University of Al- Mustaqbal

College Of Nursing

First stage/2nd semester

Physiology /lecture(6)

Physiology of Respiratory System

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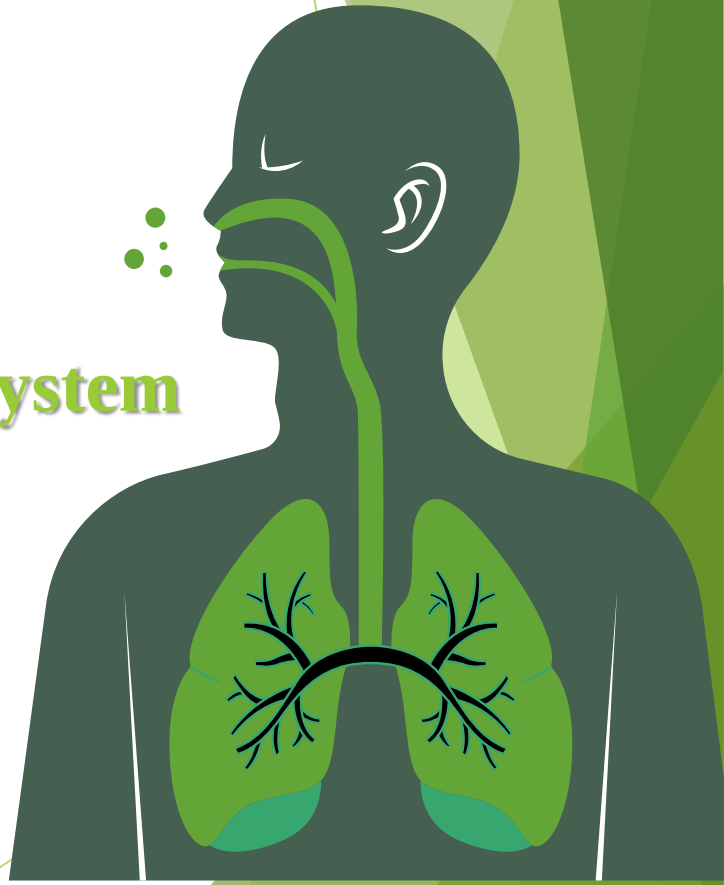


Amazing Respiratory Facts

- The right lung is slightly larger than the left.
- Every day about 10,000 L of air is inspired into the airways and the lungs.
- The surface area of the lungs is roughly the same size as a tennis court.
- The capillaries in the lungs would extend 1,600 kilometers if placed end to end.
- Breathing: It is the first activity in life; unconsciously controlled; and one of the vital sign of life. Necessary because all cells need 02 & produce CO2.

Introduction

The respiratory system delivers oxygen to the blood and removes carbon dioxide from it.

The term respiration refers to :

1. External respiration: gas exchange between the blood and the air in the lung.

Transport of oxygen and carbon dioxide in the blood

2. Respiration Ventilation: Movement of air into and out of lung.

3. Internal respiration: gas exchange between the blood and the tissues.

4. Cellular respiration: cellular utilization of O_2 for metabolism, yielding CO_2 as a waste product.

Respiratory system Functions

A. **Respiratory function:** The main function is to provide O2 to the tissues and remove CO2 through Gas exchange.

B. **Non respiratory functions:**

1-Olfaction:sense of small by the receptors in roof of nose.

2-Phonation: is the production of sounds by the movement of air through the vocal cords.

3-Pulmonary defense: The respiratory mucus membrane has muco-ciliary barrier **filter,** and it secretes: ✓Immunoglobulin A (Ig A) ✓Alpha-1 antitrypsin.

- ✓ The pulmonary macrophages in the alveoli: engulf smaller foreign particles which pass through the mucocilliary barrier filter.

Respiratory system Functions

✓ **Cough reflex:** initiated by slight foreign bodies irritation of bronchi and trachea.

