Anatomy and physiology of breathing

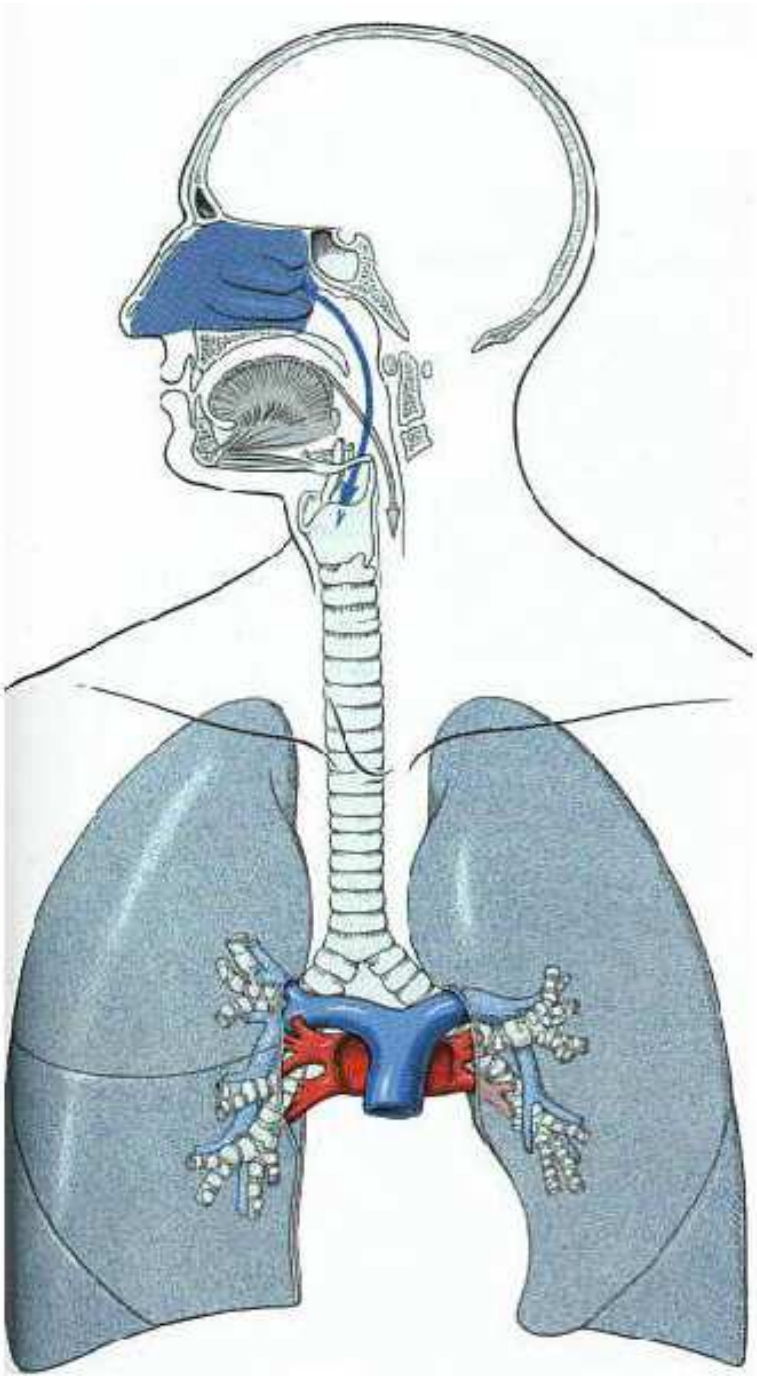
The key points

Pr Charles-Hugo MARQUETTE

Université Nice Sophia Antipolis
Faculté de Médecine

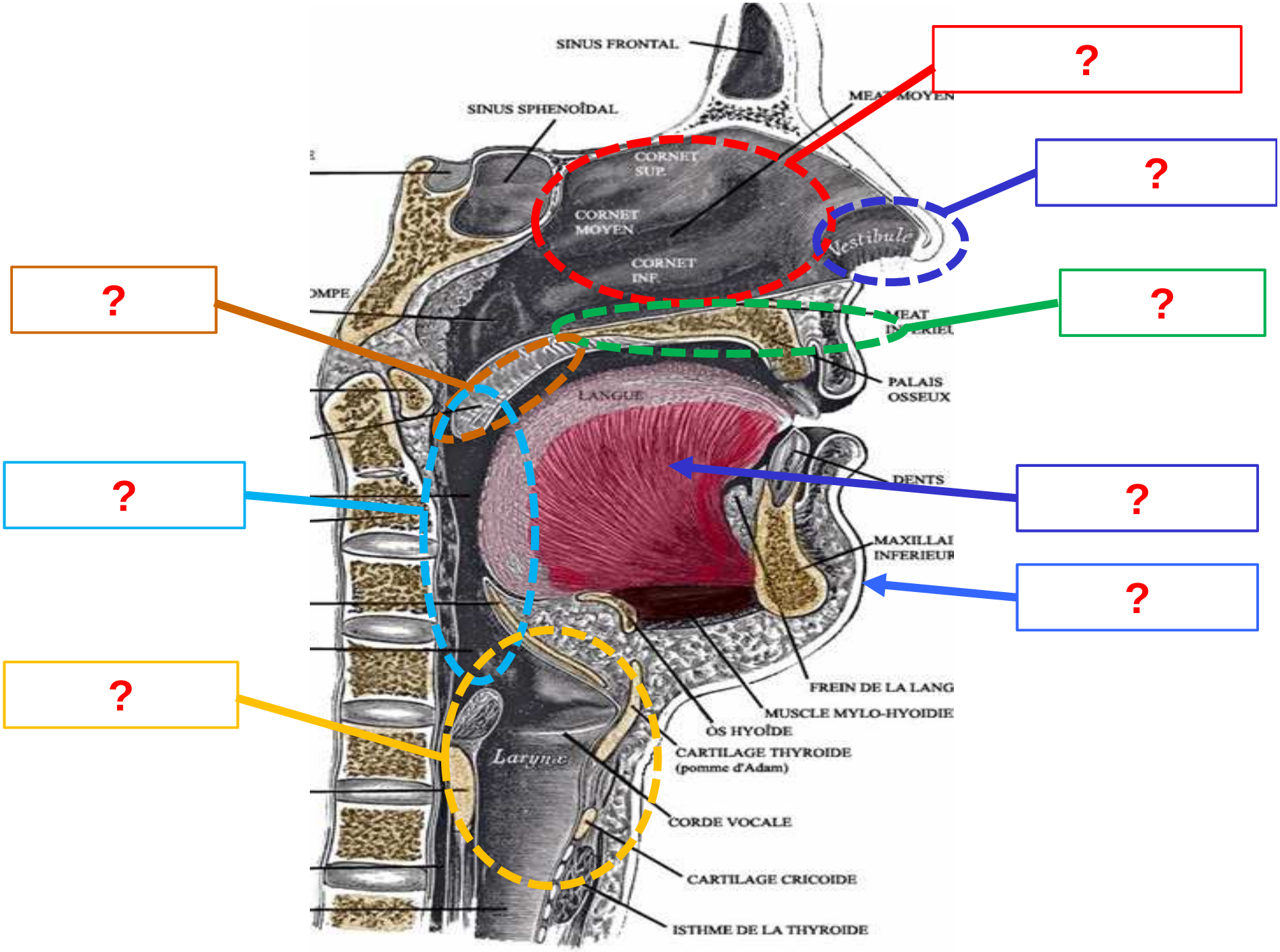
The airways

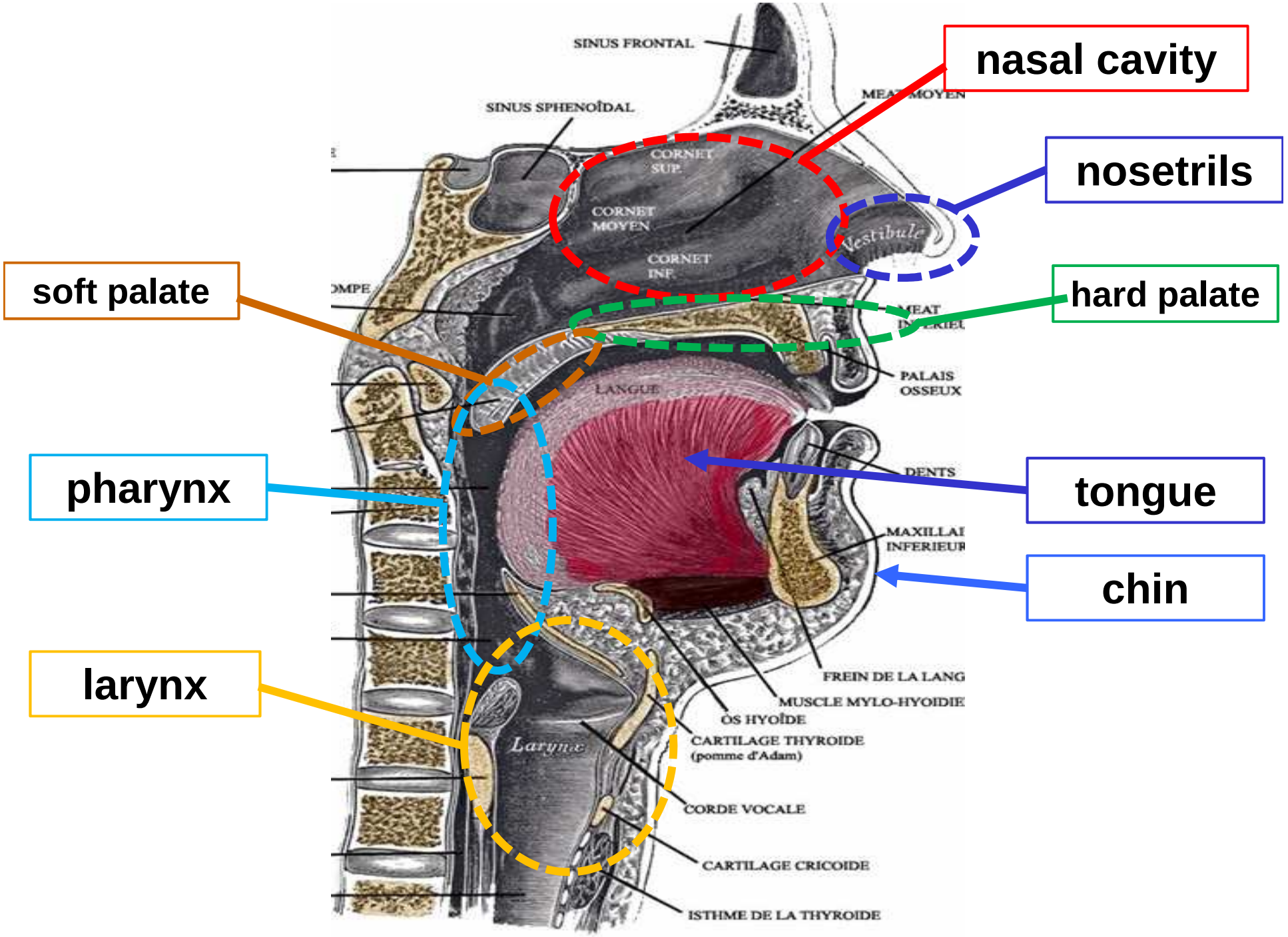
from the nosetrils to the alveoli

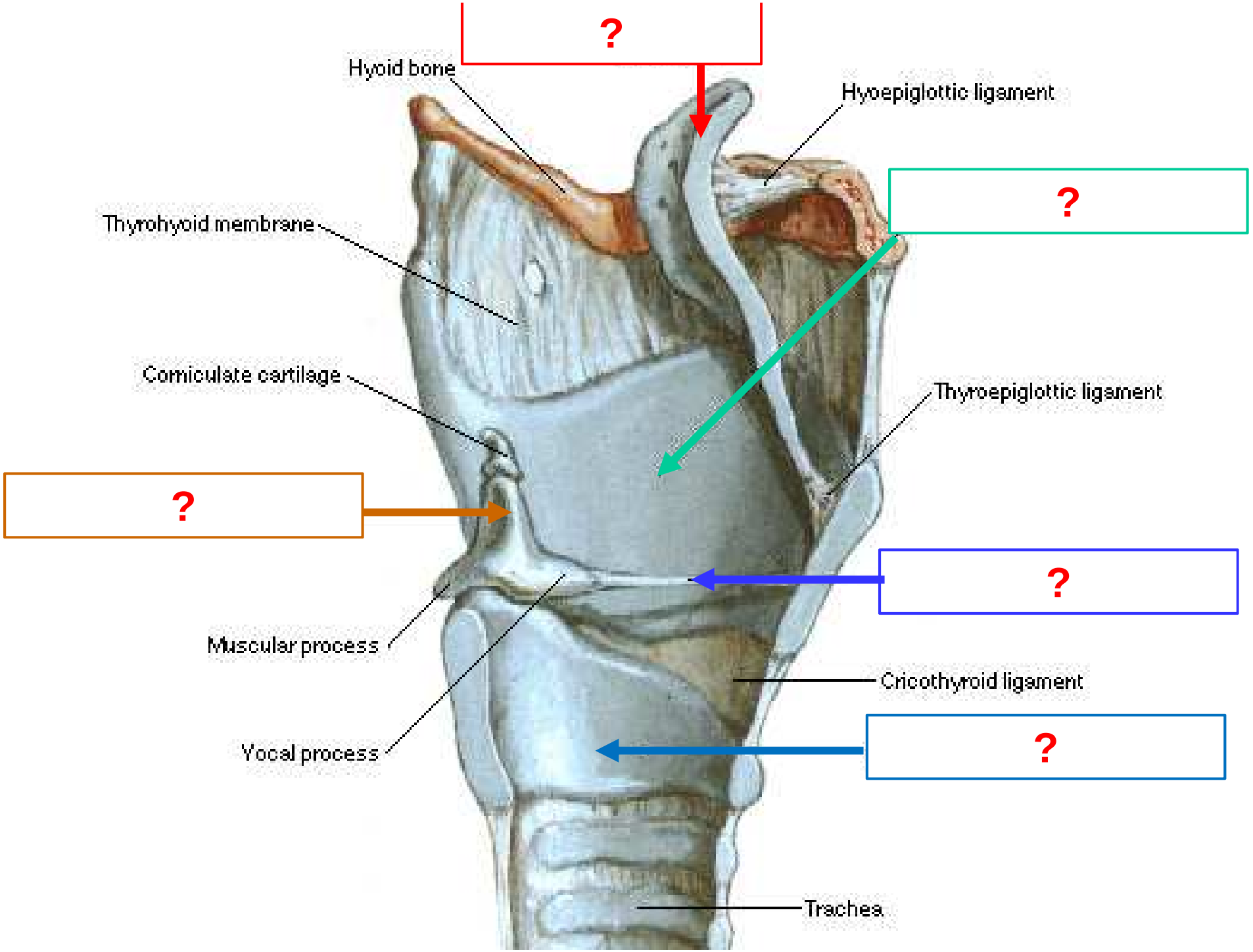


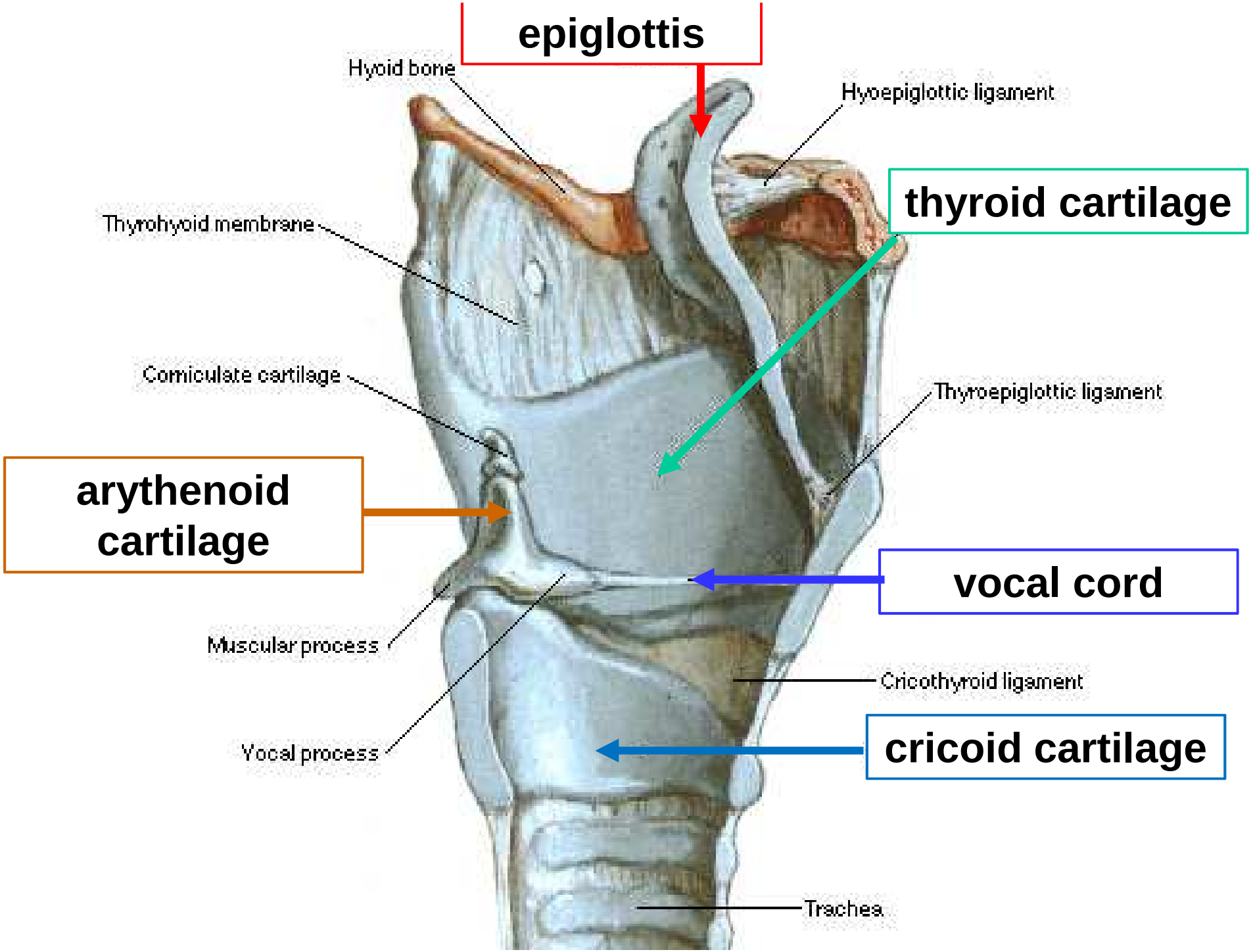
Upper airways

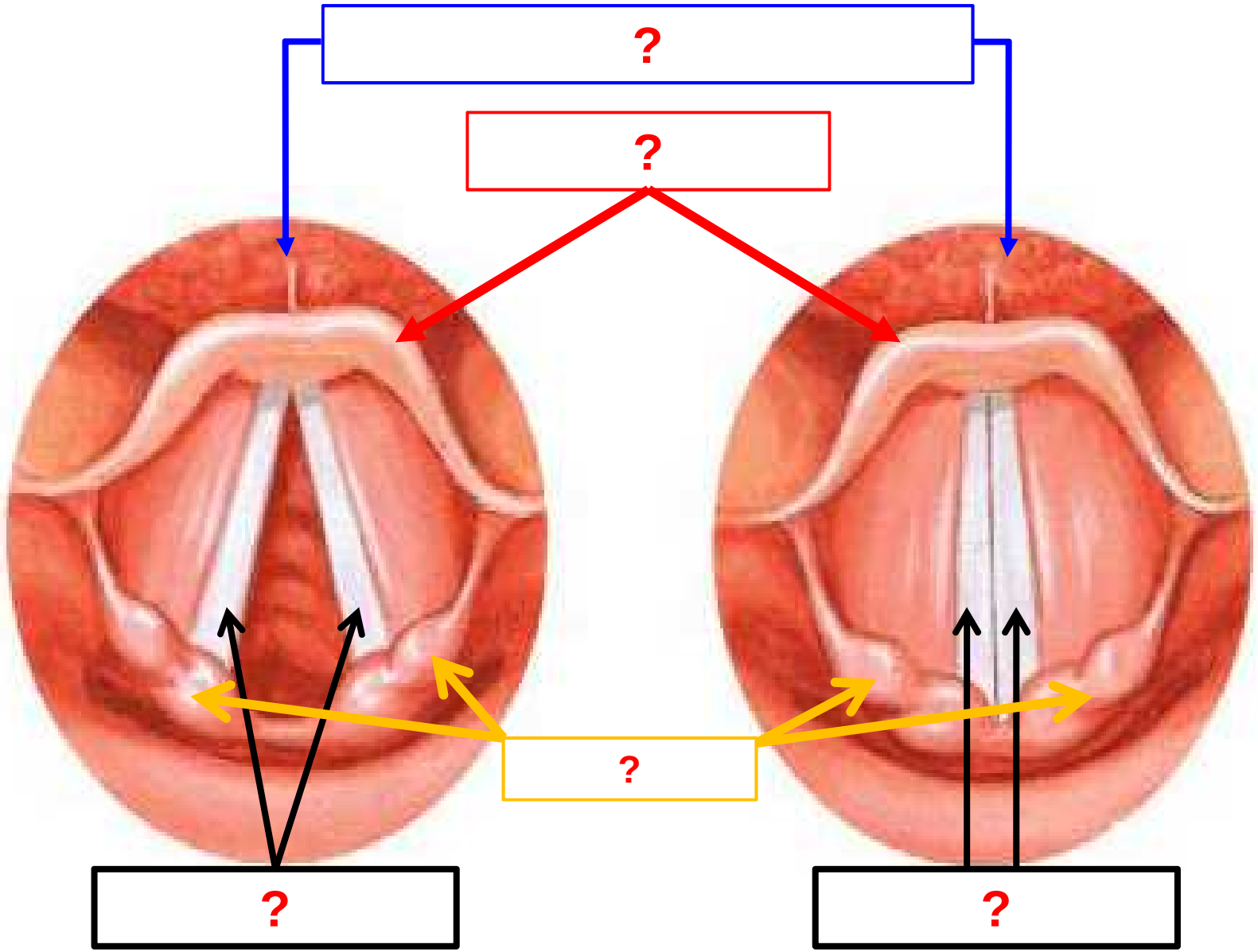
Lower airways
(lower respiratory tract)


SINUS FRONTAL
SINUS SPHENOÏDAL
CORNET SUP.
CORNET MOYEN
CORNET INF.
Vestibule
PALAIS OSSEUX
LANGUE
DENTS
FREIN DE LA LANG
MUSCLE MYLO-HYOIDIE
OS HYOÏDE
CARTILAGE THYROIDE (pomme d'Adam)
Larynx
CORDE VOCALE
CARTILAGE CRICOIDE
ISTHME DE LA THYROIDE
?
?
?
?
?
?
?

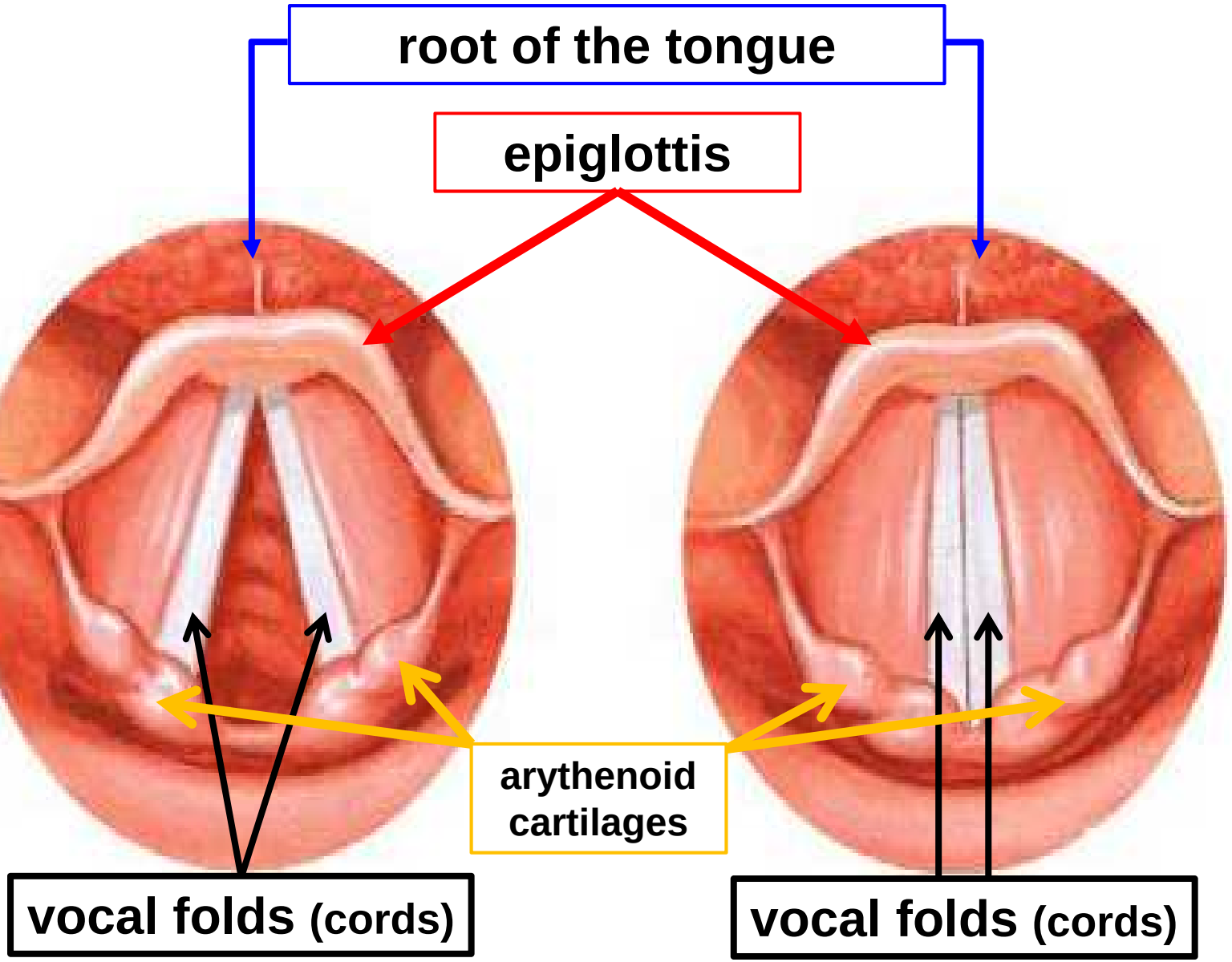

nasal cavity
nosetrils
hard palate
soft palate
pharynx
tongue
chin
larynx
SINUS FRONTAL
SINUS SPHENOÏDAL
CORNET SUP.
CORNET MOYEN
CORNET INF.
Vestibule
PALAIS OSSEUX
LANGUE
DENTS
FREIN DE LA LANG
MUSCLE MYLO-HYOIDIE
OS HYOÏDE
CARTILAGE THYROIDE (pomme d'Adam)
Larynx
CORDE VOCALE
CARTILAGE CRICOIDE
ISTHME DE LA THYROIDE


?
Hyoid bone
Hyoepiglottic ligament
?
Thyrohyoid membrane
Corniculate cartilage
Thyroepiglottic ligament
?
?
Muscular process
Cricothyroid ligament
?
Vocal process
Trachea

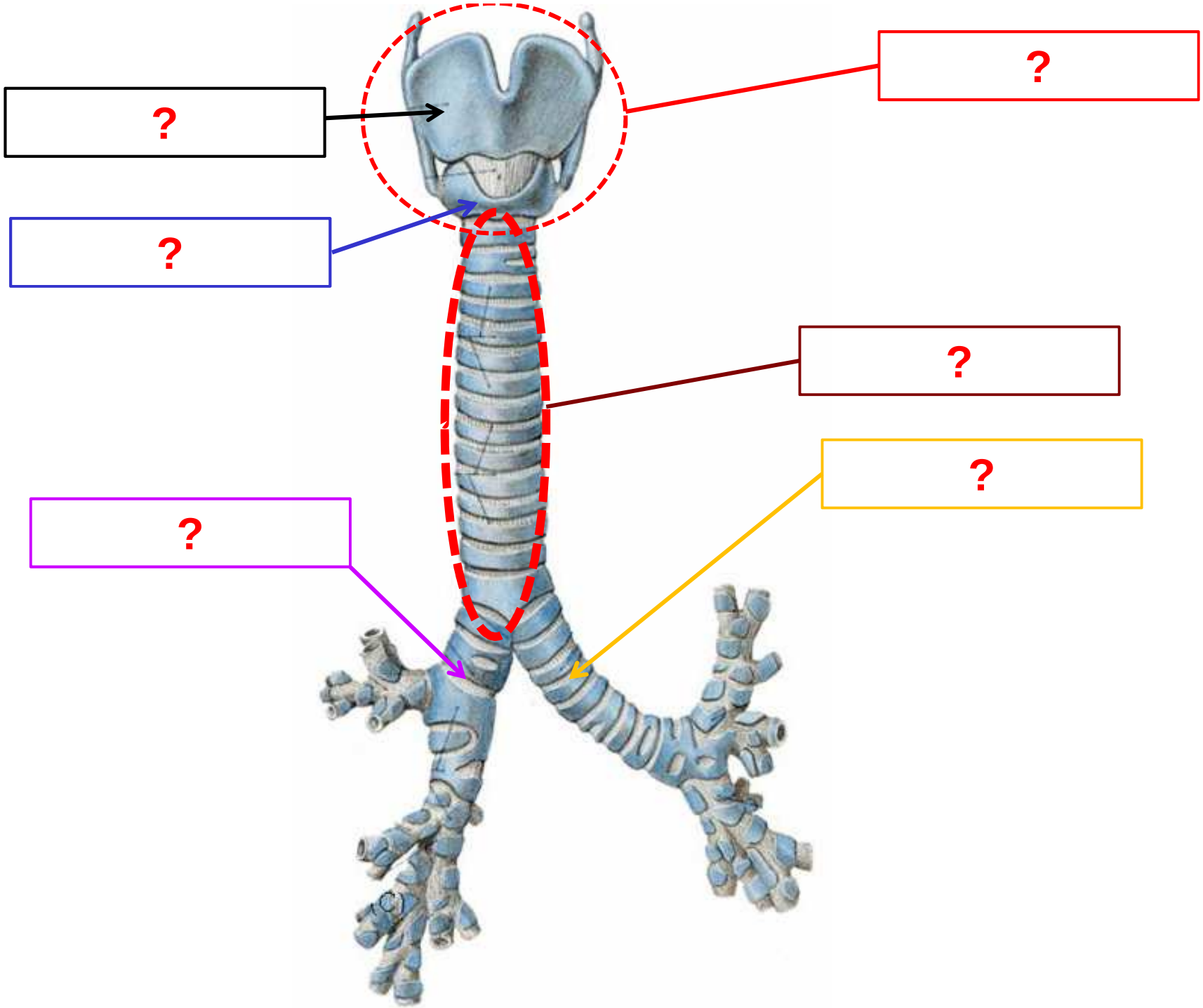

epiglottis
Hyoid bone
Hyoepiglottic ligament
thyroid cartilage
Thyrohyoid membrane
Corniculate cartilage
Thyroepiglottic ligament
arythenoid cartilage
vocal cord
Muscular process
Cricothyroid ligament
Vocal process
cricoid cartilage
Trachea

