Respiratory System

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Respiratory system

Respiratory system consist of

- **Nose**
- **Pharynx**
- **Larynx (voice box)**
- **Trachea (wind pipe)**
- **Bronchi**
- **Lungs**

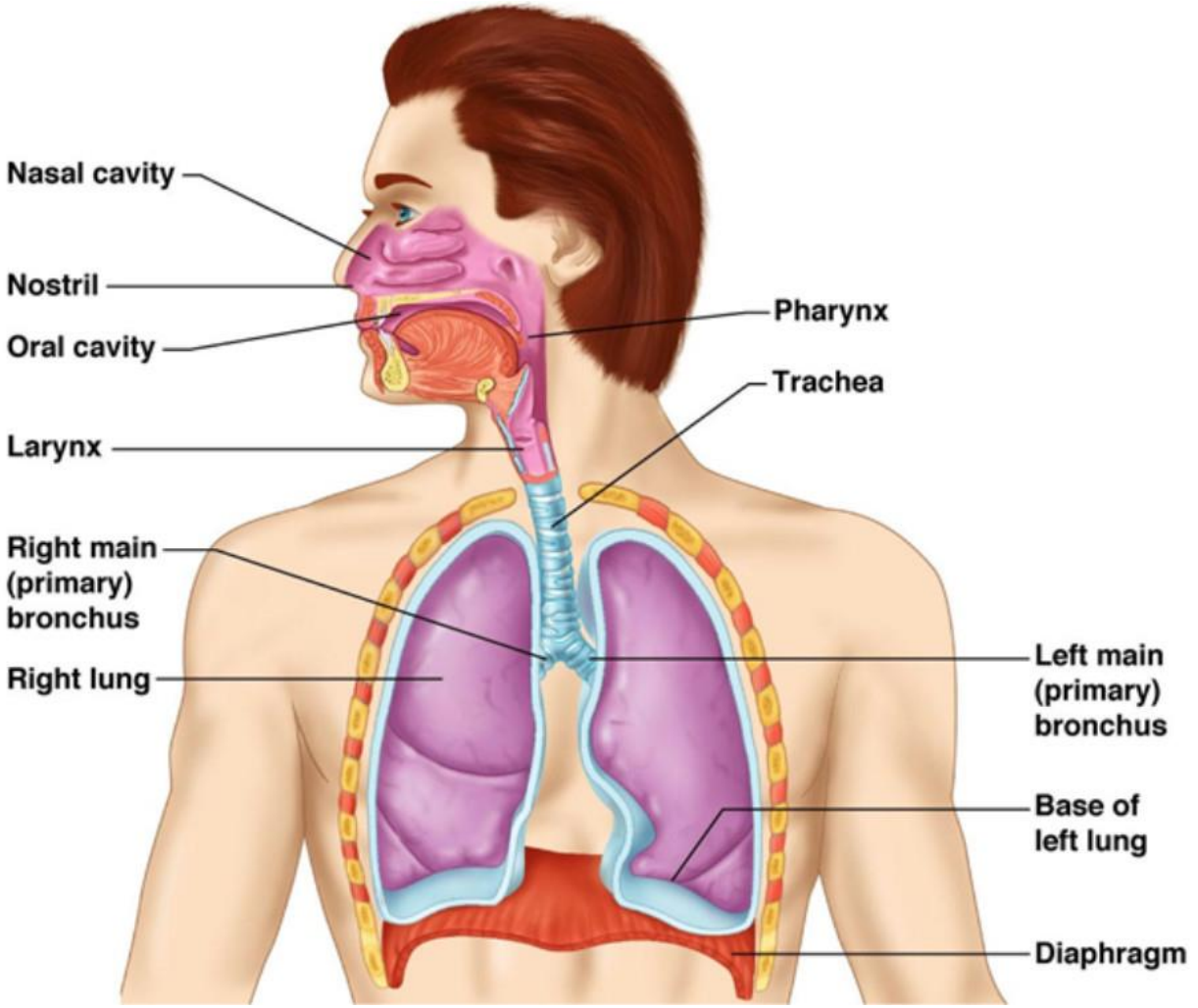
Respiratory system

- **Structurally respiratory system consist of two part**

1.Upper respiratory system consist of-nose, nasal cavity, pharynx and associated structure

2.Lower respiratory system includes larynx, trachea, bronchi and lungs

Respiratory System

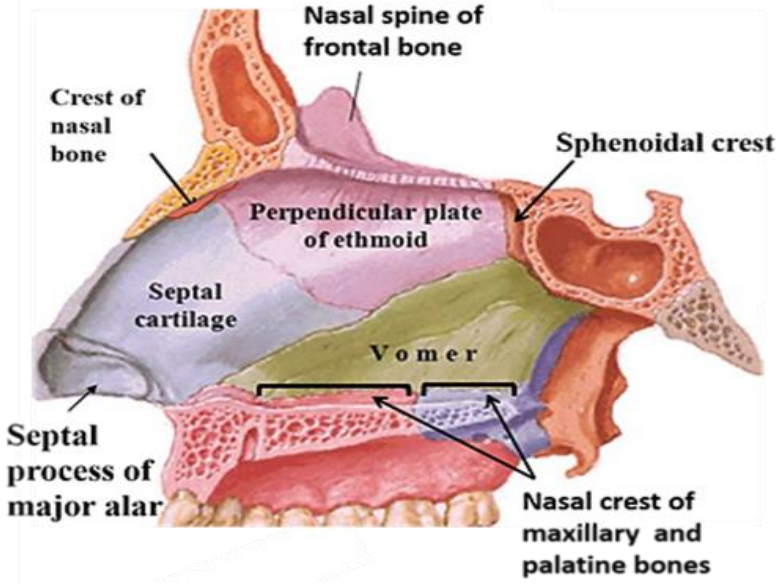


Nose

- The only the visible part of the respiratory system.
- Air enters the nose through the external nares(nostril)
- It provides an entrance for air in which air is filtered by hairs inside the nostrils
- The interior of the nose consists of nasal cavity divided by the nasal system.

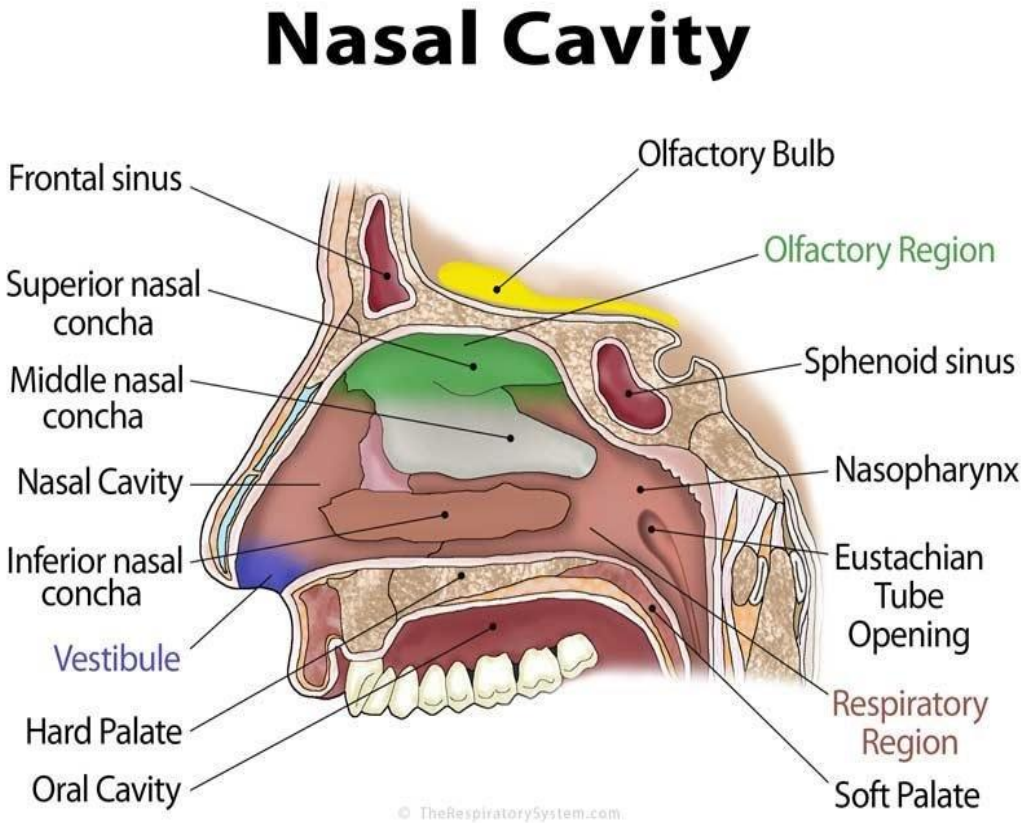
Nasal cavity

Nasal septum-Perpendicular sheet of bone and cartilage—Vomer and ethmoid bone, hyaline cartilage



Nasal cavity

- **Roof- cribriform plate of ethmoid bone, sphenoid bone, frontal and nasal bone**
- **Floor- roof of mouth (hard palate and soft palate)**
- **Medial wall- nasal septum**
- **Lateral wall- maxilla , ethmoid bone and inferior concha**
- **Posterior wall-posterior wall of pharynx**



Nasal cavity Lining

- Ciliated columnar epithelium
- Contains mucus secreting goblet cells
- Anteriorly it blends with skin
- Posteriorly, extends into the nasopharynx
- Anteriorly-has coarse hairs- filters air passing through it.

