Respiratory System

Dr. Priti Acharya

Respiratory system

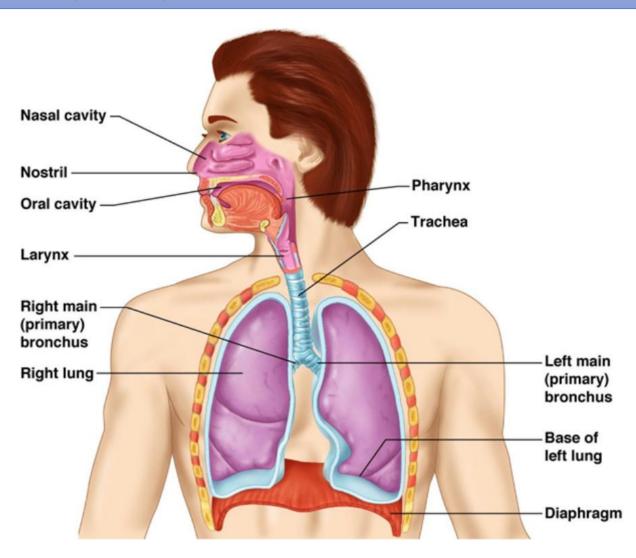
Respiratory system consist of

- 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

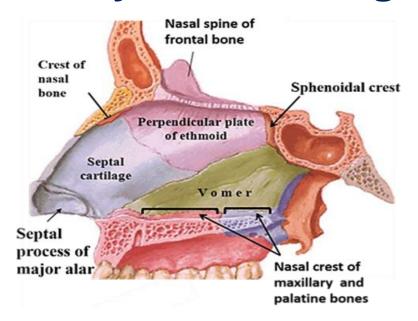


Nose

- 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

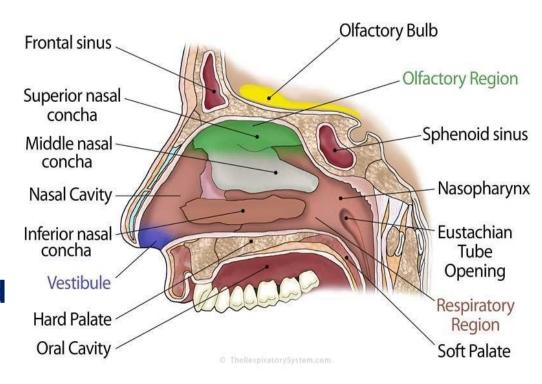
Nasal septum-Perpendicular sheet of bone and cartilage—Vomer and ethmoid bone, hyaline cartilage



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



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

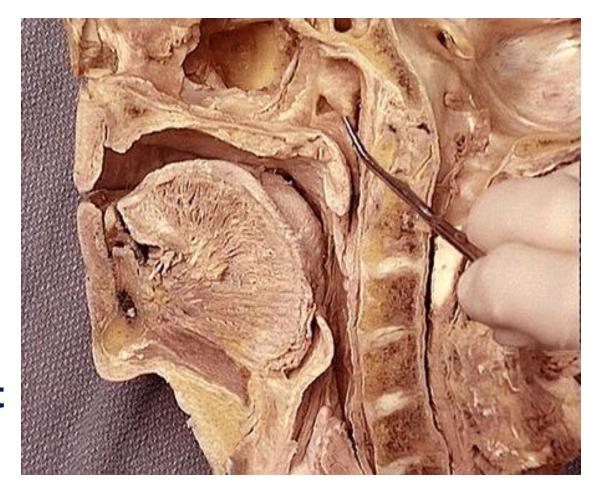
- Lighten the skull.
- Acts as resonance to the voice
- Produce mucus that drain into the nasal cavity

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.

LARYNGOPHARYNX

- 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(outer to inner)
- 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

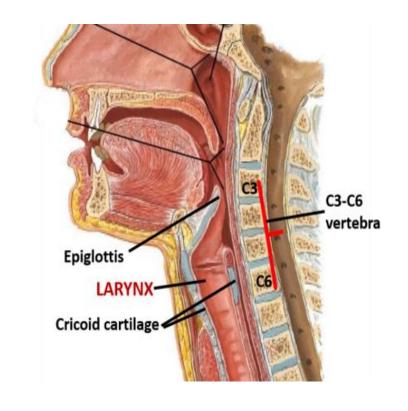
- It includes conducting airway and respiratory portion
- Composed of trachea, bronchial tree, lungs, alveolus and alveoli.
- □ Alveoli is the functional unit of lungs.
- Conducting airways (pharynx, trachea, bronchi, up to terminal bronchioles).
- Respiratory portion of the respiratory system (respiratory 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)