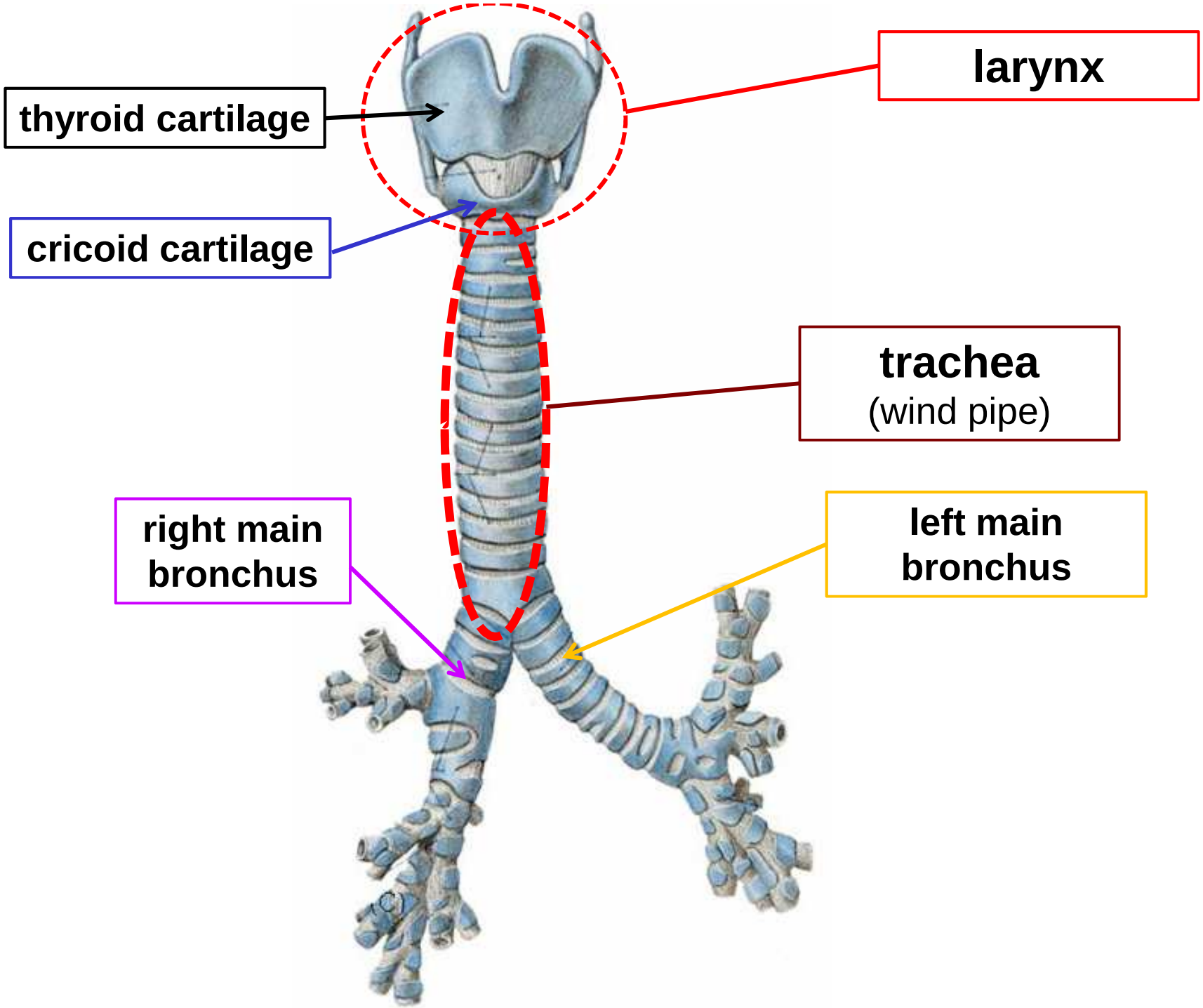


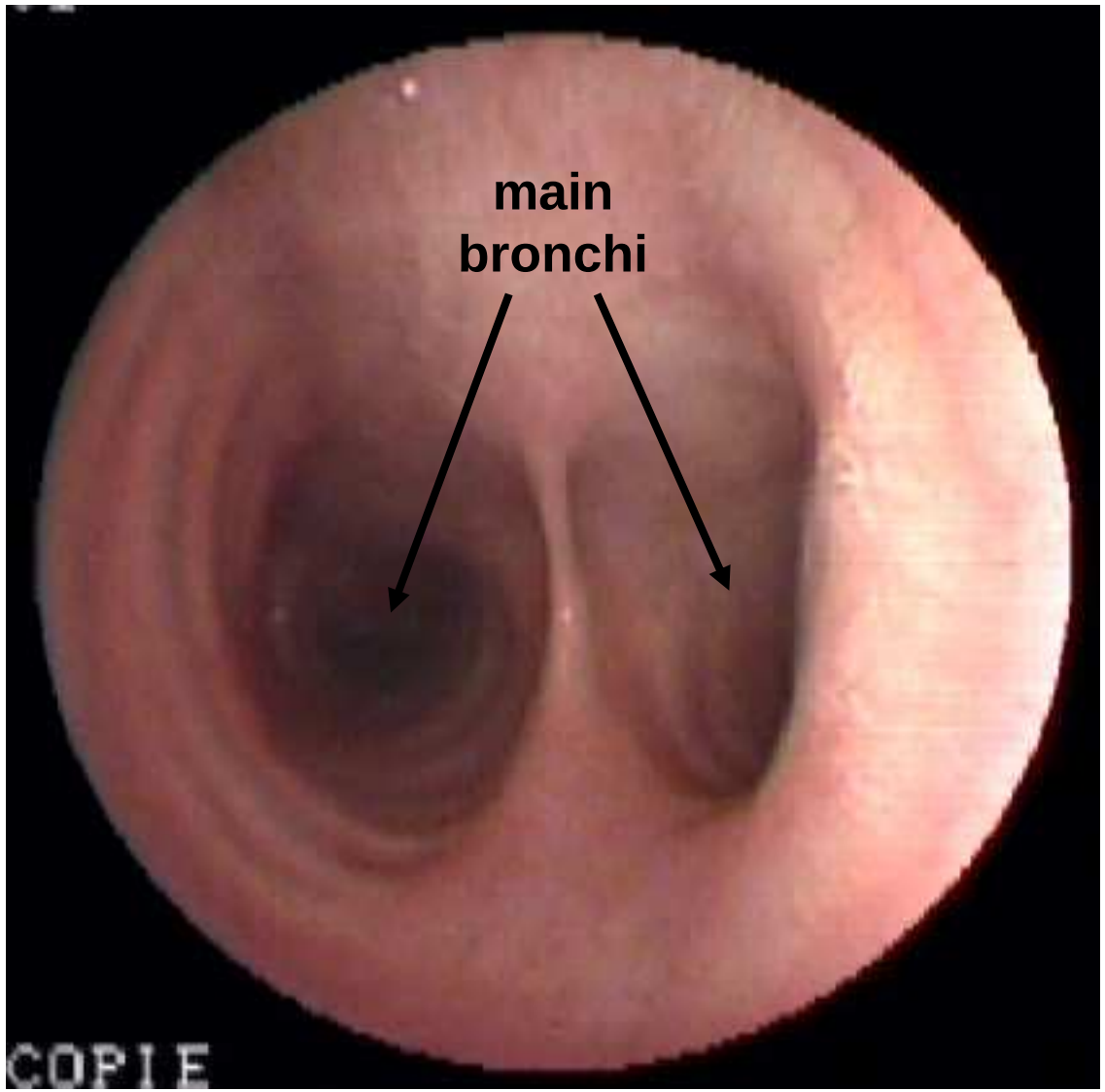
Larynx during inspiration and phonation



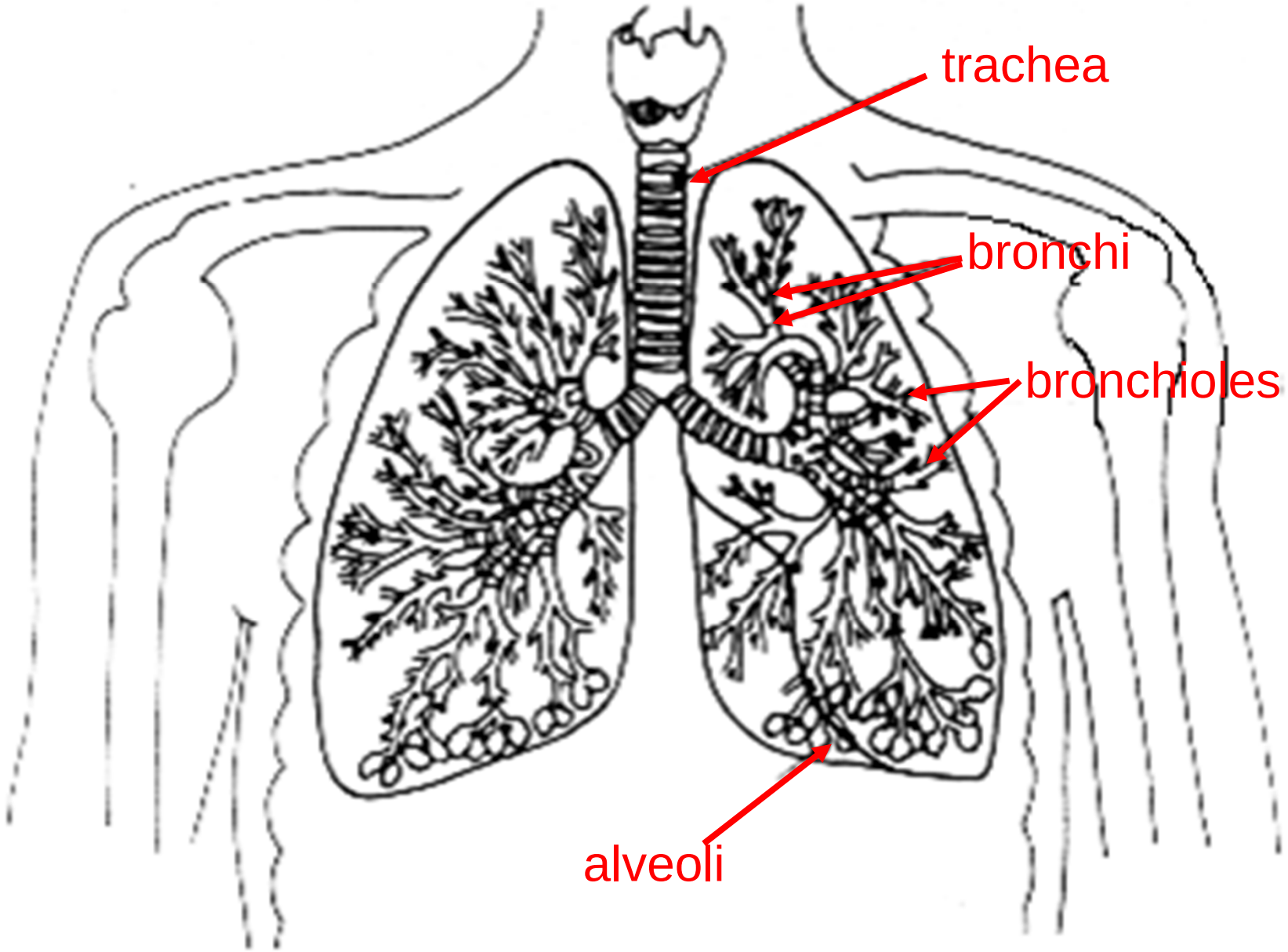
Larynx during inspiration and phonation




thyroid cartilage
larynx
cricoid cartilage
trachea
(wind pipe)
right main bronchus
left main bronchus

