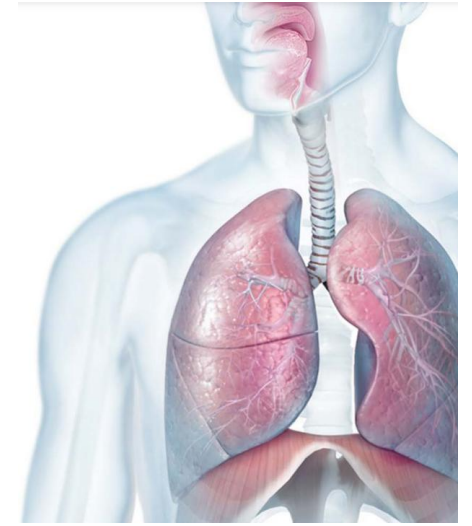




# ANATOMY OF THE RESPIRATORY SYSTEM

HUMAN ANATOMY

College of Pharmacy

Dr. Abeer Abdullah

## LEARNING OUTCOMES

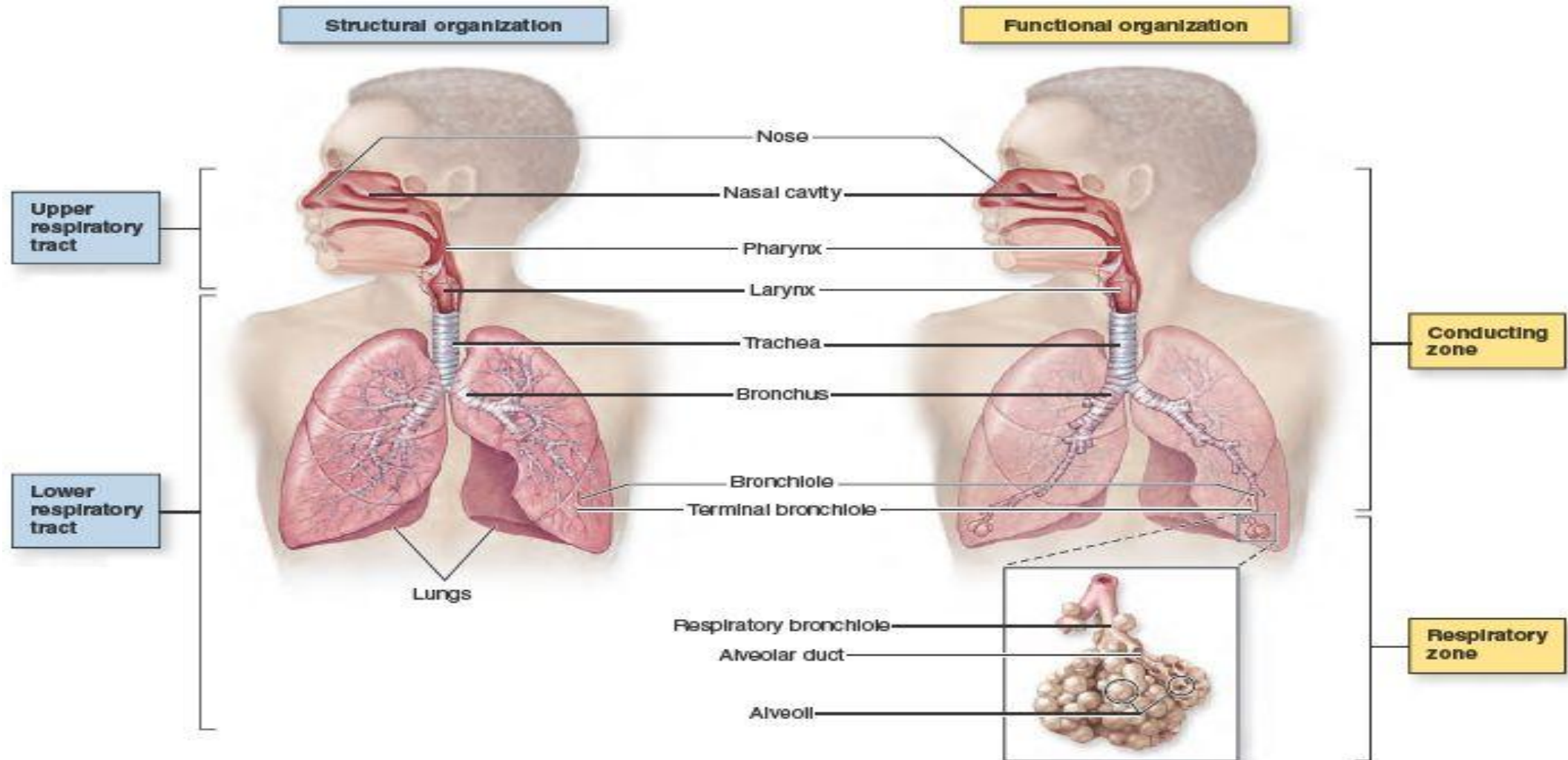
- Describe the structure and function of the respiratory system
- Identify the components of the conducting and respiratory zones
- Trace the pathway of air from the trachea to the alveoli
- Compare the anatomy of the left and right lungs

# RESPIRATORY SYSTEM OVERVIEW

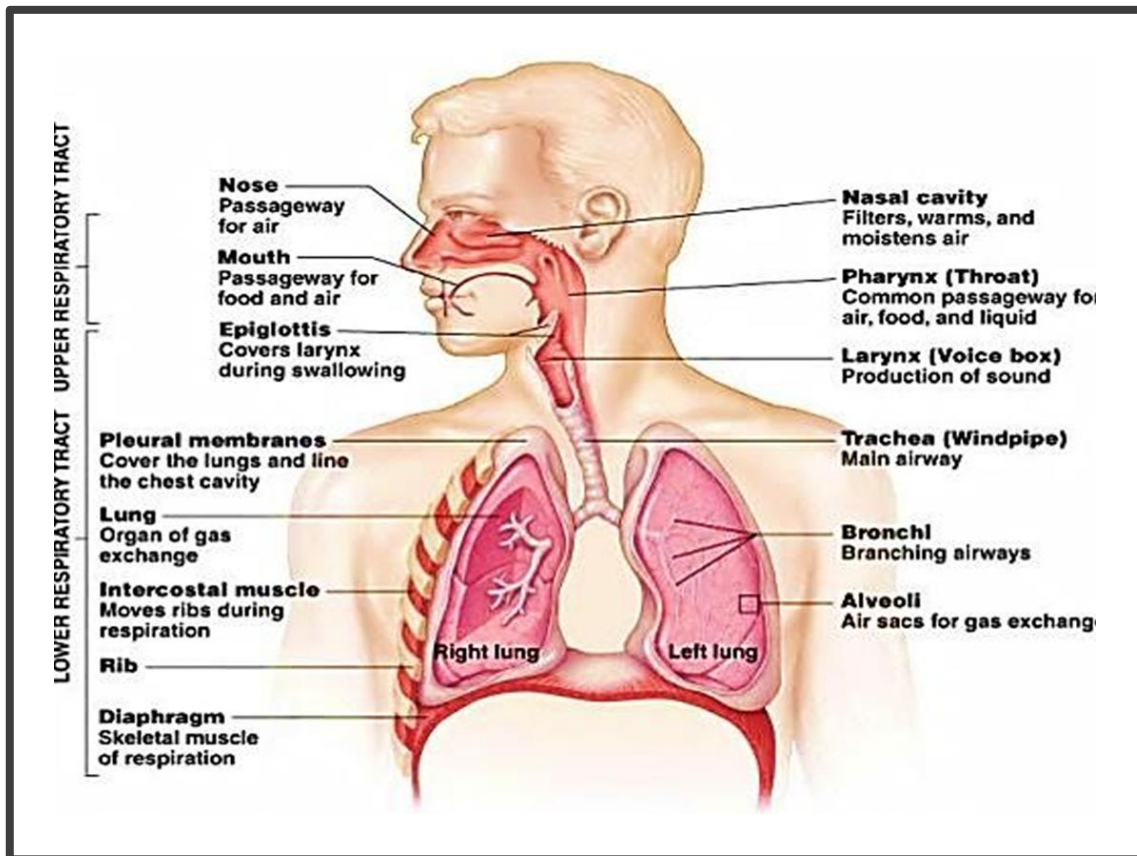
The respiratory system is an organ system specialized in following functions:

1. **Gas Exchange:** Supplies oxygen to blood and removes carbon dioxide
2. **Air Filtration:** Filters, warms, and humidifies inspired air
3. **Sound Production:** Facilitates speech via the larynx
4. **Olfaction:** Contains smell receptors in the nasal cavity
5. **Homeostasis:** Helps regulate blood pH and eliminates excess heat/water

