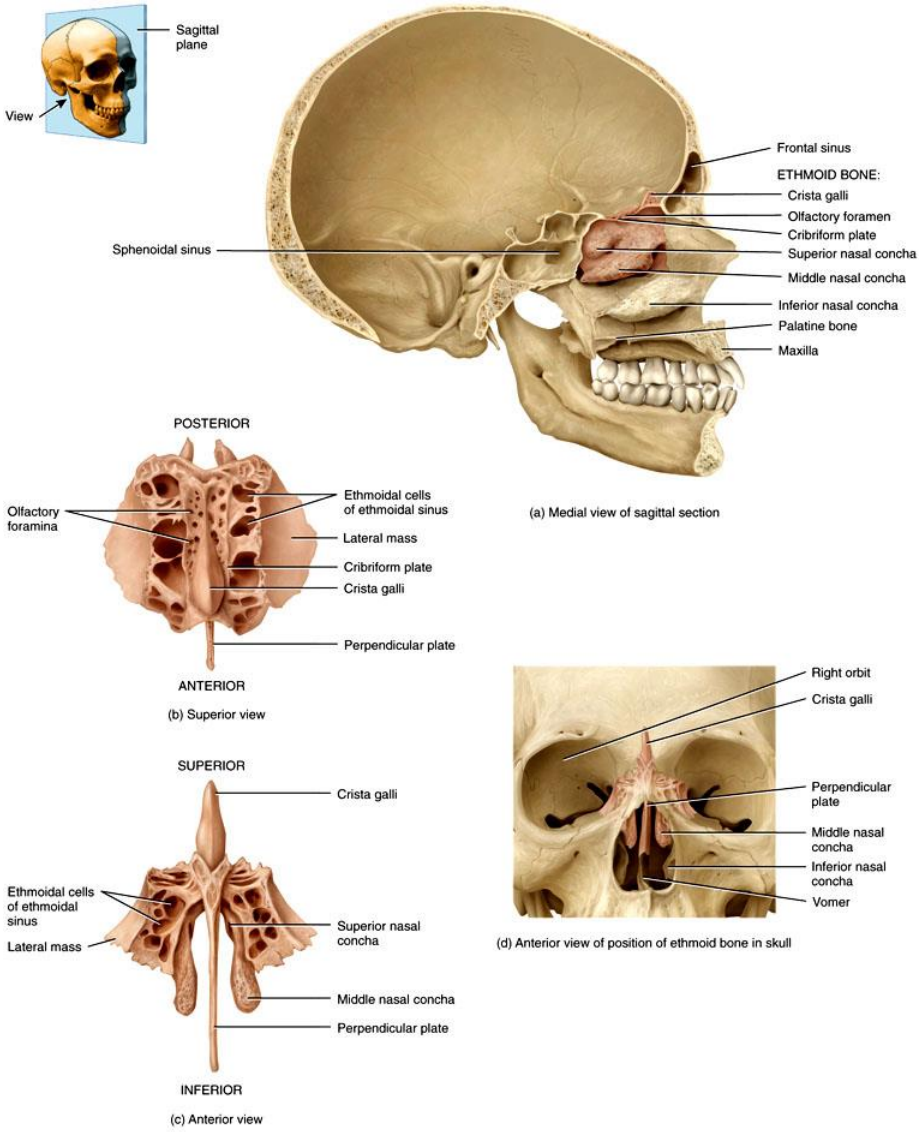


Figure 07.09 Tortora - PAP 12/e

Skull

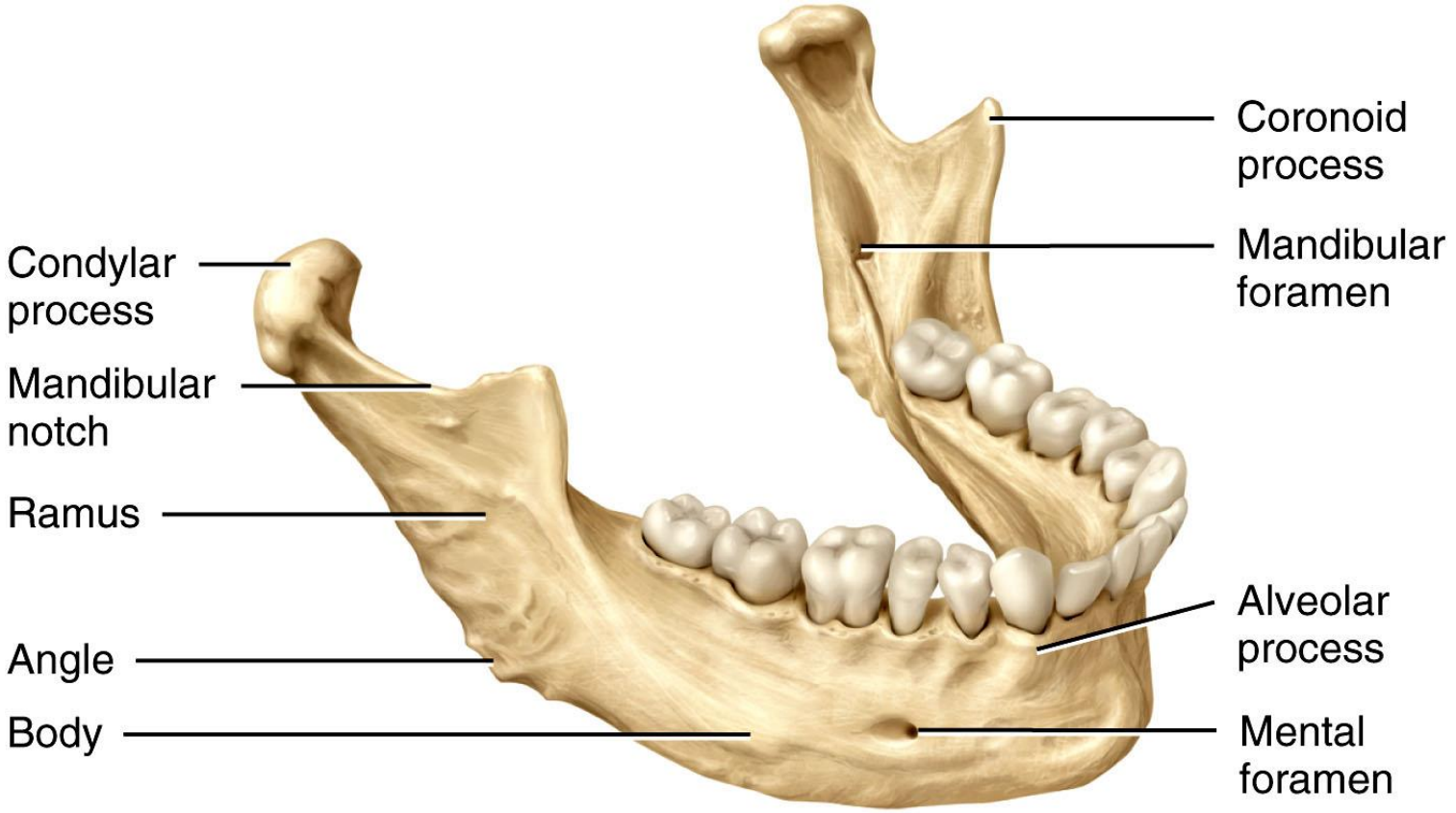


Figure 07.10 Tortora - PAP 12/e