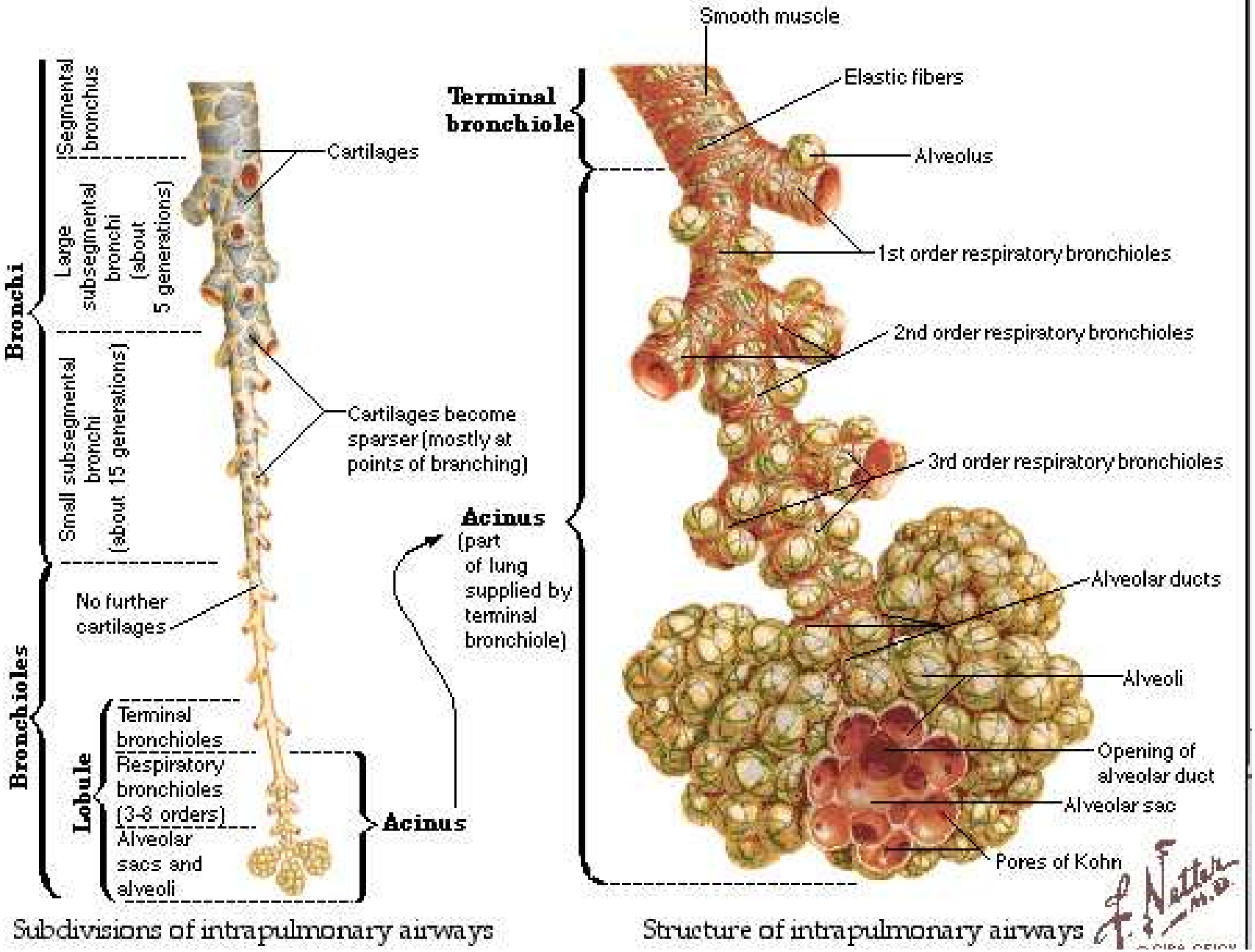


view from inside the windpipe


trachea
bronchi
bronchioles
alveoli

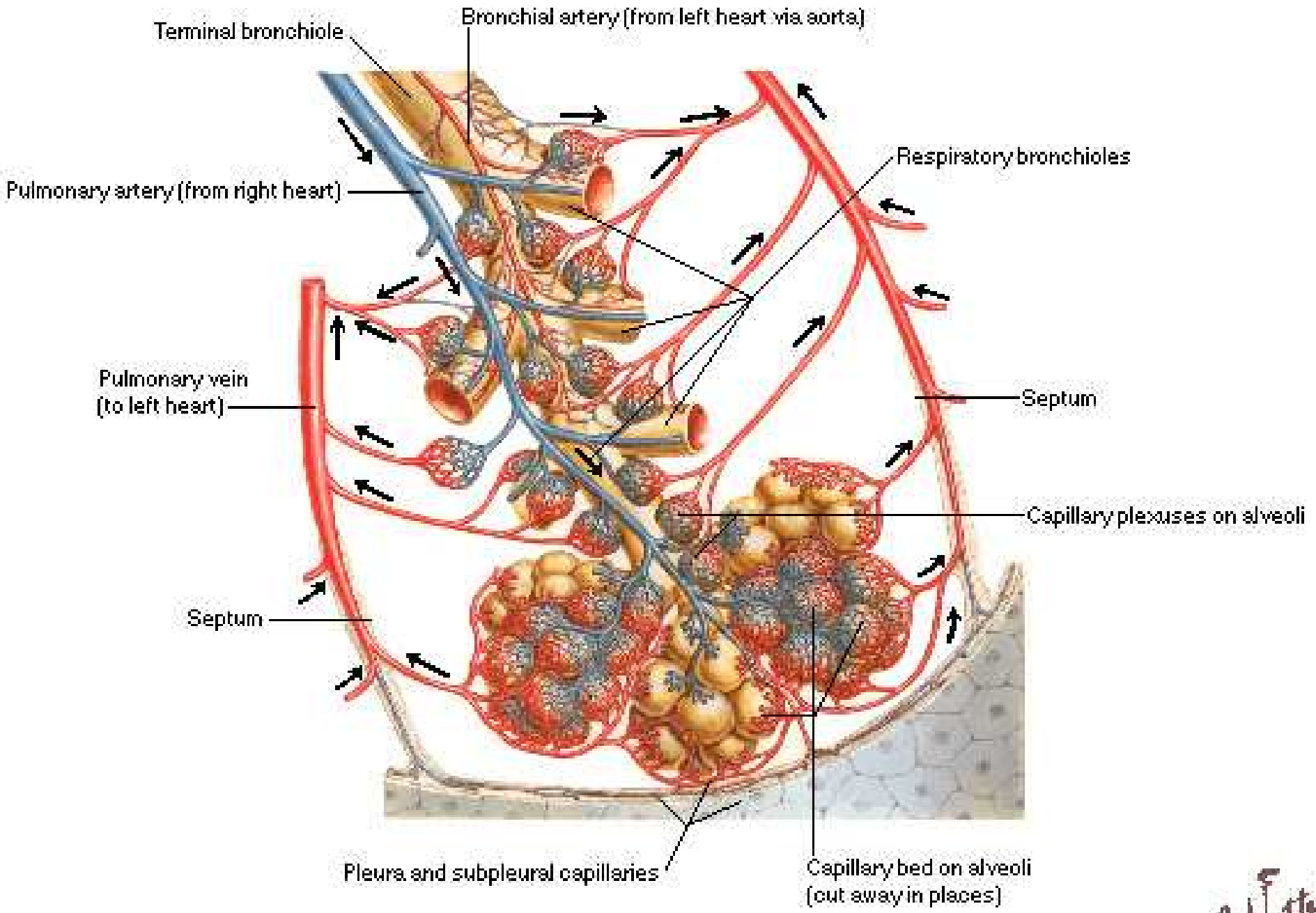
Intrapulmonary Airways

Schema



Subdivisions of intrapulmonary airways

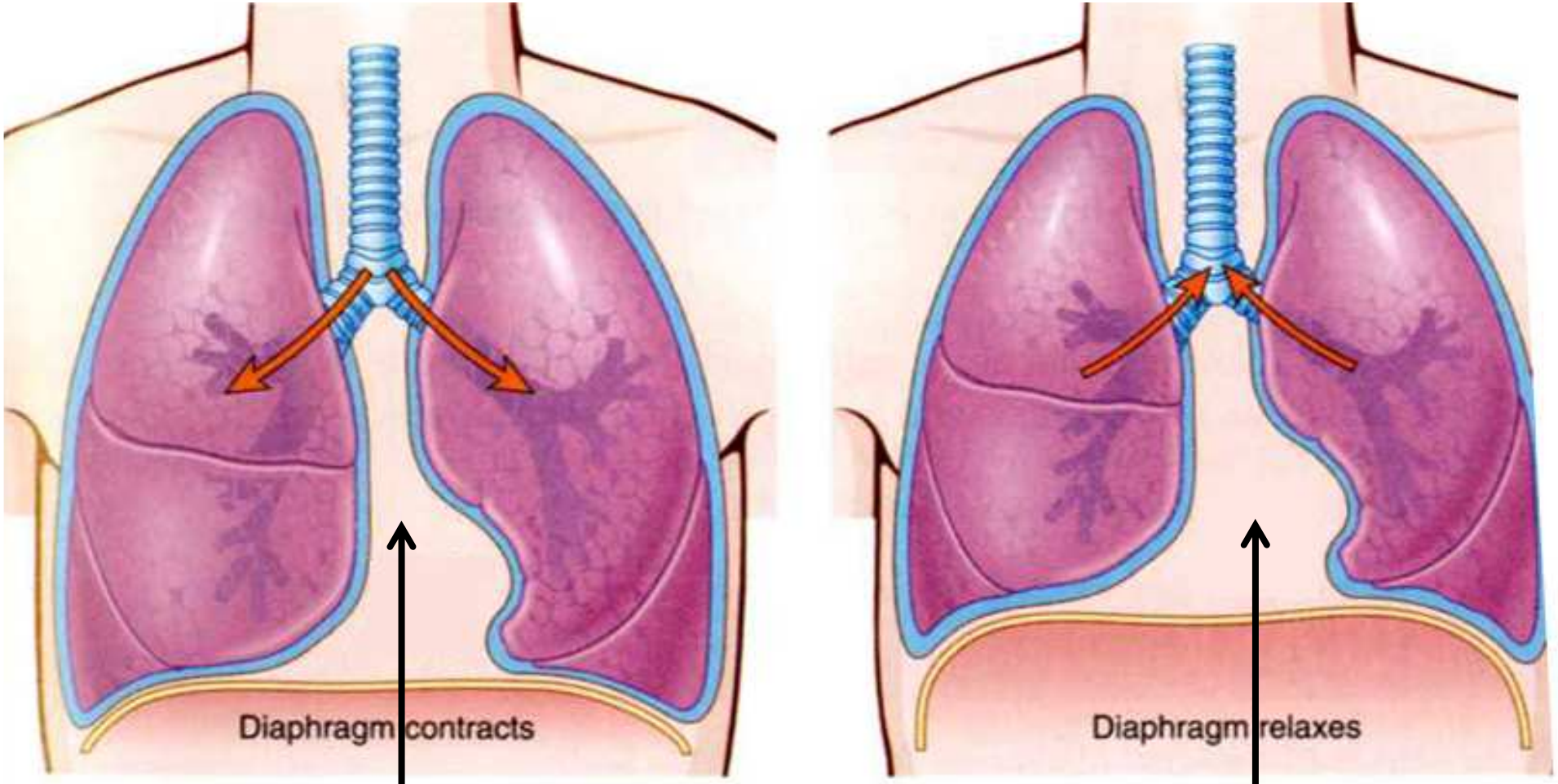
Structure of intrapulmonary airways


Terminal bronchiole
Bronchial artery (from left heart via aorta)
Pulmonary artery (from right heart)
Respiratory bronchioles
Pulmonary vein
(to left heart)
Septum
Capillary plexuses on alveoli
Septum
Pleura and subpleural capillaries
Capillary bed on alveoli
(cut away in places)

Respiratory mechanics

inspiration

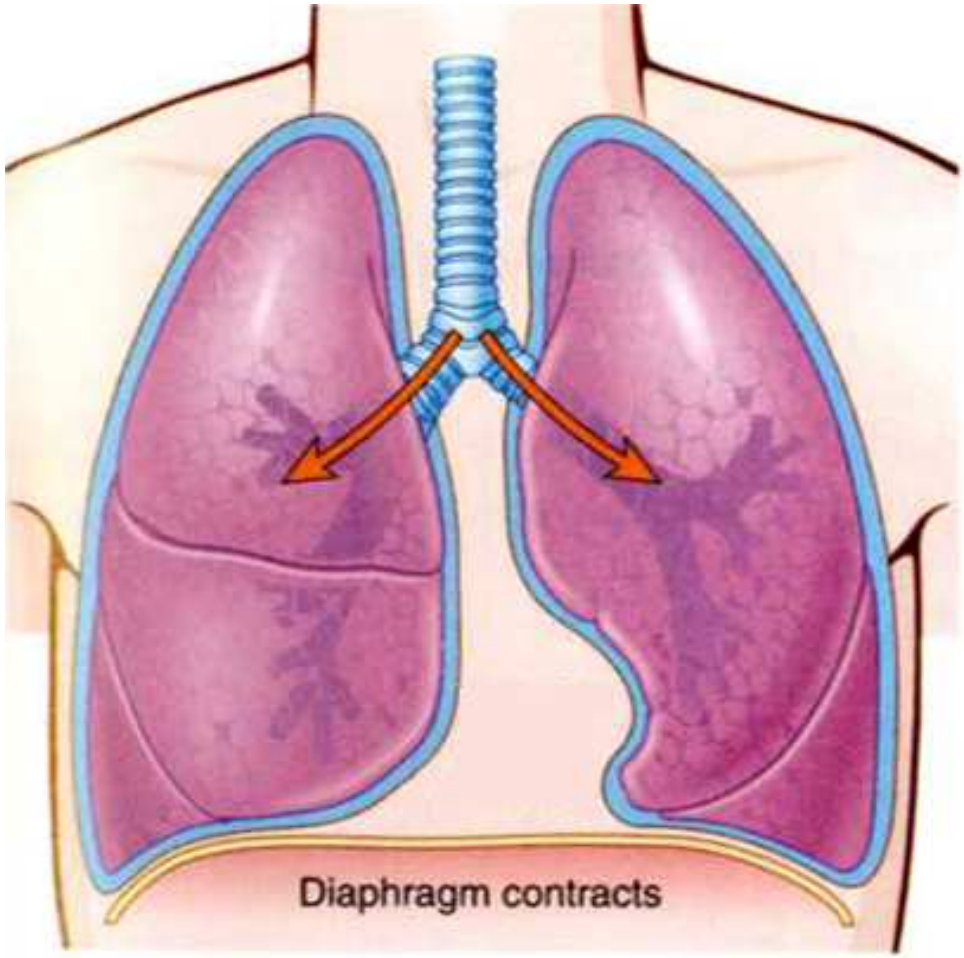
expiration



How is the intra-thoracic pressure ?

Respiratory mechanics

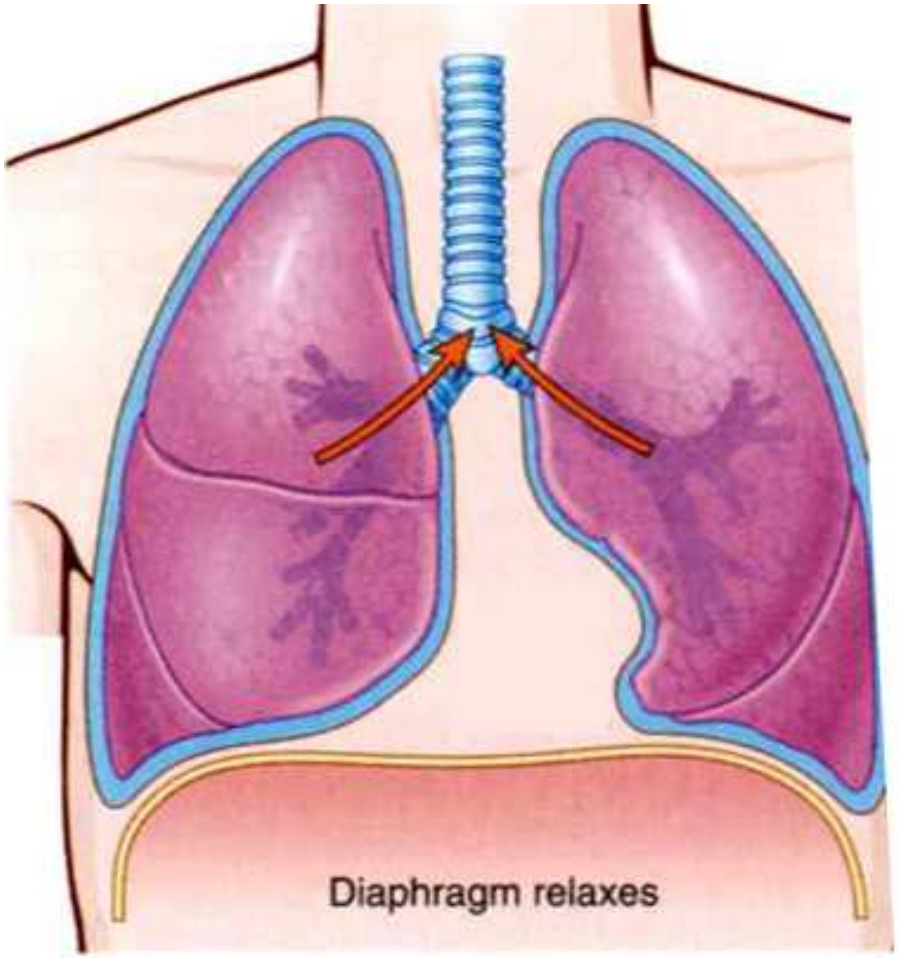
inspiration



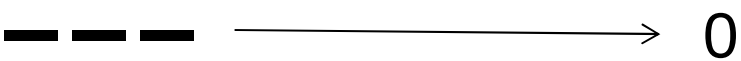
0 ⟶ – – –

Respiratory mechanics

expiration

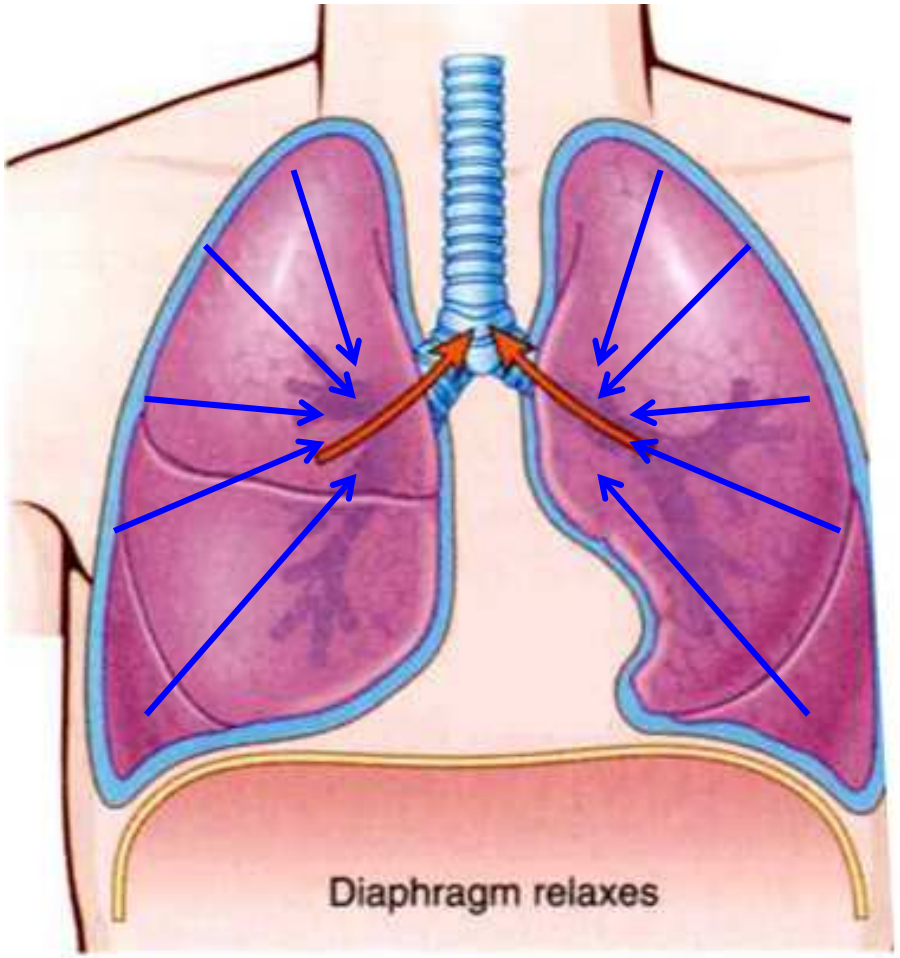


What is the driving force during expiration ?



