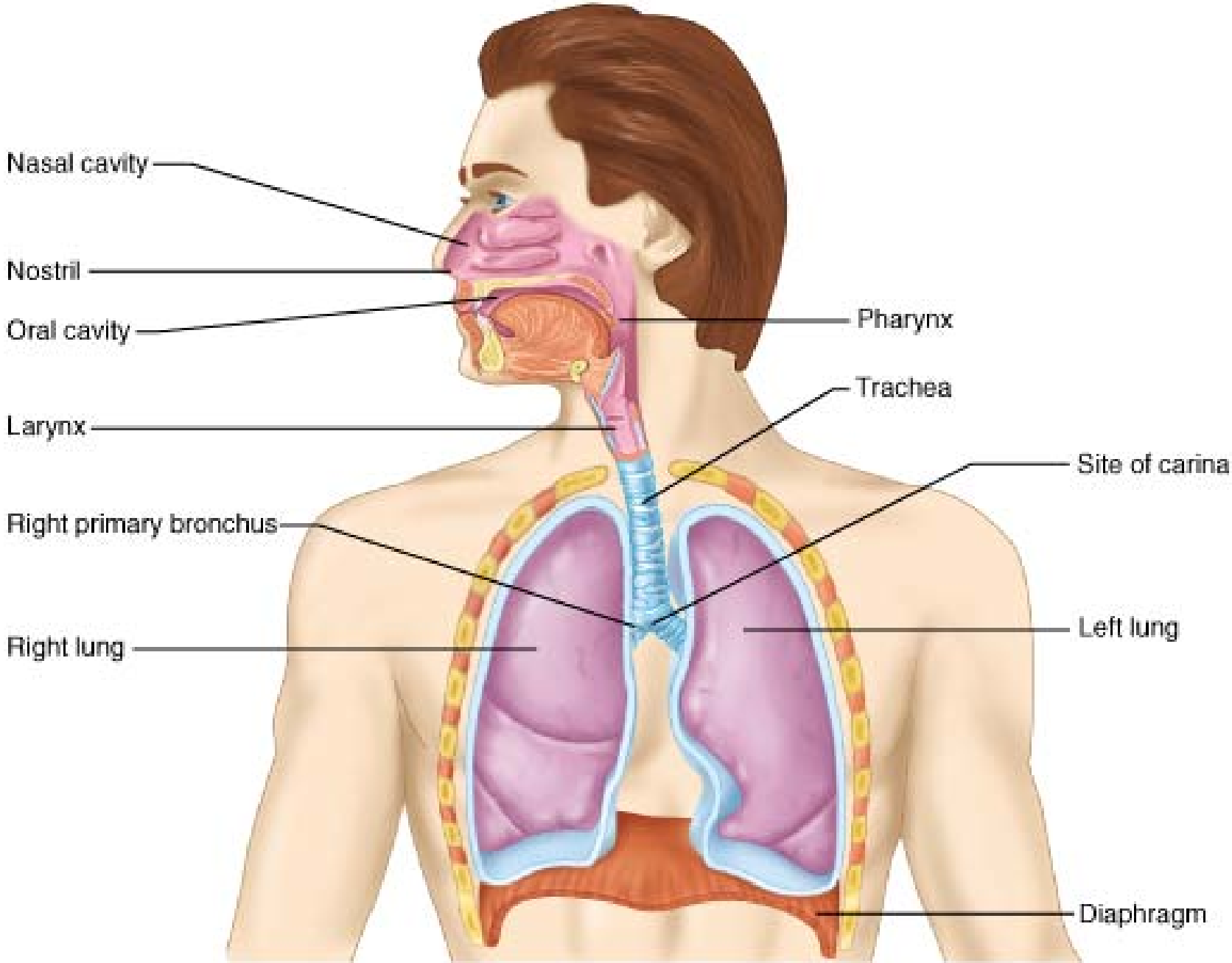
Notes on the Thorax

Anatomy

RHS 241

Lecture 19

Dr. Einas Al-Eisa



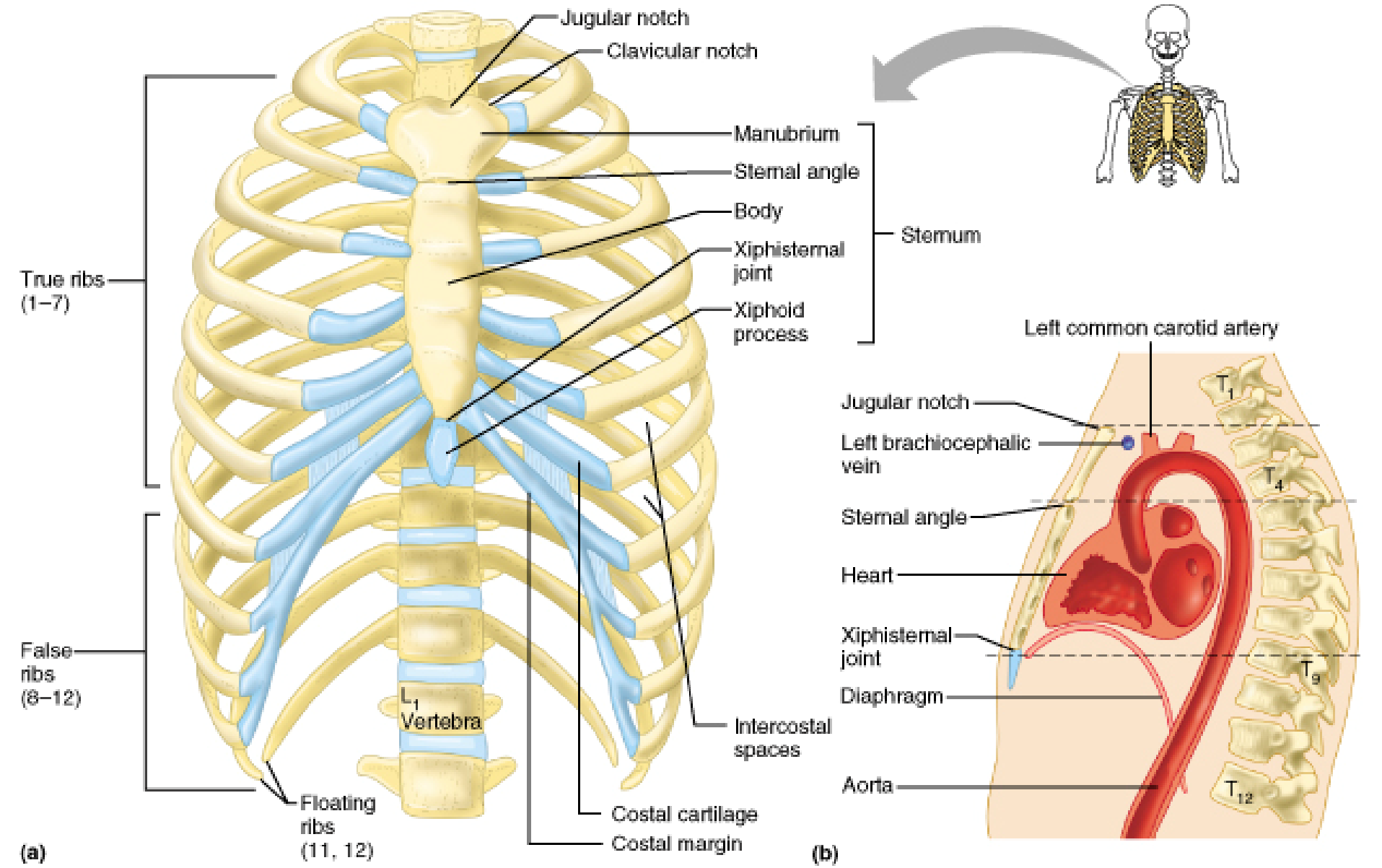
Osteology of thorax

- Ribs
- Thoracic vertebrae
- Sternum

Ribs

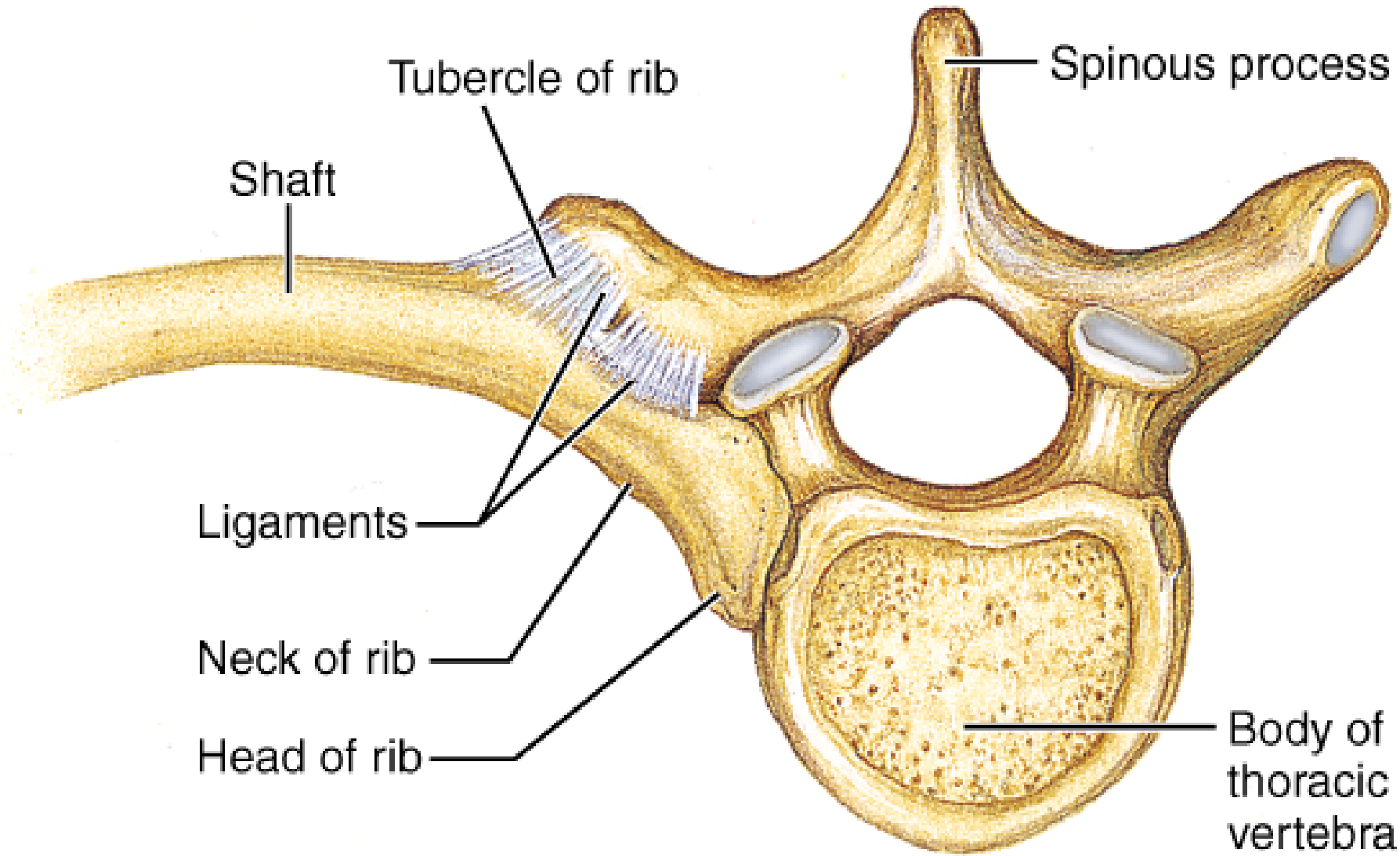
- **True ribs** (vertebrosternal ribs): 1st seven or eight ribs
- **False ribs** (vertebrochondral ribs): ribs 8-10
- **Floating ribs** (free): 11 & 12