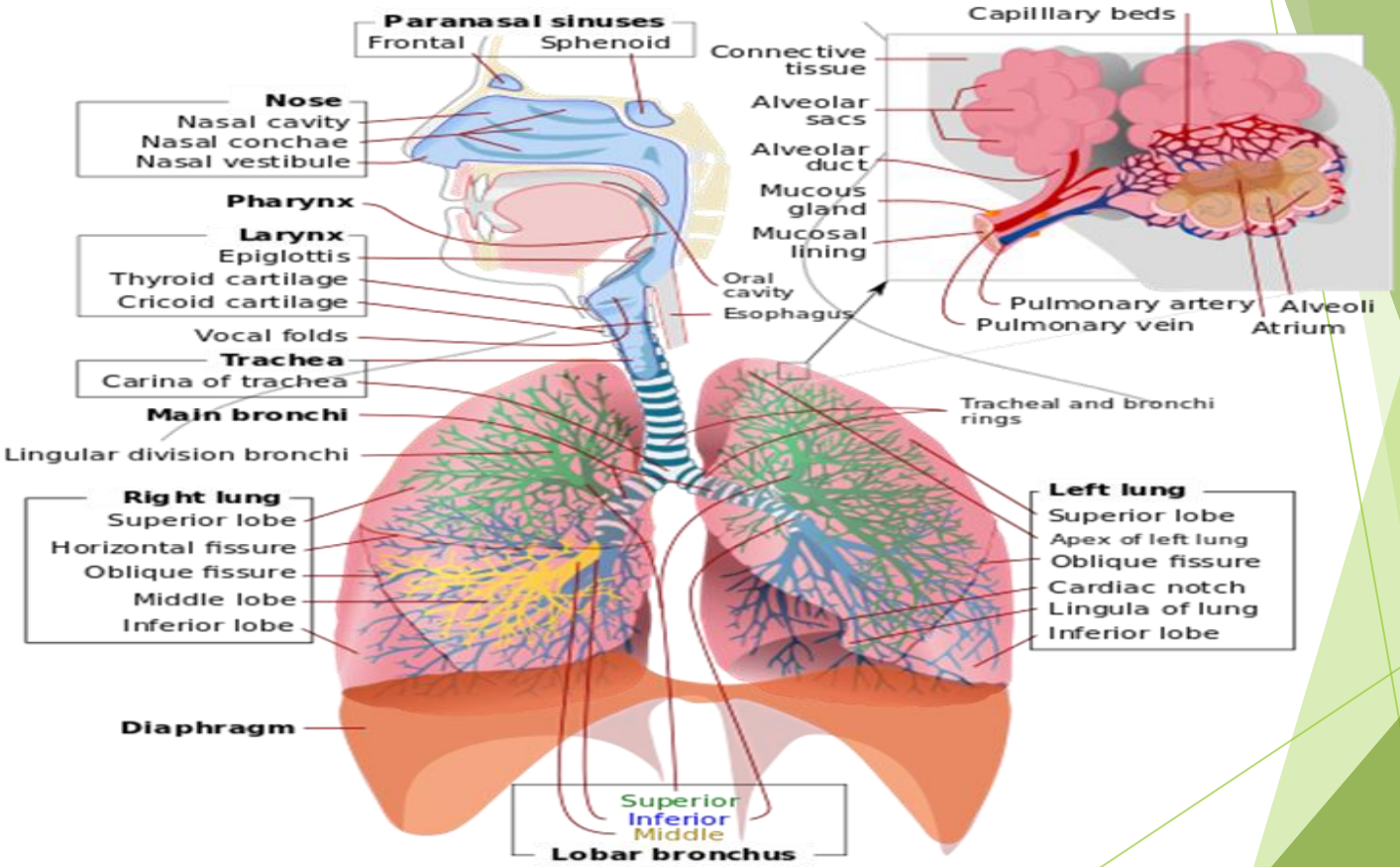
✓ **Sneezing reflex:** like the cough reflex, it applies to the nasal passageways instead of the lower respiratory passages.

4. **Activation of Angiotensin** I to angiotensin II with the help of angiotensin converting enzyme (ACE) formed by the lungs.

5. **Regulating the acid-base status** of the body by washing out extra carbon dioxide from the blood.

6. Secretion of important substances like surfactant.

7. Regulation of H2o and heat.


Paranasal sinuses
Frontal
Sphenoid
Nose
Nasal cavity
Nasal conchae
Nasal vestibule
Pharynx
Larynx
Epiglottis
Thyroid cartilage
Cricoid cartilage
Vocal folds
Trachea
Carina of trachea
Main bronchi
Lingular division bronchi
Right lung
Superior lobe
Horizontal fissure
Oblique fissure
Middle lobe
Inferior lobe
Diaphragm
Oral cavity
Esophagus
Capillary beds
Connective tissue
Alveolar sacs
Alveolar duct
Mucous gland
Mucosal lining
Pulmonary artery
Pulmonary vein
Alveoli
Atrium
Tracheal and bronchi rings
Left lung
Superior lobe
Apex of left lung
Oblique fissure
Cardiac notch
Lingula of lung
Inferior lobe
Superior
Inferior
Middle
Lobar bronchus

Respiratory System

Consist of respiratory airway, respiratory muscle and resp. control.

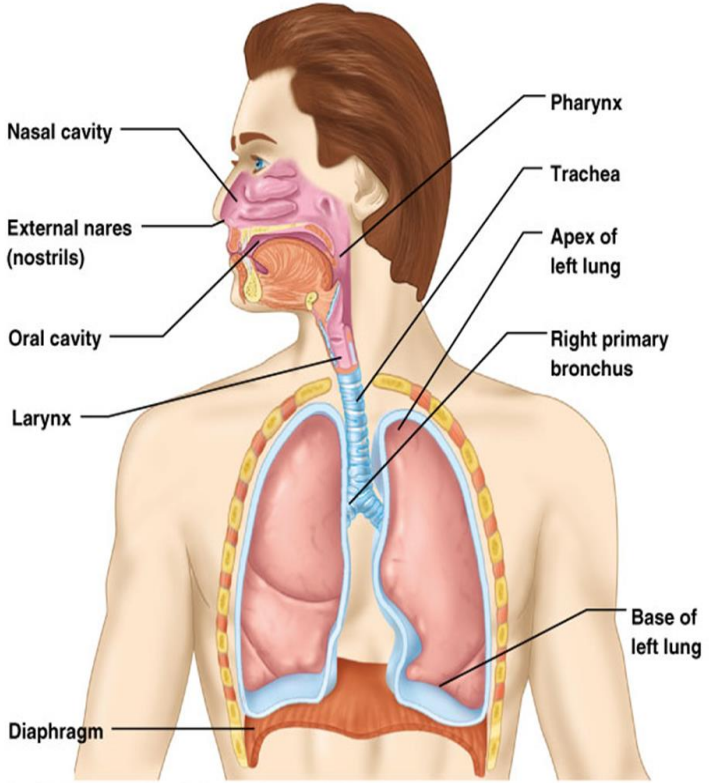
Anatomically the **respiratory airway** is divided into:

1- Upper respiratory tract: can refer to the parts of the respiratory system lying above the sternal angle (outside of the thorax), above the vocal folds. The tract consists of the nasal cavity and paranasal sinuses, the pharynx (nasopharynx, oropharynx and laryngopharynx) and sometimes includes the larynx with their associated structures.

