

Bronchial Tree and Lungs

Anatomy Lab

Dr. Essa AL-lahham

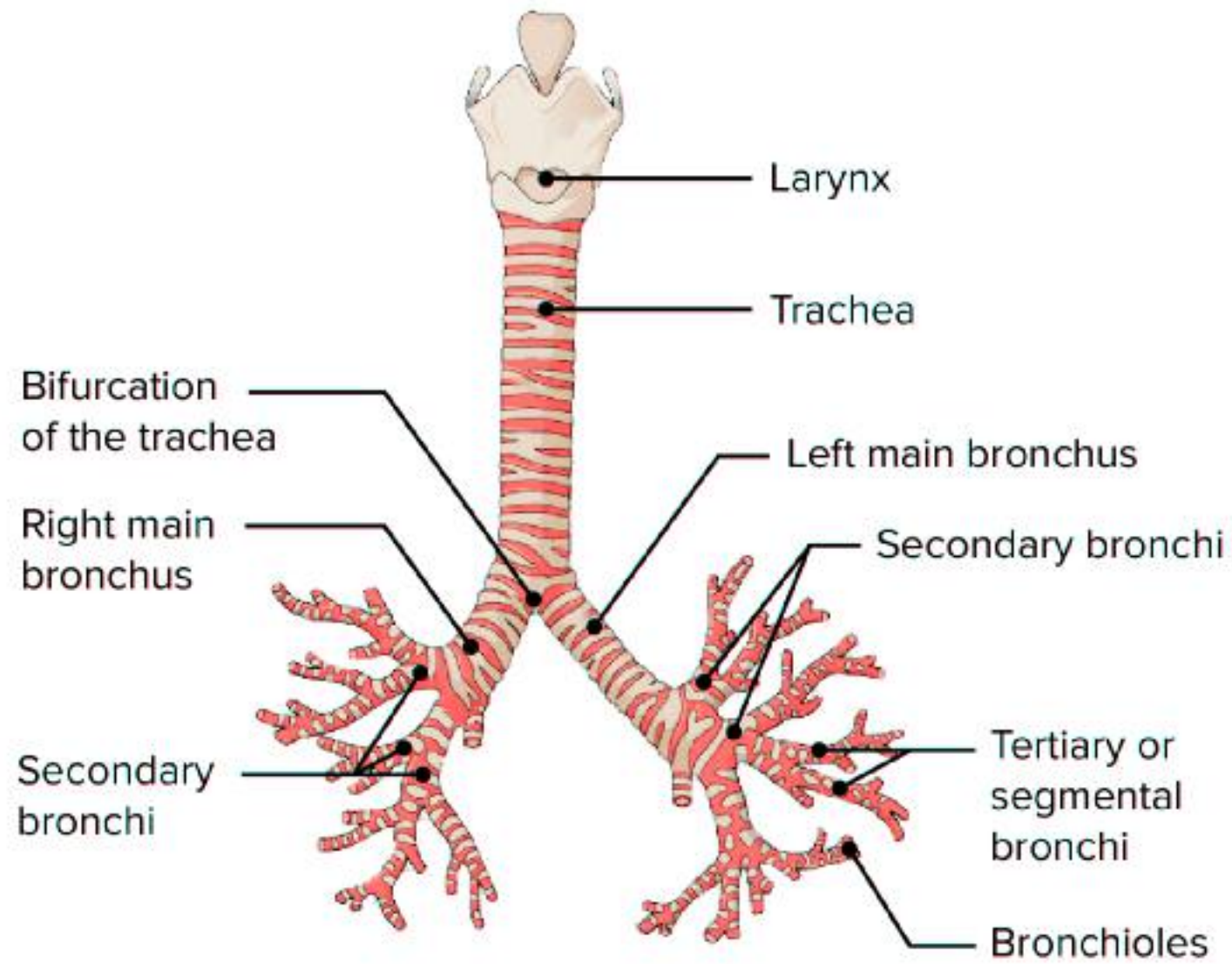
M.D , T.A

Bronchial Tree - Introduction

The trachea, bronchi and bronchioles form the **tracheobronchial tree** a system of airways that allow passage of air into the lungs, where gas exchange occurs. These airways are located in **the neck and thorax**

The tracheobronchial tree **the branching tree of airways** beginning at the **larynx**, as the **trachea** and extending inferiorly and peripherally into the lungs **two main bronchi**, and then **bronchioles**

The luminal diameter decreases as the branching increases more peripherally into the lungs.



Trachea

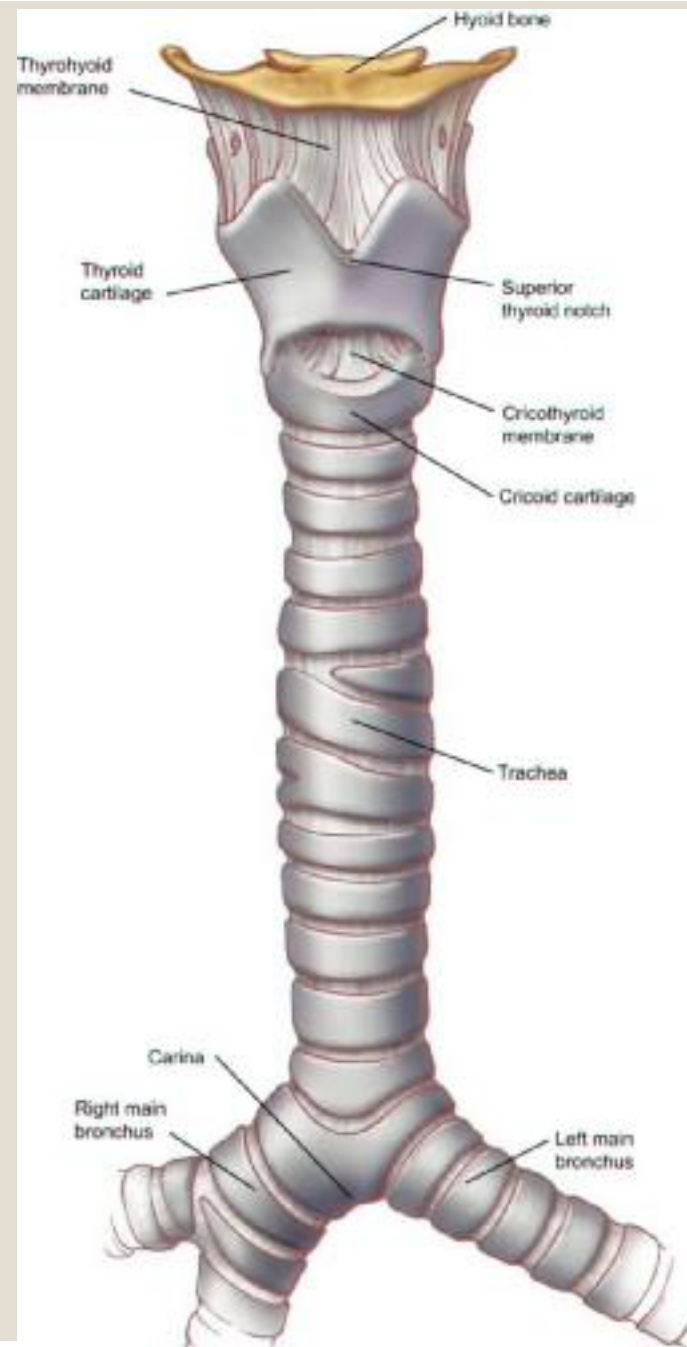
It is a mobile **cartilaginous and membranous** tube .

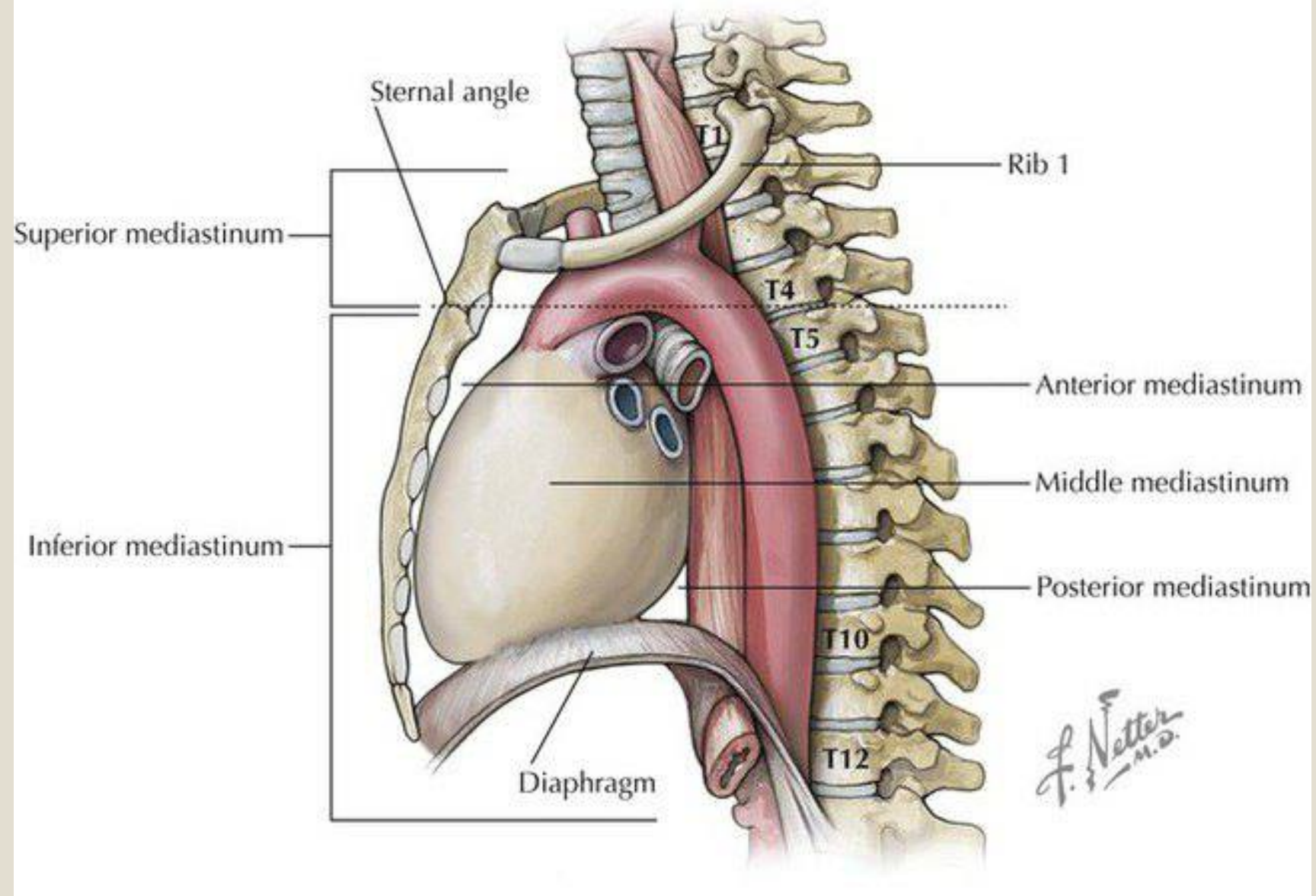
It begins in the neck as a continuation of the larynx **at the lower border of the cricoid cartilage** at the level of **the 6th cervical vertebra (C6)**.

It descends in the midline of the neck.

In the thorax, the trachea ends below at the **carina** by dividing into right and left principal (main) bronchi **at the level of the sternal angle**.

(opposite to the disc between the 4th and 5th thoracic vertebrae T4-T5).





Trachea

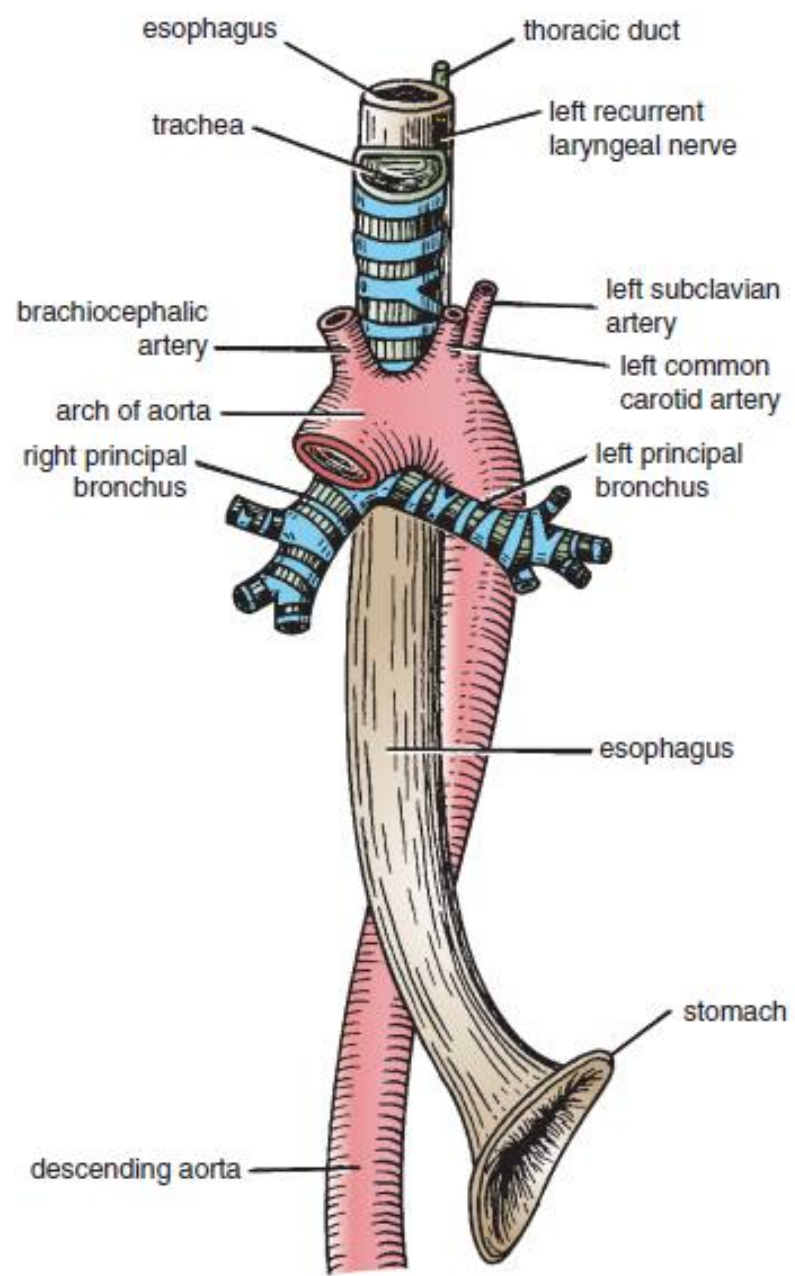
The trachea marks the beginning of the tracheobronchial tree.

It arises at the lower border of **cricoid cartilage** in the neck, as a **continuation of the larynx**

It travels inferiorly into the **superior mediastinum**, **bifurcating at the level of the sternal angle** (forming the right and left main bronchi).

As it descends, the trachea is **located anteriorly to the oesophagus**, and inclines slightly to the **right**

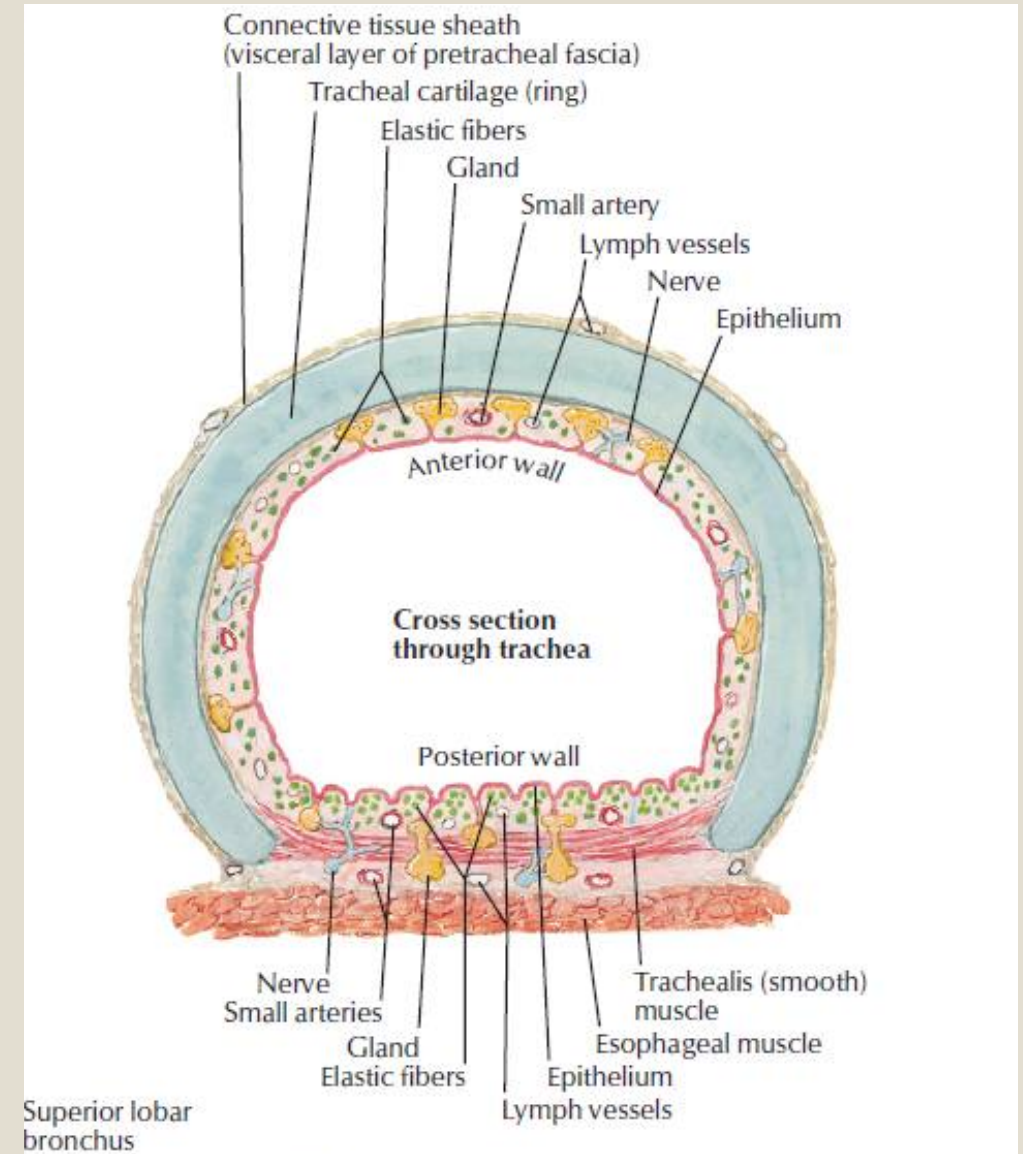
In adults, the trachea is about **12 cm long and 2.5 cm in diameter**

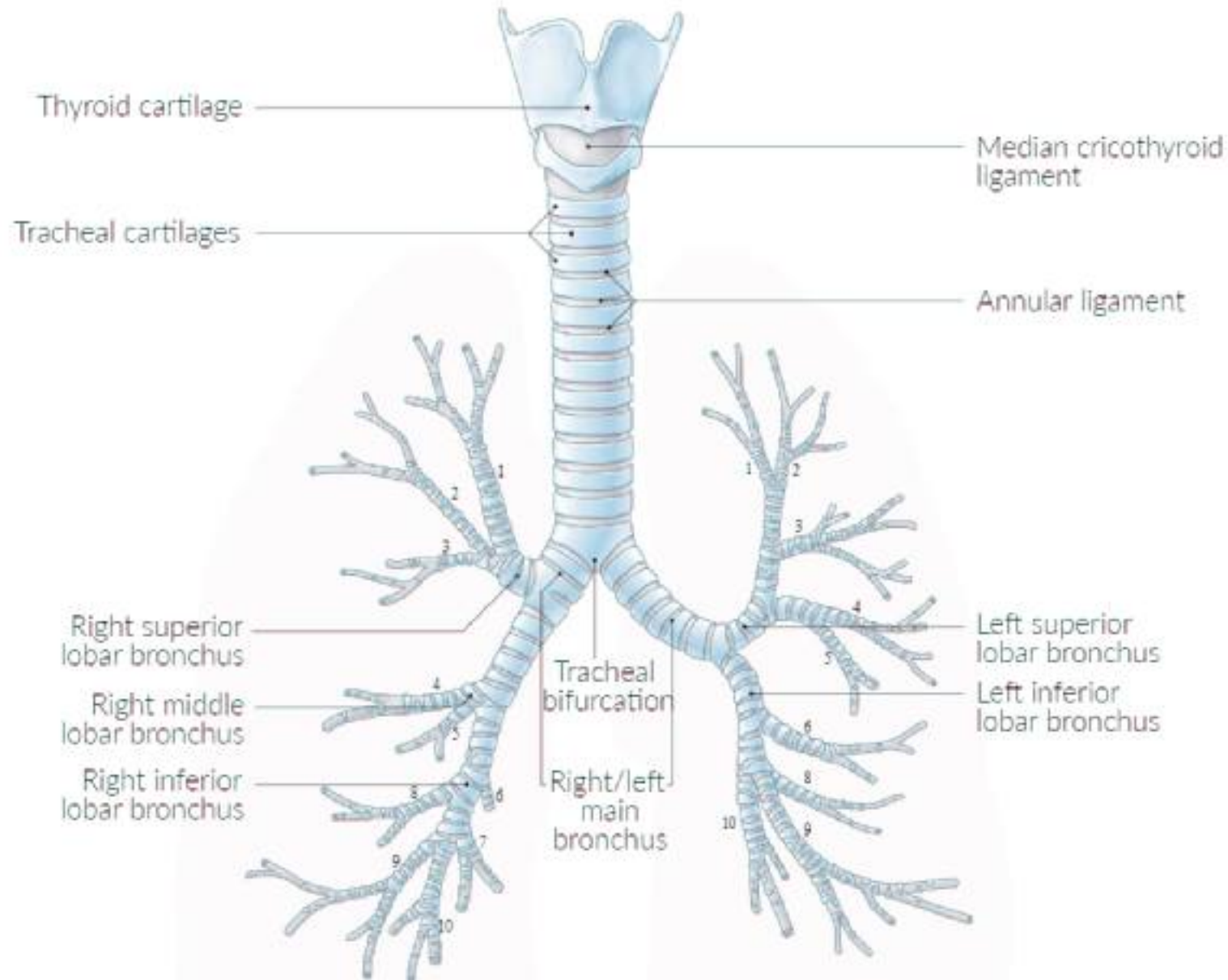


Trachea

The fibroelastic tube is kept patent by the presence of U-shaped bars (rings) of **hyaline cartilage** embedded in its wall “16 to 20 ring.”

The posterior free ends of the cartilage are connected by smooth muscle, called the **trachealis muscle**.





- **The trachea (windpipe)**

At the tracheal bifurcation, the trachea splits into the right and left main bronchus, with the latter following a more horizontal.

- Note that the left lung main bronchus splits into two lobar bronchi and that the number and position of bronchopulmonary segments varies between the two lungs.

Trachea – Anatomical Relations

The relations of the trachea in the superior mediastinum of the thorax are as follows:

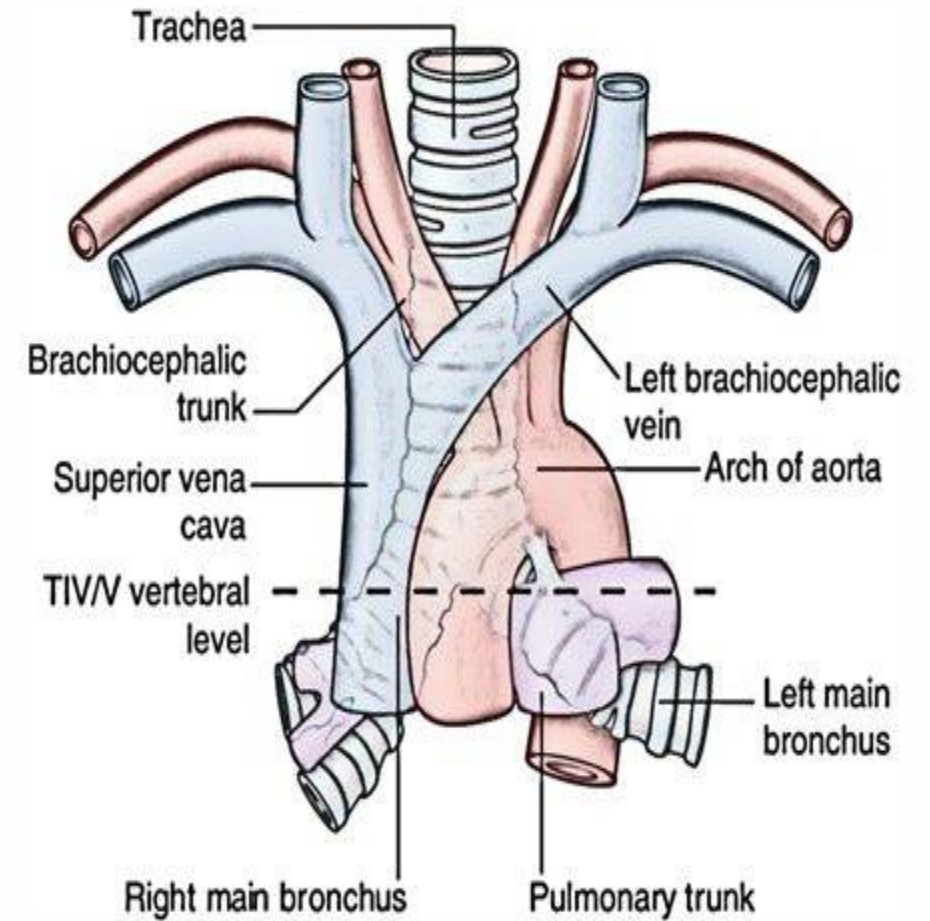
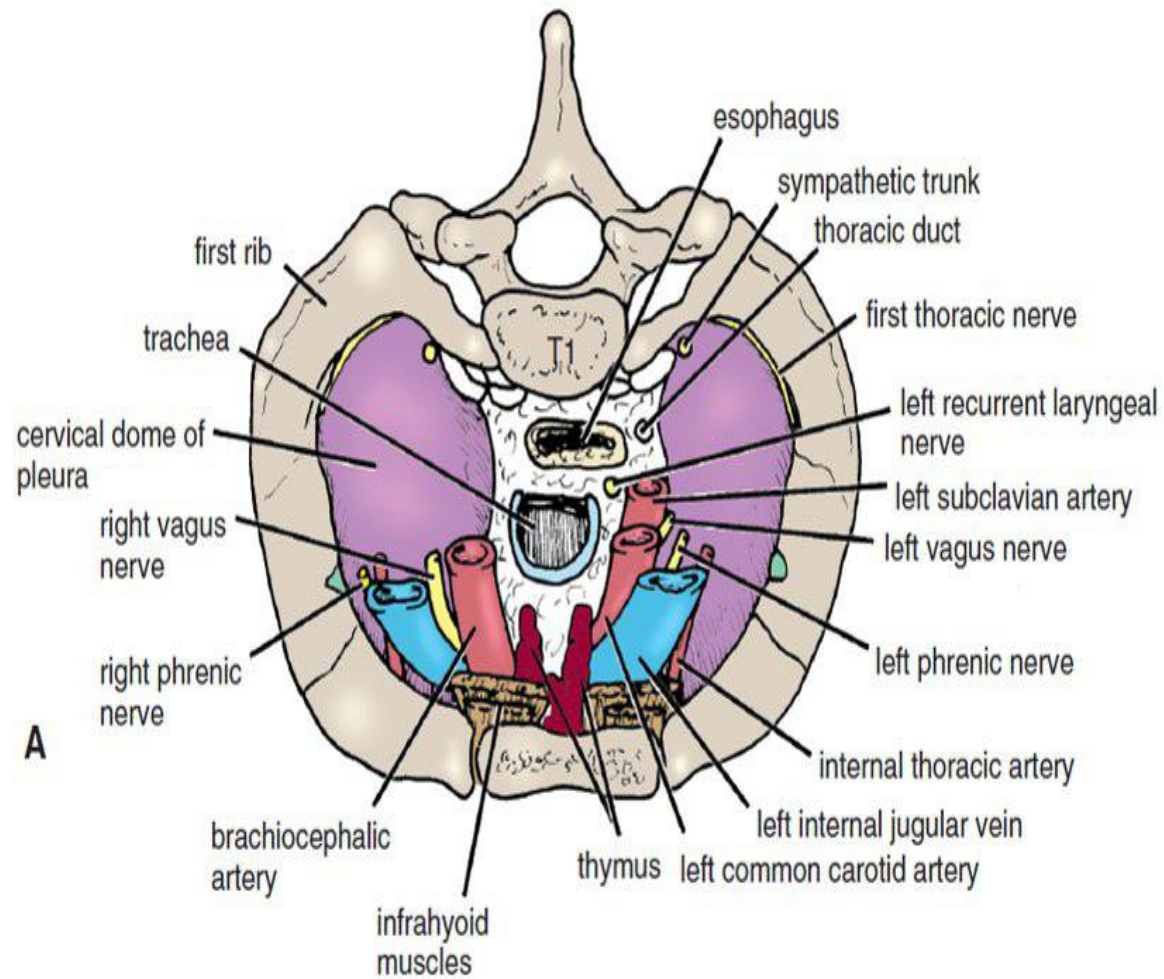
Anteriorly: The manubrium, the thymus, the left brachiocephalic vein, the origin of the brachiocephalic artery.

Posteriorly: The esophagus and the left recurrent laryngeal nerve.

Right side: The azygos vein (inf.), the right vagus nerve.

Left side: The arch of the aorta, the left common carotid and left subclavian arteries, the left vagus and left phrenic nerves .

