RESPIRATION

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OBJECTIVES

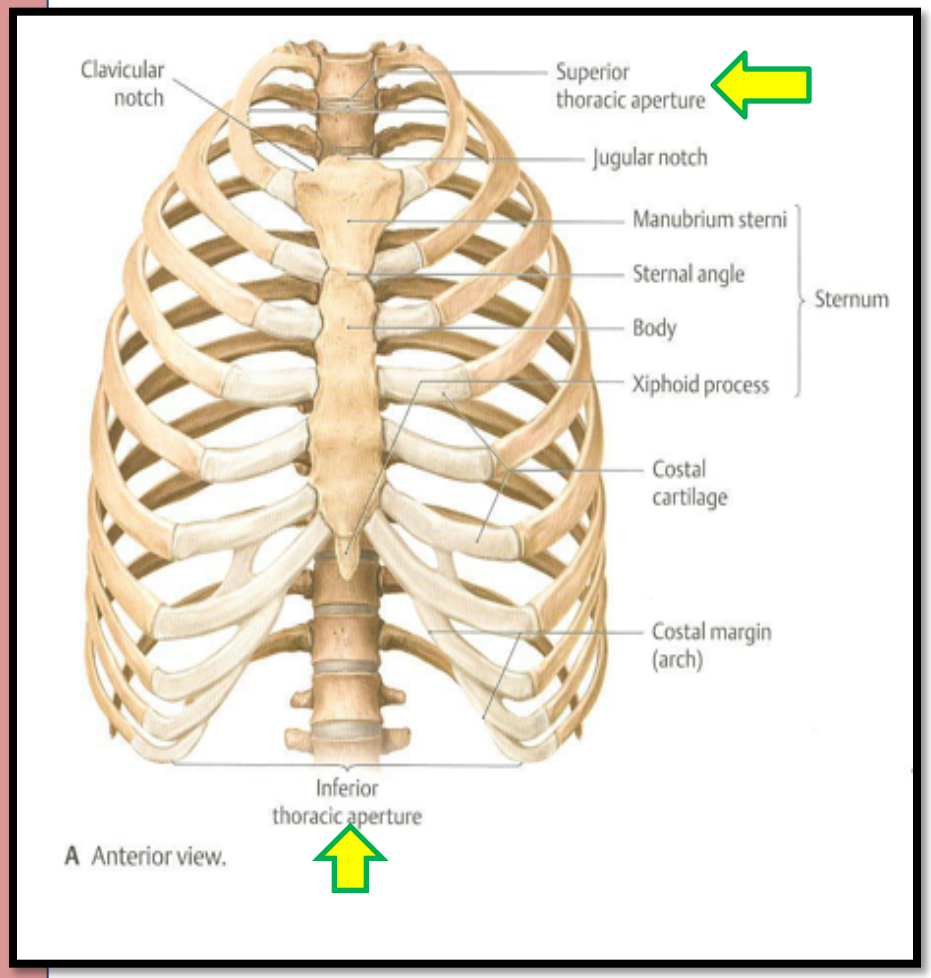
At the end of the lecture, students should:

- *Describe the components of the thoracic cage and their articulations.*
- *Describe in brief the respiratory movements.*
- *List the muscles involved in inspiration and in expiration.*
- *Describe the attachments of each muscle to the thoracic cage and its nerve supply.*
- *Describe the origin, insertion, nerve supply of diaphragm.*

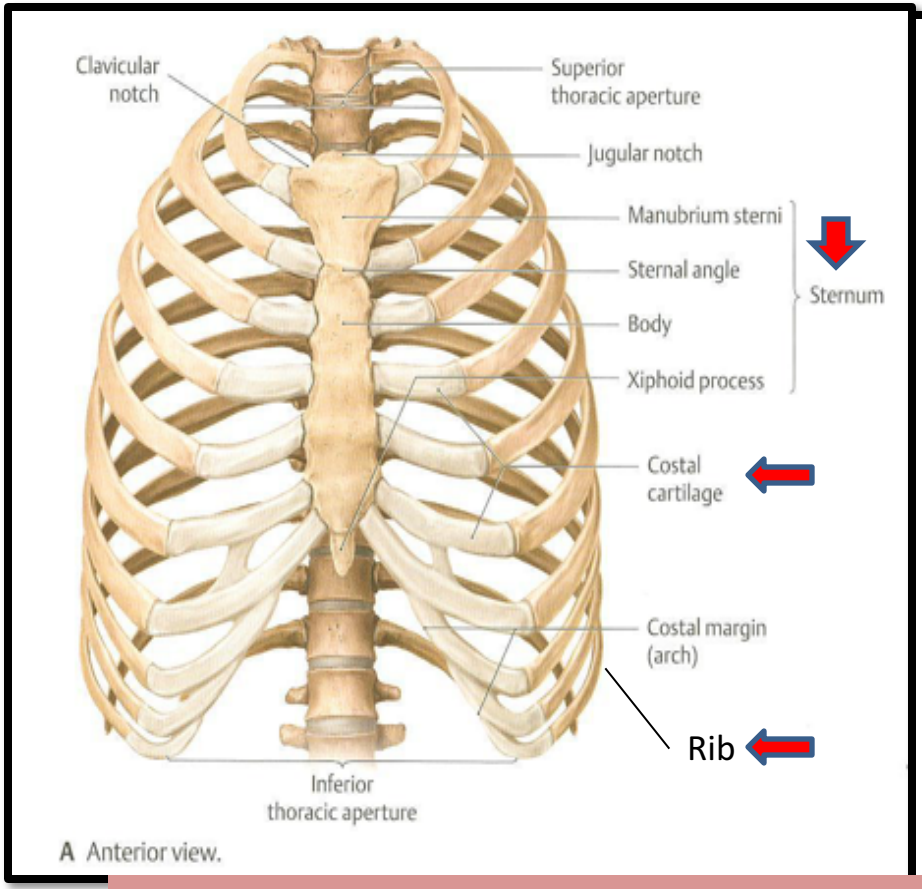
THORACIC CAGE

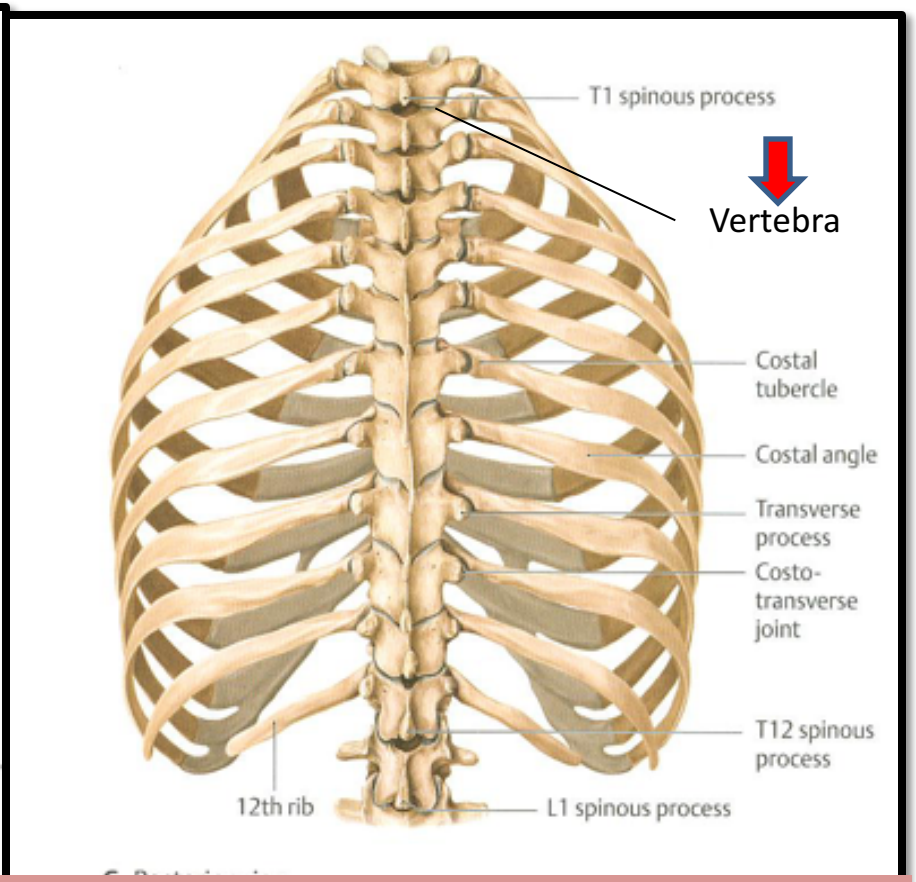
- **Conical** in shape
- Has 2 apertures (openings):