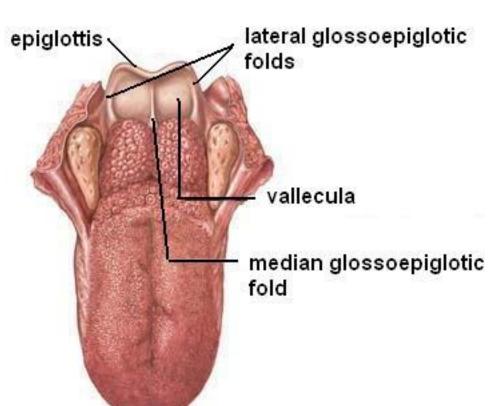
Produce sound

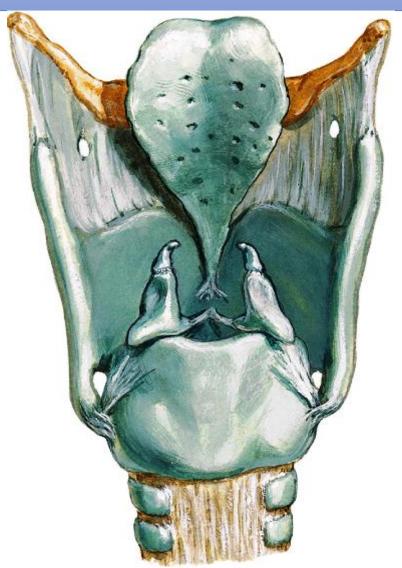
Glottis

 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.

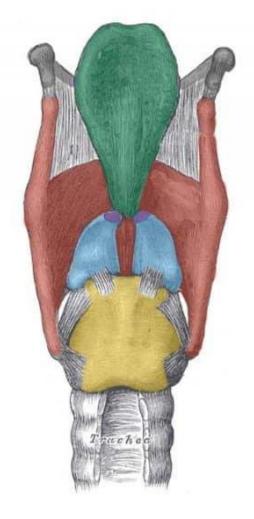


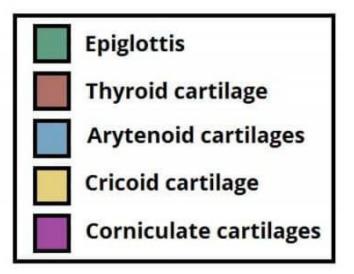


Cartilages of larynx:

- 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







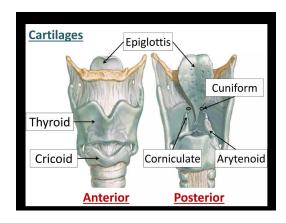


Unpaired cartilage

Thyroid cartilage.

Protects the larynx anteriorly called as shield of larynx

Has two laminae, which meet in the midline and form a prominent angle, called laryngeal prominence (Adam's apple)



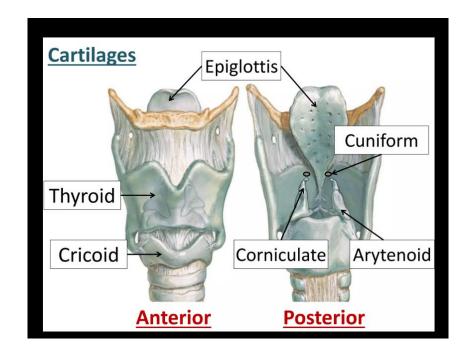
• **Cricoid cartilage** – ring-shaped, hyaline cartilage that forms the inferior wall of the larynx.

Lies below the thyroid cartilage at the level of C6

Forms a complete ring

Has a narrow anterior arch & a broad posterior lamina

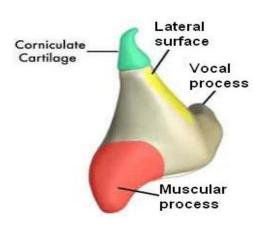
• **Epiglottis** –Leaf shaped, situated behind the root of the tongue and hyoid bone

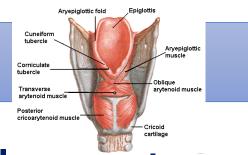


Paired Cartilage

Arytenoid cartilages – small, pyramidal in shape, Situated at the back of the larynx are triangular in shape with apex and base

- Base 2 process-
- Anterior process= Vocal process attached to vocal ligaments
- Posterior process= Muscular process



