

PRESENTING OUR

# GKTEACH

STAGE 1 SERIES



MSA  
Education

Last one for this  
term!

~~FMS - CELL BIOLOGY AND SIGNALLING~~

~~MONDAY 13TH NOV 6PM~~

~~FMS - MOLECULAR AND CELL GENETICS~~

~~THURSDAY 16TH NOV 6PM~~

~~FMS - NUTRITION AND METABOLISM~~

~~TUESDAY 21ST NOV 6PM~~

ANATOMY OF RESPIRATORY AND  
CARDIOVASCULAR SYSTEMS

~~WEDNESDAY 29TH NOV 12:30PM~~

PHYSIOLOGY OF RESPIRATORY AND  
CARDIOVASCULAR SYSTEMS

~~WEDNESDAY 29TH NOV 4PM~~

~~FPP - PHARMACOLOGY~~

~~MONDAY 4TH DEC 6PM~~

~~RESPIRATORY PHYSIOLOGY~~

~~MONDAY 11TH DEC 6PM~~

RESPIRATORY ANATOMY

THURSDAY 14TH DEC 6PM

MAKE SURE TO COME ALONG!



# The Respiratory System Anatomy



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Year 2  
Dec 2023

# Intro to Resp

- Define the limits of the thoracic cavity, including the inlet and outlet
- Know the attachments of the diaphragm and identify its openings
- Know the blood supply and innervation of the diaphragm
- Describe the role of the chest wall and diaphragm as a bellows for the lungs
- Describe the arrangements of pleural membranes, their sensory innervations, and the crucial role of pleural fluid in maintaining the lungs inflated
- Define the principal mechanisms of increasing thoracic volume during inspiration, and understand why this volume is already increased in patients with emphysema

## Anatomy of Breathing

- Describe the thoraco-abdominal pump, and give a brief account of the effects of posture on respiratory mechanics
- Describe the action of the diaphragm, and contrast this with the part played by the chest wall in respiratory movements
- Know the stabilising role of quadratus lumborum for diaphragmatic movements
- List the muscles that stabilise the 1<sup>st</sup> and 2<sup>nd</sup> ribs.
- Give an account of the intercostal muscles and their actions
- Discuss the significance of 'flail-chest' on respiratory function
- List the accessory muscles of respiration

# Learning Objectives

# Upper Resp Tract


- Know the parts of the respiratory system and be aware of some of the common conditions affecting them. Be familiar with the term 'upper respiratory tract'
- Know the respiratory functions of the nasal cavities & paranasal sinuses
- List the protective mechanisms of the airway
- Describe the phases of the cough reflex
- List the cartilages and membranes of the larynx
- Outline the structures of the laryngeal inlet and define their role in protecting the lungs
- Know how to perform an emergency laryngotomy
- Describe the anatomy of the larynx and trachea including their nerve and blood supply
- Describe the branching pattern of the trachea and bronchi, and explain why an inhaled foreign object is more likely to be found in the right lung


