



General Anatomy

Lecture 12: Respiratory System (1)

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The Respiratory System includes:

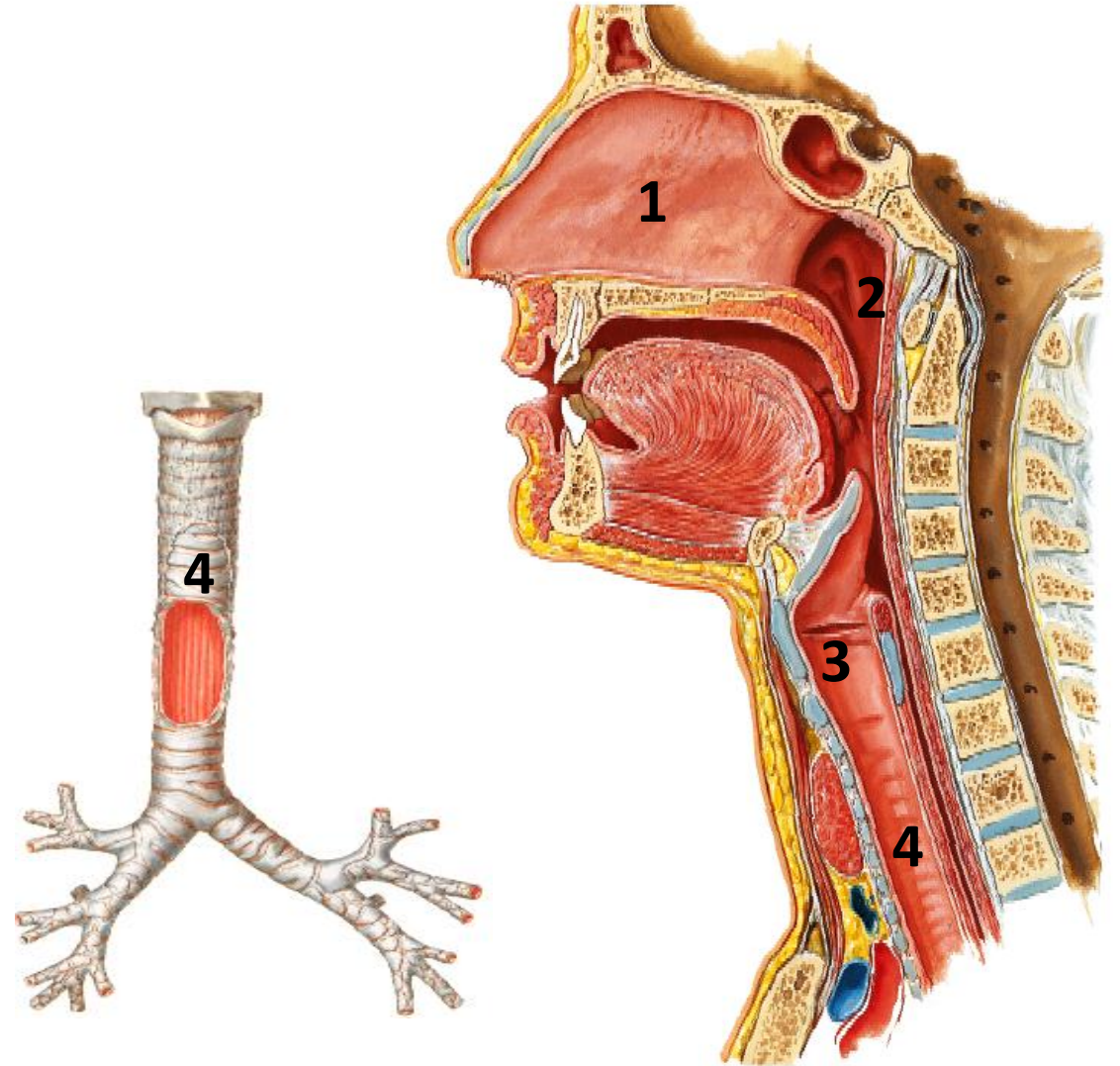
I. Respiratory Air Passages:

** Upper respiratory tract:

1. Nasal cavity.
2. Nasopharynx.

** Lower respiratory tract:

3. Larynx.
4. Trachea.
5. Bronchi.



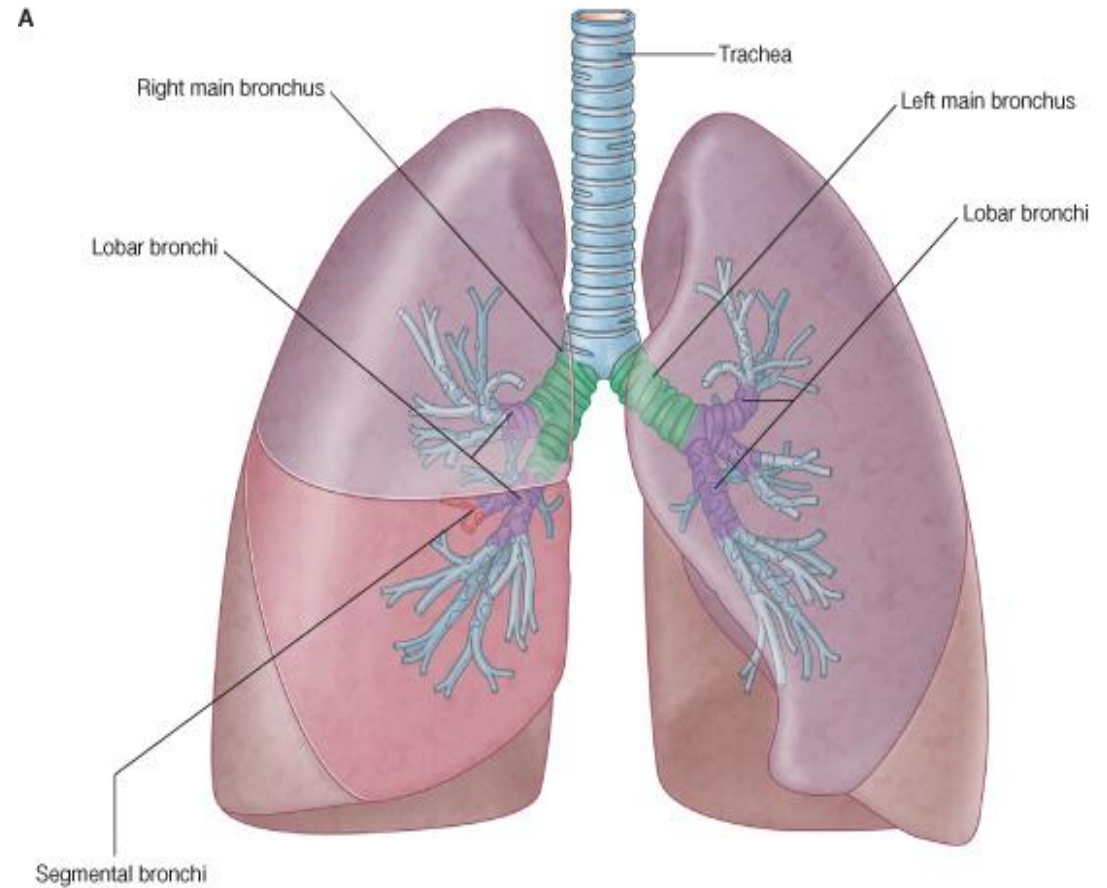
The Respiratory System includes:

II. Respiratory Organs:

The Lungs.

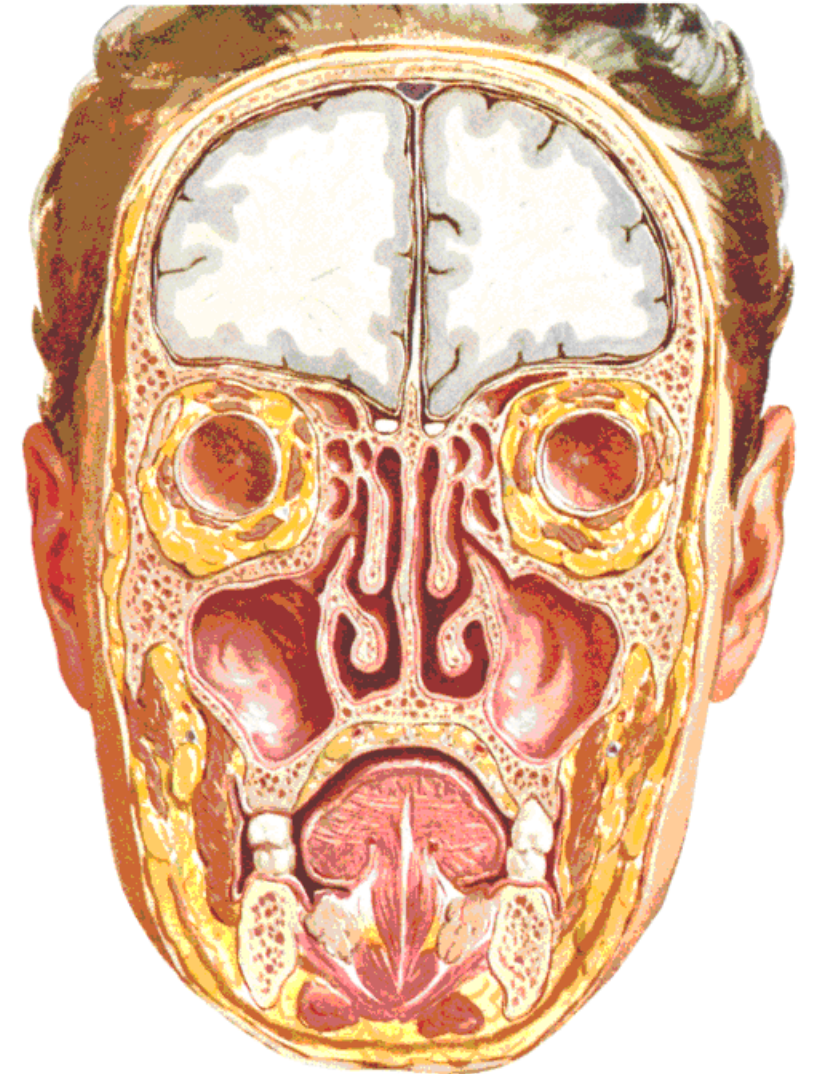
* The respiratory system functions include:

1. Air distributor.
2. Gas exchanger so that oxygen may be supplied to and carbon dioxide be removed from body's cells.



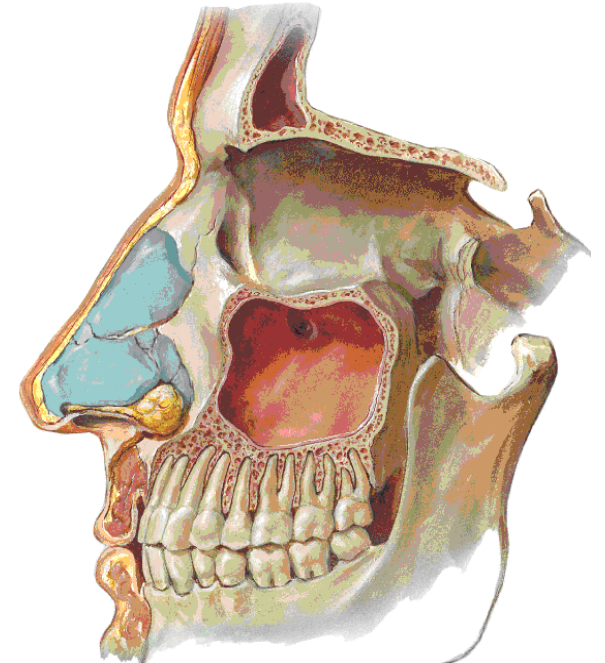
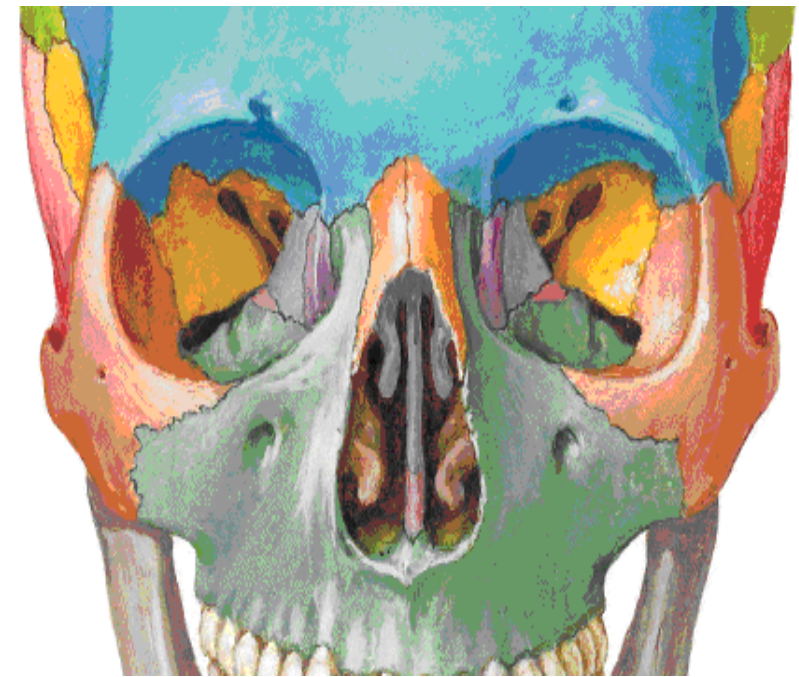
Paranasal Air Sinuses

- * **Definition** : These are air-filled spaces inside the maxillary bone, frontal bone, sphenoid bone and ethmoid bone.
- * **Function**:
 1. Lighten weight of skull
 2. Resonance of voice.
 3. Warming of air.
- * **At birth** : They are either present and small in size or they may be absent. They are fully developed in adolescence.
- * **They are lined by** : respiratory mucous membrane.
- * **All of them drain into** : the lat. wall of the nose.



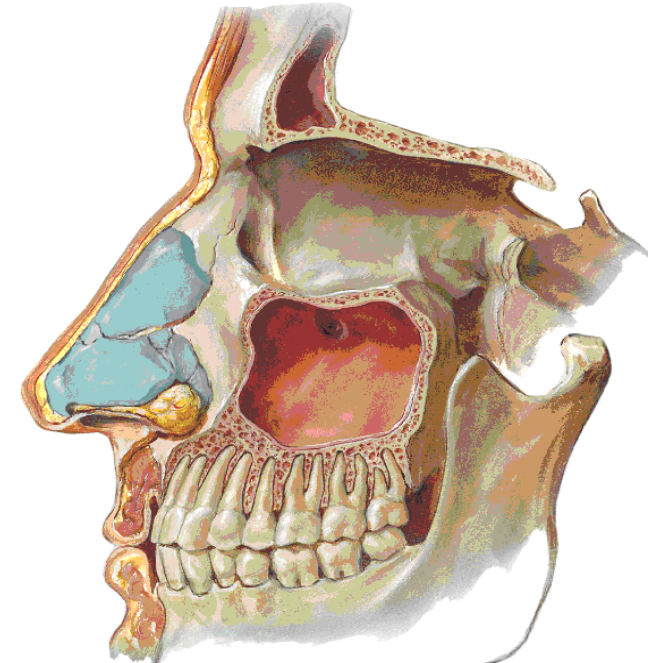
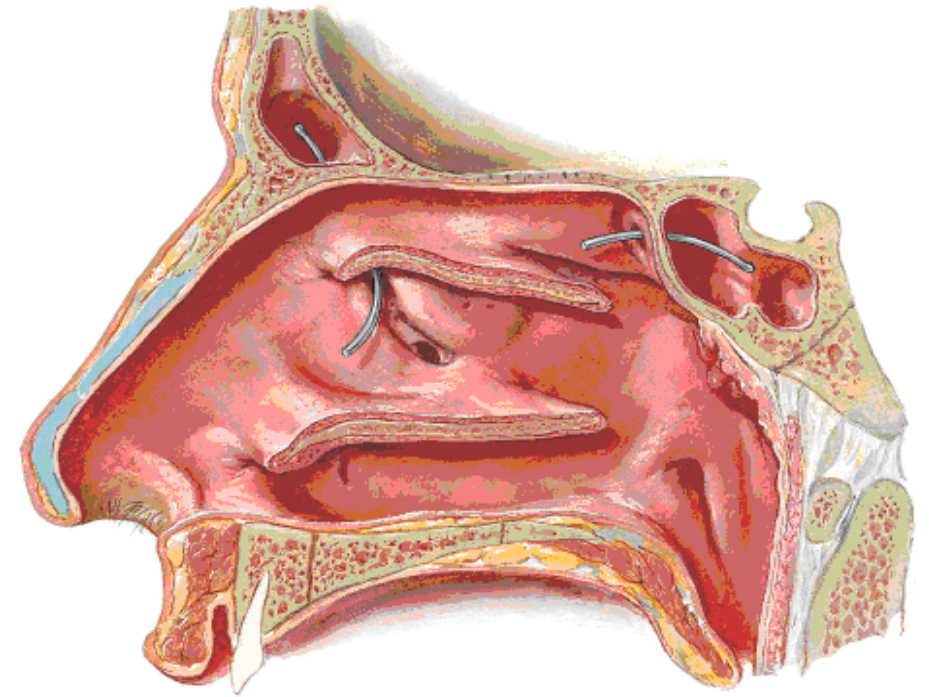
A. Maxillary Air Sinus

- * **Site** : inside the body of the maxilla.
 - * **Size** : it is the largest air sinus.
 - * **Shape** : pyramidal; with its base towards the nose and its apex towards the Zygomatic bone.
- @ **N.B.:** the roots of the maxillary teeth, particularly the first 2 molars are closely related to the floor of the maxillary air sinus.
- @ **Therefore** : extraction of a tooth may result in a fistula and an infected tooth can cause sinusitis (infection of the sinus).



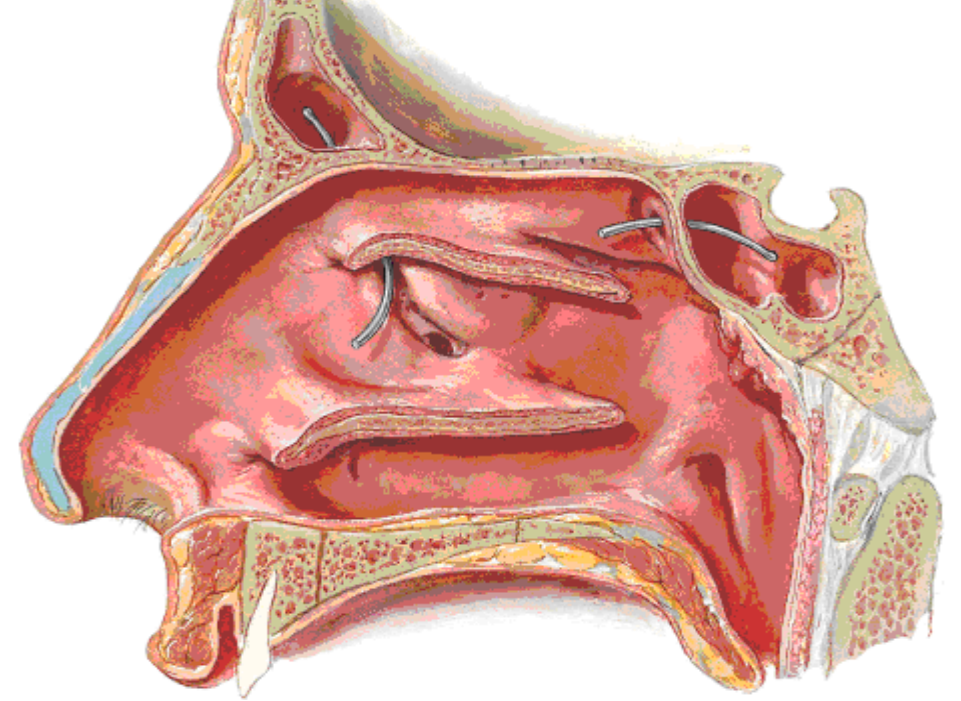
*** Maxillary air sinus is the commonest sinus to be infected due to :**

1. Its opening is high up near the roof and so it does not allow free and complete drainage since such drainage is difficult being against gravity.
2. The discharge from the frontal or ant. ethmoidal air sinuses can pass through the max. air sinus, since all of them open closely in the middle meatus of nose.
3. Spread from an infected tooth.