Trachea – Anatomical Relations

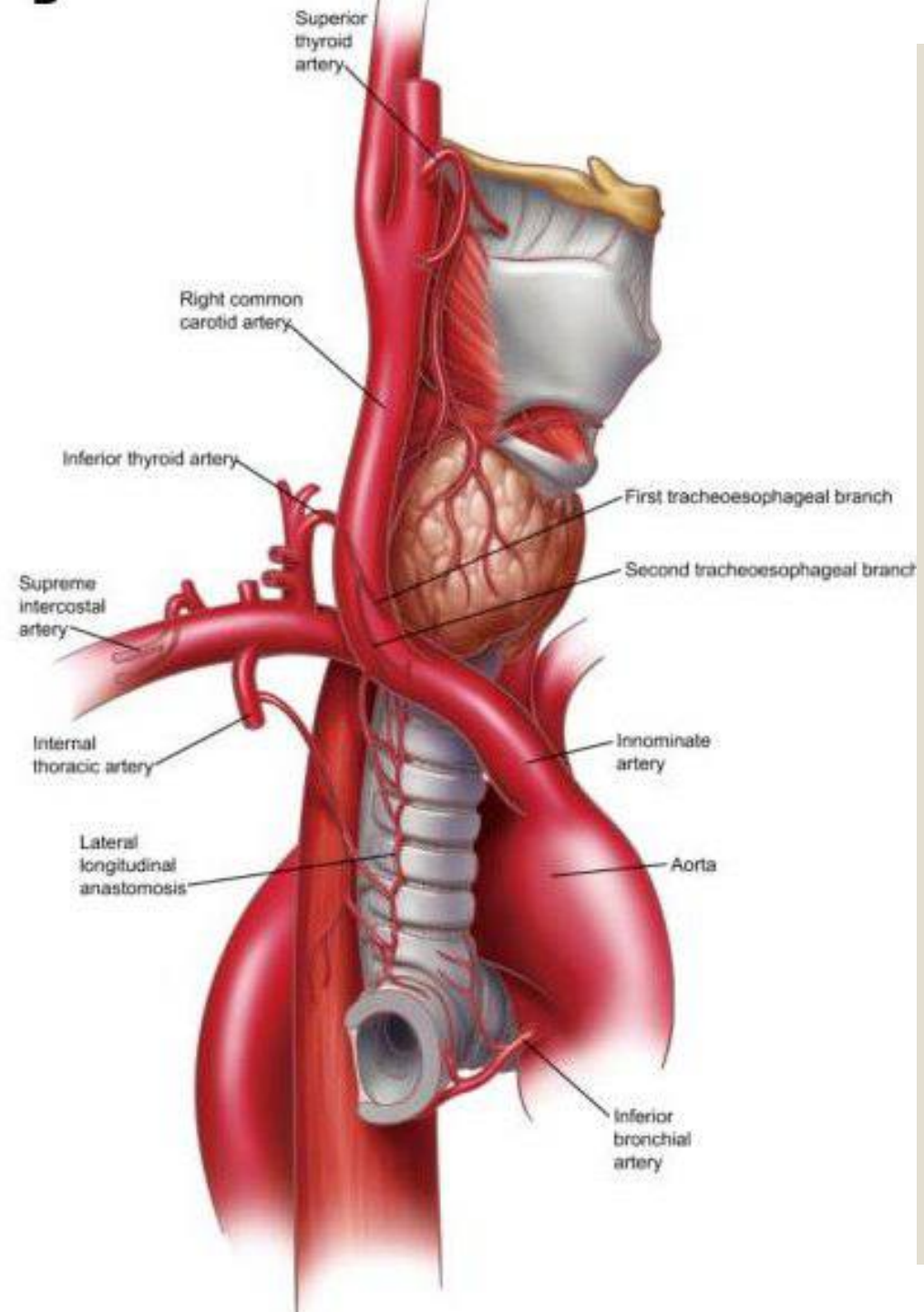
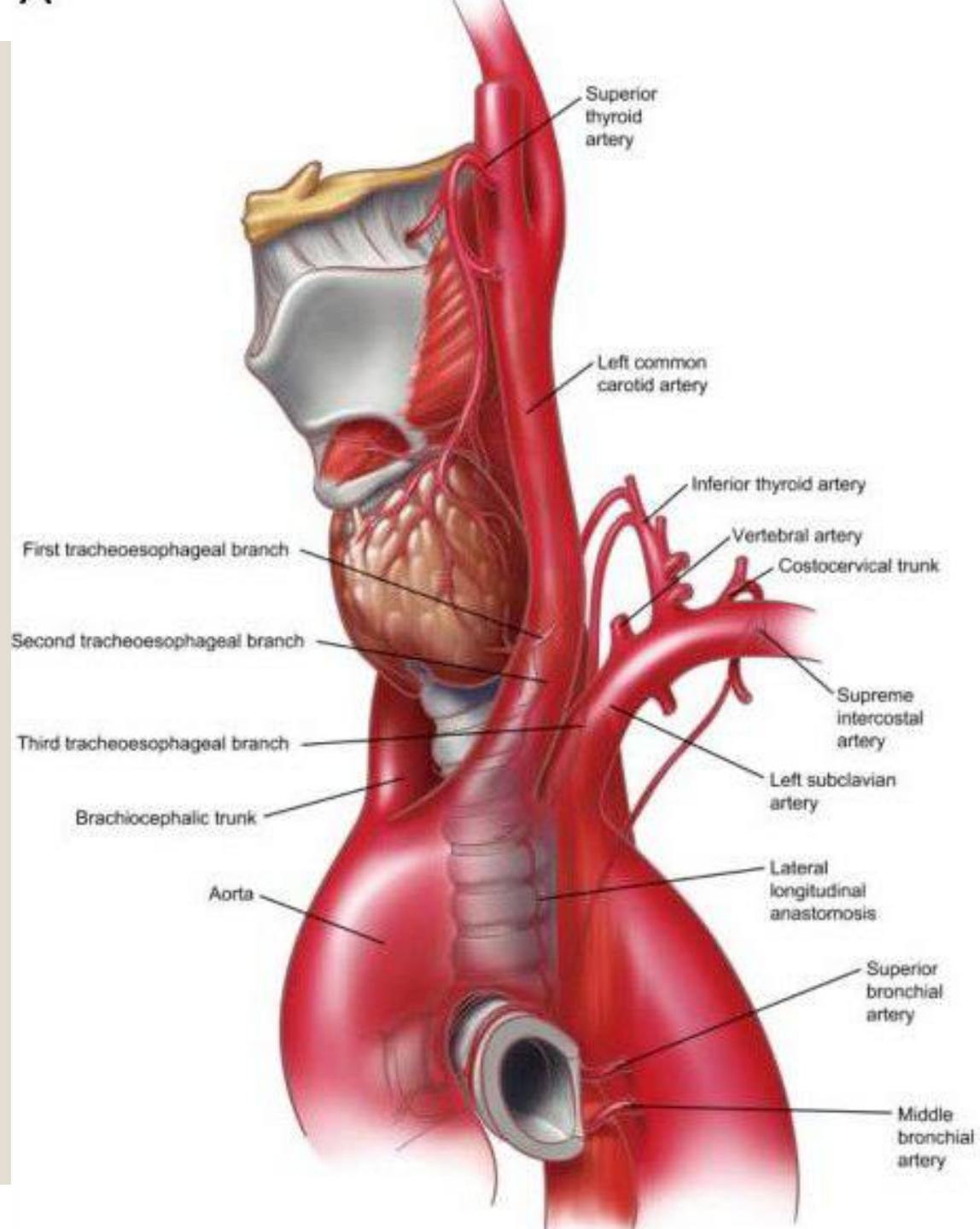


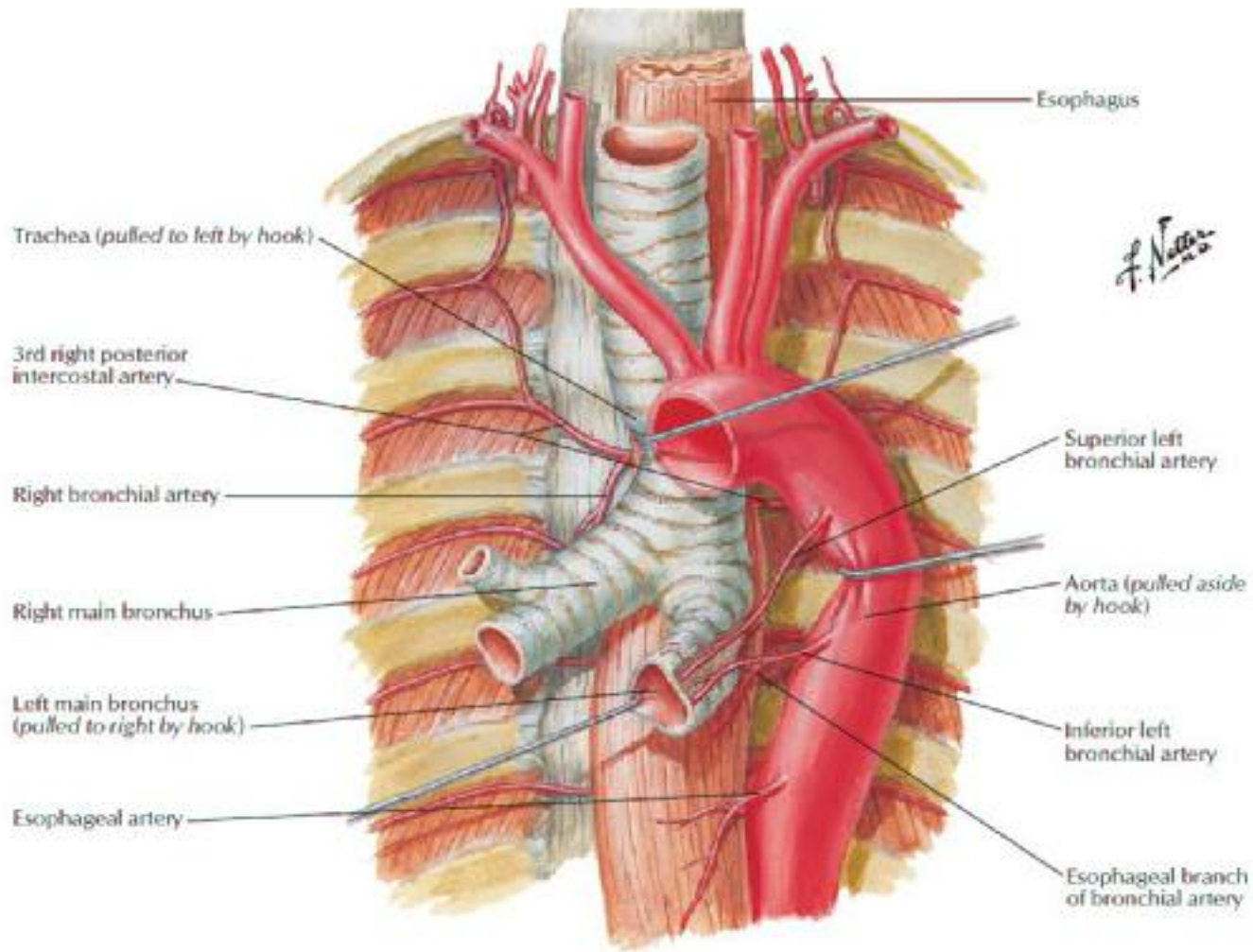
Blood Supply of the Trachea

The upper two thirds of the trachea: are supplied by:

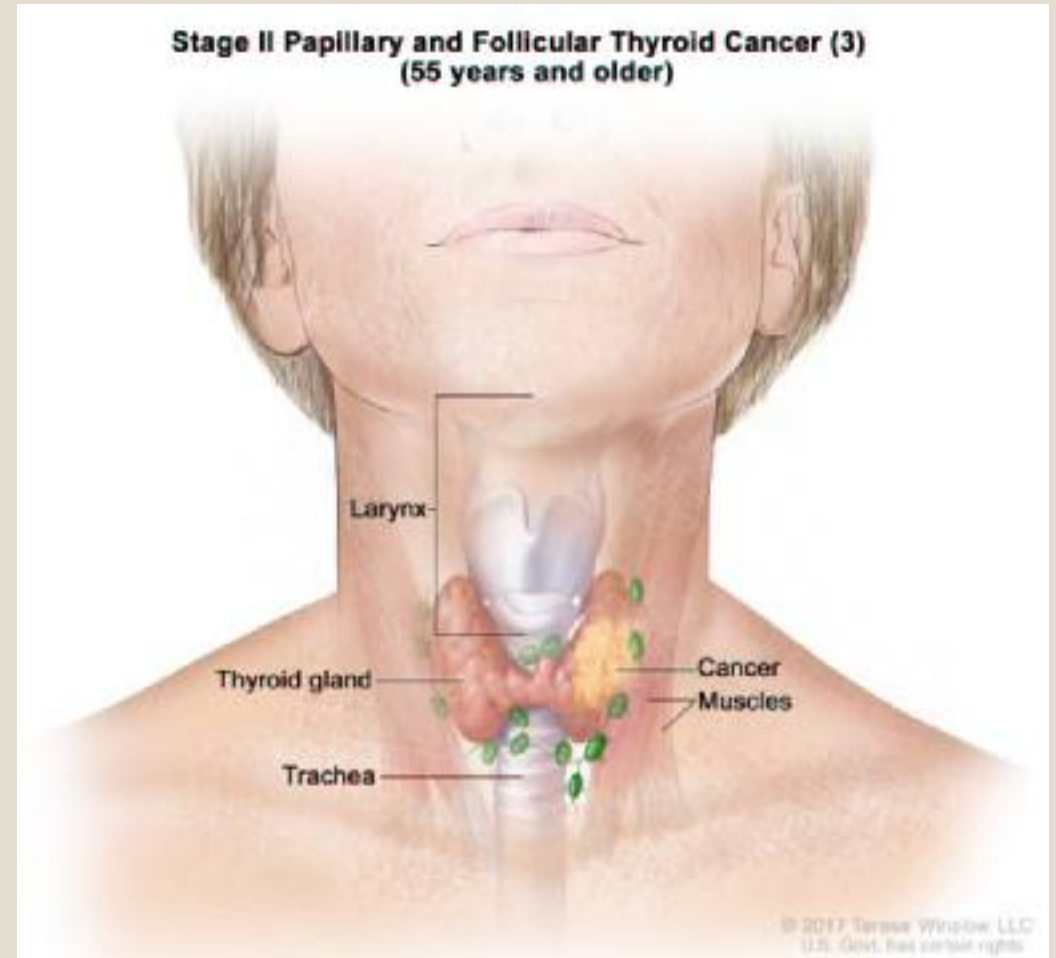
The inferior thyroid arteries (Main blood supply of the trachea)
(Inferior Thyroid Artery arises from Thyrocervical Trunk which
arises from 1st Part of Subclavian Artery)

The lower one third is supplied by the bronchial arteries.
(The bronchial arteries originate from the descending thoracic
aorta)





There are most commonly **3 main bronchial arteries**, one right and two left.



Lymph Drainage of the Trachea:

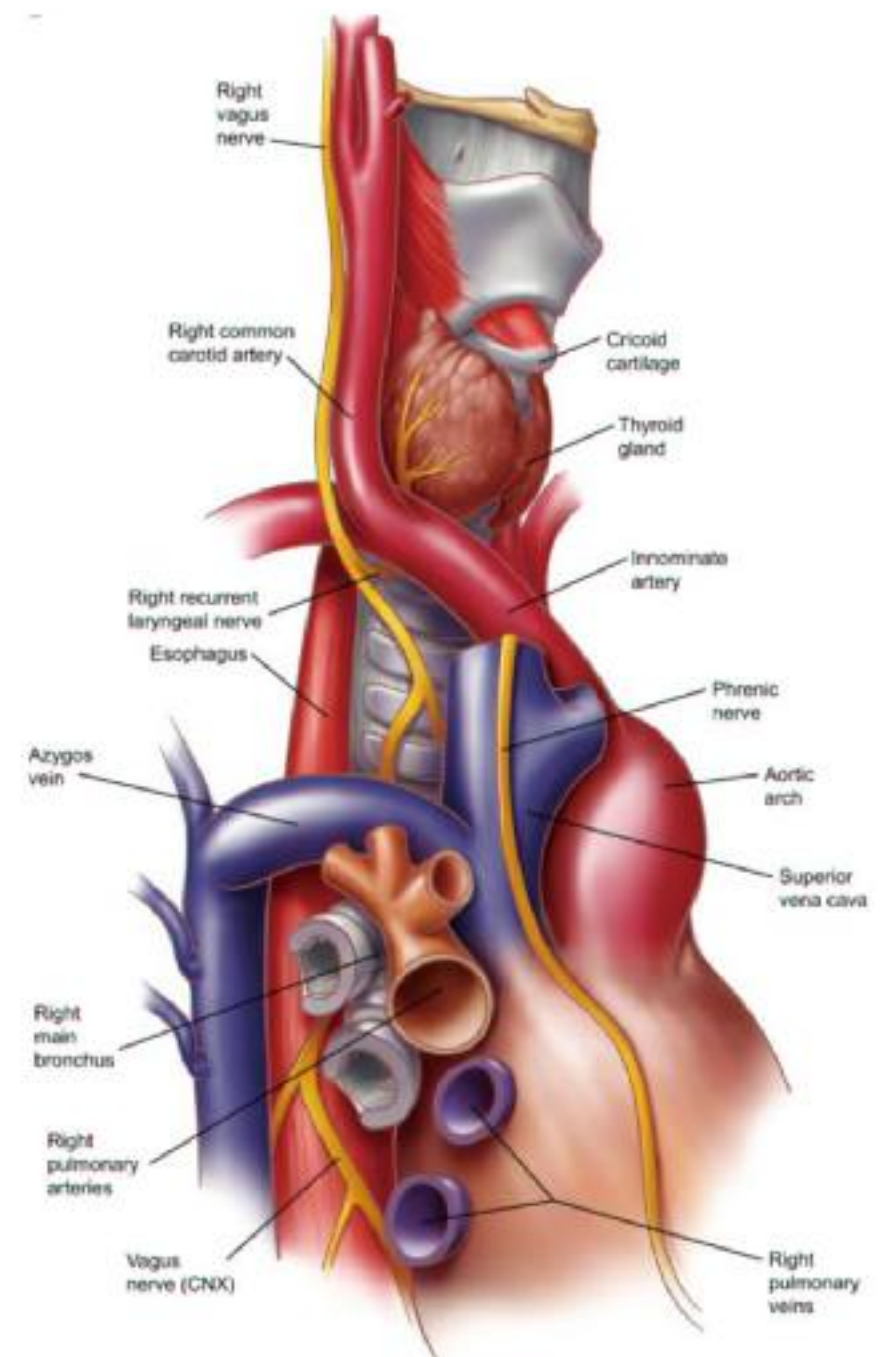
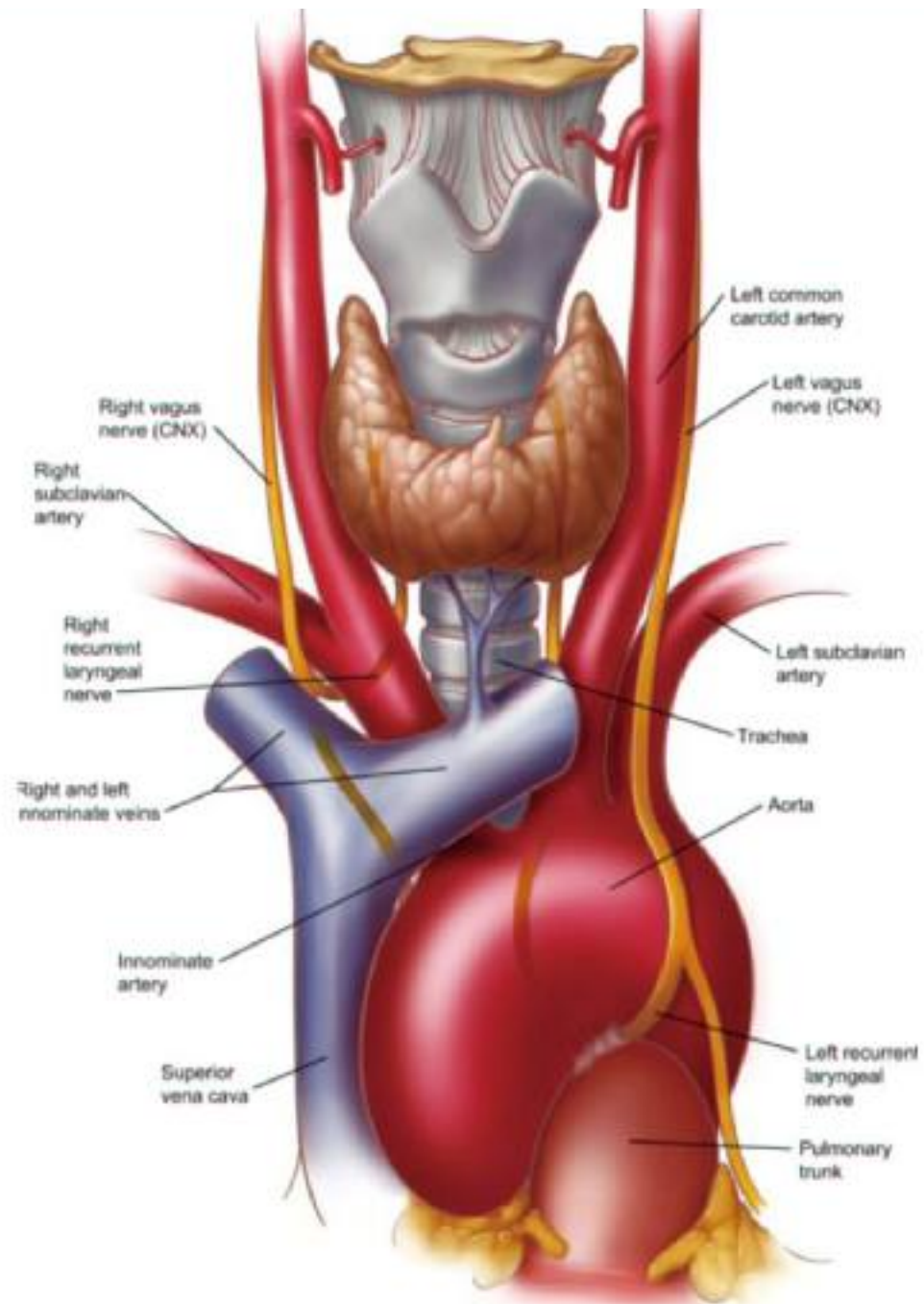
The pretracheal and paratracheal lymph nodes.
The deep cervical nodes.

Nerve Supply of the Trachea

The trachea receives sensory and motor innervation from the **recurrent laryngeal nerves**.

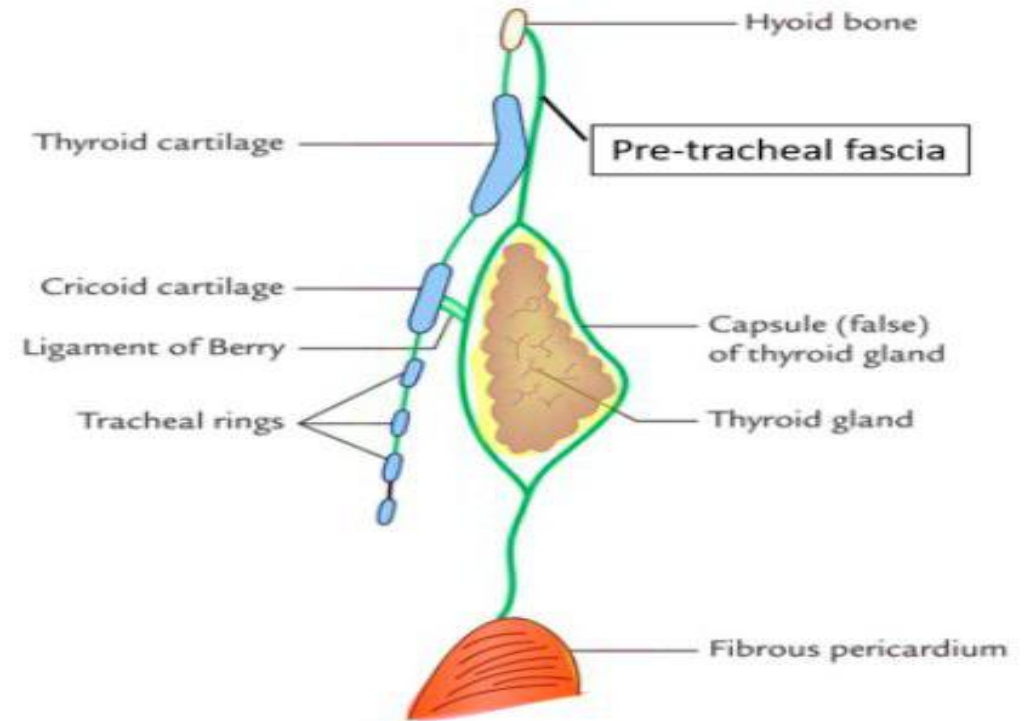
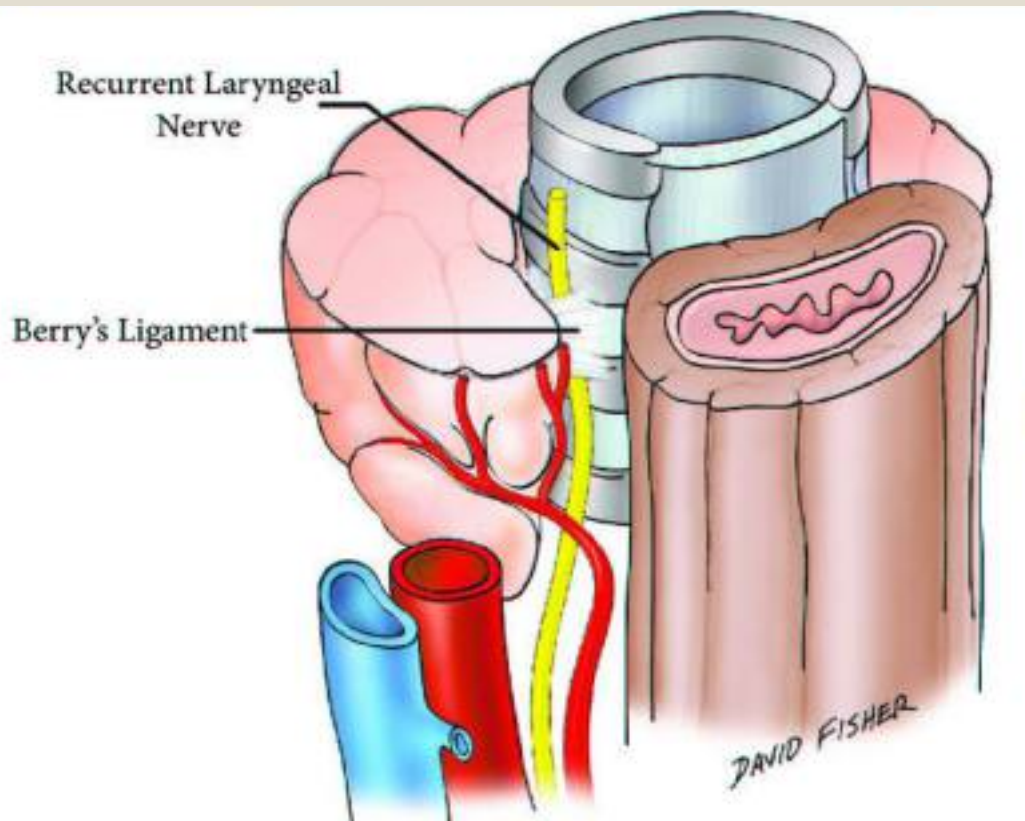
The two nerves that are branches of the vagus nerves.

(The **left** recurrent laryngeal nerve hooks under the **arch of aorta**, and the **right** recurrent laryngeal nerve hooks under the **right subclavian artery**)



Why thyroid gland (mass) moves with deglutition (swallowing) during clinical examination of thyroid gland?

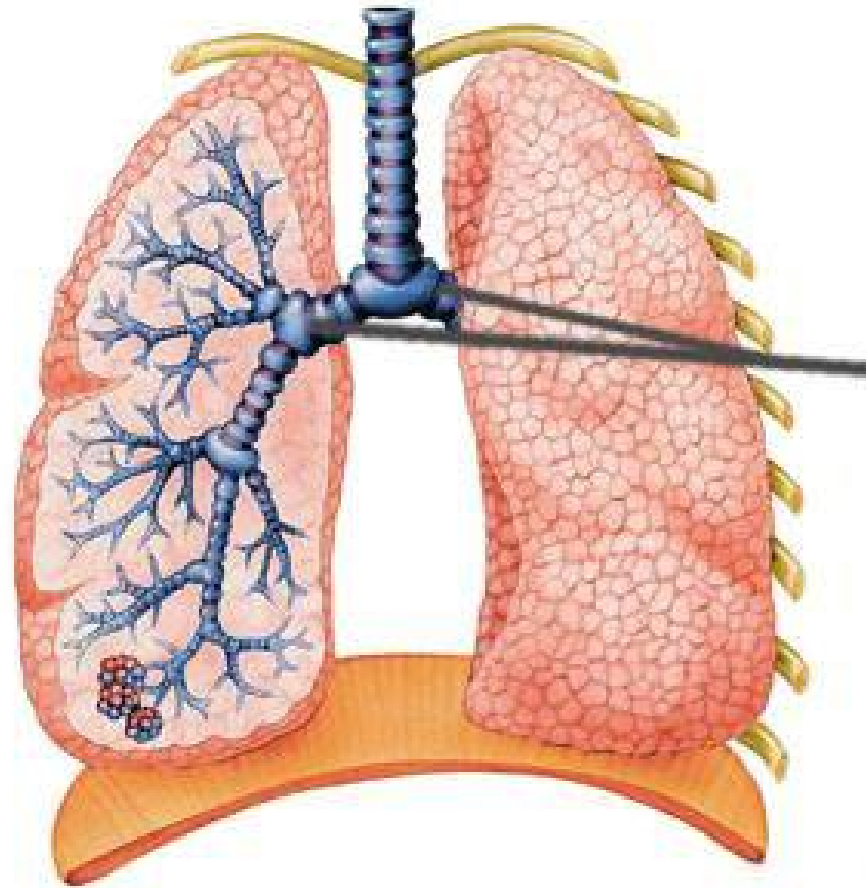
“While examining the thyroid gland, you ask the patient to **swallow (drink) amount of water** in a cup, during **inspection and palpation** of thyroid gland, in order to know if the neck mass is from thyroid gland or not”.



Thyroid gland moves up and down during deglutition

The pretracheal fascia which forms the false capsule of thyroid gland is thickened posteriorly to form the suspensory ligament of Berry. The ligament connects the medial surface of lateral lobes of thyroid gland to cricoid cartilage. Therefore, the gland moves up and down with larynx during deglutition.

