

ANATOMICAL BASIS OF BREATHING

Dr. Monqith Mazin

Objectives

- a. Describe thoracic wall: bones and muscles
- b. Define the muscles of respiration
- c. Define the mediastinum and its contents
- d. Describe the pleura, pleural cavity and pleural reflections
- e. Recognize the mechanism of breathing

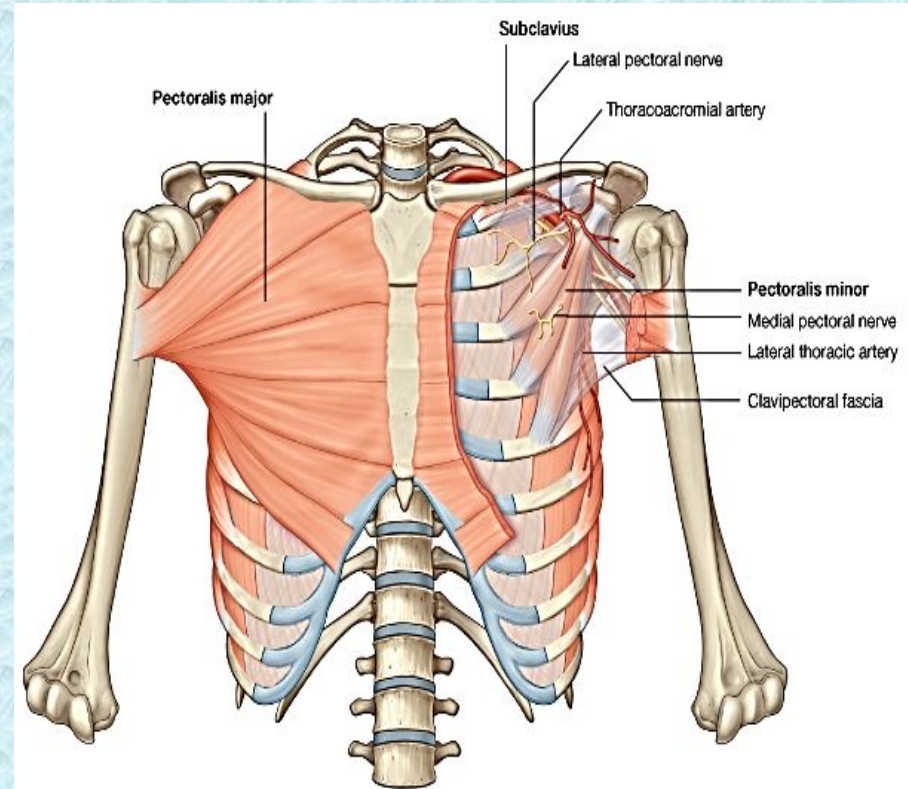
THORACIC WALL

- Bones:

- a. Sternum
- b. 12 pairs of ribs and their costal cartilages
- c. 12 thoracic vertebrae

- Muscles:

- a. Intercostal muscles
- b. Diaphragm
- c. Pectoral muscles

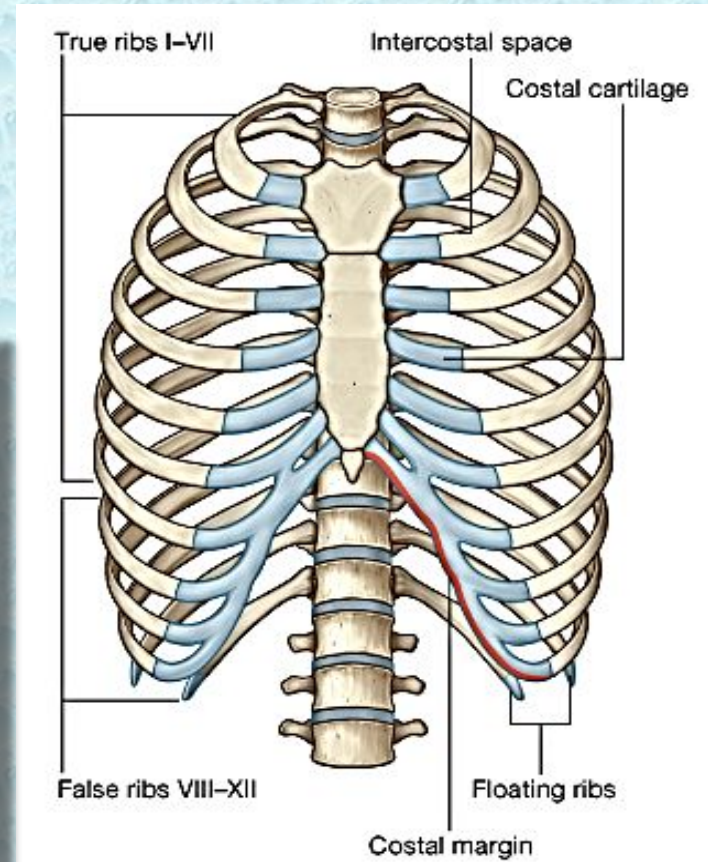
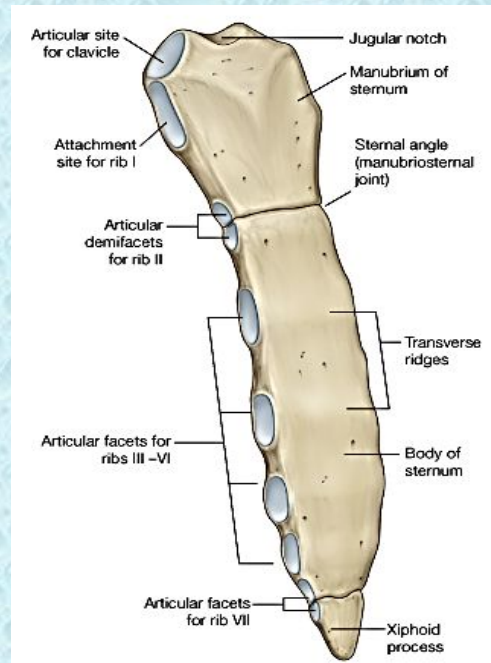


THORACIC CAGE

- **Sternum:**

flat bone consists of three parts:

