

Respiratory system

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2021.

Respiratory system

2 parts:

air conducting system (airways)

gas exchange part: alveoli in the lung

air conducting pathways:

extrapulmonary

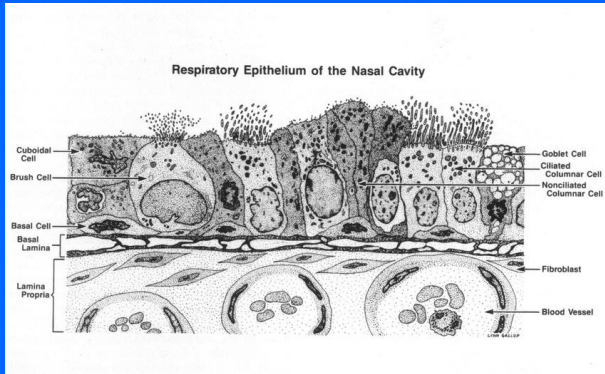
intrapulmonary

- Nasal cavity - nasopharynx
- Larynx
- Trachea
- Bronchi: principal
 - lobar
 - segmental
- Bronchioles:
 - terminals
 - respiratory
- Alveoli

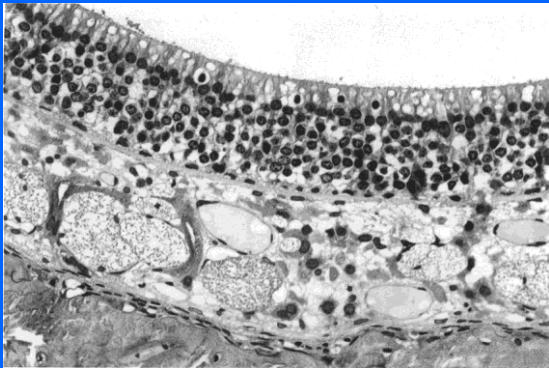
extrapulmonary

intrapulmonary

Nasal cavity

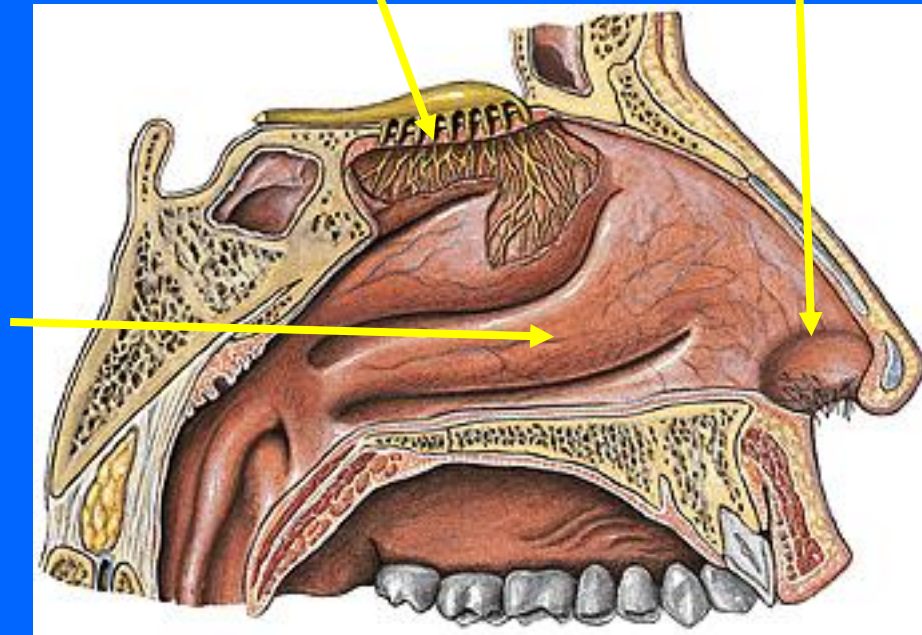


2. Regio respiratorica:
pseudostratified ciliated
epithelium (goblet cells)

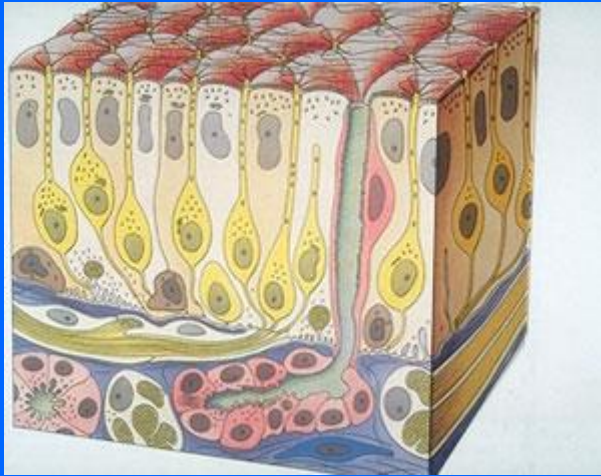


3. Olfactory area:
receptors

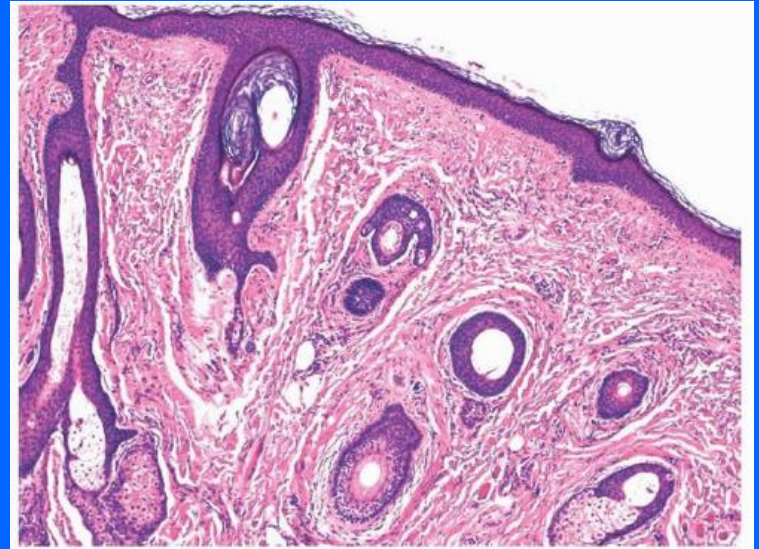
1. Vestibulum: skin



Histology of the nasal cavity

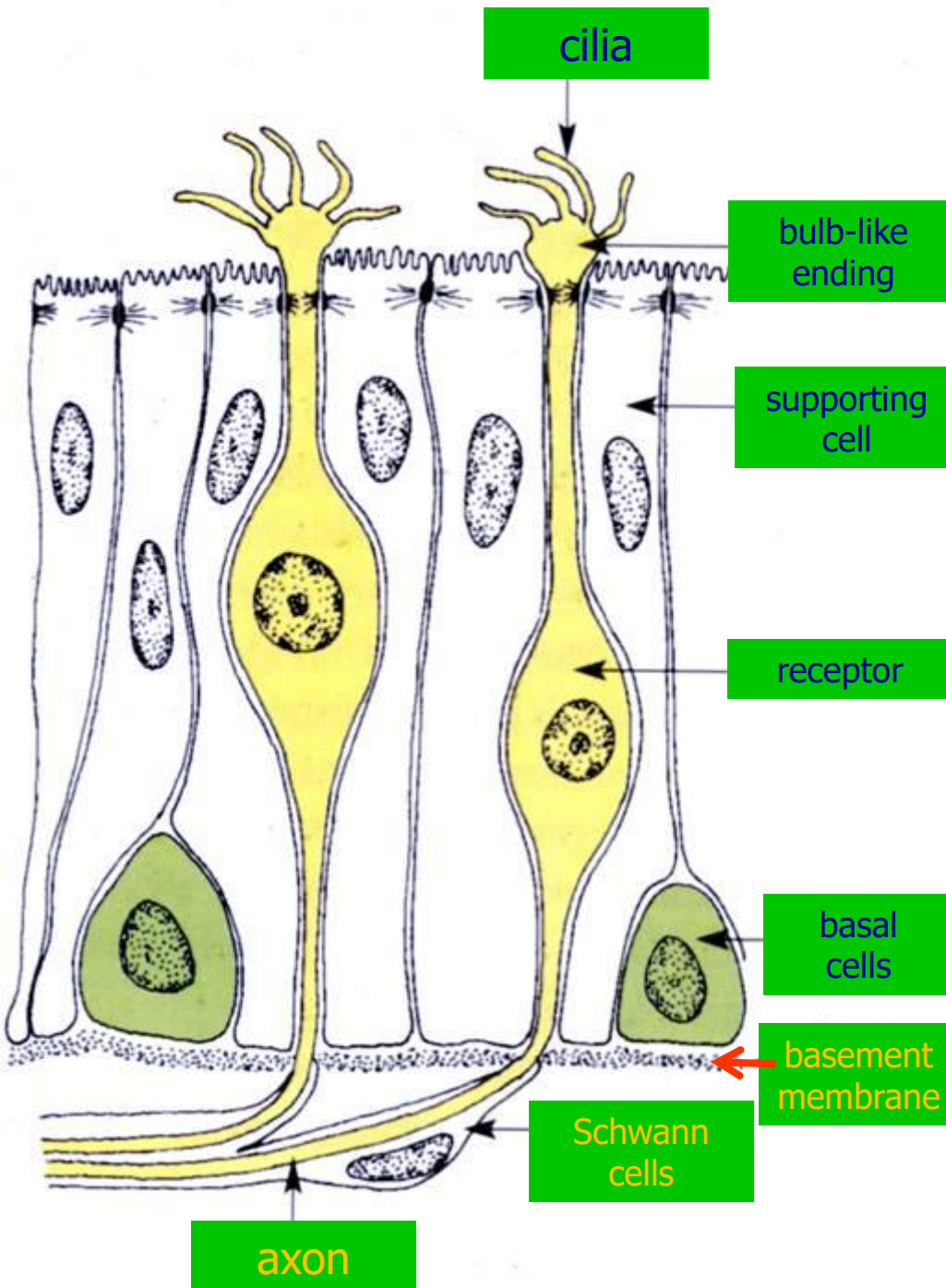


Olfactory area: receptors



Vestibulum: skin

Olfactory region

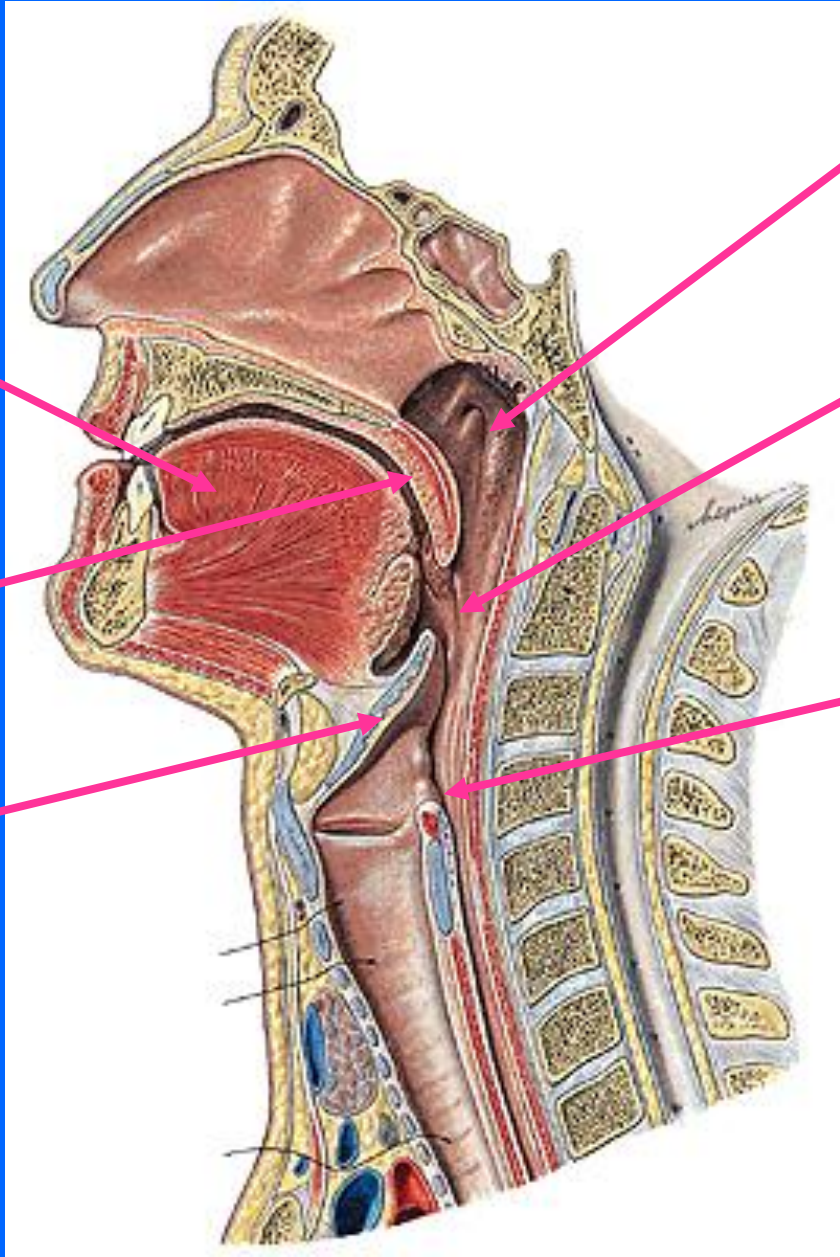


- *Receptors: primary sensory cells: bipolar cells*
- supporting cells
- stem cells (basal cells)

Nasal cavity

Function:

- a.) filtration of dust (ciliated epithelium)
- b.) humidification of inspired air (glands inside of the mucosa)
- c.) warming up the air (rich capillary network)
- d.) olfaction - smell sensation



tongue

soft palate

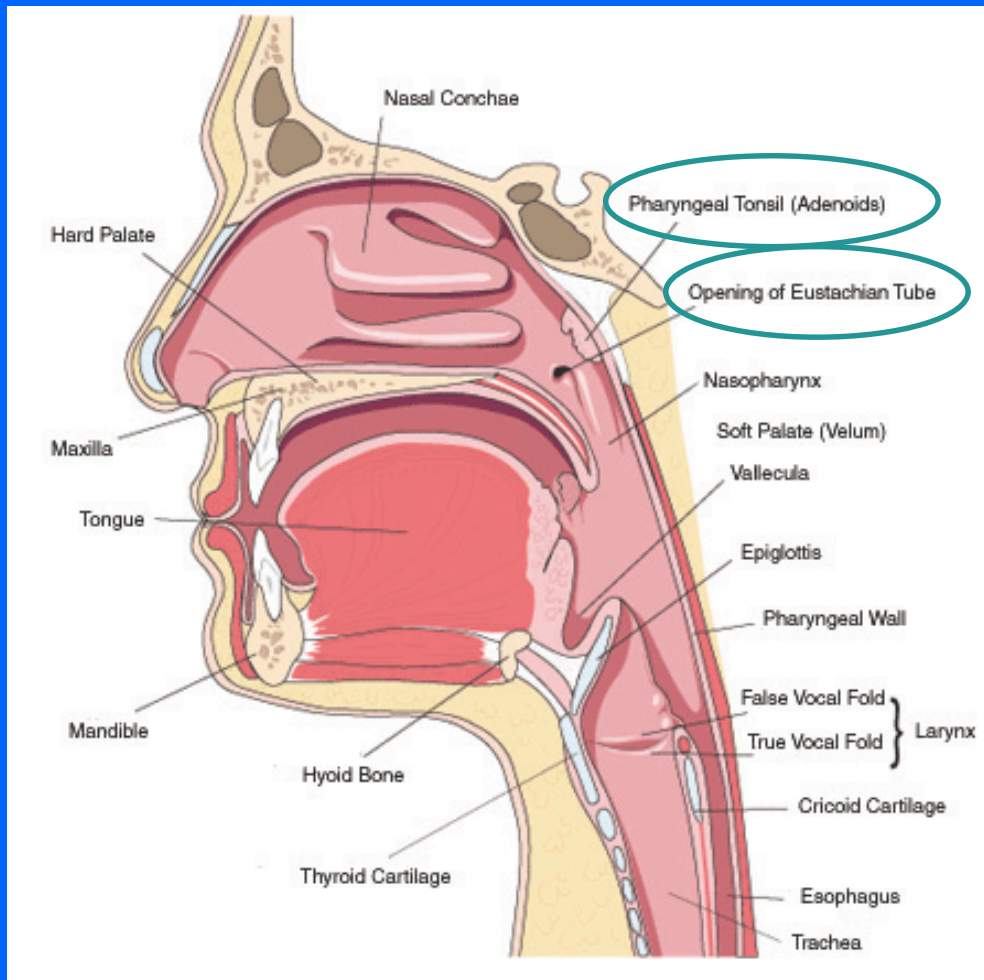
epiglottis

nasopharynx

oropharynx

laryngopharynx

Nasopharynx



Waldeyer's lymphatic ring

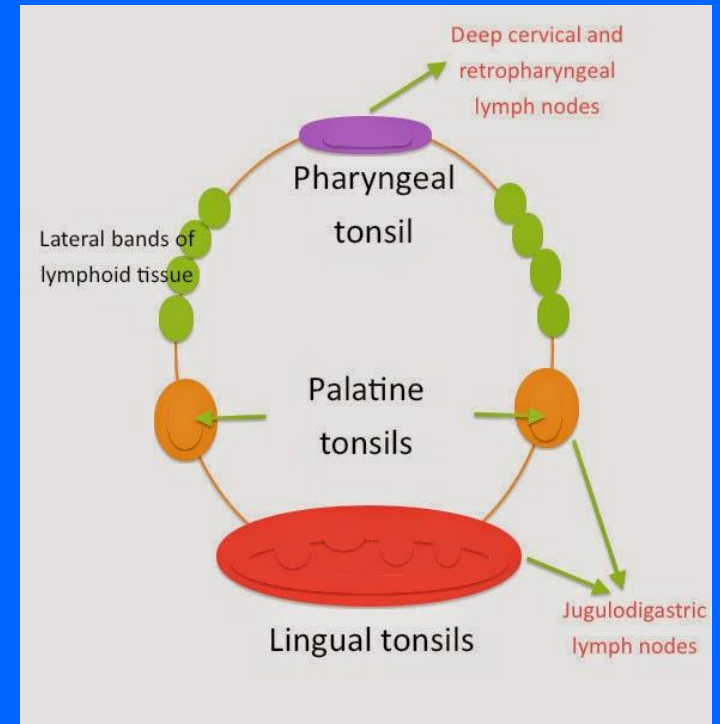
Pharynx:

pars nasalis:

- tonsilla pharyngea+tonsillae tubariae (pseudostratified ciliated epithelium)

p. oralis:

- tonsilla palatina (stratified non-keratinized epithelium)
- tonsillae linguales (stratified non-keratinized epithelium)



Larynx

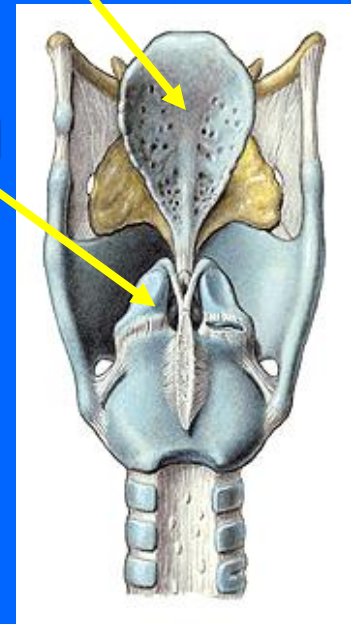
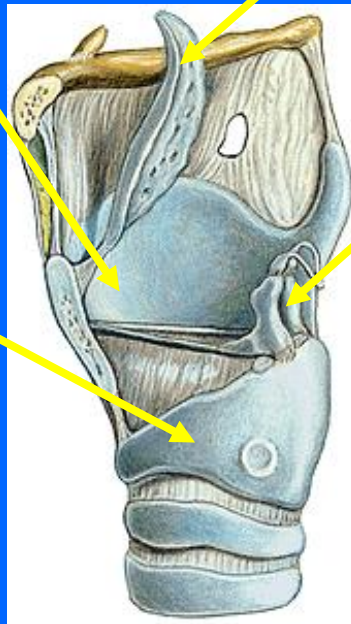
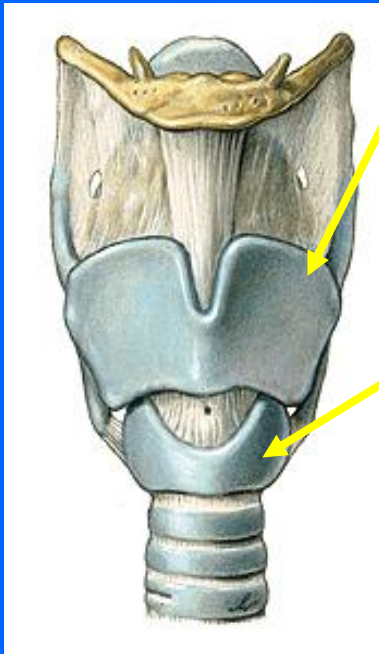
- **Cartilages: hyalin cartilage**

Epiglottis: elastic cartilage

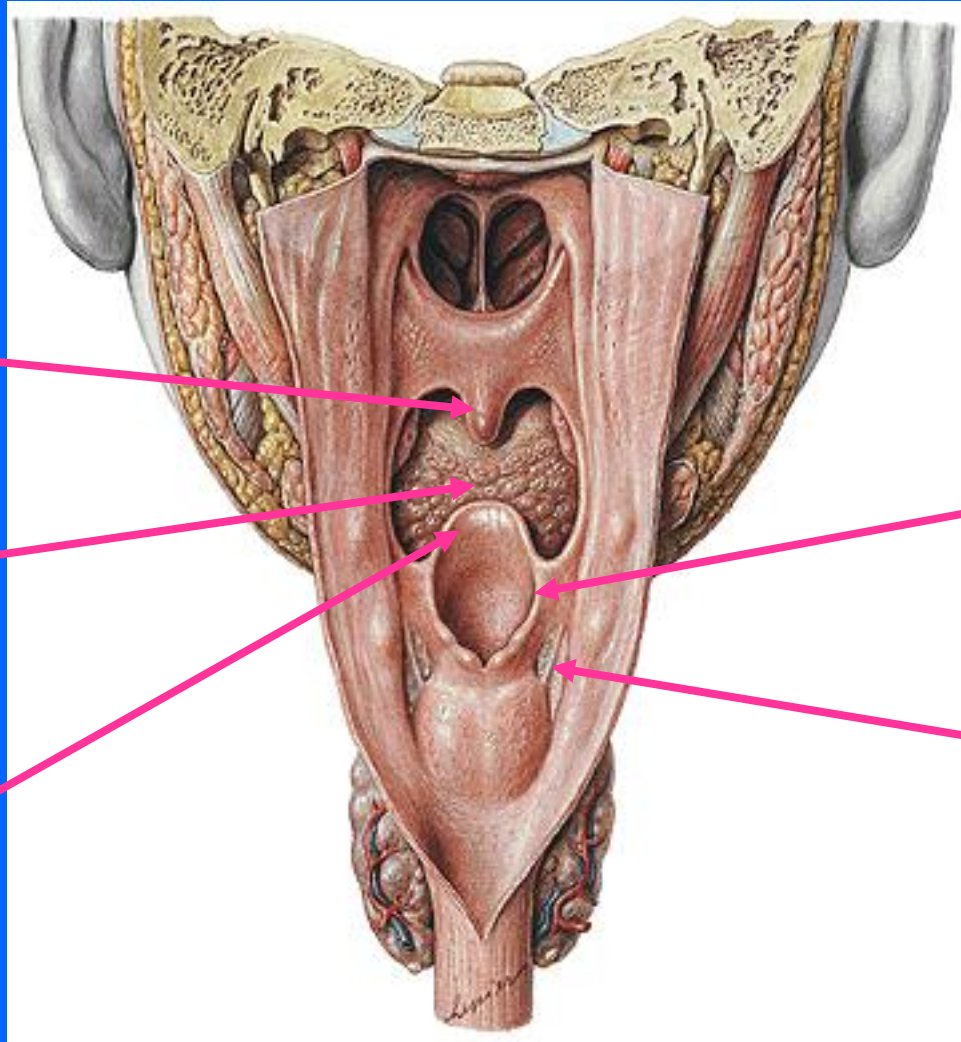
thyroid

arythenoid

cricoid



Pharynx/larynx



uvula

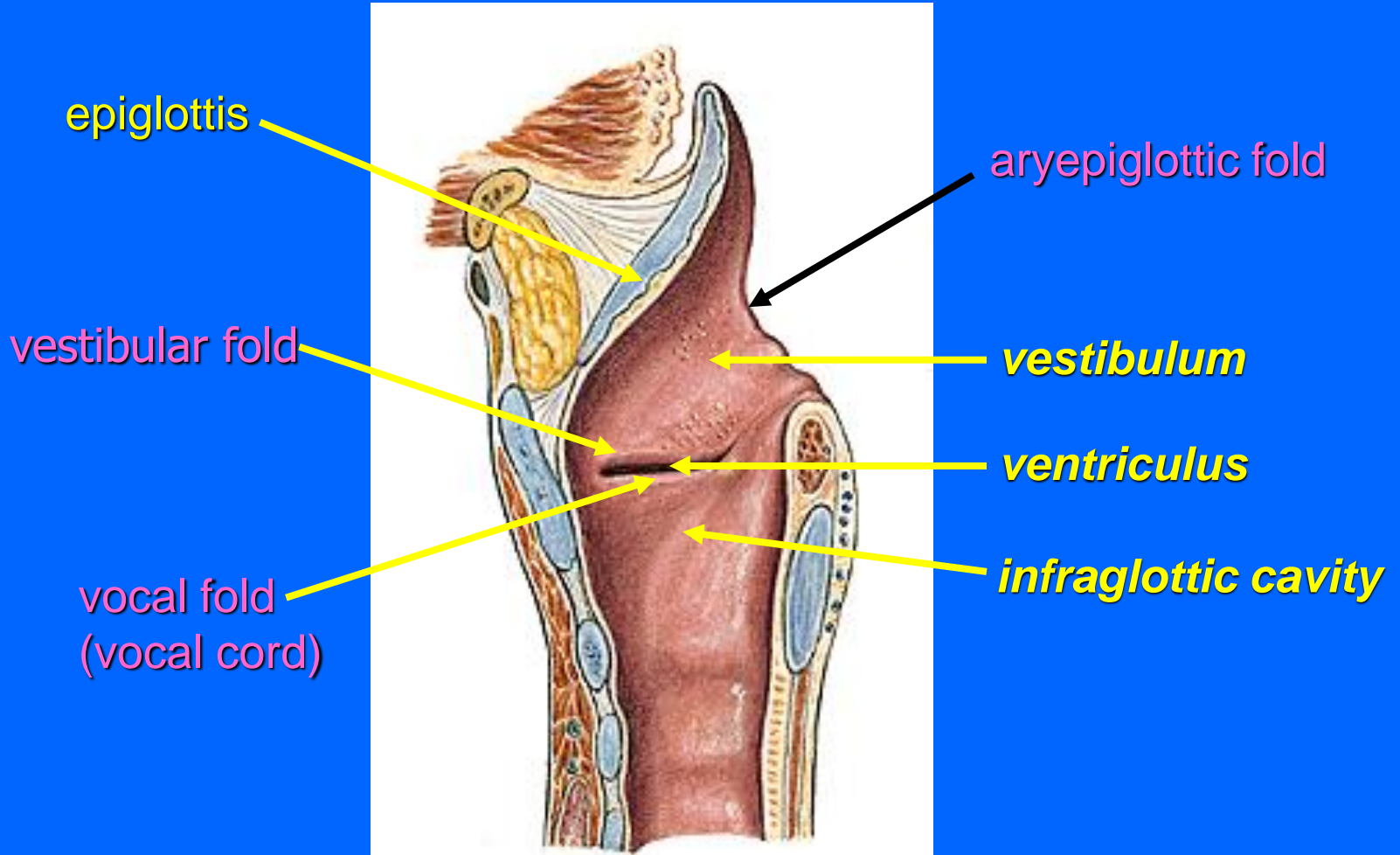
root of
the tongue

epiglottis

aryepiglottic fold

piriform recess

Larynx



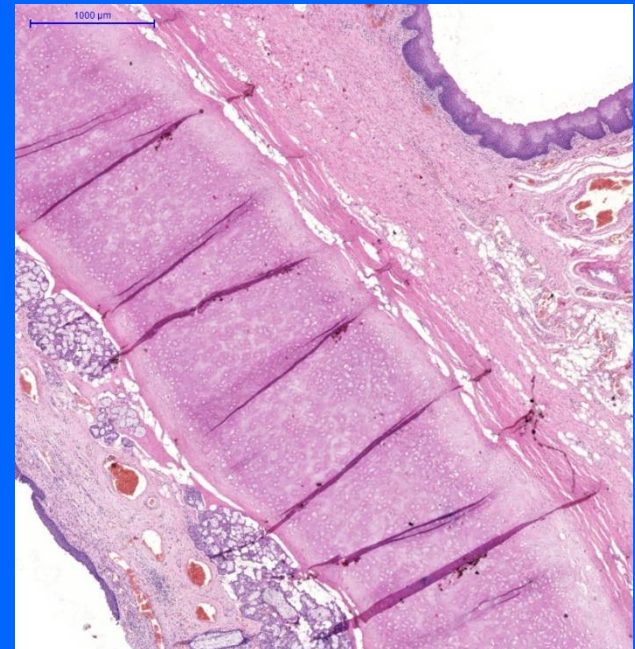
Histology of the epiglottis

Framework: elastic cartilage

covering layer: mucosa (NO muscularis mucosae)