1. **Superior *(thoracic outlet):*** narrow, open, **continuous** with neck
2. **Inferior:** wide, **closed by** diaphragm



THORACIC CAGE

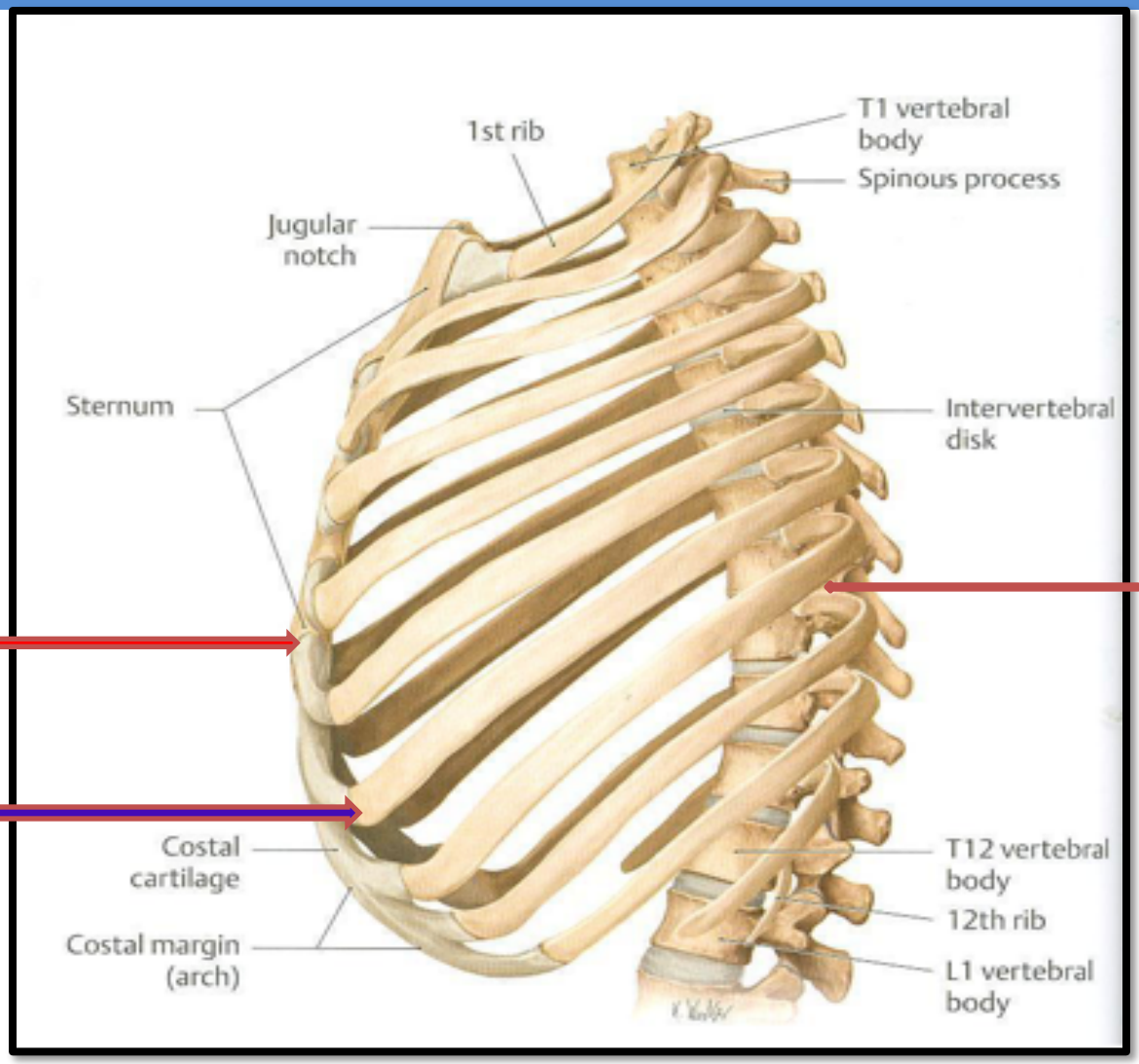




- Formed of:

1. **Sternum & costal cartilages**: ***anteriorly***
2. **Twelve pairs of ribs**: ***laterally***
3. **Twelve thoracic vertebrae**: ***posteriorly***

ARTICULATIONS



Sternocostal

- 1st costal cartilage: articulates with manubrium by a primary cartilaginous j.
- From 2nd to 7th cartilages articulate with sternum by synovial js.

Costochondral

- Between the costal cartilage and the ribs
- Cartilagenous j.

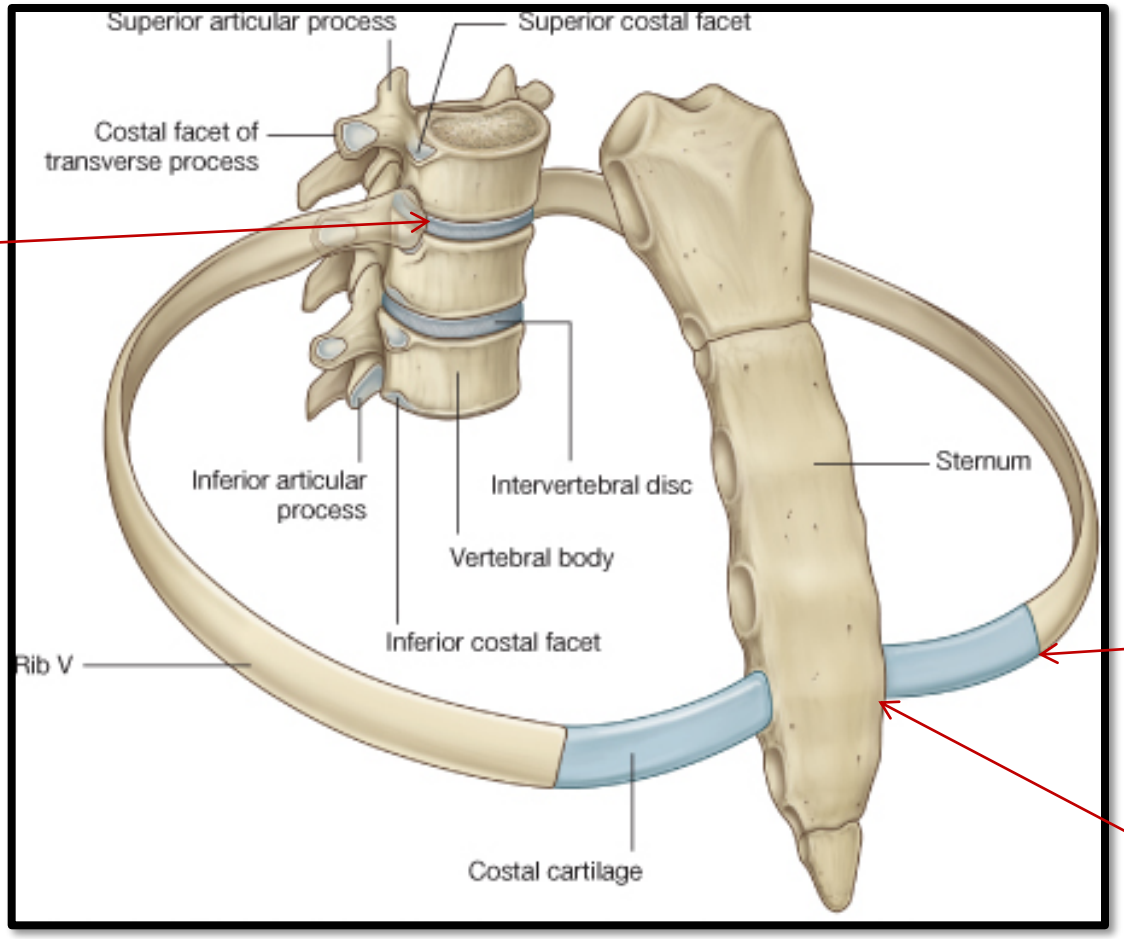
Costovertebral

- These are plane synovial joints.
- Between heads of ribs & thoracic vertebrae.