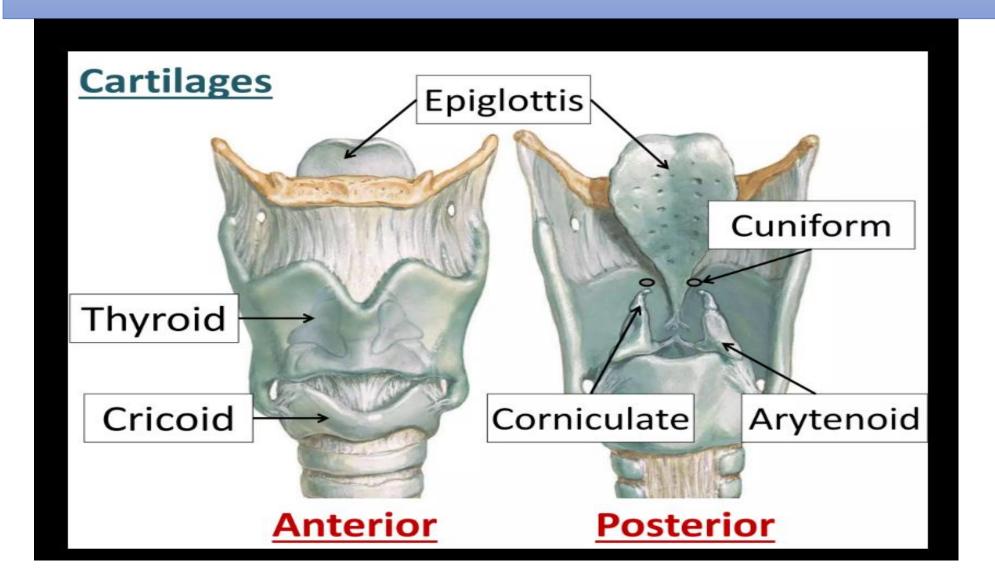


Thyroid

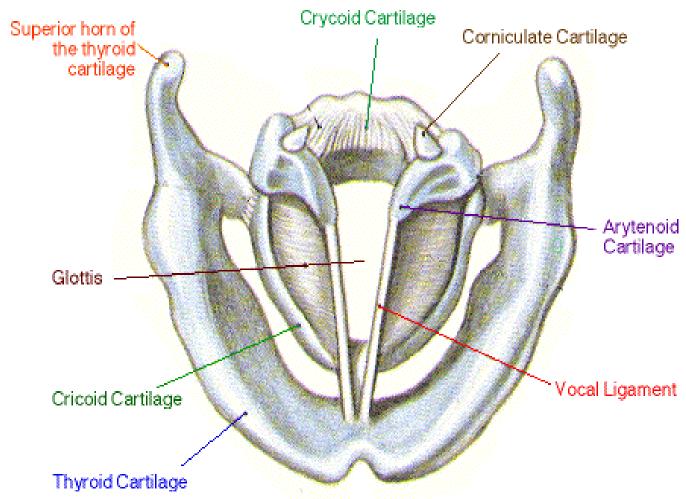
Cuneiform cartilages - club-shaped elastic cartilages anterior to the corniculate cartilages. Small nodules ,placed in each aryepiglottic fold

Corniculate cartilages - horn-shaped pieces of elastic cartilage,
 are located at the top of each arytenoid cartilage

No specific function only serves as the attachment of muscle



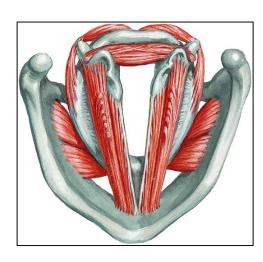
Interior of the larynx

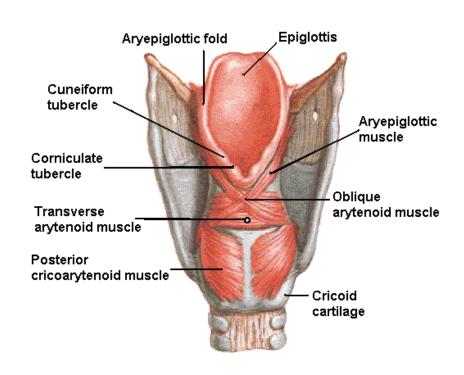


The Larynx: viewed from above

Intrinsic muscles the larynx

- 1. Cricothyroid- Tensor of VF
- 2. Posterior cricoarytenoid- abd
- 3. Lateral cricoarytenoid-add
- 4. Transverse arytenoid-add
- 5. Oblique arytenoid-add
- 6. Aryepiglotticus-closer of inlet
- 7. Thyroepiglotticus-open the inlet
- 8. Thyroarytenoid-relax the VF
- 9. Vocalis-relax the VF