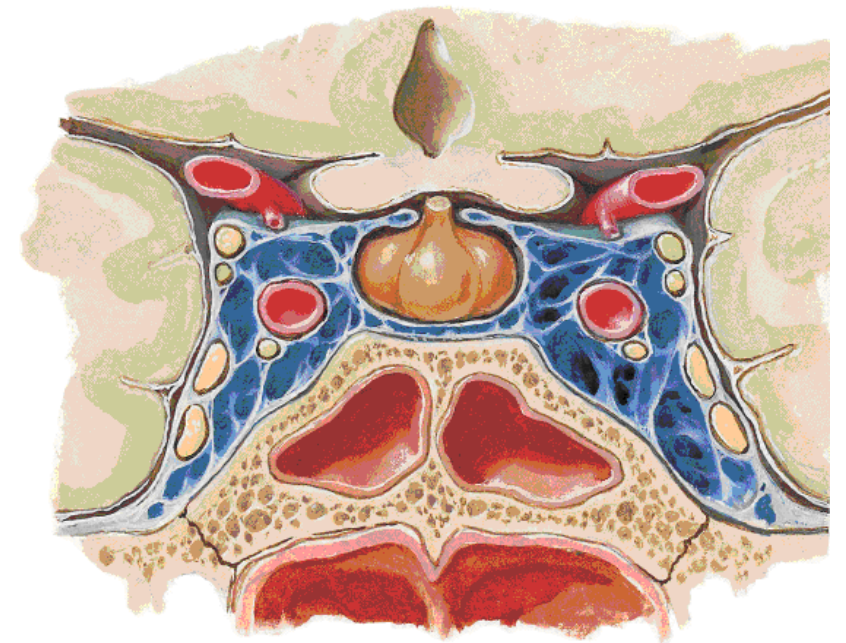
B. Frontal Air Sinus

- * They are two (right and left) which are separated from each other by a septum.
- * They lie within the frontal bone.



C. Sphenoidal Air Sinus

- * They are two (Rt. And Lt.)
- * They lie within the body of the sphenoid.
- * Related to → the pituitary gland (superiorly) & the cavernous sinus (laterally).

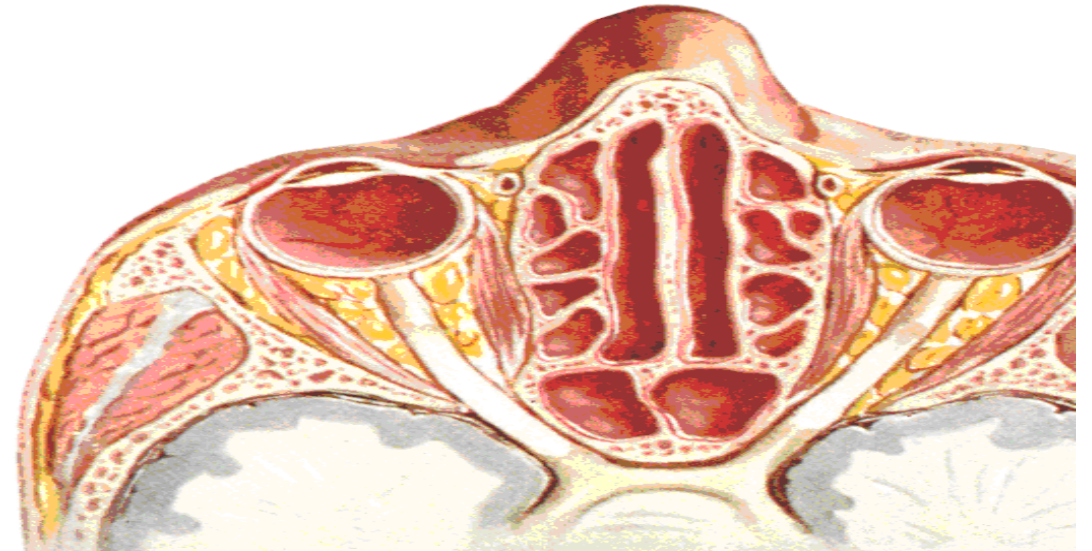
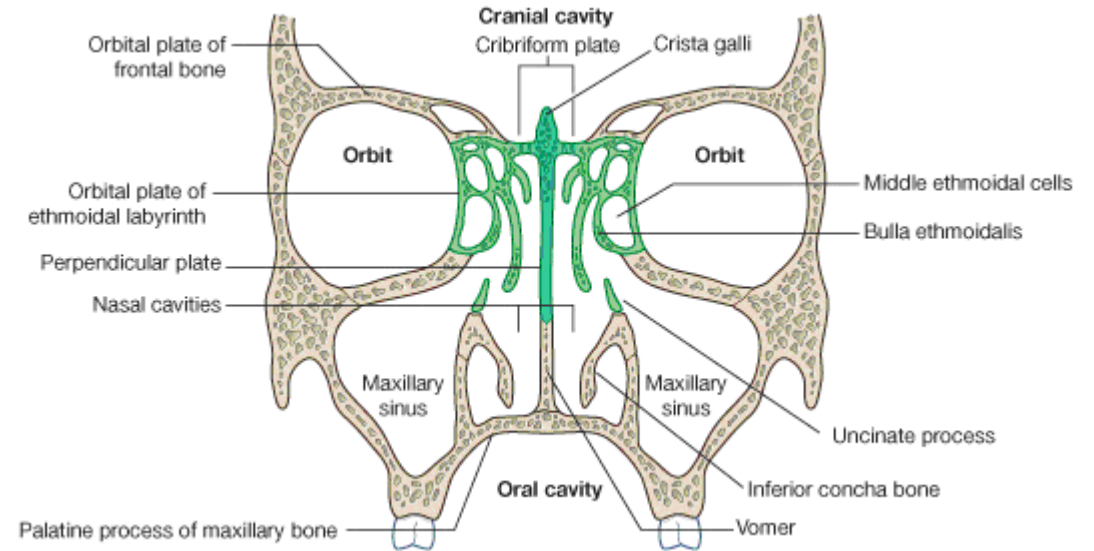


D. Ethmoidal Air Sinuses

* They lie within the ethmoidal bone (between the orbit laterally and the nose medially). Therefore, its infection can cause orbital infection.

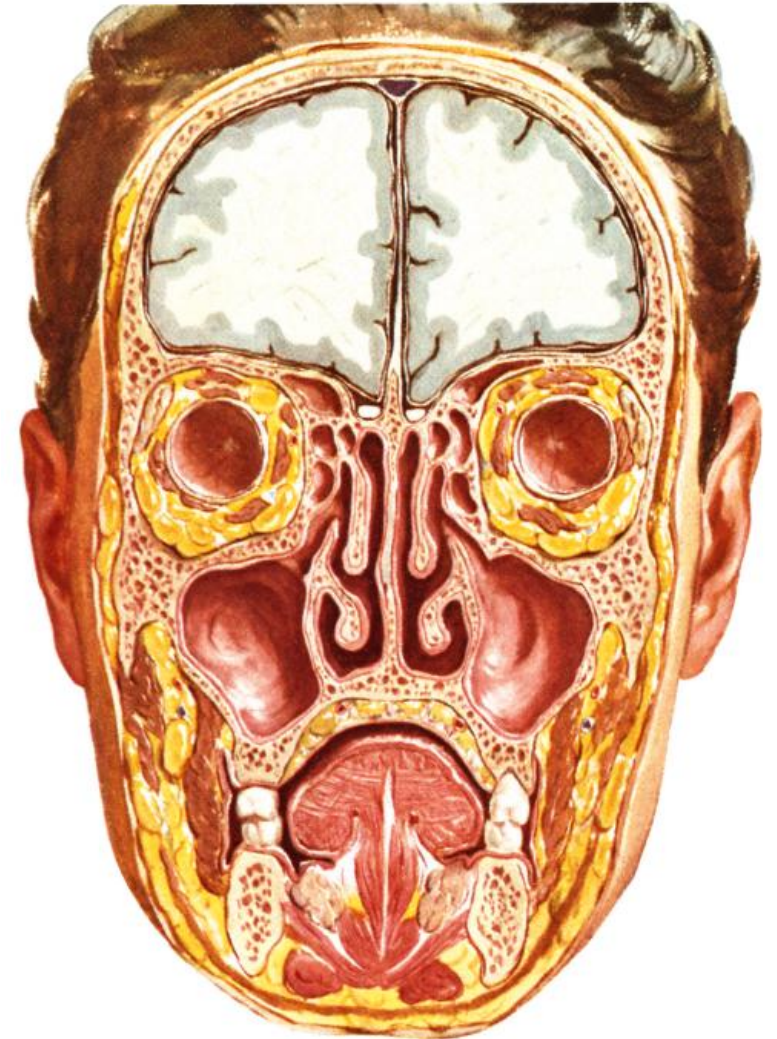
* They may be divided into 3 groups:

1. Ant. ethmoidal A.S.
2. Middle ethmoidal A.S.
3. Post. ethmoidal A.S.



Nose

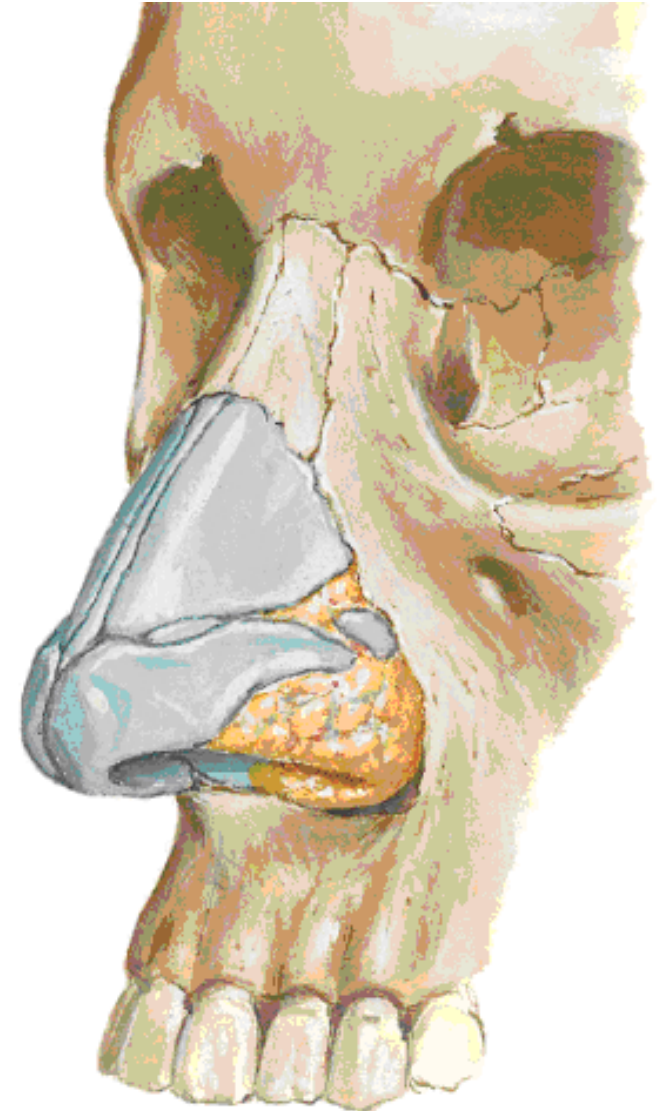
- * It is formed of 2 nasal cavities separated by a septum.**
- * It is important for warming the air & cleaning it from dust & bacteria.**
- * It is surrounded by a group of paranasal sinuses.**



A. External Nose

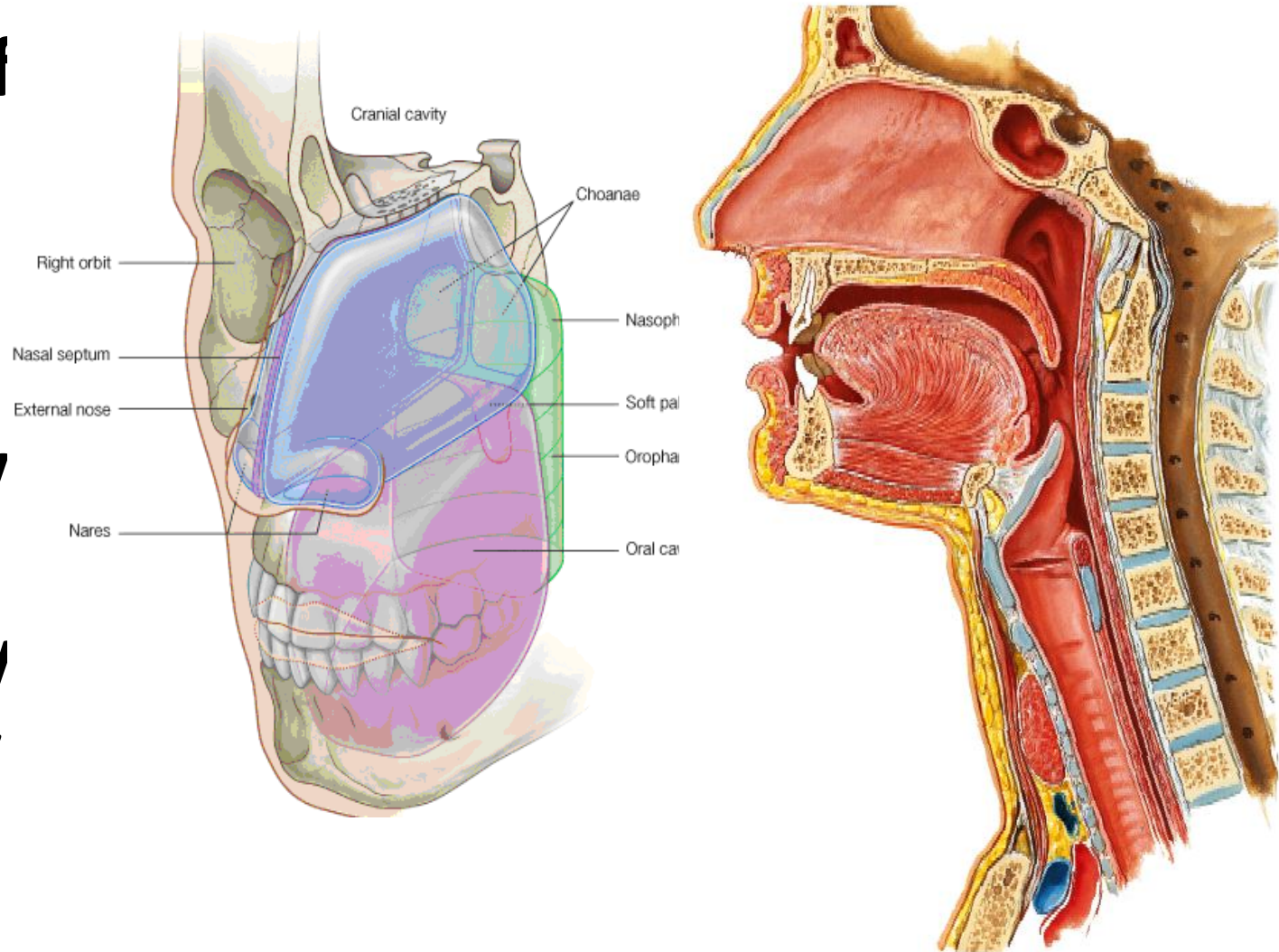
* The skeleton of the external nose is formed of :

1. Bony skeleton:
posteriorly.
2. Cartilaginous framework:
anteriorly.



B. Nasal Cavity

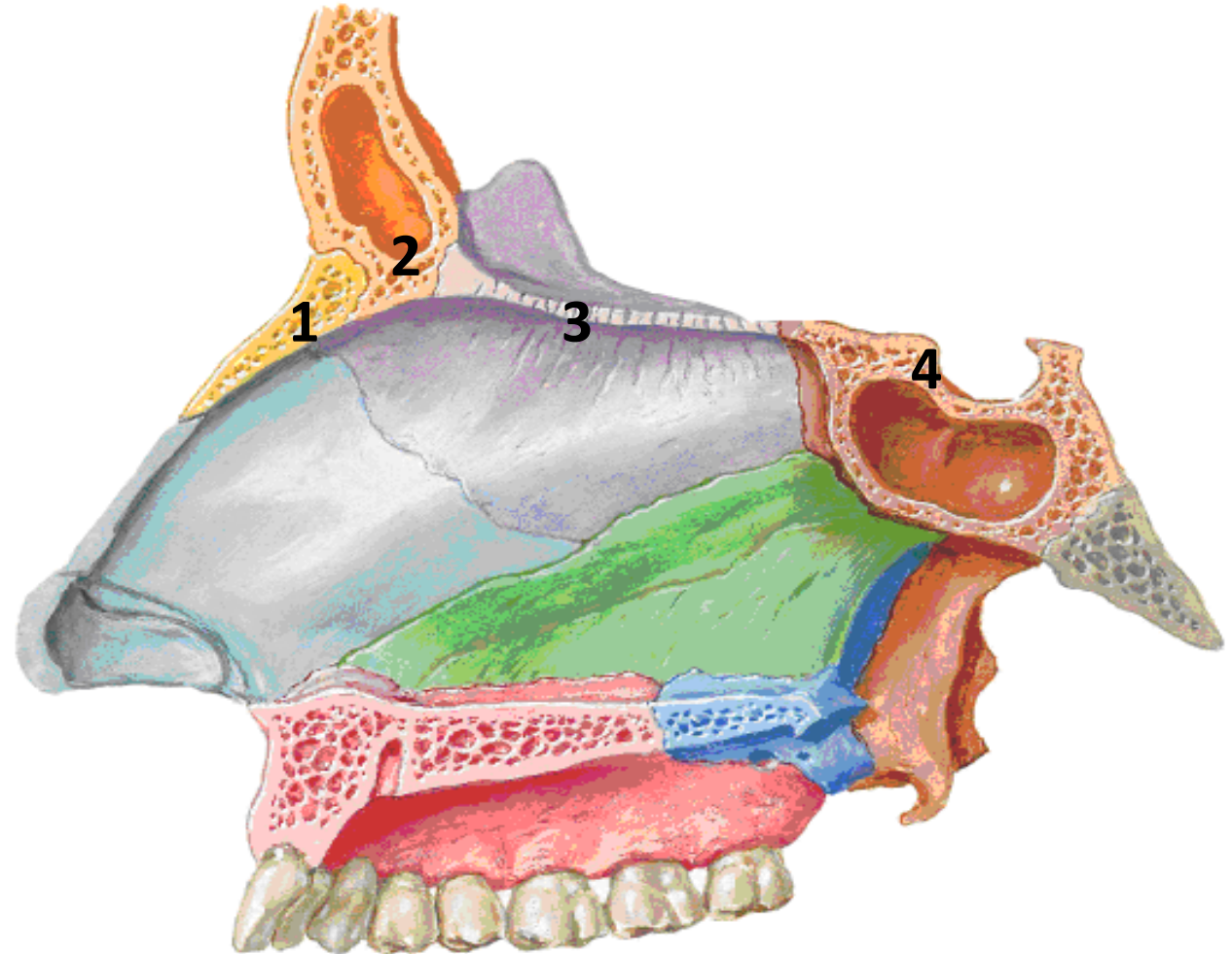
- * The nasal cavity is divided into right and left halves by the nasal septum.
- * Each cavity opens : anteriorly on the face by ant. nasal apertures (nostrils) and posteriorly into the nasopharynx by post. nasal apertures (choana).



