

HUMAN ANATOMY AND PHYSIOLOGY-II

Respiratory System

Prepared by

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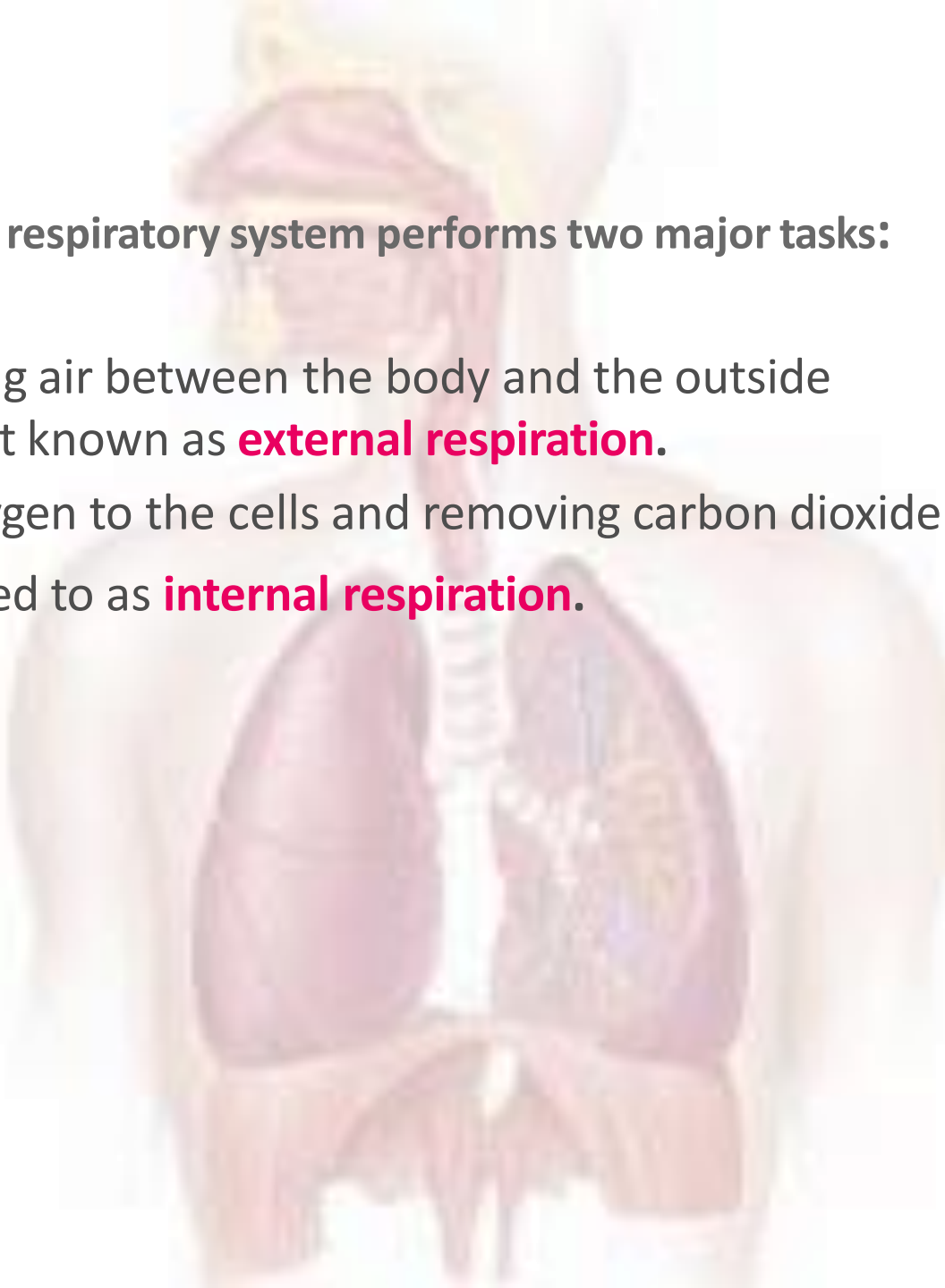


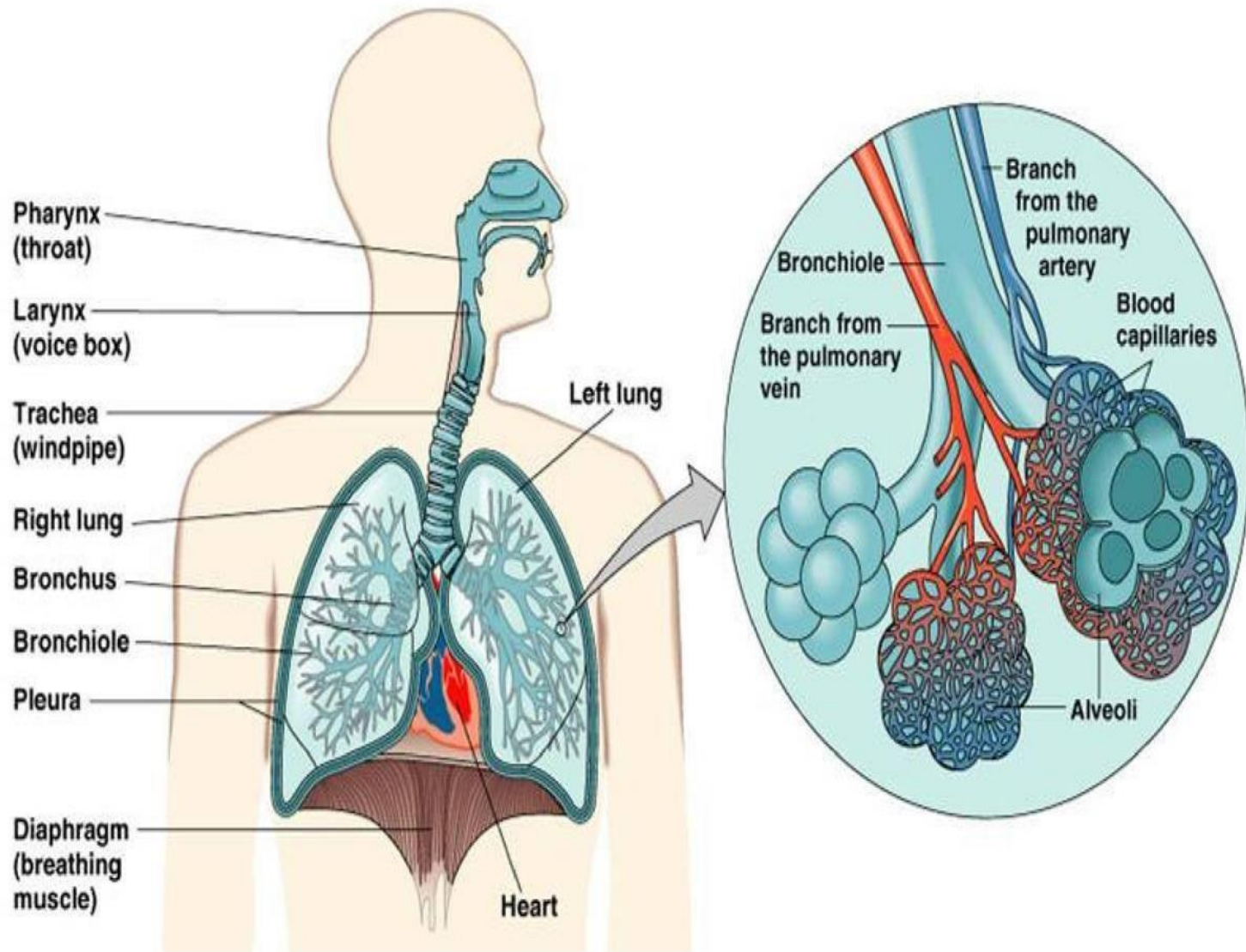
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Respiratory System: Oxygen Delivery System

