



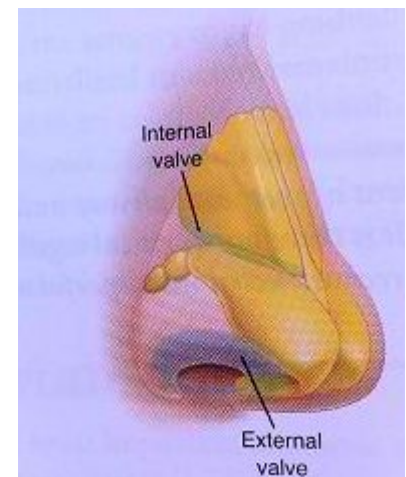
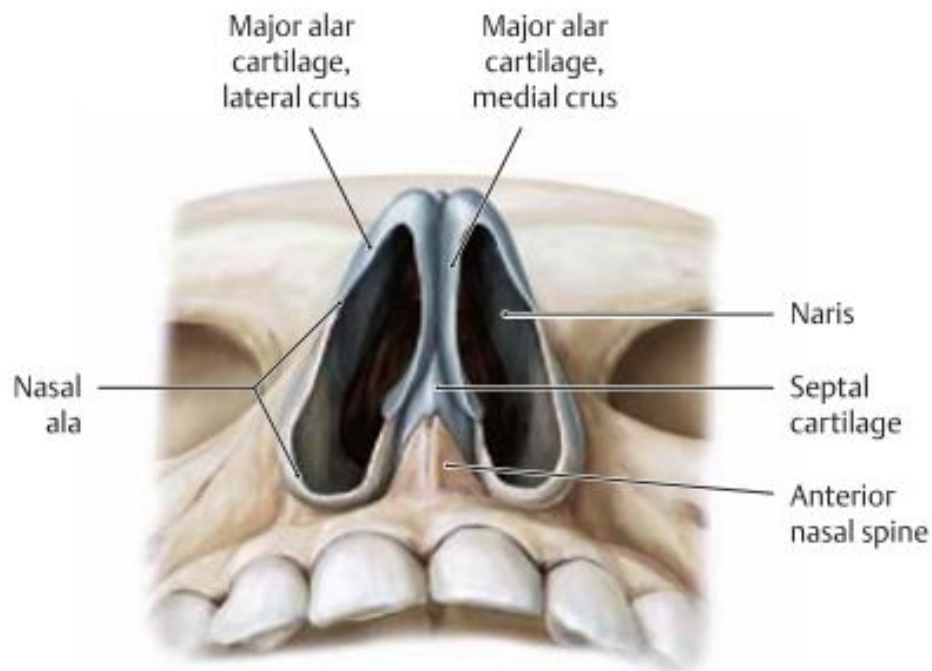
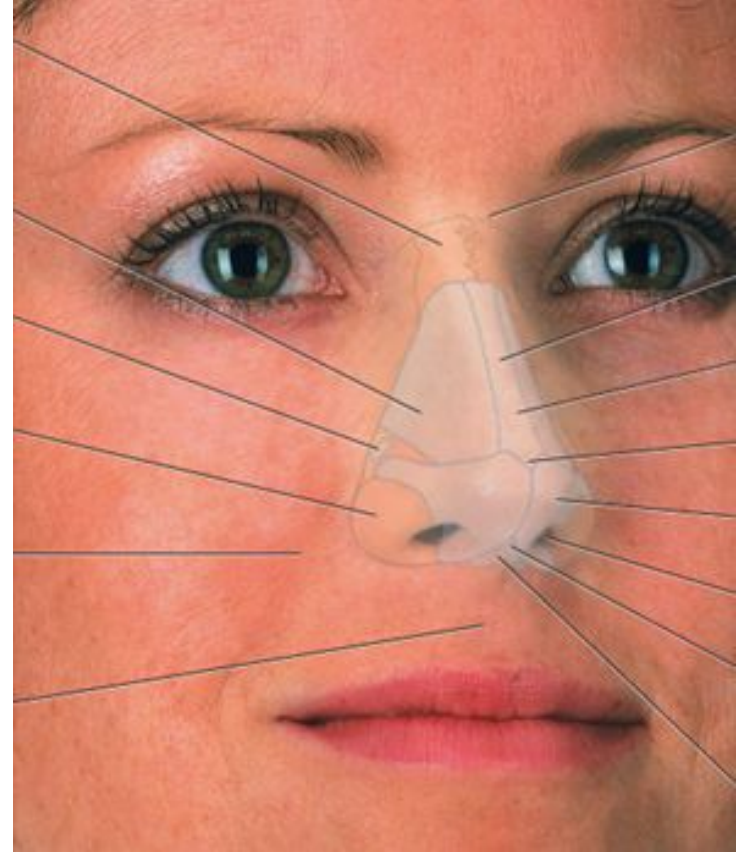
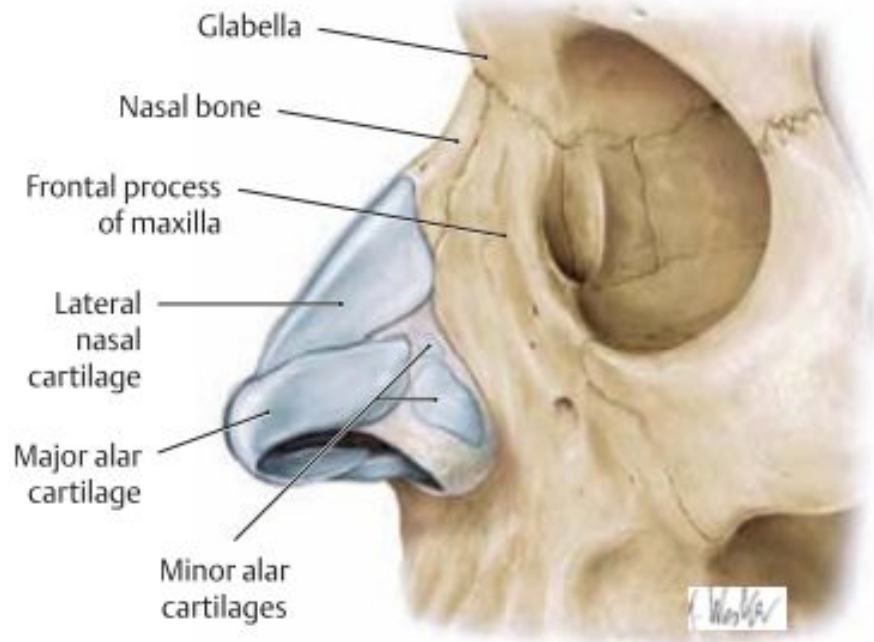
ДЫХАТЕЛЬНАЯ

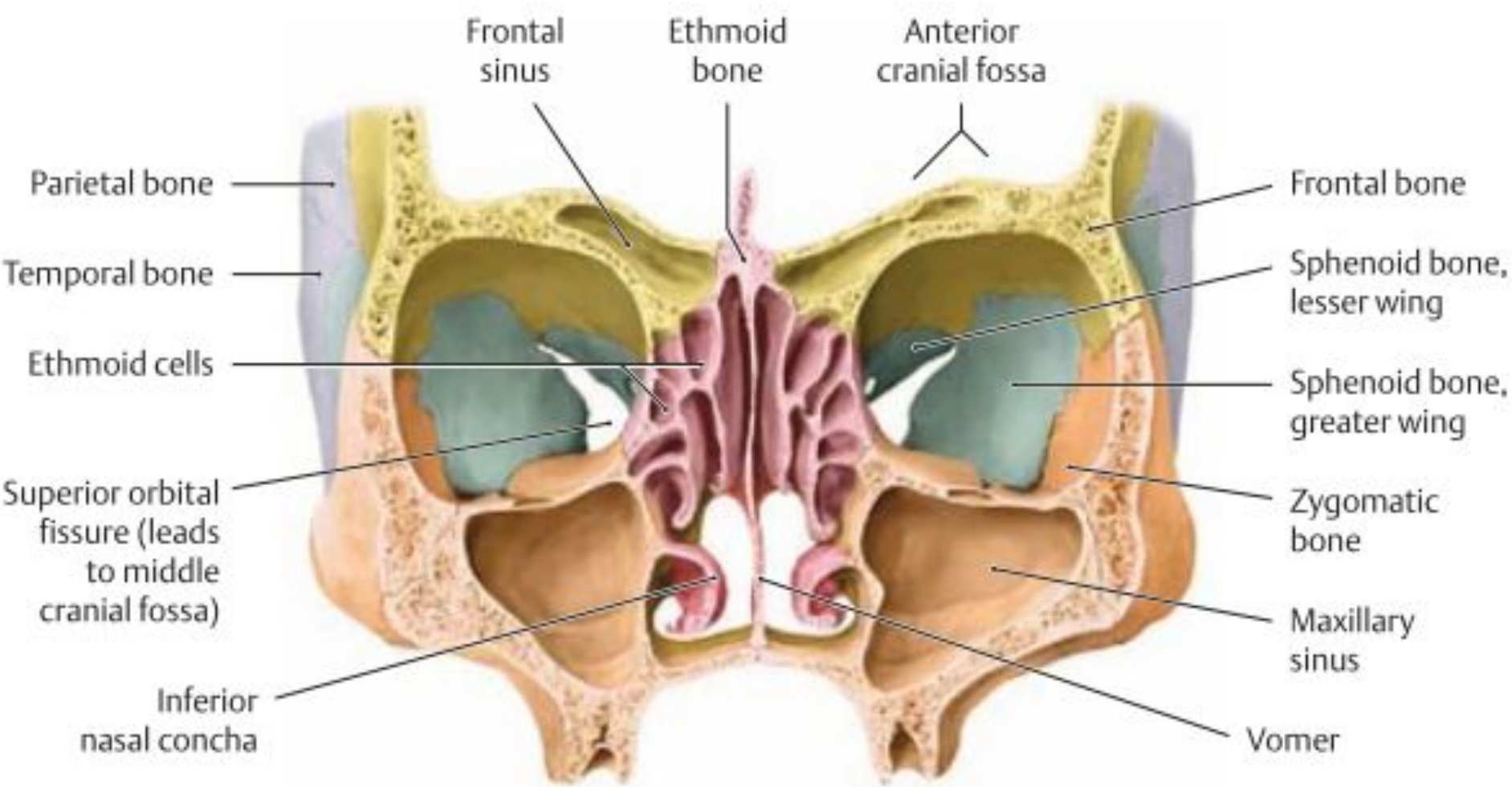
СИСТЕМА

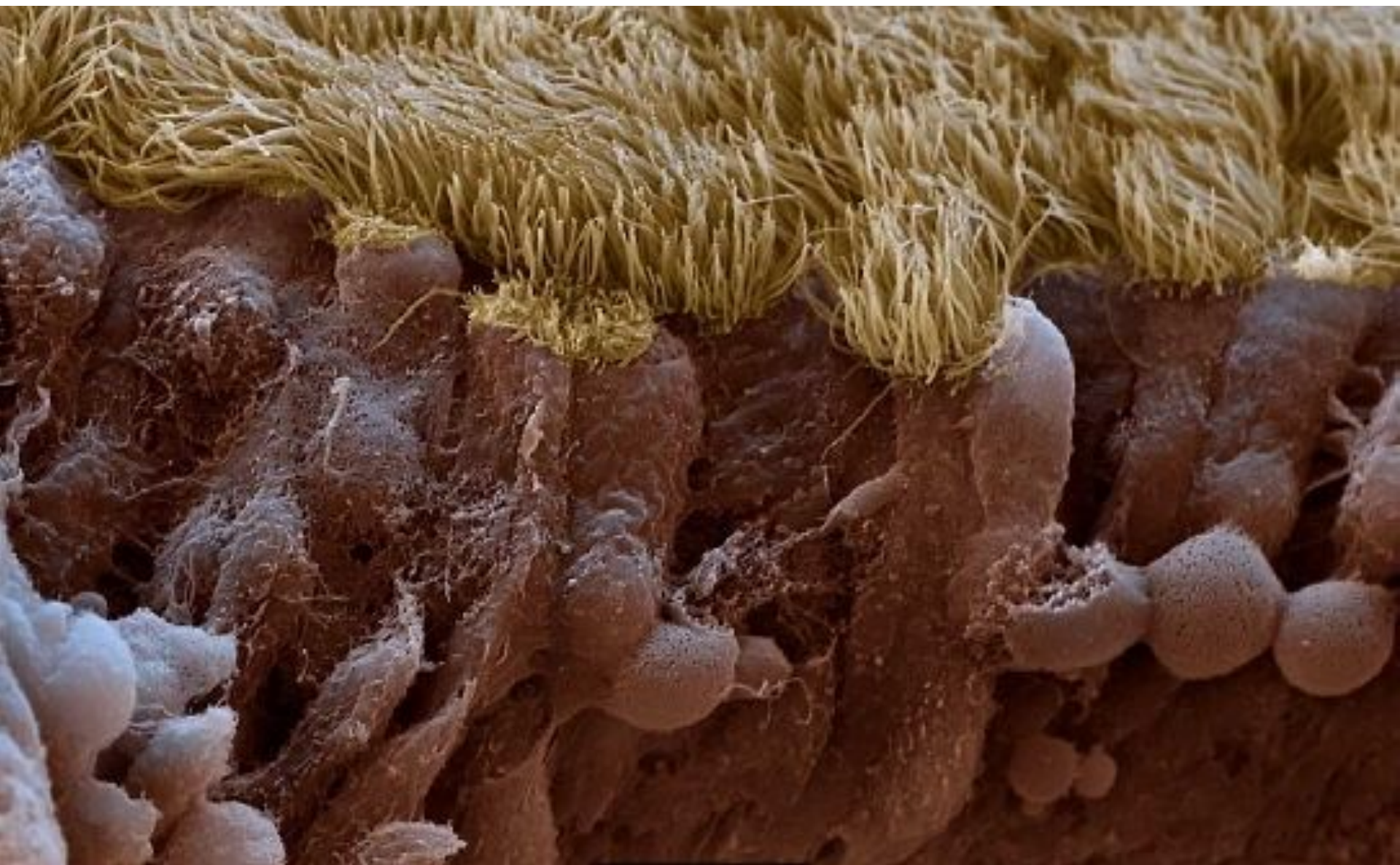


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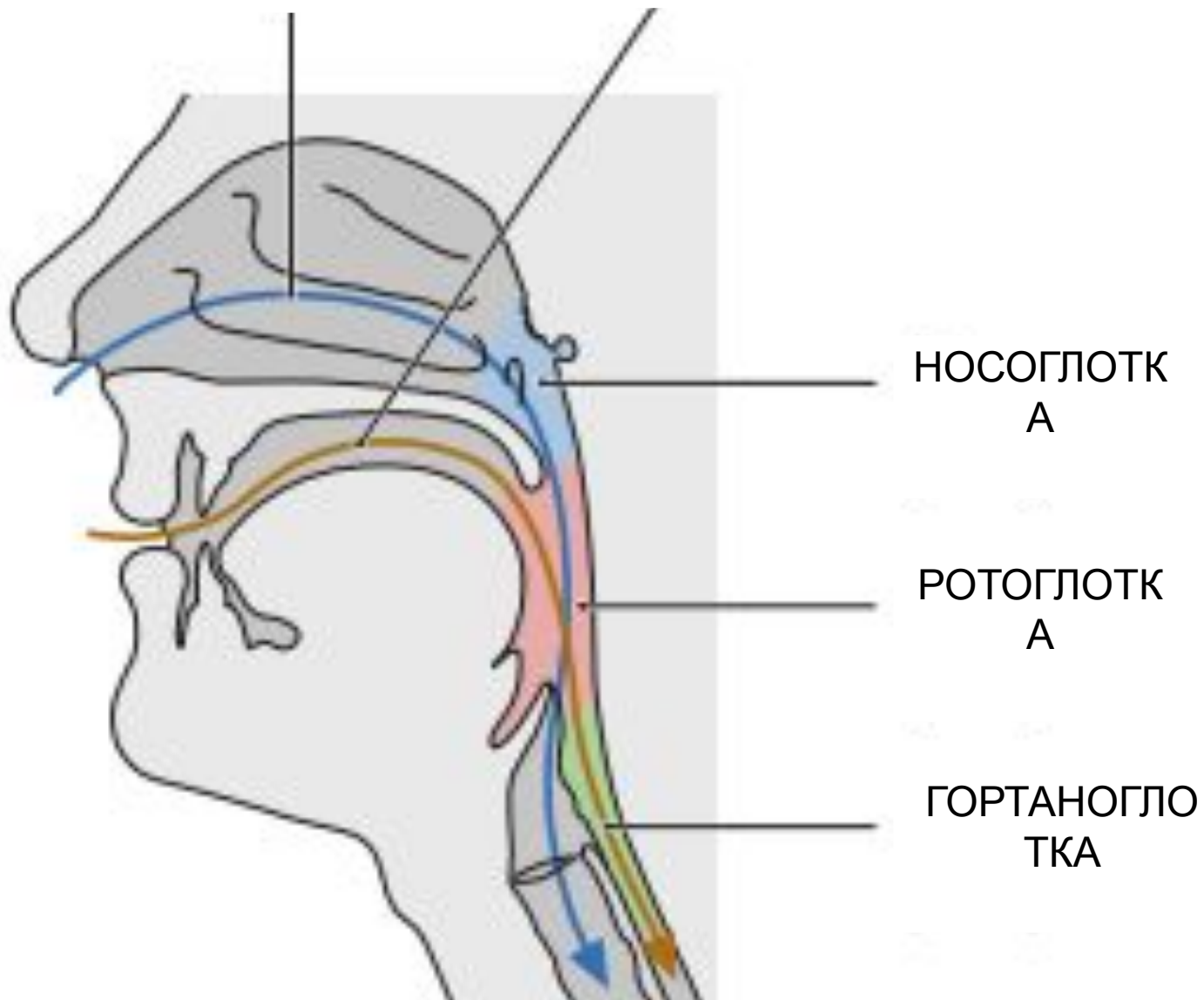