- epithelium: stratified non-keratinized epithelium: thick with deep papillae on the lingual surfac; thin on the laryngeal surface

- propria: loose connective tissue with mixed glands



Function of the epiglottis

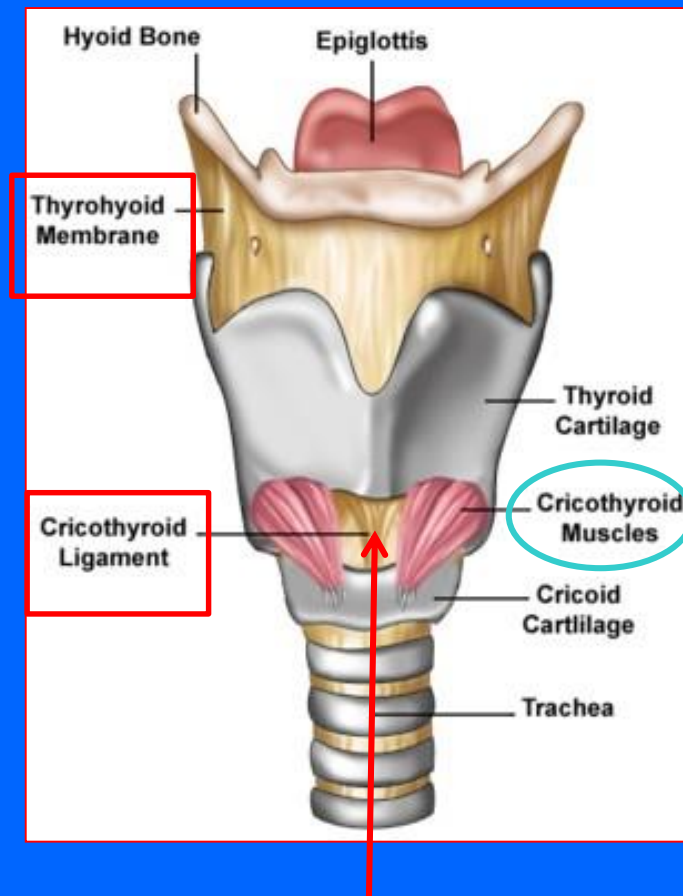
before swallow



during swallow

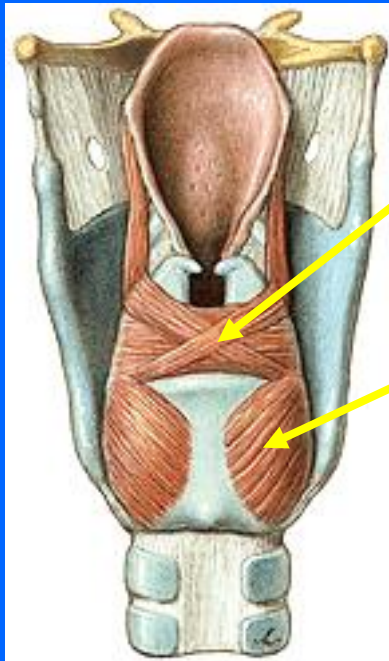


Muscles of the larynx

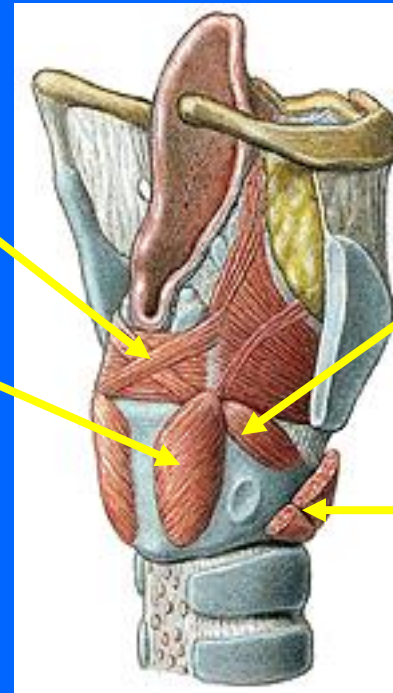


cricothyroid lig.: conicotomy!!!

Muscles of the larynx



arythenoid
posterior
cricoarythenoid



lateral
cricoarythenoid
cricothyroid

Muscles of the larynx

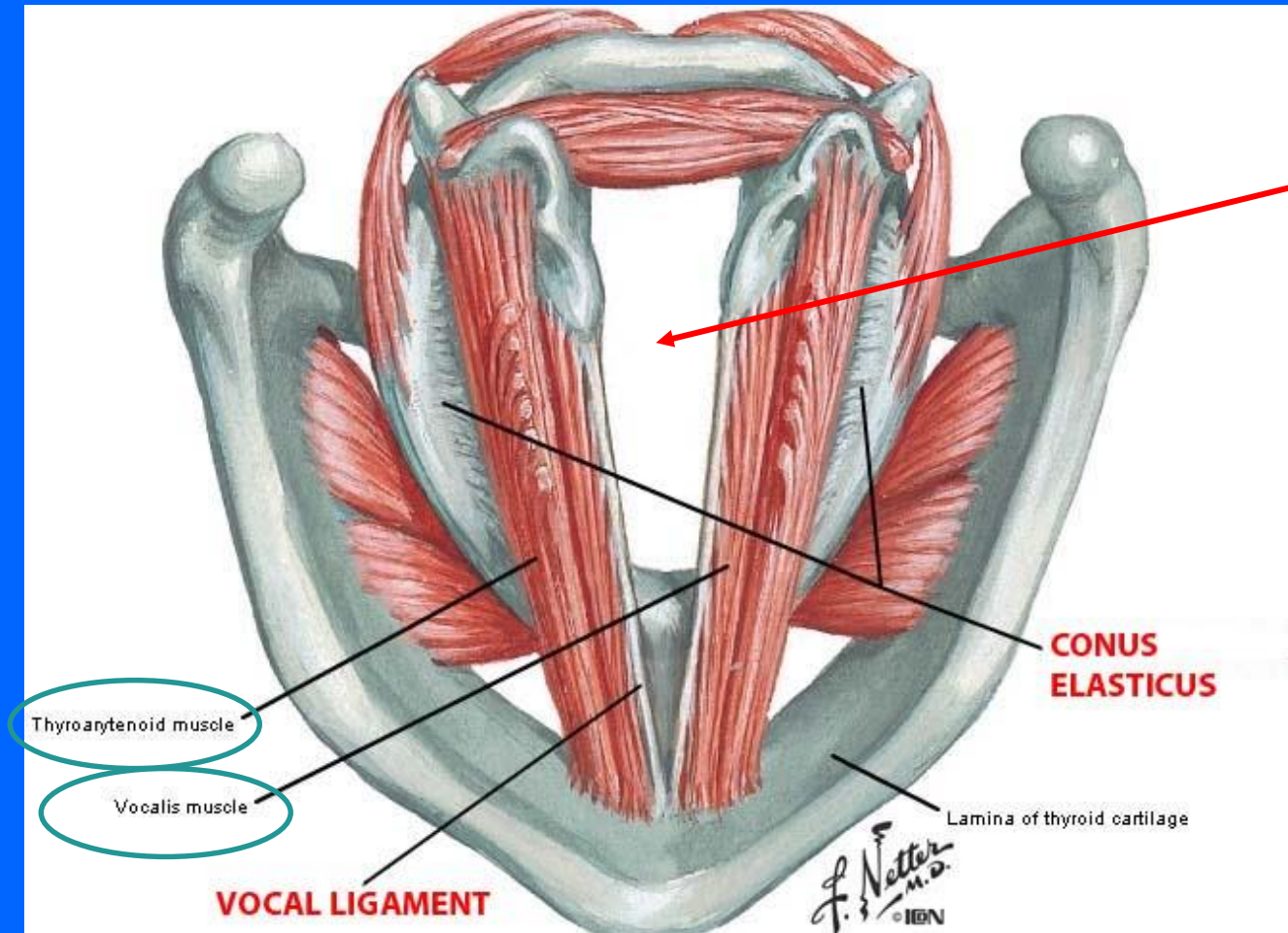
cricothyroid muscle: raises the voice

posterior cricoarythenoid muscles: narrows the rima glottidis

lateral cricoarythenoid muscle: opens the rima glottidis

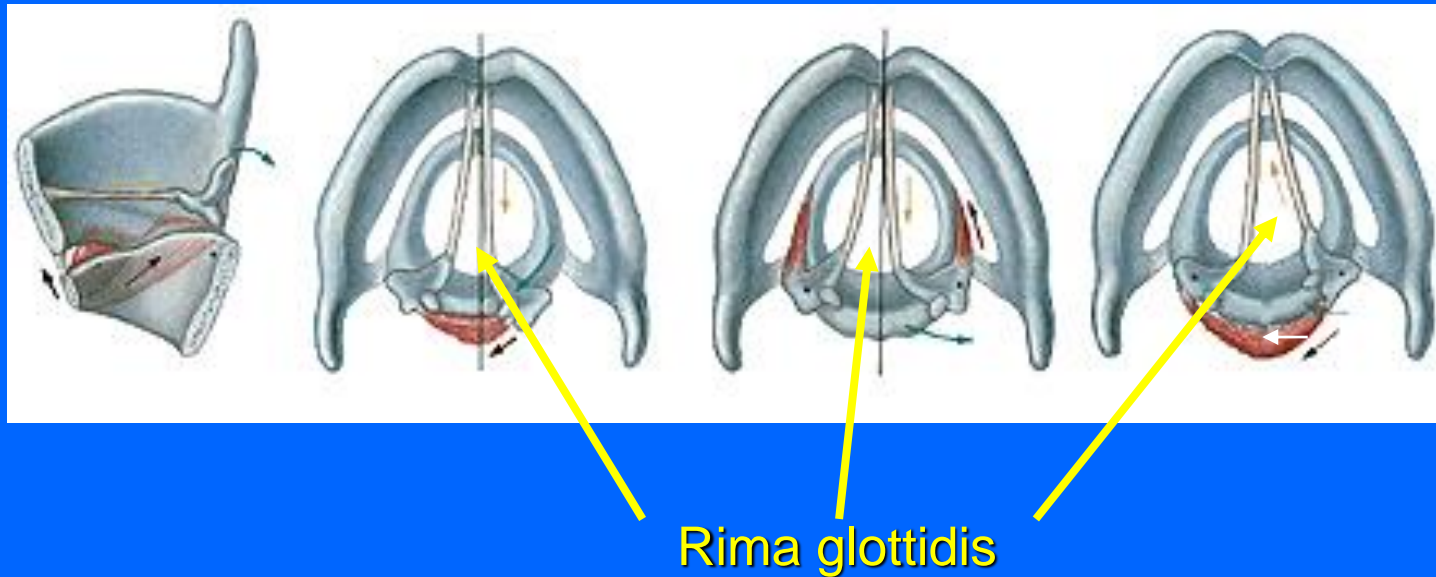
arythenoid muscles: closes the epiglottis

Larynx: rima glottidis



rima glottidis

Function of the glottis and rima glottidis



Rima glottidis: aperture between the vocal folds

Glottis: part of the larynx most directly concerned with voice production

Ordinary breathing: rima glottidis is narrow, wedge-shaped

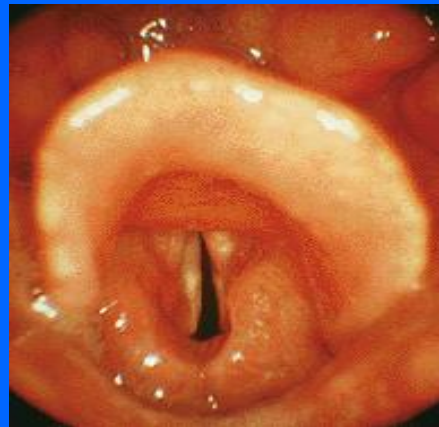
Forced respiration: rima glottidis is wide