# Lungs + Pleurae



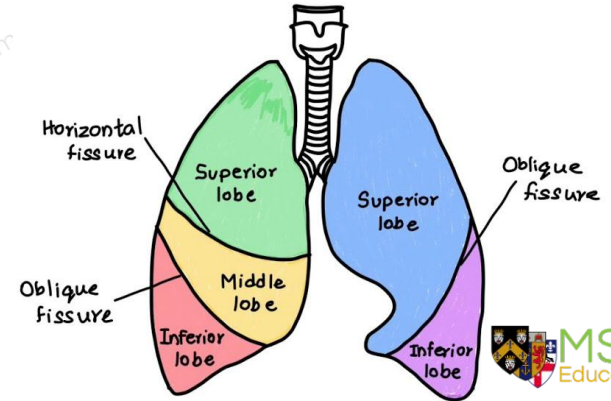
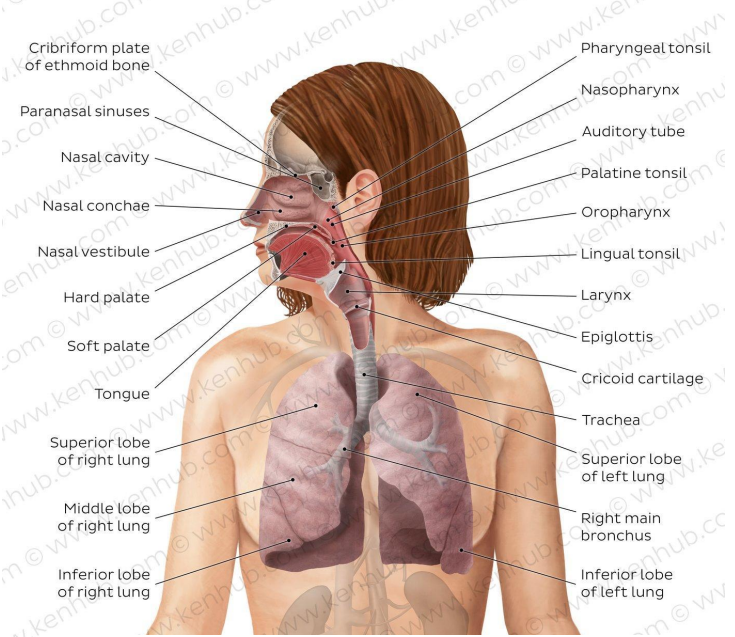
- Describe the lobes and surface features of the lungs
- Give an account of the surface anatomy of the lungs and pleurae
- Give an account of the structures found in the lung hila including their relation to one another
- Describe what lies around the lung root and know the structures which impress on the mediastinal surface of each lung
- Give a very brief account of the lymphatic drainage of the lungs and pleura, relating this to lung disease and lung cancer
- Know the innervation of both lungs and pleurae

# TL;DR

- Mouth + Nasal Cavity -> Pharynx -> Larynx -> Trachea  
-> Carina  -> Lobar bronchi -> Segmental Bronchi -> Bronchioles -> Alveoli

- Right lung has 3 lobes 
- Left lung has 2 lobes

- 2 layers of pleura (visceral and parietal) between which there's pleural fluid ; these layers form the pleural cavity between them which has a negative pressure.
- This negative pressure causes the lungs to pull outwards with the chest wall during inspiration allowing the lungs to expand
- The pleura is innervated by intercostal nerves and phrenic nerve



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HOUSE  
FOX

(SUPERIORLY)  
thoracic inlet

(POSTERIORLY)  
thoracic vertebral  
column (T1-T12)

# Thoracic Cavity

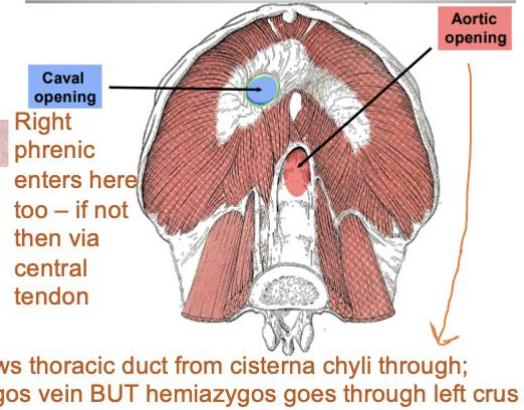
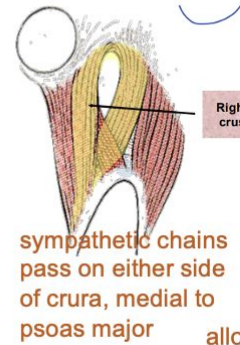
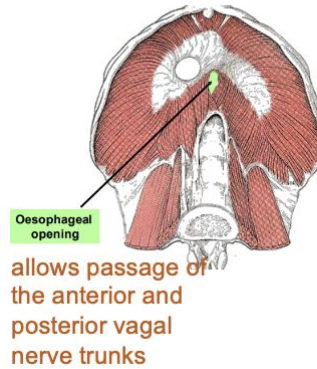
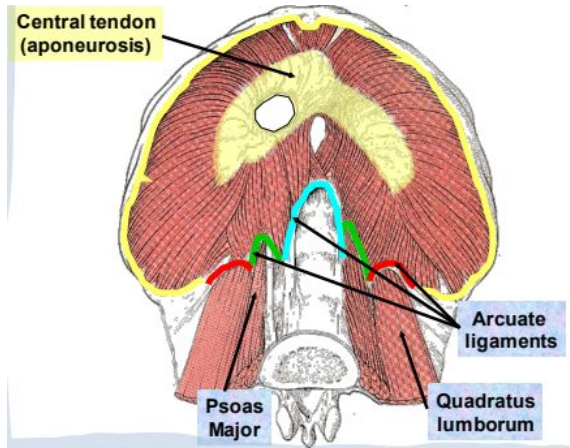
(LATERALLY)  
12 pairs of ribs  
(ANTERIORLY)  
sternum