ДЫХАТЕЛЬНЫ
Е ПУТИ

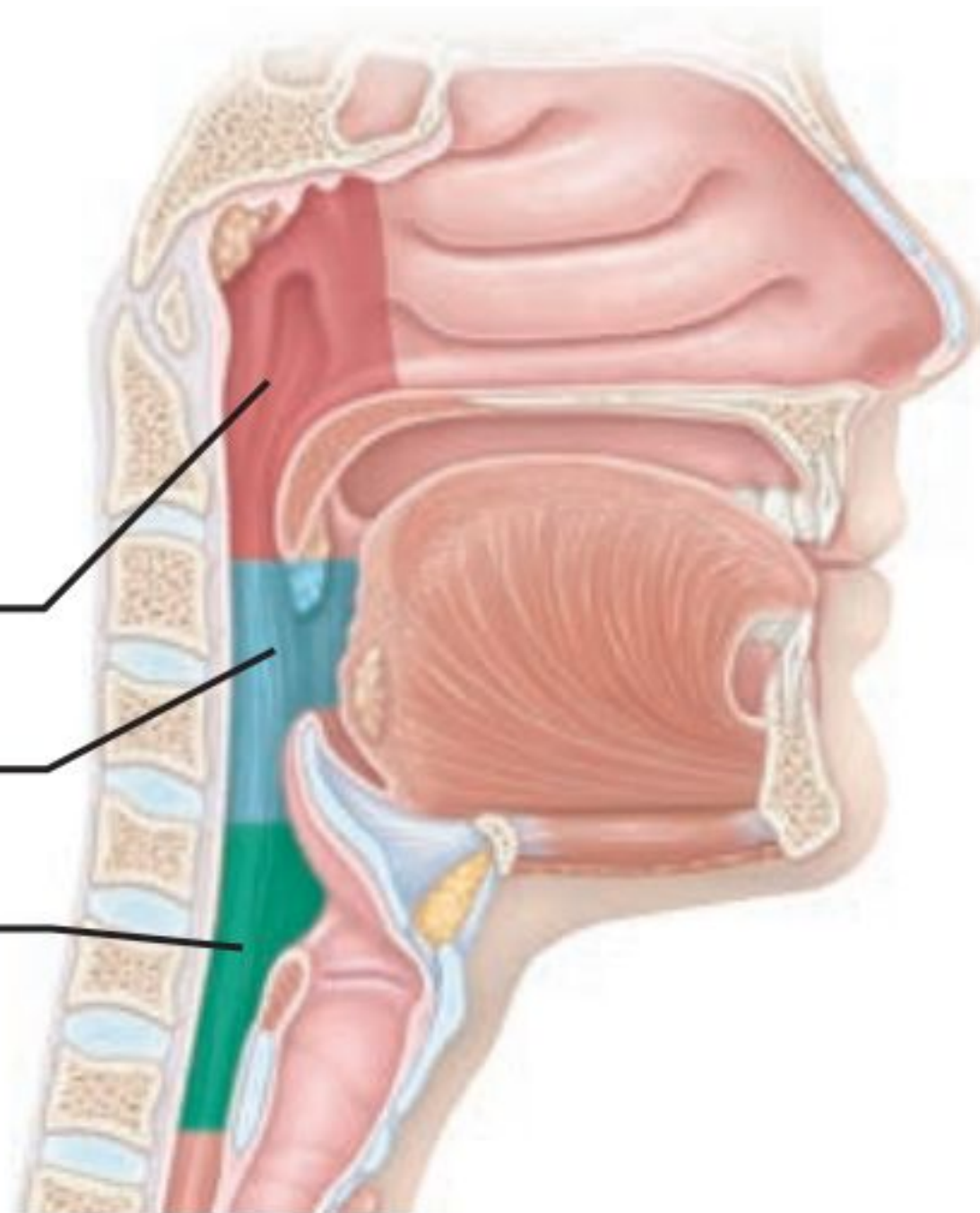
ПИЩЕВАРИТЕЛЬНЫ
Й ТРАКТ

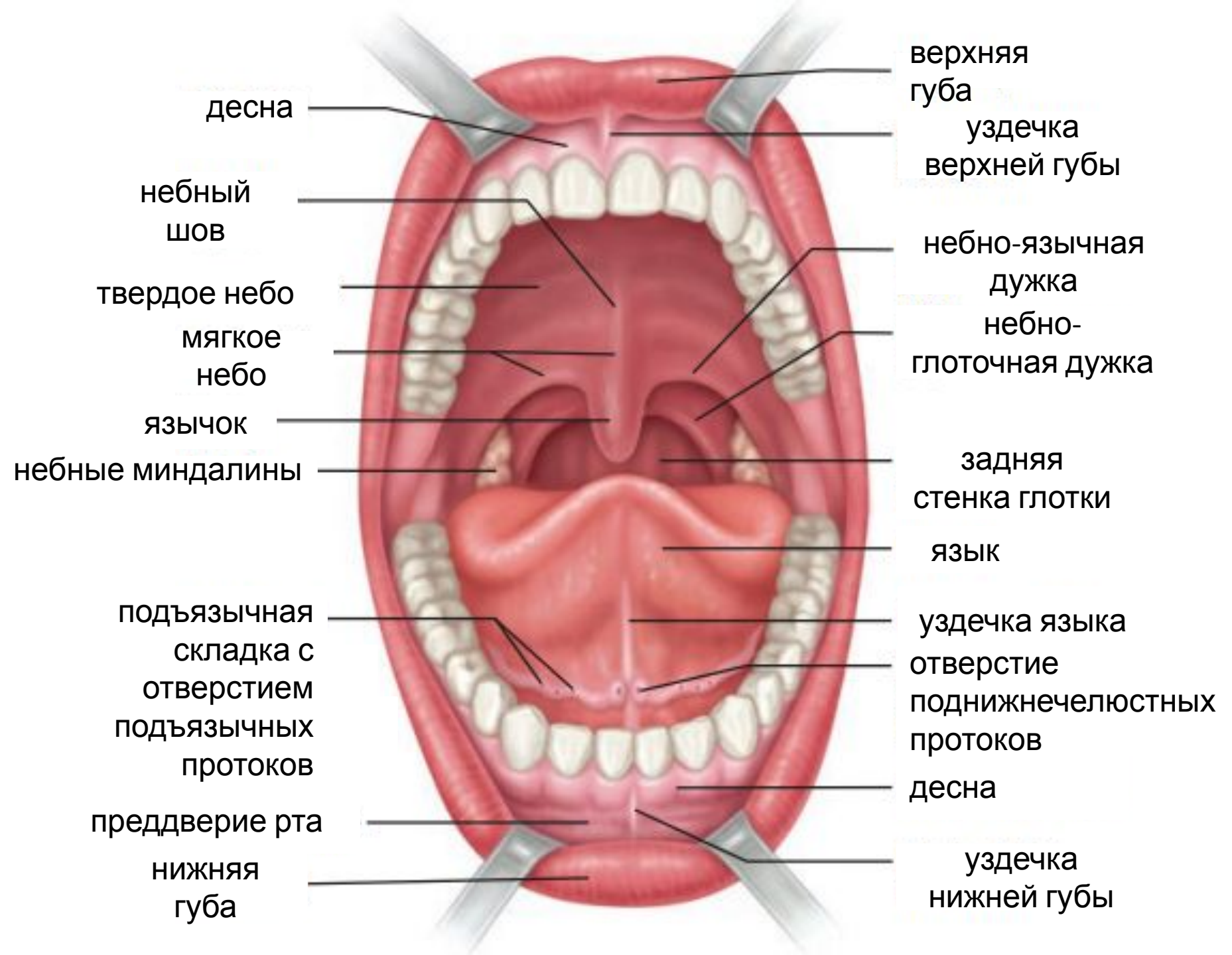


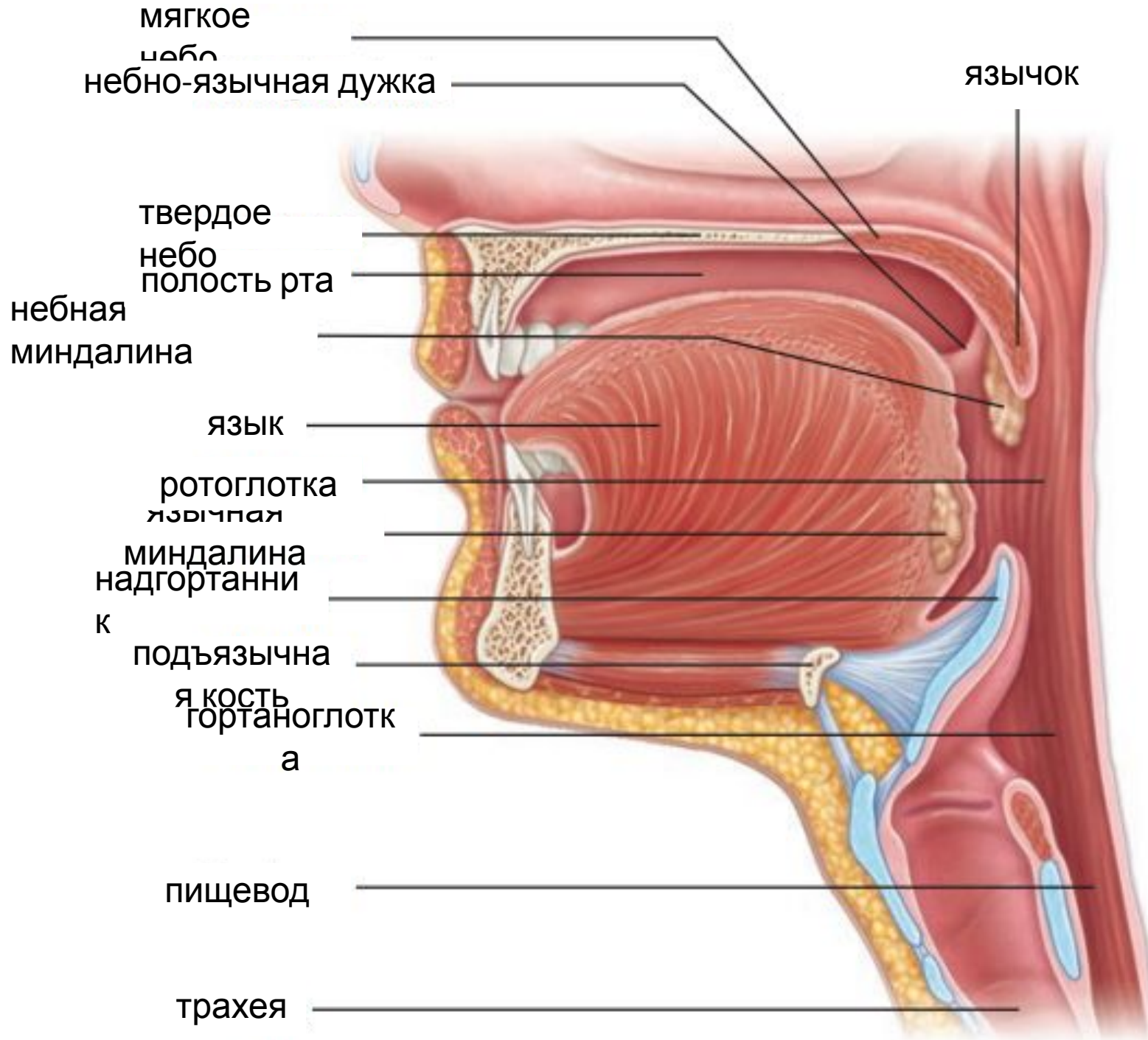
Nasopharynx

Oropharynx

Laryngopharynx

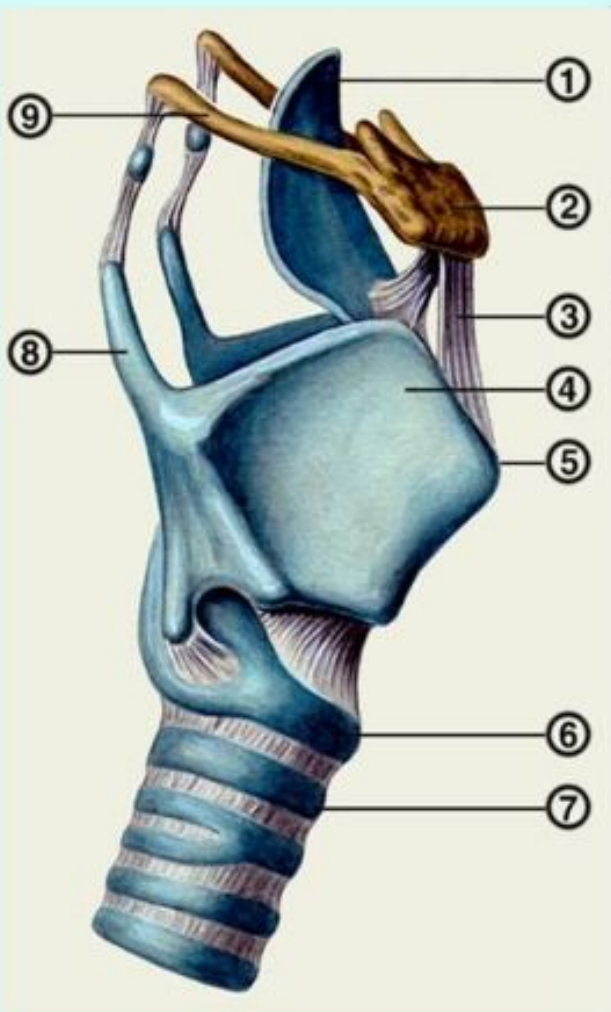




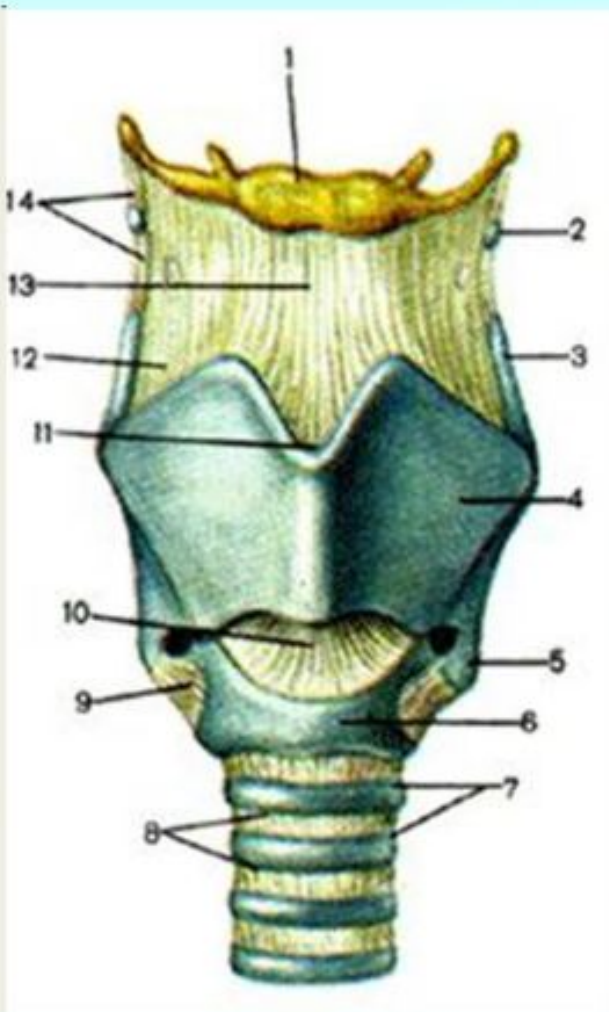


Хрящи гортани

Соединяются друг с другом, а также с подъязычной костью при помощи суставов и связок



Вид сбоку



Вид спереди

• непарные (3):