The Bronchi

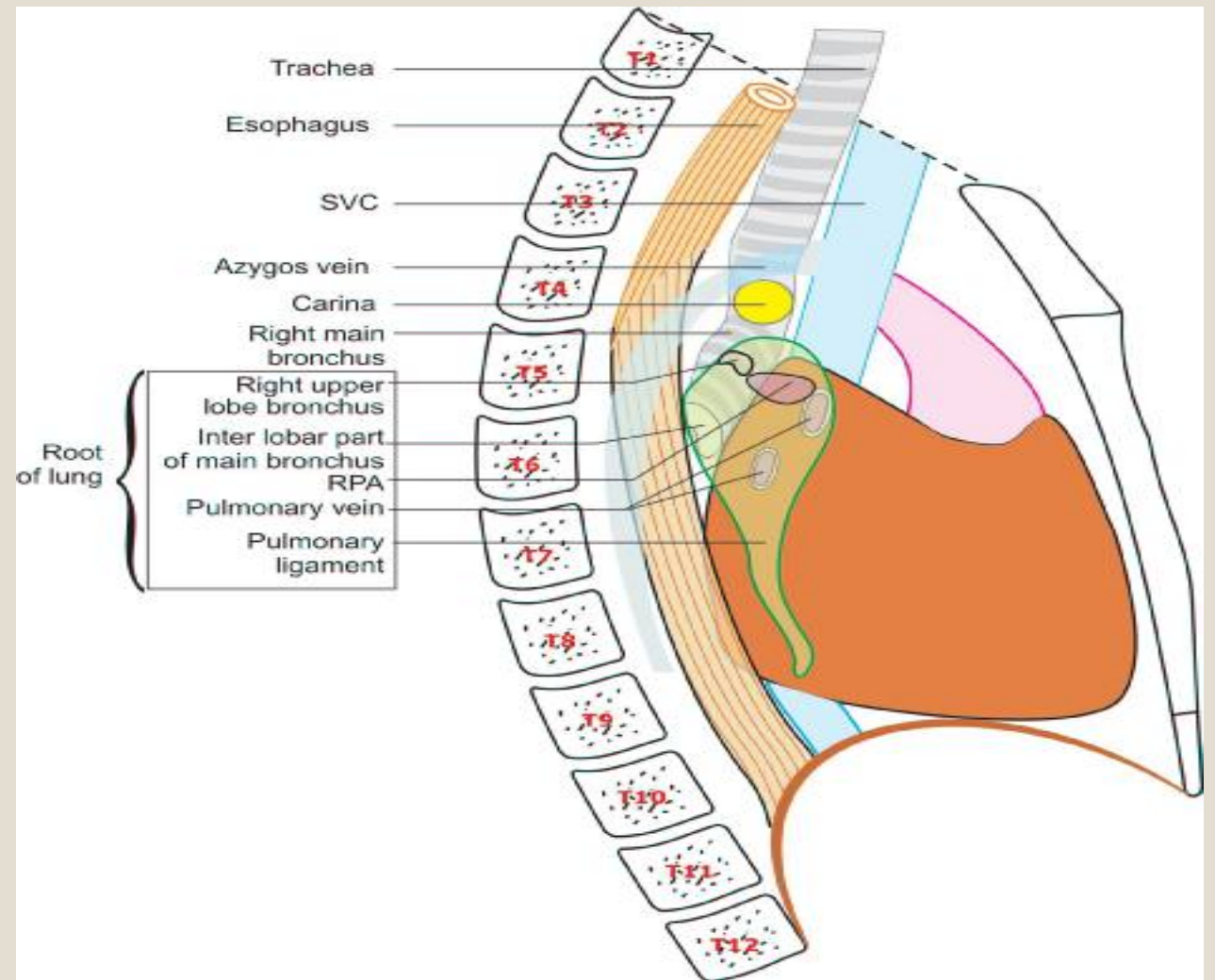


Bronchi

The Bronchi

At the level of the sternal angle, the trachea bifurcates into the right and left main bronchi **tracheal carina**

Each main bronchus undergo further branching to produce the **secondary bronchi**. Each secondary bronchus supplies a lobe of the lung.



The Bronchi

The **right** main (primary) bronchus divides into:

3 lobar bronchi (secondary bronchi).

The **left** main (primary) bronchus divides into:

2 lobar bronchi (secondary bronchi).

The lobar bronchi divide further into segmental bronchi
(**tertiary bronchi**)

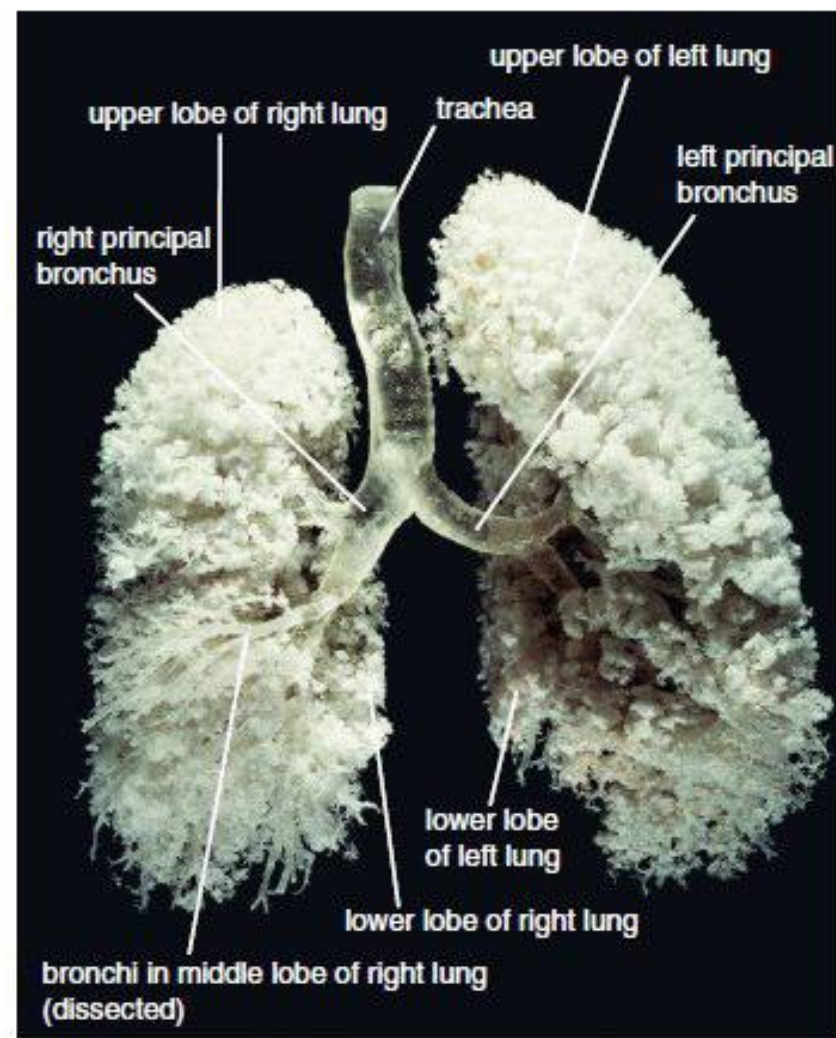
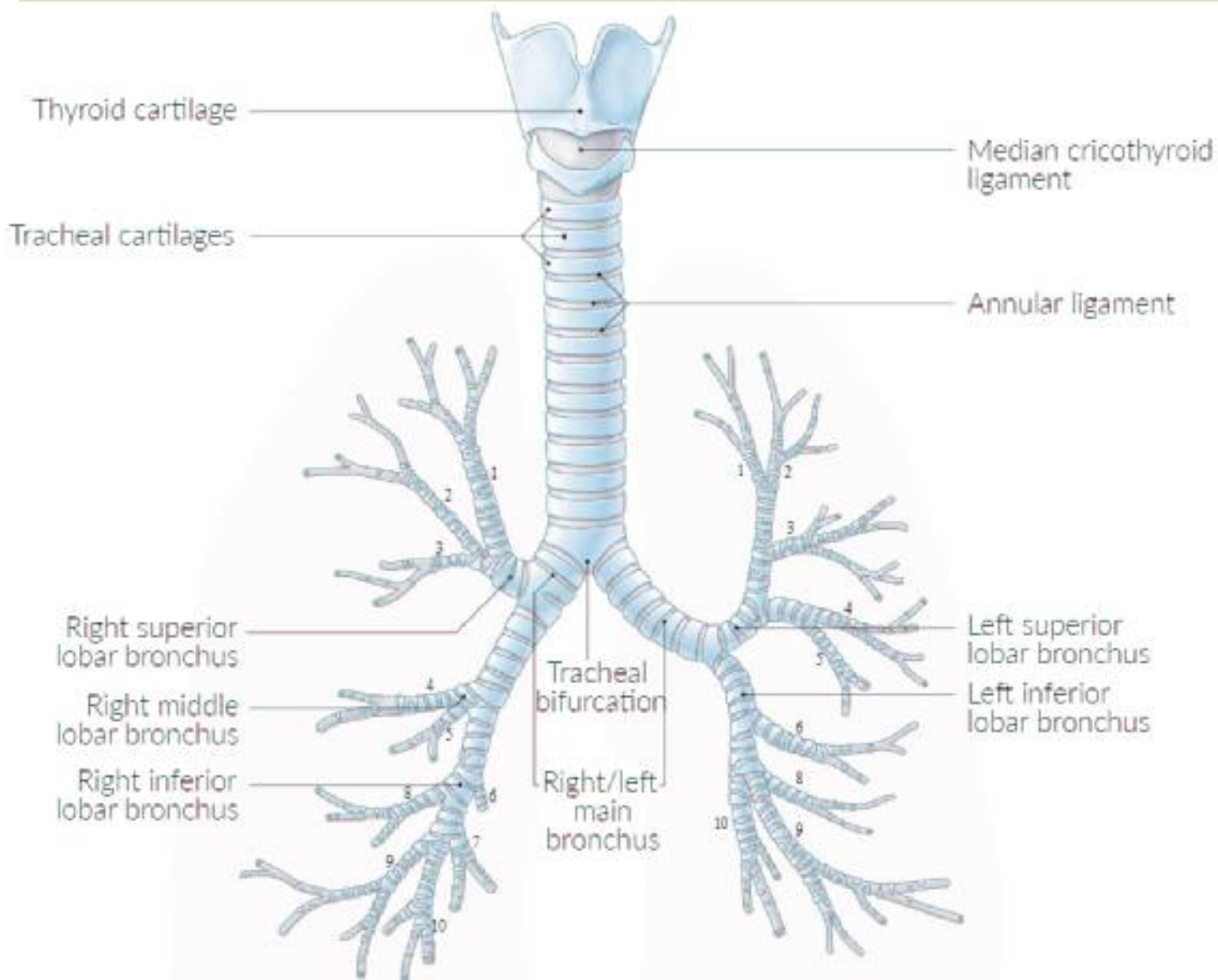
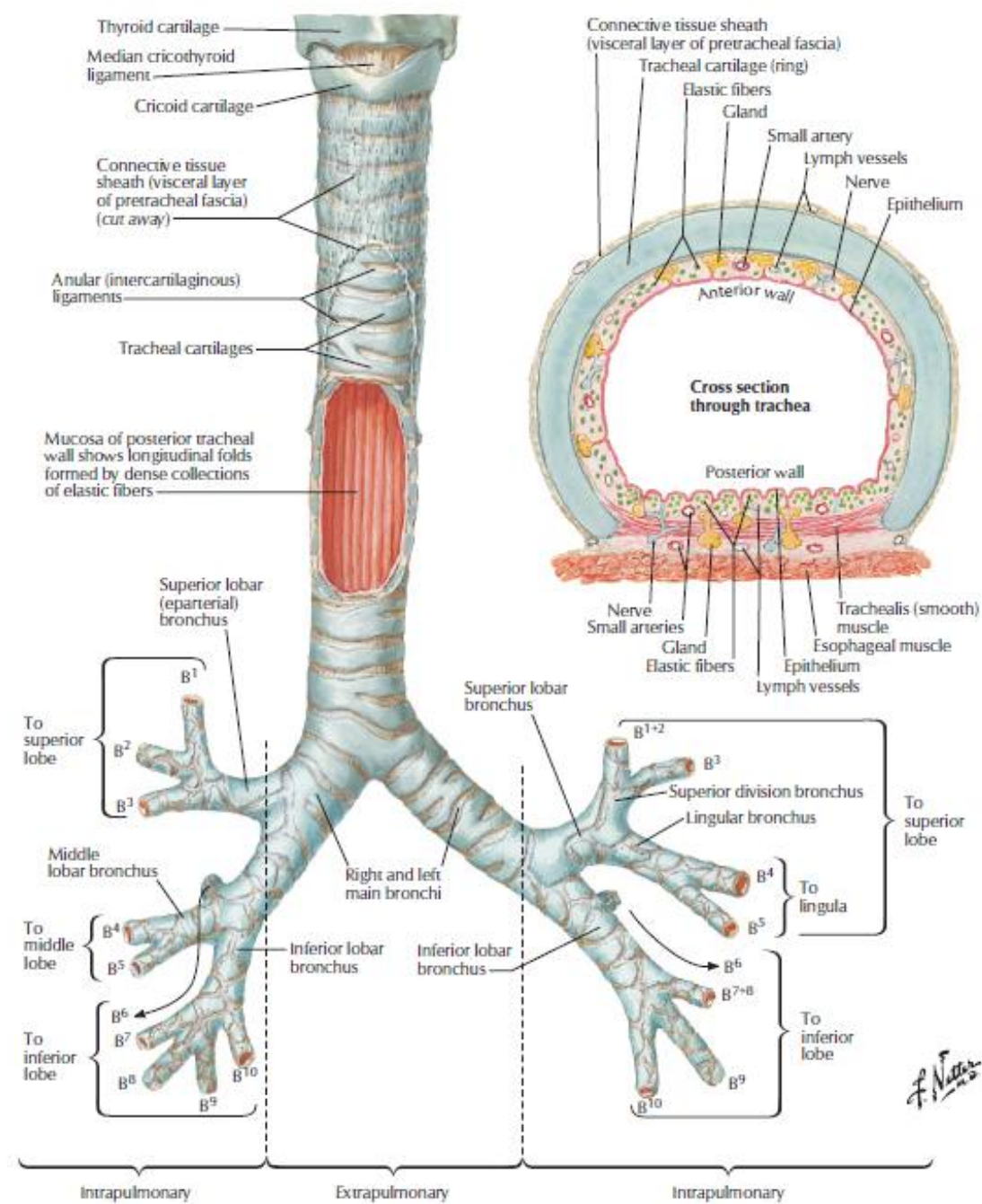
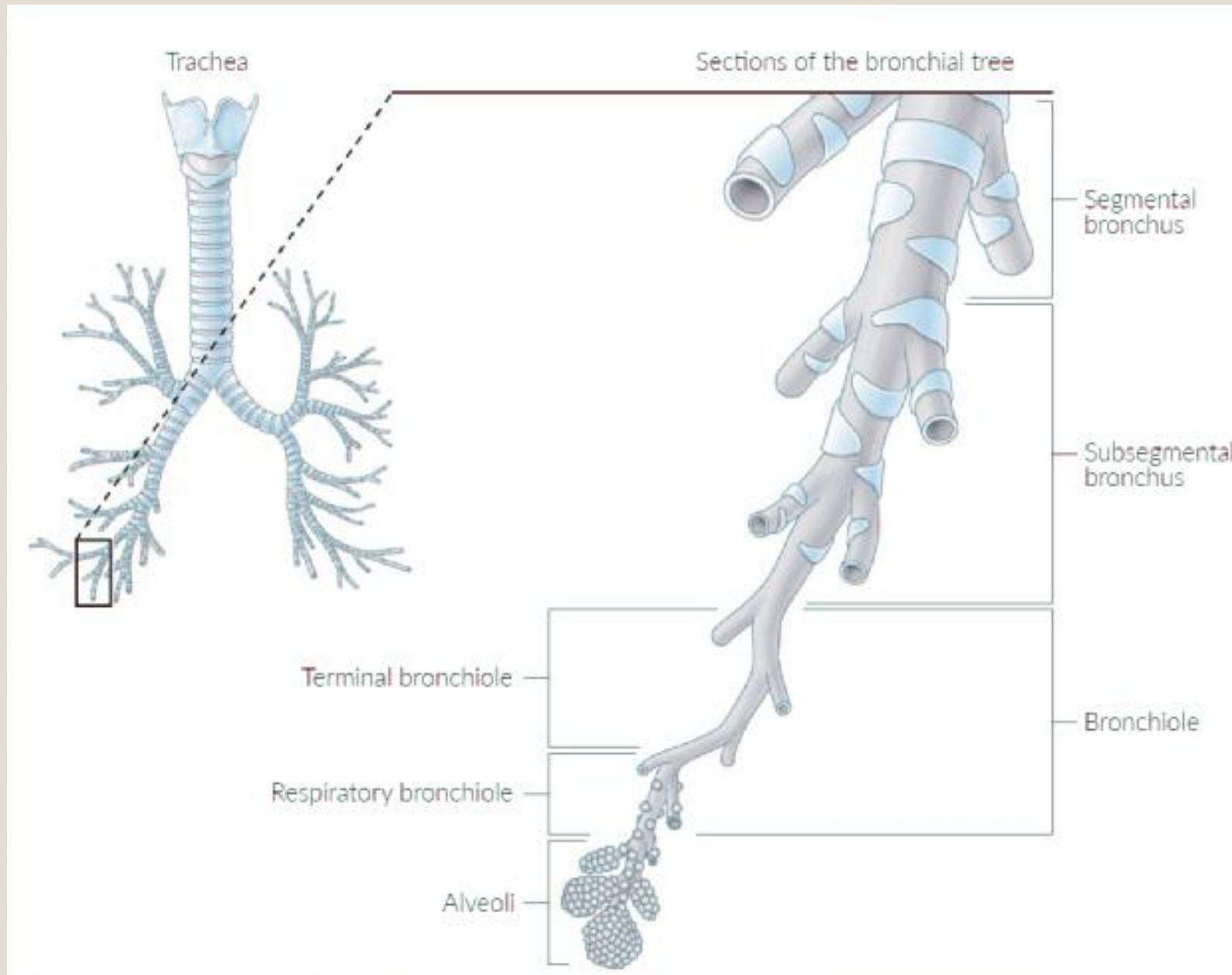


FIGURE 3.19 A plastinized specimen of an adult trachea, principal bronchi, and lung; some of the lung tissue has been dissected to reveal the larger bronchi. Note that the right main bronchus is wider and a more direct continuation of the trachea than the left main bronchus.





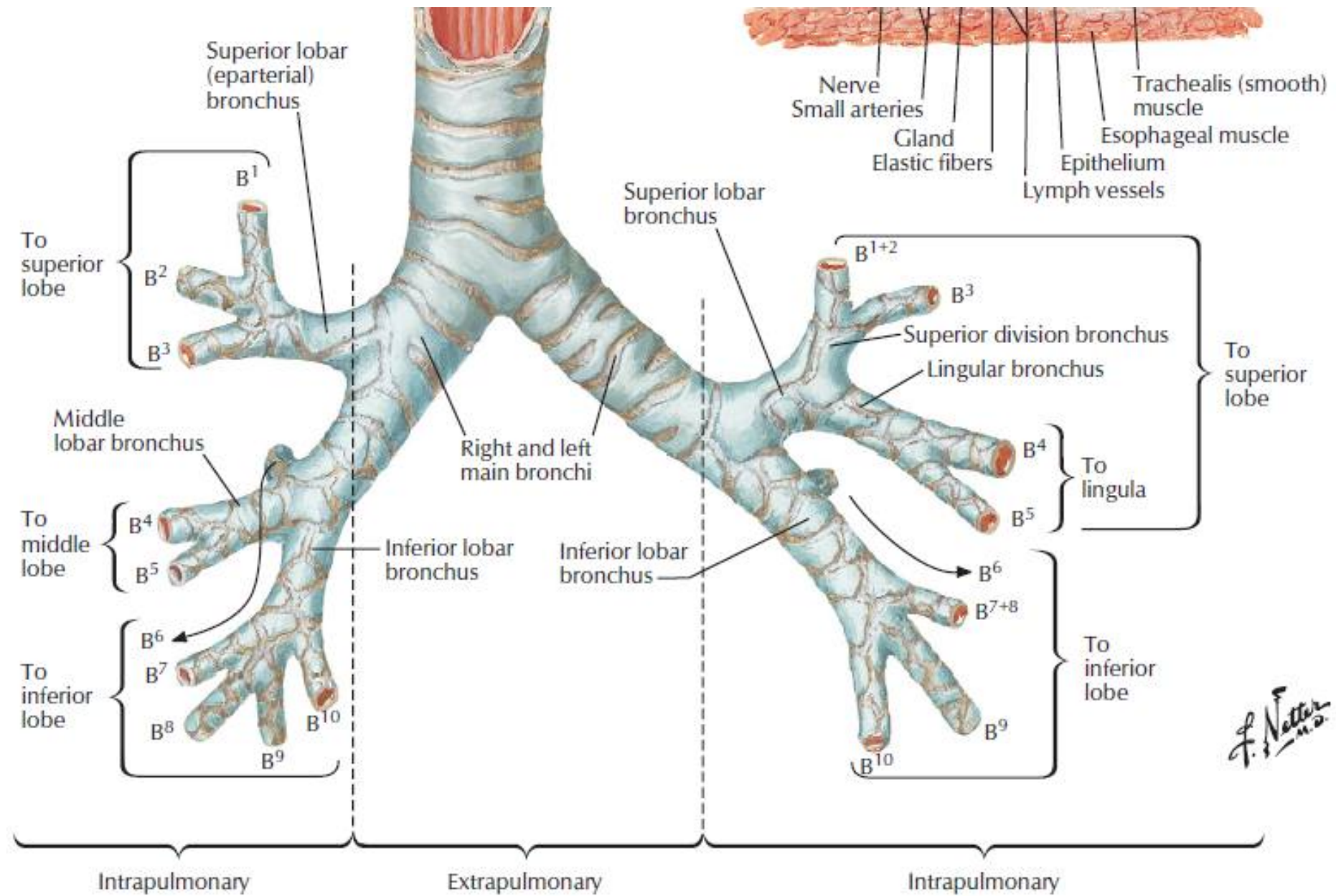
Principal Bronchi – The right bronchus

The right principal (main) bronchus is **wider, shorter, and more vertical than the left**

The right principal bronchus is about 1 inch long.

Before entering the hilum of the right lung, the principal bronchus gives off the **superior lobar bronchus**

On entering the hilum, it divides into a **middle** and an **inferior lobar bronchus**

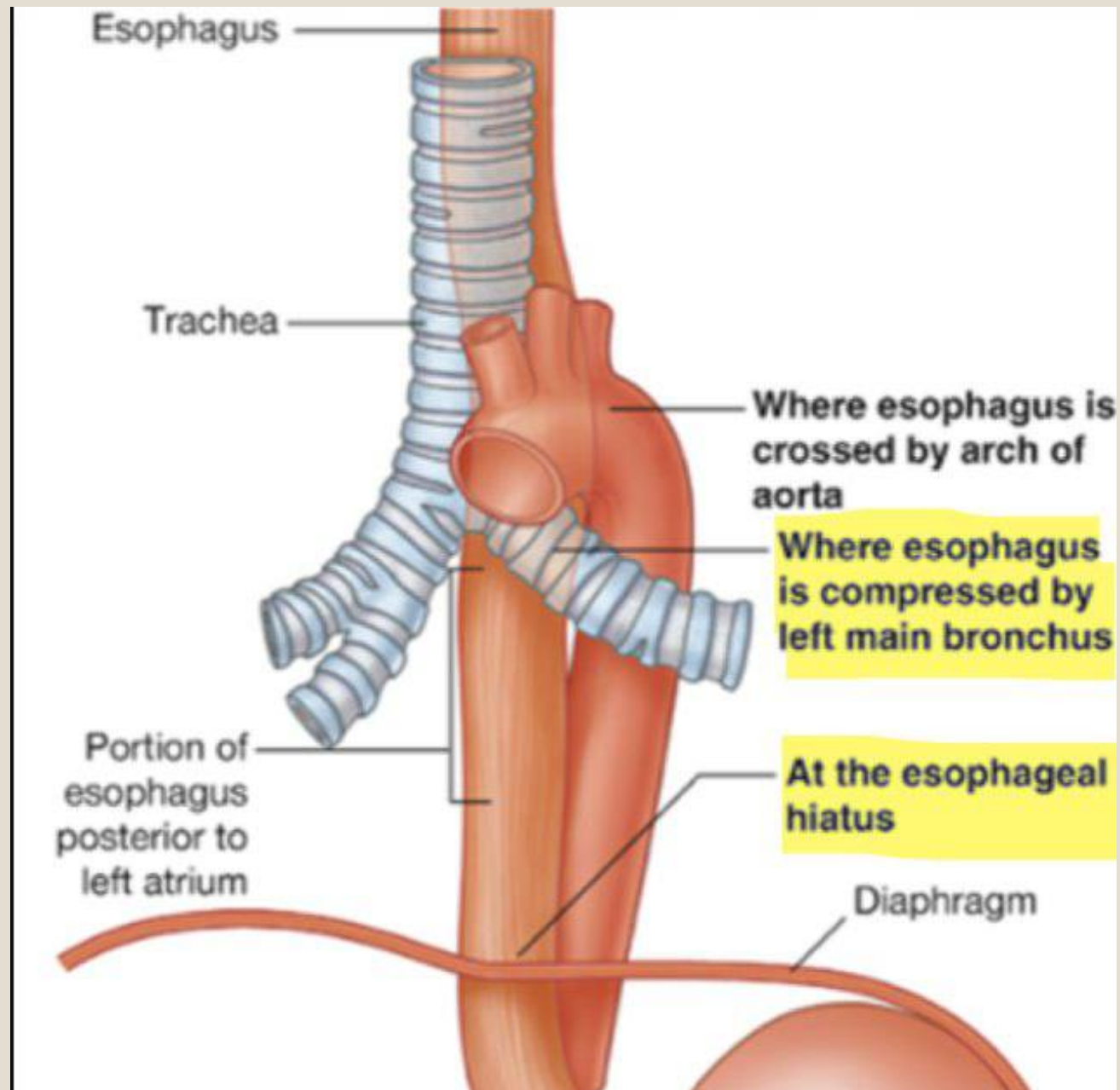


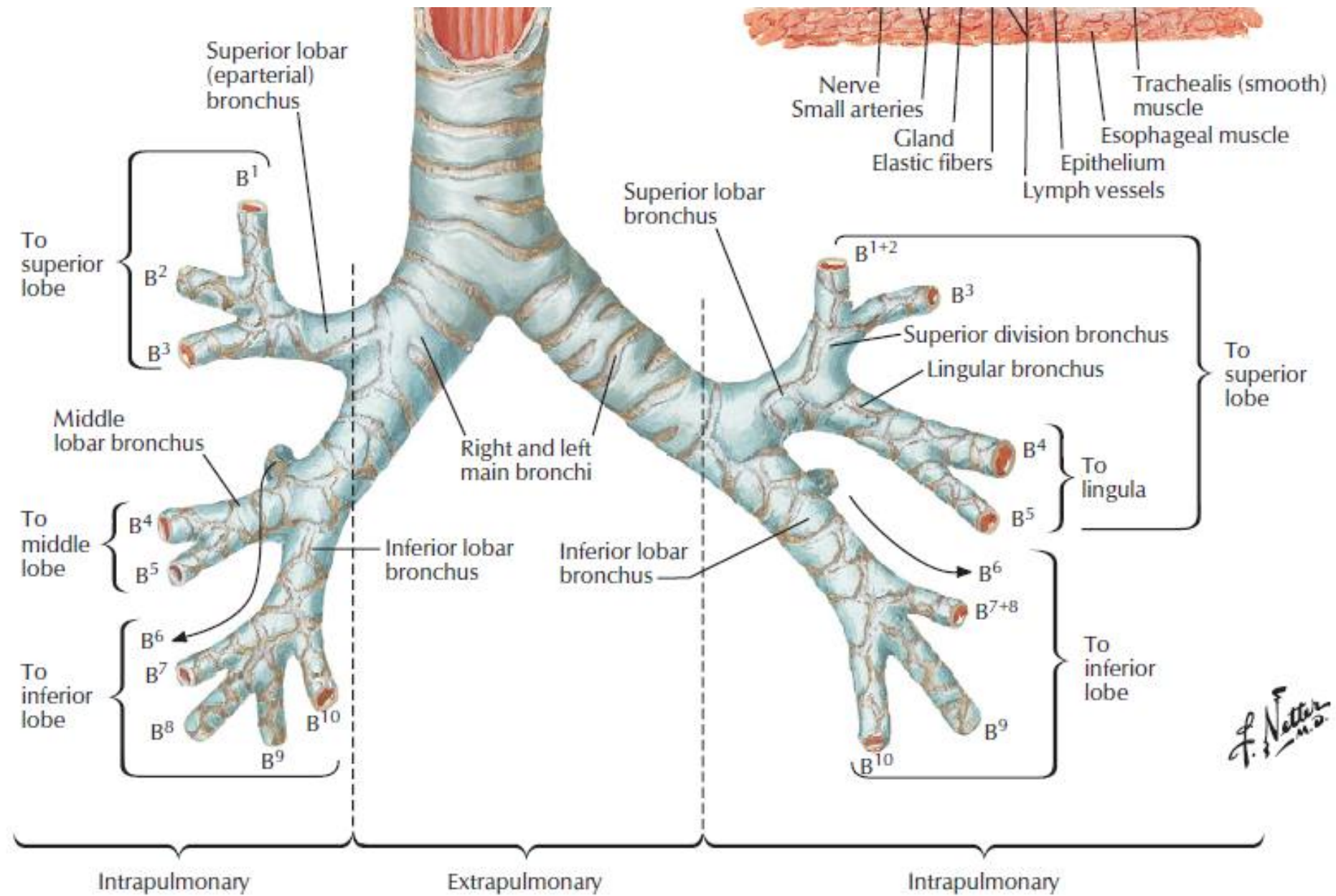
Principal Bronchi – The Left Bronchus

The left principal (main) bronchus is narrower, longer, and more horizontal than the right and is about 2 in. (5 cm) long.

It passes to the left below the arch of the aorta and in front of the esophagus.

On entering the hilum of the left lung, the principal bronchus divides into a superior and an inferior lobar bronchus.





