NARAYANA
COLLEGE OF NURSING

ANATOMY-RESPIRATORY SYSTEM

PRESENTED BY

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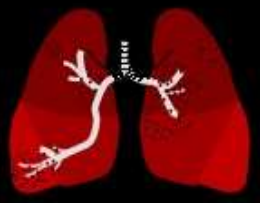
CHINTHAREDDY PALM

NELLORE

INTRODUCTION

- The cells of the body need energy fore all their metabolic activities. Most of this energy is derived from chemical reactions, which can only takes place in the presence of oxygen. the ,main waste product of these reactions is carbon dioxide.
- 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 carbondioixide.

The organs of the *"Respiratory Tract"* can be divided into two groups **"STRUCTURALLY"**



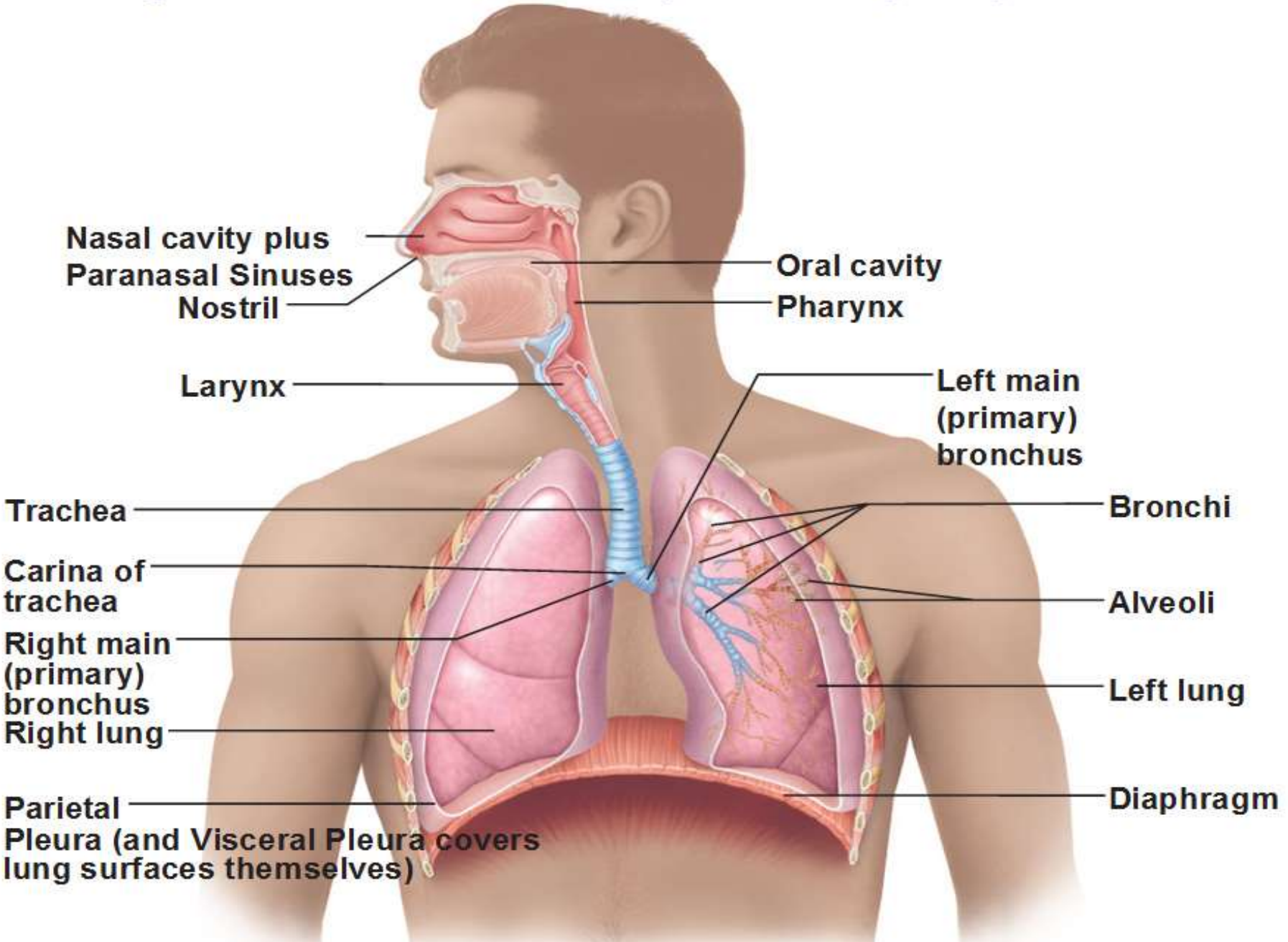
**** The Upper Respiratory Tract**

* Nose
* Nasal cavity
* Sinuses
* Pharynx

**** The Lower Respiratory Tract**

* Larynx
* Trachea
* Bronchial Tree
* Lungs

Organs of the Respiratory System



THE HUMAN RESPIRATORY SYSTEM

I. NOSE
   A. Nasal Cavity
   B. Paranasal Sinuses

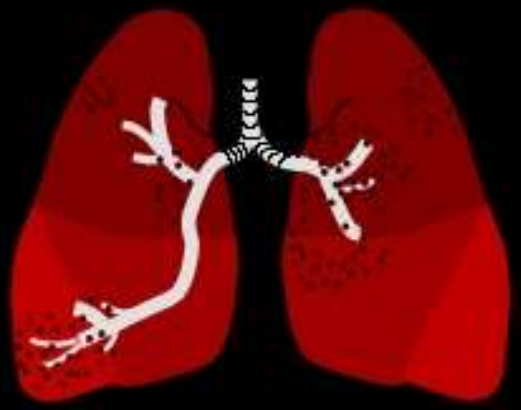
V. PHARYNX

III. LARYNX
   A. Epiglottis
   B. Vocal Cords

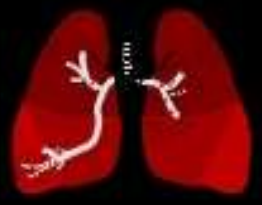
IV. TRACHEA

v. BRONCHI
   A. Bronchial Tree

VI. LUNGS
   A. Lobes of the Lungs
   B. Pleural Cavities
   C. Alveoli



THE NOSE



* It provides an entrance for air in which air is

  filtered by coarse hairs inside the nostrils.

* It has 2 portions : the external and internal

* The external portion is supported by a framework

  of bone and cartilage covered with skin and lined with mucous membrane.

* The internal portion is a large cavity in the skull,

The Nasal Cavity

* Interior area of the nose; lined with a sticky mucous membrane and contains tiny, surface hairs, cilia. divided medially by the nasal septum.