- The respiratory system is the set of organs that allows a person to breathe and exchange oxygen and carbon dioxide throughout the body.
- The integrated system of organs involved in the intake and exchange of oxygen and carbon dioxide between the body and the environment and including the nasal passages, larynx, trachea, bronchial tubes, and lungs.
- The cells of the body need energy for all their metabolic activities. Most of this energy is derived from chemical reactions, which can only take place in the presence of oxygen (O₂).
- The main waste product of these reactions is carbon dioxide (CO₂).
- The respiratory system provides the route by which the supply of oxygen present in the atmospheric air enters the body, and it provides the route of excretion for carbon dioxide.

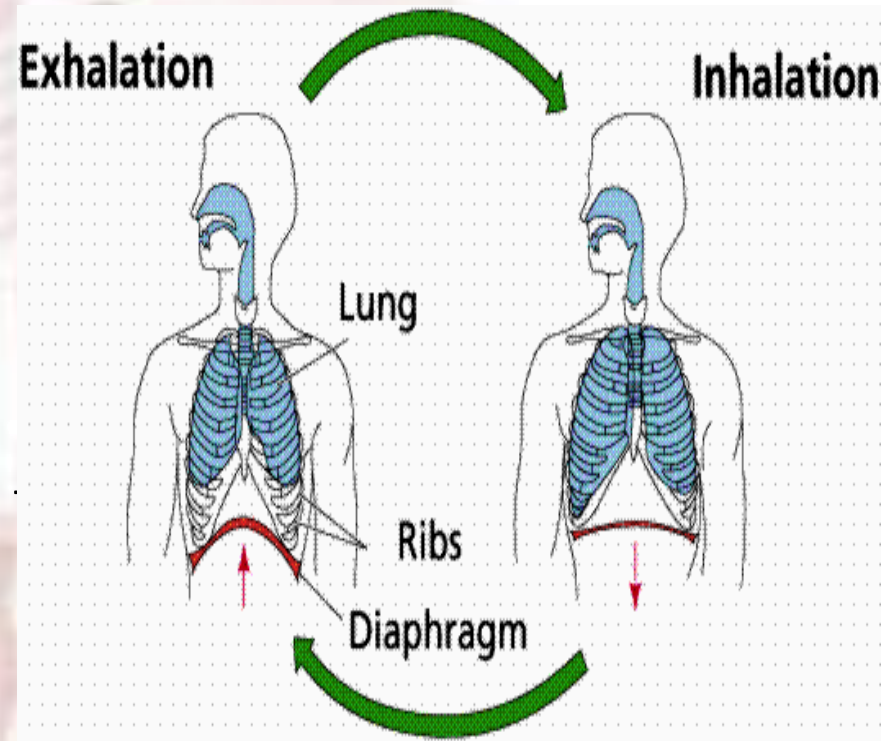
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- The respiratory system performs two major tasks:
 - Exchanging air between the body and the outside environment known as **external respiration**.
 - Bringing oxygen to the cells and removing carbon dioxide from them referred to as **internal respiration**.



Functions of Respiratory system:

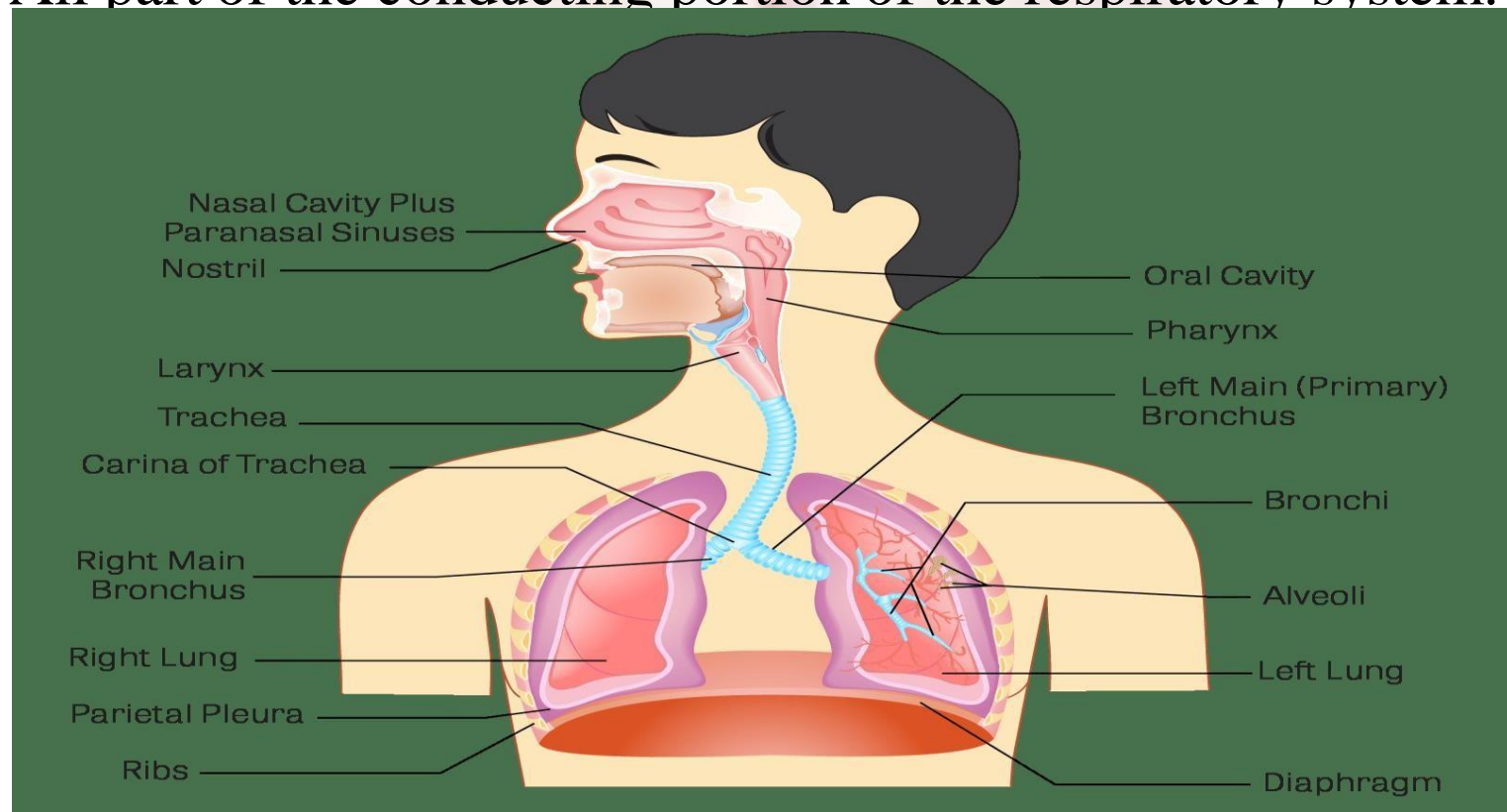
1. Supplies the body with oxygen and disposes of carbon dioxide
2. Filters inspired air
3. Produces sound
4. Contains receptors for smell
5. Removal of some excess water and heat
6. Helps regulate blood pH

- Breathing (pulmonary ventilation). consists of two cyclic phases:
 - **Inhalation**, also called inspiration draws gases into the lungs.
 - **Exhalation**, also called expiration forces gases out of the lungs.



