

RESPIRATORY SYSTEM (I)

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Ospedale
di Bergamo

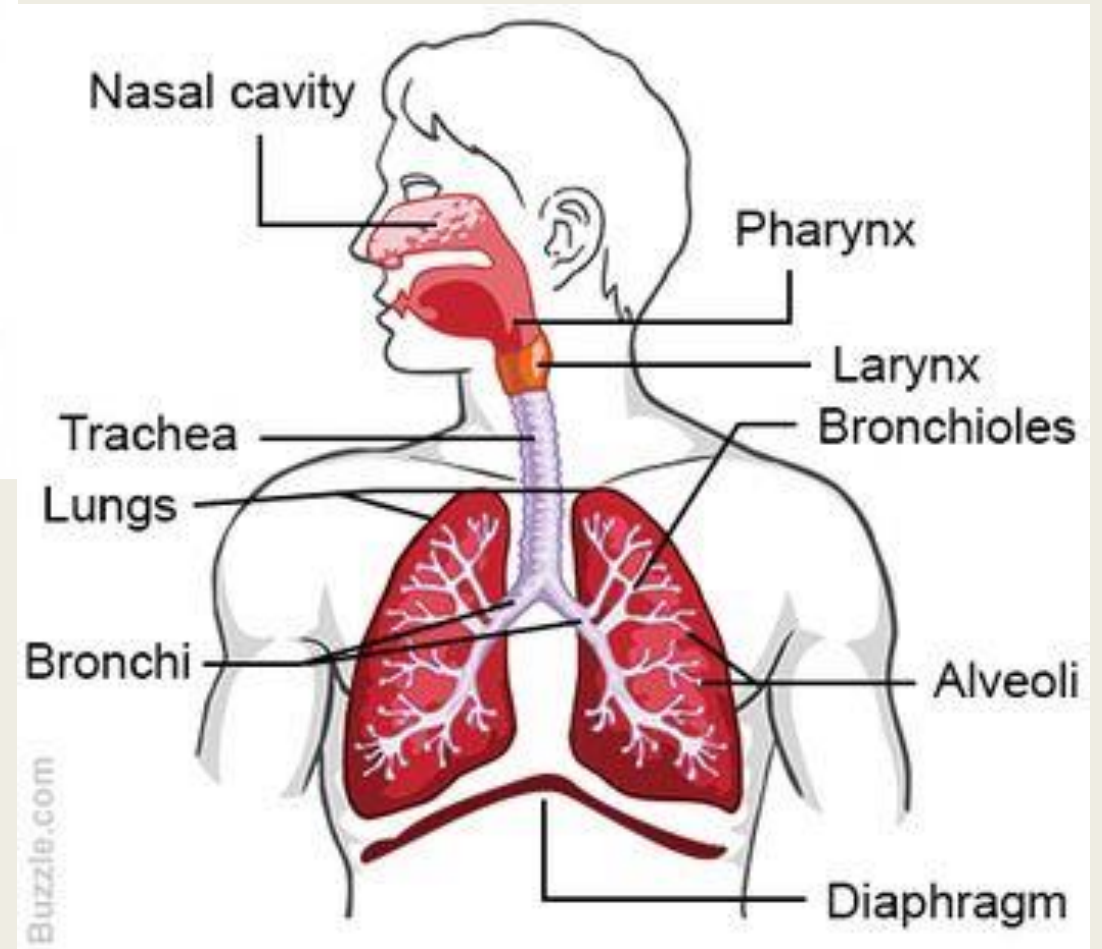
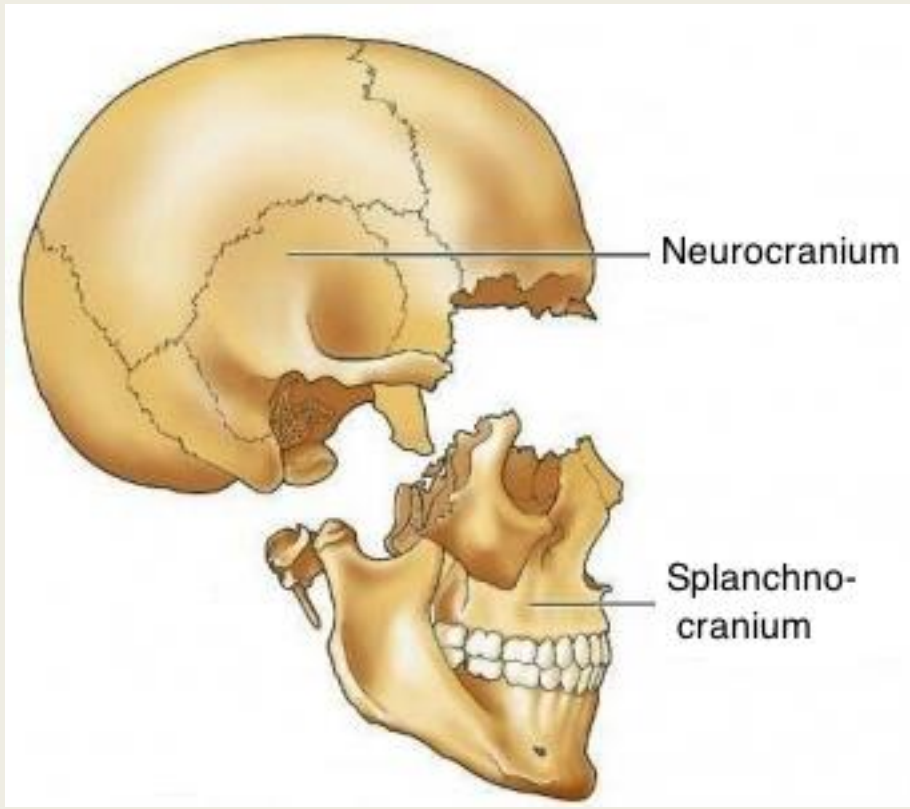
Sistema Socio Sanitario

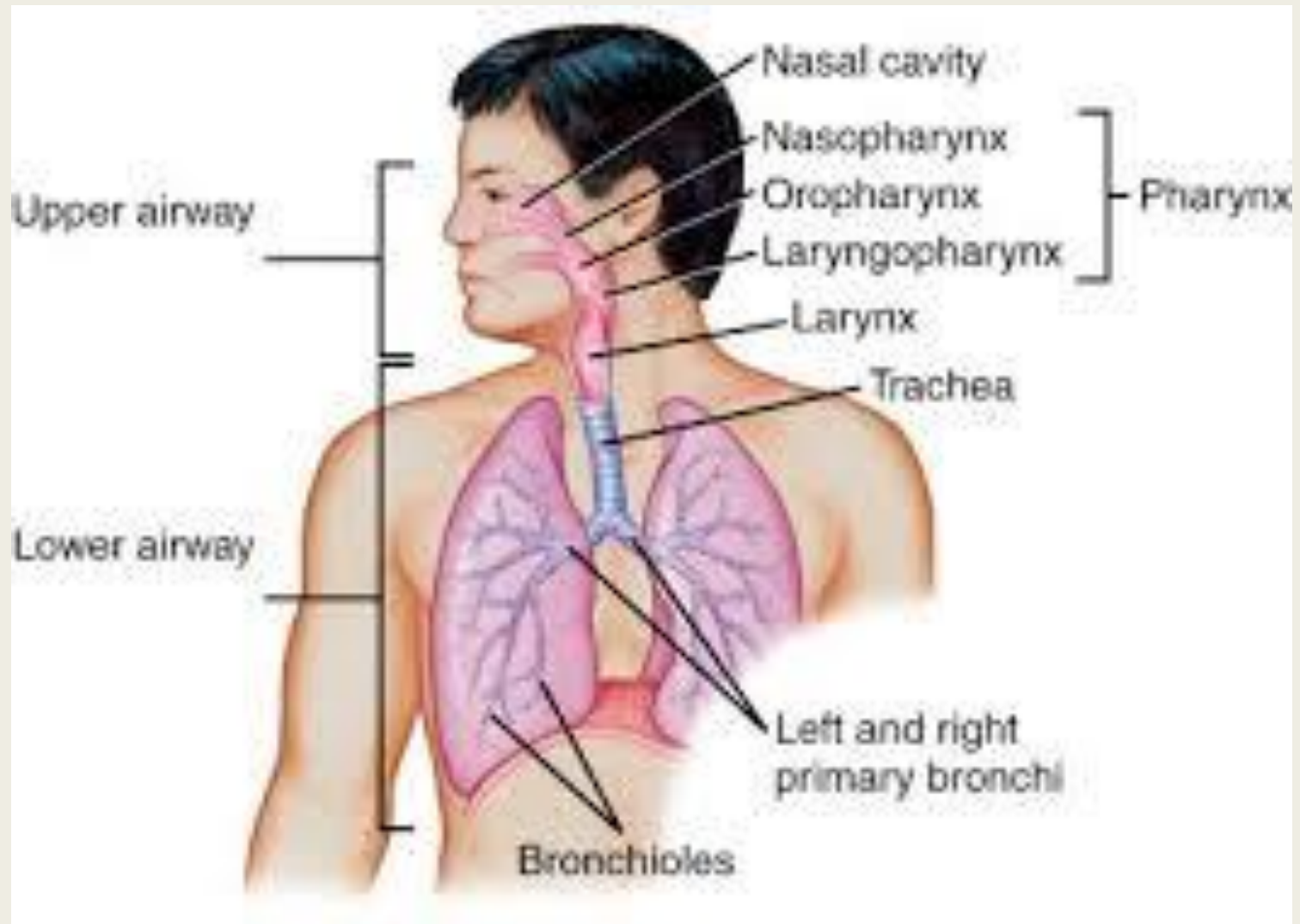


Regione
Lombardia

ASST Papa Giovanni XXIII



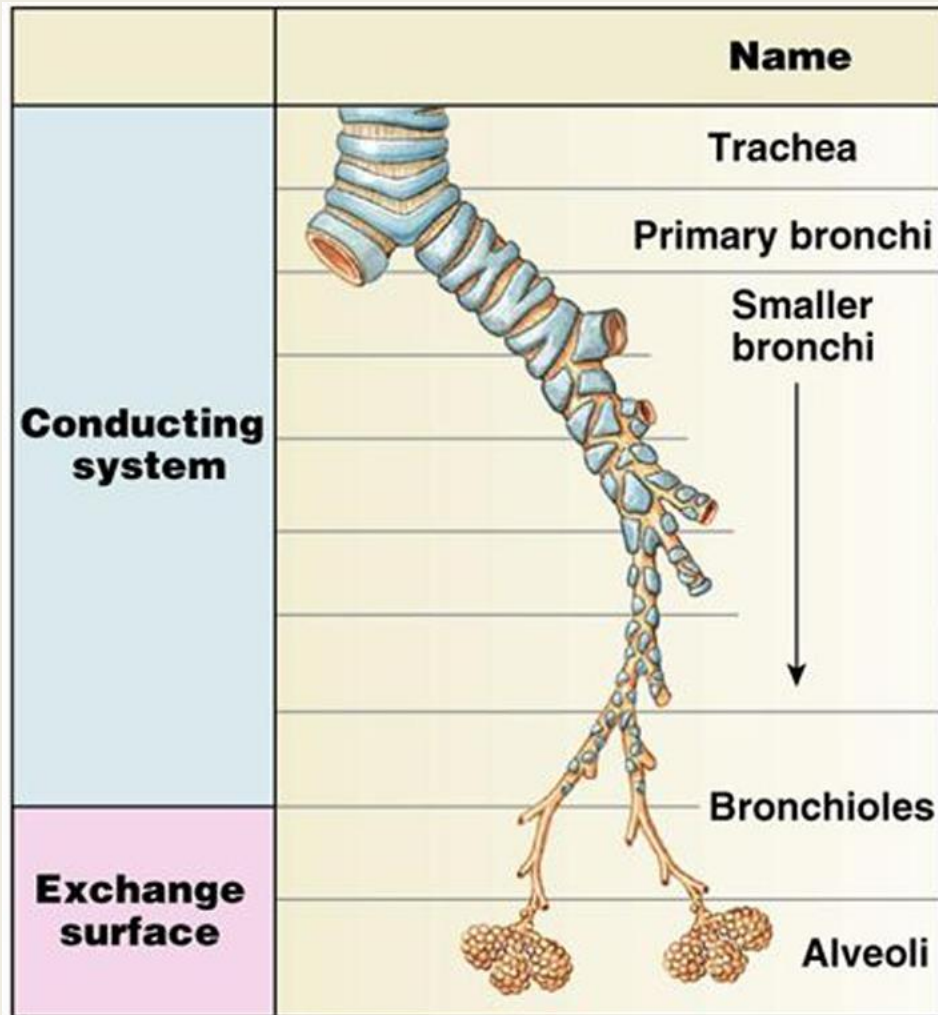




UPPER AIRWAYS

>>>Vocal cords<<<

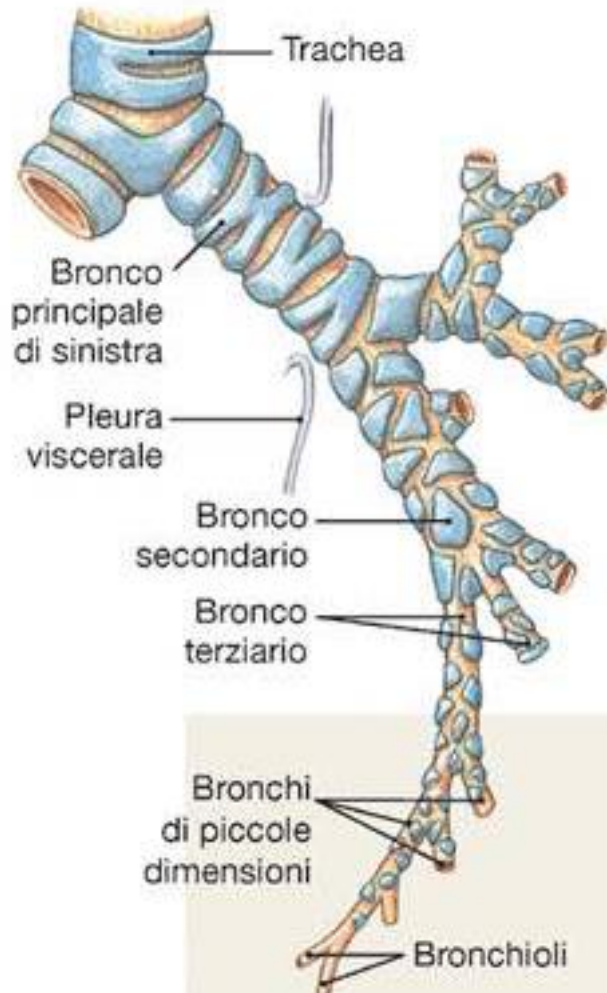
LOWER AIRWAYS



CONDUCTING SYSTEM

Respiratory tract which do not directly participate in gas exchange but it simply allows bulk flow of air to areas which are responsible for gas exchange.

The conducting airways begin with the trachea which subsequently divides into two main bronchi that in turn branch into several lobar bronchi and so on until the terminal bronchiole which is considered the final, purely conducting segment of the respiratory tract.

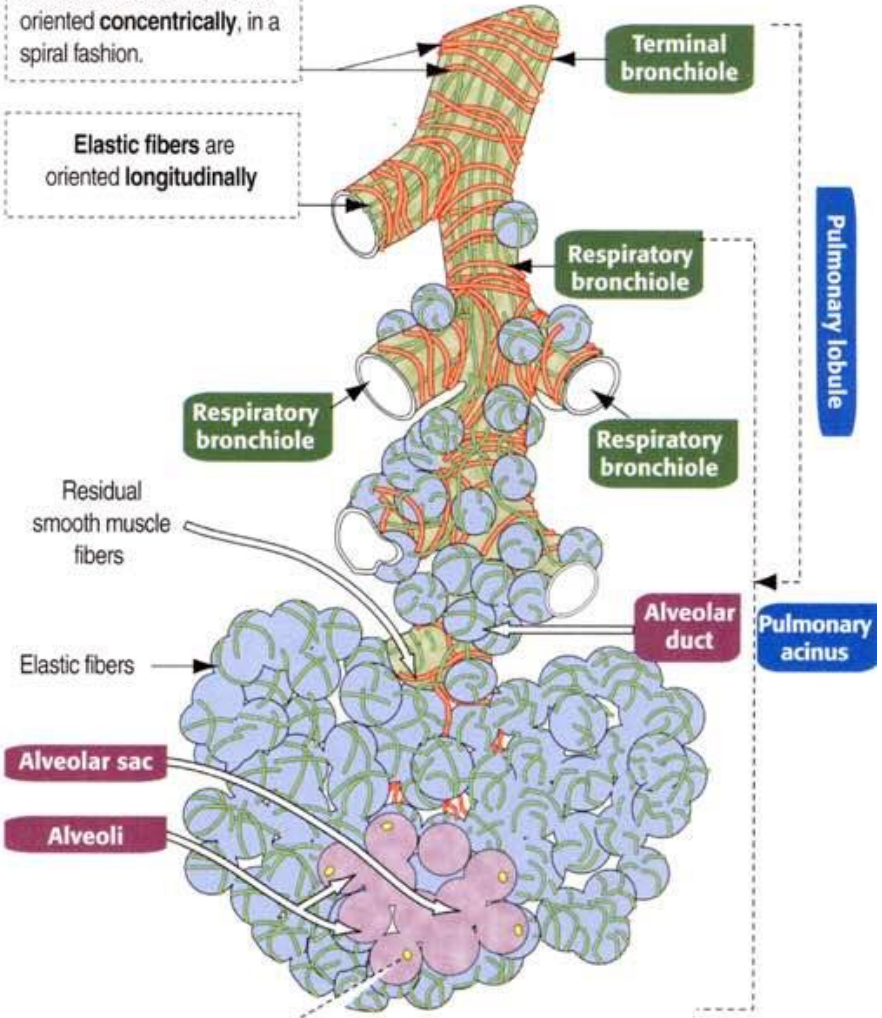


CONDUCTING zone includes ANATOMIC DEAD SPACE

Conducting zone	
Trachea	<p>Goblet cell, Basal cell, Ciliated cell</p> <p>Pseudostratified ciliated columnar epithelium</p> <p>Smooth muscle</p> <p>Cartilage</p>
Bronchi	<p>Goblet cell, Basal cell, Ciliated cell</p> <p>Pseudostratified ciliated columnar epithelium</p> <p>Smooth muscle</p> <p>Cartilage</p>
Bronchioles	<p>Club cell (Clara cell), Ciliated cell</p> <p>Simple ciliated columnar epithelium</p> <p>Smooth muscle</p>
Terminal bronchioles	<p>Cuboidal ciliated cells, Club cell</p> <p>Simple cuboidal epithelium</p> <p>Smooth muscle</p>

Smooth muscle fibers are oriented **concentrically**, in a spiral fashion.

Elastic fibers are oriented **longitudinally**



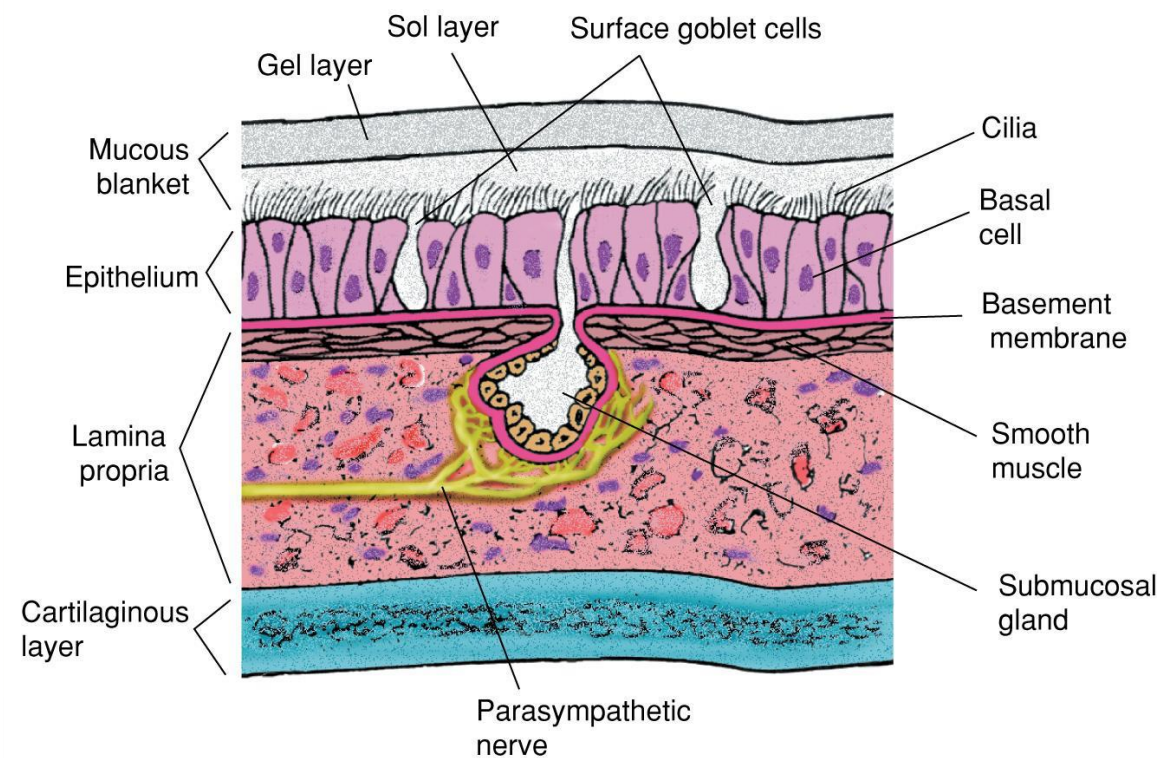
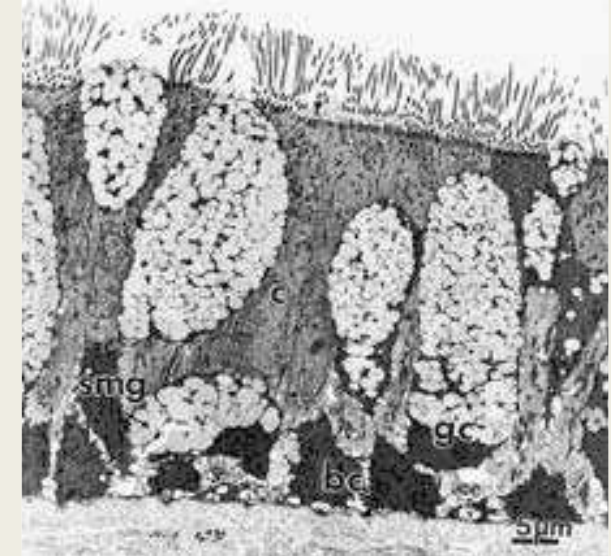
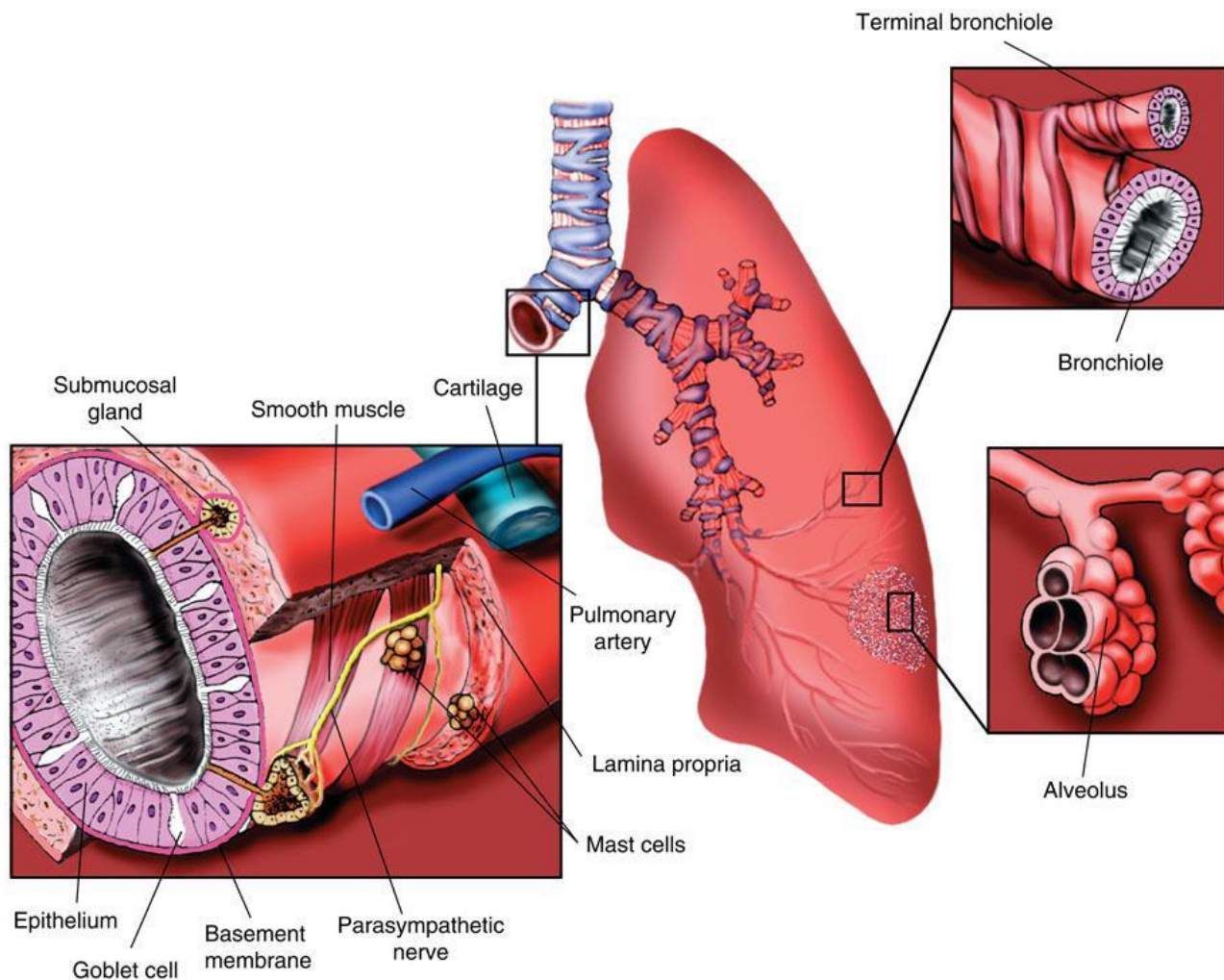
Pores of Kohn
 The alveolar pores of Kohn connect adjacent alveoli. The pores are responsible for collateral respiration when blockage of a small bronchiole occurs. Thus, **in case of a blockage, adjacent unobstructed bronchioles and associated alveoli continue to provide alveolar ventilation through the pores of Kohn.**

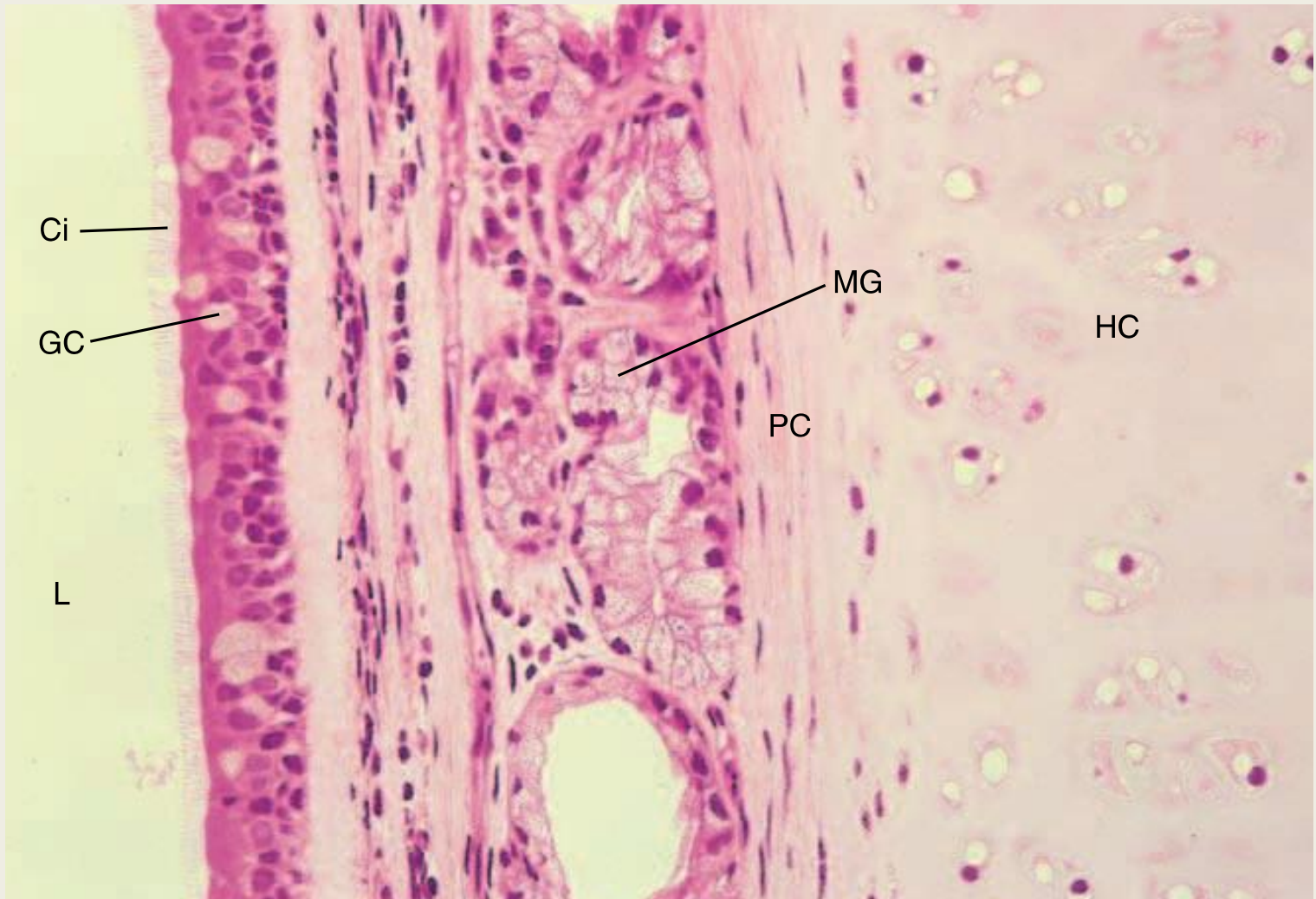
RESPIRATORY ZONE

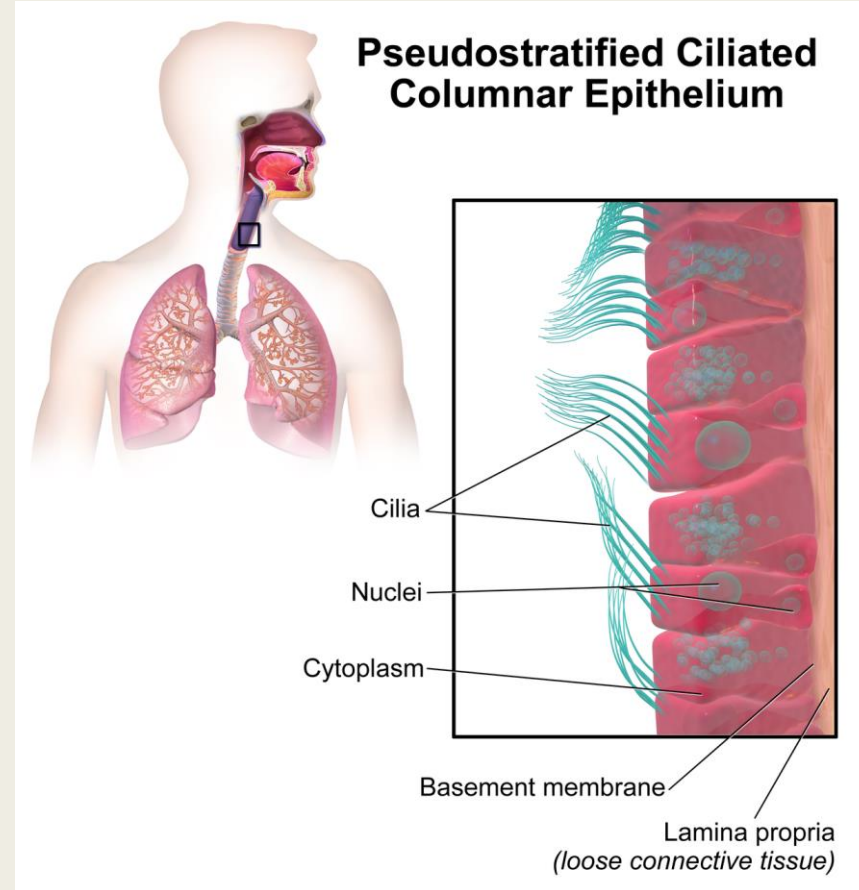
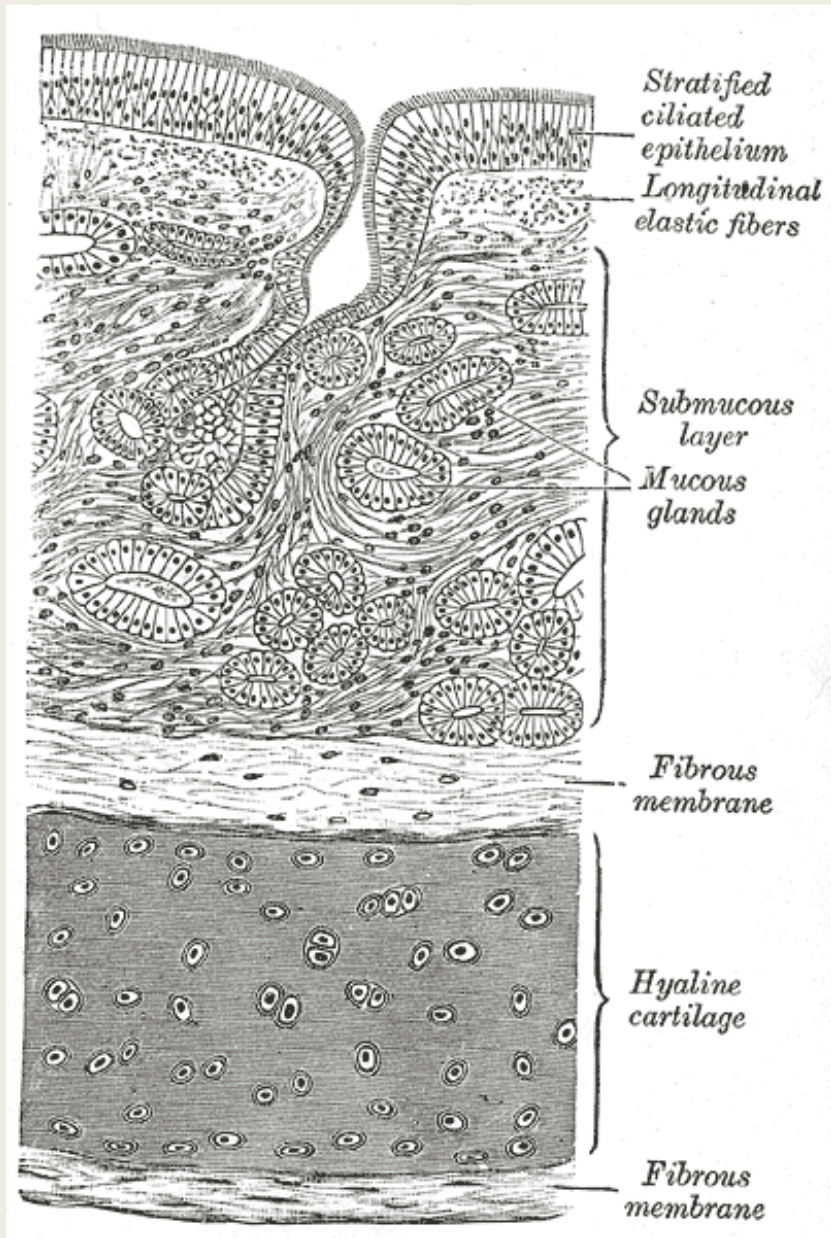
Lung parenchyma