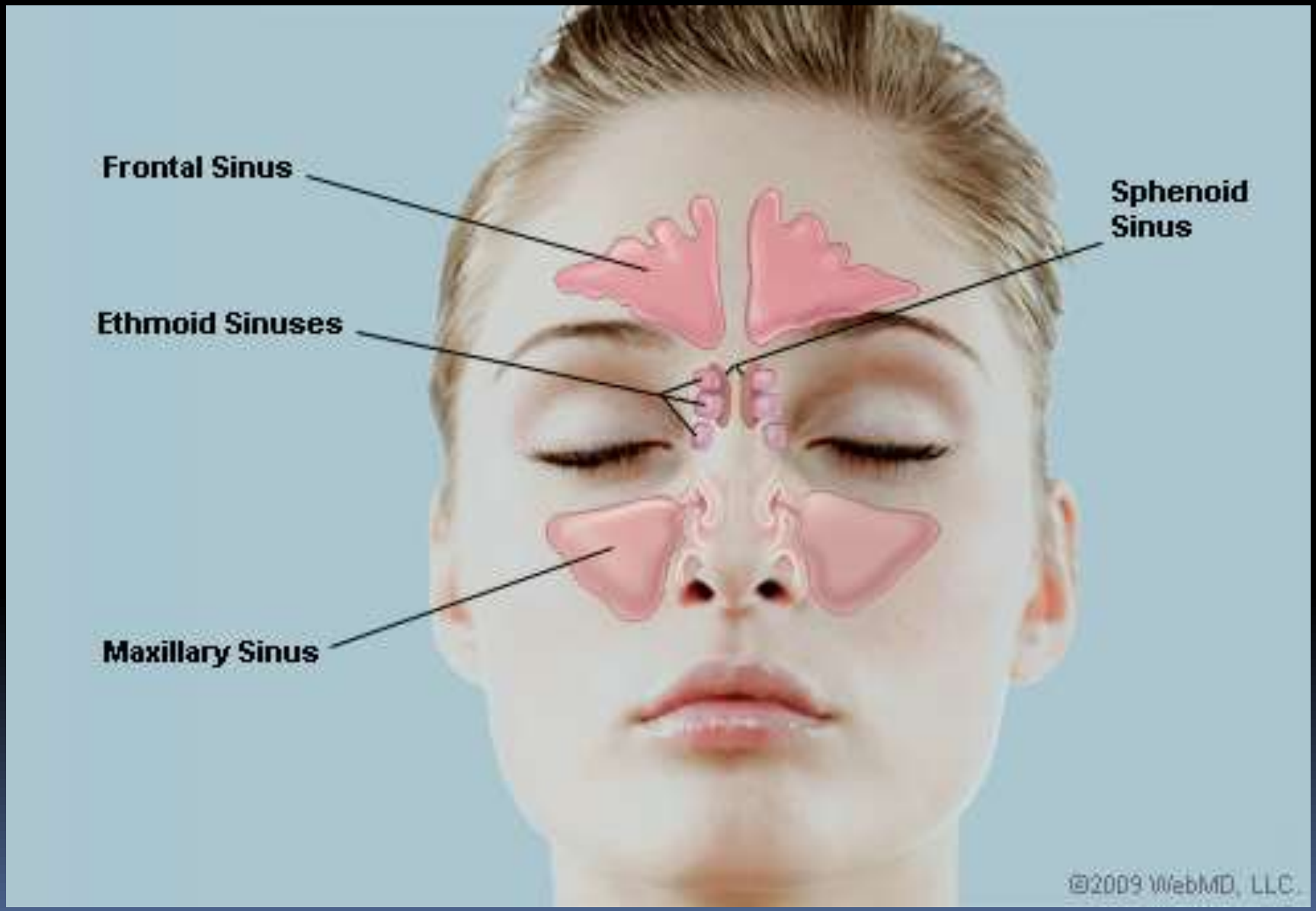
* Nasal conchae divide the cavity into passageways that are lined with mucous membrane, and help increase the surface area available to warm and filter incoming air.

•Particles trapped in the mucus are carried to the pharynx by ciliary action, swallowed,

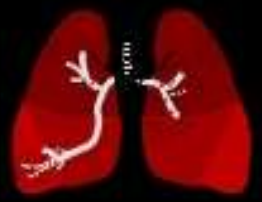
Functions of the nose

- Warming
- Filtering and cleaning
- Humidification
- Olfactory function of the nose

Para nasal sinuses



Paranasal Sinuses

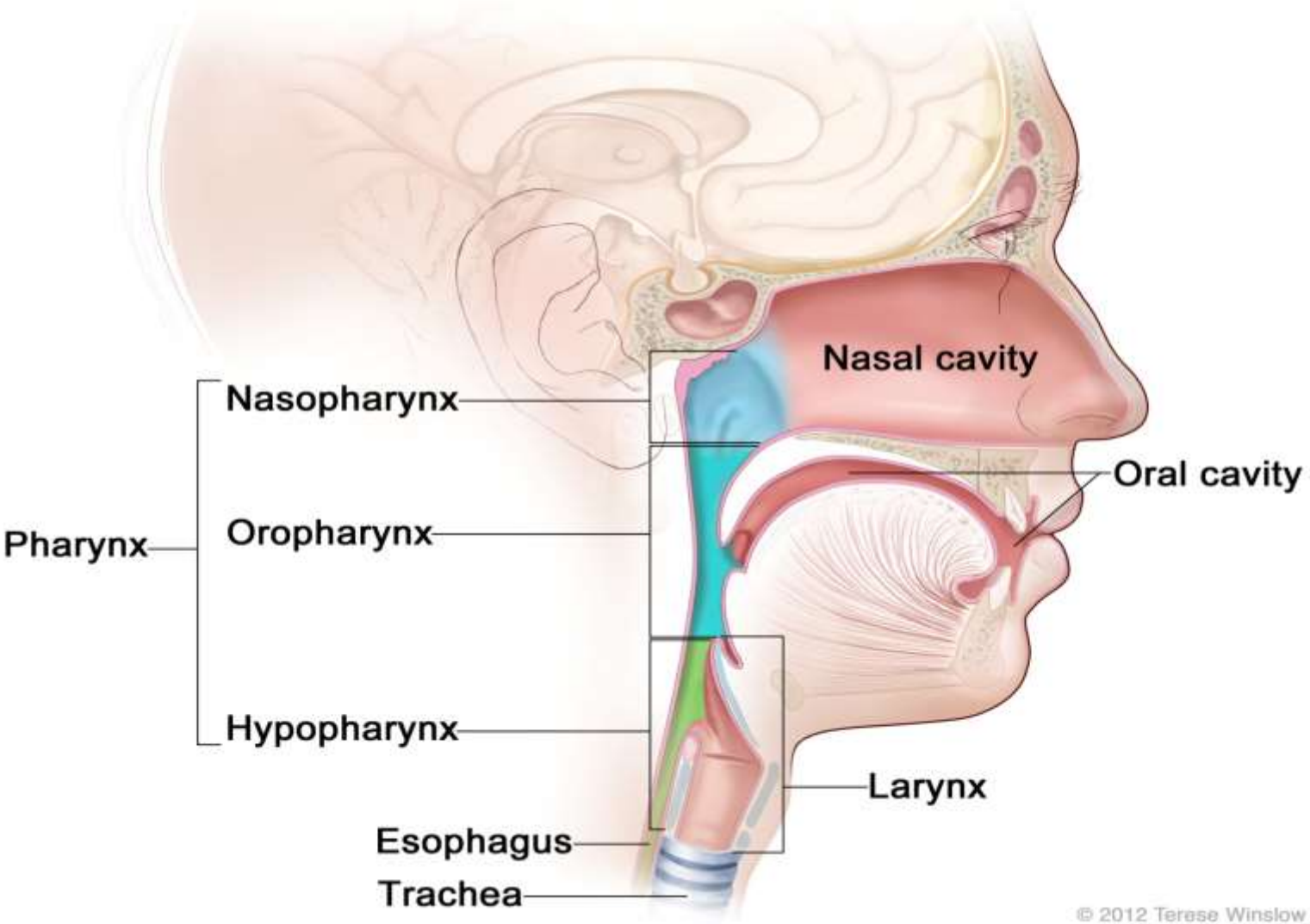


* Sinuses are air-filled spaces
  within the maxillary, frontal, ethmoid,
  and sphenoid bones of the skull.

* These spaces open to the nasal cavity
  and are lined with mucus membrane
  that is continuous with that lining the nasal cavity.

* The sinuses reduce the weight of the skull
  and serve as a resonant chamber to affect
  the quality of the voice.

Anatomy of the Pharynx



- The pharynx or throat, is a funnel shaped tube 13 cm (5 in.) long that starts at the internal nares and extends to the level of the cricoid cartilage(6 th cervical vertebra). It lies behind the nose, mouth and larynx and is wider at its upper end.

Structures associated with pharynx

- Superiorly : the inferior surface of the base of the skull.
- Inferiorly : it is continuous with the esophagus.
- Anteriorly : the wall is incomplete because of the openings in to the nose, mouth and larynx.
- Posteriorly : areolar tissue, involuntary muscle and the bodies of the first six cervical vertebrae .

For descriptive purposes the pharynx is divided in to three parts

- **Nasopharynx** – superior portion of the pharynx lies posterior to the nasal cavity and extends to the soft palate.
- **Oropharynx** – the intermediate portion of the pharynx lies posterior to the oral cavity and extends from the soft palate inferiorly to t6he level of hyoid bone.
- **laryngo pharynx** – the inferior portion begins at the level of the hyoid bone. At its inferior end it opens in the esophagus(food tube) posteriorly and the larynx.

Structure : The pharynx is composed of three layers.

Mucous lining- the mucosa varies slightly in the different regions. In the nasopharynx it is continuous with the lining of the nose and consists of ciliated columnar epithelium, in the Oropharynx, laryngo pharynx it is formed by tougher stratified sqamous epithelium, which is continuous with the lining of the mouth and esophagus.

The lining protects underlying tissues from the abrasive action of foodstuffs passing through prior to being swallowed.

Fibrous tissue: this forms the intermediate layer. It is thicker in the nasopharynx, where there is little muscle and becomes thinner towards the lower end, where the muscle layer is thicker.

Smooth muscle: this consists of several involuntary constrictor muscles that play an important part in the mechanism of swallowing, which in the pharynx is under voluntary control. The upper end of the esophagus is closed by the lower constrictor muscle expert during swallowing.