External Respiration: Upper respiratory tract

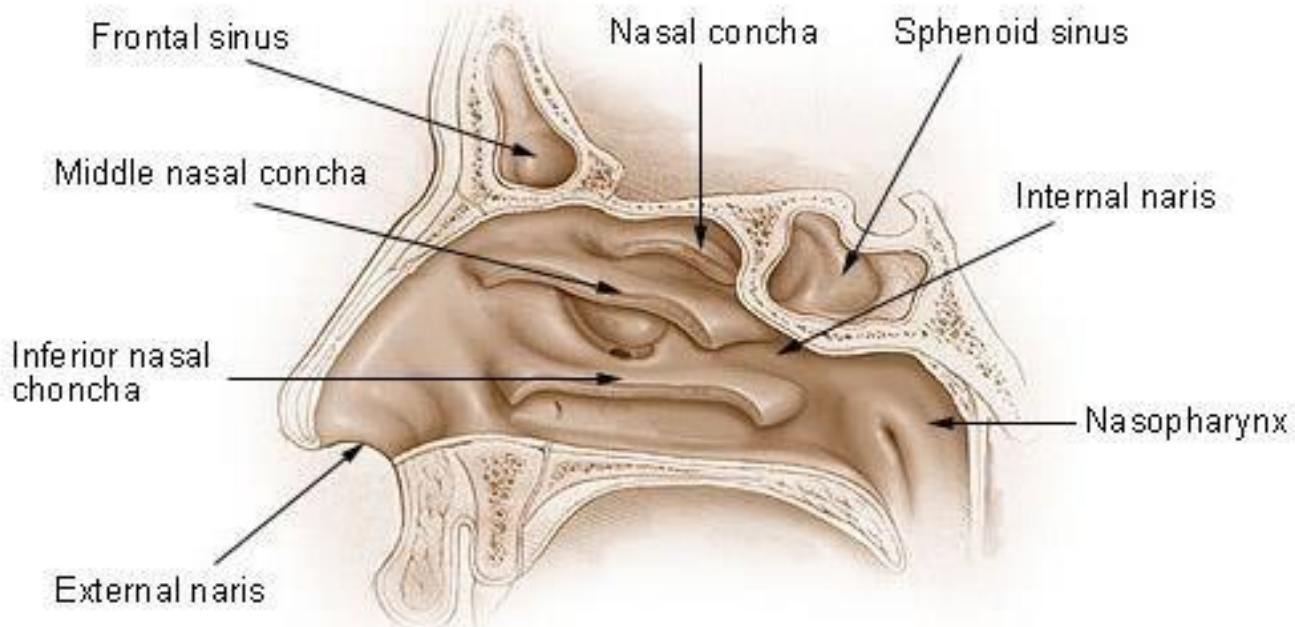
- Air from the outside environment enters the nose or mouth during *inspiration (inhalation)*.
- Composed of the **nose** and nasal cavity, paranasal sinuses, pharynx (throat), larynx.
- All part of the conducting portion of the respiratory system.

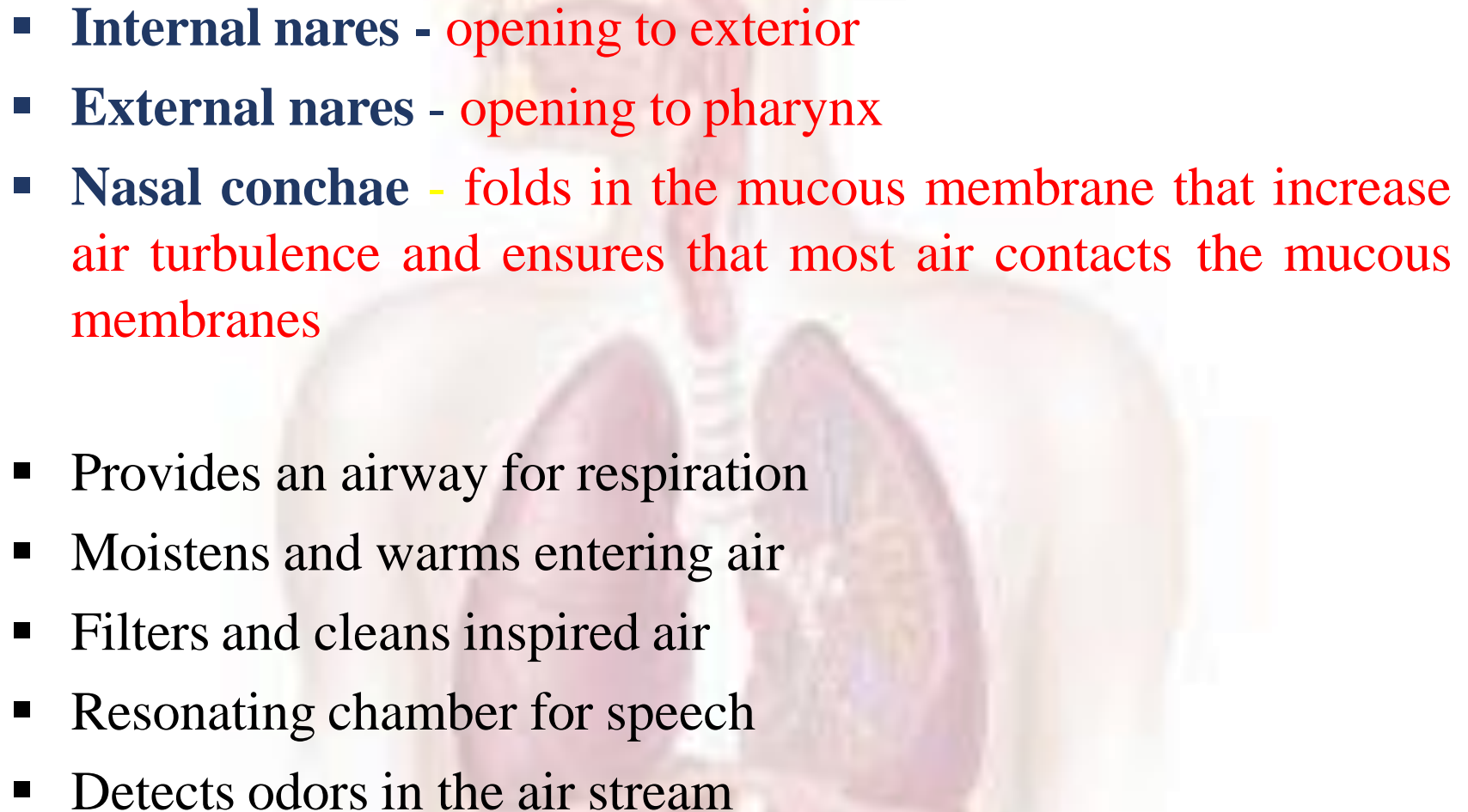


Nose:

- Also called external nares.
- Divided into two halves by the **nasal septum**.
- Contains the **paranasal sinuses** where air is warmed.
- Contains **cilia** which is responsible for filtering out foreign bodies.

