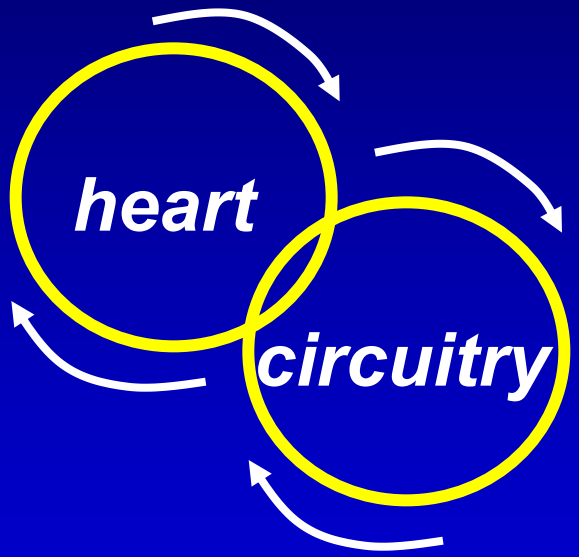
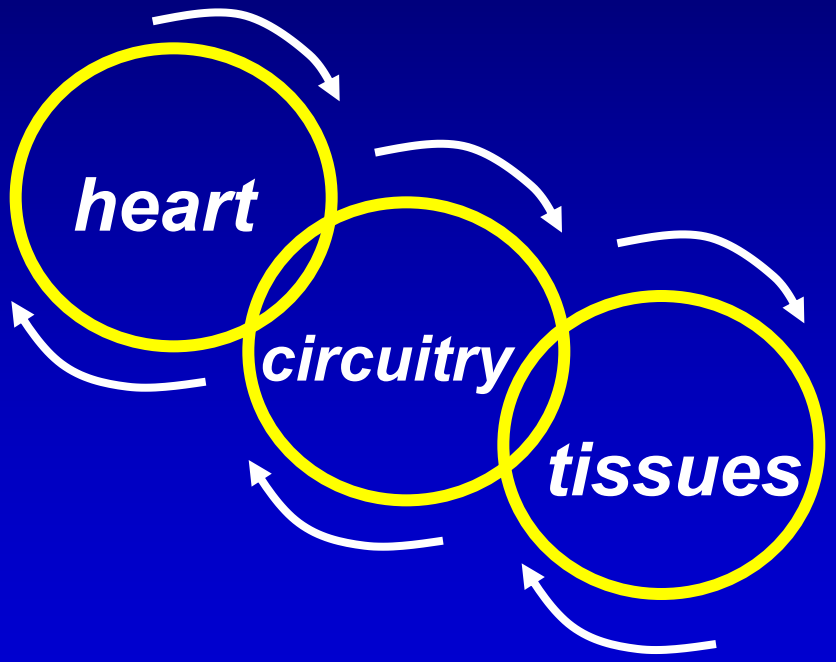