ARTICULATIONS

Costovertebral

Plane synovial j.



Costochondral

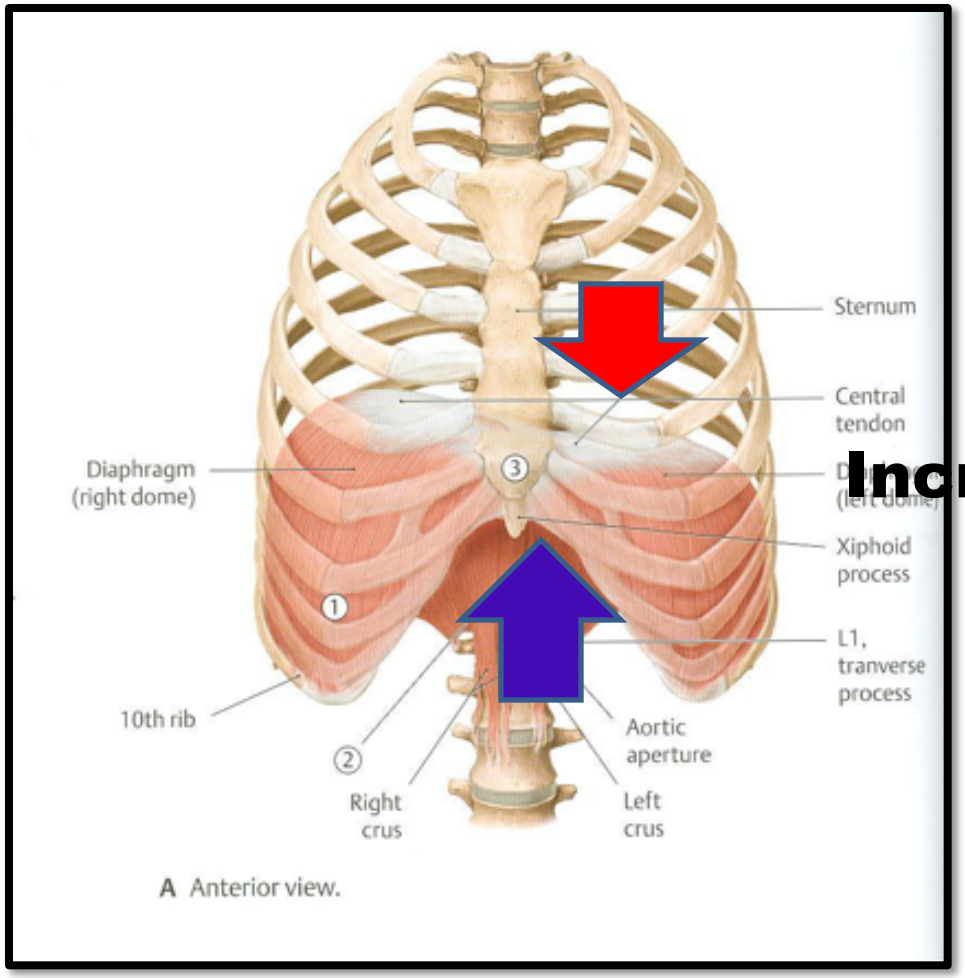
Cartilegenous j.

Sternocostal

Plane synovial j.

RESPIRATORY MOVEMENTS

A- MOVEMENTS OF DIAPHRAGM



A Anterior view.

Inspiration

Contraction (descent) of diaphragm

Increase of vertical diamete of thoracic cavity

Expiration

Relaxation (ascent) of diaphragm)

RESPIRATORY MOVEMENTS

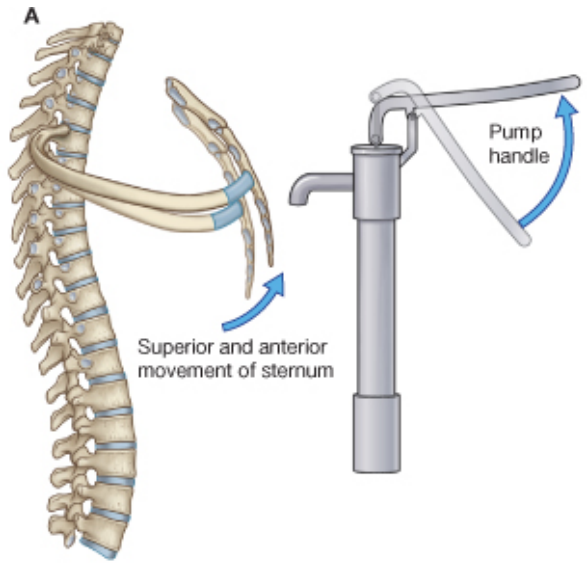
B- MOVEMENTS OF RIBS

(In Normal Inspiration)

PUMP HANDLE MOVEMENT

Elevation of ribs

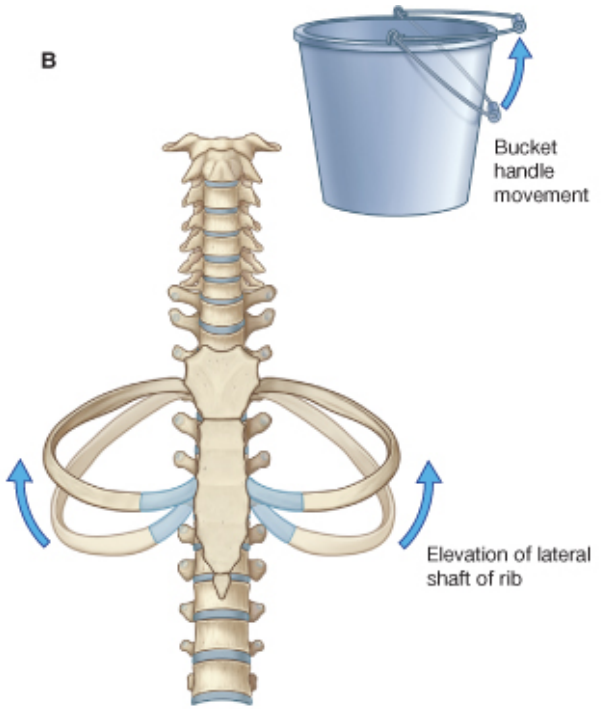
Increase in antero-posterior diameter of thoracic cavity



BUCKET HANDLE MOVEMENT

Elevation of ribs

Increase in lateral (transverse) diameter of thoracic cavity

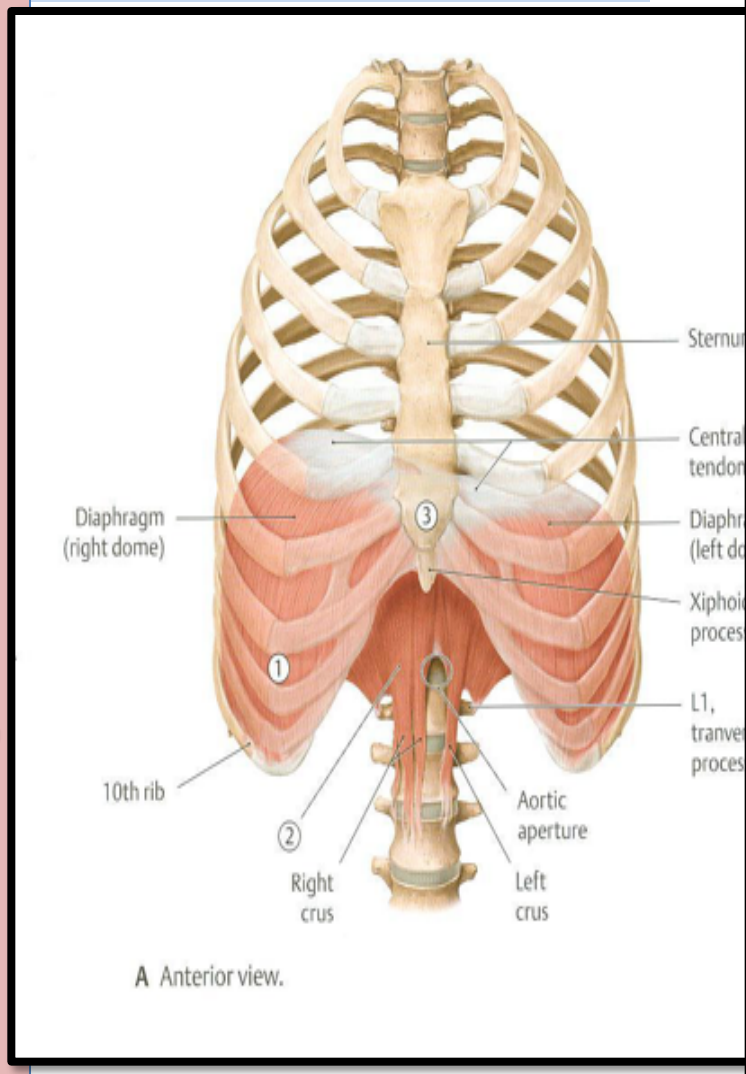


INSPIRATORY MUSCLES

- Muscles for Normal Inspiration:
- Diaphragm (most important & essential for normal breathing)
- muscle)
- Rib elevators: external intercostal muscles