Nose and Nasal Cavities



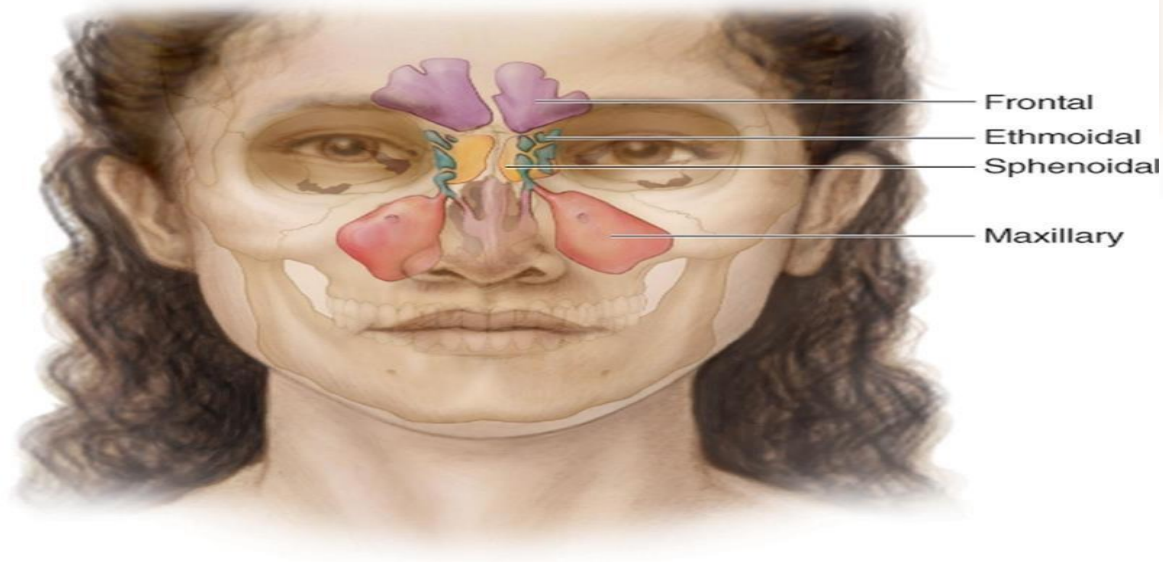
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- **Internal nares** - opening to exterior
 - **External nares** - opening to pharynx
 - **Nasal conchae** - folds in the mucous membrane that increase air turbulence and ensures that most air contacts the mucous membranes

 - Provides an airway for respiration
 - Moistens and warms entering air
 - Filters and cleans inspired air
 - Resonating chamber for speech
 - Detects odors in the air stream

Paranasal Sinuses

- Four bones of the skull contain paired air spaces called the ***paranasal sinuses*** - *frontal, ethmoidal, sphenoidal & maxillary*
- Decrease skull bone weight.
- Warm, moisten and filter incoming air.
- Add resonance to voice.
- Communicate with the nasal cavity by ducts.
- Lined by pseudostratified ciliated columnar epithelium.

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Pharynx

- Common space used by both **the respiratory** and **digestive systems**.
- Commonly called **the throat**.
- Originates posterior to the nasal and oral cavities and extends inferiorly near the level of the bifurcation of the larynx and esophagus.
- Common pathway for both air and food.
- Walls are lined by a mucosa and contain skeletal muscles that are primarily used for swallowing.
- Flexible lateral walls are distensible in order to force swallowed food into the esophagus.

Three Sections of the Pharynx

Nasopharynx

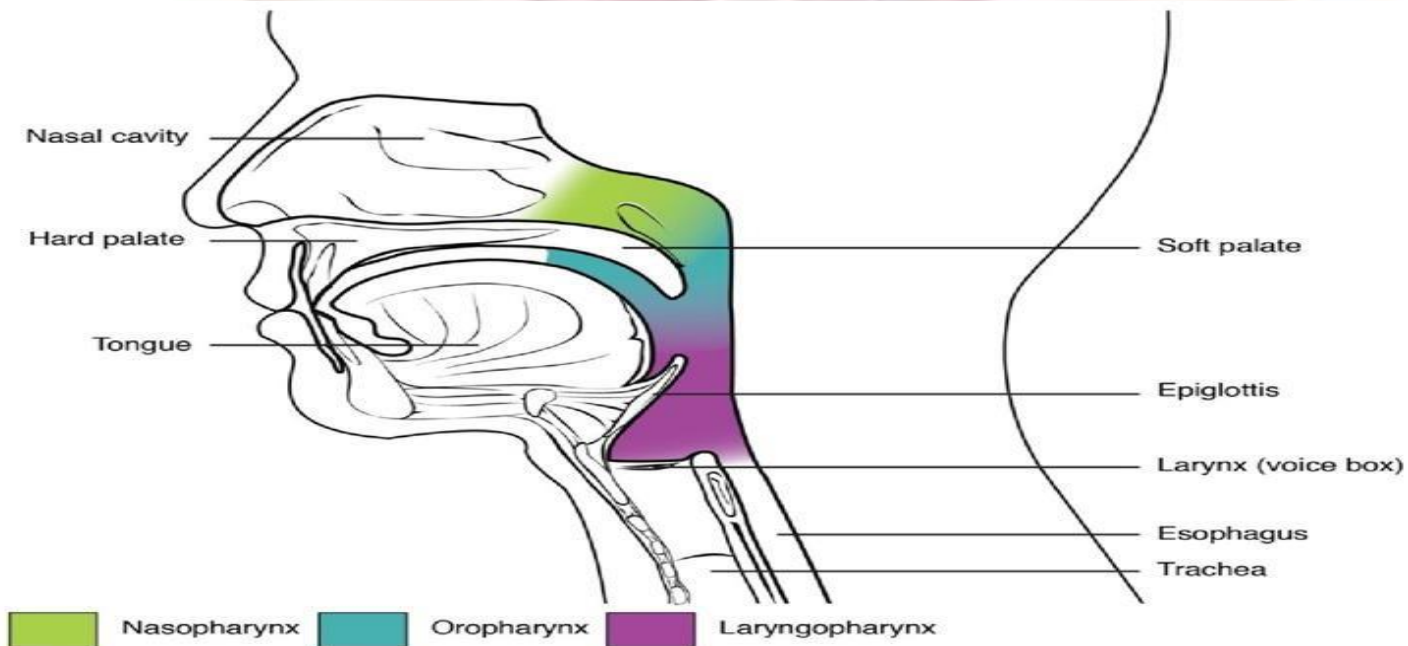
- Superior-most region of the pharynx. Covered with pseudostratified ciliated columnar epithelium

Oropharynx

- Back portion of the mouth that Contains non-keratinized stratified squamous epithelium

Laryngopharynx

- bottom section of the pharynx where the respiratory tract divides into the [esophagus](#) and the [larynx](#).