- **Costosternal joints:**
  - 1st: cartilagenous
  - 2nd – 7th: synovial



Thoracic vertebrae

- Body
- Pedicle
- Laminae
- Vertebral formina
- Transverse process
- Spinous process
- Superior & inferior articular processes

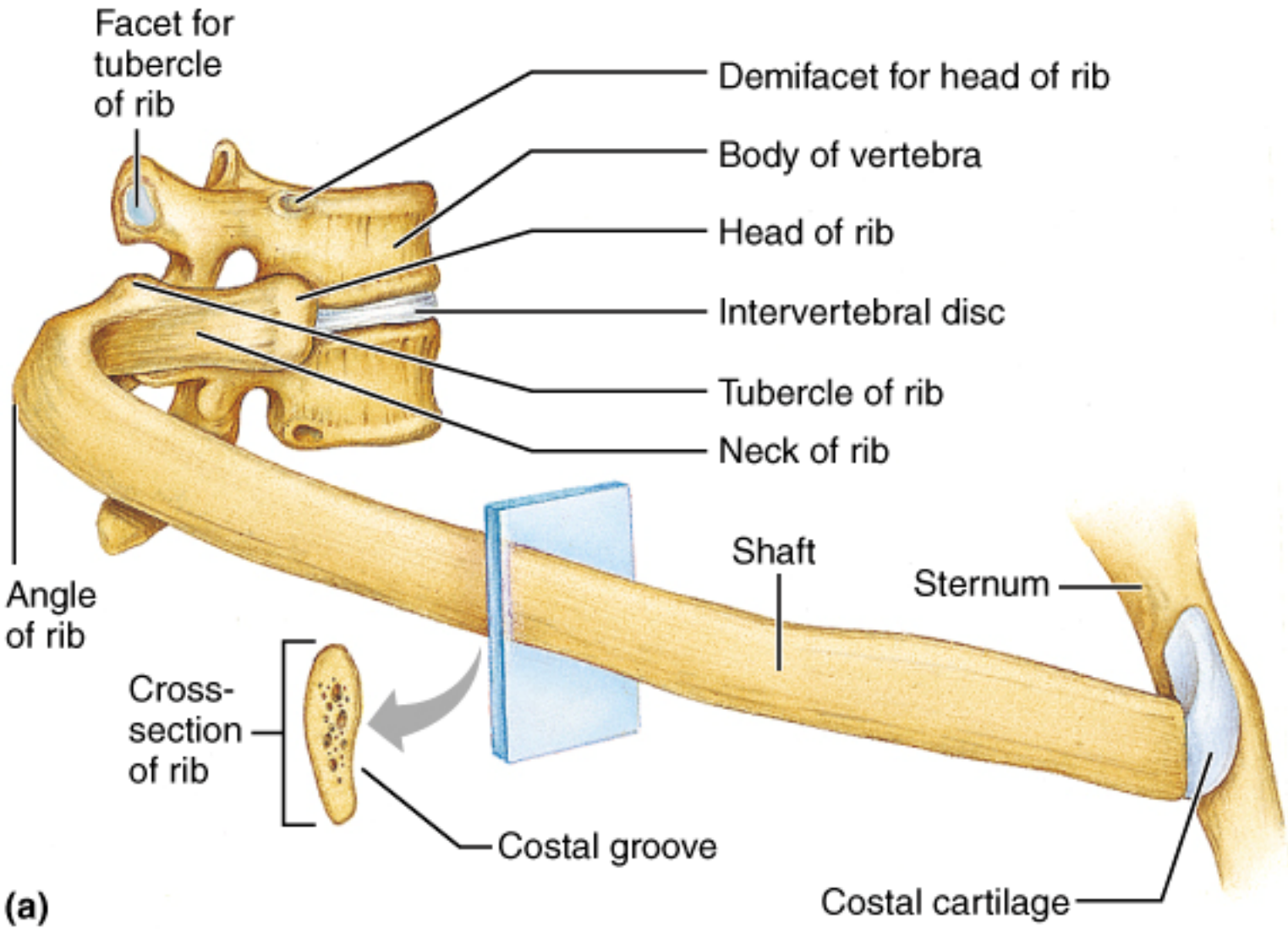


(b)

Neurovascular bundles

- Travel in the **costal groove** of the ribs (i.e., in the superior portion of the intercostal space) between the internal and innermost intercostals

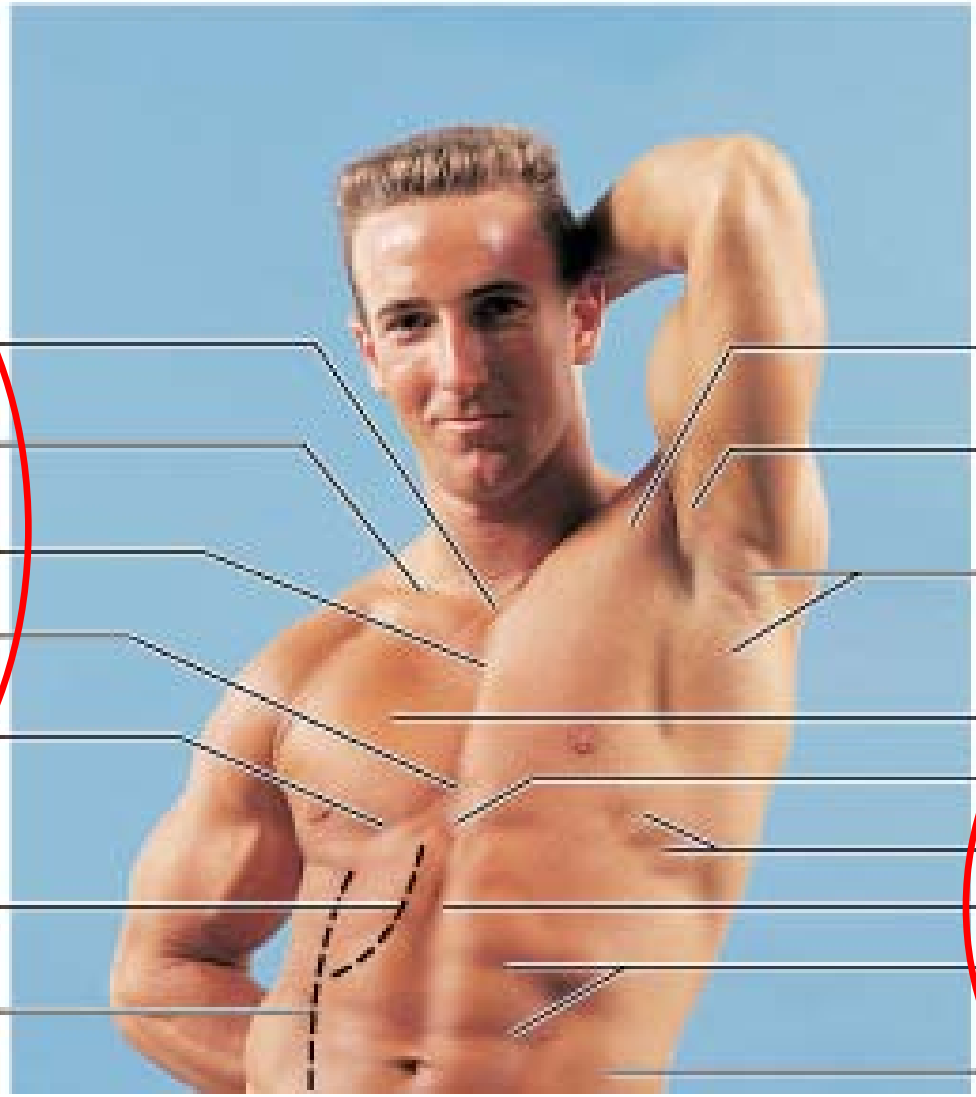
- Physicians passing needles into the thorax insert them just superior to the rib to avoid damaging the bundle



(a)

Sternum

- Manubrium
- Jugular notch
- Xiphoid process
- Sternal angle or Angle of Louis (at the junction of the manubrium & body of sternum): T4-T5 level


Jugular notch
Clavicle
Sternal angle
Xiphisternal joint
Fifth intercostal space
Costal margin
Linea semilunaris
Anterior axillary fold
Base of axilla
Posterior axillary fold
Pectoralis major
Xiphoid process
Serratus anterior
Linea alba
Tendinous insertions in the rectus abdominis
External oblique

Surface landmarks

- The scapula covers the 2nd to 7th ribs posteriorly (important landmark for defining lung fields)

- The 2nd rib joins the sternum at the level of the sternal angle (palpable landmark)

Surface anatomy

- Suprasternal notch
- Clavicle
- Sternal angle
- Xiphoid process
- Sternal attachments for ribs

Articulations

- Ribs 1, 11, & 12 articulate with their respective vertebrae
- Ribs 2-10 articulate with their own vertebra and with the one above
- Type of joints?

Table 9.2 Structural and Functional Characteristics of Body Joints

Illustration	Joint	Articulating bones	Structural type*	Functional type; movements allowed
	Sternoclavicular	Sternum and clavicle	Synovial; shallow saddle (contains articular disc)	Diarthrotic; multiaxial (allows clavicle to move in all axes)
	Sternocostal	Sternum and rib 1	Cartilaginous; synchondrosis	Synarthrotic; no movement
	Sternocostal	Sternum and ribs 2–7	Synovial; double plane	Diarthrotic; gliding

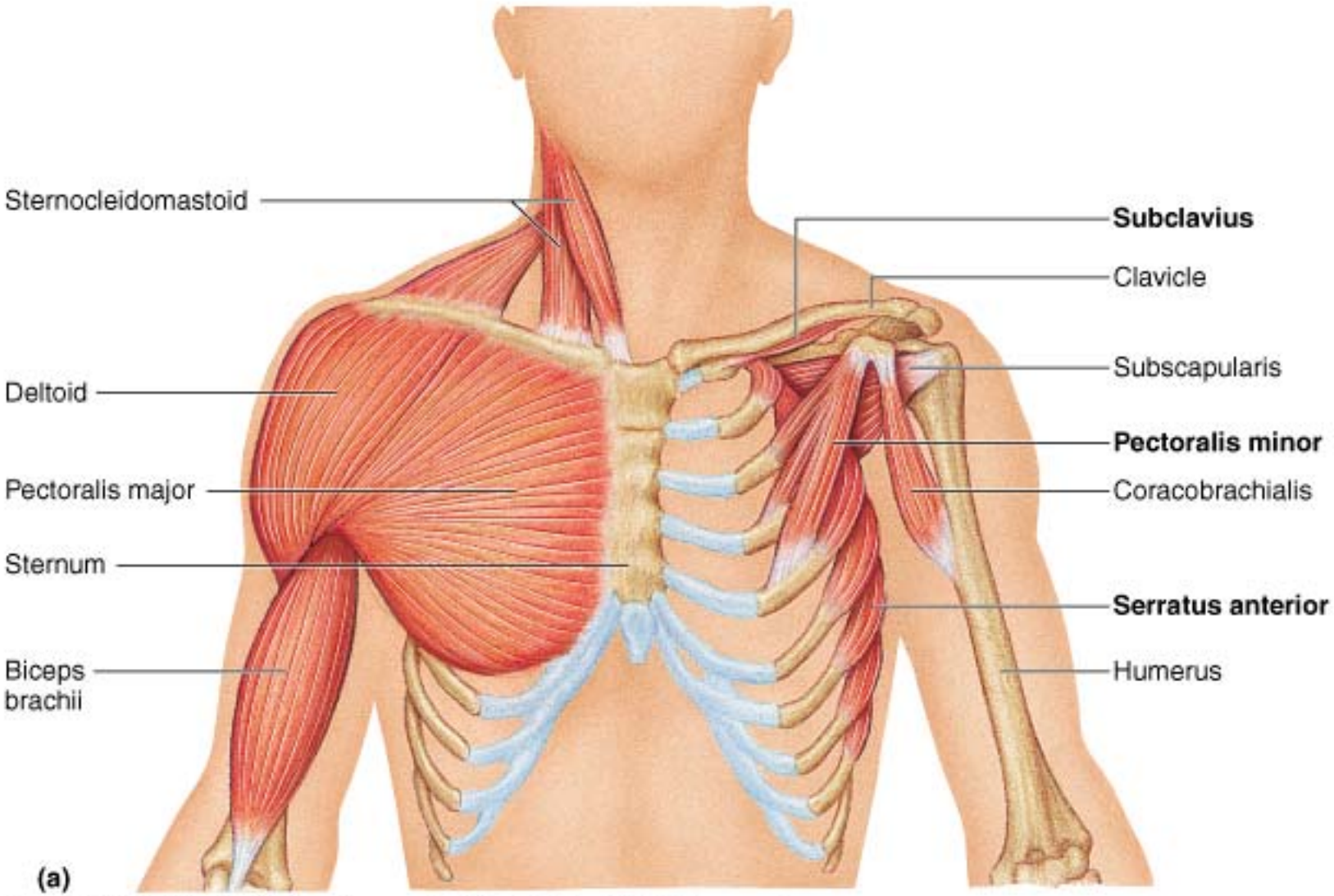
*Fibrous joints indicated by orange circles, **cartilaginous joints** by blue circles, and **synovial joints** by purple circles.