Speaking: rima glottidis appears as a linear slit

Rima glottidis (laryngoscopy)



phonation
normal speaking:
closed rima glottidis



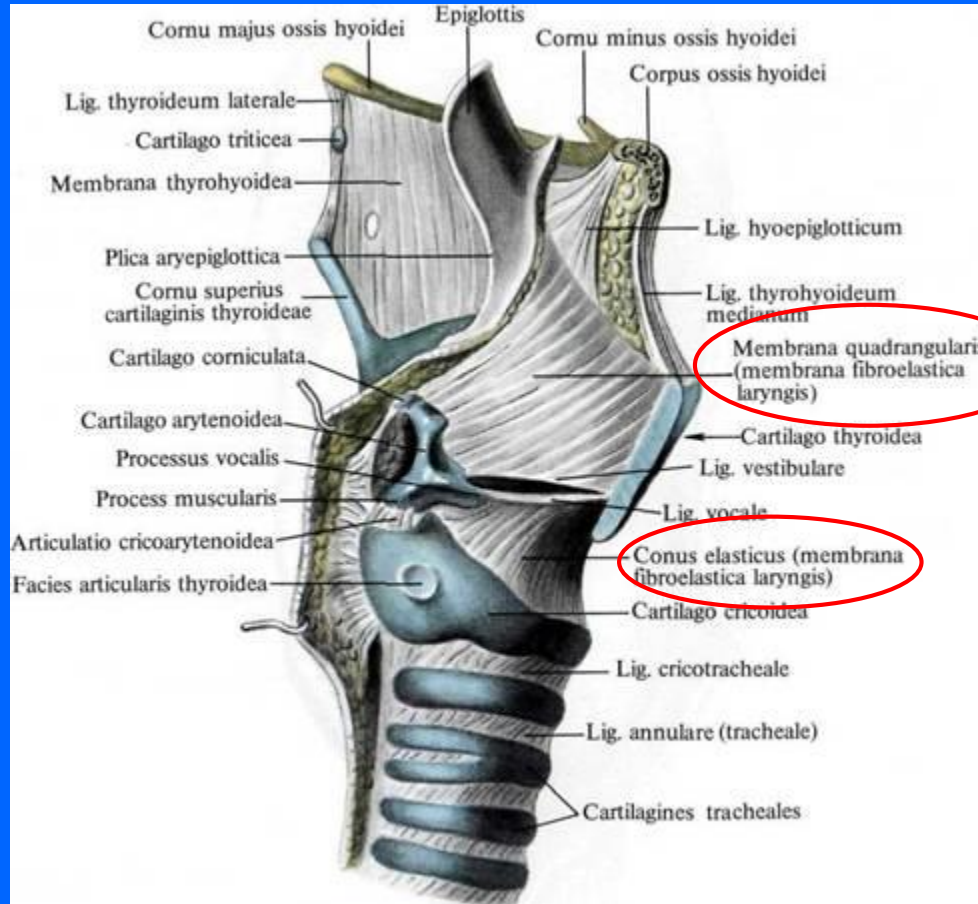
wishpering



forced respiration:
widely open rima glottidis

Laryngeal obstruction (choking): aspirated food or other material becomes lodged in the rima glottidis.

Since the lungs still contain air, compression of the abdomen (*Heimlich maneuver*) expels air from the lungs and dislodges the food or other material.



- lamina propria: fibers rich: fibroelastic membrane: prevents fold formation on the mucosa during phonation

Innervation of the larynx

Vagus nerve (cranial nerve X)

Sensory innervation:

Mucosa superior to the vocal fold:

superior laryngeal nerve r. internus

Mucosa inferior to the vocal fold:

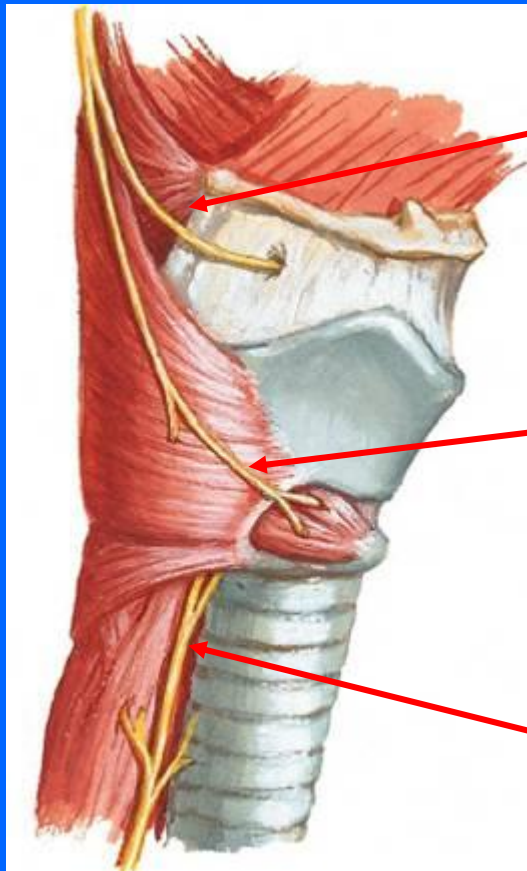
inferior (recurrent) laryngeal nerve

Motory innervation: inferior (recurrent) laryngeal nerve

superior laryngeal nerve r. externus: cricothyroid
m. only

Innervation of the larynx

sup. laryngeal n.



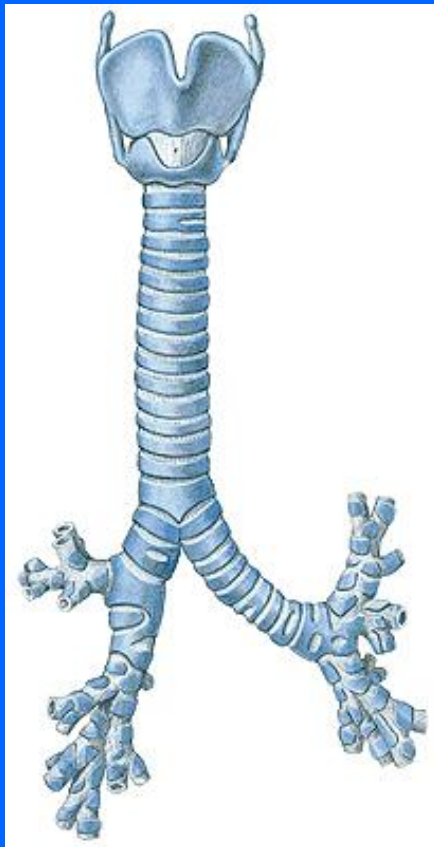
sensory innervation

motor innervation

recurrent (inf.) laryngeal n.