Paranasal Sinuses

- **Four bones of the skull contain paired air spaces called the paranasal sinuses - frontal, ethmoidal, sphenoidal, maxillary.**
- **Communicate with the nasal cavity by ducts.**
- **Lined by pseudostratified ciliated columnar epithelium.**

Function of Paranasal Sinus

- **Lighten the skull.**
- **Acts as resonance to the voice**
- **Produce mucus that drain into the nasal cavity**

Pharynx (Throat)

- The pharynx is a funnel-shaped tube about 12-14 cm long that starts at the internal nares and extends to the level of the cricoid cartilage, the most inferior cartilage of the larynx.
- The pharynx lies just posterior to the nasal and oral cavities, superior to the larynx, and anterior to the cervical vertebrae. (C6) then continues as oesophagus
- It is a common passageway for air and food.

Relations of pharynx

- Superiorly- base of the skull
- Inferiorly- Esophagus
- Anteriorly- nose, mouth and larynx
- Posteriorly- Bodies of first 6 cervical vertebrae

- **Pharynx is divided into three regions**

– Nasopharynx - uppermost portion

– Oropharynx - middle portion

– Laryngopharynx - lowermost portion

Nasopharynx

- Superior- most region of the pharynx.
- Back of the nasal cavity connected with oropharynx below with a passage called isthmus
- Covered with pseudo stratified ciliated columnar epithelium.
- Location:

– posterior to the nasal cavity

– superior to the soft palate.

– lateral walls of the nasopharynx connect to the auditory/ eustachian tubes which open into middle ear.

- Tonsils- Pharyngeal tonsils(Adenoids)

Oropharynx

- The middle pharyngeal region.
- Immediately posterior to the oral cavity.
- Middle part located between soft palate and epiglottis
- Boundaries: superiorly edge of the soft palate.

  inferiorly the hyoid bone.
- Common respiratory and digestive pathway through which both air and swallowed food and drink pass.

Tonsils- Palatine tonsils

LARYNGOPHARYNX

- Inferior, narrowed region of the pharynx.

Most distal part located between epiglottis and C6 ,continuous below with oesophagus

- Boundaries – Superiorly hyoid bone

- Inferior end it opens into the esophagus (food tube) posteriorly and the larynx (voice box) anteriorly.

- Lined with a nonkeratinized stratified squamous epithelium.

- Permits passage of both food and air.

Lingual tonsils at the base of the tongue.

Wall of Pharynx

Three layer of tissue

1.Muscle layer- Number of involuntary muscle involve in swallowing

2.Sub mucosa- Middle, connective tissue, contains of blood, lymph vessels and nerve

3 Mucosa- Inner layer , Stratified Squamous Epithelium

Lower Respiratory tract

- It includes conducting airway and respiratory portion

 Composed of trachea, bronchial tree, lungs, alveolus and alveoli.

 Alveoli is the functional unit of lungs.

- Conducting airways (pharynx, trachea, bronchi, up to terminal bronchioles).

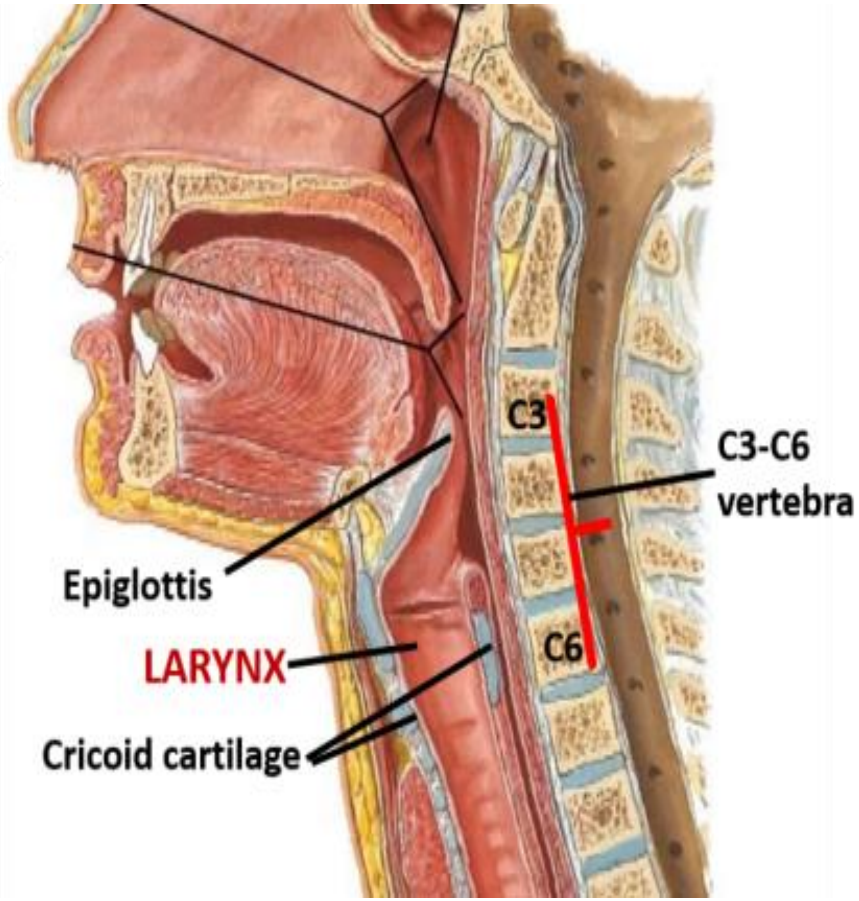
- Respiratory portion of the respiratory system (respiratory bronchioles, alveolar ducts, and alveoli).

Larynx

- Also known as voice box
- Tube like cartilaginous organ present anterior to the neck
- Suspended from the hyoid bone and C3 to C6 veterbrae
- Connects laryngopharynx with trachea
- Length – 5 cm long
- Grows relatively larger in male after puberty- Adam’s apple

Relations of Larynx/Boundries

- Superiorly- hyoid and root of tongue
- Inferiorly- trachea
- Anteriorly- Muscles attached to hyoid and that of neck
- Posteriorly- laryngopharynx and 3rd to 6th cervical vertebrae
- Laterally- thyroid lobes



Parts of the Larynx

- **Epiglottis**
- **Supraglottis- Area above the vocal cord that contains epiglottis**
- **Vocal cord**
- **Glottis- the area of vocal cord**
- **Sub glottis- parts below the vocal cord that contains cricoid cartilage**

Vocal fold

- The mucous membrane of the larynx forms two pairs of folds.
- A superior pair called the ventricular folds (false vocal cords) and an inferior pair called the vocal folds (true vocal cords).
- The space between the ventricular folds is known as the rima vestibuli.

Vocal cord

Abducted (open)- Silent

Airway

Adducted (close)- Open

Speech

Inhale air force through close vocal cord(vibrate)