(INFERIORLY)  
inferior thoracic aperture,  
closed off by the  
diaphragm



# The Diaphragm

- Diaphragm two muscular hemispheres joined by a central tendinous portion AKA aponeurosis; right dome sits higher than the left dome due to presence of liver. The quadratus lumborum helps stabilise this.



## T8• Caval opening

» IVC & R. Phrenic n.

## T10• Oesophageal opening

» Oesophagus ▶ hemiazygos  
» Ant & Post Vagal Trunks

## T12• Aortic opening

» Aorta  
» Thoracic duct  
» Azygos vein

•**Blood Supply:** Supplied by the phrenic arteries, branches of the abdominal aorta.

•**Innervation:** Mainly by the phrenic nerves (C3-C5), arising from the cervical plexus

It is a tool used to push air into a fire to help the fire to catch flame. So the lungs act like the leather bag of the bellows. When the diaphragm contracts, its domes lower and hence the lungs inflate, just as the leather bag inflates and air is sucked in. When the diaphragm relaxes it is elevated again and the lungs are deflated, and air is pushed out. The rib cage is like the other paddle.



► **Surfactant** reduces surface tension between alveoli;  
it's a lipoprotein secreted by type II pneumocyte cells lining the alveoli. Absent from premature babies so they're unable to inflate their lungs

### **Principal Mechanisms of Increasing Thoracic Volume during Inspiration:**

Diaphragmatic Contraction: Increases the vertical dimension.

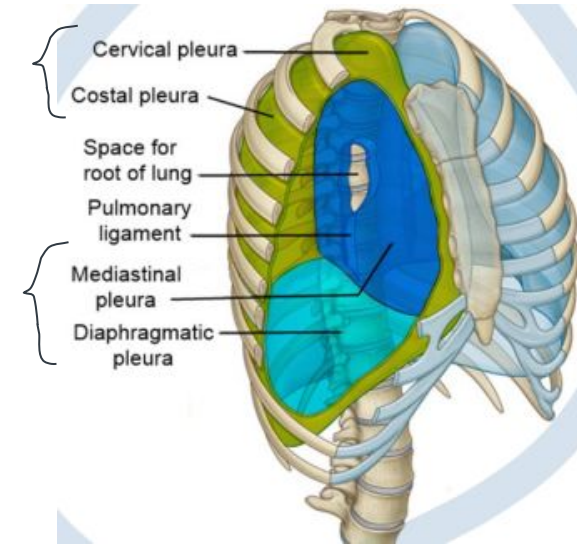
Elevation of Ribs: External intercostal muscles lift the ribs, increasing transverse and anteroposterior dimensions.

Accessory Muscles: Sternocleidomastoid, scalene, and pectoralis minor assist.