Clinical Relevance - Inhaled Foreign Bodies

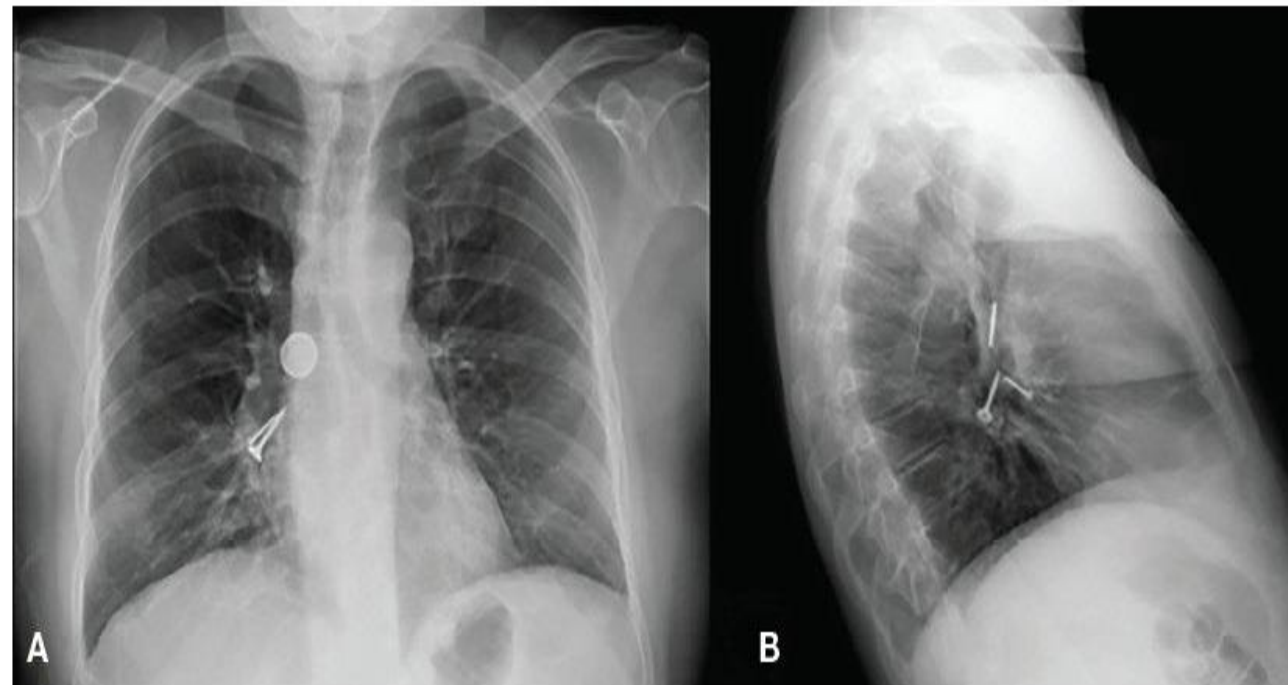
Inhalation of foreign bodies into the lower respiratory tract is common, especially in children.

Because the right bronchus is the wider and more direct continuation of the trachea, **foreign bodies tend to enter the right instead of the left bronchus.**

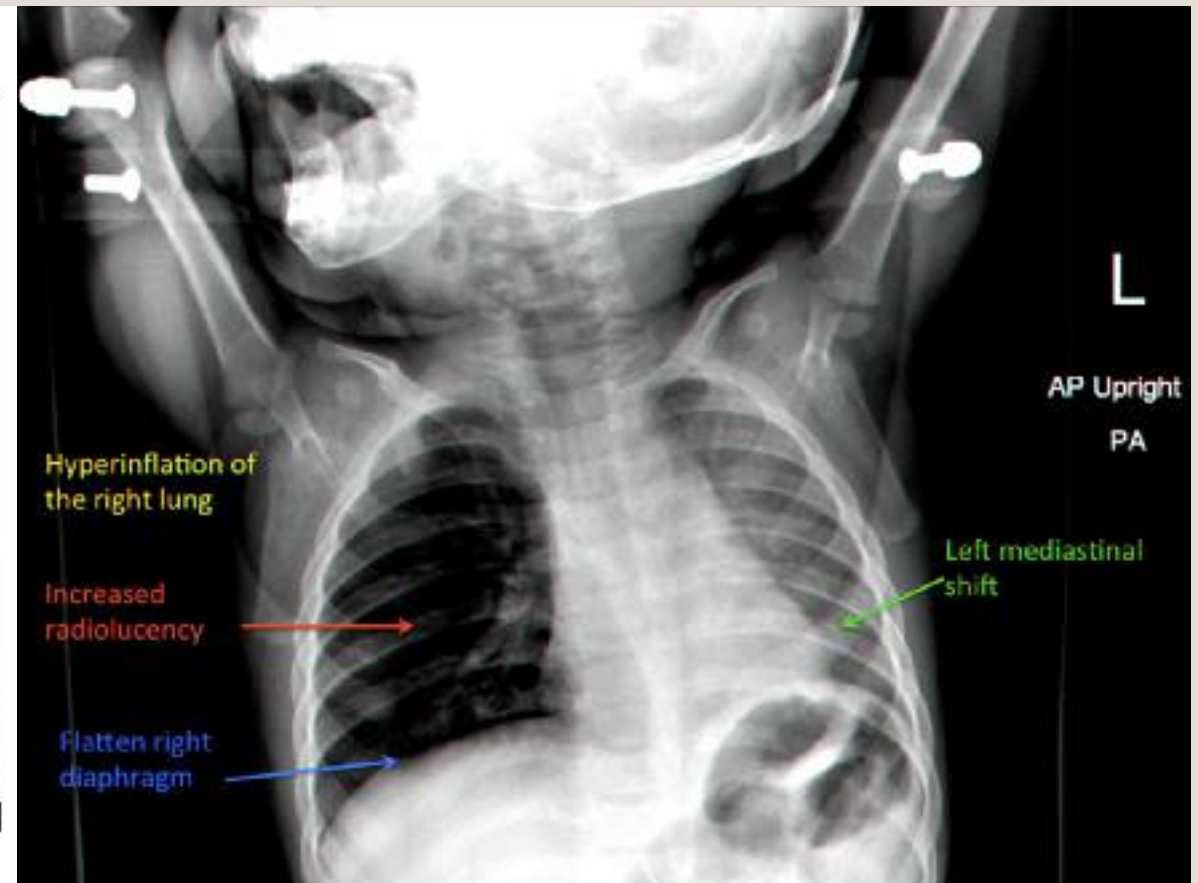
From there, they usually pass into the middle or lower lobe bronchi.
This may cause recurrent chest infections.

Foreign body aspiration can be treated through foreign body extraction **by rigid bronchoscopy.**

FIGURES 1A and 1B Chest Imaging, Posteroanterior and Lateral Views



(A) Rounded coinlike metallic density at proximal right main stem bronchus; (B) 2 additional metallic objects distally at the right main stem bronchus.



Unilateral hyperinflation (more dark area indicates more air trapping due to inhaled foreign body in the right side) is characteristic of foreign body aspiration that leads to recurrent chest infection in pediatric age from **6 months- 3 years** of age.

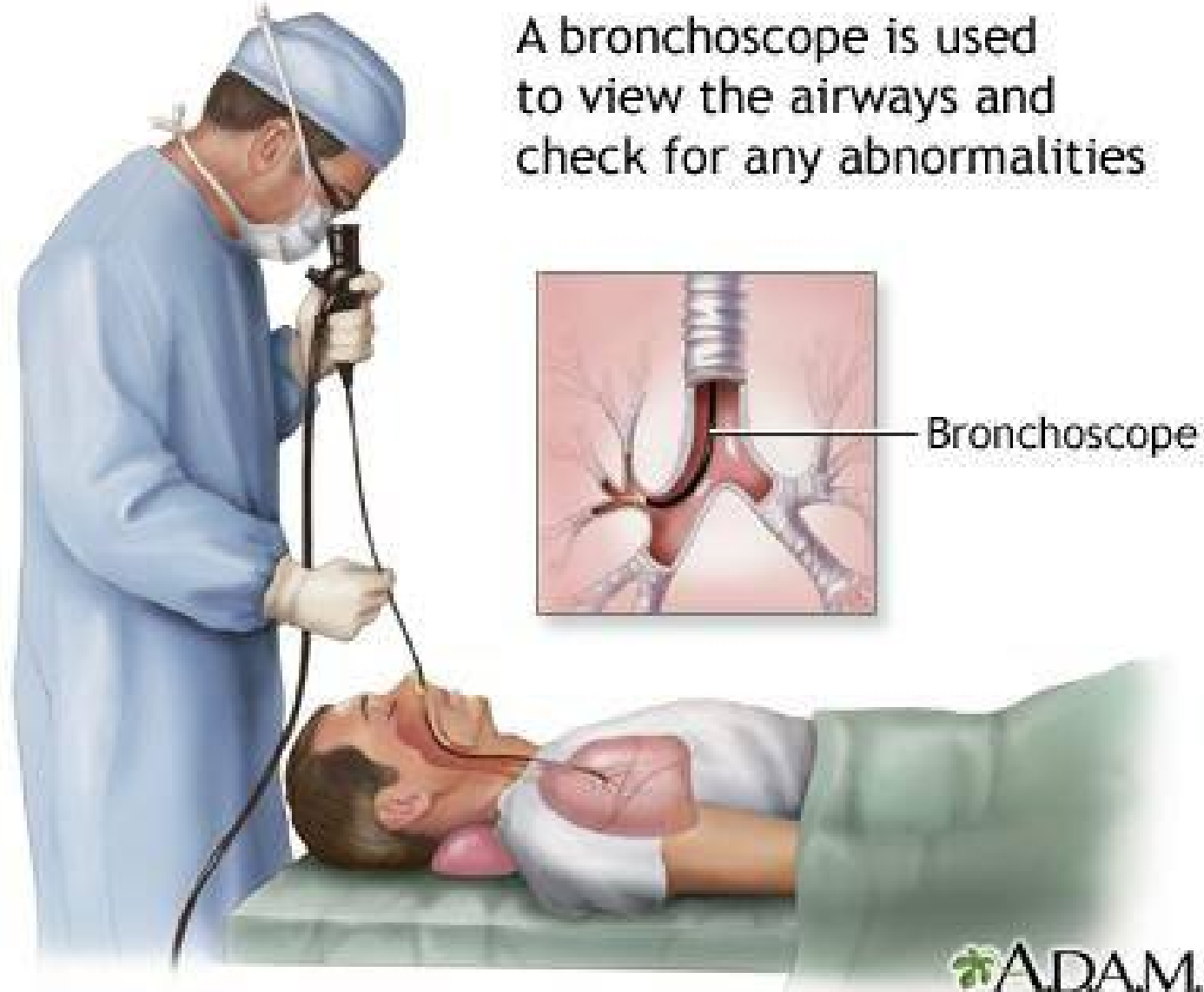
Clinical Relevance - Bronchoscopy

Bronchoscopy enables a physician to examine the interior of the trachea; its bifurcation, called the **carina**.

With experience, it is possible to examine the interior of the lobar bronchi and the beginning of the first segmental bronchi.

By means of this procedure, it is also possible to **obtain biopsy** specimens of mucous membrane and to **remove inhaled foreign bodies**.

A bronchoscope is used to view the airways and check for any abnormalities



Clinical Relevance - Bronchoscopy

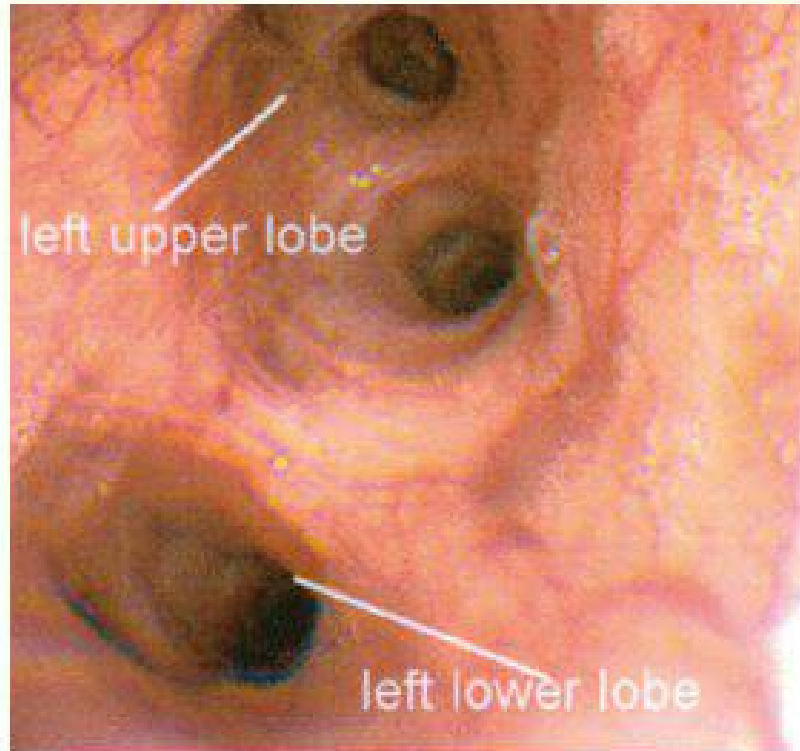


FIGURE 3.13 The interior of the left main bronchus as seen through an operating bronchoscope. The openings into the left upper lobe bronchus and its division and the left lower lobe bronchus are indicated. (Courtesy of E.D. Andersen.)



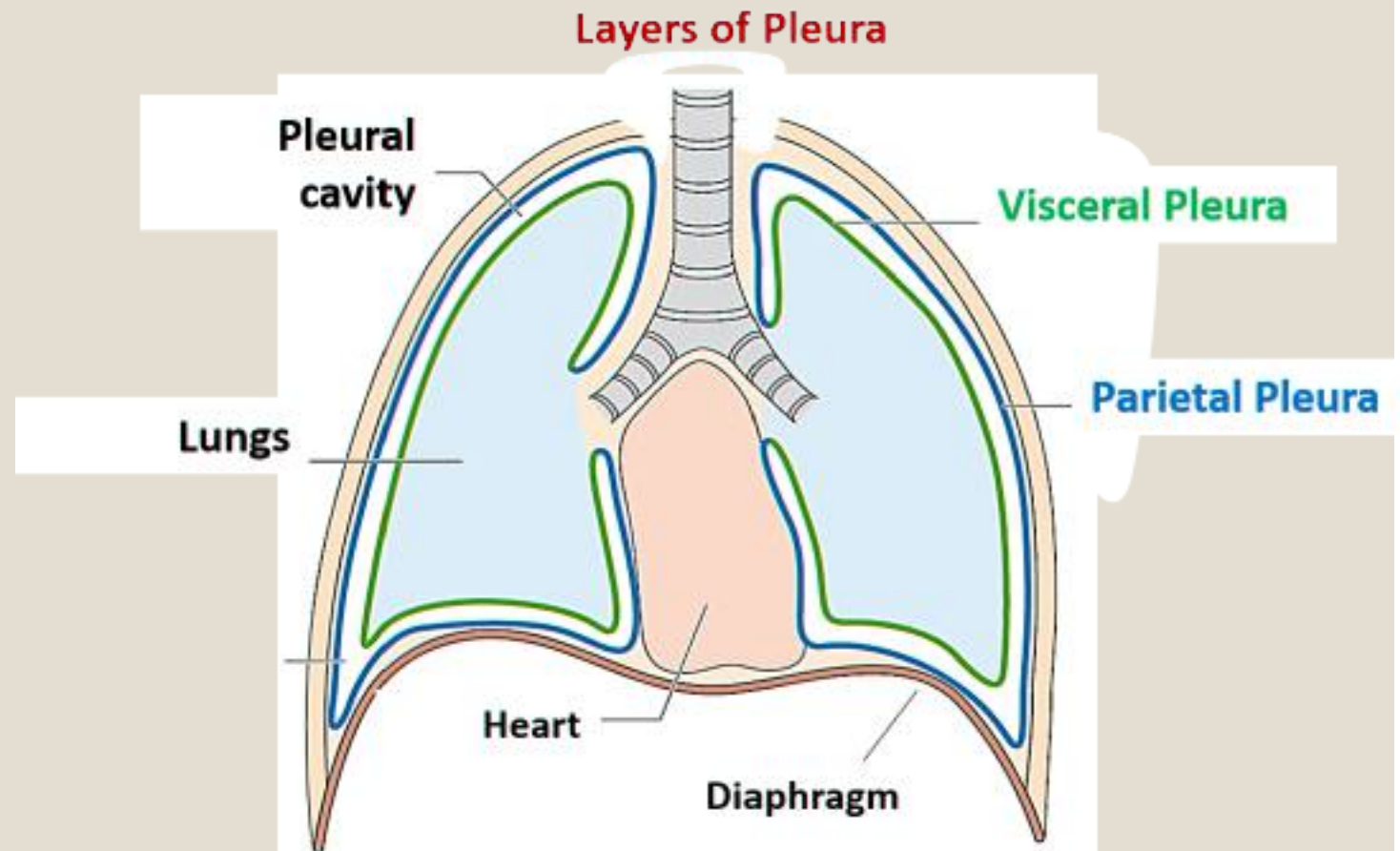
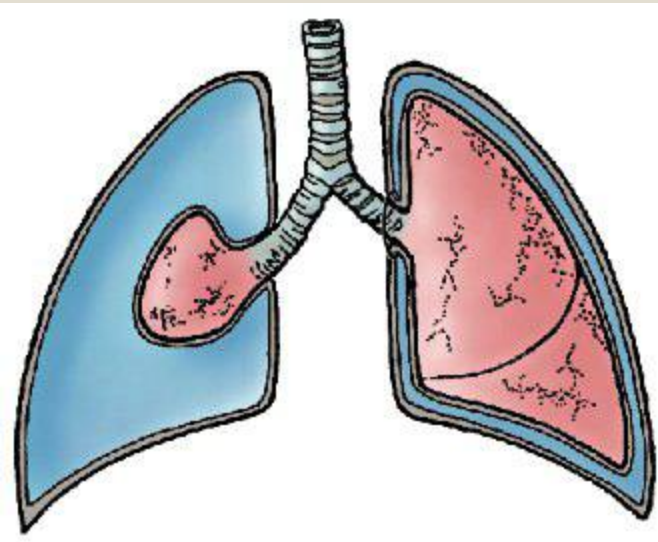
FIGURE 3.12 The bifurcation of the trachea as seen through an operating bronchoscope. Note the ridge of the carina in the center and the opening into the right main bronchus on the right, which is a more direct continuation of the trachea. (Courtesy of E.D. Andersen.)

Pleura

Fluid filled sac that surrounds the lung

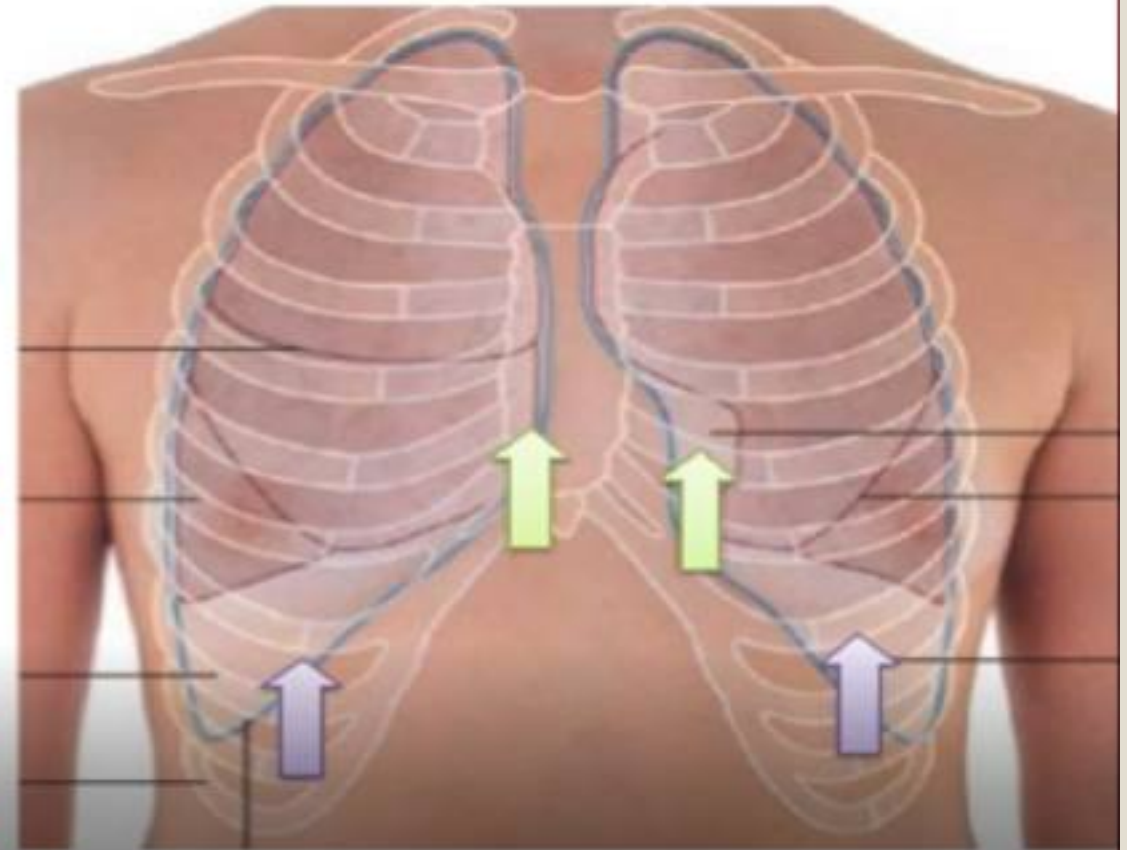
Function:

☒ **Friction between**
Parietal and visceral layers

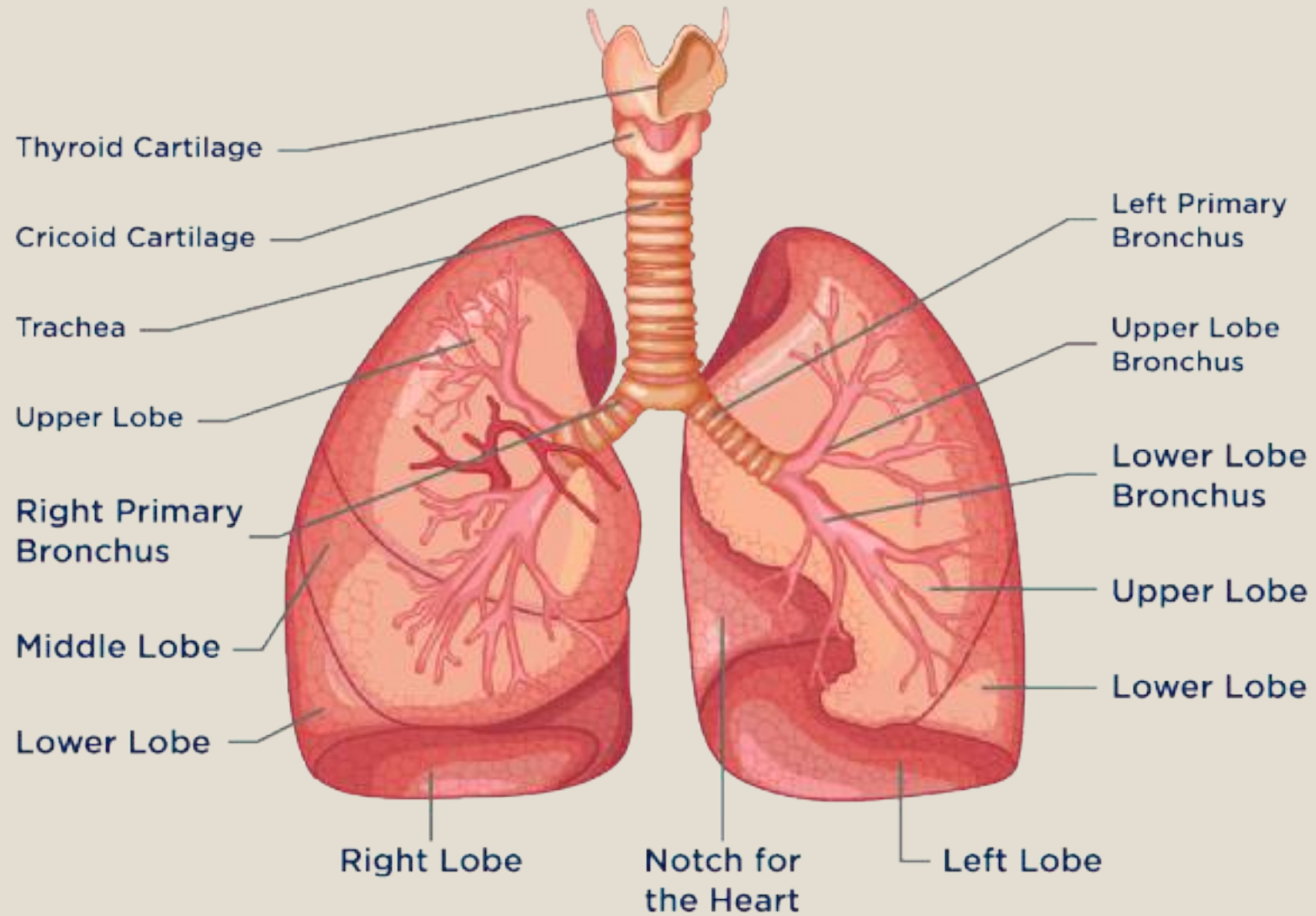


Pleural recess

- The lungs **do not** completely fill the anterior or posterior inferior regions of the pleural cavities
 - This results in recesses in which **two layers of parietal pleura become opposed.**
 - Expansion of the lungs into these spaces **usually occurs only during forced inspiration**
 - The recesses also provide potential spaces in which **fluids can collect and from which fluids can be aspirated.**
- 2
- 1- **costomediastinal recess**
 - 2- **costodaphragmatic recess**



Lungs

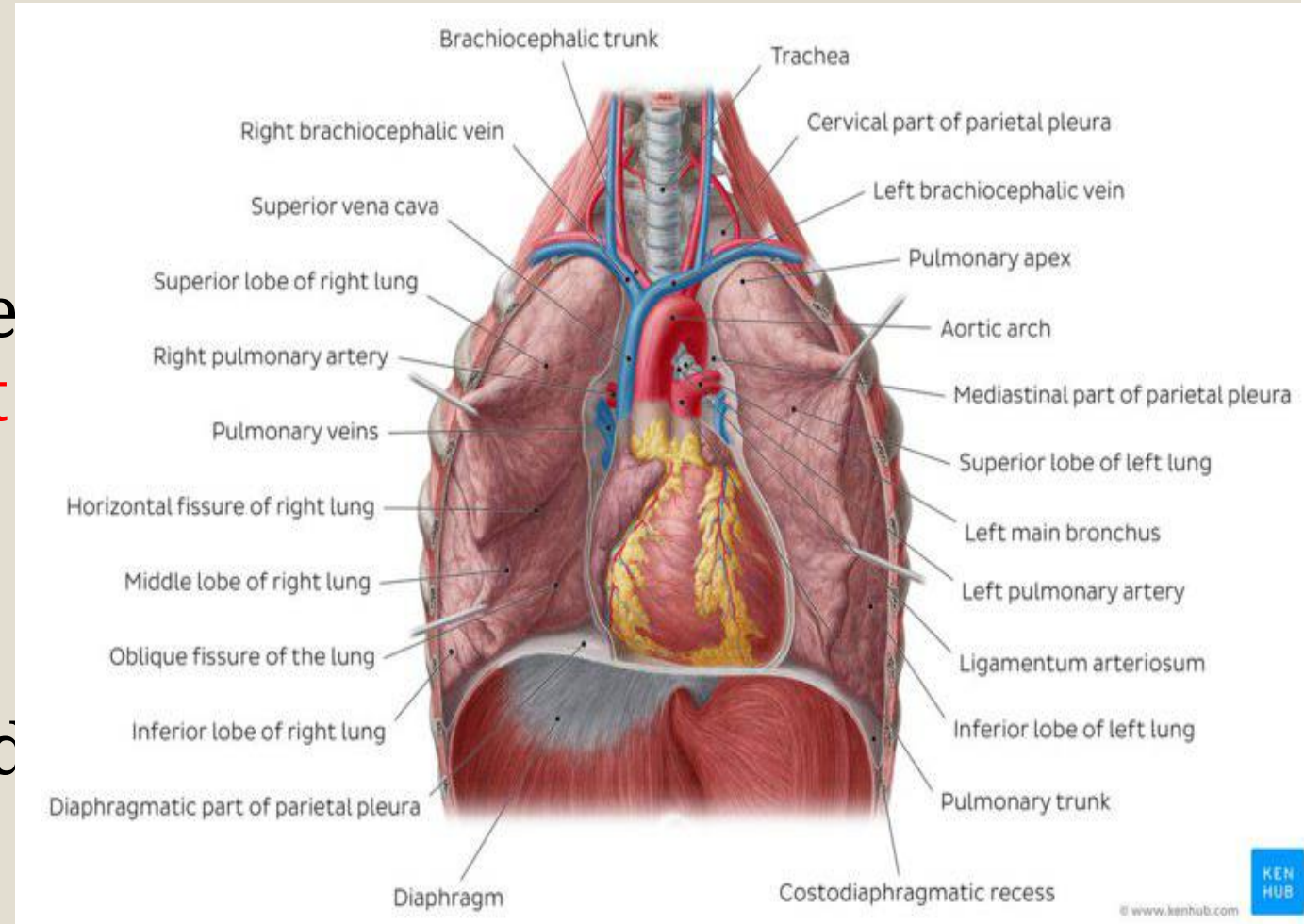


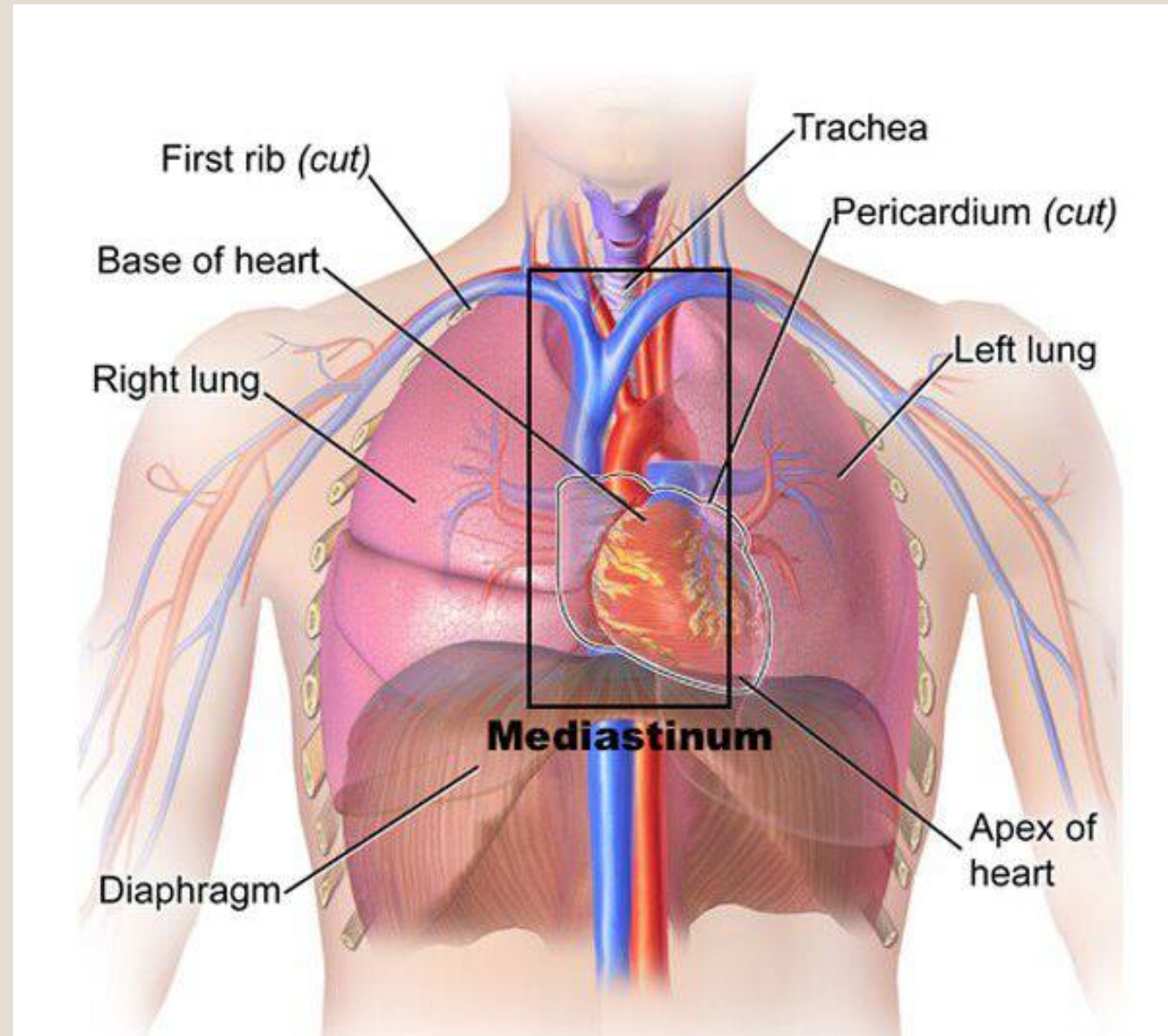
Lungs

The lungs are situated so that one lies **on each side of the mediastinum**

They are therefore separate from each other **by the heart and great vessels** and other structures in the mediastinum.