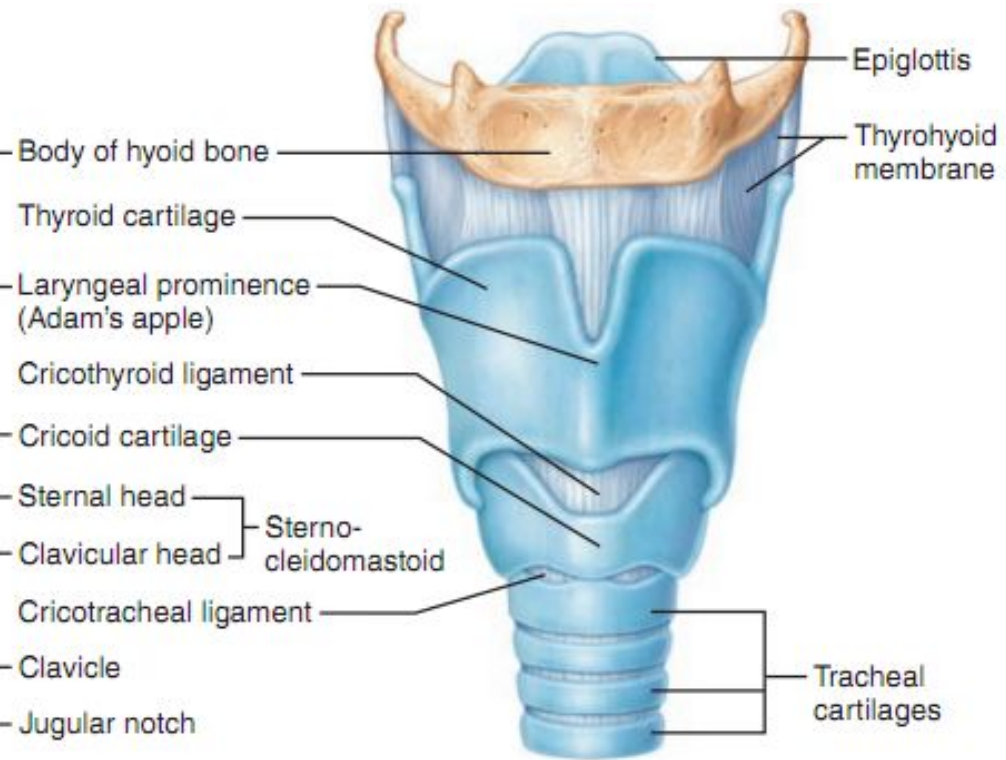
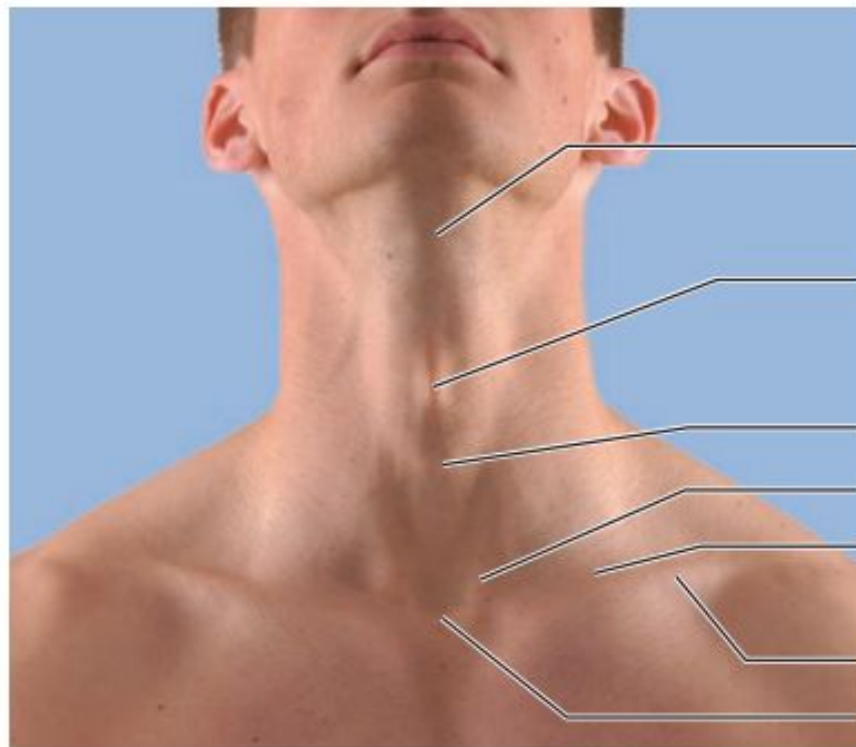
- щитовидный: гиалиновый
- перстневидный: гиалиновый
- надгортанник: эластический

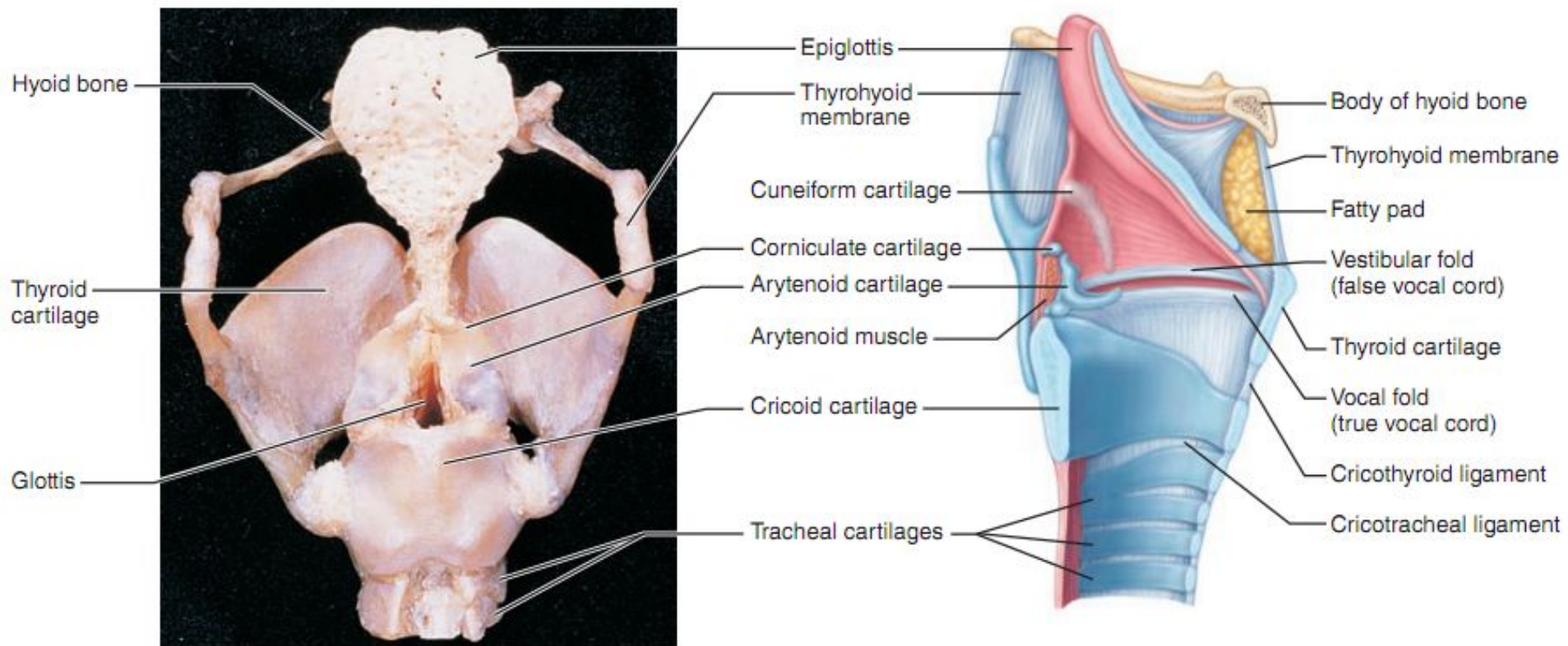
• парные (3):

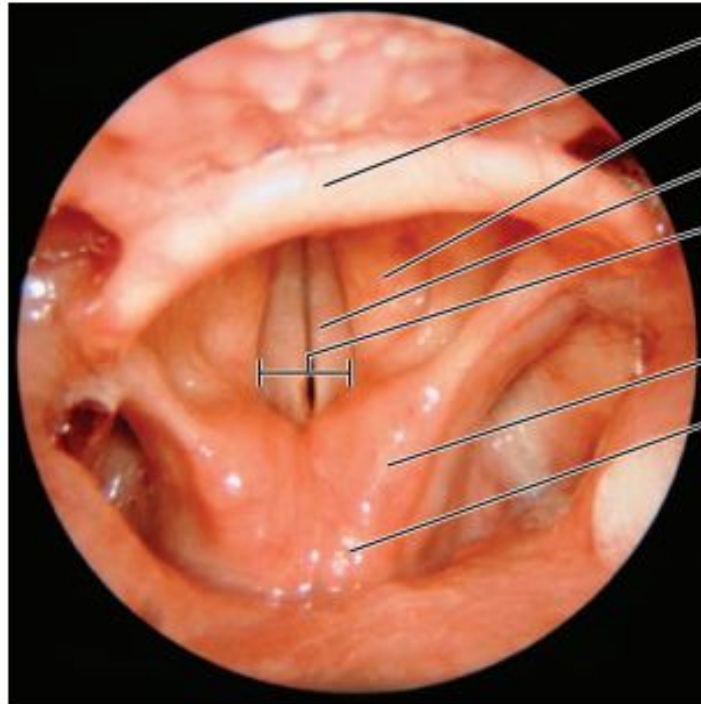
- черпаловидный: гиалиновый
- рожковидный: гиалиновый
- клиновидный: эластический

2 сустава:

- перстнещитовидный: вокруг фронтальной оси
- перстнечерпаловидный: вокруг вертикальной оси







Epiglottis

Vestibular fold (false vocal cord)

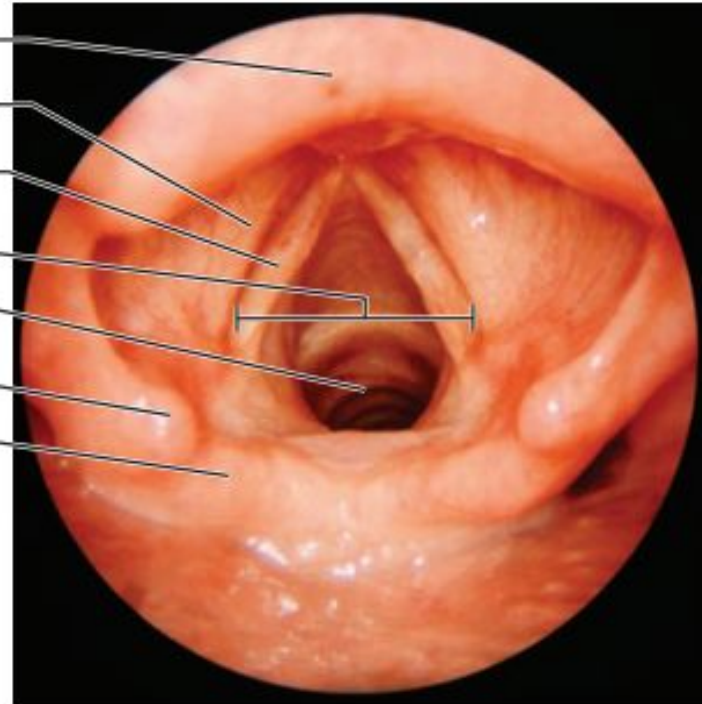
Vocal fold (true vocal cord)

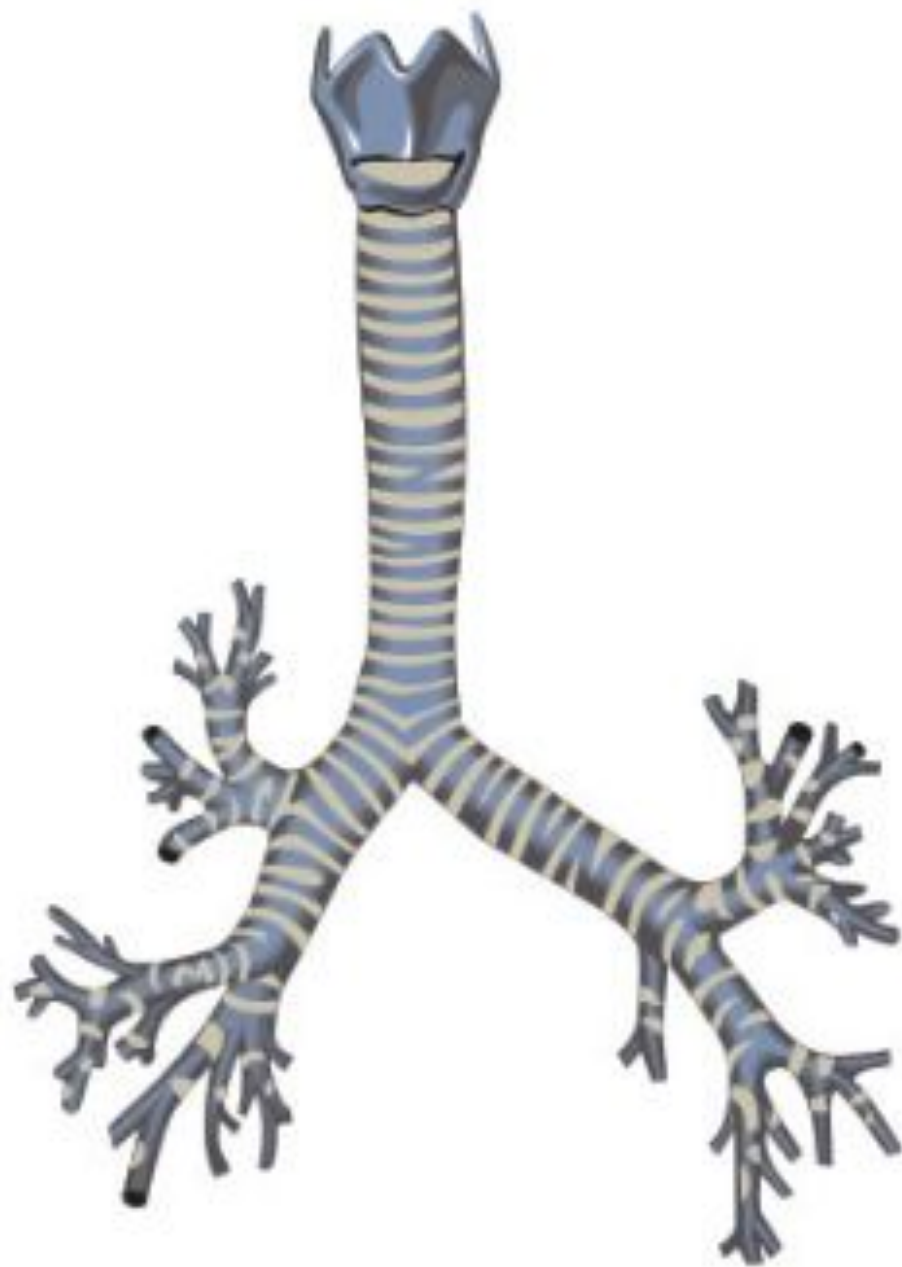
Glottis

Inner lining of trachea

Cuneiform cartilage

Corniculate cartilage





Right lung

Left lung

Right superior lobe (3 segments)

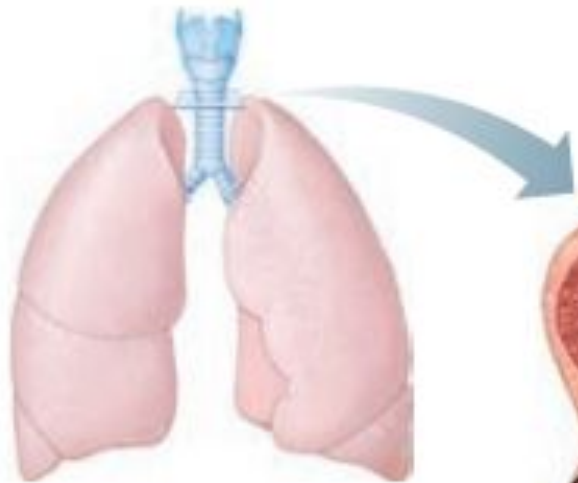
Left superior lobe (4 segments)

Right middle lobe (2 segments)

Right inferior lobe (5 segments)

Left inferior lobe (5 segments)





Posterior

Goblet cell

Mucosa

- Pseudostratified ciliated columnar epithelium
- Lamina propria (connective tissue)

