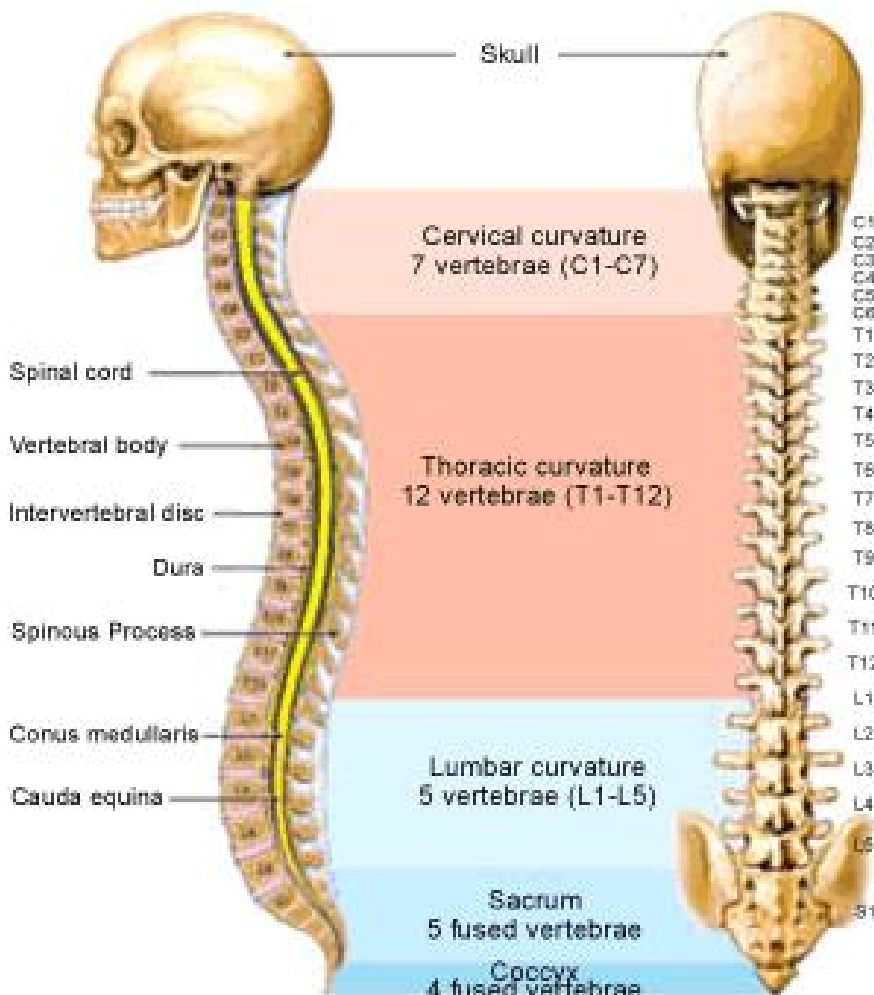


Vertebral Column and thoracic cage

Danil Hammoudi.MD



The spine, or vertebral column, is composed of 5 main segments:

- **the cervical,**
- **thoracic,**
- **and lumbar curvatures,**
- **the sacrum,**
- **and the coccyx.**

Each of these curvatures is composed of individual vertebrae, which provide structural support and protection for the spinal cord.

-There are **24 movable** vertebrae in the spine;

- **7 in the cervical curvature,**
- **12 in the thoracic curvature,**
- **5 in the lumbar curvature.**

• Additionally, **the sacrum consists of 5 fused vertebrae**

• **the coccyx is composed of three to five fused vertebrae.**

Parts of a Typical Vertebra :

Cervical
Thoracic
Lumbar

Body
Transverse process
Spinous Process
Vertebral foramen

Atlas -

Transverse foramen

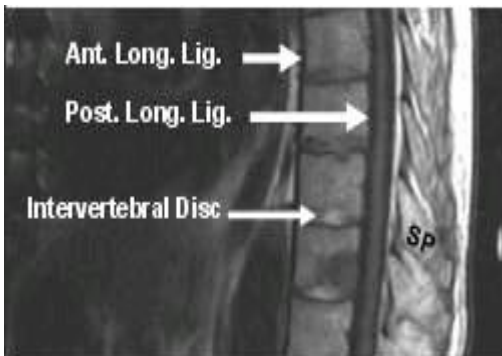
Axis —

Dens or odontoid process

Regions of Vertebral Column

Cervical	7	<u>Lordosis</u>
Thoracic	12	<u>Kyphosis</u>
Lumbar	5	<u>Lordosis</u>
Sacral	5 fused	<u>lordosis</u>
Coccygeal	4 fused	





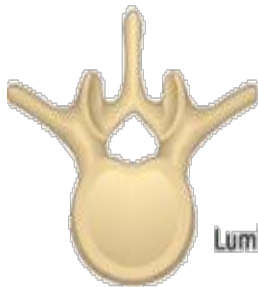
Term	# of Vertebrae	Body Area	Abbreviation
Cervical	7	Neck	C1 – C7
Thoracic	12	Chest	T1 – T12
Lumbar	5 or 6	Low Back	L1 – L5
Sacrum	5 (fused)	Pelvis	S1 – S5
Coccyx	3	Tailbone	None



Cervical vertebra

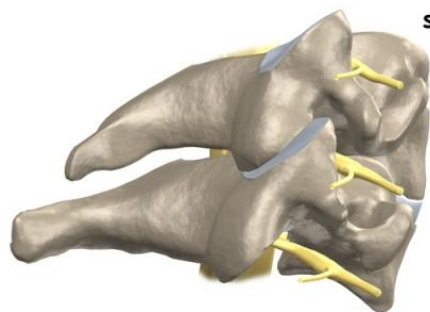


Thoracic vertebra



Lumbar vertebra

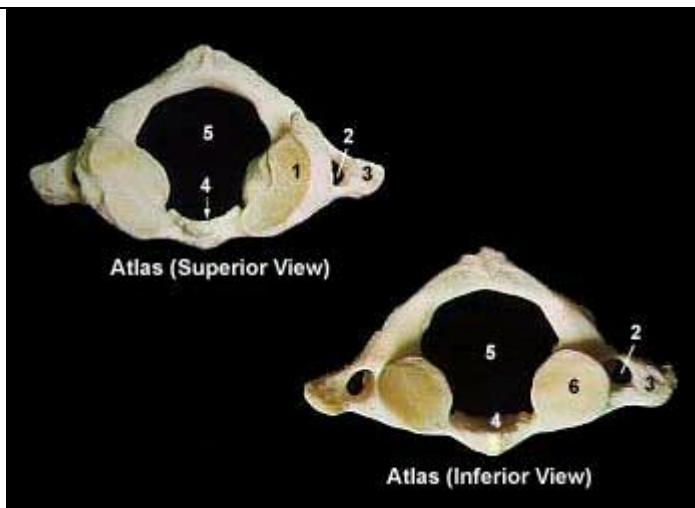
ATLAS (1ST CERVICAL VERTEBRA) — AXIS (2ND CERVICAL VERTEBRA) — TYPICAL 3RD - 7TH CERVICAL VERTEBRA — THORACIC VERTEBRA — LUMBAR VERTEBRA — SACRUM & COCCYX