Respiratory zone	
Respiratory bronchioles	<p>Cuboidal cells Club cell Squamous cell</p> <p>Simple cuboidal and squamous epithelium Smooth muscle</p>
Alveolar sacs	<p>Type I pneumocyte Type II pneumocyte Alveolar macrophage Capillary</p>

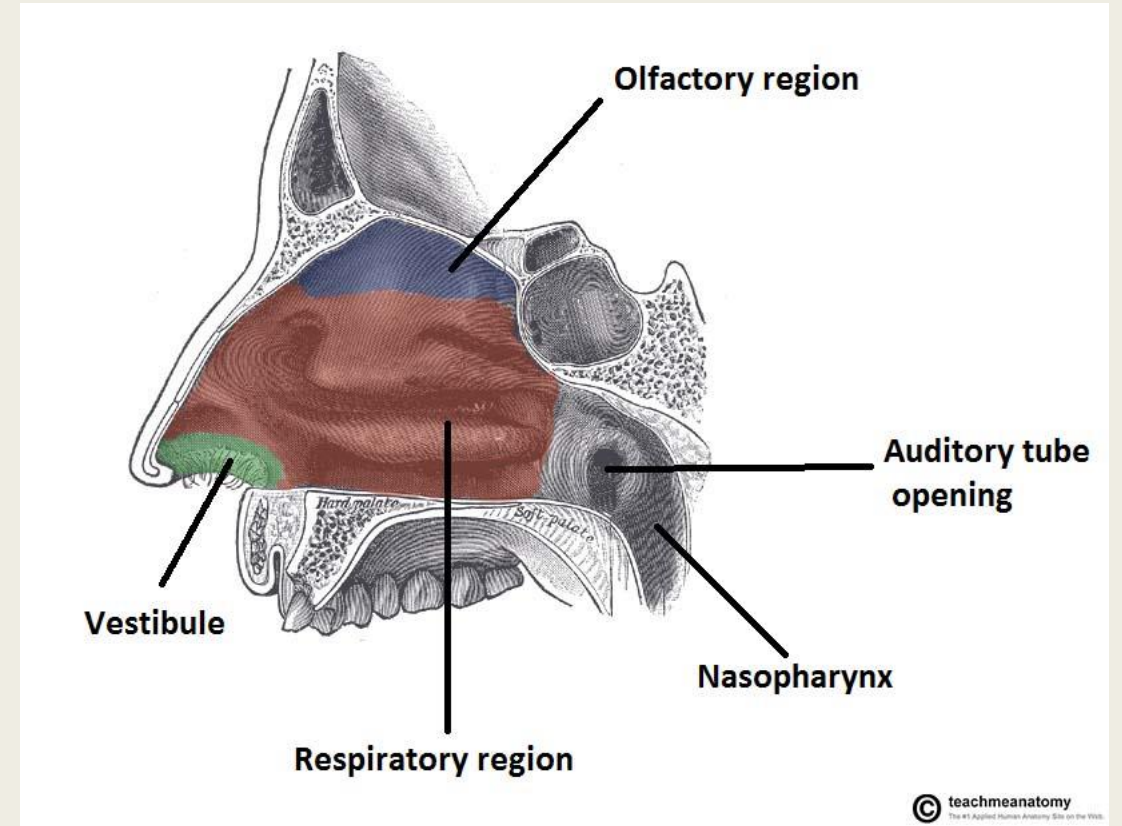
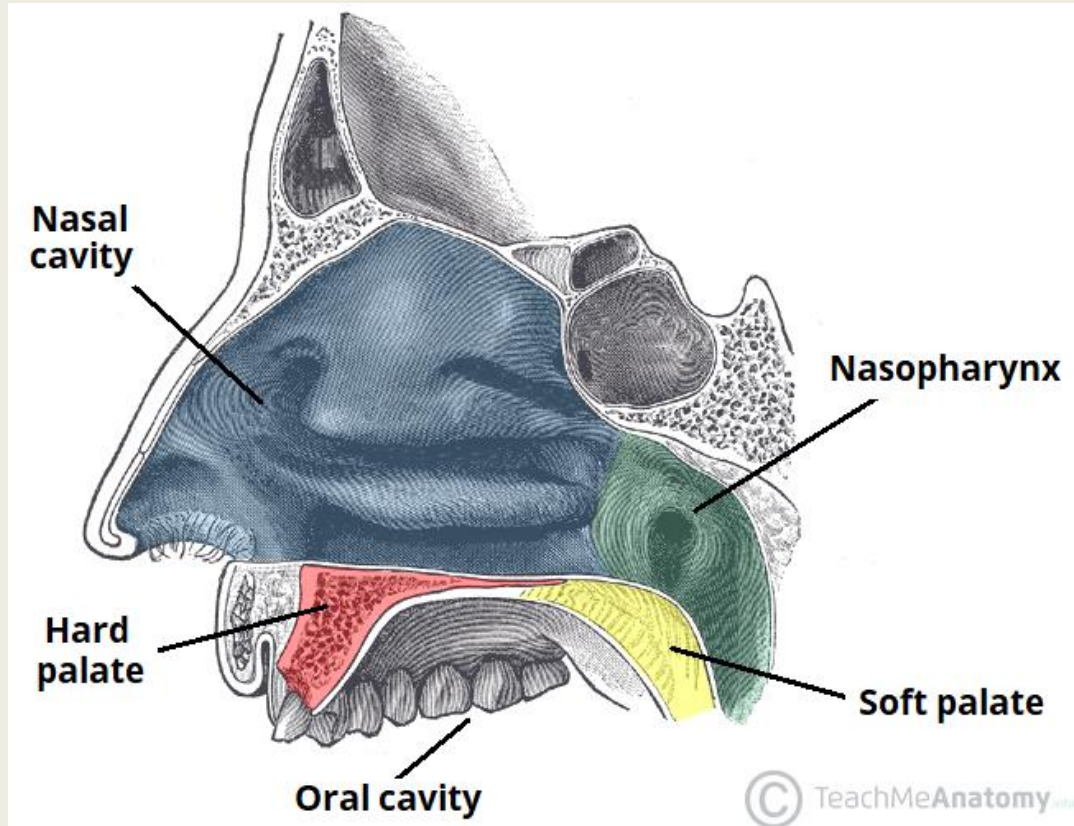
Histology of the Tracheobronchial Tree

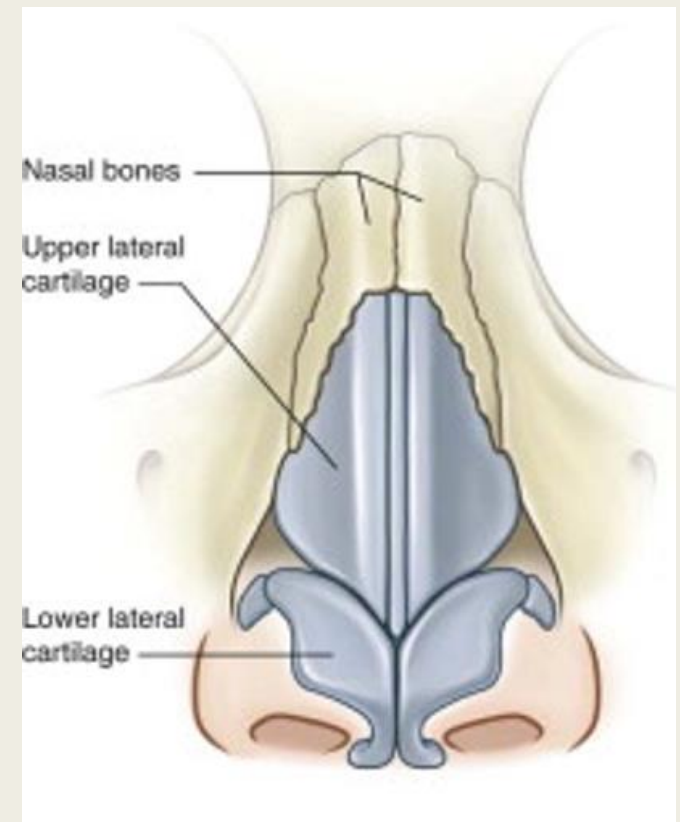
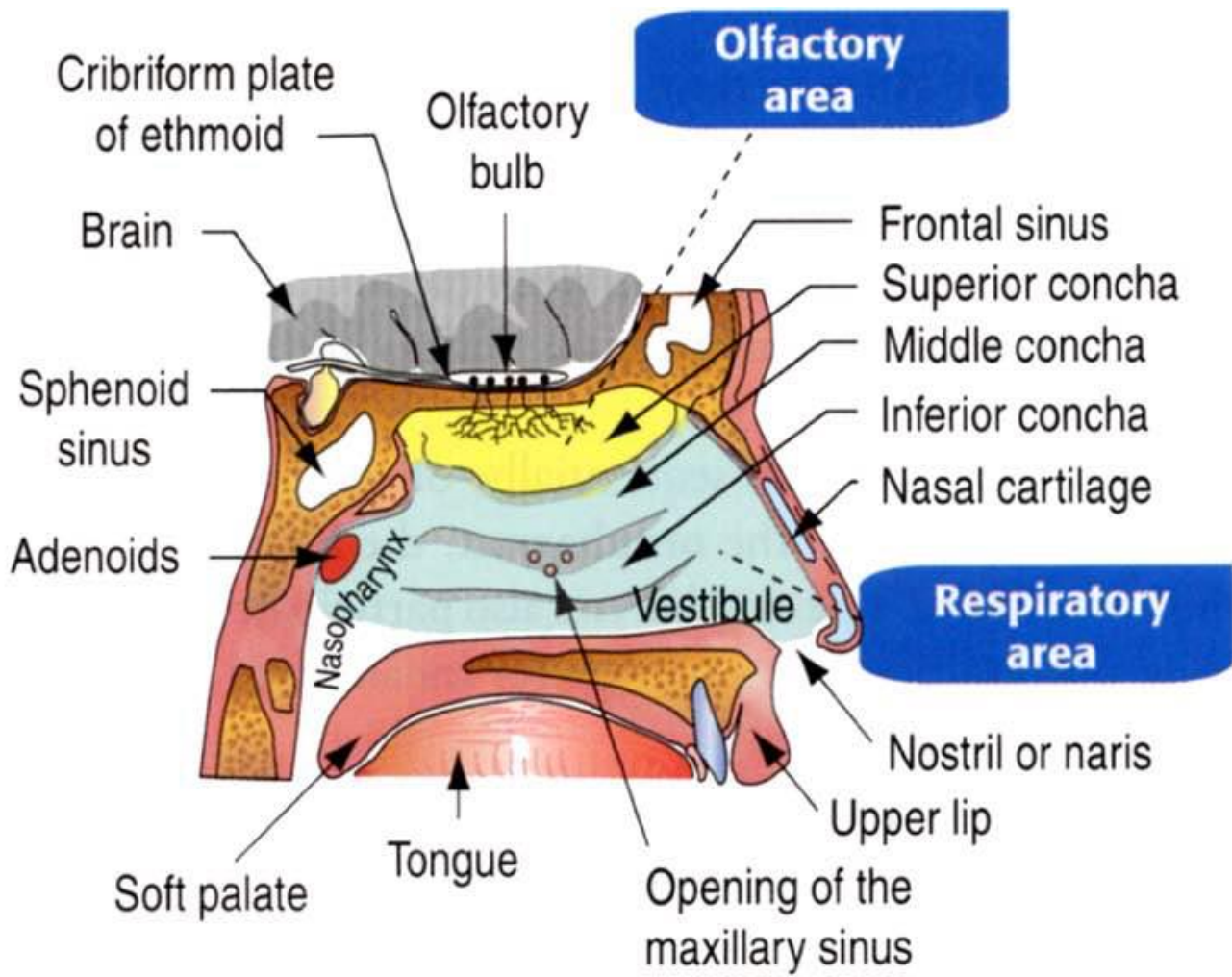


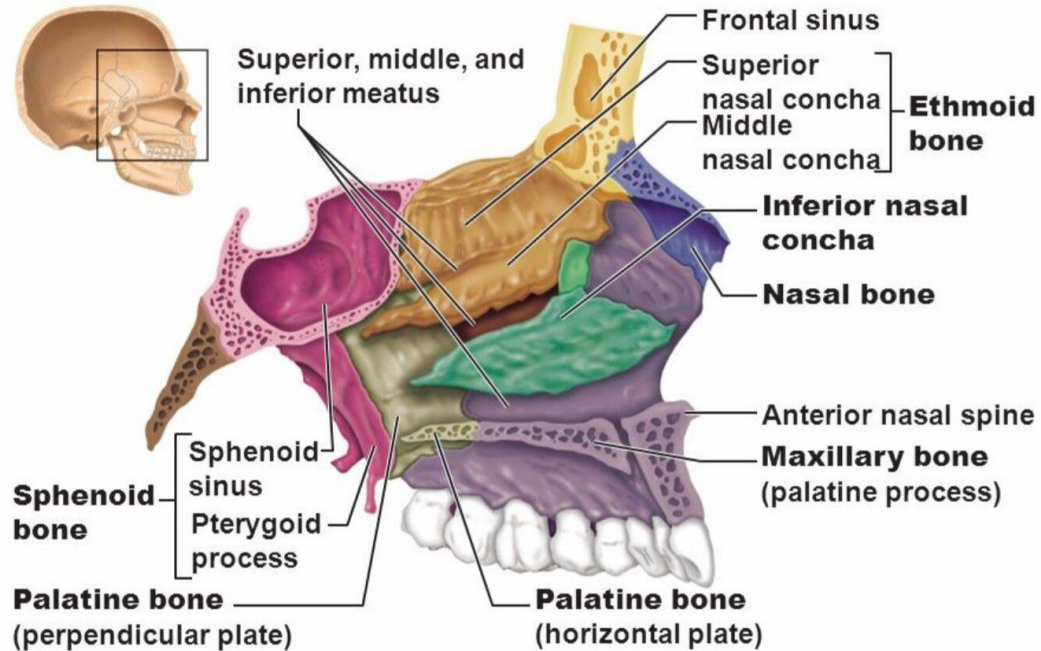




NASAL CAVITY

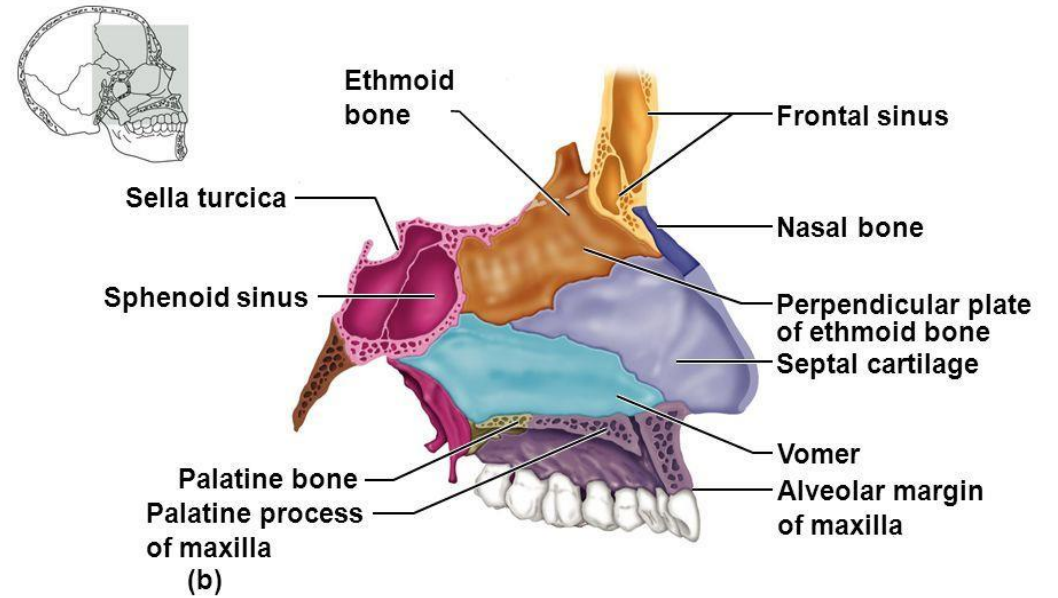






Bones forming the left lateral wall of the nasal cavity (nasal septum removed)

Bones Of The Nasal Cavity



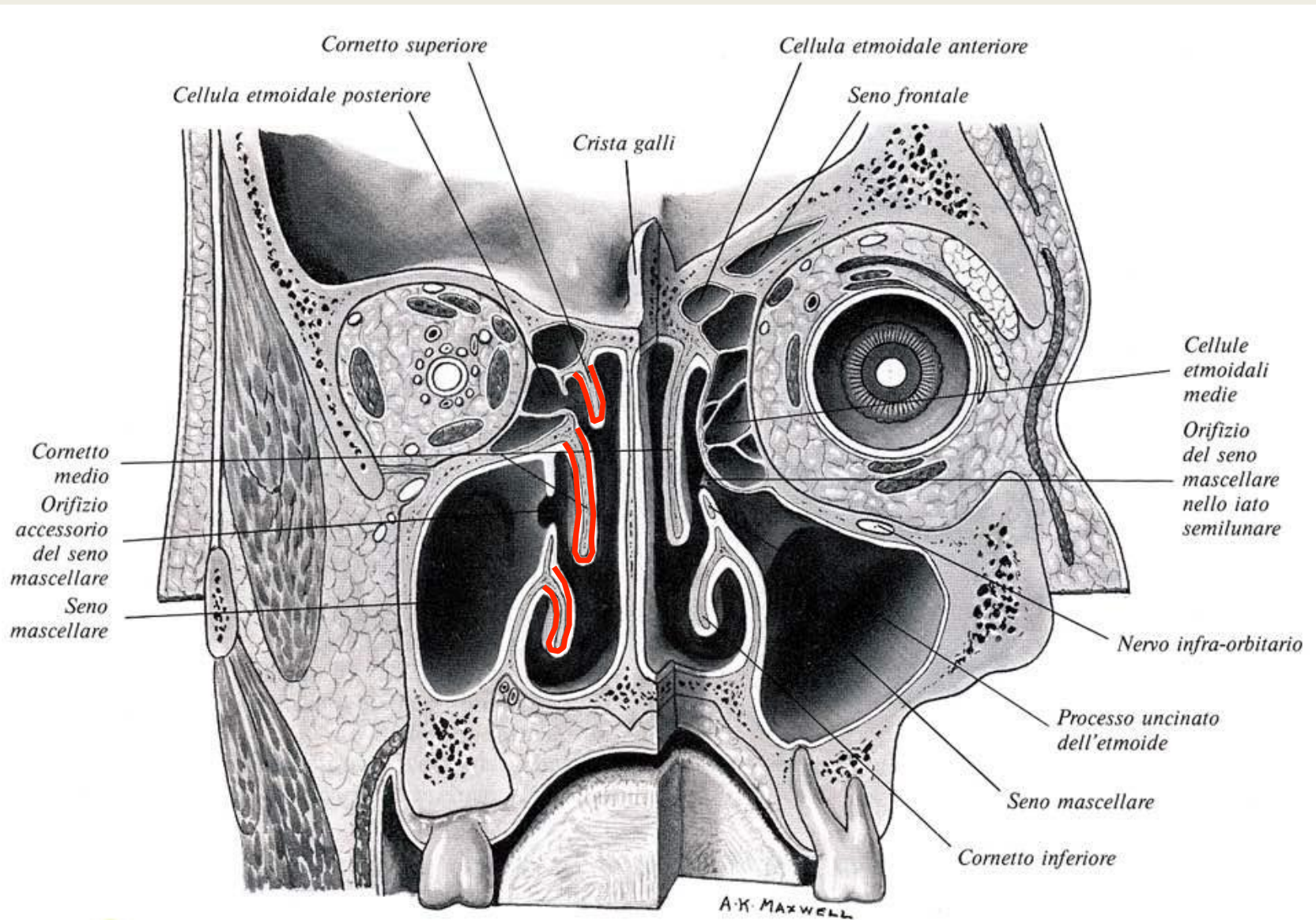
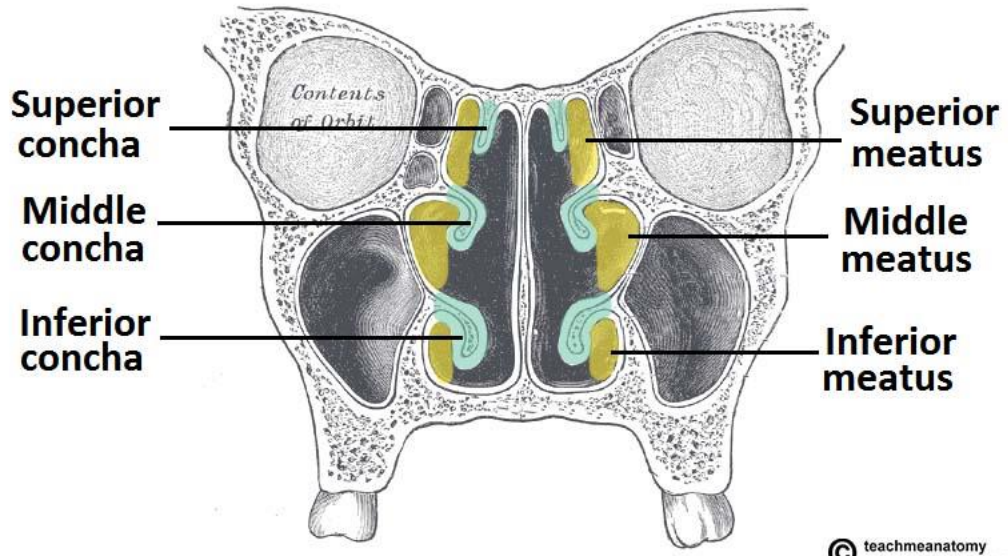
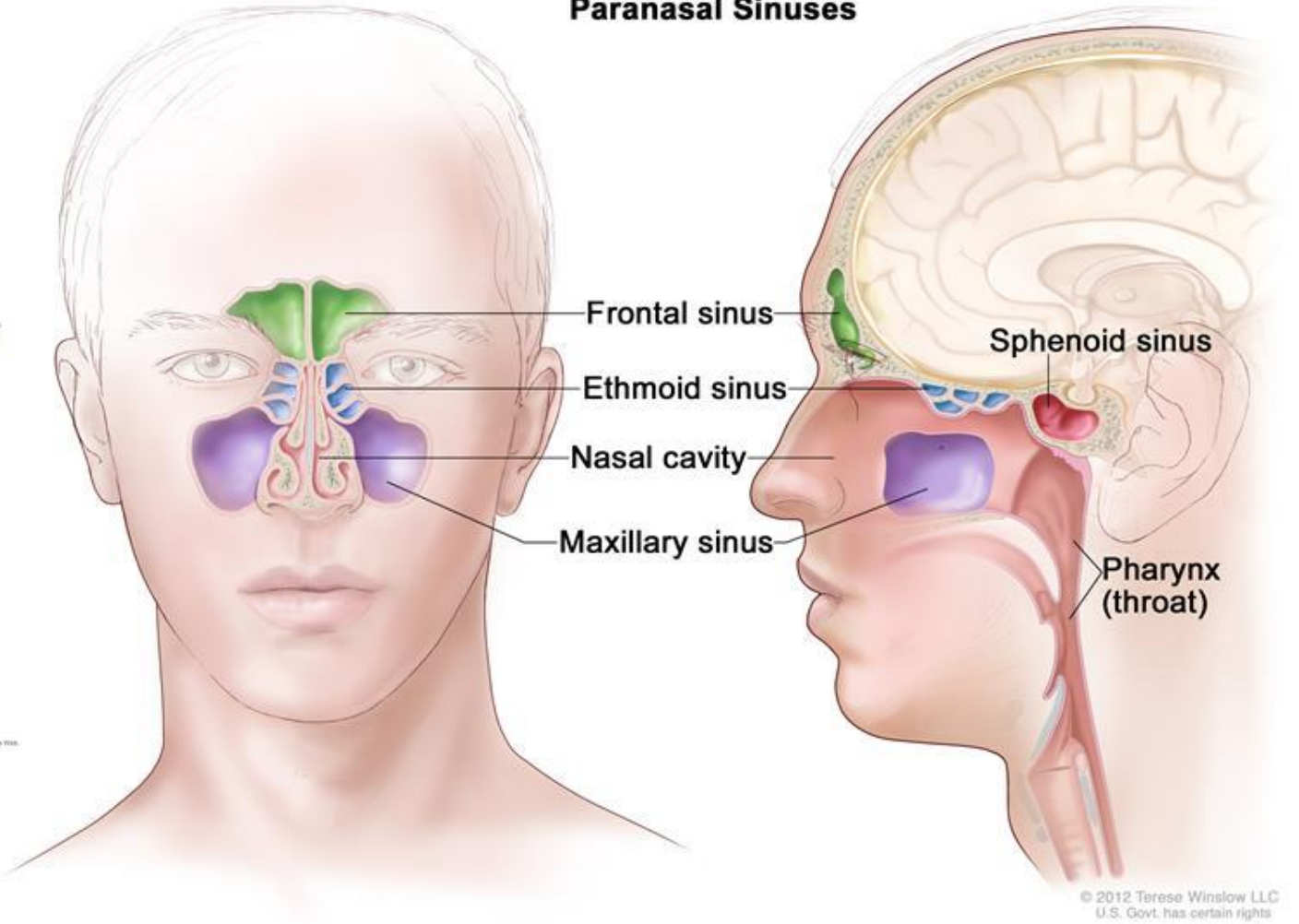


Immagine tratta da: Anatomia del Gray, Zanichelli, IV Edizione



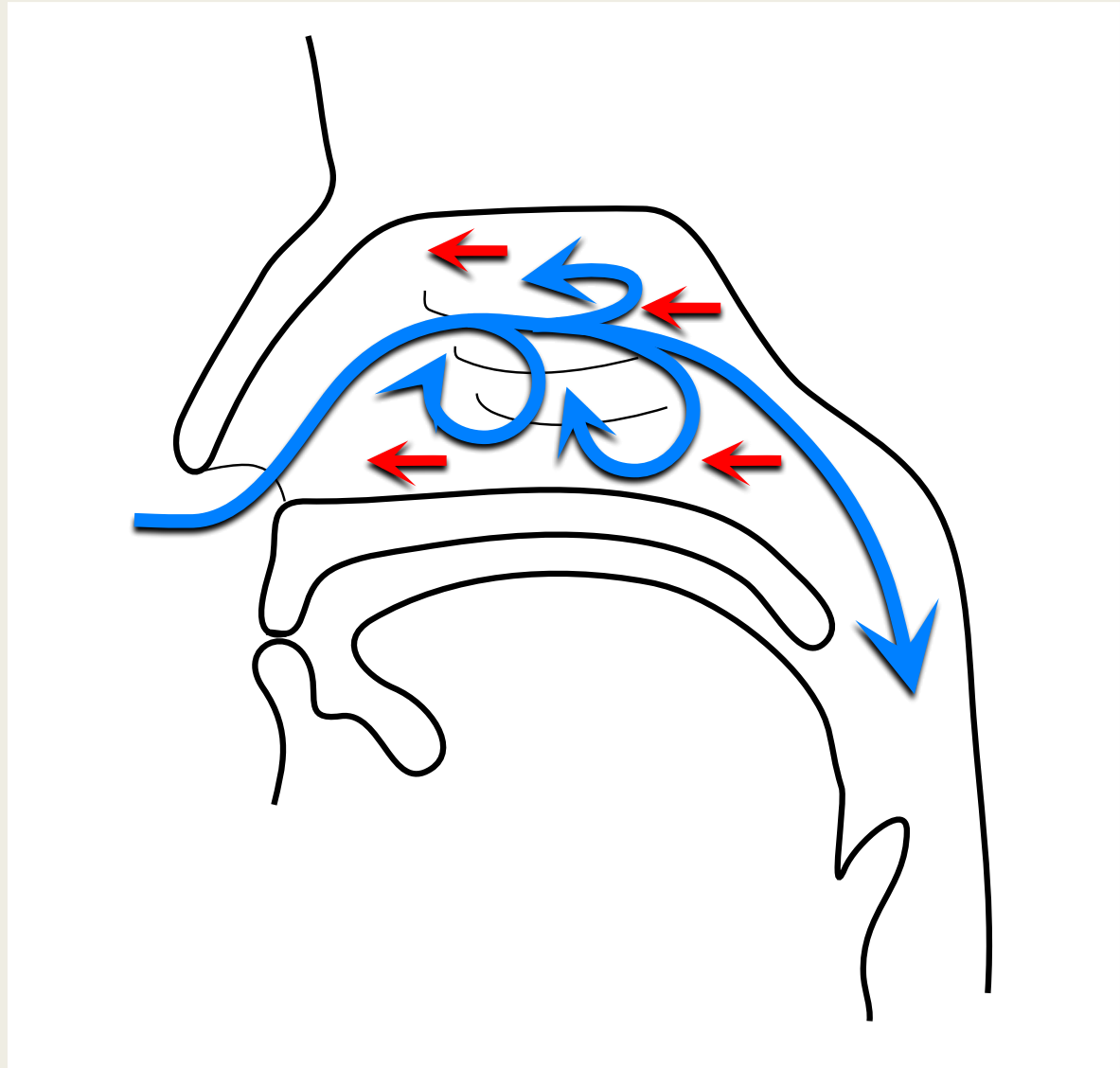
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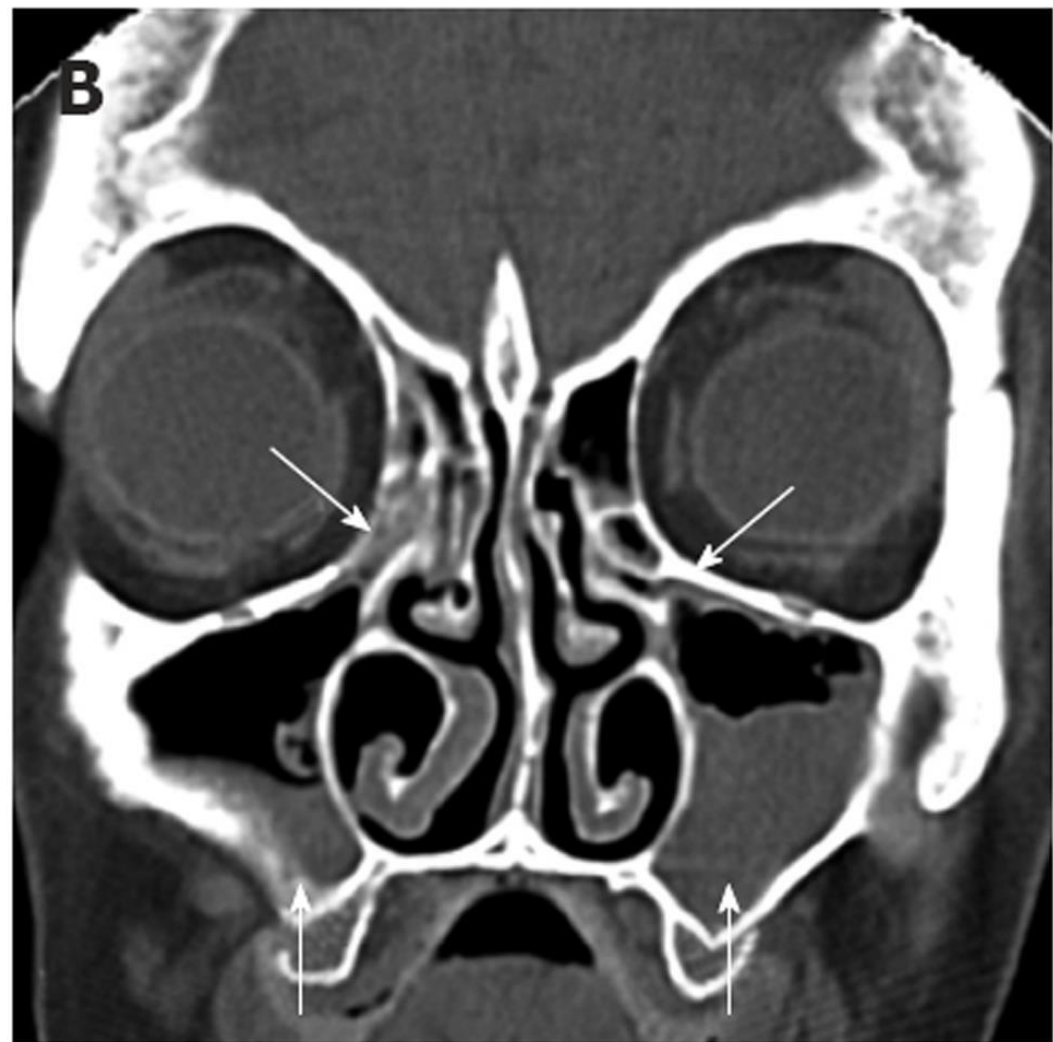
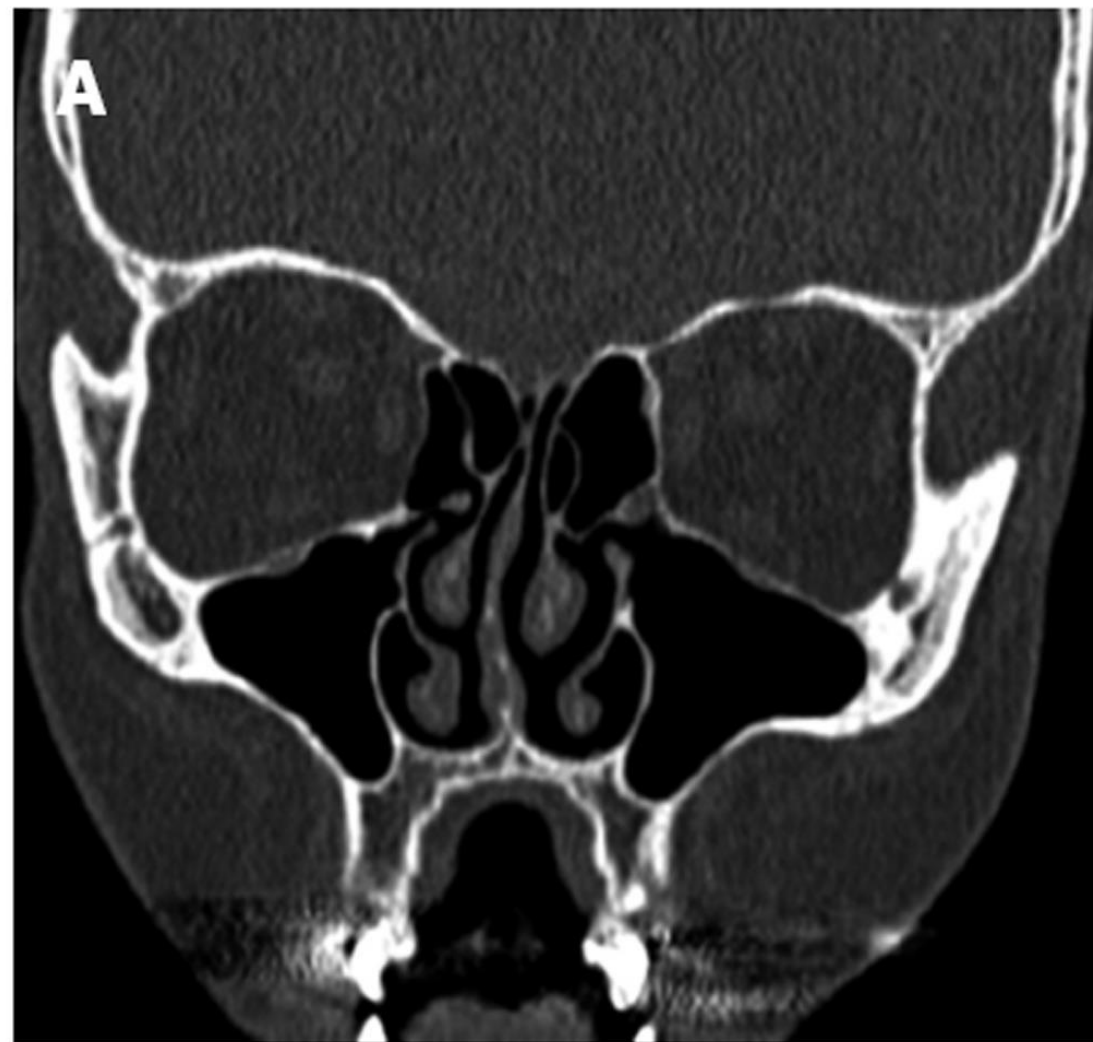
Paranasal Sinuses