Result: Expansion of the thoracic cavity and a decrease in intrathoracic pressure, facilitating air entry into the lungs.

sensation from intercostal nerves,  
localised pain

phrenic nerves C3,4,5, pain over  
shoulder



### **Increased Thoracic Volume in Patients with Emphysema:**

Emphysema: Destruction of alveolar walls leads to loss of elasticity.

Consequence: Decreased recoil during expiration.

Result: Increased residual volume and a more inflated state of the lungs.

# SBA

At the thoracic inlet, which nerve lies between the common carotid artery and internal jugular vein?

1. Internal laryngeal
2. Phrenic
3. Recurrent laryngeal
4. Sympathetic chain
5. Vagus

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- **Scalene Muscles:** Elevate the upper ribs.
- **Sternocleidomastoid:** Elevates the sternum and assists in inspiration.
- **Pectoralis Major and Minor:** May elevate the ribs during forced inspiration.
- **Abdominal Muscles:** Contribute to forced expiration.



### Sternocleidomastoid

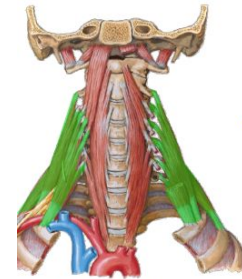
(the nosey-parker's muscle)

Action 1: Extends head, flexes neck

Action 2: Turns head

Action 3: Inspiratory Muscle

Innervation: Spinal Accessory  
CN XI



### Scalene Muscles

Action 1: Lateral flexion of neck

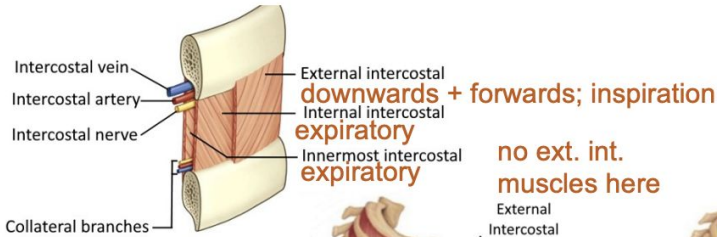
Action 2: Flexion of Neck

Action 3: Inspiratory Muscle

Innervation: Cervical Plexus

Scalene Muscles

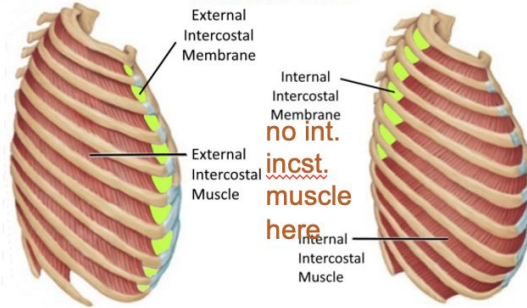
muscles attach to the cervical vertebrae proximally and 1<sup>st</sup> (scalenus anterior and medius) and 2<sup>nd</sup> (scalenus posterior) ribs distally, and hence elevate them when the neck is stable. These muscles are innervated by nerves of the cervical plexus.



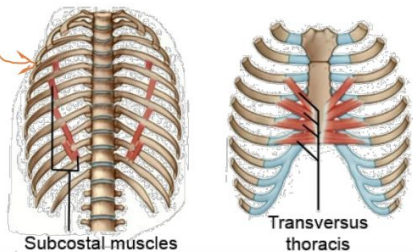
External intercostal  
**downwards + forwards; inspiration**  
Internal intercostal  
**expiratory**  
Innermost intercostal  
**expiratory**

no ext. int. muscles here

innermost muscles of chest wall like internal incst. layer but can cross more than one intrctl. space. Anteriorly, forms the transversus thoracis, post. the subcostal muscles. Weak expiratory.



no int. incst. muscle here



Subcostal muscles

Transversus thoracis

## Intercostal Muscles and Their Actions:

- The intercostal muscles are located between the ribs and are involved in breathing.
  - **External Intercostals:** Elevate the ribs during inspiration.
  - **Internal Intercostals:** Depress the ribs during forced expiration.
  - **Innermost Intercostals:** Assist in expiration.