Spinal segment



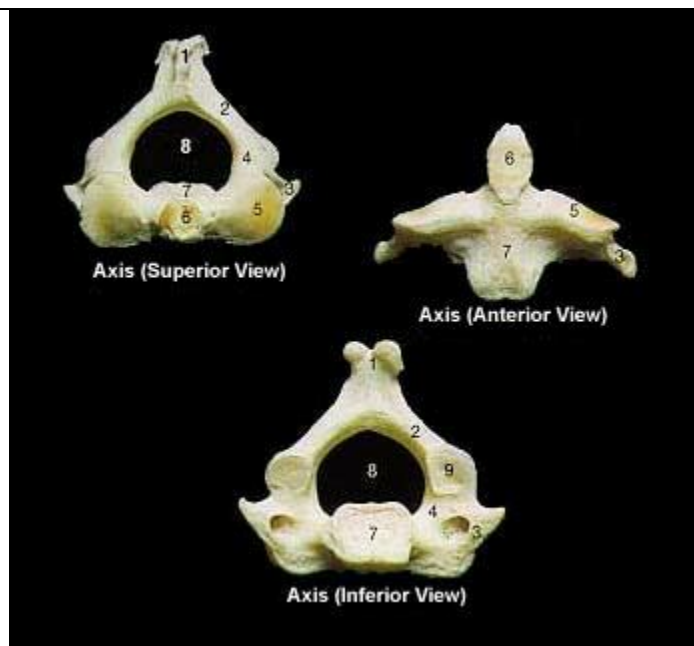
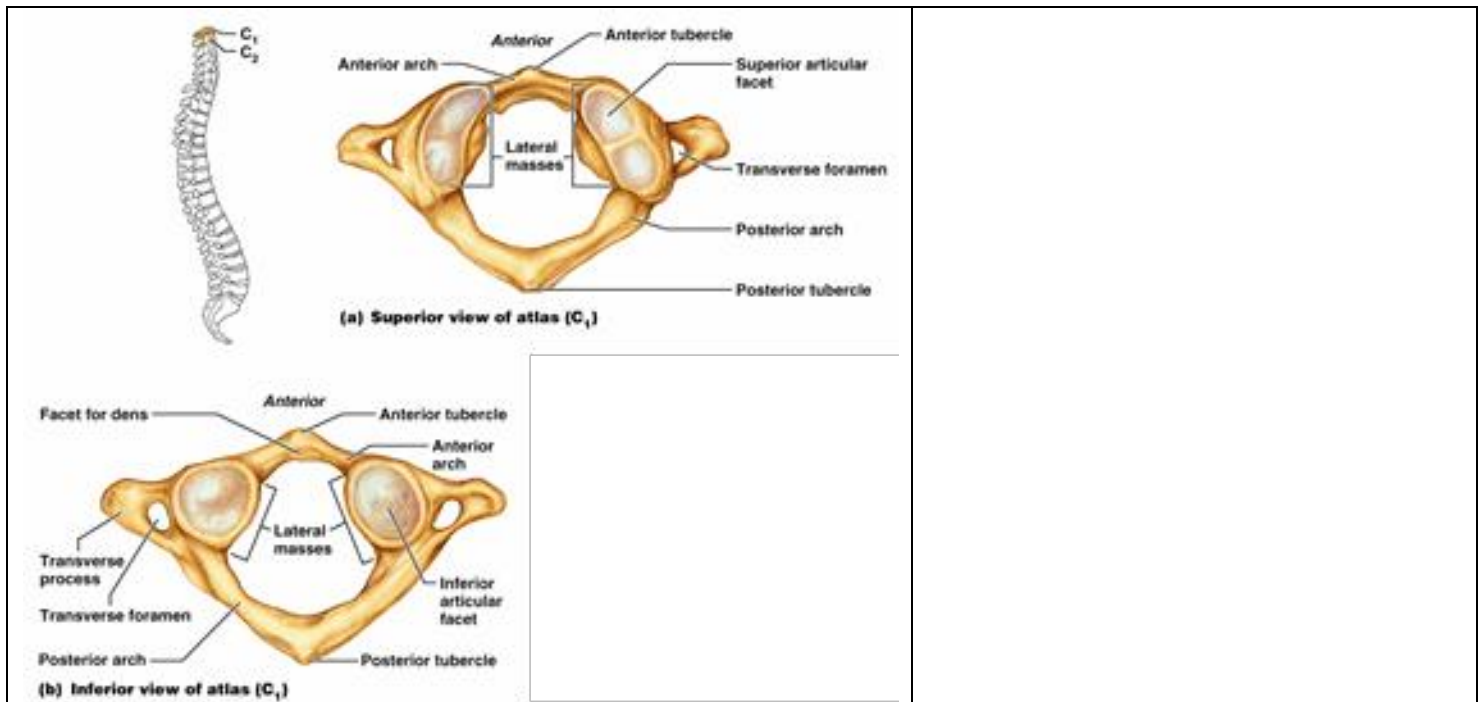
1. The **vertebral column (spine or backbone)** is a strong, flexible rod that:
 - i. surrounds and protects the spinal cord
 - ii. supports the head
 - iii. serves as a site of attachment for ribs and back muscles.
2. It is formed by 26 **vertebrae**:
 - i. **7 cervical vertebrae**
 - ii. **12 thoracic vertebrae**
 - iii. **5 lumbar vertebrae**
 - iv. one **sacrum** formed by fusion of **5 sacral vertebrae**
 - v. one (or two) **coccyx** formed by fusion of (usually) **4 coccygeal vertebrae**



1. Superior Articular Surface
2. Transverse Foramen
3. Transverse Process
4. Odontoid (Dens) Facet
5. Vertebral Foramen
6. Inferior Articular Surface

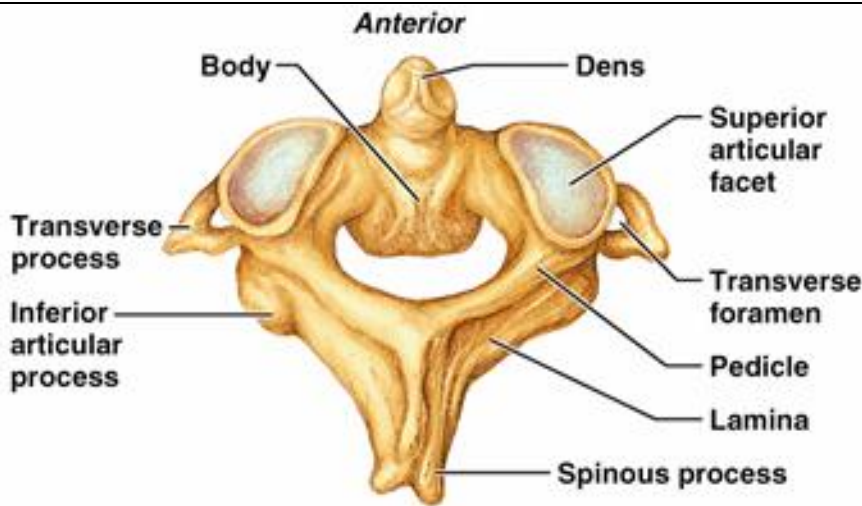
Cervical Vertebrae: The Atlas (C1)

- 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

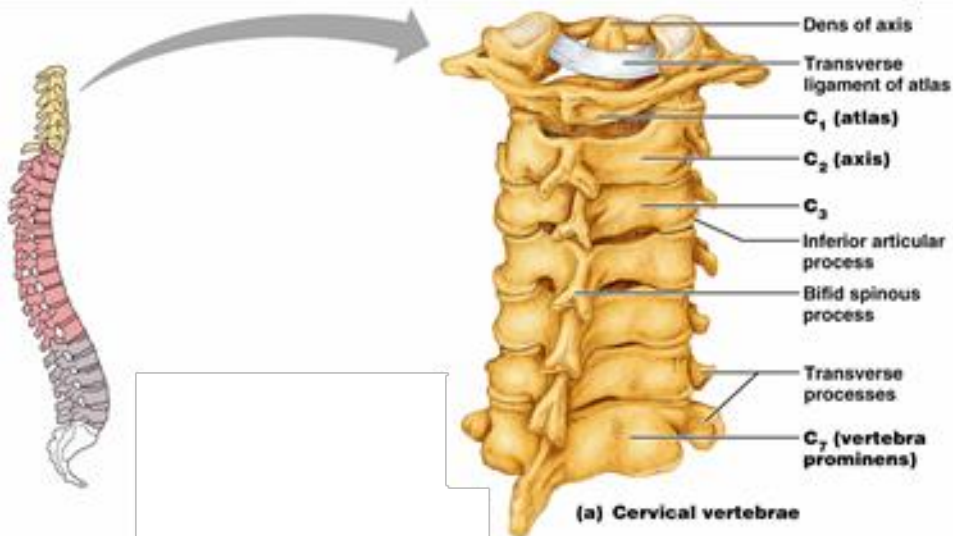


1. Spinous Process
2. Lamina
3. Transverse Process
4. Pedicle
5. Superior Articular Surface
6. Odontoid Process (Dens)
7. Body
8. Vertebral Foramen
9. Inferior Articular Surface