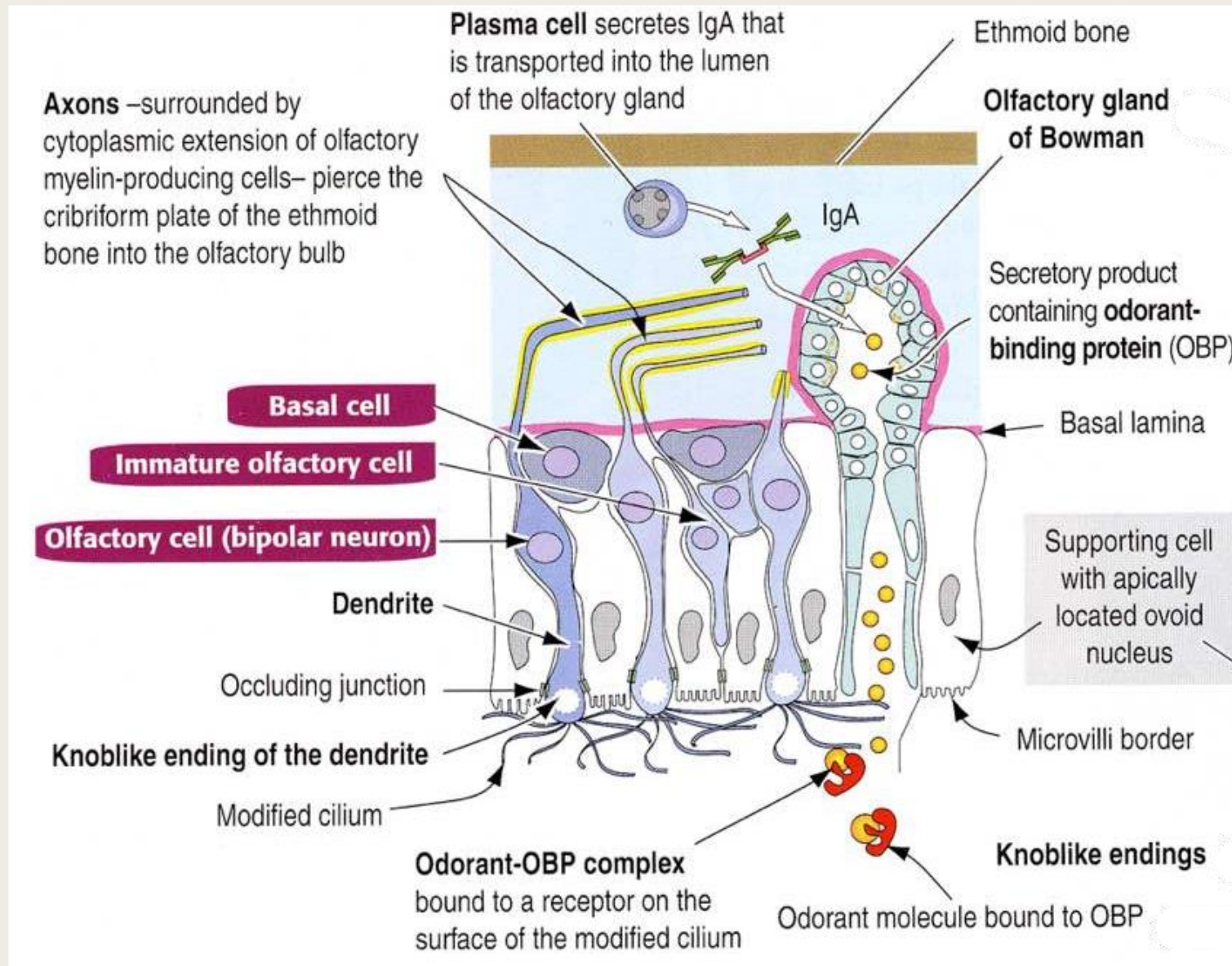
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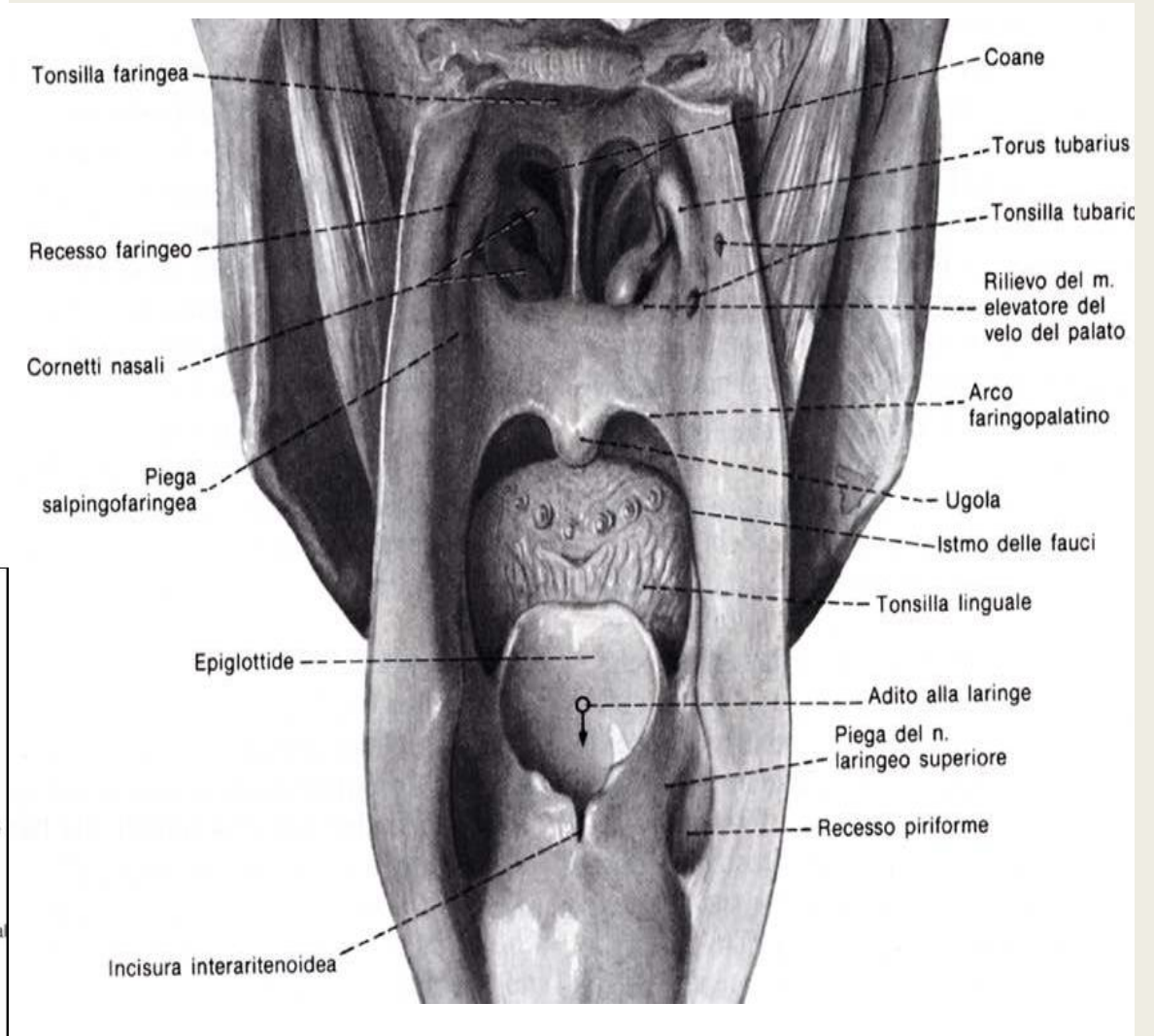
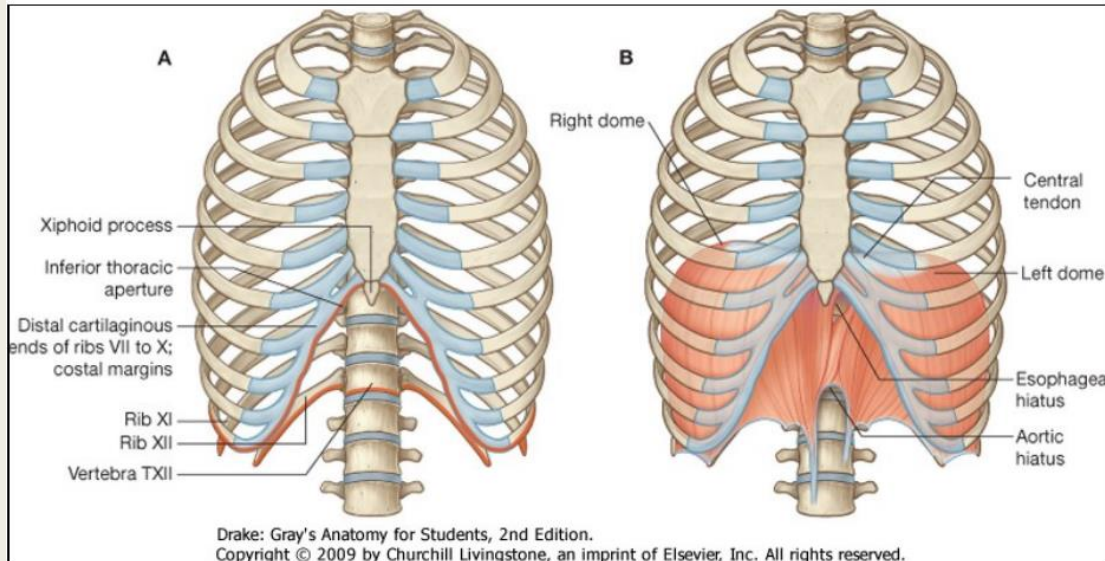
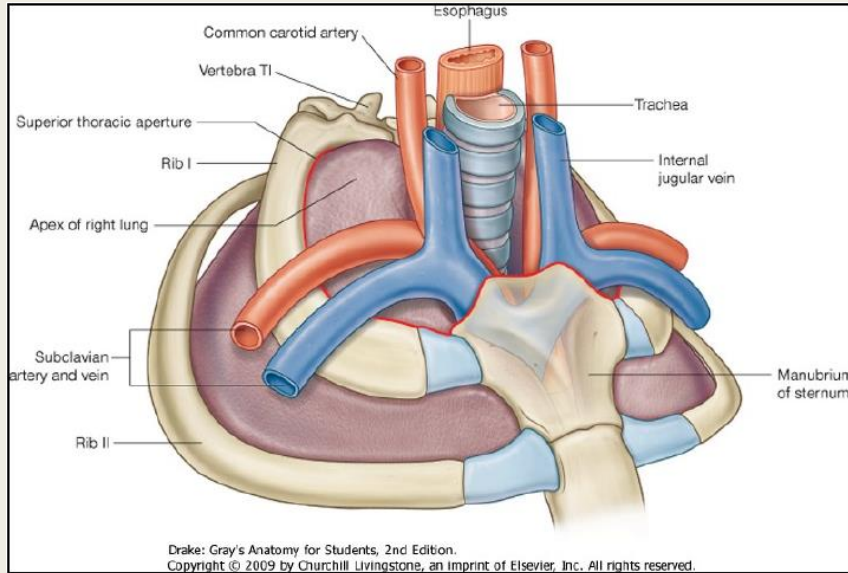
1. Warming
2. Humidifying
3. Purifying
4. Smelling





OLFACTORY EPITELIUM



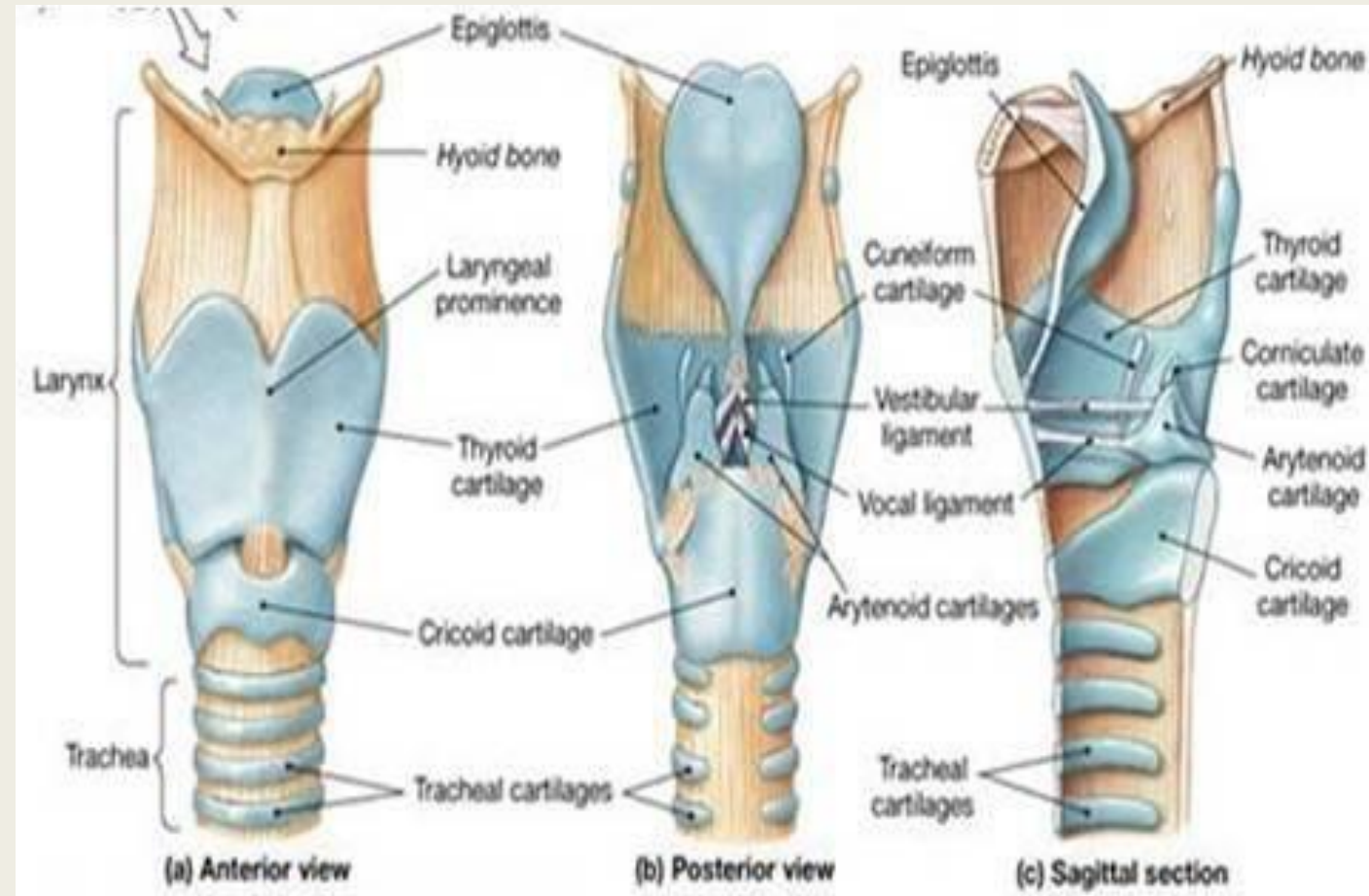


LARYNX

It is a conducting airways

It closes the path for inferior respiratory tract

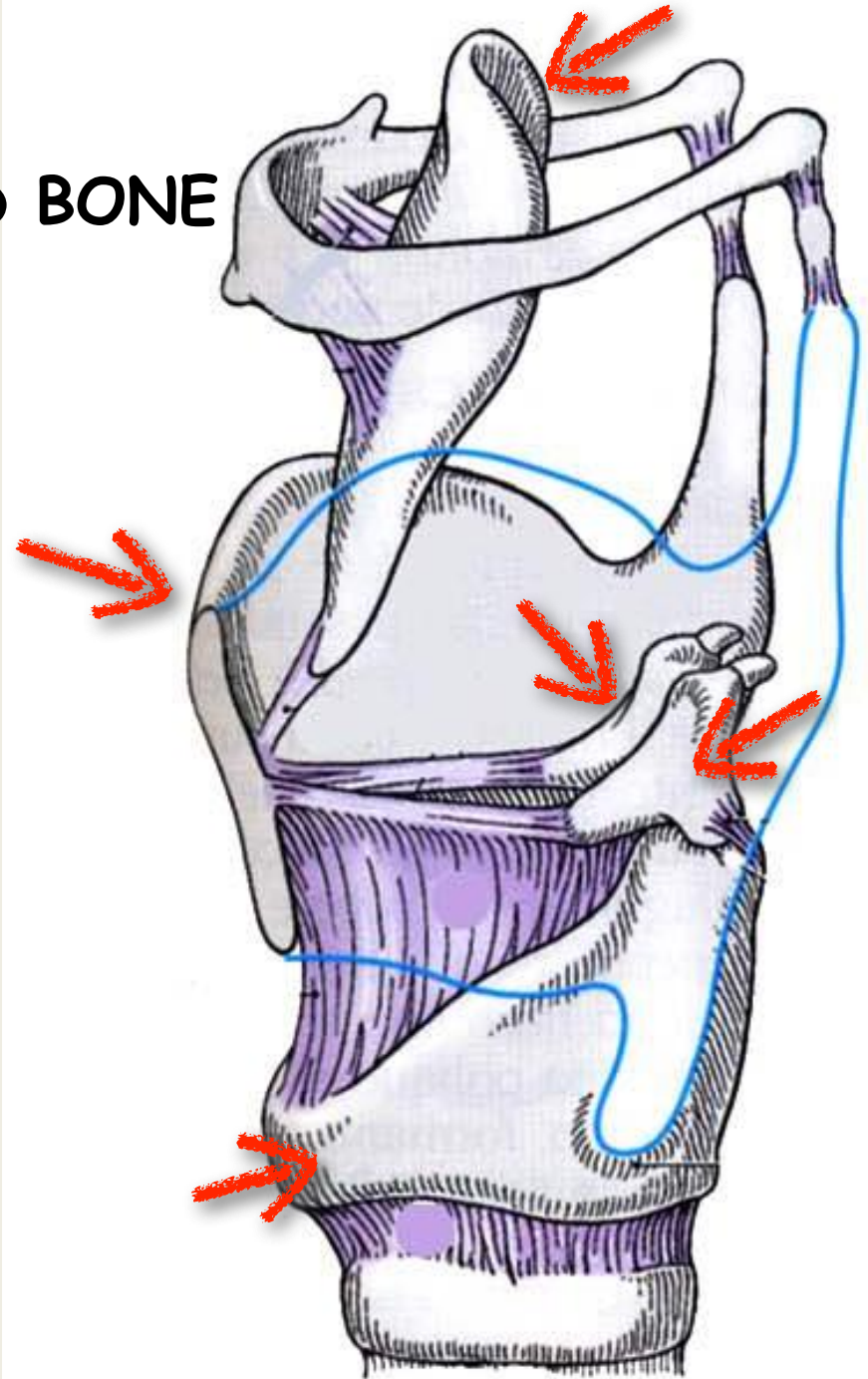
- PHONATION
- BARRIER TO AIR AND DIGESTIVE TRACT
- SWALLOWING
- PROTECTION AGAINST ASPIRATION

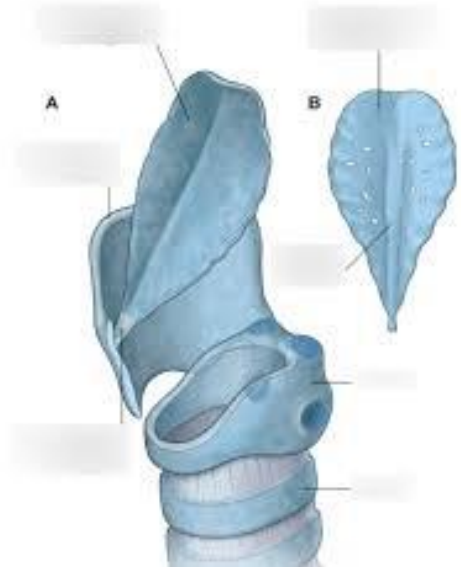
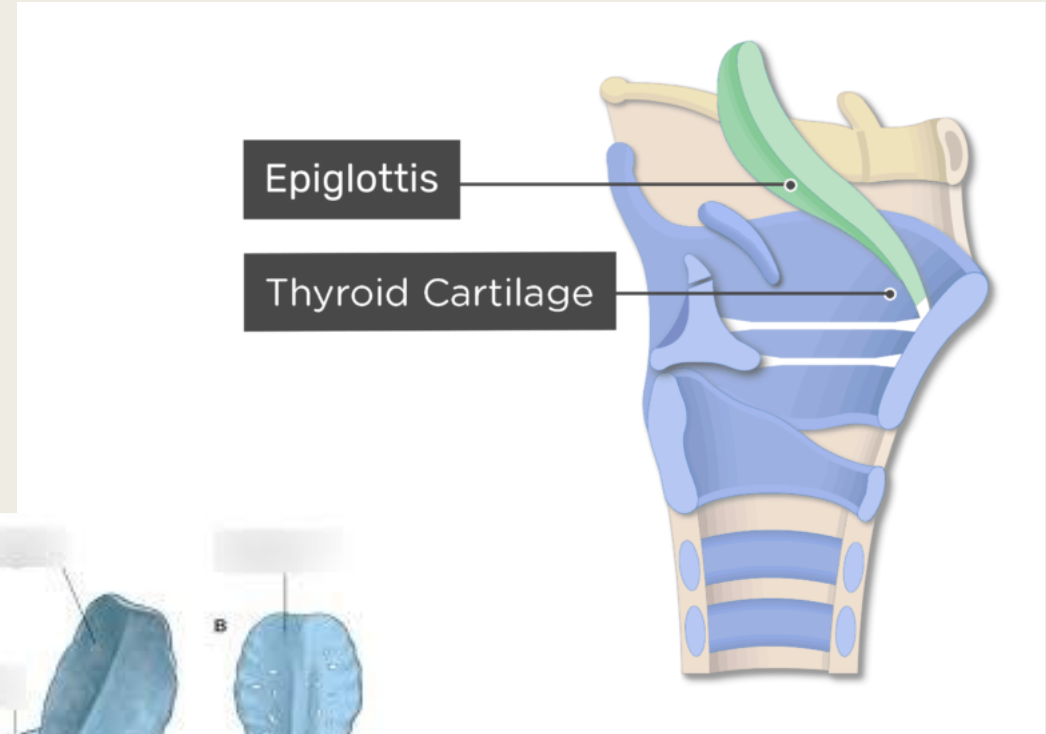
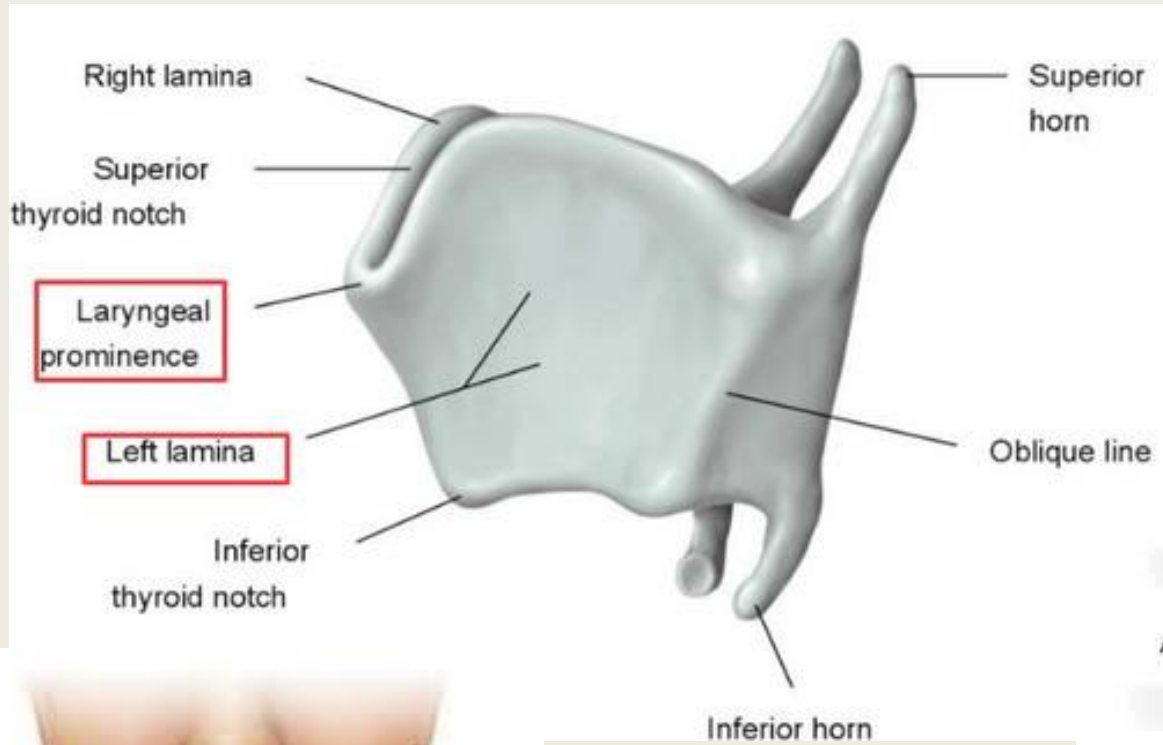


At level of C3 and C6 vertebra
Children and Women at higher level

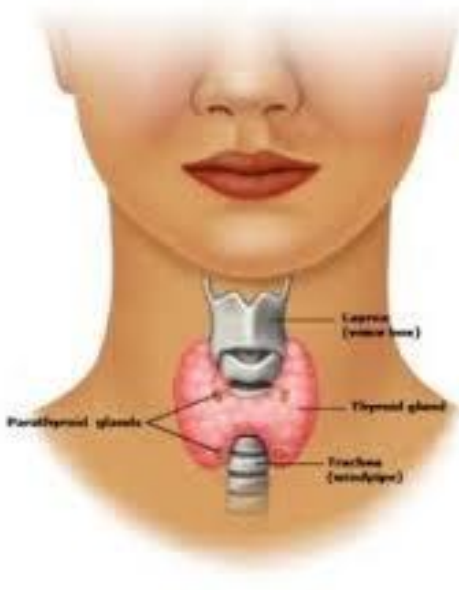
HYOID BONE

- Thyroid cartilage
- Cricoid cartilage
- Arytenoid cartilages
- Epiglottis



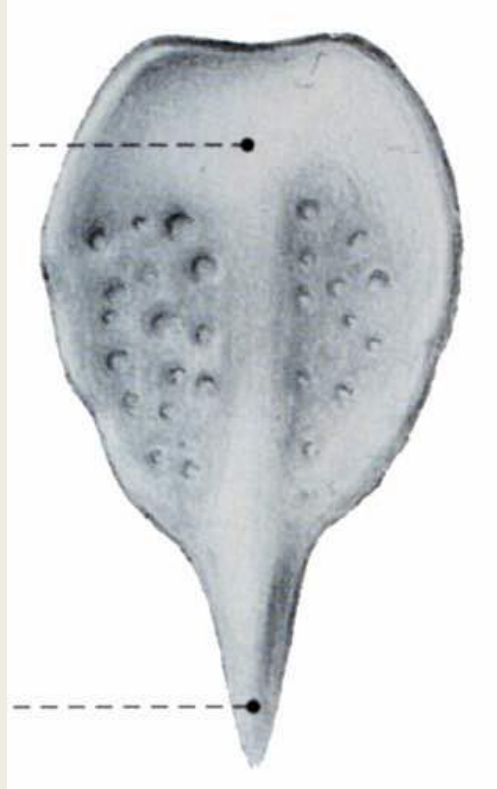


Teardrop shape fibrocartilage
 Tapers inferiorly to petiole
 Flexible and protect airways



THYROID

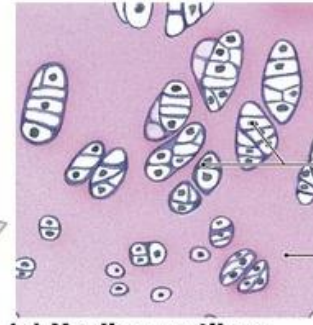
(ELASTIC CARTILAGE) EPIGLOTTIS



HYALINE CARTILAGE

LOCATIONS: Between tips of ribs and bones of sternum; covering bone surfaces at synovial joints; supporting larynx (voice box), trachea, and bronchi; forming part of nasal septum

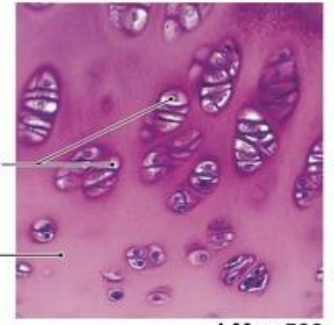
FUNCTIONS: Provides stiff but somewhat flexible support; reduces friction between bony surfaces



Chondrocytes in lacunae

Matrix

(a) Hyaline cartilage

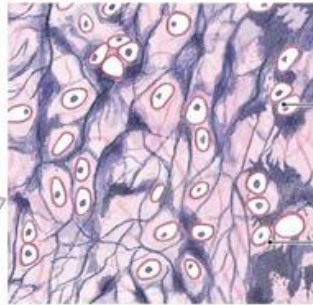


LM x 500

ELASTIC CARTILAGE

LOCATIONS: Auricle of external ear; epiglottis; auditory tube; cuneiform cartilages of larynx

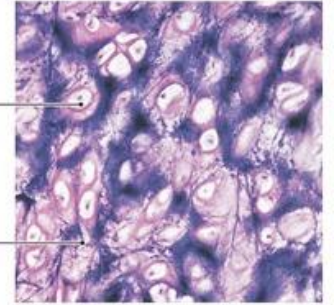
FUNCTIONS: Provides support, but tolerates distortion without damage and returns to original shape



Chondrocyte in lacuna

Elastic fibers in matrix

(b) Elastic cartilage

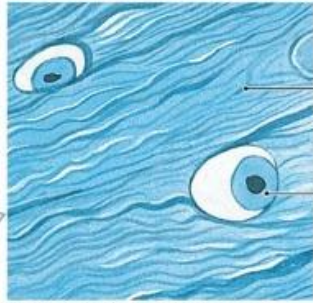


LM x 358

FIBROUS CARTILAGE

LOCATIONS: Pads within knee joint; between pubic bones of pelvis; intervertebral discs

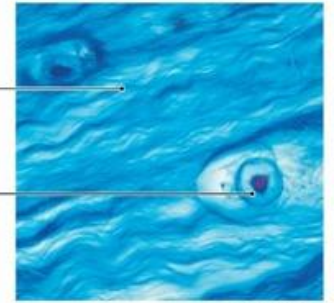
FUNCTIONS: Resists compression; prevents bone-to-bone contact; limits relative movement