Boundaries of the thoracic inlet

- The manubrium anteriorly
- 1st ribs and costal cartilage laterally
- 1st thoracic vertebra posteriorly

Pectoral region

- **Pectoralis major:**
  - covers the chest wall
  - also makes up the anterior wall of the axilla (palpate your anterior axillary fold and contract your pectoralis major)
  - clavicular & sterno-costal origins
  - its tendon inserts into the humerus…..?
  - innervated by the medial & lateral pectoral nerves



Note

- What is the positional relationship between the medial & lateral pectoral nerves in the anterior thoracic wall?

- Where do the medial & lateral pectoral nerves get their names from?

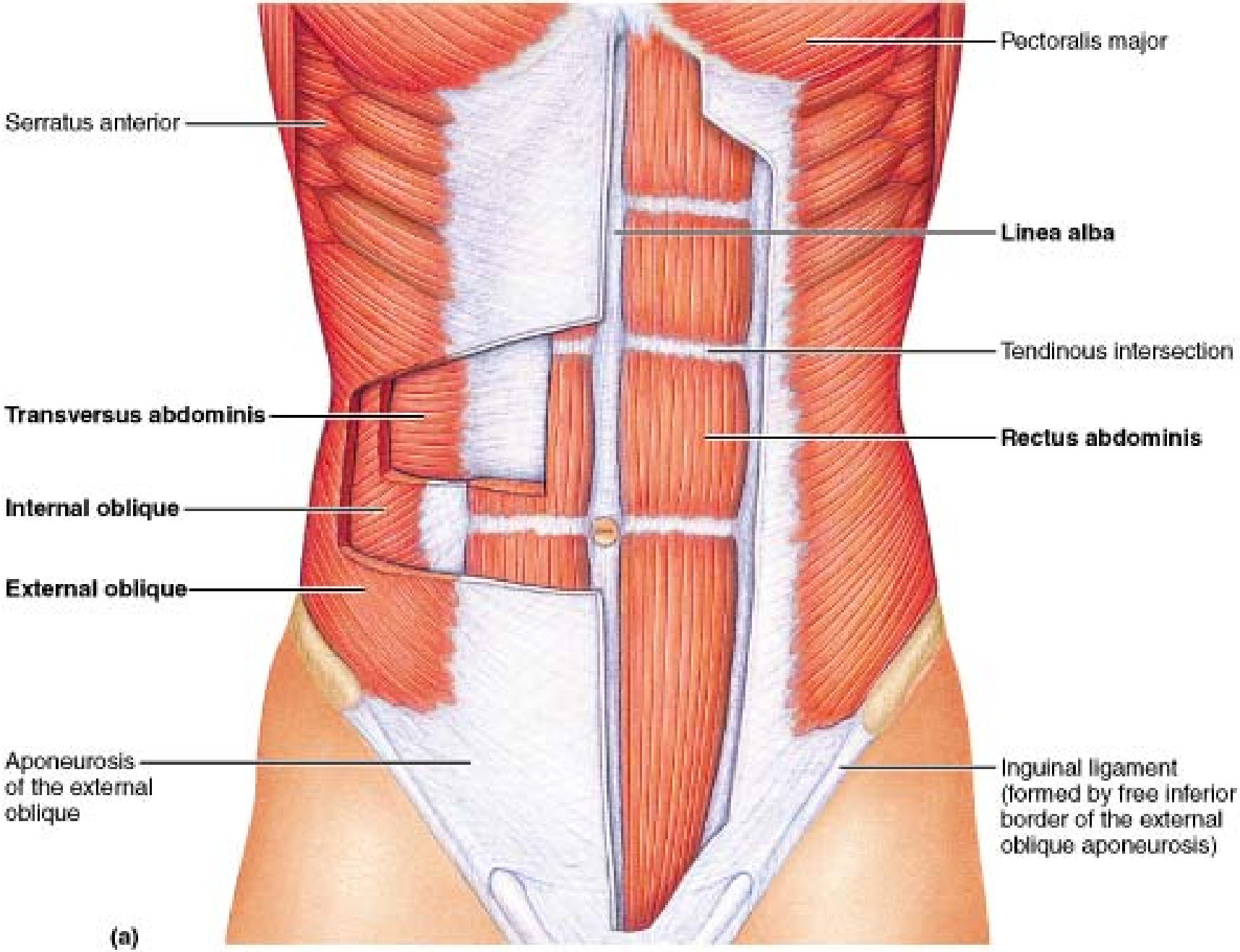
Pectoral region

- **Pectoralis minor:**
  - lies beneath the pectoralis major
  - takes its origin from the 3rd, 4th, & 5th ribs
  - makes its insertion on the coracoid process of the scapula
  - innervated by the medial pectoral nerve

- Both the pectoralis minor and major are **accessory muscles of respiration**

Muscles from abdomen to thorax

- **Rectus abdominus:** originating from the xiphoid process & costal cartilages 5, 6, & 7
- **External oblique:** attached to the external surface of the lowest 8 ribs
- **Serratus anterior** (laterally): inserting by finger-like processes into ribs 1-8 from scapula

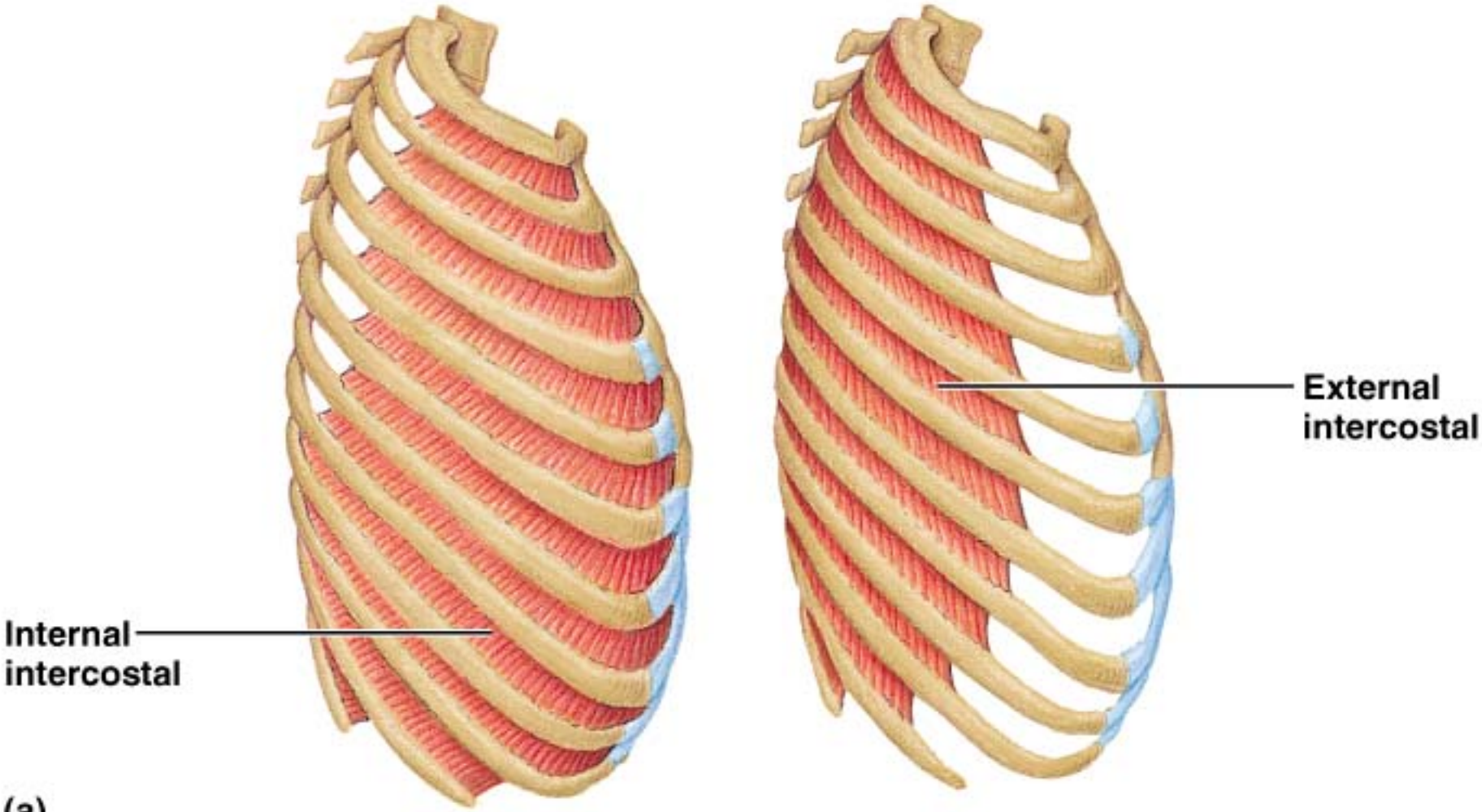


Intercostals

1. External intercostal muscle:

- its fibers are directed from superior and lateral to inferior and medial

- it loses its fleshy tissue and becomes a transparent membrane **anteriorly** (the **external intercostal membrane**)



(a)

Intercostals

2. Internal intercostal muscle:

- its fibers run perpendicular to those of the external intercostal muscle

- **posteriorly** on the thoracic wall, it becomes gradually thins to become the **internal intercostal membrane** from the angle of the ribs

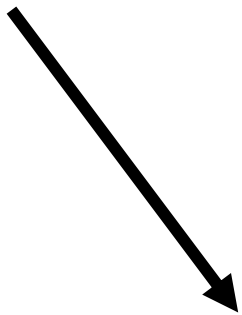
Intercostals

3. **Innermost intercostal muscle:** the deepest and thinnest intercostal muscle

- All the three intercostal muscles are **accessory muscles of respiration**

Diaphragm

- The primary muscle of respiration
- Innervated by the left and right phrenic nerves (C3, C4, C5)