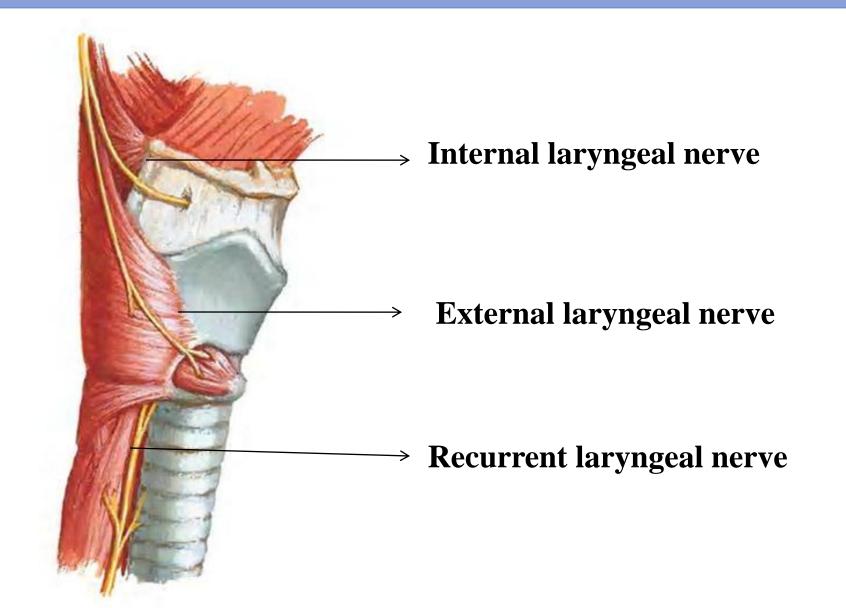


Blood and Nerve supply

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

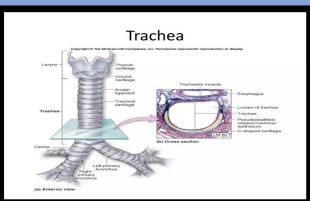


Applied anatomy

- 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

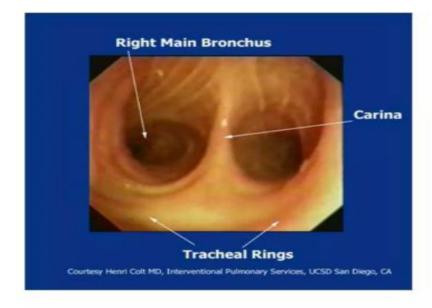
- Also known as windpipe
- Continuation of larynx
- Tubular structure with flattened posterior want
- Extends down to about the level of 5th thoracic vertebrawhere it divides at carina to right and left bronchi
- Around 10 cm long
- Lies in median plane, Infront of esophagus



- 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.

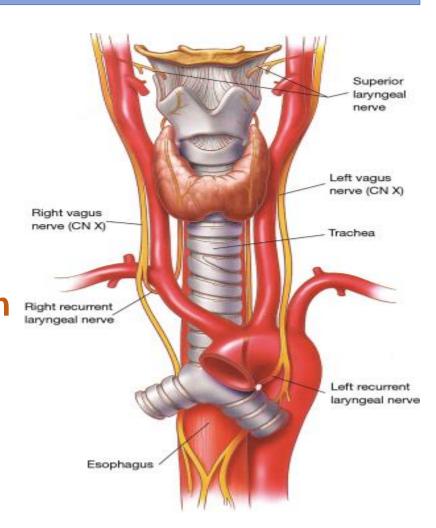
Trachea

 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.



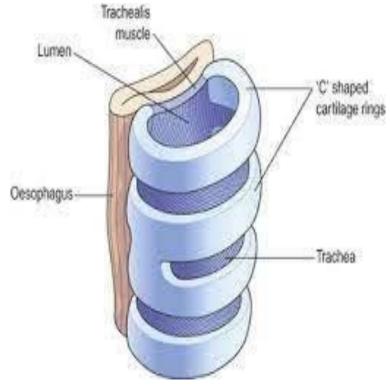
Relations of trachea

- 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 Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display. Larynx --Thyroid cartilage Cricoid cartilage Trachealis muscle Anular ligament Esophagus Tracheal cartilage Lumen of trachea Trachea-Trachea Pseudostratified ciliated columnar epithelium C-shaped cartilage (b) Cross section Carina Left primary bronchus Right brimary bronchus (a) Anterior view