# SBA

- **A 45-year-old man presents to the emergency room with severe chest pain and difficulty breathing following a motor vehicle accident. Physical examination reveals paradoxical movement of a segment of the chest wall during inspiration and expiration. Chest X-ray confirms multiple rib fractures on one side. What is the likely diagnosis?**

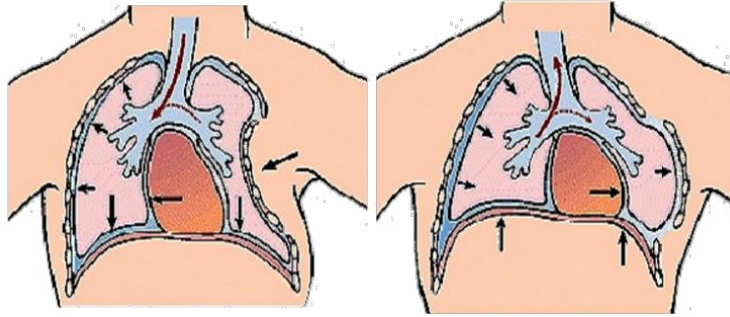
1. Tension Pneumothorax
2. Flail Chest
3. Hemothorax
4. Simple Rib Fracture
5. Pneumomediastinum



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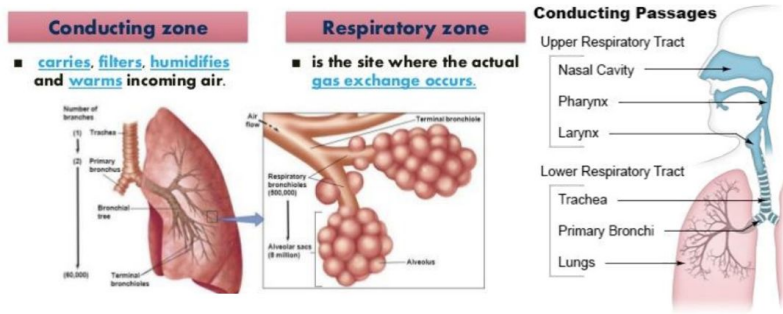


Flail Chest: if multiple ribs are broken then intercostal muscles unable to prevent the sucking-in of the chest wall during inspiration. During expiration when internal volume is reduced and pressure increased, ribs in flail segment will be blown out

The affected area moves inward during inspiration and outward during expiration, impairing the efficiency of ventilation.

# Upper Resp Tract

- Know the parts of the respiratory system and be aware of some of the common conditions affecting them. Be familiar with the term 'upper respiratory tract'
- Know the respiratory functions of the nasal cavities & paranasal sinuses
- List the protective mechanisms of the airway
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Air within conducting zone is not exchanged so its called 'anatomical dead space'. Respiratory tract can also have dead zones but this will be where there's mismatches in ventilation-perfusion matches and blood flow to an alveolus, then that's 'functional dead space'

Respiratory zone is made of alveoli and bronchioles. Alveolar type 1 cells are where diffusion of gases occurs; type 2 cells are where surfactant is made