Blood and nerve supply

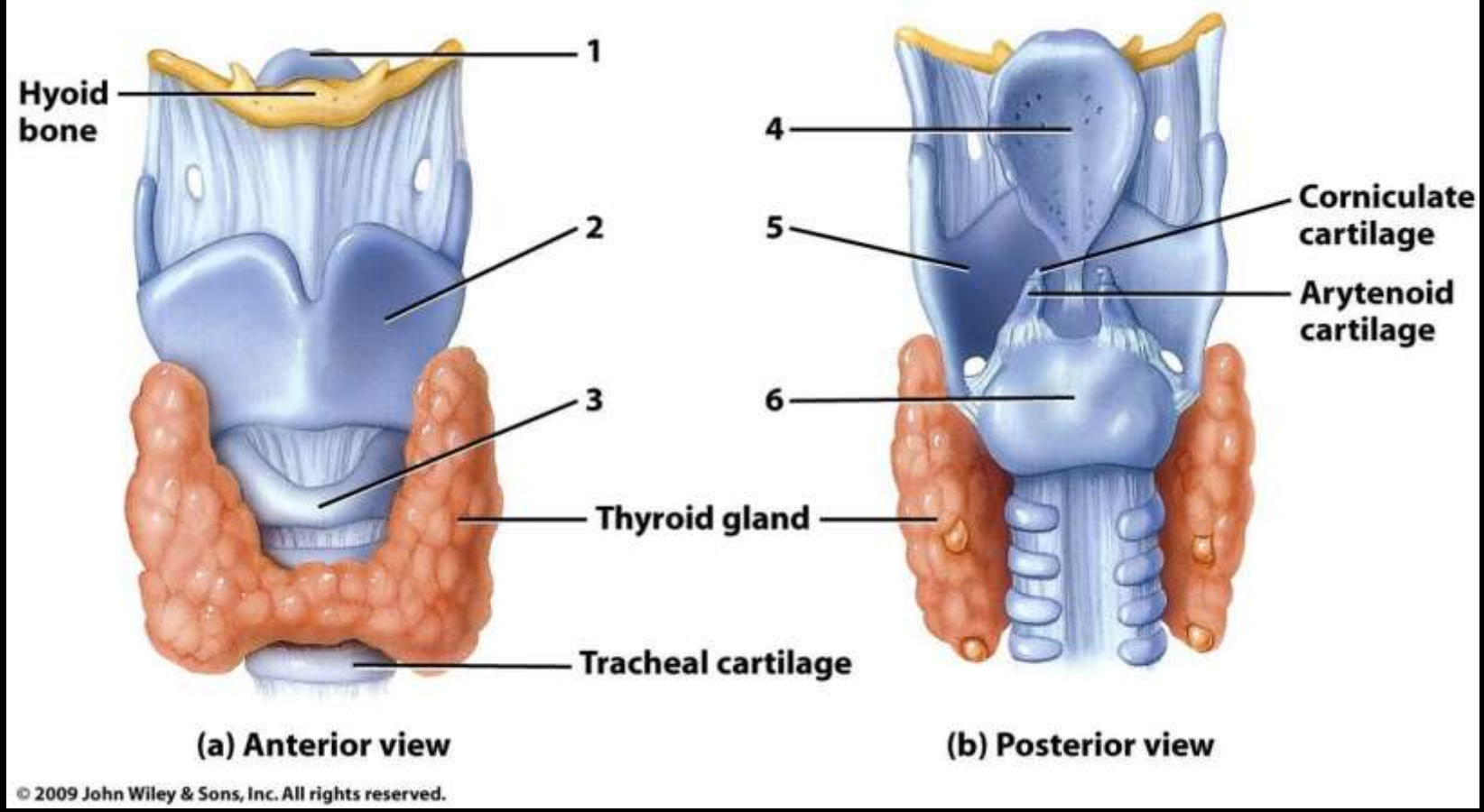
- Blood is supplied to the pharynx by several branches of the facial artery. The venous return is in to the facial and internal jugular veins.
- The nerve supply is from the pharyngeal plexus, formed by parasympathetic and sympathetic nerves. Parasympathetic supply is by vagus and glossopharyngeal nerves. sympathetic supply is by nerves from the superior cervical ganglia.

FUNCTIONS

- Passageway for air and food
- Warming and humidifying
- Taste
- Hearing
- Protection
- Speech

LARYNX

- The larynx or voice box extends from the root of the tongue and the hyoid bone to the trachea.
- It lies infront of the laryngopharynx at the level of the 3rd, 4th , 5th and 6th cervical vertebrae.
- Until puberty there is little difference in the size of the larynx between the sexes. Thereafter it grows larger in the male, which explains the prominence of the ‘Adams Apple’ and the generally deeper voice.



Structures associated with the larynx

superiorly – the hyoid bone and the root of the tongue.

inferiorly – it is continuous with the trachea

anteriorly – the muscles attached to the hyoid bone and the muscles of the neck.

posteriorly – the laryngopharynx and 3rd to 6th cervical vertebrae.

laterally – the lobes of the thyroid gland.

STRUCTURE

The larynx is composed of several irregularly shaped cartilages attached to each other by ligaments and membranes.

The main cartilages are

- Thyroid cartilage -1
- Cricoid cartilage-1
- Arytenoid cartilages-2

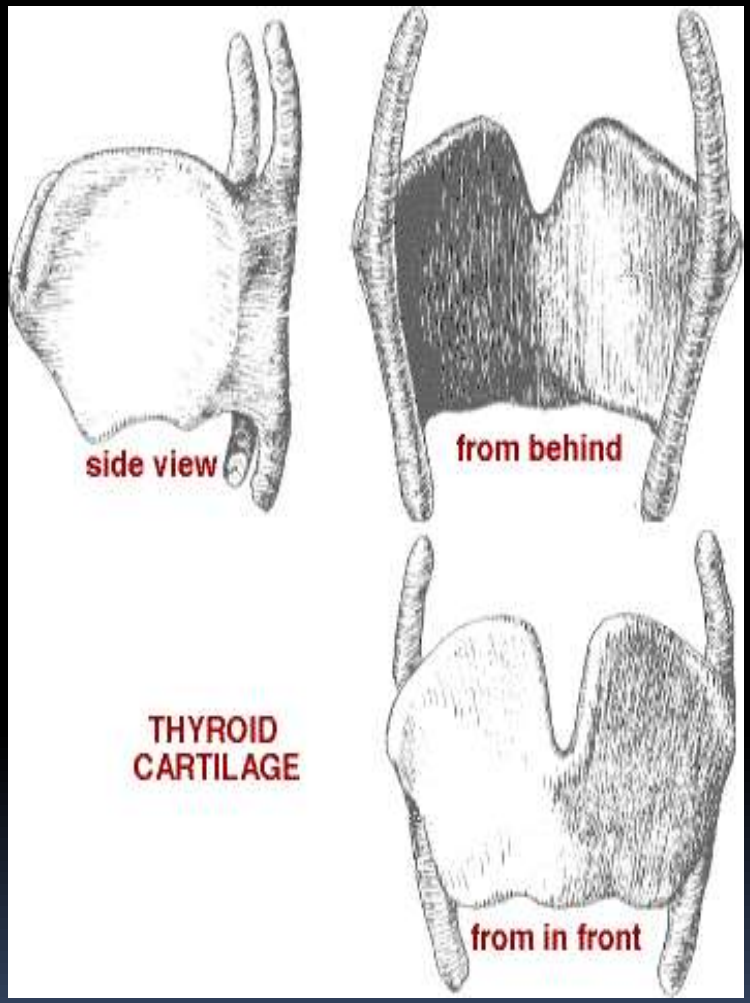
} Hyaline cartilage.