Skull

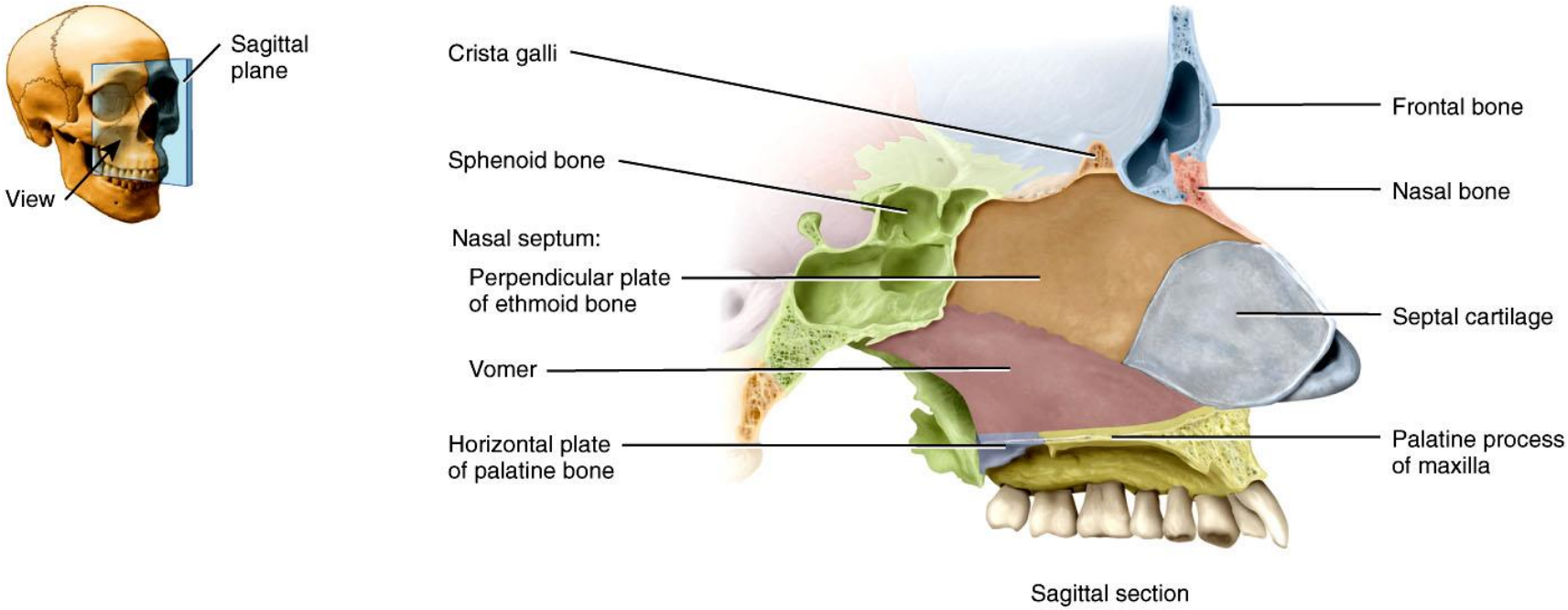
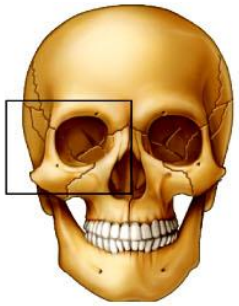
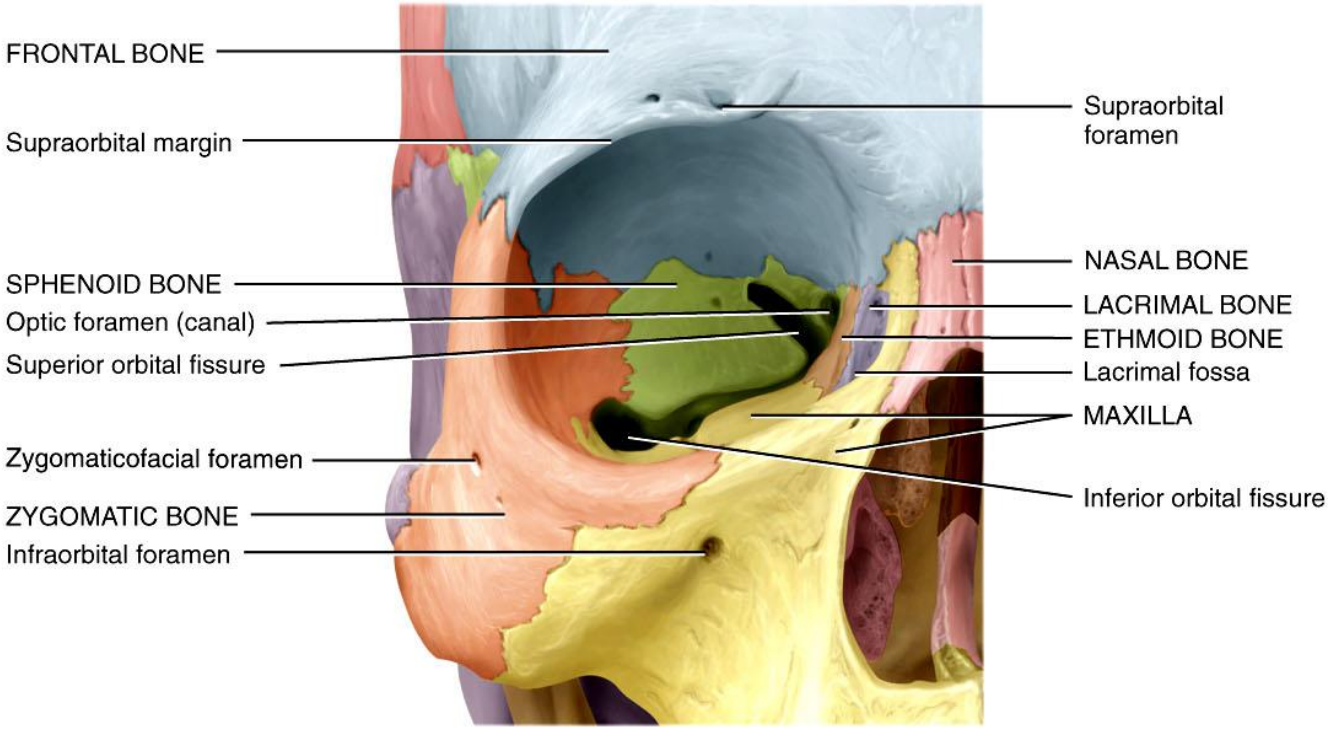