@ Boundaries of nasal cavity:

I. Roof : is bony formed of:

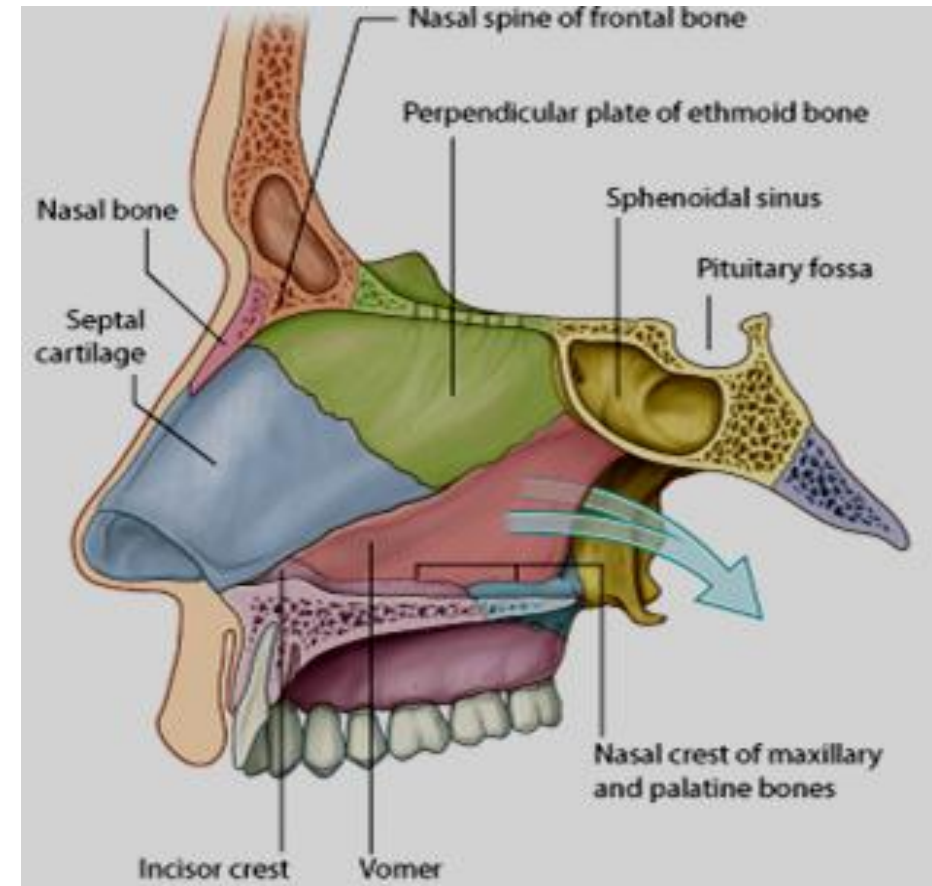
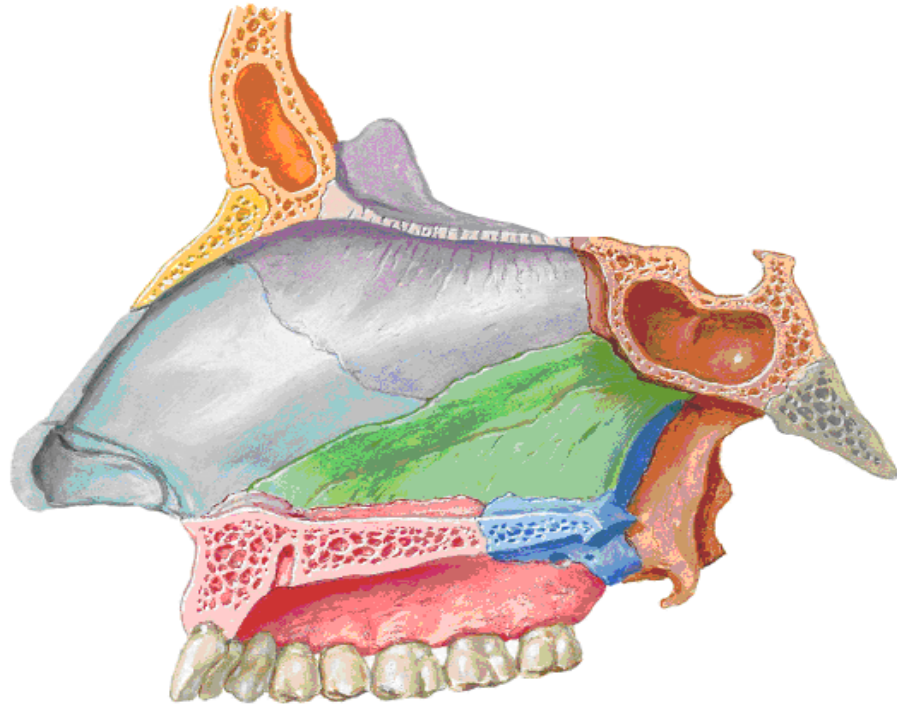
1. Nasal bone.
2. Frontal bone.
3. Ethmoid bone.
4. Body of sphenoid.



II. Floor : hard palate.

III. Medial wall : nasal septum; formed of :

1. Ethmoid (above).
2. Septal cartilage (below and in front).
3. Vomer (below and behind).



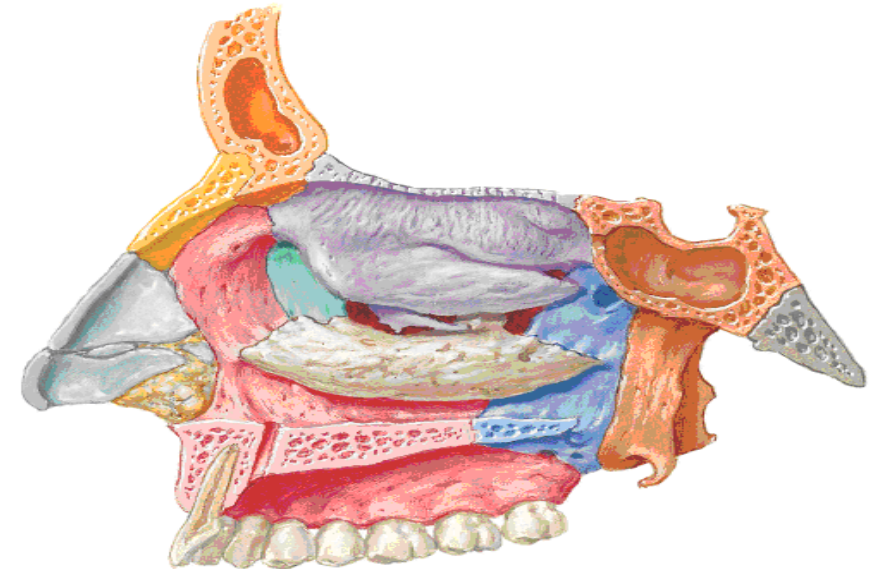
IV. Lateral wall : presents 4 elevations (conchae) and 4 depressions (recesses).

* The elevations are :

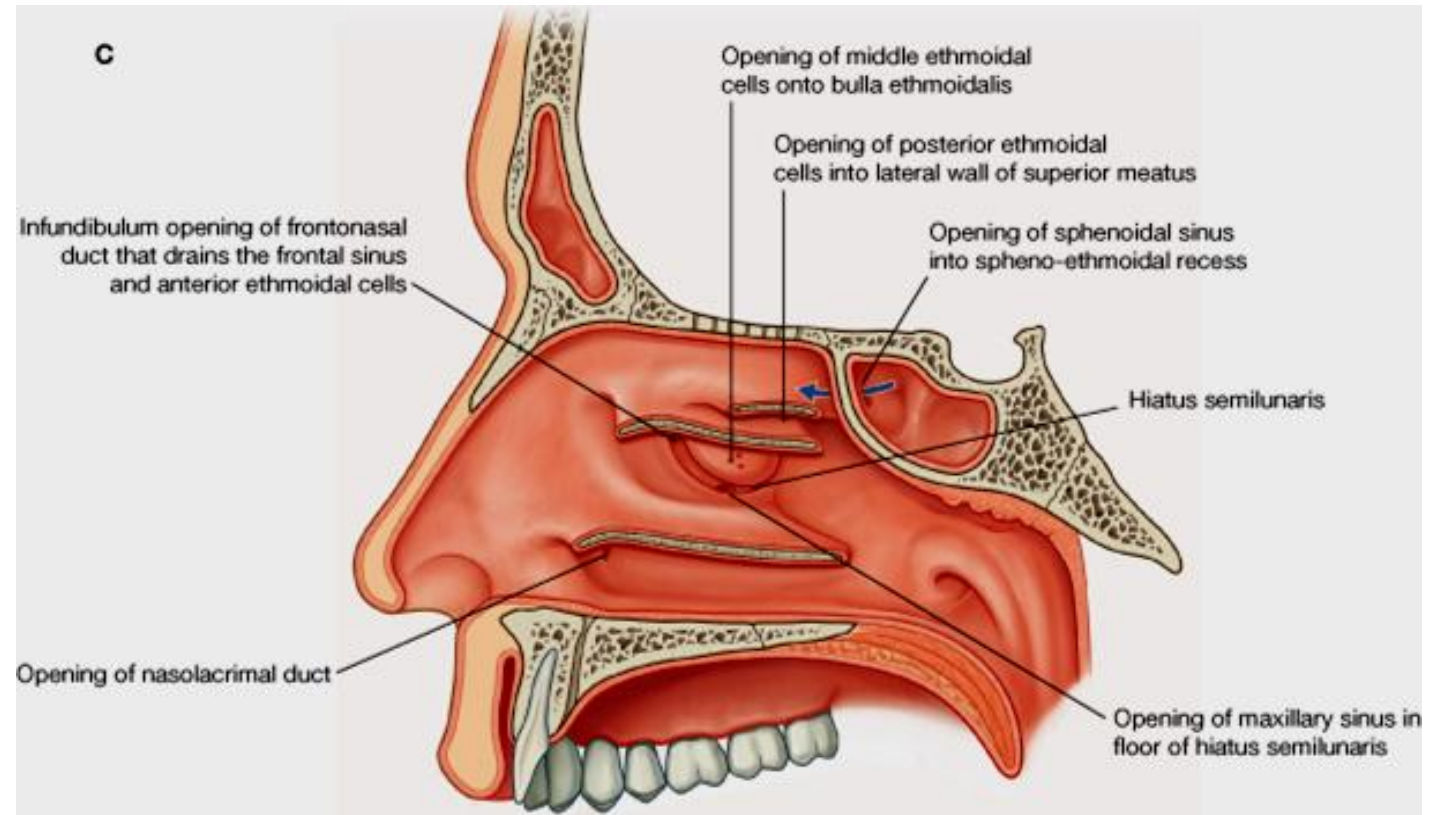
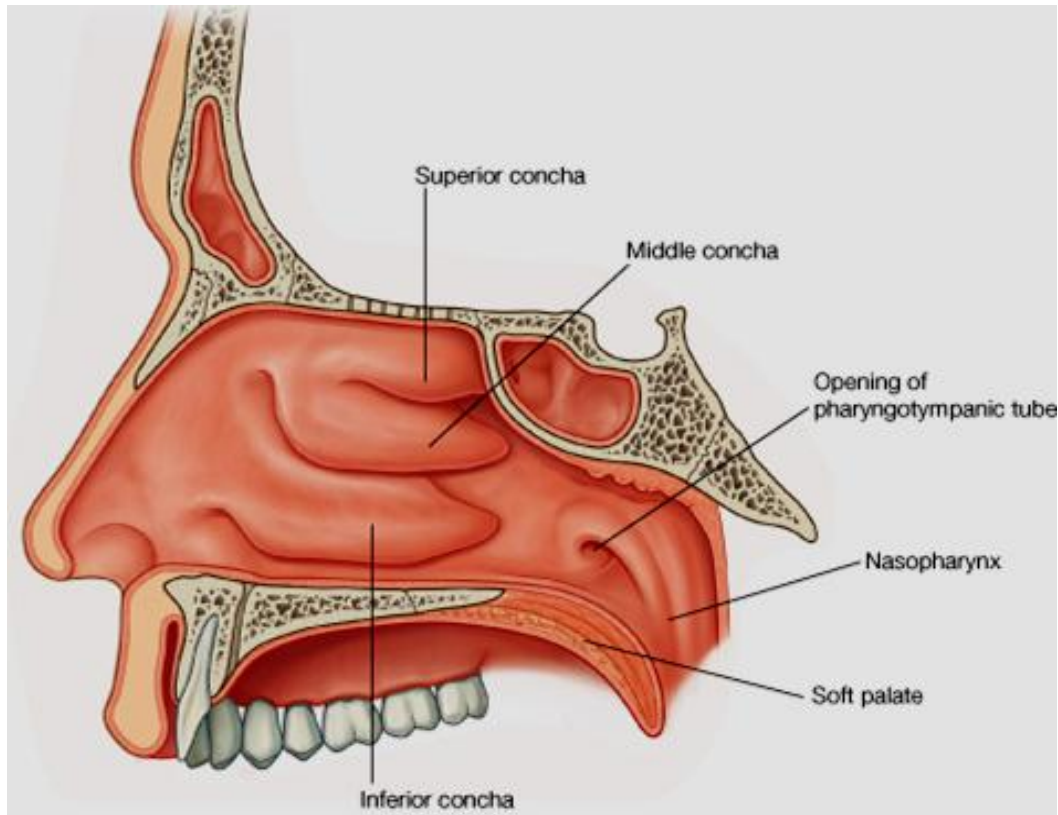
1. Highest concha. } Parts of
2. Sup. concha. } Ethmoid
3. Middle concha. } bone.
4. Inf. concha. → the largest & a separate bone of skull.

* @ The recesses are :

1. Spheno-ethmoidal recess.
2. Sup. meatus.
3. Middle meatus.
4. Inf. meatus.



1. **Spheno-ethmoidal recess** : receives opening of sphenoidal air sinus.
2. **Sup. meatus** : receives the opening of the post. ethmoidal air sinus.
3. **Middle meatus** : receives the opening of the ant. & middle ethmoidal air sinuses, maxillary air sinus & frontal air sinus.
4. **Inf. meatus** : receives opening of nasolacrimal duct.



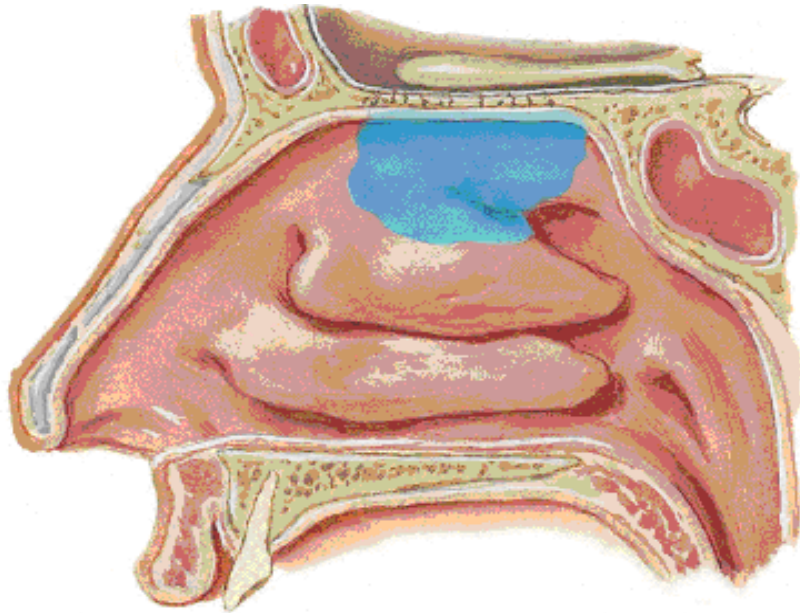
* The mucous membrane of the nasal cavity:

* The vestibule of the nose (which is a small dilatation above the nostril) is lined by modified skin with hairs.

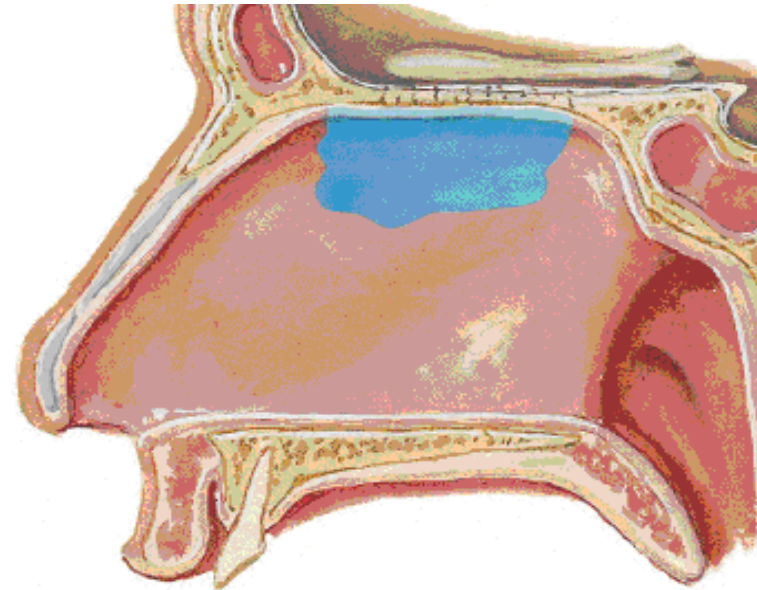
* All the other parts of the nasal cavity are lined by mucous membrane which is either:

1. Olfactory mucous membrane: In the upper 1/3 of nasal cavity.

2. Respiratory mucous membrane: lines all the other parts of the nasal cavity and cleans, warms & moistens the inspired air.