Trachea

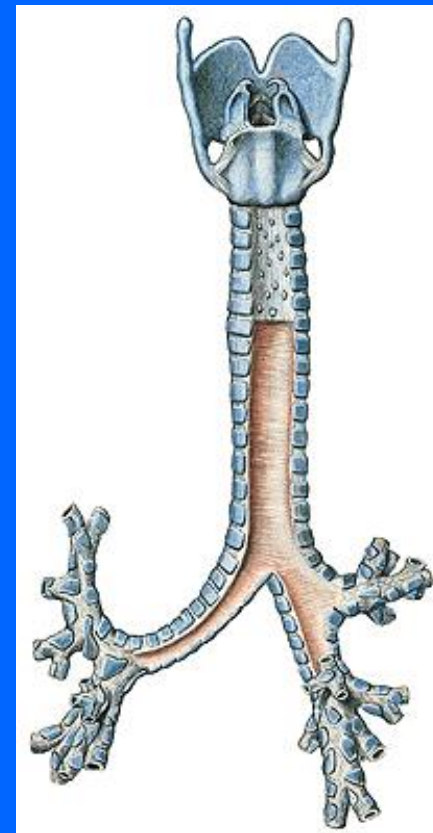
anterior view



Right

left

posterior view



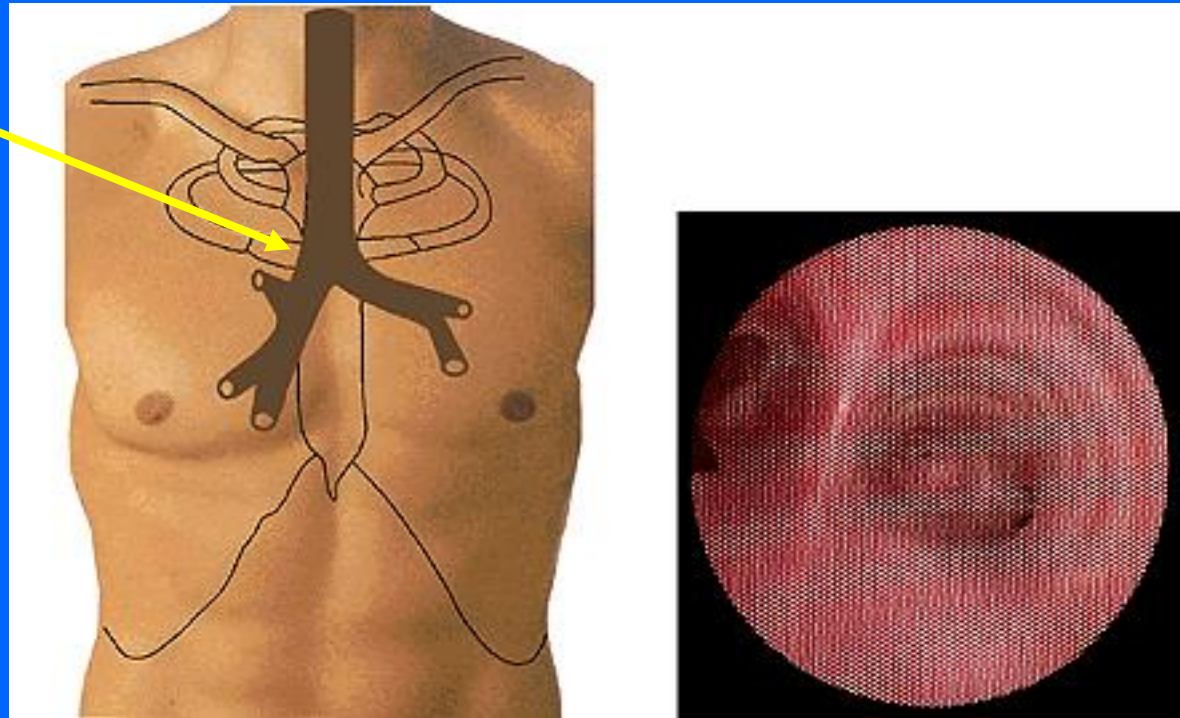
right

left

Principal bronchi

Outline of the trachea

bifurcation of
the trachea



Histology of the trachea

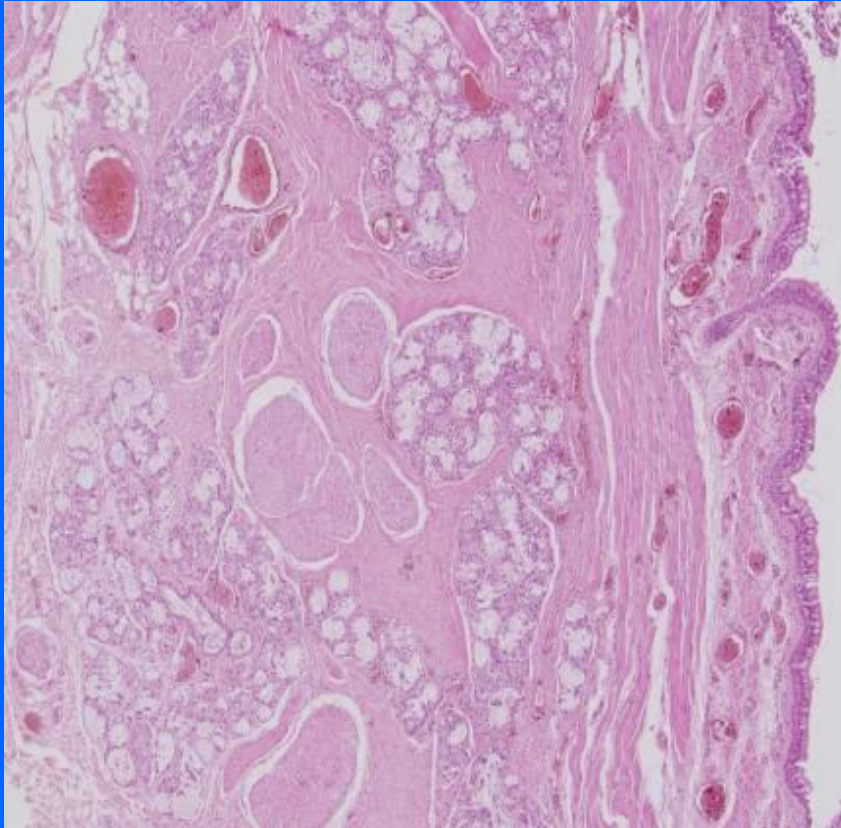


membranous part:
smooth muscle + glands

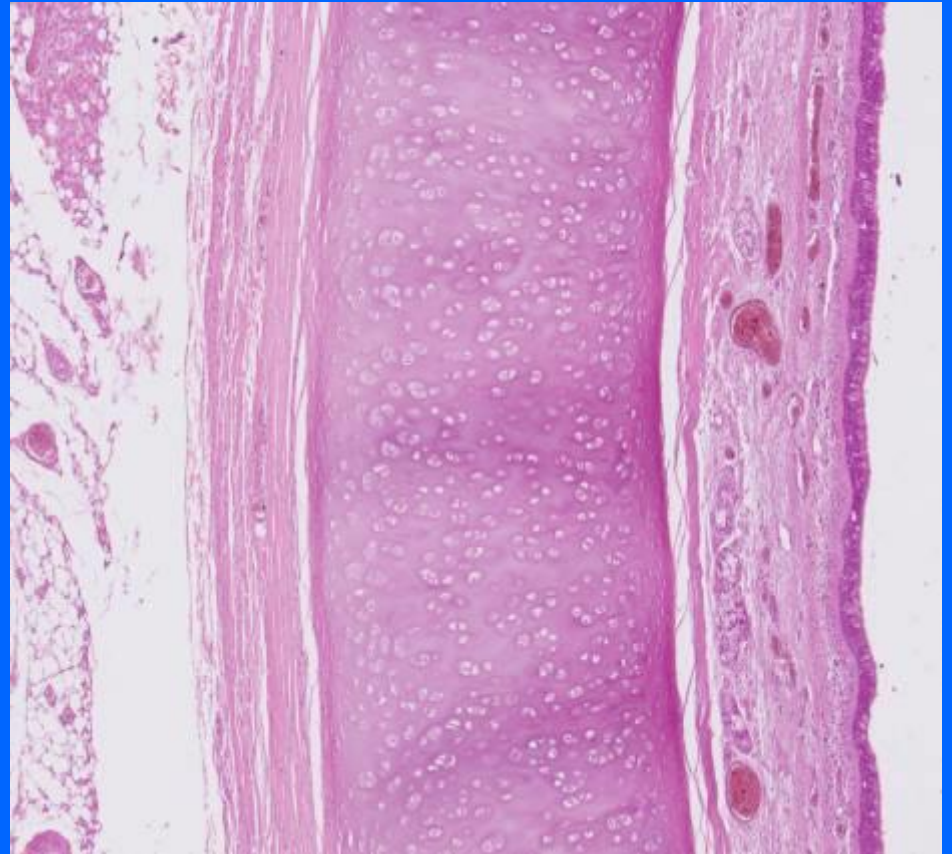
hyalin cartilaginea

Trachea

mucosa



membranous part

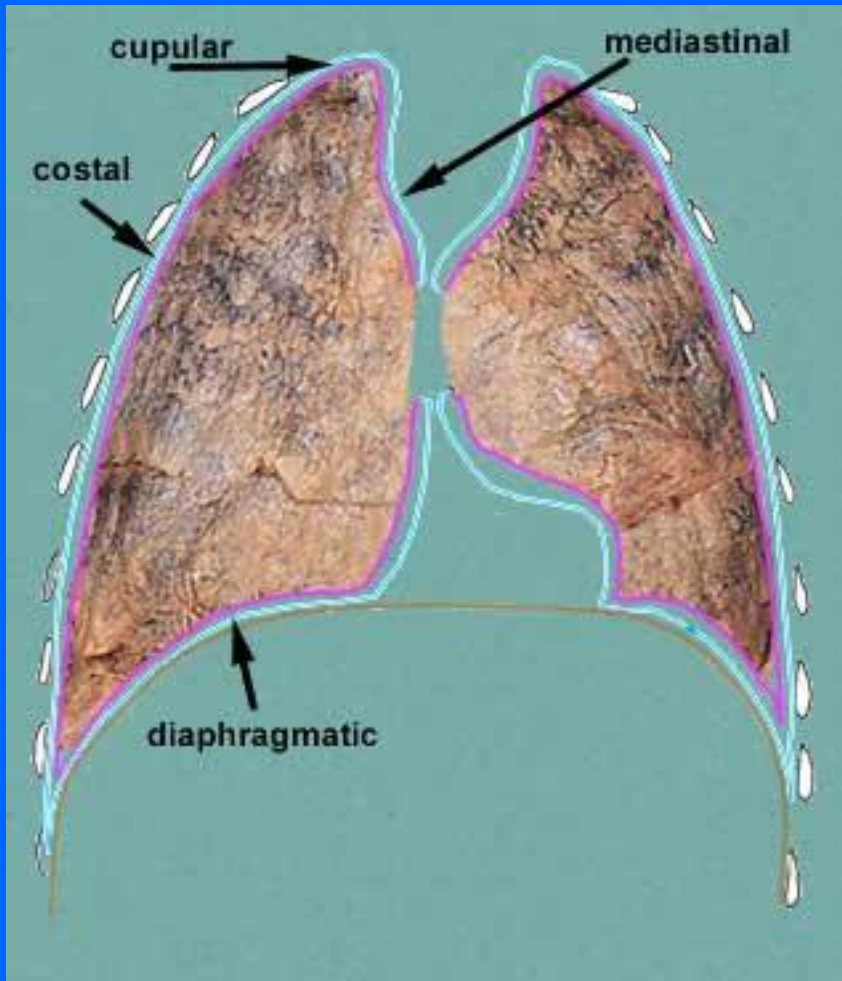


Framework: hyalin cartilage

Mucosa: epithelium: pseudostratified ciliated

propria: loose connective tissue with gland
(NO muscularis mucosae)