Figure 07.11 Tortora - PAP 12/e

Skull





(a) Anterior view showing the bones of the right orbit

Figure 07.12 Tortora - PAP 12/e

Hyoid Bone

- Does not articulate with any other bone
- attachment sites for some muscles of the tongue, neck and pharynx
- helps to keep the larynx open

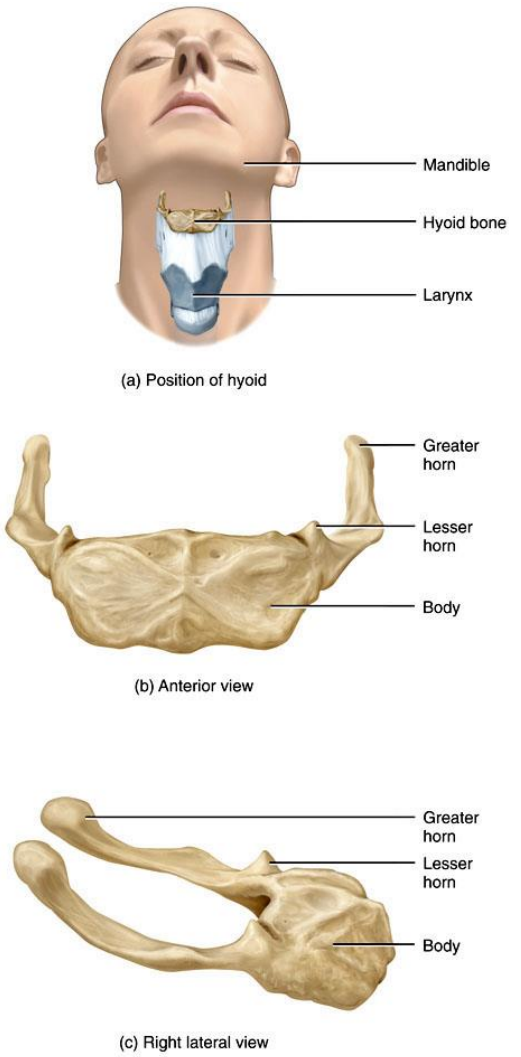


Figure 07.15 Tortora - PAP 12/e

Vertebral Column

- Also called the spine, backbone, or spinal column
- Functions to:
  - Protect the spinal cord
  - Support the head
  - Serve as a point of attachment for the ribs, pelvic girdle, and muscles
- The vertebral column is curved to varying degrees in different locations
  - Curves increase the column strength
  - Help maintain balance in the upright position
  - Absorb shocks during walking, and help protect the vertebrae from fracture

Vertebral Column

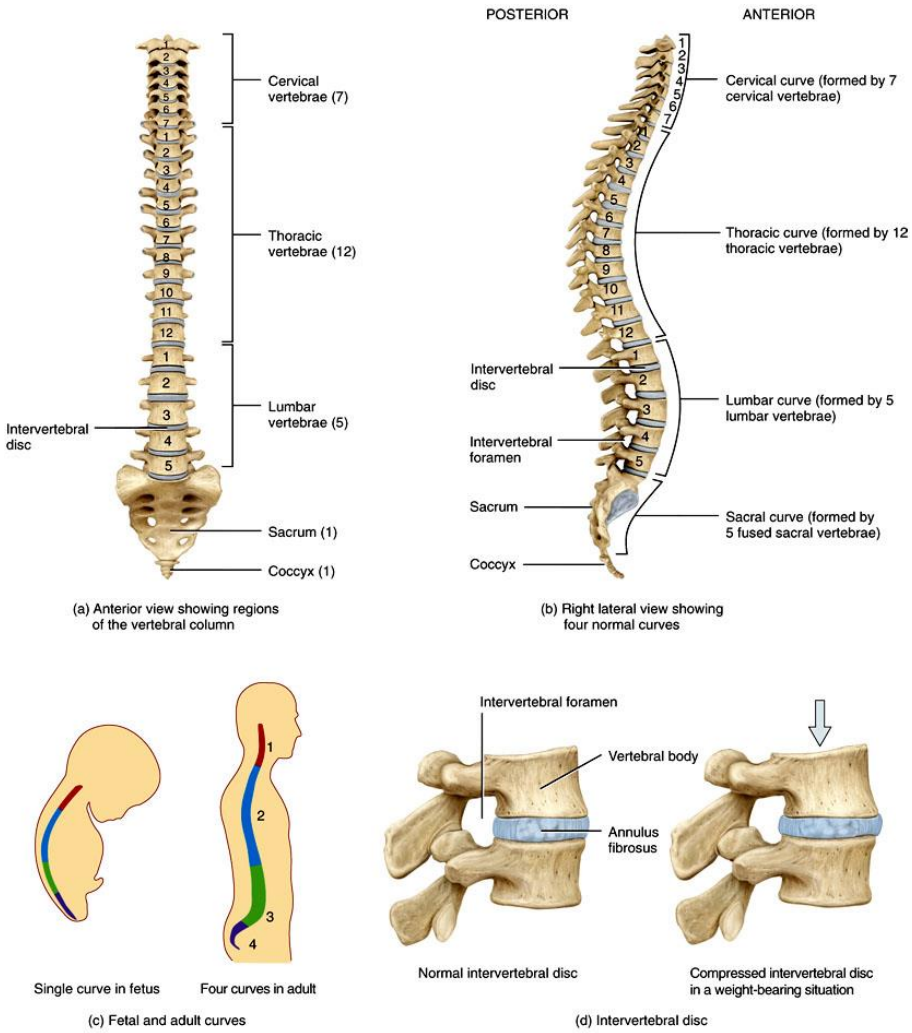


Figure 07.16 Tortora - PAP 12/e

Vertebral Column

- Composed of a series of bones called **vertebrae (**Adult=26)
  - 7 **cervical** are in the neck region
  - 12 **thoracic** are posterior to the thoracic cavity
  - 5 **lumbar** support the lower back
  - 1 **sacrum** consists of five fused sacral vertebrae
  - 1 **coccyx** consists of four fused coccygeal vertebrae

Vertebral Column (Intervertebral Discs)

- Found between the bodies of adjacent vertebrae
- Functions to:
  - Absorb vertical shock

Vertebral Column

- Vertebrae typically consist of:
  - A Body (weight bearing)
  - A vertebral arch (surrounds the spinal cord)
  - Several processes (points of attachment for muscles)