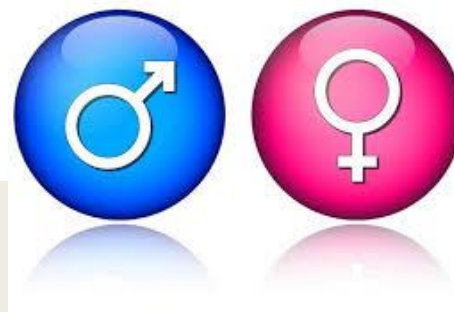
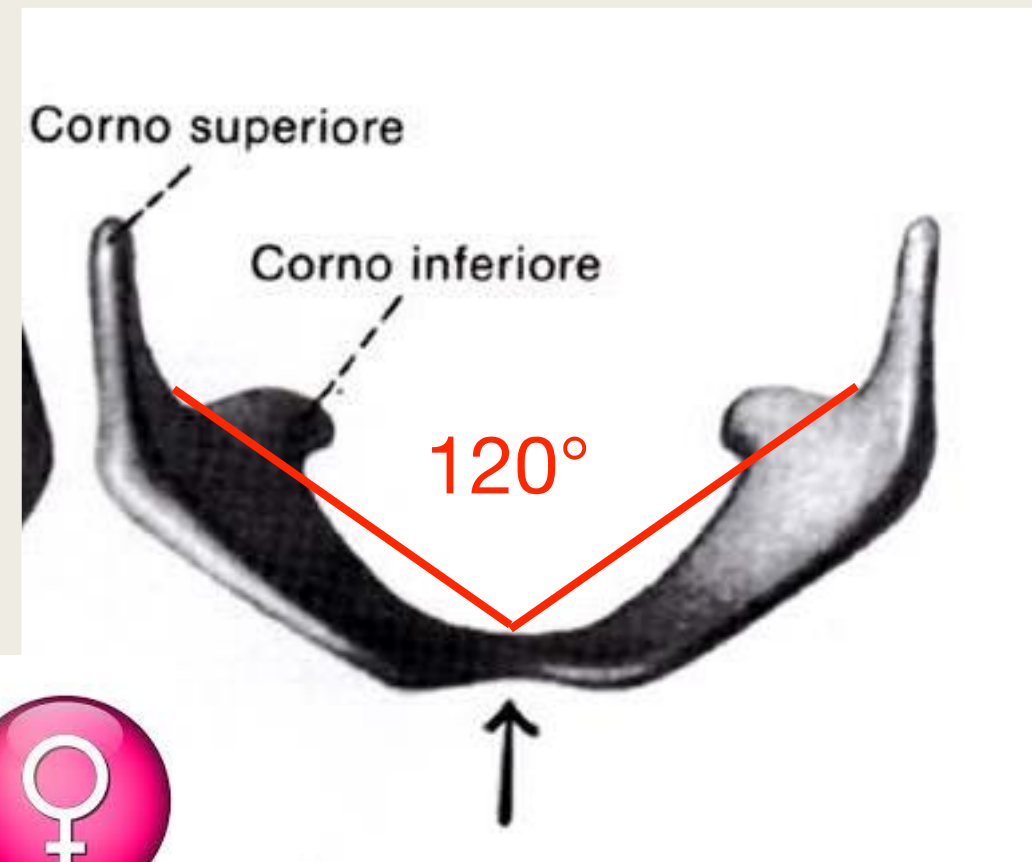
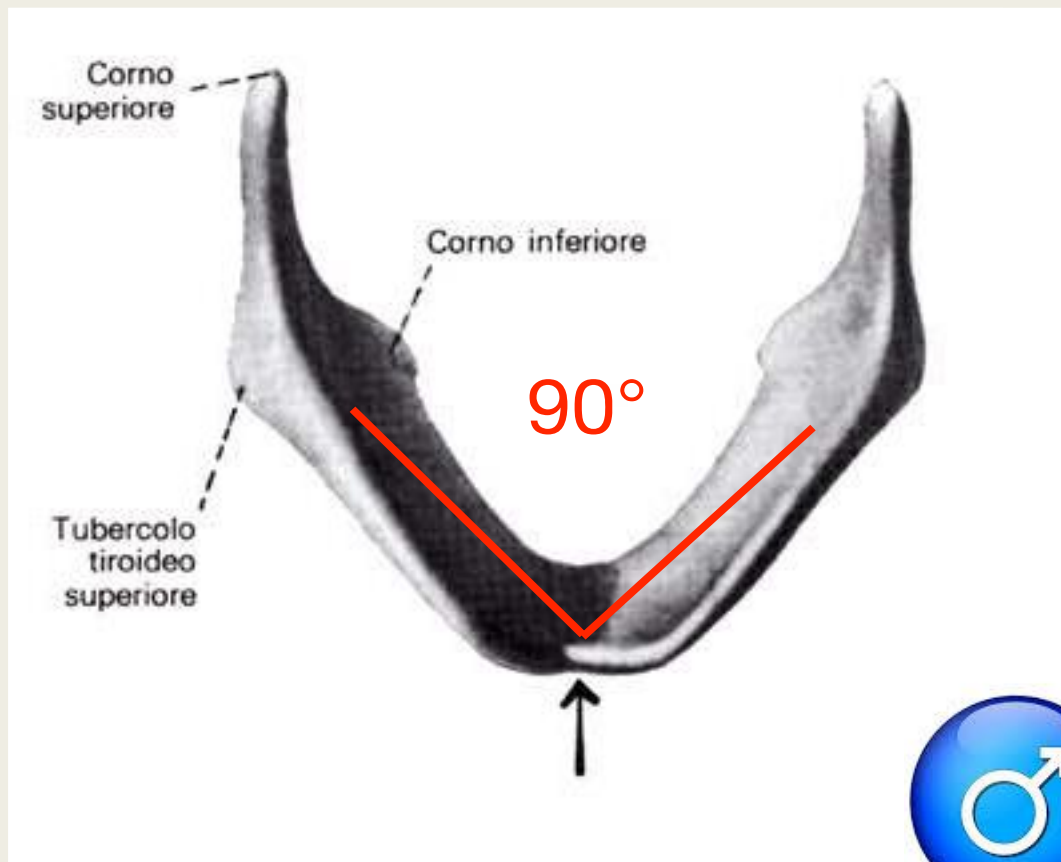
Collagen fibers in matrix

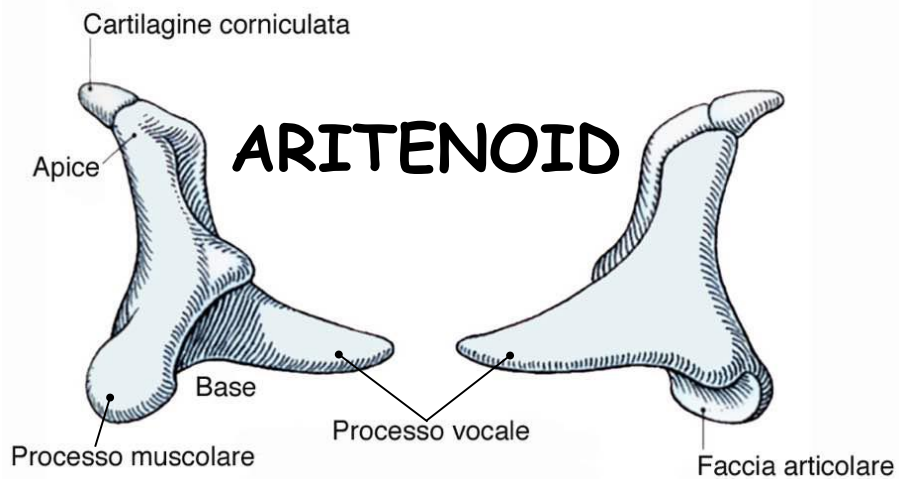
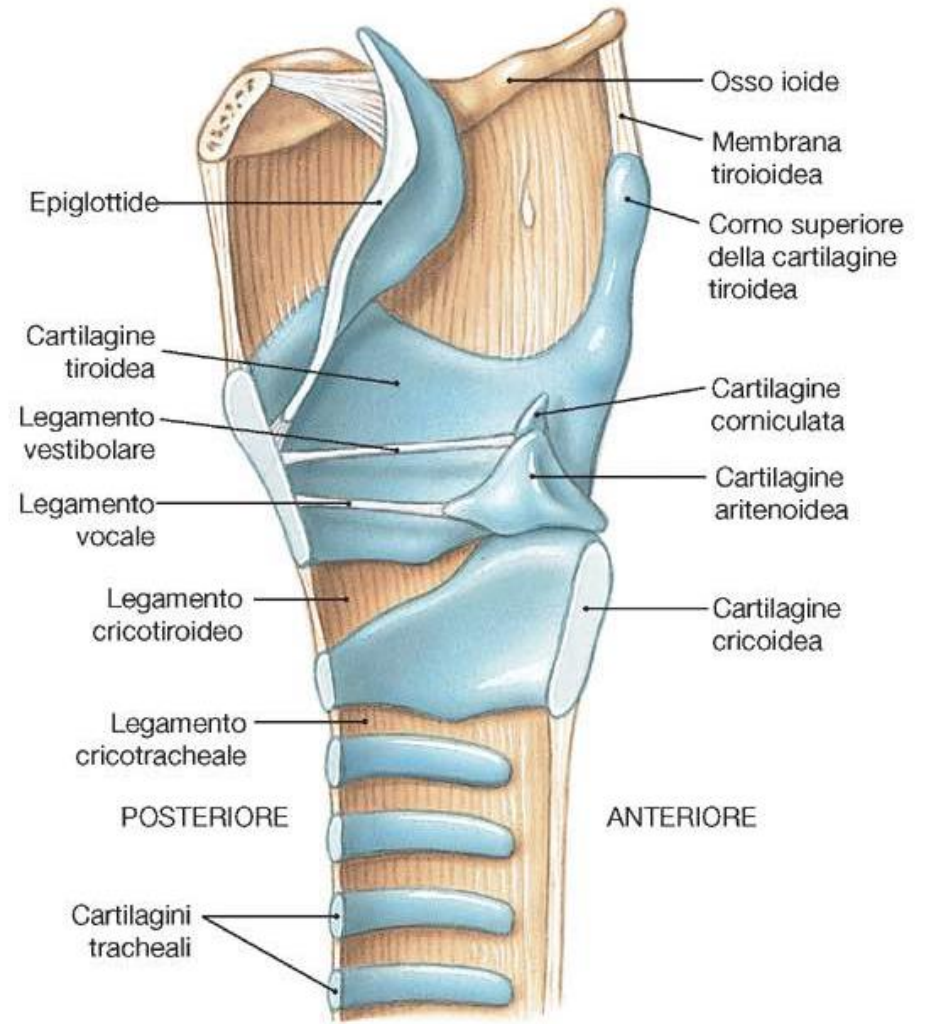
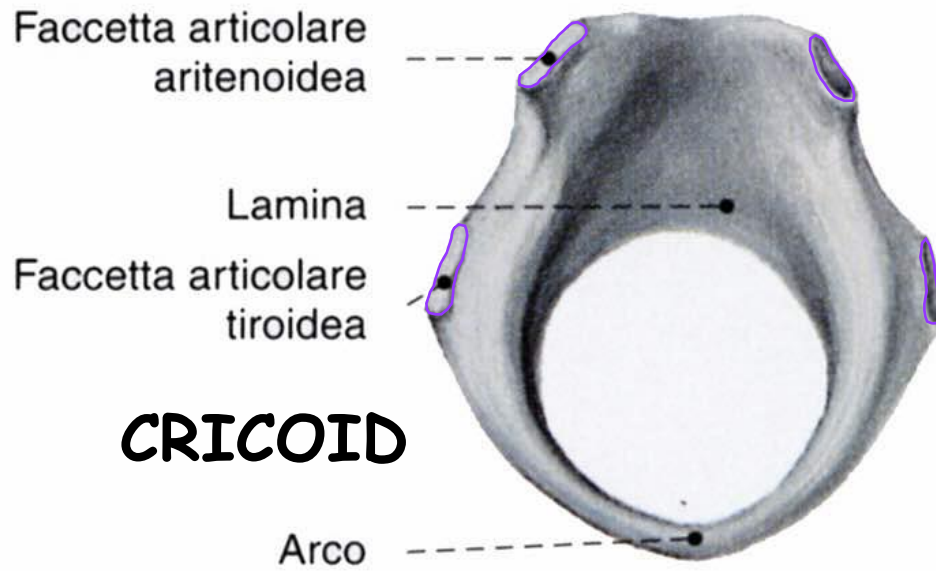
Chondrocyte in lacuna

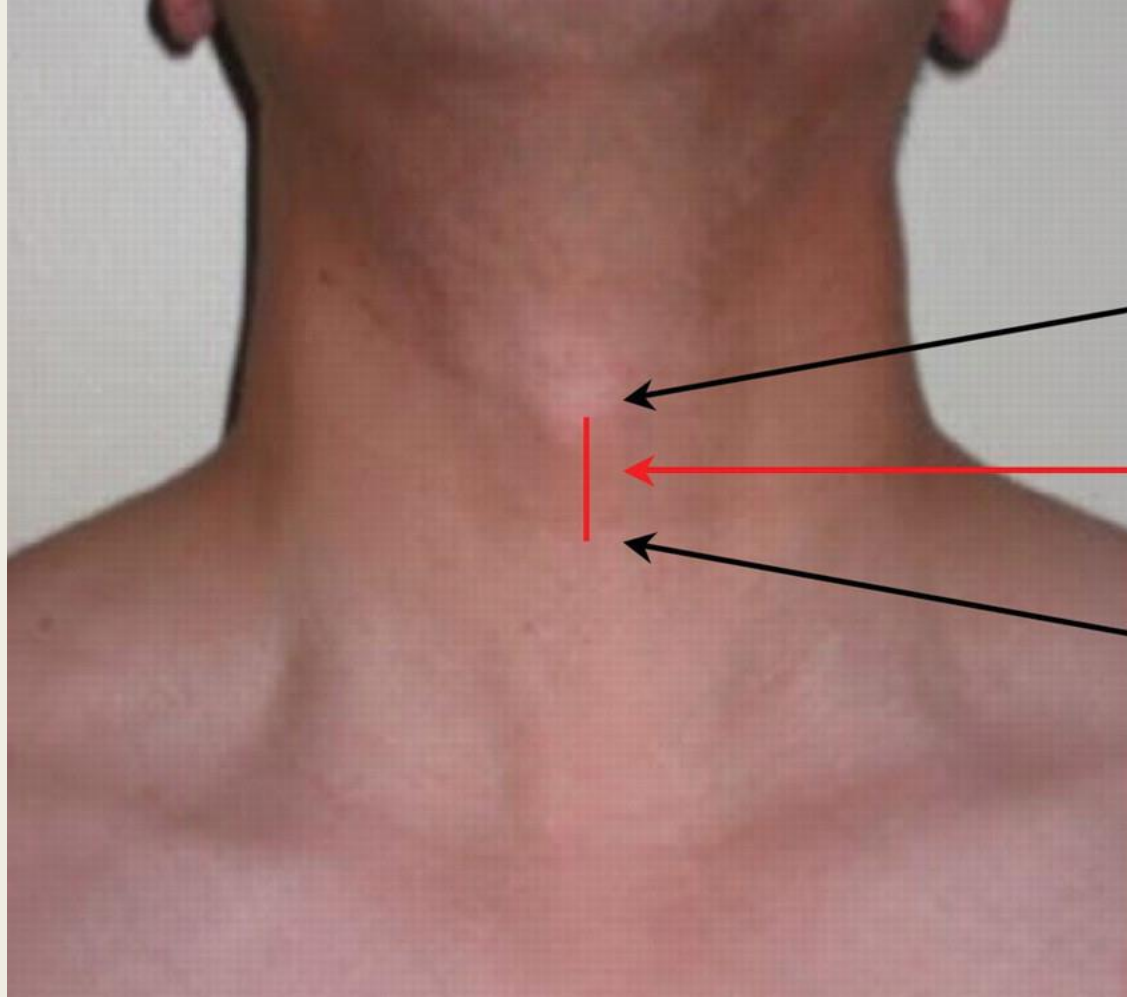
(c) Fibrous cartilage



LM x 1000





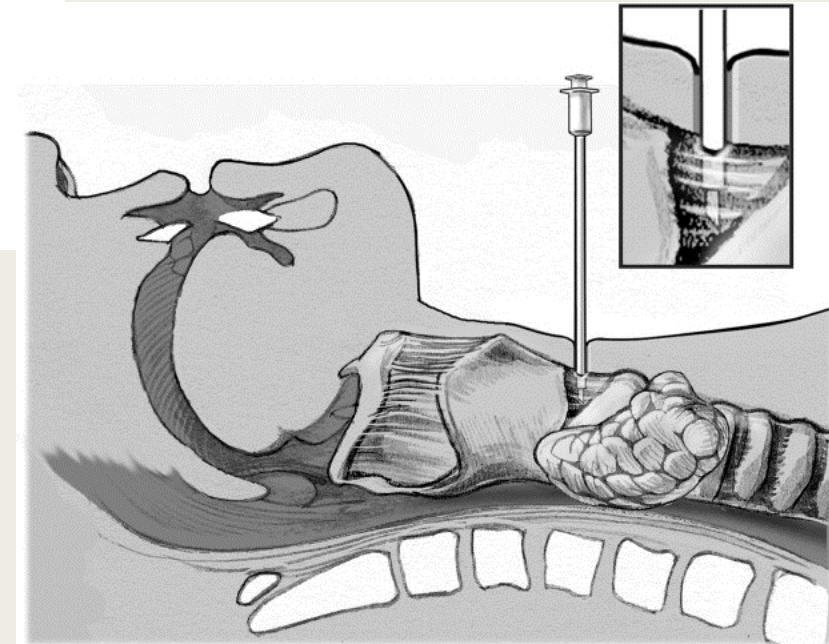


Thyroid cartilage

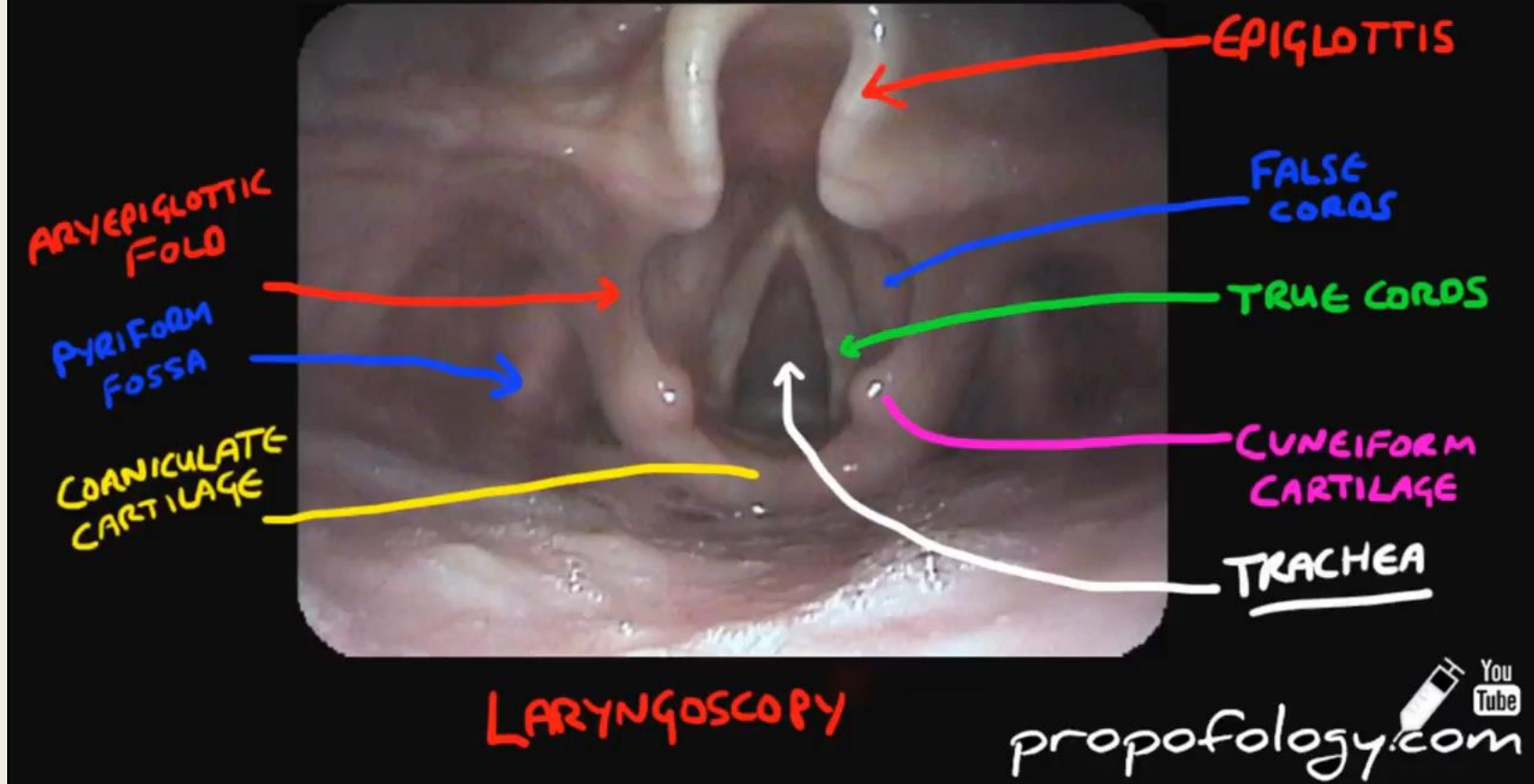
Incision

Cricoid cartilage

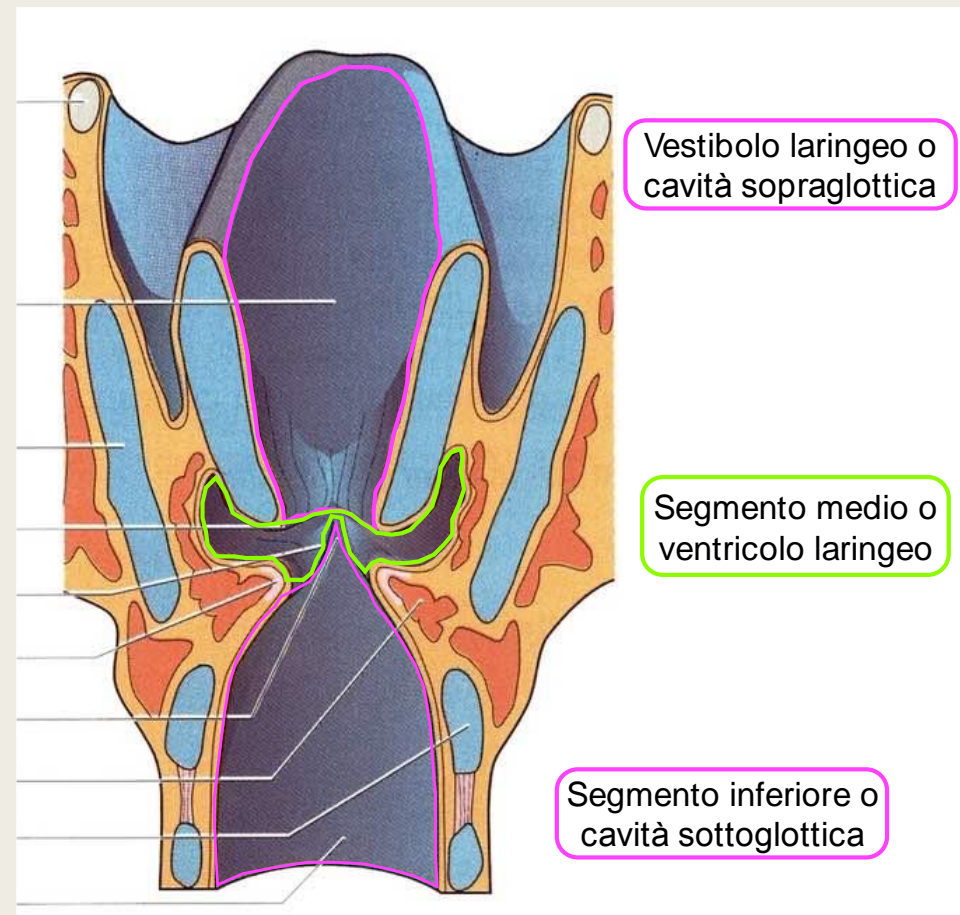
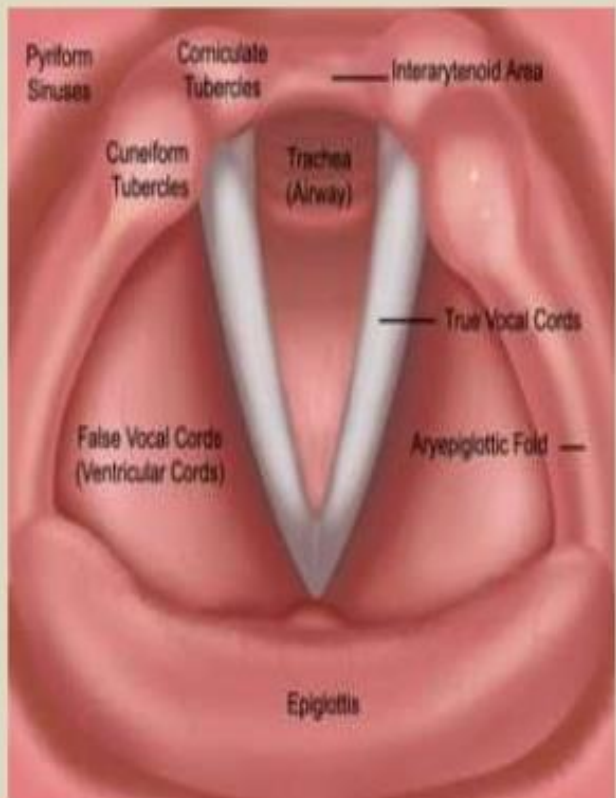
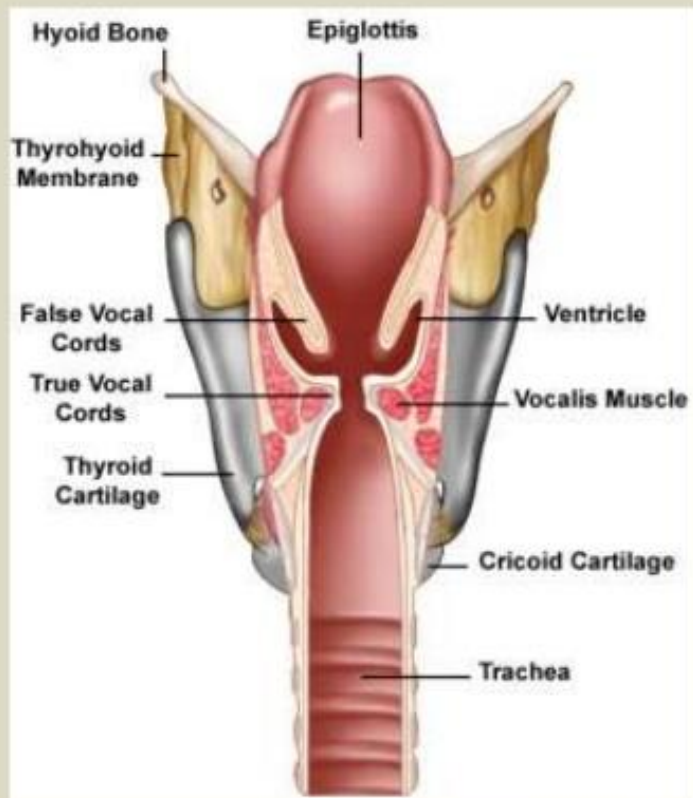
EMERGENCY CRICOTOMY



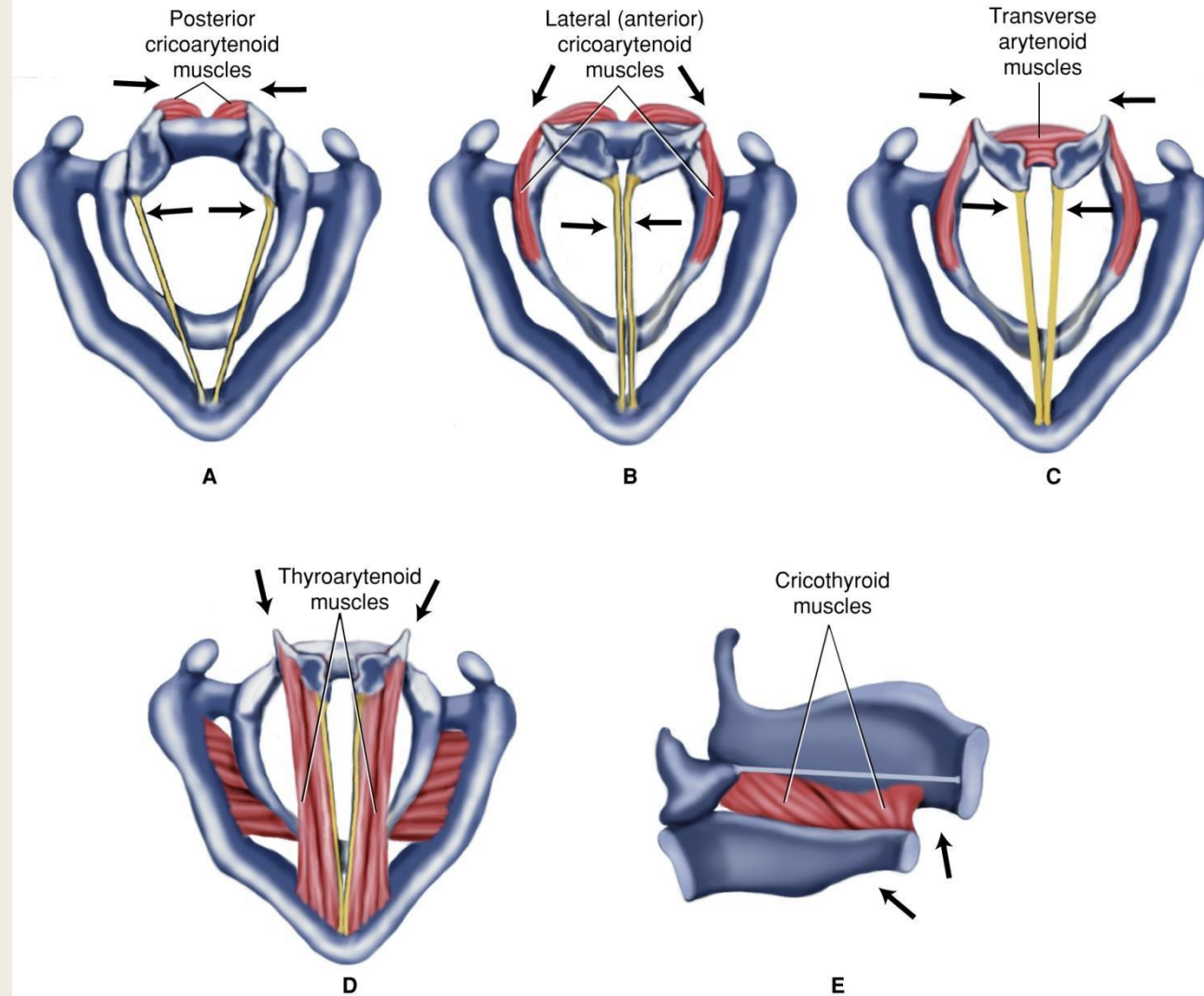
VOCAL CORD ANATOMY LESSON

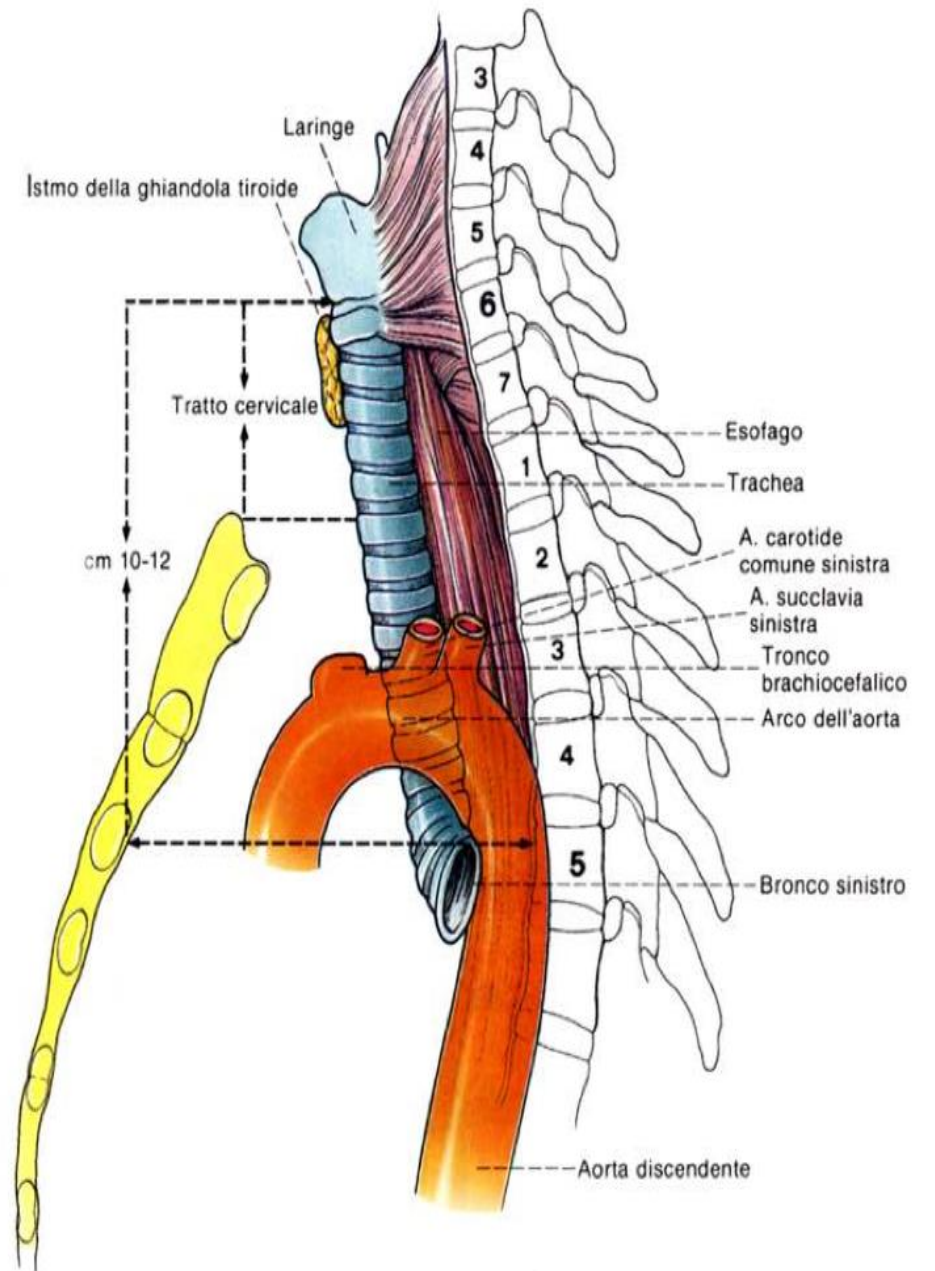
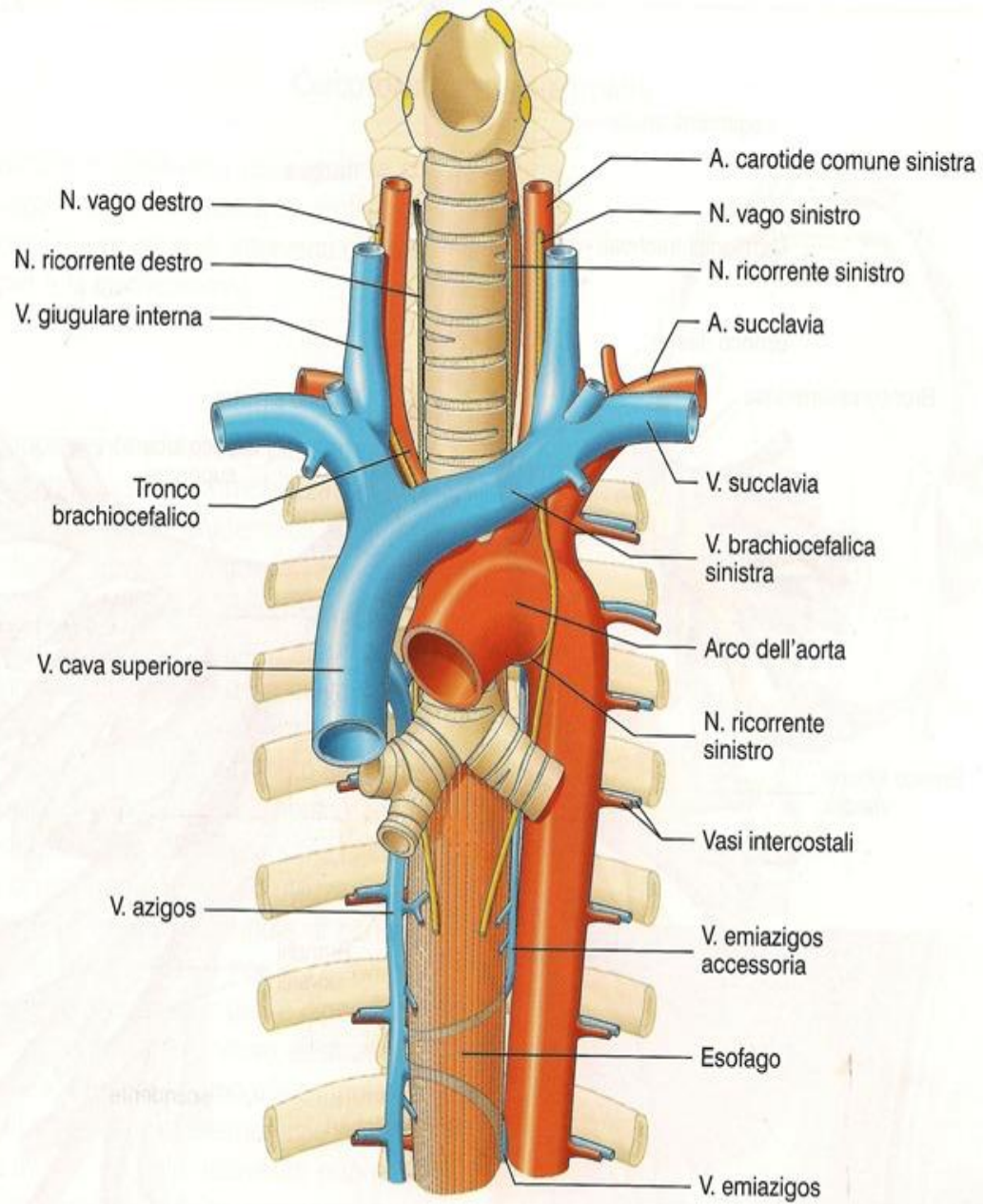


Radiological anatomy of the larynx and trachea.