Each lung is **conical**, covered with **visceral pleura**, and suspended free in its own pleural cavity, being attached to the mediastinum only by



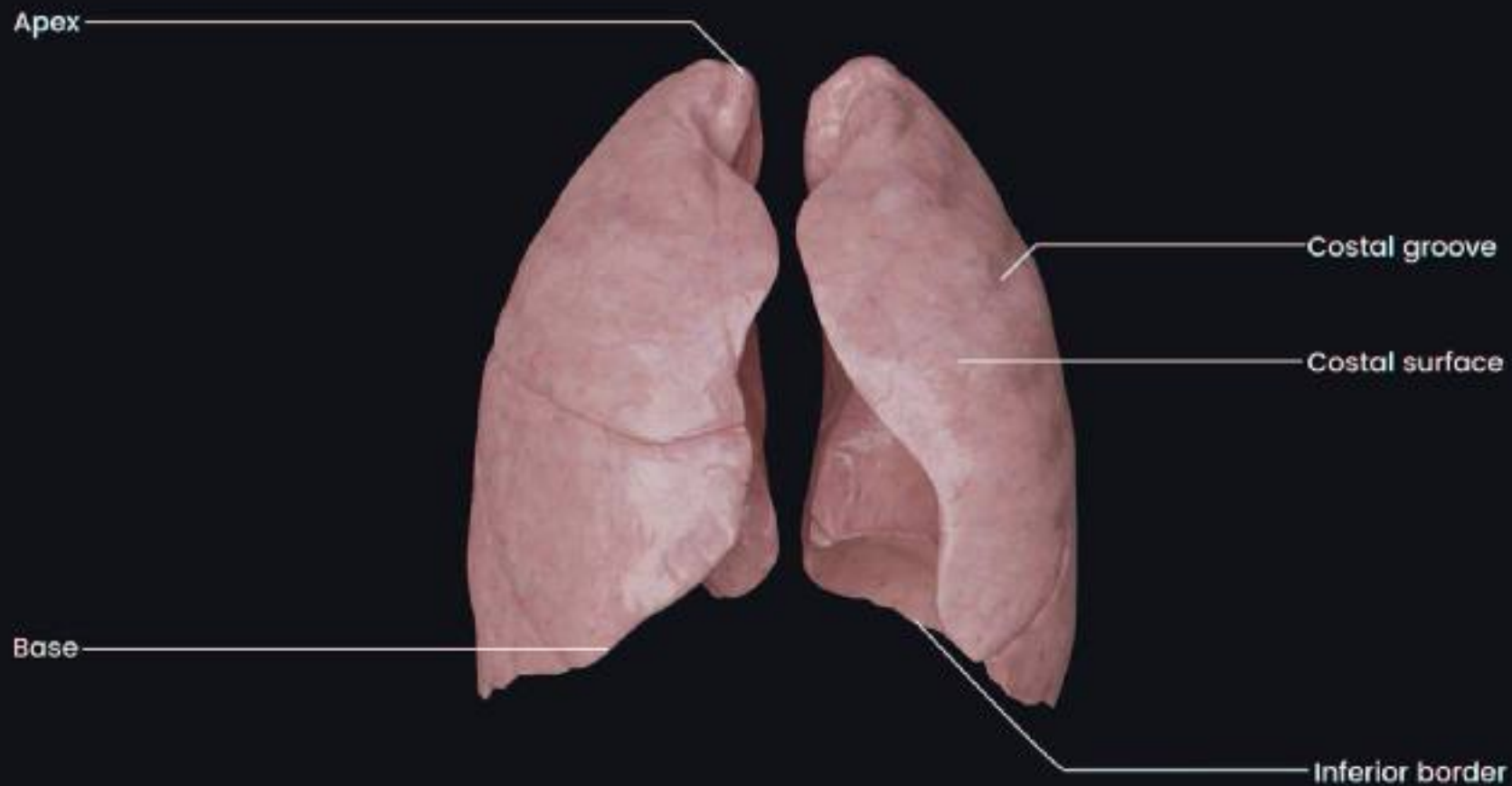


Lungs

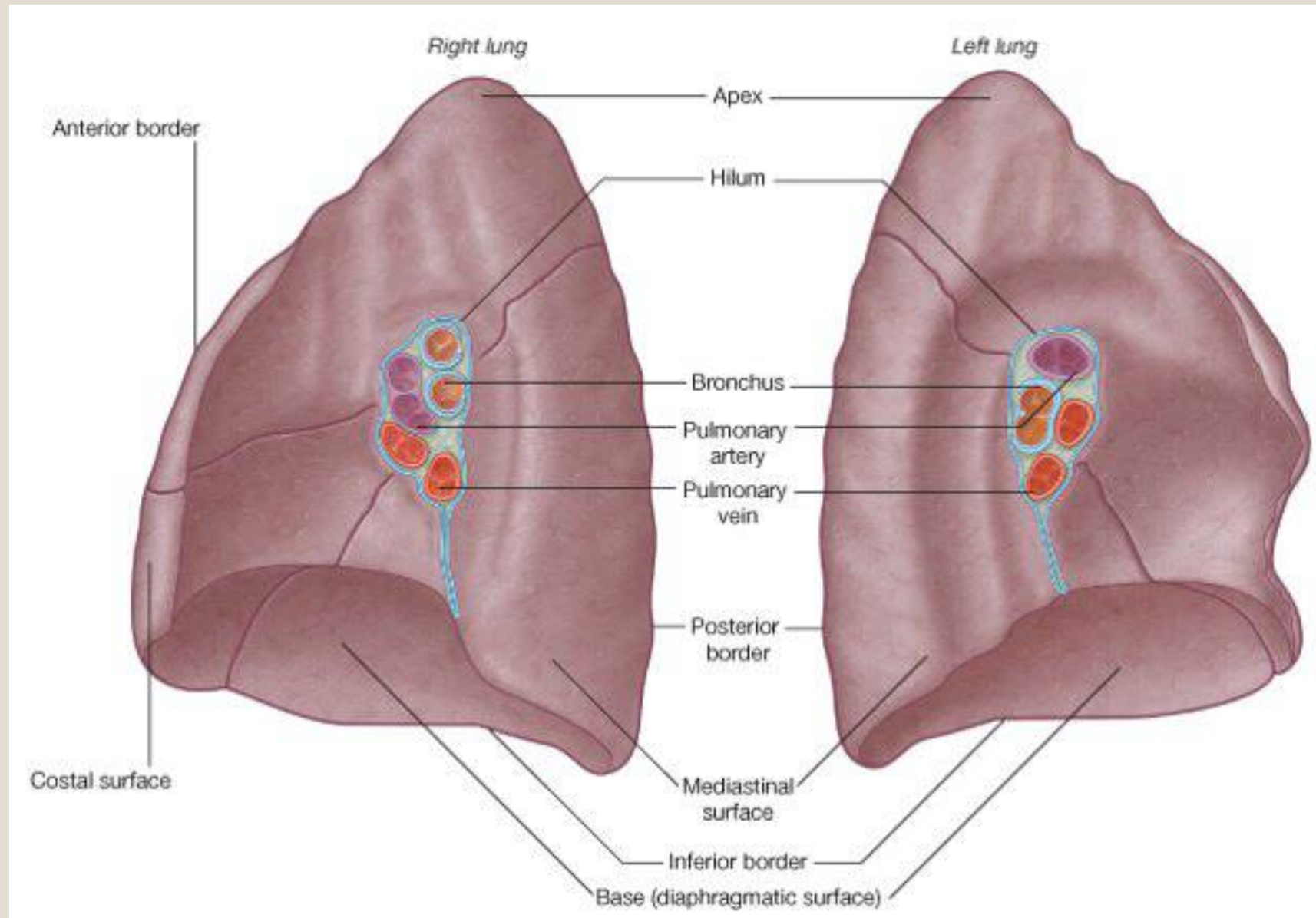
Each lung has a blunt **apex**, which projects upward into the neck for about 1 inch (2.5 cm) **above the clavicle**.

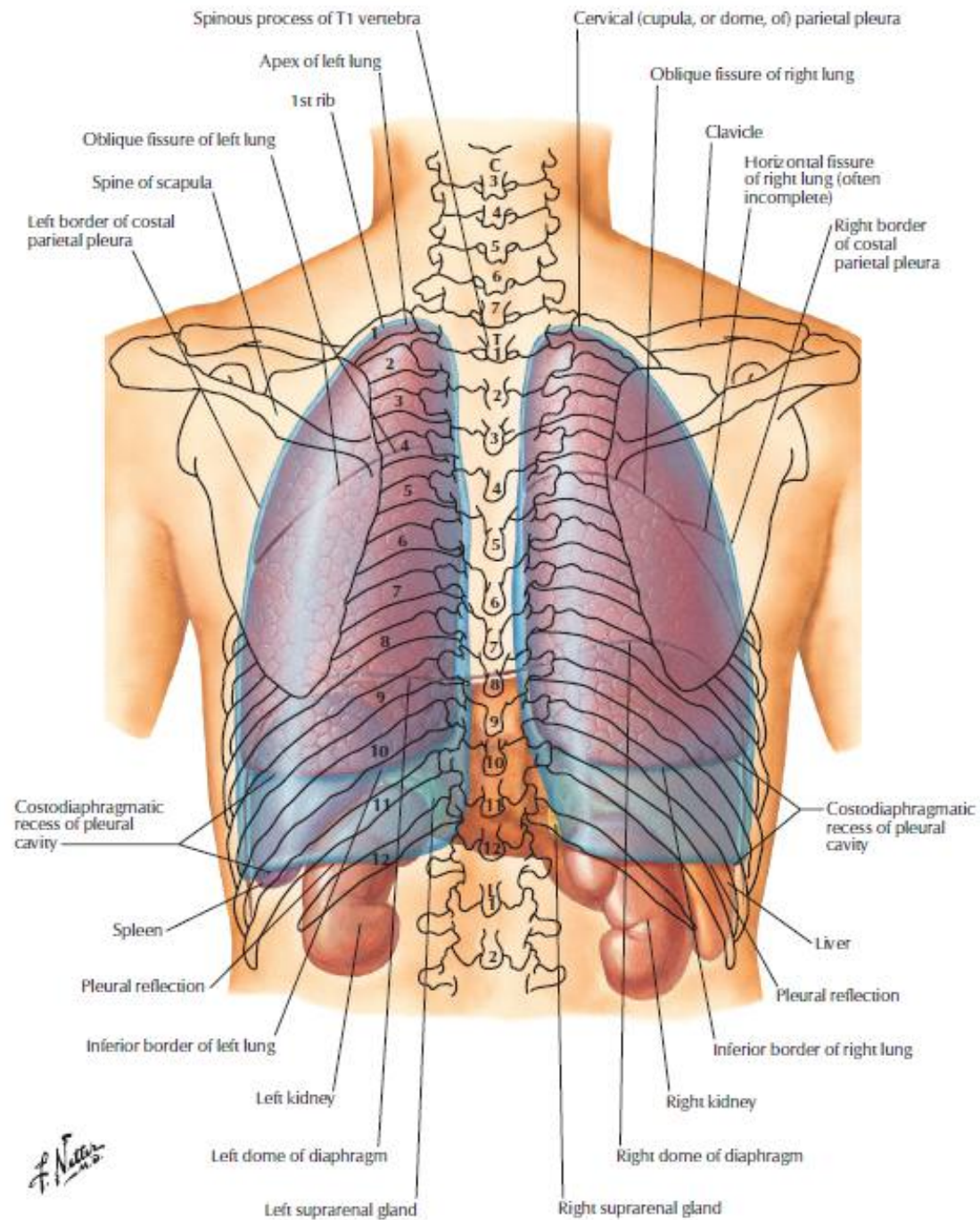
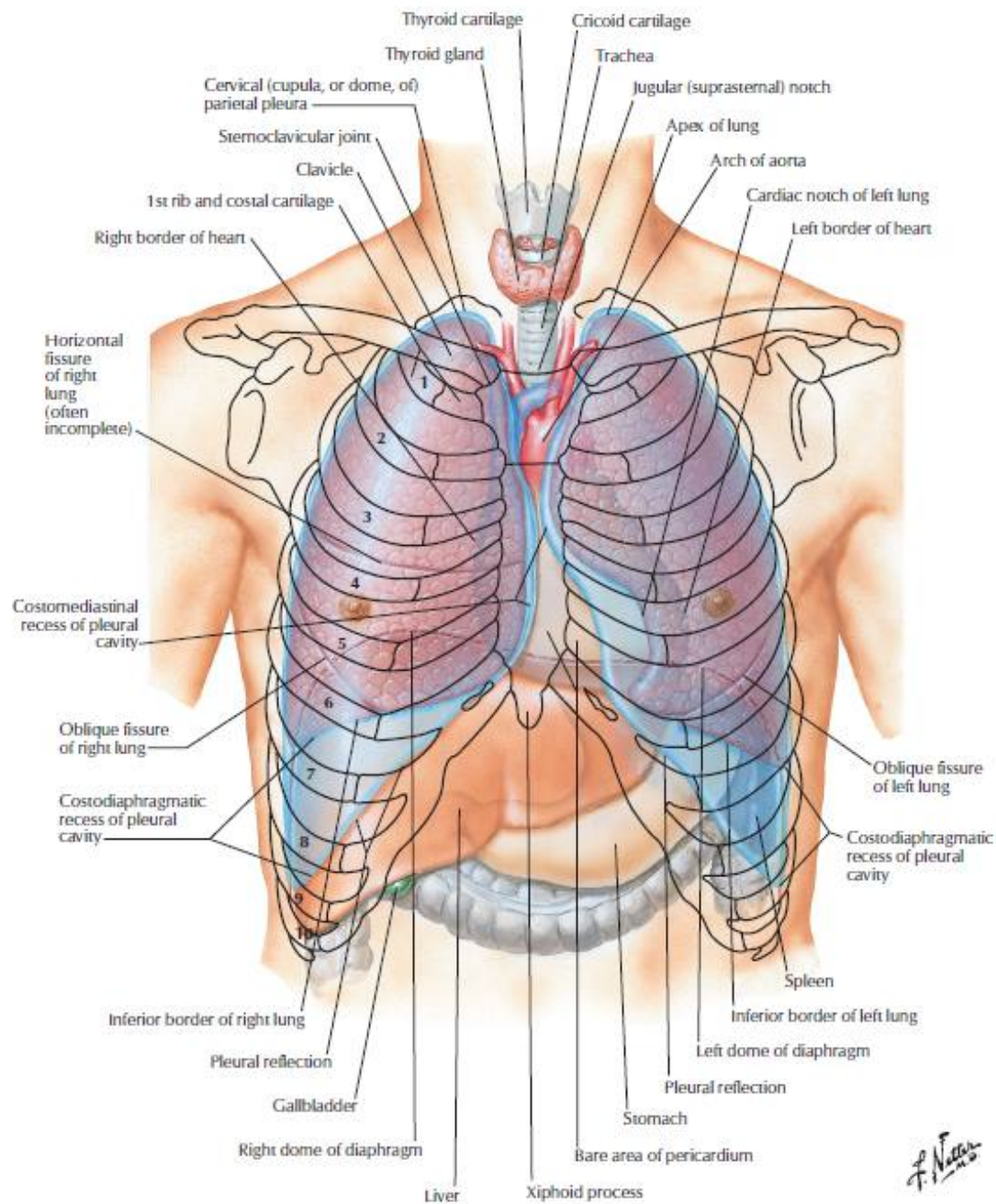
- A concave **base** that sits on the diaphragm;
- A convex **costal surface**, which corresponds to the concave chest wall.
- A concave **mediastinal surface**, (which contains the **hilum**) is molded to the **pericardium** and other mediastinal structures.

Costal surfaces of lungs



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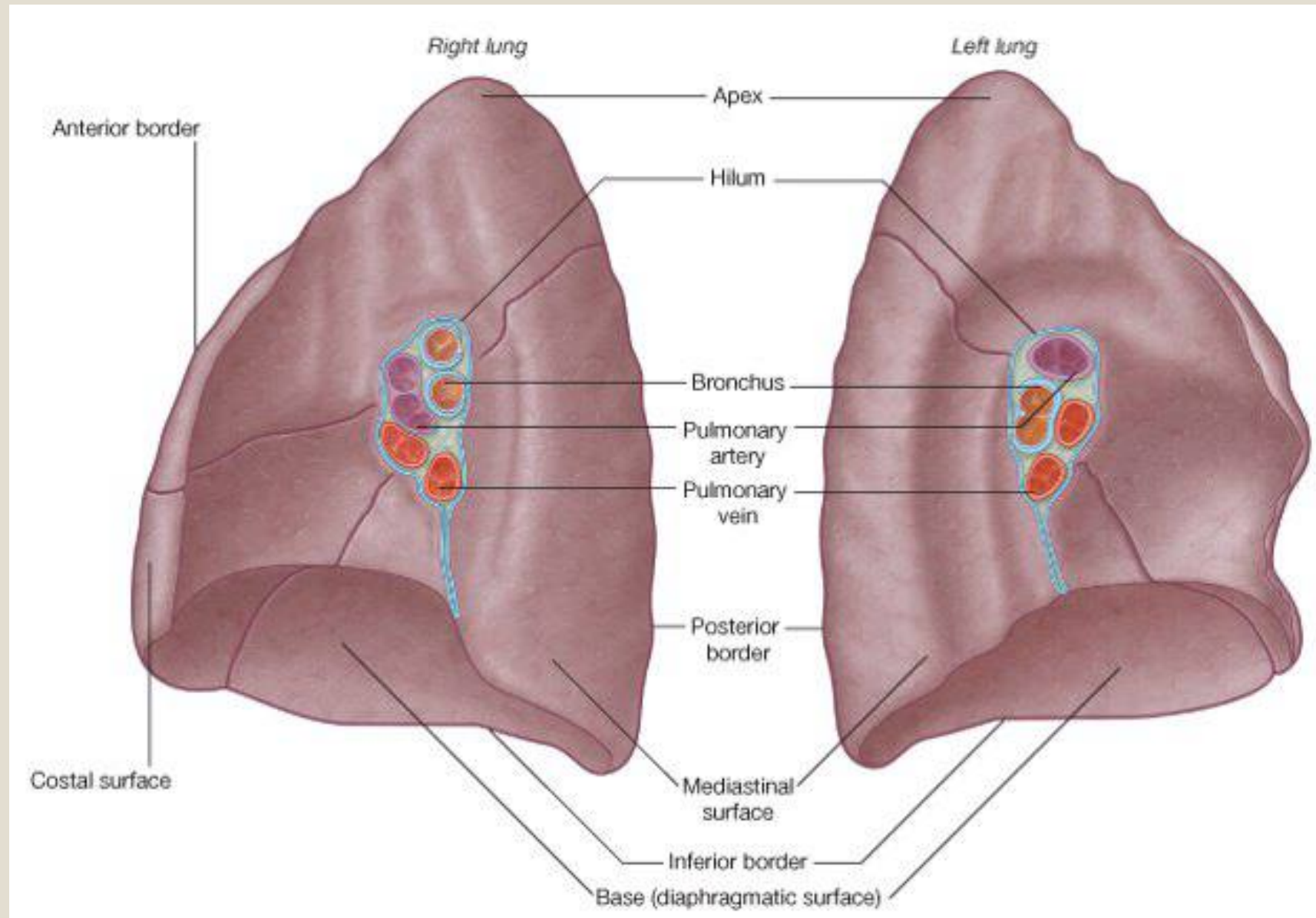




Lungs

At the medial surface there is the **hilum**, a depression in which the **bronchi, vessels, and nerves** that form the **root** enter and leave the lung.

The **anterior border** is thin and overlaps the heart; it is here on the left lung that the **cardiac notch** is found.



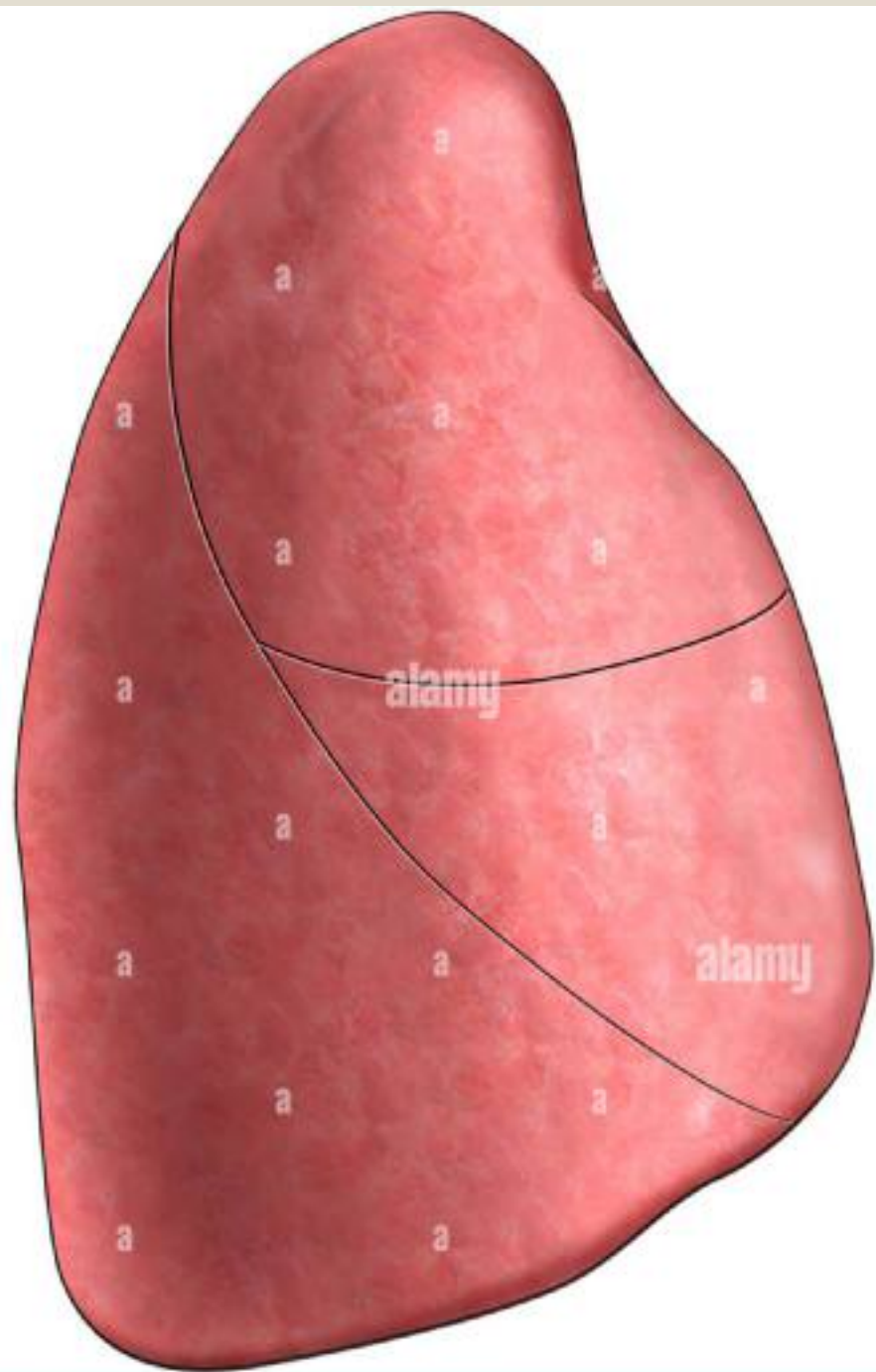
Right Lung:

The right lung is slightly larger than the left and is divided by the **oblique and horizontal fissures** into three lobes:

- **The upper, middle, and lower lobes.**
- The **oblique fissure** runs from the **inferior border** (6th cc) upward and backward across the costal surface until it cuts the posterior border about 2.5 in. (6.25 cm) below the apex.

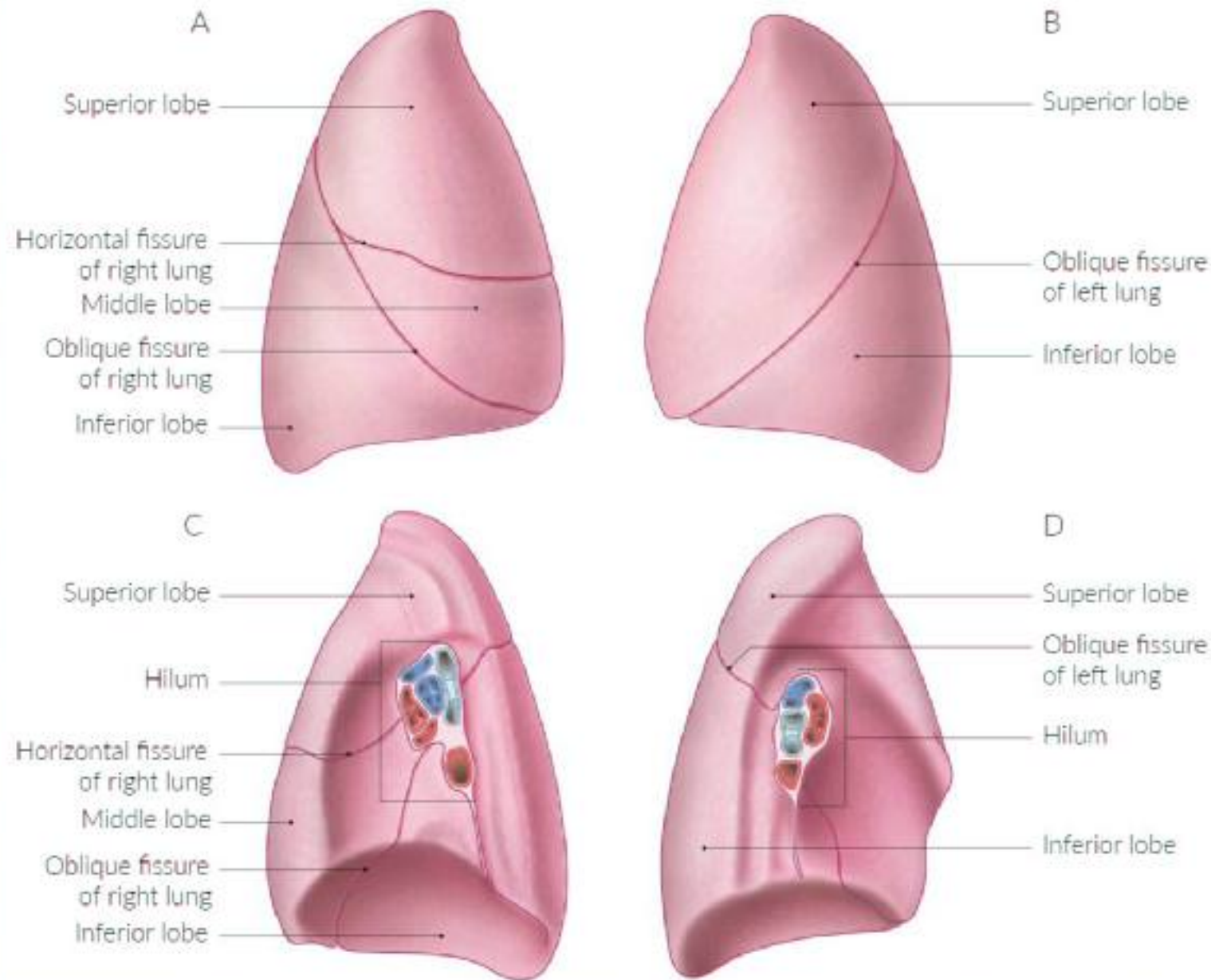
The **horizontal fissure** runs horizontally across the costal surface at the level of the **4th costal cartilage** to meet the oblique fissure in the midaxillary line.

The middle lobe is thus a small triangular lobe bounded by the horizontal and oblique fissures.



Lateral view(top) and
medial view(bottom)
of both lungs.

- The right lung (A, C)
consists of **three
lobes**, which are
separated by
**horizontal and oblique
fissures**.