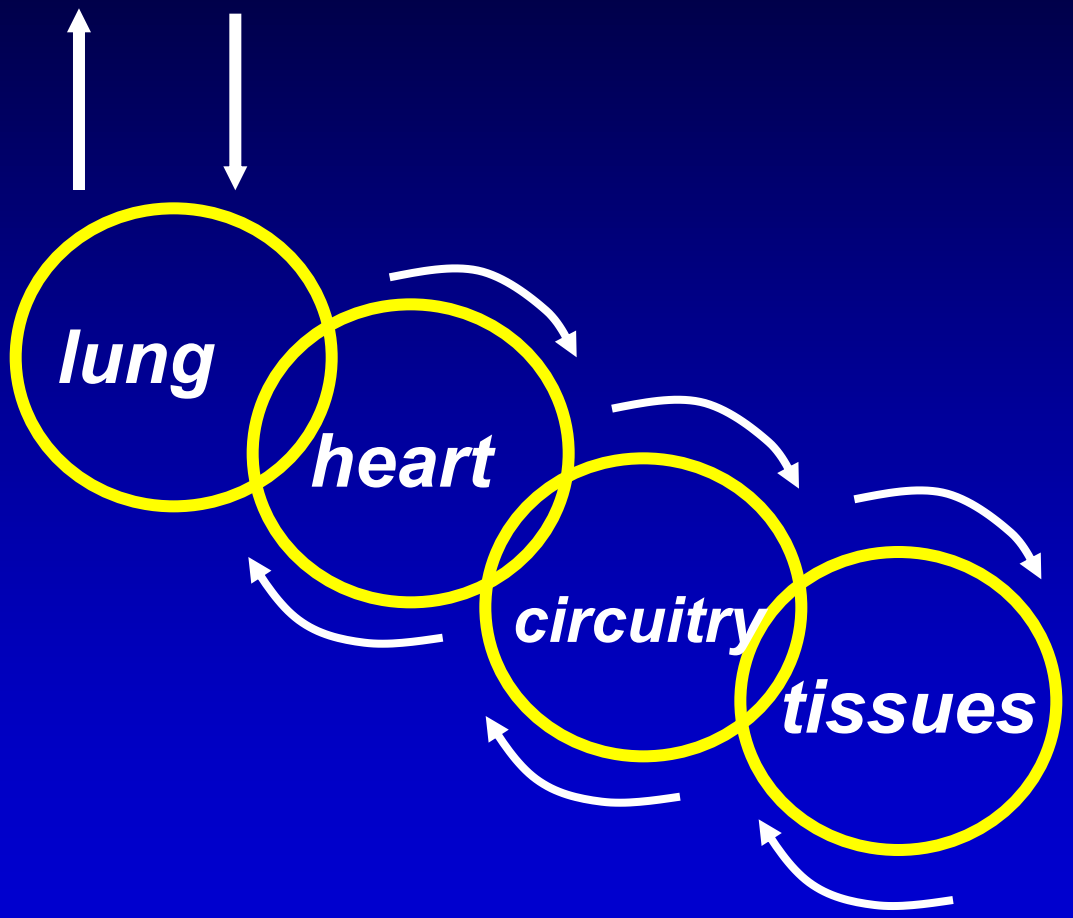
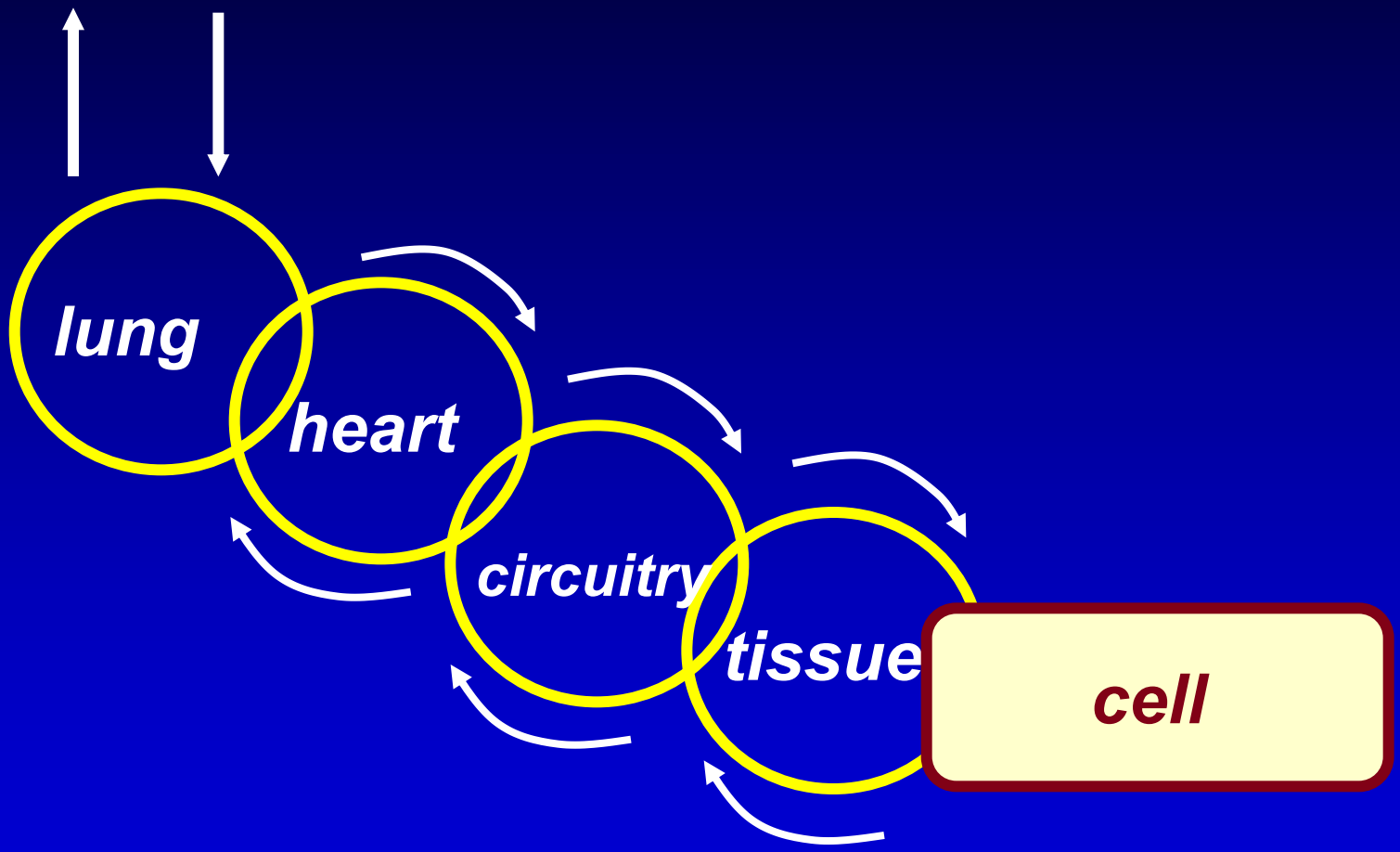
Respiratory Physiology