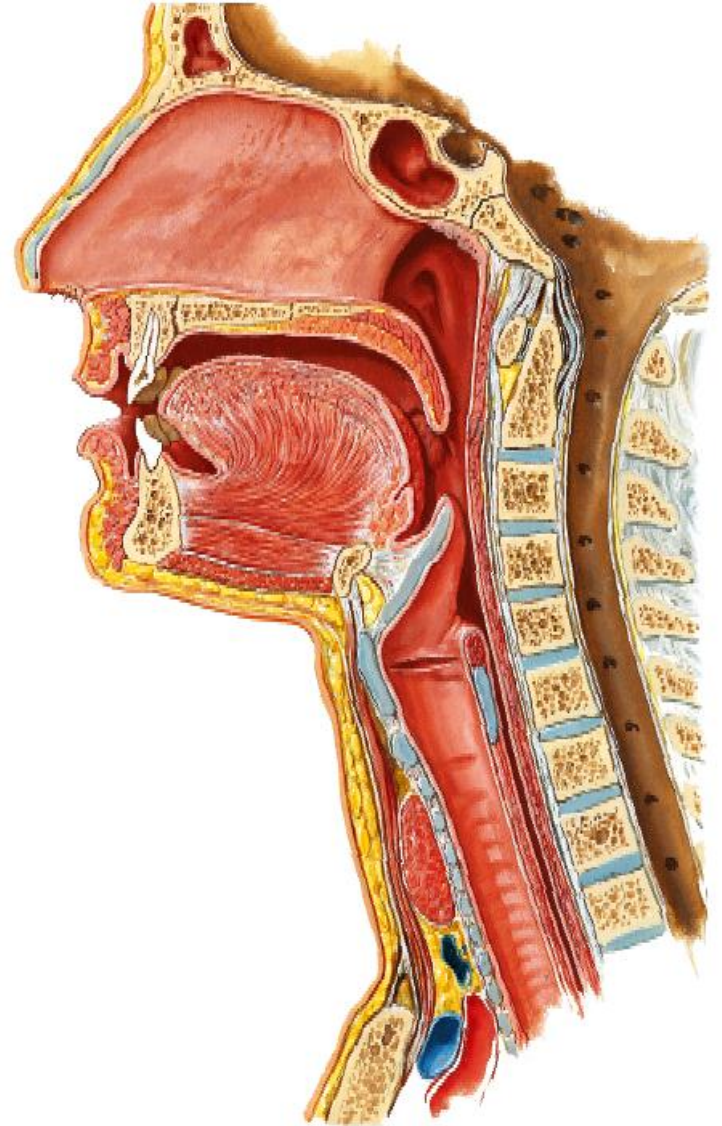
Lateral wall of nasal cavity



Nasal septum

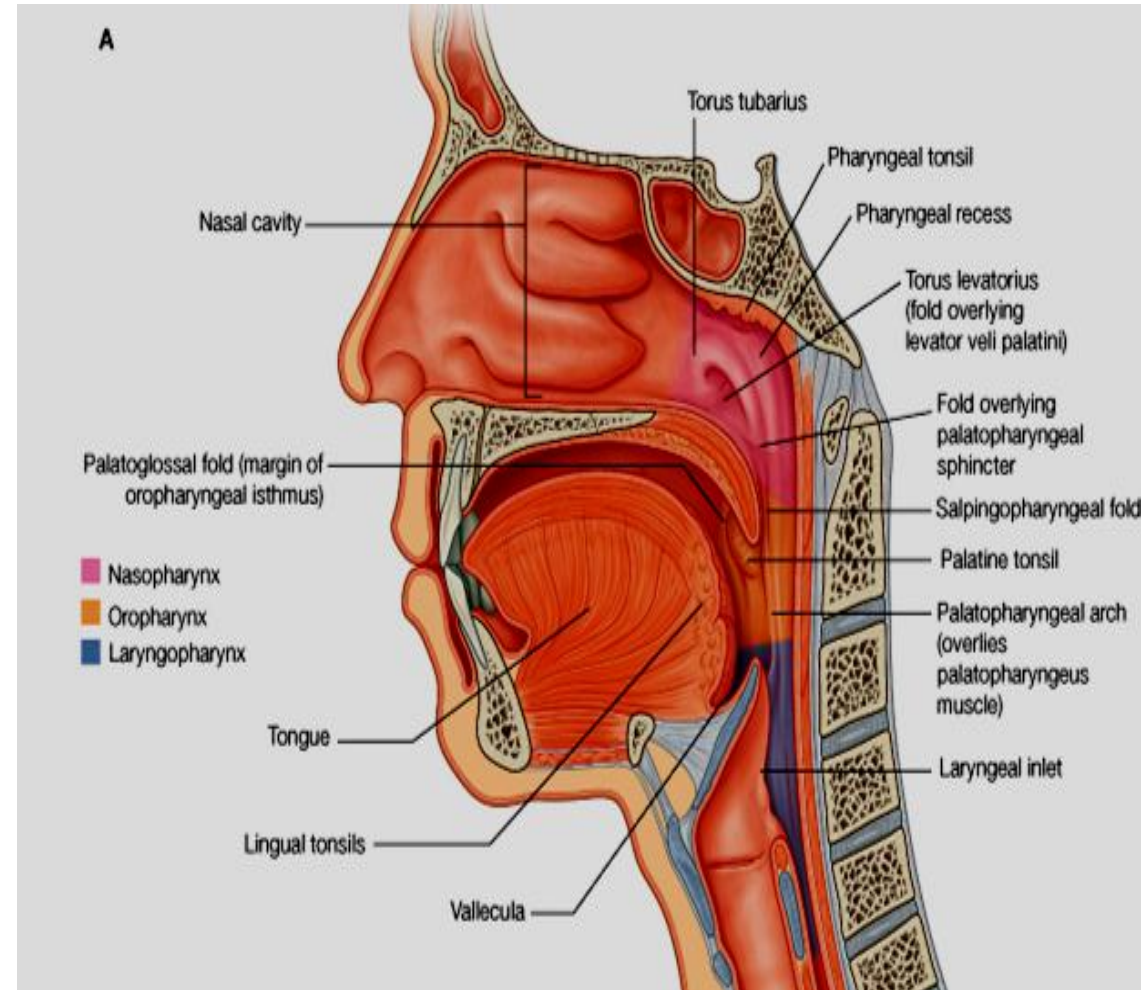
Pharynx

- * Is a funnel shaped musculo-membranous tube, about 12 – 14 cm long, and extends from the base of the skull to the level of the sixth cervical vertebra, where it becomes continuous with the esophagus.**
- * It is a tube that lies behind nose, mouth & larynx.**
- * Therefore, it is divided into:**
 - a. Nasopharynx.**
 - b. Oropharynx.**
 - c. Laryngopharynx.**
- * It is important for passage of air during respiration & passage of food during swallowing.**



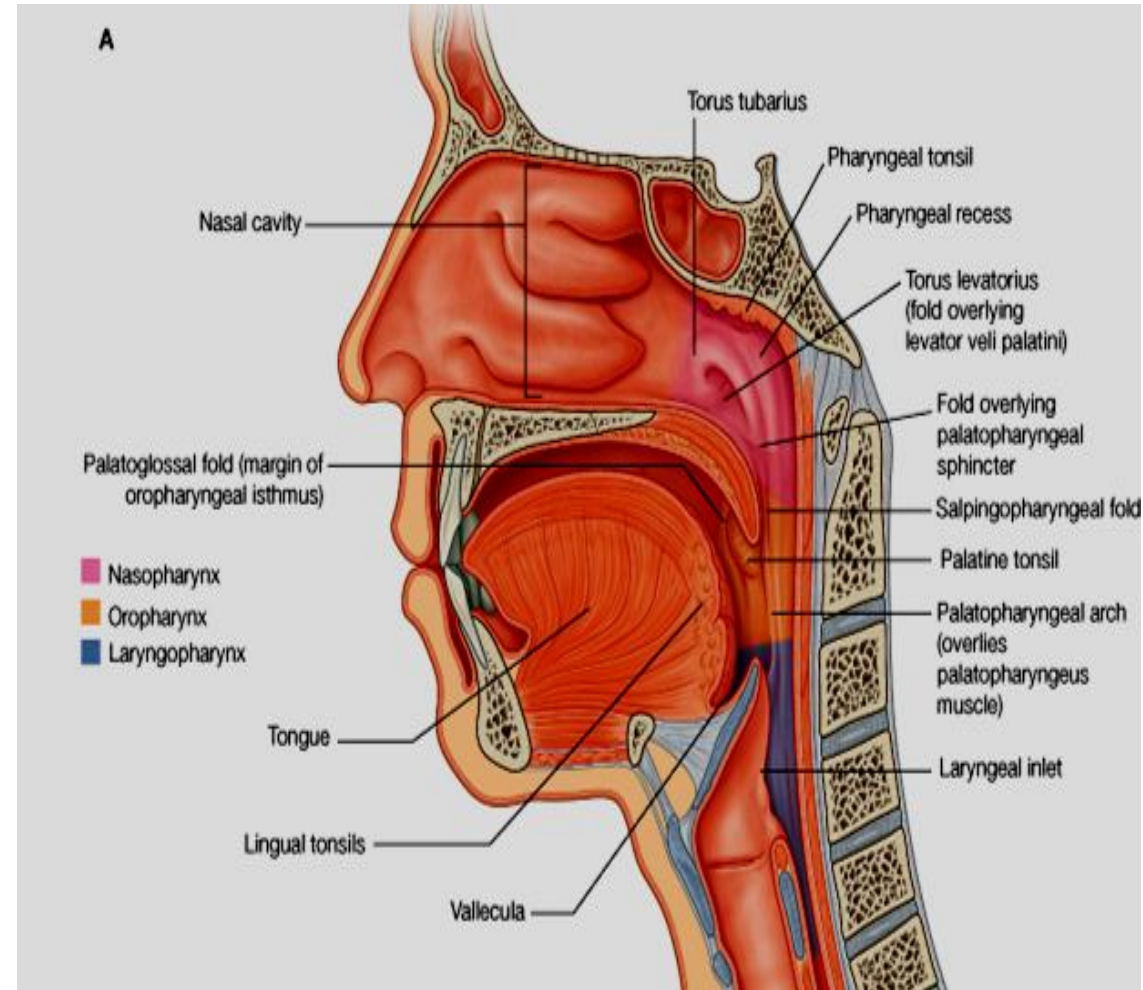
A. Nasopharynx

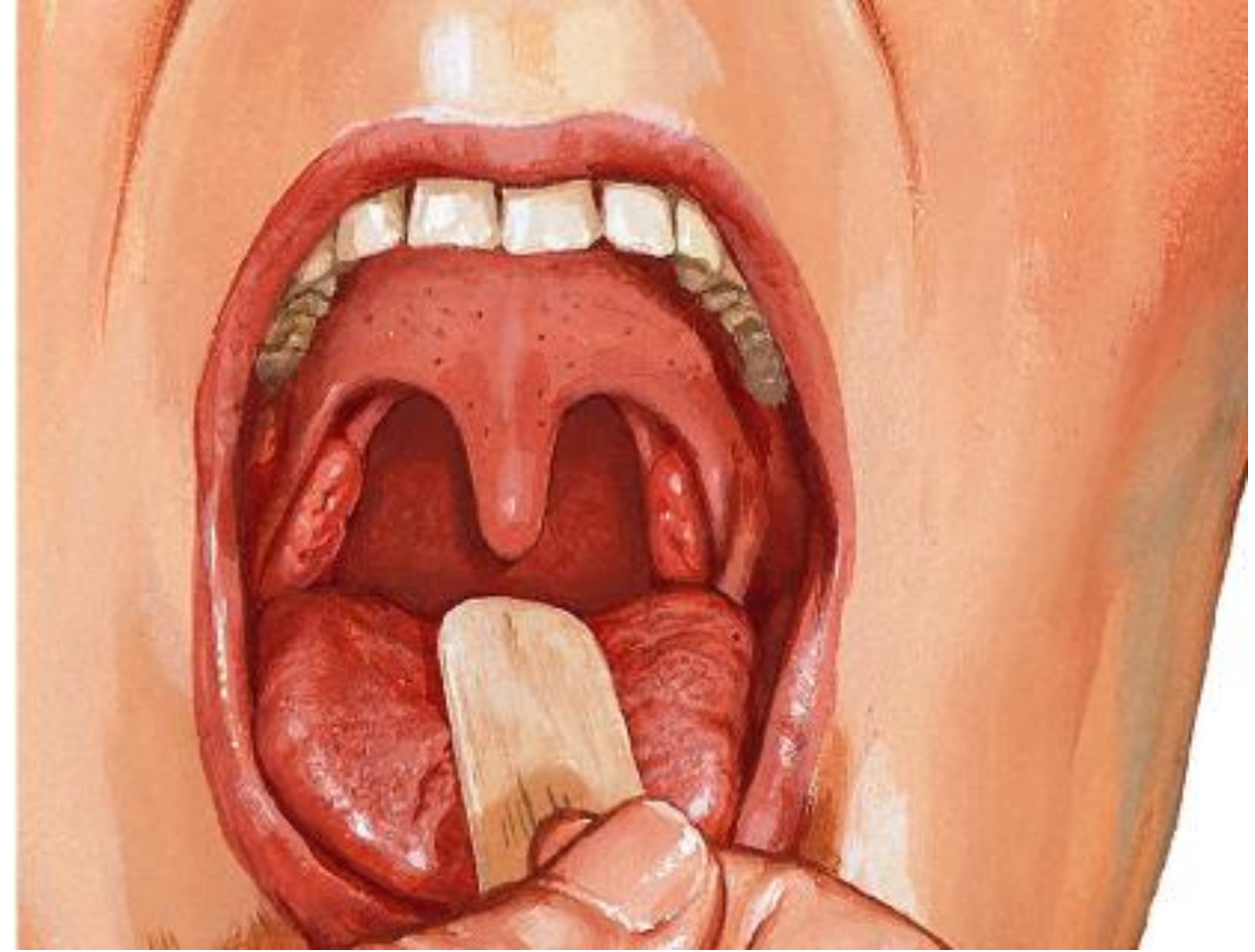
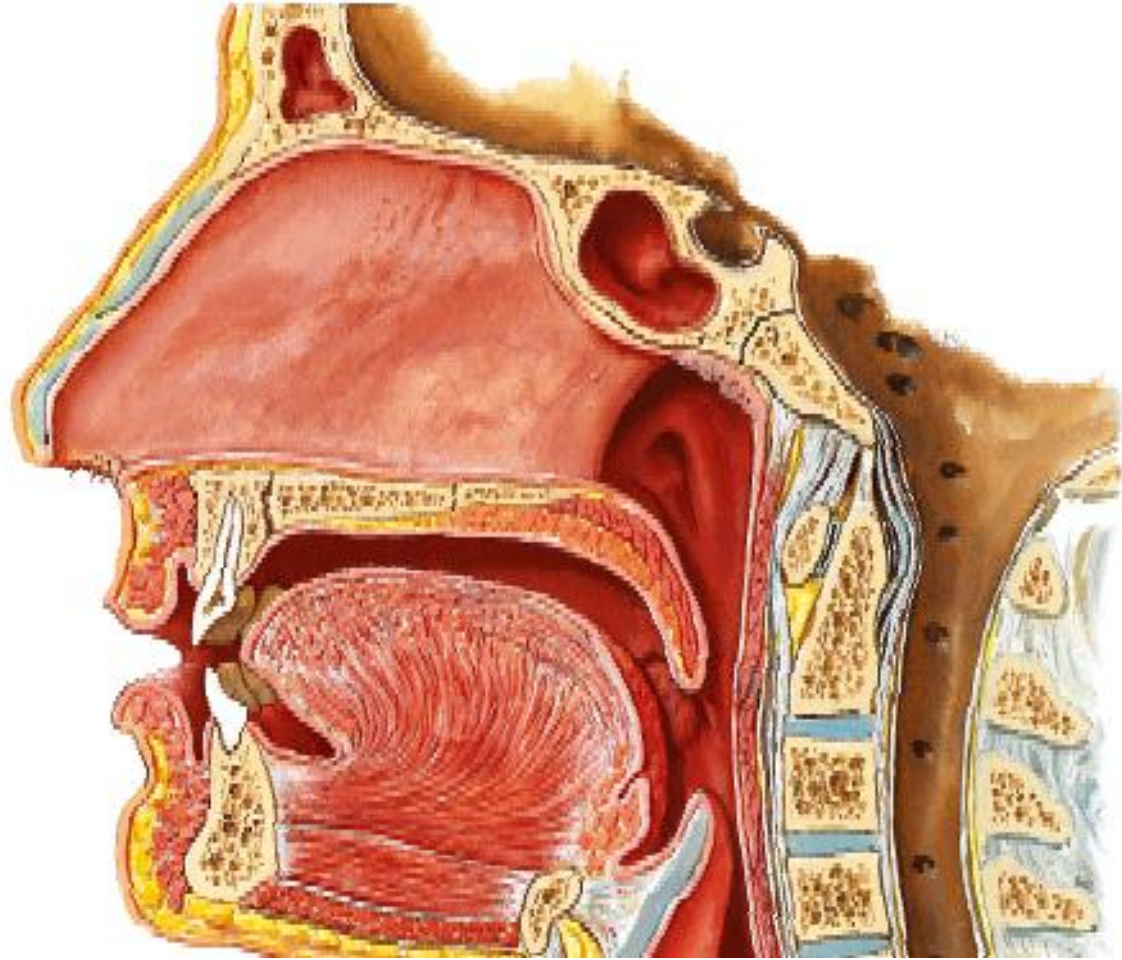
- * Lies behind the nasal cavity and communicates anteriorly with this cavity through the posterior nasal openings (choanae).
- * Inferiorly, it becomes continuous with the oropharynx behind the soft palate through the pharyngeal isthmus.
- * The pharyngeal opening of the auditory tube lies on the lateral wall, through which the pharynx communicates with the middle ear (tympanic cavity).
- * The roof contains a collection of lymphoid tissue called the pharyngeal tonsil (adenoid).
- * In infants, adenoid may enlarge to cause complete obstruction of the tube.



B. Oropharynx

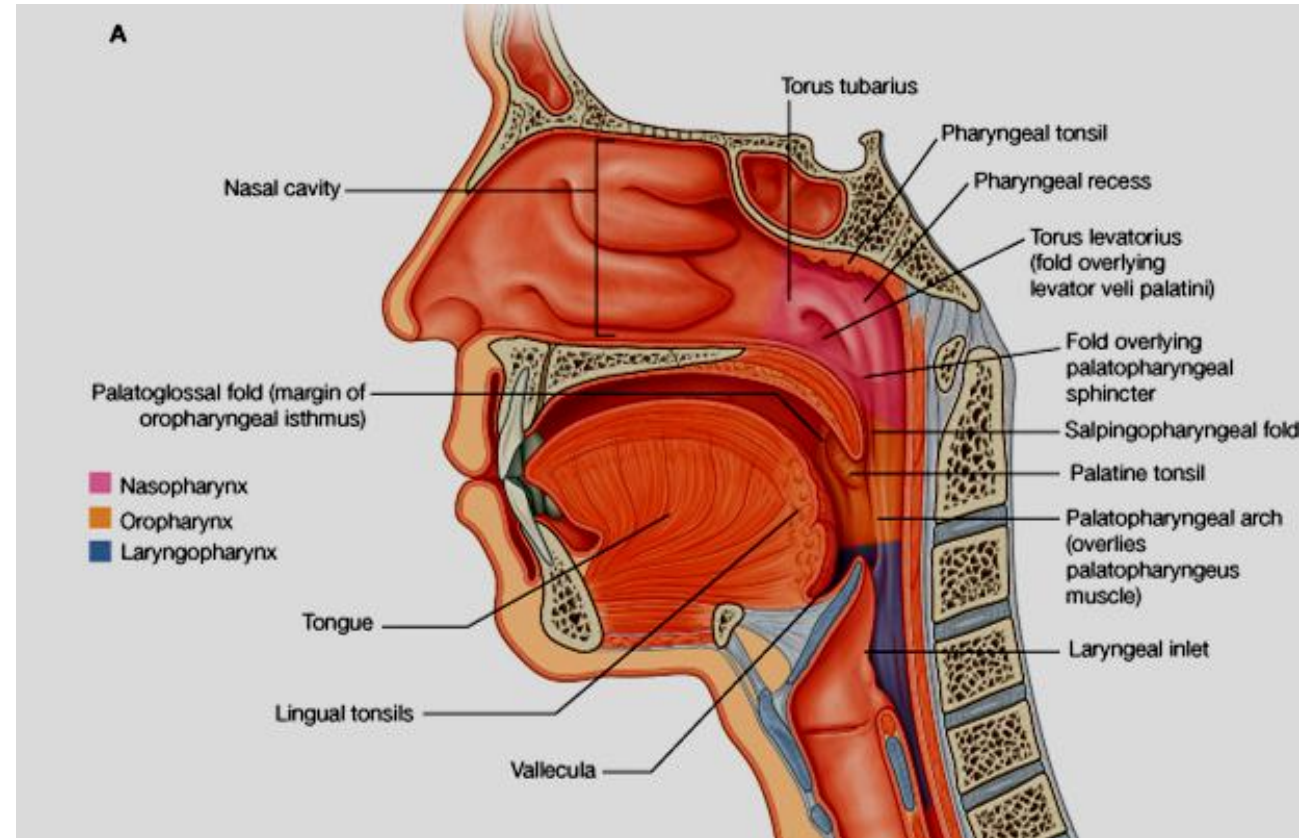
- * Lies behind the mouth cavity and communicates anteriorly with this cavity through the oropharyngeal isthmus.
- * It is continuous superiorly with the nasal part and inferiorly with the laryngeal part.
- * It contains the palatine tonsils.
- * Anteriorly, the epiglottis stands up behind the posterior third of the tongue.