Left Lung:

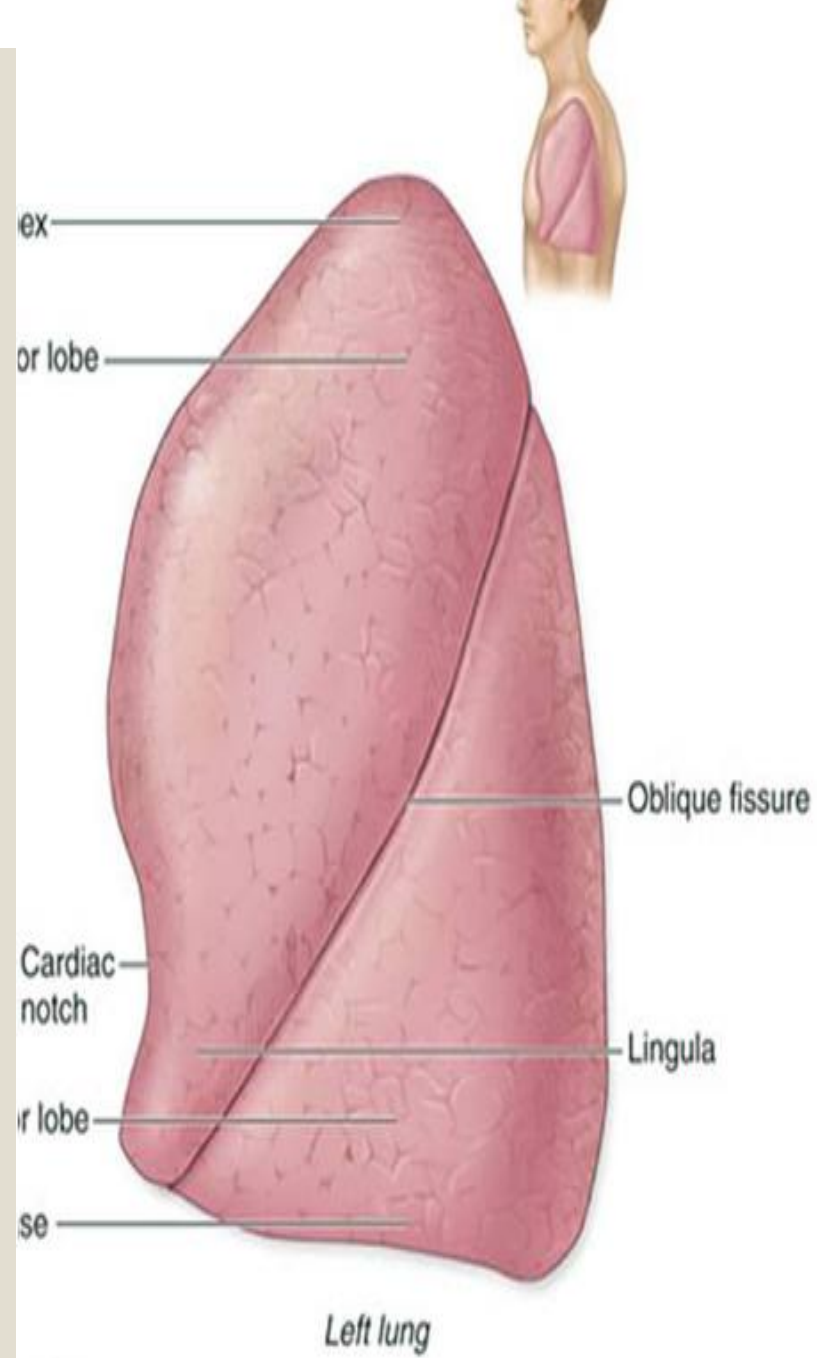
The left lung is divided by a similar oblique fissure into two lobes: the **upper** and **lower lobes**

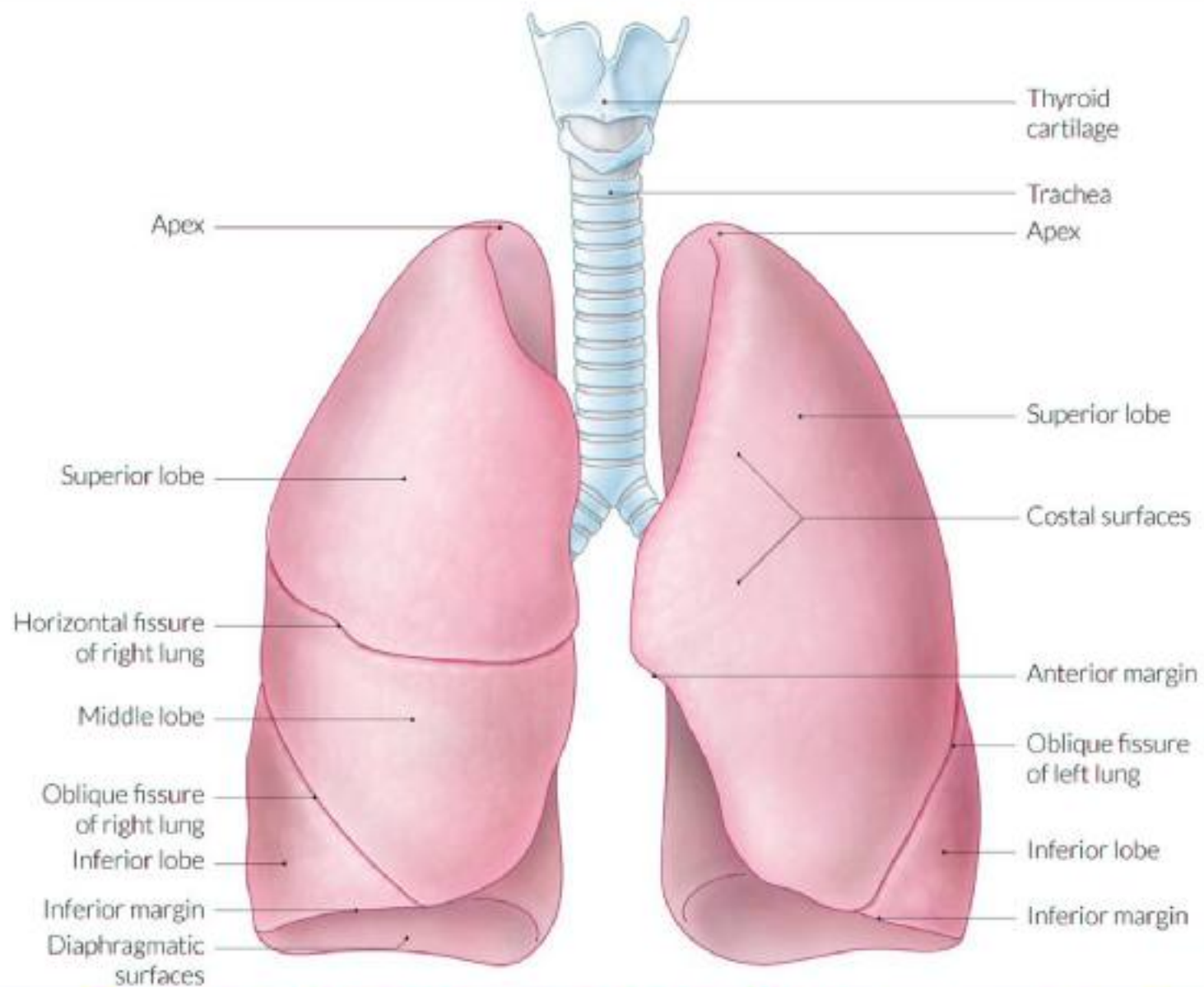
There is no horizontal fissure in the left lung.

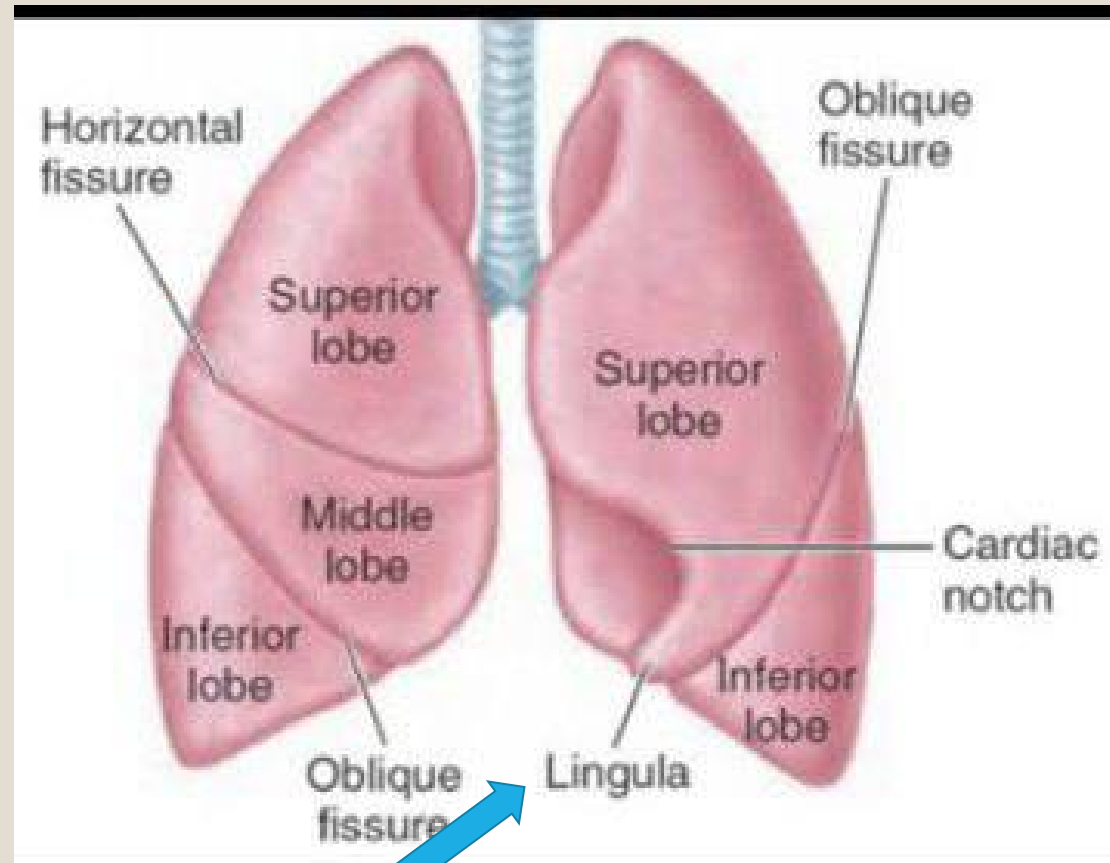
Lingula is a tongue-shaped projection homologous to the middle lobe of the right lung (the rest of the space occupied by the middle lobe in the right lung is occupied by the heart in the left lung).

The **lingula** is visible at the inferior aspect of the upper lobe of the left lung.

The lingula is only present in the left lung (there is no lingula in the right lung)







Right Lung Vs Left Lung

Left Lung: Notches:

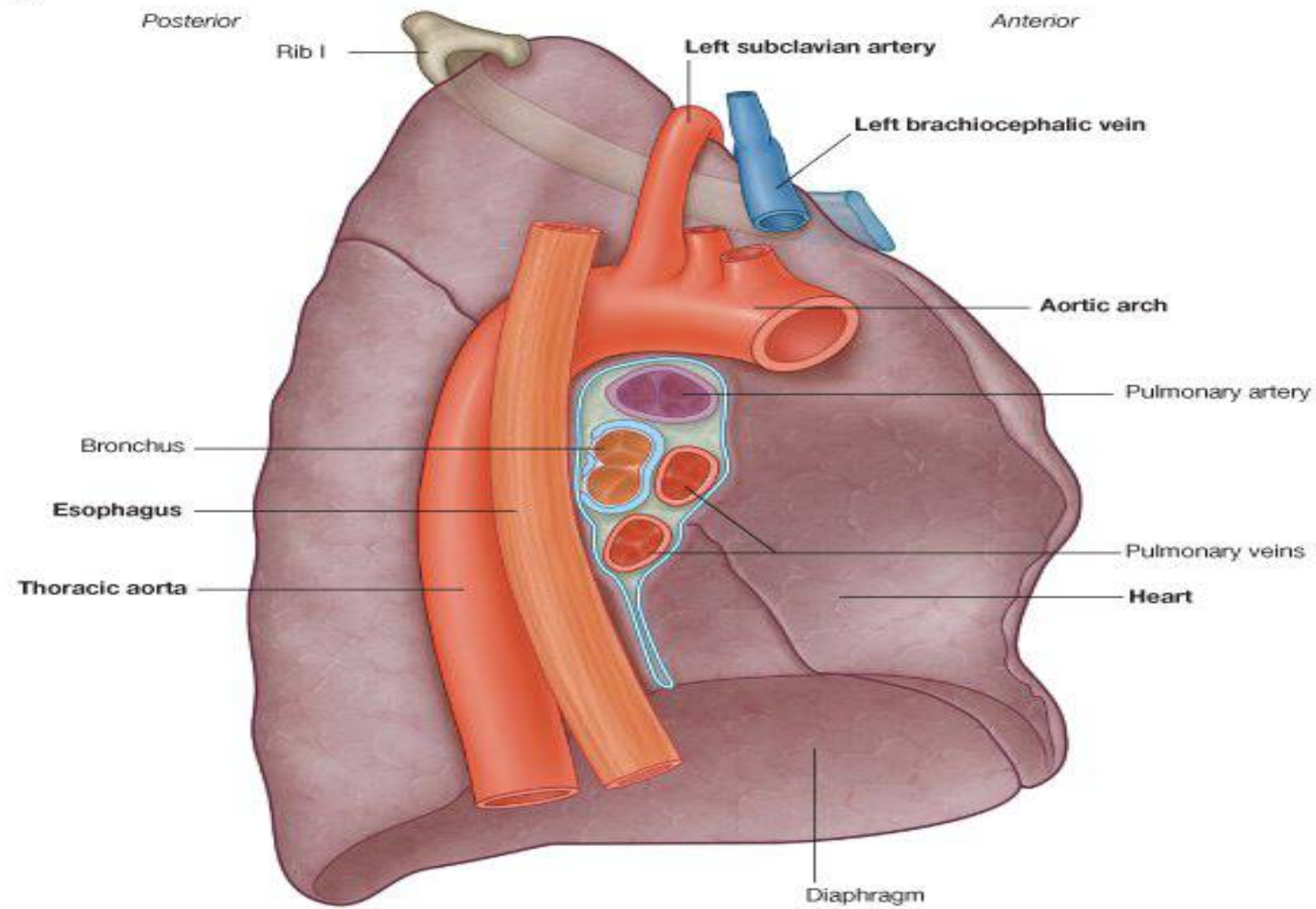
- Cardiac notch of left lung: impression on the anterior border of the left lung from 4th to 6th costal cartilage.

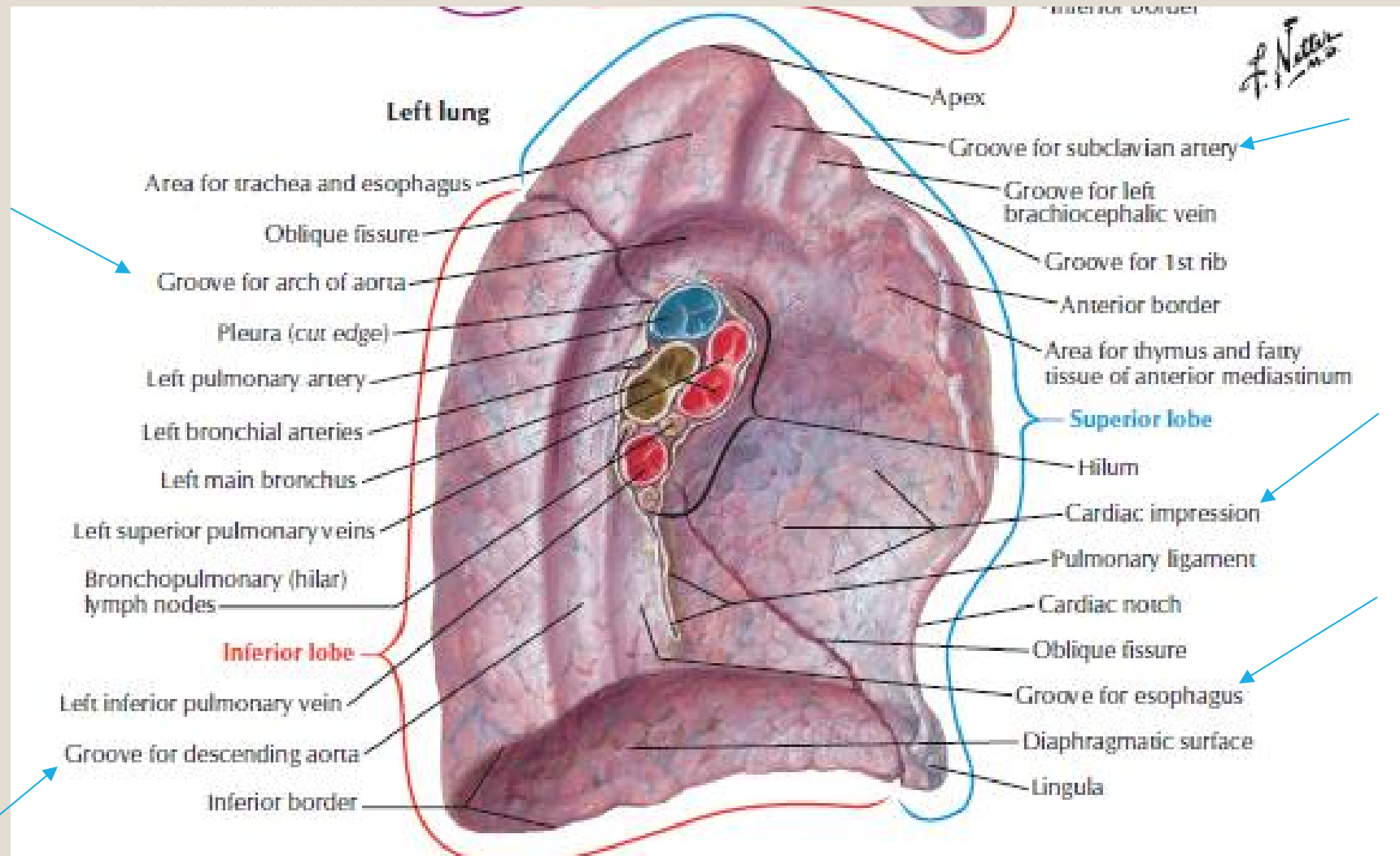
Indentations for ascending and descending aorta and left subclavian artery.

Right Lung: Notches:

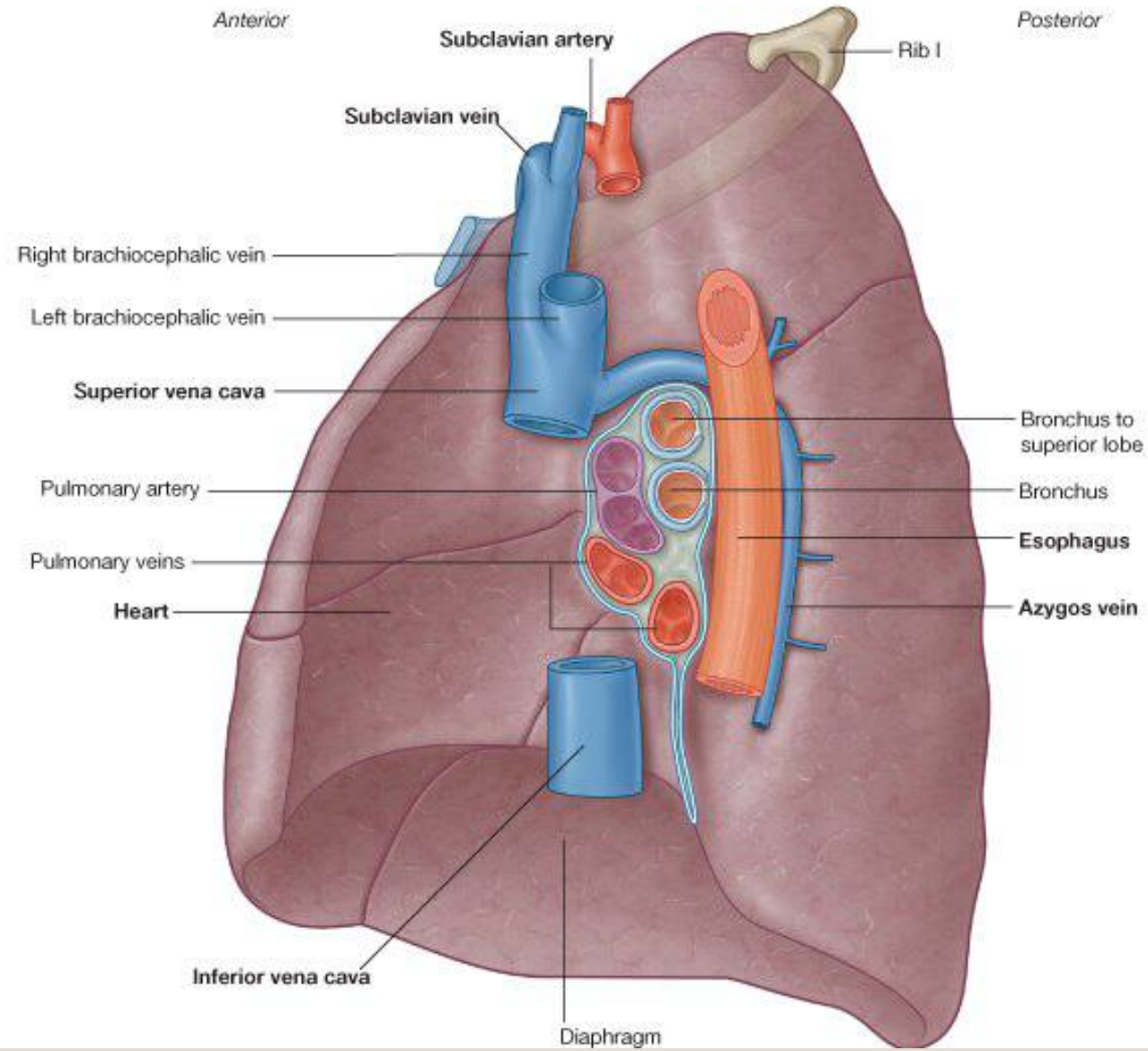
Contains several notches for superior and inferior vena cava, oesophagus, trachea, and arch of the azygos vein.

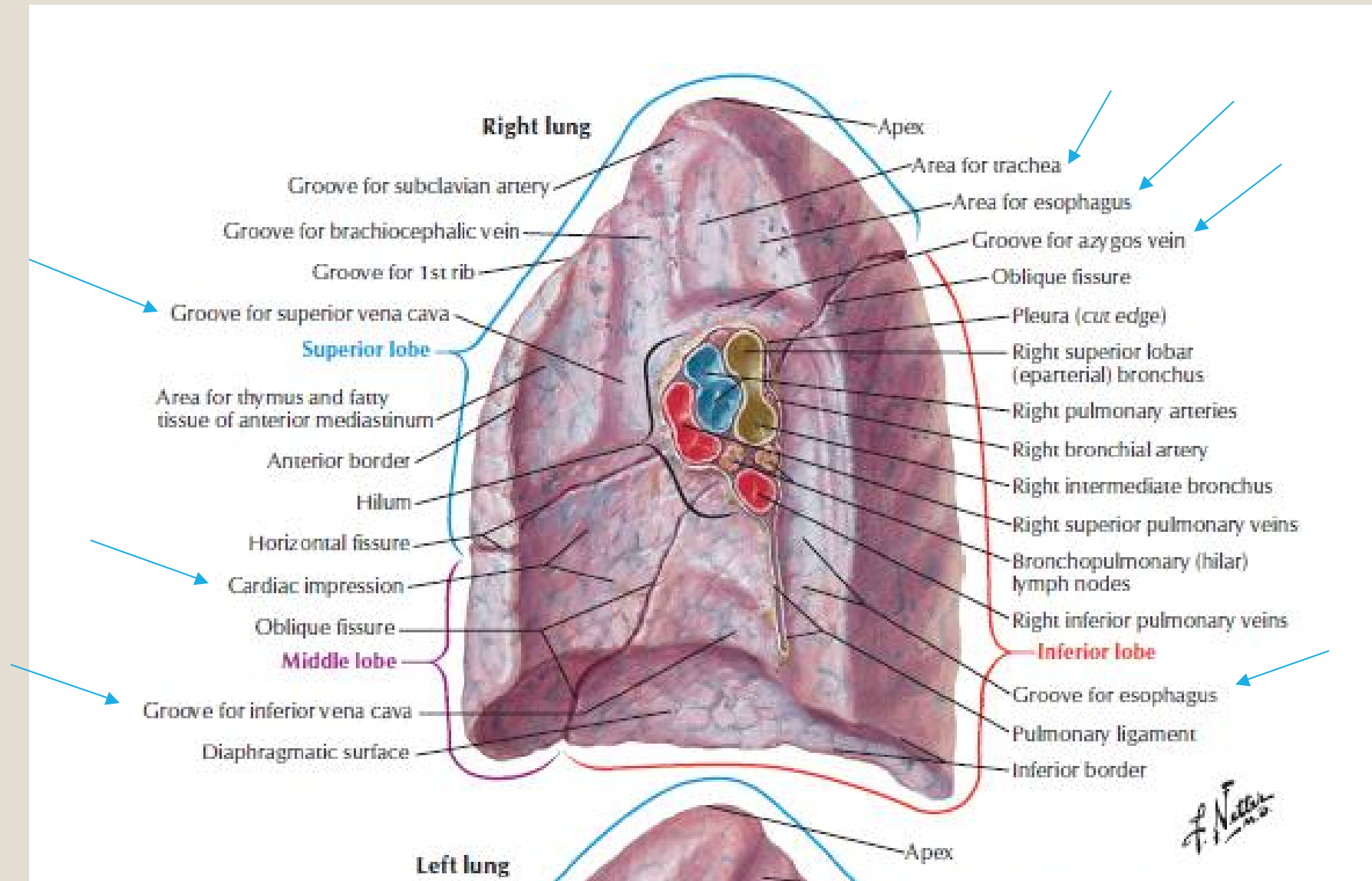
B



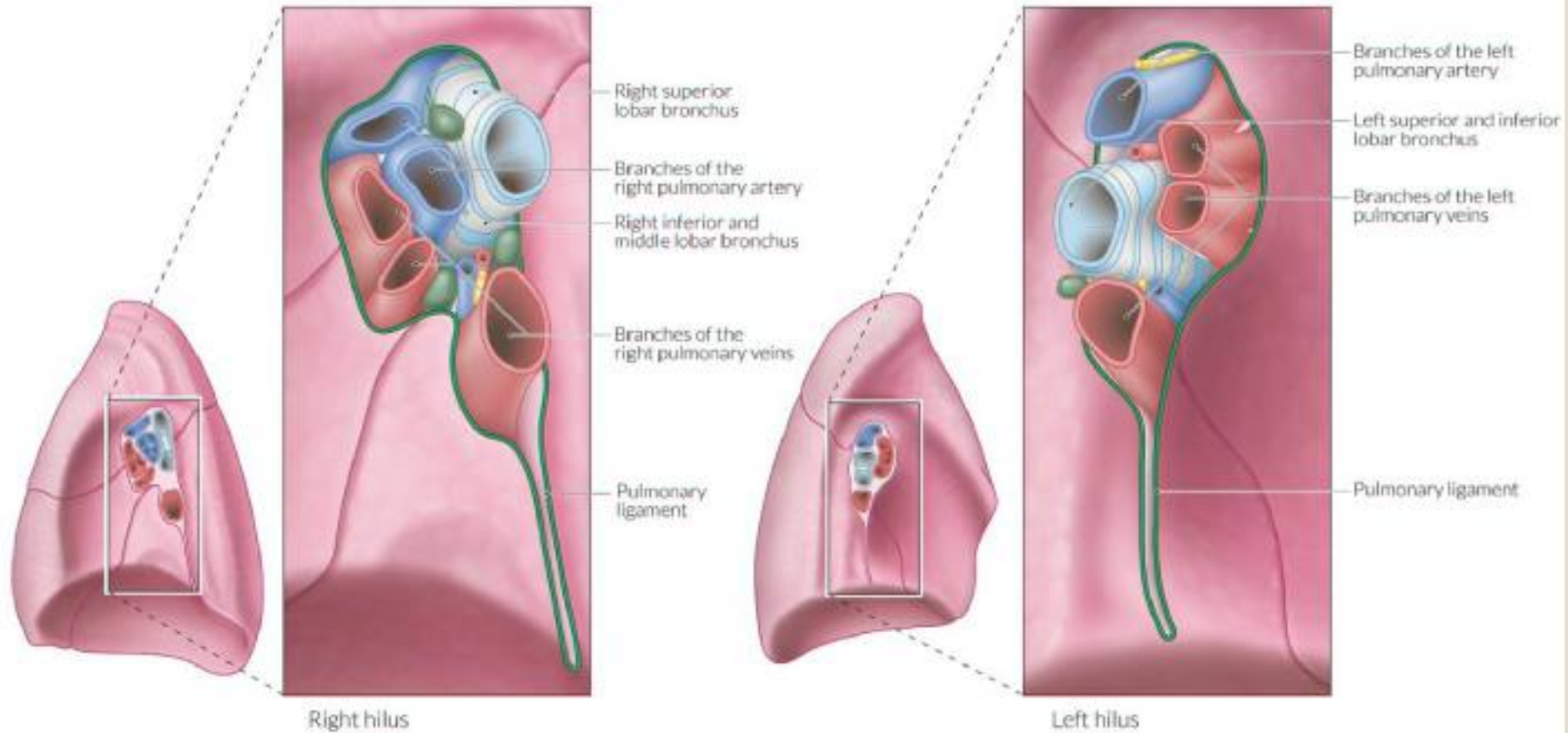


B





Hilum of Lung



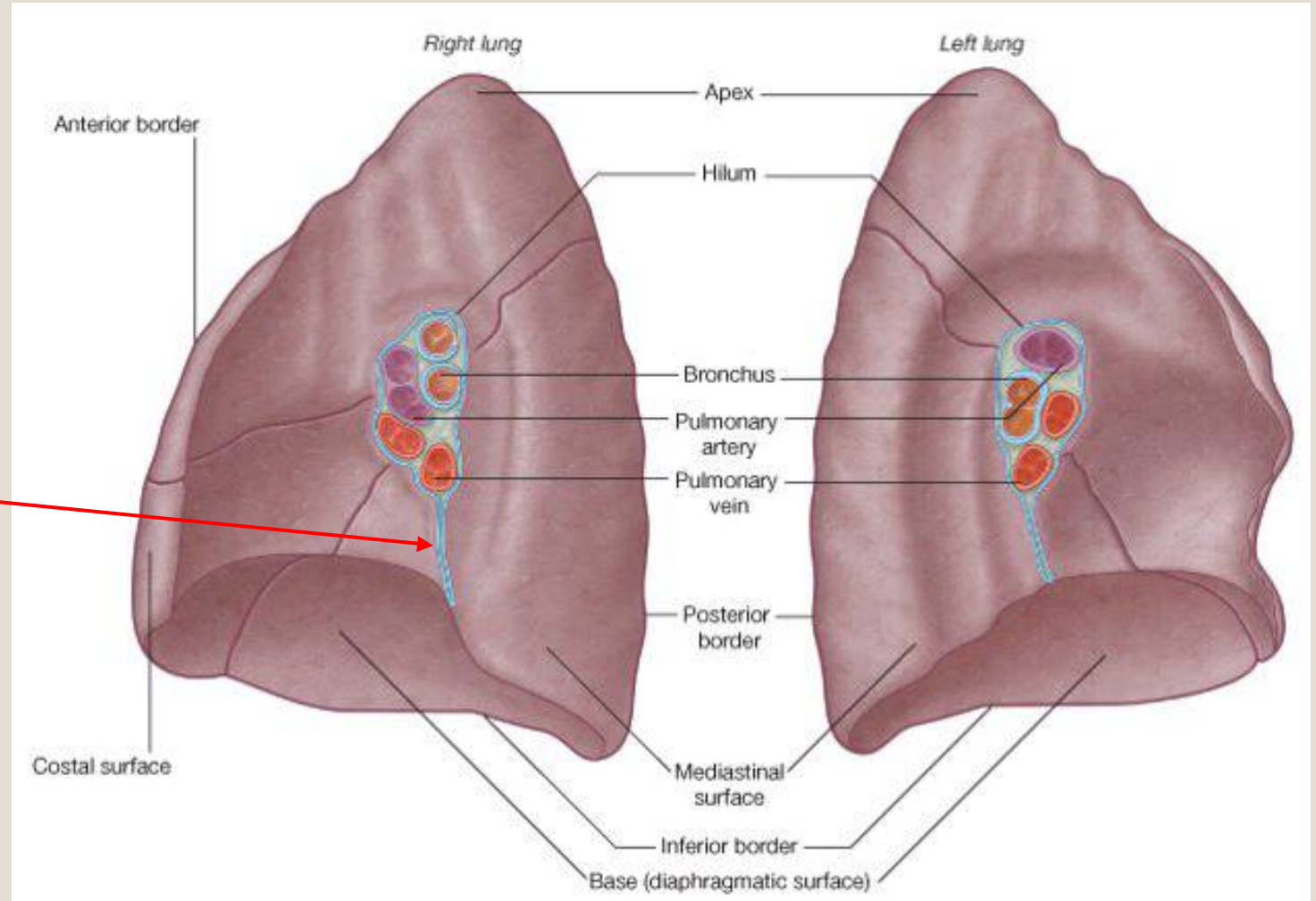
Pulmonary ligament

Two-layered fold of mediastinal pleura.