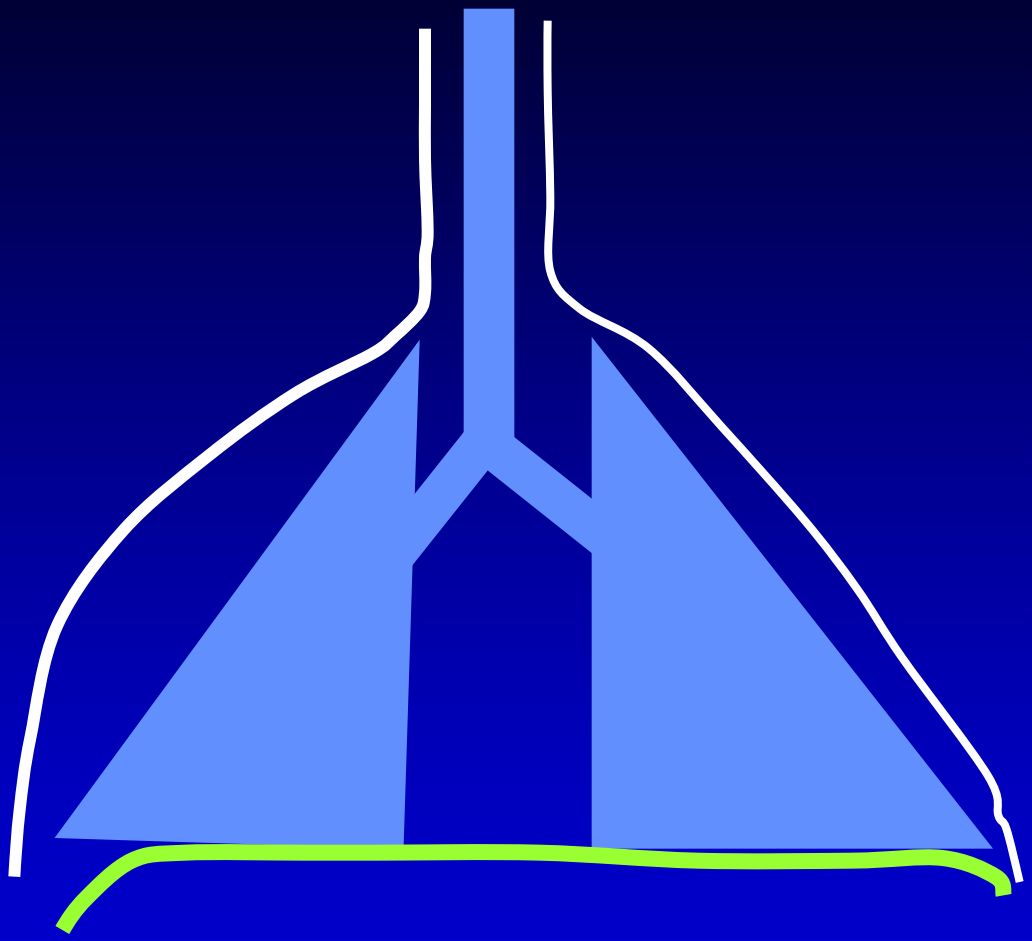

heart


heart
circuitry


heart
circuitry
tissues


lung
heart
circuitry
tissues

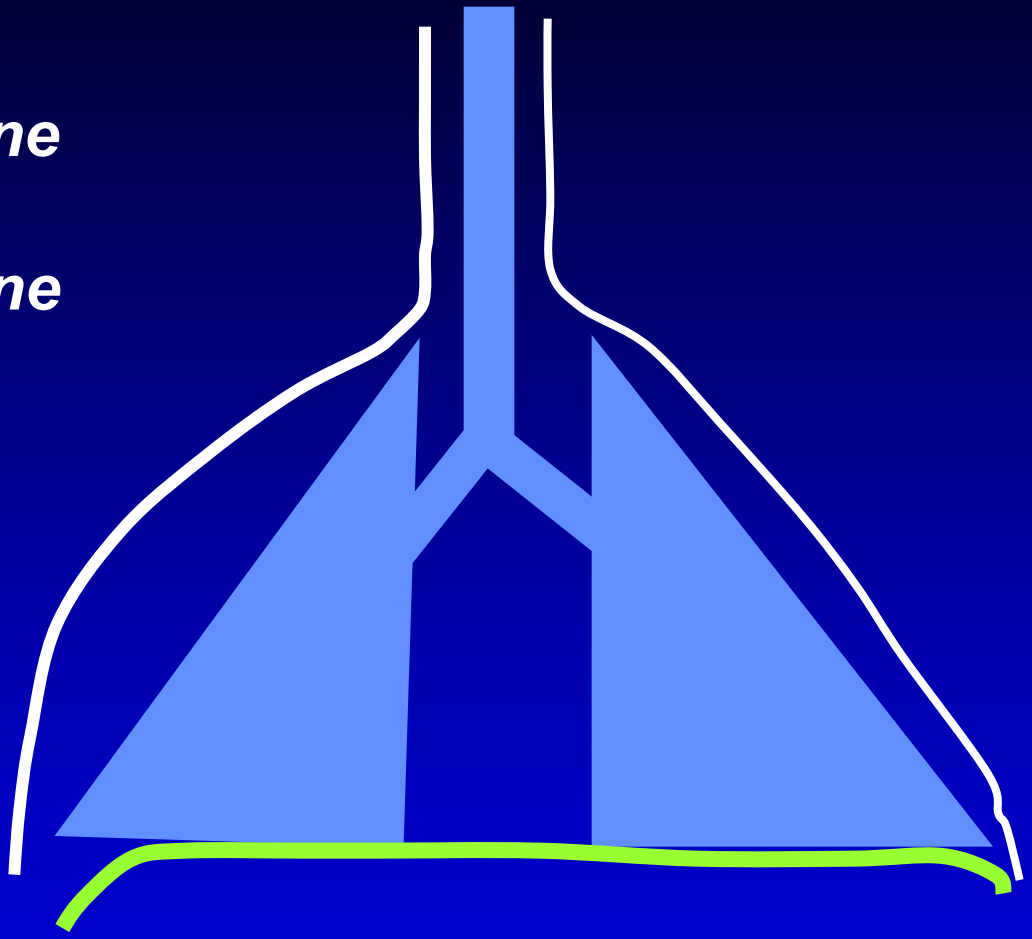

lung
heart
circuitry
tissue
cell



STRUCTURE of respiratory system

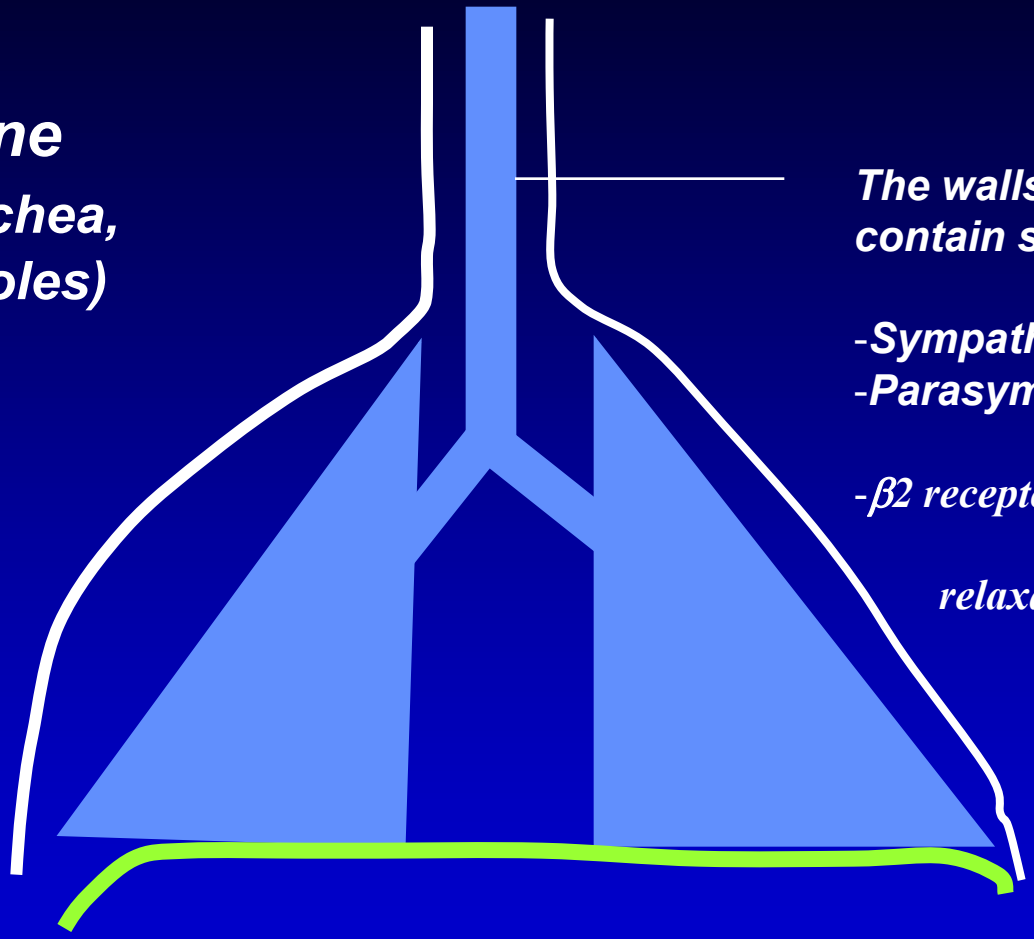
- *Conducting zone*

- *Respiratory zone*



STRUCTURE of respiratory system

- ***Conducting zone***
  (nose, larynx, trachea, bronchi, bronchioles)