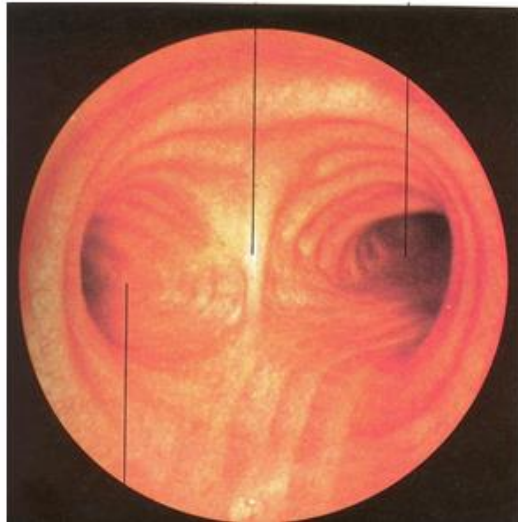


Intrinsic Laryngeal Muscles



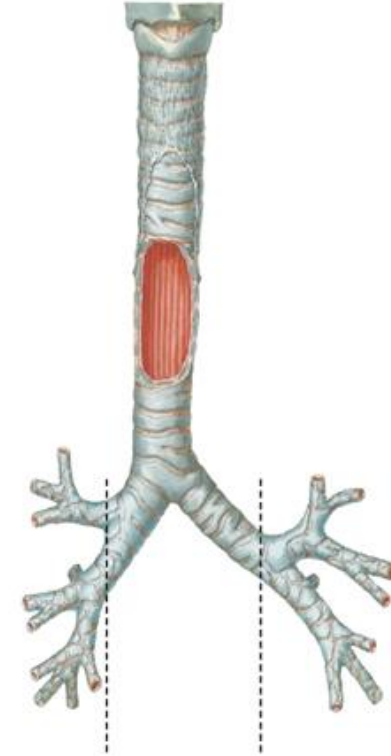


- Conducting portion from larynx, divides into right and left primary bronchi
- 16-20 rings of cartilage
- Carina- ridge inside at bifurcation of primary bronchi

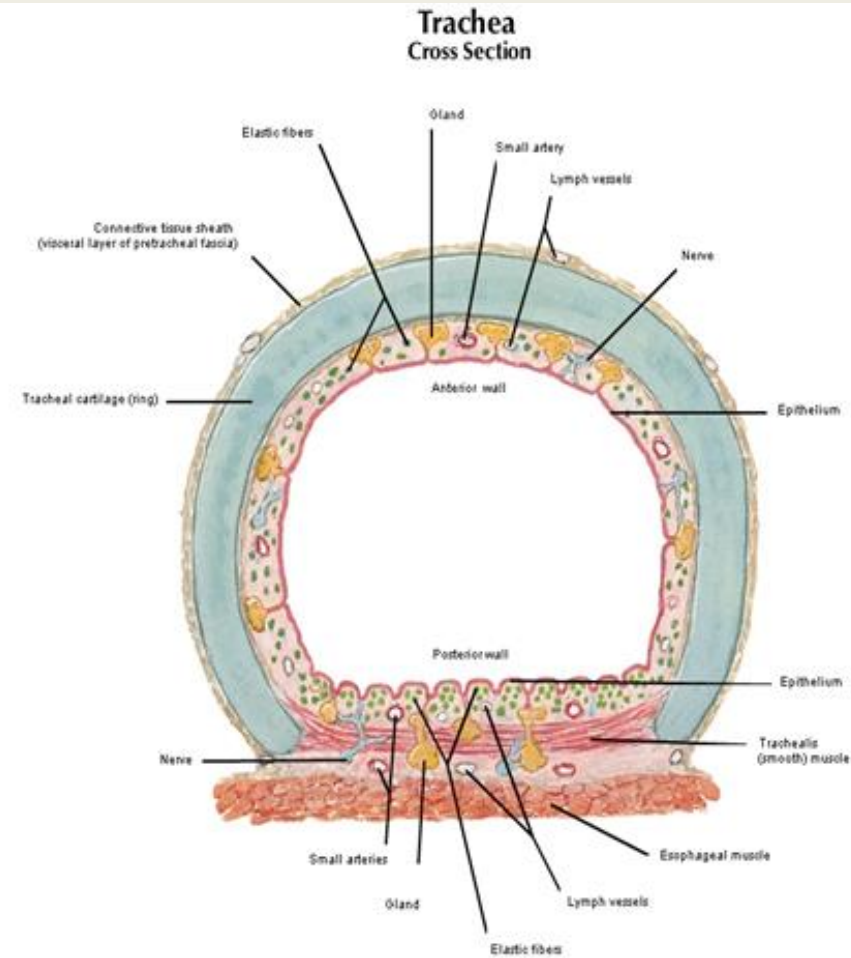


TRACHEA*

Trachea and Major Bronchi
Anterior View

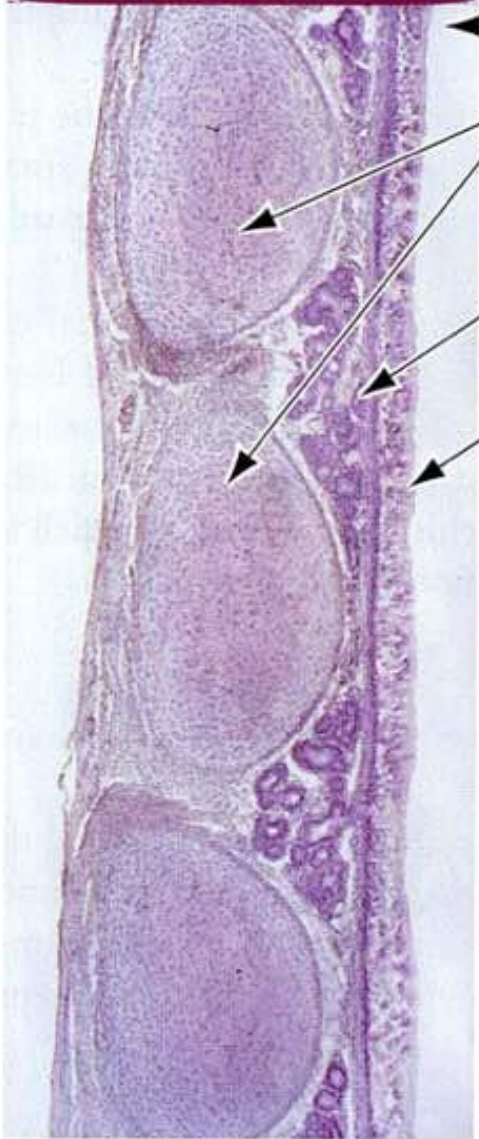


- C-shaped rings of cartilage.
- Helps keep the trachea open or patent.



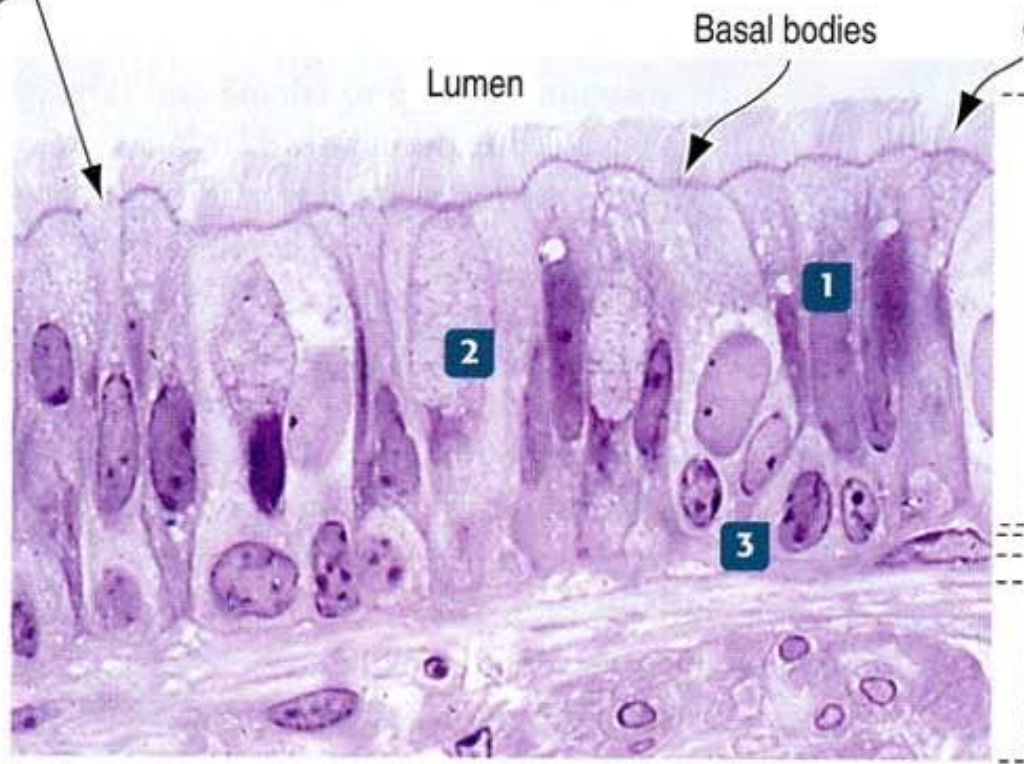
F. Netter M.D.
MIN

Trachea



Luminal surface
Cross section of hyaline cartilage rings
Seromucous glands
Respiratory epithelium

- 1 Columnar ciliated cell
- 2 Goblet cell
- 3 Basal cell



Lumen
Basal bodies
Cilia

Respiratory epithelium: pseudostratified columnar epithelium with ciliated cells, goblet and basal cells

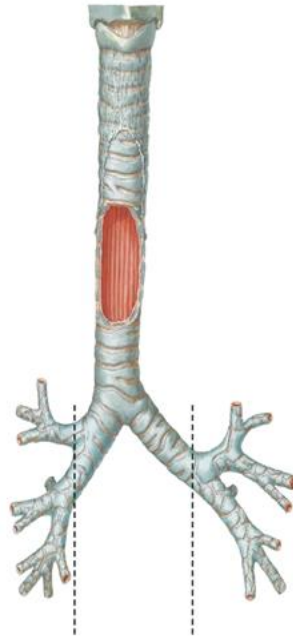
Basal lamina

Lamina propria

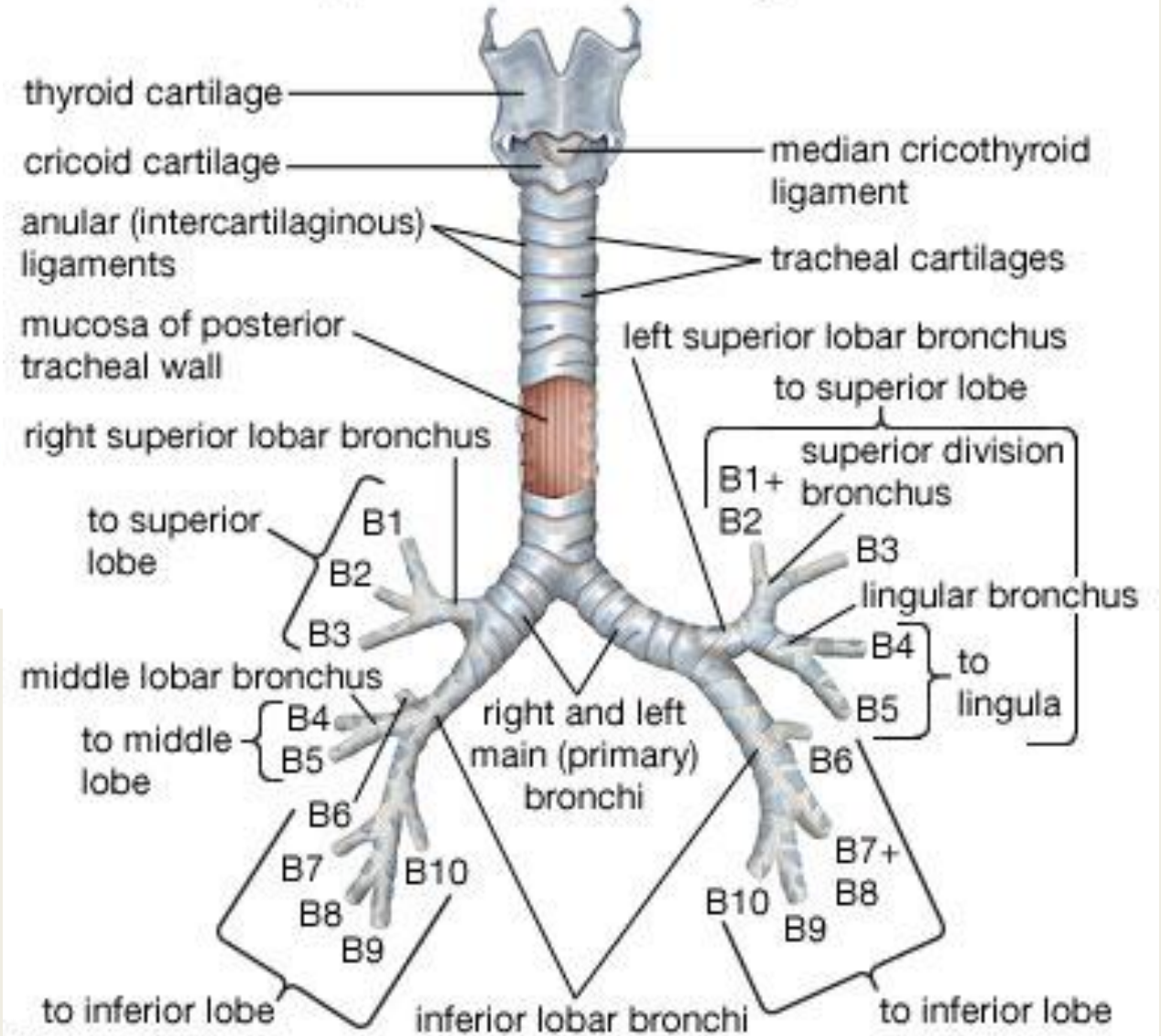
PRIMARY BRONCHI*

- The trachea divides into one primary bronchi to each lung.
- Primary bronchi have cartilage.

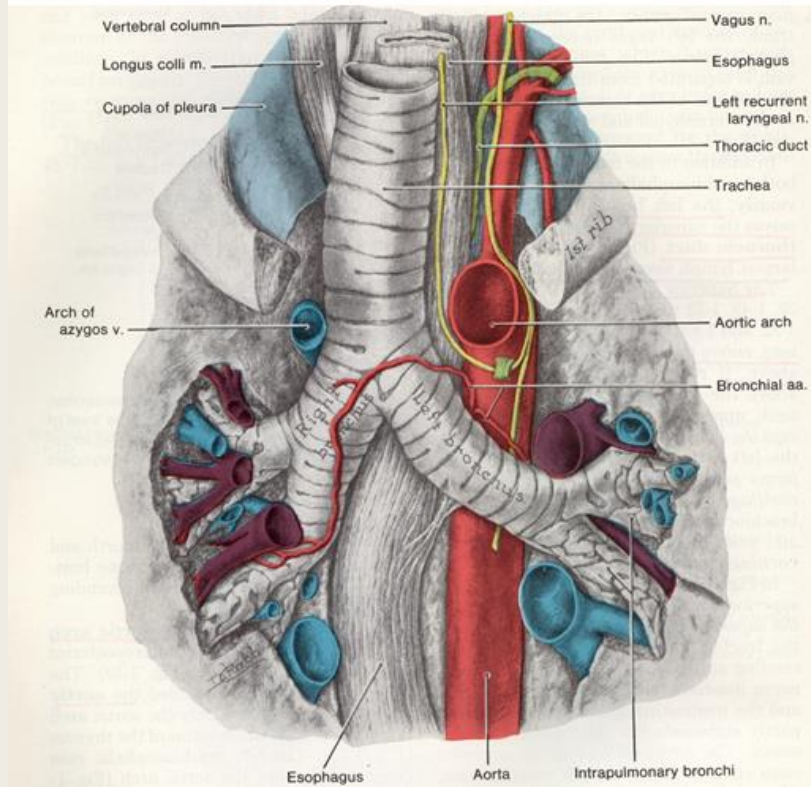
Trachea and Major Bronchi
Anterior View



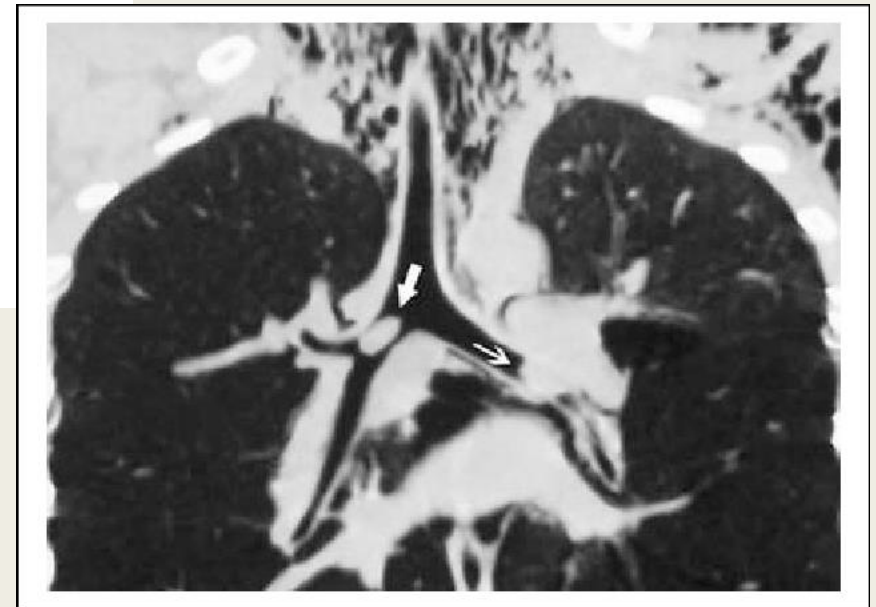
Trachea and major bronchi of the lungs



RIGHT BRONCHUS-CLINICAL CORRELATION*



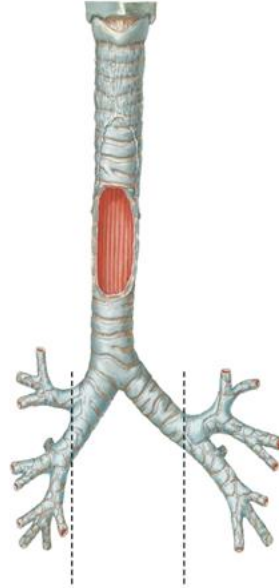
- Right Primary bronchus is more vertical, wider and shorter
- Aspirated objects have a tendency to go here



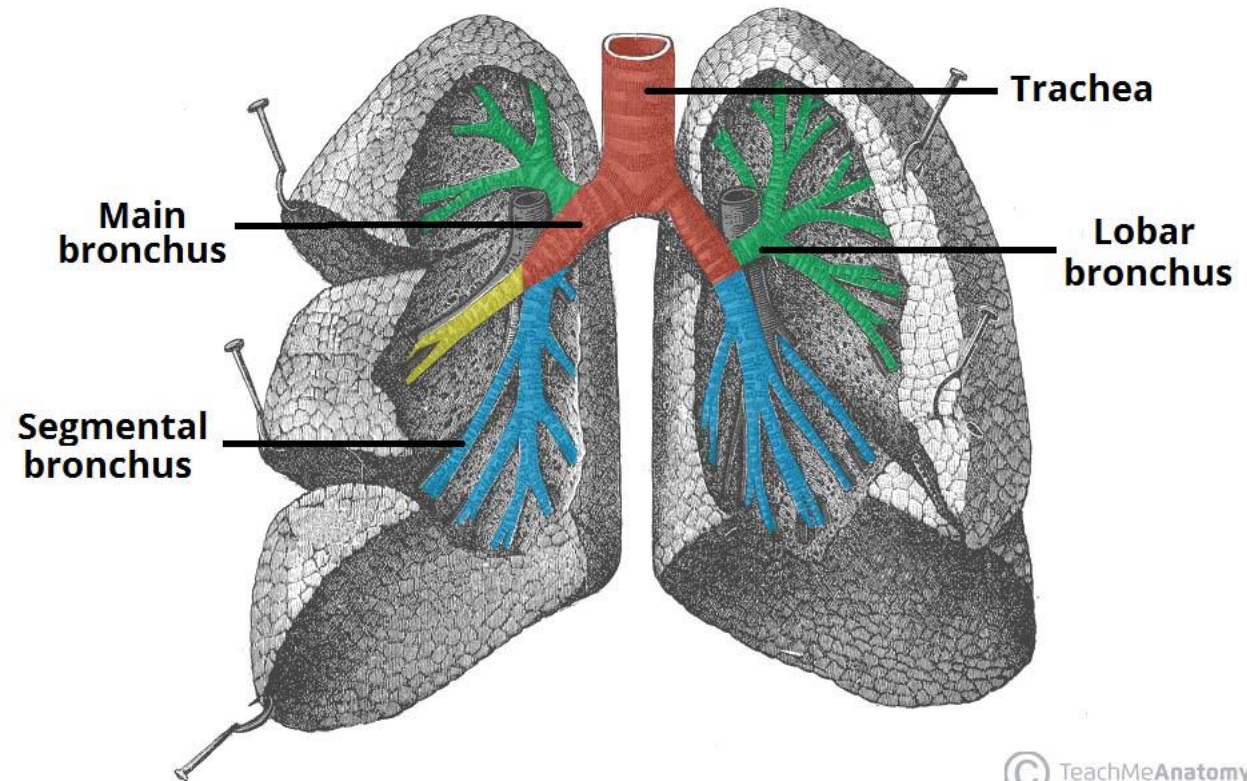
SECONDARY BRONCHI*

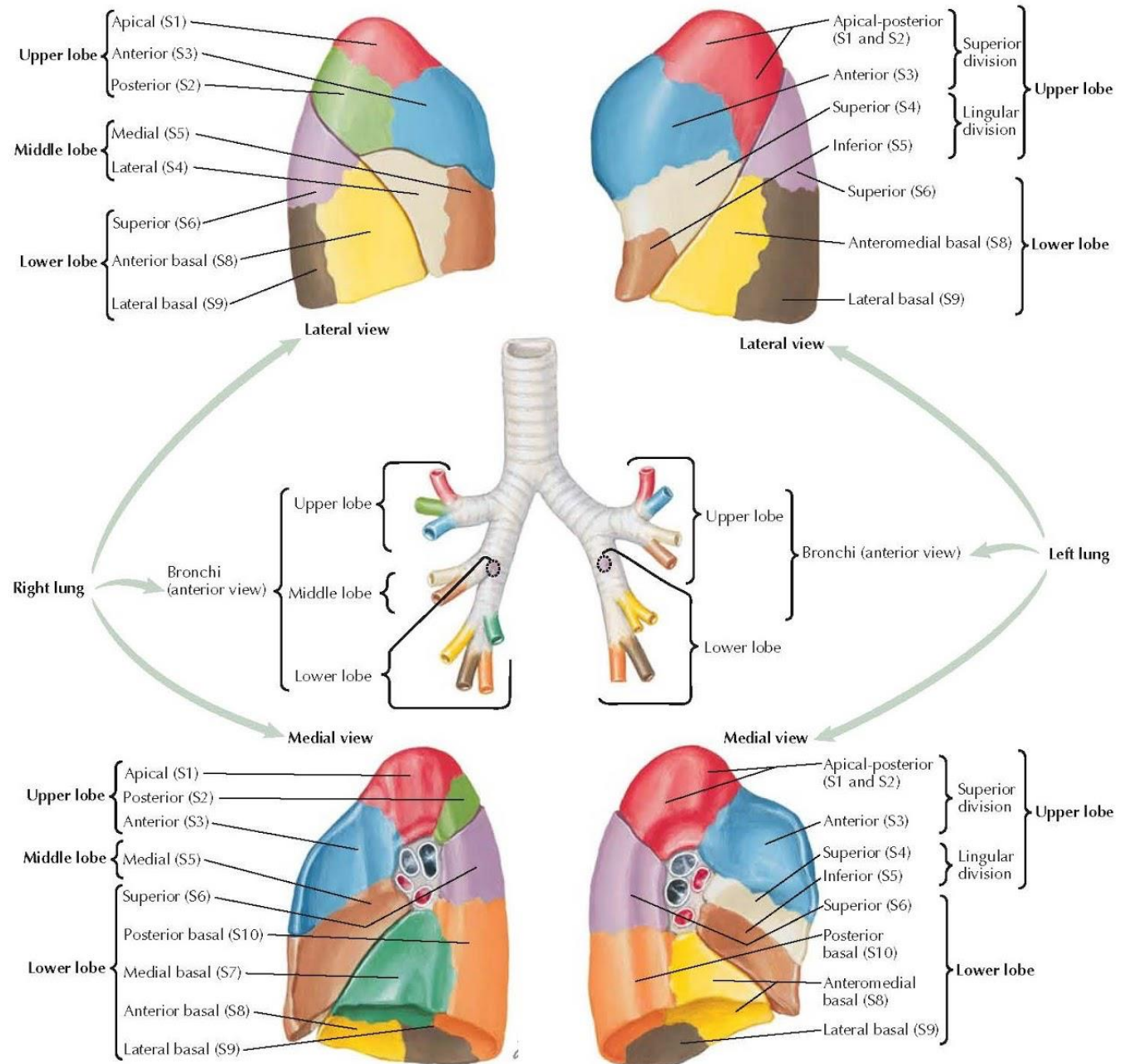
- Secondary bronchi or lobar bronchi divide from the primary bronchi and **one goes to each lobe.**
- Three secondary bronchi to the right and two to the left.

Trachea and Major Bronchi
Anterior View



F. Netter
M.D.







14,15,16



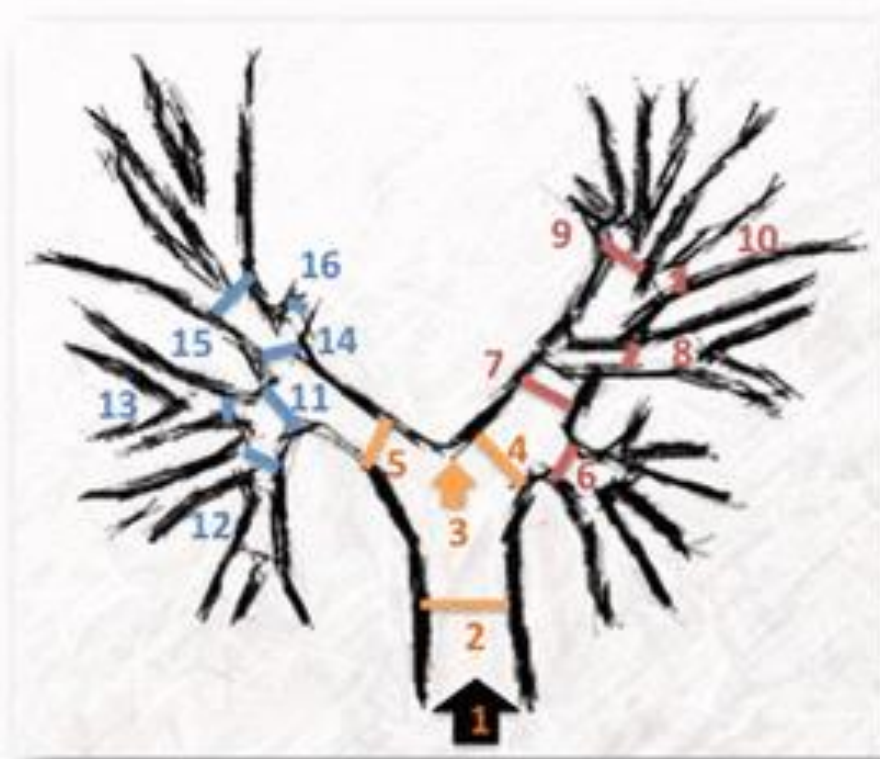
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12