1. Manubrium
2. Body
3. Xiphoid process



THORACIC CAGE

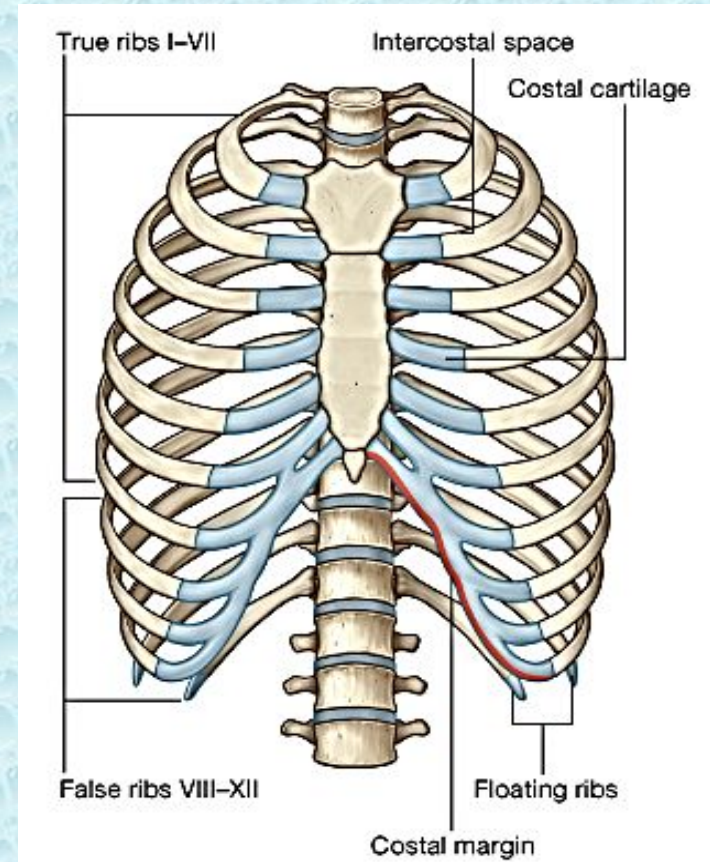
- Ribs:

12 pairs of flat bones. Divided into 3 types:

1. True ribs (1-7)
2. False ribs (8-10)
3. Floating ribs (11-12)

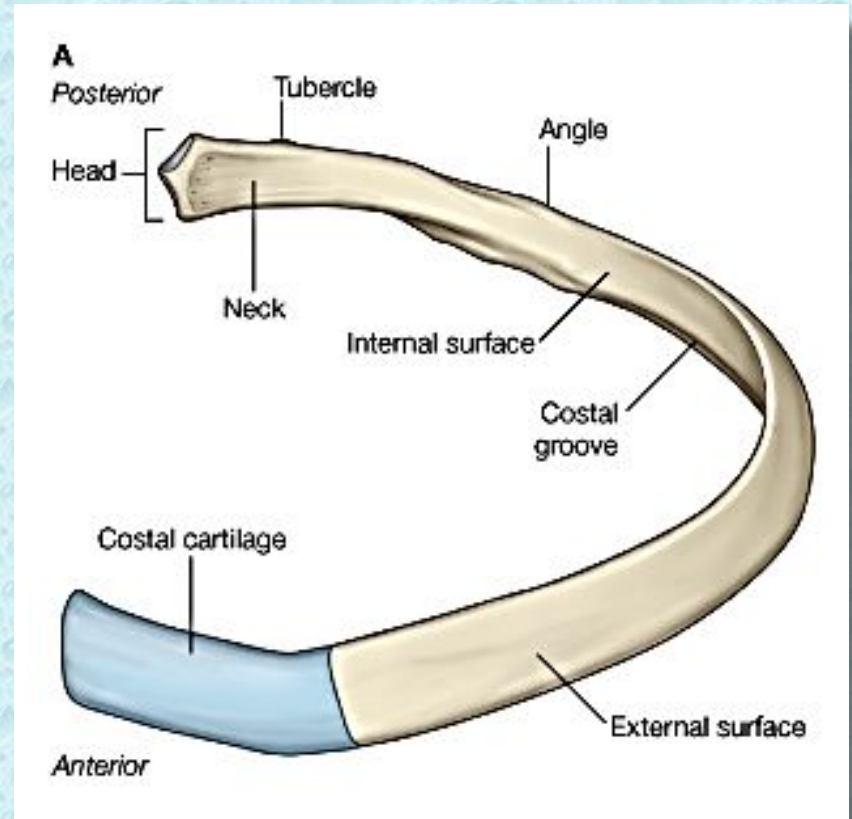
Also the ribs divided into:

- a. Typical ribs (3-9)
- b. Atypical ribs (1, 2, 10, 11, 12)



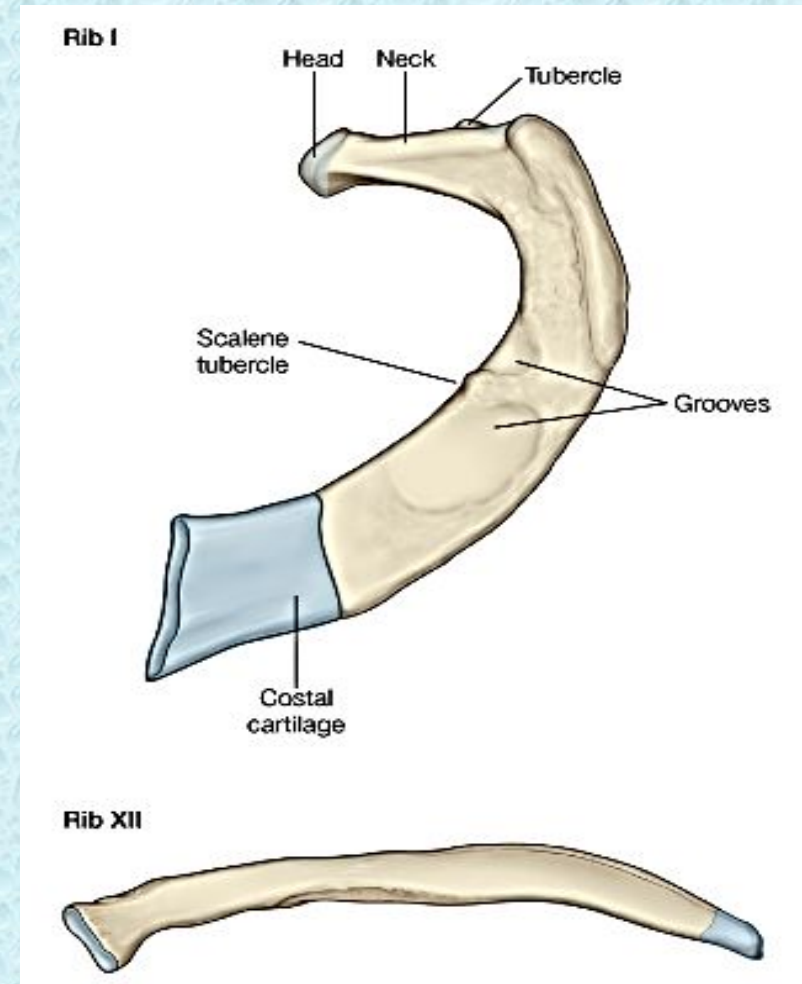
Typical rib

- Head with two articular surfaces
- Neck
- Tubercle with two parts
- Shaft with an angle and costal groove