The walls conducting airways contain smooth muscle

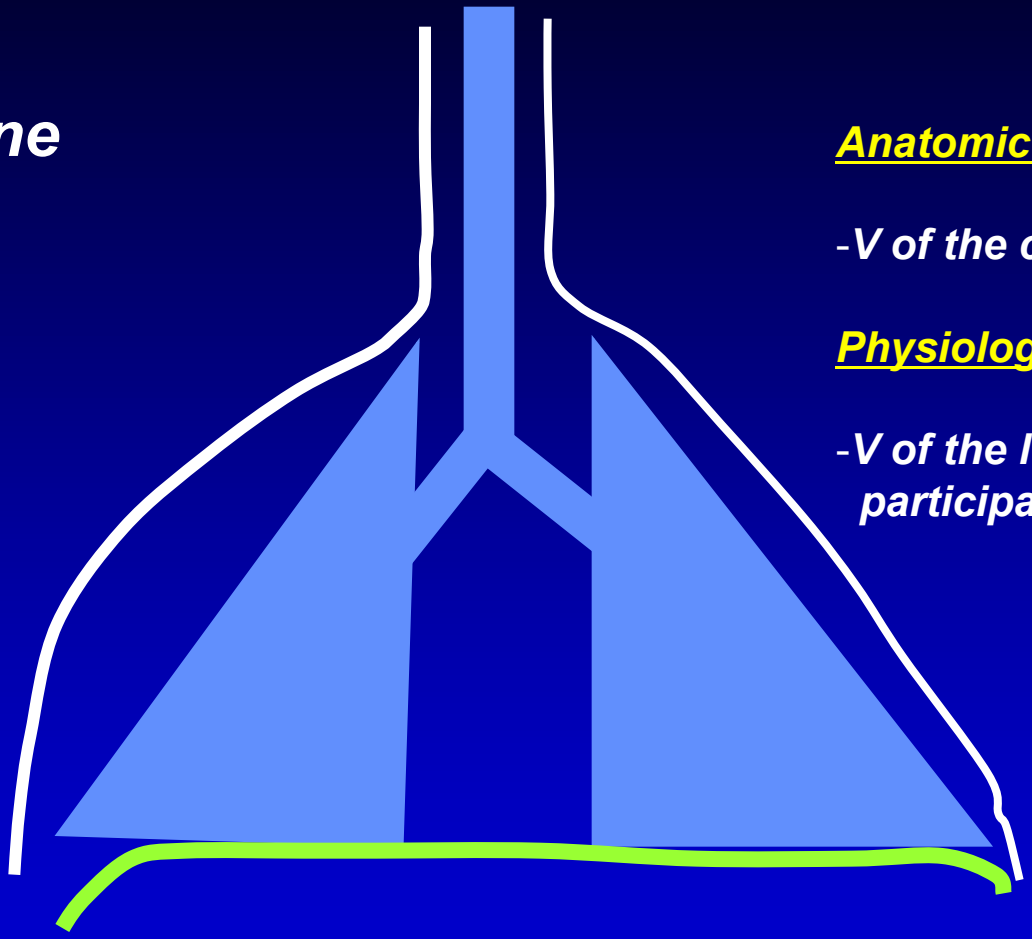
-Sympathetic
-Parasympathetic

-β2 receptors

relaxation, dilatation of the airway

STRUCTURE of respiratory system

- *Conducting zone*



Anatomic dead space

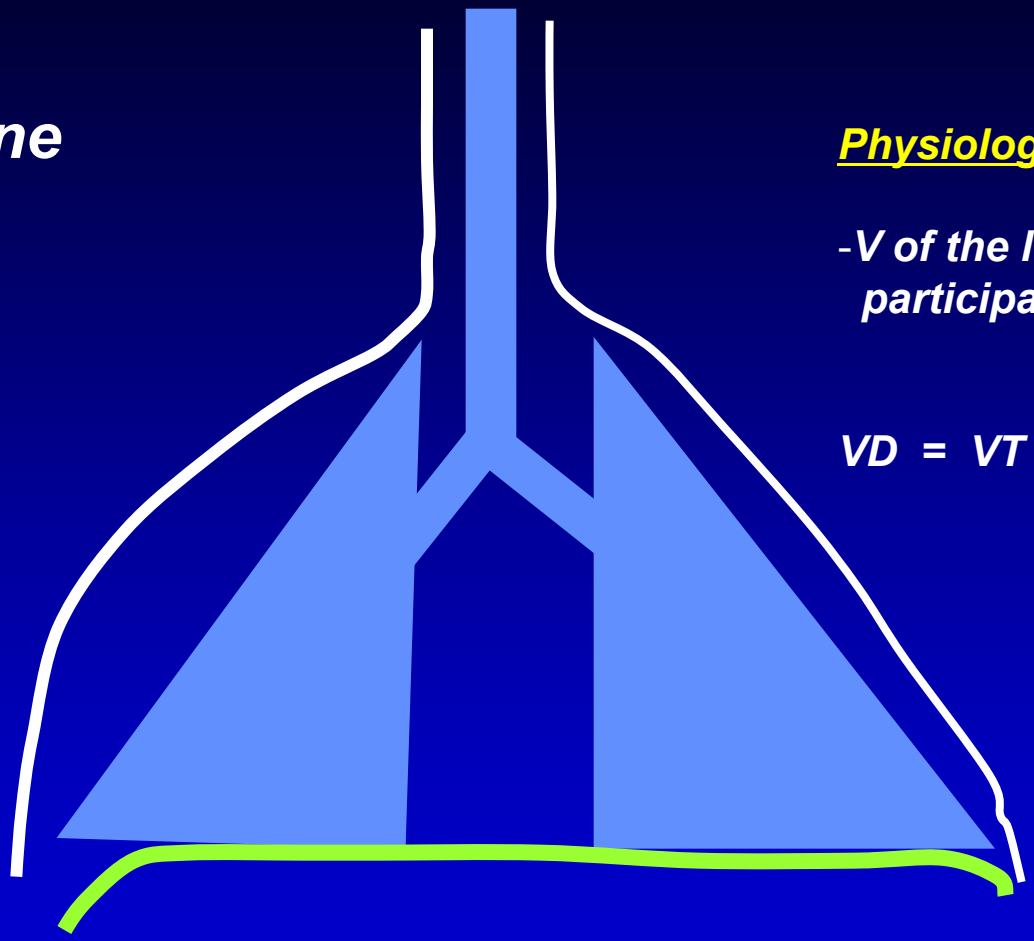
-V of the conducting airways

Physiologic dead space