11



9



10



8



7



4



6



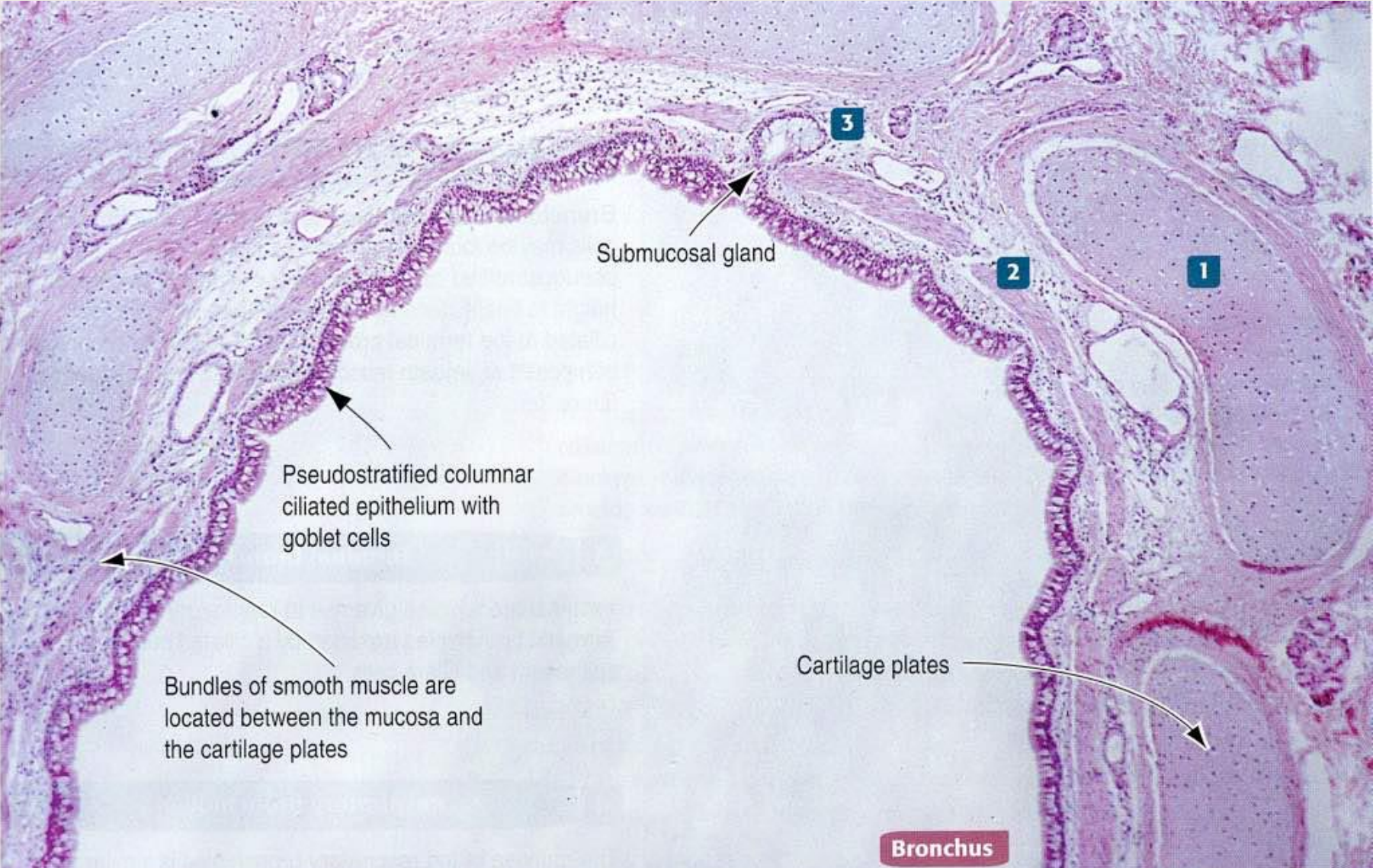
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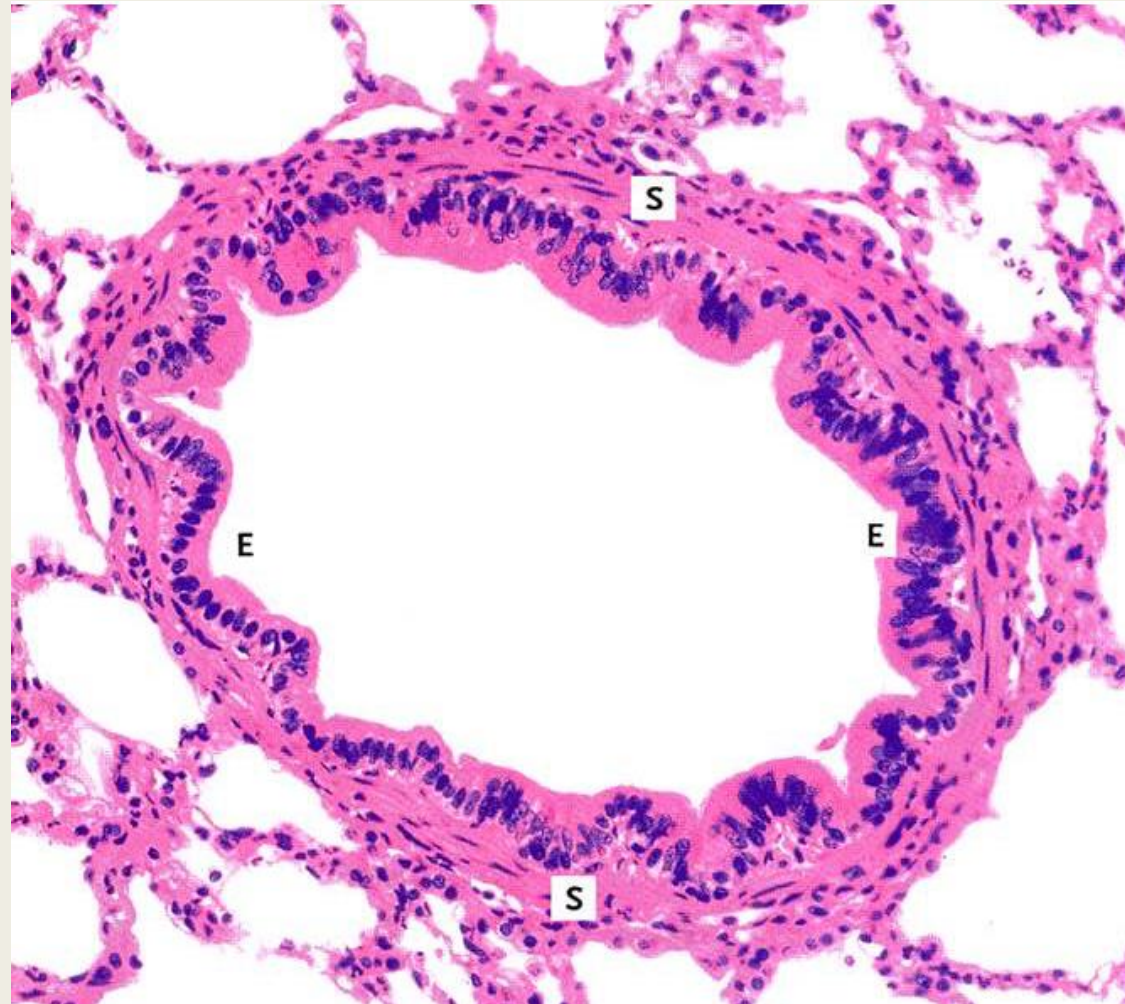
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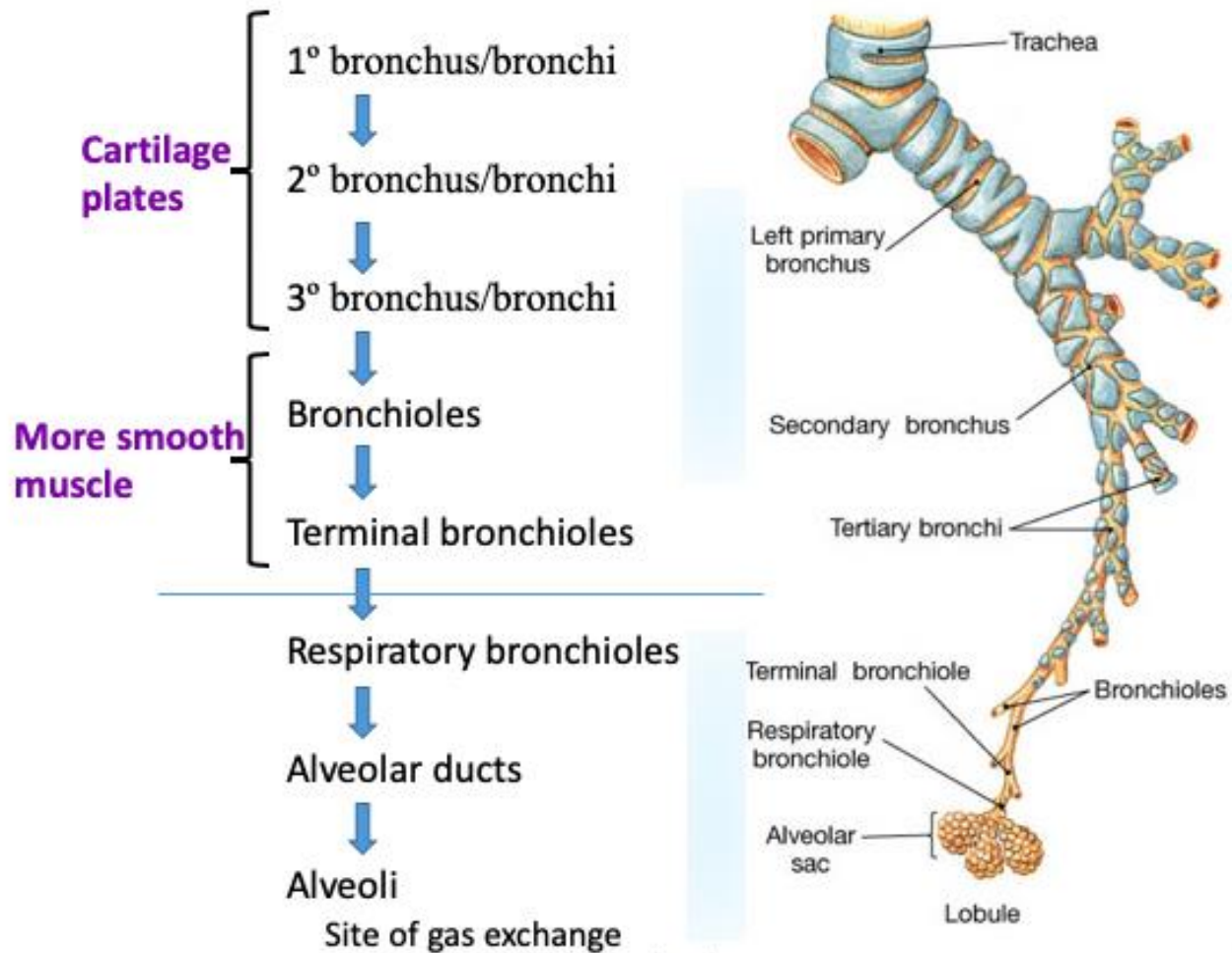


BRONCHIAL STRUCTURE



BRONCHIOLAR STRUCTURE



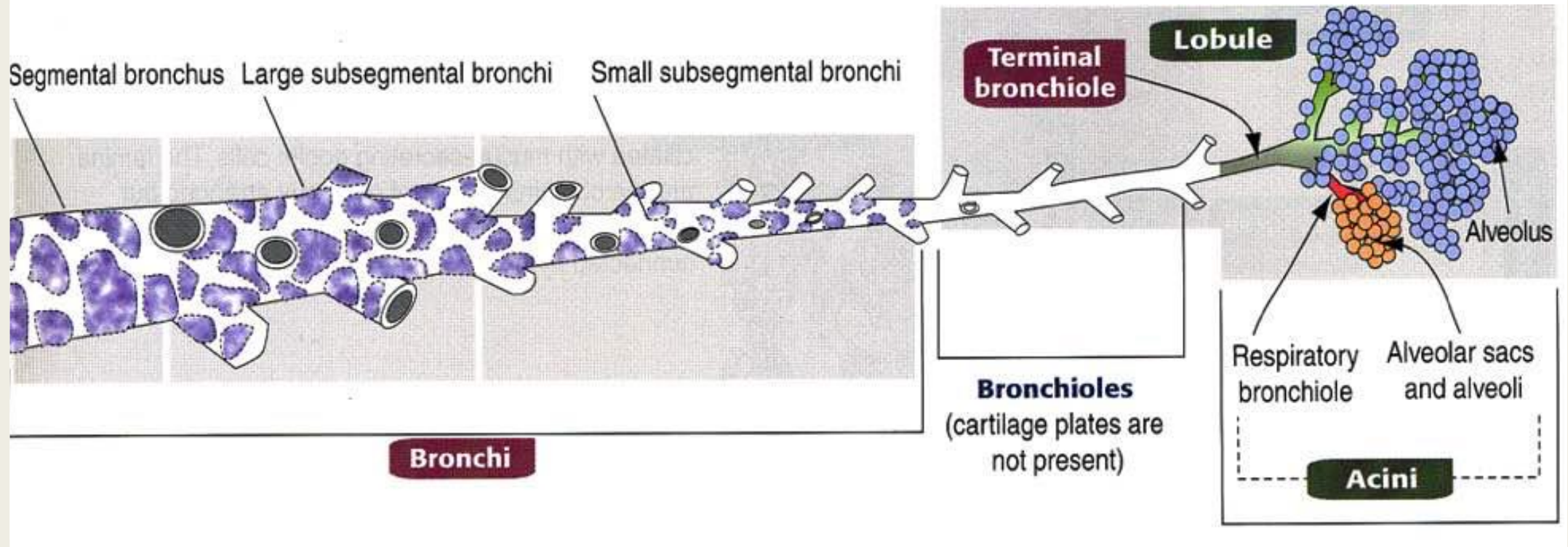


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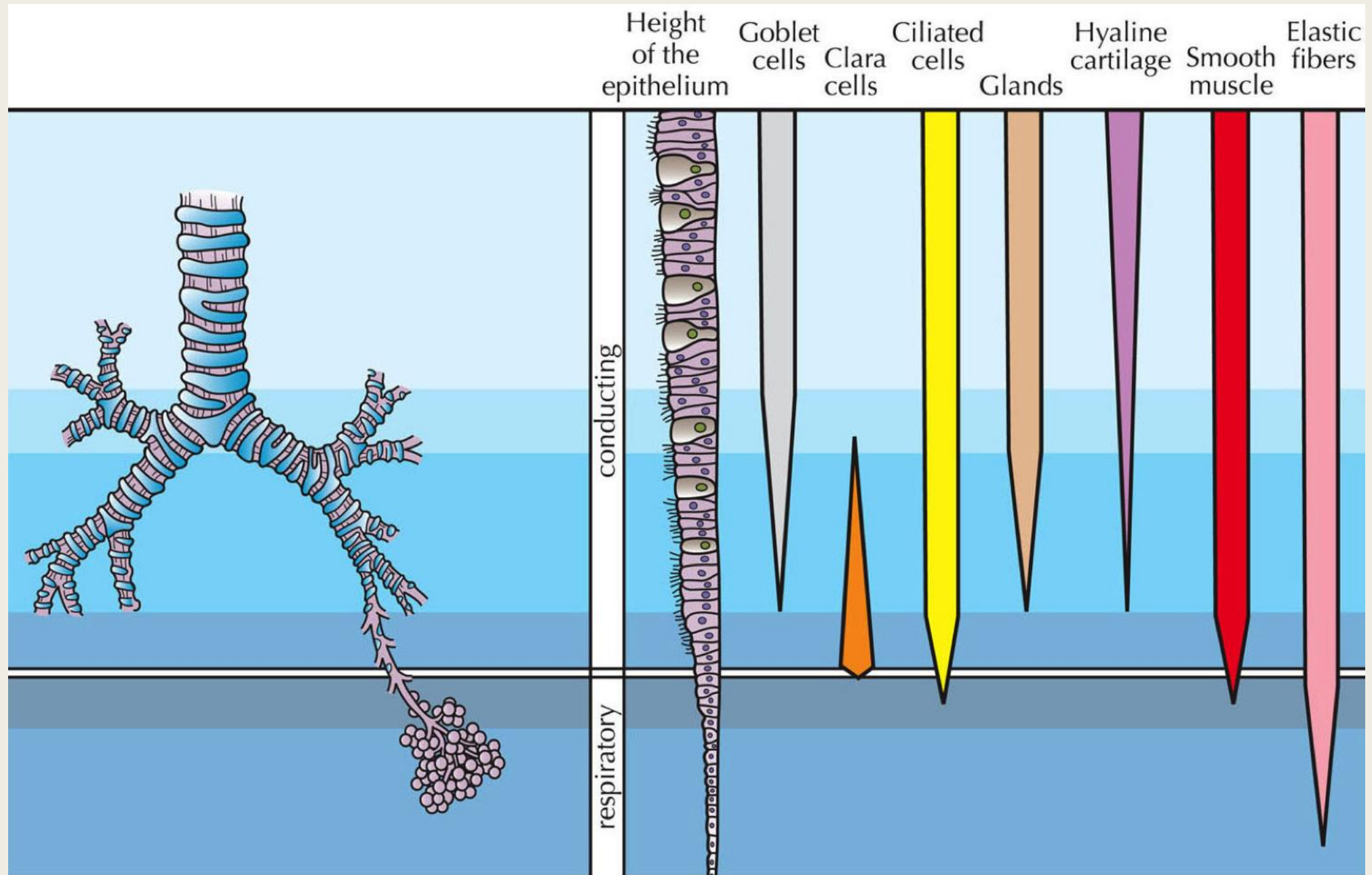
		(approx diameter)	
conducting zone	Bronchi	(~10mm)	1
			2
			3
	Bronchioles	(~3mm)	4
			5
	Terminal Bronchioles	(~1mm)	16
transitional and respiratory zones	Respiratory Bronchioles		17
			18
			19
	Alveolar Ducts		20
			21
			22

A **Terminal bronchiole** supplies air to a lung lobule. Each respiratory bronchiole, derived from a terminal bronchiole, organizes a pulmonary acinus, the functional unit of the lung



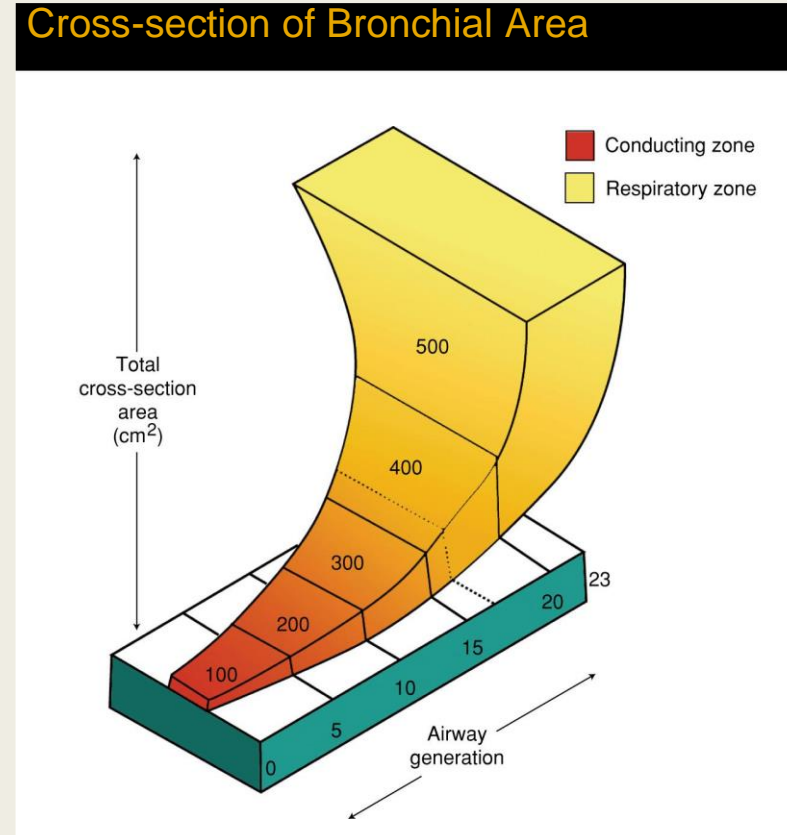
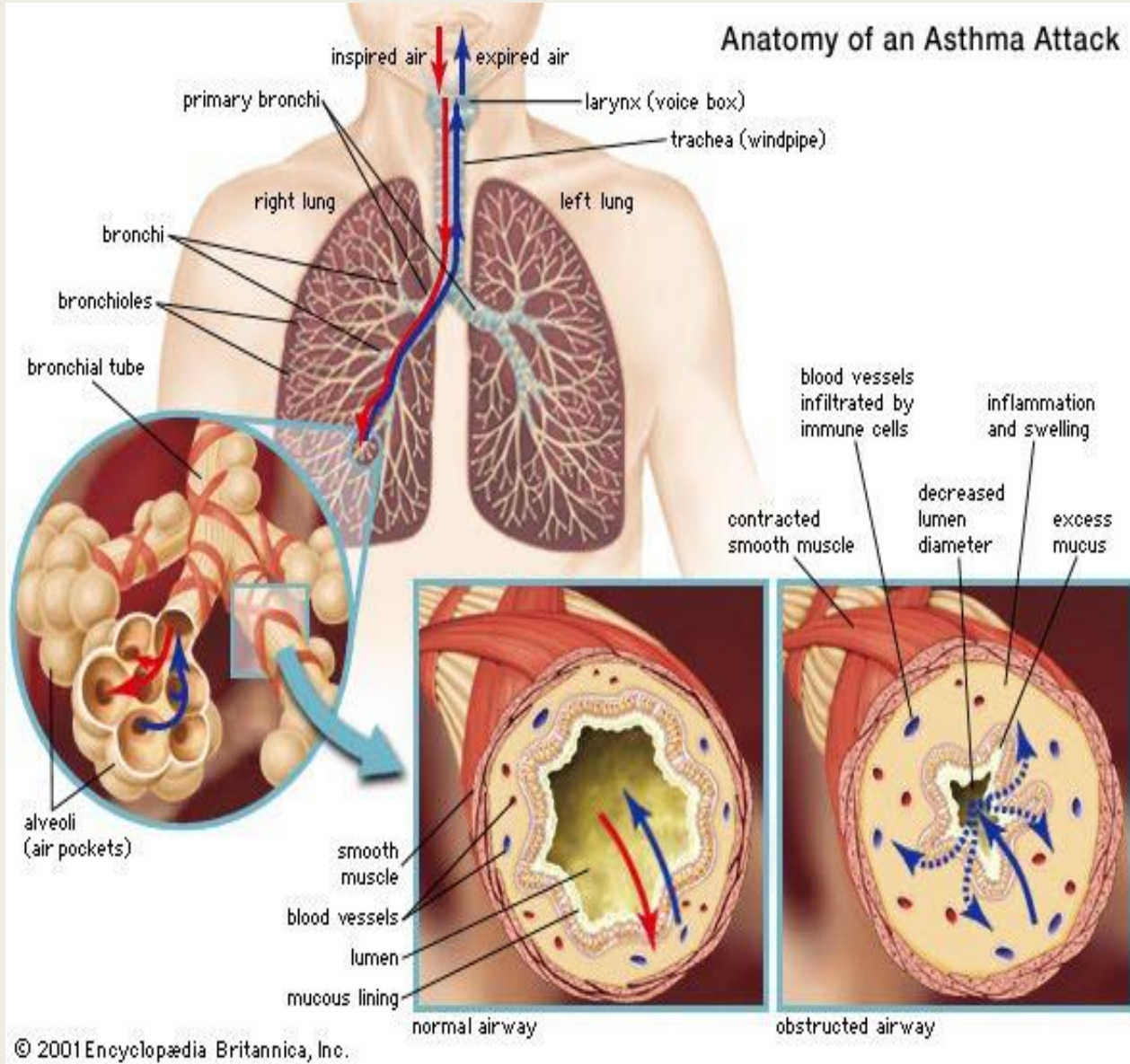
Bronchi: have cartilage in the walls. As the ramifications progress, hyaline cartilage is replaced by elastic cartilage.

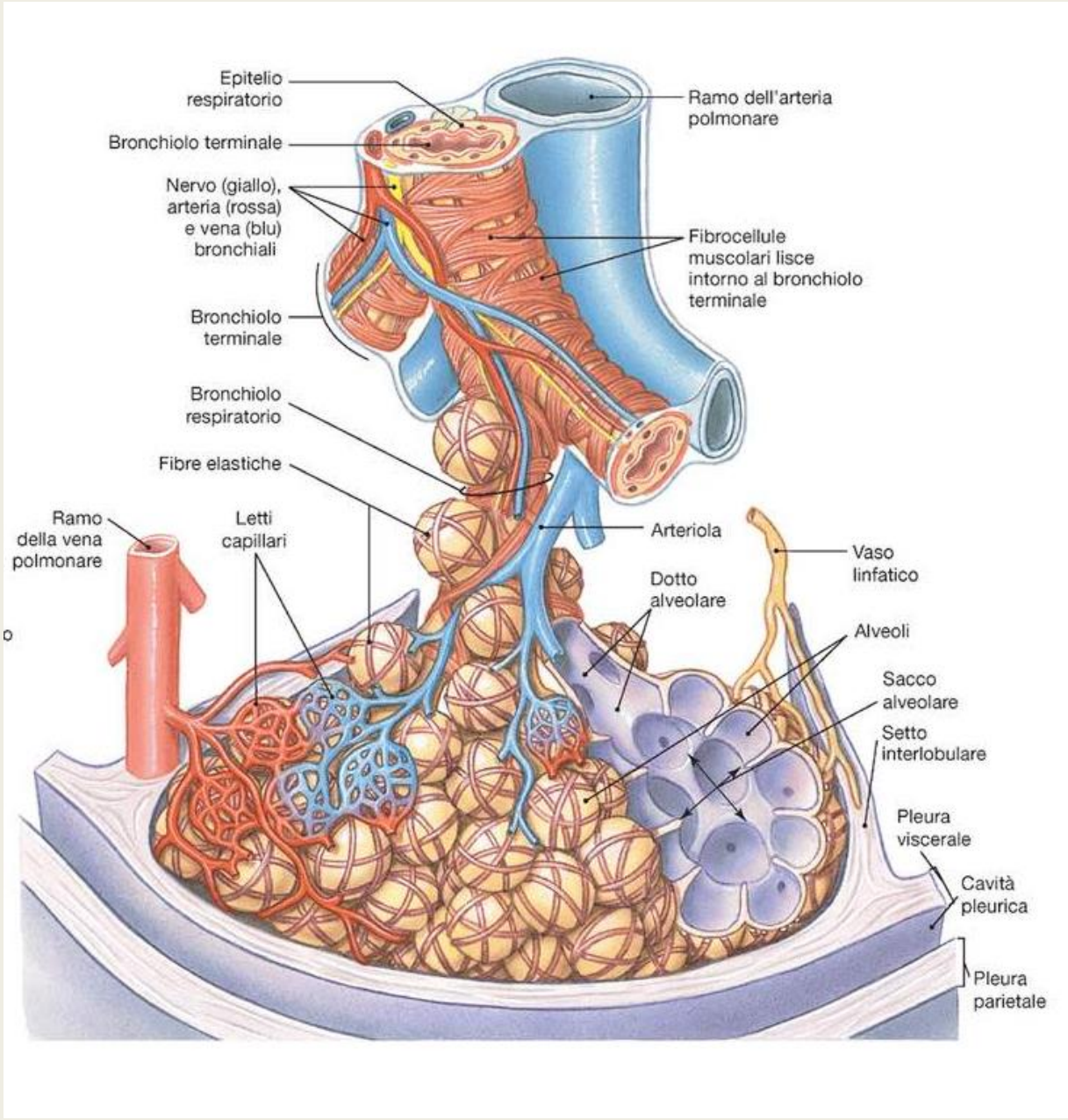
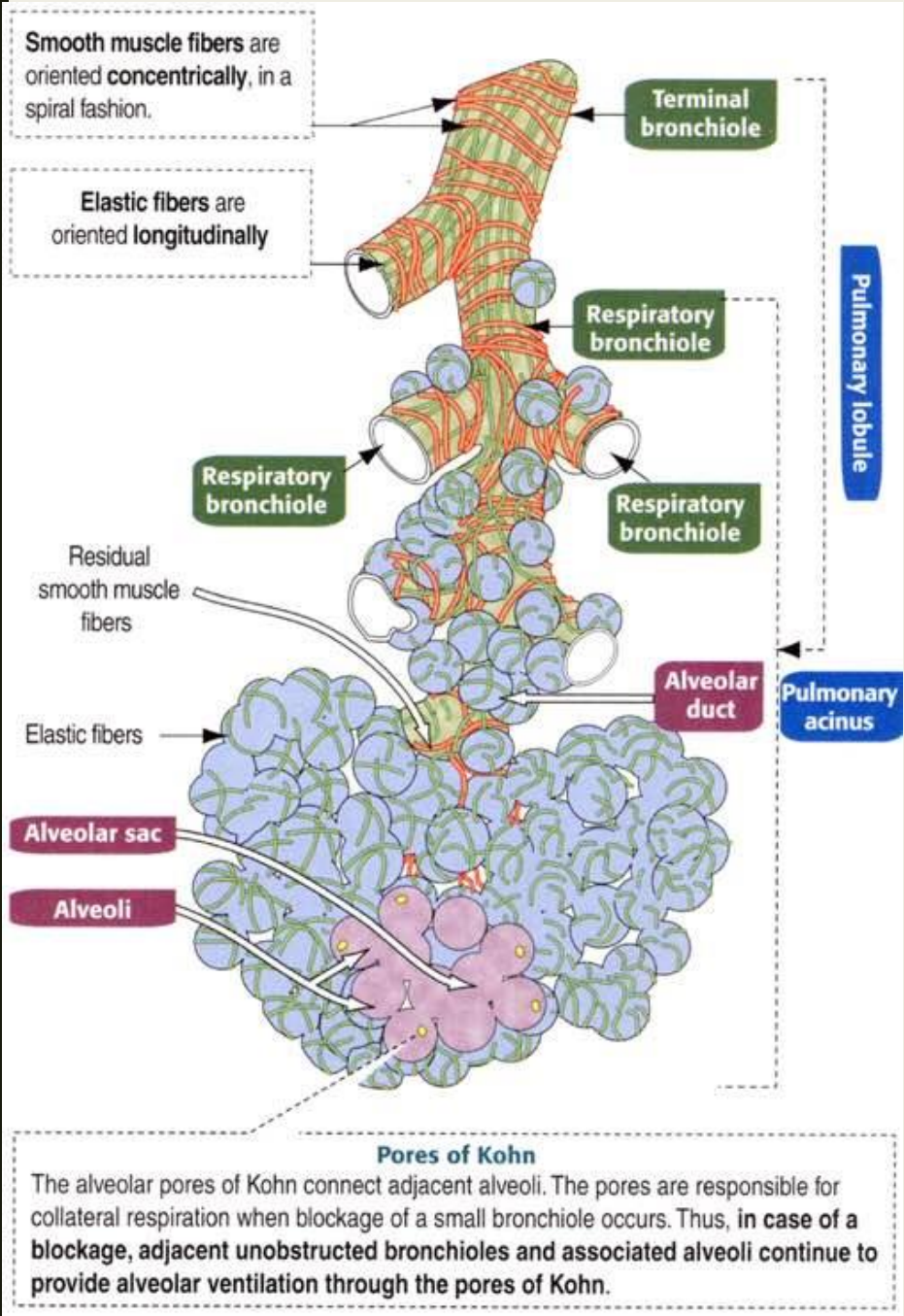
Bronchioles: they do not have cartilage in the walls but only smooth muscles.



conducting

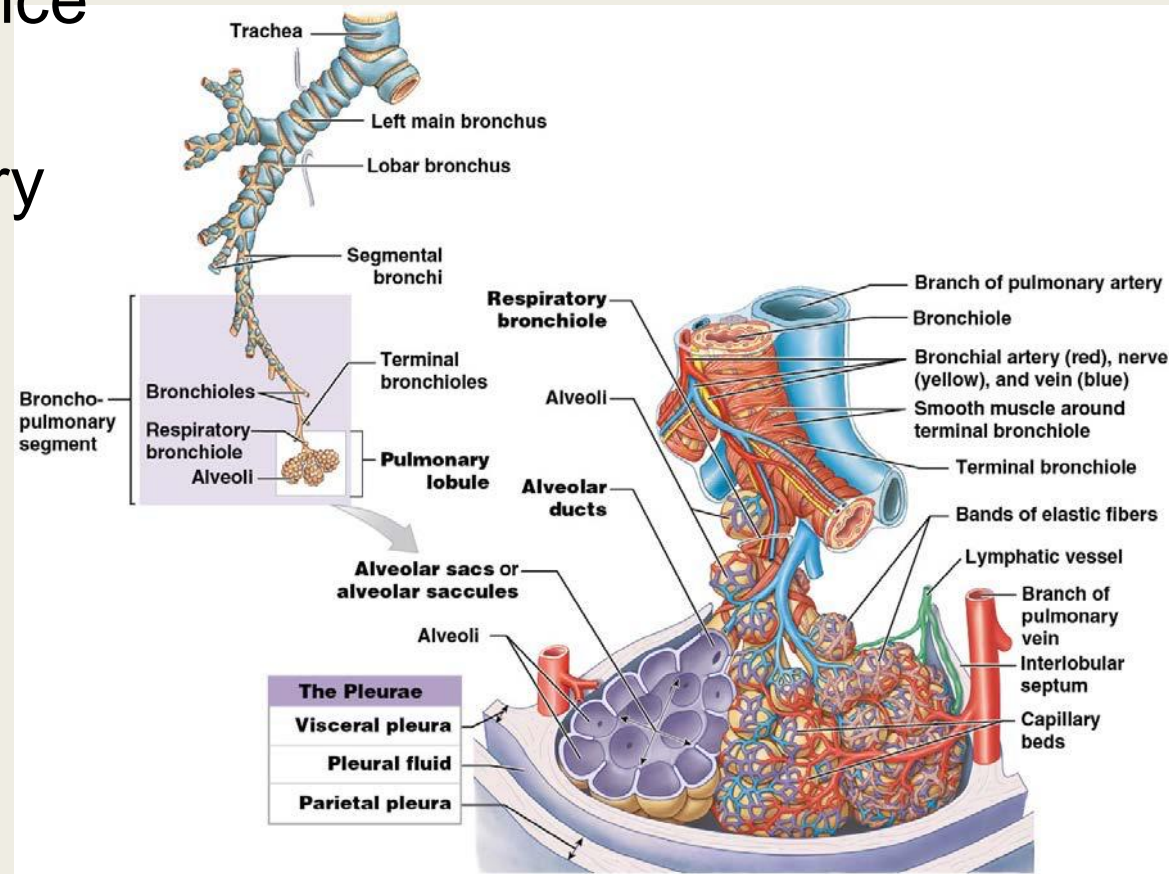
respiratory

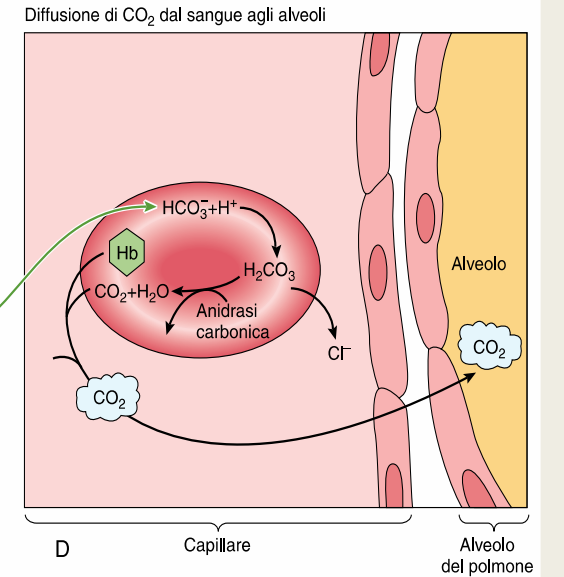
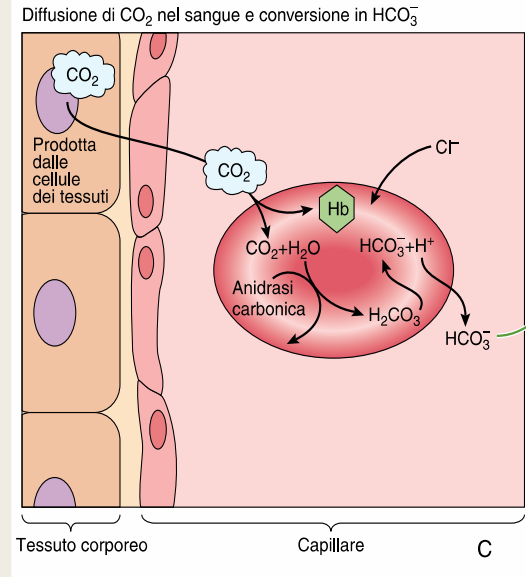
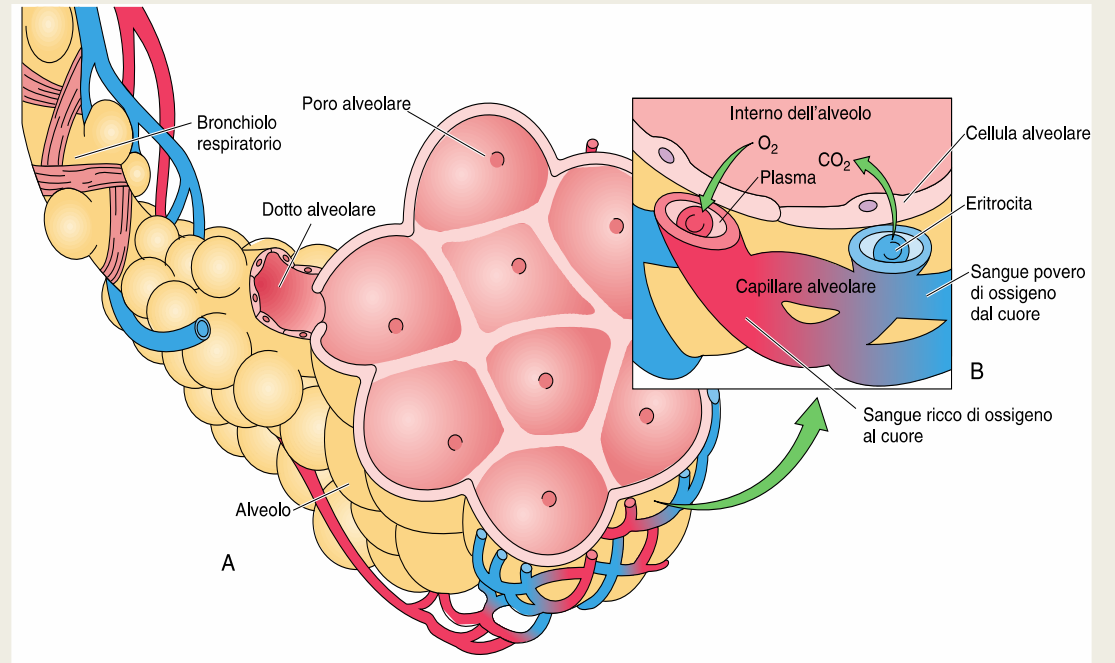
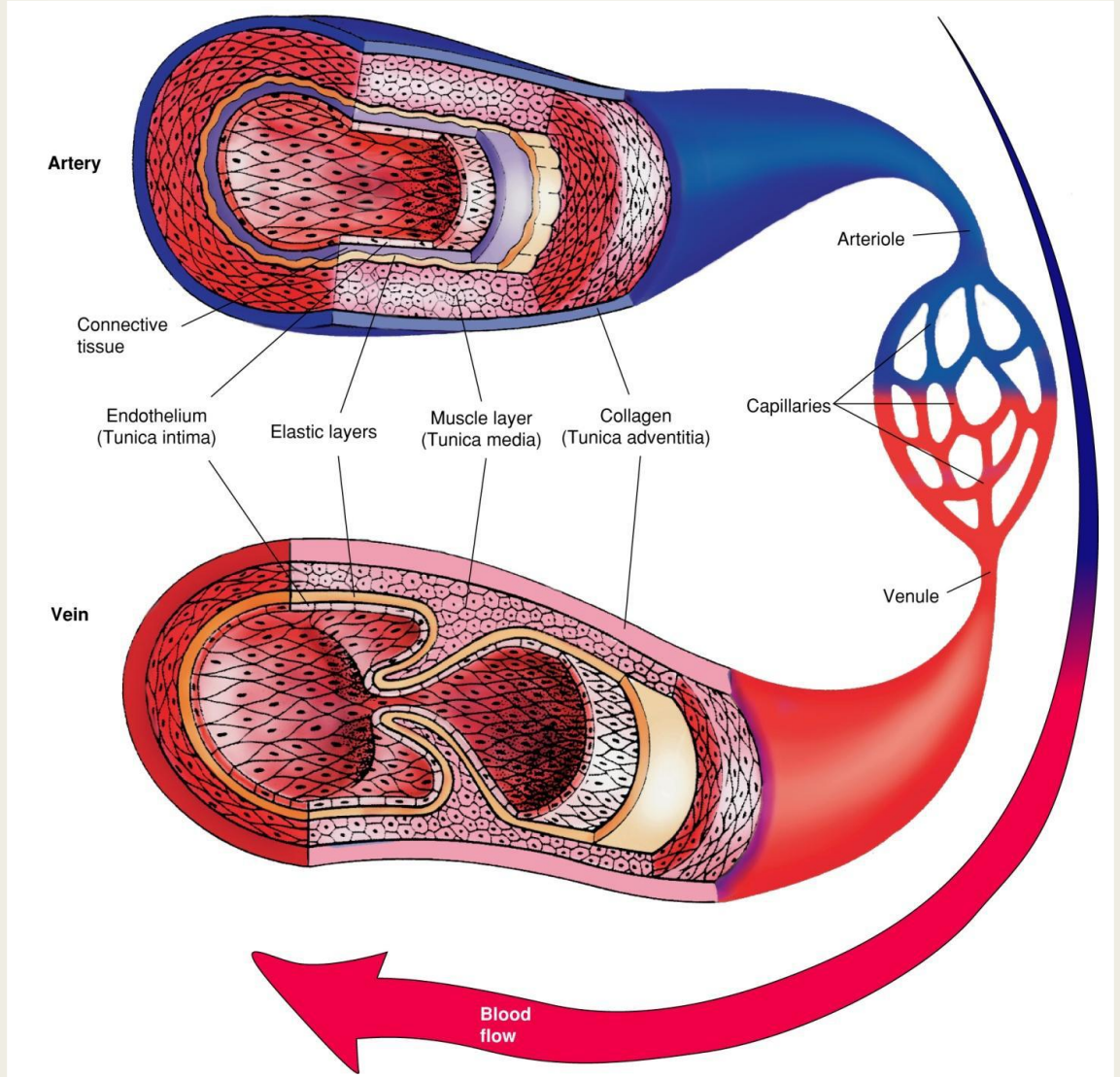