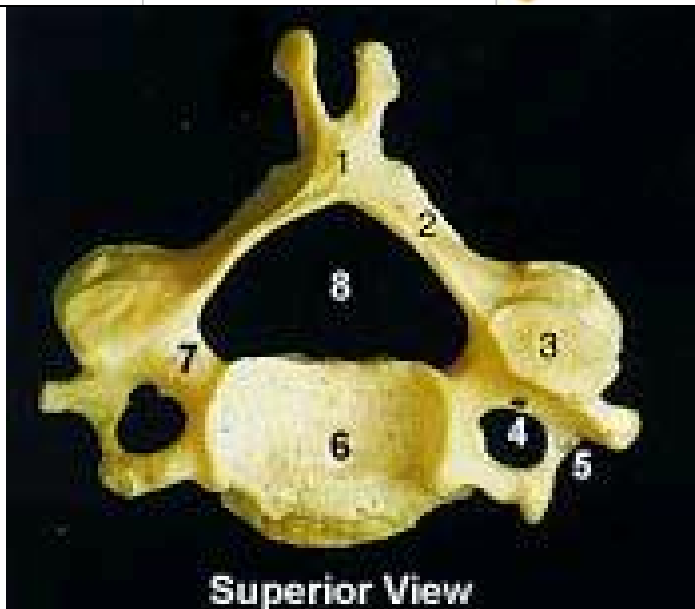
- The axis has a body, spine, and vertebral arches as do other cervical vertebrae
- Unique to the axis is the dens, or odontoid process, which projects superiorly from the body and is cradled in the anterior arch of the atlas
- The dens is a pivot for the rotation of the atlas



(c) Superior view of axis (C_2)



(a) Cervical vertebrae



Superior View

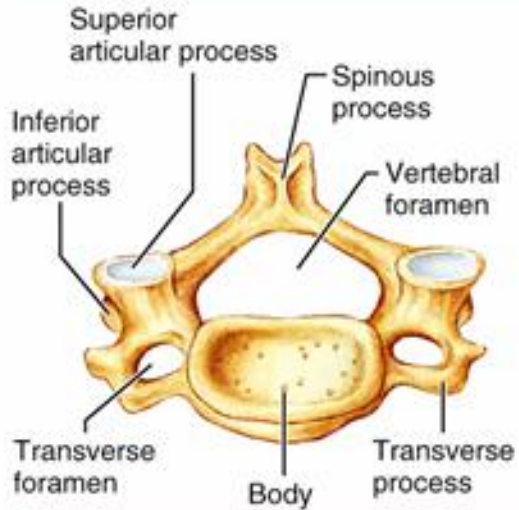
Cervical

1. Spinous Process
2. Lamina
3. Superior Articular Surface
4. Transverse Foramen
5. Transverse Process
6. Body
7. Pedicle
8. Vertebral Foramen

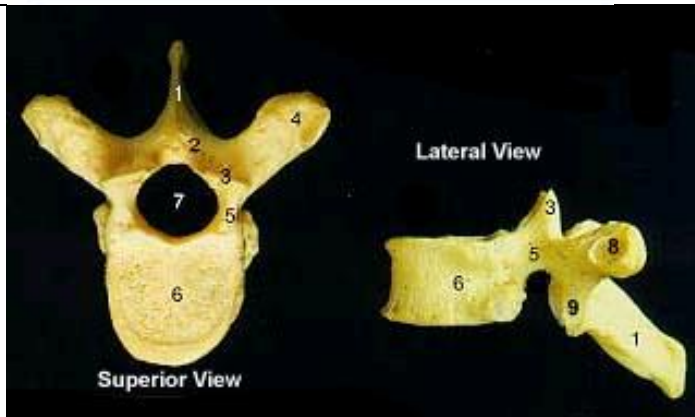
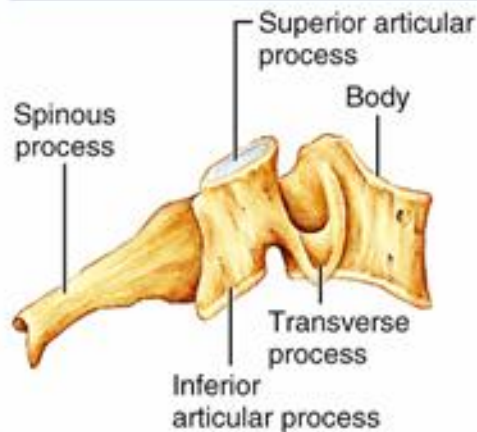
- Seven vertebrae (C_1 - C_7) are the smallest, lightest vertebrae
- C_3 - C_7 are distinguished with an oval body, short spinous processes, and large, triangular vertebral foramina
- Each transverse process contains a transverse foramen

CERVICAL (3-7)

SUPERIOR VIEW

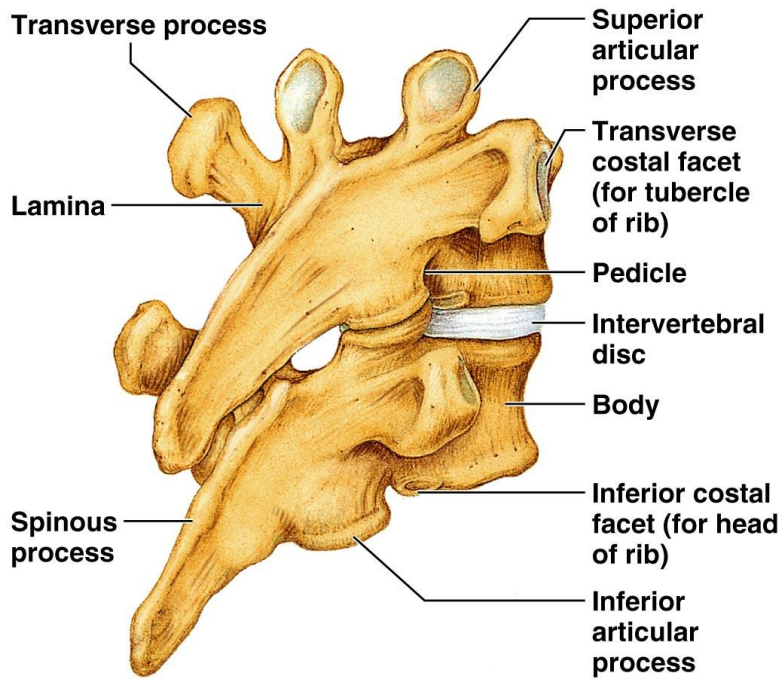


RIGHT LATERAL VIEW



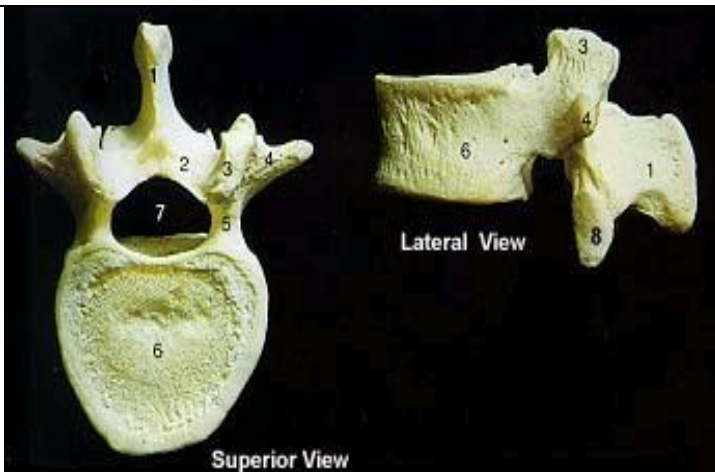
Thoracic

1. Spinous Process
 2. Lamina
 3. Superior Articular Surface
 4. Transverse Process
 5. Pedicle
 6. Body
 7. Vertebral Foramen
 8. Articular Facet for Rib
 9. Inferior Articular Surface
- There are twelve vertebrae (T1-T12) all of which articulate with ribs
 - Major markings include two facets and two demifacets on the heart-shaped body, the circular vertebral foramen, transverse processes, and a long spinous process
 - The location of the articulate