Esophagus

Trachealis

Submucosa

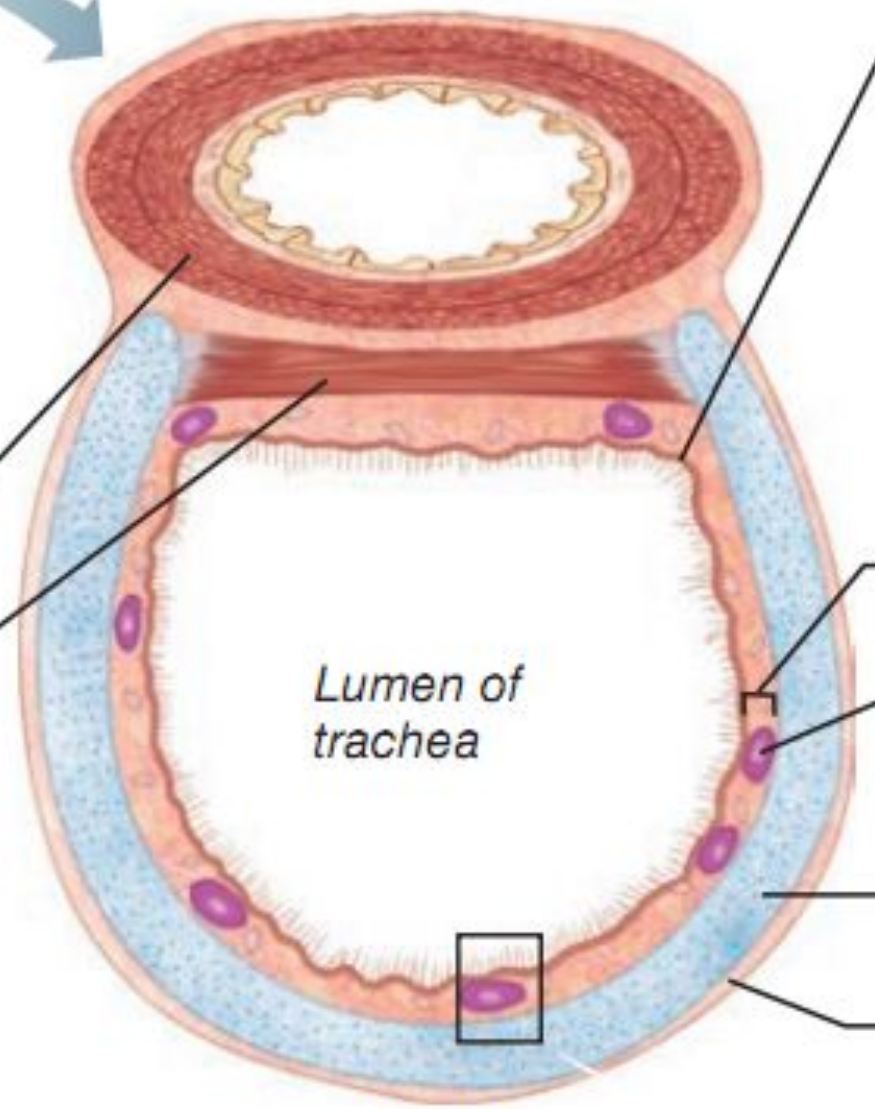
Seromucous gland in submucosa

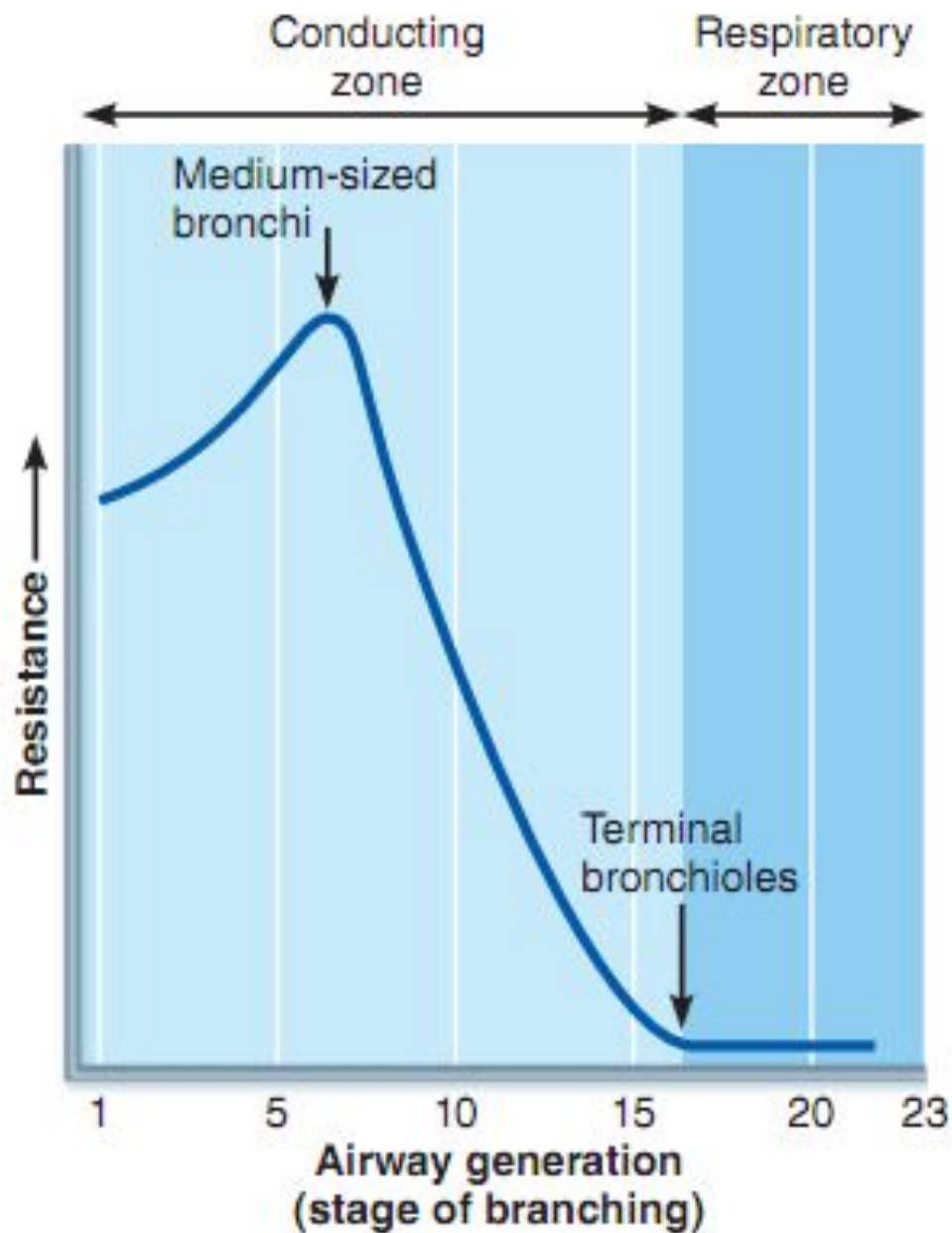
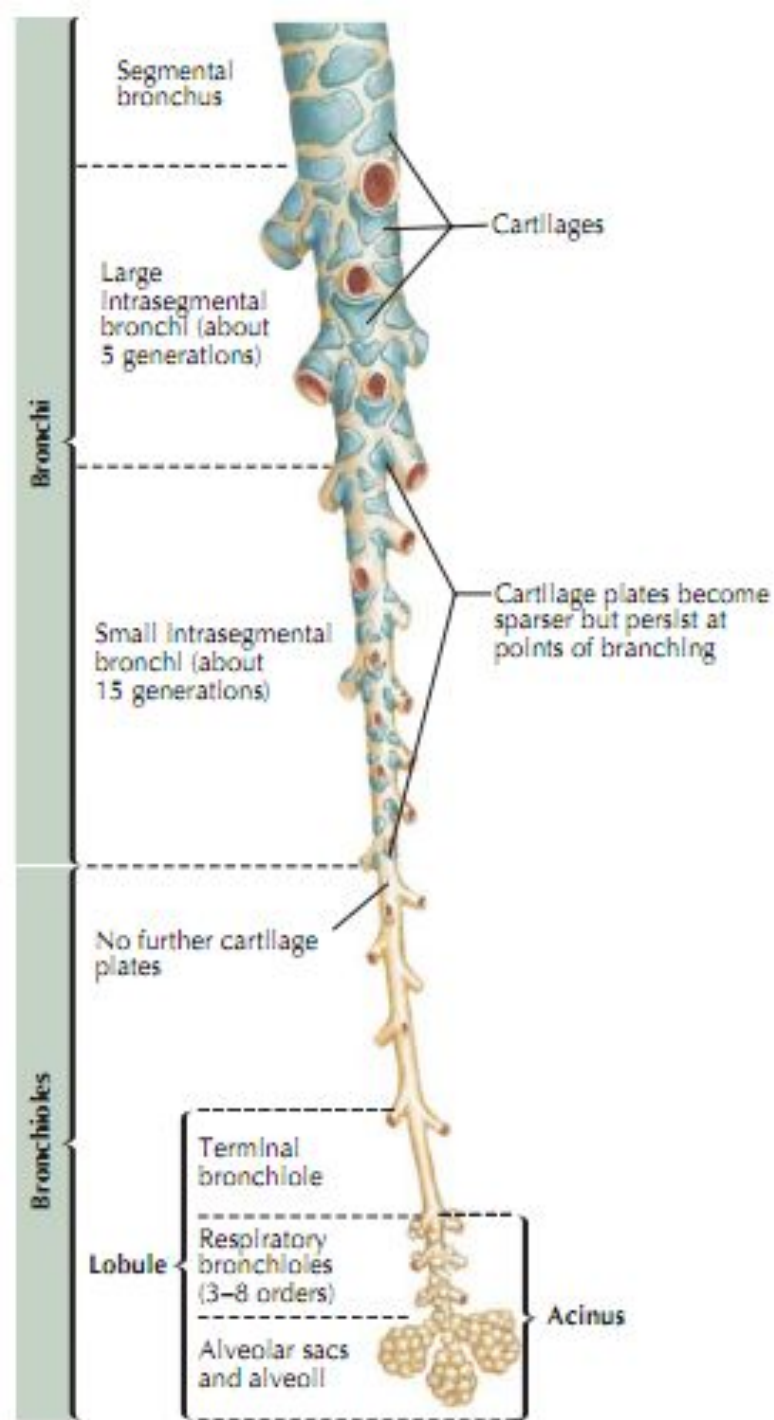
Lumen of trachea