Surrounds lung hilum.

Extend downward and ends at the lung base.

Helps supporting the lungs and it's hilar structure.

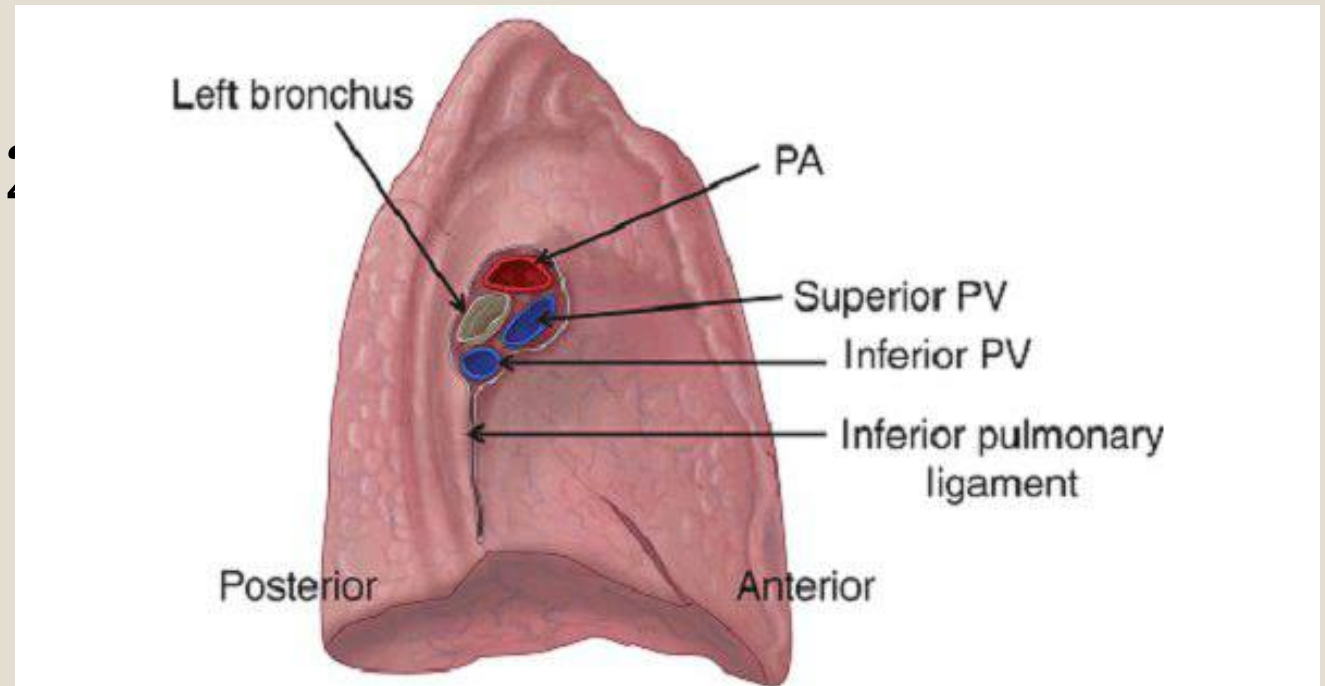


Hilum

Hilum of the lung Opposite to T5-T7

serve as the entry and exit site for:

the primary bronchi Lt
pulmonary arteries and veins 2
bronchial arteries 2 Lt, 1Rt
pulmonary nervous plexus,
and lymphatics of each lung.



The superior pulmonary vein is the most Anterior structure.

The main bronchus is the most Posterior structure.

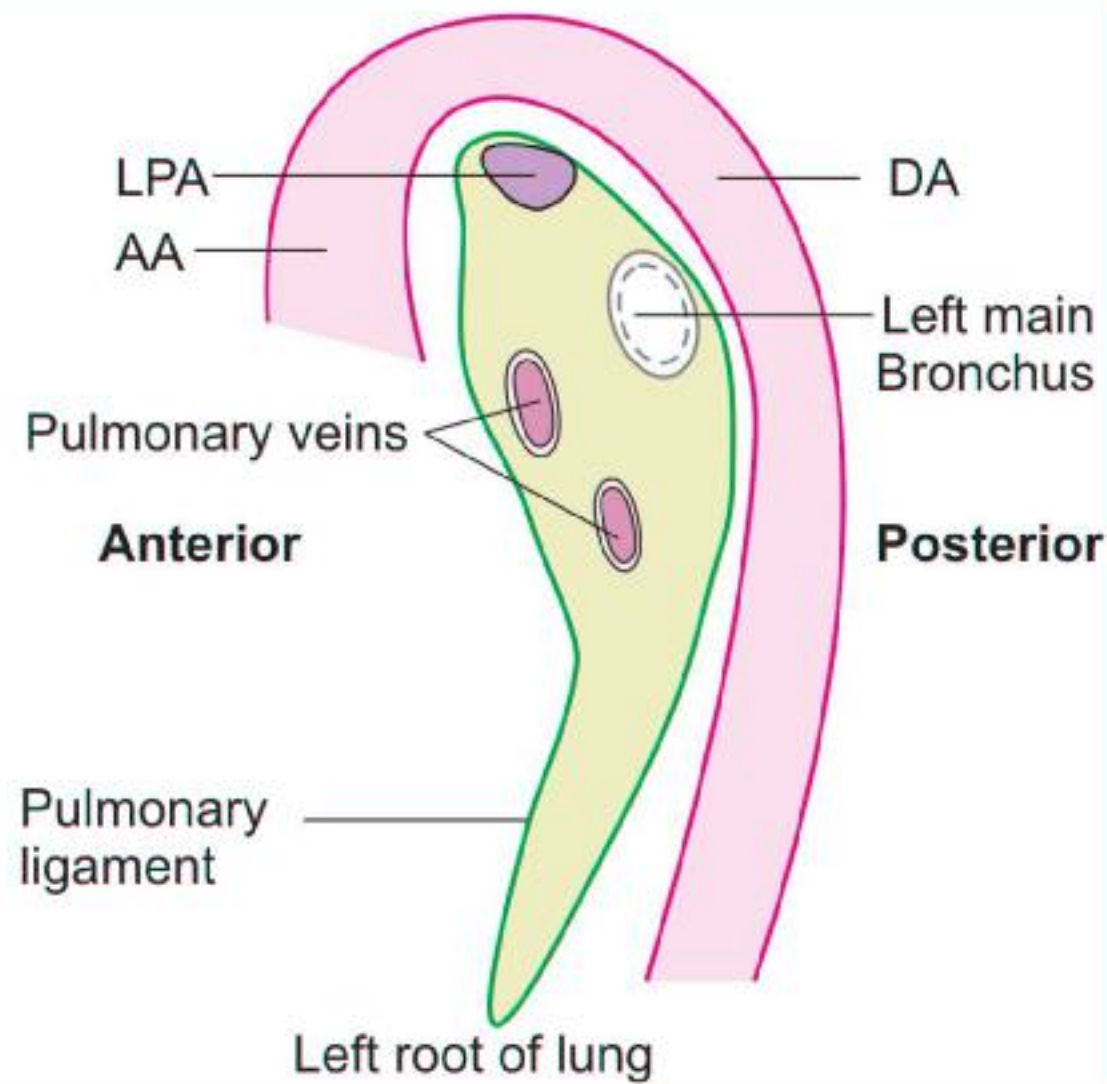
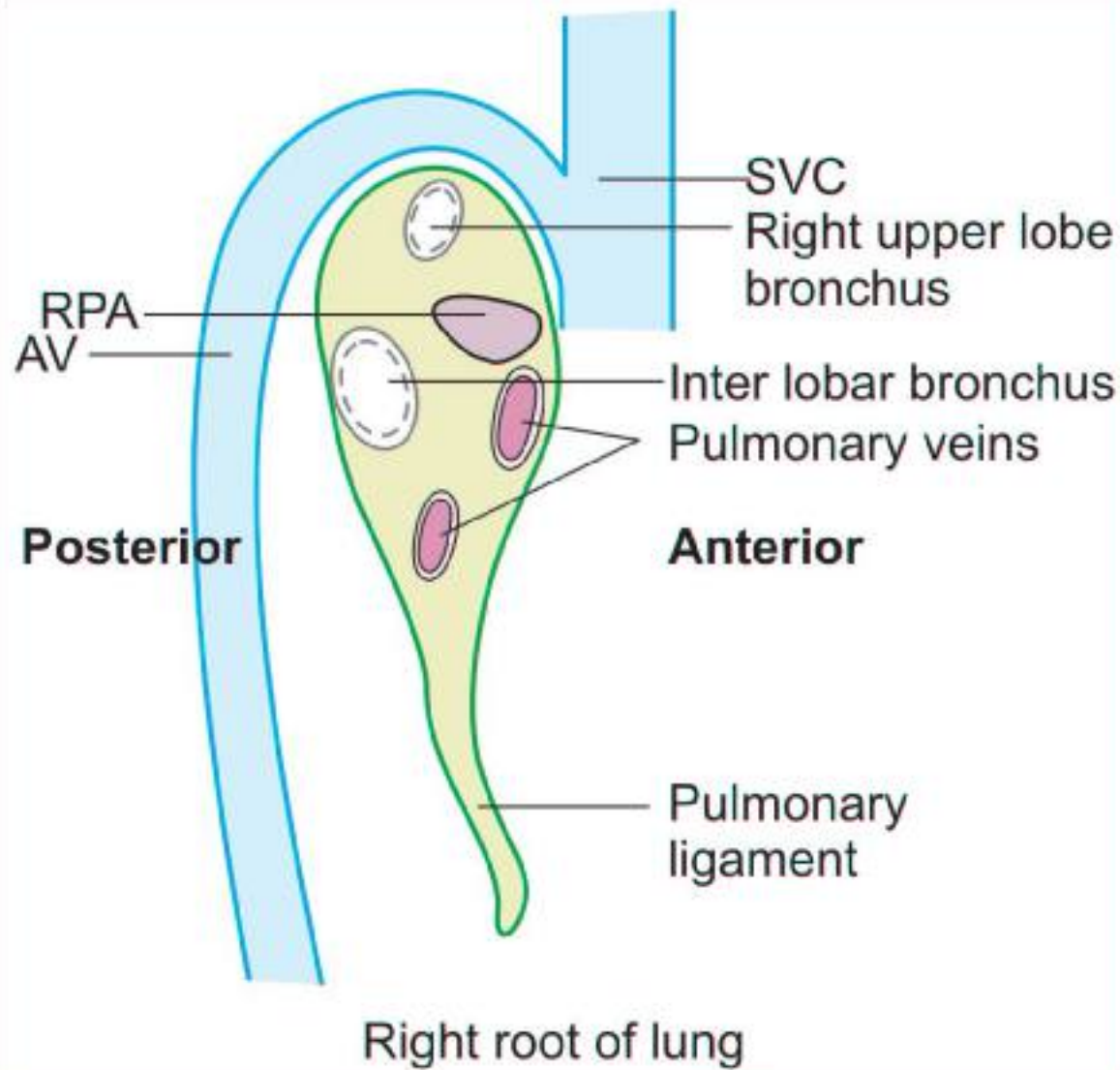
The inferior pulmonary vein is the most Inferior structure.

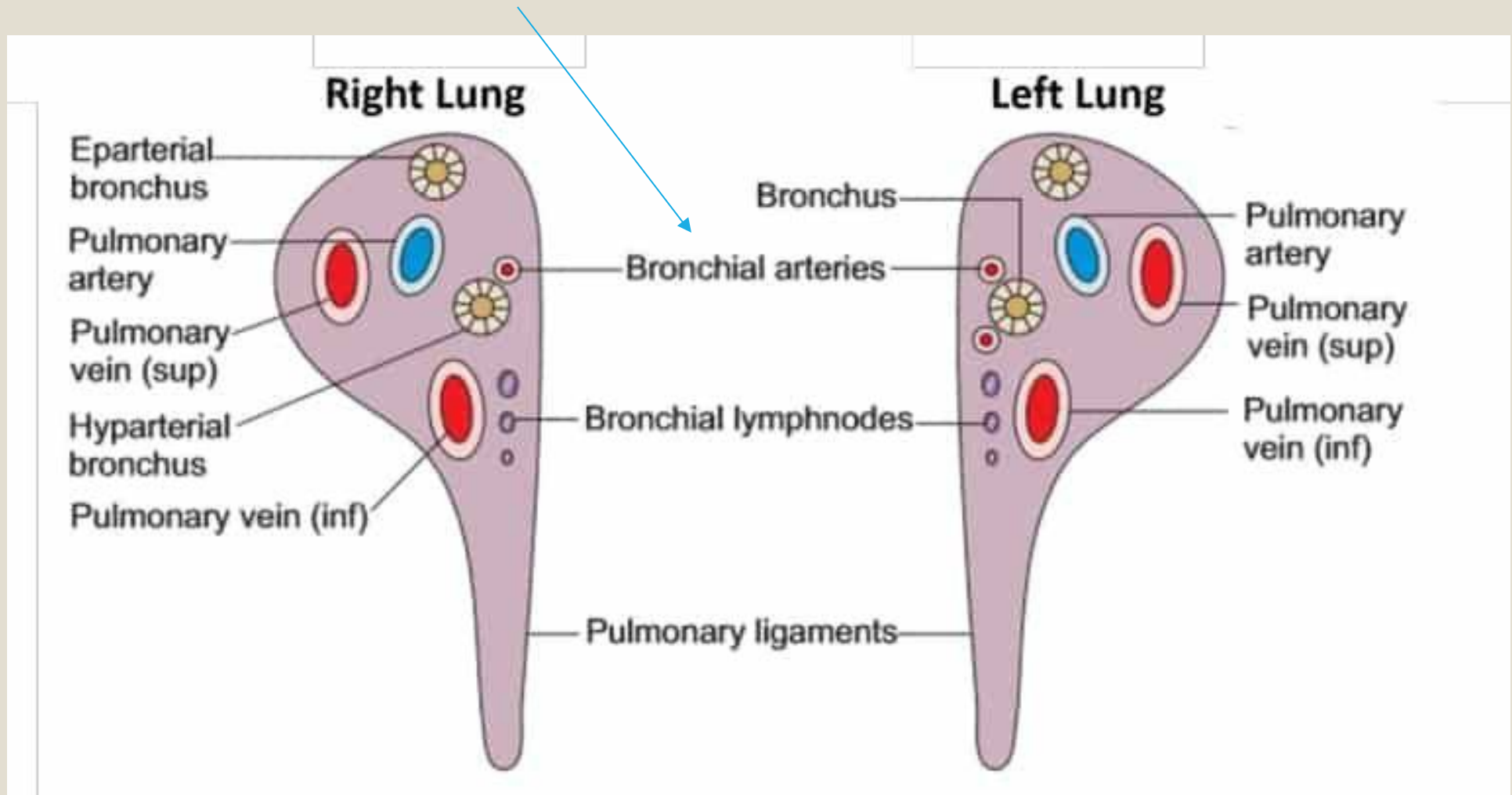
Root of **Lt lung** contain One Bronchus only.

On Rt side there is a smaller bronchus called **Eparterial bronchus**,
above main bronchus **Hyparterial bronchus**

In the Rt lung **pulmonary artery** lies **between** principle
bronchus, and SPV

In the Lt lung **pulmonary artery** lies **above and in front of main
bronchus.**



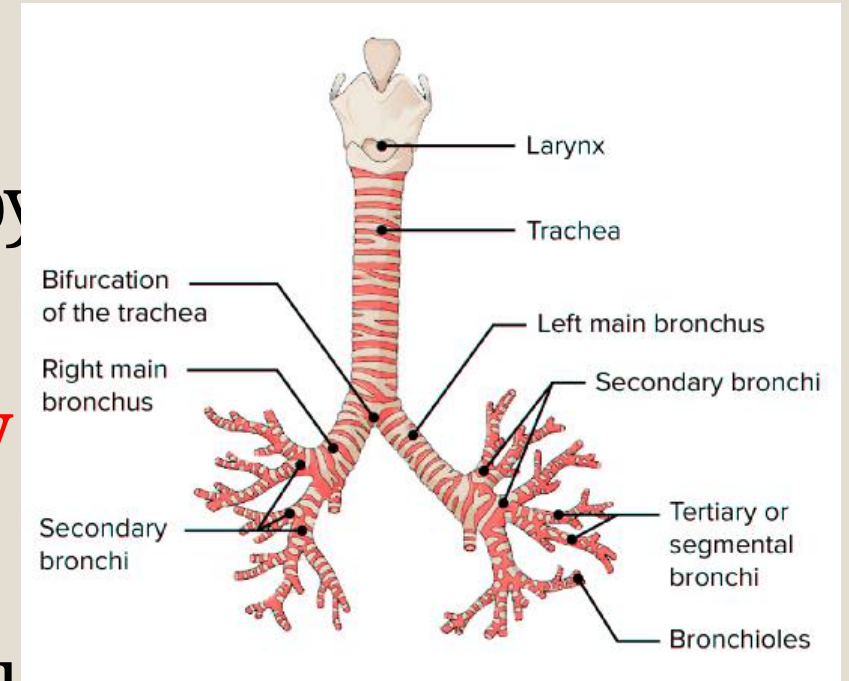


Right Lung Vs Left Lung

Right Lung	Left Lung
Heavier (625 gram)	Lighter 565 (gram)
Shorter & wider due to upward compression by liver	Longer & narrower due to side compression by heart
Has oblique & horizontal fissure	Has only horizontal fissure
Consists of 3 lobes: Upper, middle & lower	Consists of 2 lobes: upper & lower
Base more concave by liver compression	Base less concave
Anterior border is complete	Anterior border shows • Cardiac notch • Lingual (at 6th costal cartilage)
Hilum contains two bronchi: • Eparterial • Hyparterial	Hilum contains one bronchus only
Hilum contains one bronchial artery only	Hilum contains two bronchial arteries

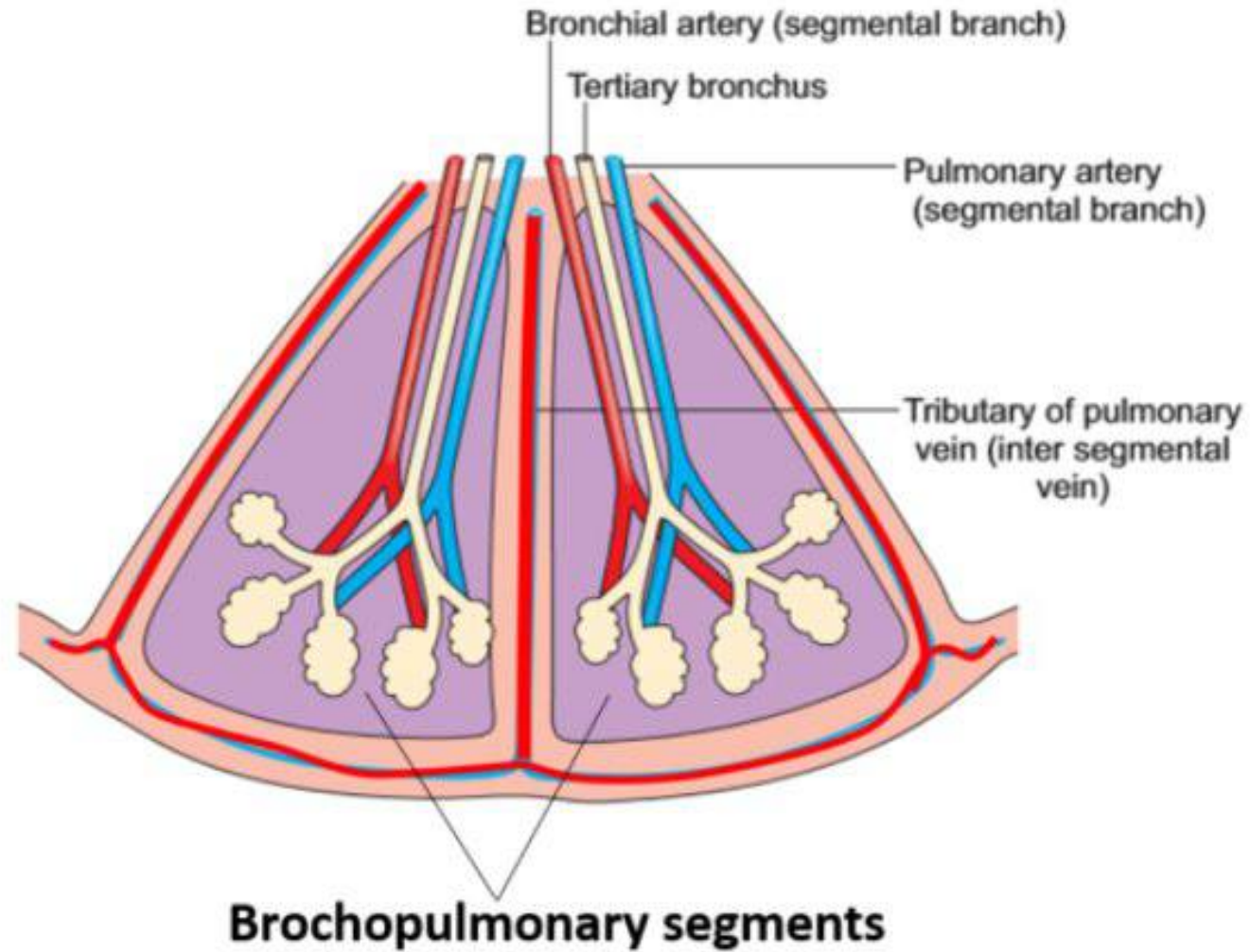
Bronchopulmonary segments

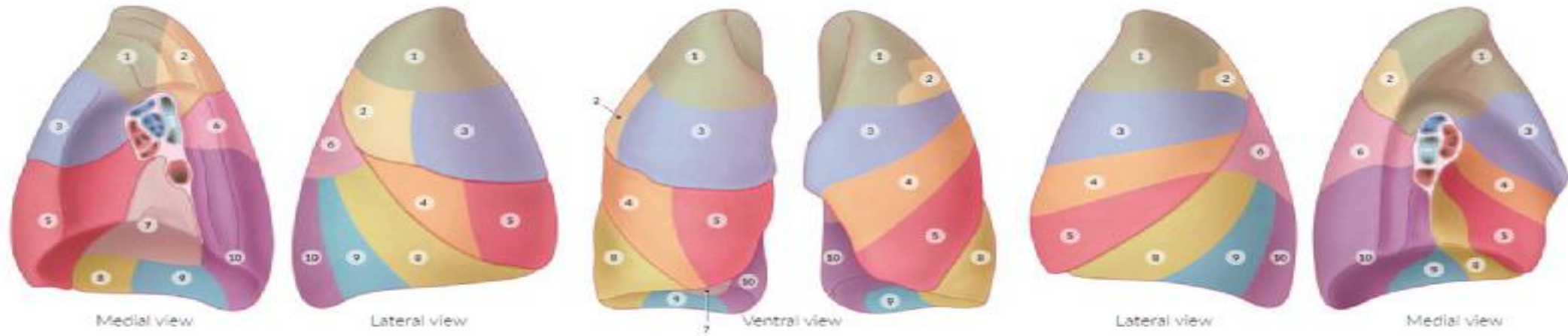
Segments of lung tissue that are supplied by
Segmental (tertiary) bronchus
segmental branch of the pulmonary artery
segmental branch of the bronchial artery



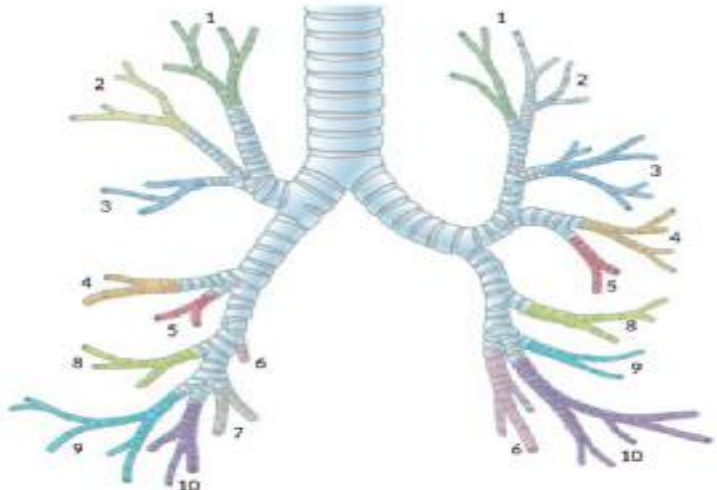
They are surrounded by a connective tissue septum (intersegmental septum), which encloses a branch of the pulmonary vein.

There are **10 bronchopulmonary segments** in each lung.





Right lung		
Superior lobe	Apical segment (I)	1
	Posterior segment (II)	2
	Anterior segment (III)	3
Middle lobe	Lateral segment (IV)	4
	Medial segment (V)	5
Inferior lobe	Superior segment (VI)	6
	Medial-basal segment (VII)	7
	Anterior-basal segment (VIII)	8
	Lateral-basal segment (IX)	9
	Posterior-basal segment (X)	10



Left lung		
1	Superior lobe	Apico-posterior segment (I+II)
2		
3		Anterior segment (III)
4		Superior lingular segment (IV)
5		Inferior lingular segment (V)
6	Inferior lobe	Superior segment (VI)
7		[Medial-basal segment (VII)]
8		Anterior-basal segment (VIII)
9		Lateral-basal segment (IX)
10		Posterior-basal segment (X)

The **bronchopulmonary segments** are the anatomic, functional, and **surgical** units of the lungs.

The bronchopulmonary segments:

The main bronchopulmonary segments are as follows:

Right lung:

- **Superior lobe (3)**: Apical, posterior, anterior
- **Middle lobe (2)**: Lateral, medial
- **Inferior lobe (5)**: Superior (apical), medial basal, anterior basal, lateral basal, posterior basal.

Left lung:

- **Superior lobe (5)**: Apical, posterior, anterior, superior lingular, inferior lingular.
- **Inferior lobe (5)**: Superior (apical), medial basal, anterior basal, lateral basal, posterior basal.

Although the general arrangement of the bronchopulmonary segments is of clinical importance, it is **unnecessary to memorize** the details unless one intends to specialize in pulmonary medicine or surgery.