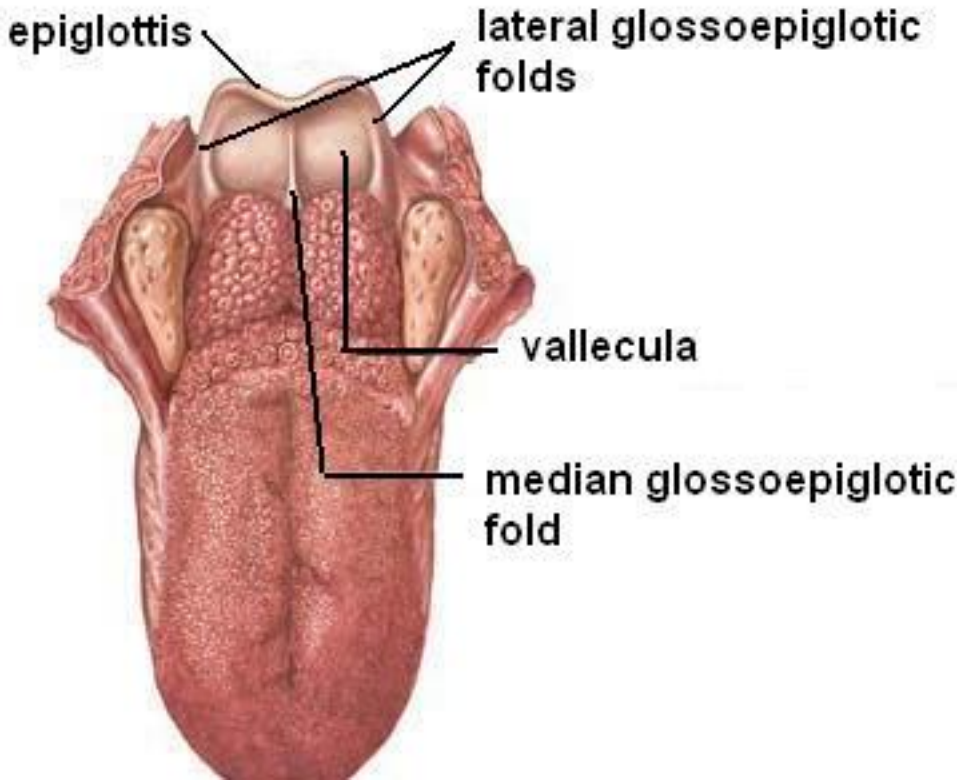
Produce sound

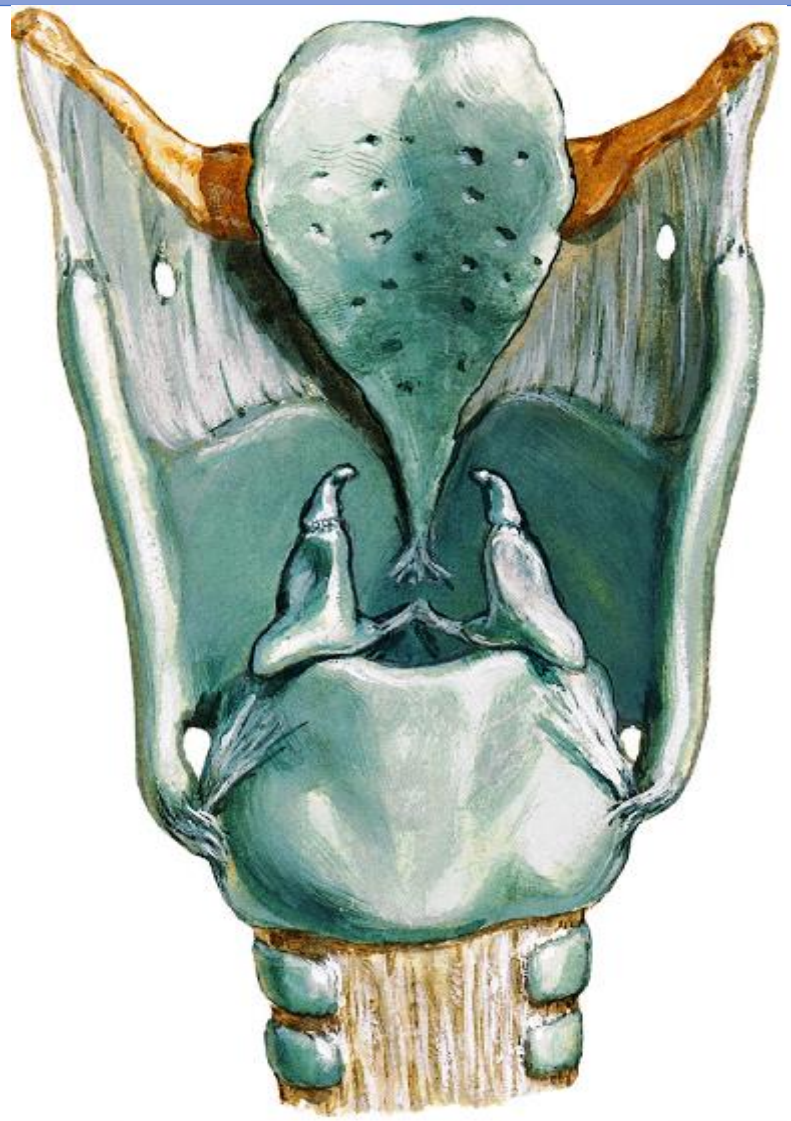
Glottis

- **Glottis – a triangular slit opening containing between the true vocal cords. Its closure helps to prevent food or liquid from entering the trachea.**

Epiglottis

- The epiglottis is a large, leaf shaped piece of elastic cartilage that is covered with epithelium
- It is the superior opening of the larynx
- Routes food to the larynx and air to the trachea.


epiglottis
lateral glossoepiglotic folds
vallecula
median glossoepiglotic fold



Cartilages of larynx:

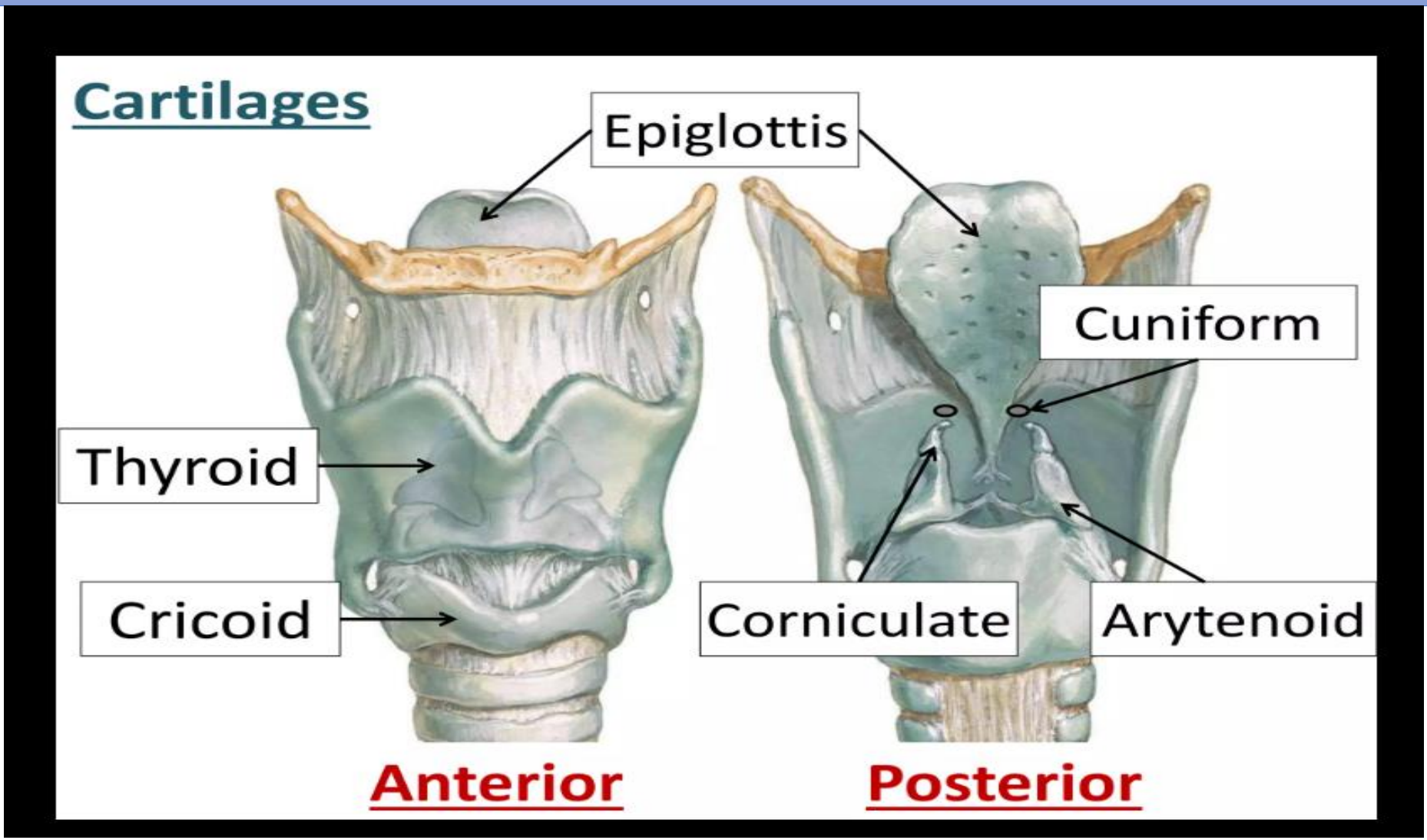
- Nine c-rings of cartilage form a framework of the larynx.
- 3 unpaired
- 3 paired
- 3 unpaired cartilages – Thyroid cartilage – Cricoid cartilage – Epiglottis
- 3 paired cartilages – Arytenoid – Cuneiform – Corniculate cartilages