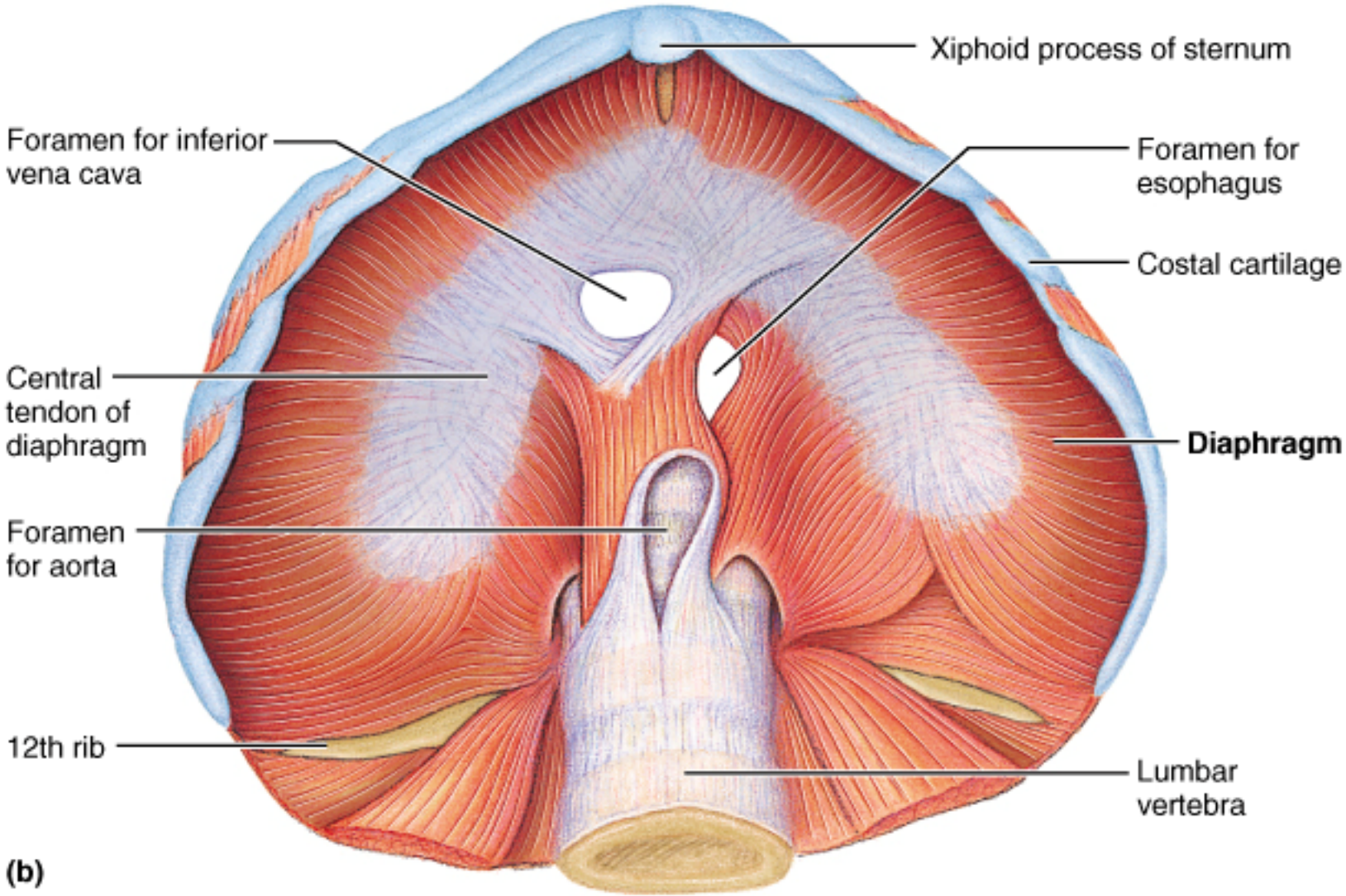


Patients with damage to the spinal cord above the level of C3 (e.g., broken neck) require mechanical respiration

Diaphragm

- Anteriorly: attaches at the level of the xiphoid process
- Posteriorly: curves downward to attach below the 12^{th} thoracic vertebra

The mediastinum increases in depth posteriorly

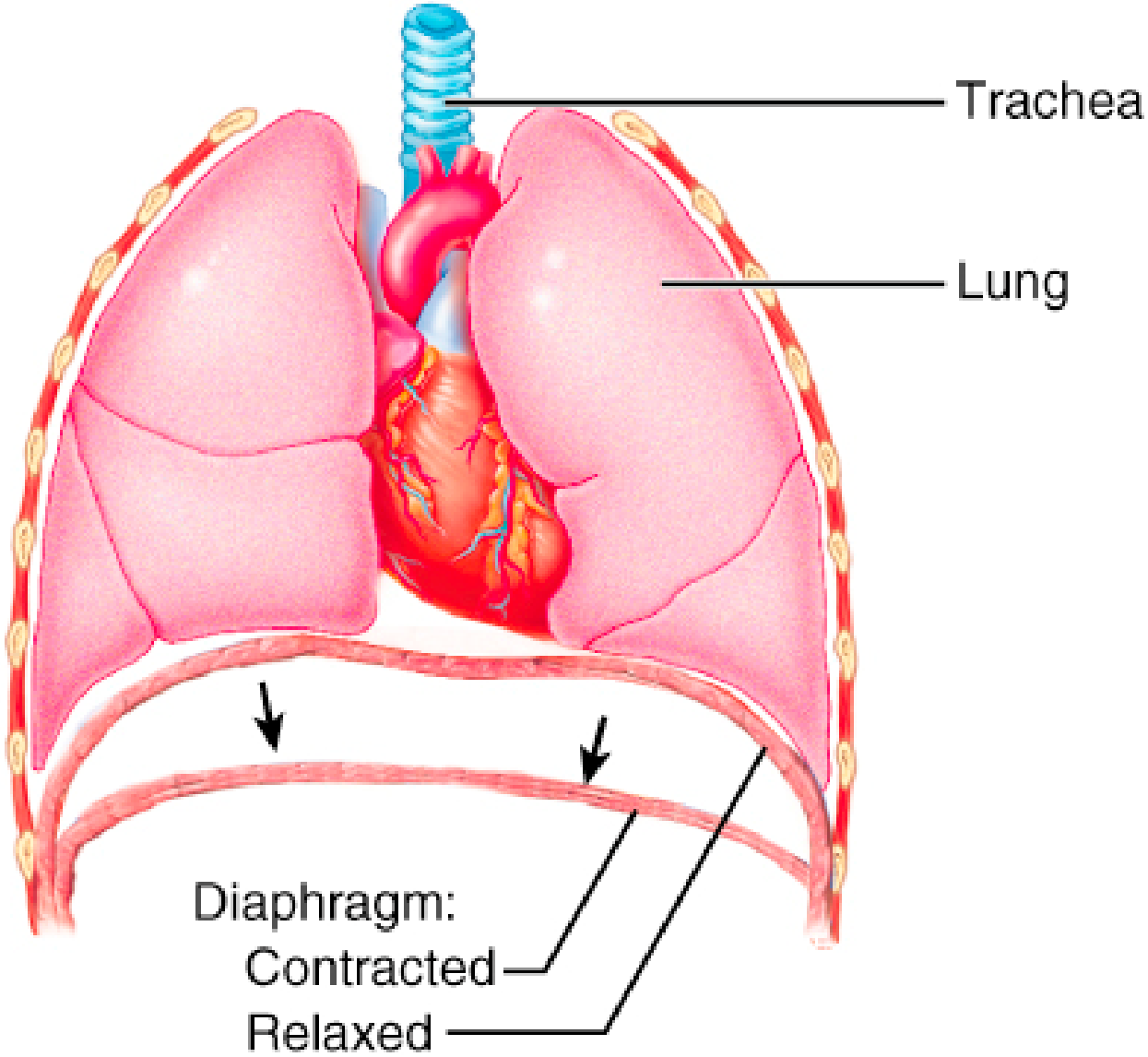


Clinical note

- The ***hiatus*** or opening through which the esophagus passes is a potential area for the herniation of abdominal organs, particularly the stomach (**hiatal herniation**)

Mechanics of respiration

- The inferior surfaces of the lungs are attached to the superior surface of the diaphragm
- When the diaphragm contracts, it increases the volume of the lungs and causes air to enter the lungs (inspiration)
- When the diaphragm relaxes, its dome moves superiorly, reducing the volume of the lungs & expelling the air out (expiration)



(a) Superoinferior expansion

Inspiration

- Requires an increase in the size of the thoracic cavity (which reduces the pressure inside the lungs)

- Three dimensions of the cavity can be modified:
  - Vertical
  - Transverse (lateral)
  - Anteroposterior

Inspiration

- **Vertical expansion** produces the greatest change in capacity & is brought about by the contraction of the diaphragm

- When the diaphragm contracts → it drops downward → increasing the vertical dimension of the thoracic cavity

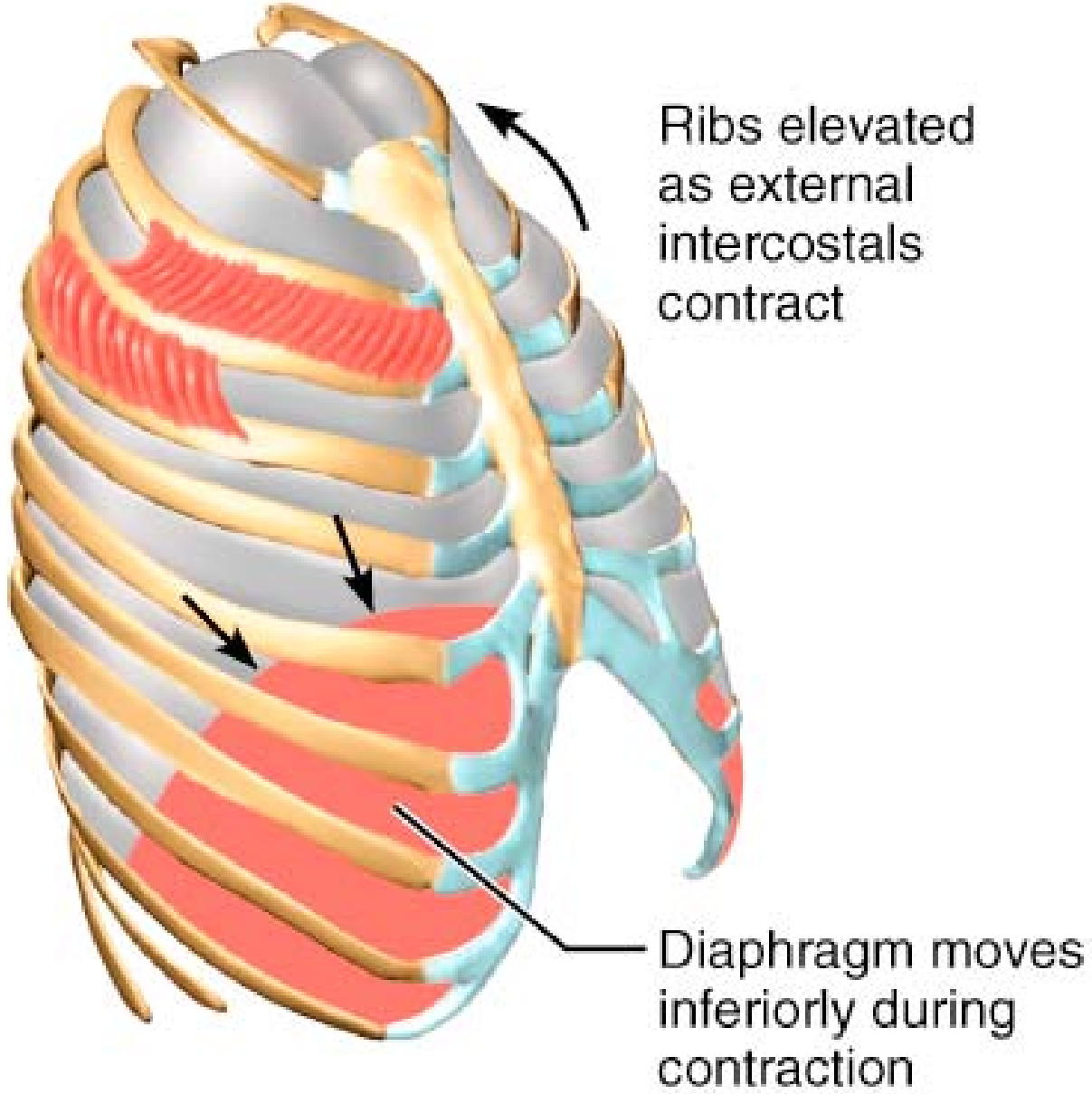
Inspiration

- In **quite breathing**: inspiration is brought about mainly by the action of the diaphragm