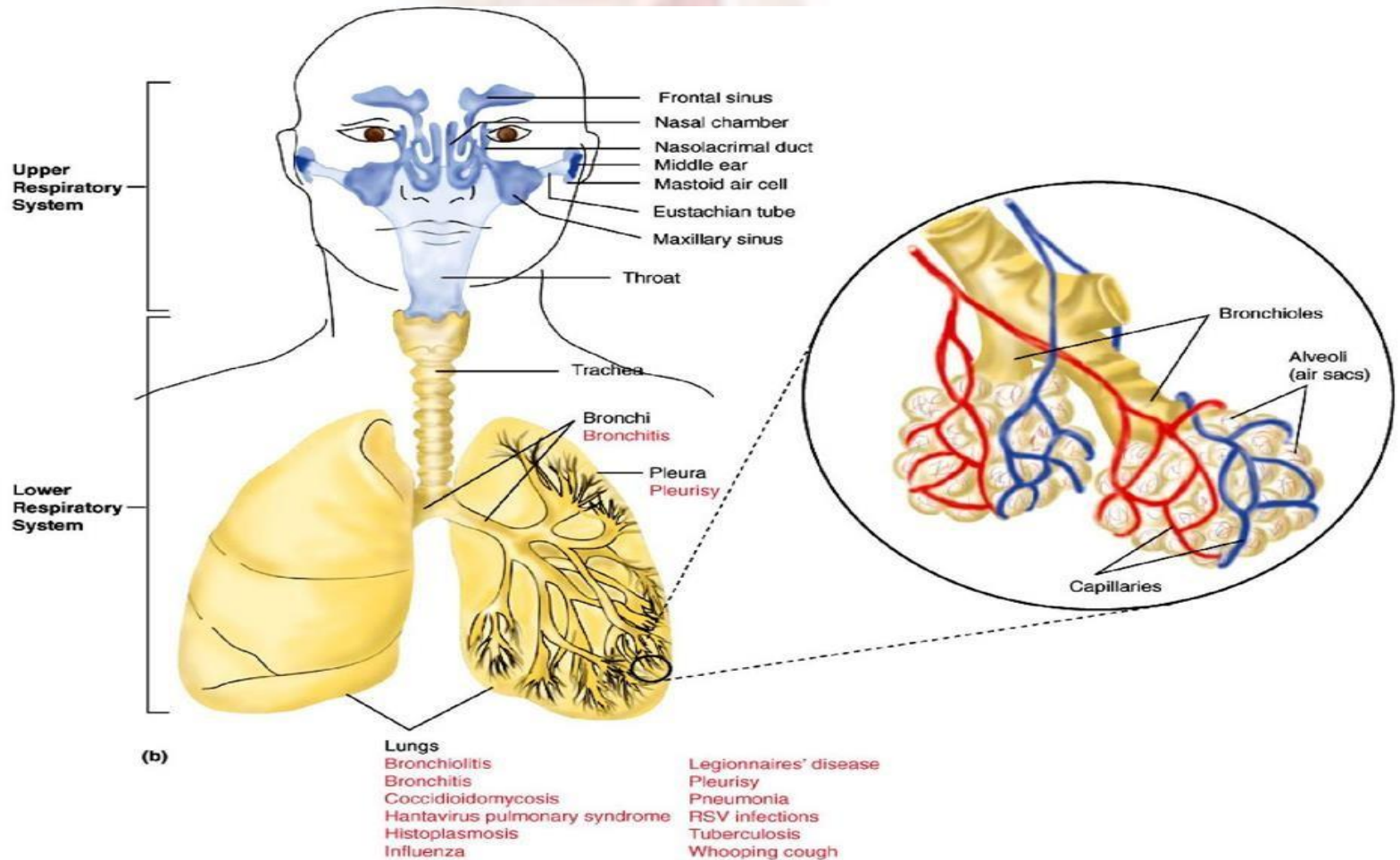


Functions

- **Passageway** for air and food The pharynx is involved in both the respiratory and the digestive systems: air passes through the nasal and oral sections, and food through the oral and laryngeal sections.
- **Warming and humidifying** By the same methods as in the nose, the air is further warmed and moistened as it passes through the pharynx.
- **Taste** There are olfactory nerve endings of the sense of taste in the epithelium of the oral and pharyngeal parts.
- **Hearing** The auditory tube, extending from the nasopharynx to each middle ear, allows air to enter the middle ear.
- **Protection** The lymphatic tissue of the pharyngeal and laryngeal tonsils produces antibodies in response to antigens, e.g. bacteria The tonsils are larger in children and tend to atrophy in adults.
- **Speech** The pharynx functions in speech; by acting as a resonating chamber for sound ascending from the larynx, it helps (together with the sinuses) to give the voice its individual characteristics.

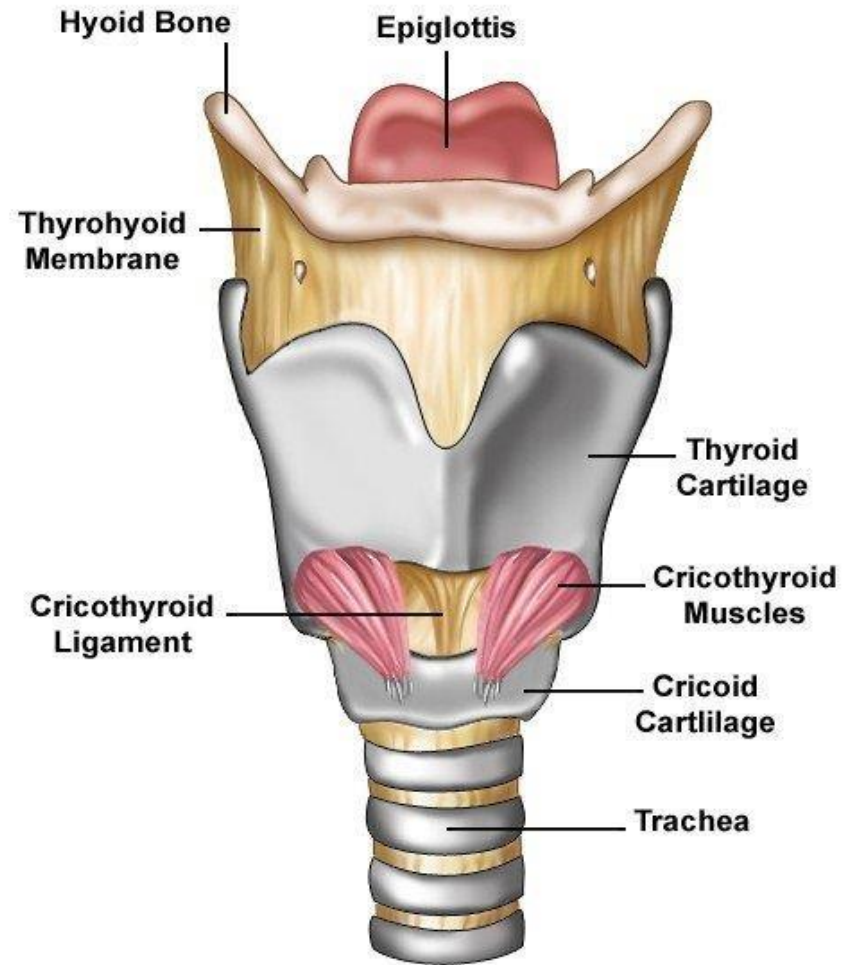
Lower Respiratory Tract

- **Conducting airways (trachea, bronchi, up to terminal bronchioles).**
- **Respiratory portion of the respiratory system (respiratory bronchioles, alveolar ducts, and alveoli).**