Unpaired cartilage

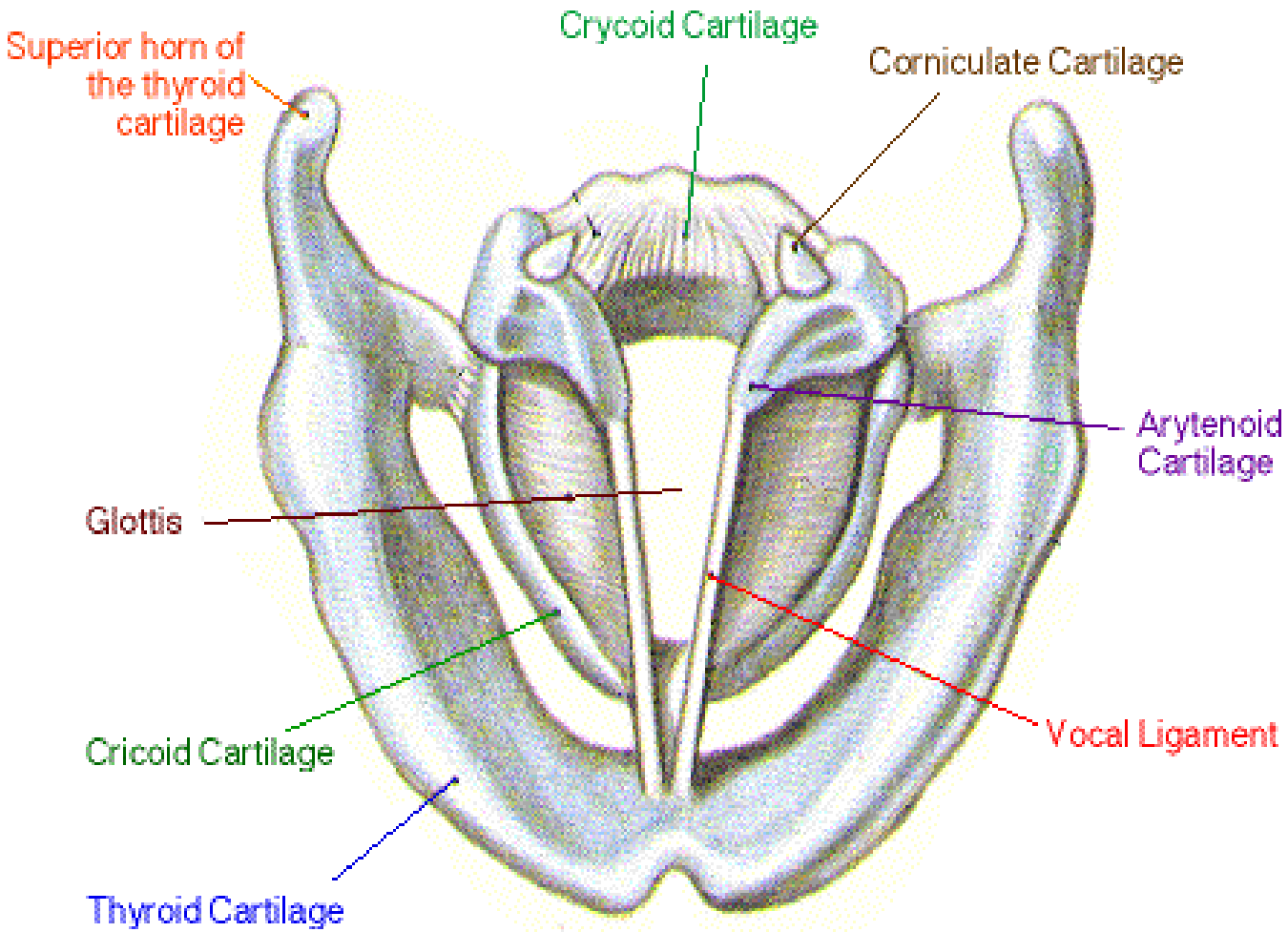
- **Thyroid cartilage – (Adam's apple) consists of two fused plates of hyaline cartilage that form the anterior wall of the larynx and give it a triangular shape. The ligament that connects the thyroid cartilage to the hyoid bone is called the thyrohyoid membrane.**
- **Cricoid cartilage – ring-shaped, hyaline cartilage that forms the inferior wall of the larynx.**
- **Epiglottis – large, leaf shaped piece of elastic cartilage that is covered with epithelium.**

Paired Cartilage

- **Arytenoid cartilages – are triangular pieces of mostly hyaline cartilage located at the posterior, superior border of the cricoid cartilage.**
- **Cuneiform cartilages - club-shaped elastic cartilages anterior to the corniculate cartilages, support the vocal folds and lateral aspects of the epiglottis.**
- **Corniculate cartilages - horn-shaped pieces of elastic cartilage, are located at the top of each arytenoid cartilage**


Cartilages
Epiglottis
Cuniform
Thyroid
Cricoid
Corniculate
Arytenoid
Anterior
Posterior

Interior of the larynx



The Larynx: viewed from above

Ligaments of the larynx

- **Extrinsic ligament connects the cartilages**
- **Intrinsic ligaments- beneath the mucous membrane of larynx**

  - **Upper part- Quadrangular membrane**

  - Lower part- Conus elasticus

MEMBRANES & LIGAMENTS

- Extrinsic
  - Thyrohyoid
  - Cricotracheal
  - Hyoepiglottic
- Intrinsic
  - Quadrangular membrane & vestibular ligament
  - Crico-vocal membrane & vocal ligament

Muscles of larynx

- **Extrinsic; attached larynx to other bones**

  -E.g.; Thyrohyoid,

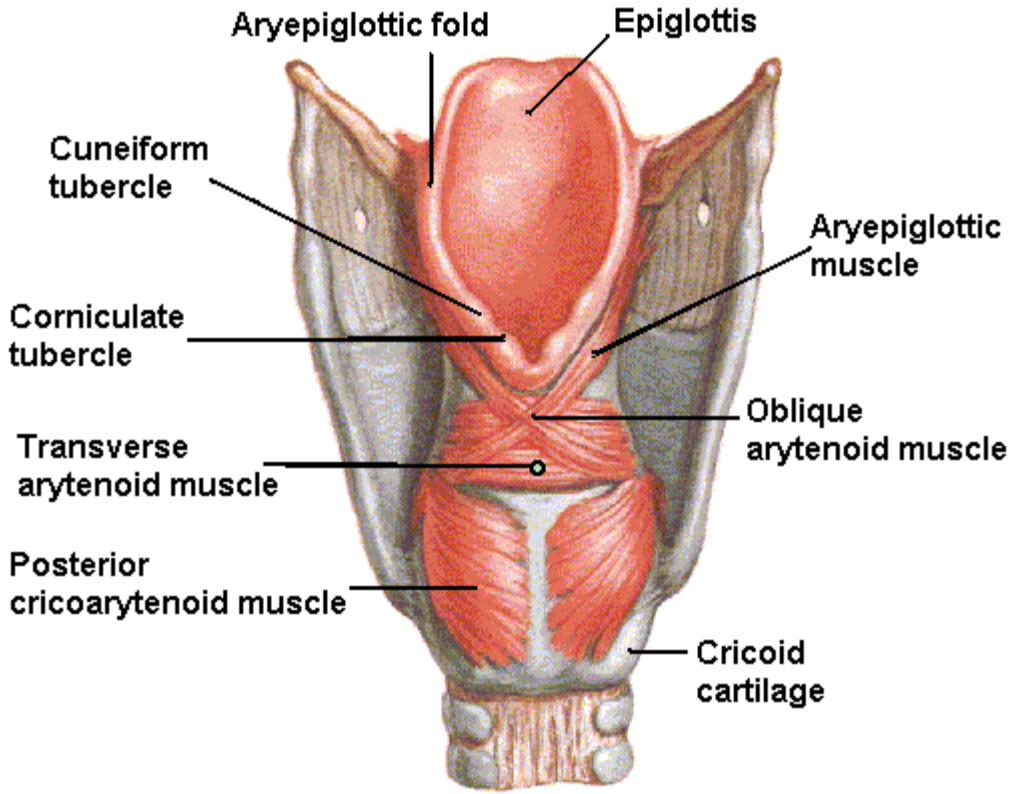
  -Moves the larynx as a whole during deglutition and respiration

- **Intrinsic; attached the larynx parts with each other**

  -E.g.; Cricothyroid, thyroarytenoid, vocalis, cricoarytenoid. Aryepiglottis, thyroepiglottis

  -Concerned with movements of vocal cords, and production of sound

Intrinsic muscle of Larynx



Blood and Nerve supply

Blood supply of larynx

- Blood is supplied to the larynx by the superior and inferior laryngeal arteries and drained by the thyroid veins, which join the internal jugular vein.