# RESPIRATORY SYSTEM DIVISIONS



# RESPIRATORY SYSTEM DIVISIONS



## Anatomical Divisions:

### 1. Upper Respiratory Tract:

- Nose, nasal cavity, pharynx, and associated structures

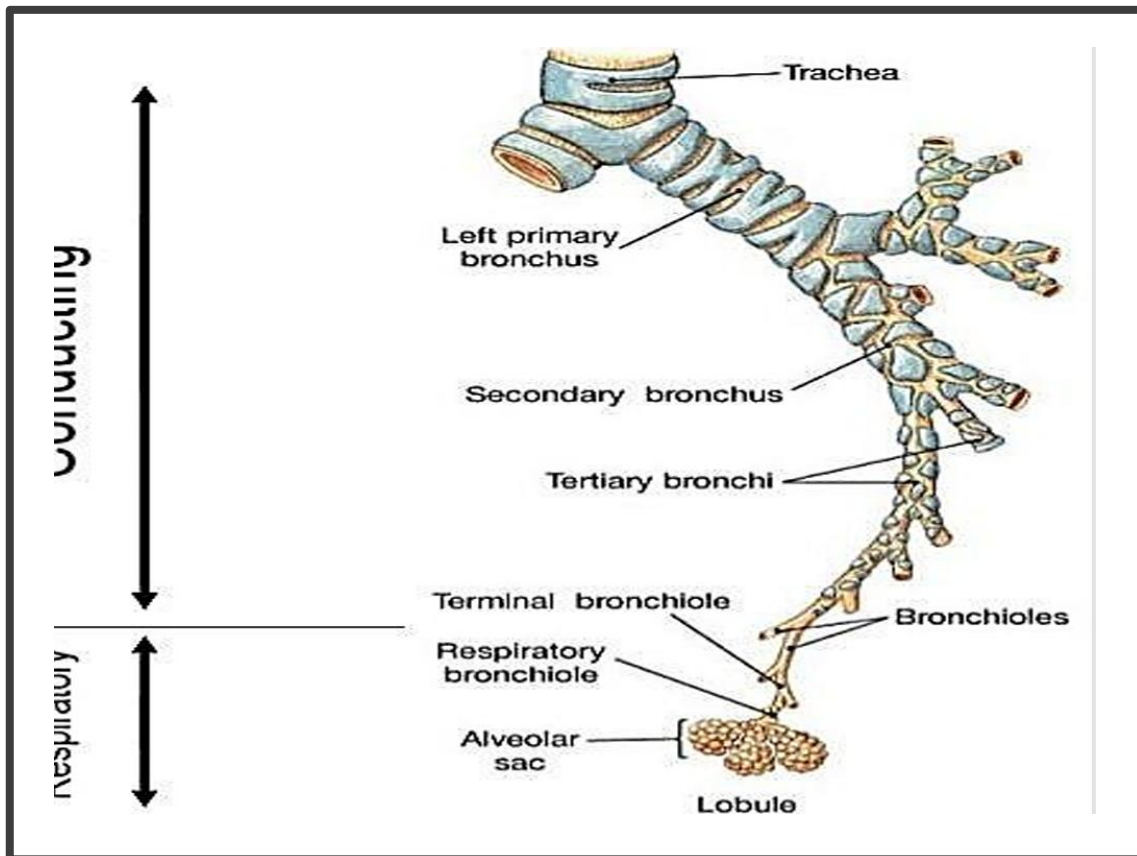
### 2. Lower Respiratory Tract:

- Larynx, trachea, bronchi, bronchioles, and lungs

## Supporting Structures:

- **Pleural Membranes:** Encase the lungs, reducing friction
- **Respiratory Muscles:**
  - **Diaphragm** (primary muscle for breathing)
  - **Intercostal Muscles** (aid in rib movement during respiration)

# RESPIRATORY SYSTEM DIVISIONS



## ■ Conducting zone

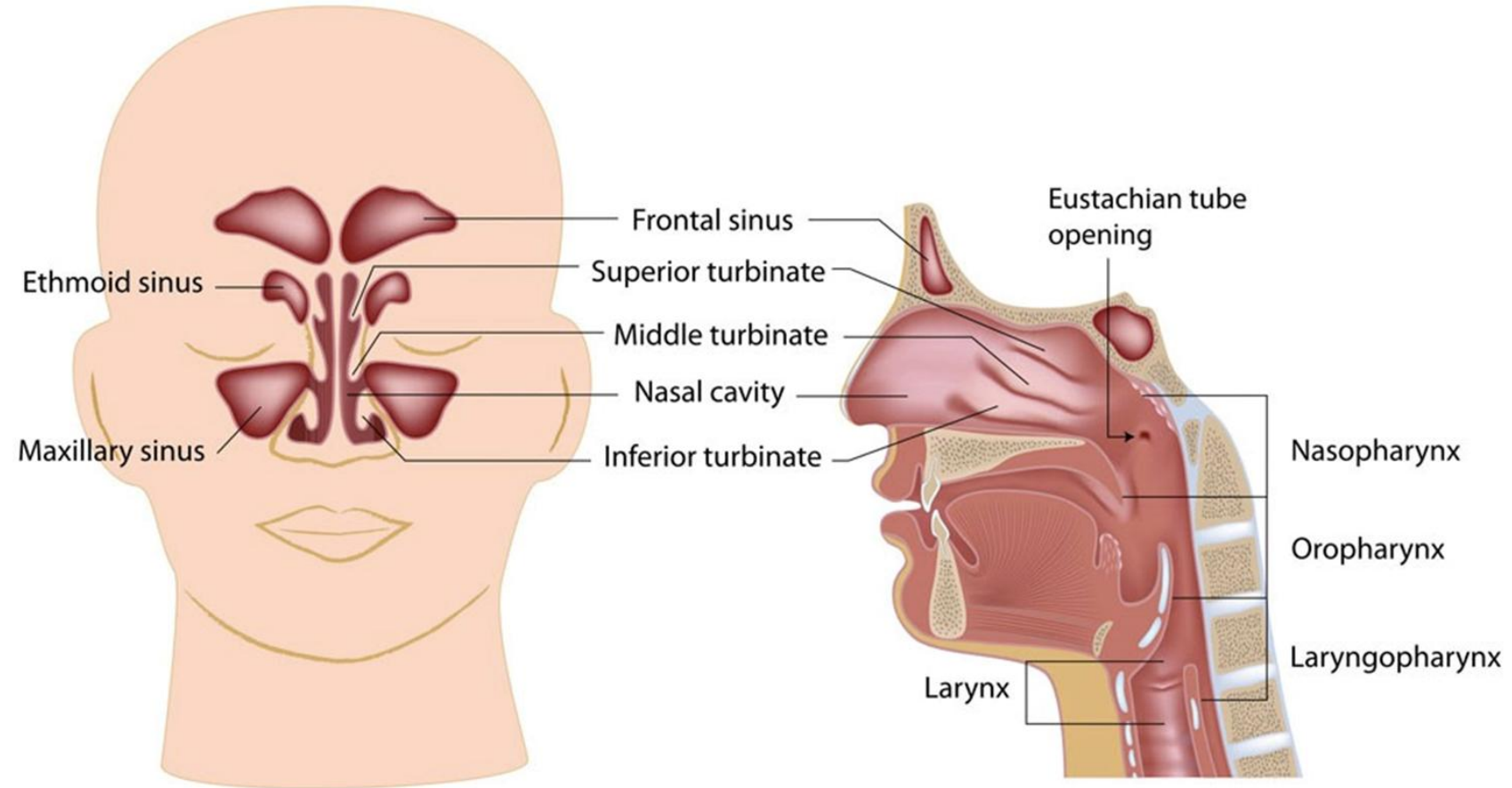
- Provides rigid conduits (passageways) for air to reach the sites of gas exchange; consists of series of interconnecting cavities and tubes
- Respiratory structures (e.g., nose, nasal cavity, pharynx, larynx, trachea, primary, secondary and tertiary bronchi)

## ■ Respiratory zone

- Site of gas exchange; consists of tubes and tissues within the lungs
- Consists of respiratory bronchioles, alveolar ducts, alveolar sacs, and alveoli

# STRUCTURE OF THE NOSE

- The nose is divided into two regions:
  - **The external nose**  
(the visible nose)
  - **The internal nasal cavity**



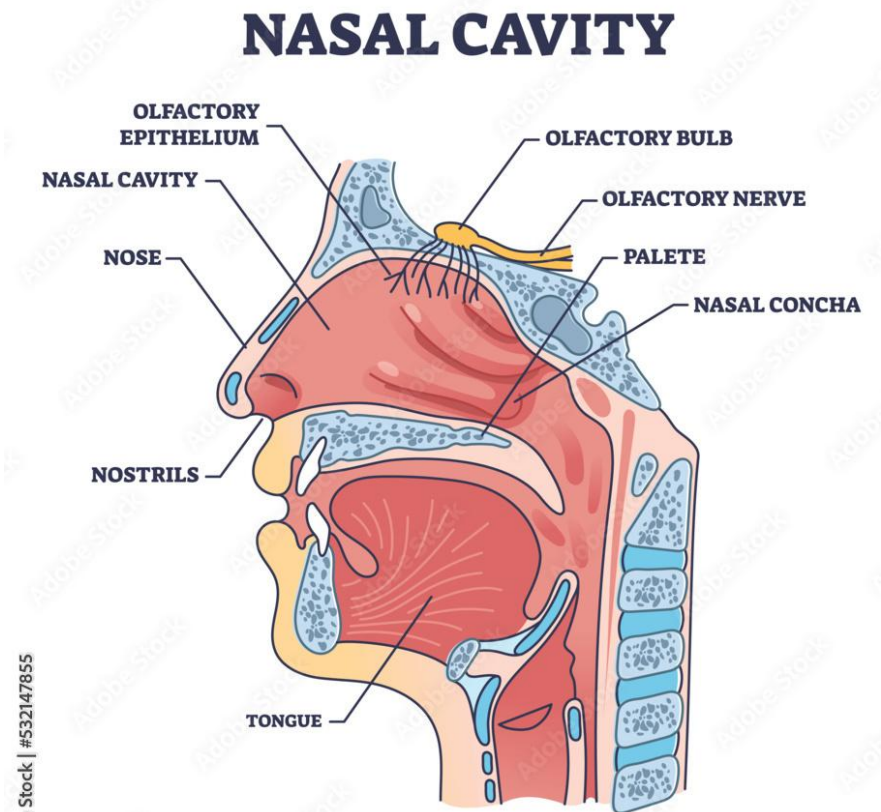
# NASAL CAVITY

## Primary Air Pathway:

- Main entry/exit point for respiratory air
- Composed of bone and cartilage framework covered by skin