Larynx:

- **Voice box** is a short, somewhat cylindrical airway ends in **the trachea**.
- It connects throat (pharynx) with the windpipe(trachea).
- At the top of the larynx is the epiglottis. This small flap prevents food & water from entering the voice box.
- Supported by a framework of nine pieces of cartilage (three individual pieces and three cartilage pairs) that are held in place by ligaments and muscles.



FUNCTION

Production of sound

- Sound has the properties of pitch, volume and resonance.
- Pitch of the voice depends upon the length and tightness of the cords. Shorter cords produce higher pitched sounds.
- At puberty, the male vocal cords begin to grow longer, hence the lower pitch of the adult male voice

Speech This is produced when the sounds produced by the vocal cords are manipulated by the tongue, cheeks and lips.

Protection of the lower respiratory tract

- During swallowing the larynx moves upwards, blocking the opening into it from the pharynx.
- the hinged epiglottis closes over the larynx. This ensures that food passes into the oesophagus and not into the trachea.

Passageway for air The larynx links the pharynx above with the trachea below.

Humidifying, filtering and warming These processes continue as inspired air travels through the larynx

Trachea

- A flexible tube also called **windpipe**.
- Extends through the mediastinum and lies anterior to the esophagus and inferior to the larynx.
- Cartilage rings reinforce and provide rigidity to the tracheal wall to ensure that the trachea remains open at all times.
- At the level of the sternal angle, the trachea bifurcates into two smaller tubes, called the **right and left-primary bronchi**.
- Each primary bronchus projects laterally toward each lung.

Functions:

- **Cough reflex**

- Nerve endings in the larynx, trachea and bronchi are sensitive to irritation, which generates nerve impulses conducted by the vagus nerves to the respiratory centre in the brain stem
- The reflex motor response is deep inspiration followed by closure of the glottis, i.e. closure of the vocal cords.
- The abdominal and respiratory muscles then contract and suddenly the air is released under pressure expelling mucus and/or foreign material from the mouth.
- ***Warming, humidifying and filtering*** These continue as in the nose, although air is normally saturated and at body temperature when it reaches the trachea

Lungs

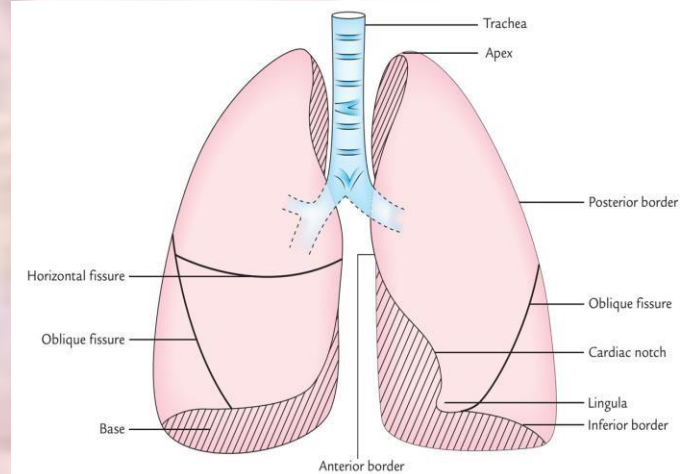
- Each lung has a conical shape. Its wide, concave base rests upon the muscular diaphragm.
- Both lungs are bordered by the thoracic wall anteriorly, laterally, and posteriorly, and supported by the rib cage.
- Toward the midline, the lungs are separated from each other by the **mediastinum**.

Left lung

- divided into 2 lobes by oblique fissure
- smaller than the right lung
- cardiac notch accommodates the heart

Right lung

- divided into 3 lobes by **oblique and horizontal fissure**
- located more superiorly in the body due to liver on right side