(b) Thoracic vertebrae

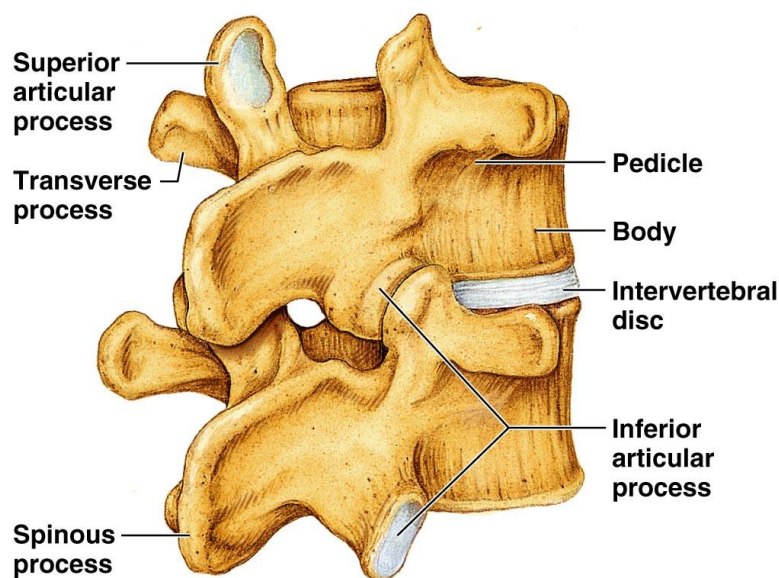
facets prevents flexion and extension, but allows rotation of this area of the spine



Lumbar

1. Spinous Process
2. Lamina
3. Superior Articular Surface
4. Transverse Process
5. Pedicle
6. Body
7. Vertebral Foramen
8. Inferior Articular Surface

- 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



(c) Lumbar vertebrae

TABLE 7.2 Regional Characteristics of Cervical, Thoracic, and Lumbar Vertebrae

CHARACTERISTIC	CERVICAL (3-7)	THORACIC	LUMBAR
Body	Small, wide side to side	Larger than cervical; heart shaped; bears two costal facets	Massive; kidney shaped
Spinous process	Short; bifid; projects directly posteriorly	Long; sharp; projects inferiorly	Short; blunt; projects directly posteriorly
Vertebral foramen	Triangular	Circular	Triangular
Transverse processes	Contain foramina	Bear facets for ribs (except T ₁₁ and T ₁₂)	Thin and tapered
Superior and inferior articulating processes	Superior facets directed superoposteriorly Inferior facets directed inferoanteriorly	Superior facets directed posteriorly Inferior facets directed anteriorly	Superior facets directed posteromedially (or medially) Inferior facets directed anterolaterally (or laterally)
Movements allowed	Flexion and extension; lateral flexion; rotation; the spine region with the greatest range of movement	Rotation; lateral flexion possible but limited by ribs; flexion and extension prevented	Flexion and extension; some lateral flexion; rotation prevented

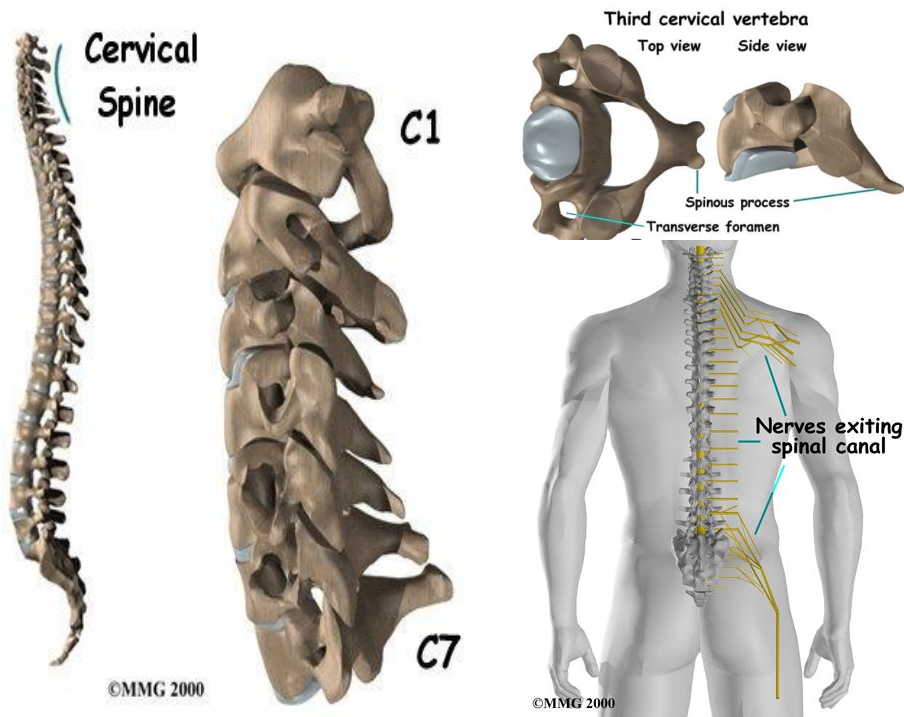


TABLE 7.2 Regional Characteristics of Cervical, Thoracic, and Lumbar Vertebrae

CERVICAL (3-7)	THORACIC	LUMBAR
SUPERIOR VIEW		
<p>Superior articular process Spinous process Vertebral foramen Inferior articular process Transverse foramen Body Transverse process</p>	<p>Spinous process Vertebral foramen Transverse process Transverse costal facet (for tubercle of rib) Superior articular process Body</p>	<p>Spinous process Vertebral foramen Transverse process Superior articular process Body</p>
RIGHT LATERAL VIEW		
<p>Superior articular process Spinous process Body Transverse process Inferior articular process</p>	<p>Superior articular process Transverse process Superior costal facet Body Inferior notch Inferior costal facet (for head of rib) Spinous process</p>	<p>Superior articular process Body Spinous process Inferior notch Inferior articular process</p>



1. 1st Lumbar vertebra
2. 2nd Lumbar vertebra
3. 3rd Lumbar vertebra
4. 4th Lumbar vertebra
5. 5th Lumbar vertebra
6. T12
7. Twelfth rib
8. Sacroiliac joint
9. Sacrum
10. Sacral foramen
11. Ilium
12. Pelvic brim
13. Superior ramus of pubic bone
14. Pubic symphysis

3. **Intervertebral discs** are located between neighboring vertebrae (from C2 down to the sacrum):
 - i. each consists of an outer **annulus fibrosus** and an inner **nucleus pulposus**
 - ii. they form strong joints, permit various movements of the spine, and absorb vertical shock
4. The vertebral column has four alternating **normal curves**:
 - i. **anteriorly convex cervical curve**
 - ii. **anteriorly concave thoracic curve**
 - iii. **anteriorly convex lumbar curve**
 - iv. **anteriorly concave sacral curve**

At birth, there is only a single anteriorly concave curve; the cervical and lumbar (i.e., secondary) curves develop in the early months of infancy as the child begins to hold its head erect and as the child begins to sit and walk, respectively.

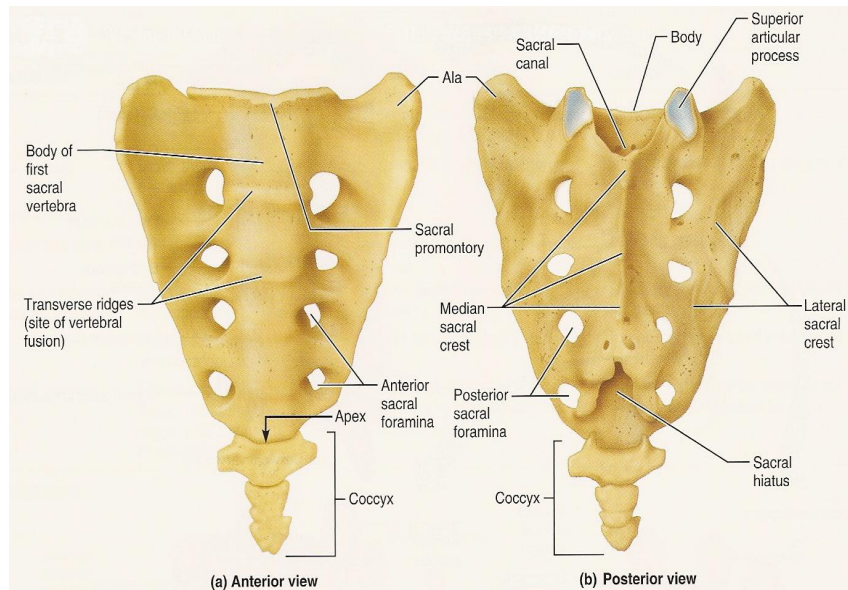
The four curves function to:

- a. increase the strength of the spine
 - b. help maintain balance in the upright position
 - c. absorb shocks from walking and jumping
 - d. help protect the spine from fracture.
5. A typical vertebra has the following structural features:
 - i. **body**
 - ii. **vertebral arch**, which consists of:
 - a. two **pedicles**
 - b. two **laminae**
 - iii. **7 processes**:
 - a. two **transverse processes**
 - b. one **spinous process (spine)**
 - c. two **superior articular processes with facets**
 - d. two **inferior articular processes with facets**

As a consequence of the above structural features, each vertebra has a **vertebral foramen** (all the vertebral foramina in the spine are aligned to form the **vertebral (spinal) canal**) and there are **intervertebral foramina** located between neighboring vertebrae.