. Its primary function is to **receive the air from the external environment and filter, warm, and humidify** it before it reaches the delicate lungs where gas exchange will occur**.**

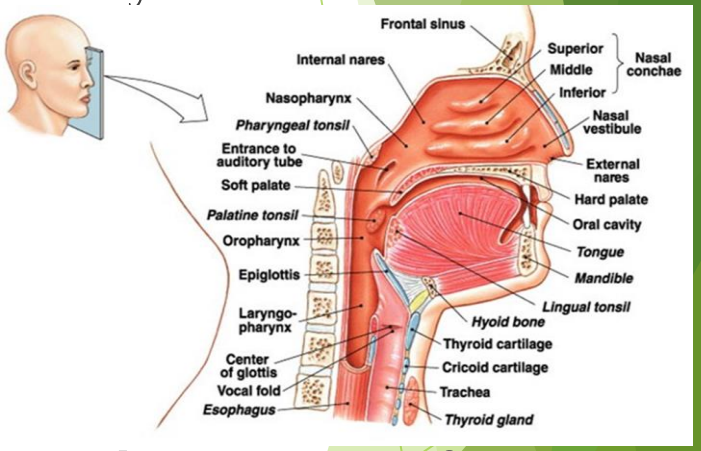
Structure of the Respiratory System

2- Lower respiratory tract: or lower airway is derived from the developing foregut and consists of the trachea, bronchial tree, pulmonary alveoli, lungs and pleurae (**L**ower respiratory tract starts from the **L**ower end of **L**arynx). This is where gas exchange actually takes place.



Nose

- External nose(nostril)
- Internal nose consist of Nasal cavity: The rest of the cavity is lined with respiratory mucosa.



Functions

- Passageway for air
- **Cleans** the air by : Traps incoming foreign particles
- Humidifies, warms air
- **Smell**: Olfactory receptors are located in the mucosa on the superior surface.
- Along with paranasal sinuses are **resonating chambers for speech**

Paranasal Sinuses

Cavities within bones surrounding the nasal cavity

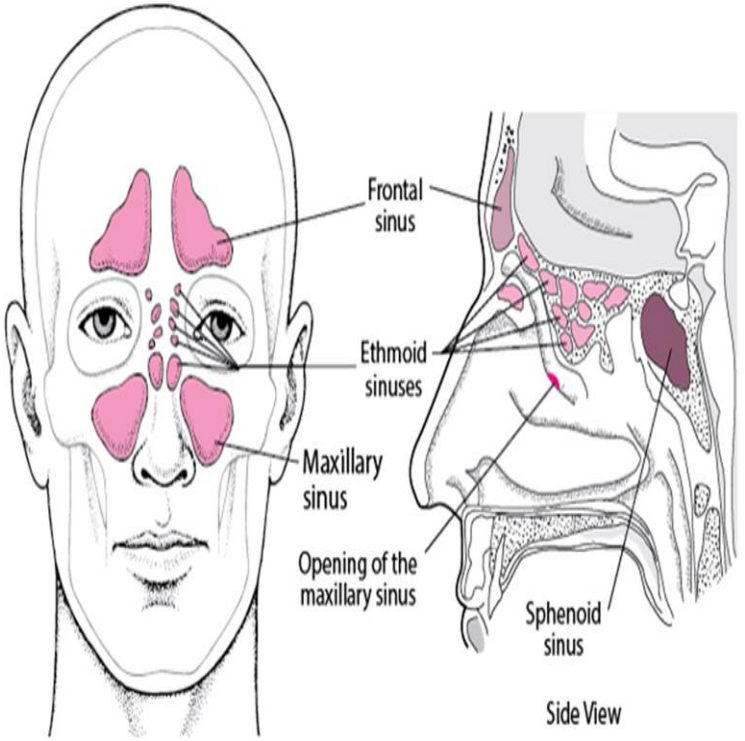
- Frontal sinus
- Sphenoid sinus
- Ethmoid sinus
- Maxillary sinus

Function of the sinuses

- Humidifying and warming inhaled air.
- Sinuses reduce the weight of the skull,

making it easier to hold up the head.

- **Enhancing vocal resonance**.
- Sinuses produce mucus that traps dust, pathogens, and the respiratory system clean.



Pharynx

Pharynx: Muscular passage from nasal cavity to larynx

- Common opening for digestive and respiratory systems

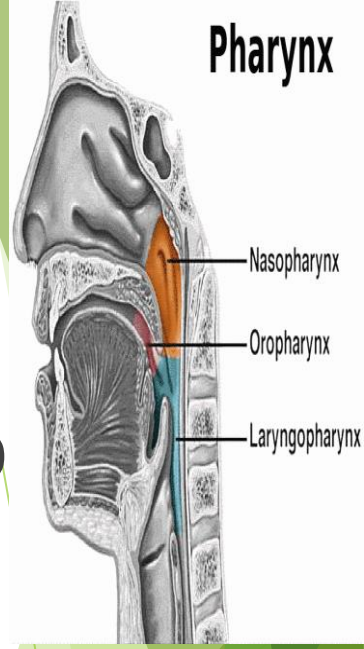
Three regions of the pharynx

Nasopharynx – superior region behind nasal cavity (respiratory only)

Oropharynx – middle region behind mouth

Laryngopharynx – behind the larynx. Spilt esophagus and larynx.