DIAPHRAGM

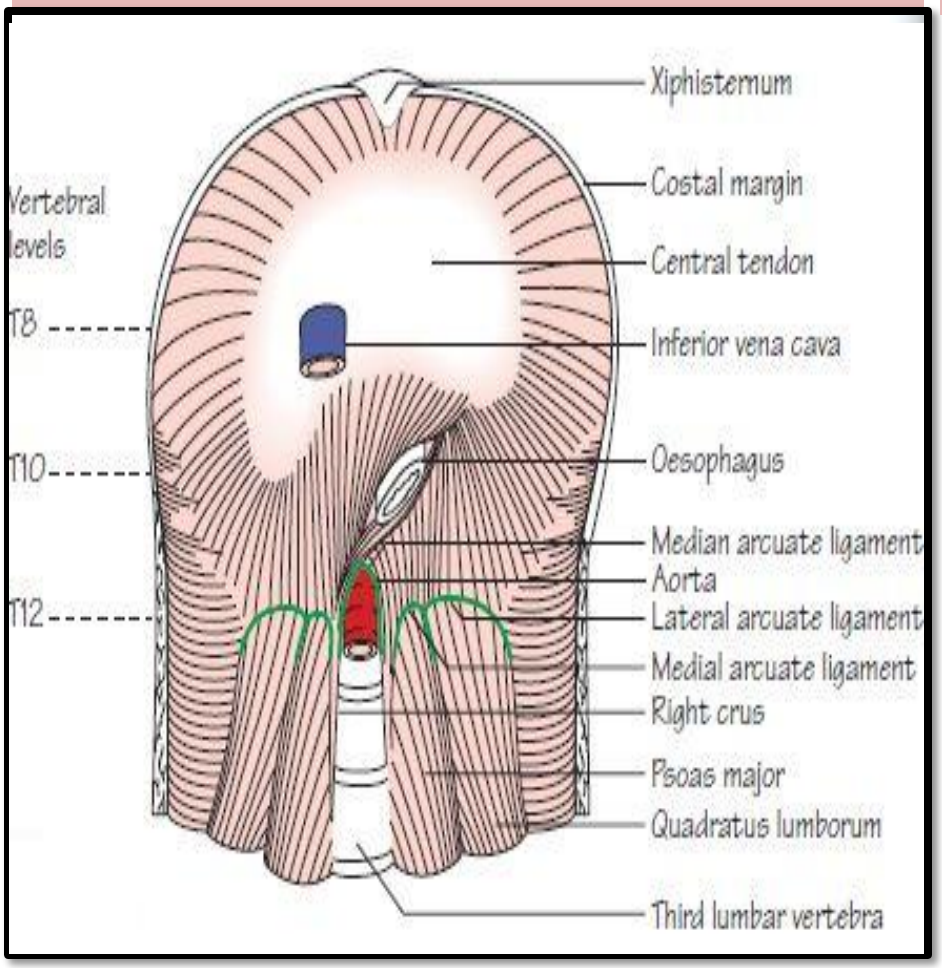
- **A musculotendinous partition** between thoracic & abdominal cavities
- **Convex** toward thoracic & **concave** toward abdominal cavity
- **Attached to:** sternum, costal cartilages,12th rib & lumbar vertebrae
- Fibers converge to join and **inserted into** the central tendon
- **Nerve supply: phrenic nerve (C3,4,5),** penetrates diaphragm & innervates it from abdominal surface
- **Action:** contraction (descent) of diaphragm increase **vertical diameter** of thoracic cavity

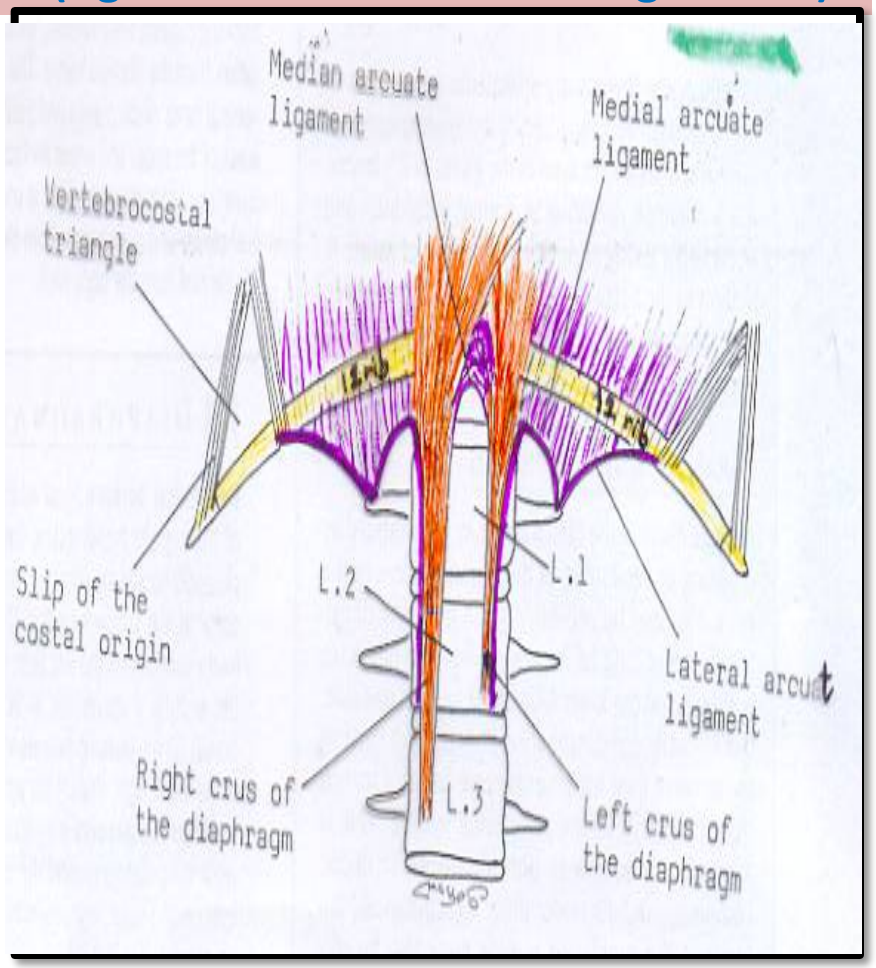


ORIGIN OF DIAPHRAGM

1) **Costal:** lower 6 costal cartilages
3) **Sternal:** xiphoid process of sternum