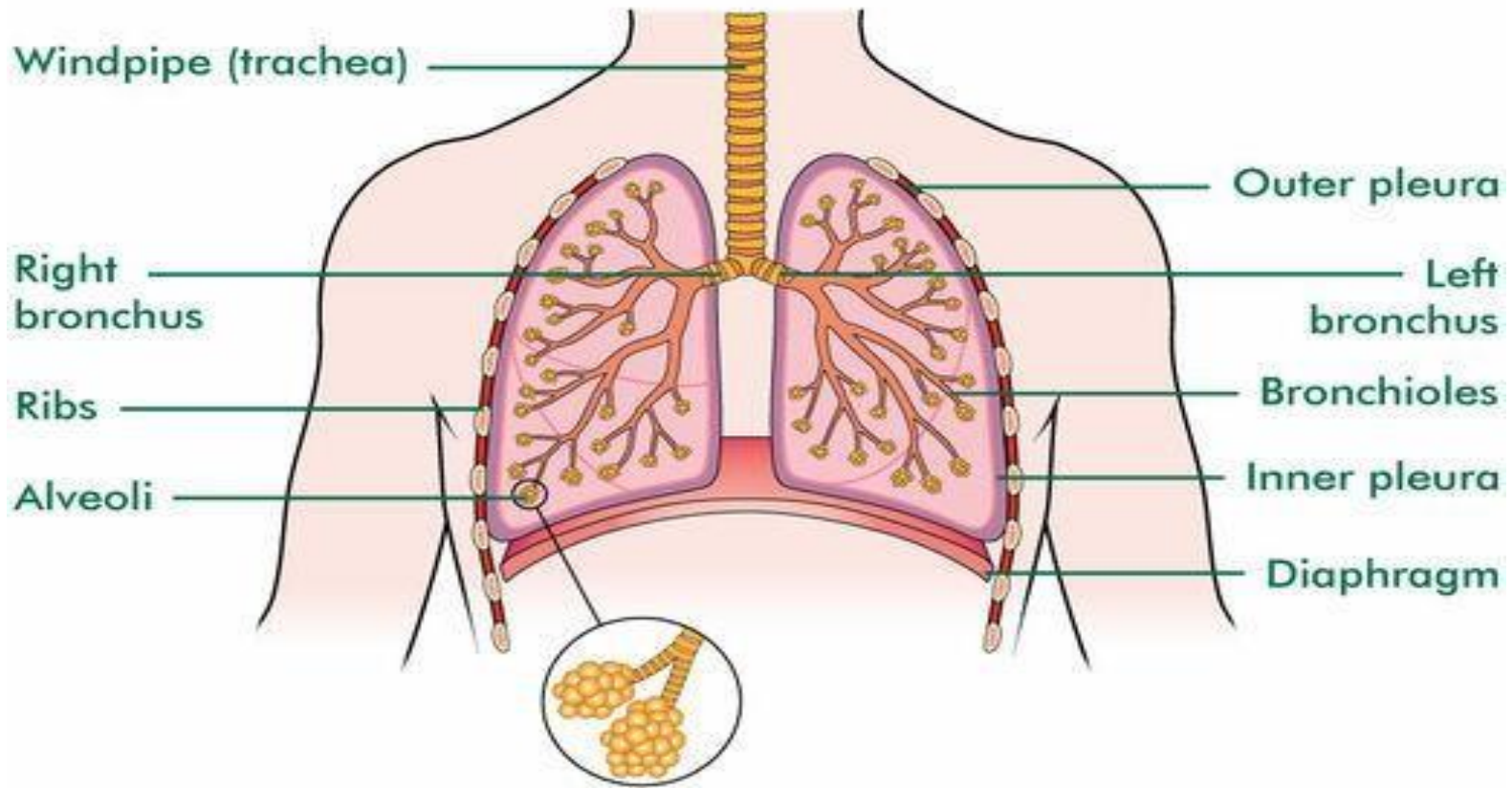


- The outer surface of each lung and the adjacent internal-thoracic wall are lined by a serous membrane called **pleura**.
- The outer surface of each lung is tightly covered by the **visceral pleura**.
- while the internal thoracic walls, the lateral surfaces of the mediastinum, and the superior surface of the diaphragm are lined by the **parietal pleura (covering the rib cage)**.

Pleural Cavities

The potential space between the two pleura of the lungs is a **pleural cavity**.

- The pleural membranes produce a thin, serous **pleural fluid** that circulates in the pleural cavity and acts as a lubricant, ensuring minimal friction during breathing.
- **Pleural effusion** –pleuritis with too much fluid

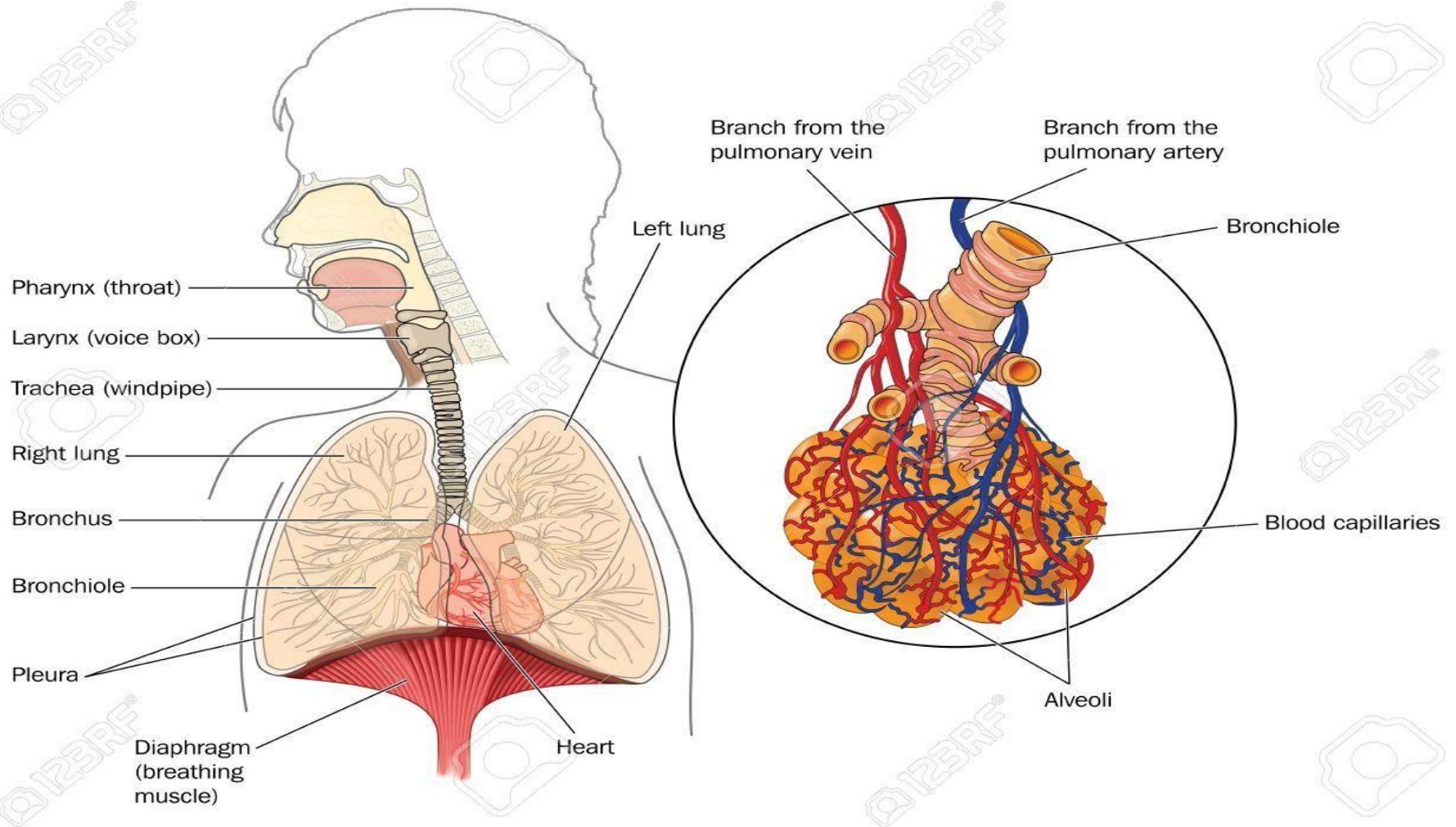


Interior of the lungs The lungs are composed of the bronchi and smaller air passages, alveoli, connective tissue, blood vessels, lymph vessels and nerves, all embedded in an elastic connective tissue matrix. Each lobe is made up of a large number of lobules.

How lung work??

- Air enters our lungs through a system of pipes called the **bronchi**.
- The **alveoli** are where the important work of gas exchange takes place between the air and our blood. Covering each alveolus is a whole network of little blood vessel called **capillaries**,
- It is important that the air in the alveoli and the blood in the capillaries are very close together, so that oxygen and carbon dioxide can move (or diffuse) between them.
- When we breathe in, air comes down the trachea and through the bronchi into the alveoli.
- This fresh air has lots of oxygen in it, and some of this oxygen will travel across the walls of the alveoli into our blood stream.
- Travelling in the opposite direction is carbon dioxide, which crosses from the blood in the capillaries into the air in the alveoli and is then breathed out. In this way, we bring in to your body the oxygen that you need to live, and get rid of the waste product carbon dioxide.

How lung work??



Pulmonary blood supply

The pulmonary trunk divides into the **right and left pulmonary arteries**, which transport deoxygenated blood to each lung.

Within the lungs each pulmonary artery divides into many branches, which eventually end in a dense capillary network around the **walls of the alveoli**

The walls of the alveoli and the capillaries each consist of only one layer of **flattened epithelial cells**.