Vertebral Column

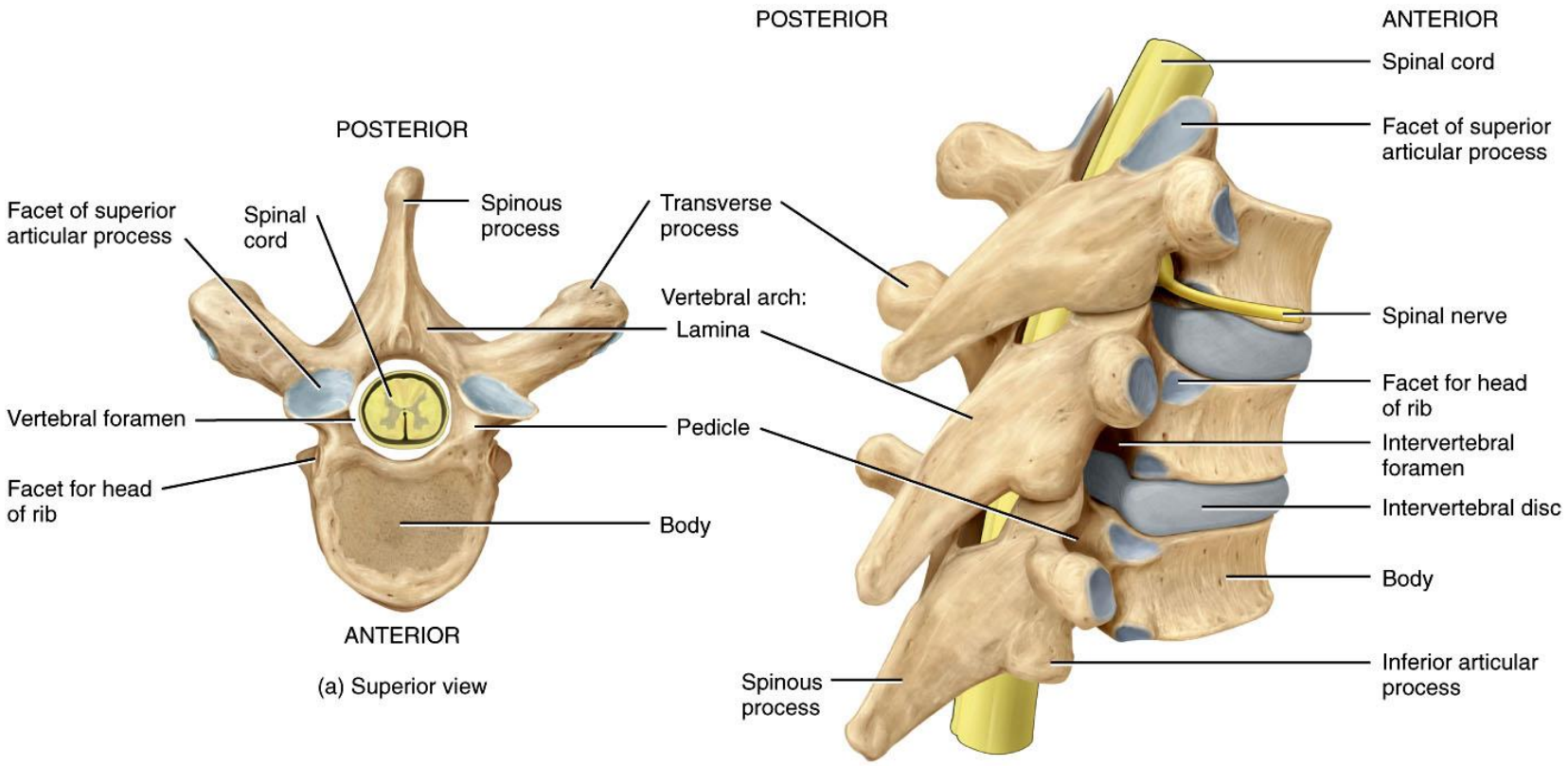


Figure 07.17 Tortora - PAP 12/e

Vertebral Column (Regions)

- **Cervical Region**
  - Cervical vertebrae (C1–C7)
  - The atlas (C1) is the first cervical vertebra
  - The axis (C2) is the second cervical vertebra
- **Thoracic Region**
  - Thoracic vertebrae (T1–T12)
  - Articulate with the ribs
- **Lumbar Region**
  - Lumbar vertebrae (L1–L5)
  - Provide for the attachment of the large back muscles
- **Sacrum**
  - The sacrum is a triangular bone formed by the union of five sacral vertebrae (S1–S5)
  - Serves as a strong foundation for the pelvic girdle
- **Coccyx**
  - The coccyx, like the sacrum, is triangular in shape
  - It is formed by the fusion of usually four coccygeal vertebrae

Vertebral Column

TABLE 7.4

Comparison of Major Structural Features of Cervical, Thoracic, and Lumbar Vetebrae

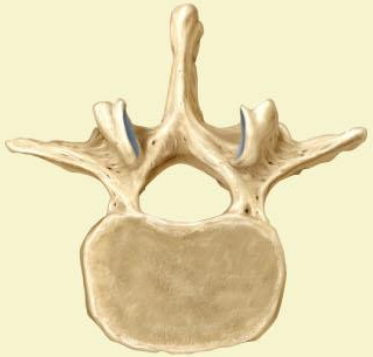
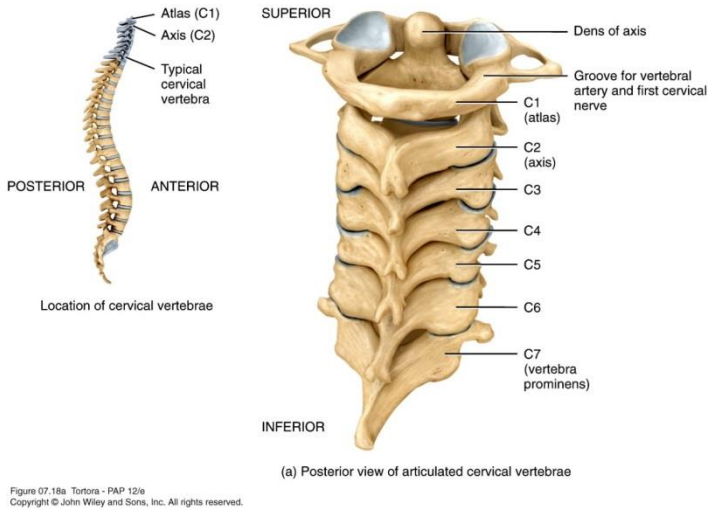
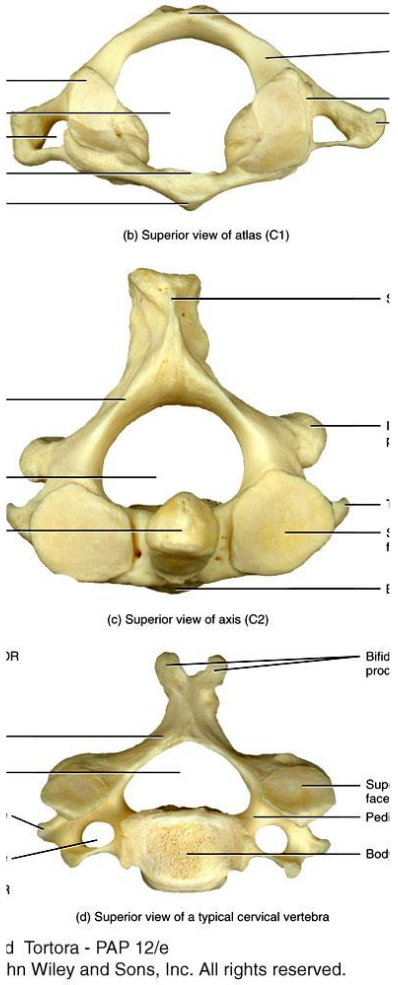
CHARACTERISTIC	CERVICAL	THORACIC	LUMBAR
Overall structure			
Body	Small.	Larger.	Largest.
Foramina	One vertebral and two transverse.	One vertebral.	One vertebral.
Spinous processes	Slender and often bifid (C2–C6).	Long and fairly thick (most project inferiorly).	Short and blunt (project posteriorly rather than inferiorly).
Transverse processes	Small.	Fairly large.	Large and blunt.
Articular facets for ribs	Absent.	Present.	Absent.
Direction of articular facets			
Superior	Posterosuperior.	Posterolateral.	Medial.
Inferior	Anteroinferior.	Anteromedial.	Lateral.
Size of intervertebral discs	Thick relative to size of vertebral bodies.	Thin relative to size of vertebral bodies.	Massive.