Respiratory mechanics

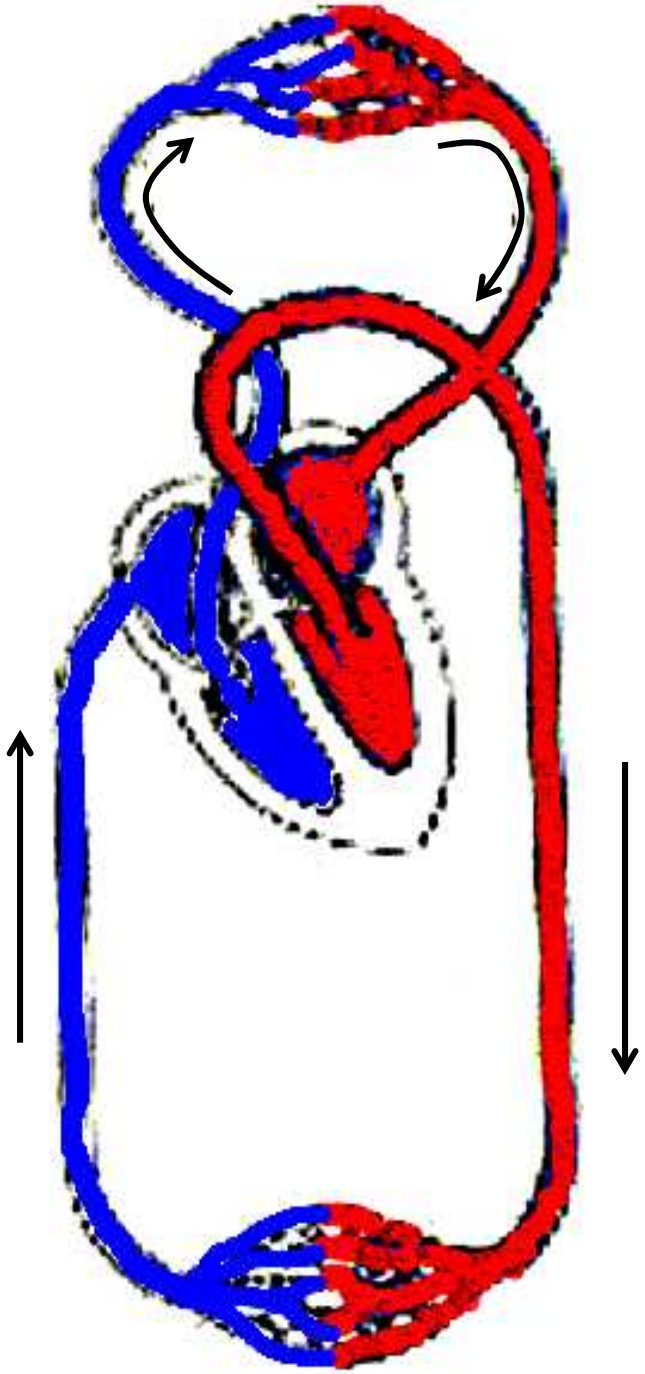
expiration



the elastic recoïl

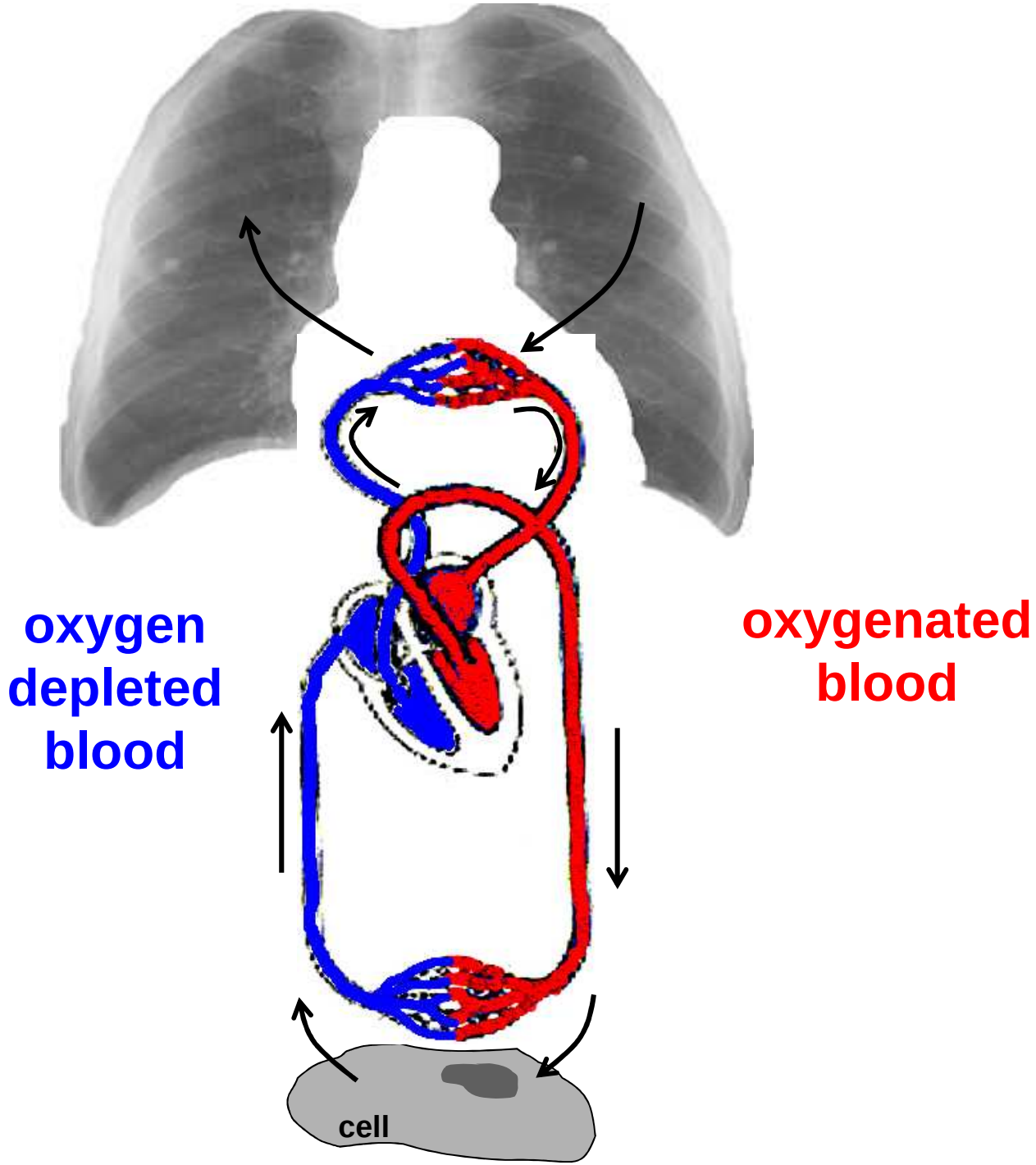
– – – ⟶ 0

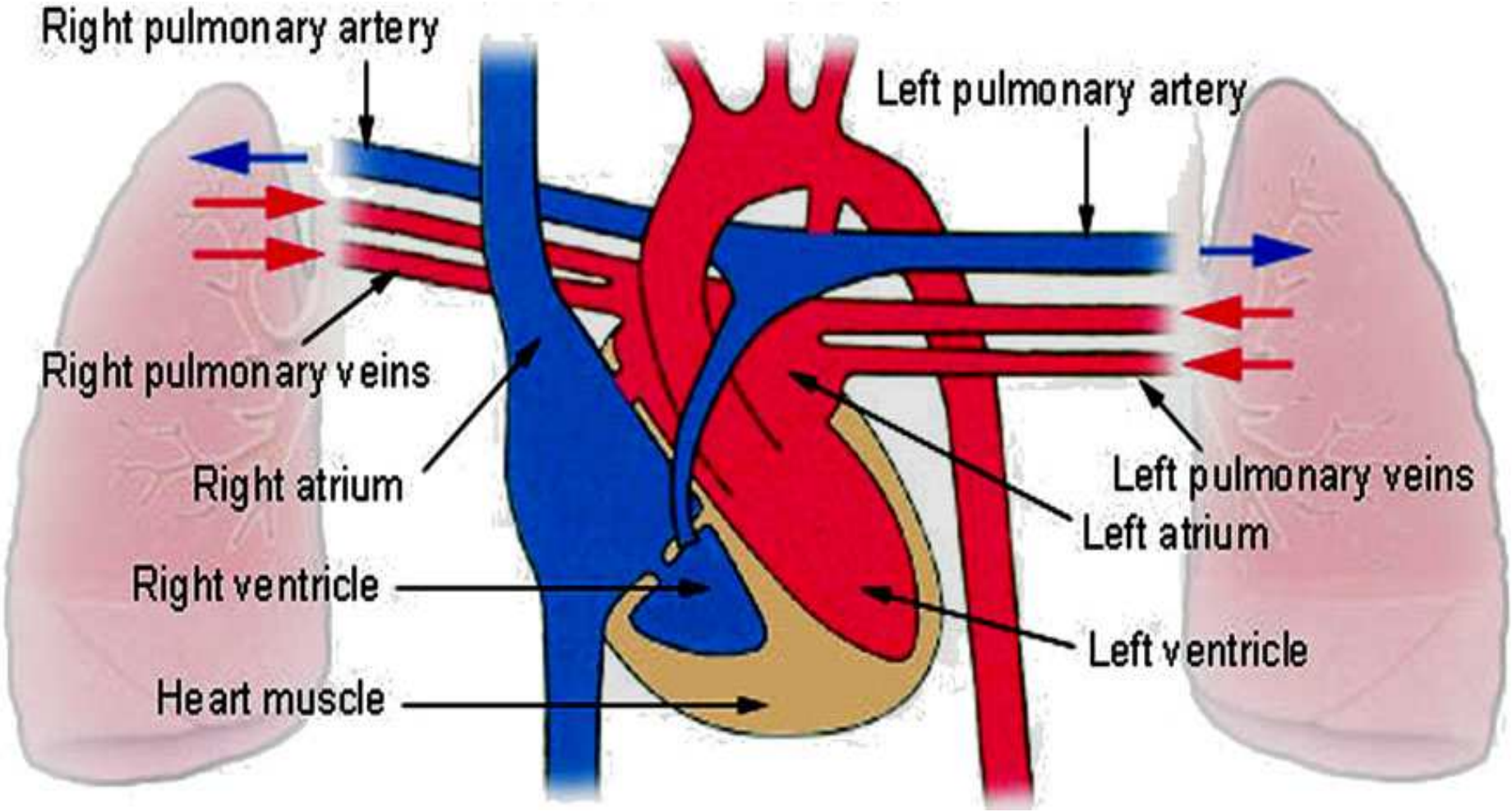
gaz exchange

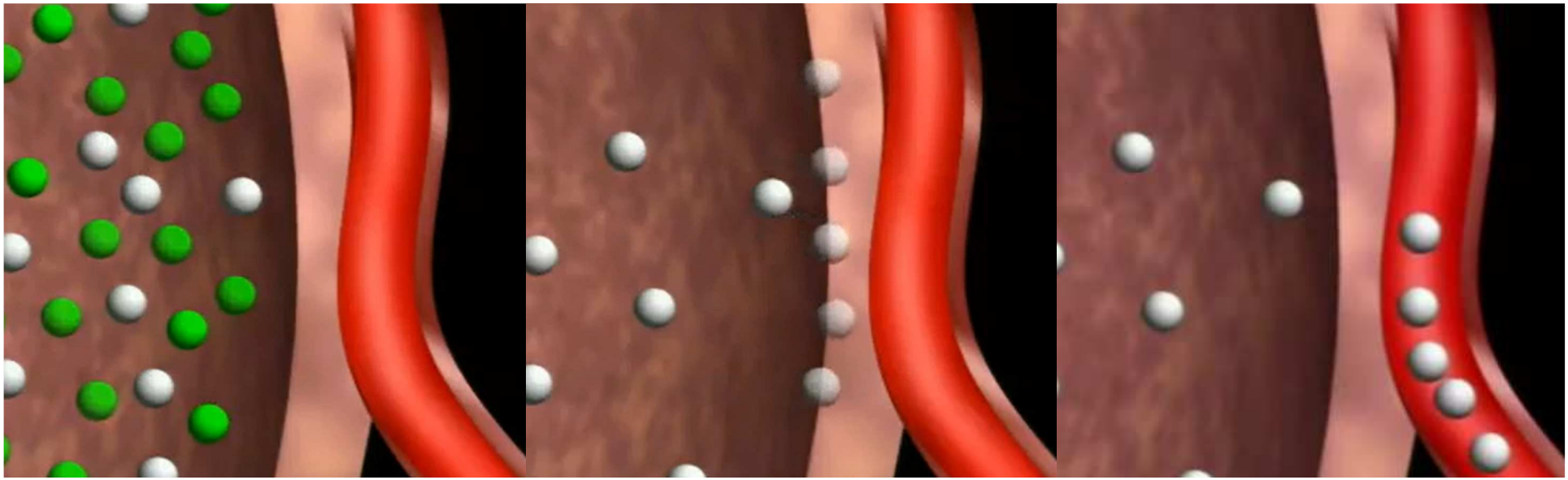


Pulmonary circulation carries oxygen-depleted-blood away from the heart, to the lungs and returns oxygenated blood back to the left part of the heart

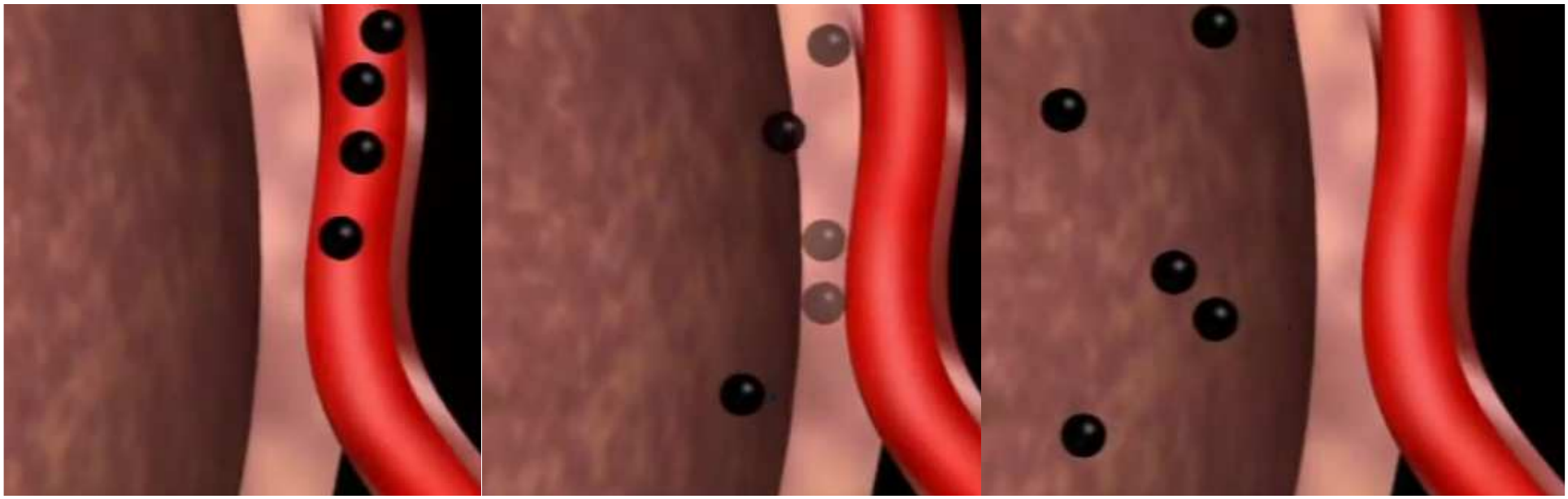
Sytemic circulation carries oxygenated blood towards the tissues and returns oxygen-depleted-blood back to the right part of the heart


oxygen depleted blood
oxygenated blood
cell


Right pulmonary artery
Left pulmonary artery
Right pulmonary veins
Right atrium
Left pulmonary veins
Left atrium
Right ventricle
Left ventricle
Heart muscle