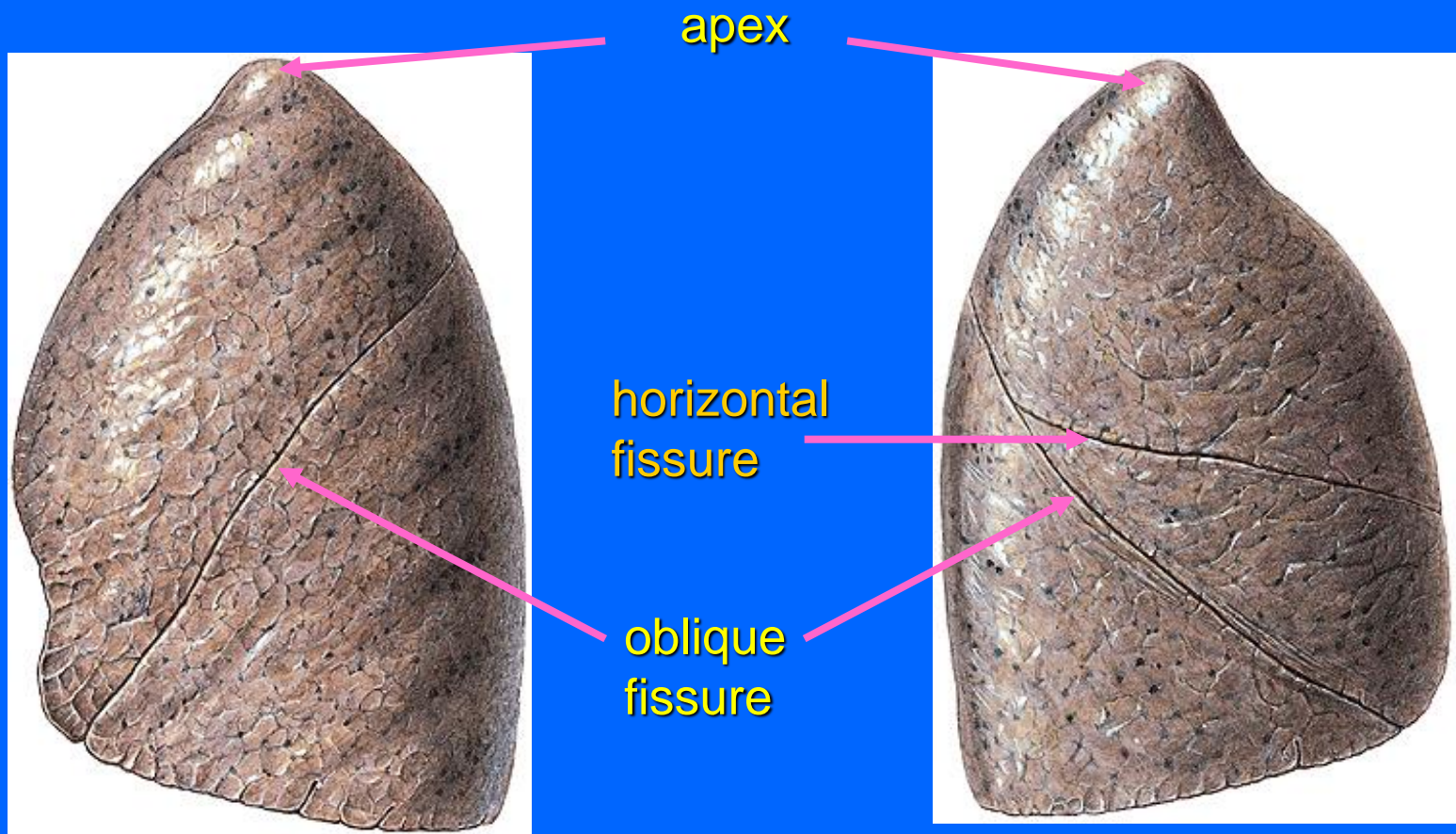
Surfaces of the lung



Lobes: right: 3
left 2

Segments:
right: 5-5
left: 3-2-5

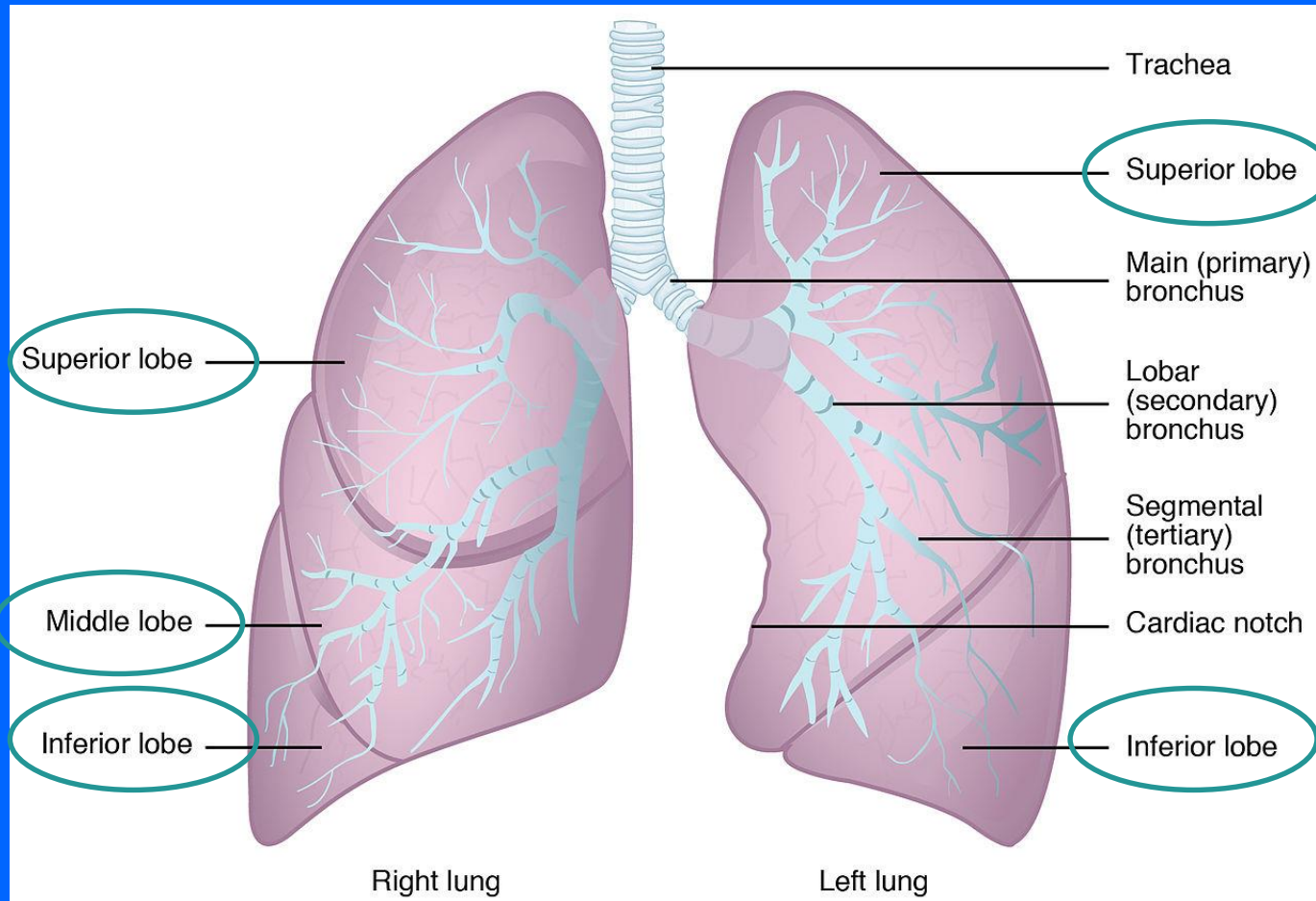
Lung



left: 2 lobes

right: 3 lobes

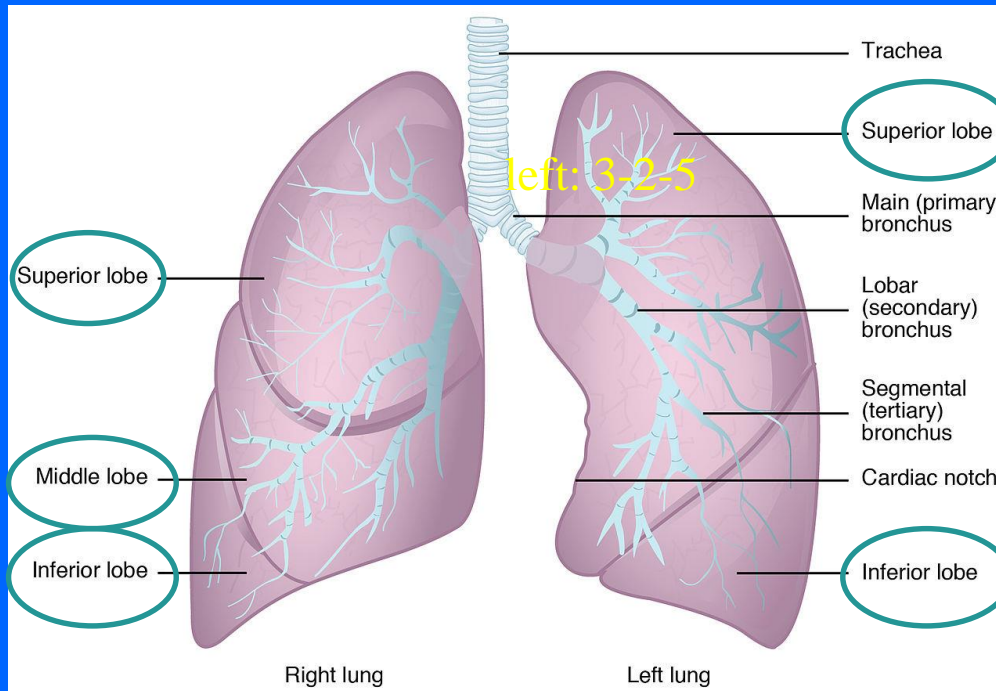
Lung



Lobes: right: 3
left 2

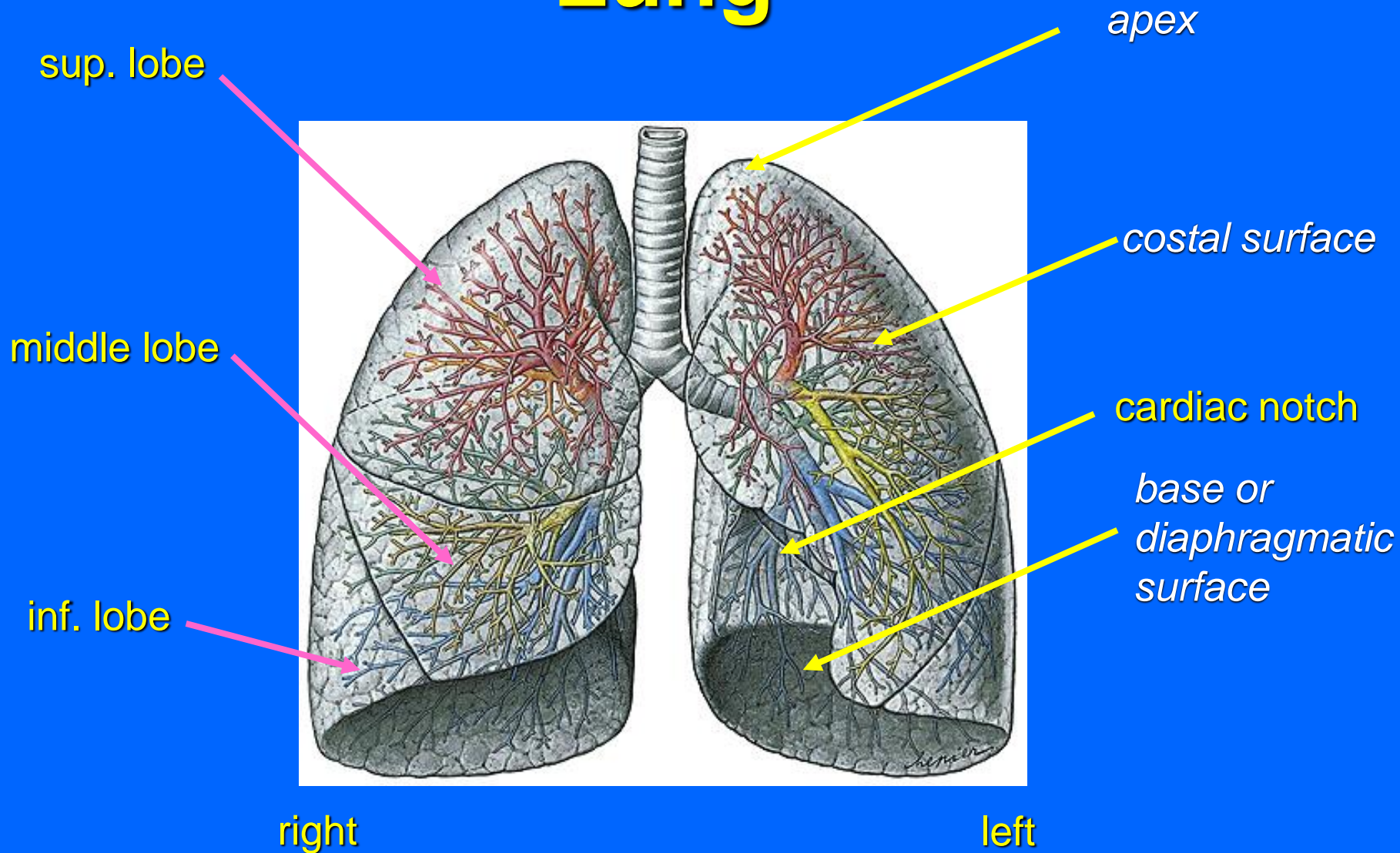
Lobes are composed of segments

Segments:
right: 3-2-5



Segments:
left: 5-5

Lung



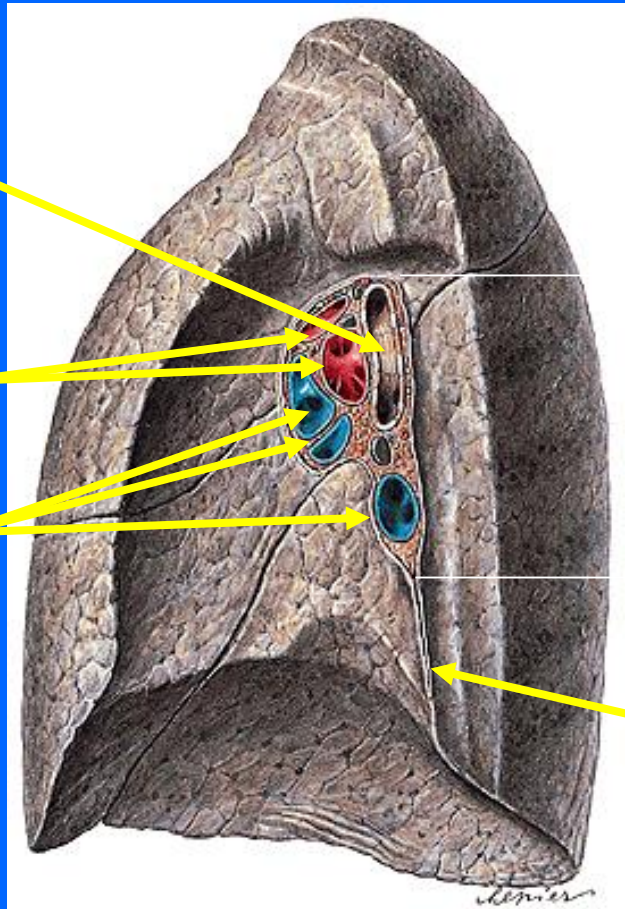
Lung – mediastinal surface

Root of the lung:

principal bronchus

right pulmonary artery

right pulmonary veins

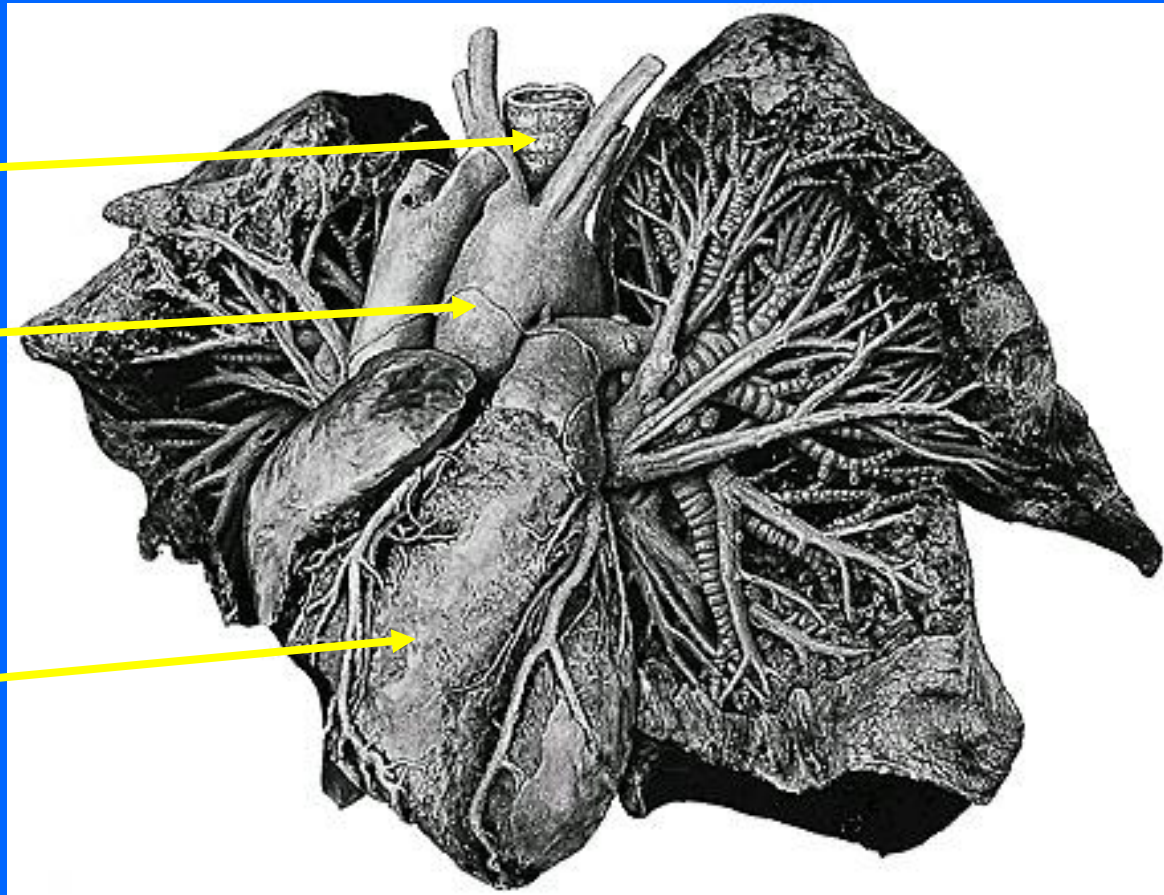


hilum of the lung:
root of the lung+
lymph nodes

lig. pulmonale:
double pleural layer

right lung

Bronchi tree



trachea

aortic arch

heart

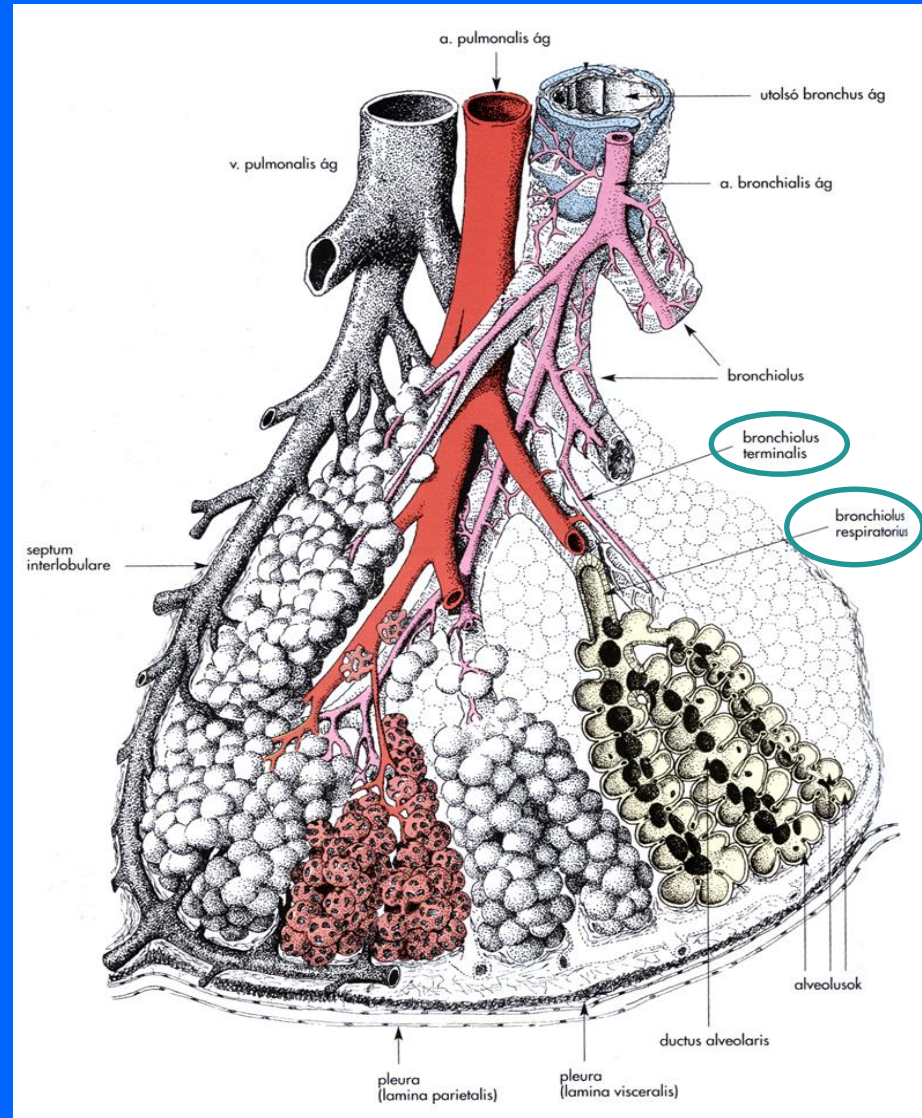
Branches of the terminal bronchi, sacculi and alveoli

Lobes : segments

Segments:

borders: veins

artery + bronchioles
(centrally)