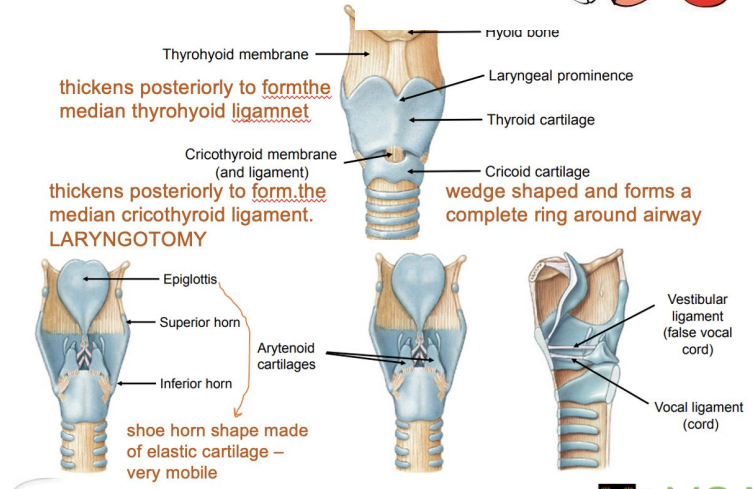
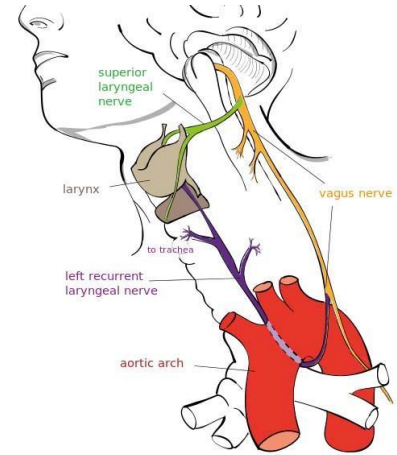
pseudostratified ciliated columnar epithelium in nasal cavity until bronchi where it becomes cuboidal epithelial. wafts down in nose, up in trachea + bronchi

## Respiratory Functions of the Nasal Cavities & Paranasal Sinuses:

- **Nasal Cavities:** Filter, humidify, and warm incoming air; trap and remove particles.
- **Paranasal Sinuses:** Lighten the skull, produce mucus, and influence vocal resonance.

## Phases of the Cough Reflex:

1. **Inhalation:** Deep breath to maximize lung expansion.
2. **Compression:** Glottis closes, and intrathoracic pressure rises.
3. **Exhalation:** Glottis opens, and a rapid rush of air expels irritants.



# SBA

What is the main cause of neonatal respiratory distress syndrome?

1. A lack of surfactant in the alveoli
2. Alveolar breakdown
3. Lung fibrosis
4. Overproduction of mucus by small bronchioles
5. Phrenic nerve damage

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# SBA

Which receptors in the lungs are stimulated by pulmonary oedema?

1. Hering-Breuer
2. Irritant
3. Juxtapulmonary
4. Proprioceptive
5. Trigeminal

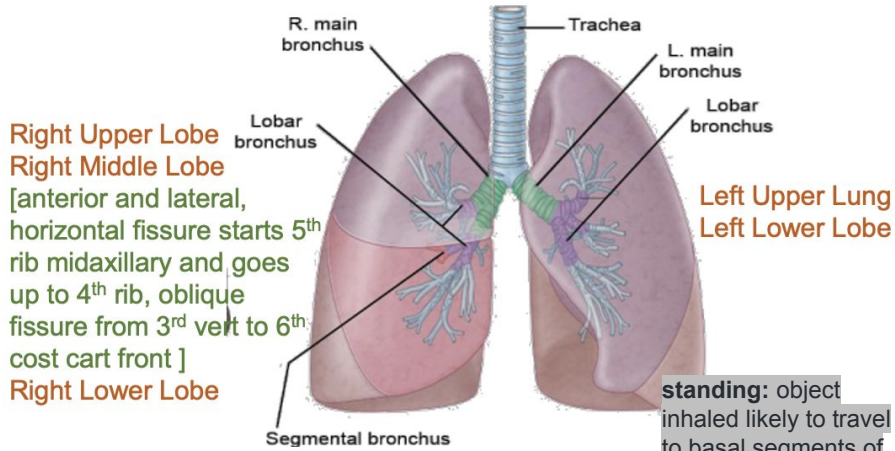
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# Lungs and Pleurae