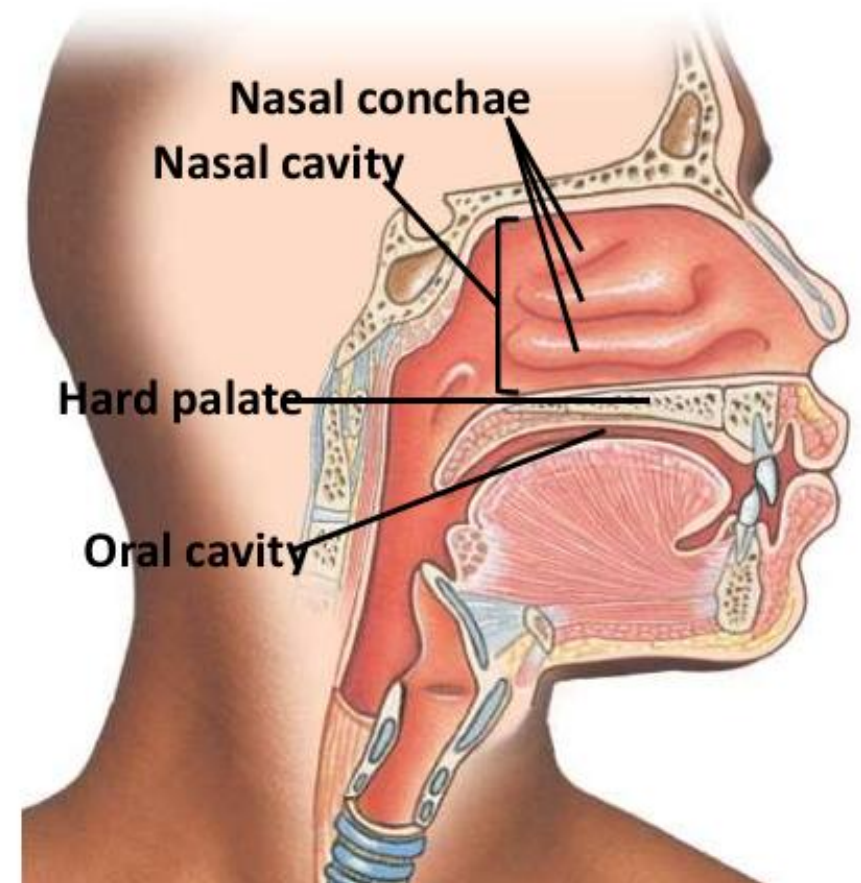
## Specialized Functions:

- Olfaction: Upper region contains smell receptors
- Air conditioning
  - Warms and humidifies incoming air
  - Filters particles via mucous and cilia



# NASAL CAVITY

- Lies posterior to the external (visible) nose
- Is divided by a midline **nasal septum** (dividing the nasal cavity into left and right)
- The nasal cavity floor is formed by the **hard and soft palates**
- Nasal cavity has turbinates (3 shelf-like bones) called **conchae** that:
  - Create turbulent airflow
  - Increase mucosal surface area
  - Connect to paranasal sinuses



# PARANASAL SINUSES

Air-filled, mucosa-lined cavities within the bones of the skull that surrounds the nasal cavity

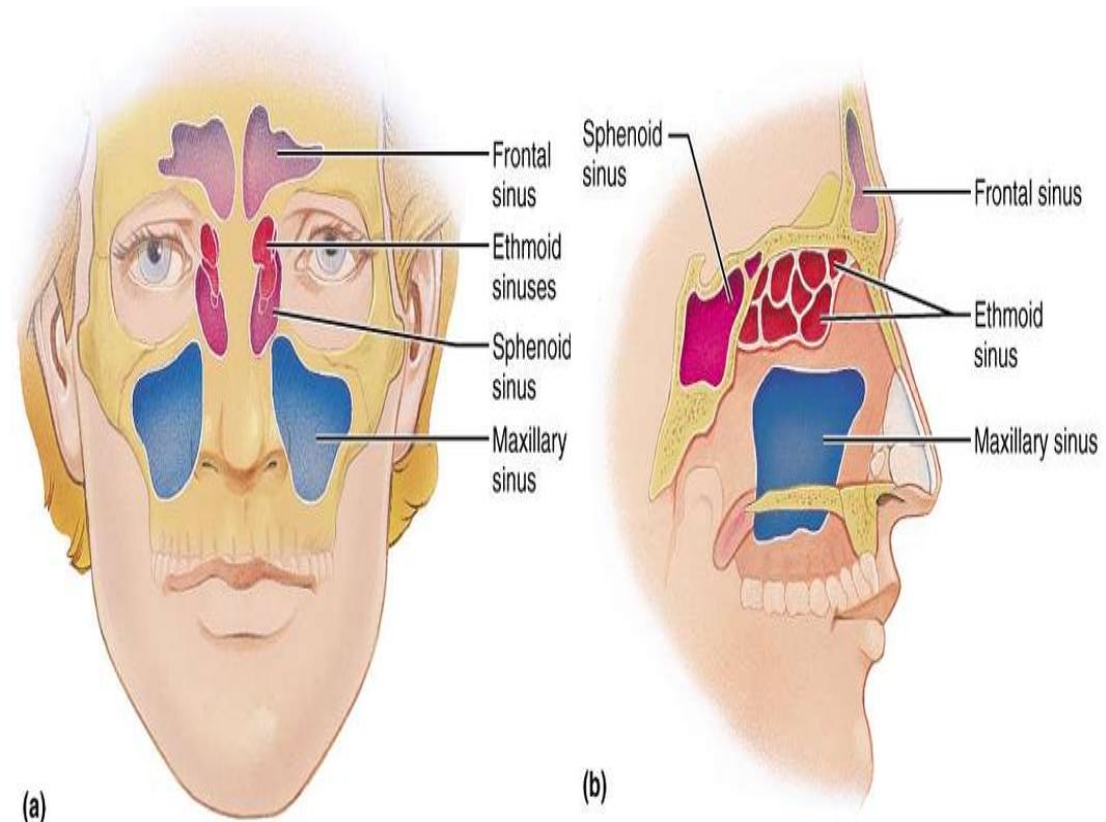
## ■ Location & Structure:

### ■ Paired cavities in **4 skull bones**:

- ✓ **Frontal bone** (pair)
- ✓ **Maxillary bones** (pair)
- ✓ **Ethmoid bone** (pair)\*
- ✓ **Sphenoid bone** (1 single cavity)

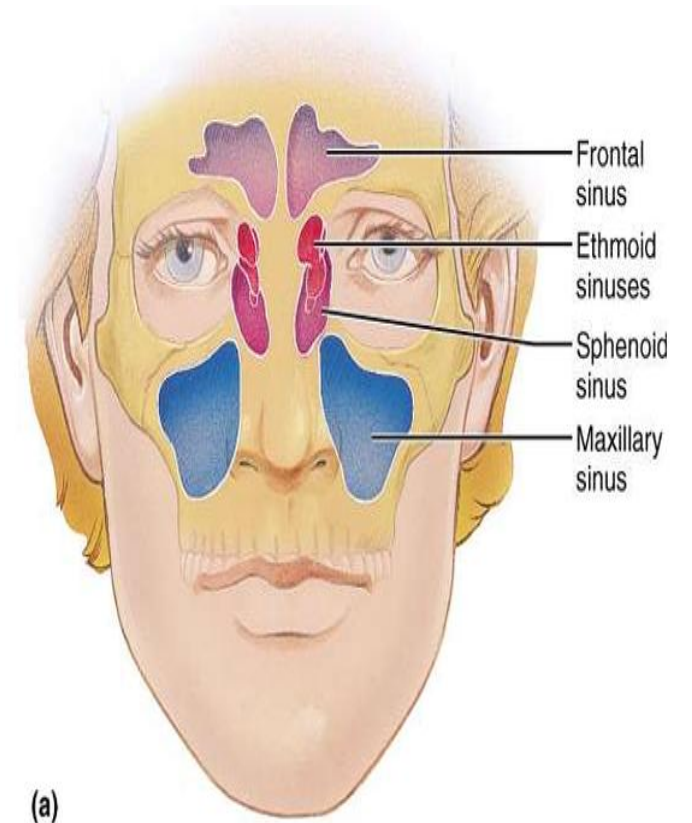
### ■ Lined with **ciliated respiratory epithelium** that:

- Produces mucus
- Drains into nasal cavity via ciliary action



# FUNCTIONS OF PARANASAL SINUSES

- **Structural:**
  - Lighten skull weight
  - Provide thermal insulation
- **Respiratory:**
  - Warm and humidify inspired air
  - Immune defense (mucus trapping)
- **Vocal:**
  - Act as resonance chambers for speech