-V of the lungs that does not participapate in gas exchance

STRUCTURE of respiratory system

- *Conducting zone*



Physiologic dead space (VD)

-V of the lungs that does not participapate in gas exchance

$$VD = VT \times \frac{Pa_{CO2} - PE_{CO2}}{Pa_{CO2}}$$

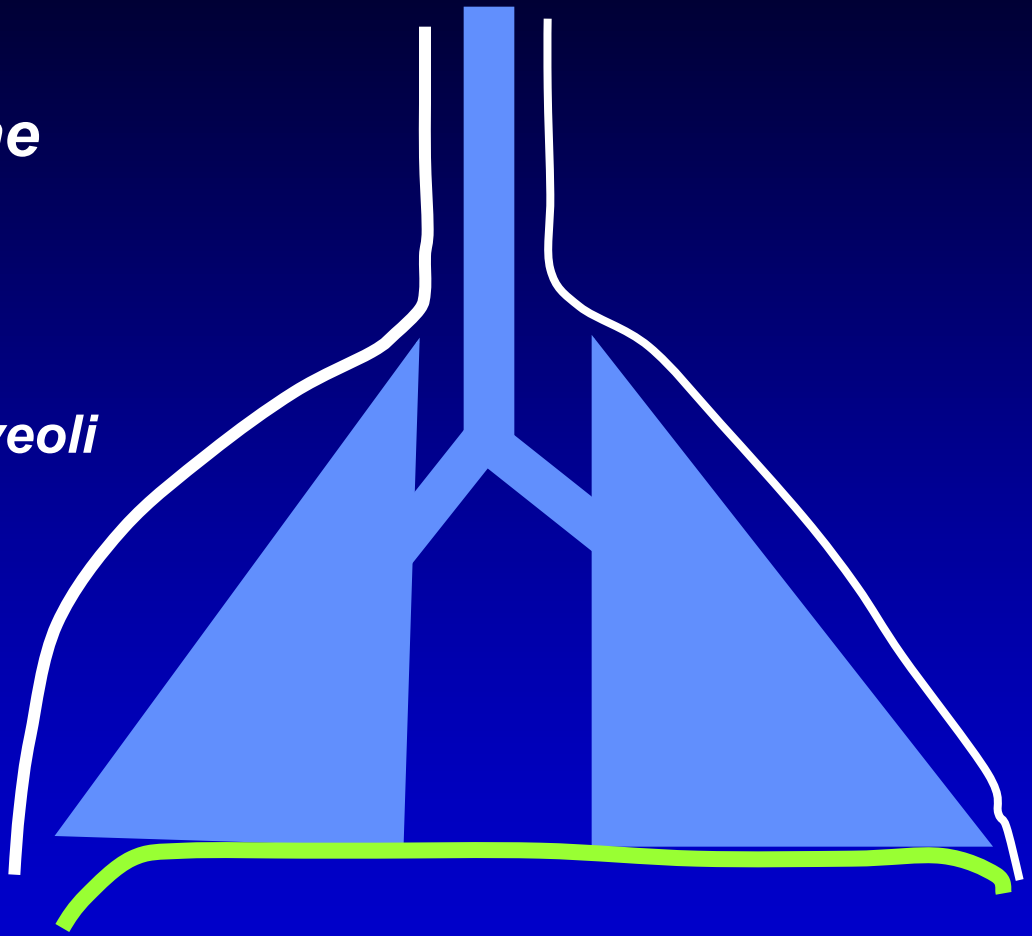
VT – tidal volume
Pa_{CO2} – P_{CO2} of arterial blood
PE_{CO2} – P_{CO2} of mixed expired air