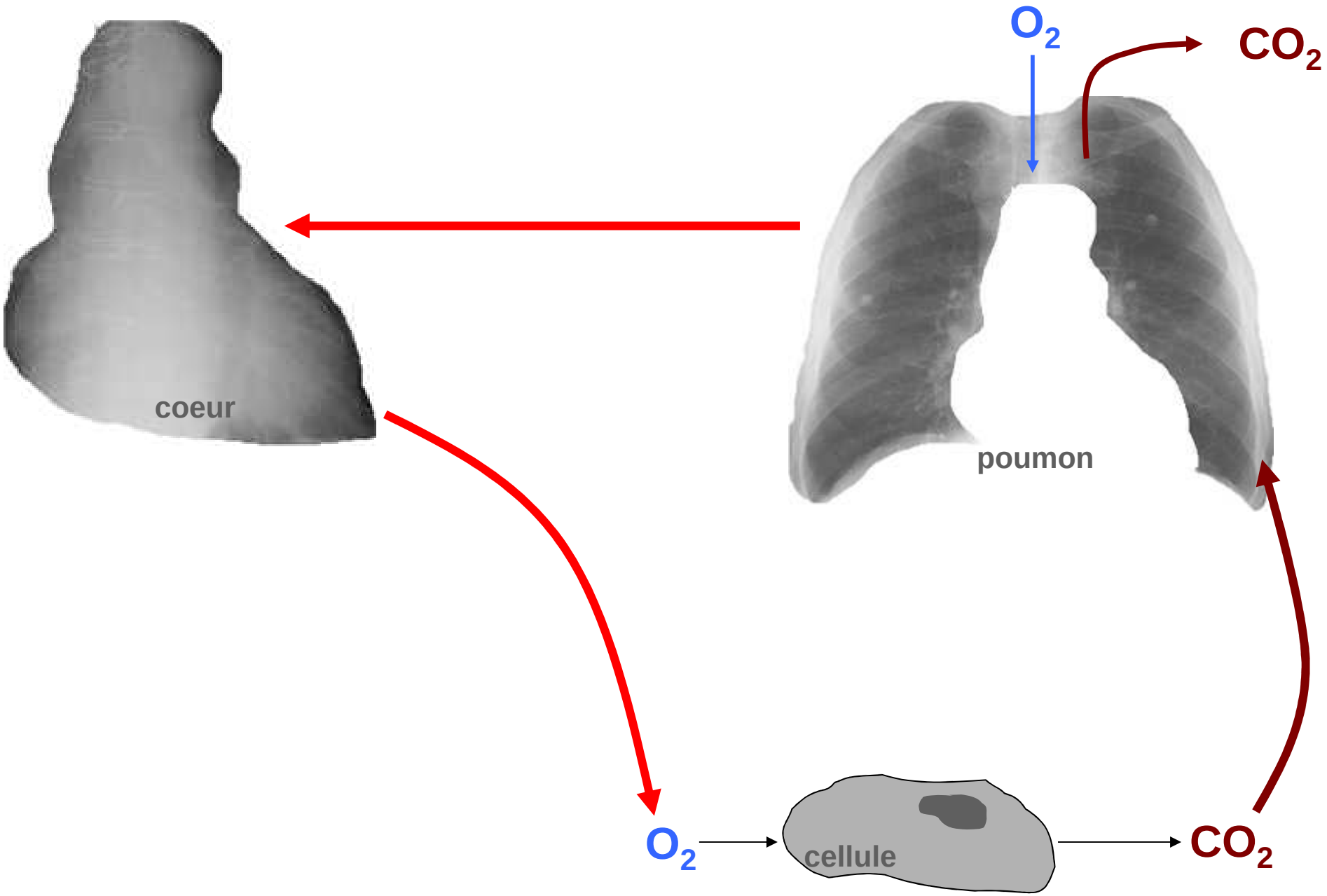
http://www.youtube.com/watch?v=d-f3RL0KiUg&NR=1