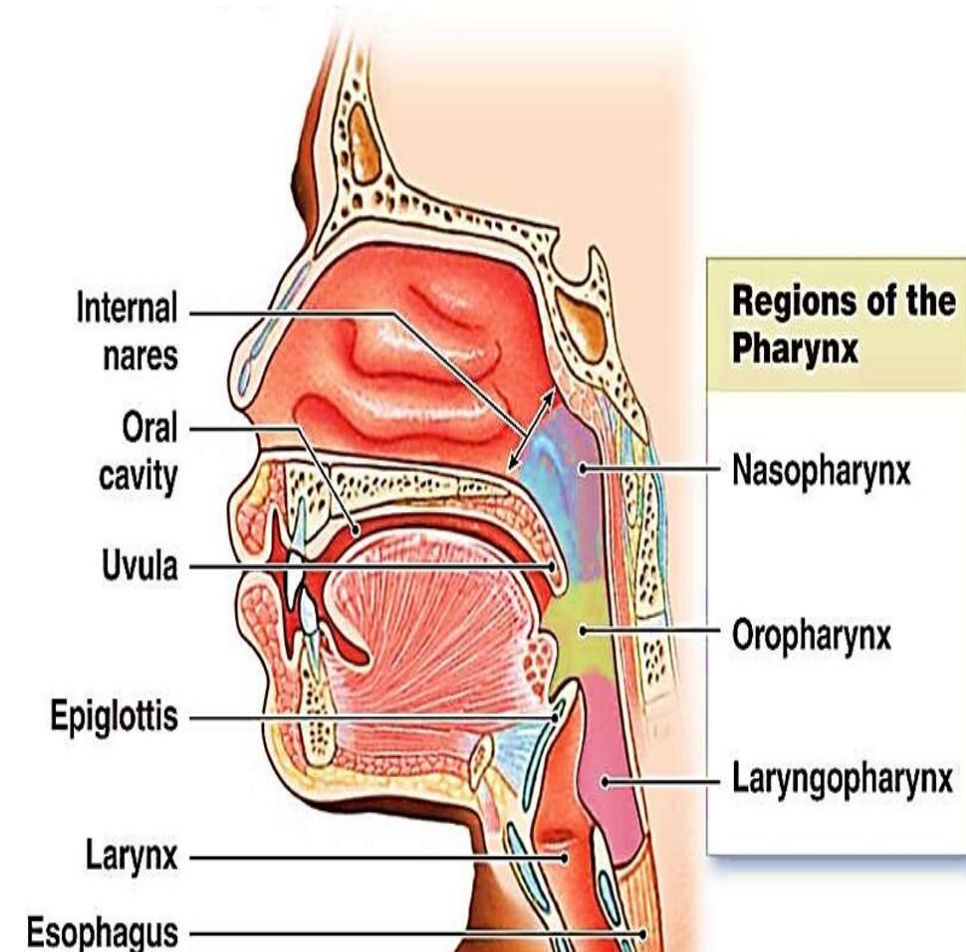


# THE PHARYNX (THROAT)

A muscular tube; posterior to the nasal and oral cavities and anterior to the cervical vertebrae  
There are three subdivisions:

## I. **Nasopharynx (Superior):**

- Posterior to nasal cavity
- **Air passage only**
- Contains two eustachian tube openings (extend to the middle ear cavities) that permits air to enter or leave the middle ears, allowing the eardrums to vibrate properly
- **Swallowing mechanism:**
  - **Soft palate** elevates to prevent food reflux
  - Uvula is the free hanging part of the soft palate you can see at the back of the throat



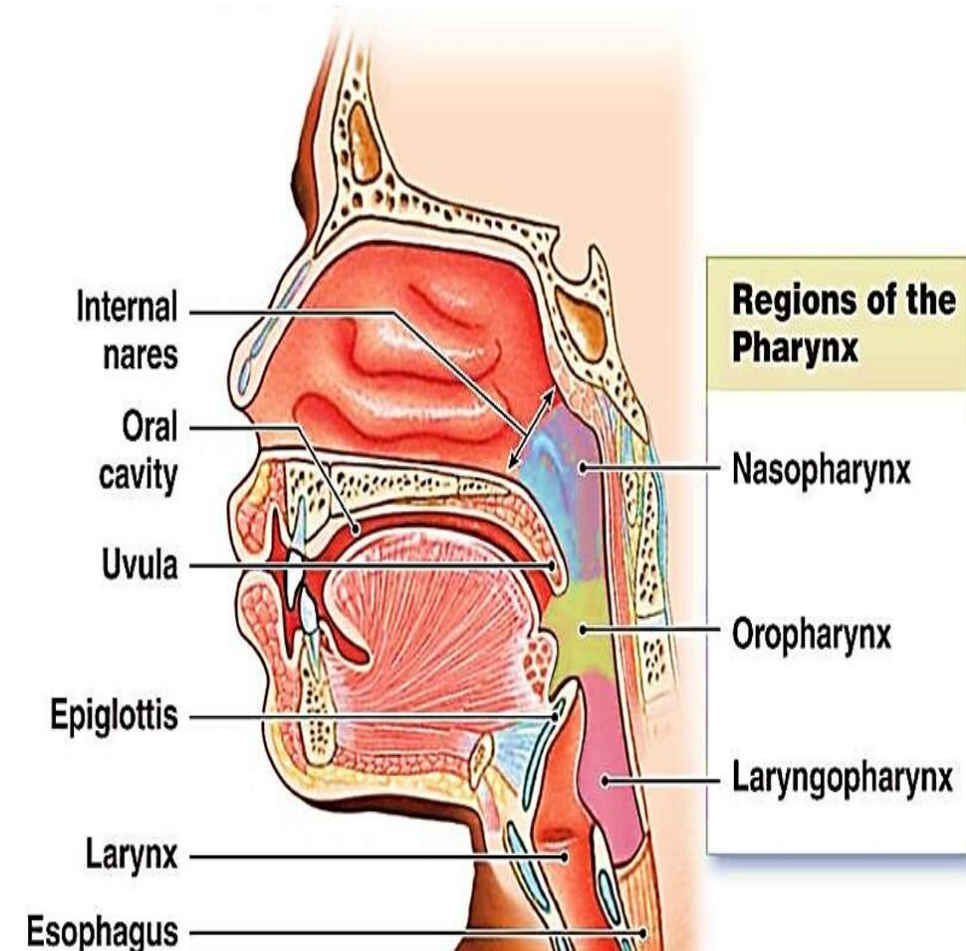
# THE PHARYNX (THROAT)

## 2. Oropharynx (Middle):

- Posterior to oral cavity/mouth
- **Air and food passage**
- Features:
  - Stratified squamous epithelium
  - Palatine tonsils (on lateral walls)

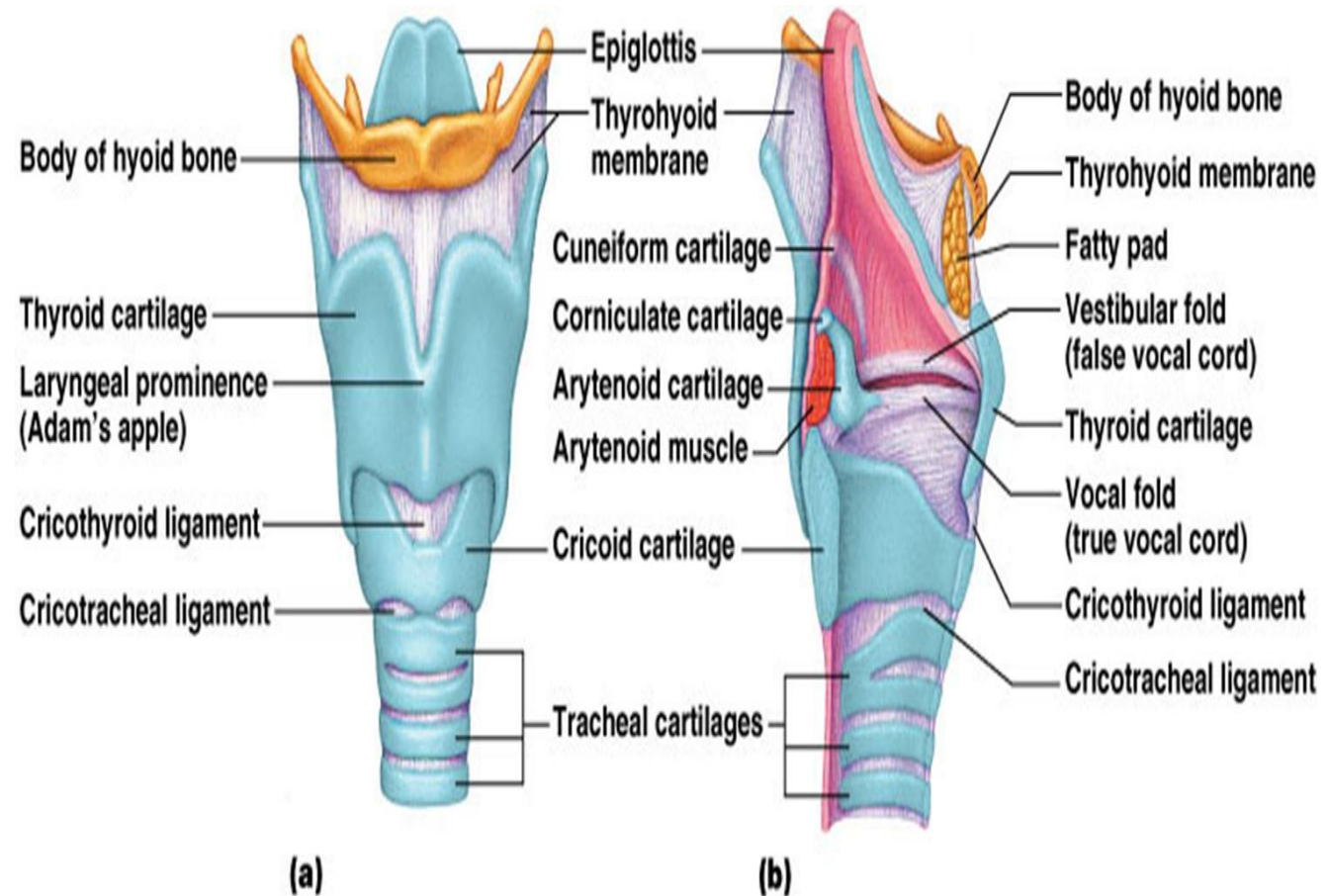
## 3. Laryngopharynx (Inferior):