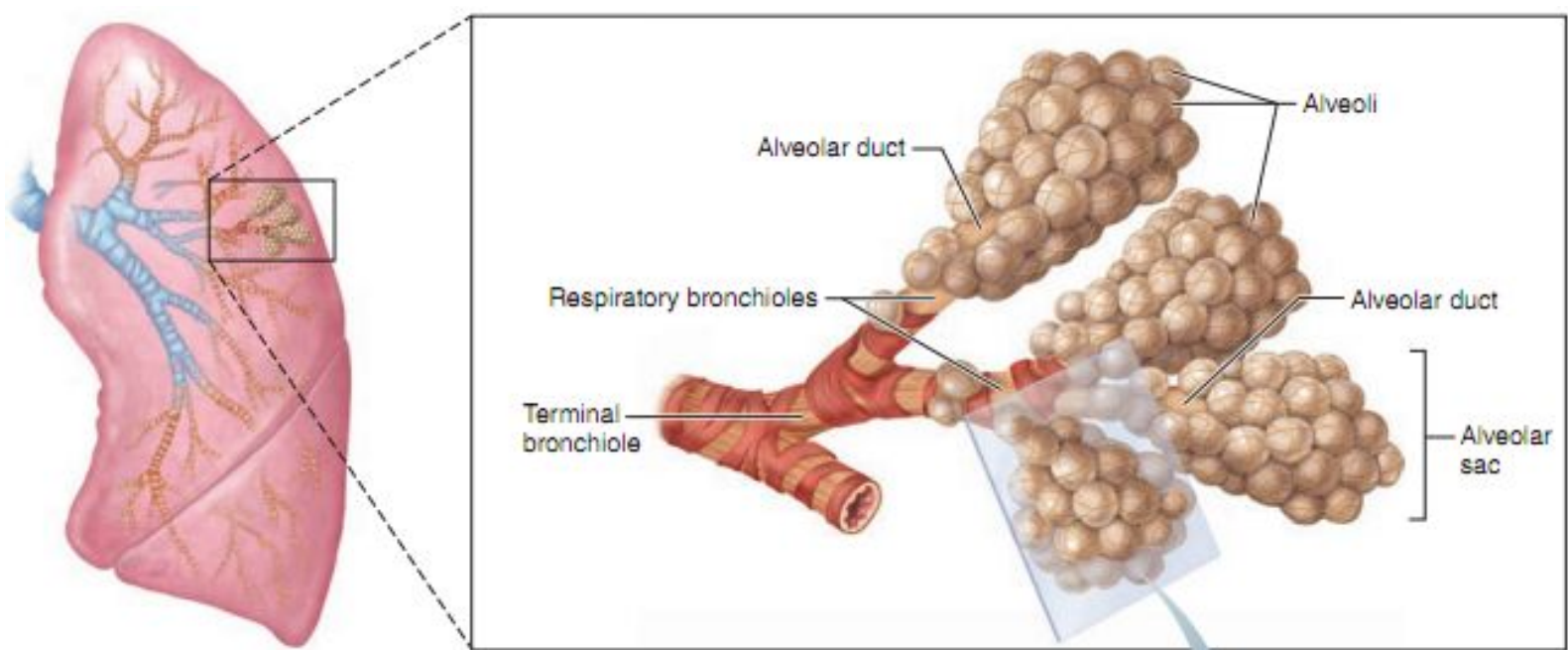
Hyaline cartilage

Adventitia

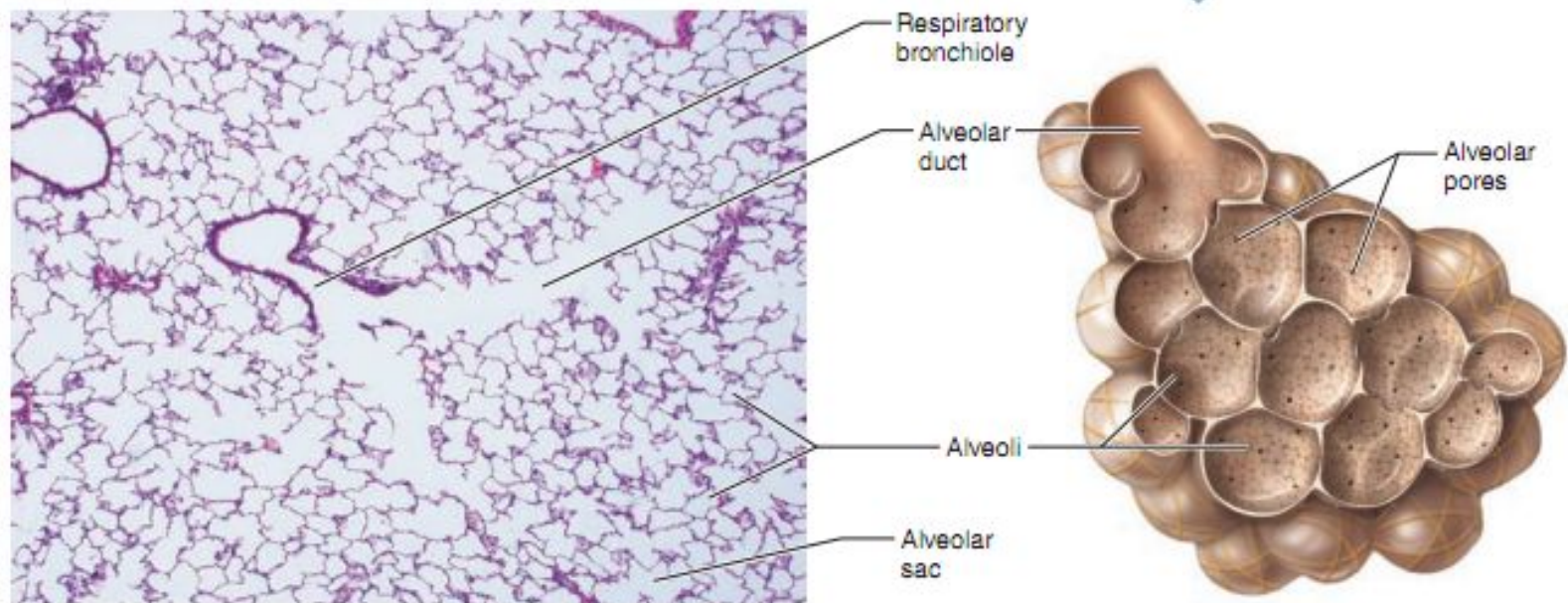
Anterior



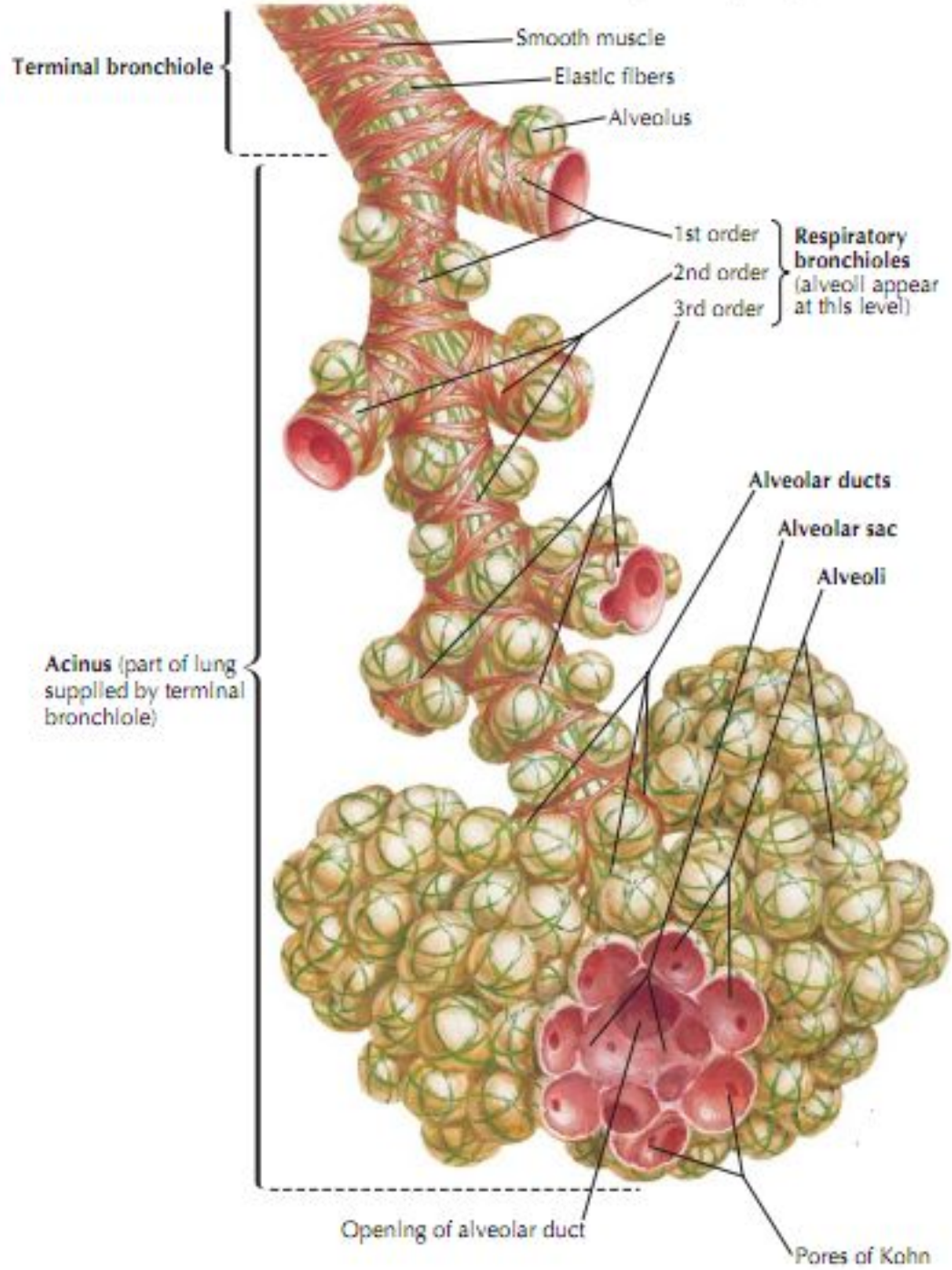


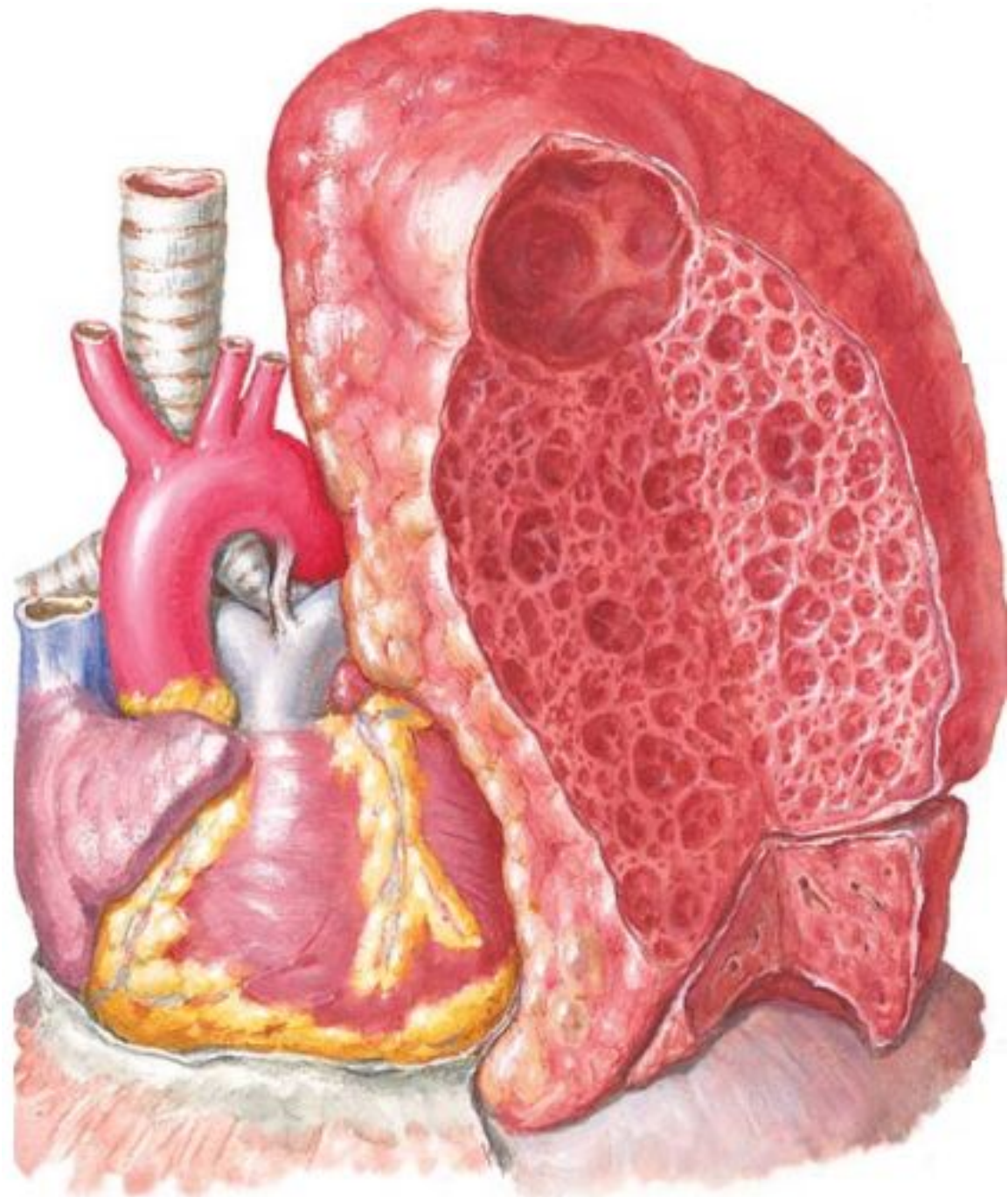


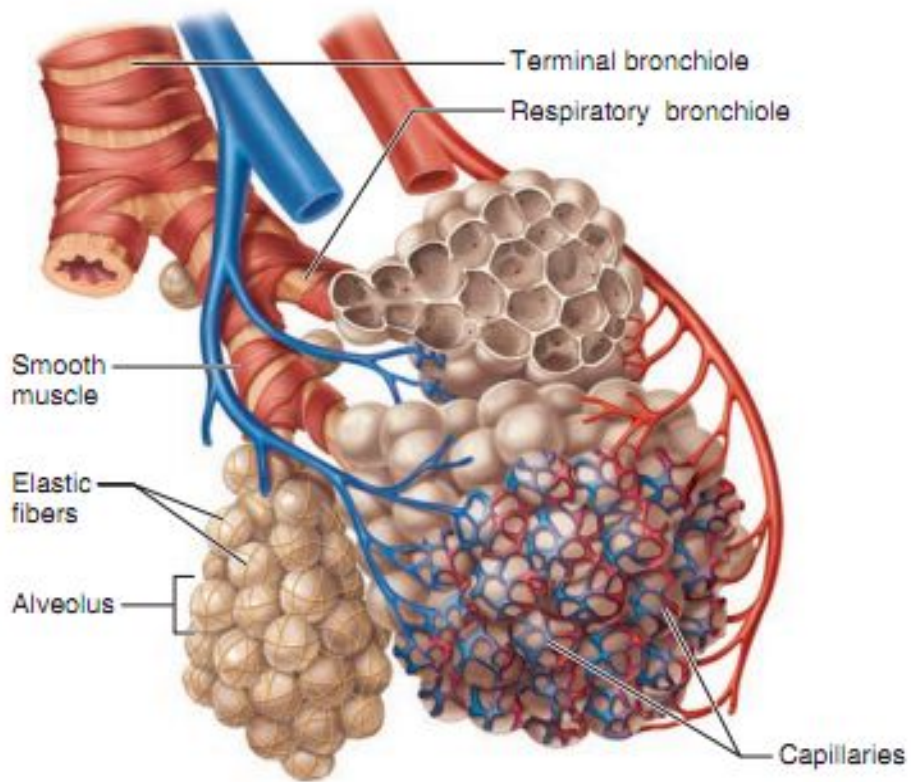
(a)

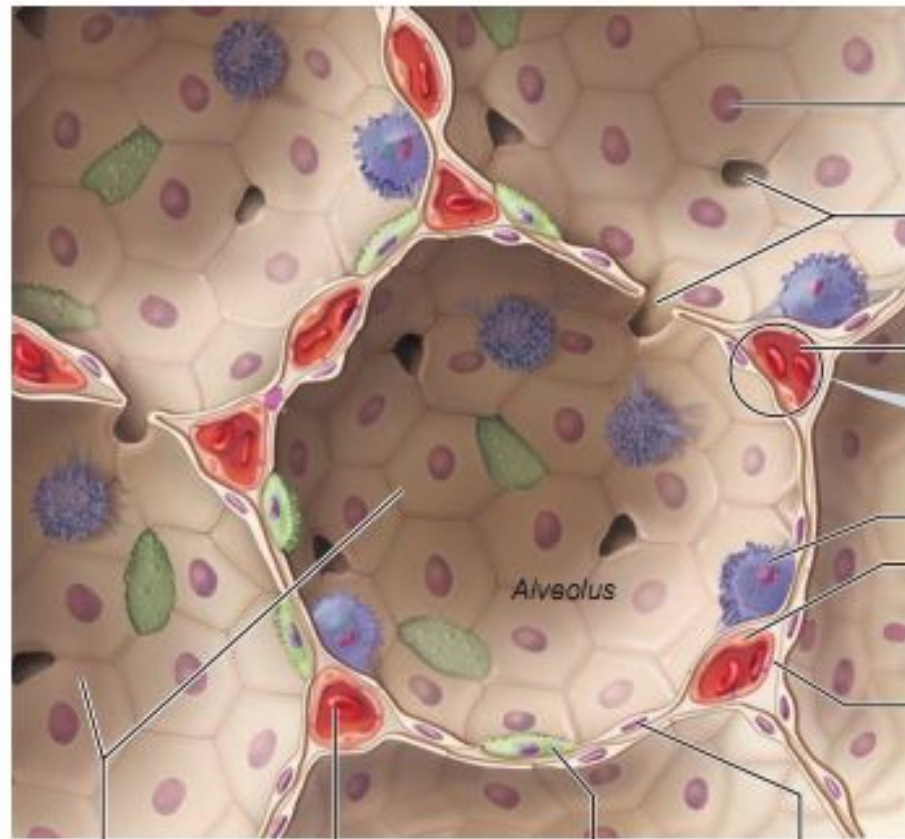


(b)