Nerve supply of larynx

- The parasympathetic nerve supply is from the superior laryngeal and recurrent laryngeal nerves, which are branches of the vagus nerves, and the sympathetic nerves are from the superior cervical ganglia, one on each side

Applied anatomy

- Glottis- vocal cords-voice production
- Rima glottis- narrowest part- risk of aspirated food lodgment- laryngeal obstruction
- Recurrent laryngeal nerve- vulnerable to injury during thyroidectomy
- Fb insert into larynx- sever cough- protective response
- Injury to internal laryngeal nerve- loss of sensation and absence of cough reflex
- Laryngoscopy- visualization of the larynx
- Hoarseness of voice- common of larynx

Trachea

- Also known as windpipe
- Continuation of larynx
- Tubular structure with flattened posterior wall
- Extends down to about the level of 5th thoracic vertebra- where it divides at carina to right and left bronchi
- Around 10 cm long
- Lies in median plane , Infront of esophagus

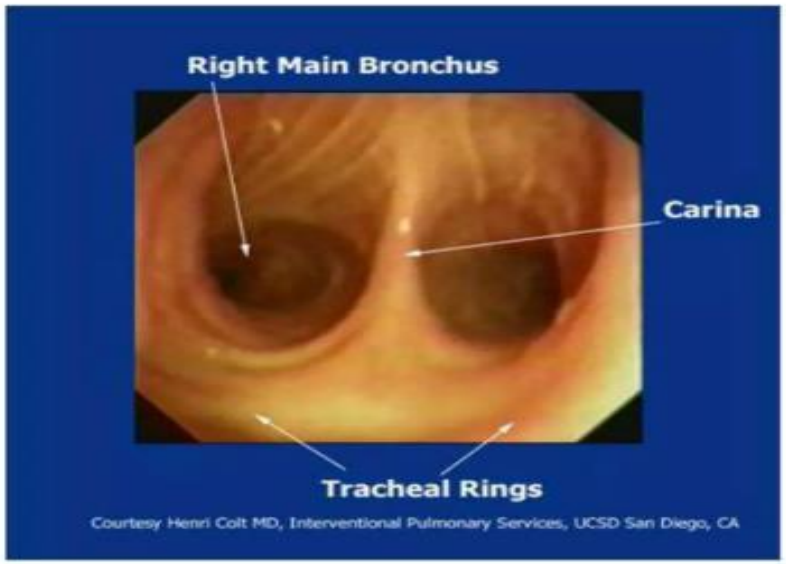
- **Layers of trachea:**
- **Innermost layer (mucosa) = pseudostratified columnar with cilia & goblet cells**

outer layer (submucosa) = loose connective tissue & mucous glands

- **At the level of the sternal angle, the trachea divides into two smaller tubes, called the right and left primary bronchi.**
- **Each primary bronchus projects laterally toward each lung.**
- **The inferior tracheal cartilage separates the primary bronchi and forms an internal ridge called the carina.**

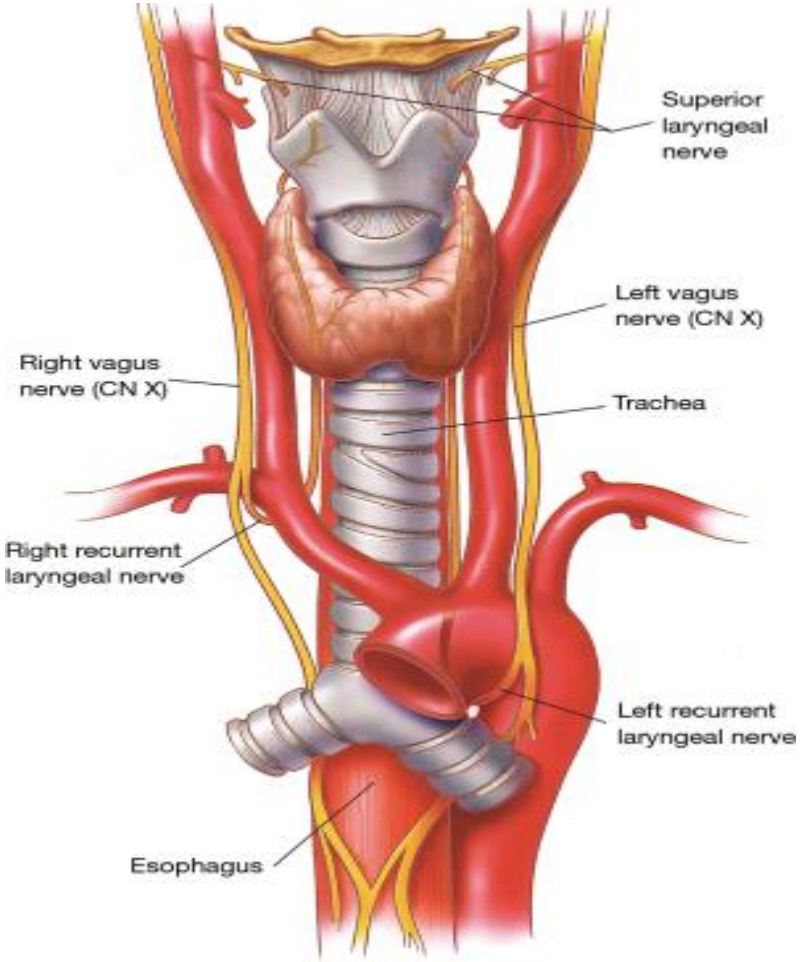
Trachea

- The trachea divides into two main bronchi : the left and the right bronchi, at the level of the sternal angle at the anatomical point known as the **carina**.



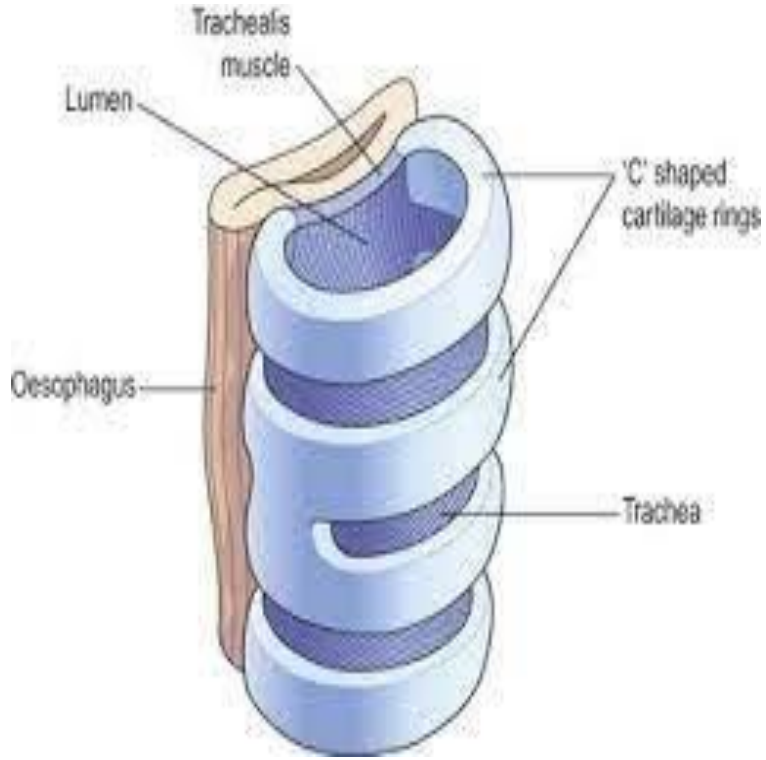
Relations of trachea

- **Superiorly- larynx**
- **Inferiorly- bronchi**
- **Anteriorly- isthmus of thyroid gland, sternum, arch of aorta**
- **Posteriorly- Esophagus, vertebral column**
- **Laterally- lobes of thyroid gland and the lungs**