- Epiglottis-1

- **Thyroid cartilage:**

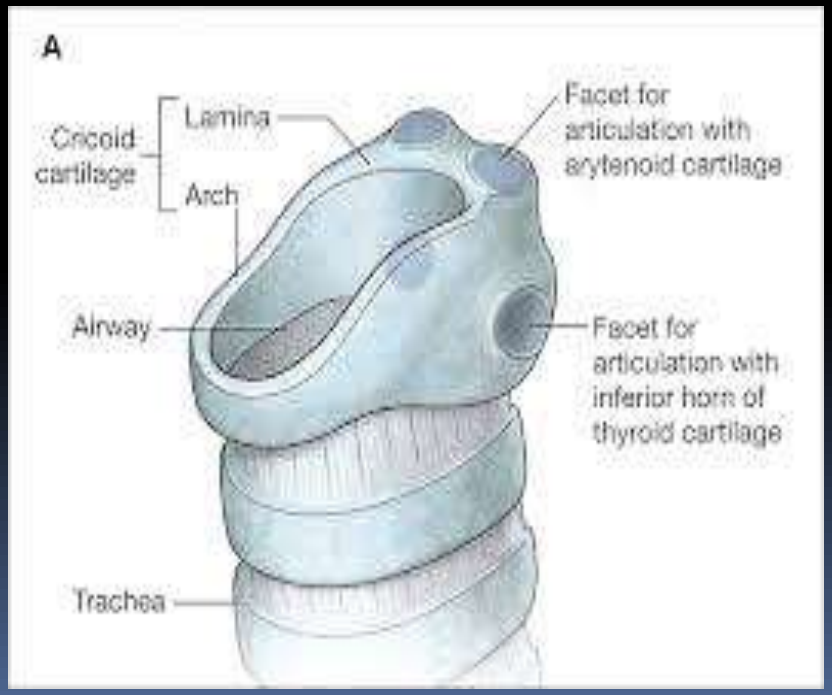
Is the most prominent and consists of the flat pieces of cartilage, or laminae, anteriorly, forming the ***laryngeal prominence.*** Immediately above the laryngeal prominence the laminae are separated by a v- shaped notch known as ***thyroid notch***.

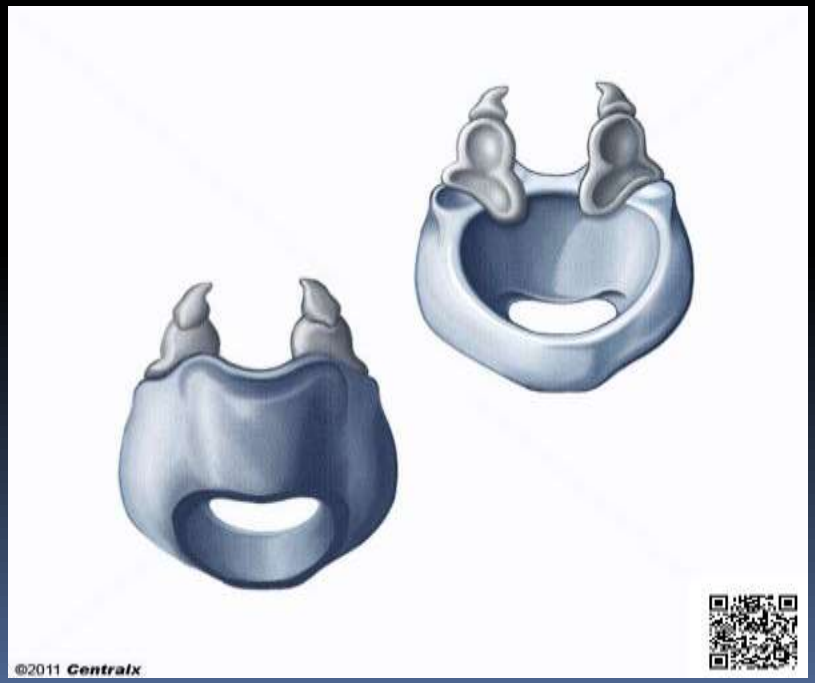
The thyroid cartilage is incomplete posteriorly and the posterior border of each lamina is extended to form two processes called the ***superior and inferior cornu***.



Cricoid cartilage

It lies below the thyroid cartilage. It is shaped like a *signet ring,* completely encircling the larynx with the narrow part anteriorly and the broad part posteriorly. The broader pert articulates with the arytenoid cartilages above and with the inferior cornu of the thyroid cartilage below.



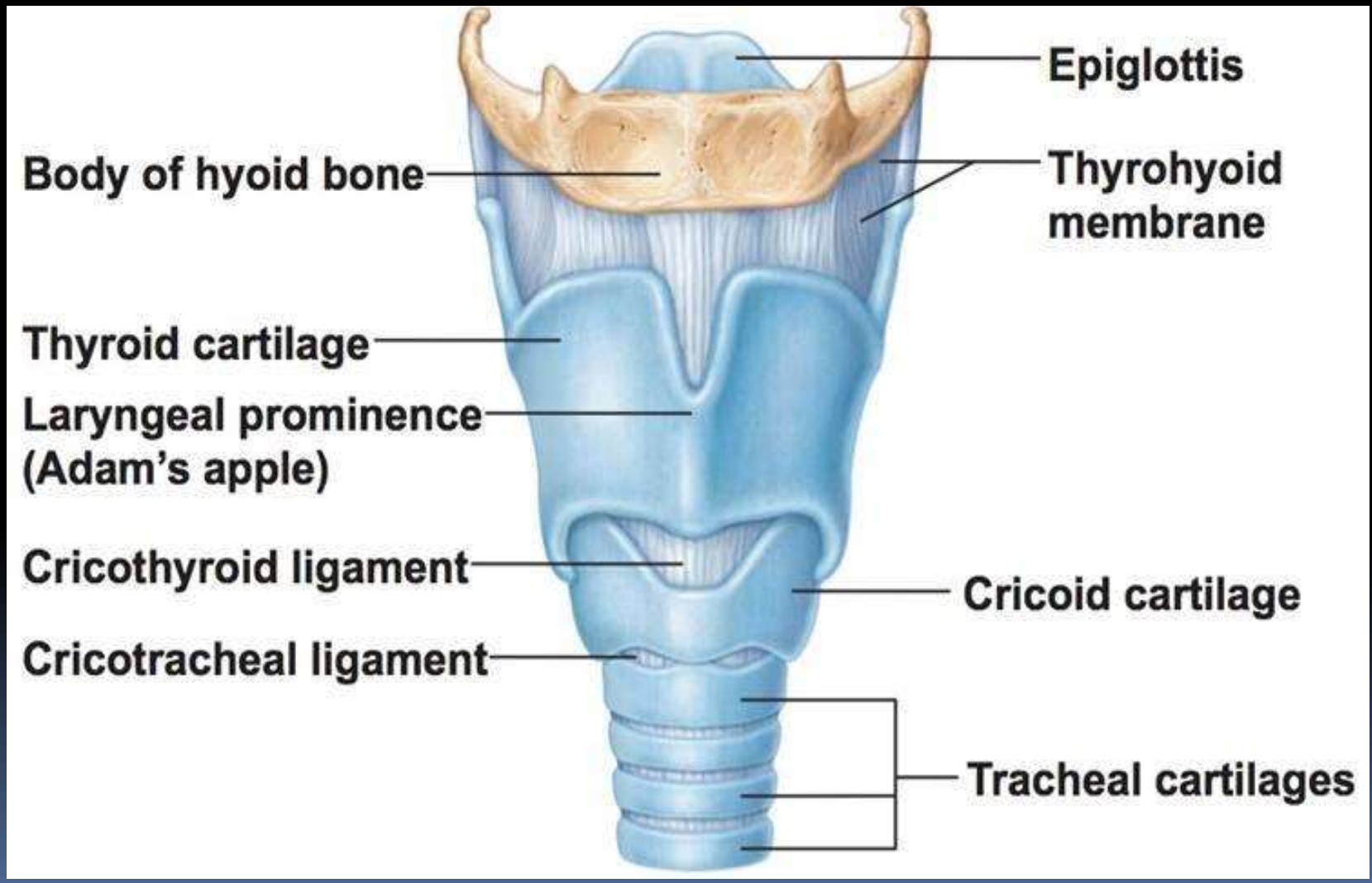


The arytenoid cartilages :

Are two roughly pyramid shaped cartilages situated on top of the broad part of the cricoid cartilage forming part of the posterior wall of the larynx. They give attachment to the vocal cards and to muscles and are lined with columnar epithelium.

The epiglottis: is a leaf shaped cartilage attached to the inner surface of the anterior wall of the thyroid cartilage immediately below the thyroid notch. It raises obliquely upwards behind the tongue and the body of the hyoid bone. It is covered with stratified squamous epithelium.