The oropharynx and laryngopharynx are common passageways for air and food.

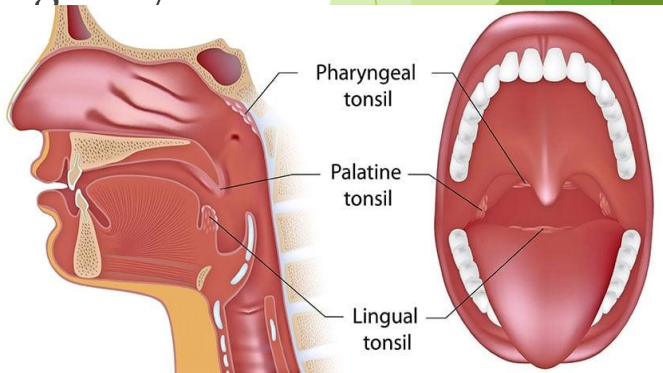


Tonsils of the pharynx the first line of defenders.

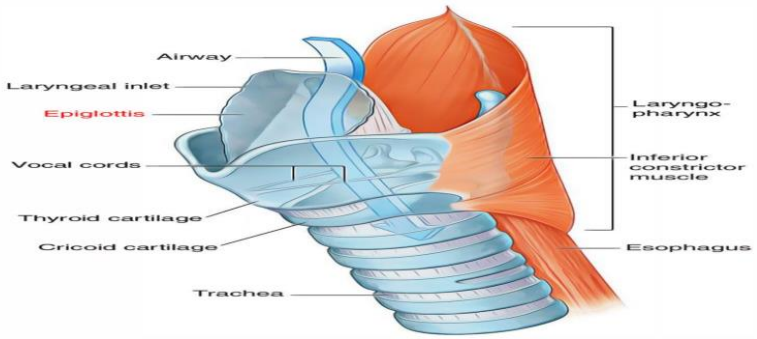
Pharyngeal tonsil (adenoids) in the nasopharynx

Palatine tonsils in the oropharynx

Lingual tonsils at the base of the tongue



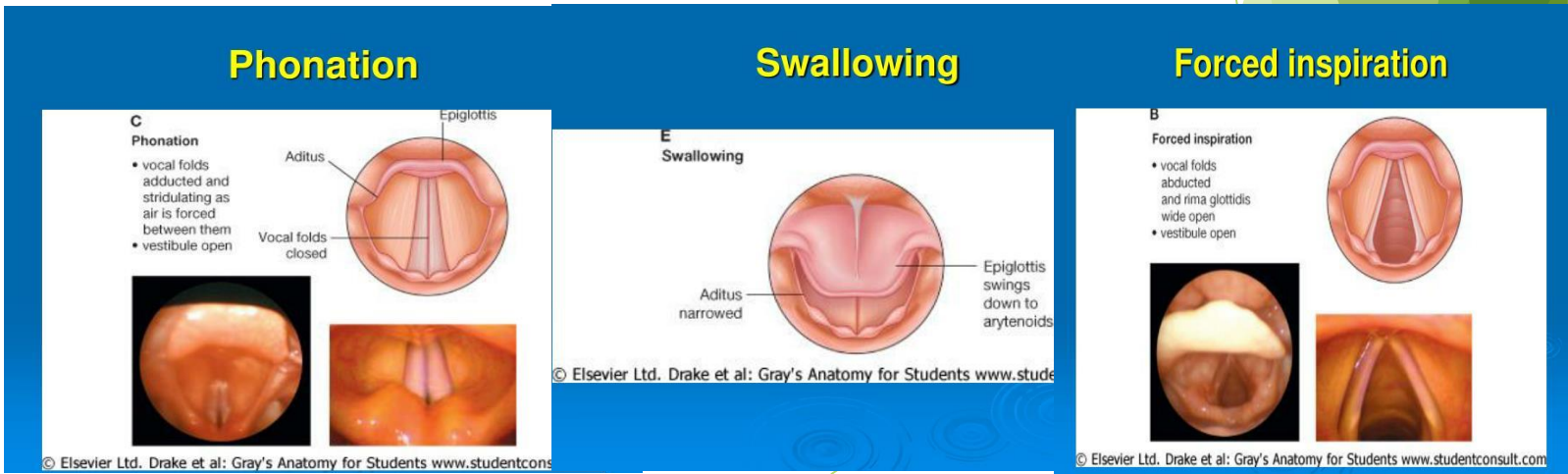
Larynx (Voice Box)