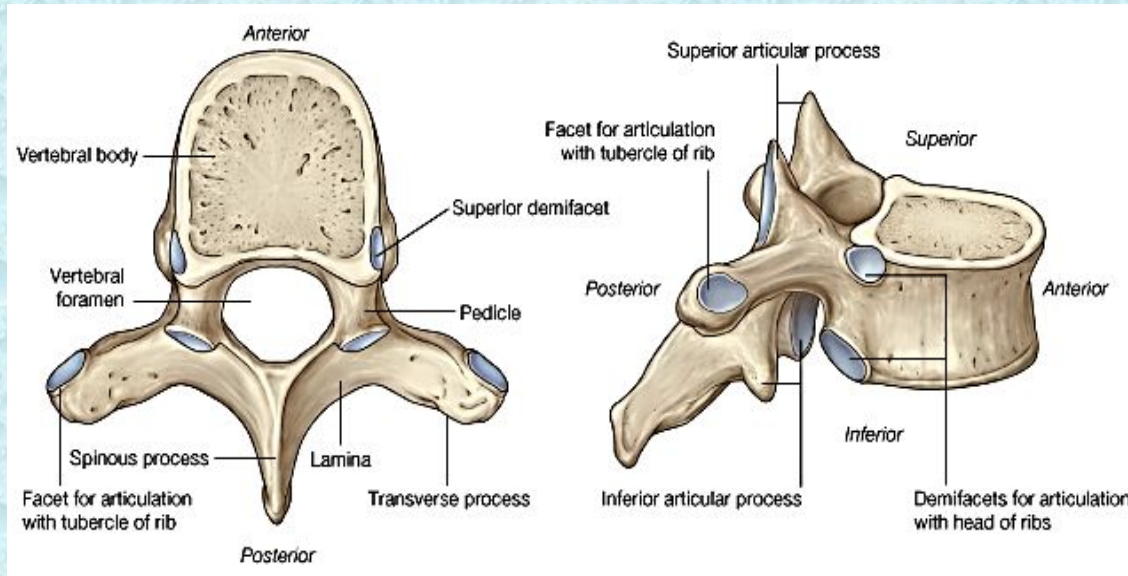


Atypical ribs

- Head with one articular surface
- Neck not present in 11 & 12
- No tubercle in 11 & 12
- No costal groove
- First rib is shortest and broadest one with flat shaft.



Thoracic Vertebrae



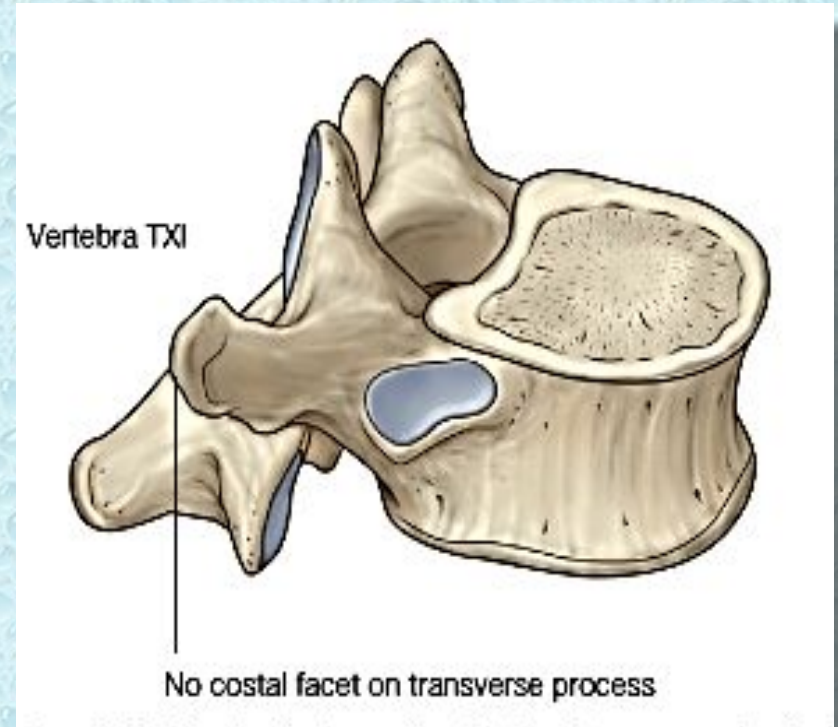
Typical thoracic vertebra

- Body: heart shape, with two articular demi facets
- Long spinous process
- Circular vertebral foramen
- Flat articular processes

Thoracic Vertebrae

Atypical thoracic vertebra

- Vertebra 1, 10, 11 and 12
- Body has complete articular facet
- Spinous process becomes shorter downward



Joints

□ Intervertebral joints:

- a. Symphyses: vertebral bodies;
- b. synovial joints: articular processes

□ Costovertebral joints:

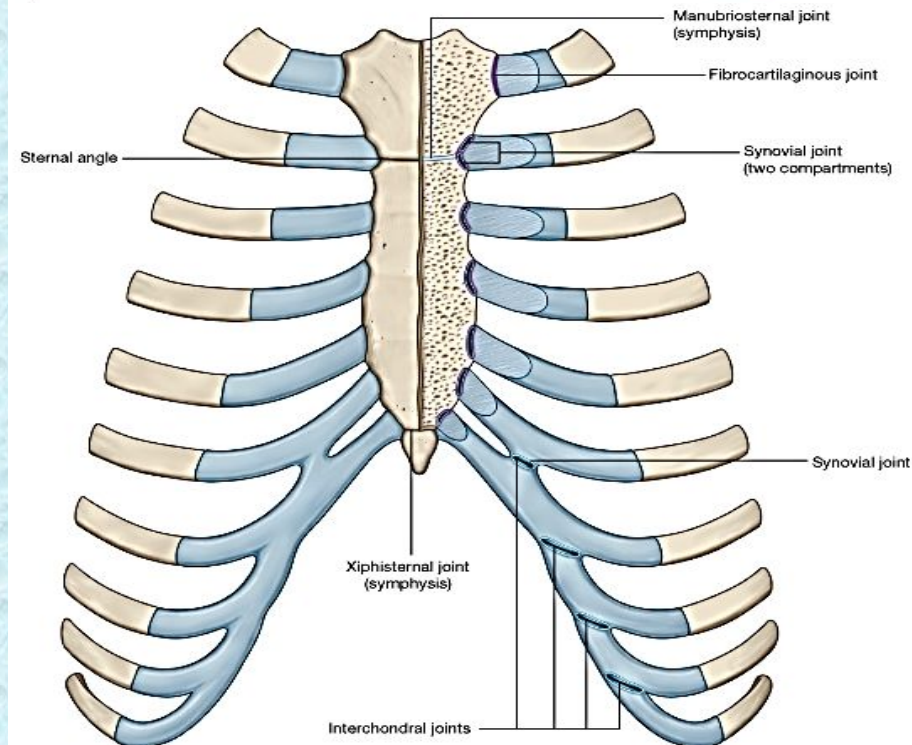
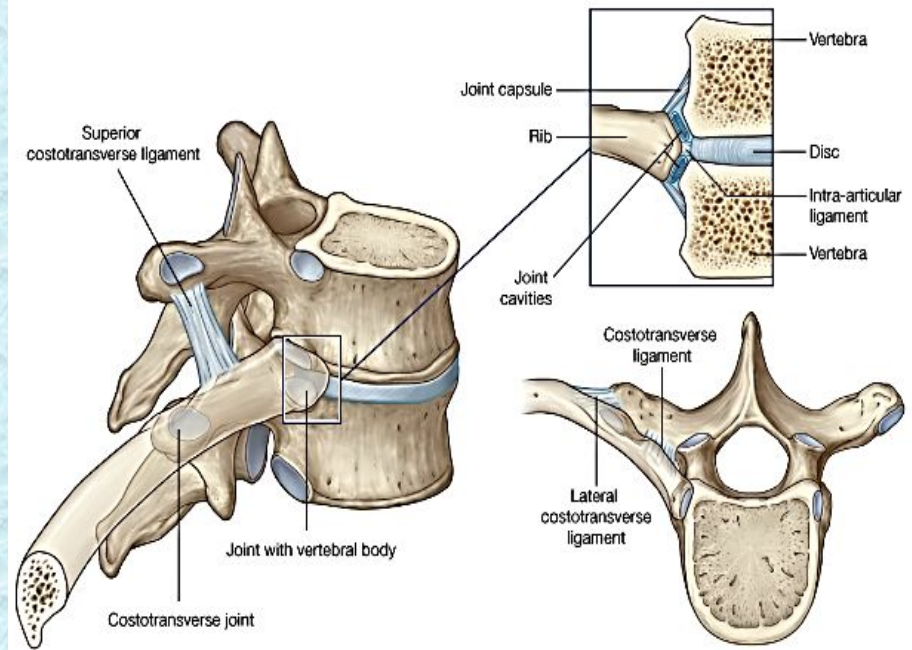
synovial

□ Sterno-costal joints:

- a. First rib: Primary cartilaginous
- b. 2nd - 7th ribs: synovial

□ Inter-chondral joints:

synovial



Muscles of thorax

- A. Muscles of pectoral region
- B. Intercostal muscles
- C. Diaphragm

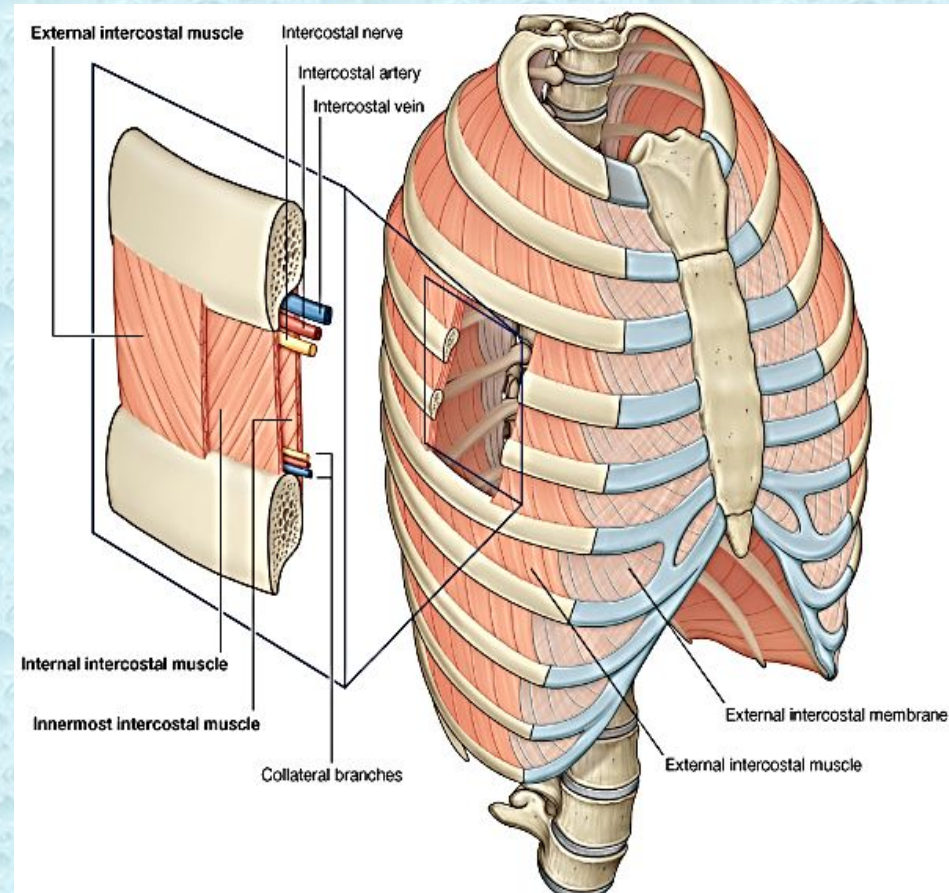
Intercostal muscles

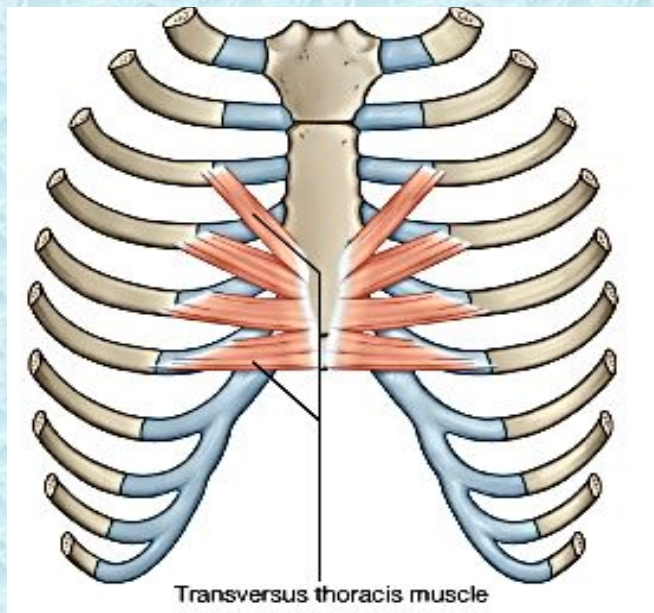
- Three flat muscles in each intercostal space.

a) External I.C.M. extend from the inferior edges of the ribs above to the superior surfaces of the ribs below, downward forward.