Ligaments and membranes of larynx

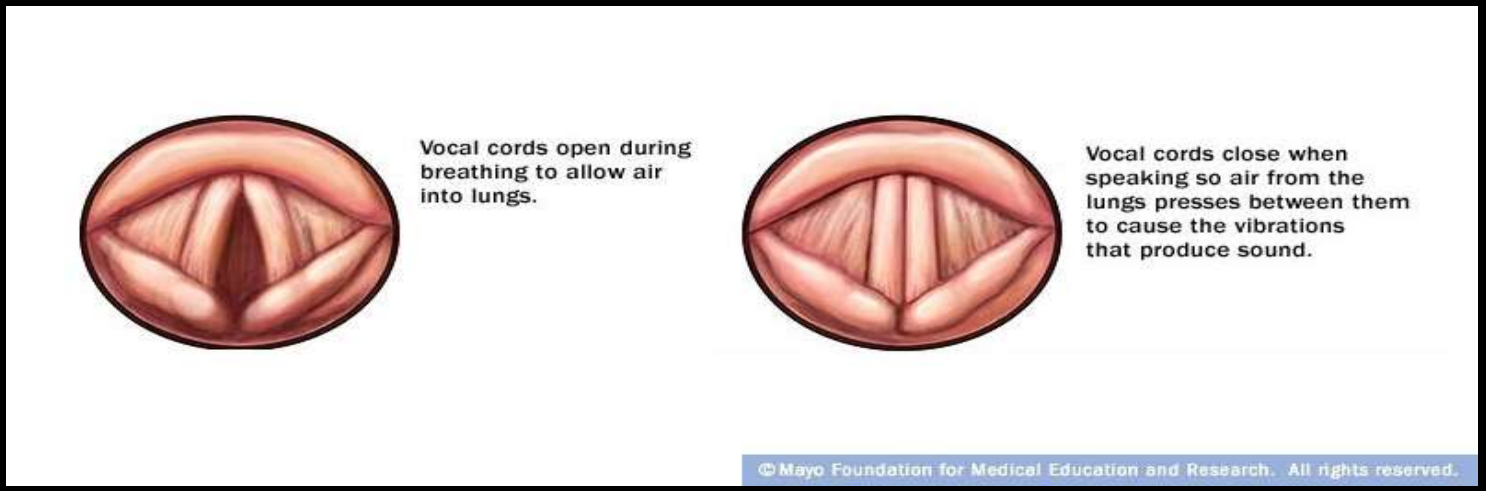


Blood and nerve supply

- Blood is supplied to the larynx by the superior and inferior laryngeal arteries and drained by the thyroid vein which joins the internal jugular vein.
- The parasympathetic nerve supply is from the superior laryngeal and recurrent laryngeal nerves, which are branches of the vagus nerve, and the sympathetic nerves are from the superior cervical ganglion.
- These provide the motor nerve supply to the muscles of the larynx and sensory fibers to the lining membrane.

VOCAL CARDS:

- These are the two pale folds of mucous membrane with cord like edges which extend from the inner wall of the thyroid prominence anteriorly to the arytenoid cartilages posteriorly.



- when the muscles of the arytenoid cartilages contract, the cartilages ***adduct*** and rotate medially, pulling the vocal cords together and narrowing the gap between them, thus forming the *chink of the glottis*.
- If the air is forced through this chink it causes vibration of the cords and sound is produced. When the muscles relax the cartilages rotate laterally and ***abduct,*** separating the cords, and no sound is produced.

Functions of larynx

- It provides a passage for air between the pharynx and trachea. As air from the outside passes through, it is further moistened, filtered and warmed thus continuing the process started in the nose.
- The vocal cords produce sounds of varying loudness and pitch.
- During swallowing the larynx moves upwards, occluding the opening in to it from the pharynx. this ensures that food passes in to the esophagus and not in to the lower respiratory passages.

STRUCTURE OF TRACHEA

Position :

The trachea or ***wind pipe*** is a continuation of the larynx and extends downwards to about the level of the 5th thoracic vertebra where it divides(bifurcates) at the carina into the right and left primary bronchi, one bronchus going to each lung. It is approximately 10 to 11 cm long and lies mainly in the medium plane in front of the esophagus.

Structures associated with the trachea

Superiorly – the larynx

Inferiorly – the right and left bronchi

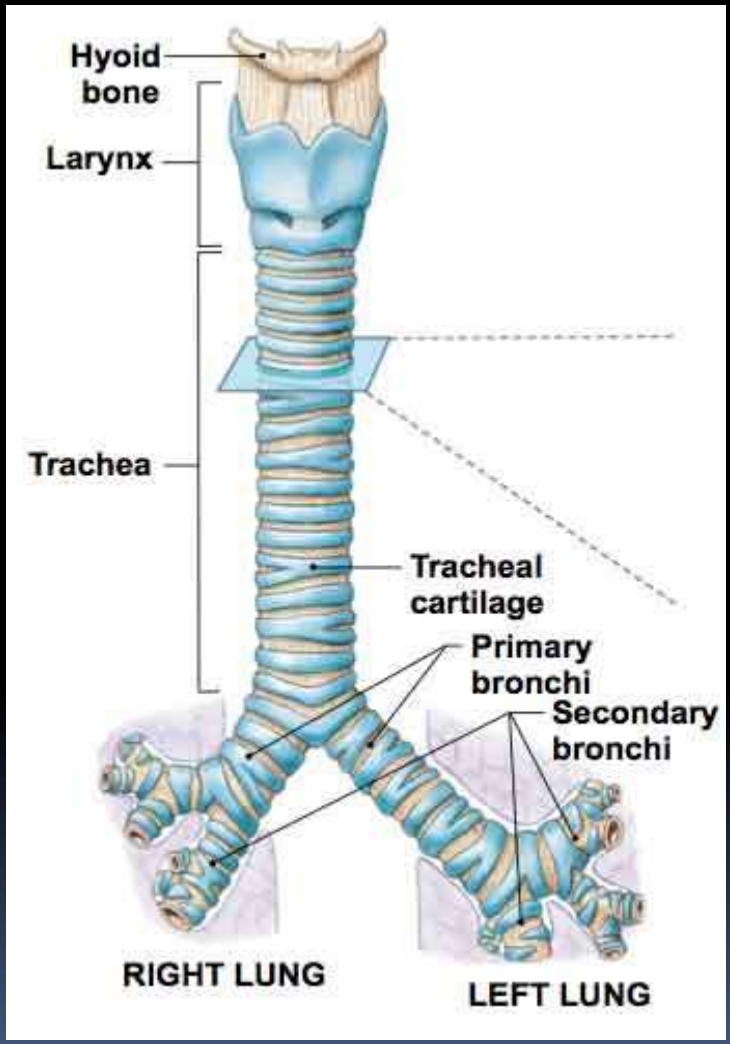
Anteriorly – upper part: the isthmus of the thyroid gland

lower part: the arch of the aorta and the sternum

Posteriorly – the esophagus

separates the trachea from the vertebral column

Laterally – the lungs and the lobes of the thyroid gland.



STRUCTURE

- The trachea is composed of three layers of tissue, and held open by between 16 and 20 incomplete rings of the hyaline cartilage lying one above the other.
- The rings are incomplete posteriorly. Connective tissue and involuntary muscle join the cartilages, and form the posterior wall where the rings are incomplete. The soft tissue posterior wall is in contact with the esophagus.
- Three layers of tissue ‘clothe’ the cartilages of the trachea.

The outer layer consists of fibrous and elastic tissue and encloses the cartilages.

The middle layer consists of cartilages and bands of the smooth muscle that wind round the trachea in a helical arrangement. There is some areolar tissue, containing blood and lymph vessels and autonomic nerves.

The inner lining consists of ciliated columnar epithelium, containing mucus- secreting goblet cells.