6. There are unique structural features in each of the vertebrae in the cervical (e.g., **atlas**, **axis**), thoracic, and lumbar regions of the spine).

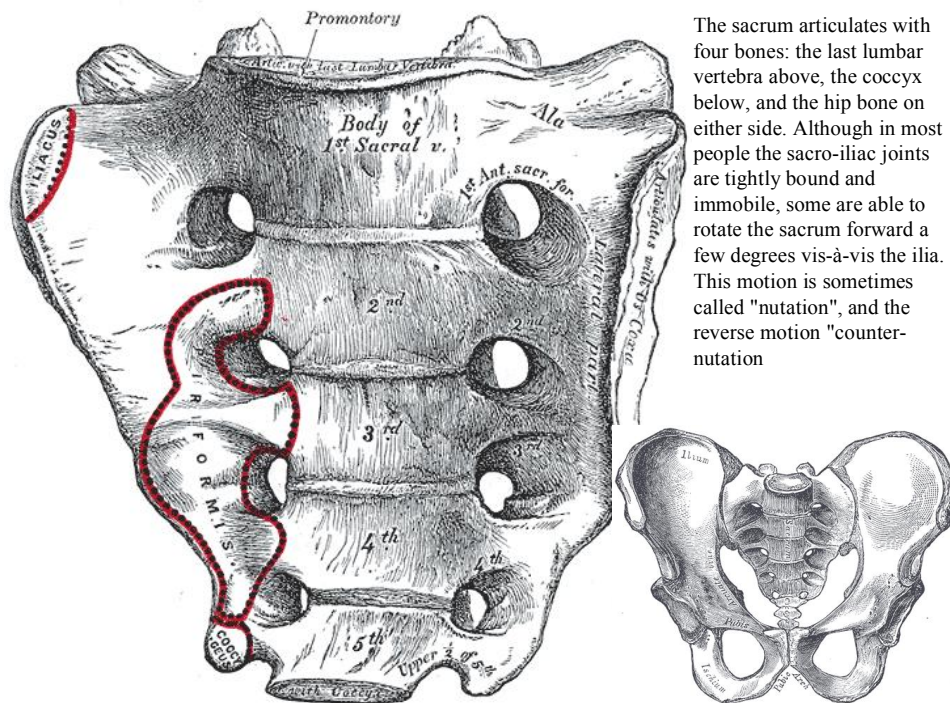
Sacrum



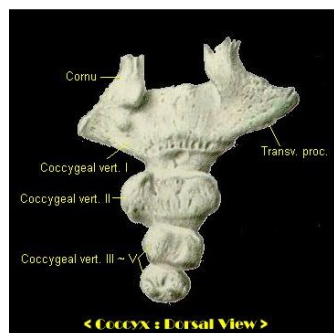
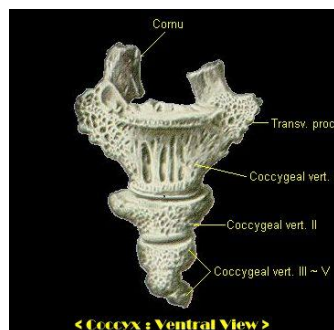
- 5 vertebrae fuse together to form a single bone
- Articulates with:
 - L5 (through SAP)
 - Coccyx
- Functions in weight transfer
- Anterior surface
 - Sacral promontory
 - Transverse ridges
 - Anterior sacral foramina
- Posterior surface
 - Median and lateral sacral crest
 - Posterior sacral foramen

7. Important surface markings of the **sacrum** include:

- a. **transverse lines (ridges)**
- b. **anterior sacral foramina**
- c. **sacral ala**
- d. **median sacral crest**
- e. **lateral sacral crest**
- f. **posterior sacral foramina**
- g. **sacral canal**
- h. **sacral hiatus**
- i. **sacral cornua**
- j. **sacral promontory**
- k. **auricular surfaces**
- l. **sacral tuberosity**
- m. **superior articular processes**

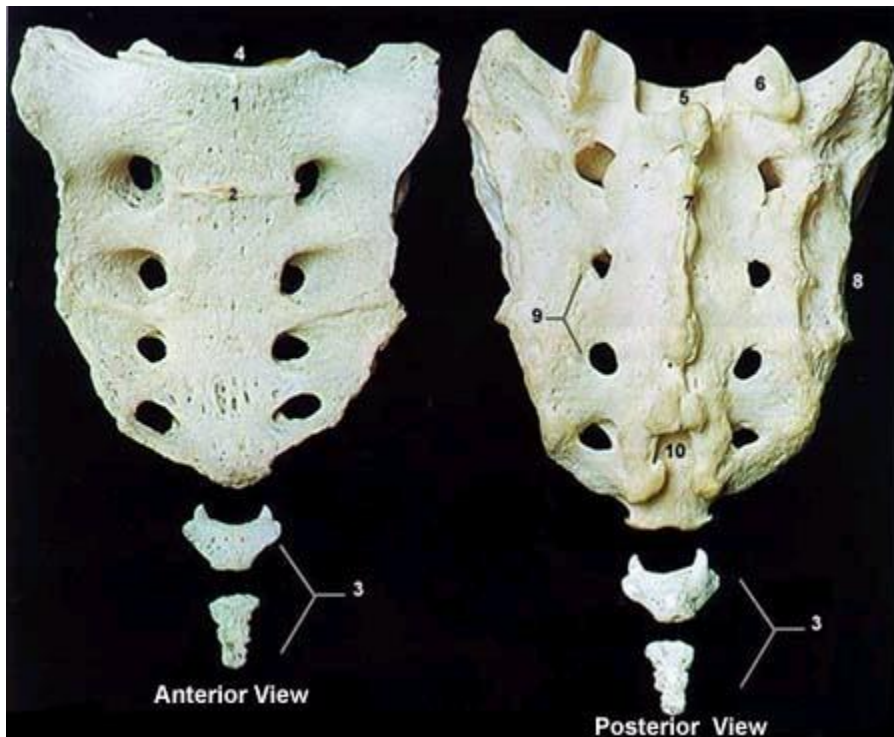


8. Important surface markings of the **coccyx** are **coccygeal cornua** and **transverse processes**.



Coccyx (3-5 fused)

- “**T**ailbone”
- Useless bone.....
 - But painful!
- Slight support to pelvic organs and ligament attachment
- Articulates superiorly with sacrum
- Anterior concave
- Posterior convex



1. Promontory
2. Transverse Ridges
3. Coccyx
4. Body of Sacrum
5. Sacral Canal
6. Superior Articular Surface
7. Median Sacral Crest
8. Sacrum to Ilium Articular Surface
9. Dorsal Sacral Foramina
10. Sacral Hiatus