Table 07.04 Tortora - PAP 12/e

Vertebral Column: cervical region



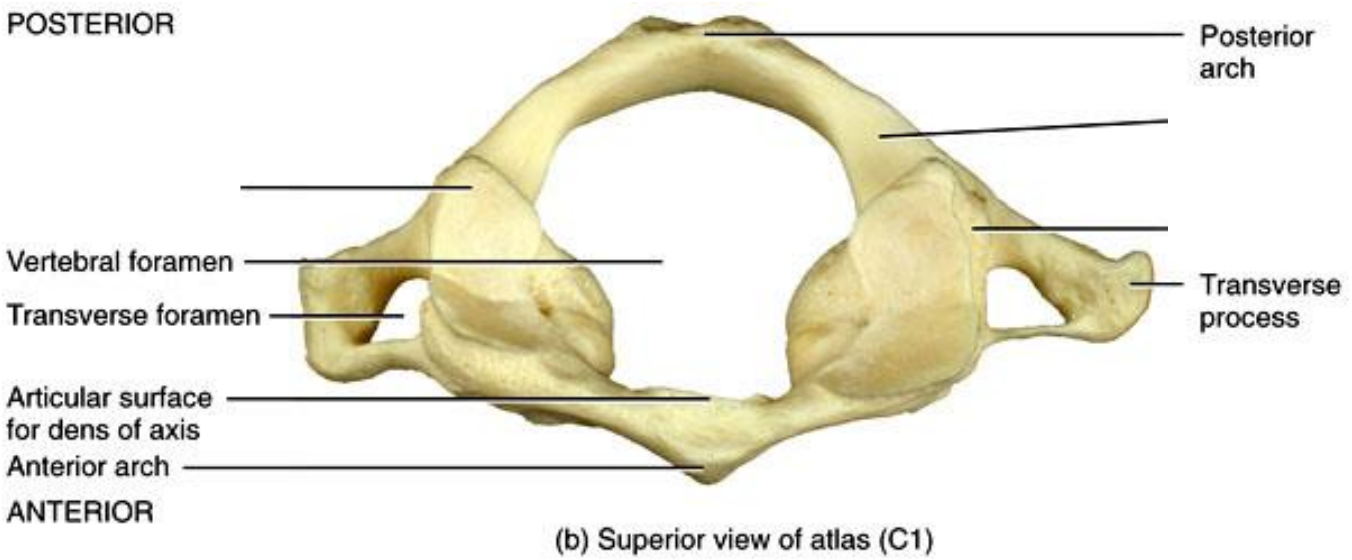


- **Small body (support only head)**
- **C1 (atlas) has no spinous process**
- **All others have short spinous processes**

tip of each spinous process is notched (bifid)

Vertebral Column:

Atlas(C1)



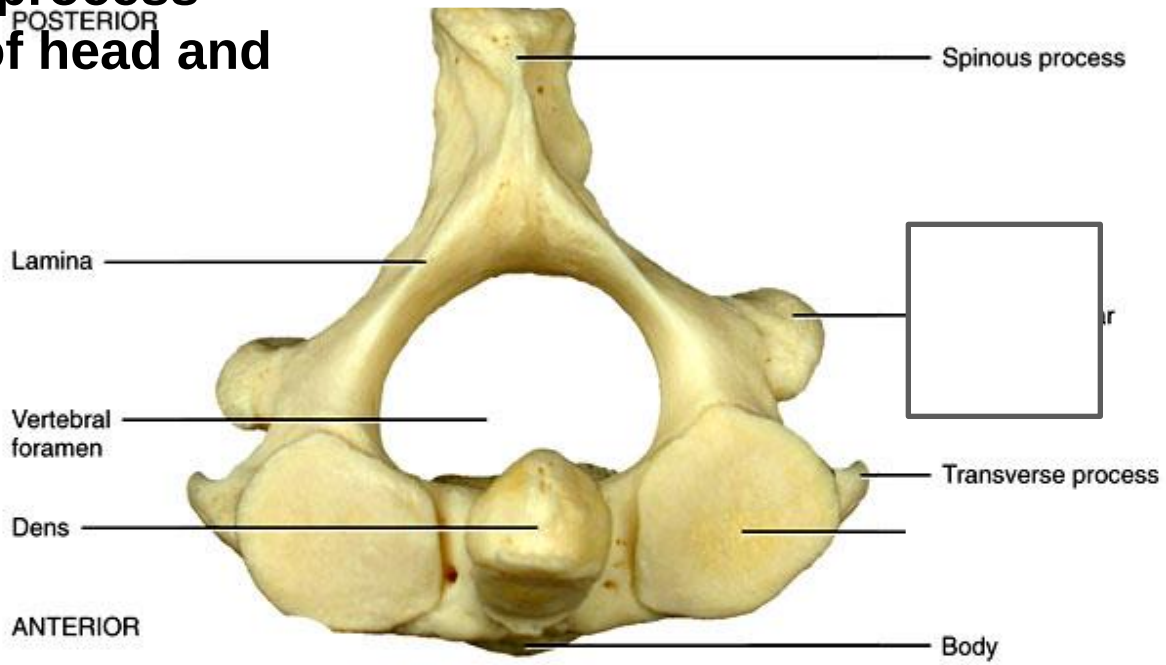
(b) Superior view of atlas (C1)