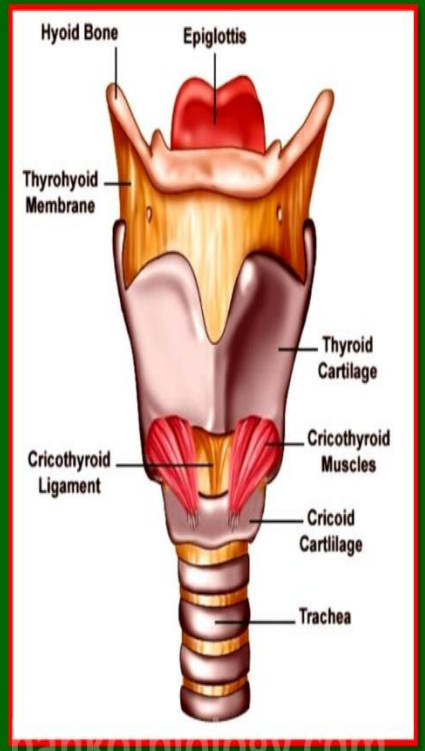
- Lies in neck .3.5-4.5 cm. formed by cartilage .
- The larynx houses the vocal cords.
- its situated just below where the tract of the pharynx splits into the trachea and the esophagus. The larynx contains two important structures: the epiglottis and the vocal cords.
- The epiglottis is a spoon-shaped flap of elastic cartilage located at the opening to the larynx (directed food and drink into esophagus).
- The vocal cords consist of two folds of connective tissue that stretch and vibrate when air passes through them, causing **vocalization.**

Function of larynx

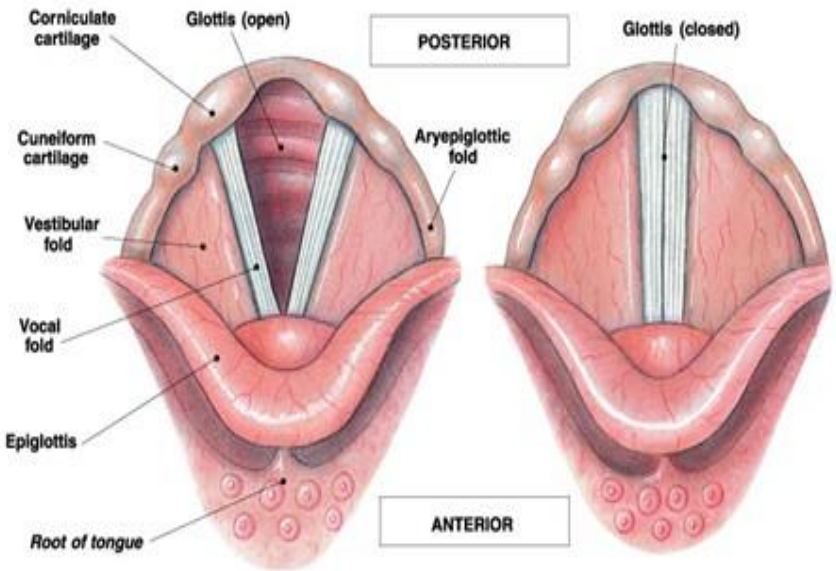
- **The most important function of the larynx is to** Protect the lower airways from aspiration, where the epiglottis descends like a lid over the larynx during swallowing and thus directing food or fluid down to the esophagus. Closure of the vocal cords also helps protect the airway.
- **Phonation :Producing sound**
- **Respiration**
- **Swallowing**

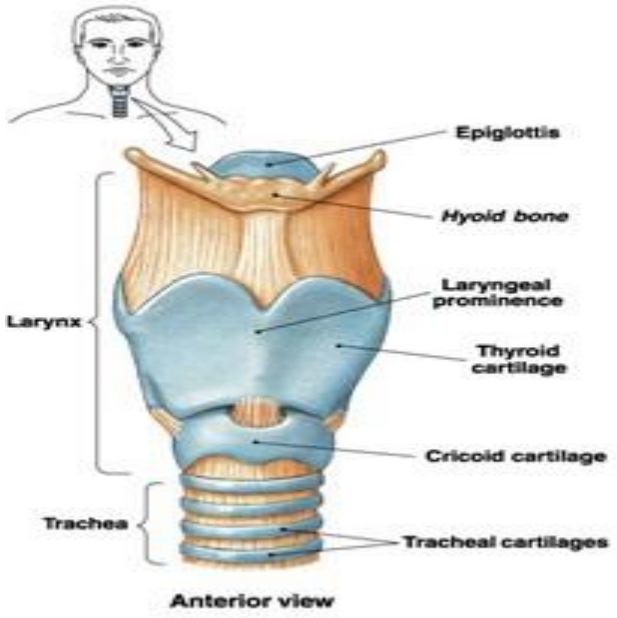


Larynx (Voice Box)

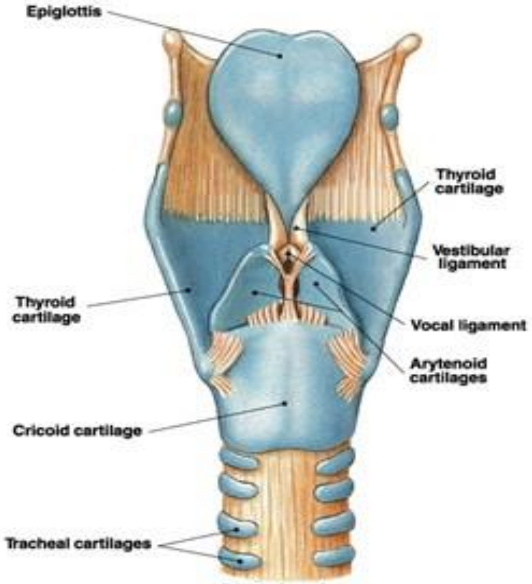


- Larynx (sound box or voice box) is a cartilaginous box which helps in sound production.
- During swallowing, *glottis* is closed by *epiglottis* (a thin elastic cartilaginous flap) to prevent the entry of food into larynx.
- Trachea, all bronchi and initial bronchioles are supported by incomplete cartilaginous half rings.