Blood and nerve supply, lymph drainage

- The arterial blood supply is mainly by the inferior thyroid and bronchial arteries and venous return is by the inferior thyroid veins in to the brachiocephalic veins.
- Parasympathetic nerve supply is by the recurrent laryngeal nerves and other branches of the vagi.
- Sympathetic supply is by nerves from the sympathetic ganglia. Parasympathetic stimulation constricts the trachea, and sympathetic stimulation dilates it.
- Lymph from the respiratory passages drains through lymph nodes situated round the trachea and in the carina, the area where it divides in to two bronchi

FUNCTIONS

- ***Support and patency:*** The arrangement of cartilage and elastic tissue prevents kinking and obstruction of the airway as the head and neck move.
- The cartilages prevent collapse of the trachea when the internal pressure is less than intrathoracic pressure, at the end of the forced expiration.
- ***Mucociliary escalator:*** this is the synchronous and regular beating of the cilia of the mucous membrane lining that wafts mucus with adherent particles upwards towards the larynx where it is either swallowed or coughed up.
- ***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 body from the mouth. pressure
- ***Warming, humidifying and filtering***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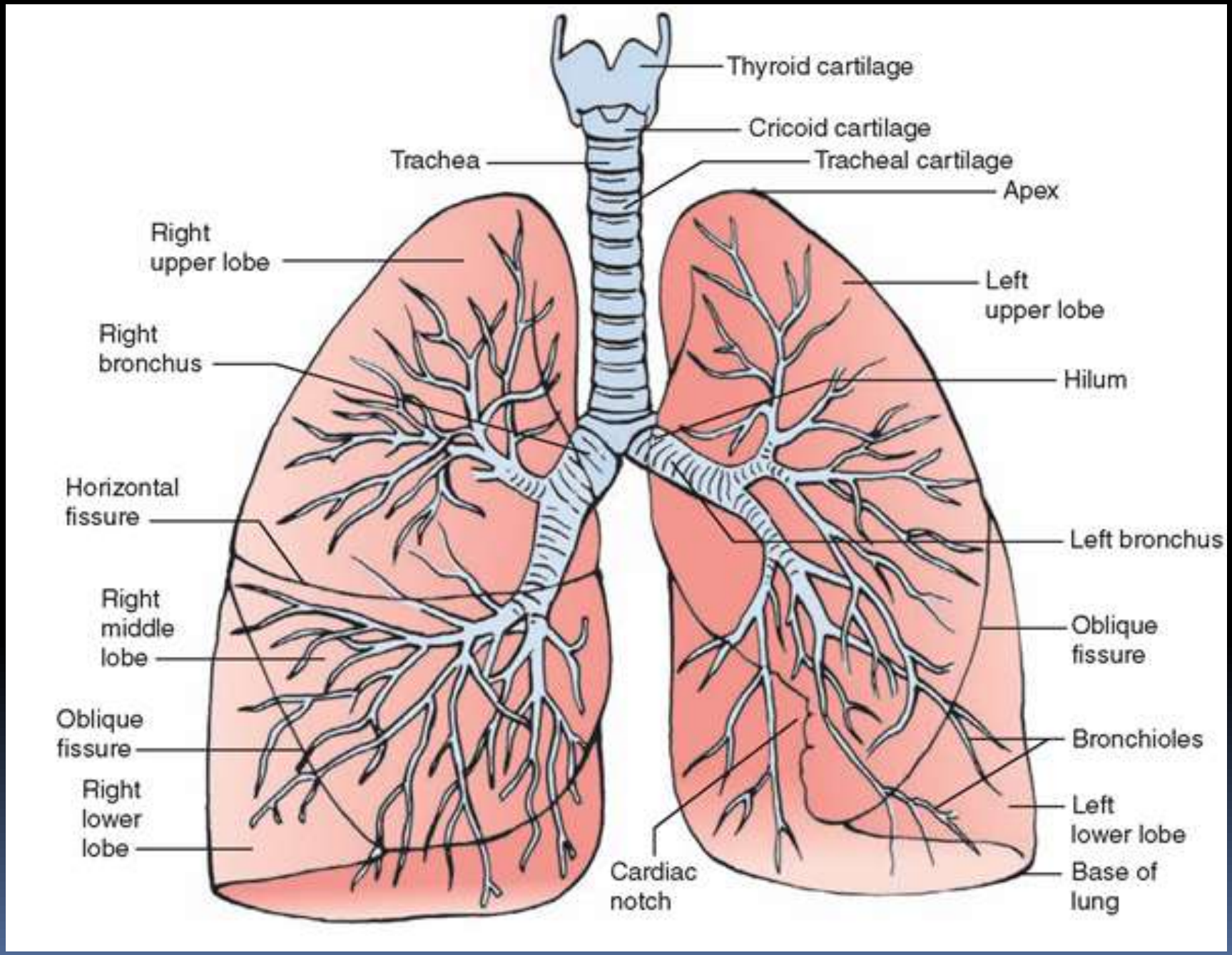
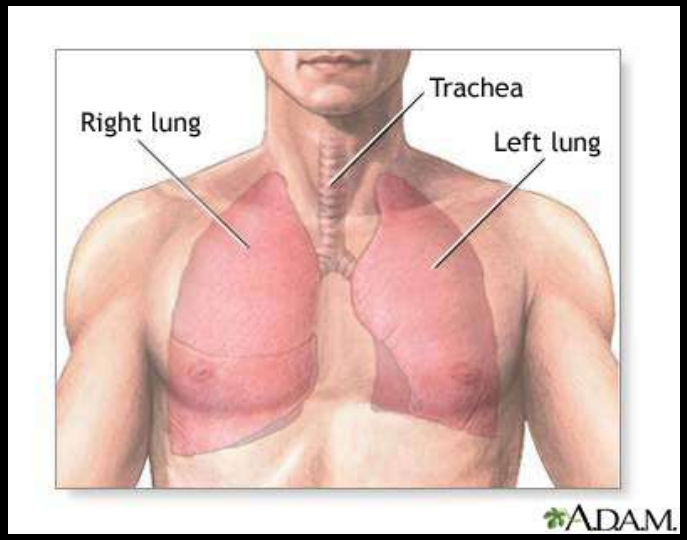

Thyroid cartilage
Cricoid cartilage
Trachea
Tracheal cartilage
Apex
Right upper lobe
Left upper lobe
Right bronchus
Hilum
Horizontal fissure
Left bronchus
Right middle lobe
Oblique fissure
Oblique fissure
Bronchioles
Right lower lobe
Left lower lobe
Cardiac notch
Base of lung

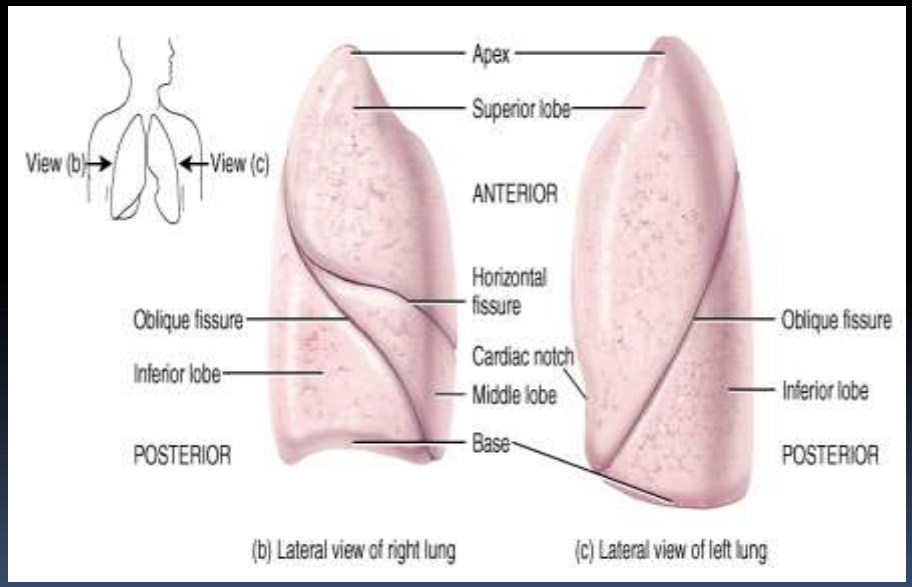
STRUCTURE OF LUNGS



Position and gross structure:

There are two lungs, one lying on each side of the midline in the thoracic cavity. They are cone shaped and have an ***apex***, a***base, costal surface*** and ***medial surface.***

- ***The apex*** : this is rounded and arises in to the root of the neck, about 25mm above the level of the middle third of the clavicle. It lies close to the first rib and the blood vessels and nerves in the root of the neck.



- ***The base***: this is concave and semilunar in shape, and lies on the thoracic surface of the diaphragm.
- ***The costal surface:*** this surface is concave against the costal cartilages, the ribs and the intercostal muscles.

- ***Medial surface***: This surface is concave and has a roughly triangular shaped area, called the ***hilum,*** at the level of the $5^{th,}$ 6^{th} and 7^{th} thoracic vertebrae.
- Structures forming the root of the lung enter and leave at the hilum. These include the primary bronchus, the pulmonary artery supplying the lung and two pulmonary veins draining it, the bronchial artery and veins and the lymphatic and nerve supply.
- The area between the lungs is the mediastinum. It is occupied by the heart, great vessels, trachea, right and left bronchi, esophagus, lymphnodes, lymph vessels and nerves.
- The right lung is divided into three distinct lobes. Superior, middle and inferior. The left lung is smaller because the heart occupies space left of the midline. It is divided in to only two lobes: superior and inferior.