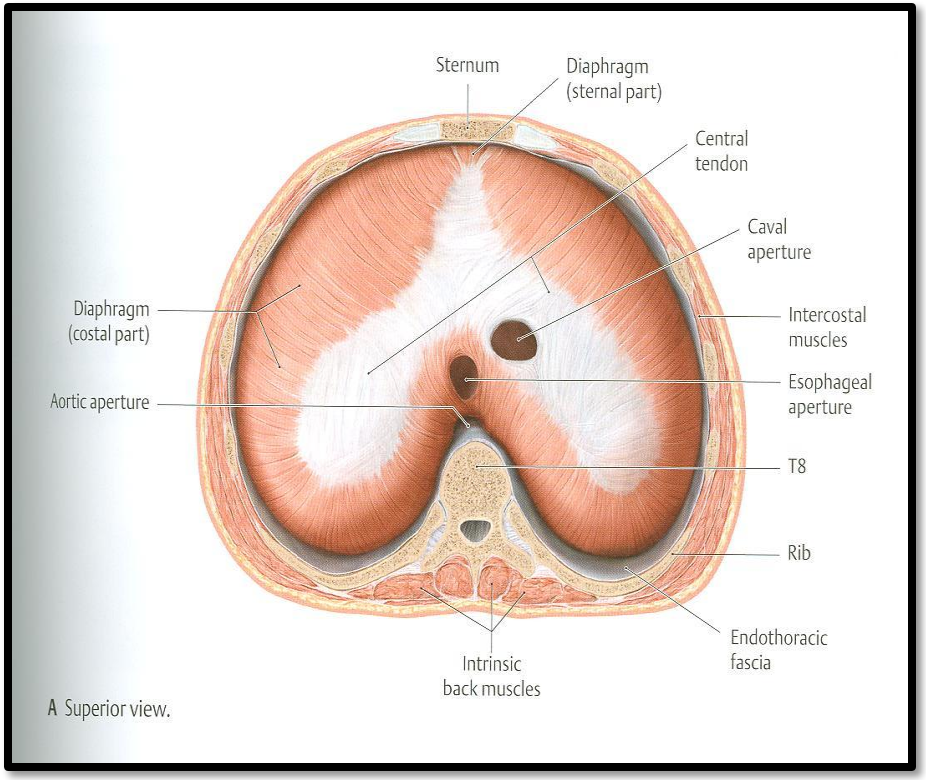
2) **Vertebral:** upper 3 lumbar vertebrae
(right & left crus + arcuate ligaments)

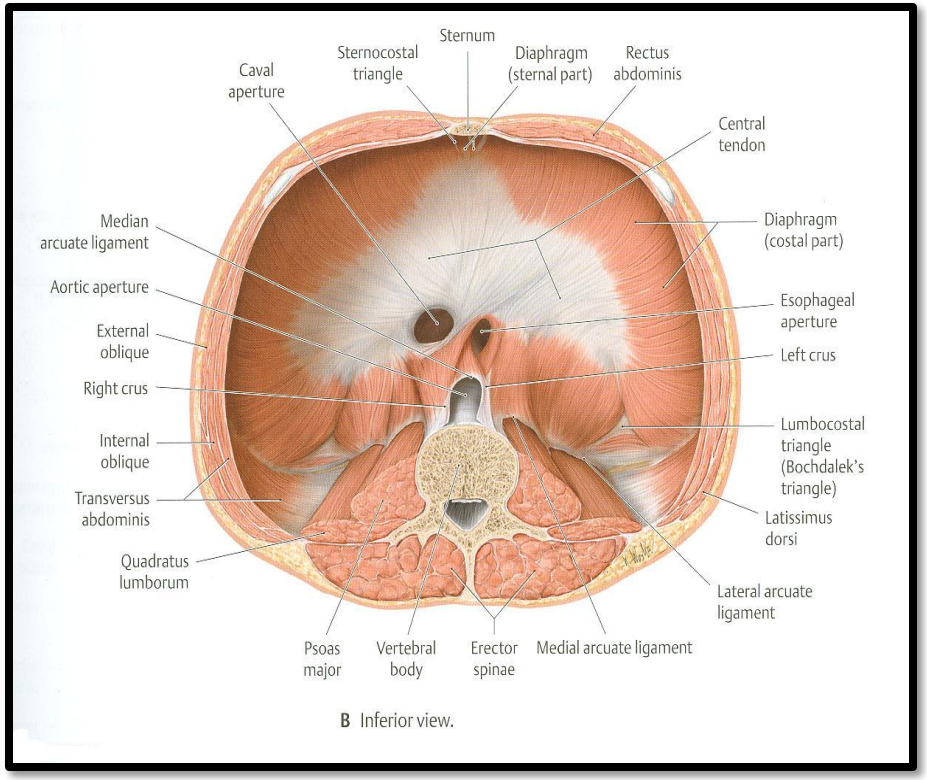




INSERTION OF DIAPHRAGM (CENTRAL TENDON)

- (lies at the level of xiphisternal joint, at 9th thoracic Vertebra)

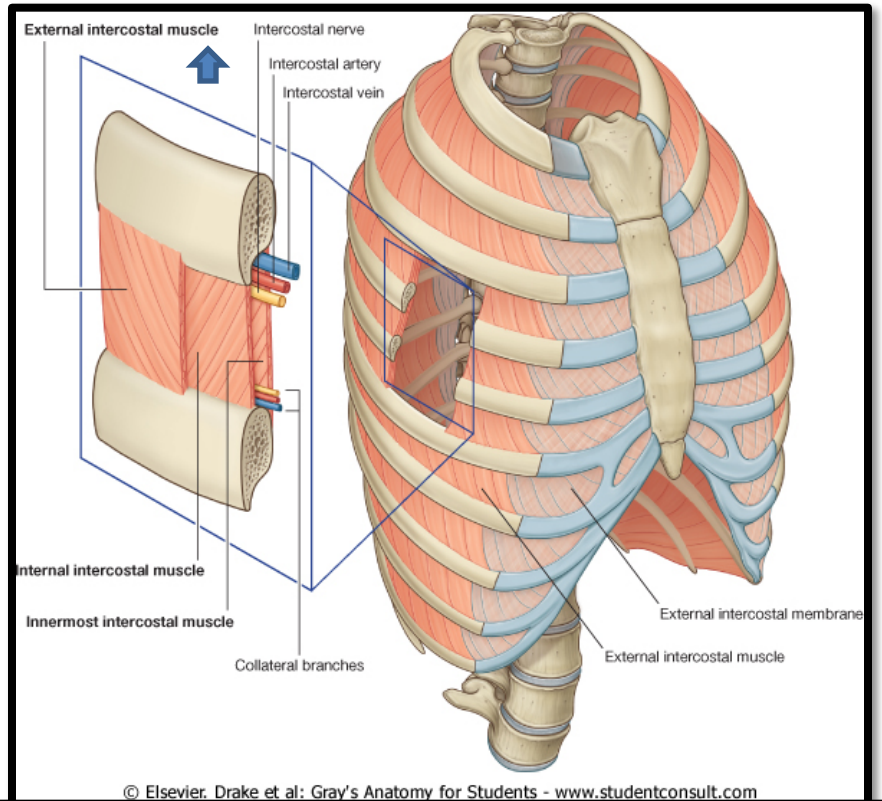


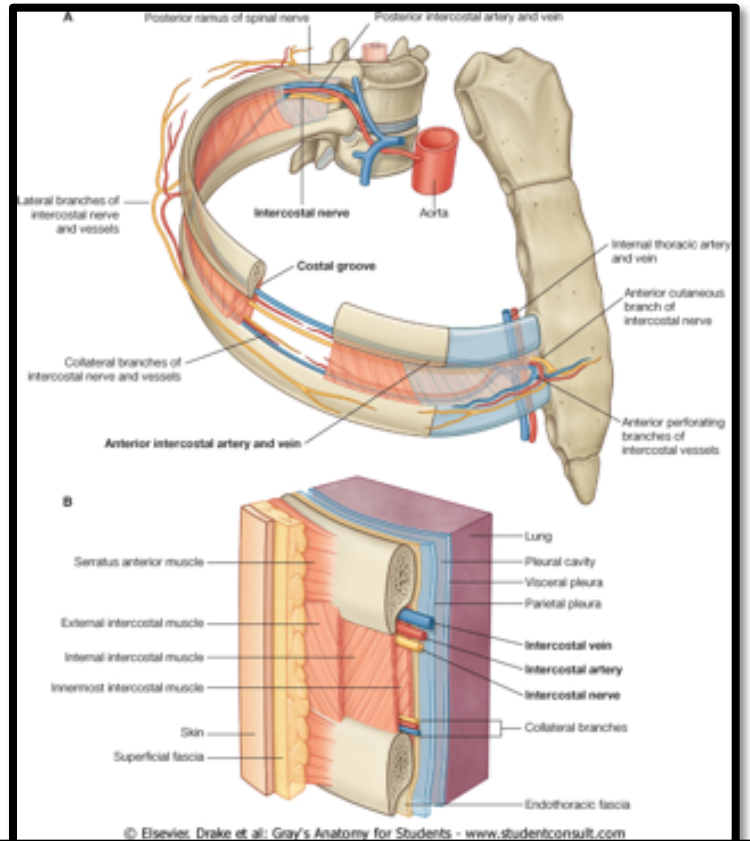


EXTERNAL INTERCOSTAL

- **Attachments:** from lower border of rib above to upper border of rib below
- **Direction of fibers:** downward forward & medially