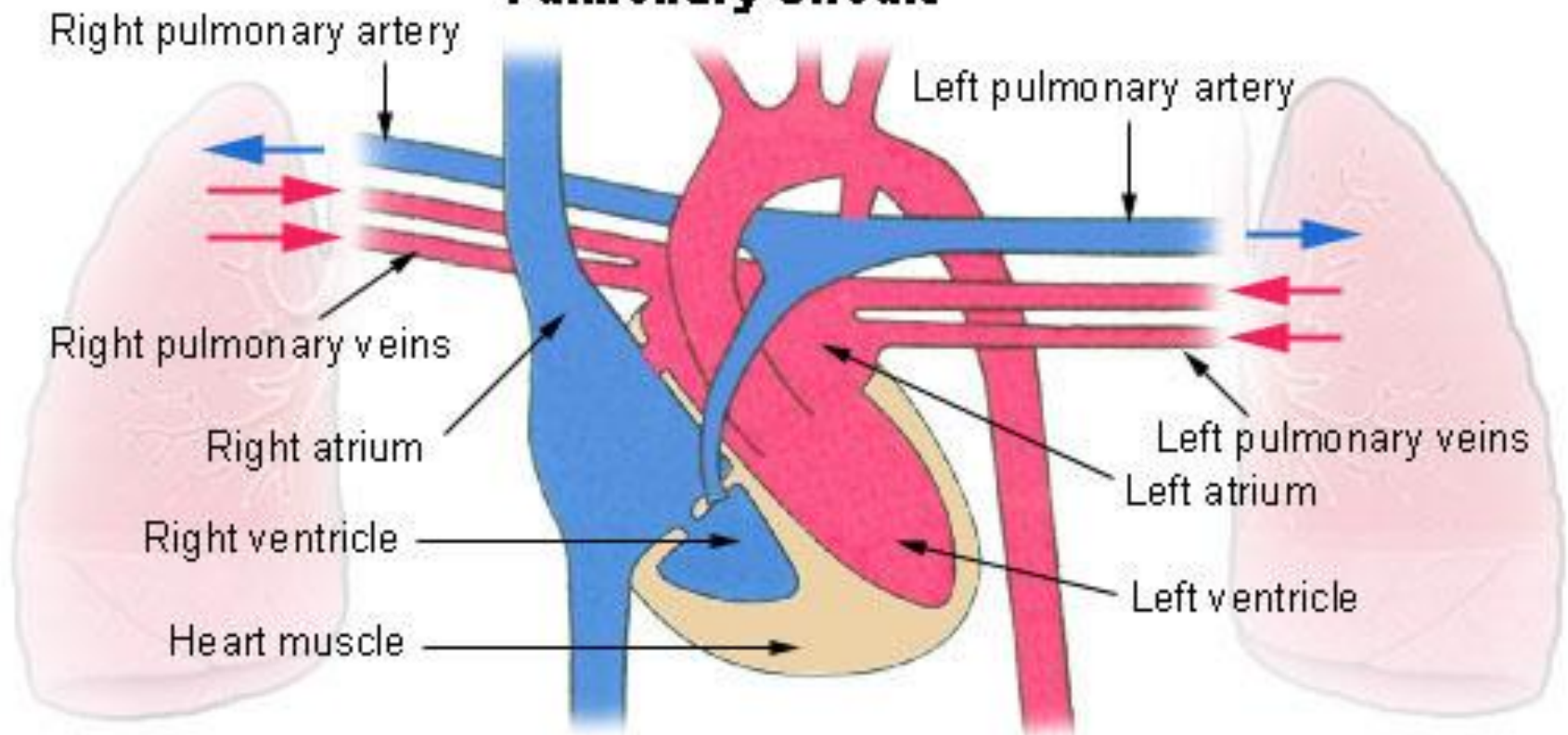
The exchange of gases between air in the alveoli and blood in the capillaries takes place across these two very fine membranes (*together called the respiratory membrane*).

The pulmonary capillaries join up, forming two **pulmonary veins in each lung**.

They leave the lungs at the hilum and carry oxygenated blood to the **left atrium of the heart**.

The innumerable blood capillaries and blood vessels in the lungs are supported **by connective tissue**

Pulmonary Circuit



Bronchi and bronchioles

The two primary bronchi are formed when the trachea divides, at about the level of the 5th thoracic vertebra

The right bronchus

- wider, shorter and more vertical than the left bronchus and is therefore more likely to become obstructed by an inhaled foreign body.
- approximately 2.5 cm long.
- After entering the right lung at the hilum it divides into three branches, one to each lobe.
- Each branch then subdivides into numerous smaller branches

The left bronchus

- 5 cm long and is narrower than the right.
- After entering the lung at the hilum it divides into two branches, one to each lobe.
- Each branch then subdivides into progressively smaller airways within the lung substance.

Functions

- Control of air entry
 - The diameter of the respiratory passages is altered by contraction or relaxation of the smooth muscle in their walls, thus regulating the speed and volume of airflow into and within the lungs.
 - These changes are controlled by the autonomic nerve supply: parasympathetic stimulation causes constriction and sympathetic stimulation causes dilation

The following functions continue as in the upper airways:

- warming and humidifying
- support and patency
- removal of particulate matter
- cough reflex
- Respiratory bronchioles and alveoli

- Within each lobe, the lung tissue is further divided by fine sheets of connective tissue into *lobules*.
- Each lobule is supplied with air by a terminal bronchiole, which further subdivides into respiratory bronchioles, alveolar ducts and large numbers of *alveoli (air sacs)*.
- There are about 150 million alveoli in the adult lung. It is in these structures that the process of gas exchange occurs.
- As airways progressively divide and become smaller and smaller, their walls gradually become thinner until muscle and connective tissue disappear, leaving a single layer of *simple squamous epithelial cells in the alveolar ducts and alveoli*.
- These distal respiratory passages are supported by a loose network of elastic connective tissue in which *macrophages, fibroblasts, nerves and blood and lymph vessels are embedded*.
- The alveoli are surrounded by a dense network of capillaries
- Exchange of gases in the lung (**external respiration**) takes place across a membrane made up of the alveolar wall and the capillary wall fused firmly together. *This is called the respiratory membrane*.

Functions

- **External respiration**
- **Defence against infection**
 - At this level, ciliated epithelium, goblet cells and mucus are no longer present, because their presence would impede gas exchange and encourage infection.
 - By the time inspired air reaches the alveoli, it is usually clean.
 - Defence relies on protective cells present within the lung tissue.
 - These include lymphocytes and plasma cells, which produce antibodies and phagocytes, including alveolar macrophages.
 - These cells are most active in the distal air passages where ciliated epithelium has been replaced by flattened cells.
- **Warming and humidifying** These continue as in the upper airways. Inhalation of dry or inadequately humidified air over a period of time causes irritation of the mucosa and encourages infection

An anatomical illustration of the human respiratory system, showing the trachea, bronchi, and lungs. The illustration is rendered in a soft, painterly style with a muted color palette of pinks, purples, and yellows. The text "Thank you" is overlaid in a large, bold, black serif font, centered horizontally and vertically.

Thank you