Articulates with occipital condyles of skull

Vertebral Column:

Axis (C2)

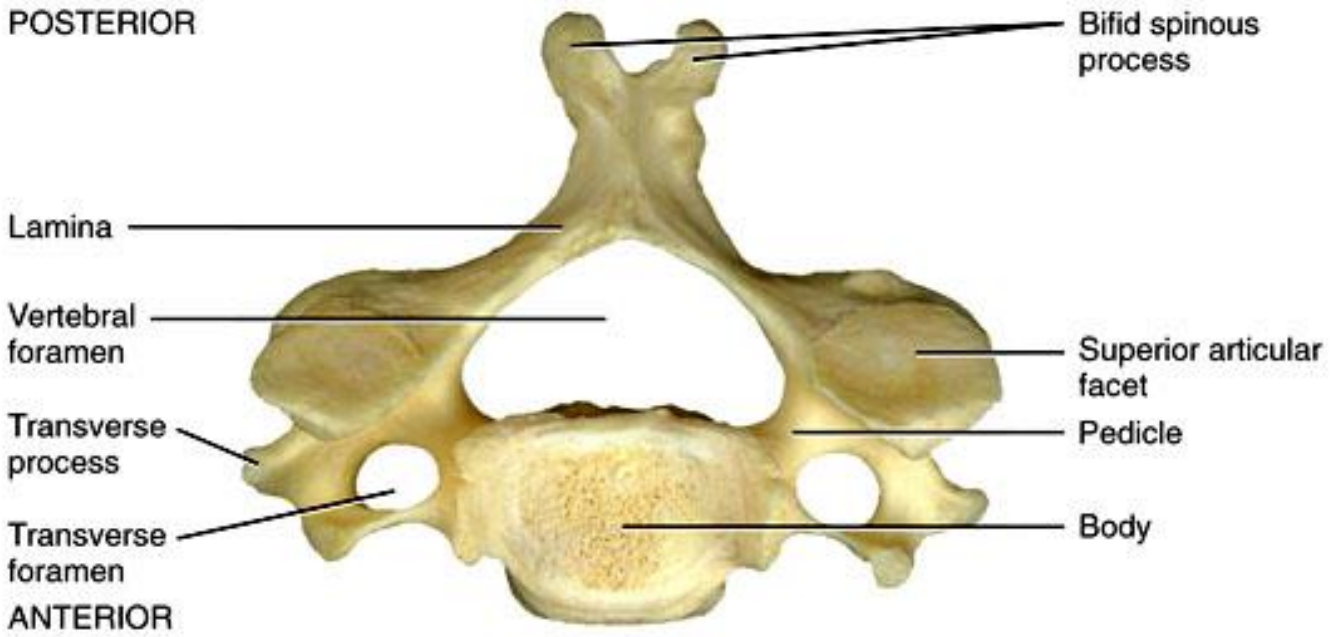
- **Supports the atlas**
- **Has heavy spinous process**
- **To attach muscles of head and neck**
- **Axis and atlas bodies fuse during development to form the dens**



(c) Superior view of axis (C2)

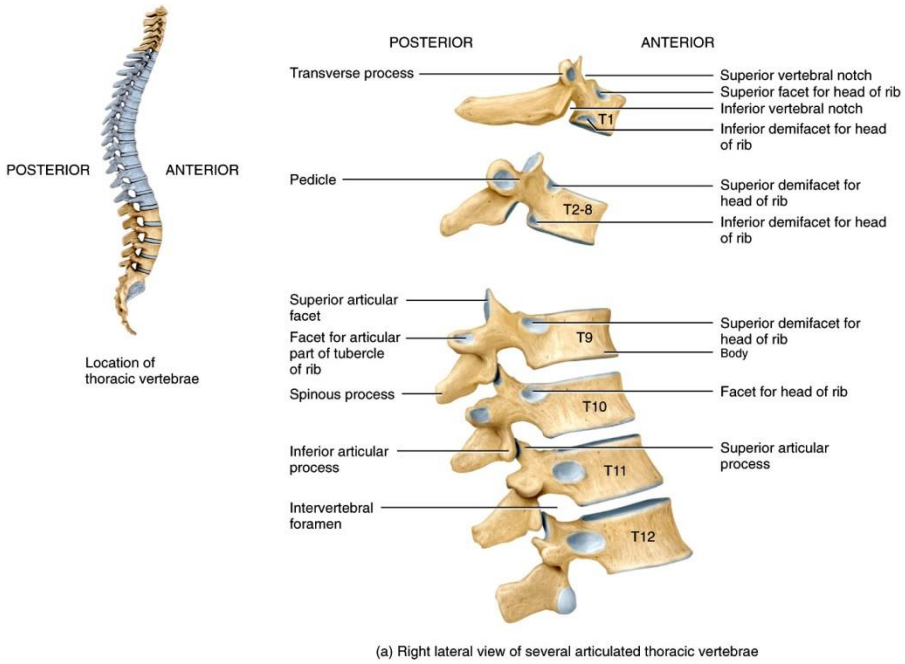
Vertebral Regions

- The Cervical Vertebrae
  - **Axis** (C_2)
    - Supports the atlas
    - Has heavy spinous process
    - To attach muscles of head and neck
  - Axis and atlas bodies fuse during development to form the **dens**
  - **Vertebra prominens** (C_7)
    - Transitions to thoracic vertebrae
    - Has a long spinous process with a broad tubercle
    - Has large transverse processes



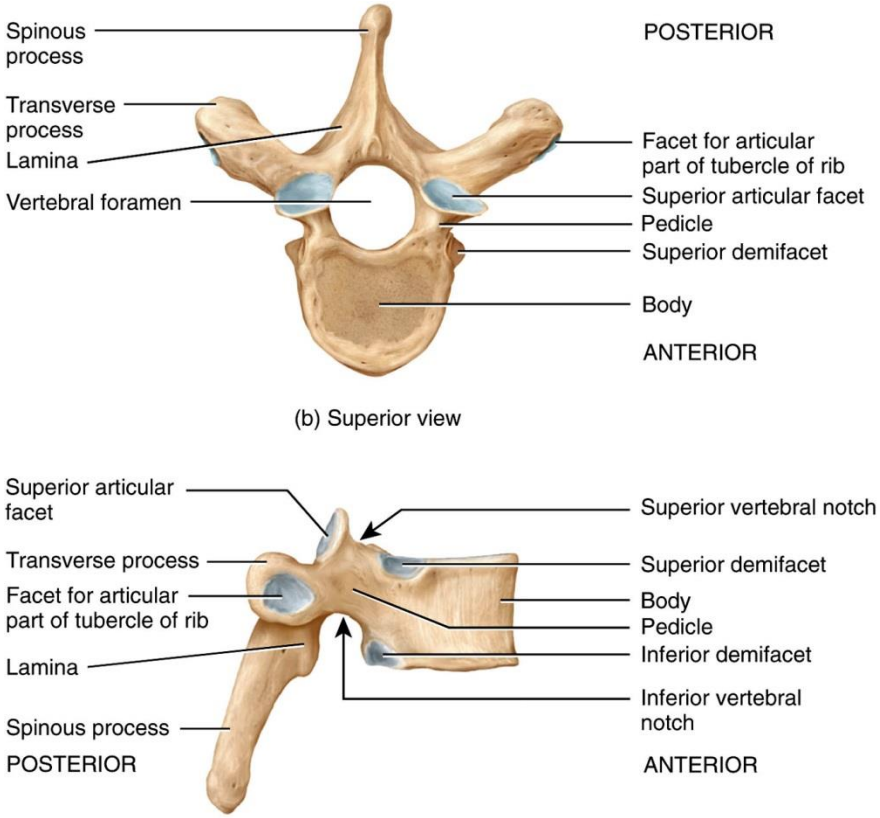
(d) Superior view of a typical cervical vertebra