- During **forced inspiration**: many other muscles that are attached to the ribs may assist in raising the ribs (e.g., scalenus, sternocleidomastid)

Inspiration

- The pectoral muscles can be used if the arms are fixed
- The function of the intercostals is controversial



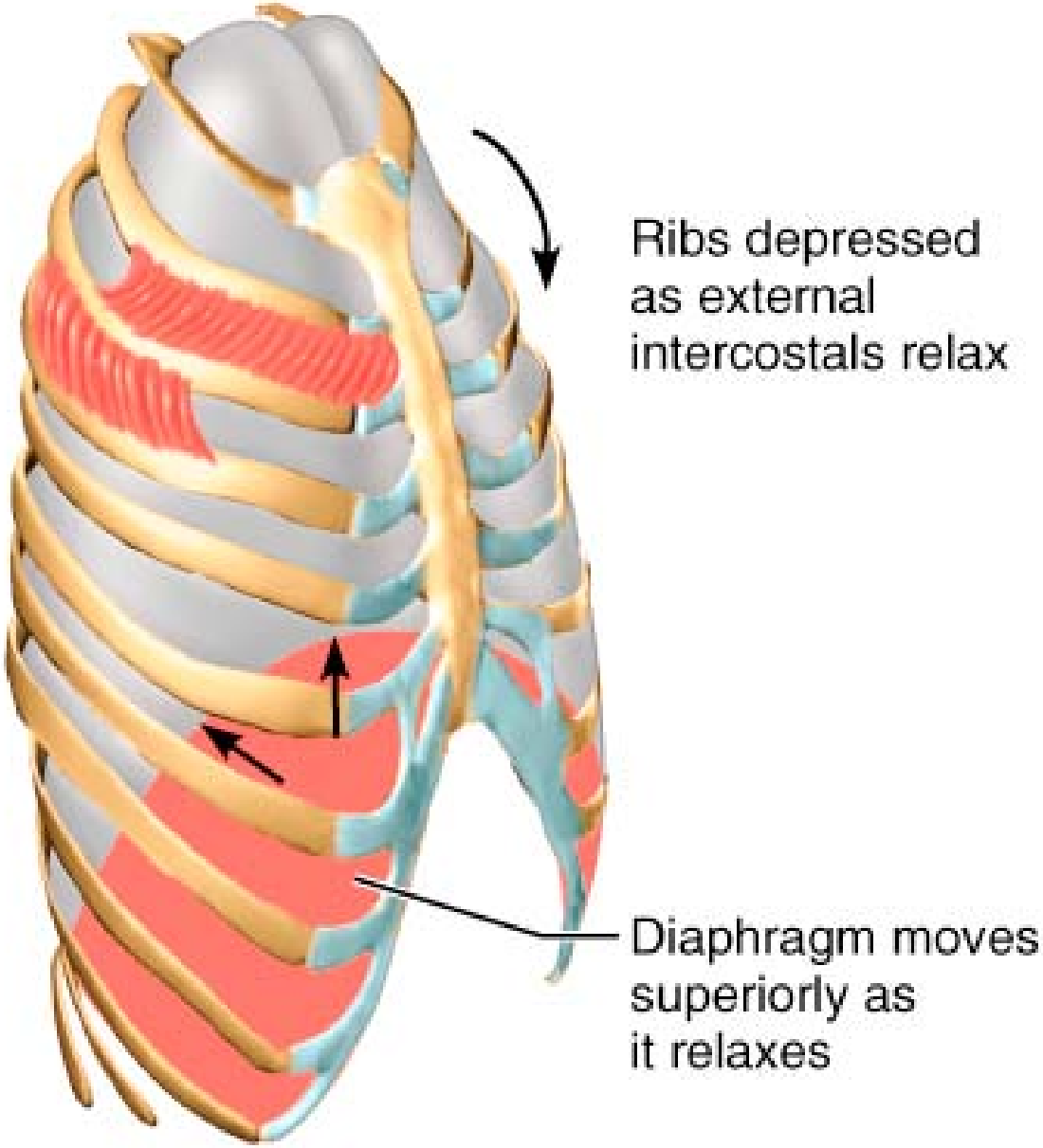
(d) Inspiration

Expiration

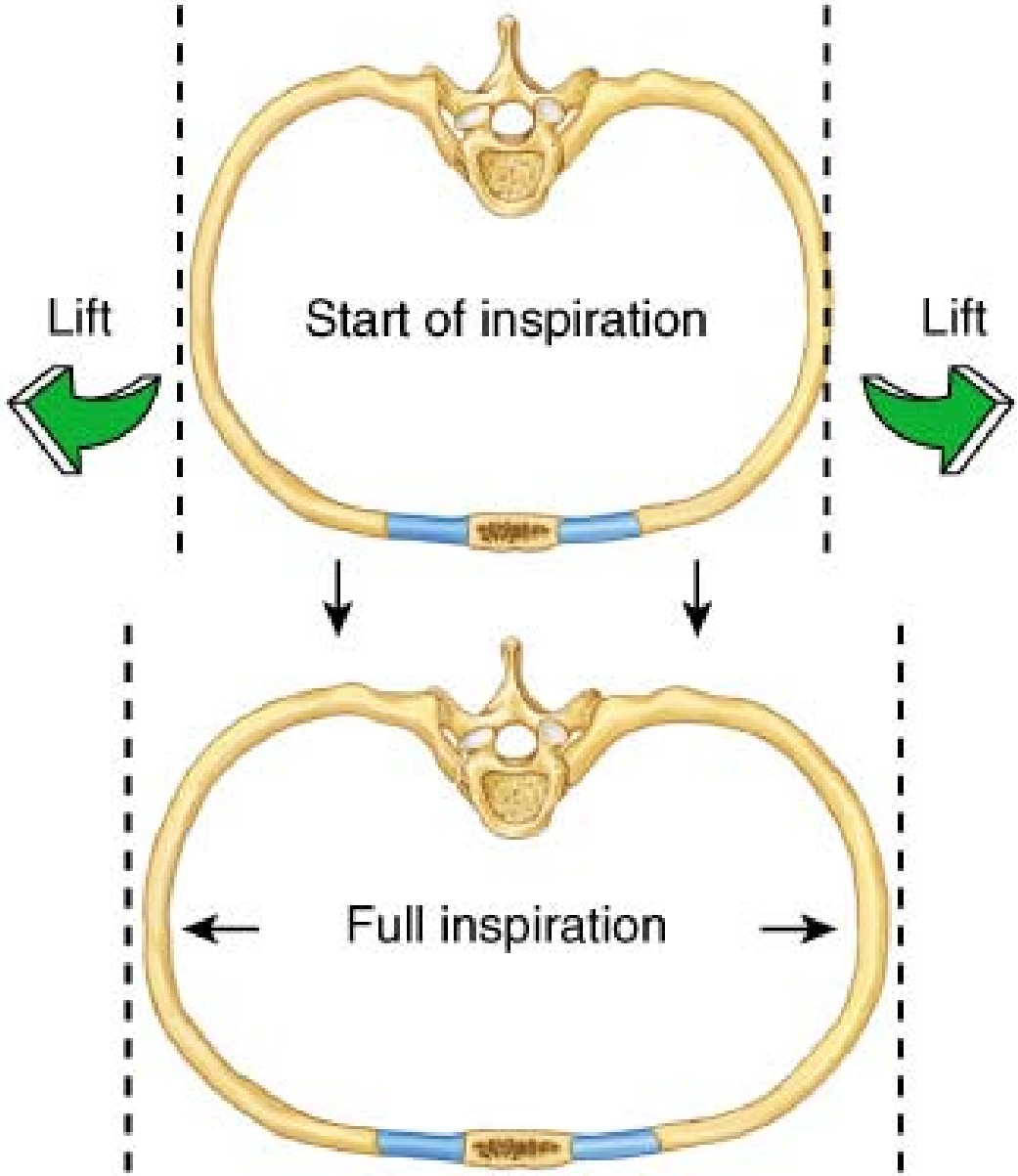
- Can be a passive process
- When the diaphragm contracts during inspiration, it compresses the abdominal organs, increasing pressure within the abdominal cavity
- This increased pressure helps push the diaphragm upward

Expiration

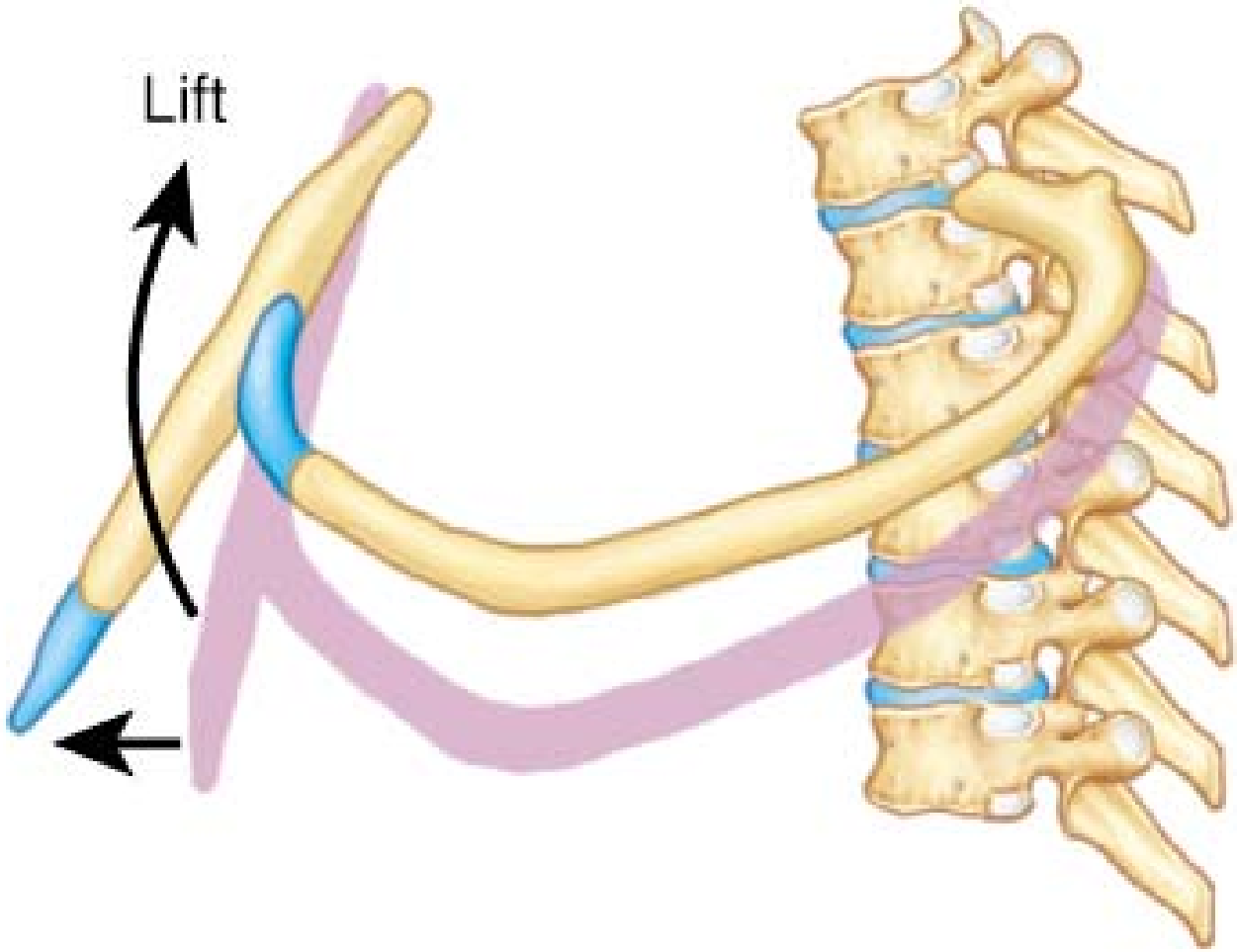
- In **forced expiration**: the muscles of the abdominal wall contract to provide additional pressure on the diaphragm