b) Internal I.C.M. extend from the costal grooves of the ribs above, to the superior surface of the ribs below, downward backward

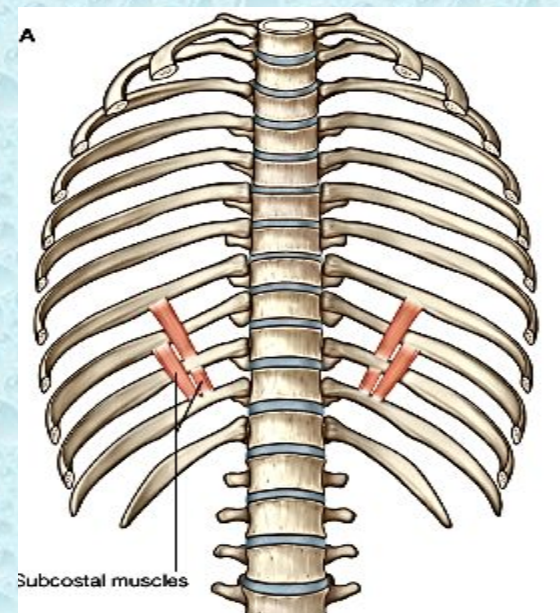
c) Innermost I.C.M. attached to the inner surfaces of adjacent ribs along the medial edge of the costal groove, same as internal I.C.M.





thoracis

from the posterior aspect of the xiphoid process, the inferior part of the body of the sternum, and the adjacent costal cartilages of the lower true ribs. They pass superiorly and laterally to insert into the lower borders of the costal cartilages of ribs III to VI.



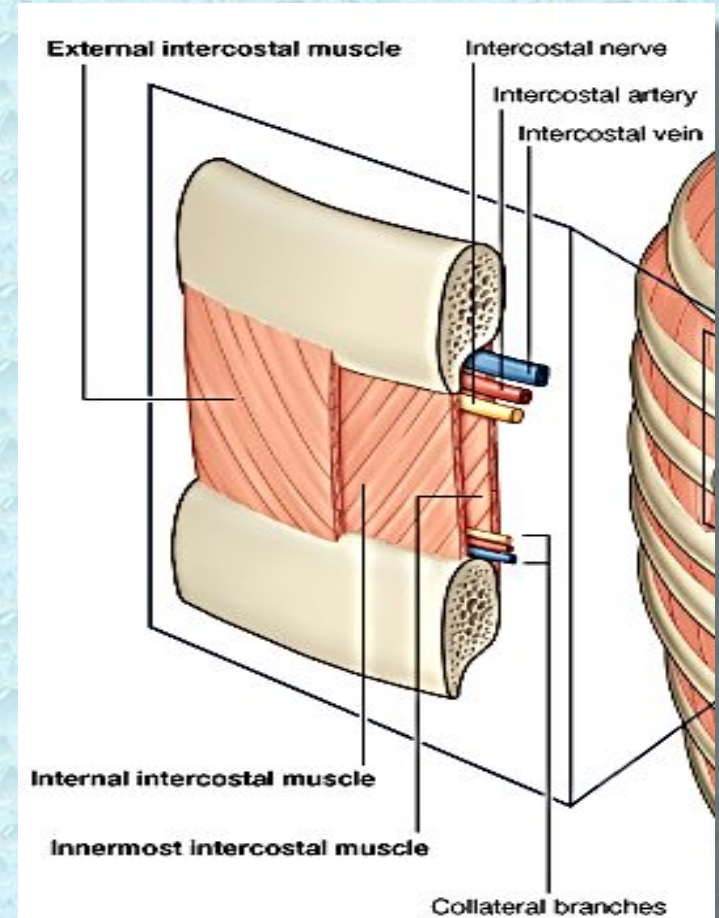
Subcostales

They extend from the internal surfaces of one rib to the internal surface of the second or third rib below. Their fibers parallel the course of the internal intercostal muscles and extend from the angle of the ribs to more medial positions on the ribs below.

Muscle	Superior attachment	Inferior attachment	Innervation	Function
External intercostal	Inferior margin of rib above	Superior surface of rib below	Intercostal nerves; T1-T11	Most active during inspiration; supports intercostal space; moves ribs superiorly
Internal intercostal	Lateral edge of costal groove of rib above	Superior surface of rib below deep to the attachment of the related external intercostals	Intercostal nerves; T1-T11	Most active during expiration; supports intercostal space; moves ribs inferiorly
Innermost intercostal	Medial edge of costal groove of rib above	Internal aspect of superior surface of rib below	Intercostal nerves; T1-T11	Acts with internal intercostals muscles
Subcostales	Internal surface (near angle) of lower ribs	Internal surface of second or third rib below	Related intercostal nerves	May depress ribs
Transversus thoracis	<u>Lower margins and internal surfaces of costal cartilages of second to sixth ribs</u>	<u>Inferior aspect of deep surface of body of sternum, xiphoid process and costal cartilages ribs IV-VII</u>	<u>Related intercostal nerves</u>	<u>Depresses costal cartilages</u>

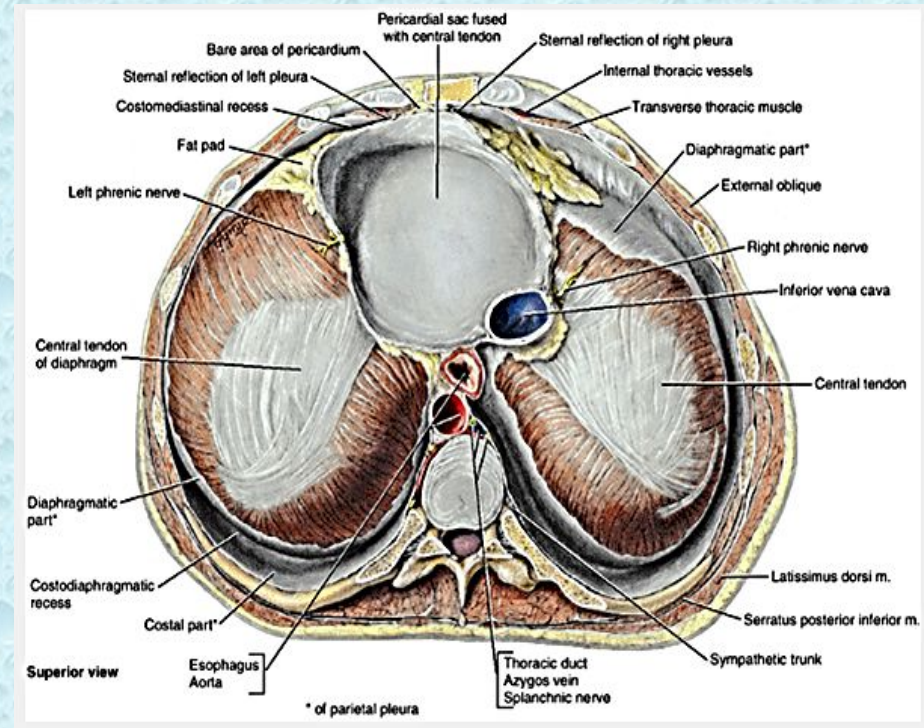
Intercostal neurovascular bundle

- Each intercostal space has its own intercostal blood vessels and nerve.
- Protected by the costal groove
- Arranged from above downward as V. A. N.