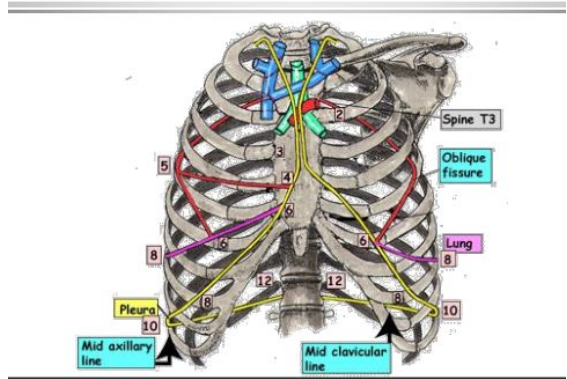
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- Know the innervation of both lungs and pleurae



Right Upper Lobe  
Right Middle Lobe  
[anterior and lateral, horizontal fissure starts 5<sup>th</sup> rib midaxillary and goes up to 4<sup>th</sup> rib, oblique fissure from 3<sup>rd</sup> vert to 6<sup>th</sup> cost cart front]  
Right Lower Lobe

**standing:** object inhaled likely to travel to basal segments of lower lobe  
**supine:** object flow into posteriorly placed segment of lung

## Location of the Parietal Pleurae



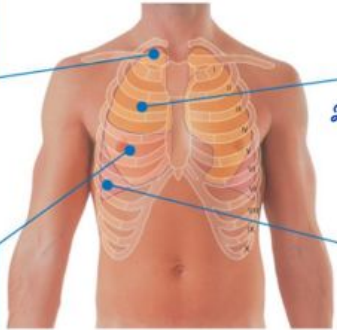
## apex of R. lung



Apex of right lung  
medial end of the clavicle



Superior lobe of right lung  
2<sup>nd</sup> intercostal space



4<sup>th</sup> intercostal space

middle lobe of R. lung

5<sup>th</sup> intercostal space



Middle lobe of right lung



Inferior lobe of right lung

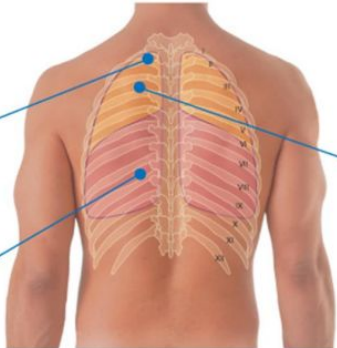
inferior lobe of R. lung



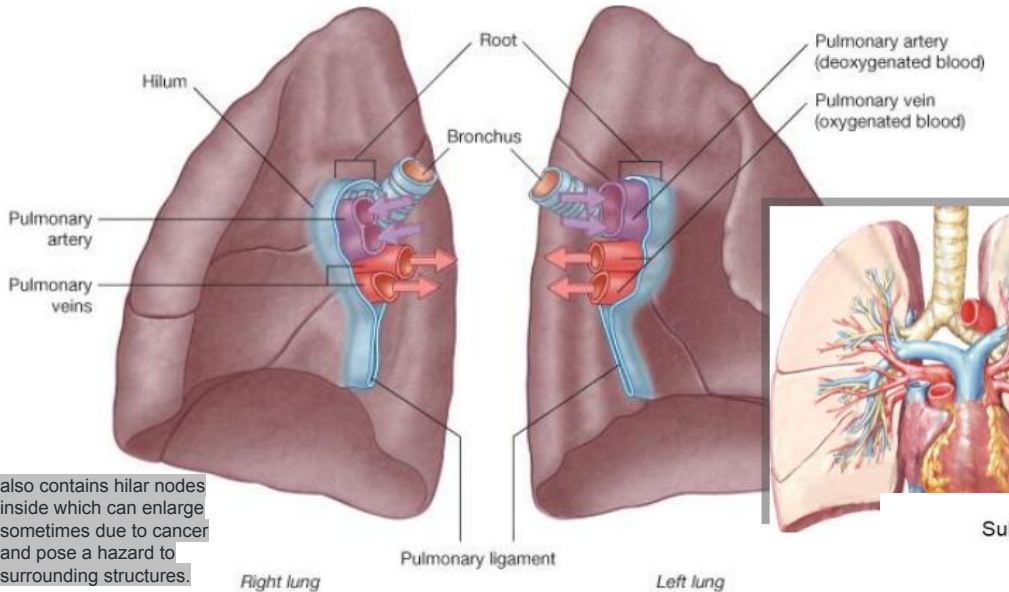
Apex of left lung



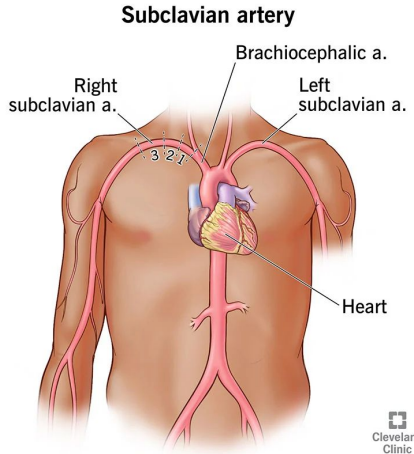
Superior lobe of left lung  