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 bronchione to each lobe

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

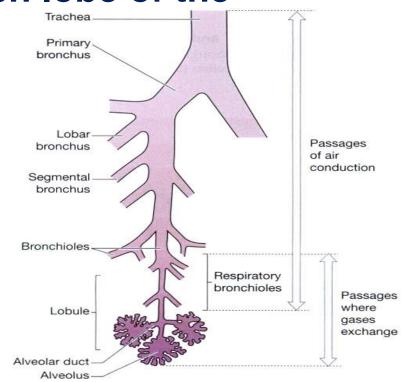
Bronchi

 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

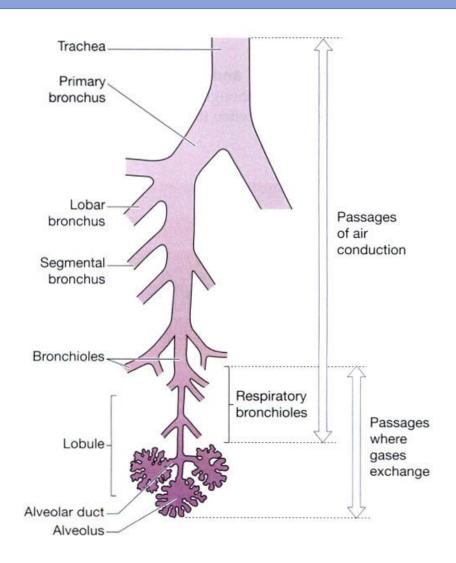


- The left main bronchus enters the hilum and divides into a superior and inferior lobar bronchus
- The right main bronchus give off the bronchus to upper lobe prior to entering the hilum(superior lobar bronchus)and once into the hilum divides into middle and inferior lobar bronchi

- 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 timestracheobronchial tree
- Trachea and first 16 generations of the tree- conducting zone- no gas exchange occurs



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.
- 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 CO₂.
- 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

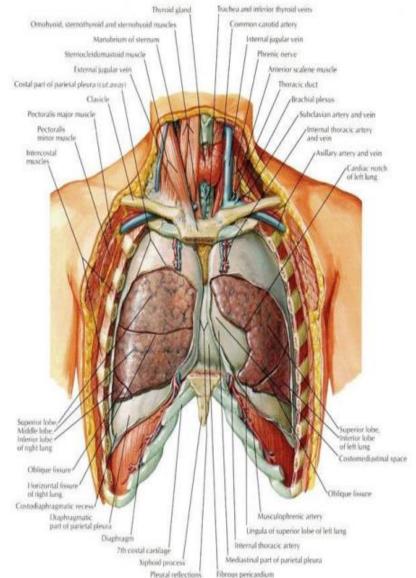
- Bronchoscopy- visualization of larynx, trachea and bronchi- FB removal and biopsy
- Carina- observed during bronchoscopy-most sensitive part-associated with cough reflex
- FB has tendency to enter into right bronchus –as it is more wider and in line with trachea

LUNGS/ Pleura / Diaphragm

LUNG

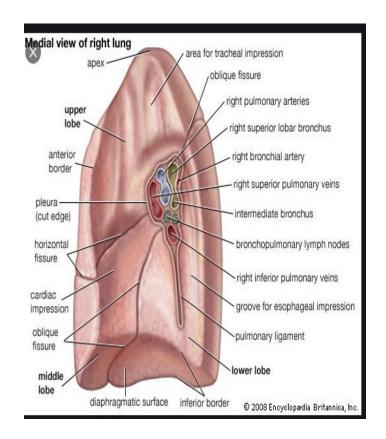
- Situated on either side of the heart
- A fresh lung is spongy, can float in water
- At birth the lungs are pink, but in adults they are dark grey

Lungs in Situ: Anterior View





- Anatomical position and side determination
- (a) its conical end (apex) is directed upwards its broader end (base) is directed downwards,
- (b) its convex surface (costal surface) is directed outwards its flat medial surface presenting hilum is directed inwards,
- (c) its thin margin (anterior margin) should face forwards and its rounded border (posterior border) should face backwards

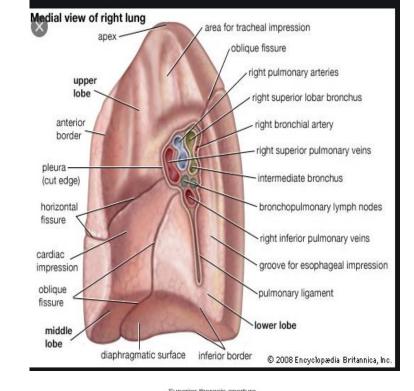


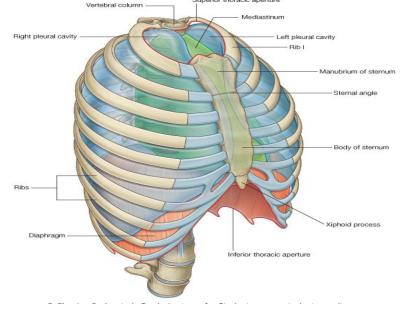
PARTS

 Each lung has an apex, base, 3 borders and two surfaces

APEX-

• The rounded upper extremity, protrudes above the thoracic inlet





BASE

- Semilunar and concave
- Since the diaphragm extends higher on the right than on the left, the concavity is deeper on the base of the right lung
- RELATION:
- Rests upon the superior surface of the diaphragm,
- Separates the right lung from the right lobe of the liver
- The left lung from the left lobe of the liver, the gastric fundus and spleen.