- Air and food passage
- Opens into Larynx anteriorly & Esophagus posteriorly



# LARYNX (VOICE BOX)

- Tubular organ for air passage between pharynx (superior) and the trachea (inferior) and for voice production
- It is made up of:
  - **9 Cartilages:** keep air passages open; prevents collapse of the larynx
  - Membranes and **ligaments**
  - Muscles

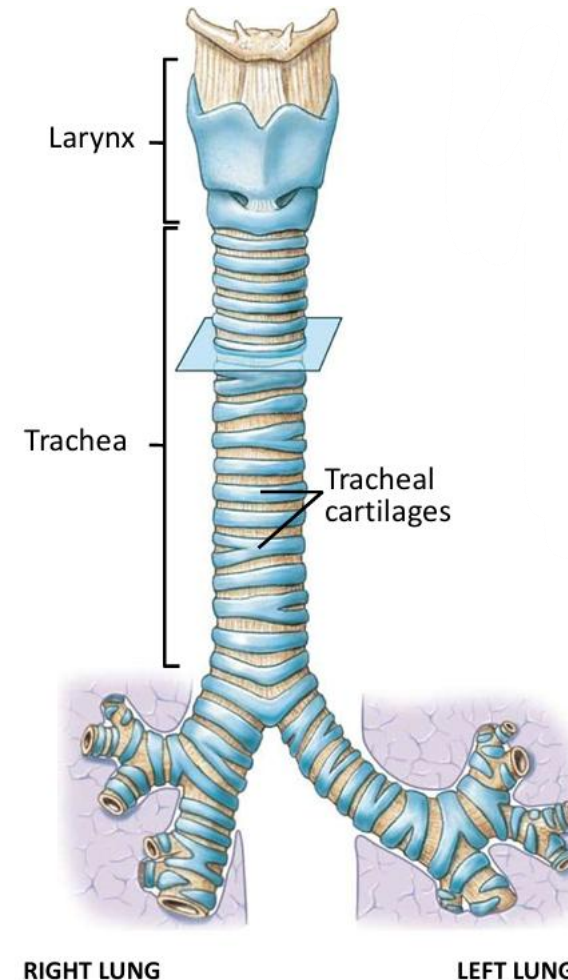


# LARYNGEAL CARTILAGES & VOCAL CORDS

- **Unpaired:**
  - Thyroid cartilage (largest - also known as Adam's apple)
  - Cricoid cartilage
  - Epiglottis cartilage (the only elastic cartilages, all others are hyaline cartilages)
- **Paired:**
  - Arytenoids cartilages
  - Corniculates cartilages
  - Cuneiforms cartilages
- **The mucous membrane lining the larynx forms two pairs of folds:**
  - Superior pair: the vestibular folds (false vocal cords)
  - Inferior pair: the vocal folds (true vocal cords)

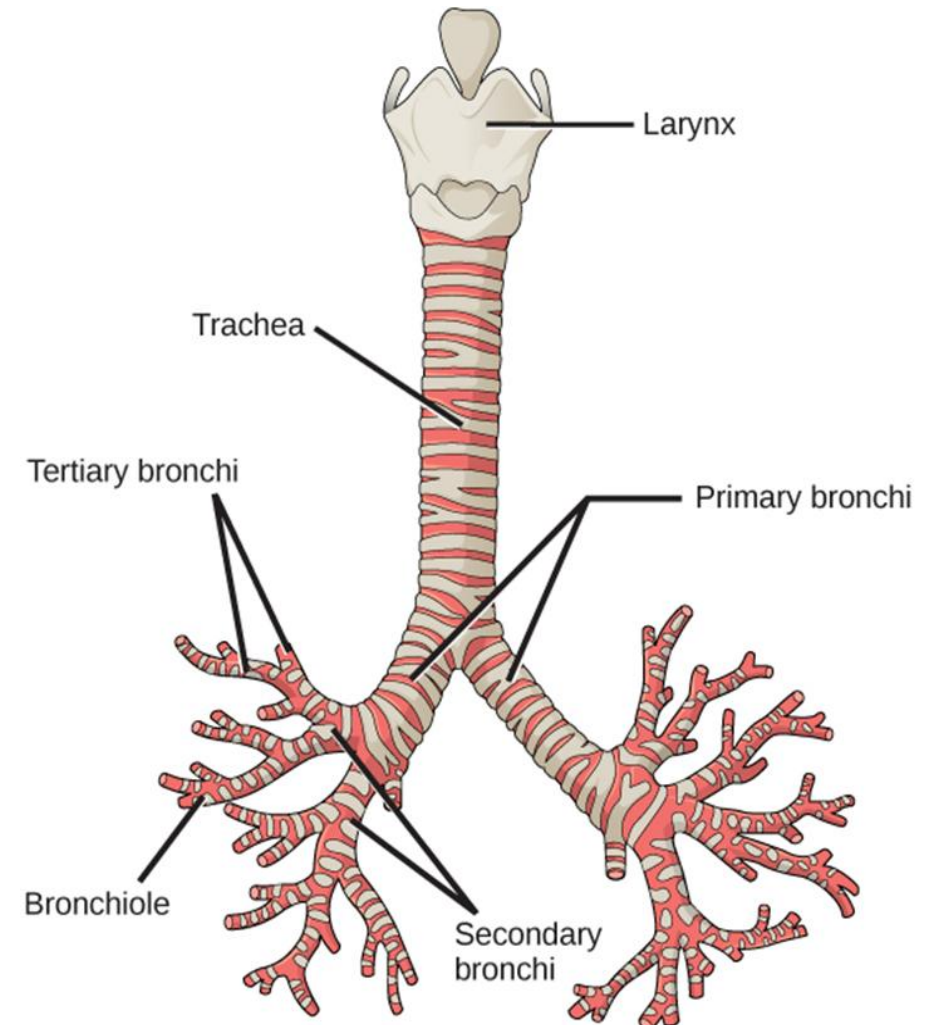
# TRACHEA (WINDPIPE)

- Trachea extends from larynx to the primary bronchi (about 10-13 cm)
- Anterior to the oesophagus
- Tracheal rings are 16 to 20 C-shaped pieces of cartilage → keep trachea open
- The posterior gaps in these incomplete cartilage rings are lined by trachealis muscle → to permit the expansion of the esophagus when swallowing food



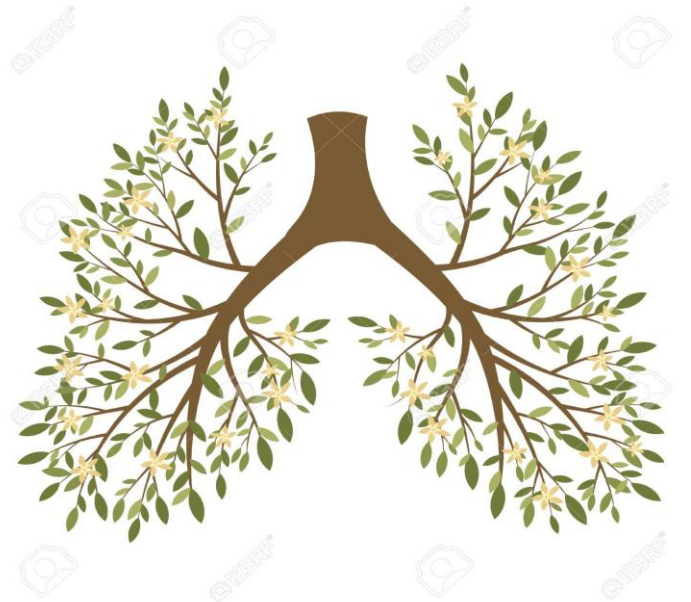
# BRONCHIAL TREE

- **Primary (Main) Bronchi:** First branches of the trachea
- **Structure:** C-shaped cartilaginous rings (like the trachea)
  - Right bronchus: Wider, shorter, more vertical
  - Left bronchus: Narrower, longer, more horizontal
- **Branching Pattern:**
- **Secondary (Lobar) Bronchi:**
  - Supply each lung lobe
  - **Right lung:** 3 branches (3 lobes)
  - **Left lung:** 2 branches (2 lobes)



# BRONCHIAL TREE

- **Tertiary (Segmental) Bronchi:**
  - Further divide into smaller airways
- **Bronchioles:**
  - Cartilage becomes patchy, then **absent**
  - Walls contain smooth muscle only
- **Terminal Structures:**
- **Respiratory bronchioles** → **Alveolar ducts** → **Alveoli** (air sacs for gas exchange)
- **Analogy "Bronchial Tree":**
  - Trachea = trunk
  - Bronchioles = smaller twigs
  - Bronchi = large branches
  - Alveoli = leaves (gas exchange sites)



# Bronchial Tree

Trachea

(R) Primary Bronchi

(L) Primary Bronchi

Secondary Bronchi (Lobar)