C. Laryngopharynx

- * Lies behind the larynx.
- * It communicates anteriorly with the cavity of the larynx through the inlet of the larynx.
- * It is continuous superiorly with the oral part & inferiorly with the esophagus.



Larynx

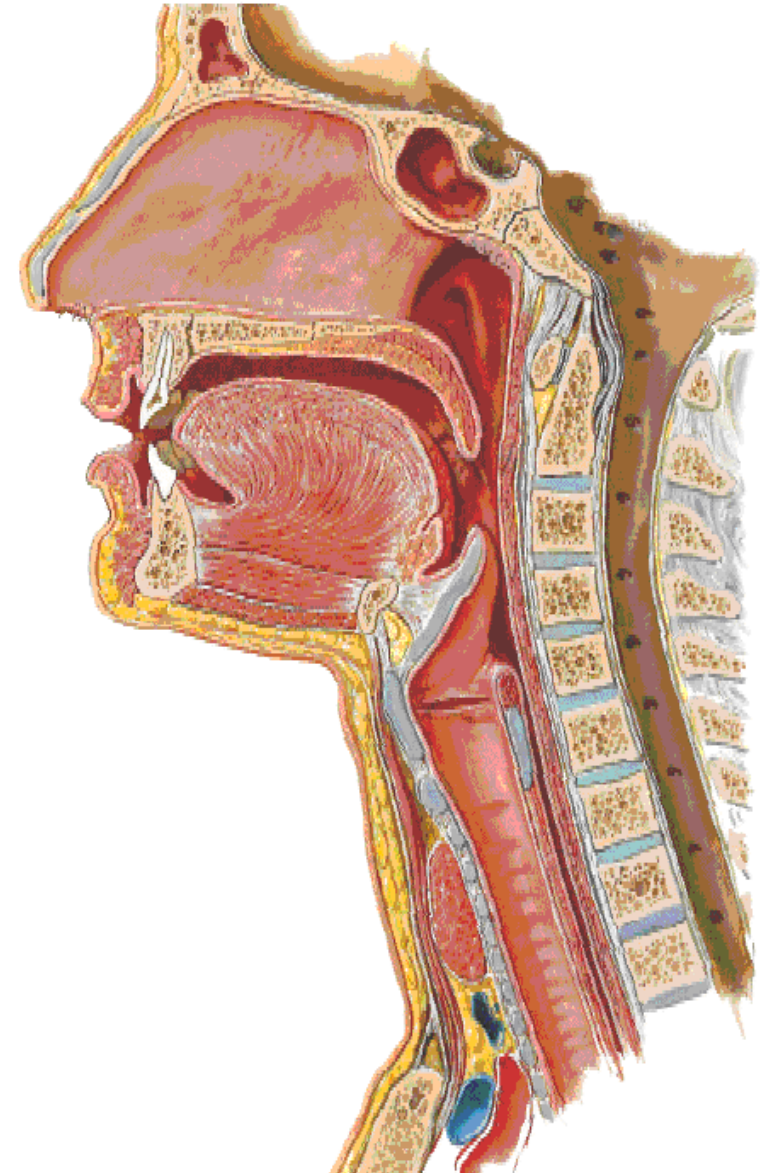
**** Definition:** part of respiratory tract that acts as organ of phonation (voice production) & it has a sphincteric function to prevent passage of food and foreign bodies through its inlet.

**** Extent:** Lies in midline of neck extending from the root of tongue to trachea. It lies in front of C3-C6 vertebrae

**** Size:**

a- In adult male its length is: 44 mm.

b- In adult female its length is: 36 mm.



**** Constructions:**

- * A frame of cartilages.**
 - * Connected by membranes.**
 - * Moved by muscles.**
 - * Lined by mucous membrane.**
- ** Therefore the skeleton of the larynx is formed by a number of cartilages but with no bones.**



**** Cartilages of Larynx:**

A. Single : Thyroid, cricoid & epiglottis.

B. Paired: Arytenoid, corniculate and cuneiform.

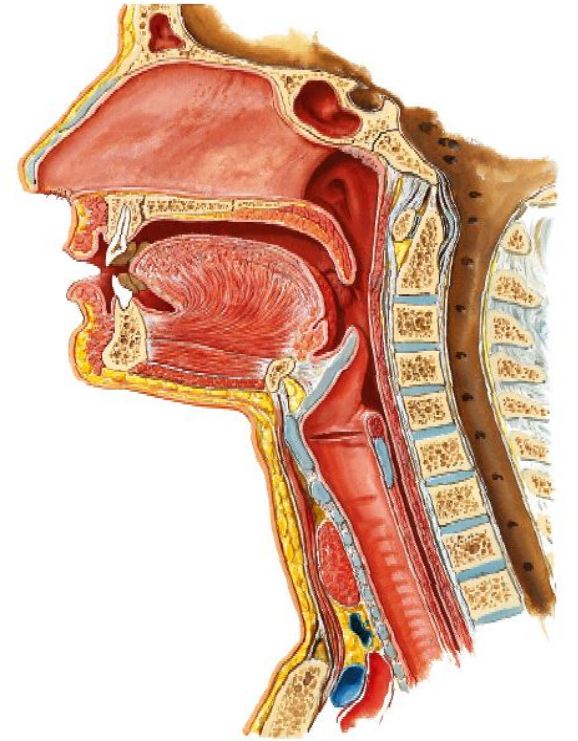
1. Epiglottis:

* Leaf like.

* projects behind the tongue and hyoid bone.

* It has an upper free broad end and a narrow lower end.

* Its posterior surface shows pits for mucous glands.



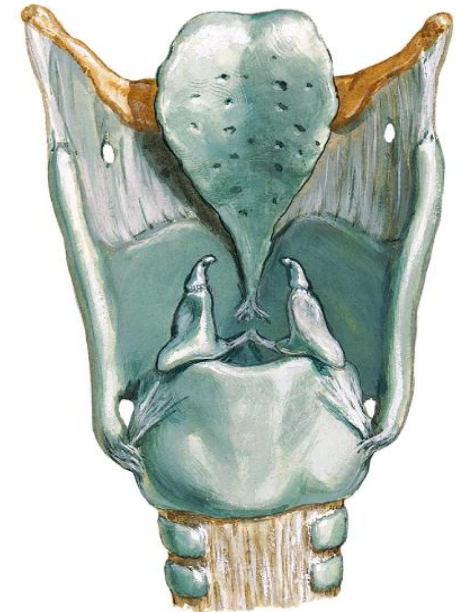
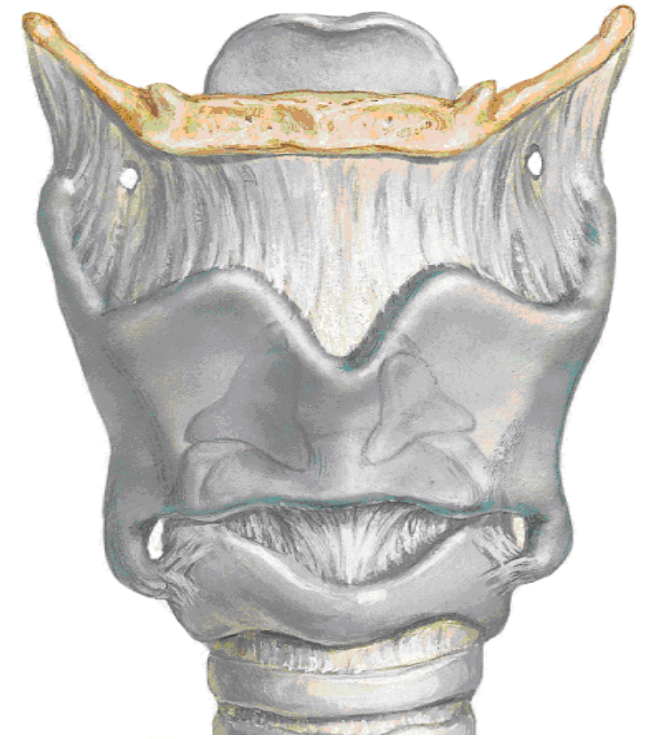
2. Thyroid cartilage :

****Looks like an open book having 2 lamina, united ant. but separated post.**

****Its upper border shows the thyroid notch.**

****The angle between the lamina is 120° in females and 90° in males ; forming Adam's apple.**

**** The anterior border forms the laryngeal prominence "Adam's apple" in the male.**



3. Cricoid cartilage :

****signet-ring in shape, having an ant. narrow arch and a post. broad lamina.**

****N.B.: It is the only complete ring in the respiratory system.**

*** Paired Cartilages:**

1. Arytenoids:

****3 sided pyramid with its base sitting on the upper border of the lamina of cricoid cartilage.**

2. Corniculates : lies at the apex of the arytenoid cartilages.

3. Cuneiforms





General Anatomy

Lecture 12: Respiratory System (2)

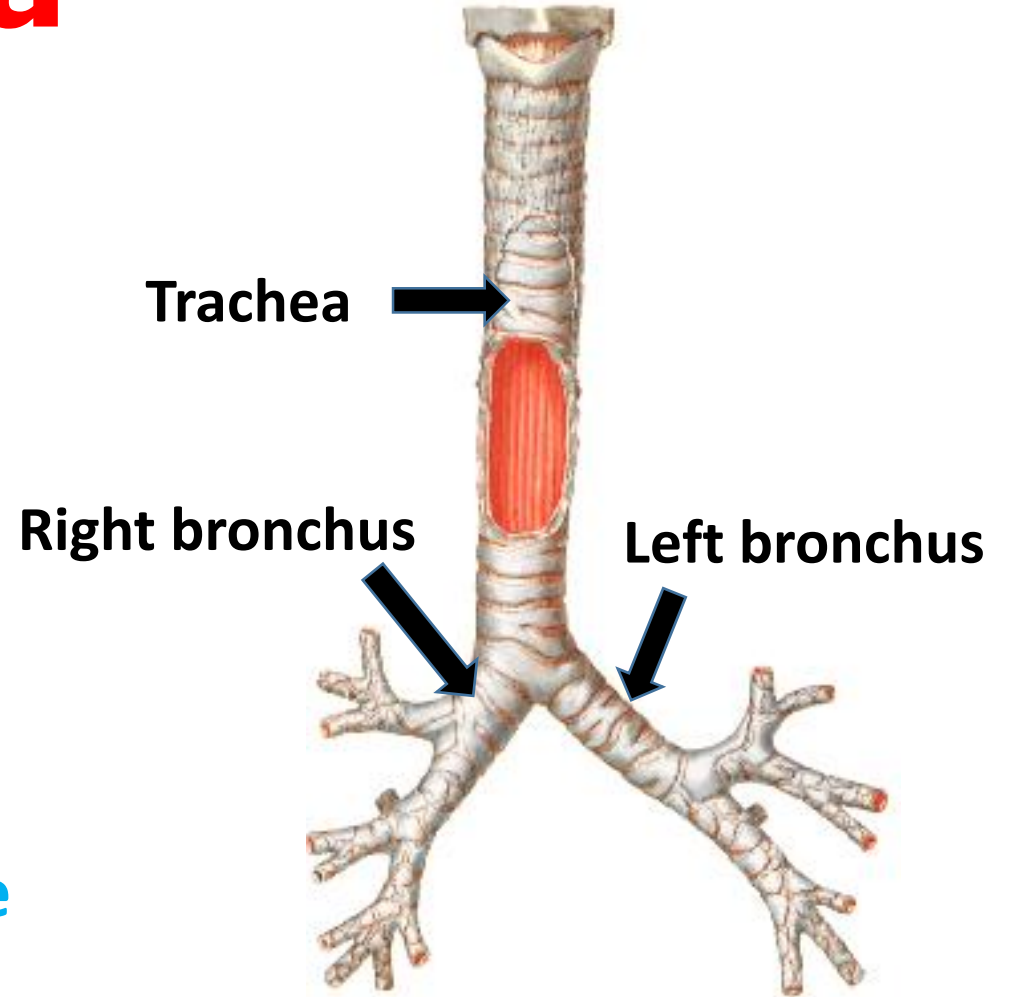
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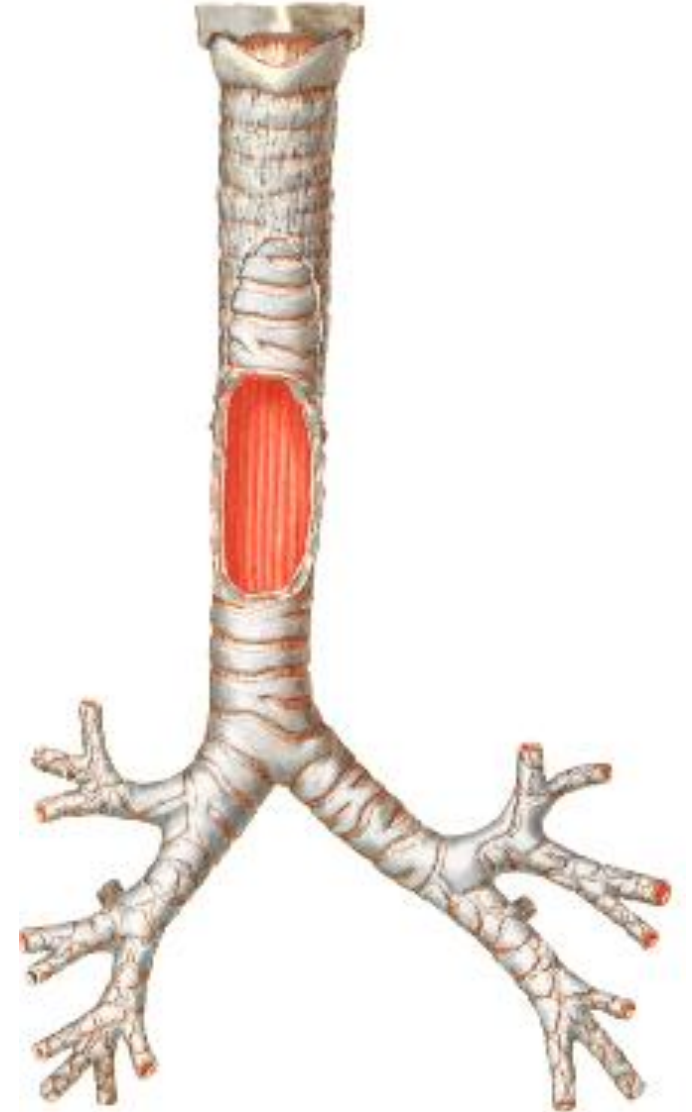
Trachea

- * It is a **fibroelastic tube** which begins in the lower part of the neck & ends in the thorax (extending from C6 till T4).
- * **Length:** 11 cms.
- * **Diameter:** 2.5 cms.
- * **Connected upwards** with the larynx.
- * **Ends in** the thorax by dividing into 2 main bronchi.
- * It is formed of a number of **C-shaped hyaline cartilages** (15-20) to be kept opened all the time & prevent its collapse.
- * It lies anterior to esophagus.



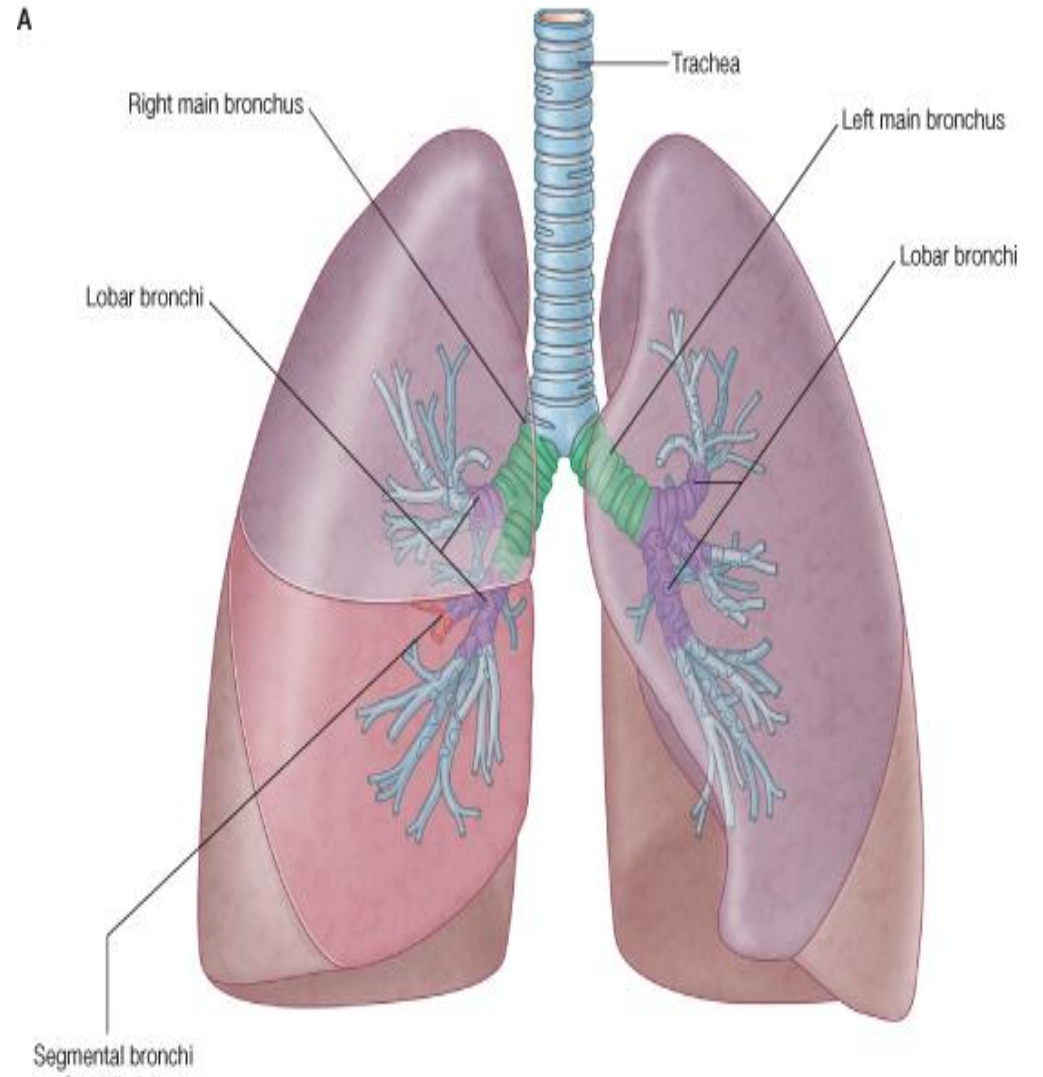
Bronchi

- * The trachea ends by dividing into 2 main bronchi; right bronchus which enters the right lung & left bronchus which enters the left lung.
- * The right bronchus is shorter, wider & more in line with the trachea; that is why foreign bodies which pass through the trachea usually passes through the right bronchus.