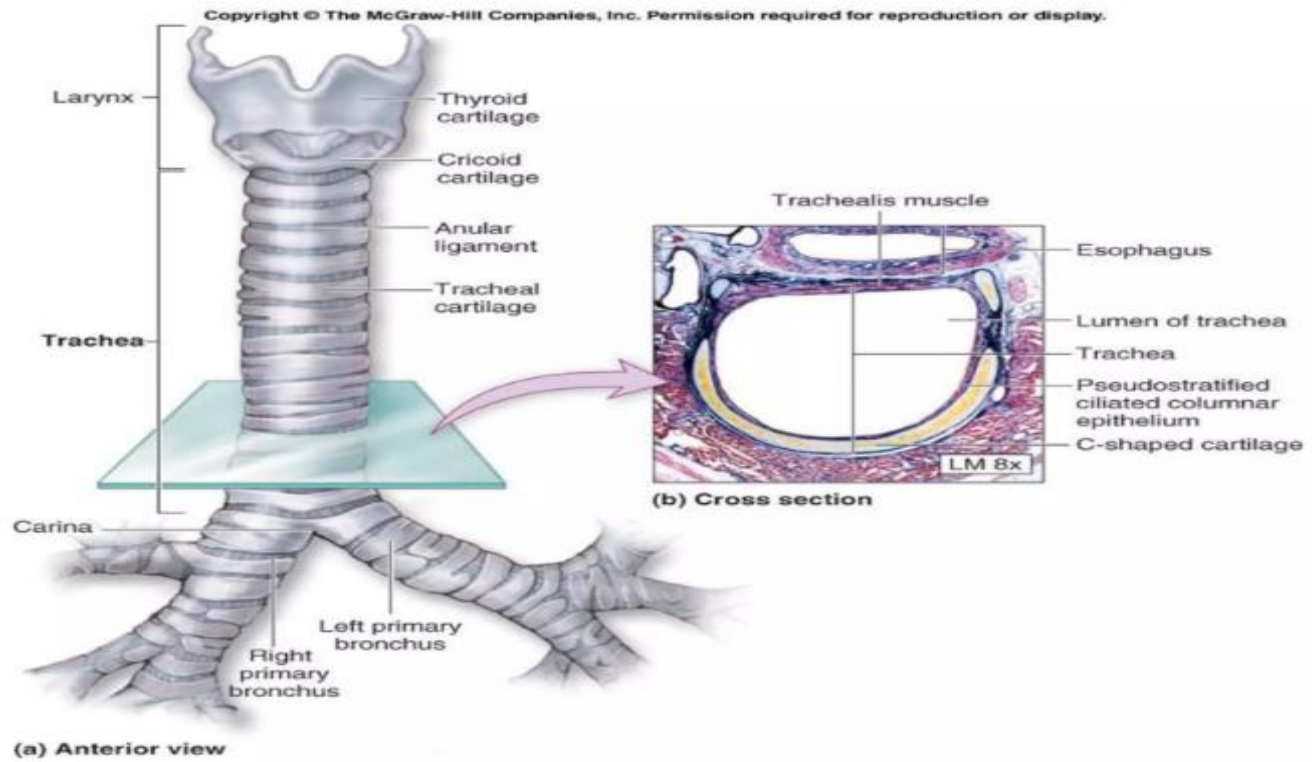


Structure of trachea

- Composed of 16-20 incomplete- c shaped hyaline cartilages one above other
- Incomplete- posteriorly
- Between the rings lies the connective tissue



Trachea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Larynx
Thyroid cartilage
Cricoid cartilage
Anular ligament
Tracheal cartilage
Trachea
Carina
Left primary bronchus
Right primary bronchus
(a) Anterior view
Trachealis muscle
Esophagus
Lumen of trachea
Trachea
Pseudostratified ciliated columnar epithelium
C-shaped cartilage
LM 8x
(b) Cross section

Blood and nerve supply

- Arterial- Inferior thyroid and bronchial arteries
- Venous- Inferior thyroid veins
- Parasympathetic - Recurrent laryngeal nerves and other branches of vagus
- Sympathetic- Sympathetic ganglia
- Lymph nodes situated around the trachea and carina too.

Bronchi and bronchioles

- Trachea divides at the level of 5th thoracic vertebra into two primary bronchi
- Right and left bronchus
- Right bronchus;

- Wider, shorter and more vertical
- Risk of FB inhalation more
- Approx 2.5 cm long
- In the hilum of the lung- divides into 3 branches-secondary bronchi- one to each lobe

- **Left bronchus;**

- **Around 5 cm long**
- **Narrower than right**
- **Reaching the hilum – divides into two secondary bronchi, then as in right**

Bronchi

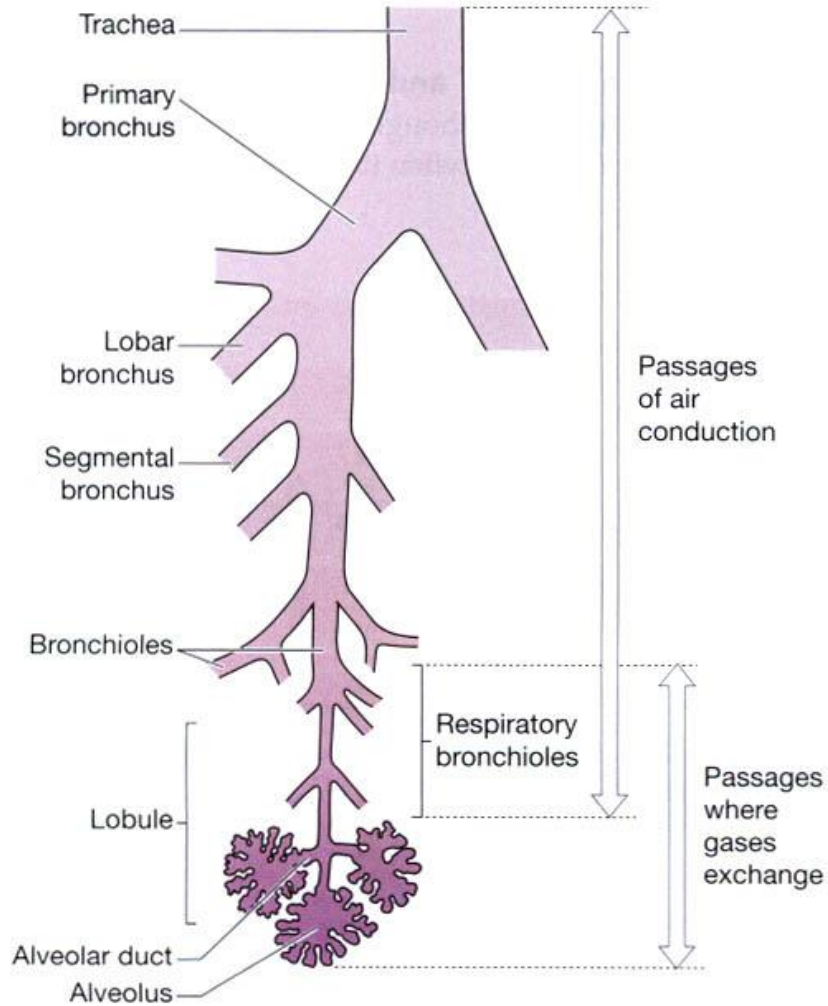
- The primary bronchi divide to form secondary bronchi(Lobar bronchi)
- There is one secondary bronchus for each lobe of the lungs
- There are 2 lobes on the left lung
- There are 3 lobes on the right lung

- **The left main bronchus enters the hilum and divides into a superior and inferior lobar bronchus**
- **The right main bronchus give off the bronchus to upper lobe prior to entering the hilum(superior lobar bronchus)and once into the hilum divides into middle and inferior lobar bronchi**

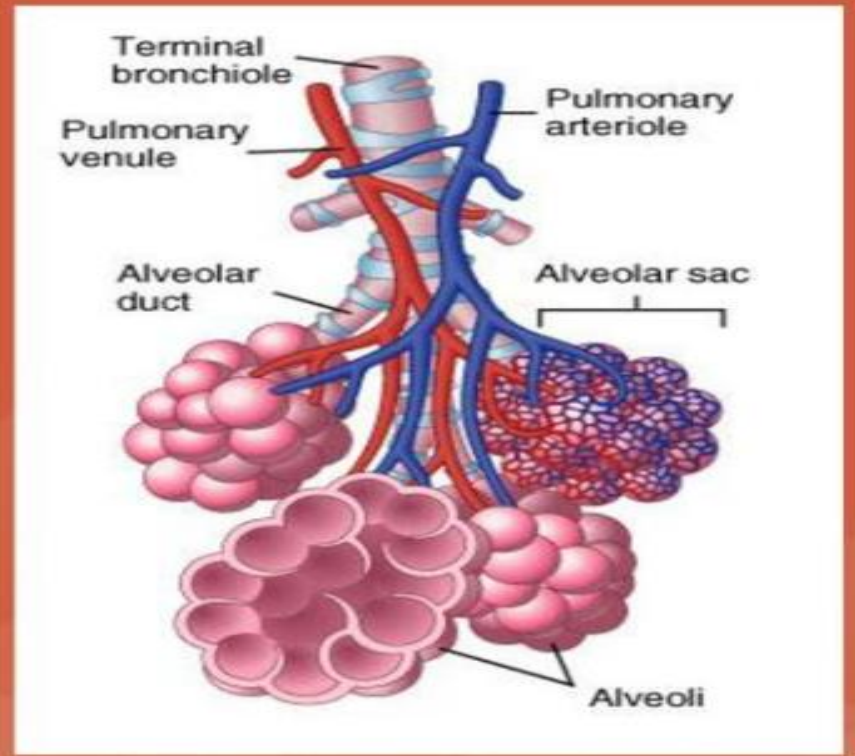
- **Each lobar bronchi divides into a lobes- tertiary or segmental bronchi- lobular – terminal bronchiole - respiratory bronchiole- alveolar duct and alveoli**
- **Each tertiary bronchi – then further divides into successive generation of smaller bronchi and bronchioles within the lung parenchyma**

- **Each lobar bronchi divides within a lobe- tertiary or segmental bronchi**
- **Each segmental bronchus enter the Bronchopulmonary segments**
- **Each bronchopulmonary segments is a pyramidal in shape with its apex directed towards the hilum**

- **Air passage between trachea and alveoli –divides 23 times- tracheobronchial tree**
- **Trachea and first 16 generations of the tree- conducting zone- no gas exchange occurs**
- **Smallest airway in the conducting zone is the terminal bronchiole**


Trachea
Primary bronchus
Lobar bronchus
Segmental bronchus
Bronchioles
Lobule
Alveolar duct
Alveolus
Passages of air conduction
Respiratory bronchioles
Passages where gases exchange

ALVEOLI


Terminal bronchiole
Pulmonary arteriole
Pulmonary venule
Alveolar duct
Alveolar sac
Alveoli

Alveoli

- Lungs contain small saccular out pocketing called alveoli.
- The alveoli are where the lungs and the blood exchange oxygen and carbon dioxide during the process of breathing in and breathing out.
- They have a thin wall specialized to promote diffusion of gases between the alveolus and the blood in the pulmonary capillaries.
- Gas exchange can take place in the respiratory bronchioles and alveolar ducts as well as in the alveoli, (range: 274–790 million). The spongy nature of the lung is due to the packing of millions of alveoli together.