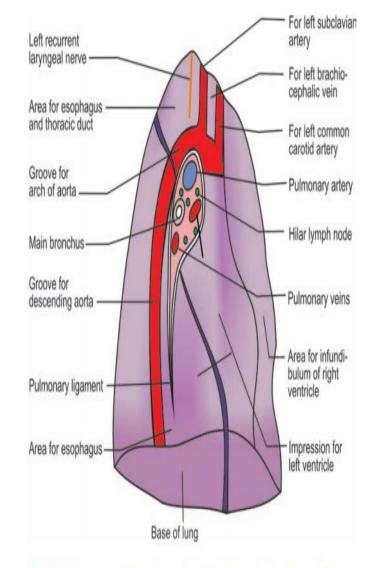
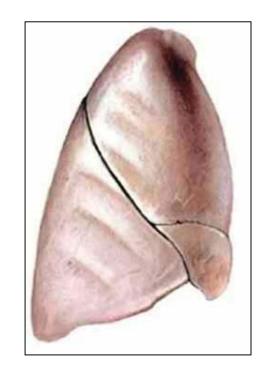
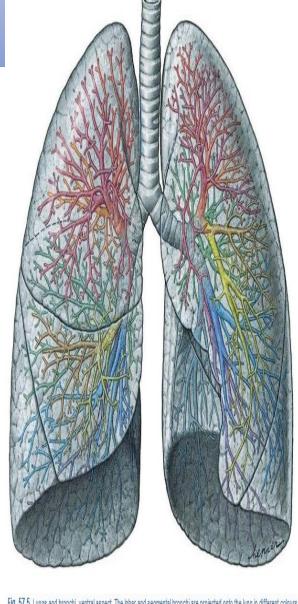


Fig. 25.25: Relations of medial (mediastinal and vertebral) surface of left lung

COSTAL SURFACE

- Is convex, smooth
- Its shape is adapted to that of the thoracic wall
- It is in contact with the costal pleura
- Presents impression for ribs and costal cartilages

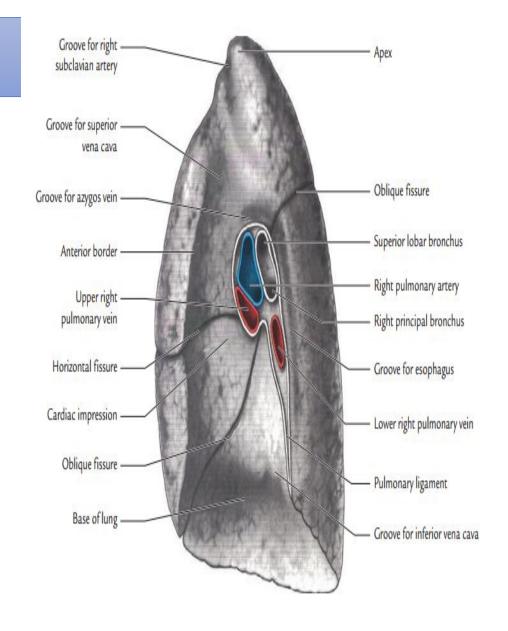




57.5 Lungs and bronchi, ventral aspect. The lobar and segmental bronchi are projected onto the lung in different colo

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



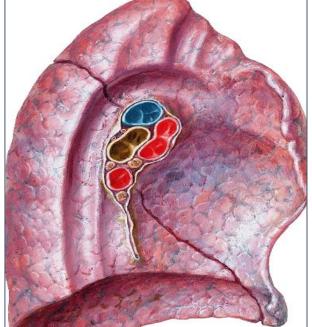
-BORDERS OF LUNG

1. Anterior border:

• The sharp anterior border separates the mediastinal and costal surfaces.

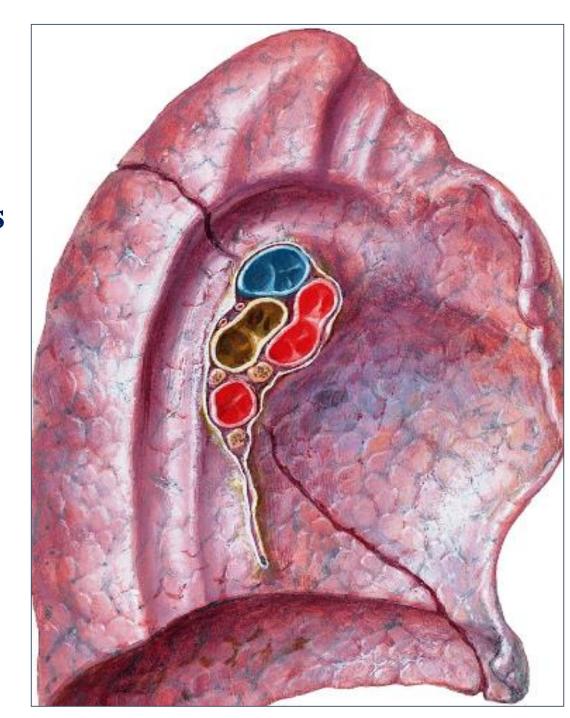
• It is thin and shorter than the posterior border.