Expiration



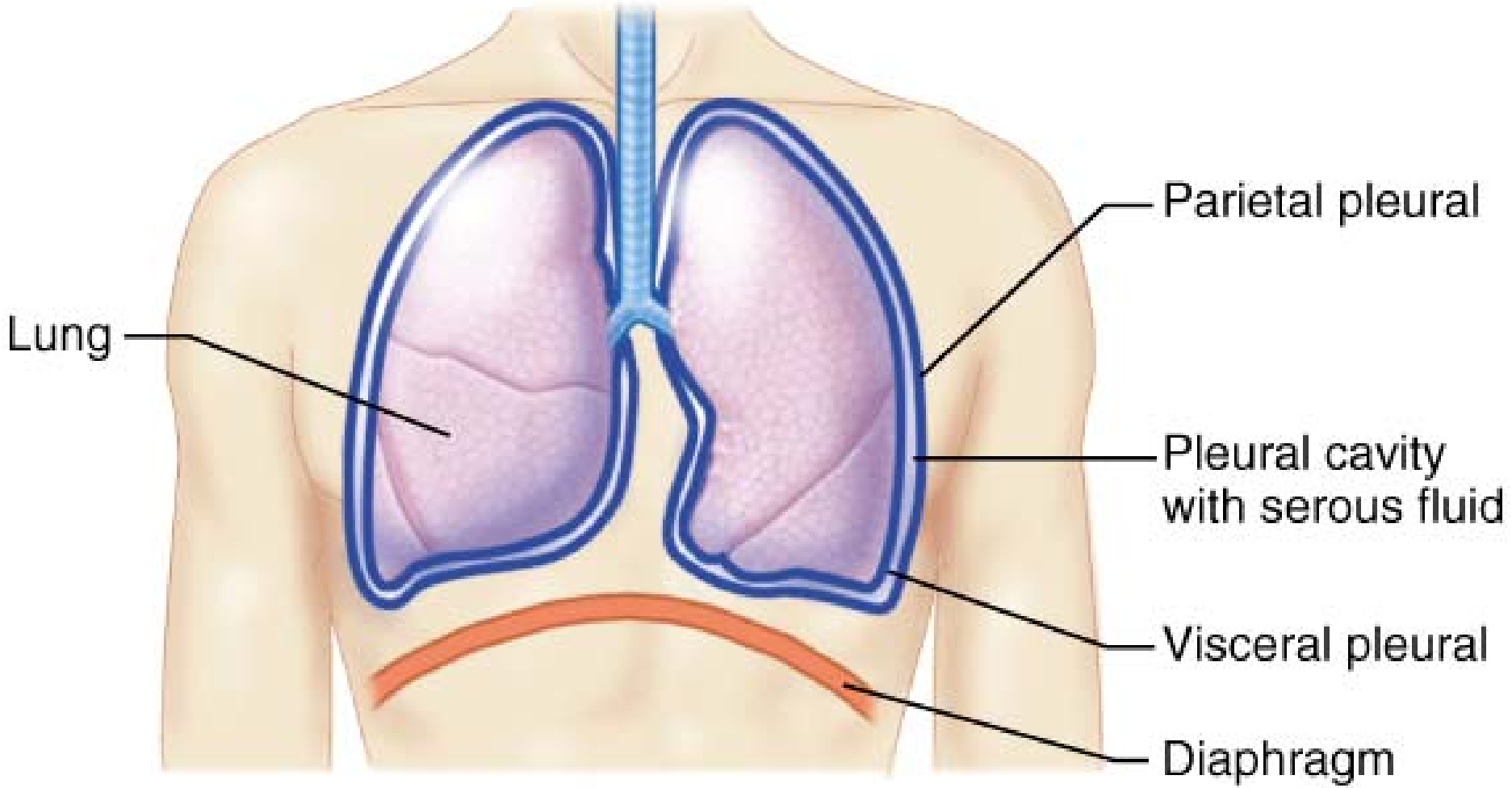
(b) Lateral expansion



(c) Anteroposterior expansion

Thorax

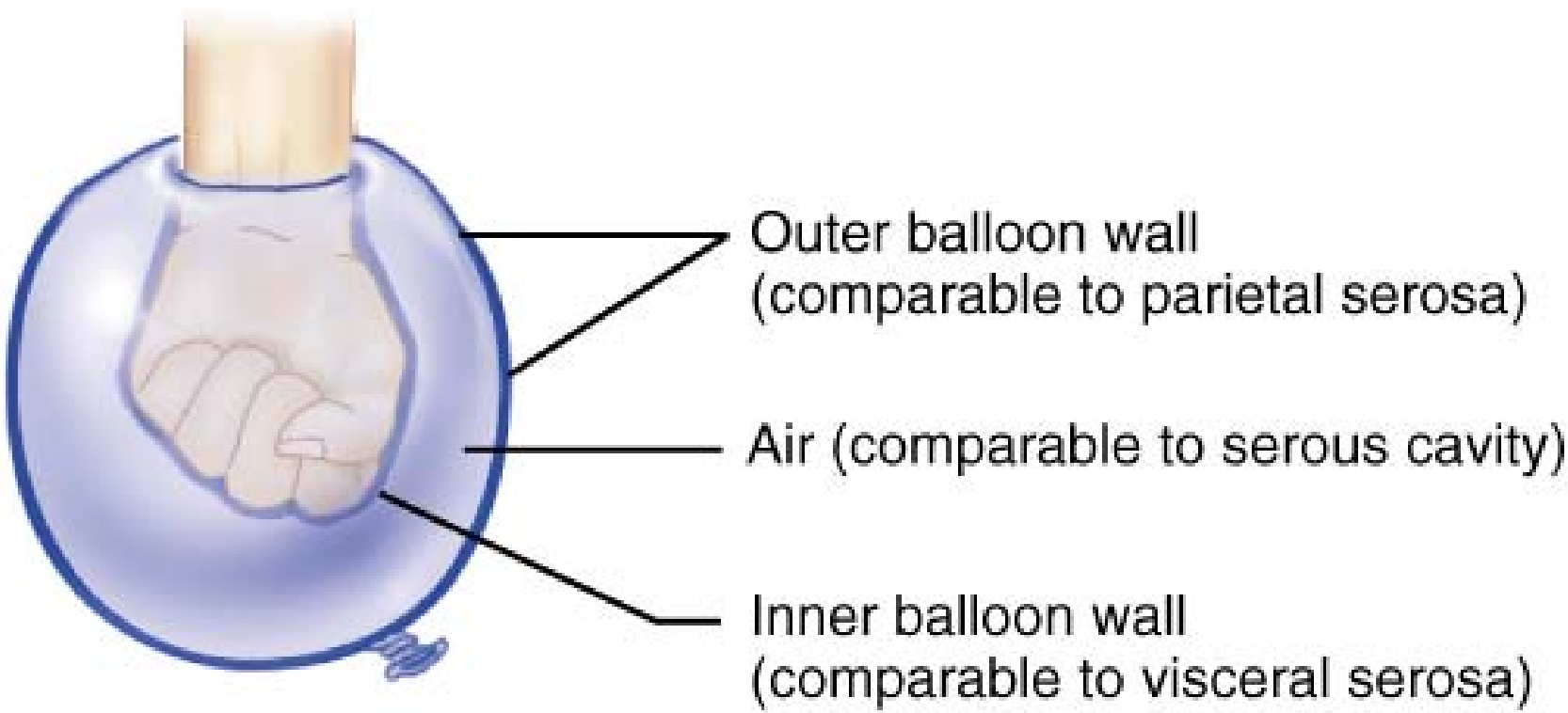
- **Pleural cavities:**
  - ➢ two; separate
  - ➢ contain few milliliters of fluid allowing the lungs to move easily inside the thorax
  - ➢ pleural effusion: when the cavity accumulates fluid in certain diseases



(c)

Pleura

- **Visceral** & **parietal** pleura
- The **cupola** (cervical pleura): rises into the root of the neck where it can be damaged



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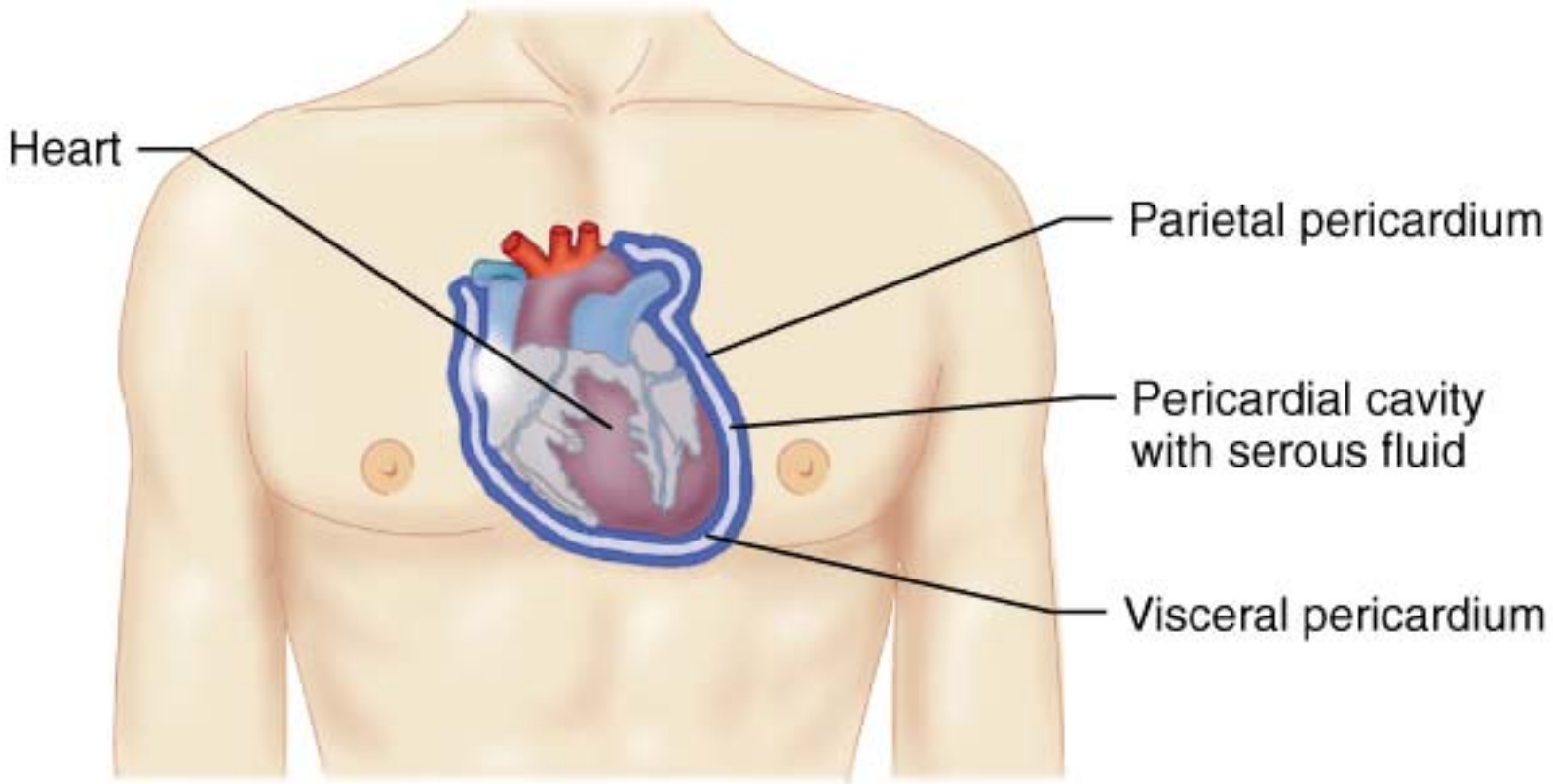