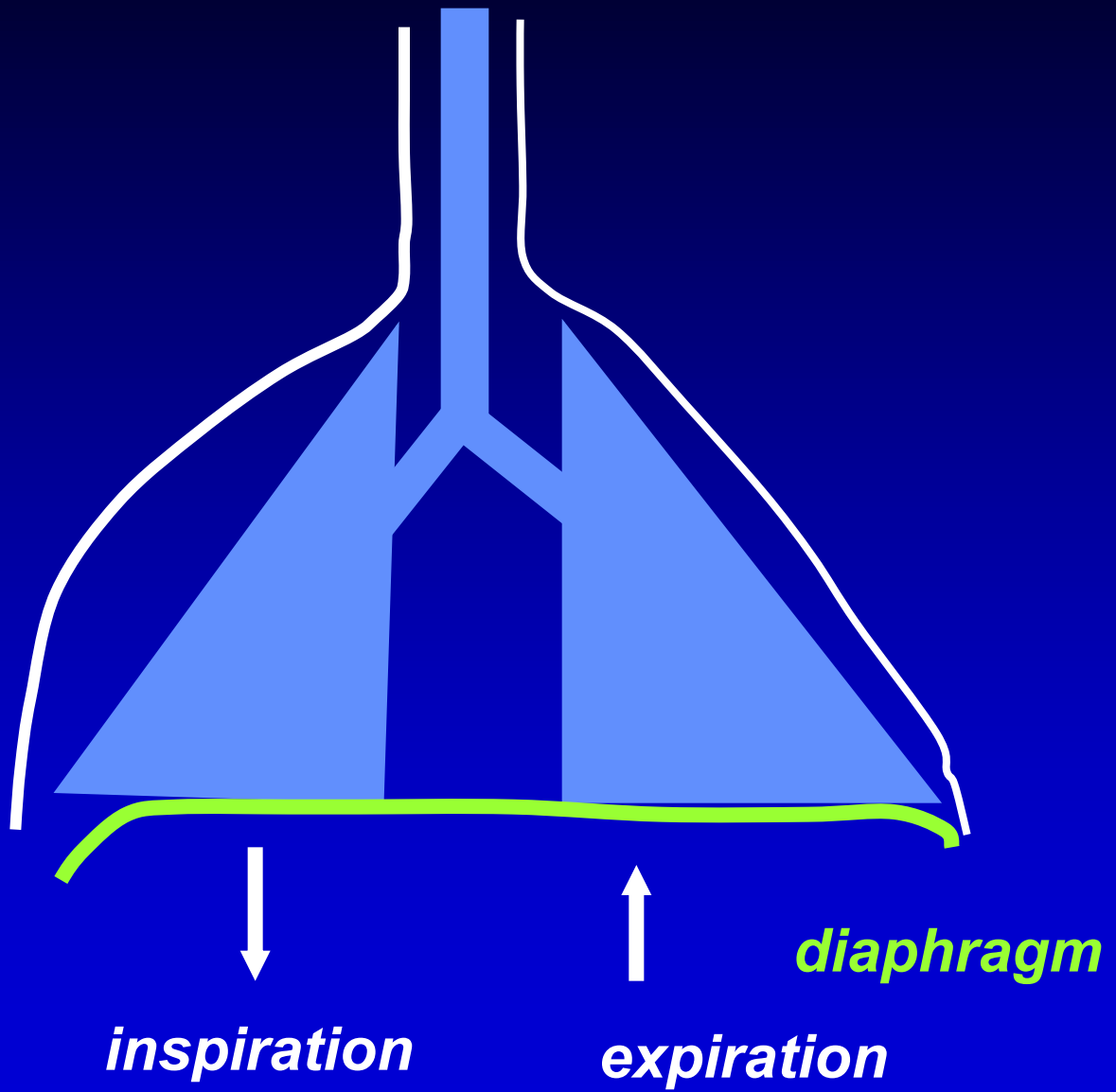
STRUCTURE of respiratory system

Respiratory zone

Alveoli

Lung ~ 300 x 10^6 alveoli




diaphragm
inspiration
expiration

inspiration – mm. intercosales externi

expiration – mm. intercosteles interni

inspiration – mm. intercosales externi