Pleura and pleural cavity

- The pleura consists of a closed sac of serous membrane

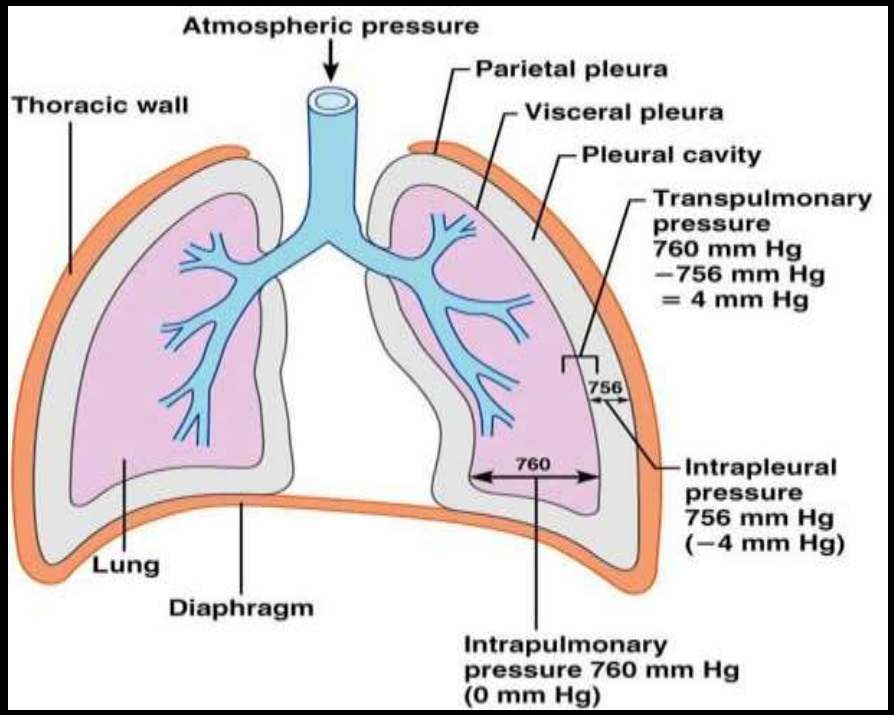
(one for each lung) which contains a small amount of serous fluid.

- The lung is invaginated (pushed into) into this sac so that it forms two Layers, one adheres to the lung an the other to the wall

  of the thoracic cavity.

The visceral pleura: this is adherent to the lung covering each lobe and passing in to the fissures that separate them.

The parietal pleura: this is adherent to the inside of the chest wall and the thoracic surface of the diaphragm. It remains detached from the adjacent structures in the mediastinum and is continuous with the visceral pleura round the edges of the hilum.



The pleural cavity: this is only a potential space. In health, two layers of pleura are separated by thin film of serous fluid which allows them top glide over each other, preventing friction between them during breathing. The serous fluid is secreted by the epithelial cells of the membrane.

Interior of the lungs

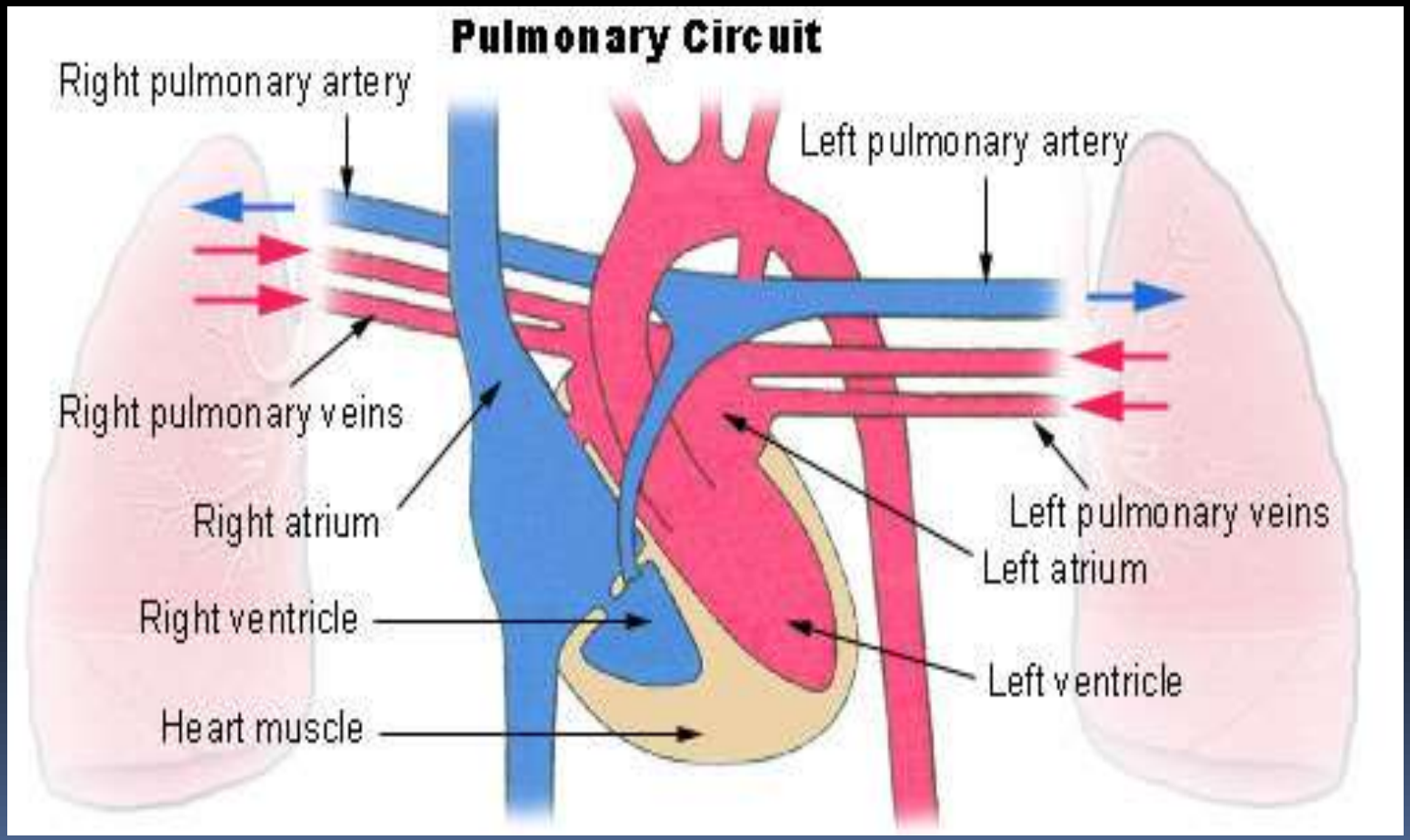
The lungs are composed of the bronchi and smaller passages, alveoli, connective tissue, blood vessels, lymph vessels and nerves, all embedded in an elastic connective tissue matrix. Each lobe is made up of a large number of lobules.

Pulmonary blood supply

- The pulmonary trunk divides into right and left pulmonary arteries, which transport deoxygenated blood to each lung. within the lungs each artery divides into many branches, which eventually end in a dense 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.