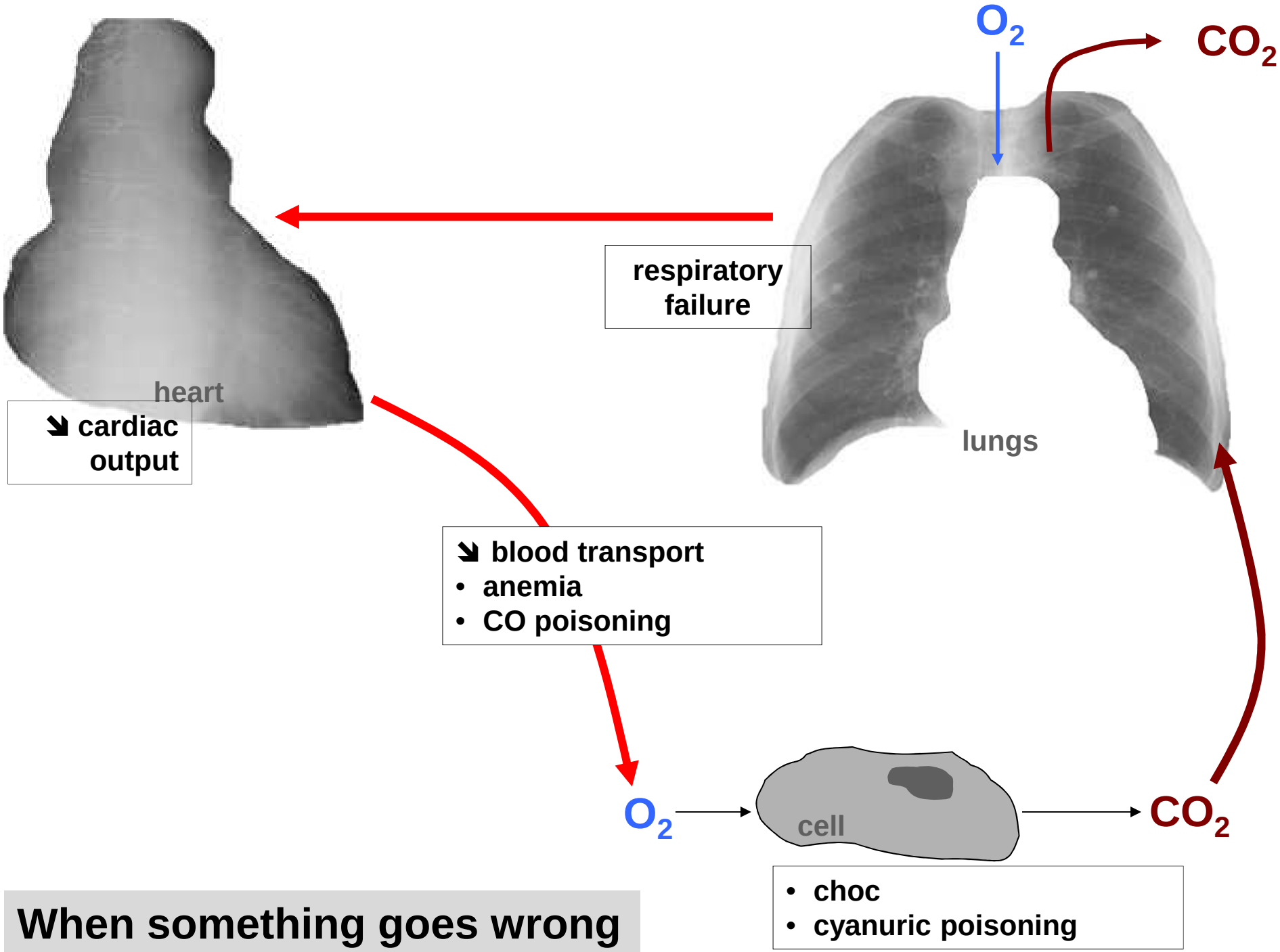
nitrogen

oxygen

carbon dioxide

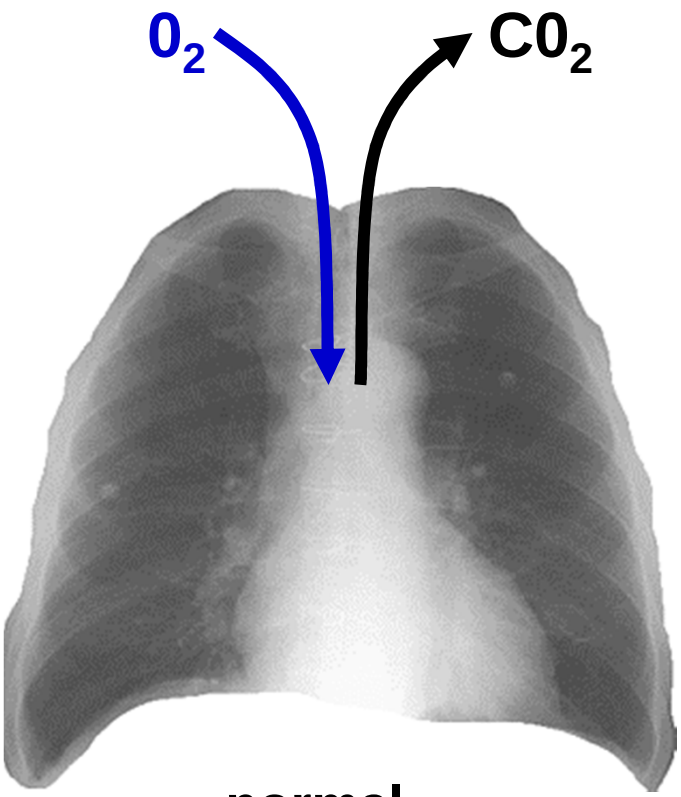


When things go the right way

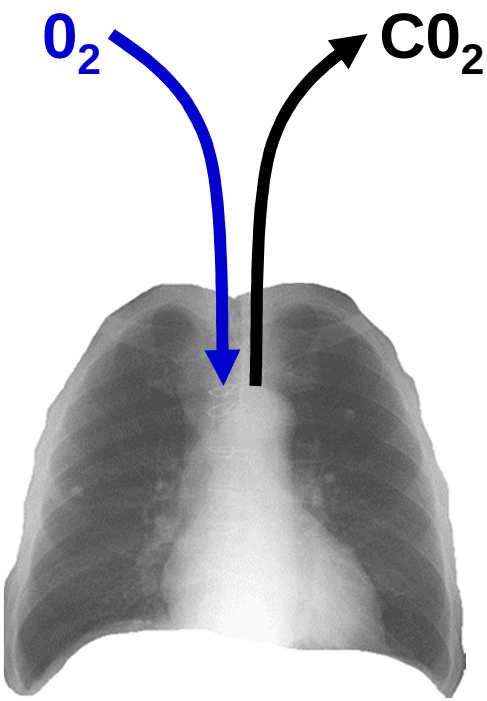


When something goes wrong

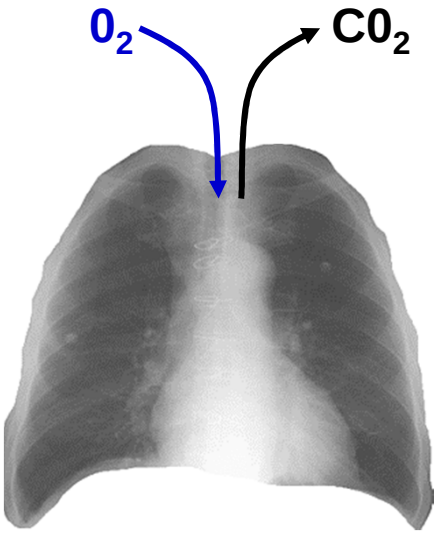
from health to disease



normal



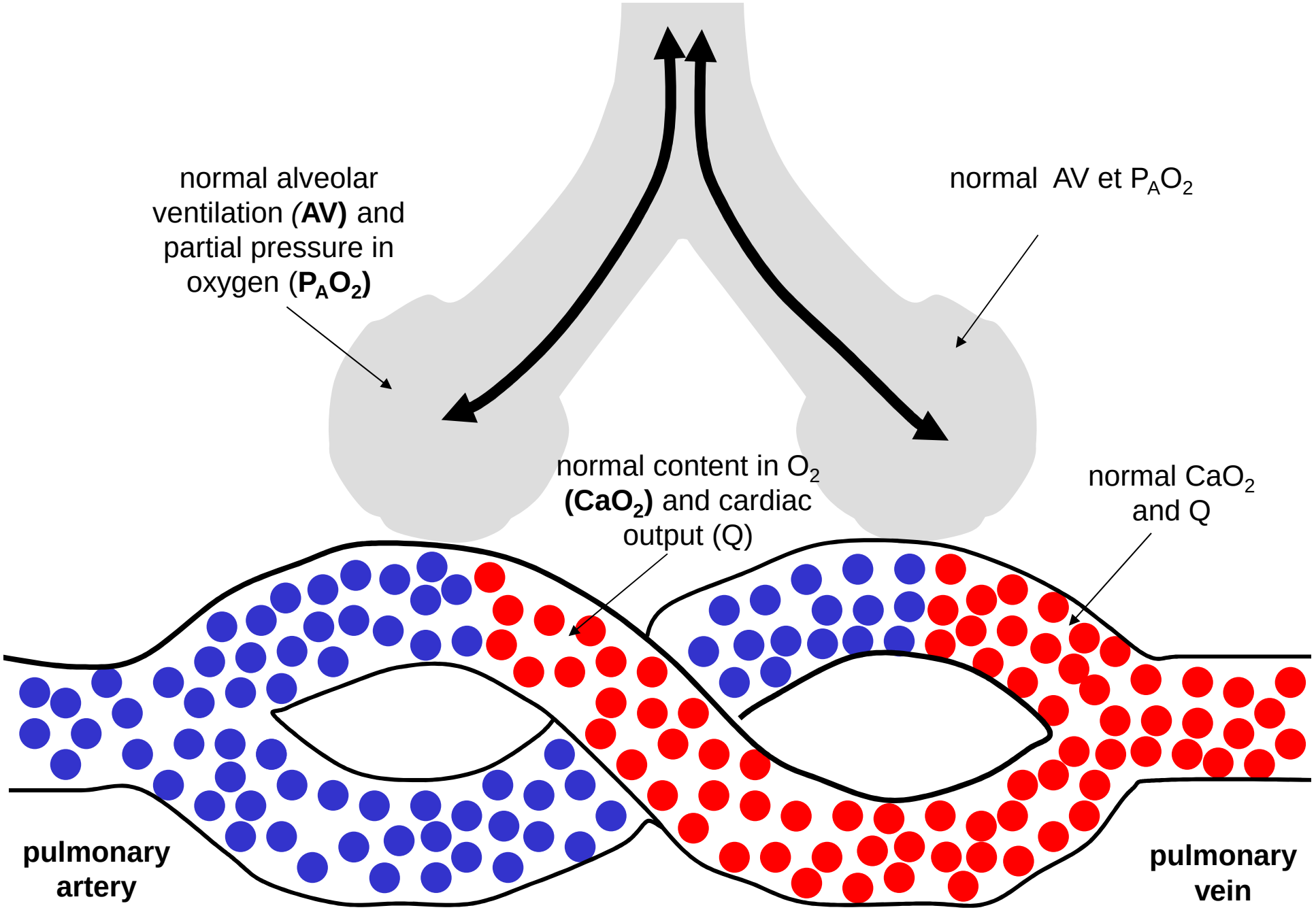
impaired ventilation



impaired gaz exchange

respiratory insufficiency is usually the result of severely impaired ventilation

normoxemia - hypoxemia



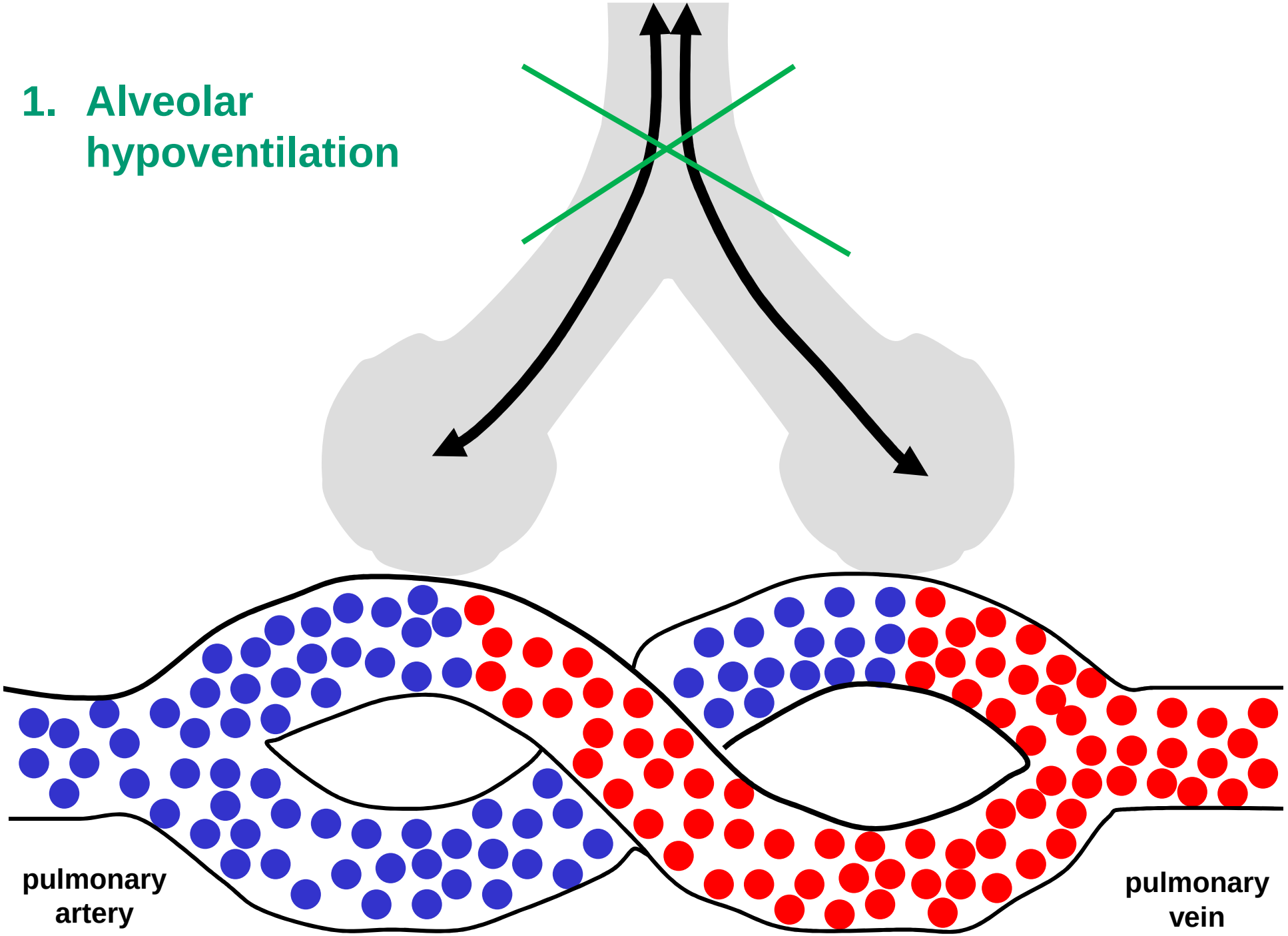
hypoxemia: three mechanisms

1. Alveolar hypoventilation