Secondary Bronchi (Lobar)

Tertiary Bronchi (Segmental)

Tertiary Bronchi (Segmental)

Smaller Bronchi

Smaller Bronchi

Bronchioles

Bronchioles

Terminal Bronchioles

Terminal Bronchioles

Respiratory Bronchioles

Respiratory Bronchioles

Alveolar Duct

Alveolar Duct

Alveolar Sac

Alveolar Sac

Alveolus

Alveolus

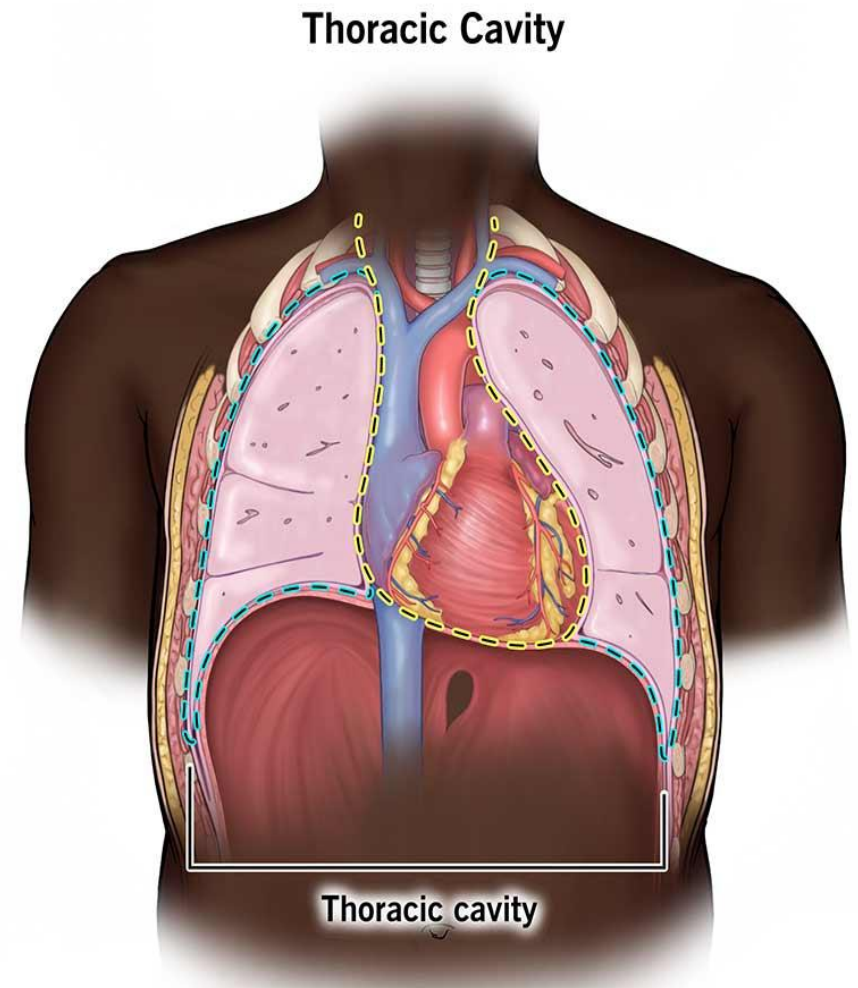
# THE LUNGS

## Location & Position:

- **Thoracic cavity**, flanking the heart
- Protected by **the rib cage**
- **Apex (superior tip)**: Extends to clavicle level
- **Base (inferior surface)**: Rests on diaphragm

## Medial Surface Features:

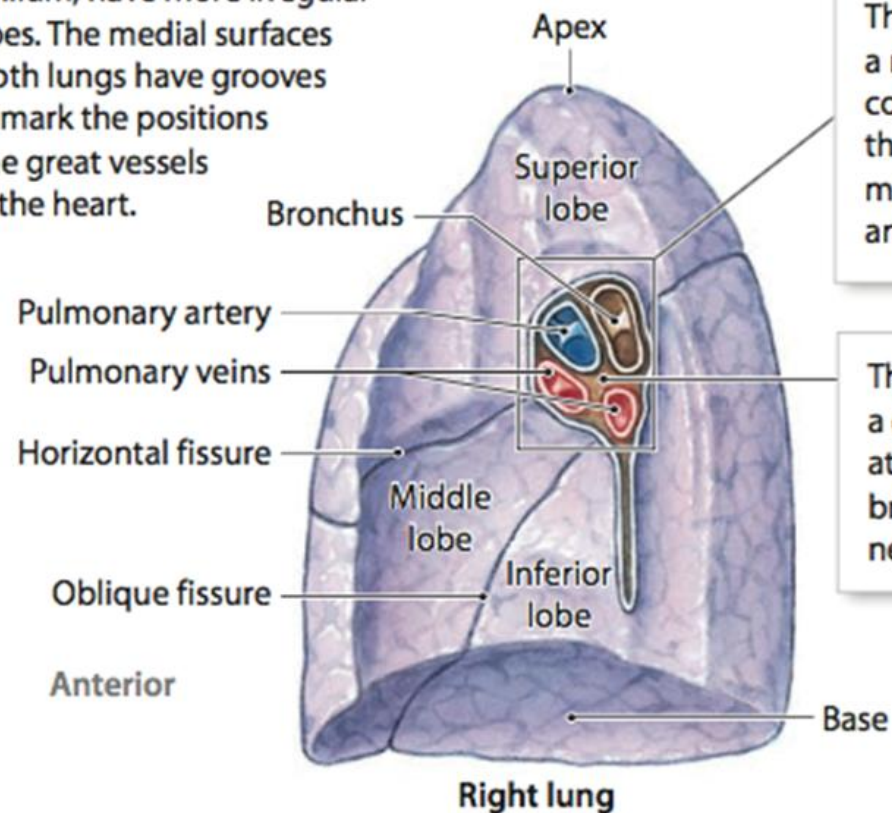
- **Hilus (Root of the Lung)**:
  - Entry/exit point for:
    - ✓ Primary bronchus
    - ✓ Pulmonary artery/veins
    - ✓ Bronchial artery



# THE LUNGS

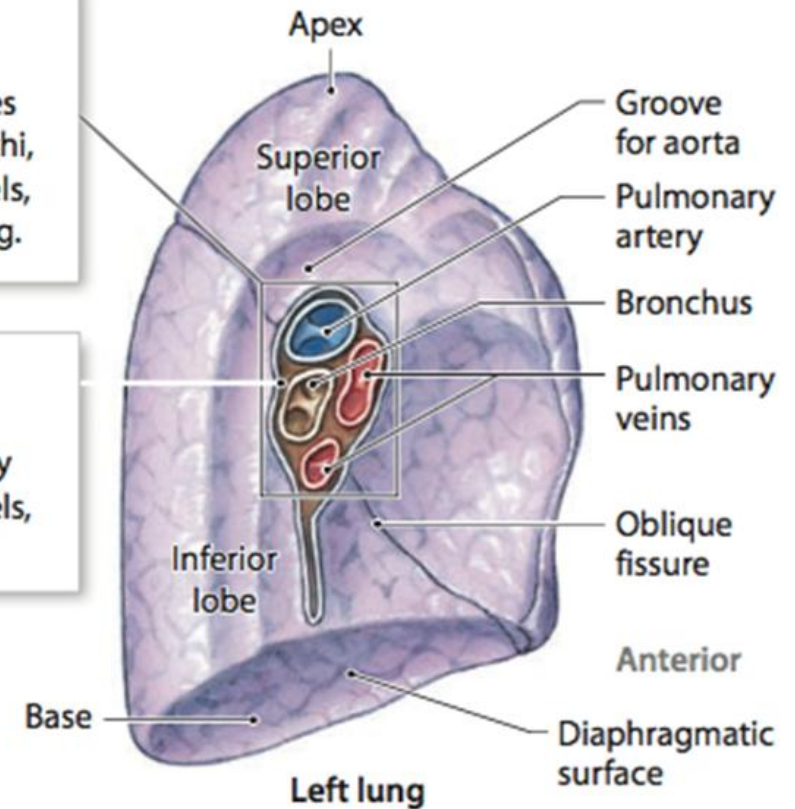
## Medial Surfaces

The medial surfaces, which contain the hilum, have more irregular shapes. The medial surfaces of both lungs have grooves that mark the positions of the great vessels and the heart.



The **root of the lung** is a meshwork of dense connective tissue that fixes the positions of the bronchi, major nerves, blood vessels, and lymphatics to the lung.

The **hilum** of the lung is a depression that allows attachment of the primary bronchi, pulmonary vessels, nerves, and lymphatics.