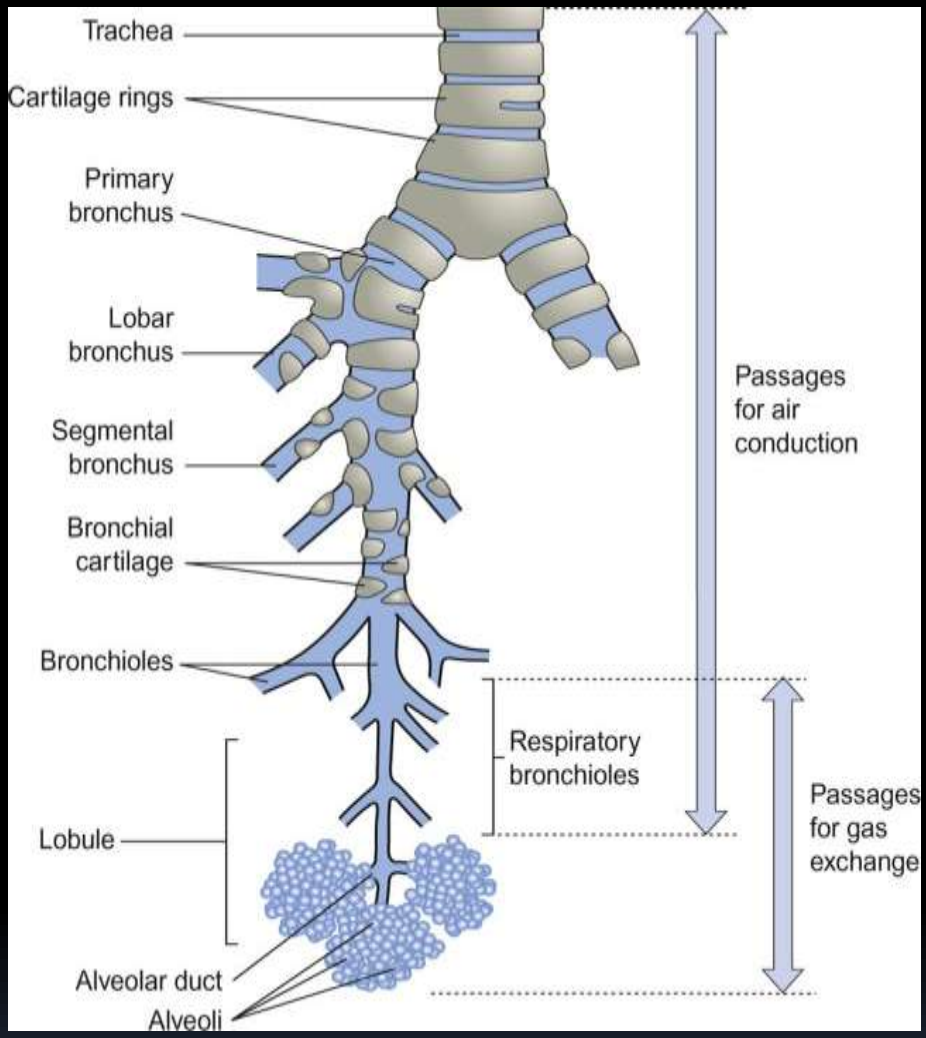


Bronchi and bronchioles:

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

The right bronchus- this is wider, shorter and more vertical than the left bronchus and is therefore more likely to become obstructed by an inhaled foreign body. It is approximately 2.5cm long.

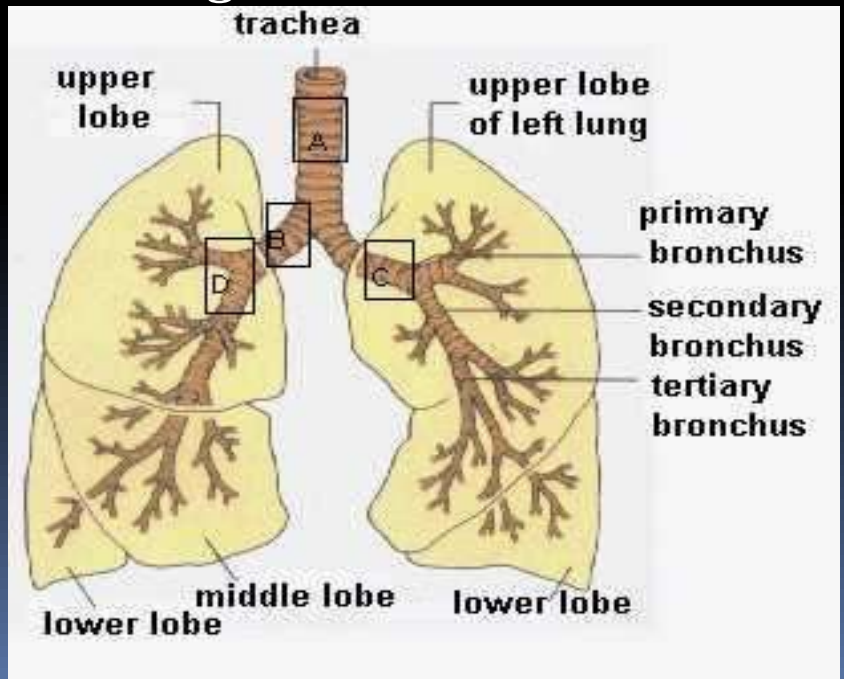
After entering the right lung at the hilum it divides into three branches, one to each lobe. Each branch then subdivides into numerous smaller branches.



The left bronchus- this is about 5cm 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 tubes within the lung substance.

STRUCTURE OF BRONCHI

- The bronchi is composed of the same tissues as the trachea and are lined with ciliated columnar epithelium. The bronchi progressively subdivided into bronchioles, terminal bronchioles, respiratory bronchioles, alveolar ducts and finally alveoli.
- Towards the distal end of the bronchi the cartilages become irregular in shape and are absent at bronchiolar level.
- Ciliated columnar mucous membrane changes gradually to non-ciliated cuboidal shaped cells in the distal bronchioles. The wider passages are called conducting airways because their function is to bring air into the lungs, and their walls are too thick to permit gas exchange.



Blood and nerve supply, and lymph drainage

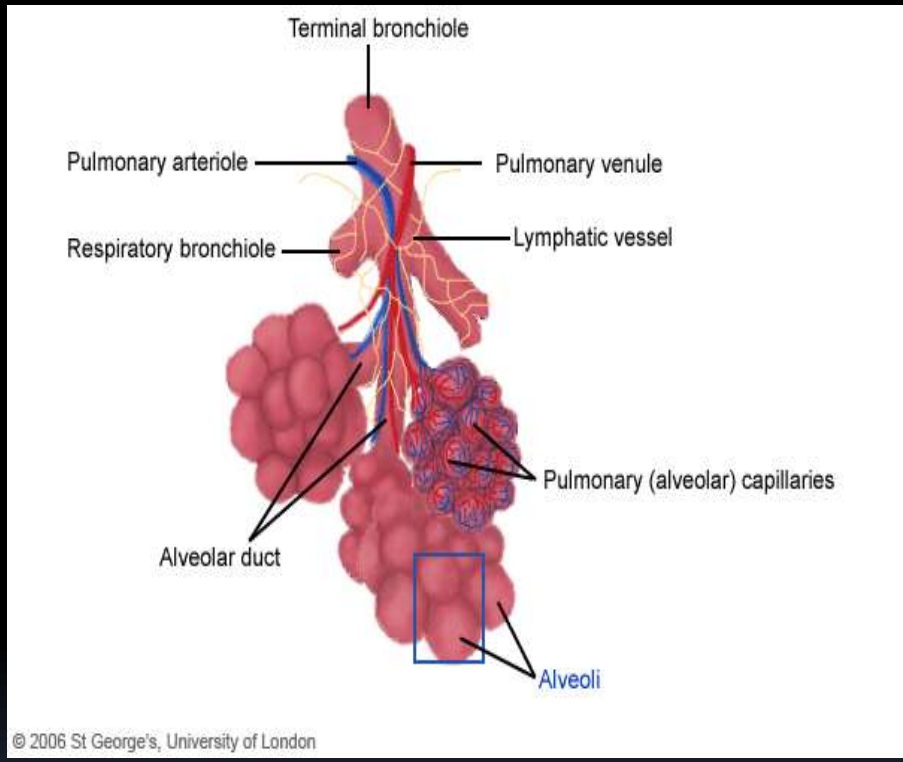
- The arterial supply to the walls of the bronchi and smaller air passages is through branches of the right and left bronchial arteries and the venous return is mainly through the bronchial veins.
- On the right side they empty into the azygos vein and on left into superior intercostal vein.
- The vagus nerve stimulate contraction of smooth muscle in the bronchial tree, causing bronchoconstriction, and sympathetic causes brochodilatation.
- Lymph is drained from the walls of the air passages in a network of lymph vessels. It passes through lymph nodes situated around the trachea and bronchial tree then into the thoracic duct on the left side and right lymphatic duct on the other.

Functions

- Regulating the volume of air entering the lungs. These changes are controlled by the autonomic nerve supply.
- Warming and humidification
- Support and patency
- Removal of particulate matter
- Cough reflex

Bronchioles and alveoli

- ***Structure:*** within each lobe, the lung tissue is further divide by fine sheets of connective tissue in to lobules. Each lobule is supplied with air by a terminal bronchiole, which further subdivides into respiratory bronchioles, alveolar ducts and large number 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.
- 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 respiratory membrane.

- Lying between the squamous cells are ***septal cells*** that secrete surfactant, a phospholipid fluid which prevents the alveoli from drying out. In addition, surfactant reduces surface tension and prevents alveolar walls collapse during expiration.
- Secretion of surfactant into the distal air passages and alveoli begins about the 35^{th} week of fetal life.
- Its presence in newborn babies facilitates expansion of the lungs and the establishment of respiration.
- It may not be present in sufficient amounts in the immature lungs of premature babies, causing serious breathing problems

Nerve supply to the bronchioles

- parasympathetic fibers from the vagus nerve cause bronchoconstriction.