- **1.Type I alveolar cells – are the cells responsible for the exchange of oxygen and CO_2.**
- **2. Type II alveolar cells (septal cells) – free surface has microvilli – secrete alveolar fluid containing surfactant (reduces surface tension). They make the fluid that helps keep alveoli from collapsing.**
- **3. Alveolar dust cells – cells to repair damage/ macrophages remove debris**

Applied anatomy

- **Bronchoscopy- visualization of larynx, trachea and bronchi- FB removal and biopsy**
- **Carina- observed during bronchoscopy-most sensitive part-associated with cough reflex**
- **FB has tendency to enter into right bronchus –as it is more wider and in line with trachea**

THANK YOU

LUNGS/ Pleura / Diaphragm

LUNGS

- Lung occupies most of the space within the thoracic cavity. It has a conical shape.
- Toward the midline, the lungs are separated from each other by the mediastinum and this is called the mediastinal surface
- The medial aspect of each lung and the site of entrance or exit are called the hilum of lung.
- The structures connecting lung to the mediastinum are called Root of the lung, it includes – Bronchus (Rt and Lt) – Bronchial vessels – Pulmonary artery – 2 Pulmonary veins – Pulmonary nerve plexuses -Bronchopulmonary lymph nodes and lymphatics.

Costal surface of Lungs

- The relatively broad, rounded surface in contact with the thoracic wall is called the costal surface of the lung.
- The lungs extend laterally from the heart to the ribs on both sides of the chest and continue posteriorly toward the spine.

Lungs

- 2 in number
- Cone shaped, lying on each side of midline in thoracic cavity
- Parts; Apex, Base, Costal and Medial surface

- **Apex;**

- **Rounded, rises into root of neck**
- **About 25 mm above level of middle third of clavicle**
- **Close to the first rib and blood vessel and nerves there**

- **Base;**

- **Concave, semilunar**
- **Lies on upper surface of diaphragm**

- **Costal surface;**

- **Broader outer surface**

- **Lies against costal cartilage, ribs and intercostal muscles**

- **Medial surface;**

- **Concave**

- **Triangular area called hilum at the level of 5, 6 and 7th thoracic vertebra**

- **Areas through which bronchus, pulmonary artery, pulmonary veins , bronchial artery and bronchial vein enter and leave the lung**

Lobes of lungs

- **Right lung- three distinct lobes; superior, middle and inferior**
- **Left lung- 2 lobes- superior and inferior**
- **Division is by fissure; oblique and horizontal**

Difference between Right and left lungs

S.N	Right Lung	Left Lung
1	Shorter and broader	Longer and narrower
2	Larger and heavier, weighs about 700 g	Smaller and lighter, weighs about 600g
3	Cardiac notch absent.	Cardiac notch present.
4	Absence of lingula	Lingula present
5	It has 2 fissures and 3 lobes	It has only one fissure and 2 lobes

Blood supply

- **Bronchial and pulmonary arteries**

- Bronchial arteries; arise form thoracic aorta or one of the posterior intercostal arteries, supplies the bronchial tree as far as respiratory bronchioles then anastomose with pulmonary arteries

- Pulmonary arteries;

- Enter from the hilum of lungs, carry deoxygenated blood form right ventricle

-Ends in the capillary plexus on alveola walls of lungs

Nerve supply

- **Parasympathetic; vagus nerves- motor to the bronchial muscles ad secretomotor to the glands of bronchial tree**
- **Sympathetic; form the spinal segments of T2-T5**

Structure of lung

- **Lung parenchyma; bronchopulmonary tree, accompanied by branches of pulmonary artery, tributaries of pulmonary veins, associated with lymphatics and nerves enclosed in connective tissue framework**

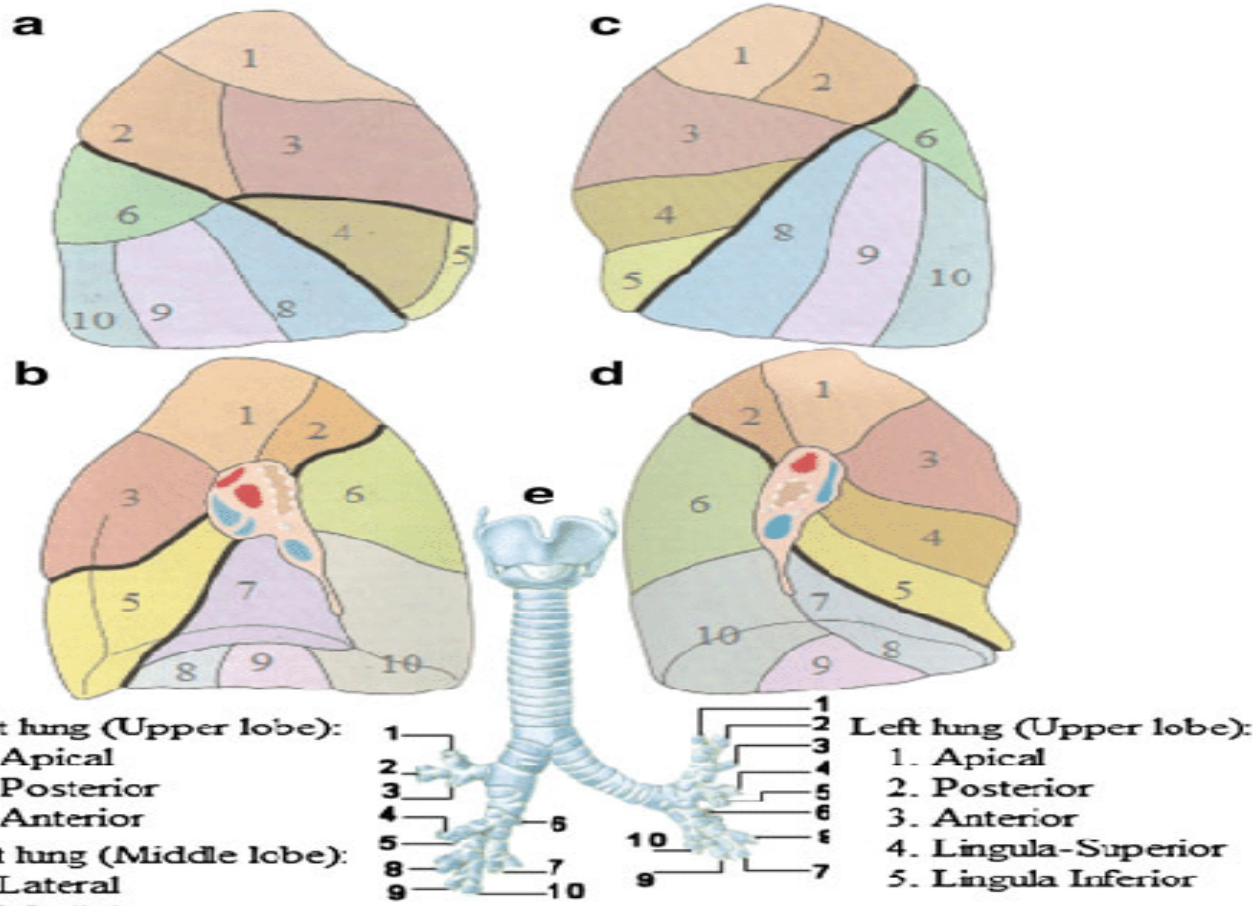
- **Bronchopulmonary segment;**

- Independent functional unit of lung made up of tertiary bronchus, with its bronchial tree up to alveoli, accompanied by independent branch from pulmonary artery

- Venous drainage in intersegmental

- **Each lung has 10 bronchopulmonary segment**
- **Each unit is surrounded by connective tissue**

Name of bronchopulmonary segment



Right lung (Upper lobe):
1. Apical
2. Posterior
3. Anterior

Right lung (Middle lobe):
4. Lateral
5. Medial

Right lung (Lower lobe):
6. Superior
7. Medial basal
8. Anterior basal
9. Lateral basal
10. Posterior basal

Left lung (Upper lobe):
1. Apical
2. Posterior
3. Anterior
4. Lingula-Superior
5. Lingula Inferior

Left lung (lower lobe):
6. Superior
7. Medial basal
8. Anterior basal
9. Lateral basal
10. Posterior basal

Applied anatomy

- Usually infections are confined to each bronchopulmonary segment
- Useful for bronchoscopy
- If segment is diseased, it is possible to resect that segment only

Pleura and Pleural cavity

- The rib cage is separated from the lung by a two layered membranous coating called the pleura. the potential space between the serous membrane layers 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.