# THE LUNGS

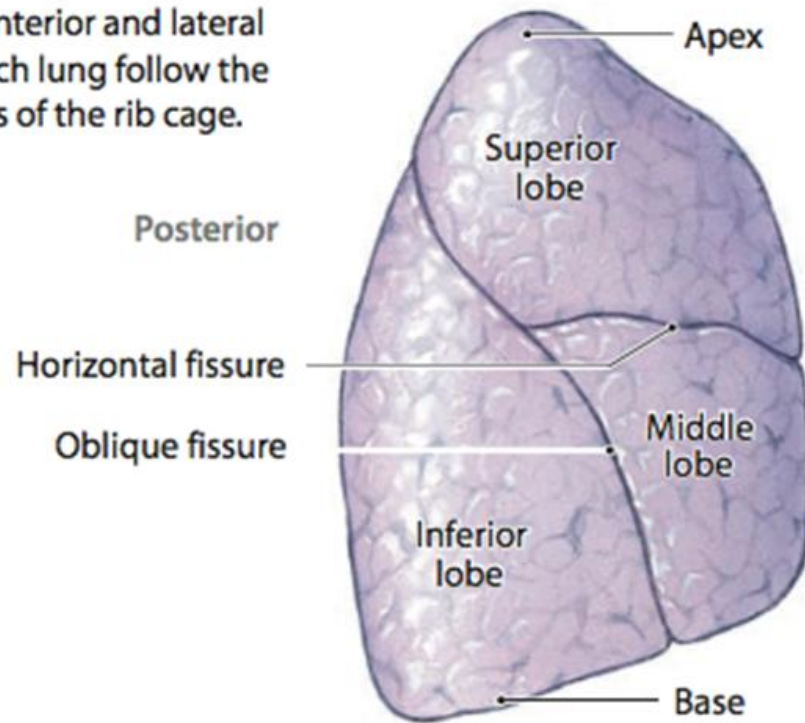
## Lung Lobes & Special Features:

- **Left Lung:**
  - **2 lobes** (separated by **oblique fissure**)
  - Smaller volume (due to heart position)
  - **Cardiac notch:** Concavity for heart apex
- **Right Lung:**
  - **3 lobes** (separated by **oblique** and **horizontal fissures**)
  - More superior position (due to liver-RUQ)

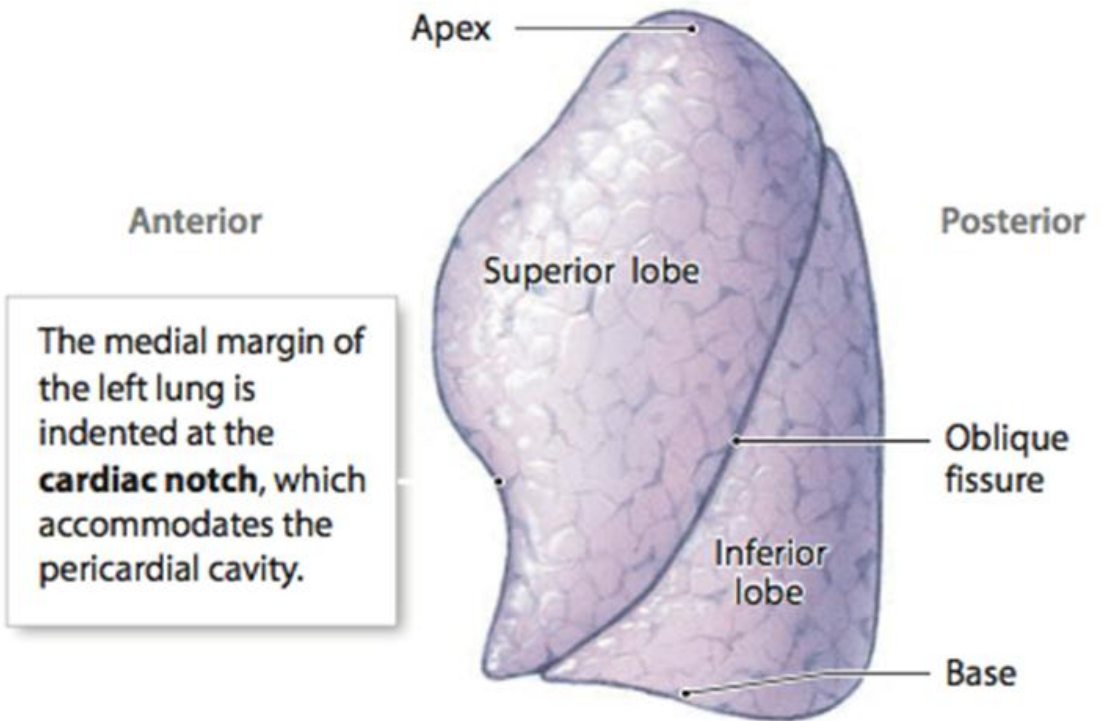
# THE LUNGS

## Lateral Surfaces

The curving anterior and lateral surfaces of each lung follow the inner contours of the rib cage.



The right lung is divided by the **horizontal** and **oblique fissures** into three lobes: the **superior**, **middle**, and **inferior lobes**.



The left lung is divided by the **oblique fissure** into only two lobes: the **superior** and **inferior lobes**.

# PLEURAL MEMBRANES

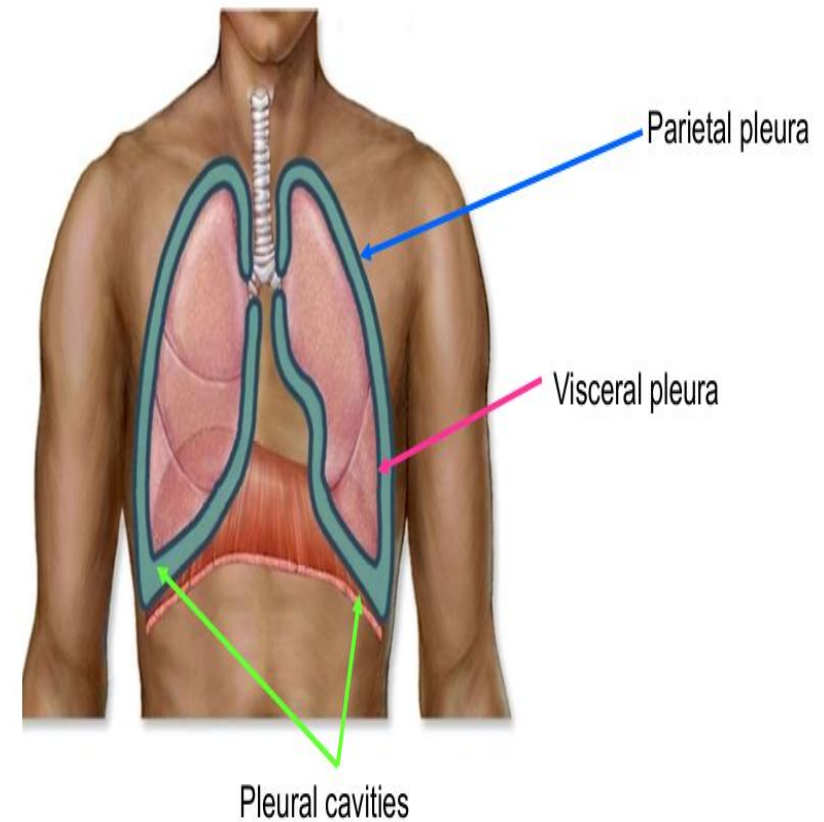
- The pleural membranes are the serous membranes lining the thoracic cavity and lungs

## Layers:

1. **Parietal Pleura** - Lines the chest wall (inner surface of thoracic cavity)
2. **Visceral Pleura** - Lines the lung surfaces

## Pleural Space (a potential space between the two layers)

- Contains **serous fluid** that:
  - ✓ Reduce friction during breathing
  - ✓ Maintains surface tension to keep lungs expanded



# LUNG BLOOD SUPPLY

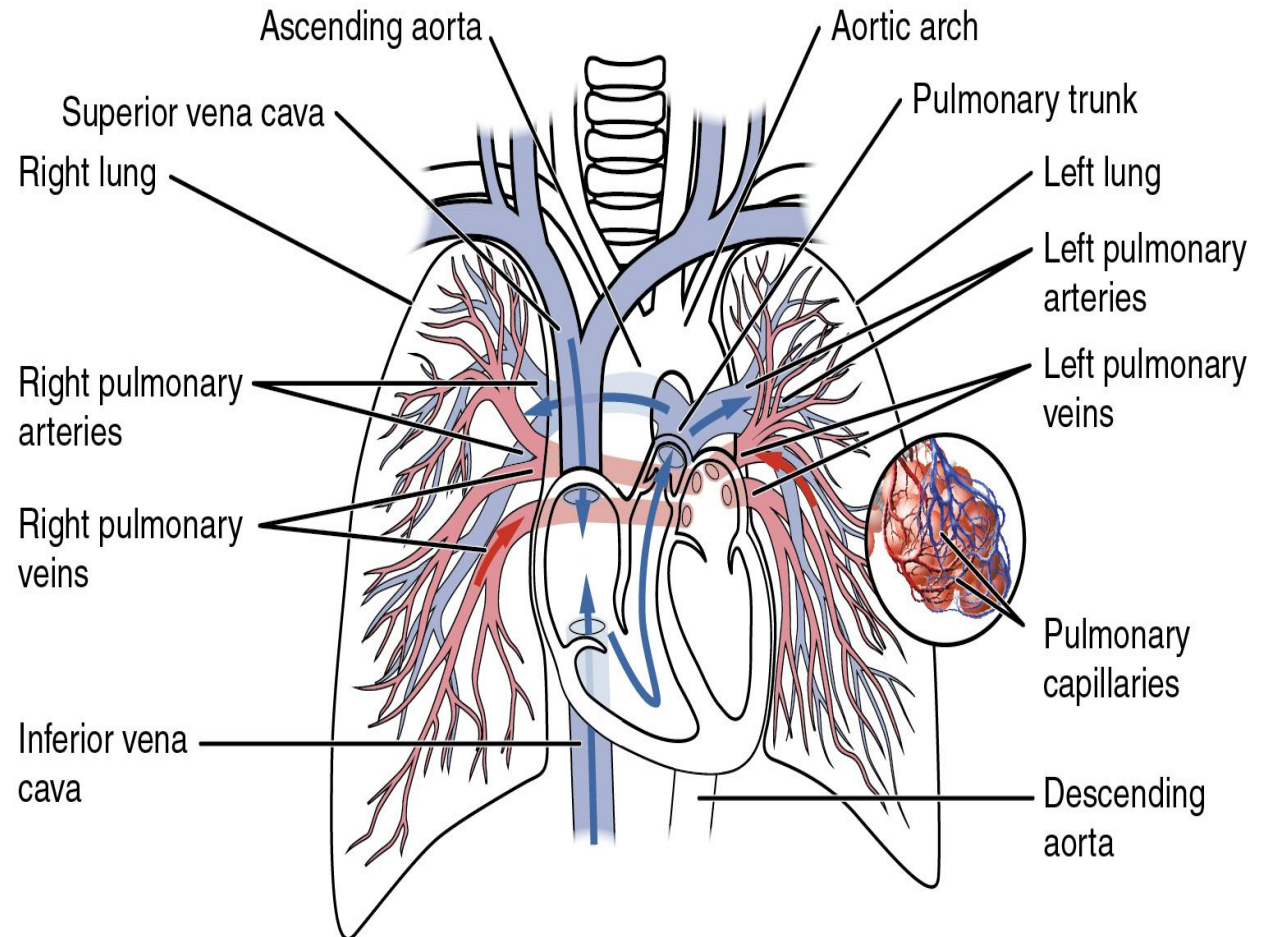
## I. Pulmonary Circulation (Gas Exchange)