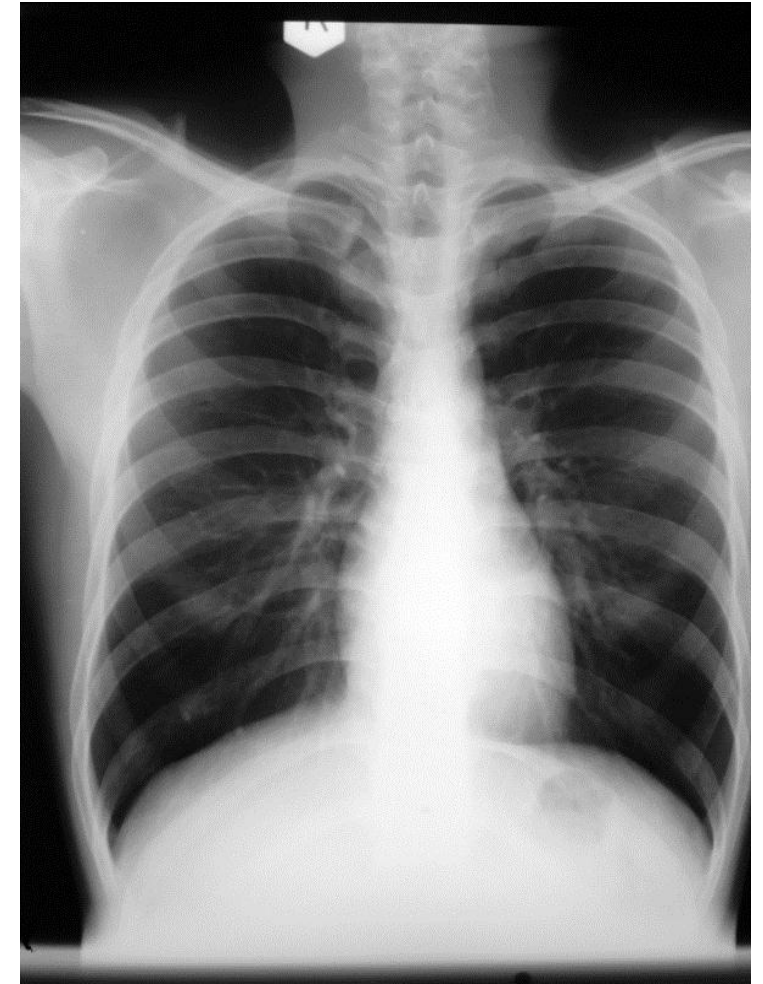
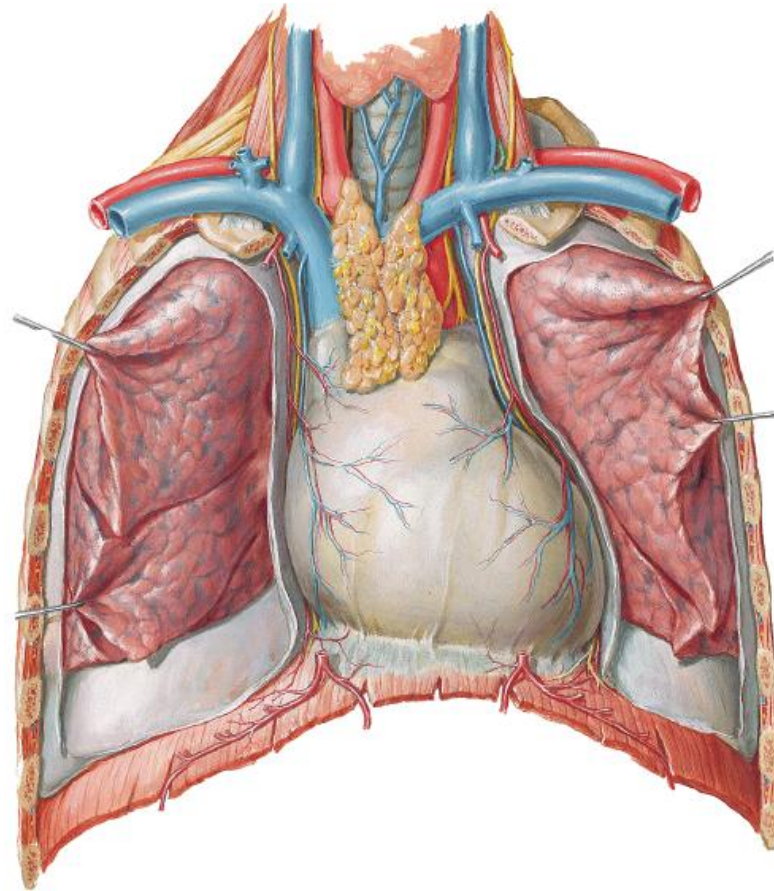
THE LUNGS

- * Lungs (Pulmones) are the chief respiratory organs.
- * Lungs are pink at birth but become dark grey in adults due to deposition of inhaled carbon particles.
- * Normal adult lung is spongy & can float if placed in water.
- * In fetuses, lung is hard & sinks if placed in water → **WHY?** → This is because its alveoli were not used in respiration & are not distended with air & are filled with secretions.



THE LUNGS (Contd)

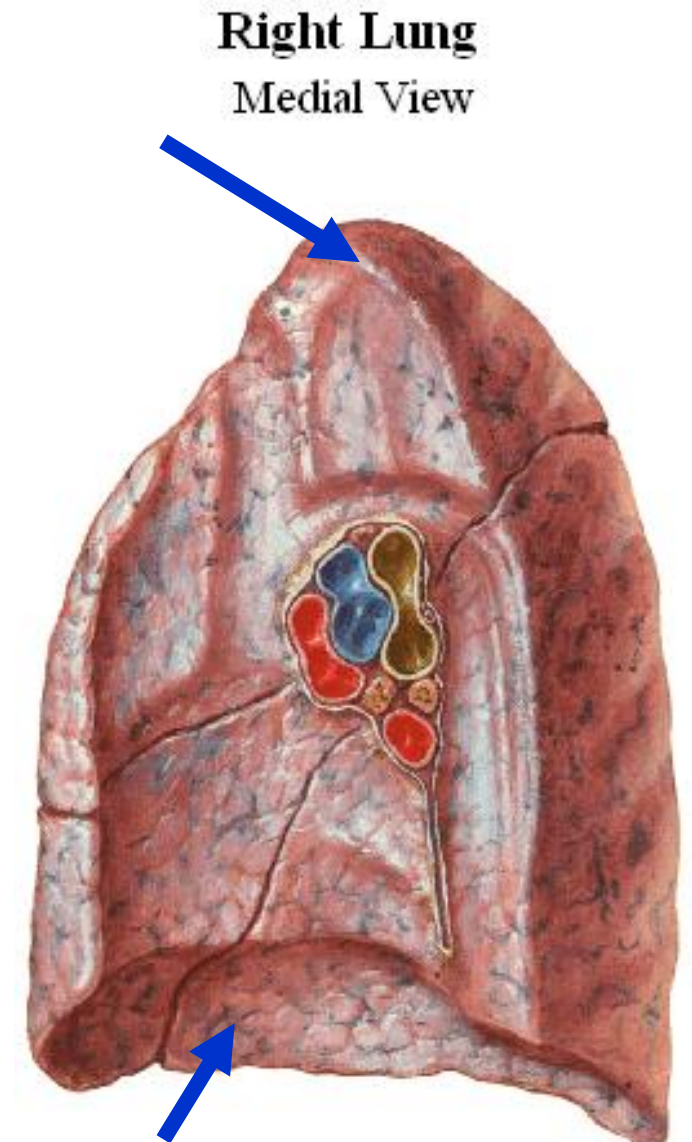
- * Lungs lie in the thoracic cavity on either side of heart.
- * Each Lung is covered with pleura.
- * Rt. Lung = 625 gms
- * Lt. Lung = 550 gms



Normal adult x-ray chest

Shape, Surfaces & Borders of lungs

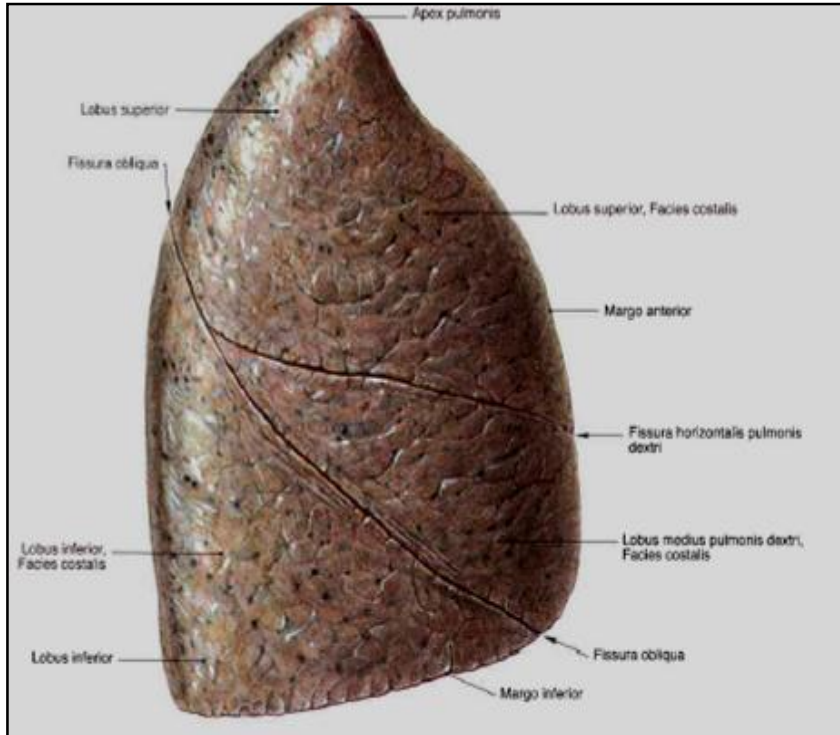
- * Shape → like half a cone.
- * Has: an **apex (above) & a base (below)**.
- * **Apex is:** rounded in shape, directed superiorly & extends to the root of the neck.
- * **Base is:** concave, directed inferiorly, bounded by sharp inferior border. It rests on diaphragm, that separates it from liver, stomach & spleen.



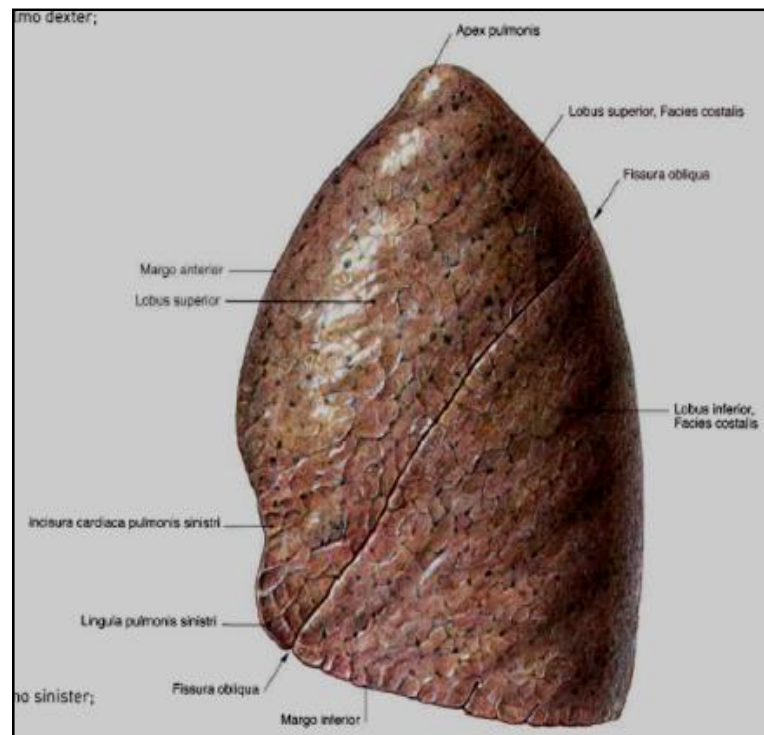
Shape, Surfaces & Borders of lungs

- * The lung has a costal surface & a medial surface.
- * Has a sharp anterior, a rounded posterior & a sharp inferior border.

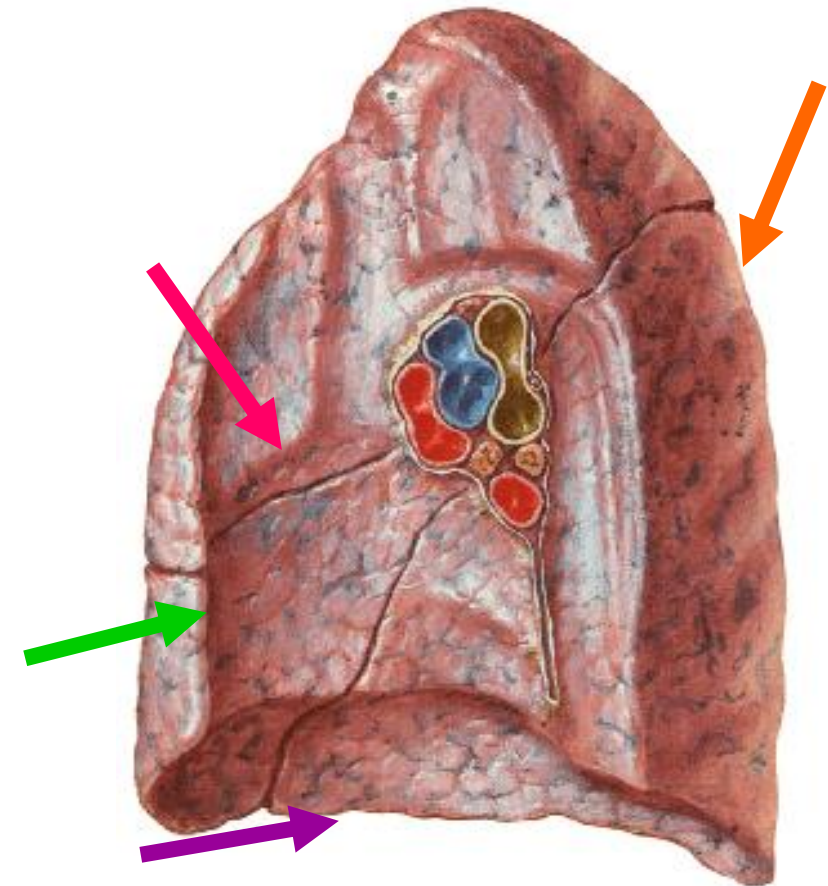
Right Lung
Medial View



Costal surface of right lung

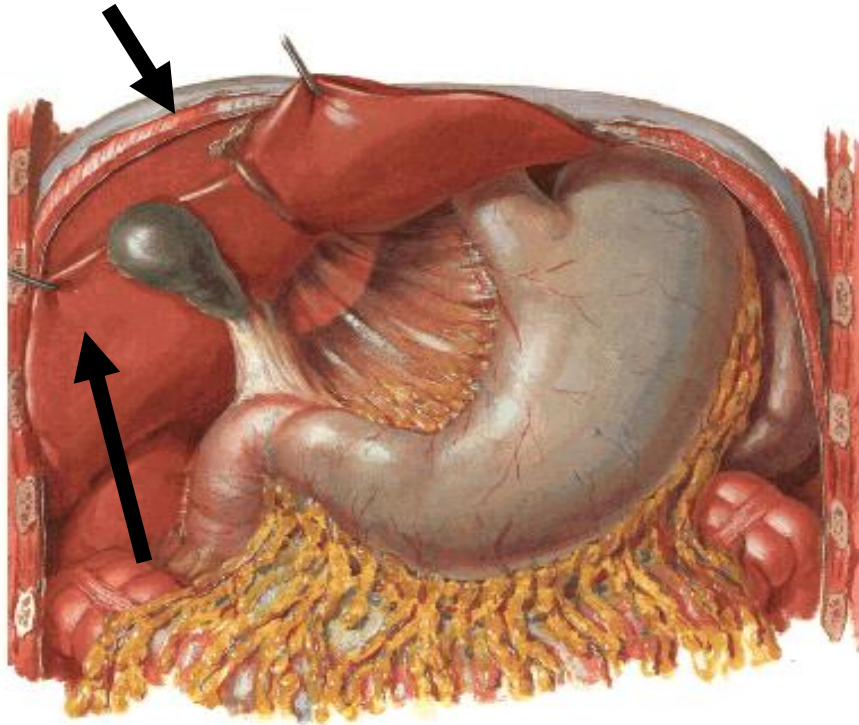


Costal surface of left lung



Base of right lung

* More concave on right lung which lies over right $\frac{1}{2}$ of diaphragm that separates right lung from right lobe of liver.

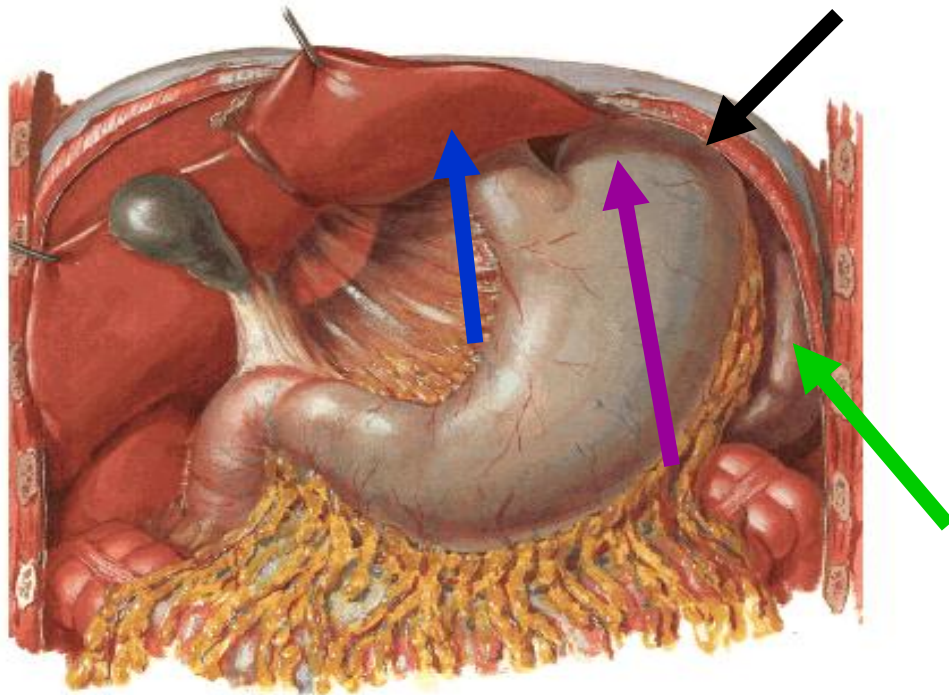


Right Lung
Medial View

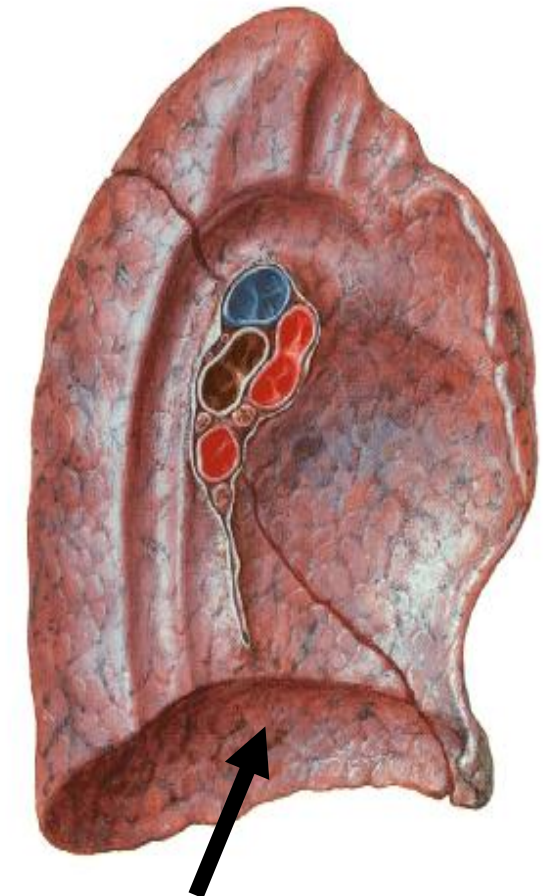


Base of left lung

* Less concave on left lung which lies over left 1/2 of diaphragm that separates left lung from **left lobe of liver**, **stomach** & **spleen**.