Anterior view



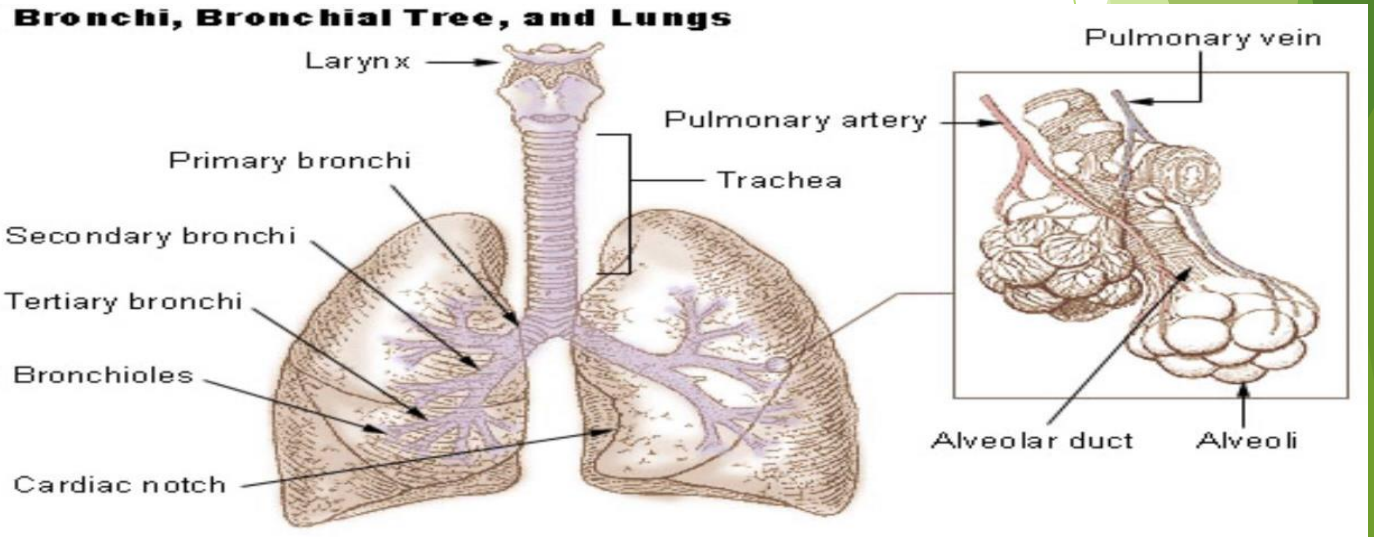
Posterior view

Trachea (Windpipe)

1. The trachea is the main conducting airway, is a semirigid, tubular organ, It is positioned anterior to the esophagus. Connects larynx with bronchi.
2. Lined with ciliated mucosa: It provides the same **protection against dust** and other micro-particles as that of the lining membrane in the nasal cavity and larynx.
3. Walls are reinforced with A series of **15 to 20 C-shaped rings of hyaline cartilages . These rings provides flexibility and strength** to trachea. The open part of each of these cartilages faces the esophagus and permits the esophagus to expand slightly into the trachea during swallowing. trachea usually ends at about the level of the fifth thoracic segment.
4. The carina is the last tracheal cartilage and forms a cartilage division into right and left bronchi (Primary).

Bronchial tree

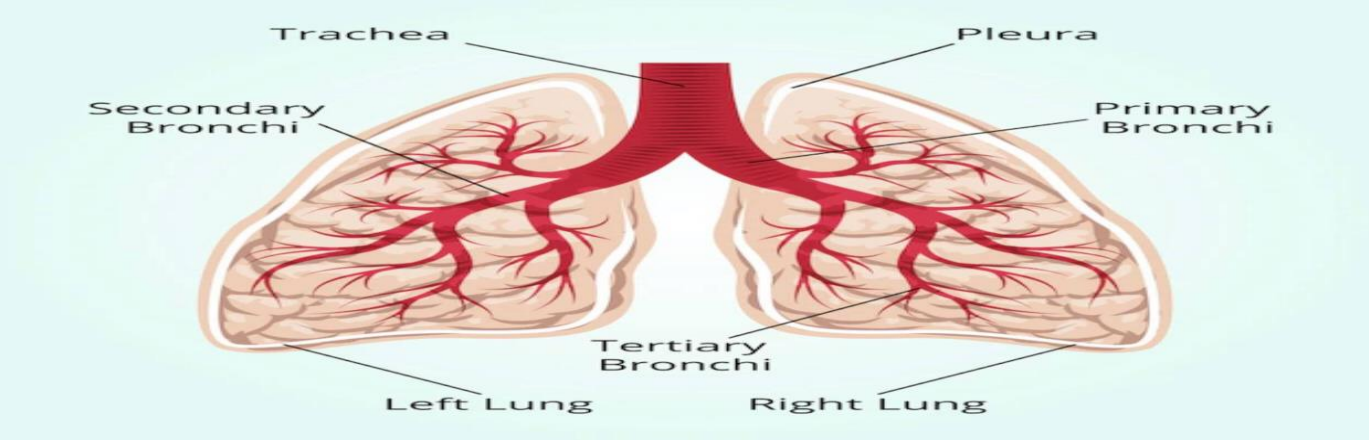
1. Formed by division of the trachea. It control air entry. The first spilt produces two bronchial tubes called primary bronchi (right and left) (single bronchus).
2. The primary bronchi branches into secondary bronchi , which lead to each of the lobes of the lungs the **hilus** (medial depression).
3. Right bronchus is wider, shorter, and straighter than left. Right (3)branches while the left (2) branches.