Diaphragm

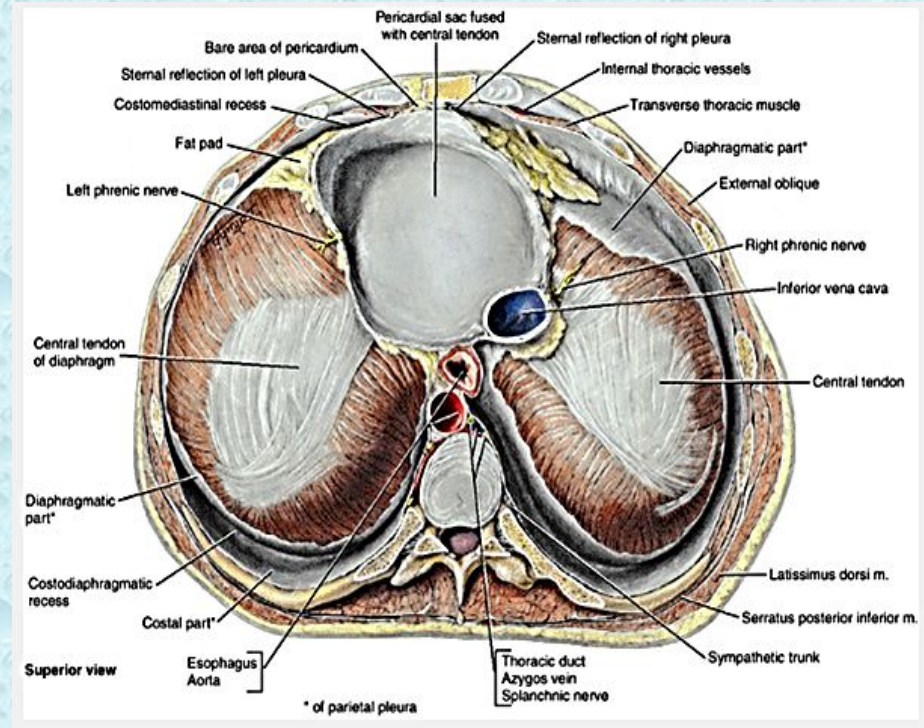
- It is a thin musculotendinous structure that fills the inferior thoracic aperture and separates the thoracic cavity from the abdominal cavity.
- Attachments:
 - i. the xiphoid process of the sternum;
 - ii. the costal margin of the thoracic wall;
 - ii. the ends of ribs XI and XII;
 - iv. vertebrae of the lumbar region.



Diaphragm

- Structures passing through it:

1. Inferior vena cava: T8.
2. Esophagus: T10
3. Vagus nerves pass through the diaphragm with the esophagus.
4. Aorta: T12
5. Thoracic duct passes behind the diaphragm with the aorta.
6. Azygos and hemiazygos veins may also pass through the aortic hiatus.

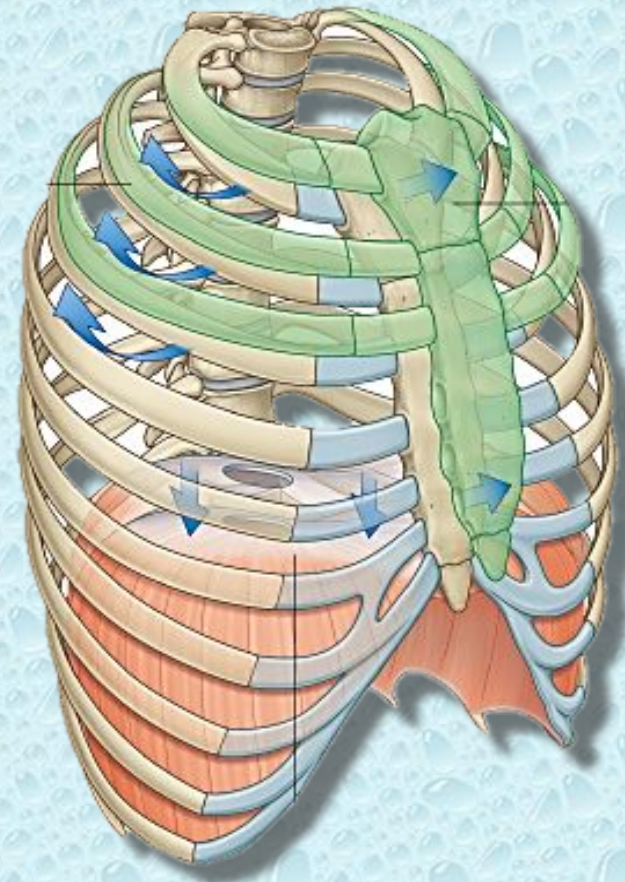


Diaphragm

- **Blood supply:**
 - i. From above, **Pericardiophrenic** and **Musculophrenic** arteries; branches of the internal thoracic artery.
 - ii. From below, **inferior phrenic arteries**, which branch directly from the abdominal aorta.
- **Nerve supply:**
Phrenic nerves (C3 to C5)