- **Nerve supply:** intercostal nerves
- **Action:** rib elevators (inspiratory)



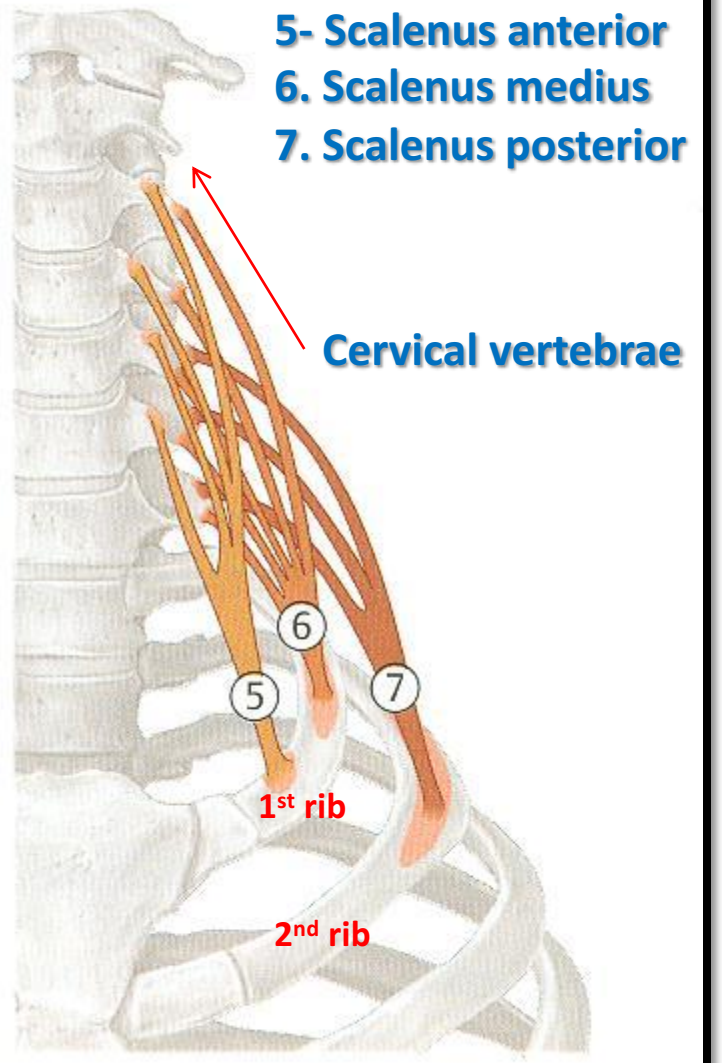


Accessory muscles (only during forced inspiration

1. Muscles attaching cervical vertebrae to first & second ribs: **scalene muscles**
2. Muscles attaching thoracic cage to upper limb: **pectoralis major**

SCALENE MUSCLES

- **Origin:** cervical vertebrae
- **Insertion:** 1st & 2nd ribs
- **Action:** elevates 1st & 2nd ribs (inspiratory)



B Scalene muscles, anterior view.

PECTORALIS MAJOR

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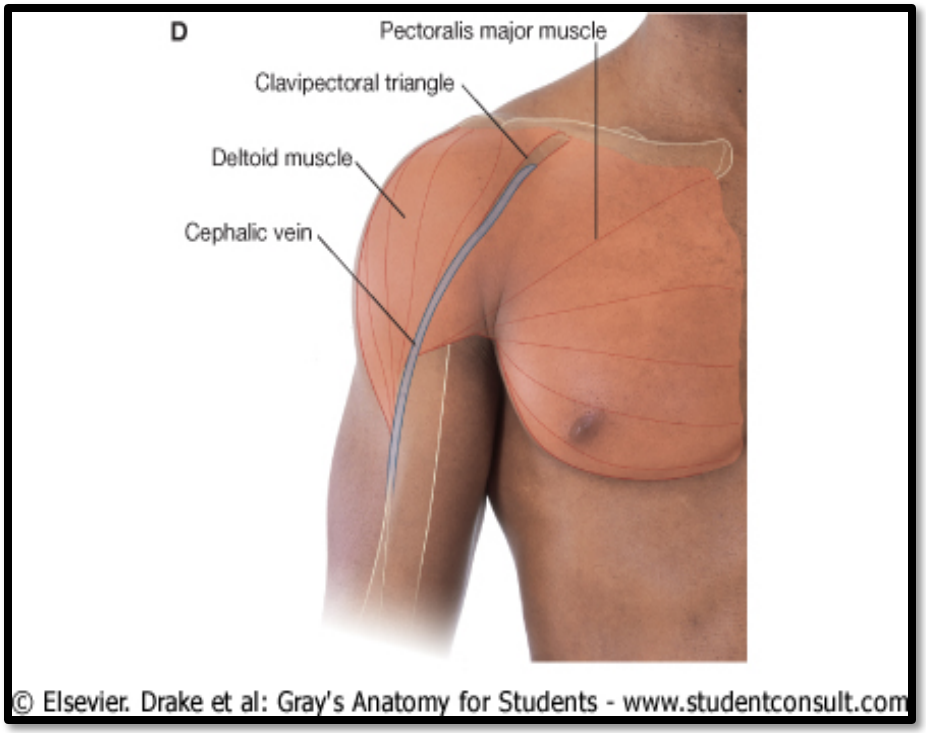
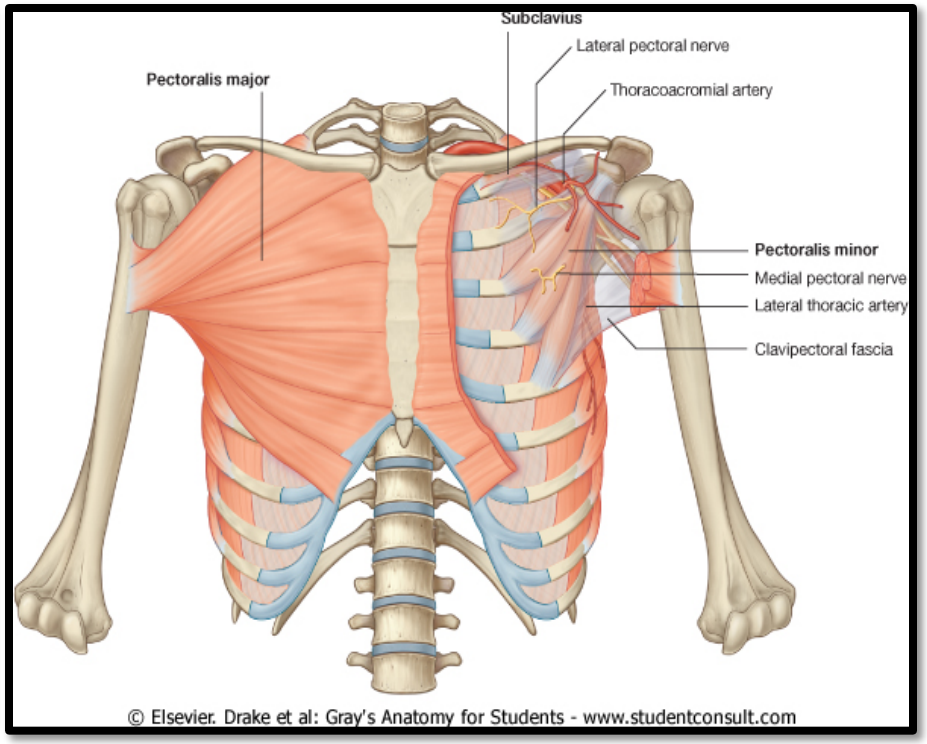
- **Origin:** sternum + costal cartilages
- **Insertion:** humerus

- **Action:** increases antero-posterior diameter of thoracic cavity, when arm is fixed (inspiratory)