Bronchi tree

Principal bronchus → lobal bronchus →

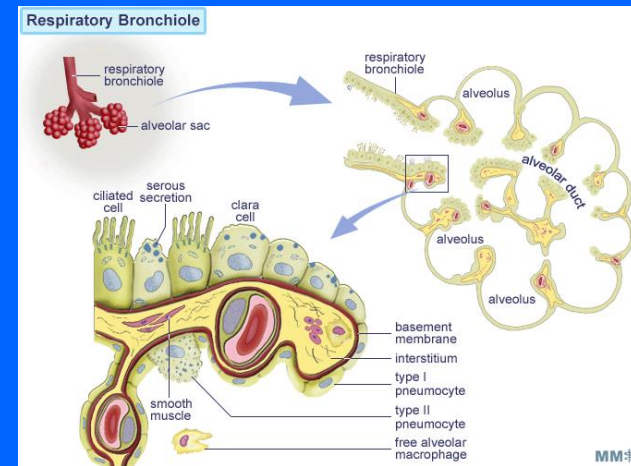
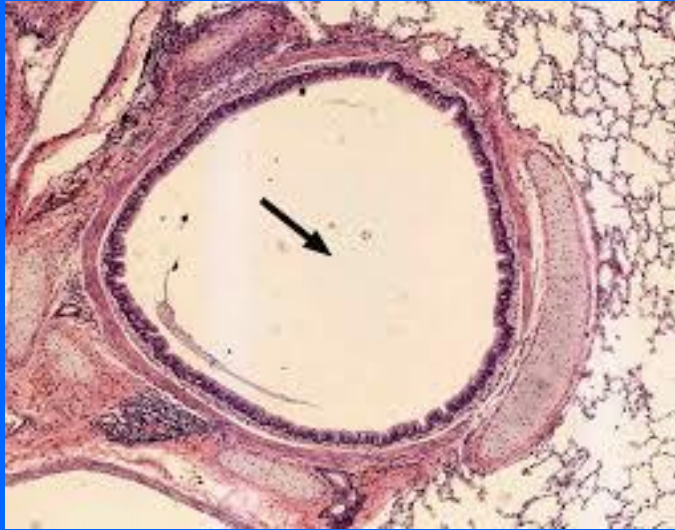
segmental bronchus → terminal bronchus →

bronchiolus → terminal bronchiolus →

bronchiolus respiratoricus → sacculus: ductus
alveolaris

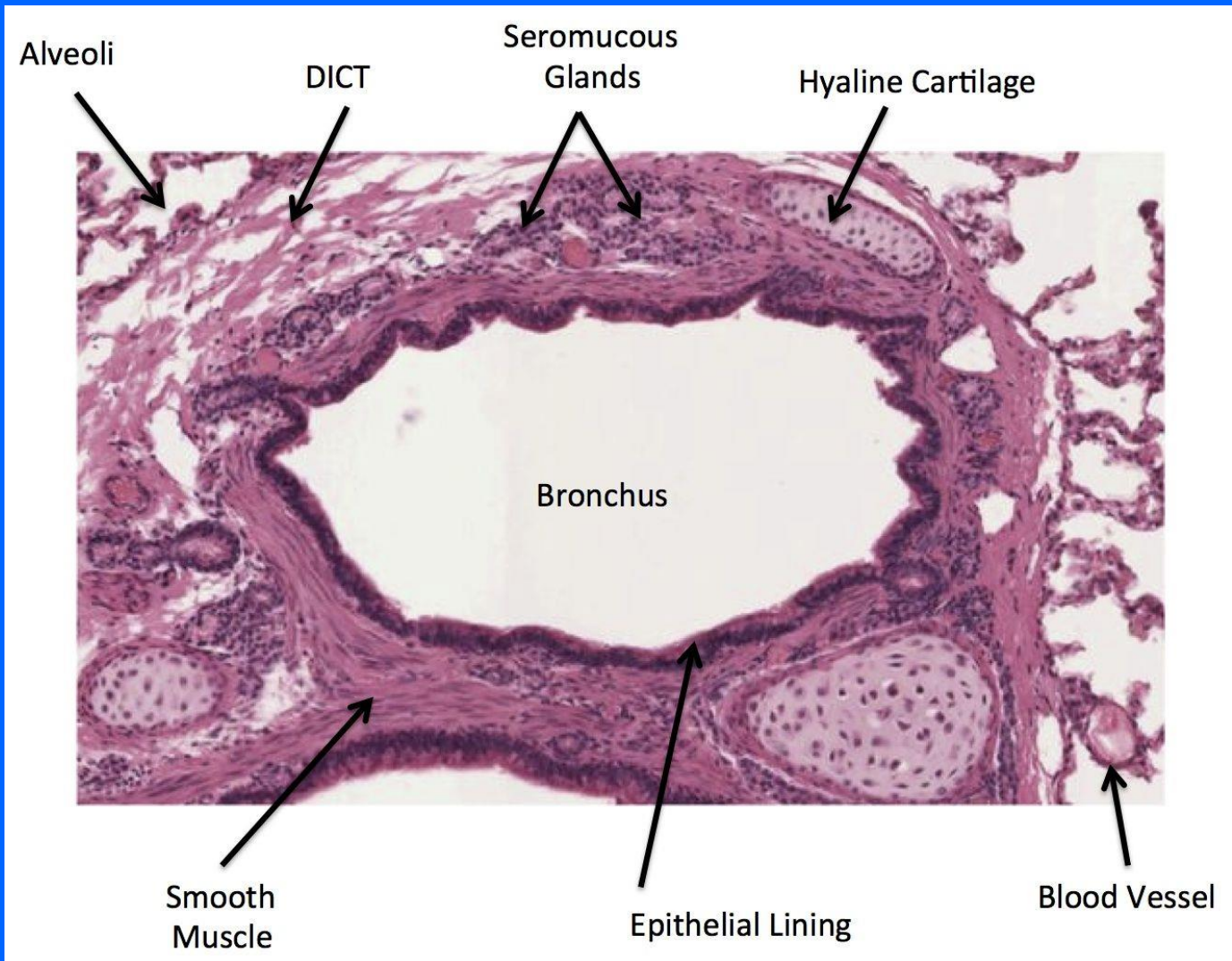
→ alveoli

Histological changes in the respiratory system

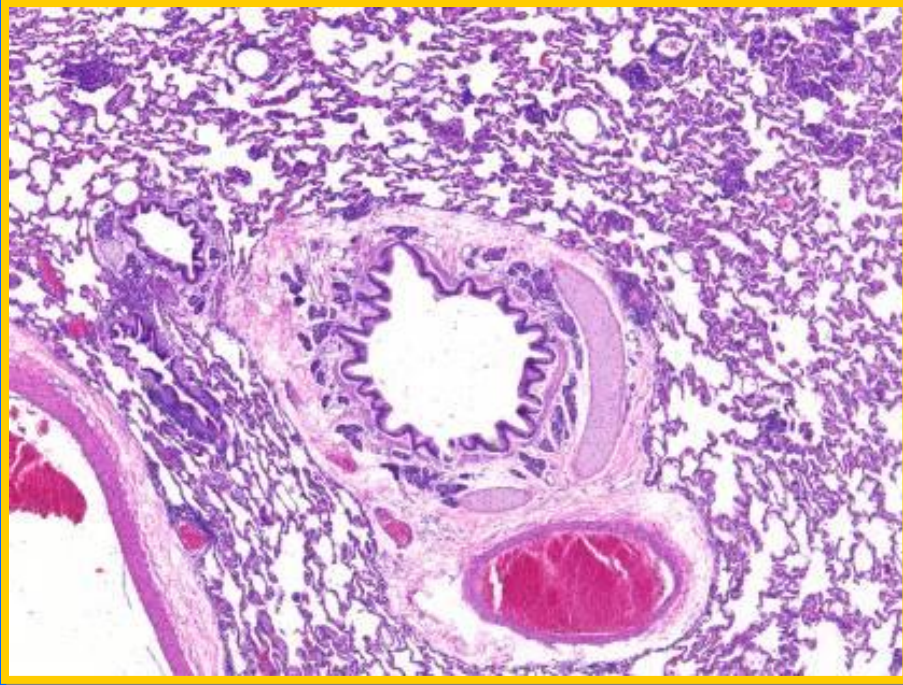


- cartilage disappears
- glands are disappearing
- smooth muscle becomes continuous (bronchioles) and then disappears
- epithelium becomes thin

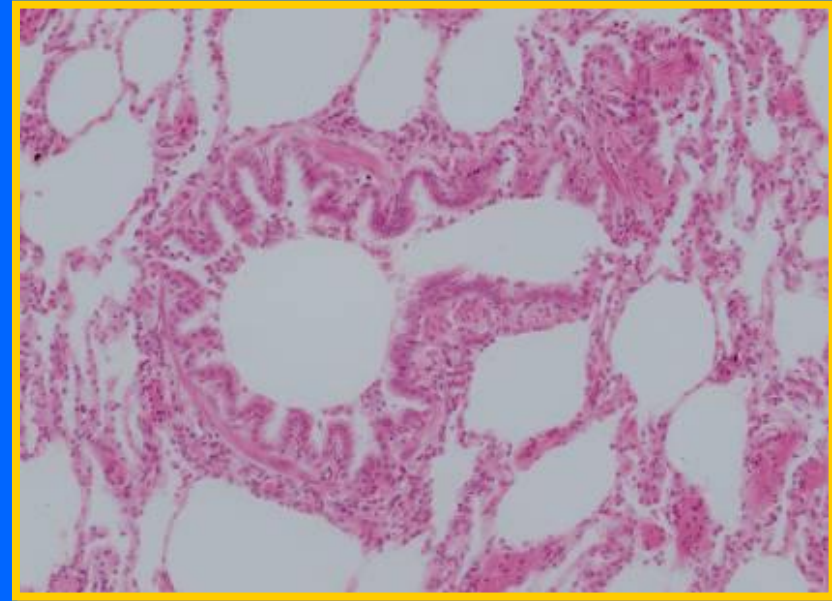
Histology of the bronchus



Lung

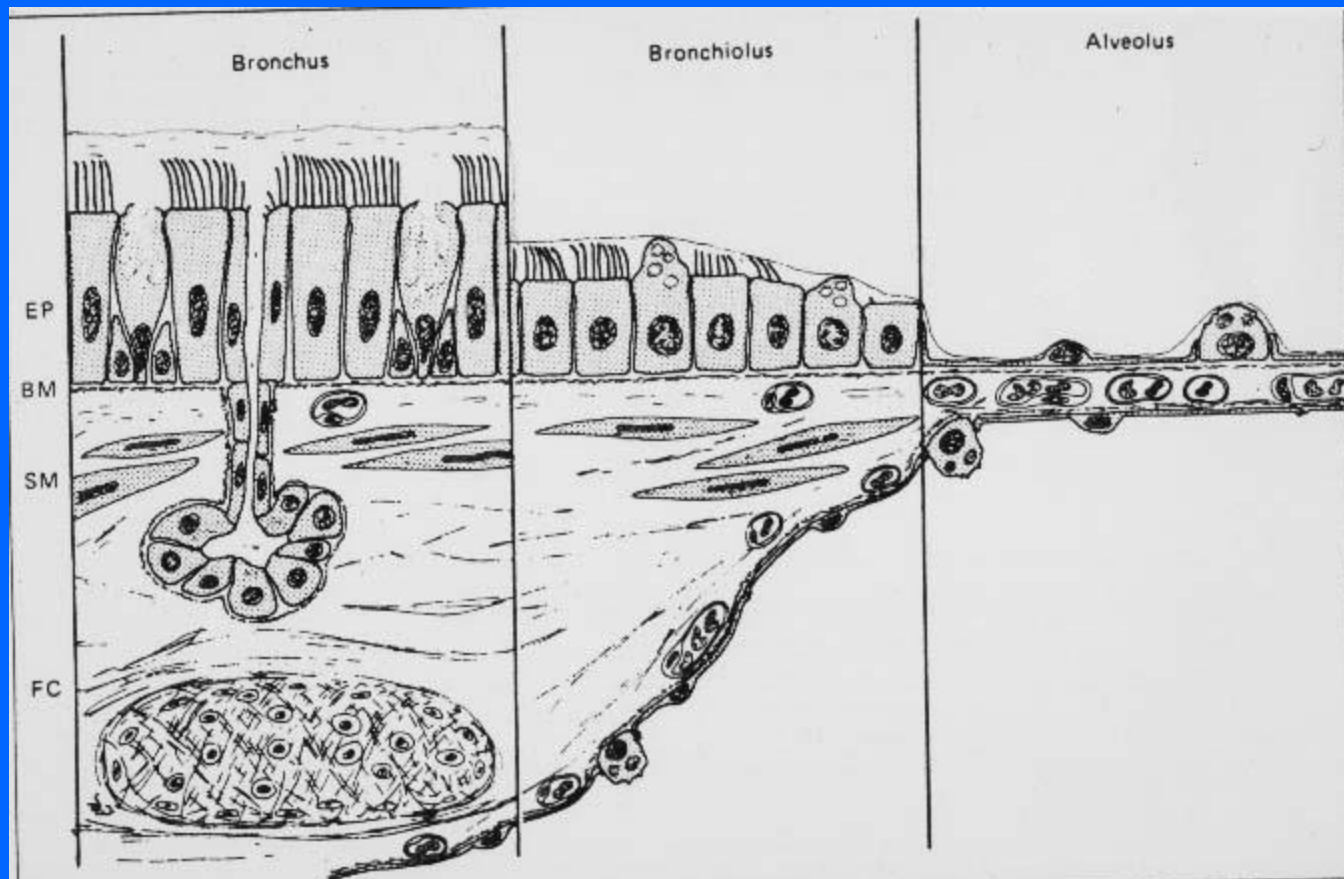


bronchus
(segmental)