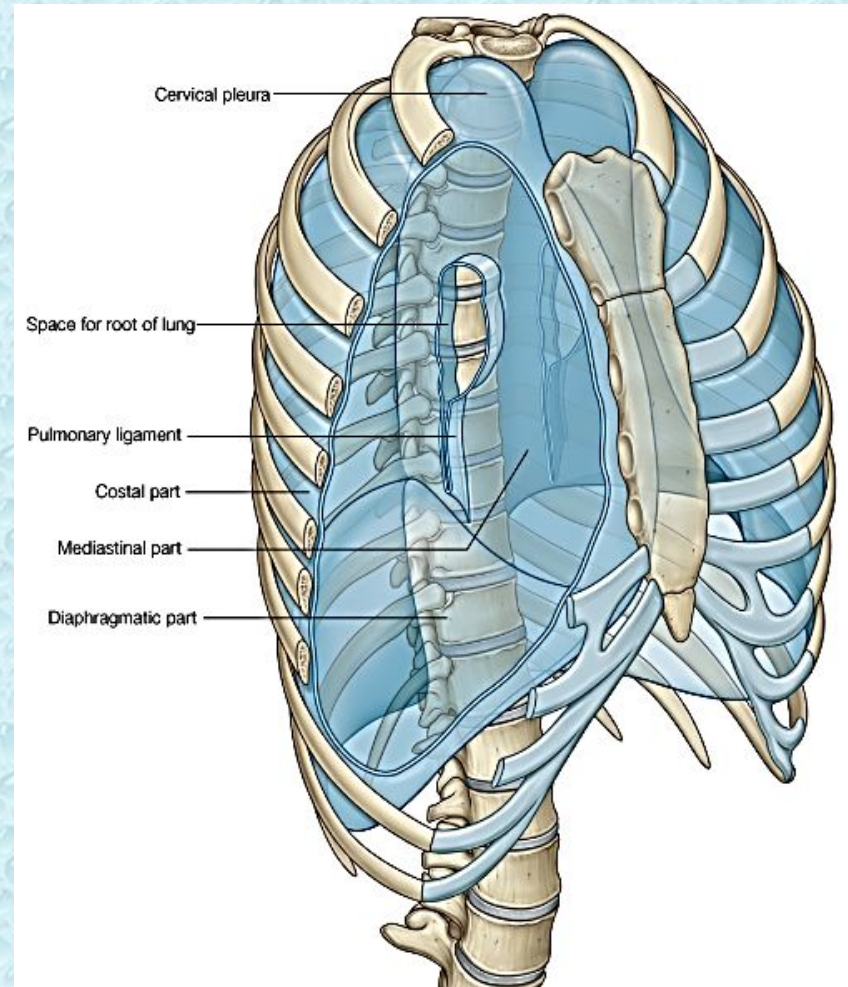
Thoracic Cavity

- The cavity of thorax extends from superior to inferior thoracic apertures.
- Superior thoracic aperture is bounded by T1 vertebra, 1st ribs and manubrium.
- Inferior thoracic aperture is bounded by attachments of diaphragm.
- It is divided into bilateral pleural cavities and a central mediastinum



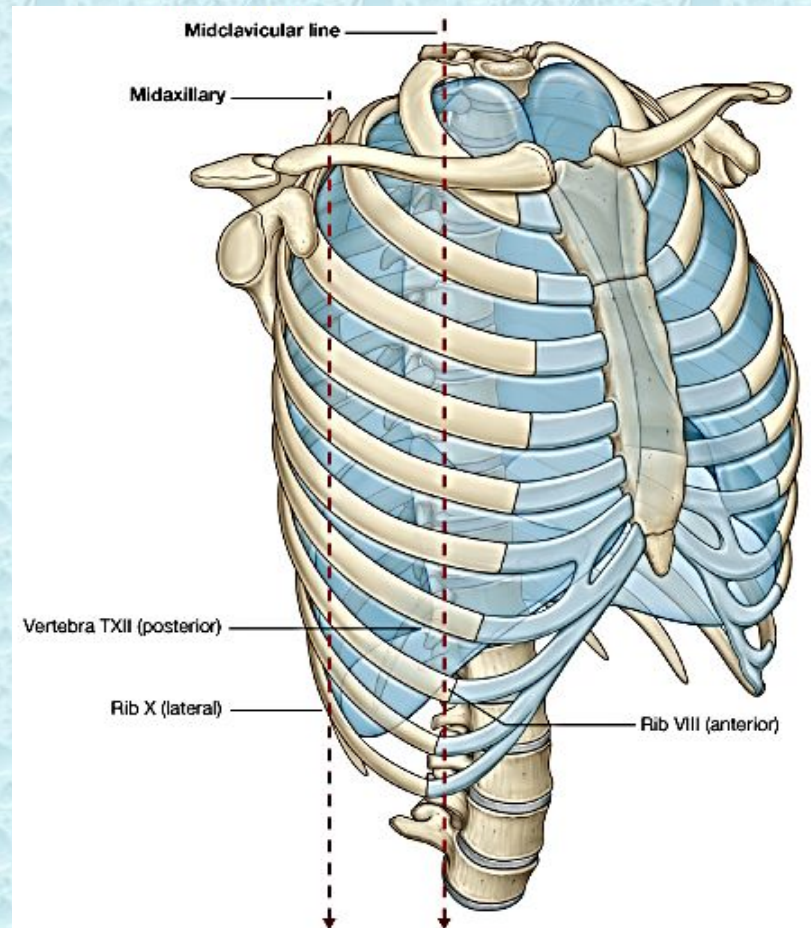
Pleura

- Each pleural cavity is lined by a single layer of flat mesothelial cells, and an associated layer of supporting connective tissue; together, they form the pleura.
- It is divided into two major types, based on location:
 - a) **Parietal pleura;** lines pleural cavity
 - b) **Visceral pleura;** adheres to and covers the lung.
- Plural space between the two layers contain thin film of serous fluid.



Pleural Reflections

- Superiorly: 3-4 cm above the first costal cartilage.
- Anteriorly: meet at sternal angle.
- R. pleura descends vertically till 6th costal cart., while the L. pleura deviated laterally at 4th costal cart. and return medially at 6th cart.
- At midclavicular line the two pleura cross 8th rib.
- At midaxillary line the two pleura cross 10th rib.
- Then it runs backward horizontally till reach the 12th vertebra.