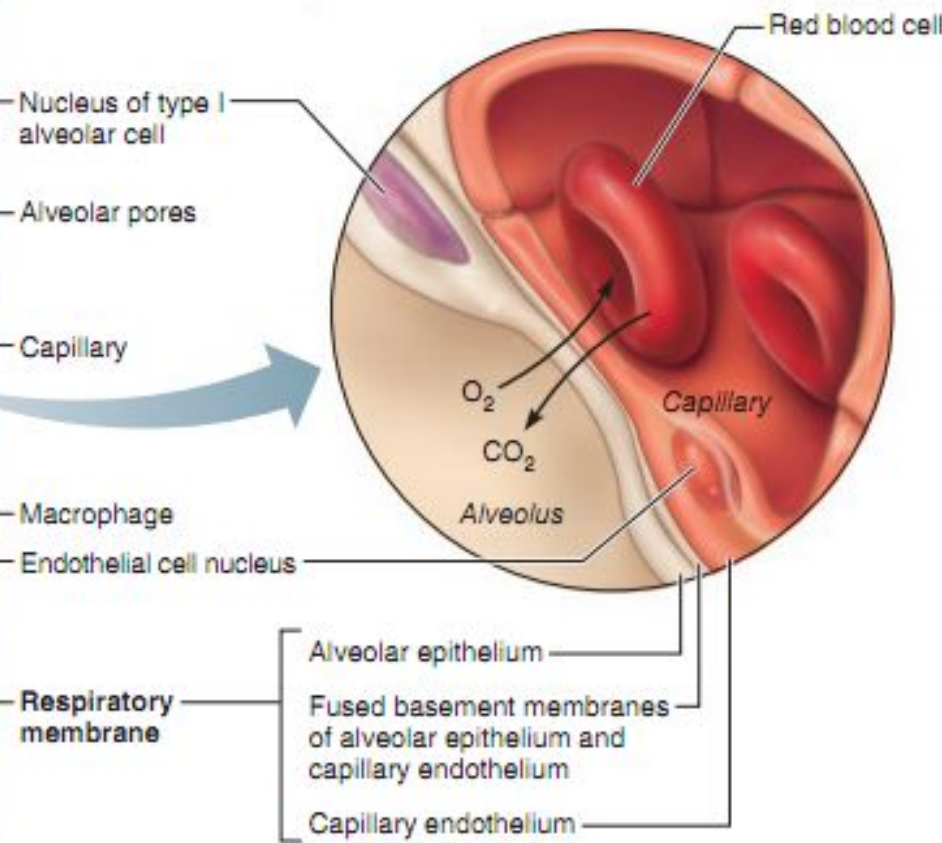


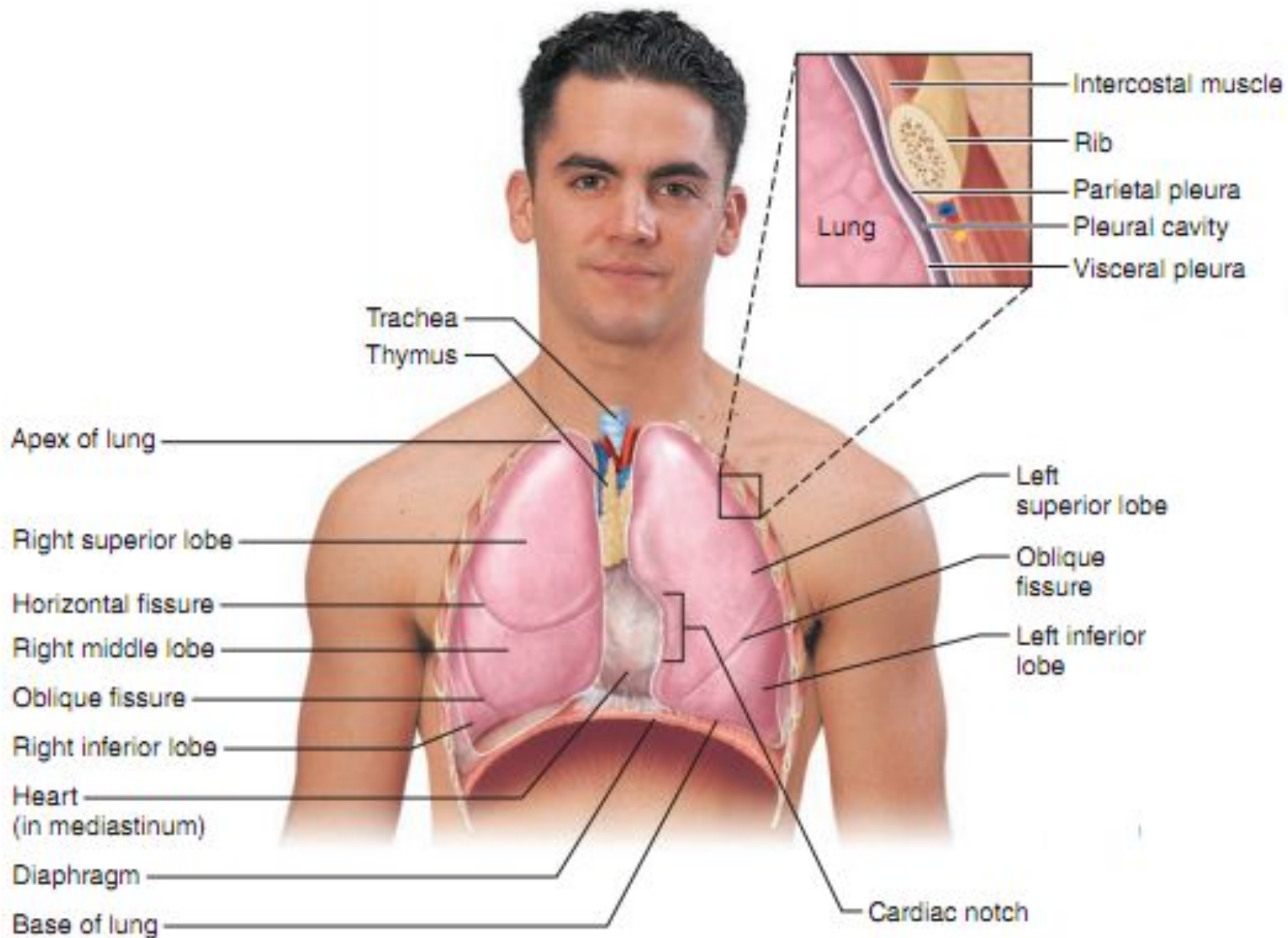


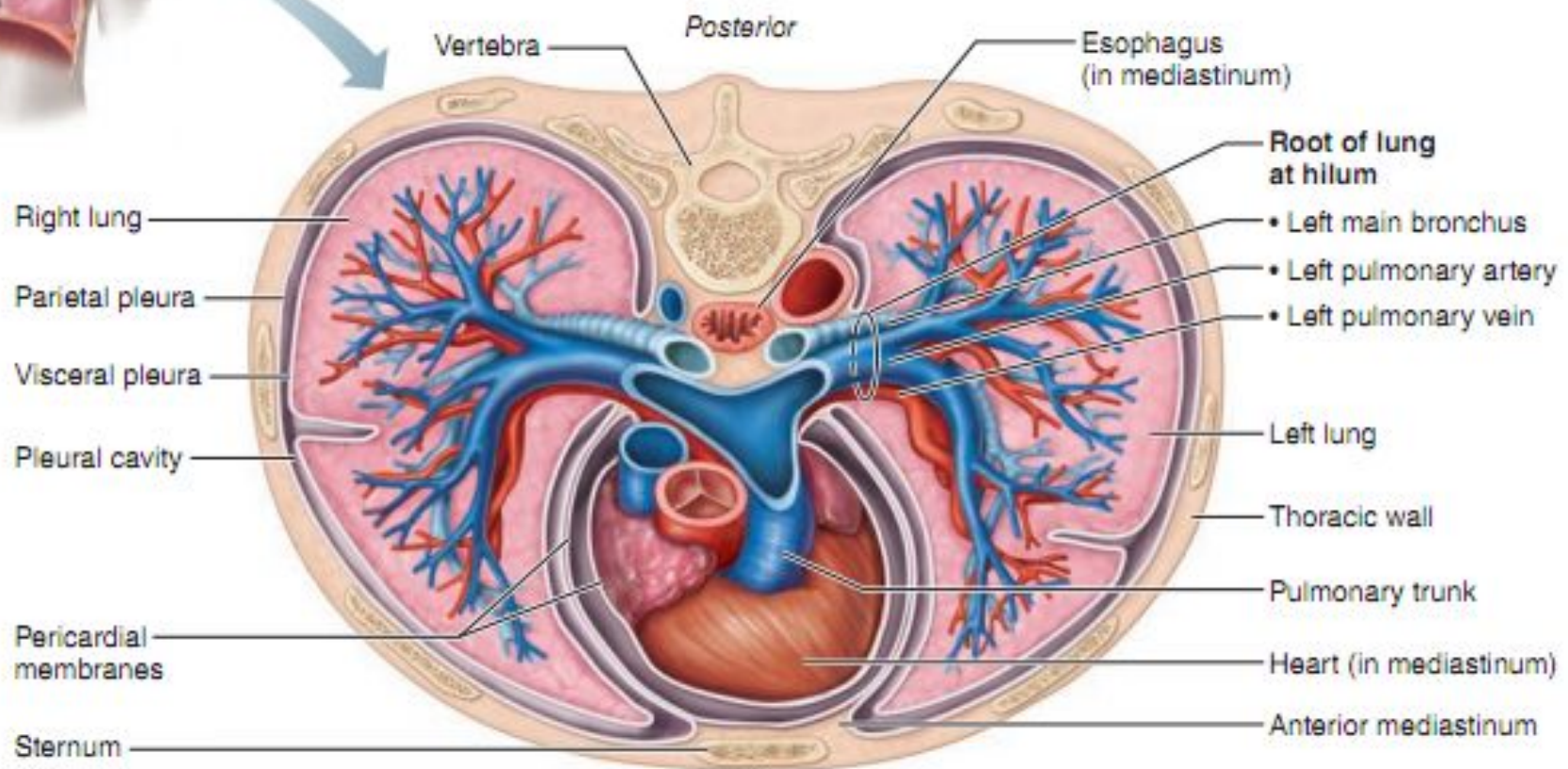


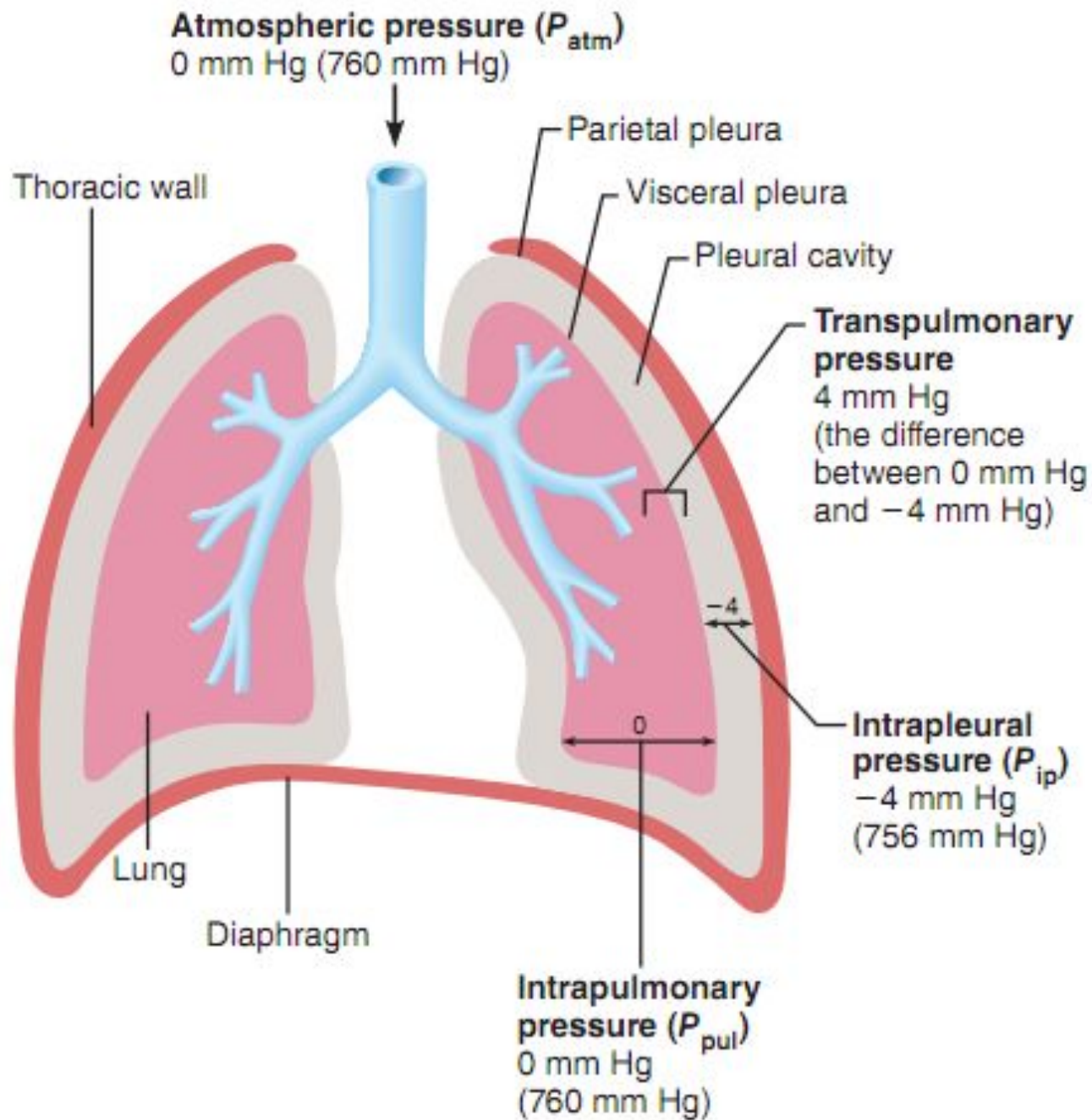


Alveoli (gas-filled air spaces) Red blood cell in capillary Type II alveolar cell (secretes surfactant) Type I alveolar cell



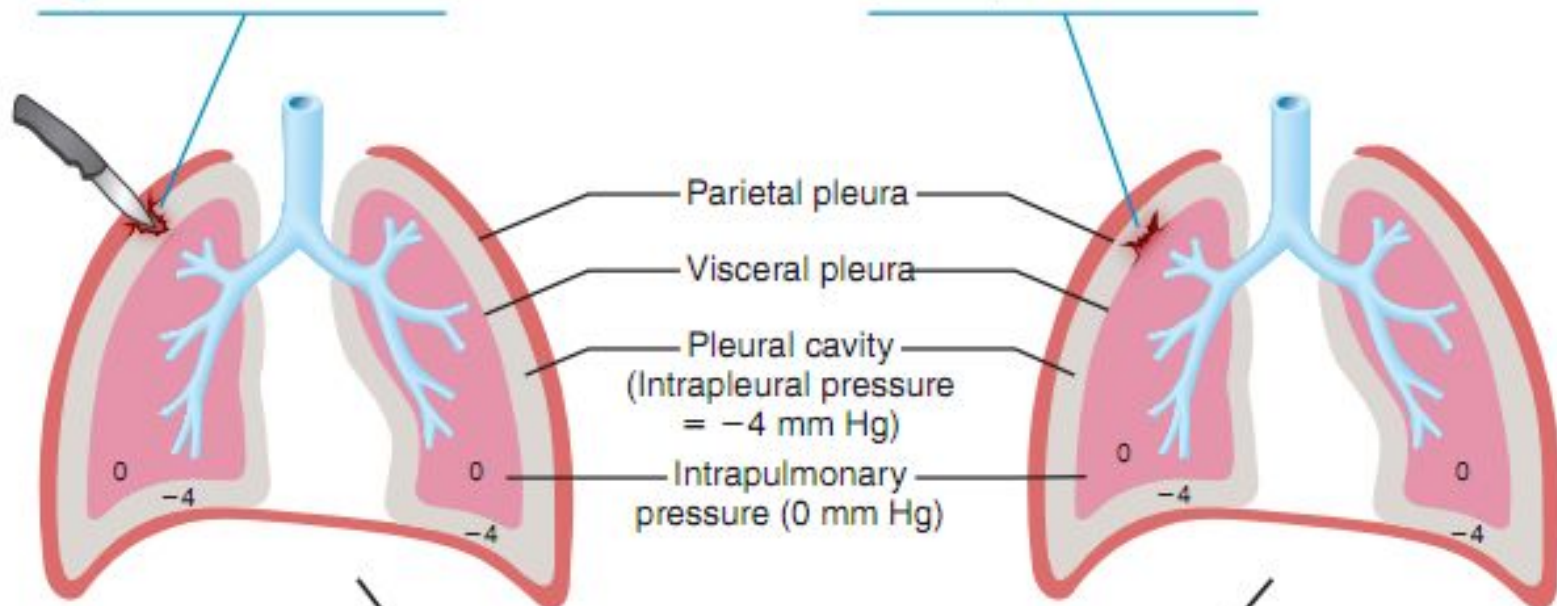






Punctured parietal pleura
(e.g., knife wound)

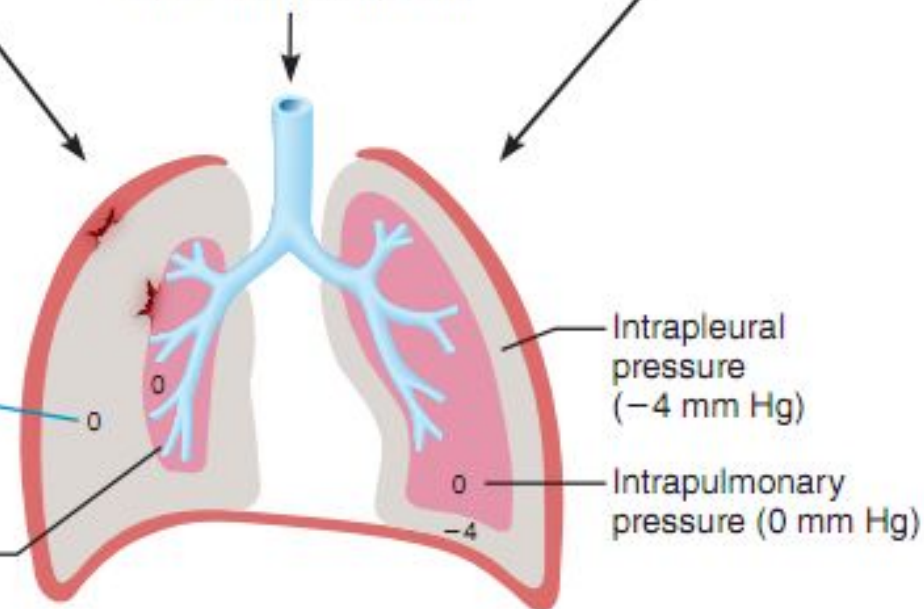
Ruptured visceral pleura
(often spontaneous)

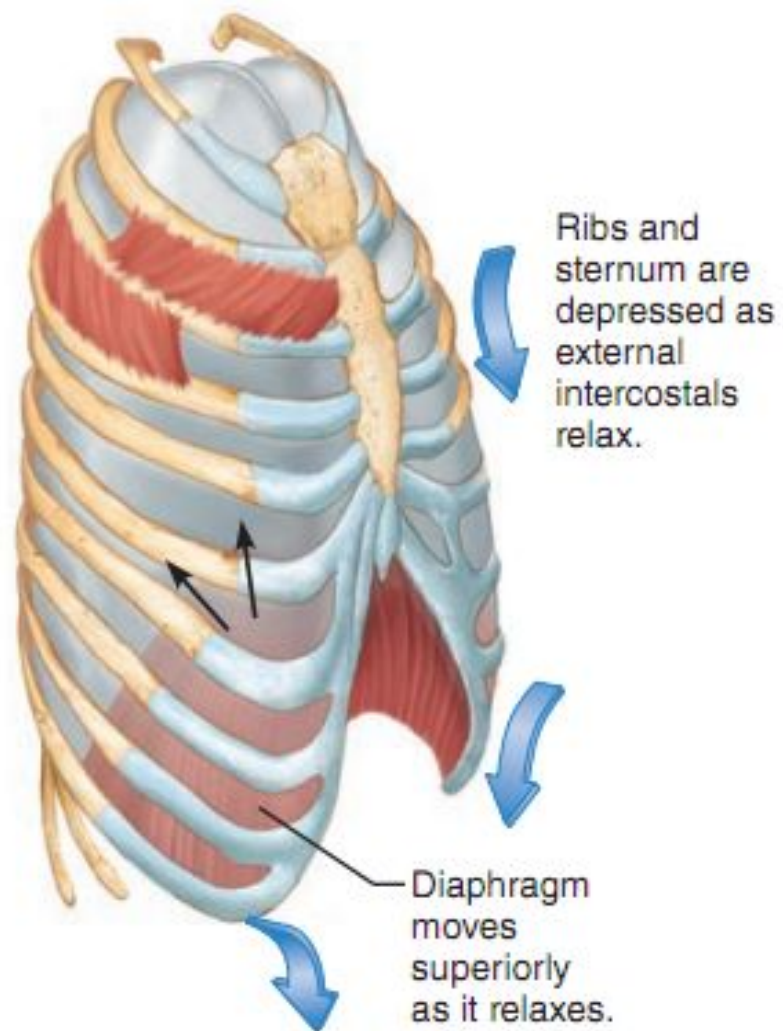
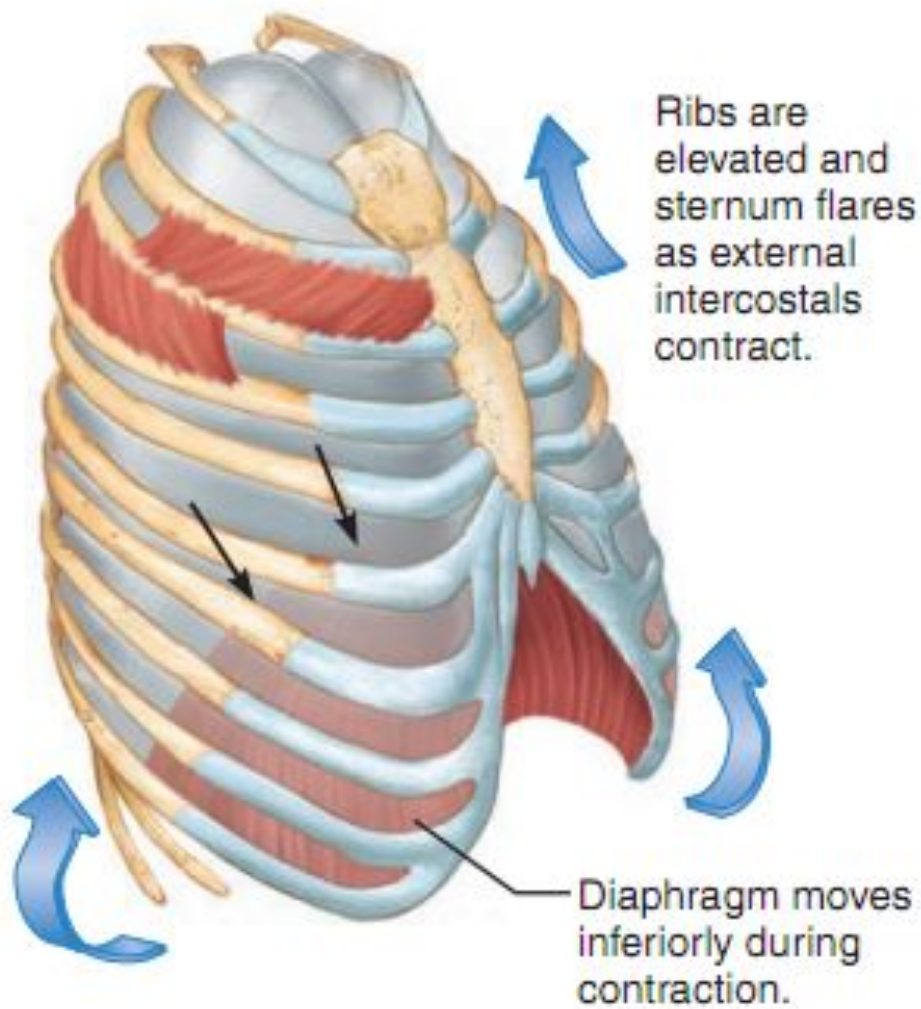


Atmospheric pressure
0 mm Hg (760 mm Hg)

Pneumothorax (air in pleural cavity):
intrapleural pressure becomes equal to atmospheric pressure

Collapsed lung
(atelectasis)





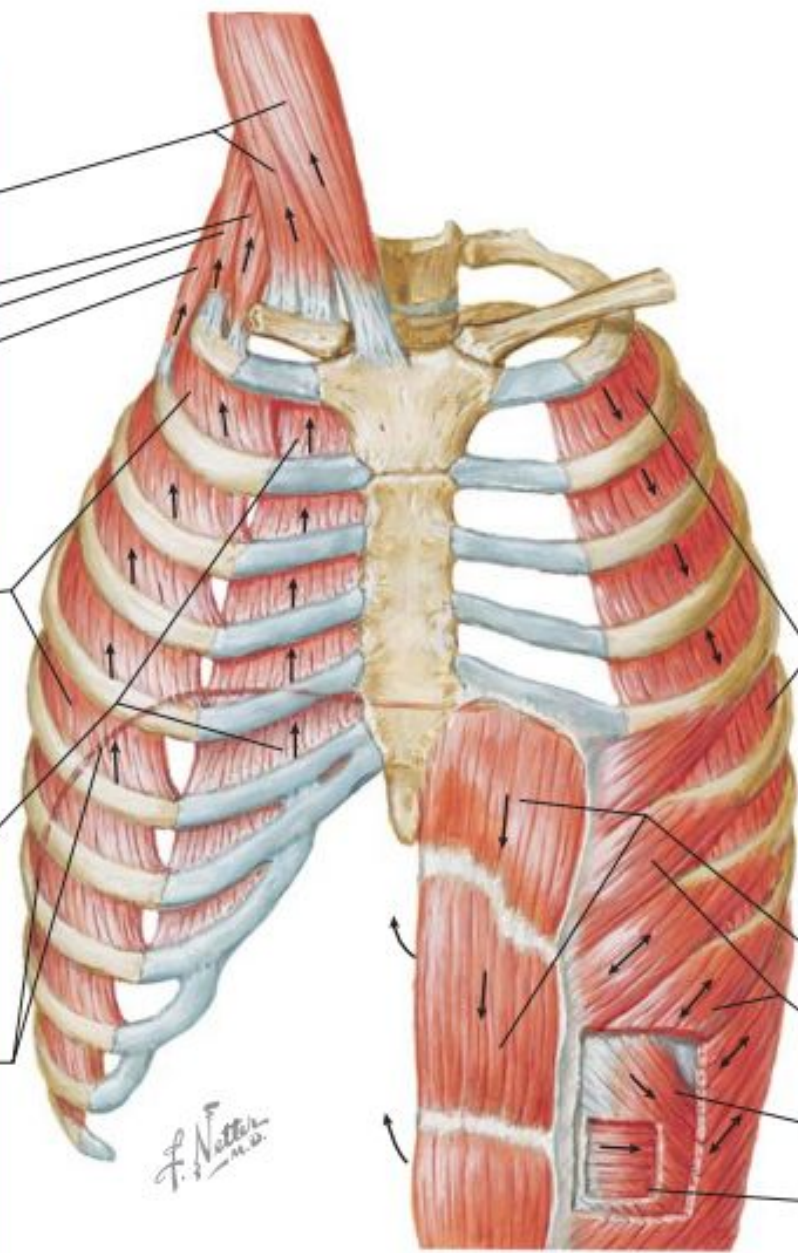
Muscles of inspiration

Accessory

- Sterno-cleidomastoid (elevates sternum)
- Scalenes Anterior
- Middle
- Posterior (elevate and fix upper ribs)