Pulmonary alveoli (singular, *alveolus*)

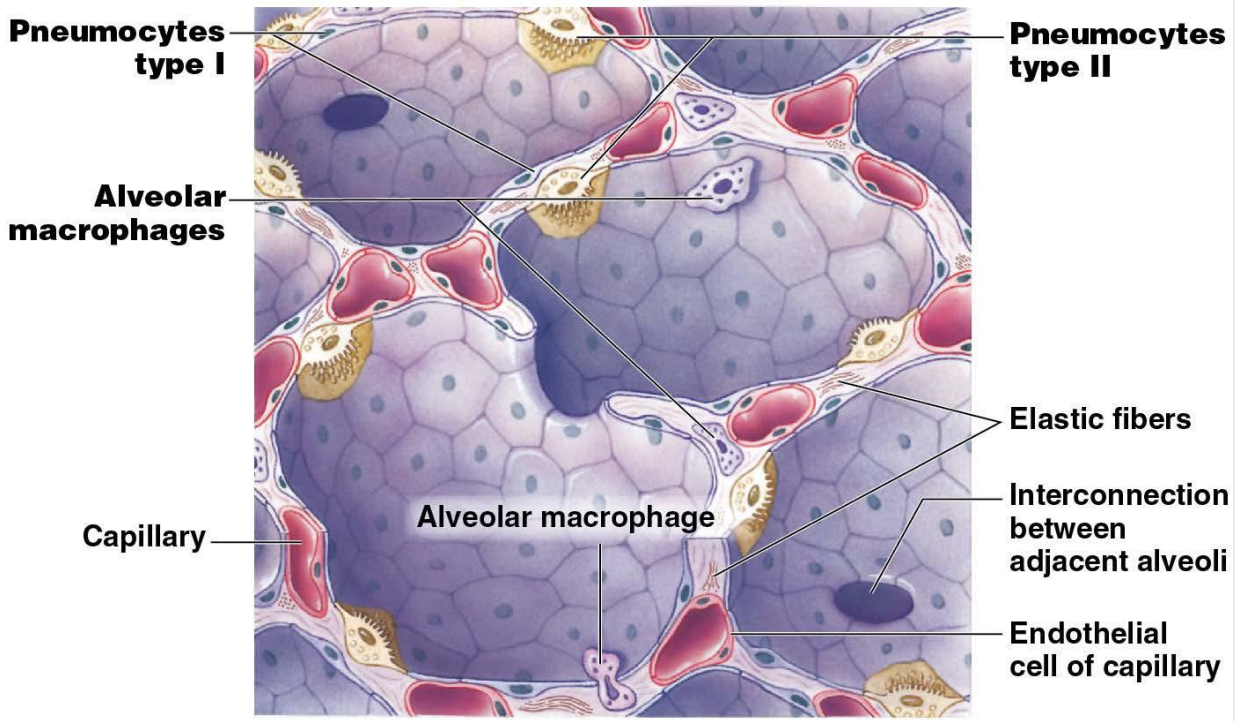
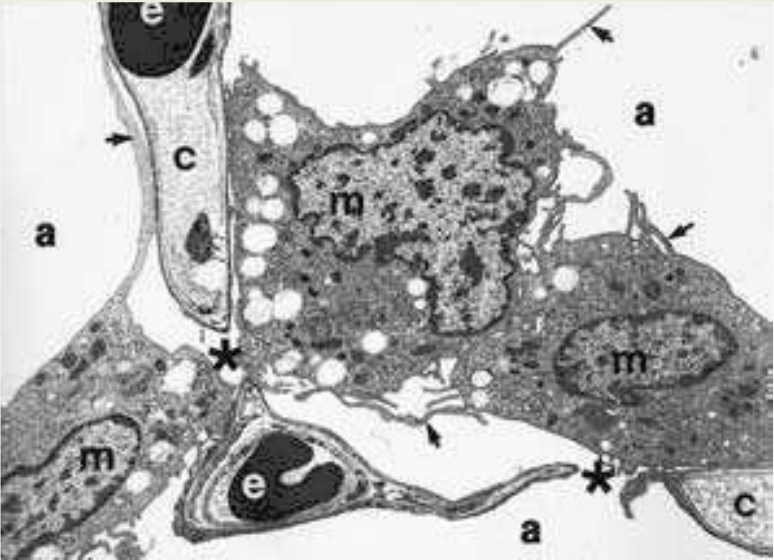
- ~150 million alveoli per lung; give lungs an open, spongy appearance
- Surrounded by extensive capillary network for gas exchange

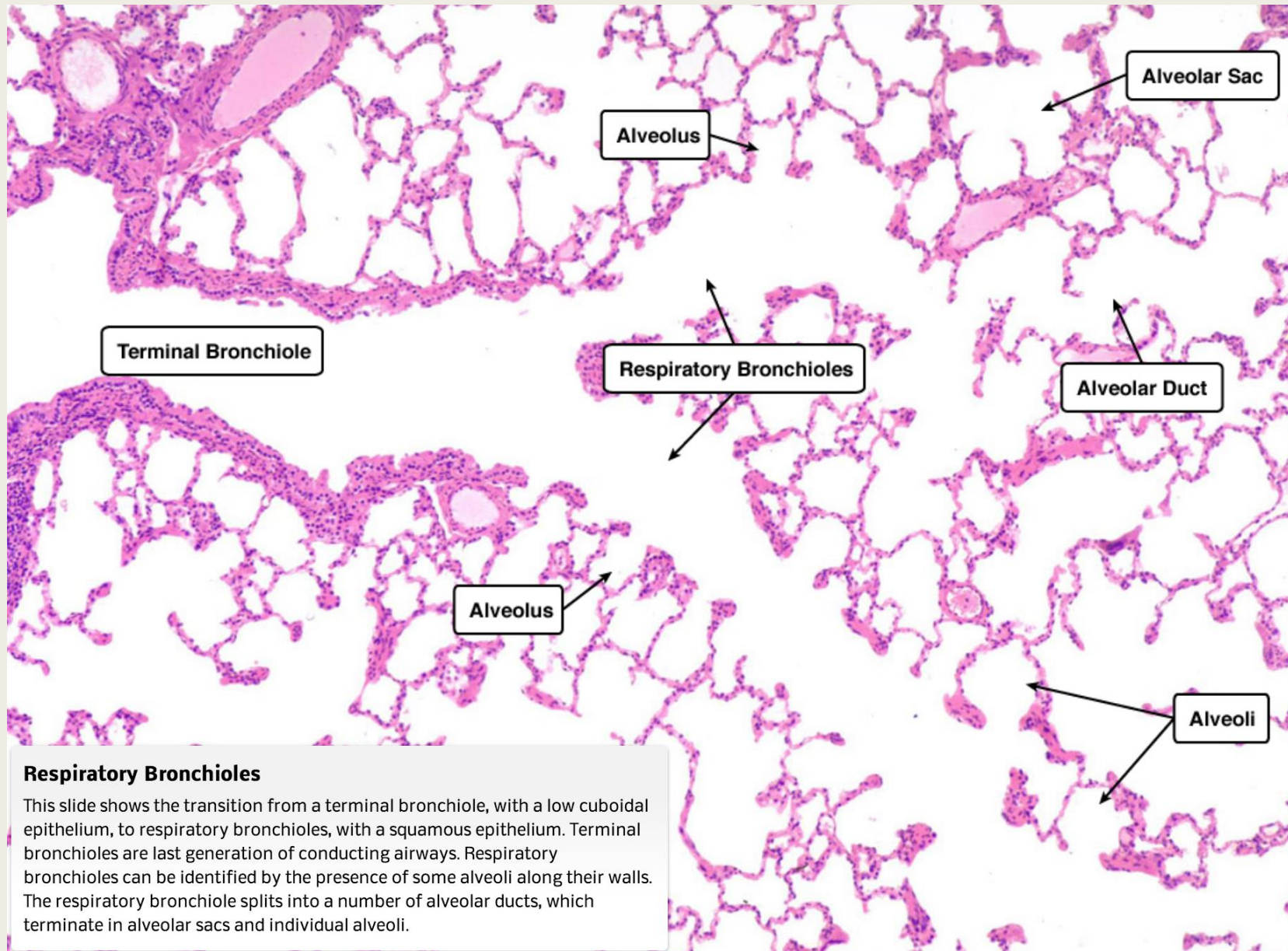




Alveolar epithelium (continued)

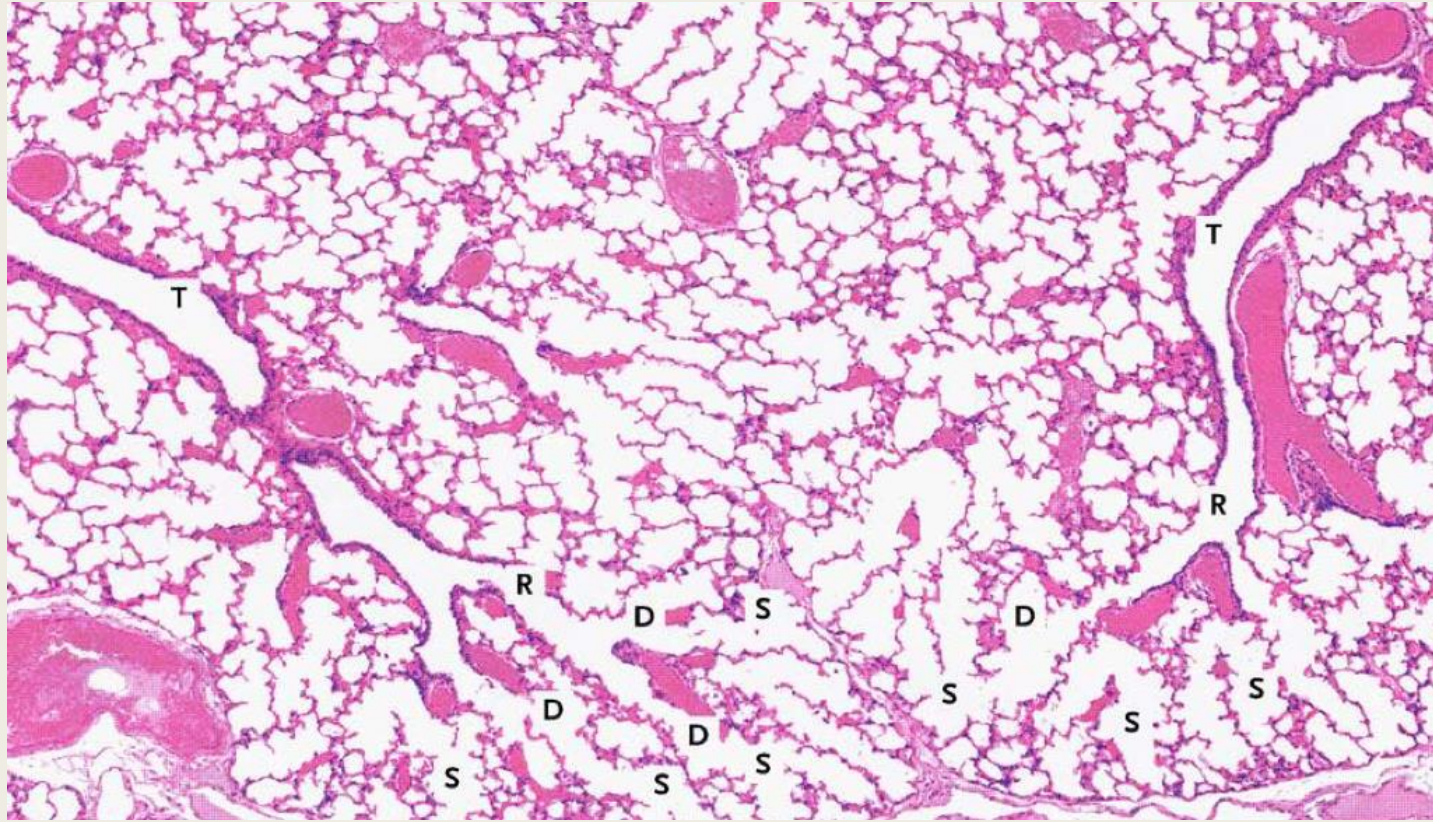
- 3. Roaming **alveolar macrophages** locate and phagocytize particles that could clog the alveoli





Respiratory Bronchioles

This slide shows the transition from a terminal bronchiole, with a low cuboidal epithelium, to respiratory bronchioles, with a squamous epithelium. Terminal bronchioles are last generation of conducting airways. Respiratory bronchioles can be identified by the presence of some alveoli along their walls. The respiratory bronchiole splits into a number of alveolar ducts, which terminate in alveolar sacs and individual alveoli.

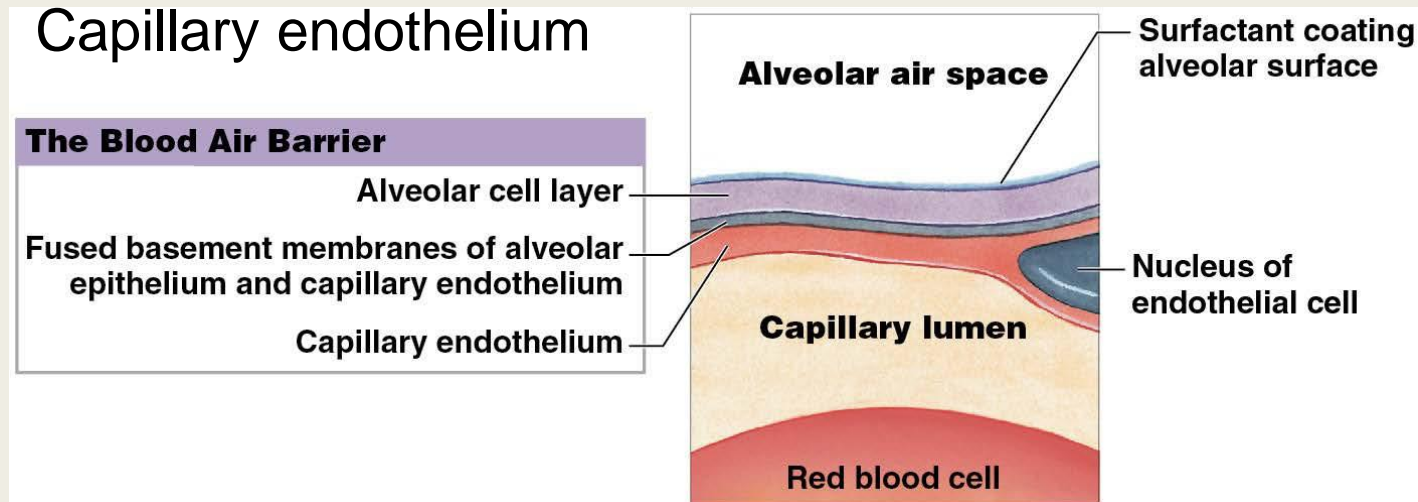


T: bronchiolo terminale, **R:** bronchiolo respiratorio, **D:** dotto alveolare, **S:** sacco alveolare

Blood air barrier—where gas exchange occurs between blood and alveolar air

- Three layers:

1. Alveolar cell layer (epithelium)
2. Fused basement membranes (alveolar and capillary)
3. Capillary endothelium



Very rapid diffusion

- Minimal distance separating air and blood (average ~0.5 μm)
- Both oxygen and carbon dioxide are lipid soluble

Trachea 5 cm²

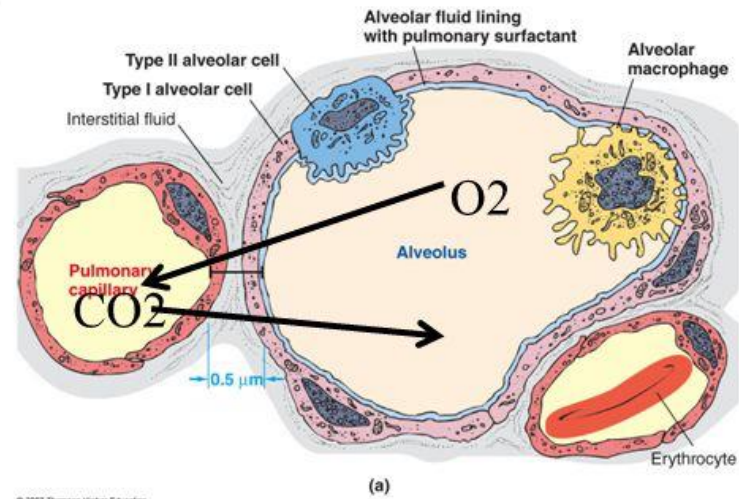
300 million alveoli with a diameter of 200-300 μm for a total of 70 m² total exchange surface

Conduction zone 150 ml

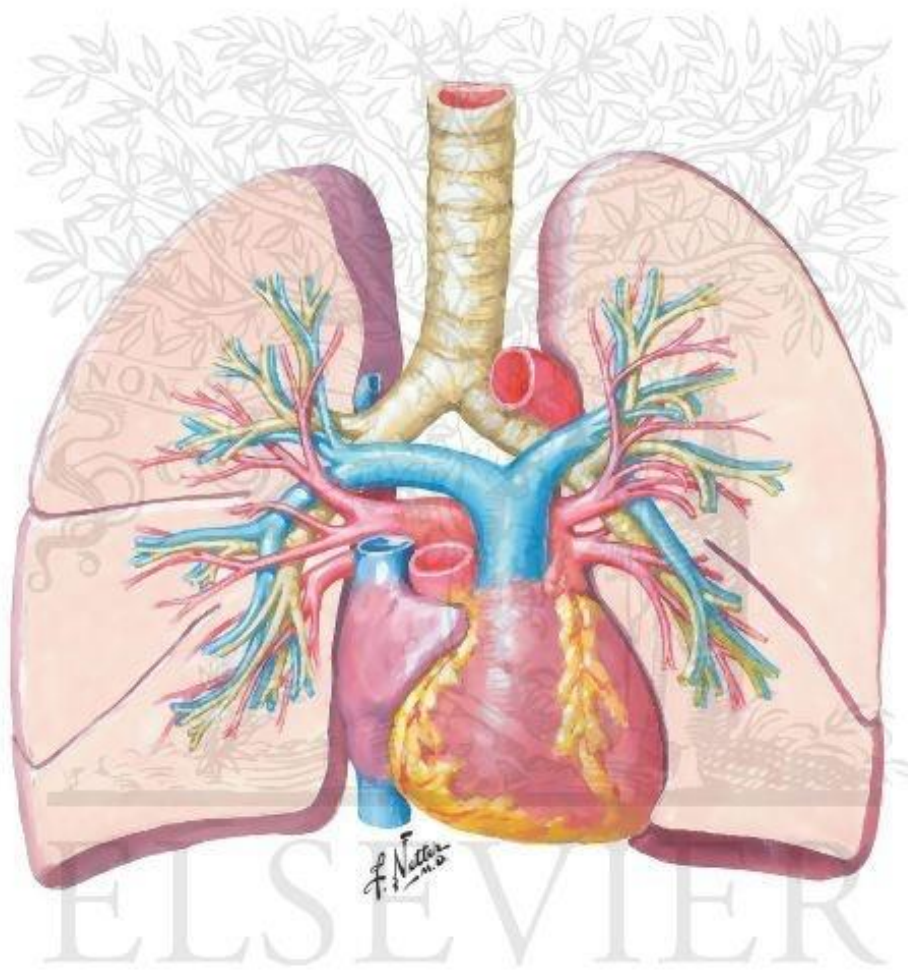
Capillaries with a diameter of 10 μm in which about 100-300 ml of blood flow for an estimated length of ≈1600 km

Cells Types of the Alveoli

- ***Type I alveolar cells***
 - simple squamous cells where gas exchange occurs
- ***Type II alveolar cells (septal cells)***
 - free surface has microvilli
 - secrete alveolar fluid containing *surfactant*
- ***Alveolar dust cells***
 - wandering macrophages remove debris

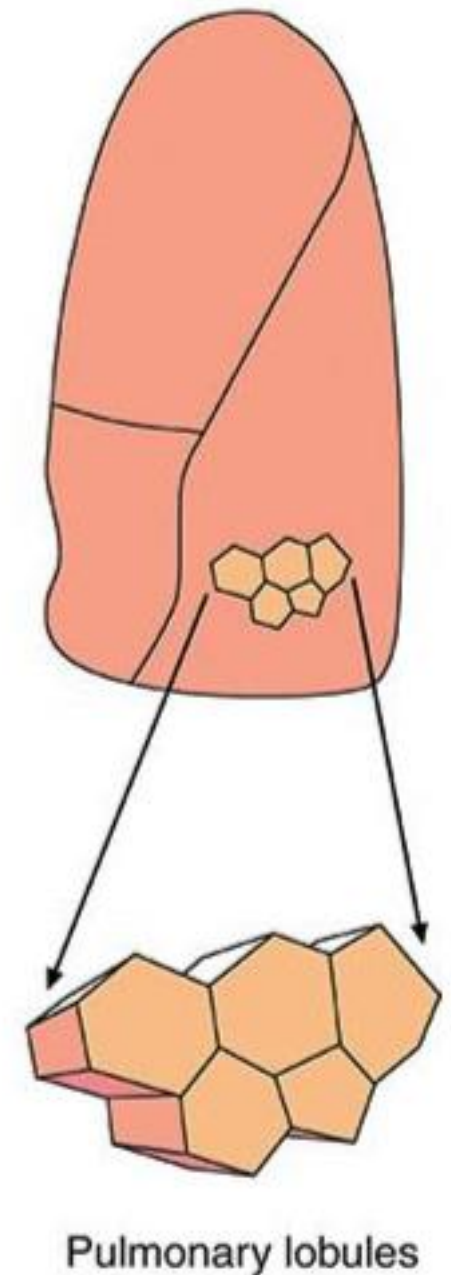
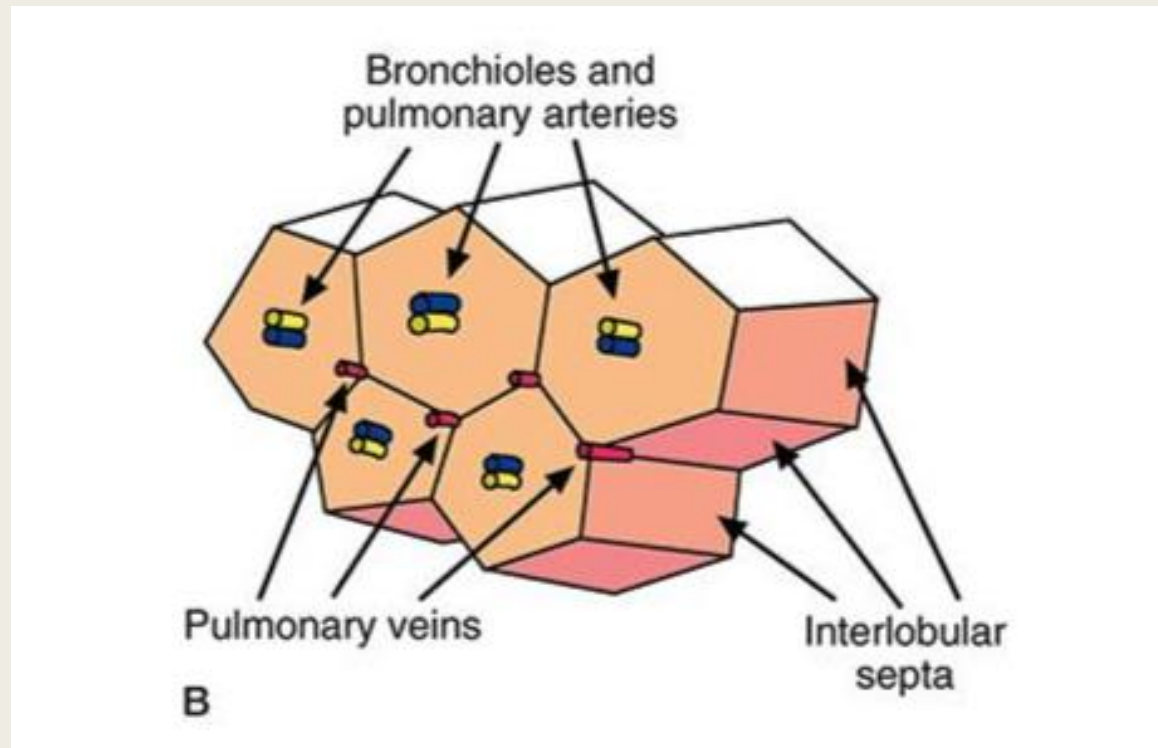


- Respiratory membrane = 1/2 micron thick



The *secondary pulmonary lobule*

- refers to the smallest unit of lung structure margined by connective tissue septa
- They are irregularly polyhedral in shape and vary in size, measuring from 1 to 2.5 cm