EXPIRATORY MUSCLES

❑ Act only during forced expiration

- **Rib depressors:**

1. Internal intercostal
2. Innermost intercostal
3. Subcostals
4. Transversus thoracis

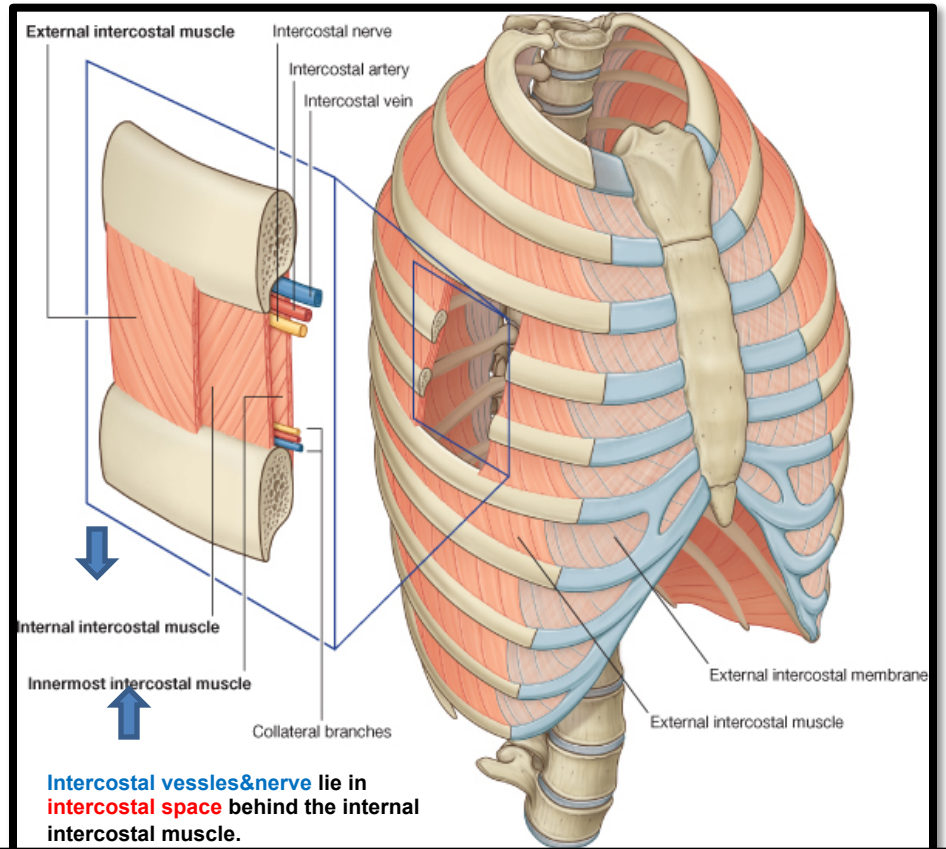
RIB DEPRESSORS: REST OF INTERCOSTAL MUSCLES

1. Internal intercostal
2. Innermost intercostal

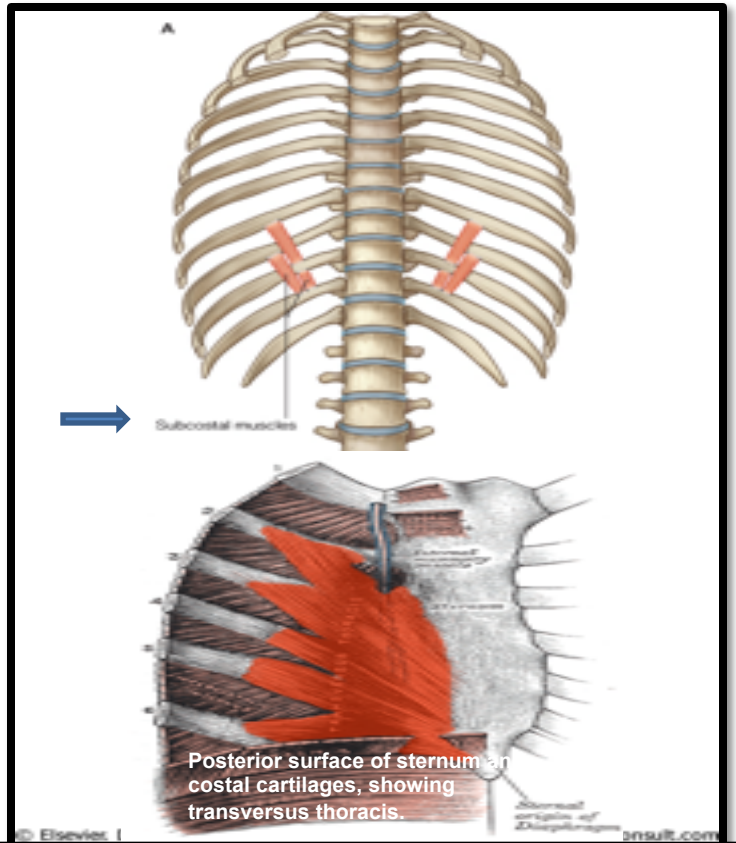
Direction: upward backward & medially

3. Subcostal
4. Transversus thoracis

Nerve supply: intercostal nerves (ventral rami of T1-T11)



Intercostal vessles&nerve lie in intercostal space behind the internal intercostal muscle.



Posterior surface of sternum and costal cartilages, showing transversus thoracis.

Muscles of Anterior Abdominal Wall

Is formed of 3 layers of muscles fibers running in different directions (to increase strength of anterior abdominal wall)

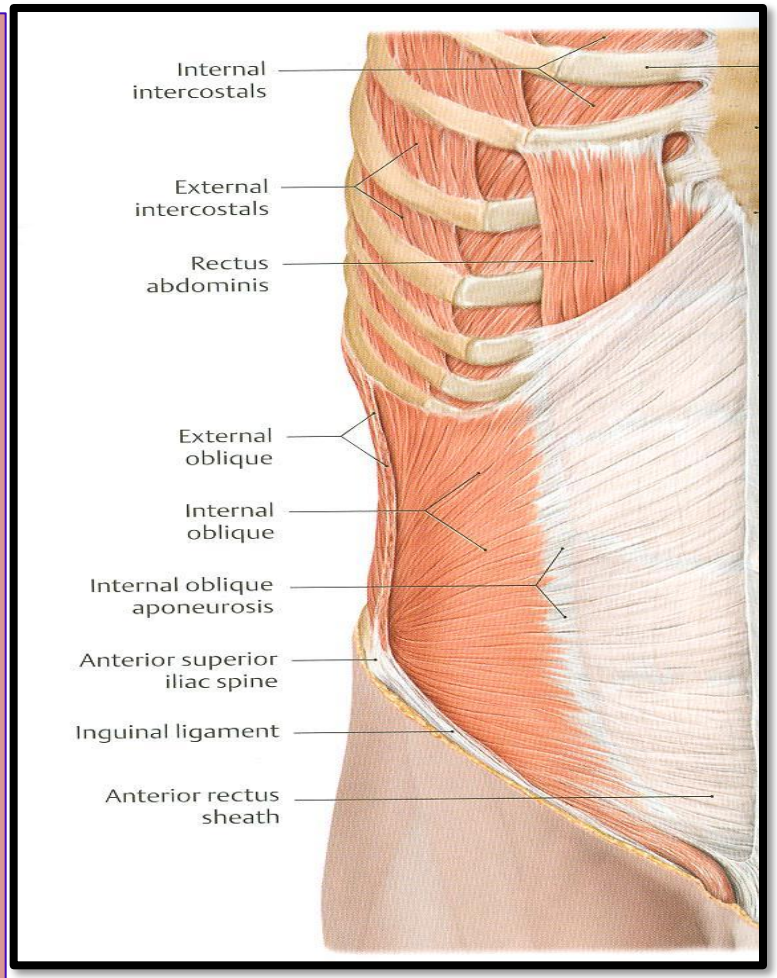
The 3 muscles form a sheath in which a fourth muscle lies (rectus abdominis)

Muscles are attached to: sternum, costal cartilages and ribs + hip bones

The aponeurosis of the 3 muscles on both sides fuse in the midline to form linea alba

Action (during forced expiration): Compression of abdominal viscera to help in ascent of diaphragm .

Nerve supply: lower 5 intercostal nerves (T7 – T11 , subcostal nerve (T12) and first lumbar nerve (L1).