Principal

- External intercostals (elevate ribs, thus increasing width of thoracic cavity)
- Interchondral part of internal intercostals (also elevates ribs)
- Diaphragm (dome descends, thus increasing vertical dimension of thoracic cavity; also elevates lower ribs)



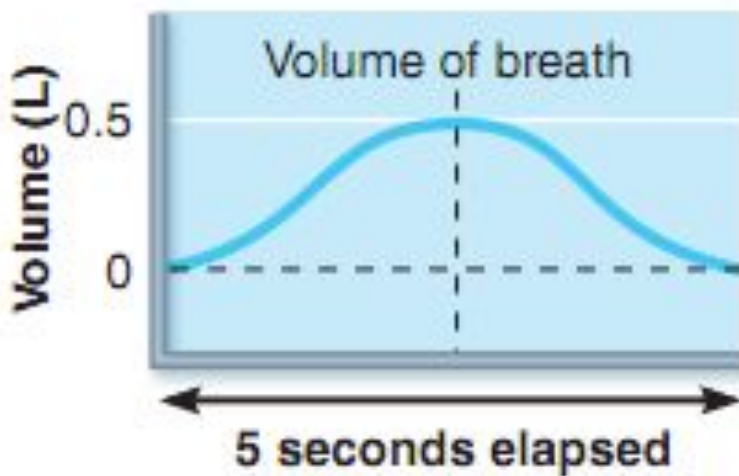
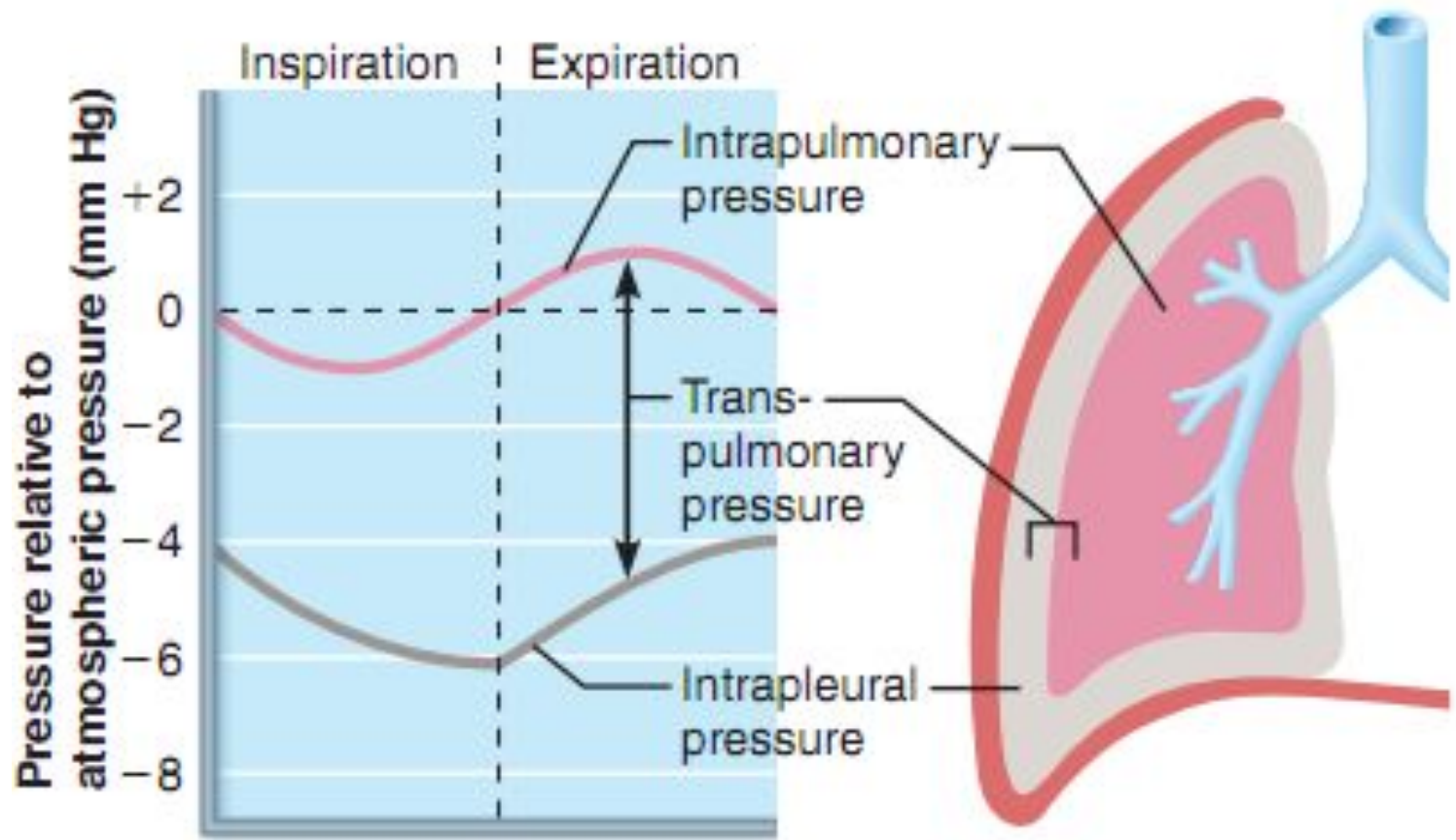
Muscles of expiration

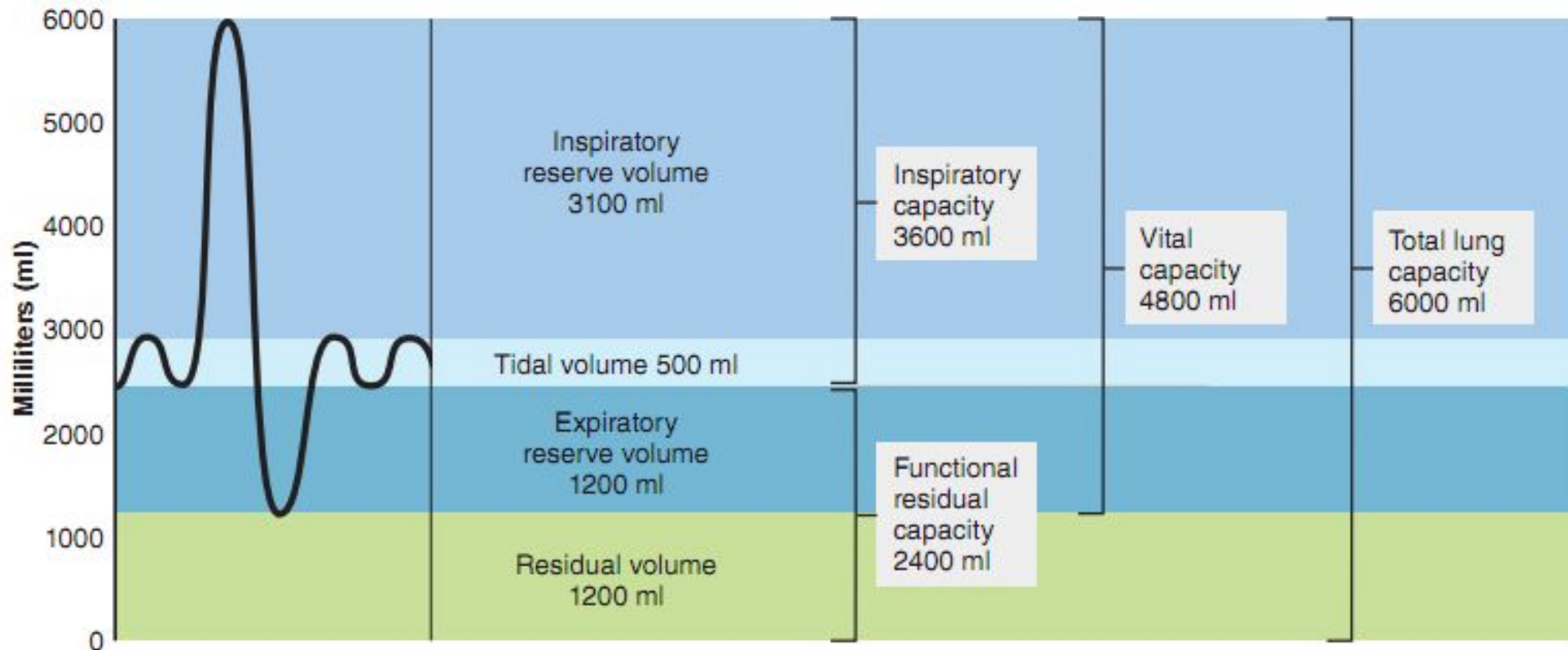
Quiet breathing

Expiration results from passive recoil of lungs and rib cage

Active breathing

- Internal intercostals, except interchondral part
- Abdominals (depress lower ribs, compress abdominal contents, thus pushing up diaphragm)
- Rectus abdominis
- External oblique
- Internal oblique
- Transversus abdominis

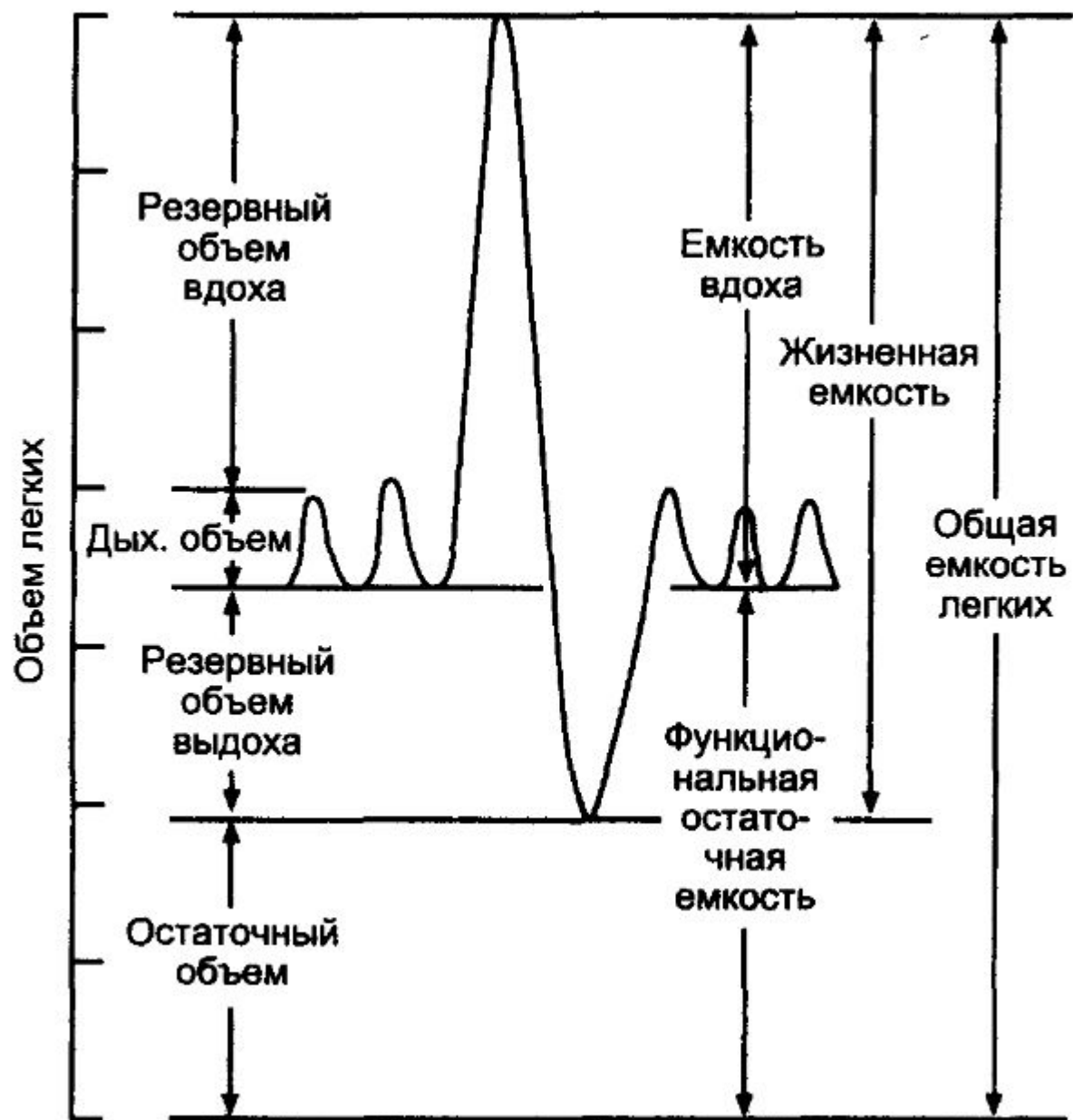




Spirographic record for a male

Table 22.4 Comparison of Gas Partial Pressures and Approximate Percentages in the Atmosphere and in the Alveoli

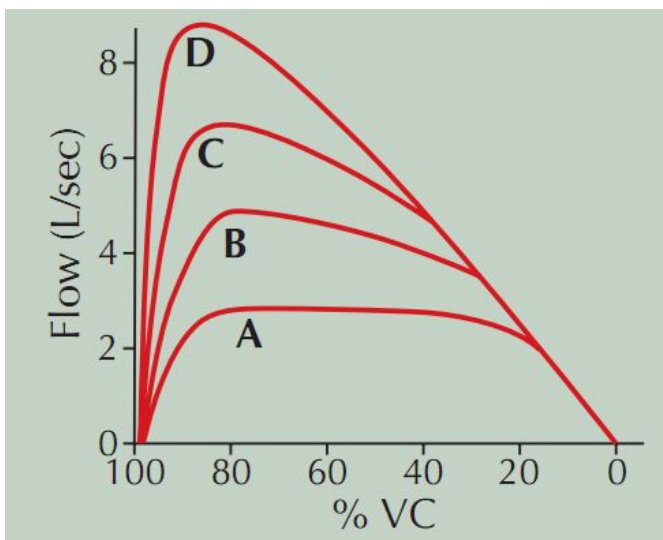
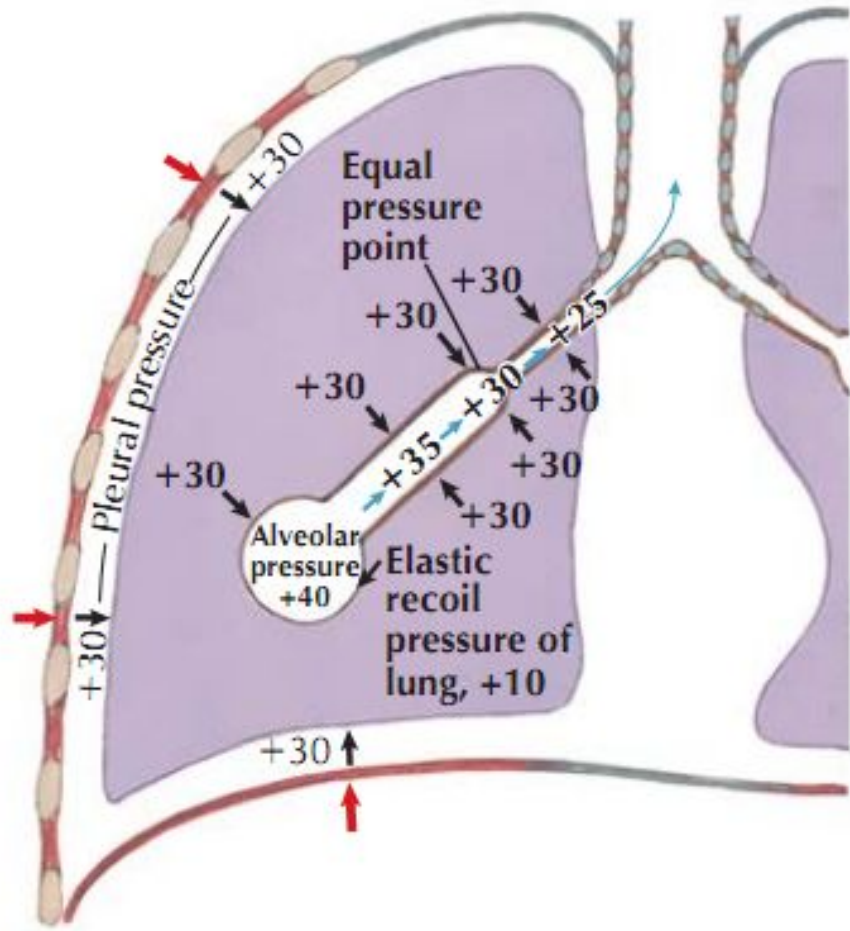
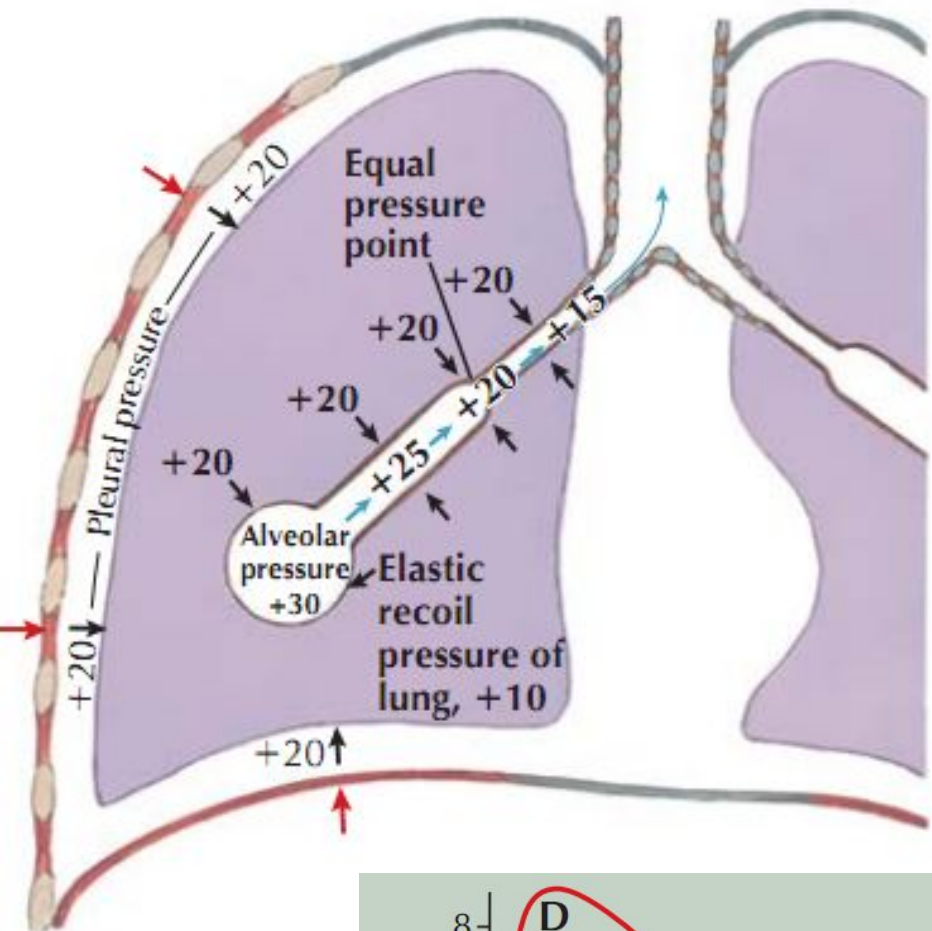
GAS	ATMOSPHERE (SEA LEVEL)		ALVEOLI	
	APPROXIMATE PERCENTAGE	PARTIAL PRESSURE (mm Hg)	APPROXIMATE PERCENTAGE	PARTIAL PRESSURE (mm Hg)
N ₂	78.6	597	74.9	569
O ₂	20.9	159	13.7	104
CO ₂	0.04	0.3	5.2	40
H ₂ O	0.46	3.7	6.2	47
	100.0%	760	100.0%	760