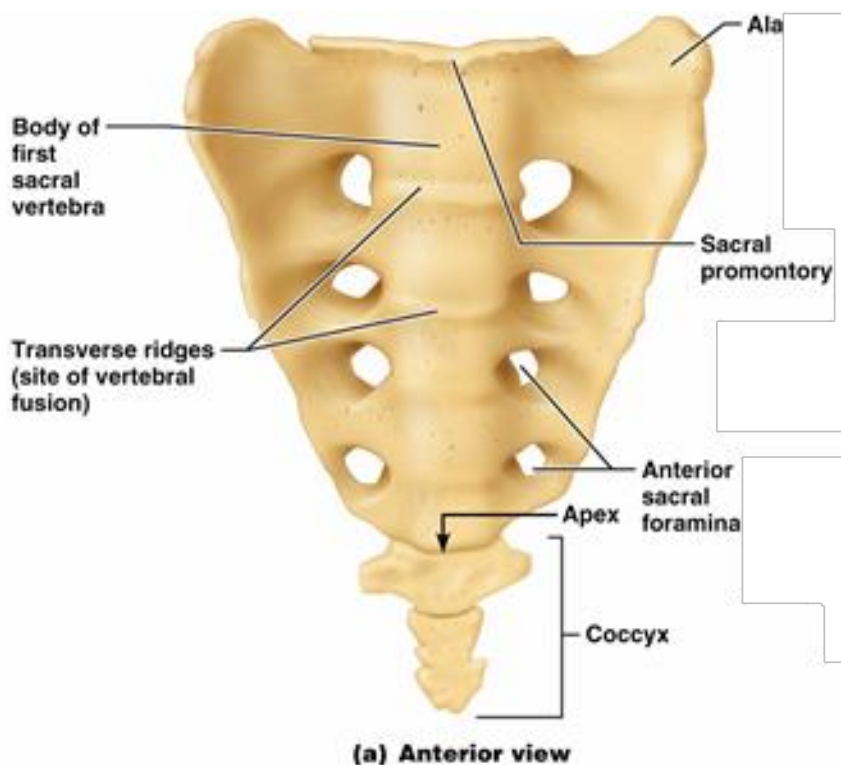
- Consists of five fused vertebrae (S1-S5), which shape the posterior wall of the pelvis

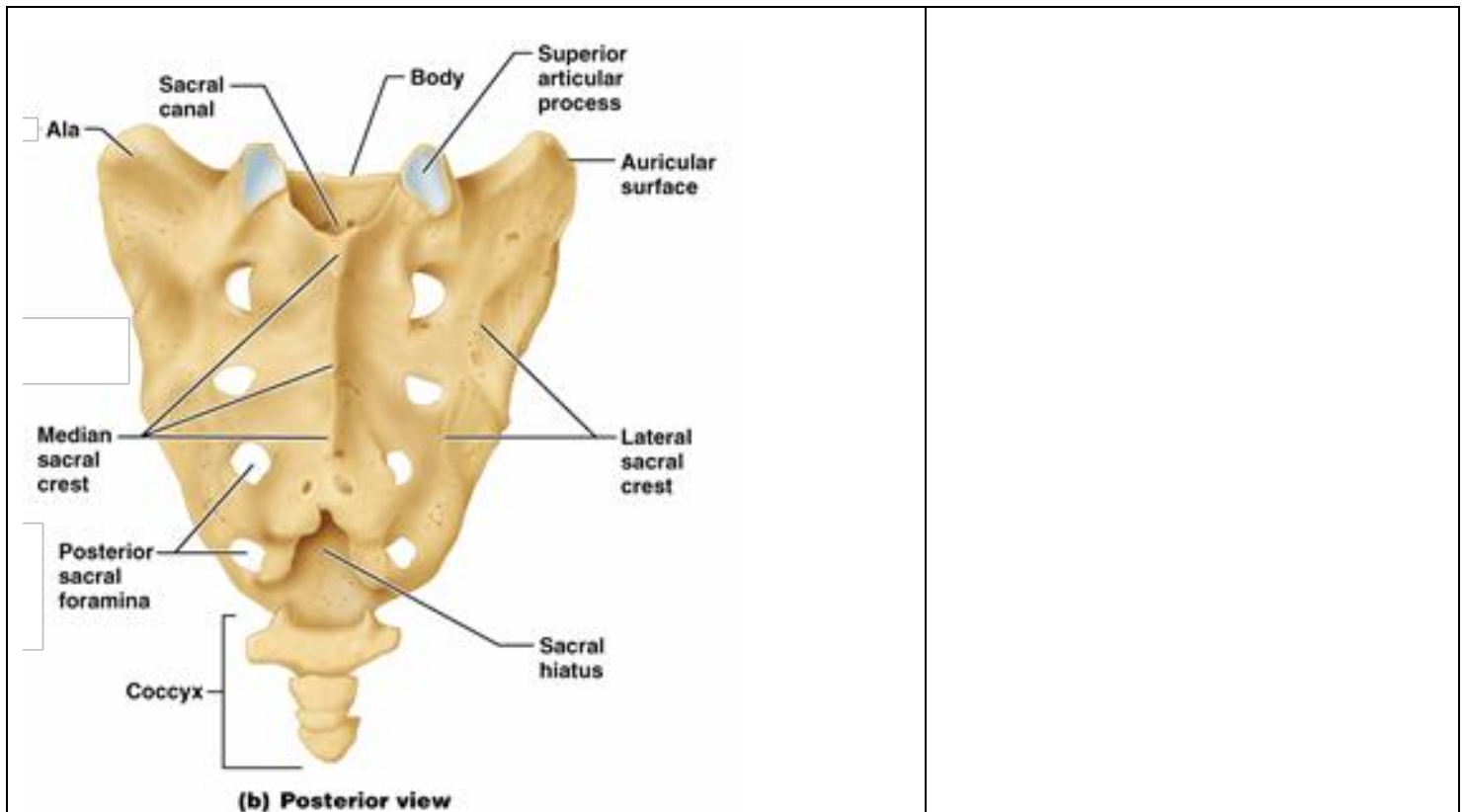
- It articulates with L5 superiorly, and with the auricular surfaces of the hip bones

- Major markings include the sacral promontory, transverse lines, alae, dorsal sacral foramina, sacral canal, and sacral hiatus

- Coccyx (Tailbone)

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





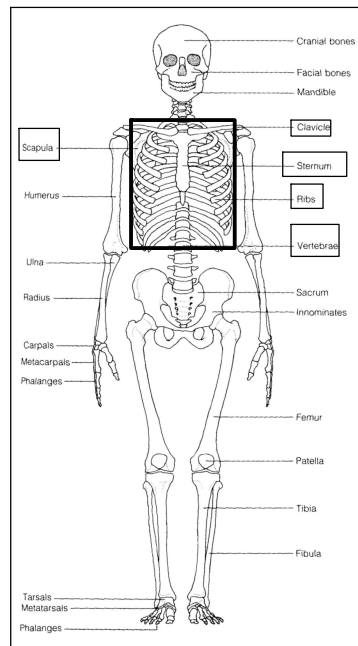
Functions of the Vertebral or Spinal Column Include:

Protection	<ul style="list-style-type: none"> •Spinal Cord and Nerve Roots •Many internal organs
Base for Attachment	<ul style="list-style-type: none"> •Ligaments •Tendons •Muscles
Structural Support	<ul style="list-style-type: none"> •Head, shoulders, chest •Connects upper and lower body •Balance and weight distribution
Flexibility and Mobility	<p>Flexion (forward bending)</p> <ul style="list-style-type: none"> •Extension (backward bending) •Side bending (left and right) •Rotation (left and right) •Combination of above
Other	<ul style="list-style-type: none"> •Bones produce red blood cells •Mineral storage