expiration – mm. intercosteles interni

inspiration – mm. intercosales externi

expiration – mm. intercosteles interni

inspiration – mm. intercosales externi

expiration – mm. intercosteles interni

inspiration – mm. intercosales externi

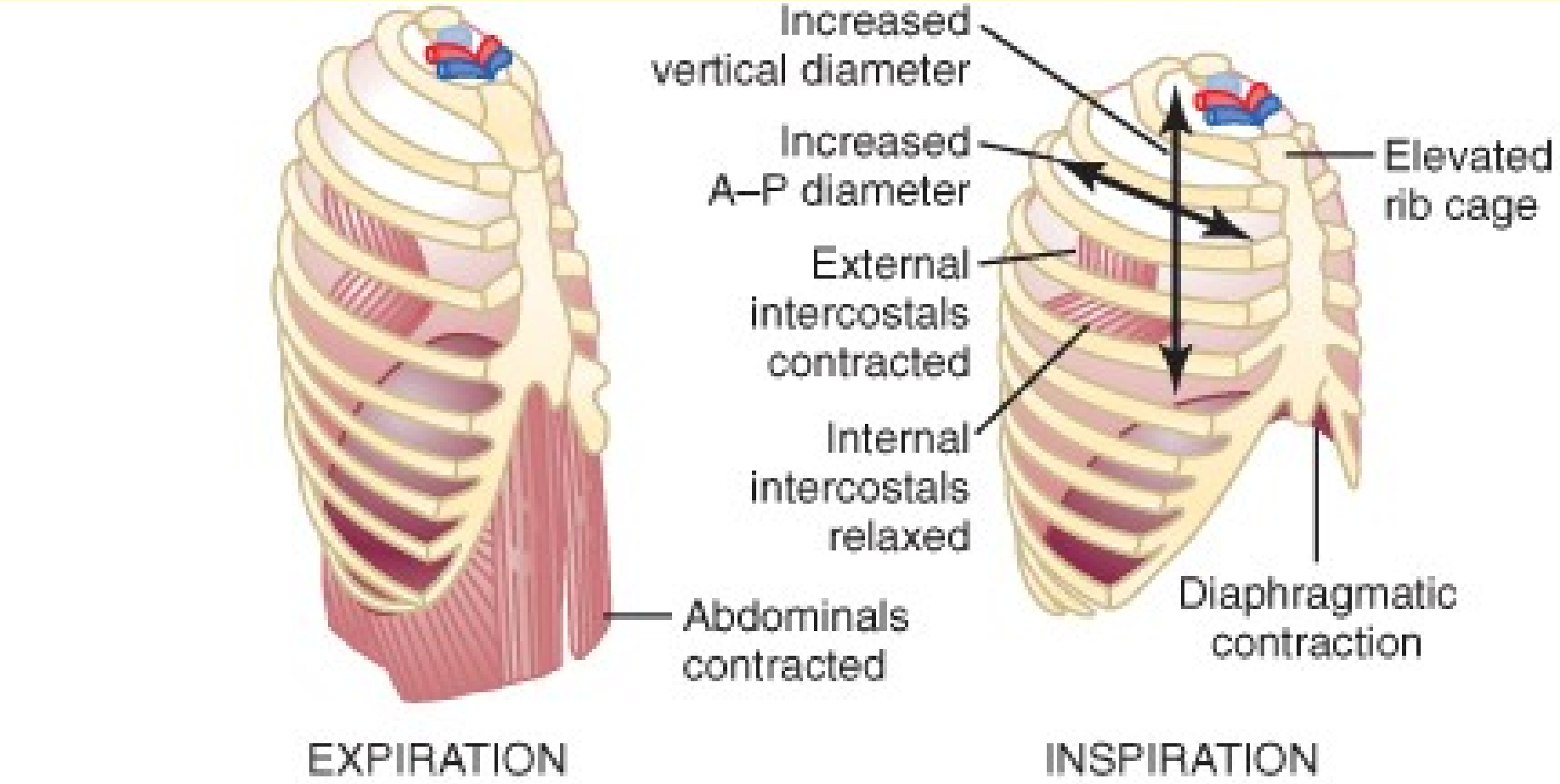