Vertebral Column



(a) Right lateral view of several articulated thoracic vertebrae

Figure 07.19a Tortora - PAP 12/e

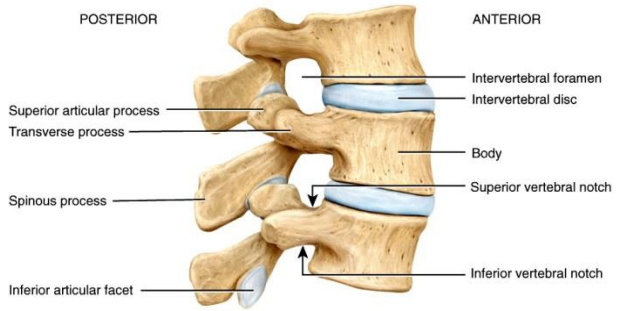


(b) Superior view

(c) Right lateral view

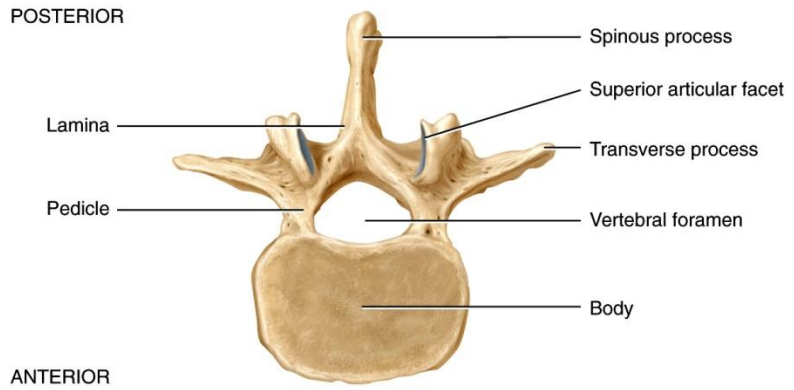
Figure 07.19bc Tortora - PAP 12/e

Vertebral Column

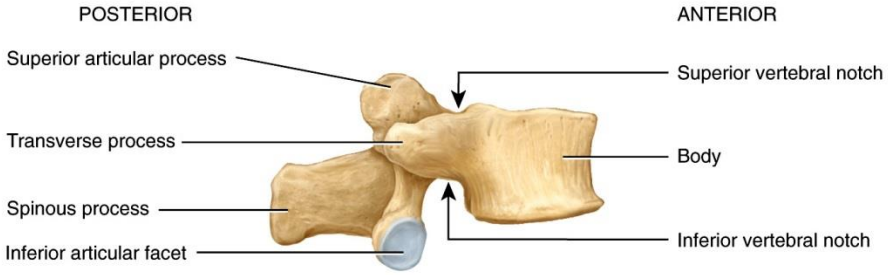


(a) Right lateral view of articulated lumbar vertebrae

Figure 07.20a Tortora - PAP 12/e



(b) Superior view



(c) Right lateral view

Figure 07.20bc Tortora - PAP 12/e

Vertebral Column

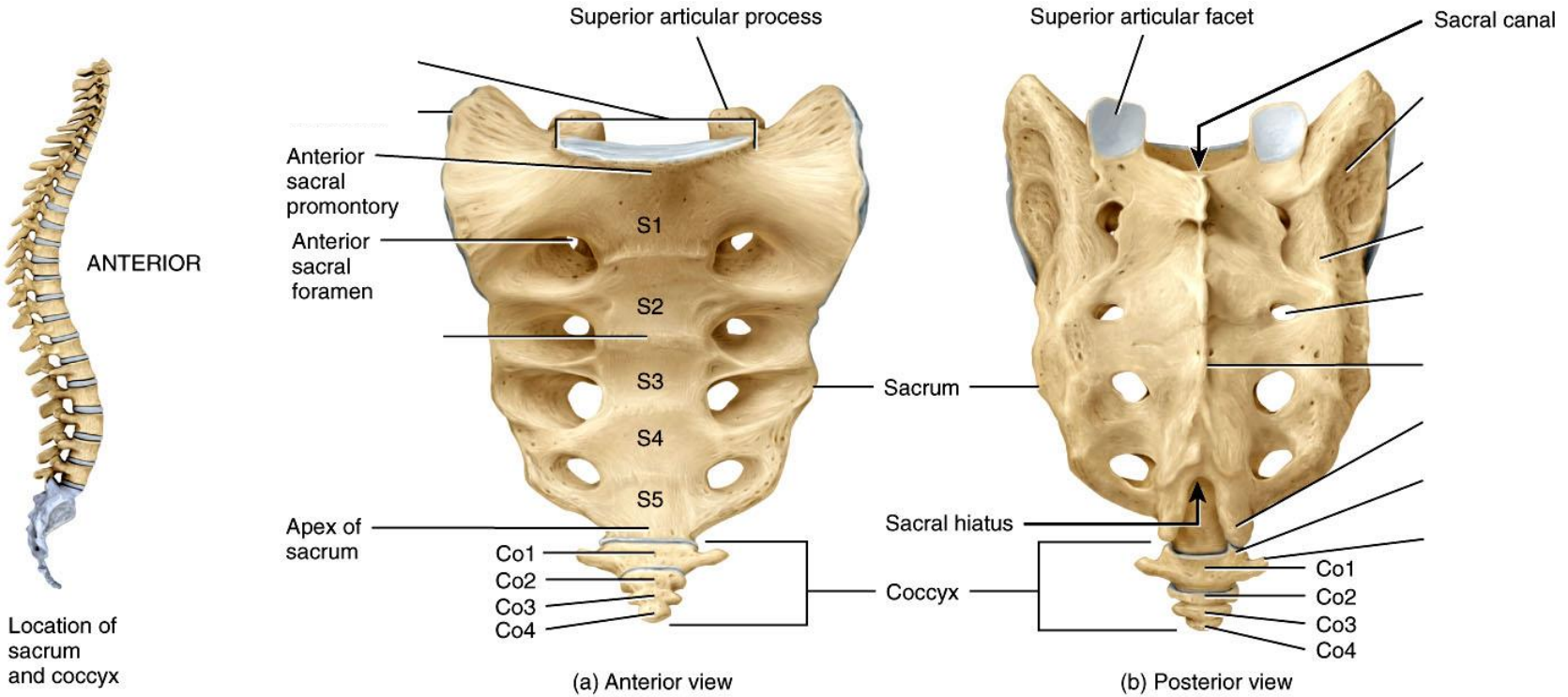


Figure 07.21 Tortora - PAP 12/e

Thorax

- Thoracic cage is formed by the:
  - Sternum
  - Ribs
  - Costal cartilages
  - Thoracic vertebrae
- Functions to:
  - Enclose and protect the organs in the thoracic and abdominal cavities
  - Provide support for the bones of the upper limbs
  - Play a role in breathing