Pleura and Pleural Cavity

- **Closed sac of serous membrane, lined by single layer of squamous cell**
- **The pleural cavity is a space between the visceral and parietal pleura.**
- **Visceral pleura; adheres to the lung , firmly covers each lung and passes into the fissures that separate them and folds back on itself at hilum to form parietal pleura**

- **Parietal pleura; adheres to the inside of chest wall and upper surface of diaphragm and not attached to other structure in the mediastinum, pain sensitive- supplied by the intercostal nerves**

Pleural cavity

- The pleural cavity is a space between the visceral and parietal pleura.
- Contains no air, thus pressure is negative; -2mm hg during expiration ad -6mm hg during inspiration
- Contains around 7- 10 ml of pleural fluid, which lubricates the lung movement during breathing

Applied anatomy

- **Inflammation of pleura; pleuritis or pleurisy**
- **May be associated with collection of fluid in pleural cavity- pleural effusion, common in tuberculosis and malignancy of bronchus and lungs**
- **Presence of air in pleural cavity- pneumothorax, and that of blood- hemothorax, that of pus- empyema**
- **Aspiration of any fluid from thoracic cavity- paracentesis thoracis- done in 6^{th} intercostal space in mid axillary line**

Respiration

- **Movement of air into and out (O2 and C02) of the lungs**
- **Inspiration- Active process**
- **Expiration – Passive process(muscle relax)**

Muscles of respiration

- **Main muscles in normal quiet breathing-external intercostal muscles and diaphragm**
- **Intercostal muscles;**

- 11 pairs of intercostal muscles between 12 pairs of ribs- arranged in two layers- external an internal

Muscles of Respiration

- **Diaphragm= Normal inspiration(Radial muscle)**
- **Intercostal muscle**

External intercostal muscle- Normal inspiration

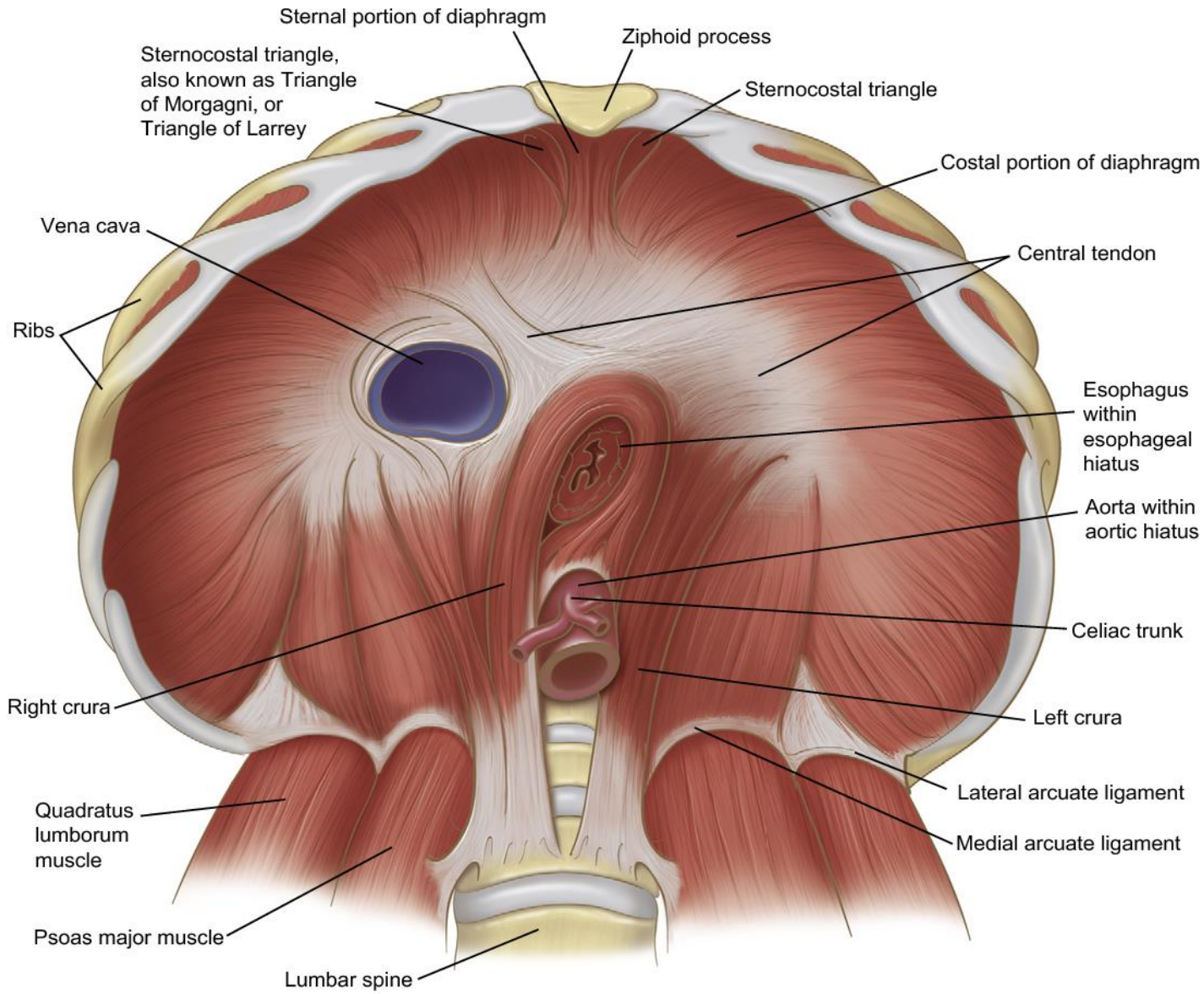
Internal intercostal muscle- forceful expiration

- **Abdominal muscle-forceful expiration**

Accessory muscles of respiration

- **forces inspiration -Sternocleidomastoid muscles, scalene-scalenus anterior, medius, and posterior, the pectoralis major and minor, the inferior fibres of serratus anterior and latissimus dorsi**
- **forced expiration=Internal intercostal muscles, abdominal muscles - (rectus abdominis, external oblique, internal oblique, and transversus abdominis.)**

- **External -** **extends downward and forward from lower border of rib above to upper border of rib below and involved in respiration**
- **Internal- Extends downward and backward, from lower border of rib above to below, are used when expiration becomes active as in exercise**


Sternal portion of diaphragm
Ziphoid process
Sternocostal triangle, also known as Triangle of Morgagni, or Triangle of Larrey
Sternocostal triangle
Costal portion of diaphragm
Vena cava
Central tendon
Ribs
Esophagus within esophageal hiatus
Aorta within aortic hiatus
Celiac trunk
Right crura
Left crura
Lateral arcuate ligament
Quadratus lumborum muscle
Medial arcuate ligament
Psoas major muscle
Lumbar spine

Diaphragm

- Dome shaped muscular structure, separating thoracic an abdominal cavities
- the chief muscle of quiet respiration.
- During inspiration, external intercostal and diaphragm contracts- enlarging thoracic cavity in all direction
- Supplied by phrenic nerves

Origin

Sternal, Costal and Lumbar

Insertion

The *central tendon* of the diaphragm lies below the pericardium and is fused to the latter

Openings in the Diaphragm

- *Aortic opening-(*It lies at lower border of the 12th thoracic vertebra.)
- *Oesophageal opening-* (lies in the muscular part of the diaphragm, at the level of the 10th thoracic vertebra)
- *Venacaval opening-(*lies in the central tendon of the diaphragm at the level of the 8th thoracic vertebra)

Large Opening of Diaphragm

1.Aortic Opening

Aorta

Thoracic duct

Azygos vein

2. Oesophagus Opening

Oesophagus

Gastric or vagus nerves

Oesophageal branches of the left gastric artery

3. Vena caval opening

The inferior vena cava

Branches of the right phrenic nerve

Lymphatics of liver.

Small Openings in the Diaphragm

- greater and lesser splanchnic nerves.
- subcostal nerve and vessels
- The superior epigastric vessels and some lymphatics
- The musculophrenic vessels pierce
- Intercostal nerves and vessels
- Left phrenic

Relations

Superiorly

1 Pleurae and lungs

2 Pericardium

Inferiorly

1 Peritoneum

2 Liver

3 Fundus of the stomach

4 Spleen

5 Kidneys

6 Suprarenals

Thank You