(b)

- Fibrous pericardium = the outermost layer of the sac which contains the heart

Clinical note

- **Pneumothorax** = presence of air in the pleural cavity

- When the pleura is injured either from a wound in the thoracic wall or through the lung itself

- In this case, the lung collapses

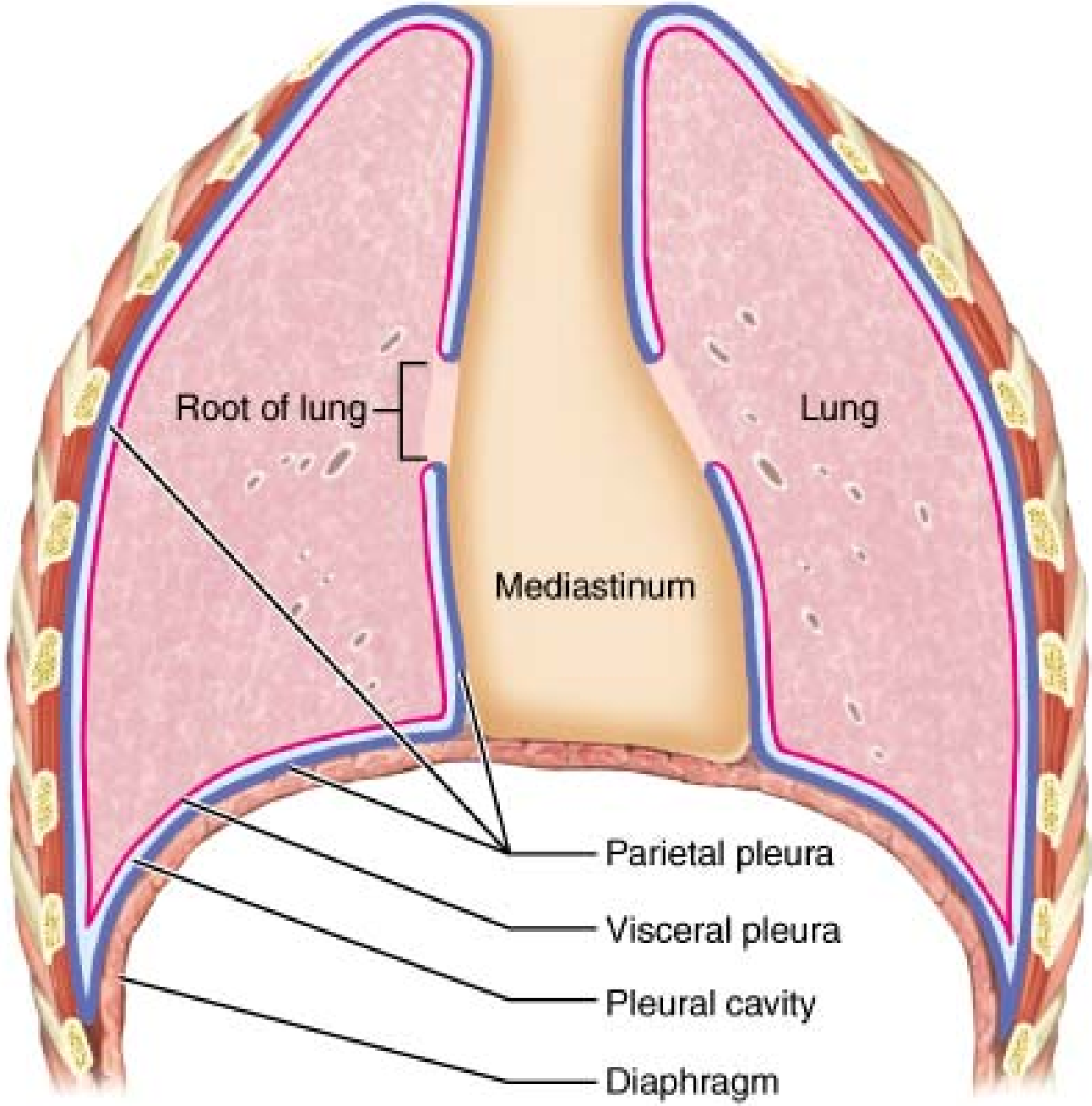
Mediastinum

- = the mass of tissue / organs separating the pleural cavities

- Extends:
  - from the **thoracic inlet** superiorly to the **diaphragm** inferiorly
  - from the **sternum** anteriorly to the bodies of **thoracic vertebrae** posteriorly

Thoracic inlet

- Bounded by:
  - 1st thoracic vertebra
  - 1st pair of ribs and cartilage
  - superior boarder of manubrium



Mediastinum

- Important landmark: the horizontal plane between the **sternal angle** and the intervertebral disc of **T4 and T5**

  - divides the superior mediastinum from the anterior, middle, and posterior subdivisions

  - marks the upper border of the fibrous pericardium
  - indicates the bifurcation of the tracheha

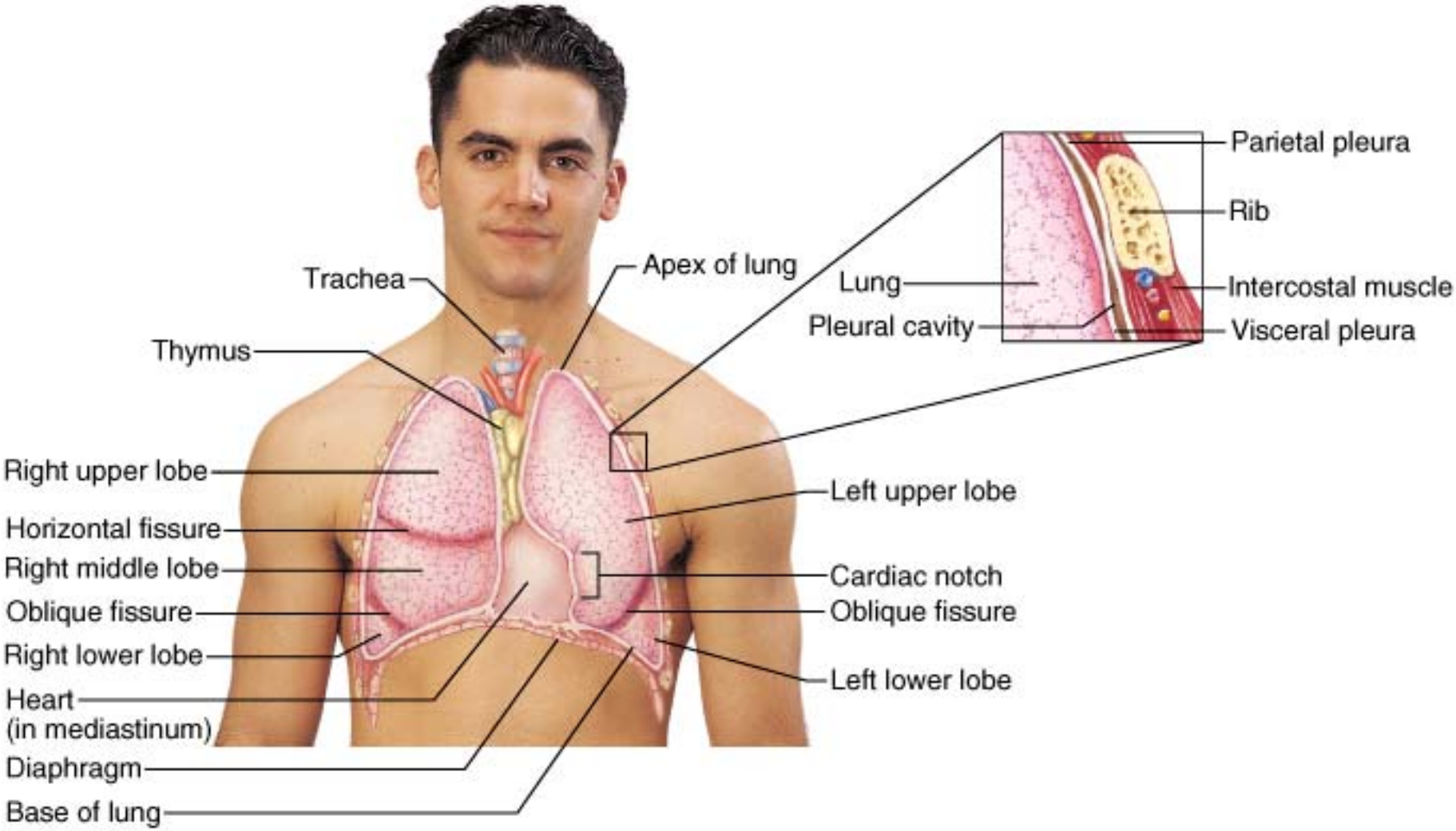
Mediastinum

- **Anterior mediastinum:**
  - between the sternum & fibrous pericardium
  - small
  - contains the thymus gland (greatly reduced in size in the adult compared to infants)

Mediastinum

- **Middle mediastinum:** consists of the pericardium around the heart, its contents, and the roots of the great vessels

- **Posterior mediastinum:** the area behind the pericardium and in front of the lower 8 thoracic vertebrae



(a)

Left lung

- **Upper & lower lobes** divided by the **oblique fissure**

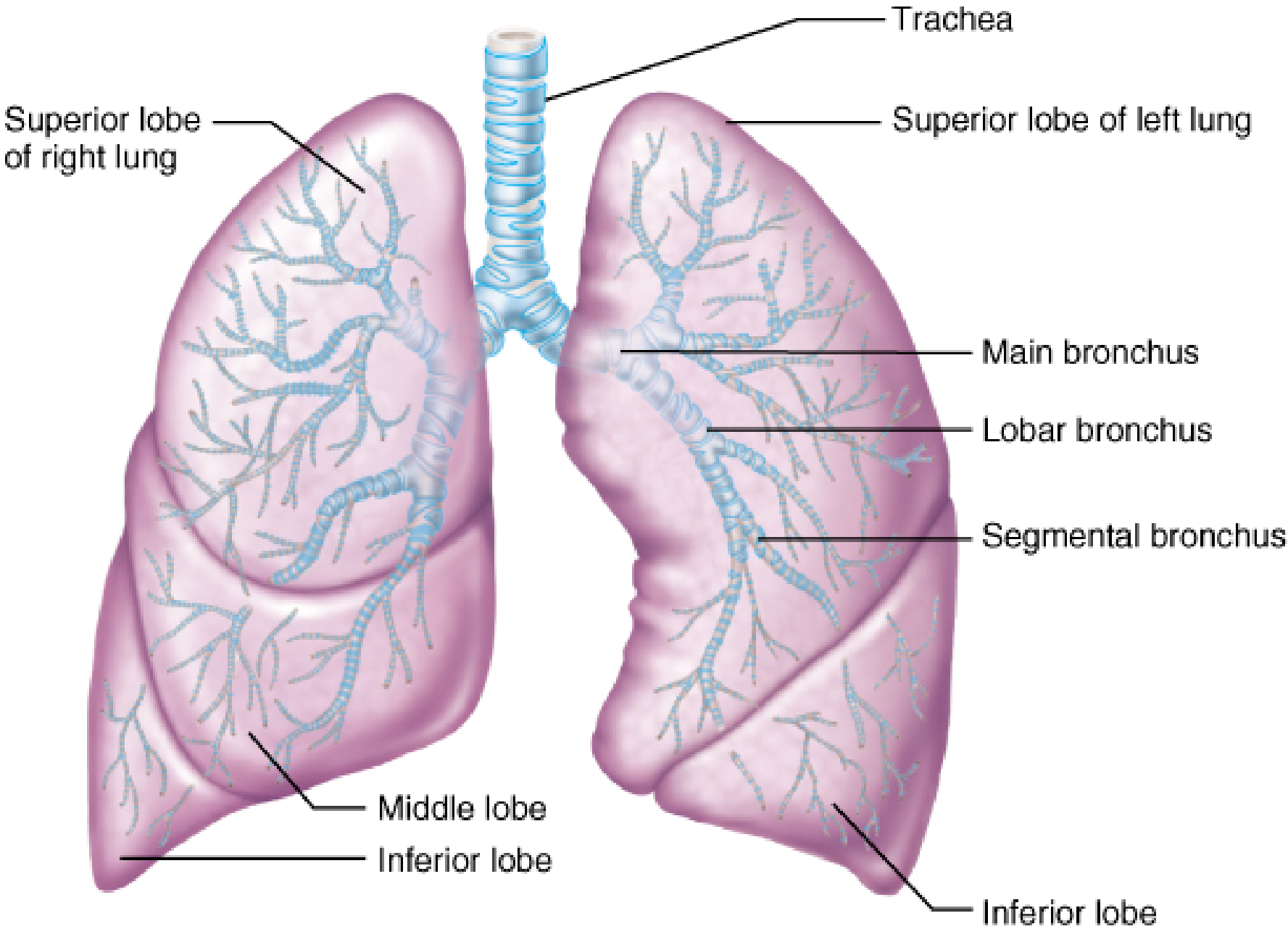
- **Base** of the lung = the lower part of the posterior surface of the lower lobe
- **Apex**
- **Lingula**: part of the upper lobe of the left lung
- **Cardiac notch**