- 2. Posterior border: It is thick and rounded.
- The rounded posterior border separates the vertebral and costal surfaces.

• 3. Inferior border: It is semilunar in shape and separates the costal and medial surfaces



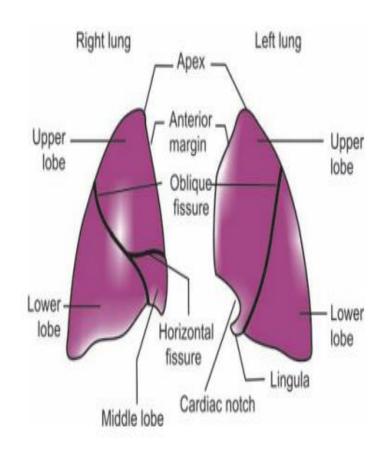
LOBES &FISSURE

RIGHT LUNG

 There are two fissures (oblique and horizontal) in right lung, which divide the right lung into three lobes (upper, middle and lower)

LEFT LUNG

 There is one fissure (oblique) in left lung, which divides the left lung into two lobes (upper and lower).



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 of Lungs

- 1. The pulmonary arteries carry deoxygenated blood to the lung from the right ventricle.
- 2. The pulmonary veins carry oxygenated blood from the lungs to the left atrium.
- 3. The bronchial arteries provide nutrition to the bronchial tree up to the level of terminal bronchioles (to the non-respiratory portions of the lungs).

The respiratory portions of the lungs are nourished from pulmonary capillary beds and directly from atmospheric air contained inside the alveoli.

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

Bronchopulmonary Segments

The bronchopulmonary segment is defined as a structural and functional unit of the lung parenchyma ventilated by a segmental or a tertiary bronchus

Characteristic features:

- 1. It is a subdivision of the lobe of the lung.
- 2. It is pyramidal in shape with apex directed towards the hilum and base towards the surface of the lung.

- 3. It is surrounded by the connective tissue.
- 4. It is aerated by the segmental (tertiary) bronchus.
- 5. Each segment has its own artery, a segmental branch of the pulmonary artery.

Thus, bronchopulmonary segments are the well-defined anatomical, functional, and surgical units of the lungs

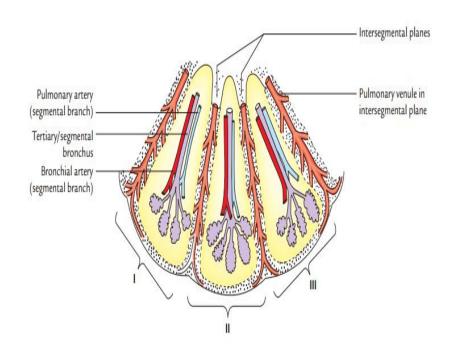
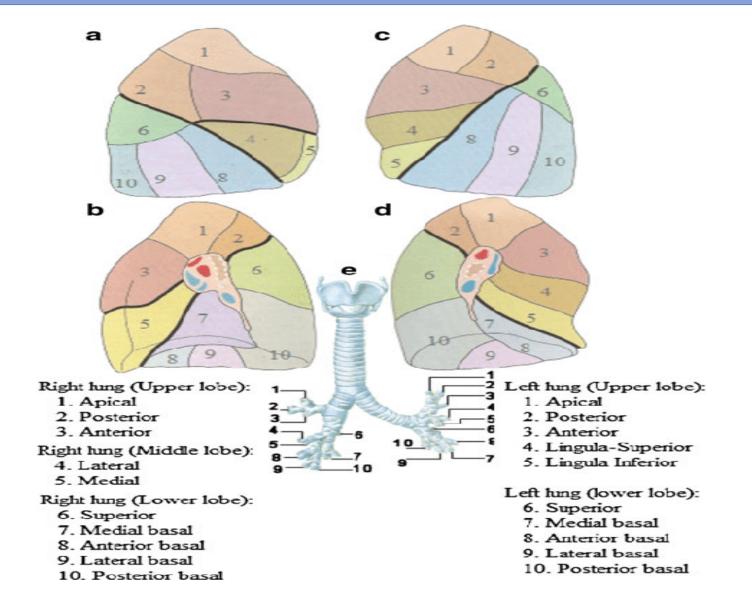


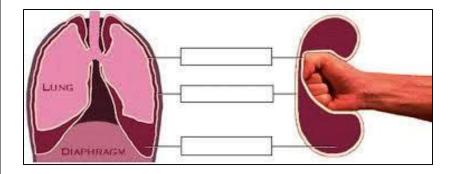
Fig. 18.17 Schematic diagram showing three bronchopulmonary segments (I, II, and III).