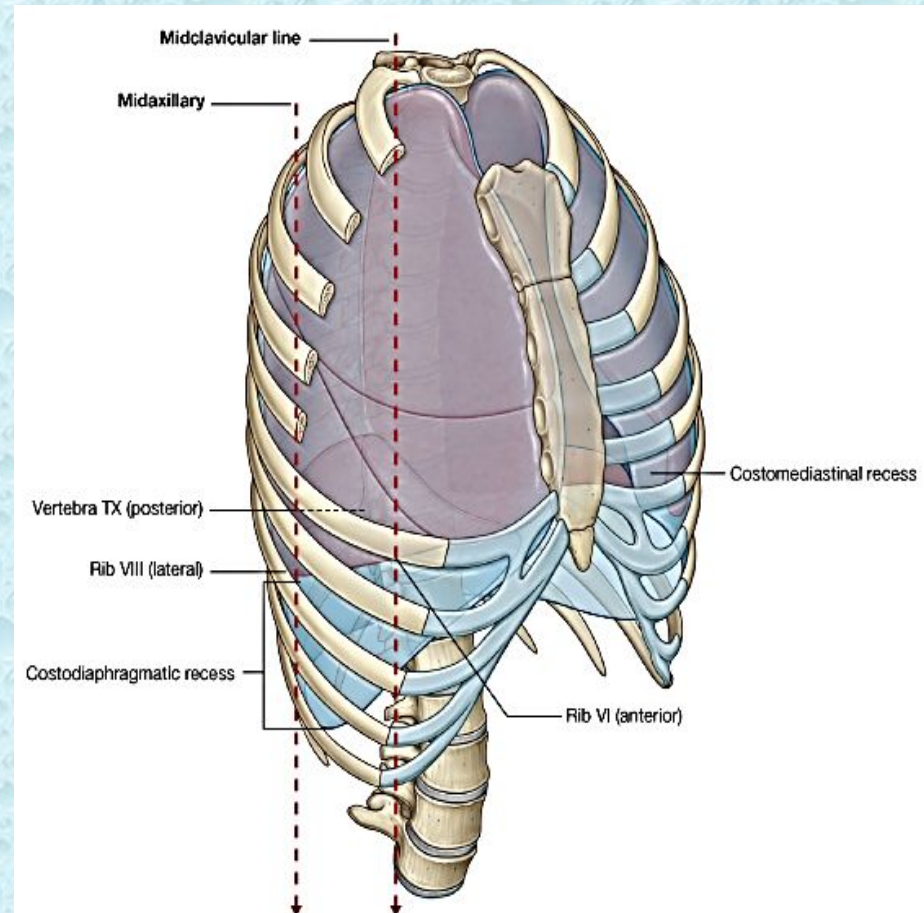


Pleural Recesses

- Spaces where the two layers of pleura become opposed as the lung do not fill the pleural cavity.

a) Costomediastinal recesses

b) Costodiaphragmatic recesses



Mechanism of Breathing

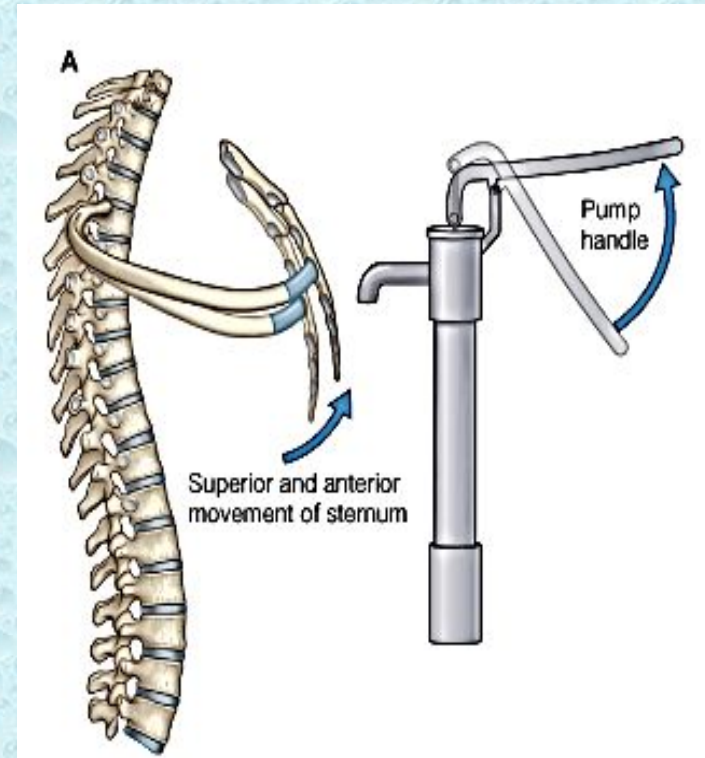
- One of the principal functions of the thoracic wall and the diaphragm is to alter the volume of the thorax and thereby move air in and out of the lungs.
- During breathing, the dimensions of the thorax change in the vertical, lateral, and anteroposterior directions.
- The primary muscle of respiration is the diaphragm.
- Accessory muscles of respiration assist the diaphragm include: I.C.M., Pectoral muscles, neck muscles and abdominal muscles.

Breathing Movements

- **Pump handle movement:**

change the A.P. diameter due to elevation of ribs and sternum in inspiration and depression of ribs and sternum in expiration.

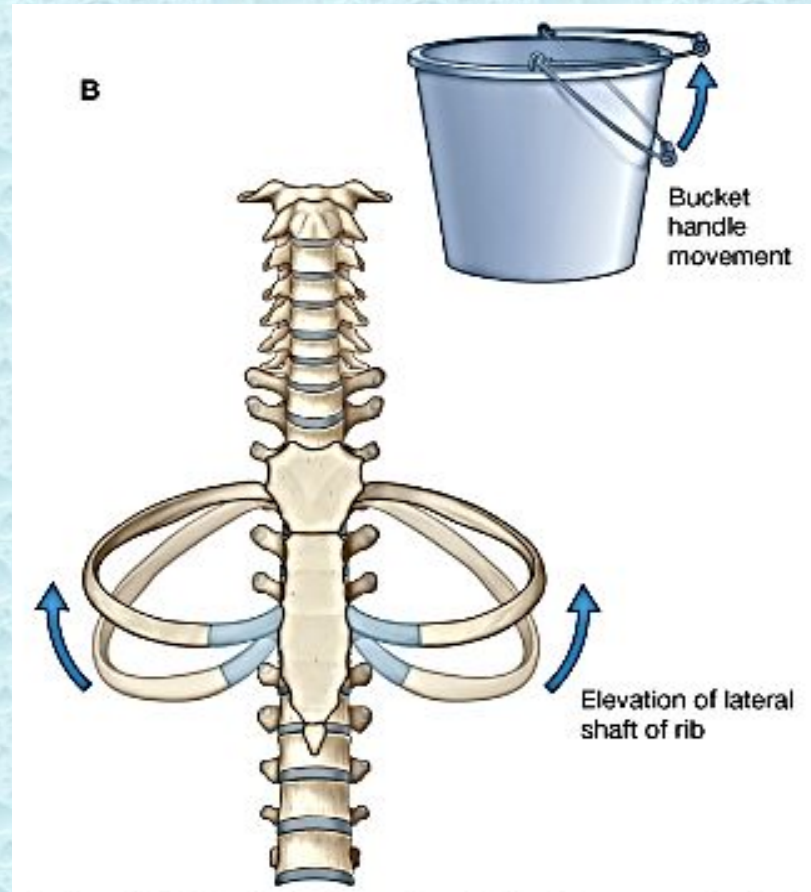
This occur because the anterior ends of the ribs are inferior to the posterior ends.



Breathing Movements

- **Bucket handle movement**

Increases the lateral dimensions of the thorax, because the middles of the shafts tend to be lower than the two ends. When the shafts are elevated, the middles of the shafts move laterally.



So,

- *In Inspiration:*

- i. Diaphragm contracts and depressed that increases vertical diameter of thoracic cavity.
- ii. Elevation of anterior parts of ribs with the sternum by pump handle mechanism increases the anteroposterior diameter of thoracic cavity.
- iii. Elevation of middle parts of ribs by bucket handle mechanism increases the lateral diameter of thoracic cavity.

- *In expiration:*

vice versa



**THANK YOU
FOR LISTENING**