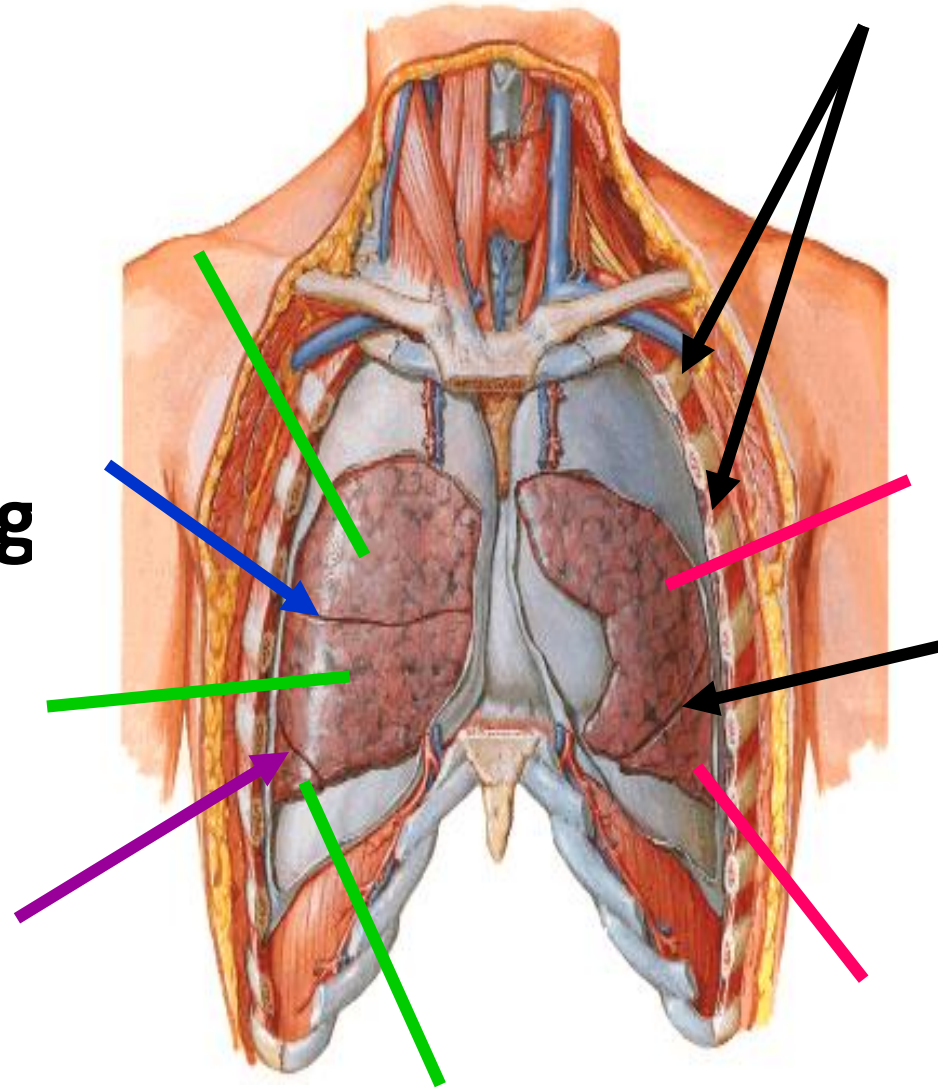


Left Lung
Medial View



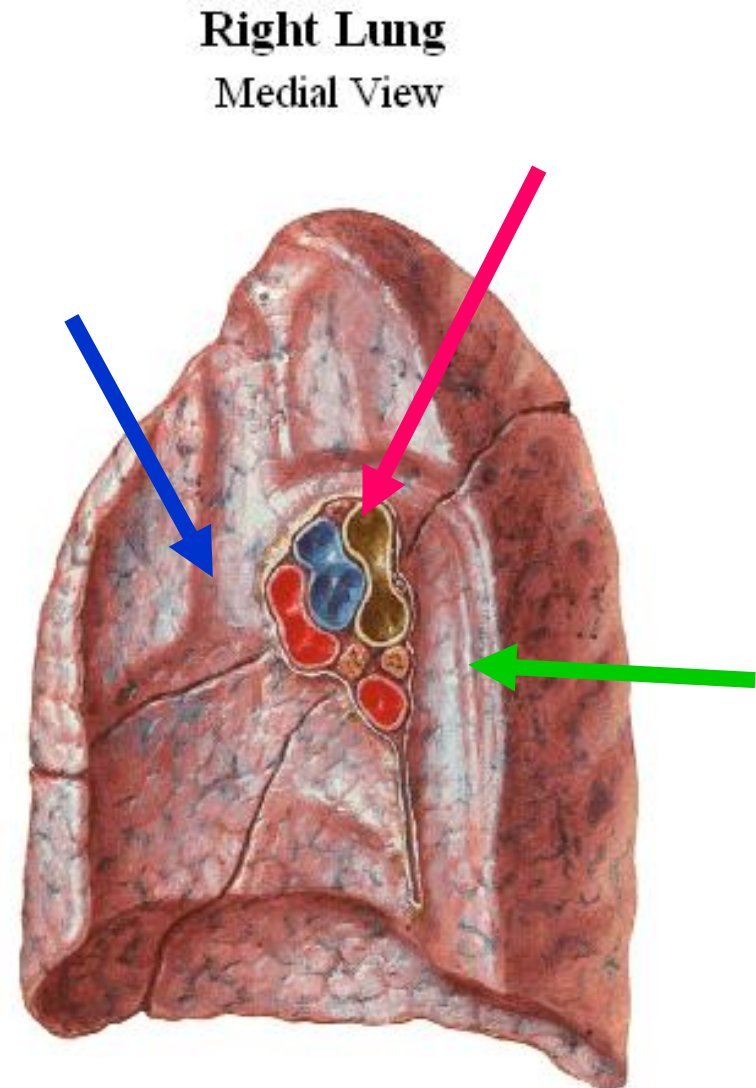
Costal (lateral or outer) surface of lung

- * Convex & related to chest wall (ribs & intercostal muscles) & costal pleura.
- * Right lung has 2 fissures → **horizontal** & **oblique** dividing lung into 3 lobes : **upper, lower & middle lobes.**
- * Left lung has one oblique fissure dividing lung into **upper & lower lobes.**



Medial (inner or mediastinal) surface of lung

- * Related to all mediastinal structures.
- * Its middle part contains the **hilum of the lung** (area which gives passage to structures forming root of lung).

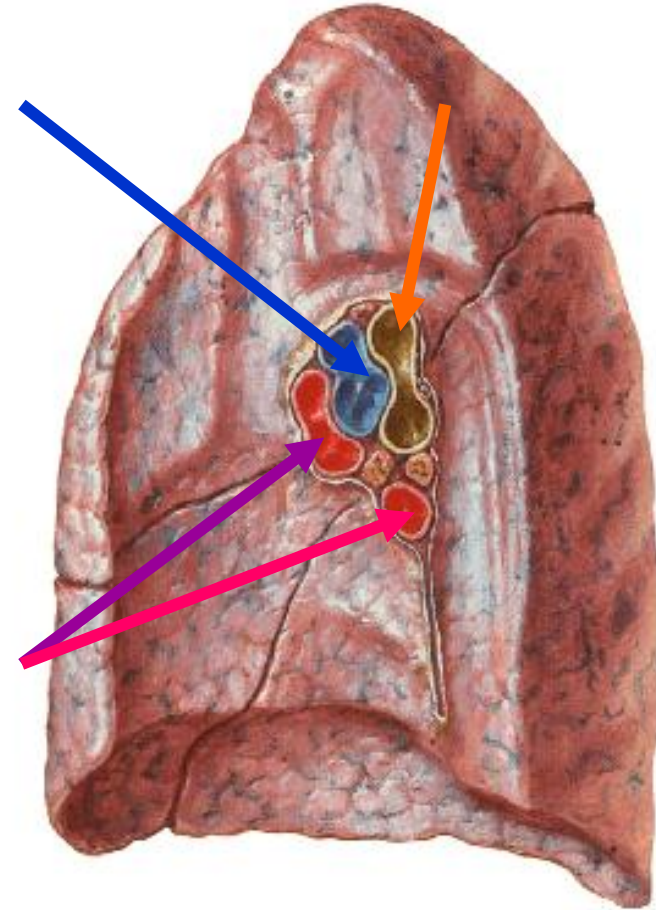


Root of right lung

* Contains 3 major structures → two bronchi, one pulmonary artery & 2 pulmonary veins.

* Contains 3 minor structures → bronchial vessels, autonomic nerves & lymphatics.

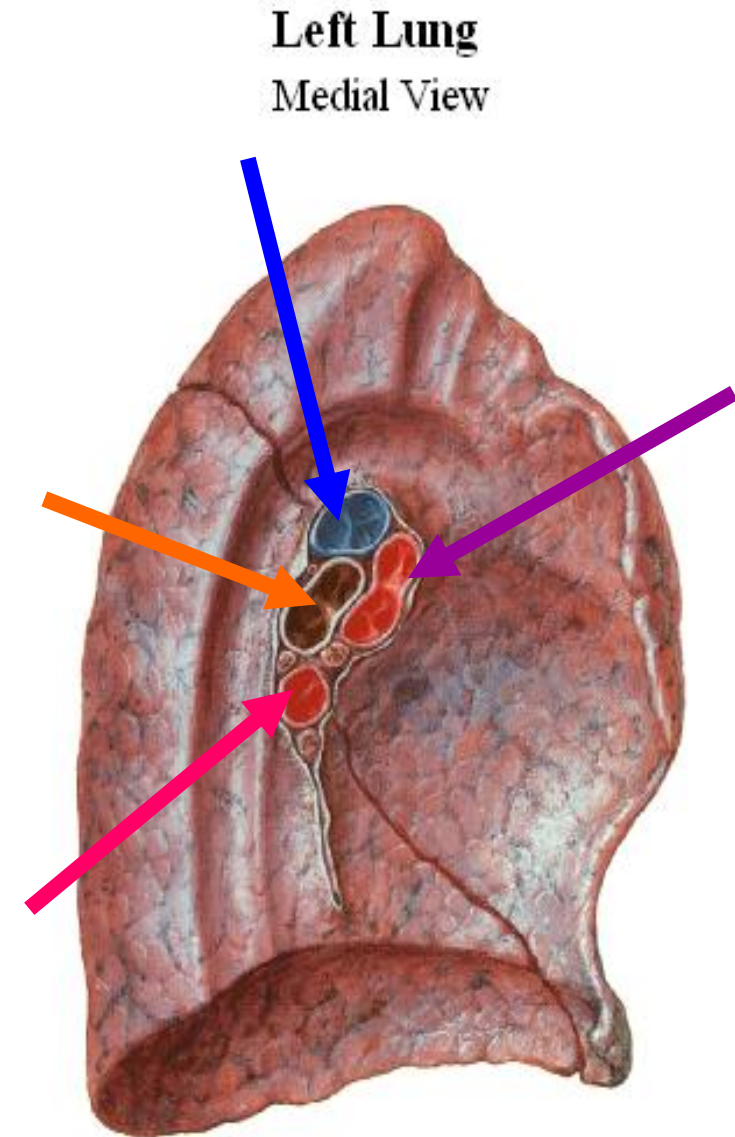
Right Lung
Medial View



Root of left lung

* Contains 3 major structures → **one main bronchus**, **one pulmonary artery** & **2 pulmonary veins**.

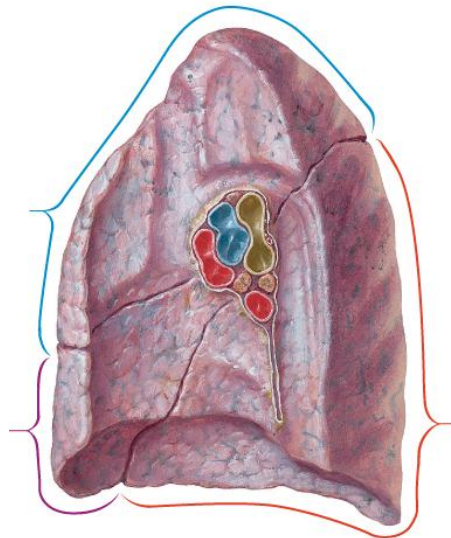
* Contains 3 minor structures → **bronchial vessels**, **autonomic nerves** & **lymphatics**.



Differences between Right & Left Lungs

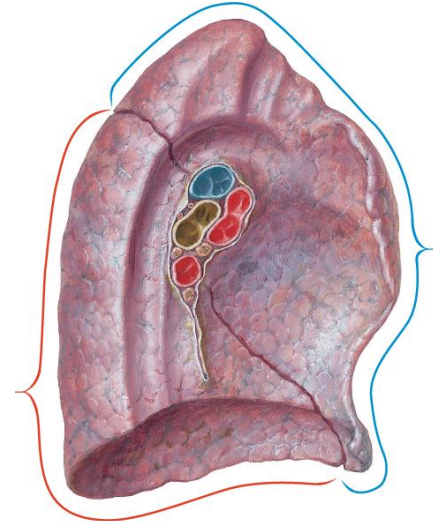
Right Lung

1. Shorter & heavier.
2. Wider.
3. Anterior border is straight.
4. Has 3 lobes.
5. Has 2 fissures.
6. Root has 2 bronchi.
7. One bronchial artery.



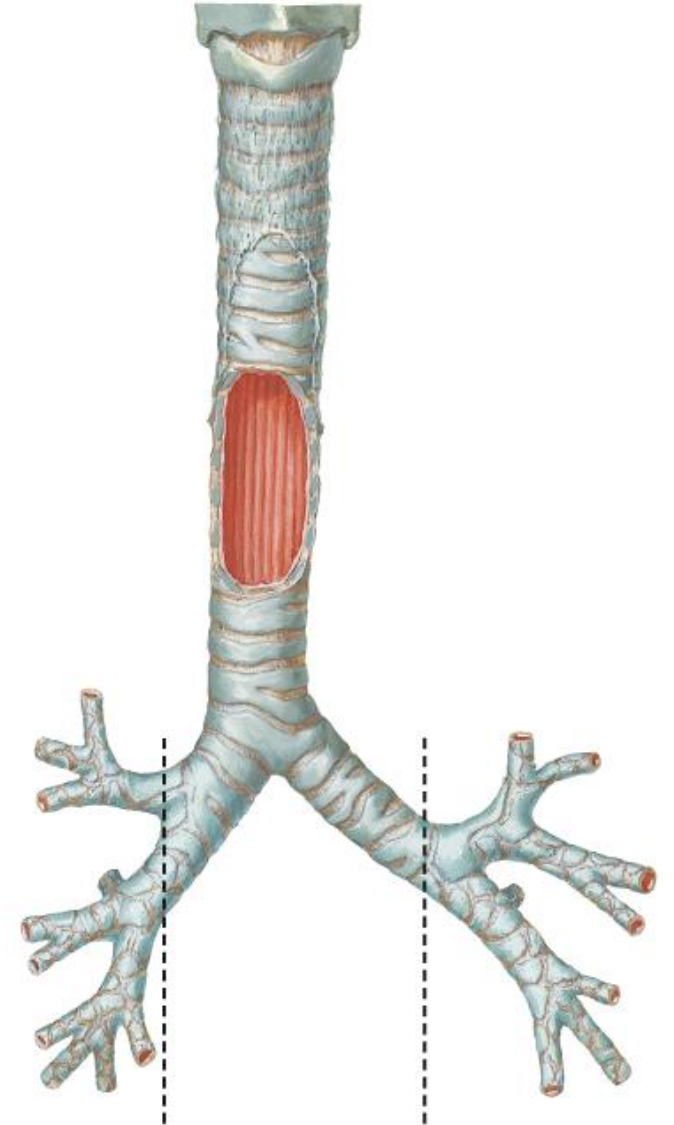
Left Lung

1. Longer & lighter.
2. Narrower.
3. Anterior border has a cardiac notch.
4. Has 2 lobes.
5. Has one fissure.
6. Root has one bronchus.
7. Two bronchial arteries.



Bronchopulmonary segments

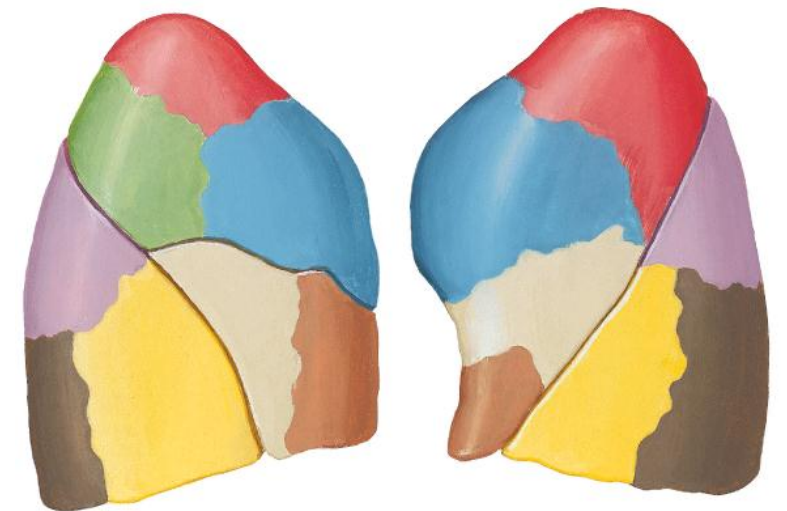
- ** Trachea divides into 2 main bronchi**
- ** Each bronchus divides into lobar bronchi; 3 on the right side & 2 on the left side.**
- ** Each lobar bronchus divides into segmental bronchi.**
- ** Each segmental bronchus ends in a segment in the lung.**



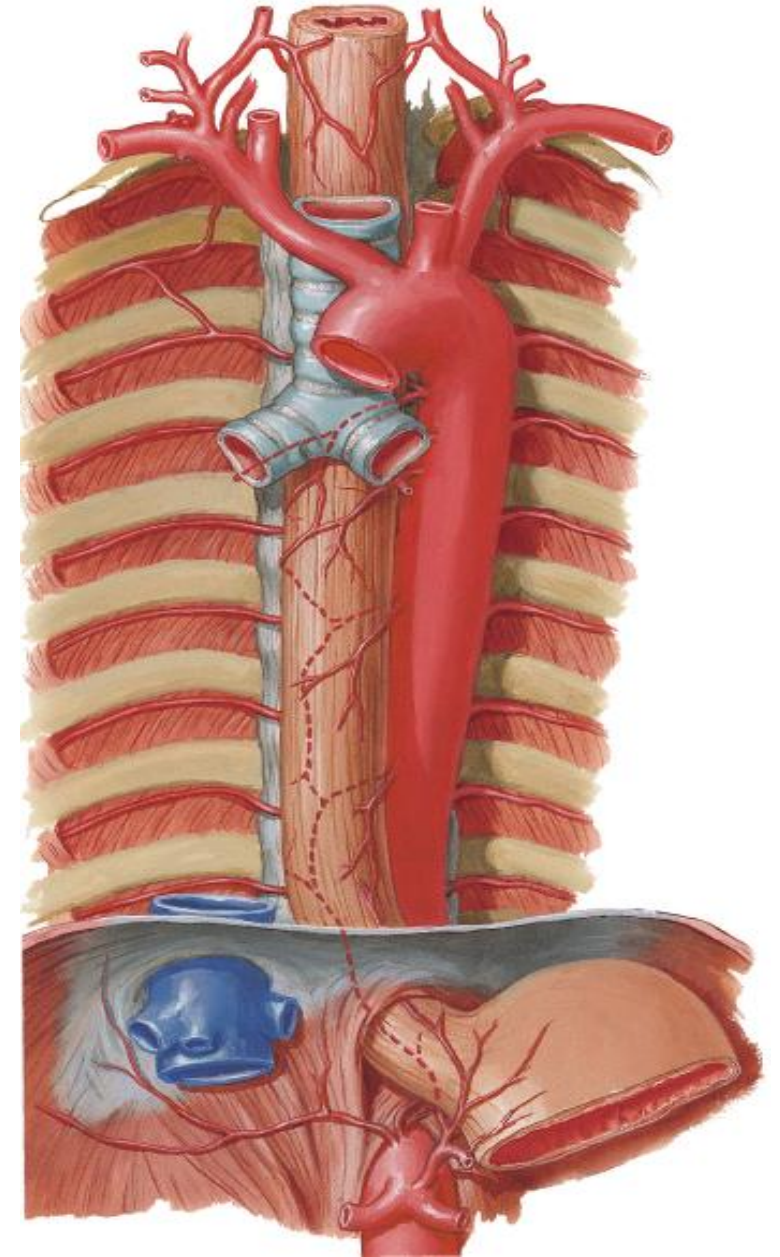
Bronchopulmonary segments (contd)