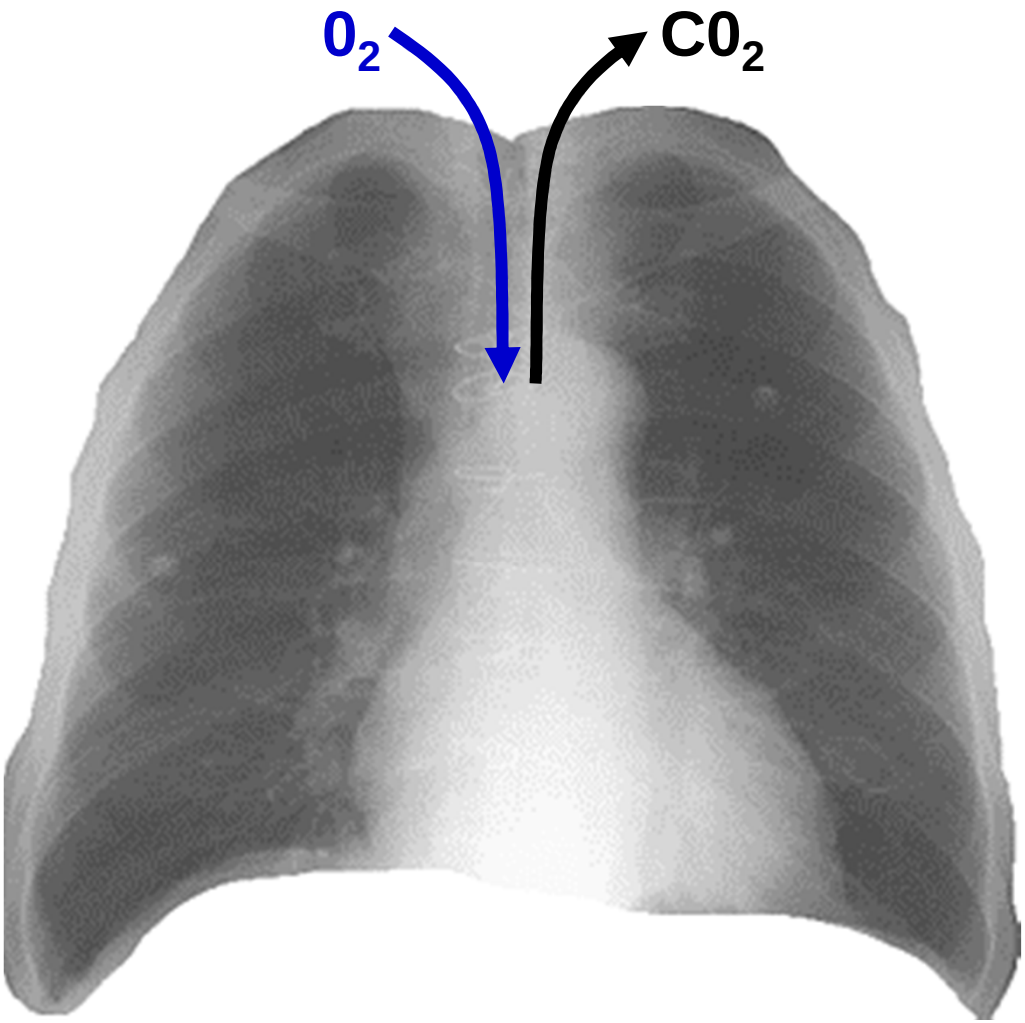
2. Abnormality of the alveolo-capillary membrane (barrier)

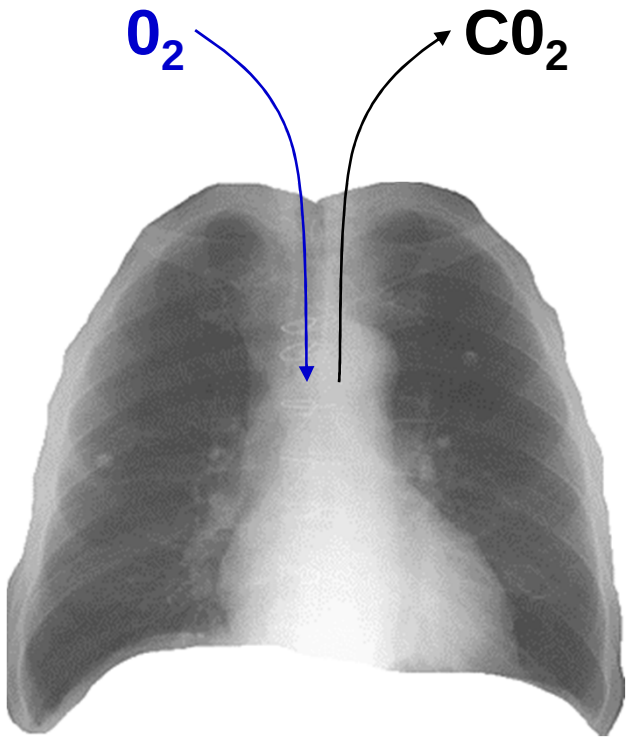
3. Ventilation/Perfusion missmatch
   - Right to left shunt
   - Intrapulmonary shunt

1. Alveolar hypoventilation

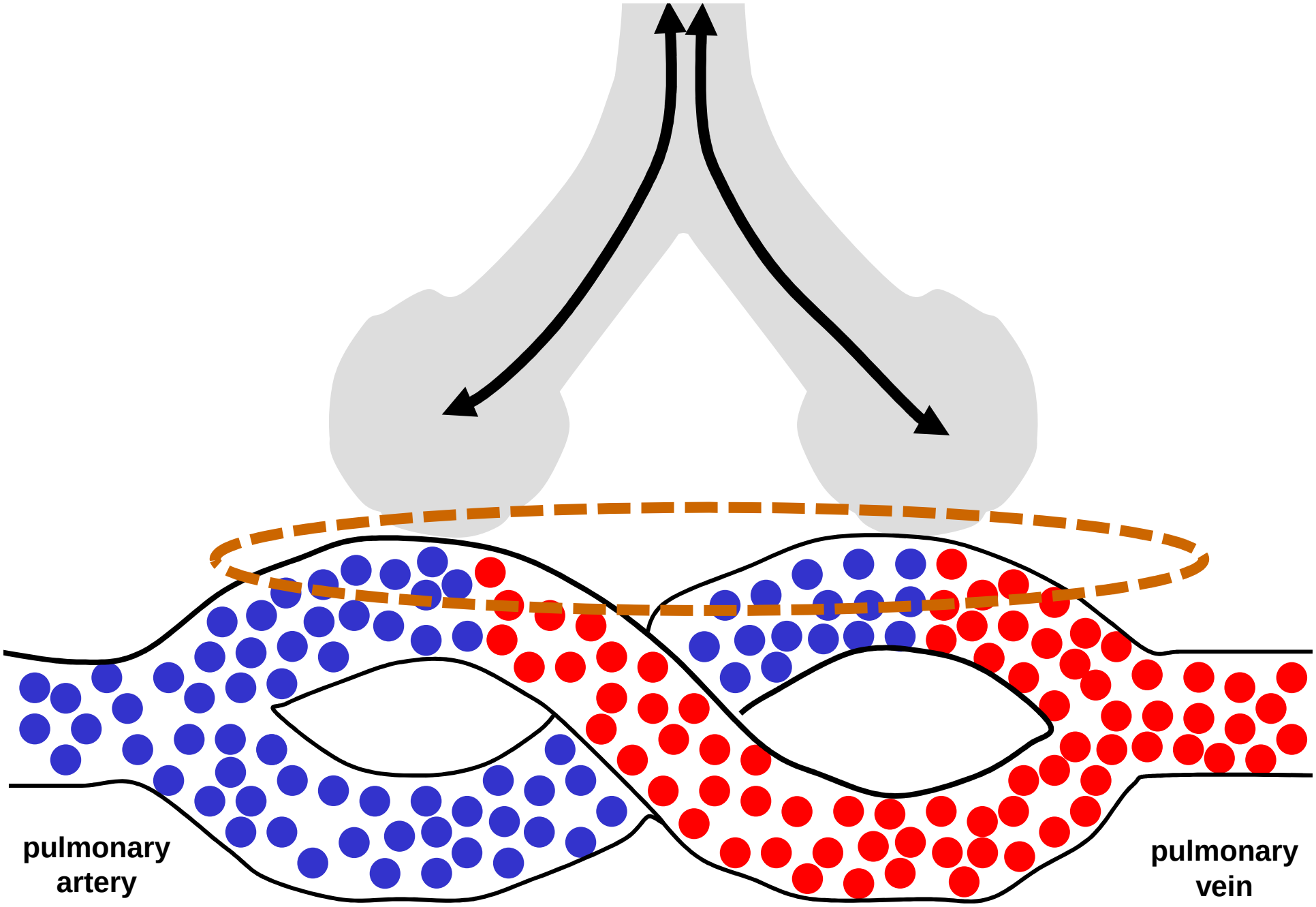


Alveolar hypoventilation





Abnormality of the alveolo-capillary membrane

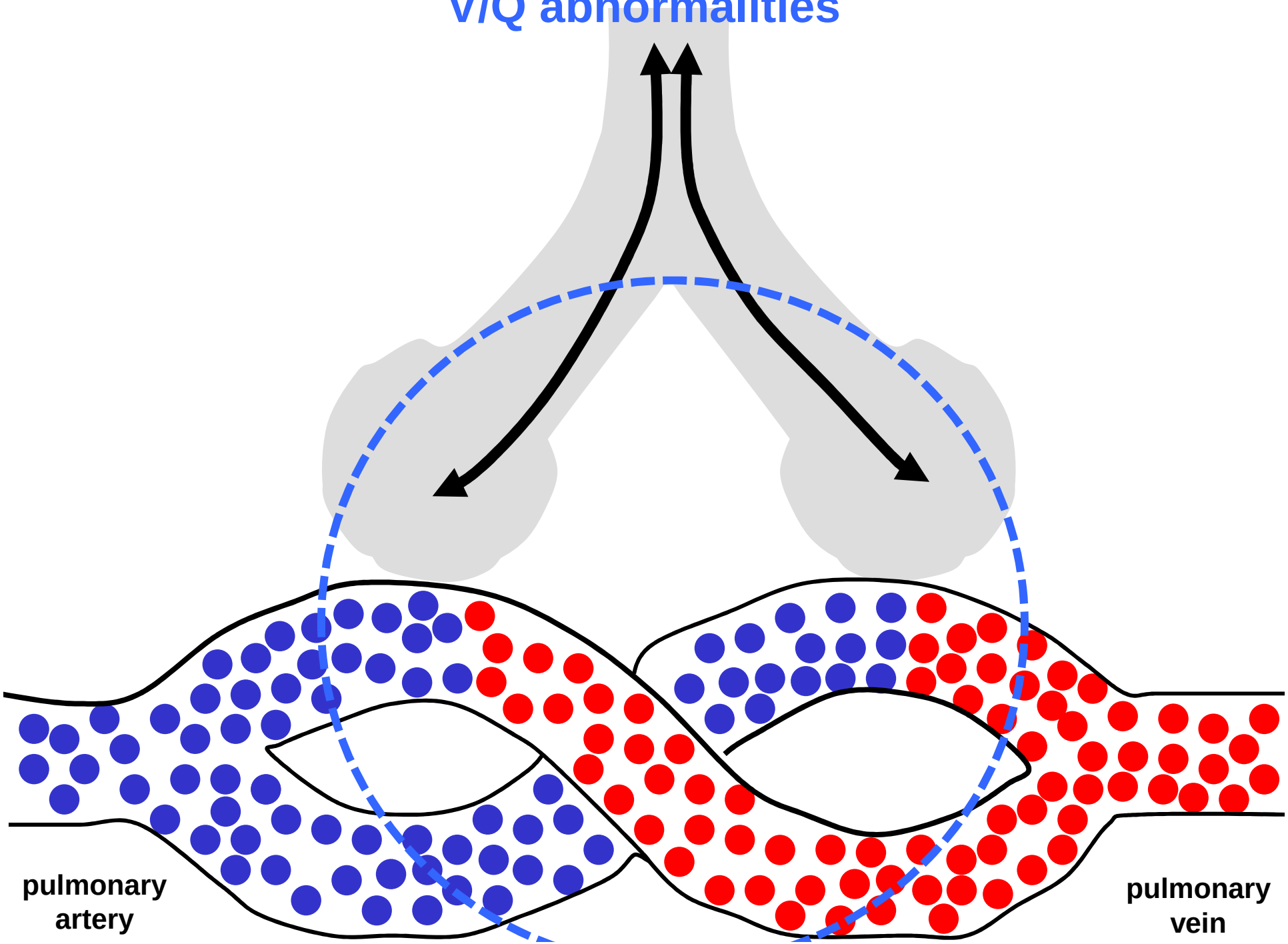


Abnormality of the alveolo-capillary membrane

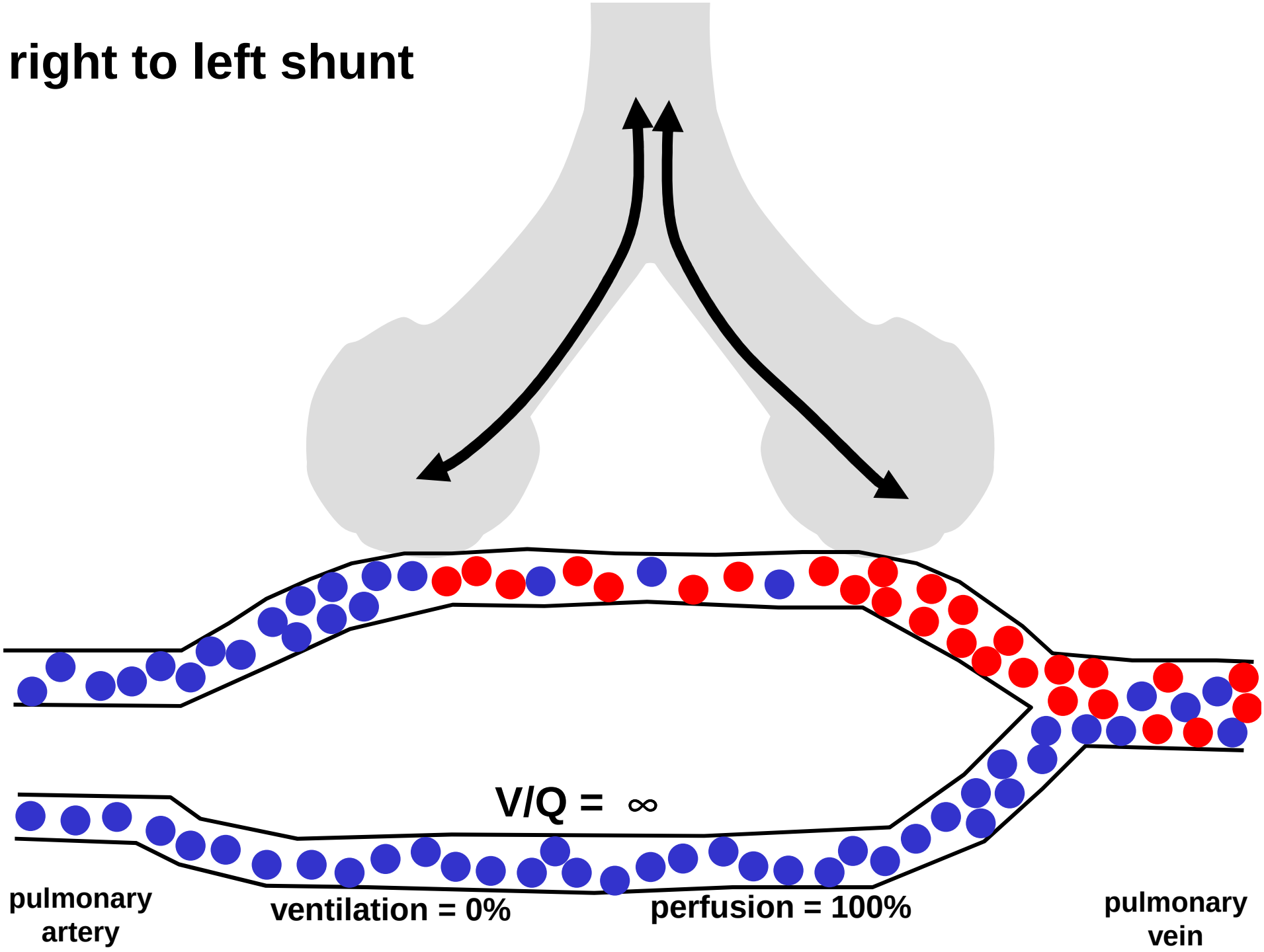
1. Thickening of the AC membrane (intertitial lung diseases)