### ■ Pulmonary Arteries:

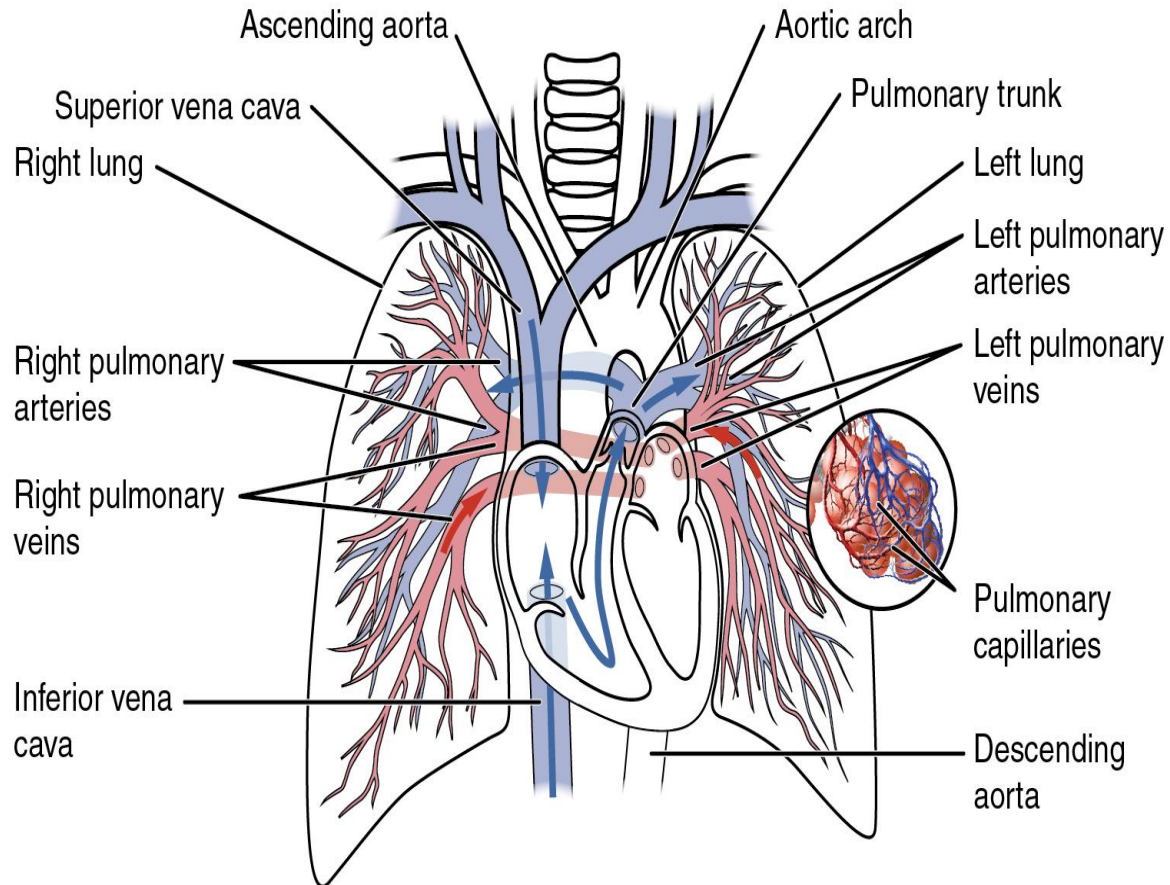
- Carry **deoxygenated** blood from heart to lungs
- Deoxygenated blood passes through the Pulmonary trunk which divide into:
  - Left pulmonary artery → left lung
  - Right pulmonary artery → right lung

### ■ Pulmonary Veins (4 total):

- Return **oxygenated** blood to left atrium



# LUNG BLOOD SUPPLY



## 2. Bronchial Circulation (Lung Nutrition)

### ■ **Bronchial Arteries:**

- Branch from aorta (oxygenated blood)
- Supply oxygenated blood to:
  - ✓ Bronchi
  - ✓ Connective tissue
  - ✓ Visceral pleura

### ■ **Venous Drainage** (blood return to heart):

- Mostly to **pulmonary veins**
- Minor drainage via bronchial veins → superior vena cava

Note: connections between bronchial arteries and pulmonary arteries exist

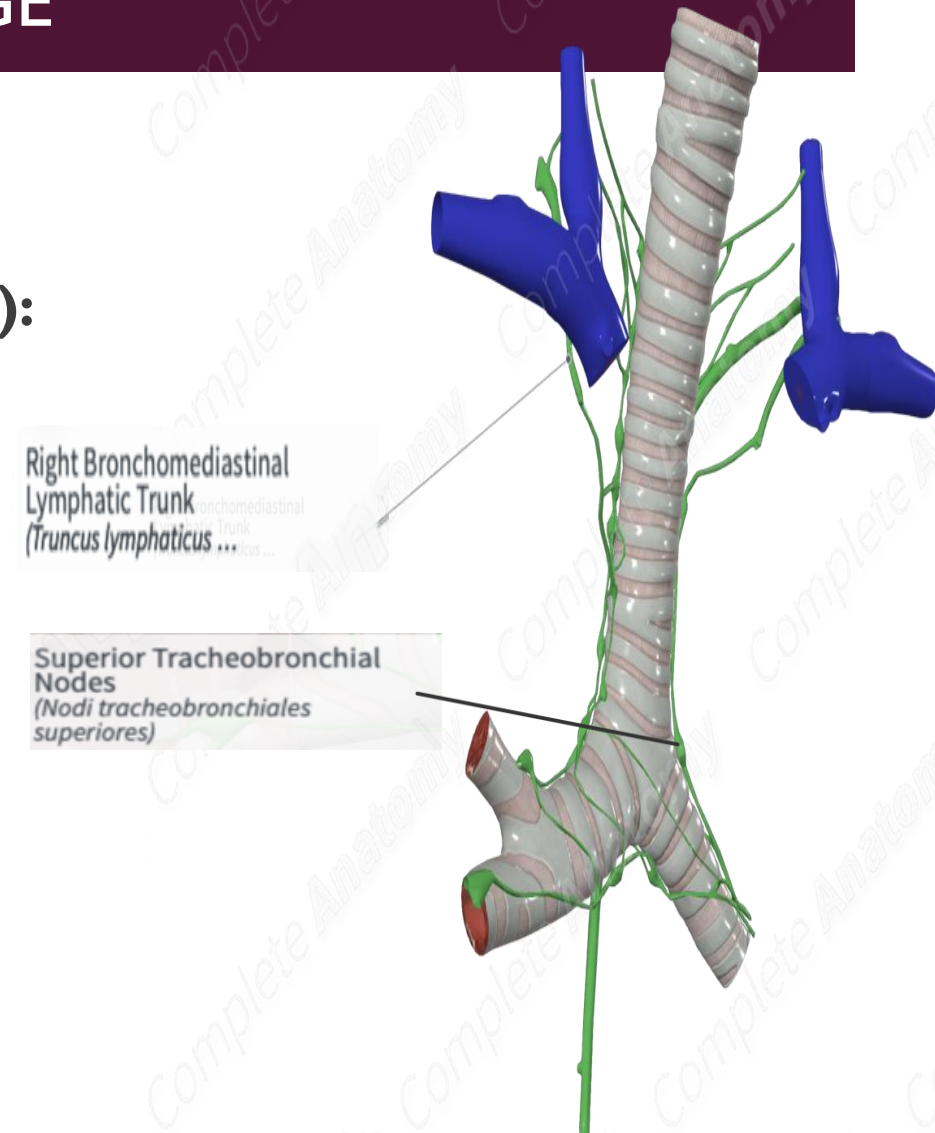
# LYMPHATIC DRAINAGE

Lymph draining by **Two Lymphatic Plexuses (lymph vessels):**

1. **Superficial (Subpleural) Plexus**
2. **Deep Plexus**

**Drainage Pathway:**

- All lung lymph leaves the **hilum**, then drains sequentially into **Tracheobronchial lymph nodes** then into the **Bronchomediastinal lymph trunks**





THANK YOU