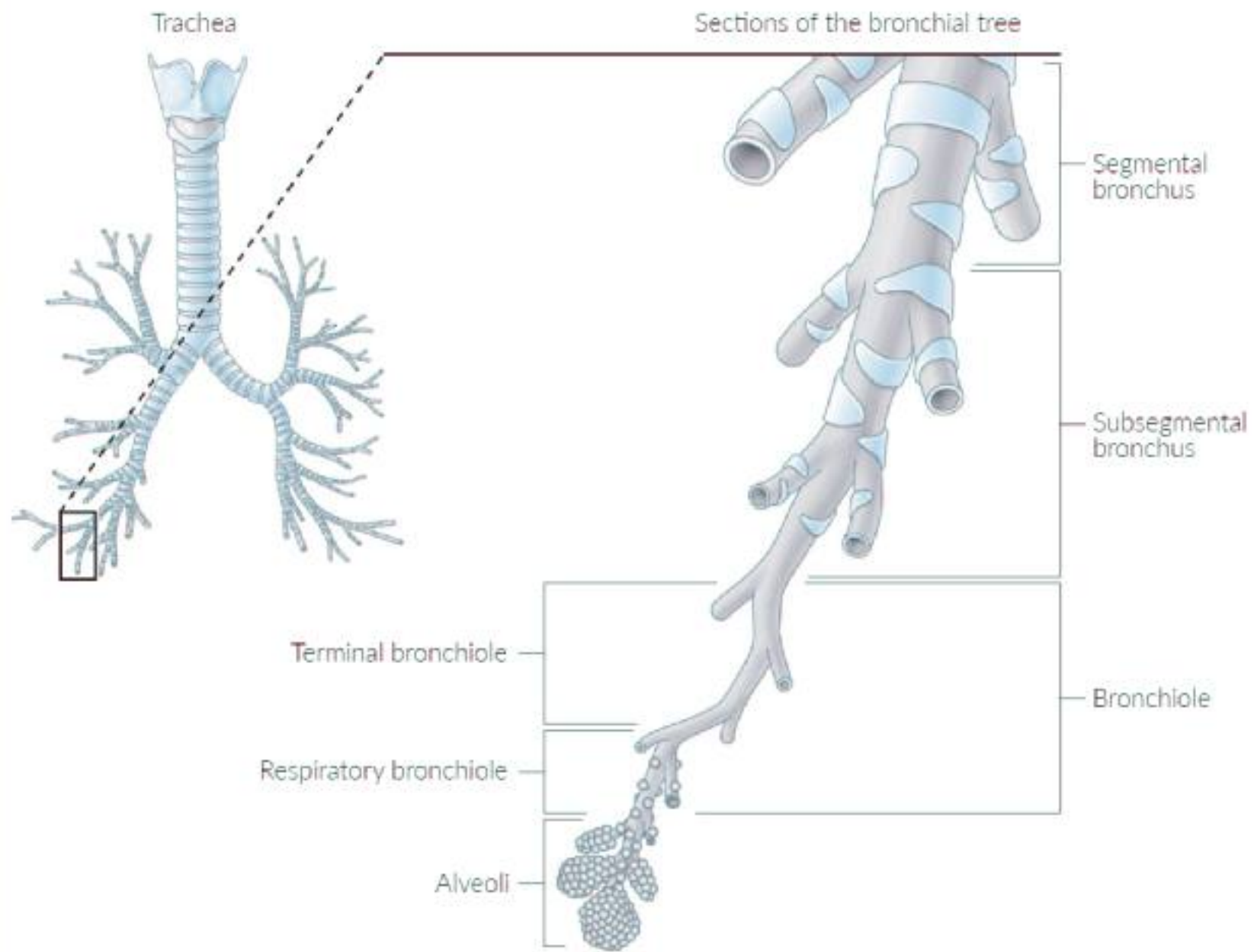
Bronchopulmonary Segments

The smallest bronchi divide and give rise to **bronchioles**, which are <1 mm in diameter.

Bronchioles **possess no cartilage** in their wall.

The bronchioles then divide and give rise to **terminal bronchiole**

Gaseous exchange between blood and air takes place in the walls of these outpouchings, which explains the name **respiratory bronchiole**.



Bronchopulmonary Segments

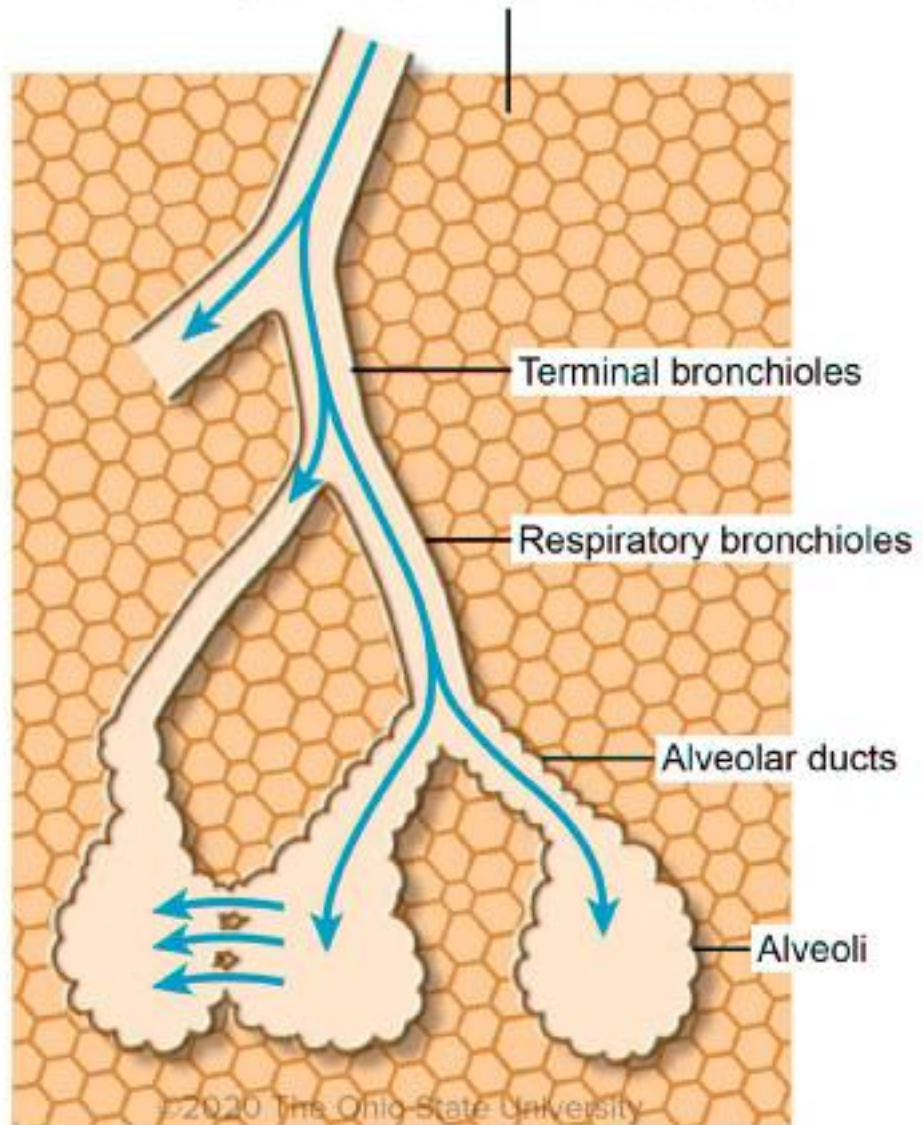
The **respiratory bronchioles** end by branching into **alveolar ducts**, which lead into tubular passages with numerous thin-walled outpouchings called **alveolar sacs**.

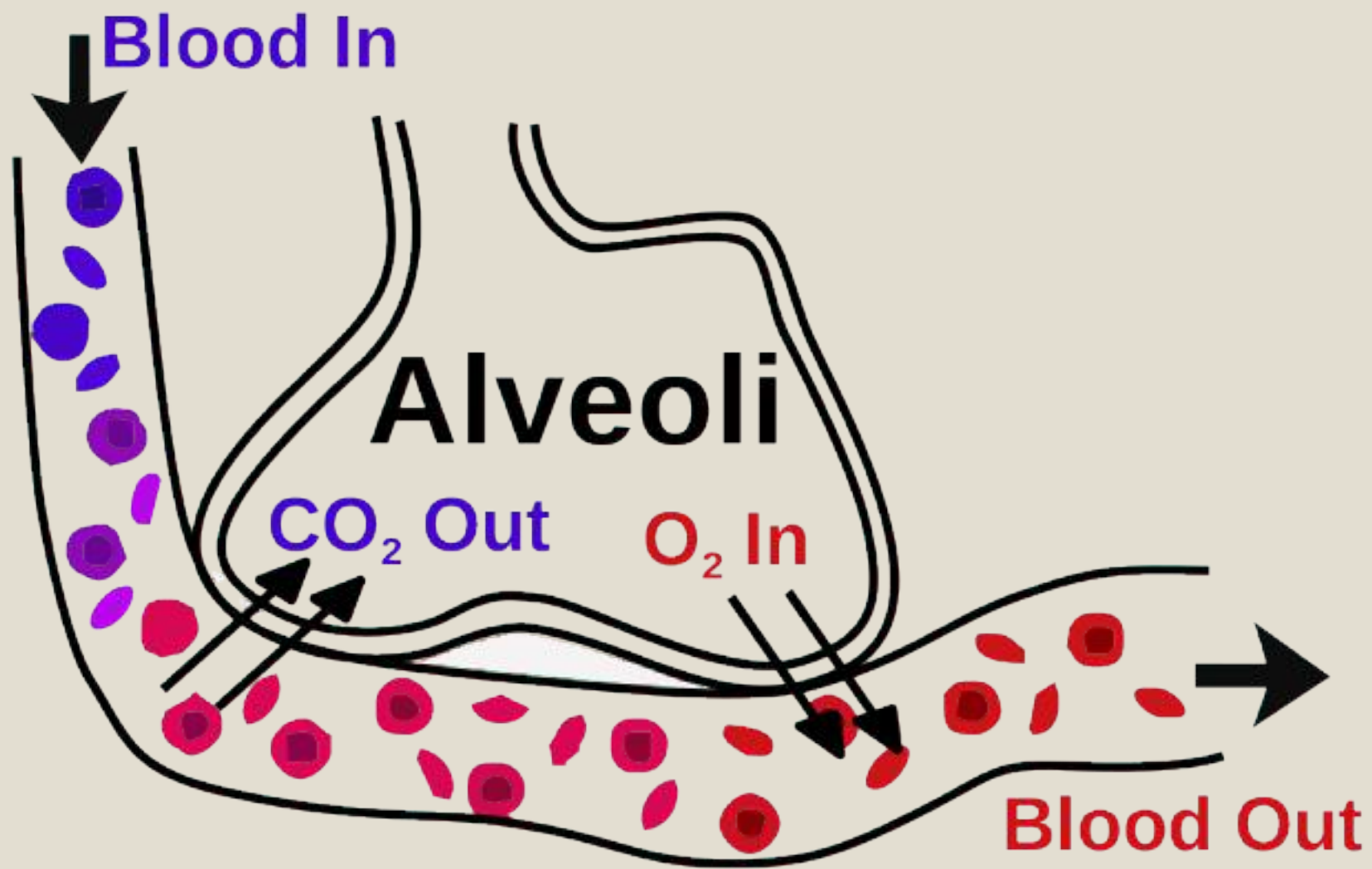
The alveolar sacs consist of **several alveoli** opening into a single chamber.

Each alveolus is surrounded by a **rich network of blood capillaries**.

Gaseous exchange takes place between the air in the alveolar lumen through the alveolar wall into the blood within the surrounding capillaries.

Cross section of alveolar network





The main characteristics of a bronchopulmonary segment may be summarized as follows:

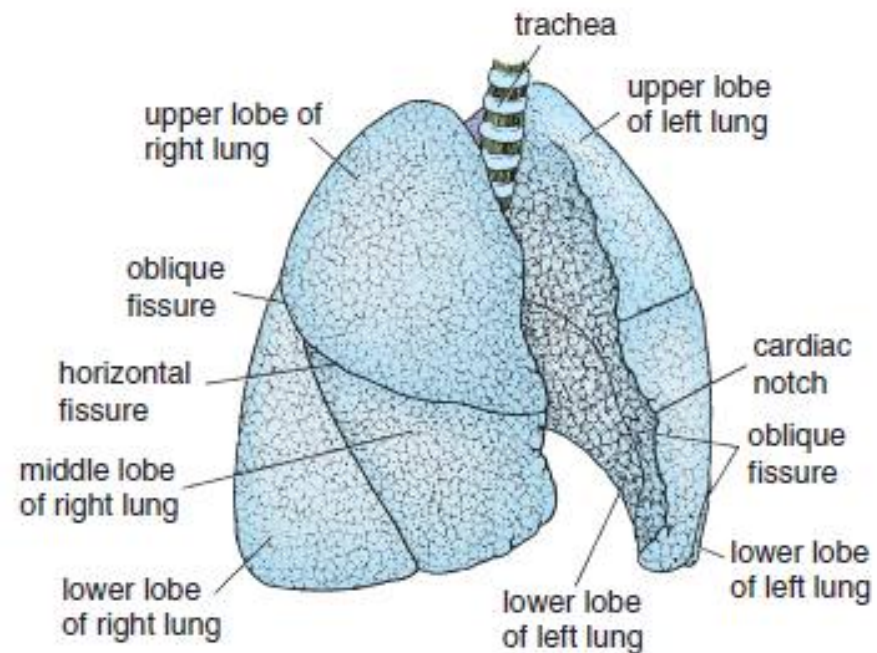
It is **pyramid shaped** with its apex toward the lung root.

It is surrounded by connective tissue septum .

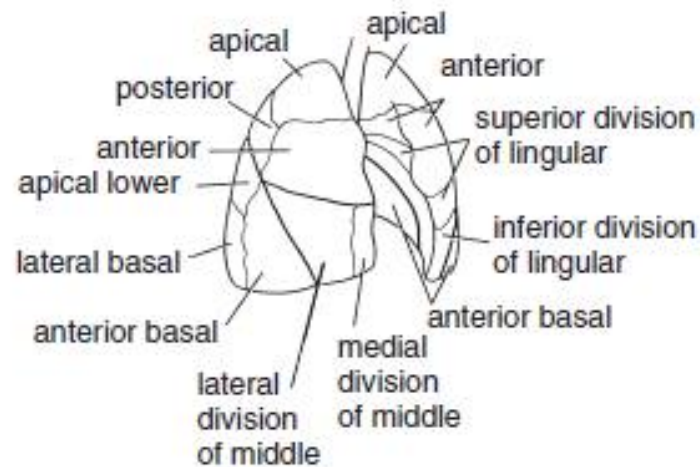
It has a segmental bronchus, a segmental artery, lymph vessels, and autonomic nerves.

The **segmental vein** lies in the connective tissue septum between adjacent bronchopulmonary segments.

Because it is a structural unit, a diseased segment can be removed surgically.

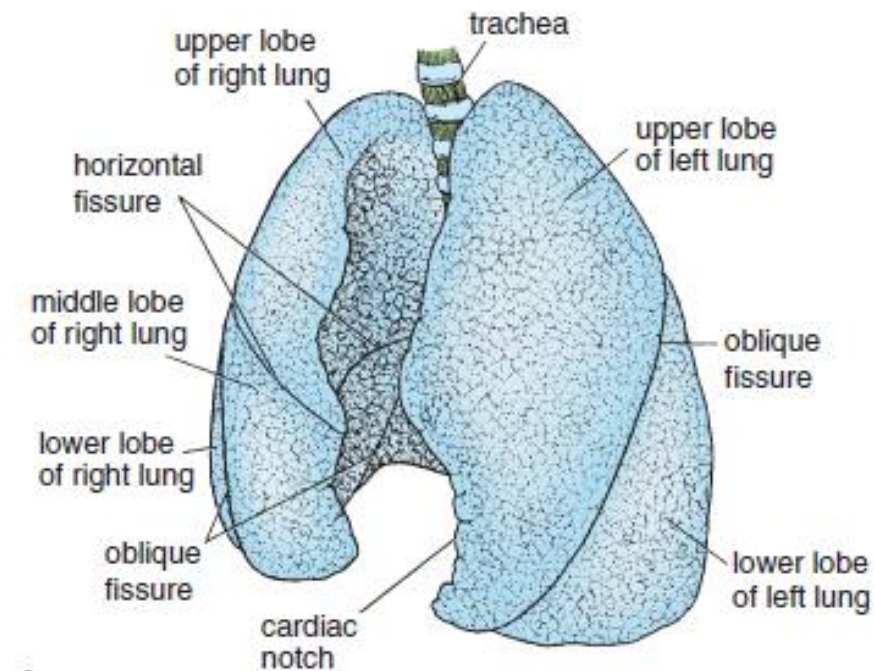


A

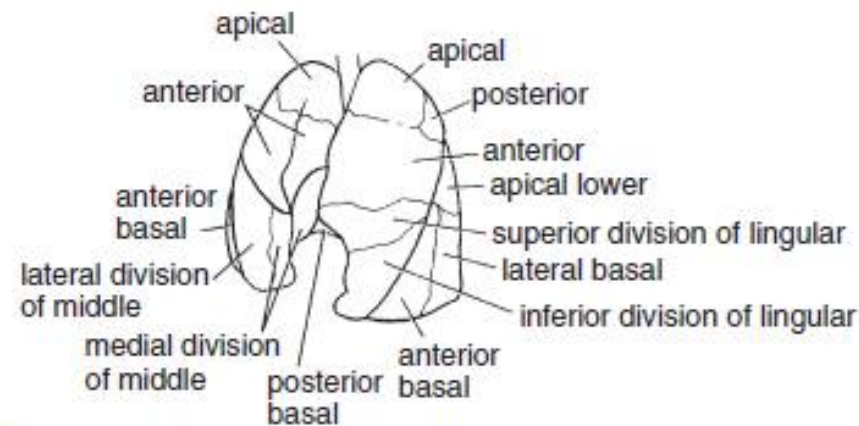


B

FIGURE 3.24 Lungs viewed from the right. **A.** Lobes. **B.** Bronchopulmonary segments.



A



B

FIGURE 3.25 Lungs viewed from the left. **A.** Lobes. **B.** Bronchopulmonary segments.

Blood Supply of the Lungs

The lung receives **DUAL** blood supply “ pulmonary and bronchial”

The bronchi, the lung and the pleura receive their blood supply from **the bronchial arteries**, which are branches of the **descending aorta**

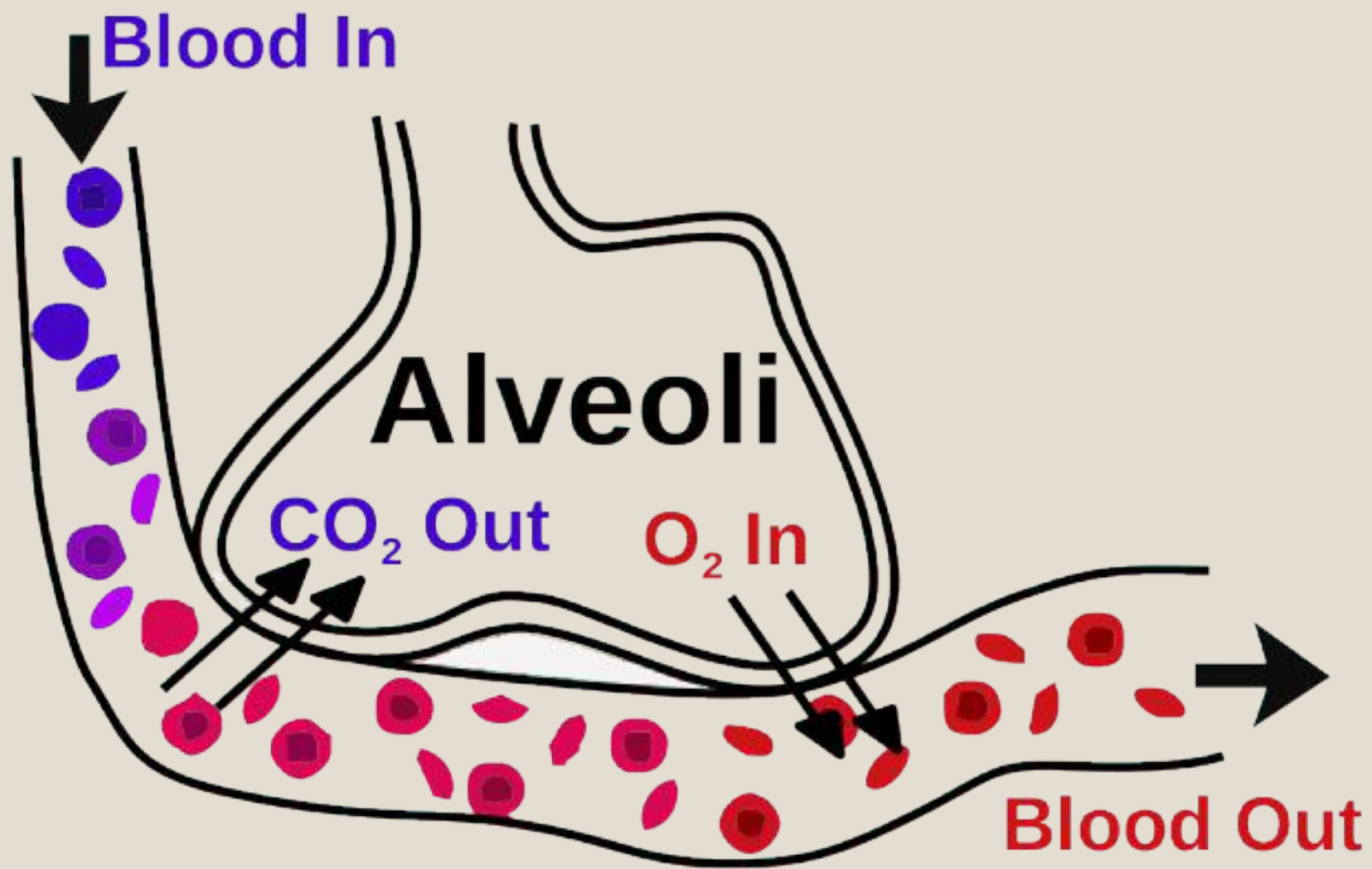
The **bronchial veins** drain into **the azygos and hemiazygos veins**

Blood Supply of the Lungs

The alveoli receive deoxygenated blood from the terminal branches of **the pulmonary arteries**.

The oxygenated blood leaving the alveolar capillaries drains into the tributaries of the **pulmonary veins**, which follow the intersegmental connective tissue septa to the lung root.

Two pulmonary veins leave each lung root, to empty into the left atrium of the heart.

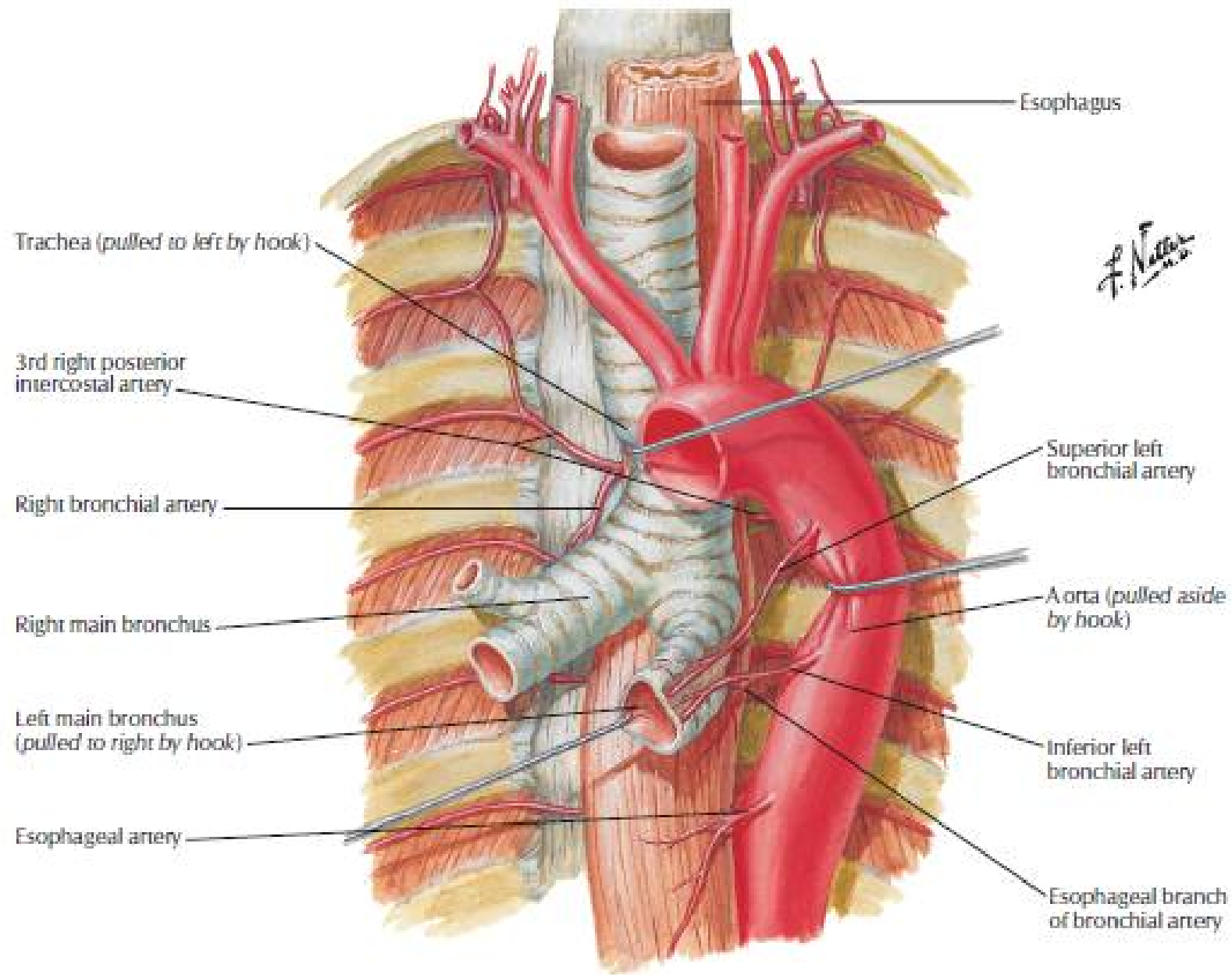


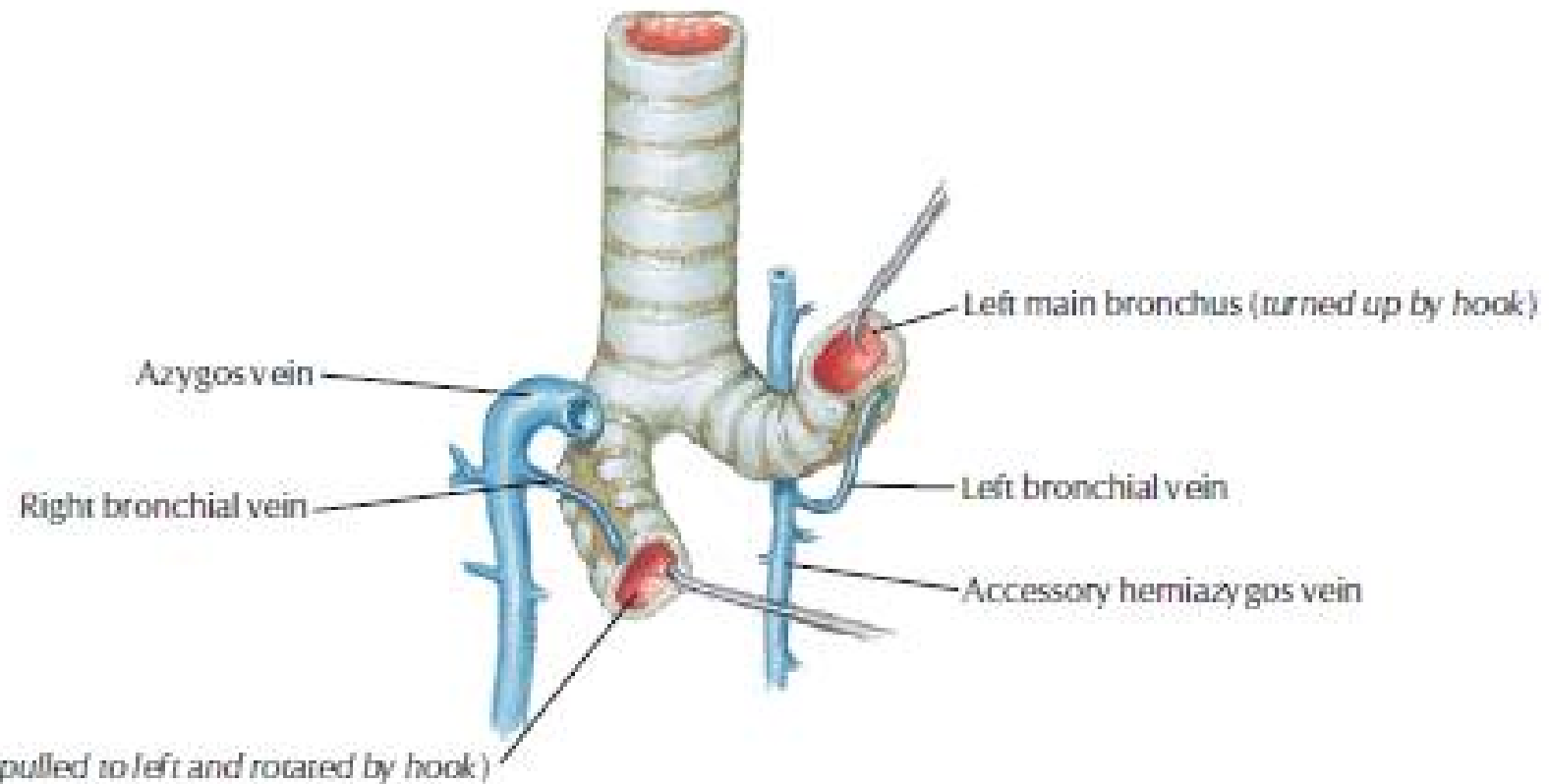
Overview of pulmonary circulation

Vessels	Anatomy	Characteristics
Pulmonary trunk	• Originates in the right ventricle of the heart • Divides into the left and right pulmonary arteries → lobar, segmental, and subsegmental arteries	• Carries deoxygenated blood from the right ventricle to the lungs for oxygenation
Left pulmonary artery 🗺️	• Superior to the left main bronchus. • Connects to the arch of the aorta by the ligamentum arteriosum	• Carries deoxygenated blood from the pulmonary trunk to the left lung for gas exchange
Right pulmonary artery 🗺️	• Posterior to the aorta and the superior vena cava • Anterior to the right main bronchus	• Carries deoxygenated blood from the pulmonary trunk to the right lung for gas exchange
Pulmonary veins	• Originate in the alveoli from venules → form 2 pulmonary veins in each lung → 4 pulmonary veins merge into the left atrium	• Drain oxygenated blood from alveoli to the left atrium • Drain deoxygenated blood from the visceral pleura and respiratory zones to the left atrium

Overview of bronchial circulation

Vessels	Anatomy	Characteristics
Bronchial arteries	• Left: usually 2 arteries that arise from the thoracic aorta • Right: usually 1 artery that arises from one of the following ◦ Right posterior intercostal artery ◦ Thoracic aorta ◦ Left superior bronchial artery	• Supply oxygenated blood to the lung parenchyma, bronchi, and the visceral pleura
Bronchial veins	• Originate near the bronchi • Empty into the <u>azygos vein</u> (right) and into the <u>accessory hemiazygos vein</u> or the superior intercostal vein (left)	• Drain deoxygenated blood from hilar structures and conducting zone structures





Nerve Supply of the Lungs

At the root of each lung is **pulmonary plexus** .

The plexus is formed from branches **the sympathetic trunk** and receives **parasympathetic fibers from the vagus nerve**

The **sympathetic** fibers produce **bronchodilatation** and vasoconstriction.

The **parasympathetic** fibers produce **bronchoconstriction**, vasodilatation, and increased glandular secretion.