2. Reduced pulmonary vascular bed (pulmonary hypertension, emphysema)

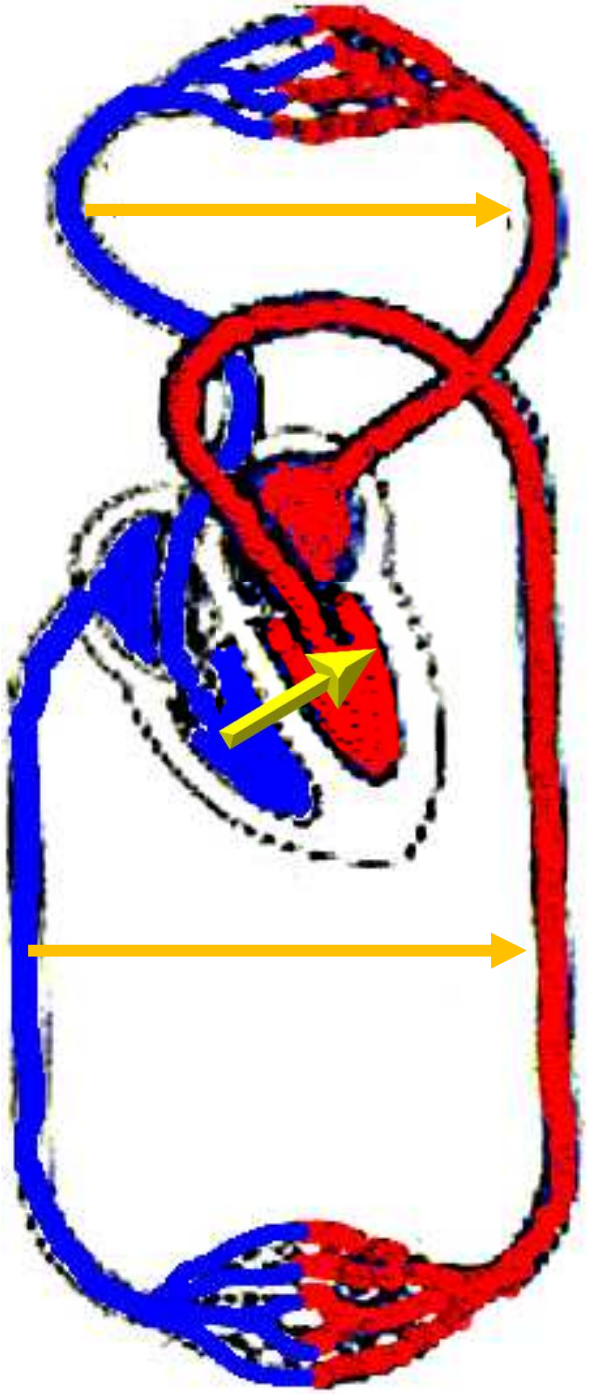
V/Q abnormalities



right to left shunt



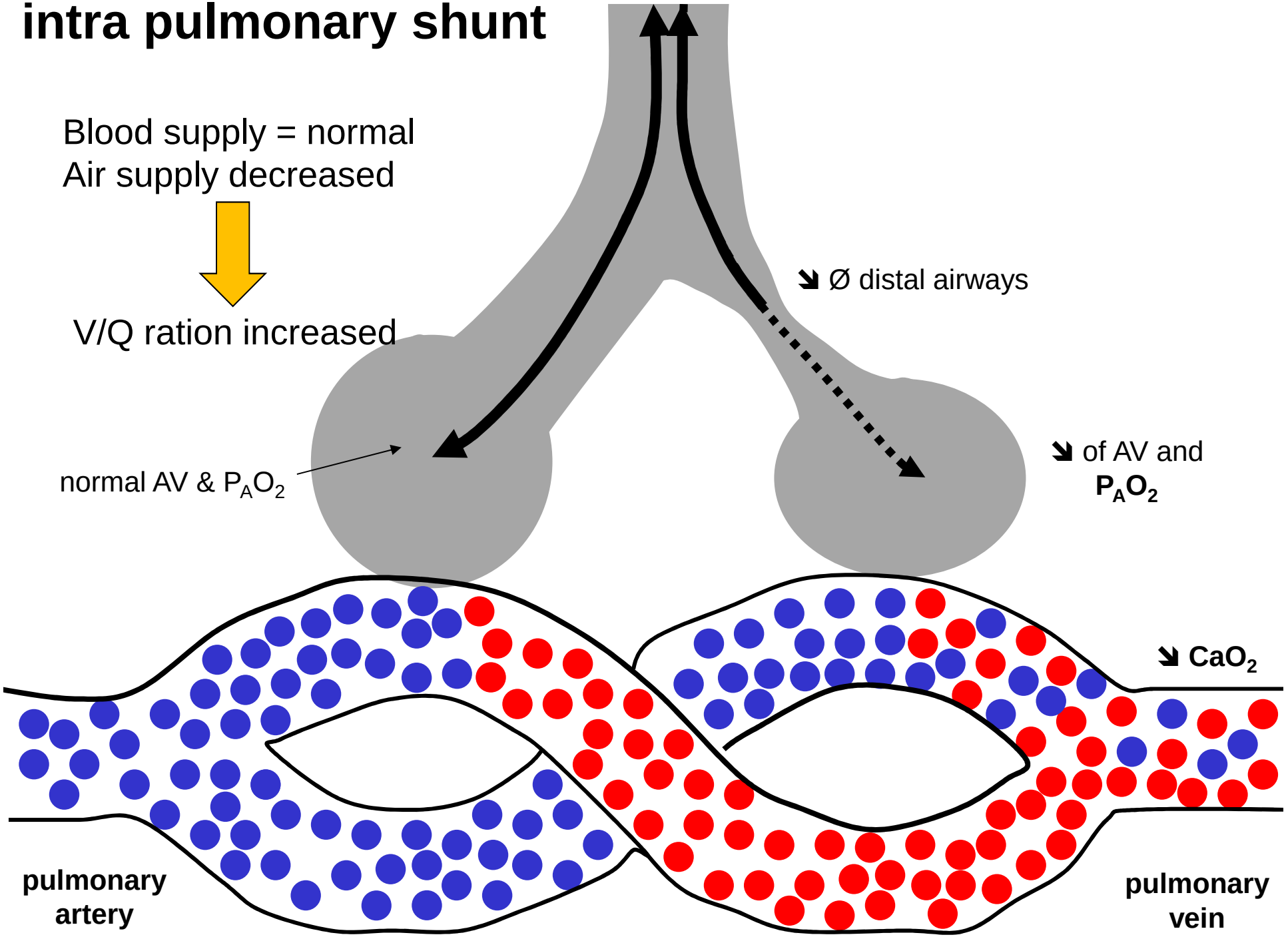
right to left shunt



intra pulmonary shunt

Blood supply = normal
Air supply decreased

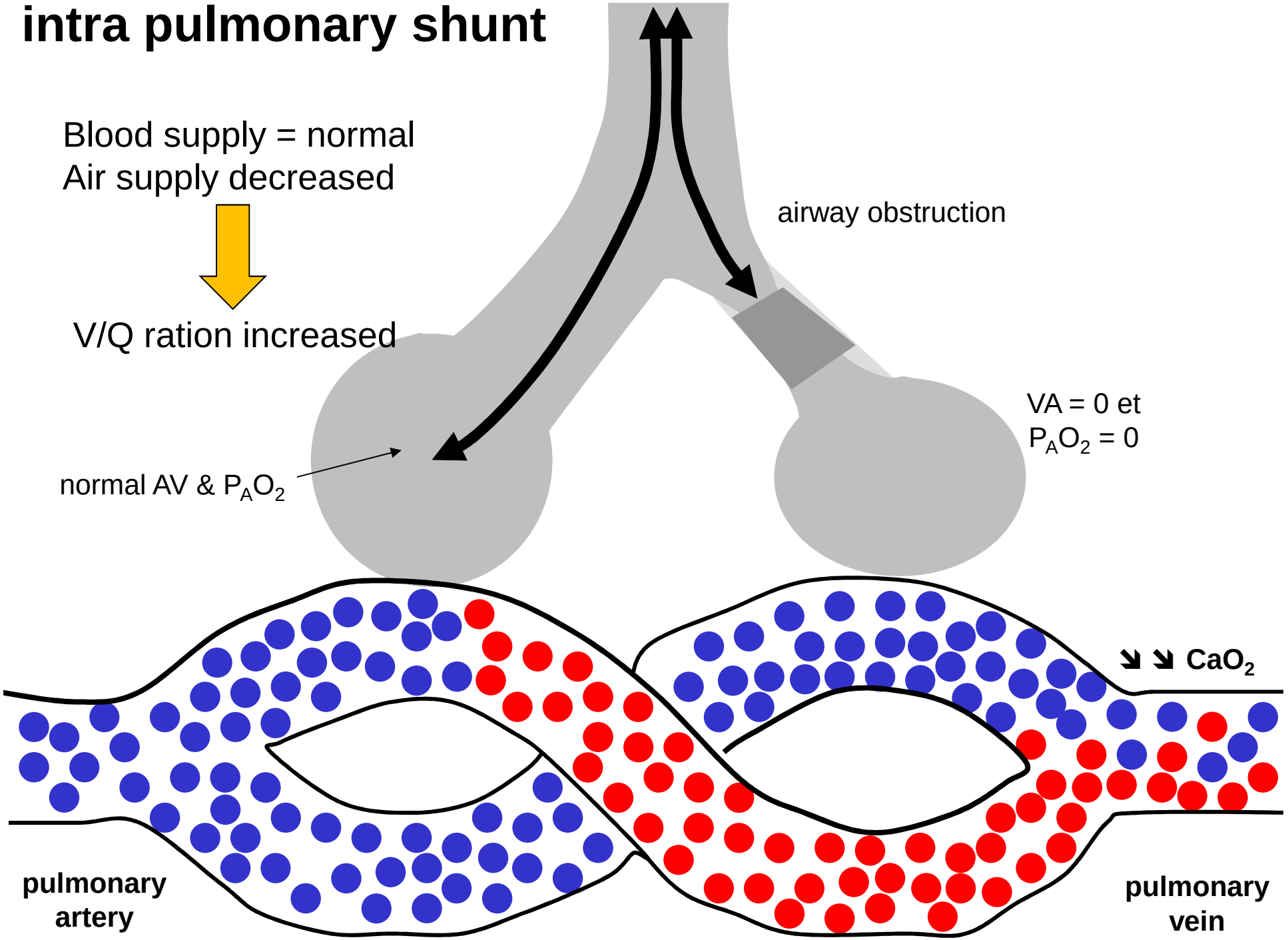
V/Q ration increased



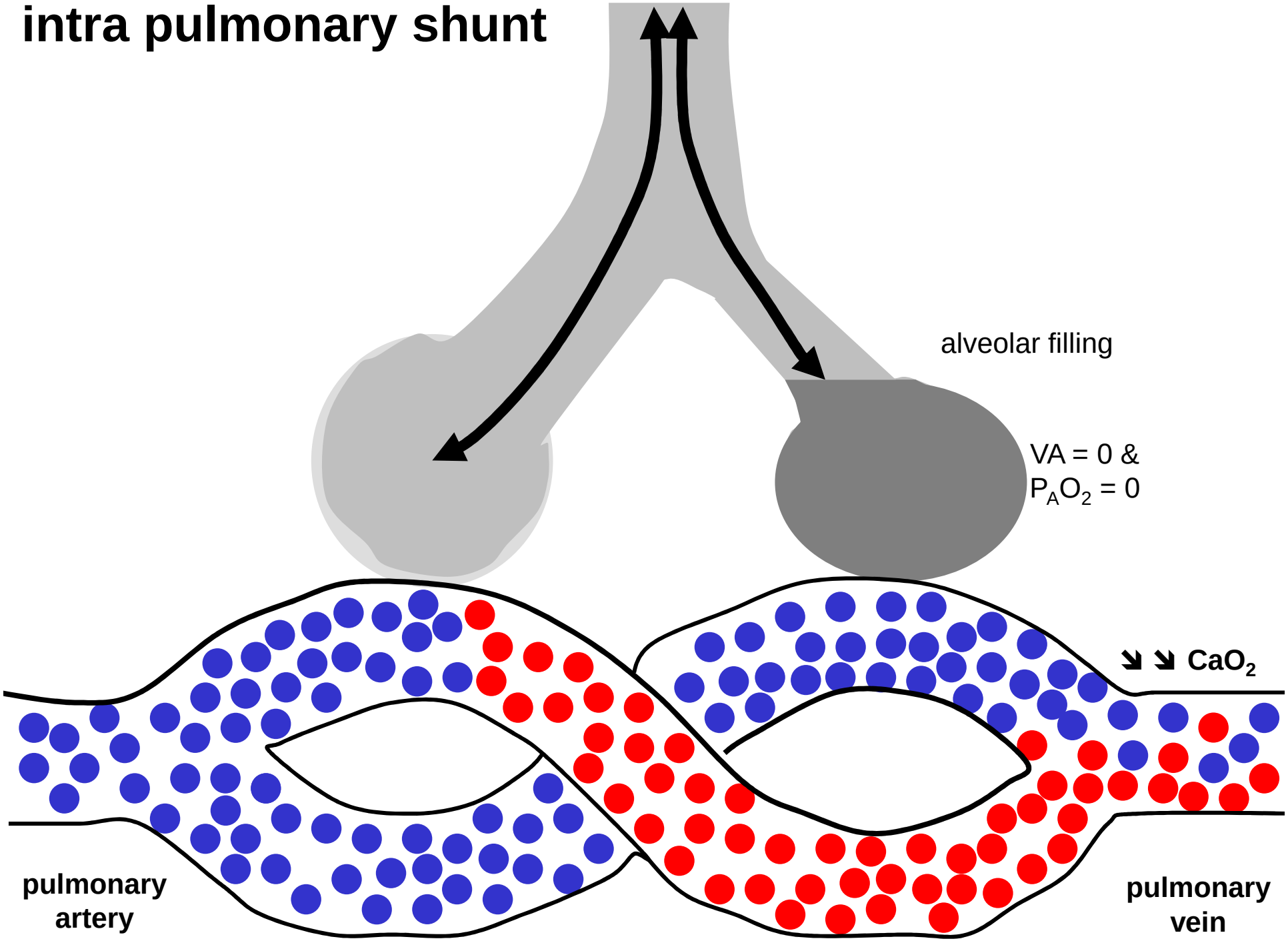
intra pulmonary shunt

Blood supply = normal
Air supply decreased

V/Q ration increased



intra pulmonary shunt



summary