**** Areas of lung supplied by segmental bronchi are called bronchopulmonary segments. Each lung has 10 segments. Each is pyramidal in shape with its apex towards the hilum while its base looks towards the surface of the lung.**

**** Each segment has its own segmental bronchus & artery. They act as anatomical, functional & surgical units.**

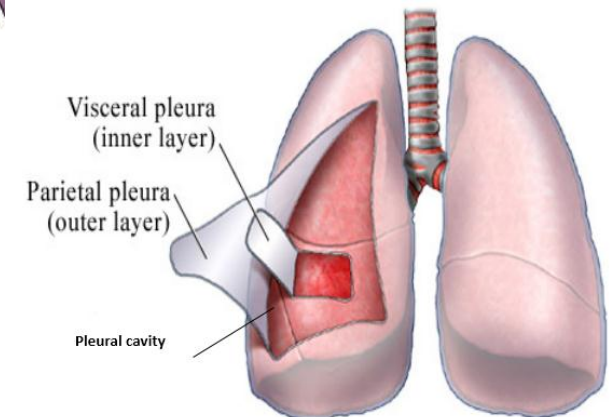
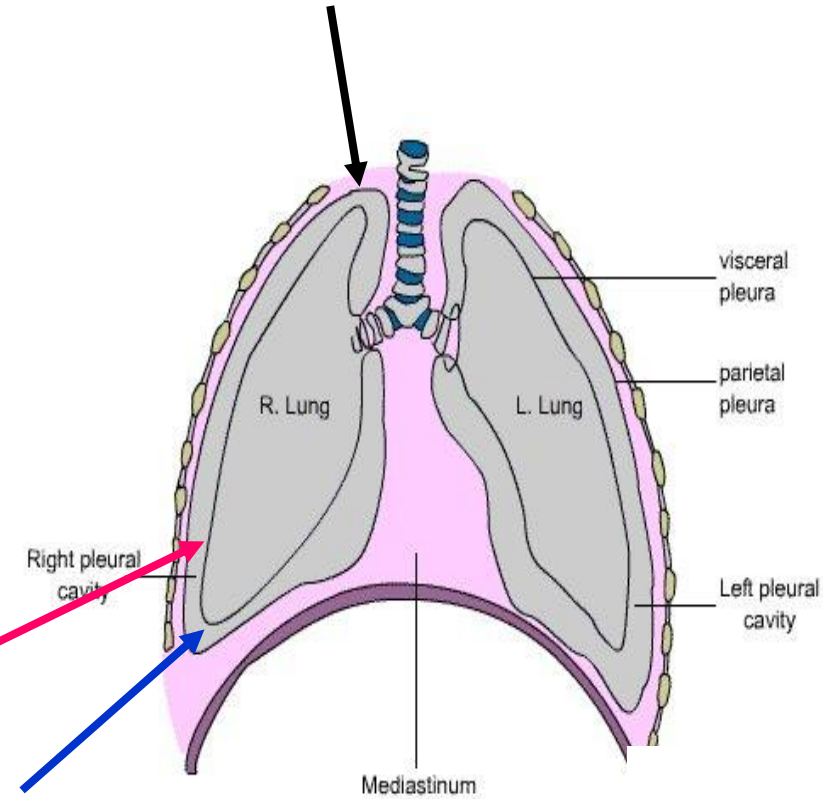


- * **Arterial blood supply of the lung:** Bronchial arteries; they are branches from the descending thoracic aorta; two to the left lung & one to the right lung.
- * **Venous drainage of the lung:** Bronchial veins.
- * **Lymphatic drainage:** Tracheobronchial lymph nodes.



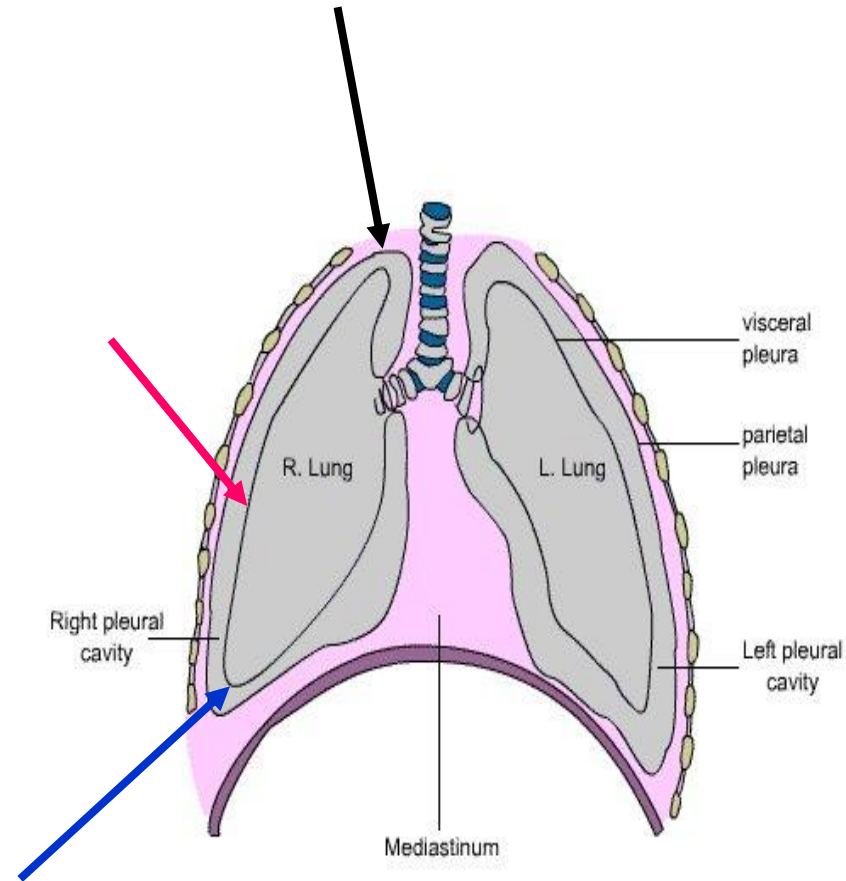
Pleura

- * It is a completely closed serous sac enclosing each lung.
- * Inner part of pleura covering the lung (adherent to the lung surfaces & lining the fissures) → **visceral pleura**.
- * Outer part of pleura lining thoracic wall → **parietal pleura**.



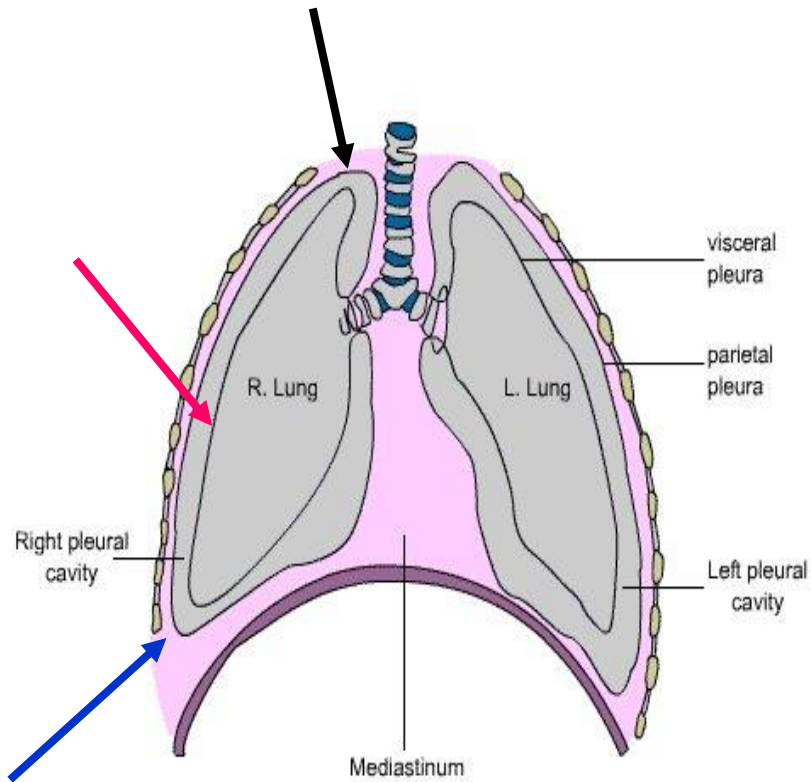
Pleura

- * Visceral & parietal pleura are separated by pleural cavity.
- * Pleural cavity is a potential space filled with a thin film of serous fluid, which facilitates the movement of the lungs & protects against friction.



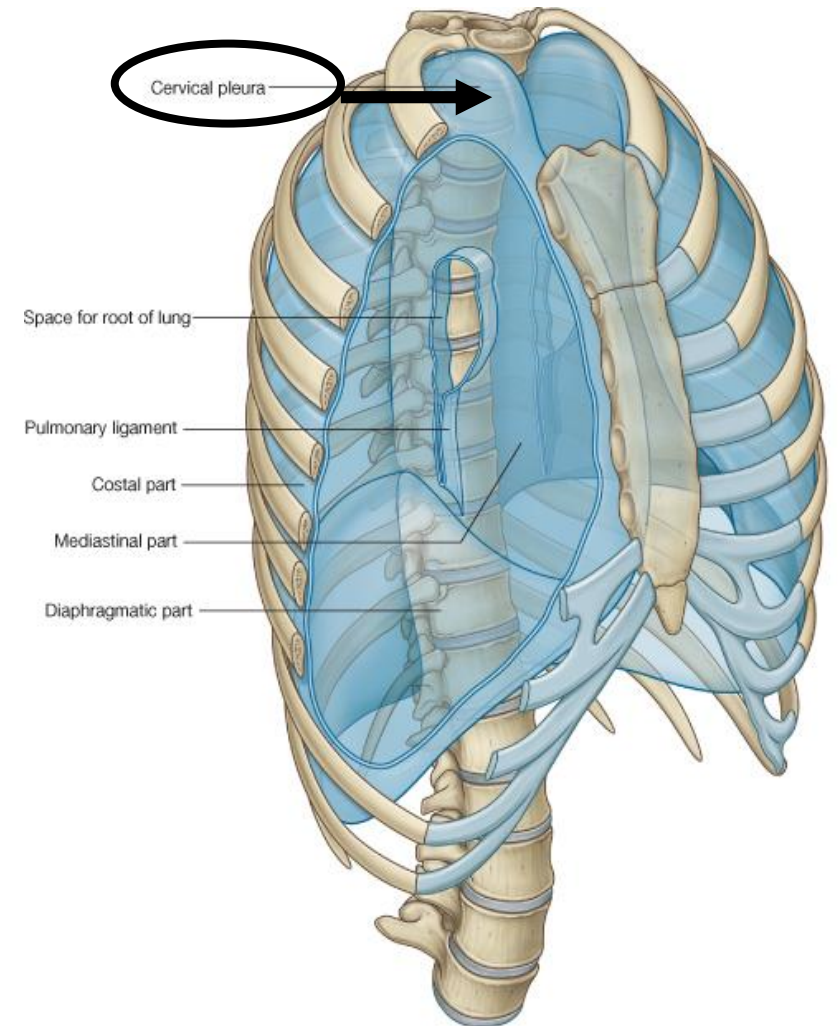
Clinical Notes

- * Inflammation of parietal pleura produces severe pain & is called **pleurisy**.
- * Visceral pleura is not sensitive to pain.
- * In some clinical cases, pleural cavity may be filled with air, blood or pus.



Subdivisions of Parietal Pleura

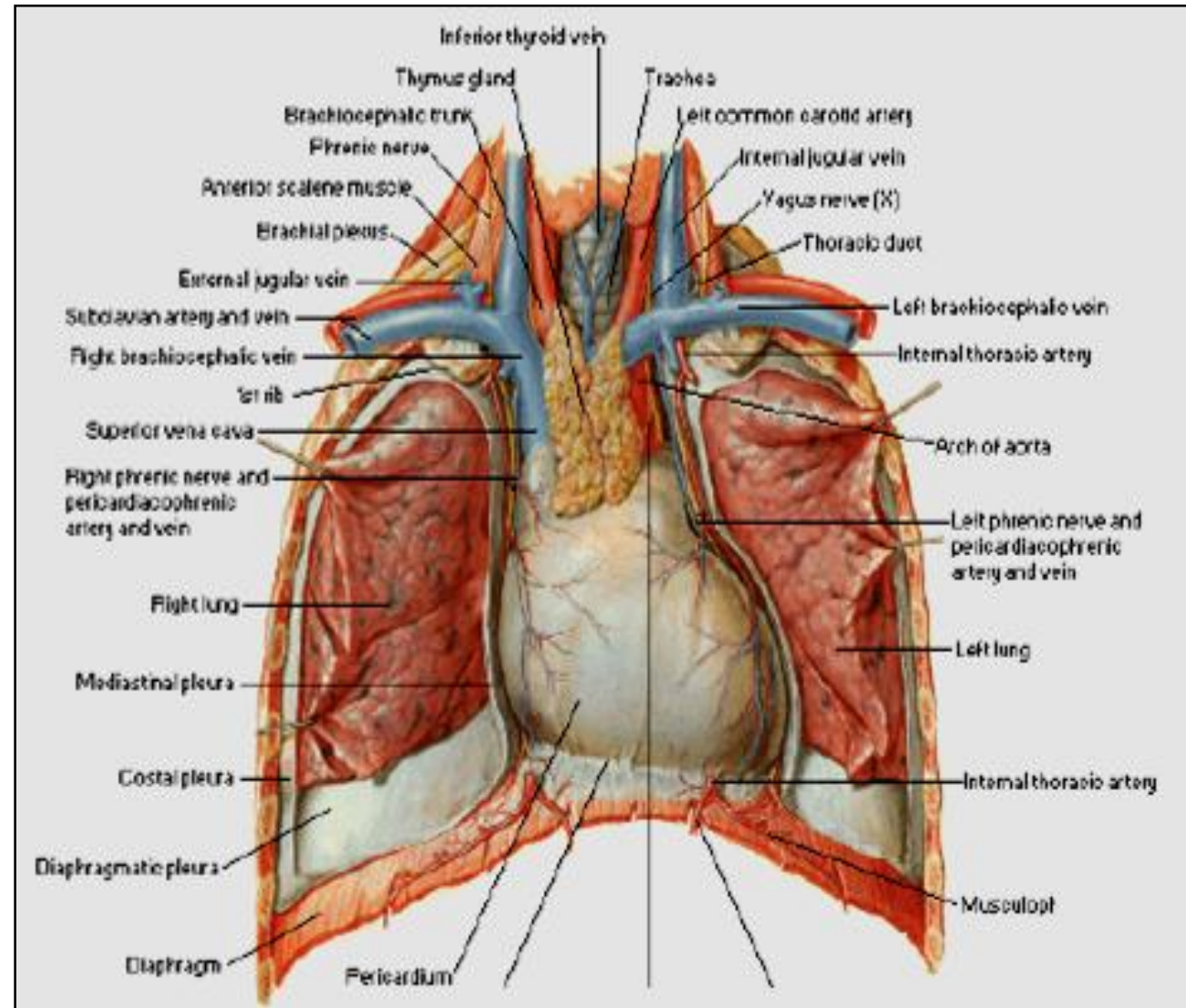
1. Cervical Pleura → part of parietal pleura bulging up through the thoracic inlet into root of neck.



2. Costal pleura → part of parietal pleura which lines ribs & intercostal spaces.

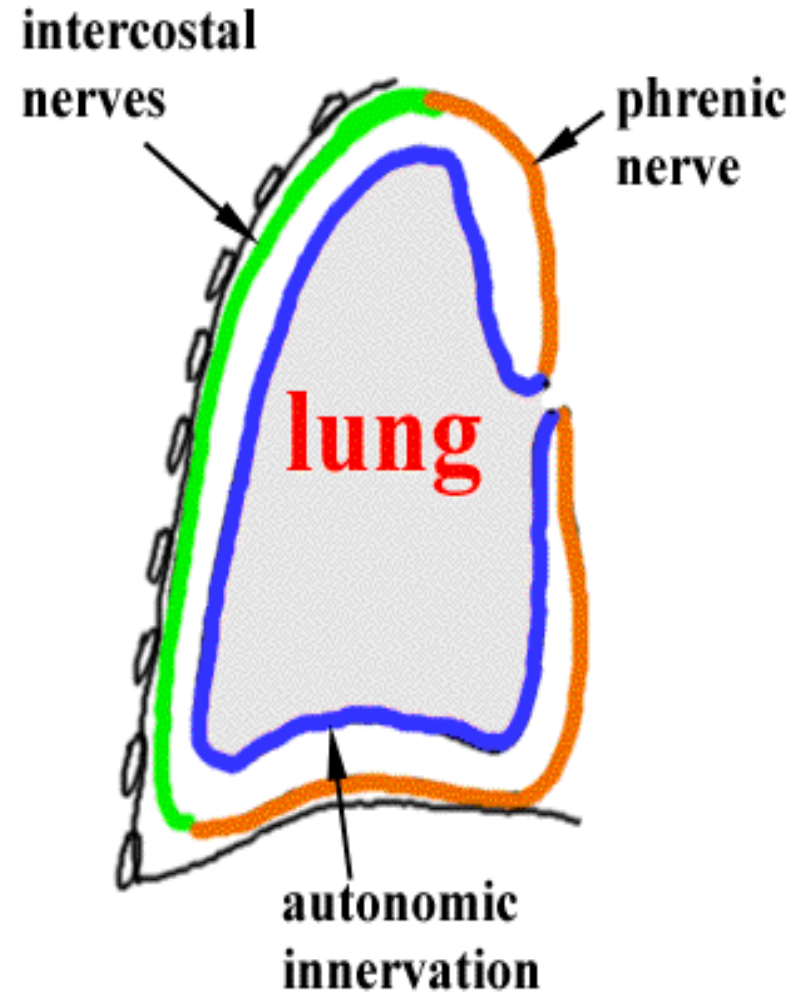
3. Mediastinal pleura → part of parietal pleura covering the side of the mediastinum.

4. Diaphragmatic pleura → part of the parietal pleura which covers upper surface of diaphragm.



Nerve supply of pleura

- * **Parietal pleura is highly sensitive to pain.**
- * **Visceral pleura is not sensitive to pain.**
- * **Visceral pleura is supplied by autonomic nerve plexuses.**



Nerve supply of pleura

* Costal pleura & peripheral part of diaphragmatic pleura → are supplied by **intercostal nerves**.

* Mediastinal pleura & central part of diaphragmatic pleura → are supplied by **phrenic nerve**.