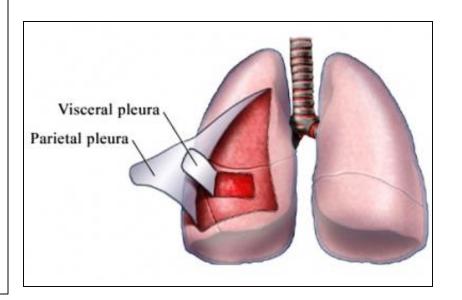
Name of bronchopulmonary segment



Pleura

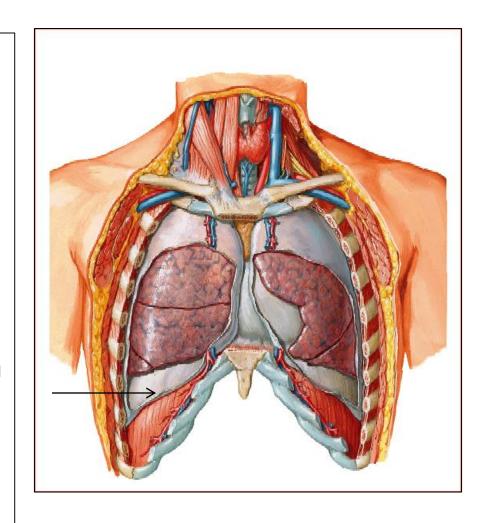
- Delicate and closed serous sac, into which corresponding lung invaginates from the medial side and reduces into a potential space.
- Parts:- 2 layers
- Outer-parietal layer
- Inner visceral layer
- In b/w –pleural space





Pleural Cavity

- The parietal and visceral layers are separated from one another by a slitlike space called pleural cavity
- Clinicians use the term pleural space instead of the anatomic term pleural cavity
- Pleural cavity contains thin film of tissue fluid called pleural fluid
- Fluid permits the two layers to move on each other with the minimum of friction



Applied anatomy

- Inflammation of pleura; pleuritis or pleurisy
- May be associated with collection of fluid in pleural cavitypleural 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

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 ribsarranged in two layers- external an internal

Muscles of Respiration

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

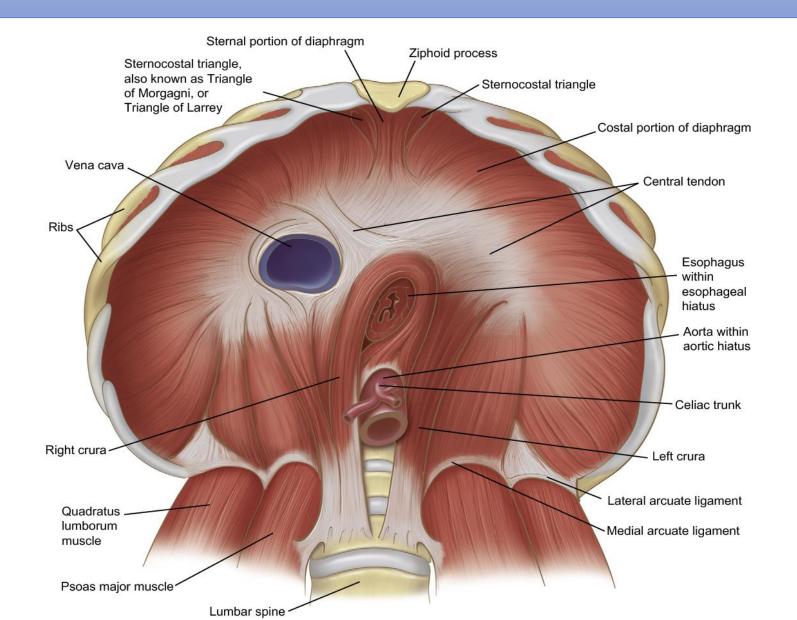
External intercostal muscle- Normal inspiration

Internal intercostal muscle- forceful expiration

Abdominal muscle-forceful expiration

Accessory muscles of respiration

- forces inspiration -Sternocleidomastoid muscles, scalenescalenus 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.)



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

Openings in the Diaphragm

- Aortic opening-(It lies at lower border of the 12th thoracic vertebra.)
- Oesophageal opening- (at the level of the 10th thoracic vertebra)
- Venacaval opening-(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