Right lung

- Apex
- Base

- **Horizontal fissure**: separates the upper and middle lobes

- **Oblique fissure**: separates the middle and lower lobes



Right lung

- **Lower lobe**: makes up most of the posterior surface of the lung
- **Middle lobe**: located in the anterior 2/3rds of the lung
- **Anterior lobe**: located in the anterior surface of the lung

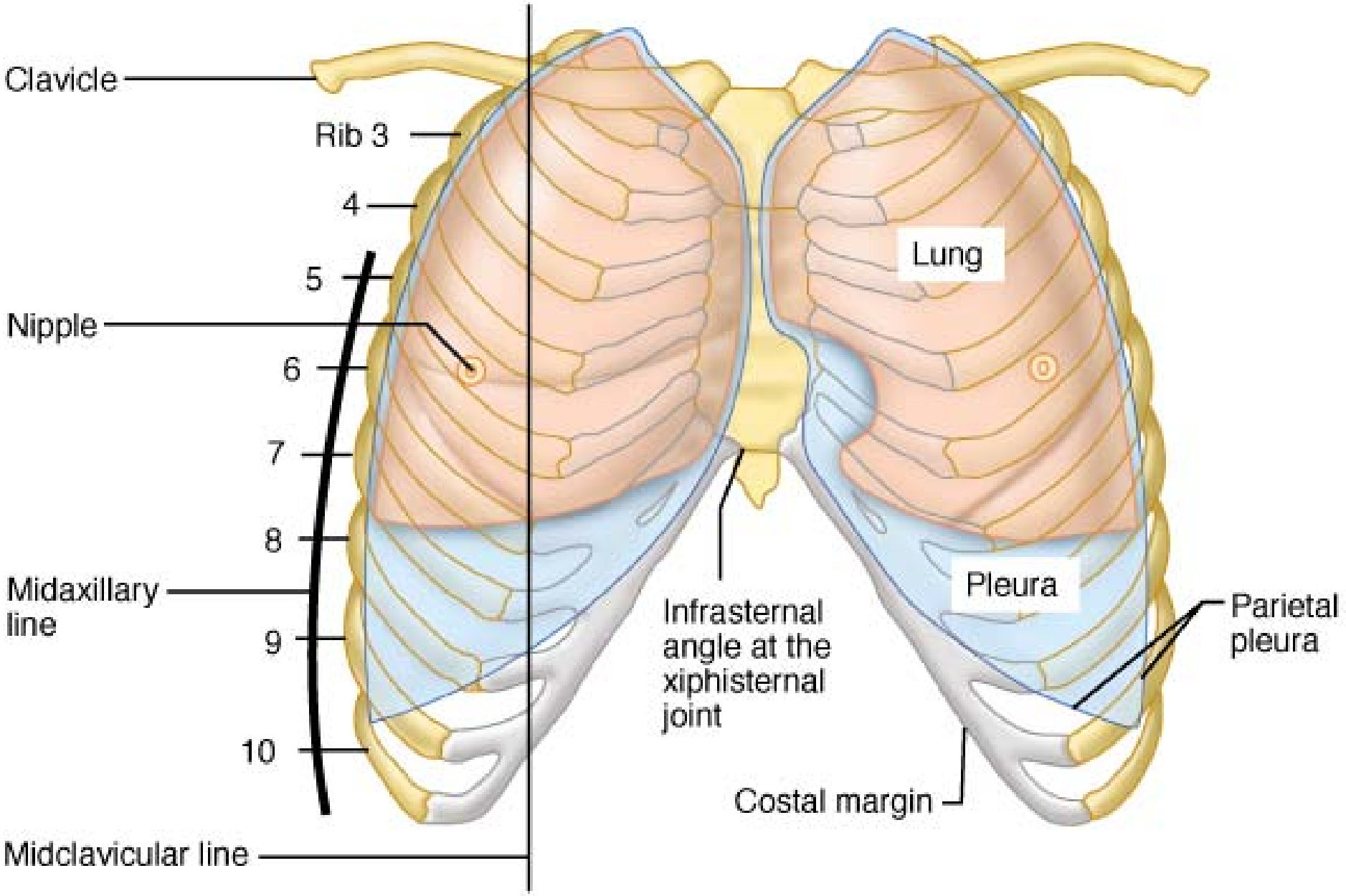
- Lung disease may affect individual lobes (at least initially)

Surface landmarks

- The **inferior border of the lung** extends to:
  - **6th rib** on the midclavicular line
  - **8th rib** on the midaxillary line
  - **10th rib** on the midscapular line

Surface landmarks

- The **pleura** lies two rib levels lower than the inferior border of the lung:
  - **8th rib** on the midclavicular line
  - **10th rib** on the midaxillary line
  - **12th rib** on the midscapular line



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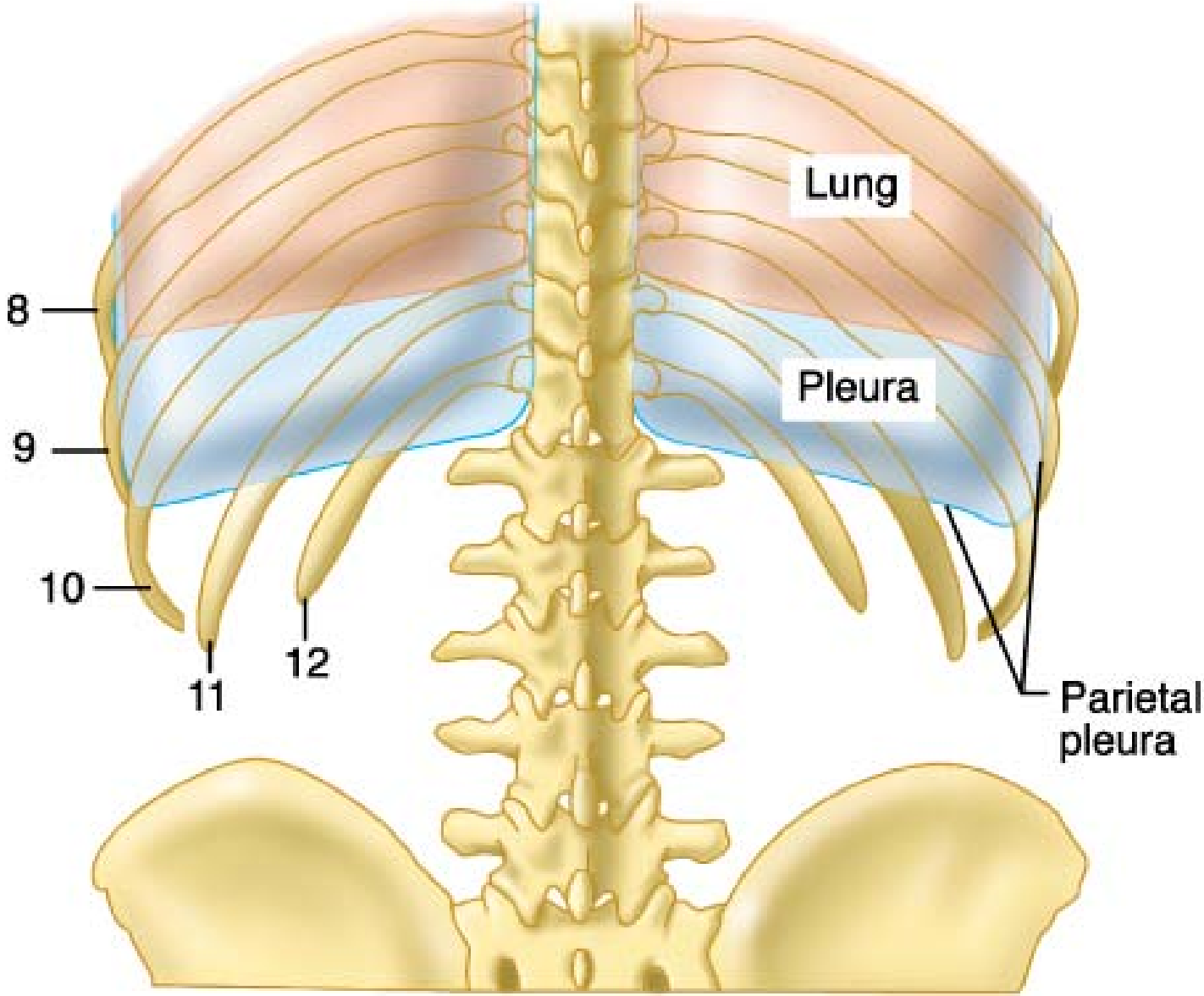

(b)

Lung structures

- The lung receive air by the **trachea**
- The trachea ends in the upper part of the thorax by branching into two **main bronchi**
- The right main bronchus branches into 3 **labor bronchi** (one for each of the 3 lobes)
- The left main bronchus branches into 2 labor bronchi

Lung structures

- The bronchi branch repeatedly within the lungs forming the **bronchioles**

- The bronchioles end in connection with the **alveoli** (small, thin-walled air sacs)

Lung structures

- Branching of the labor bronchi is important when it is desired to facilitate **drainage** of some particular bronchus by gravity

- Within a lobe, each labor bronchus gives off 2-5 smaller bronchi collectively known as **segmental bronchi** (running in different directions within a lobe)

Lung innervation

- **Sympathetic**: from the right & left sympatehtic trunks (2-5 thoracic ganglion)

- **Parasympathetic**: vagus nerve

Cardiac silhouette

- **Right border:** from the **3rd costal cartilage to the 6th** costal cartilage (a fingers breadth from the right margin of the sternum)
- **Lower border:** across the **xiphisternal junction** to a point just medial to the mid-clavicular line in the 5th intercostal space
- **Left border:** from the apex to the **2nd intercostal space** (a finger's breadth from the left margin of the sternum)

Heart valves

- The **tricuspid valve**: located posterior to the body of sternum at the level of 4^{th} intercostal space

- The **mitral valve**: located posterior to the body of sternum at the level of 4^{th} left costal cartilage

Heart valves

- The **aortic valve**: located posterior to the left side of sternum at the level of 3rd intercostal space

- The **pulmonic valve**: located at the level of 3rd costal cartilage at the left side of sternum