Bronchial tree

4. The secondary bronchi continue to divided into smaller and smaller tubes called tertiary and quaternary bronchi until they finally reach they smallest tubes called bronchioles which divide to form terminal bronchioles.

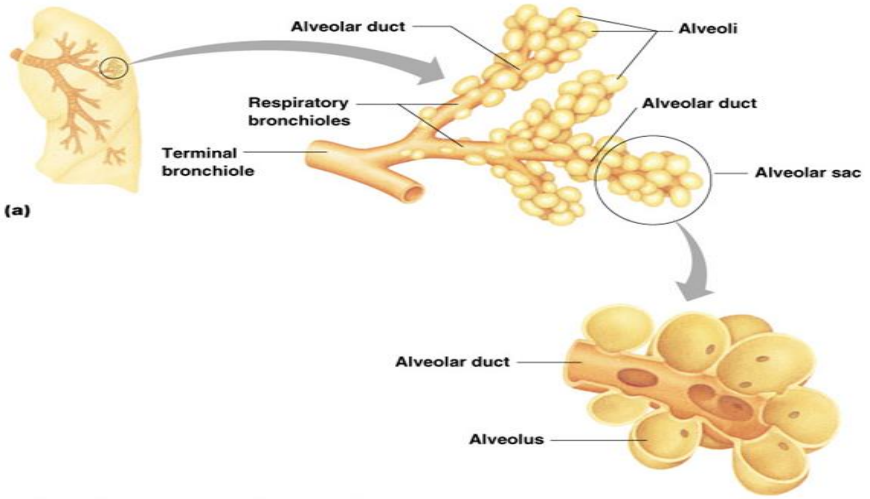
5. The primary , secondary ,tertiary and quaternary bronchi are much like trachea in composition but as they get smaller they lose cartilage an fibrous tissue until the bronchiole walls are composed of only a thin layer of muscular and elastic tissue .



Alveoli

1. At the end of the smallest bronchioles (the terminal bronchioles) are grape cluster-like structures called alveolar sacs, and each sac contains alveoli (functional unit of the lung represent the sit of gas exchange).
2. The alveoli's walls are composed of a simple squamous epithelium designed to facilitate rapid diffusion and elastic tissue. The interface of simple squamous epithelium of the alveolus and pulmonary capillary is called the **respiratory membrane** and it is here where gas exchange takes place.
3. Blood vessels criss cross each alveolus, providing a large surface area for gas exchange between the alveoli and pulmonary capillarie

Notes : (Human beings have a thin layer of about 700 million alveoli within their lungs. Which is crucial for respiration, exchanging O2 & CO2 with the surrounding blood capillaries.)



Lungs

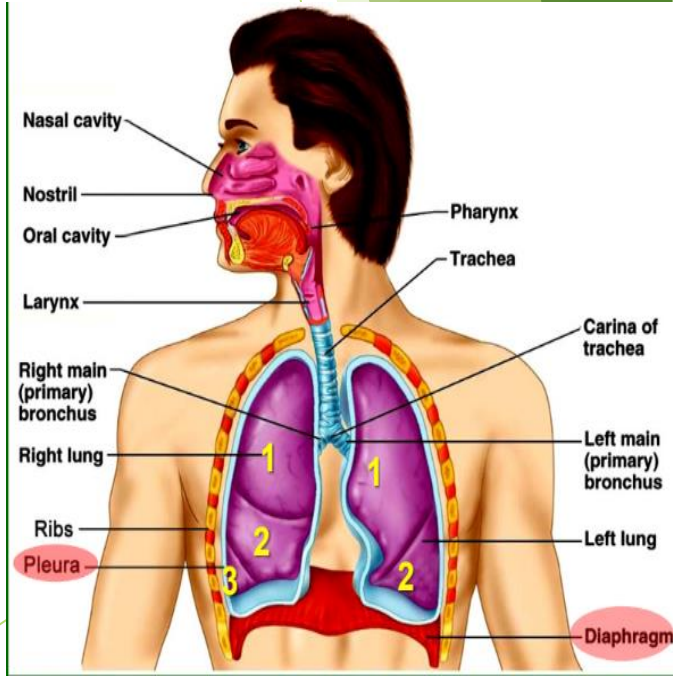
Two cone shaped, Soft, spongy organs residing in the thoracic cavity and rest on the diaphragm on either side of the heart. They are protected by the rib cage.