sup. lobe of L. lung



Inferior lobe of left lung



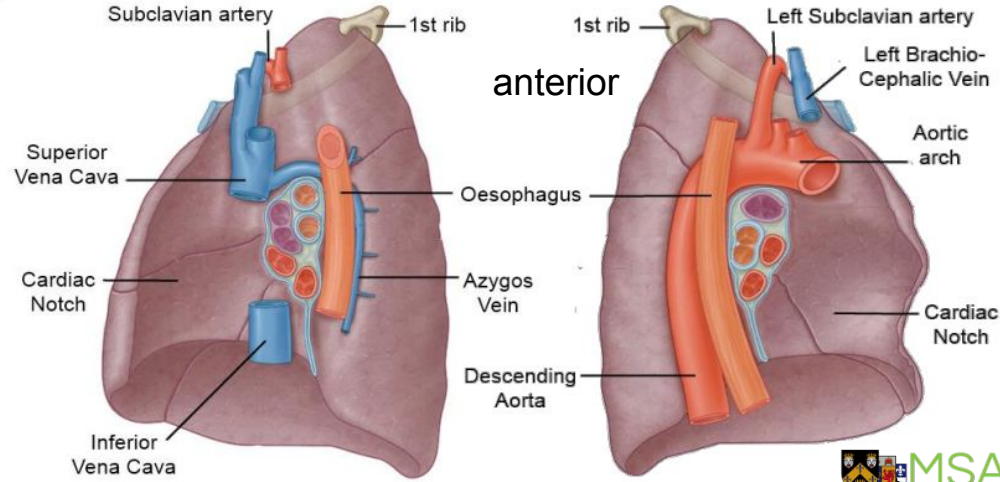
also contains hilar nodes inside which can enlarge sometimes due to cancer and pose a hazard to surrounding structures.



Cleveland Clinic ©2022

**Lymph Nodes:**

Drainage occurs to hilar and mediastinal lymph nodes. Lymphatic drainage is crucial for staging and diagnosing lung diseases, including lung cancer.



# SBA

A 50 year old woman visits her GP after finding a lump in her left breast. The GP identifies enlarged lymph nodes in her left axilla. What does the lymphatic system of the left breast drain to?

1. Cervical lymph nodes
2. Cisterna chyli
3. Para-aortic lymph nodes
4. Right lymphatic duct
5. Thoracic duct



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# Questions?

# To summarise



- Study by lesson objectives
- There's a lot of faff, ignore it
- Focus on PCRS more than the anatomy

## Sources:

- Hunter's Lectures
- Sources on Keats
- NinjaNerd
- Dr Mike



Thank you for attending the session -

Please fill in the feedback form:

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