H. Thorax

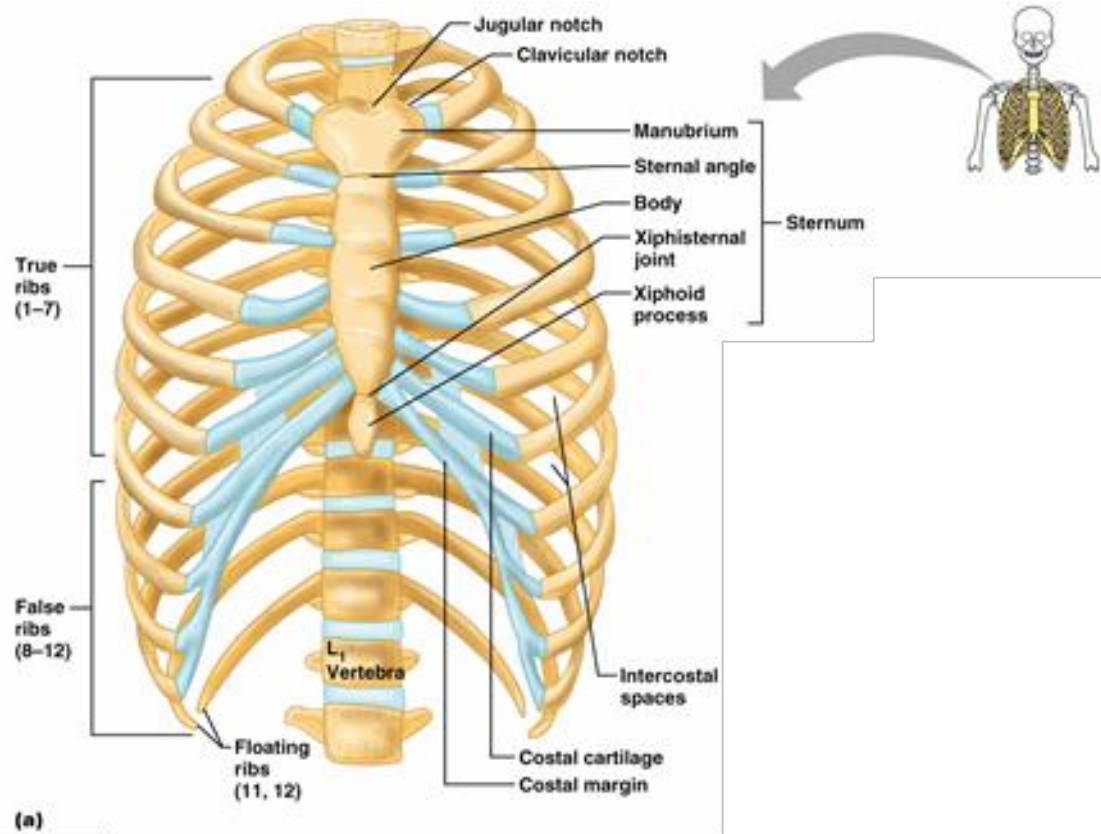
The Bony Thorax

- Sternum (3 parts)
- Ribs
- Clavicle
- Scapula
- Vertebrae (5 parts)

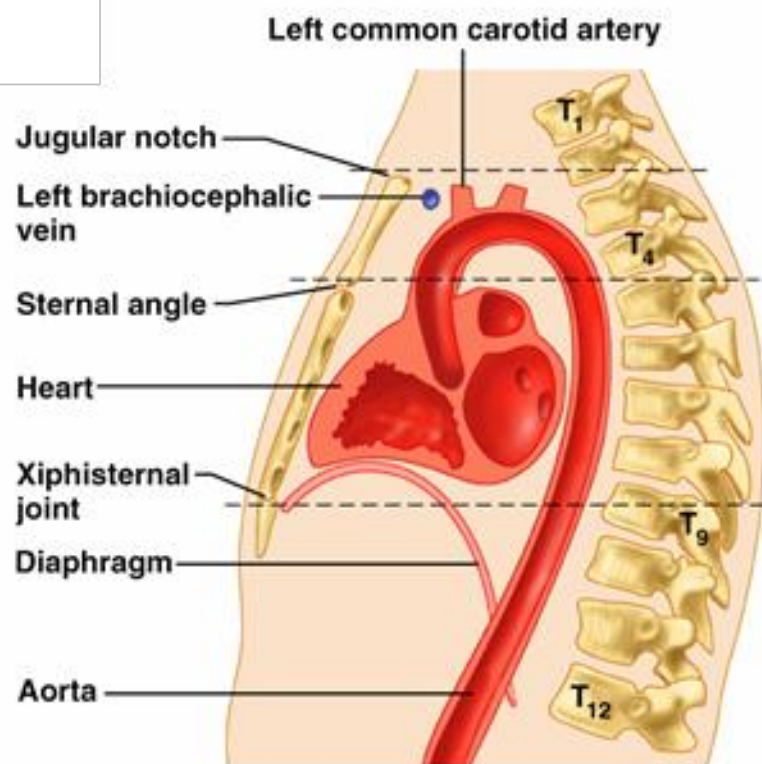


1. The skeletal portion of the thorax (chest) is a cage formed by several bones; the thoracic cage surrounds and protects organs in the thoracic cavity and upper abdominal cavity as well as providing support for the bones of the pectoral girdles and upper limbs.
2. The bones (each having specific **surface markings**) of the thoracic cage are:
 - i. **sternum**, which consists of (three) major regions and major surface markings:
 - a. **manubrium**
 - b. **body**
 - c. **xiphoid process**
 - d. **sternal angle**
 - e. **suprasternal (jugular) notch**
 - f. **clavicular notches**
 - ii. 12 pairs of **ribs**:
 - a. pairs 1-7 are **true (vertebrosternal) ribs**, which are attached directly to the sternum by **costal cartilage**
 - b. pairs 8-12 are **false ribs**
 - pairs 8-10 are **vertebrochondral ribs**
 - pairs 11-12 are **floating (vertebral) ribs**
 - c. important surface markings are:
 - **head**
 - **facets**
 - **neck**
 - **tubercle** (both **articular** and **nonarticular** parts)
 - **body (shaft)**
 - **costal angle**
 - **costal groove**
 - d. **intercostal spaces** are spaces between neighboring ribs
 - e. structures pass through the **superior** and **inferior thoracic apertures**

iii. 12 thoracic vertebrae



(a)

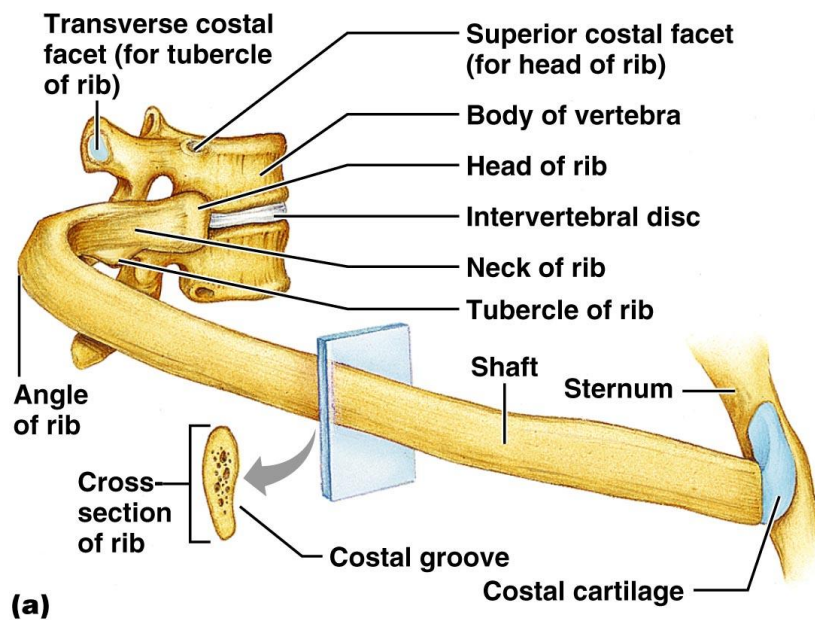


(b)