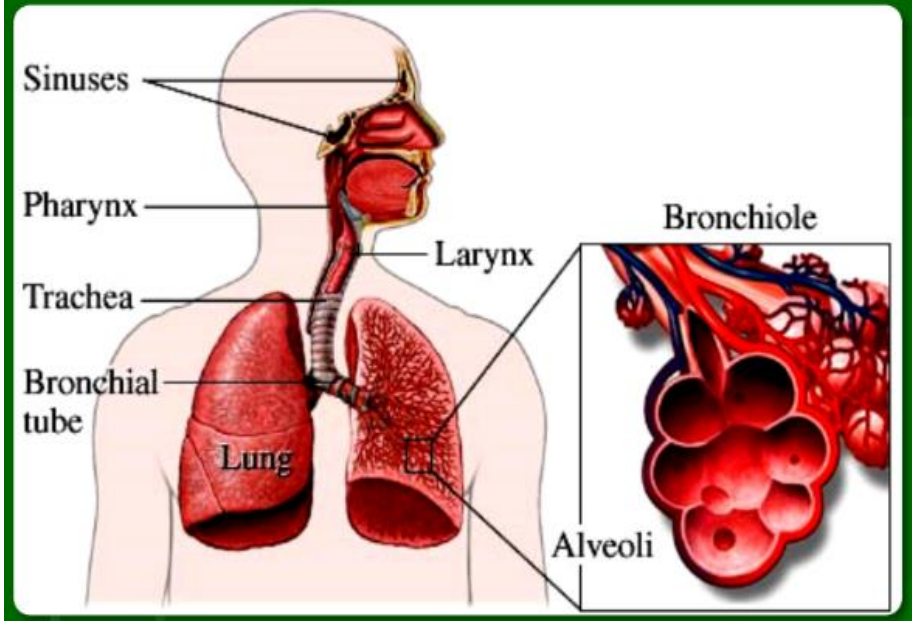
• The lungs are sealed off from the inside surface of the thoracic (chest) cavity by two layers of **pleurae**.

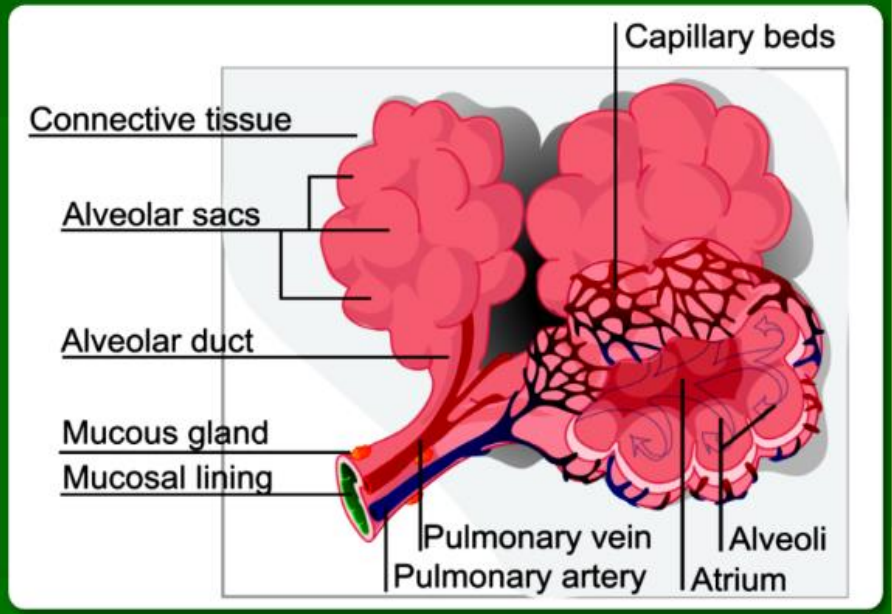
- Apex is near the clavicle (superior portion)
- Base rests on the diaphragm (inferior portion)
- Each lung is divided into lobes by fissures

a) Left lung – two lobes (superior and inferior).

b) Right lung – three lobes. (superior, middle and inferior).







- *Lungs= Bronchi + bronchioles + alveoli*
- Alveoli & their ducts form *respiratory* or *exchange part* of respiratory system.
- *Alveoli are the structural and functional units of lungs.*

Pleura

- **Pleura** :a serous membrane two layered membrane structure.
- The thin space between the two layer is **pleural space**; it normally contains a small amount of lubricating fluid called **pleural fluid** secreted by each membrane. **which** that **reduces friction and helps to hold the membranes together.**
- Parietal pleura(outer): Lining the interior of the thoracic cavity
- Pulmonary (visceral) pleura(inner) covers the lung surface
- Because the pressure between the two pleurae is about 4 mmHg (milimetres of mercury) lower than that of the atmosphere and the inside of the lungs, the outer surfaces of the visceral pleurae are always "stuck" to the internal surface of the parietal pleurae, and the lungs are kept inflated in this way.

***Physiologically* it is divided into two zones**:

1- Conducting zone: includes all of the cavities and tubes both outside and within lungs. The part starting with the external nostrils up to the terminal bronchioles. the function is to filter , warm, and moisten air and conduct it into the lungs .

2- Respiratory zone: includes all parts of the respiratory system where gas exchange between the air and the blood occur (i.e. any part of the respiratory system that has alveoli).

RESPIRATORY ANATOMY

COMPONENT	DESCRIPTION
Nose	Entry point for inhaled air; contains nasal passages
Pharynx	Passage for both air and food; connects nose to trachea
Larynx	Voice box; contains vocal cords; air passage to trachea
Trachea	Windpipe; carries air to and from the lungs
Bronchi	Primary airways branching from trachea; lead to each lung
Bronchioles	Smaller airways branching from bronchi; end in alveoli
Alveoli	Tiny air sacs; site of gas exchange in the lungs

Muscles:

- Diaphragm: Primary muscle for inhalation; flattens to increase thoracic volume.

- Intercostal Muscles: External (lift ribs for inhalation) and internal (aid forced exhalation).


THANK
YOU