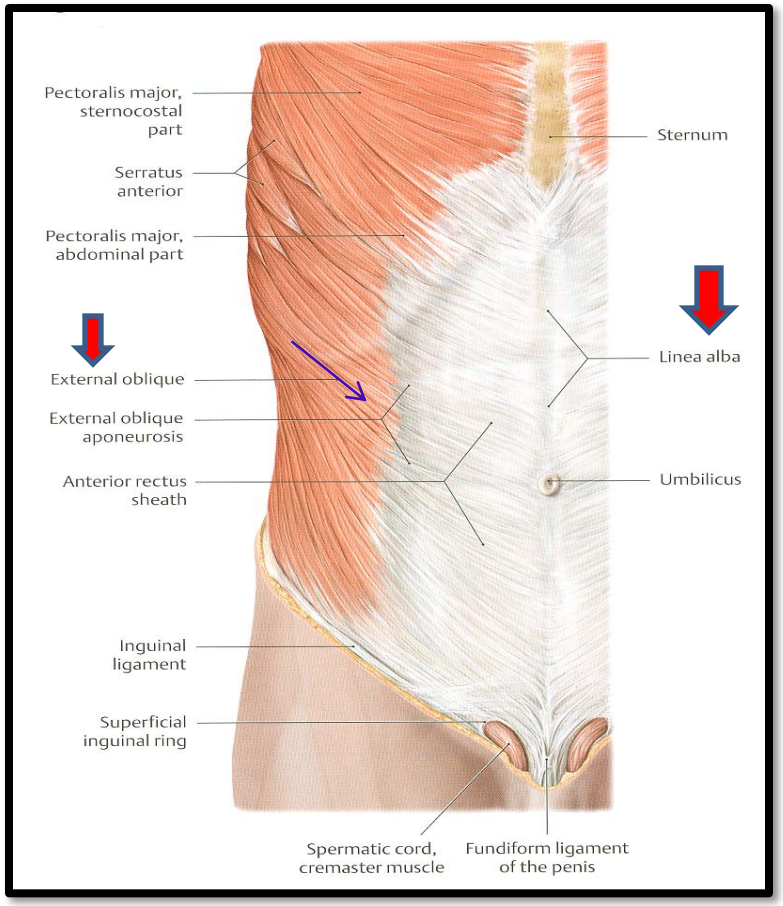
ANTERIOR ABDOMINAL WALL

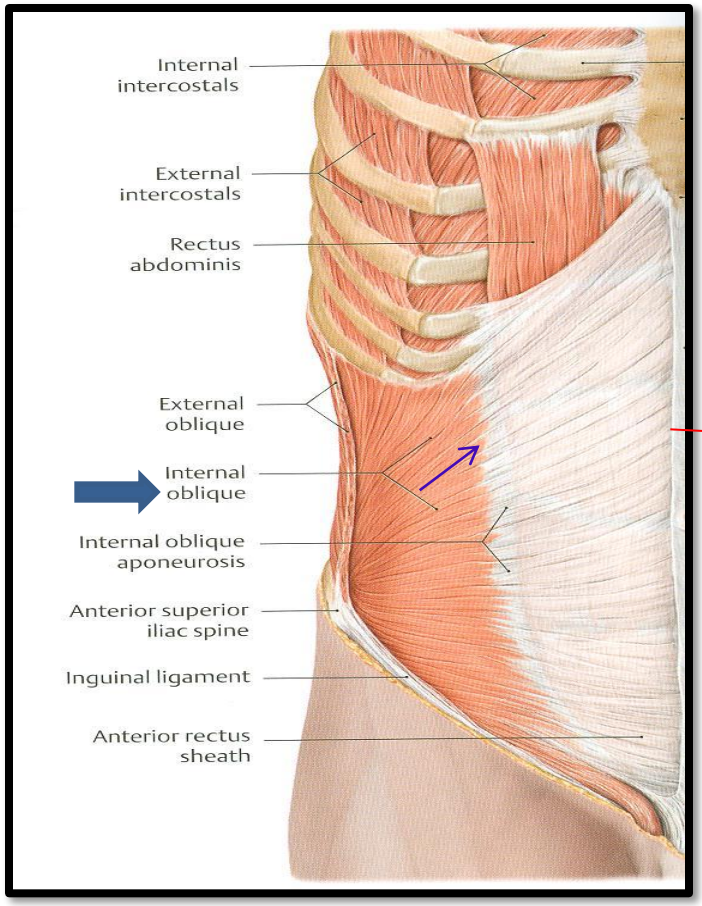
External oblique (outer layer)

- **Direction:** downward ,forward & medially

Internal oblique (middle layer)

- **Direction:** upward backward & medially





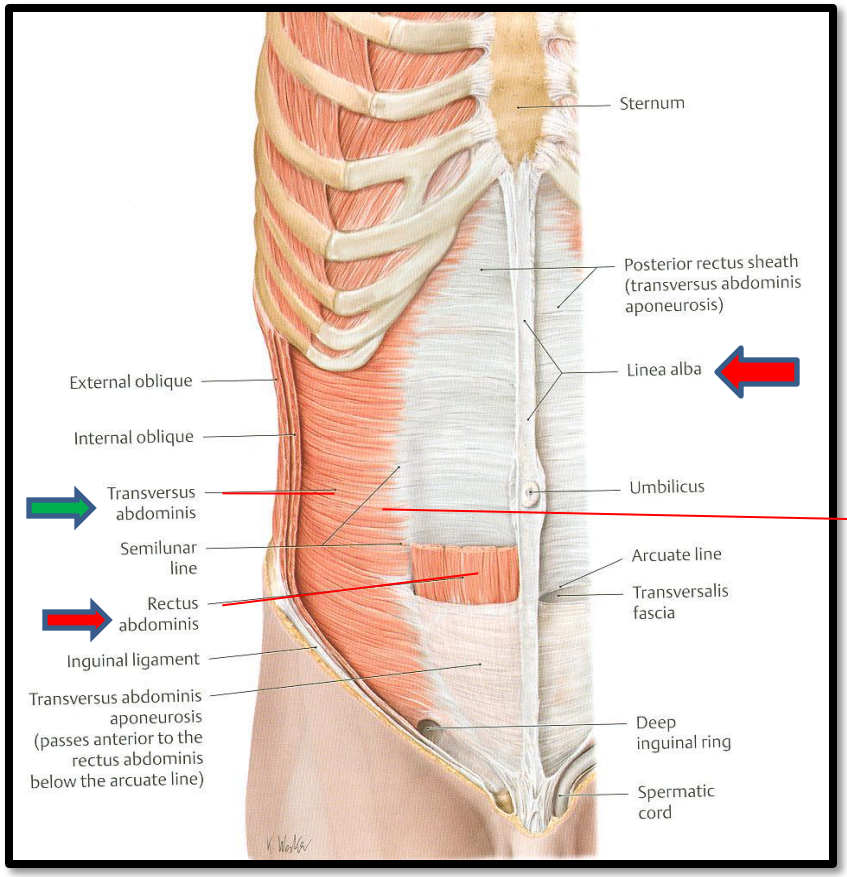
ANTERIOR ABDOMINAL WALL

Transversus abdominis (inner layer)

- **Direction:** transverse

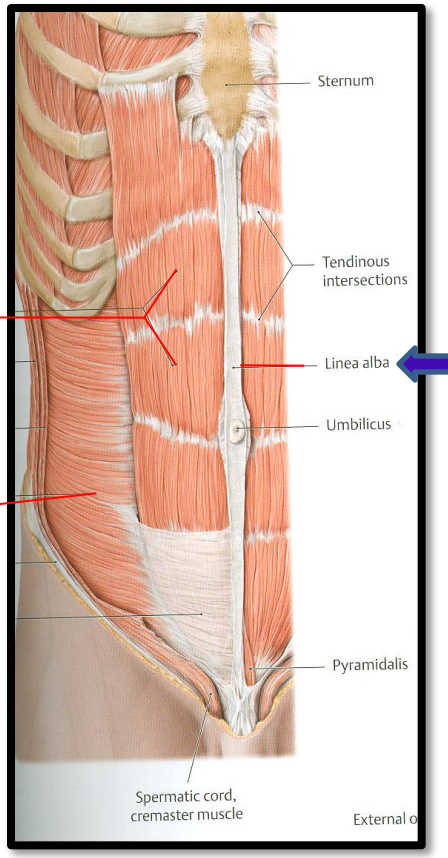
Rectus abdominis

- **Direction:** vertical



Rectus abdominis

Transversus abdominis




THANK YOU