Thorax

- **Sternum**
  - “Breastbone” located in the center of the thoracic wall
  - Consists of the manubrium, body, xiphoid process
- **Ribs**
  - Twelve pairs of ribs give structural support to the sides of the thoracic cavity
- **Costal cartilages**
  - contribute to the elasticity of the thoracic cage

Vertebral Column

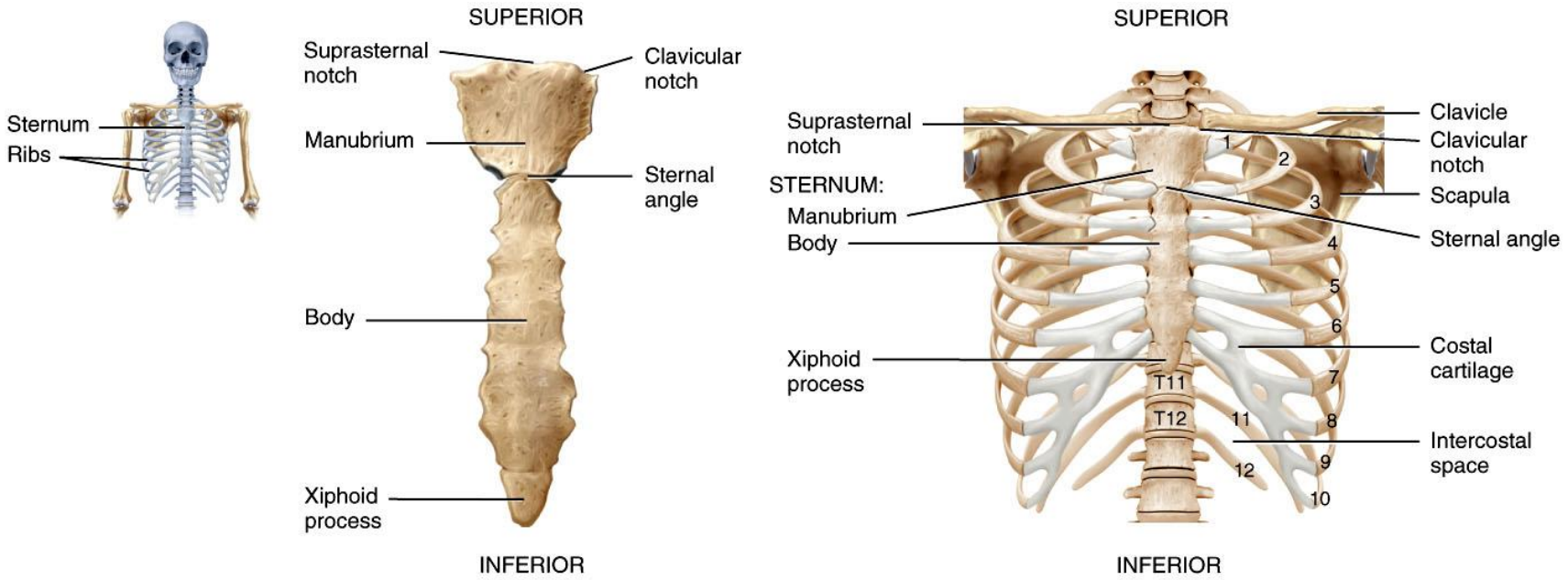


Figure 07.22 Tortora - PAP 12/e

Vertebral Column

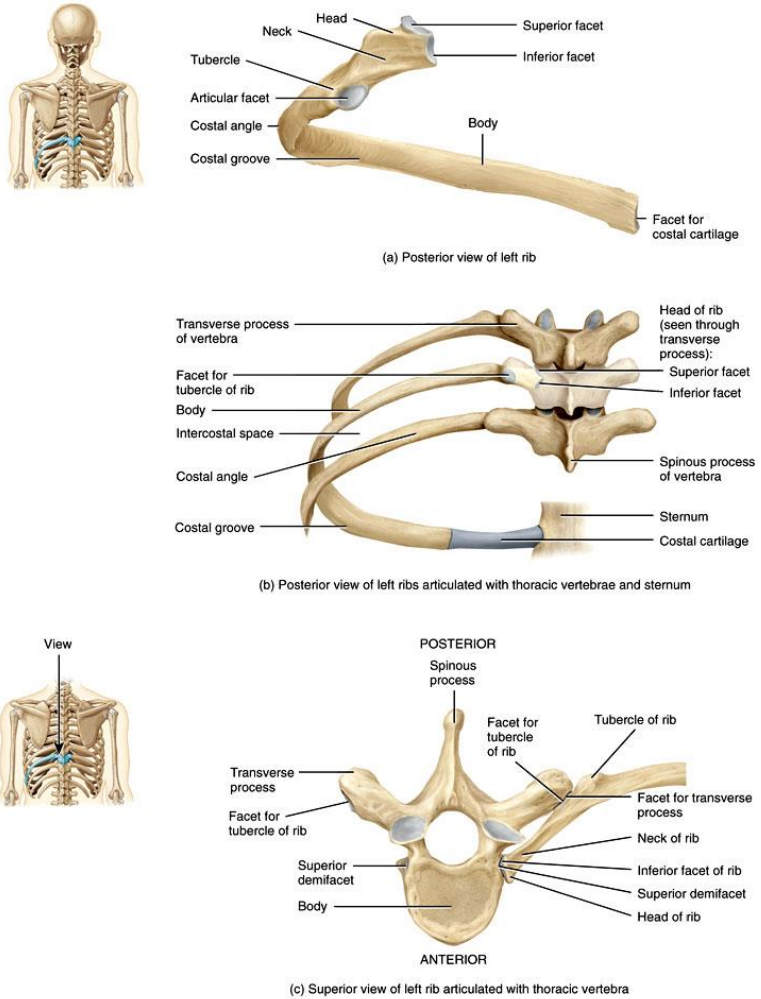


Figure 07.23 Tortora - PAP 12/e