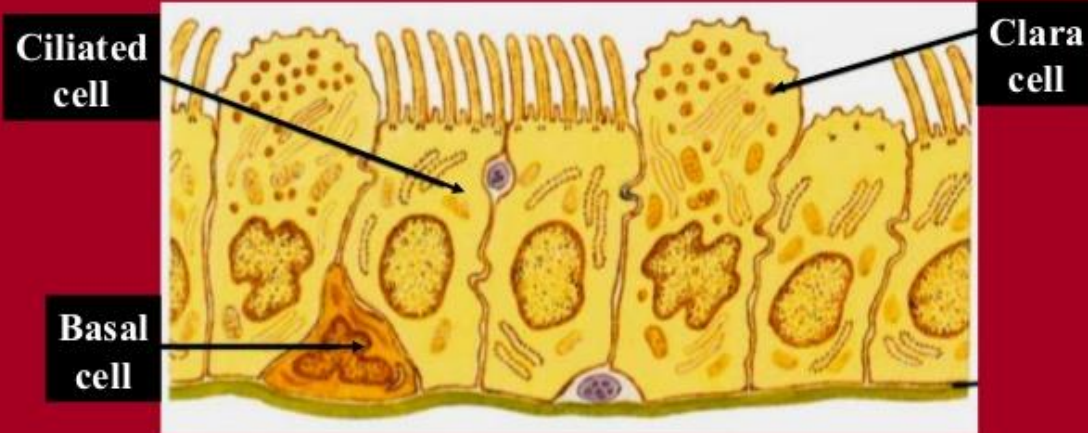
bronchiole

Histological changes in the bronchi tree



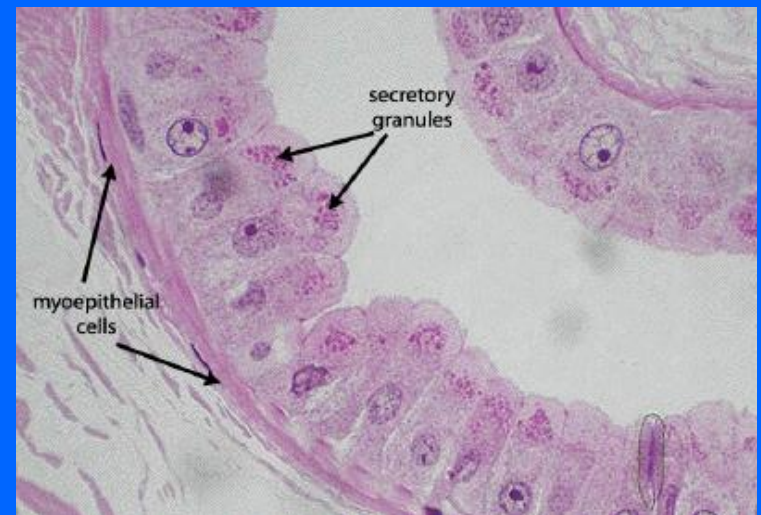
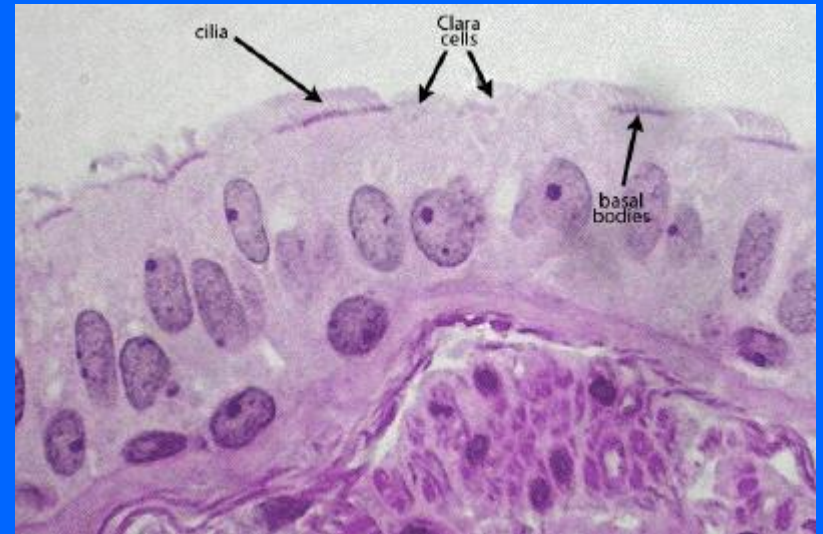
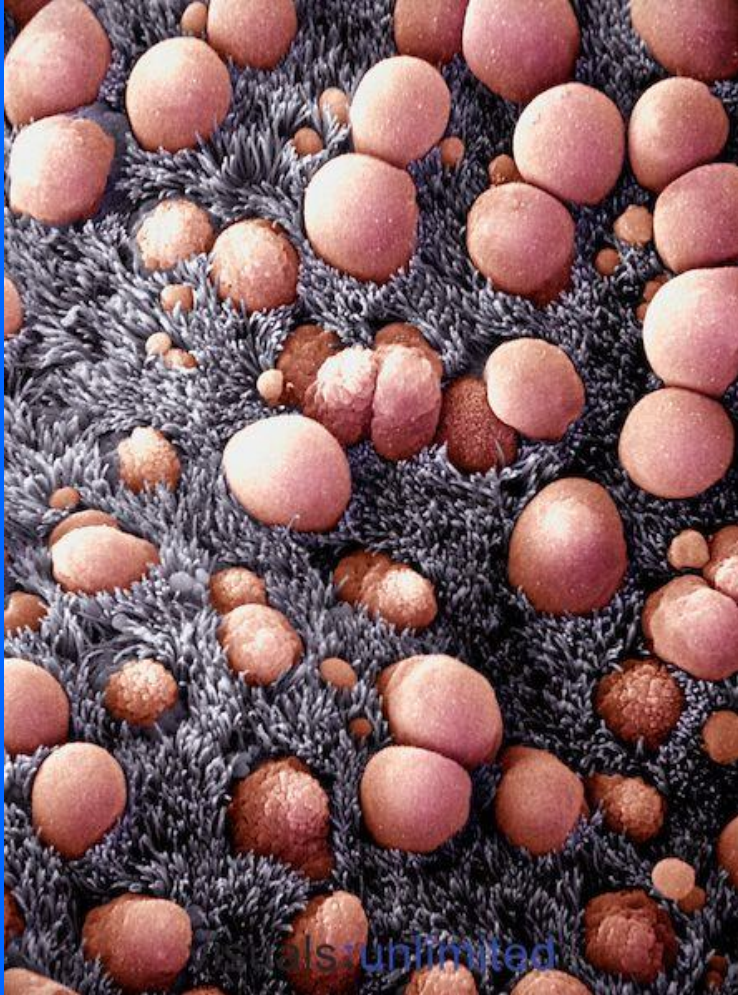
Clara cells

CELLS LINING BRONCHIOLES

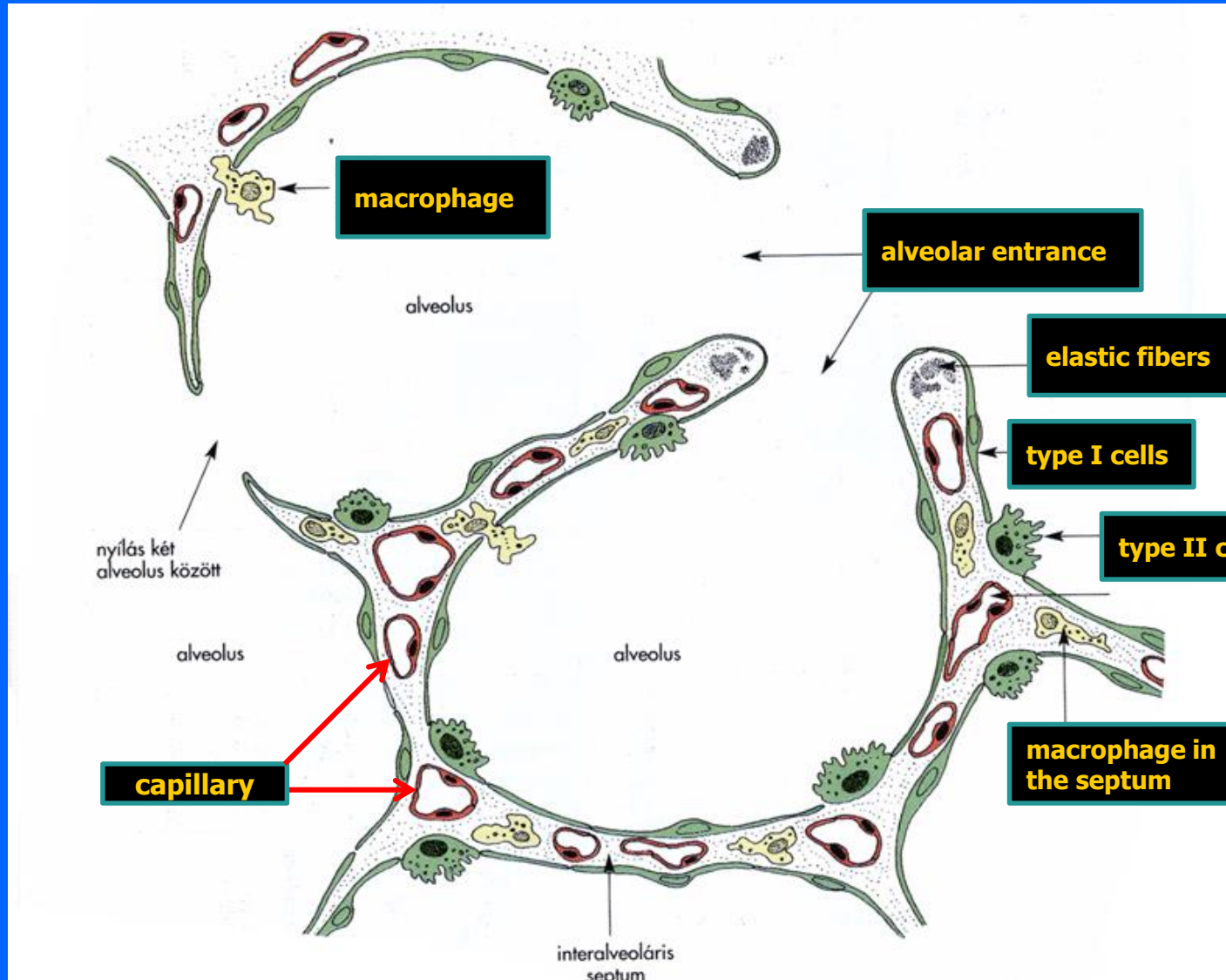


Clara (bronchiolar) cells – columnar cells with domed apices and short blunt microvilli. Apical cytoplasm filled with secretory granules containing surfactant-like material that reduces surface tension and facilitates patency of bronchioles. Cells also degrade inhaled toxins.

Clara cells



Alveoli and alveolar septi

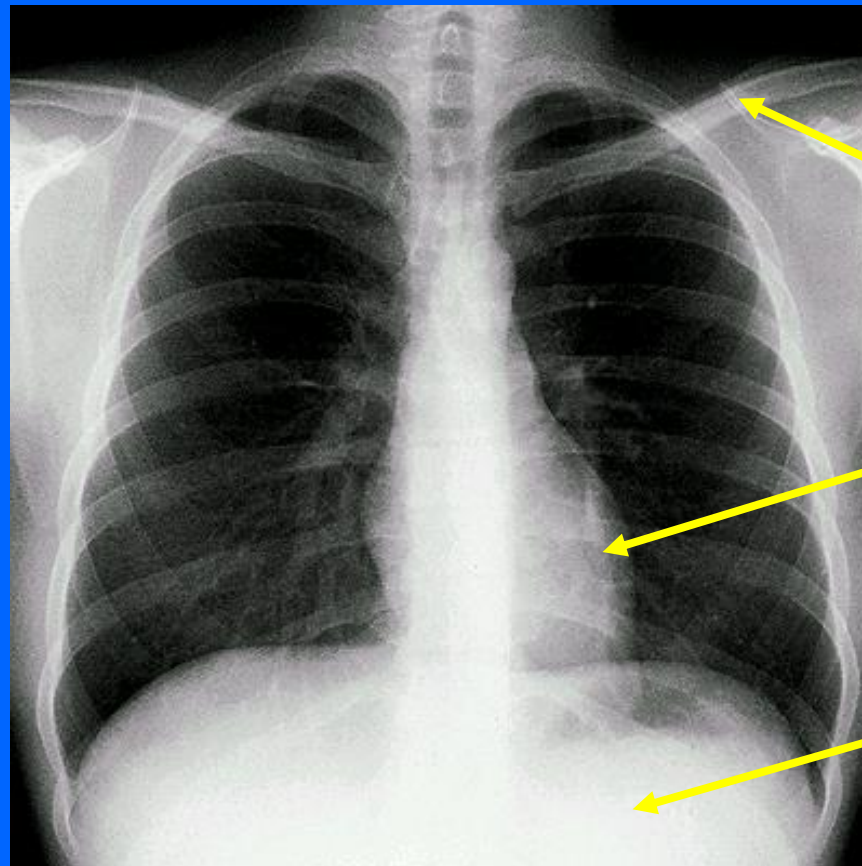


Pneumocytes: simple squamous epithelial cells

Type I cells: flat, squamous cells: gass exchange

Type II cells: surfactant secretion: decreases the surface tension

Lung – X-ray image

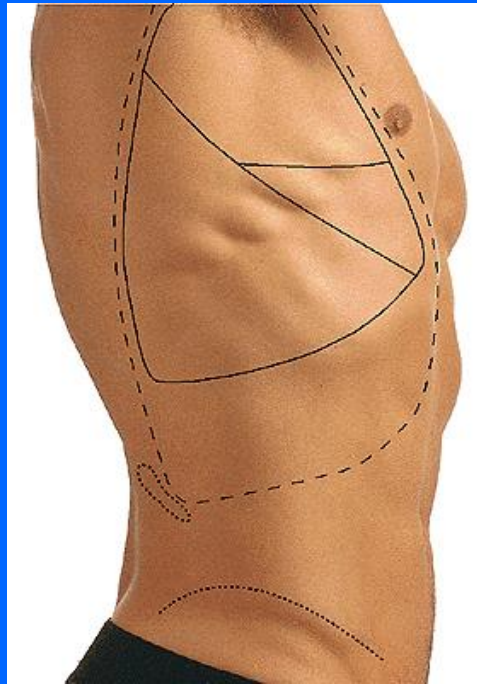
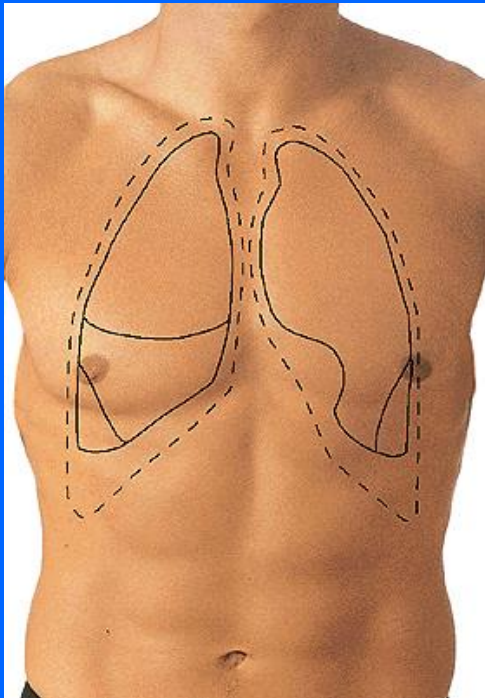


clavicle

heart

diaphragm

Surface markings of the lung and pleura



Pleura: double layered serous membrane:

- parietal layer: chest cavity
- visceral layer: on the surface of the lung
- few amount of fluid between the 2 layers

Pleural recesses (sinuses)

- ***Costodiaphragmatic (phrenicocostal):***
a slitlike space between the costal and the diaphragmatic surface
- ***Costomediastinal:*** potential space along the anterior margin of the pleura, between the mediastinal and costal surface

Volume changes of the lung

Volume of the lung: changes as the pleura moves

Inspiration: active muscle work:

intercostal muscles+diaphragm contract → volume of the chest cavity is increasing → parietal pleura moves together with the chest cavity → visceral pleura follows the movement → lung dilates

Expiration: muscles relax

Bibliography

- Snell RS, Clinical Anatomy, Little, Brown & Co, Boston, 1995
- Moore KL, Dalley AF: Clinically Oriented Anatomy, Lippincott, 1999
- Sobotta: Atlas of Human Anatomy
- Röhlich: Szövettan