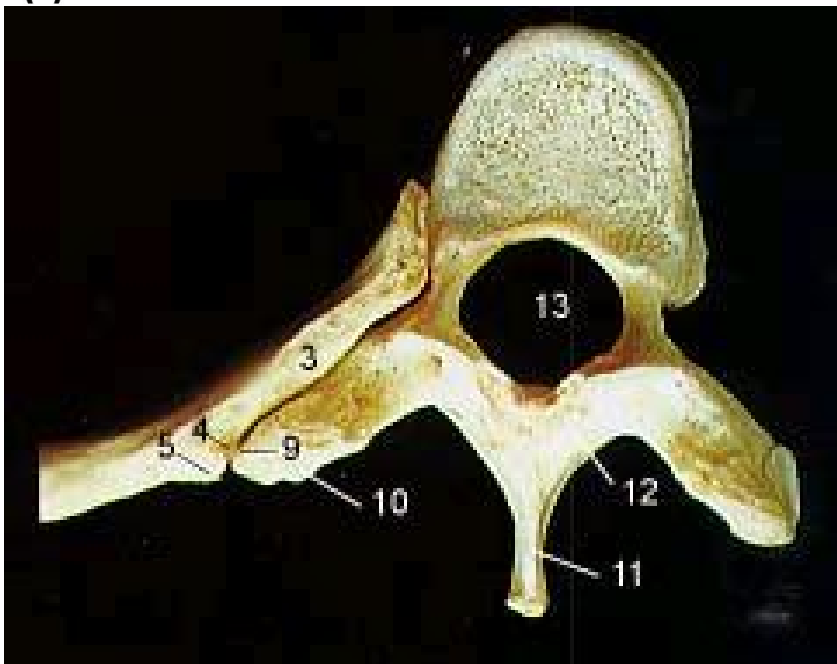
Rib & Vertebra Articulated

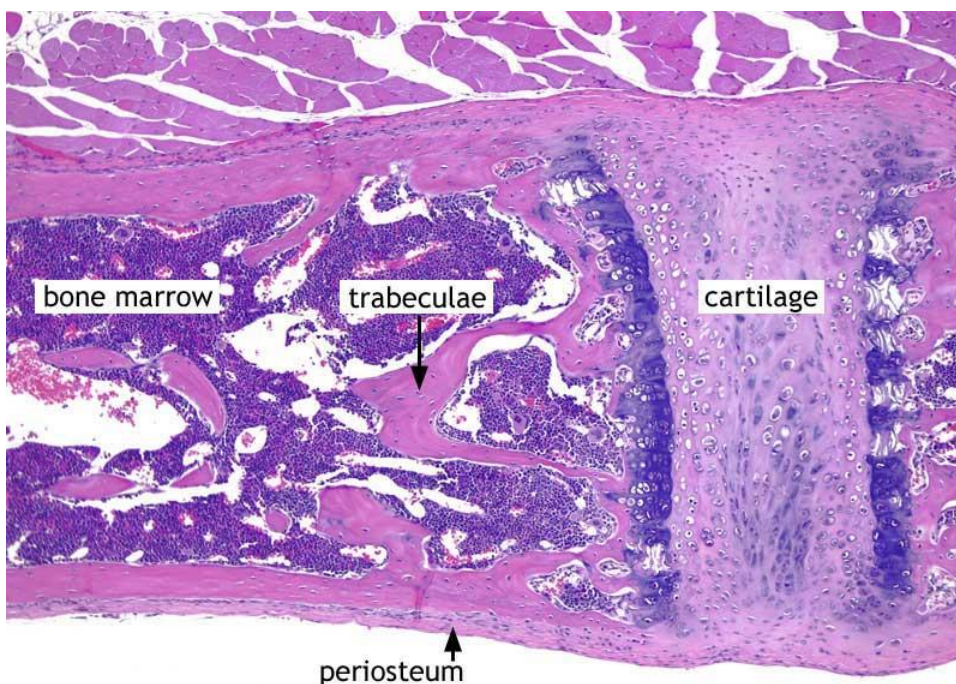
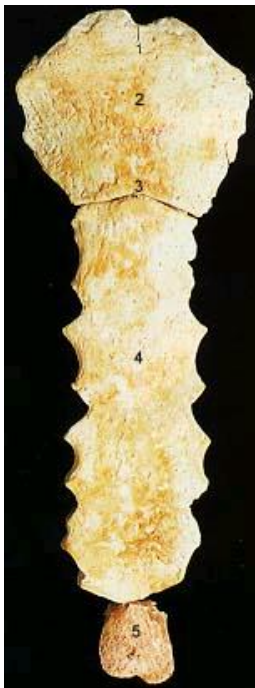
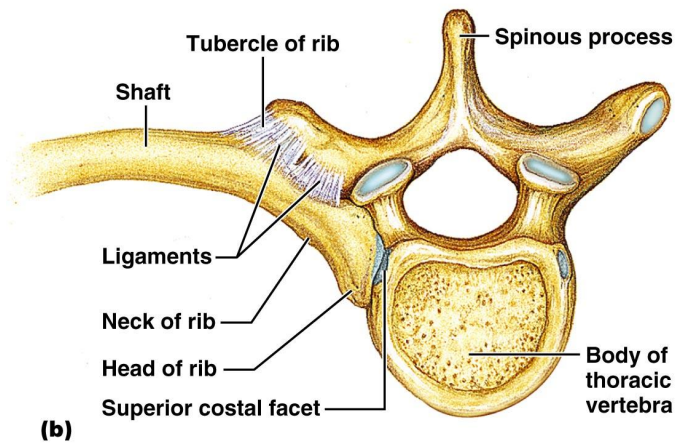
1. Articular Facet of Rib
2. Interarticular Crest
3. Neck
4. Articular Portion of Tubercle
5. Nonarticular Portion of Tubercle
6. Angle of Rib
7. Costal Groove
8. Body of Rib
9. Articular Facet of Transverse Process
10. Transverse Process
11. Spinous Process
12. Lamina
13. Vertebral Foramen



- 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

Bowed, flat bone consisting of a head, neck, tubercle, and shaft





Sternum

1. Jugular Notch

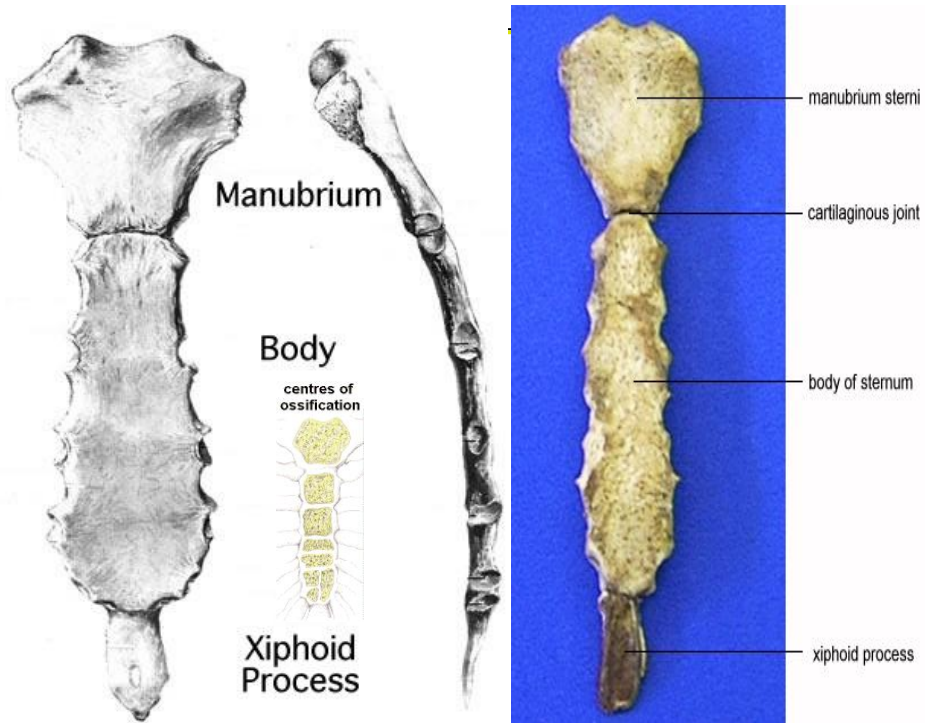
2. Manubrium

3. Sternal Angle

4. Body (Gladiolus)

5. Xiphoid Process

- A dagger-shaped, flat bone that lies in the anterior midline of the thorax
- Results from the fusion of three bones – the superior manubrium, the body, and the inferior xiphoid process
- Anatomical landmarks include the jugular (suprasternal) notch, the sternal angle, and the xiphisternal joint



Thoracic Cage

Boundaries:	Posteriorly:	Thoracic Vertebra
	Superiorly:	Clavicle
	Anteriorly:	Sternum (manubrium, body, xiphoid)
	Inferiorly:	Diaphragm

Protects heart/lungs

Permits movement of thorax for respiration

Support pectoral girdle

Ribs: 24 2 pair of 12