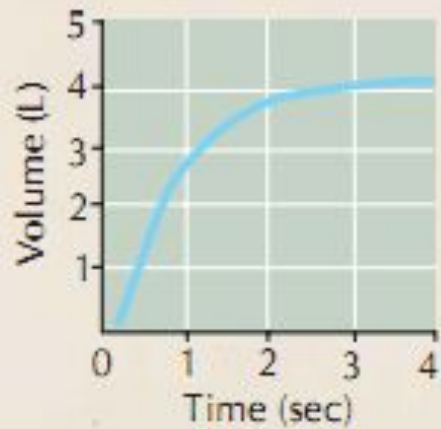
$$\text{AVR (ml/min)} = \text{frequency (breaths/min)} \times (\text{TV} - \text{dead space (ml/breath)})$$

Table 22.3 Effects of Breathing Rate and Depth on Alveolar Ventilation of Three Hypothetical Patients

BREATHING PATTERN OF HYPOTHETICAL PATIENT	DEAD SPACE VOLUME (DSV)	TIDAL VOLUME (TV)	RESPIRATORY RATE*	MINUTE VENTILATION (MVR)	ALVEOLAR VENTILATION (AVR)	% EFFECTIVE VENTILATION (AVR/MVR)
I—Normal rate and depth	150 ml	500 ml	20/min	10,000 ml/min	7000 ml/min	70%
II—Slow, deep breathing	150 ml	1000 ml	10/min	10,000 ml/min	8500 ml/min	85%
III—Rapid, shallow breathing	150 ml	250 ml	40/min	10,000 ml/min	4000 ml/min	40%

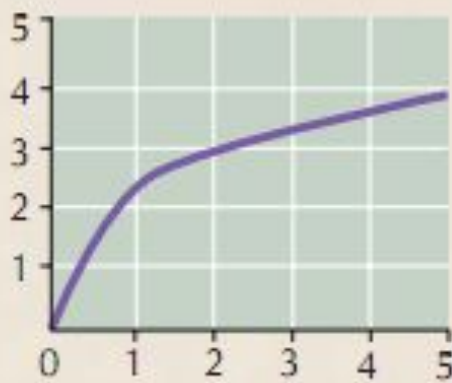


Normal



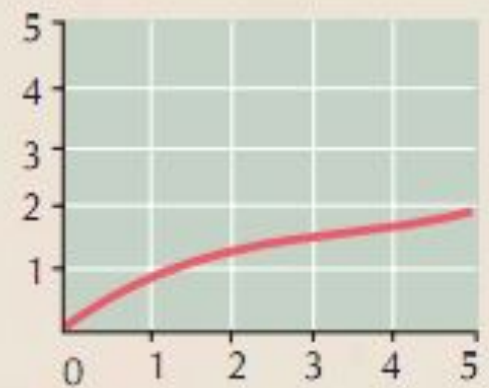
$FEV_1 = 3.00$
 $FVC = 4.00$
 $FEV_1/FVC = 75\%$

Mild obstruction



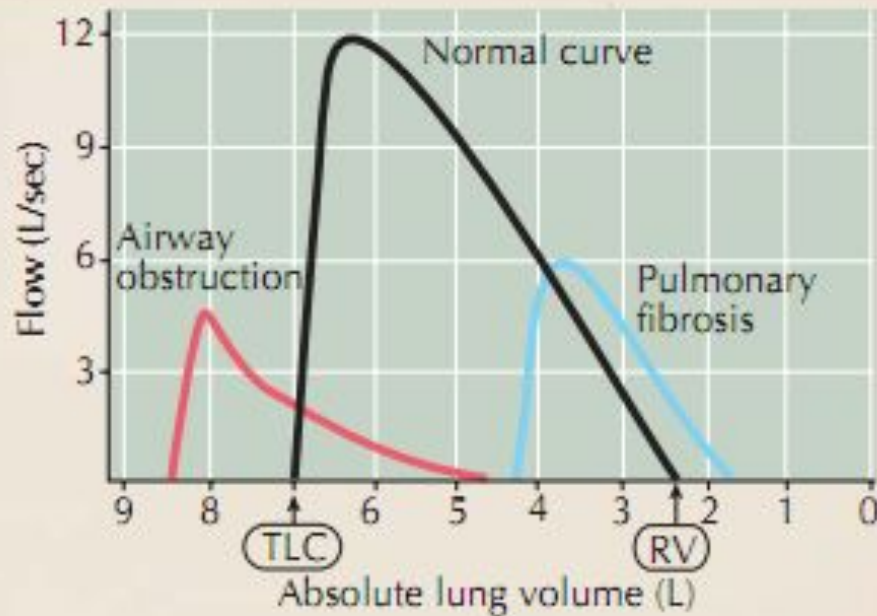
$FEV_1 = 2.60$
 $FVC = 4.00$
 $FEV_1/FVC = 65\%$

Severe obstruction

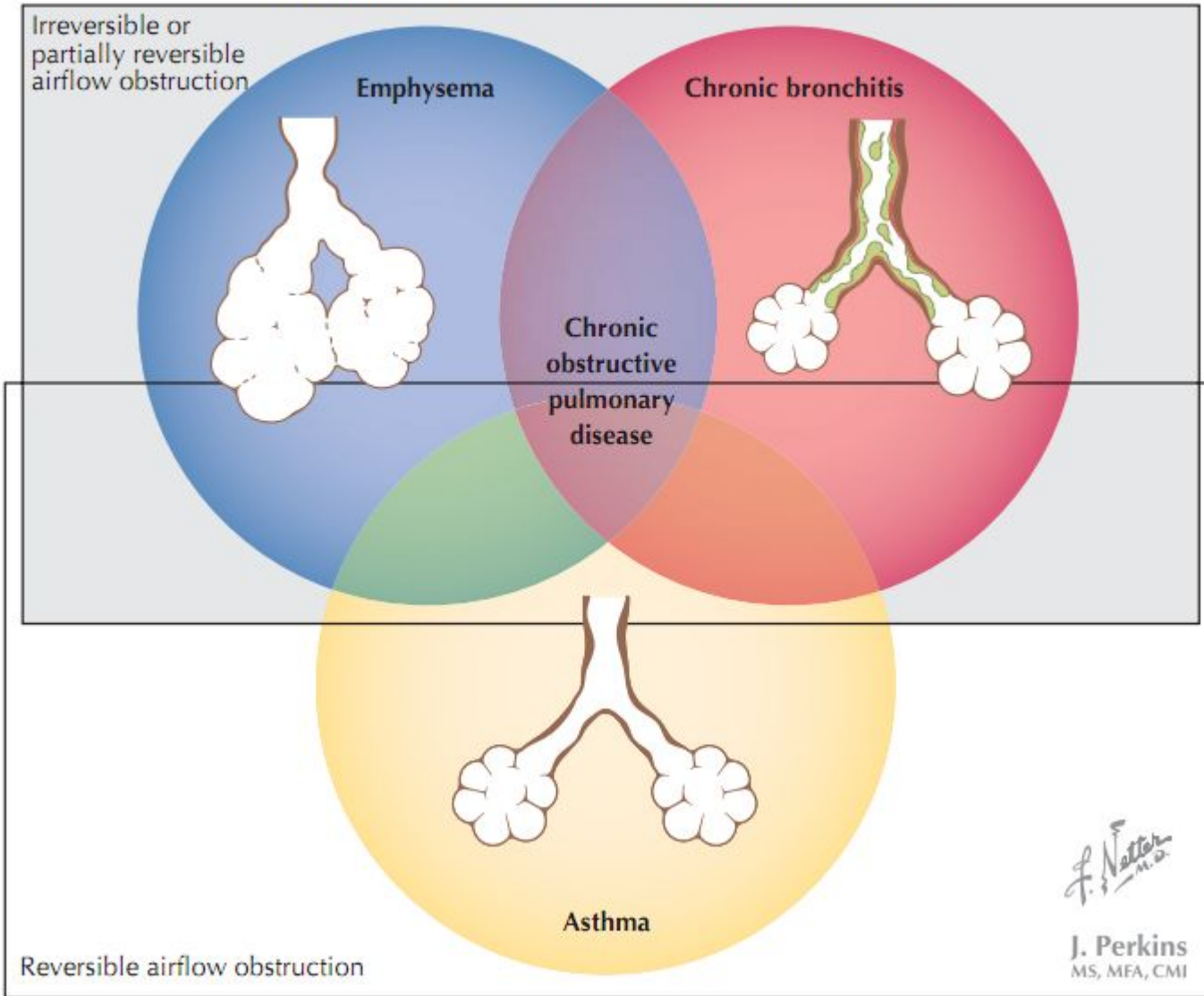


$FEV_1 = 0.90$
 $FVC = 2.00$
 $FEV_1/FVC = 45\%$

Maximal expiratory flow-volume curve



INTERRELATIONSHIPS OF CHRONIC BRONCHITIS AND EMPHYSEMA



Irreversible or partially reversible airflow obstruction

Emphysema

Chronic bronchitis

Chronic obstructive pulmonary disease

Asthma

Reversible airflow obstruction

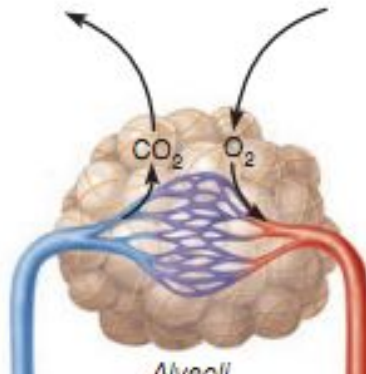
F. J. Natter
M.D.

J. Perkins
MS, MFA, CMI

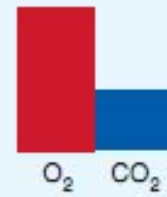
Inspired air:
 P_{O_2} 160 mm Hg
 P_{CO_2} 0.3 mm Hg



External respiration



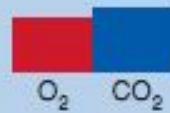
Alveoli of lungs:
 P_{O_2} 104 mm Hg
 P_{CO_2} 40 mm Hg



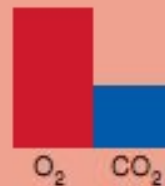
Pulmonary arteries

Pulmonary veins (P_{O_2} 100 mm Hg)

Blood leaving tissues and entering lungs:
 P_{O_2} 40 mm Hg
 P_{CO_2} 45 mm Hg



Blood leaving lungs and entering tissue capillaries:
 P_{O_2} 100 mm Hg
 P_{CO_2} 40 mm Hg

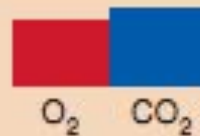
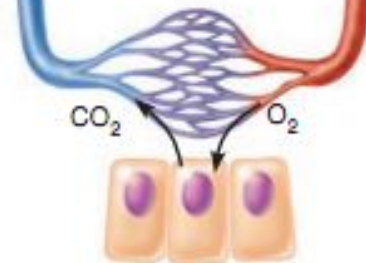


Heart

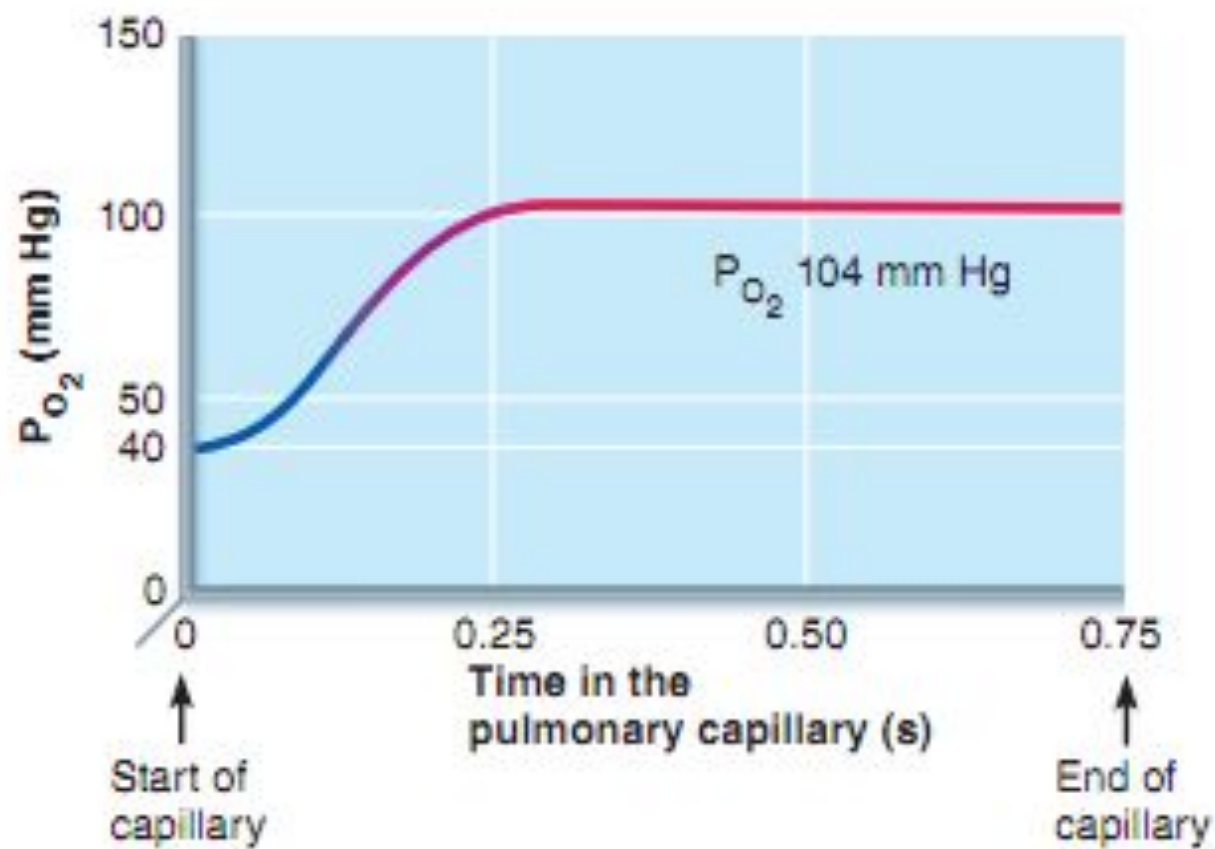
Systemic veins

Systemic arteries

Internal respiration



Tissues:
 P_{O_2} less than 40 mm Hg
 P_{CO_2} greater than 45 mm Hg



(a) Ventilation less than perfusion



Mismatch of ventilation and perfusion
↓ ventilation and/or ↑ perfusion of alveoli
causes local ↑ P_{CO_2} and ↓ P_{O_2}

O_2 autoregulates
arteriolar diameter



Pulmonary arterioles
serving these alveoli
constrict



Match of ventilation
and perfusion
↓ ventilation, ↓ perfusion

(b) Ventilation greater than perfusion



Mismatch of ventilation and perfusion
↑ ventilation and/or ↓ perfusion of alveoli
causes local ↓ P_{CO_2} and ↑ P_{O_2}

O_2 autoregulates
arteriolar diameter



Pulmonary arterioles
serving these alveoli
dilate



Match of ventilation
and perfusion
↑ ventilation, ↑ perfusion