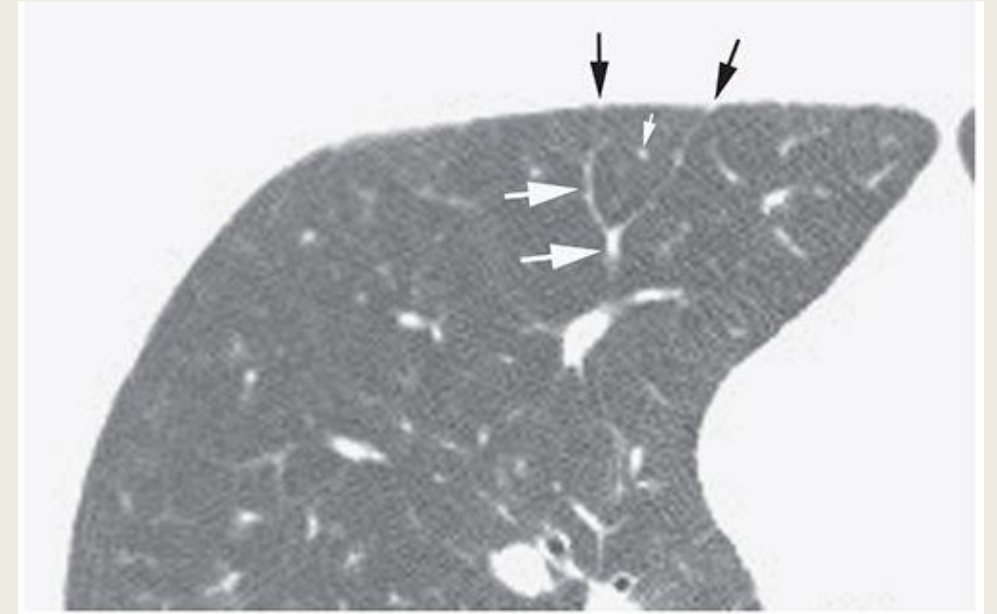
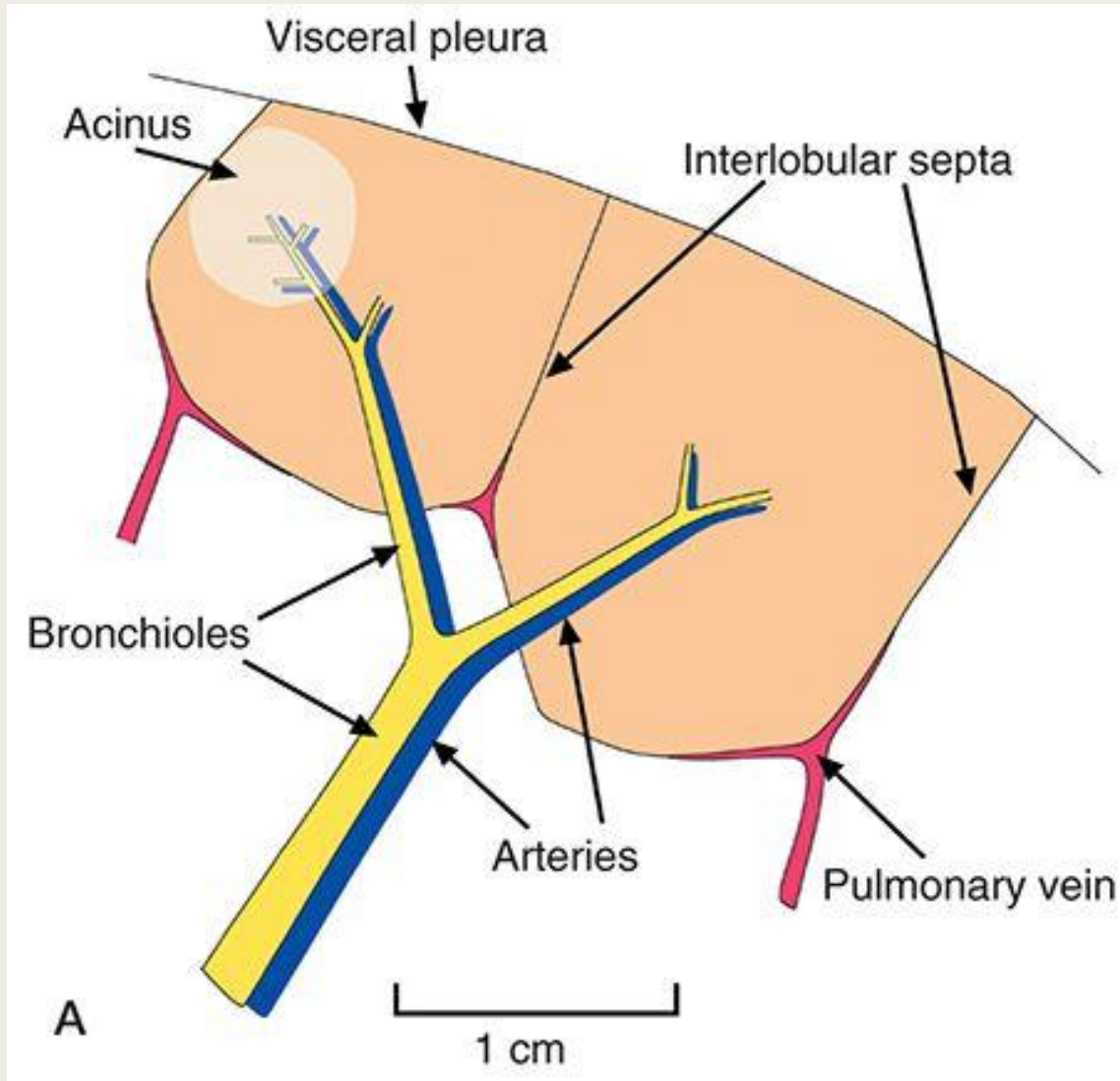
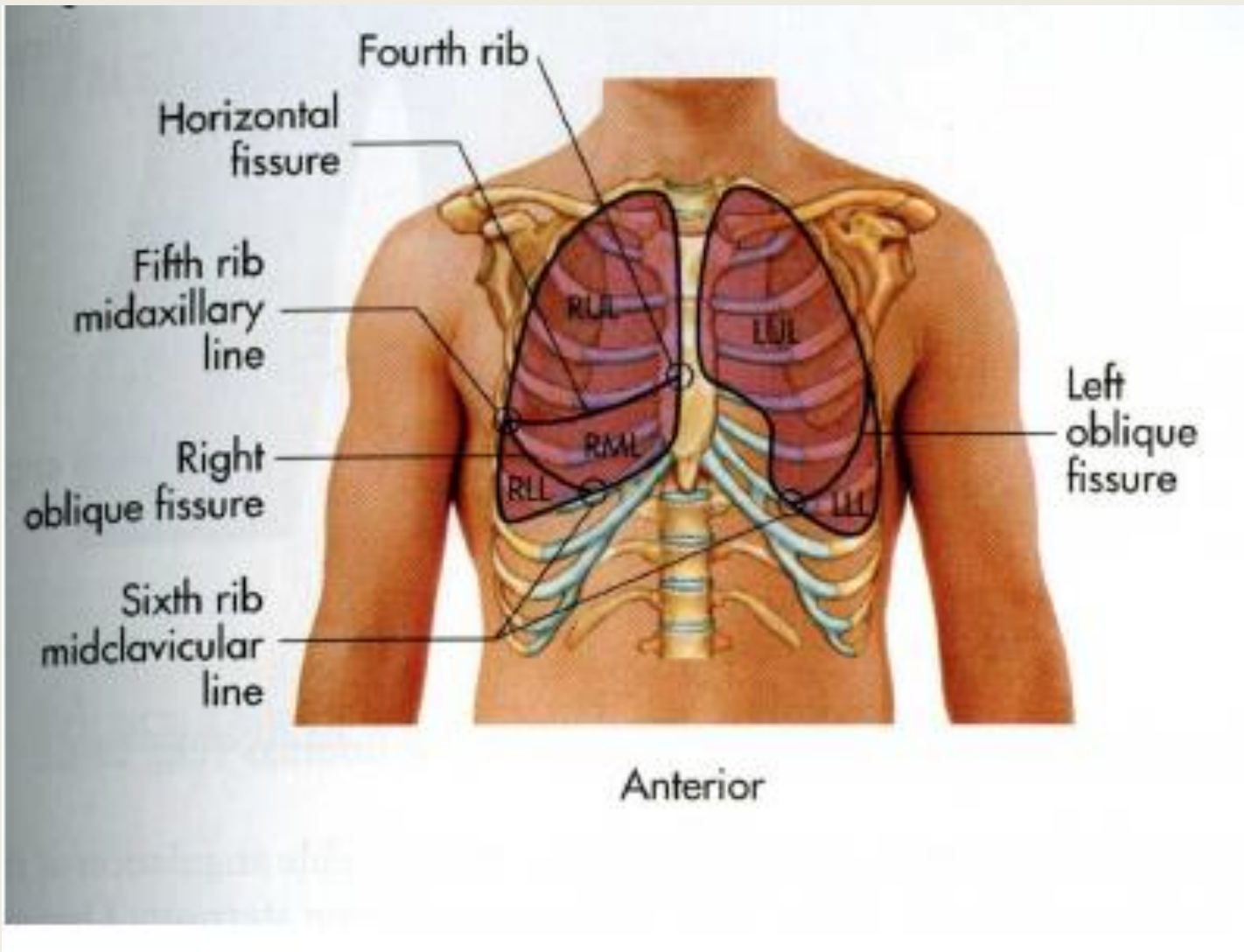
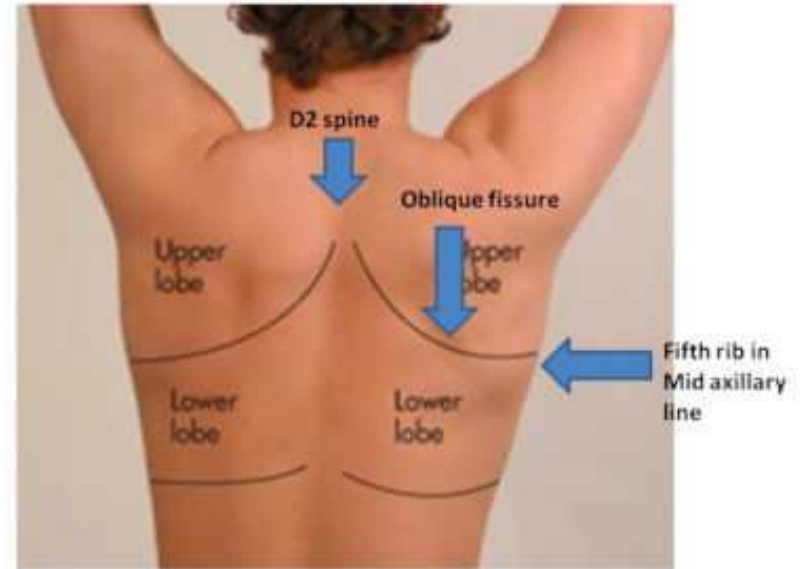
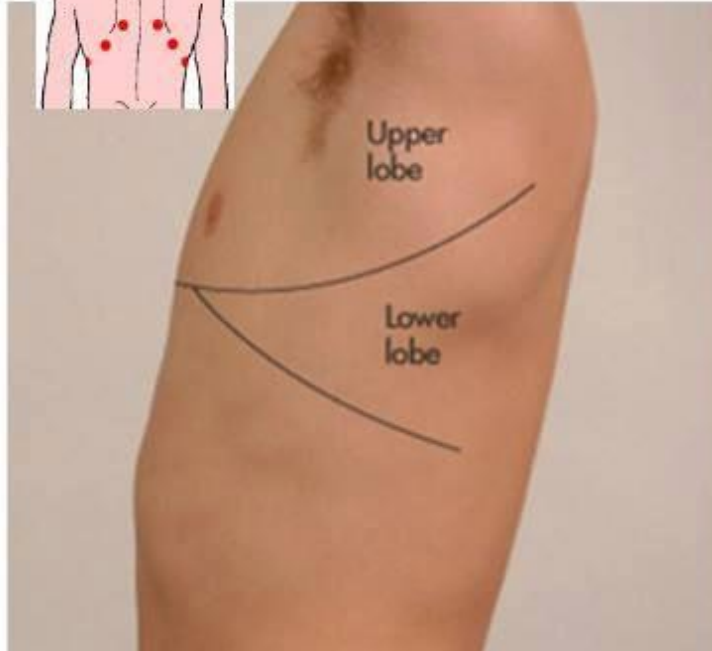
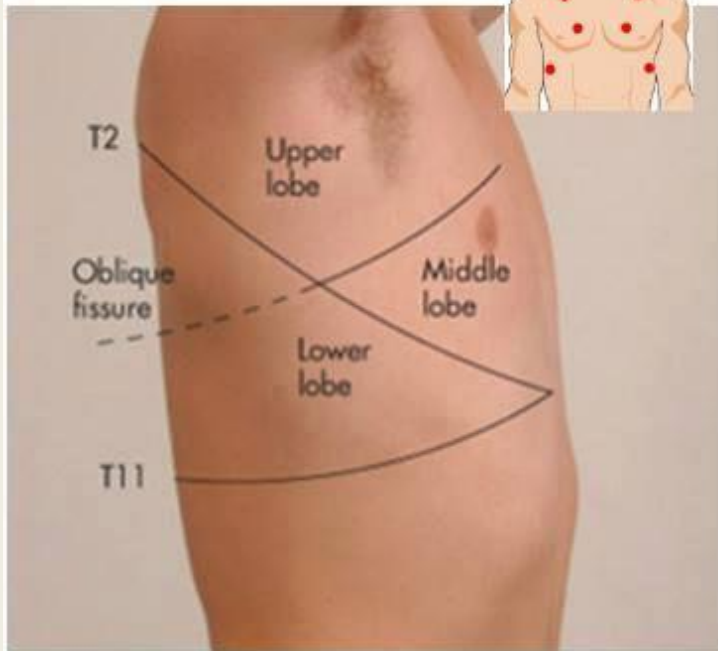
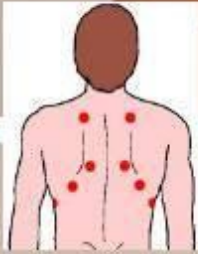
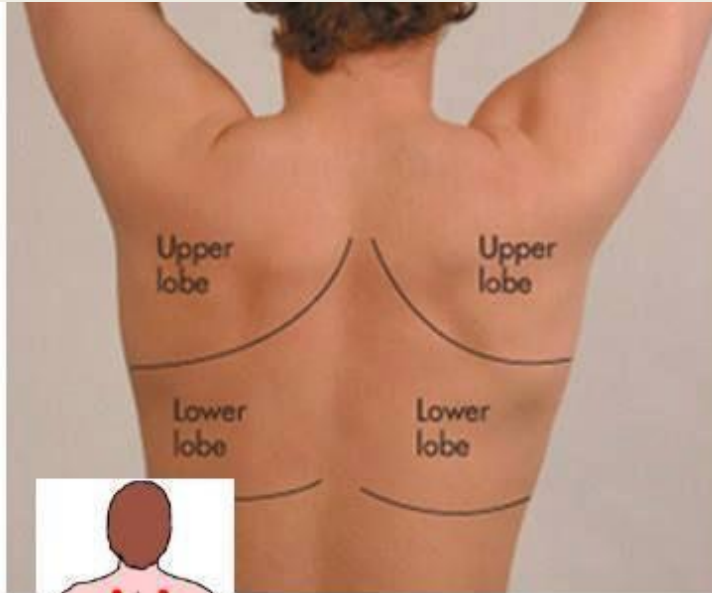
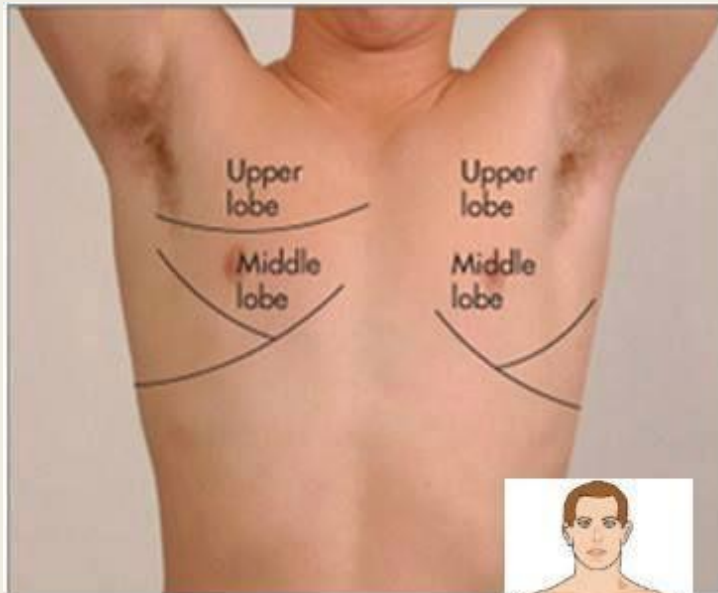
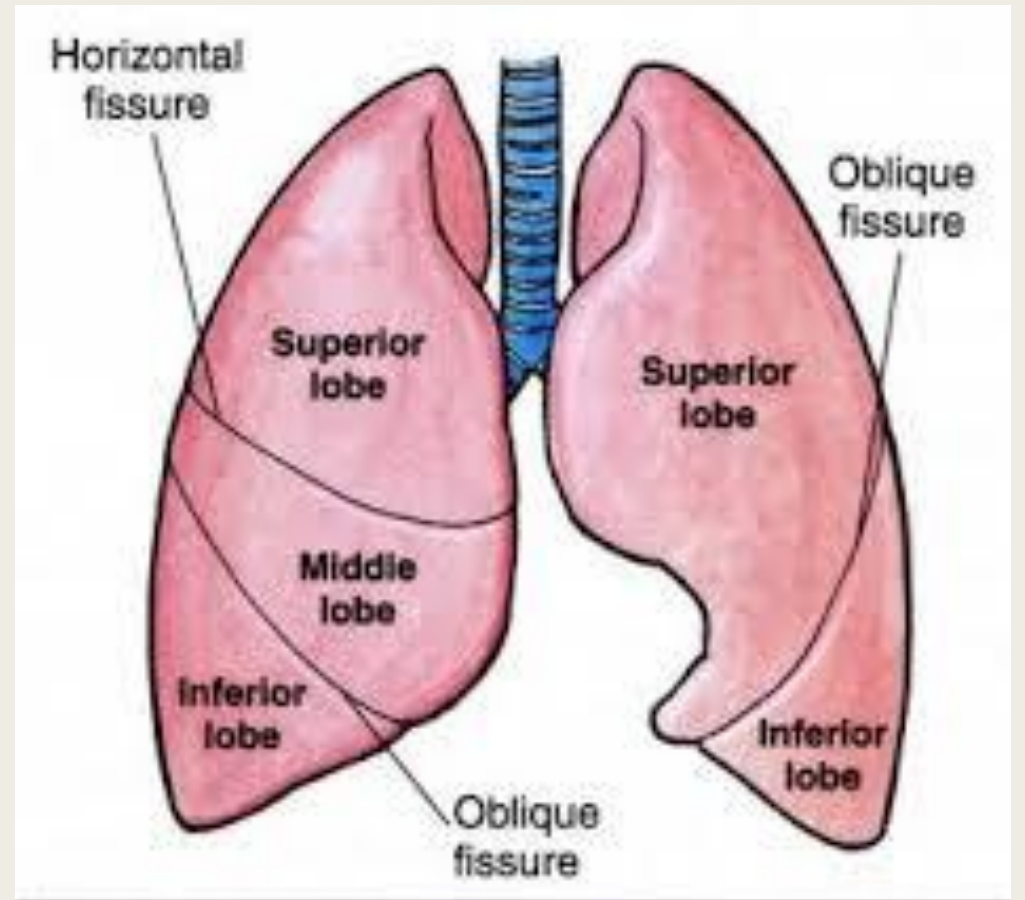
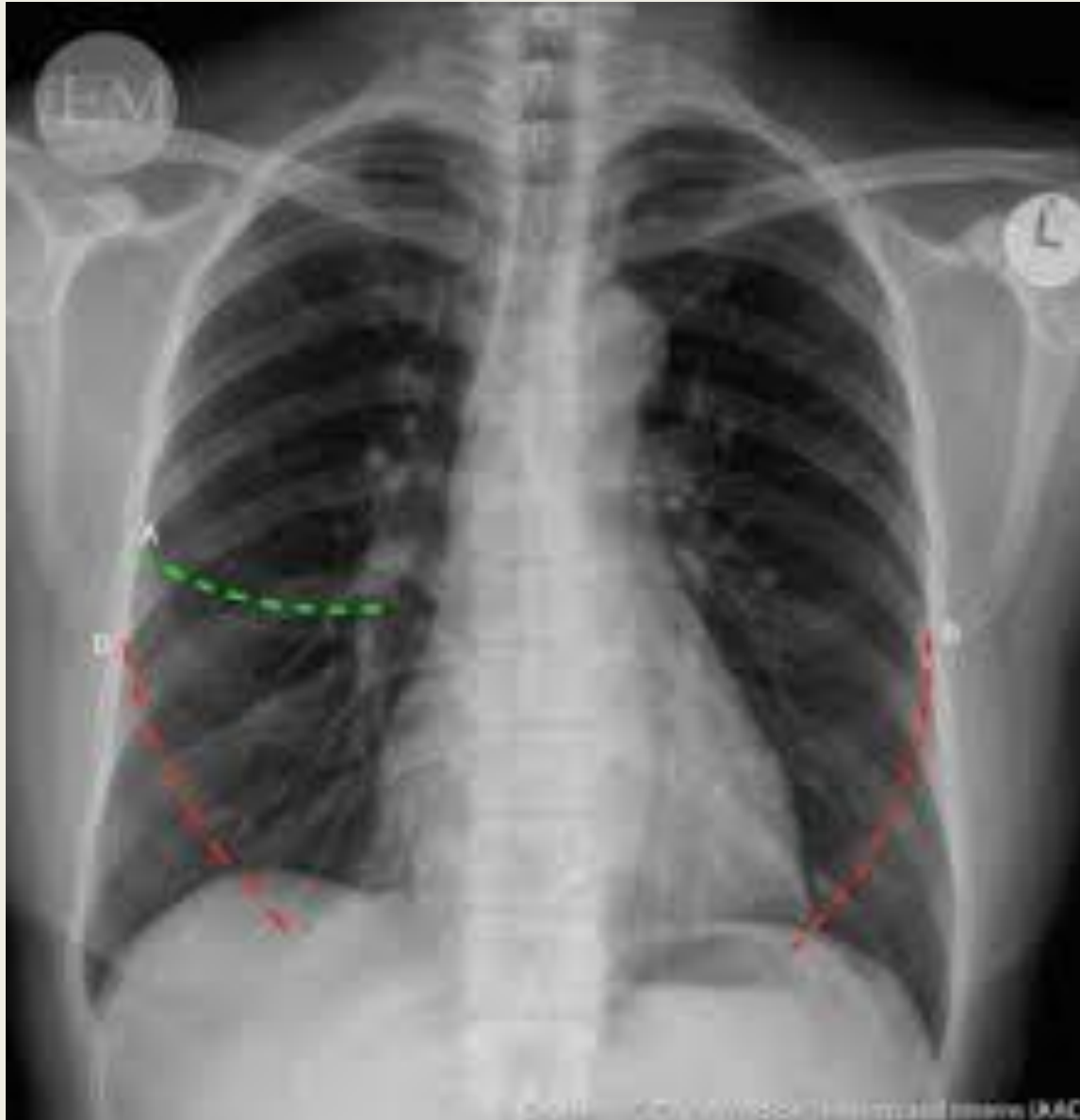


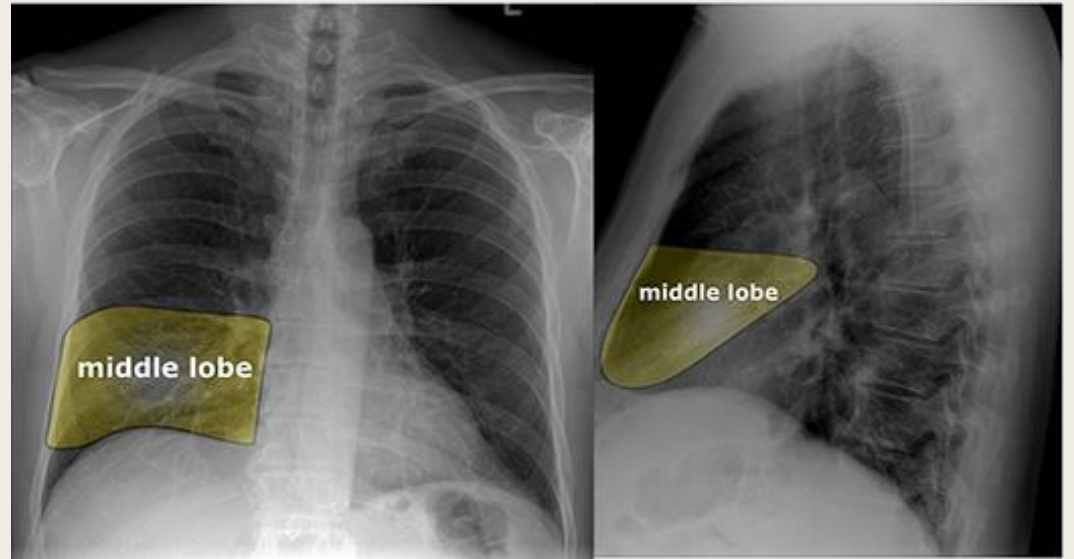
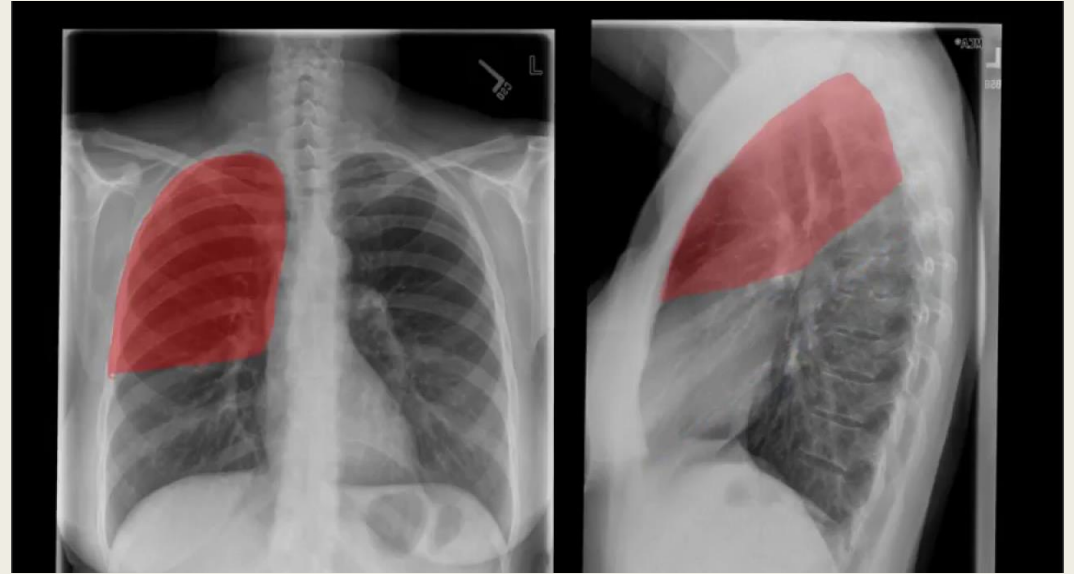
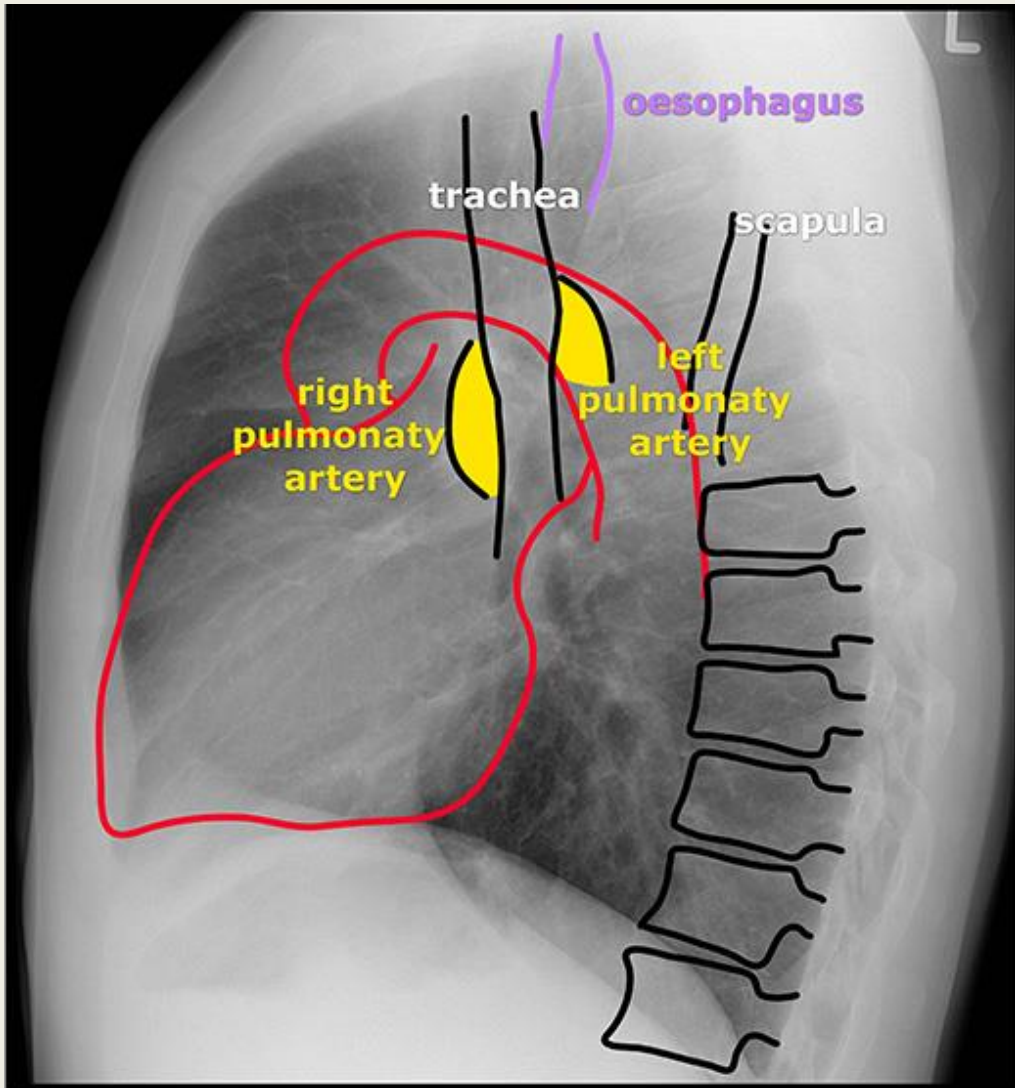
FIGURE 2-21 Normal HRCT lobular anatomy. HRCT of the right upper lobe in a normal subject. Thin interlobular septa identify a lobule (*black arrows*) in the lung periphery. A pulmonary vein branch (*large white arrows*) is visible in relation to the periphery of the lobule. The centrilobular artery is also seen as a white dot (*small white arrow*). Other pulmonary artery branches are visible 5 to 10 mm from the pleural surface.



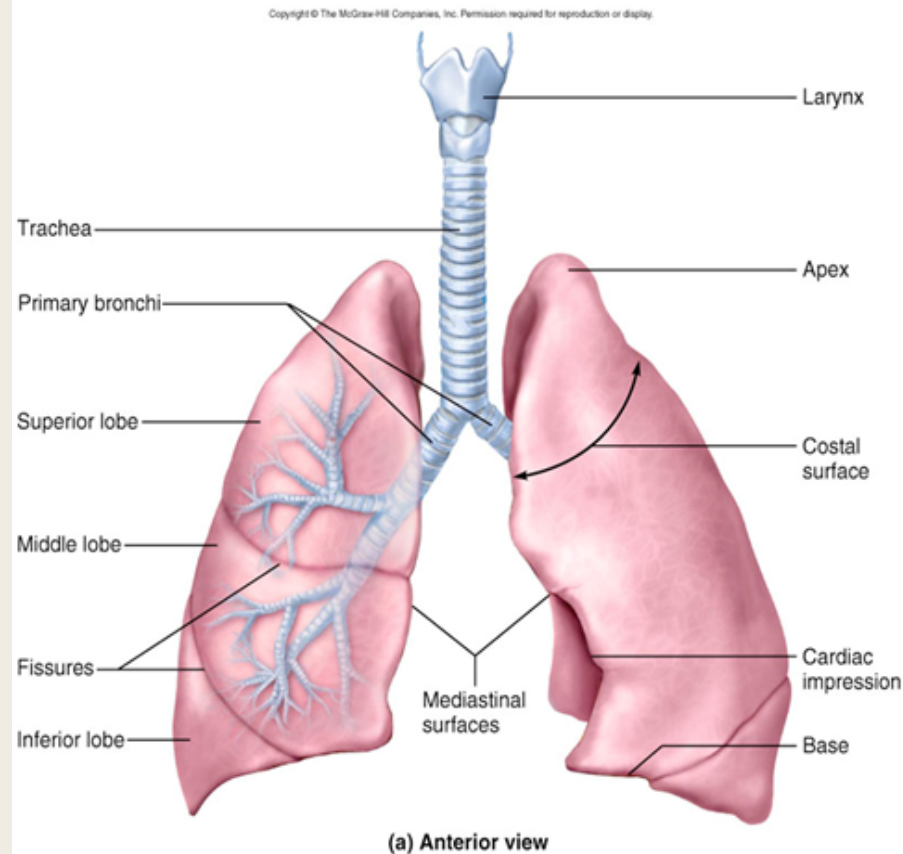


LUNG FISSURES





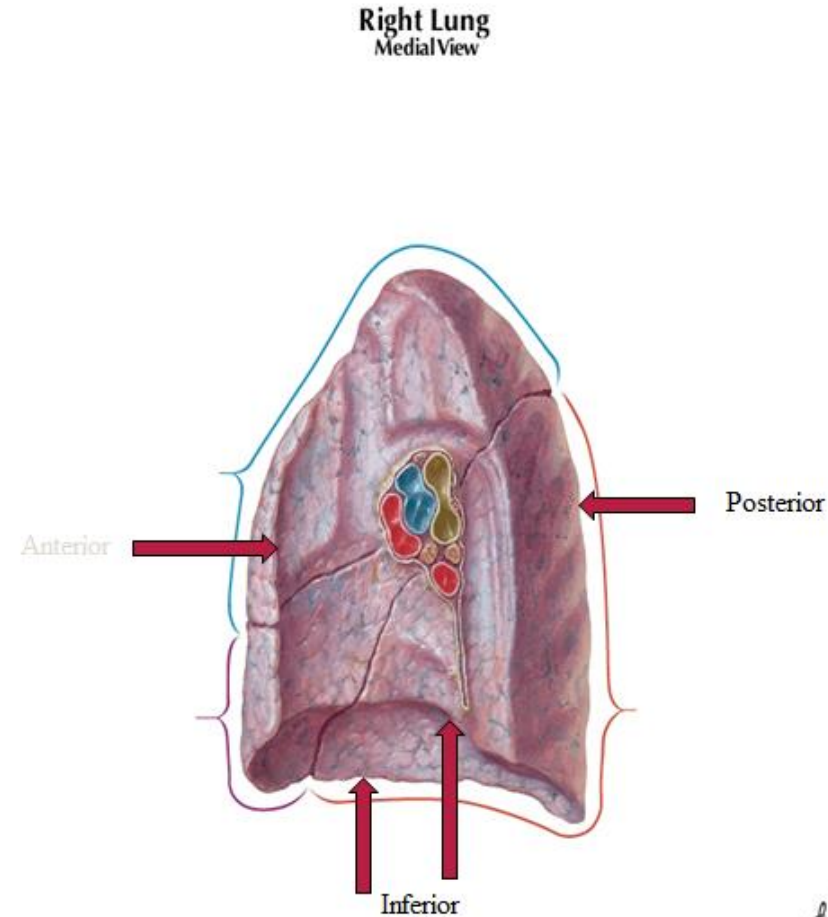
SURFACES OF LUNGS

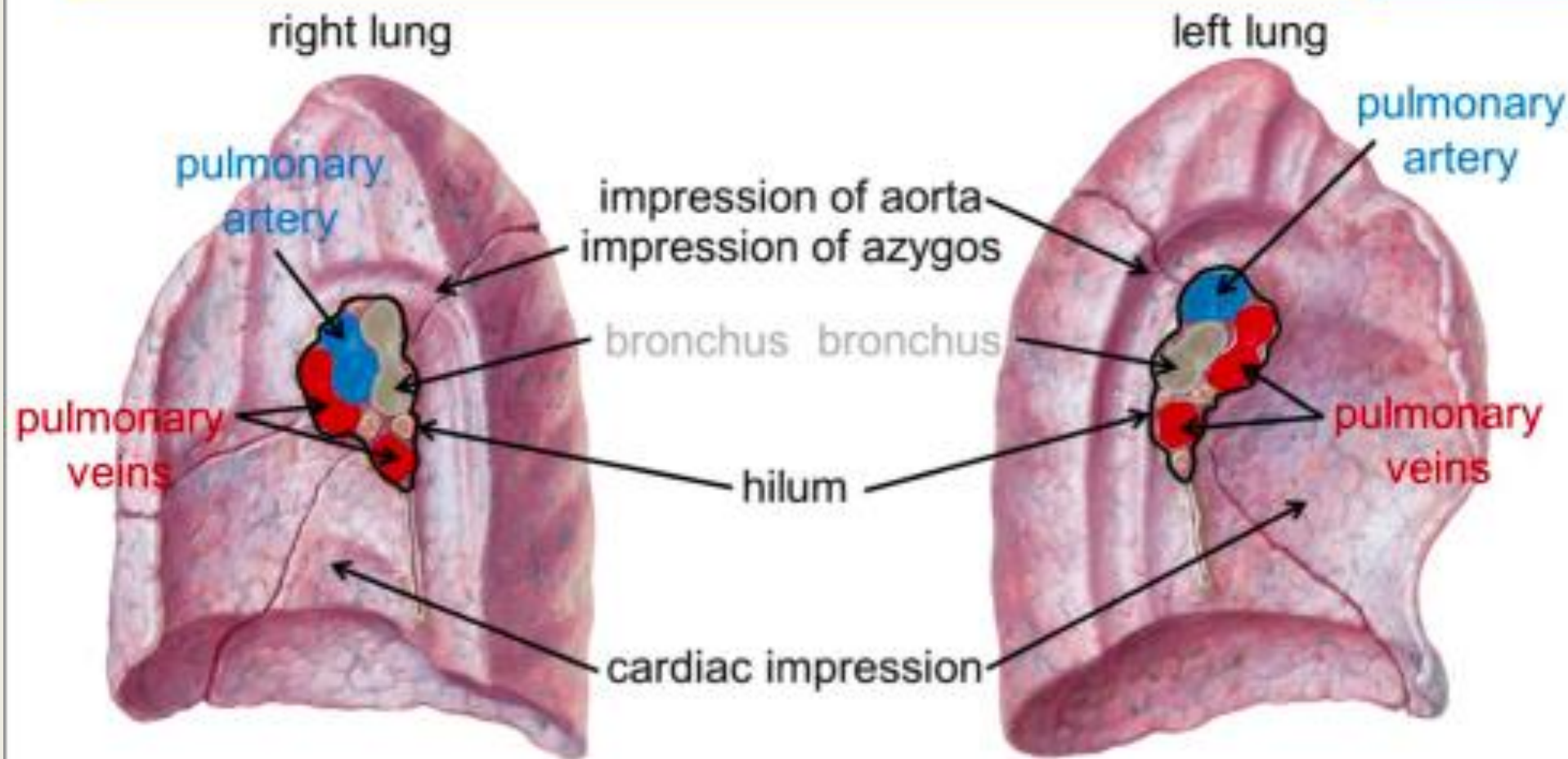


- **Base**-concave, located along diaphragm
- **Costal**- Along thoracic wall (ribs)
- **Mediastinal**- near midpoint, has cardiac impression on left lung (cardiac notch)
- **Apex**-rounded superior portion
- **Hilus**-point at which nerves, vessels & primary bronchi penetrate the parenchyma of each lung.

BORDERS OF THE LUNGS

- Anterior-meeting of costal and anterior mediastinal , sharp edge
- Posterior-meeting of costal and posterior mediastinal surfaces near vertebrae. Very round contour.
- Inferior-very sharp connects diaphragmatic surface to mainly costal.





RALS

right anterior, left superior

position of *pulmonary artery* relative to *mainstem bronchus*

also present in hilum:

pulmonary veins, *nerves*, *lymphatics*