expiration – mm. intercosteles interni

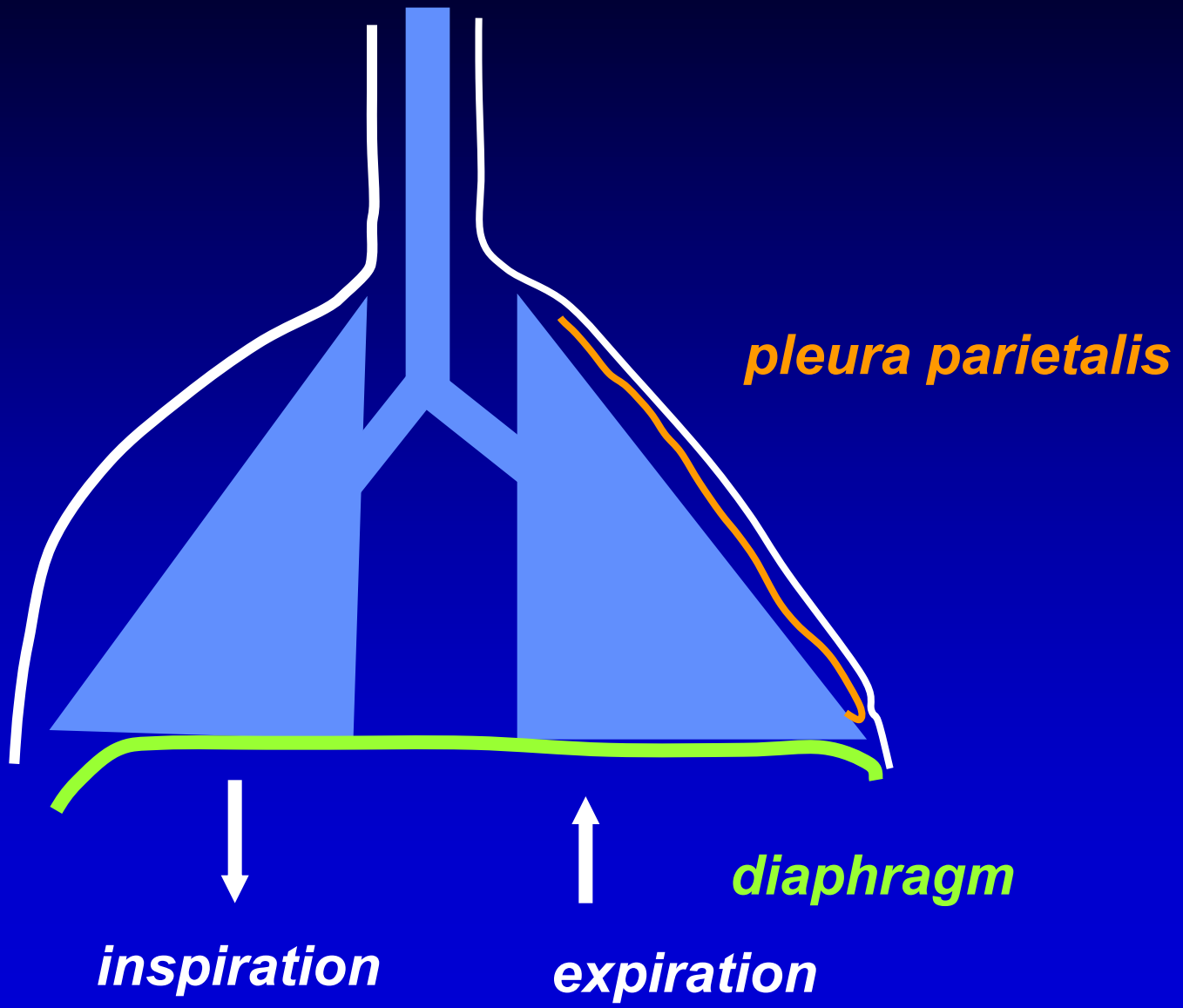
inspiration – mm. intercosales externi

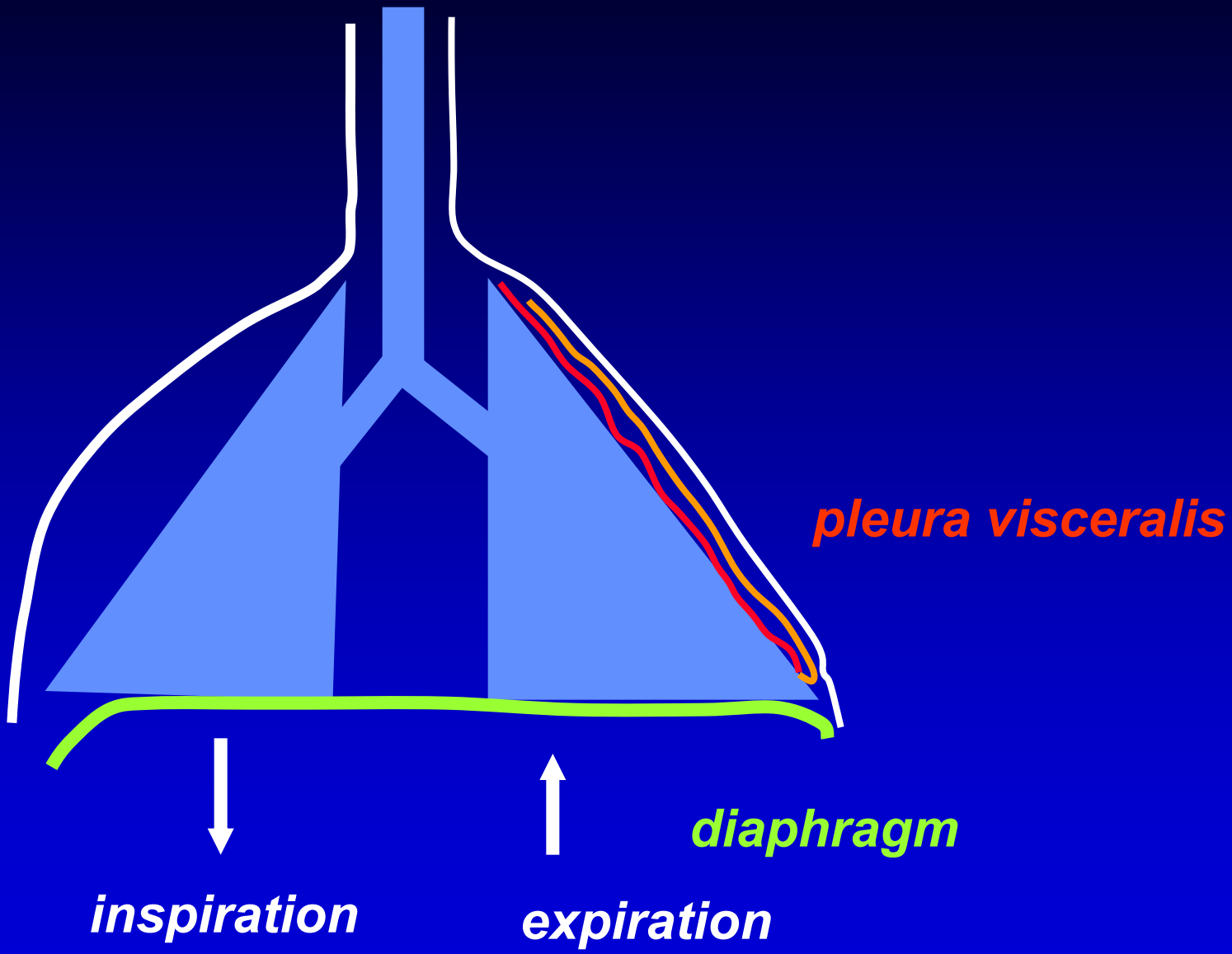
expiration – mm. intercosteles interni

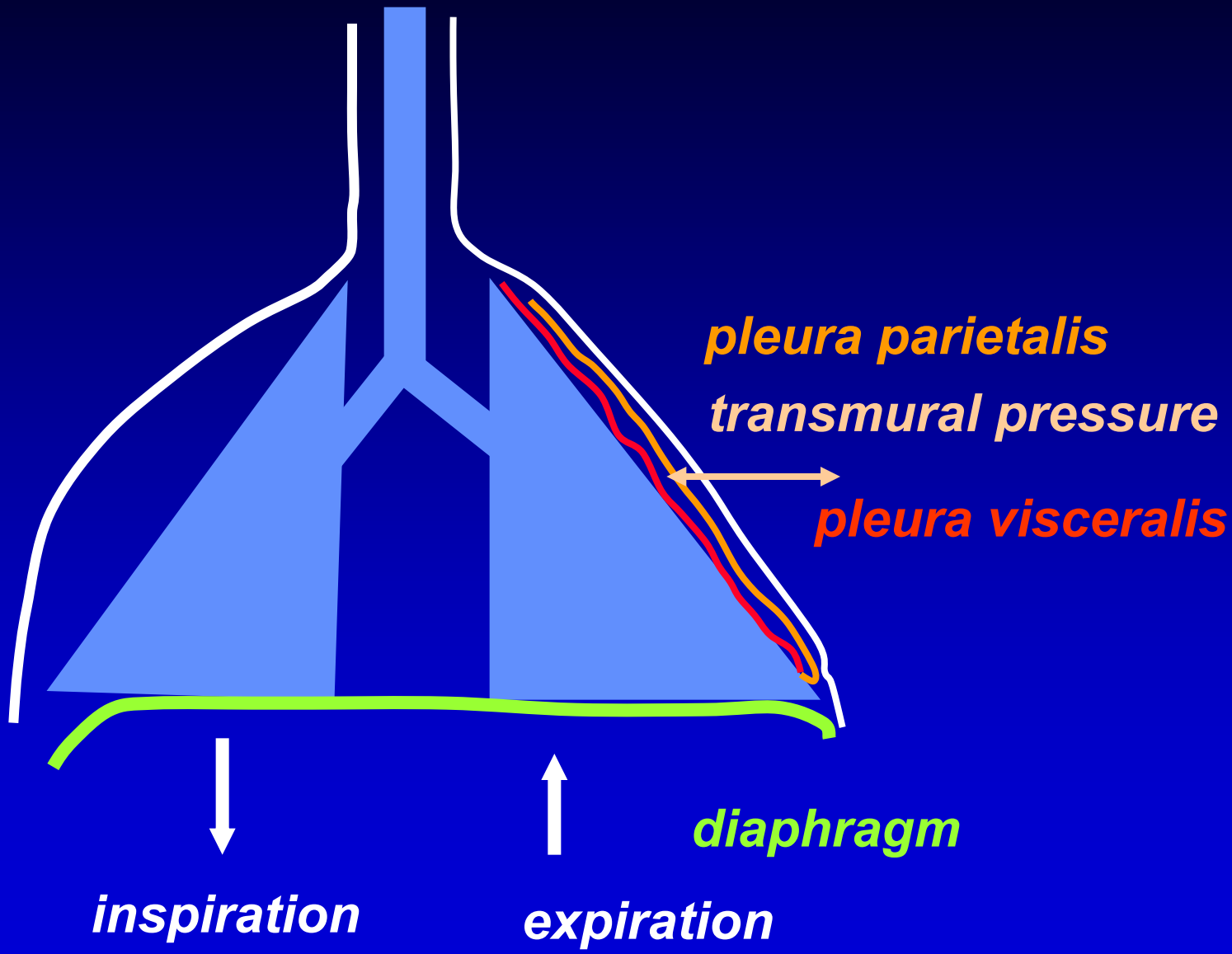
inspiration – mm. intercosales externi

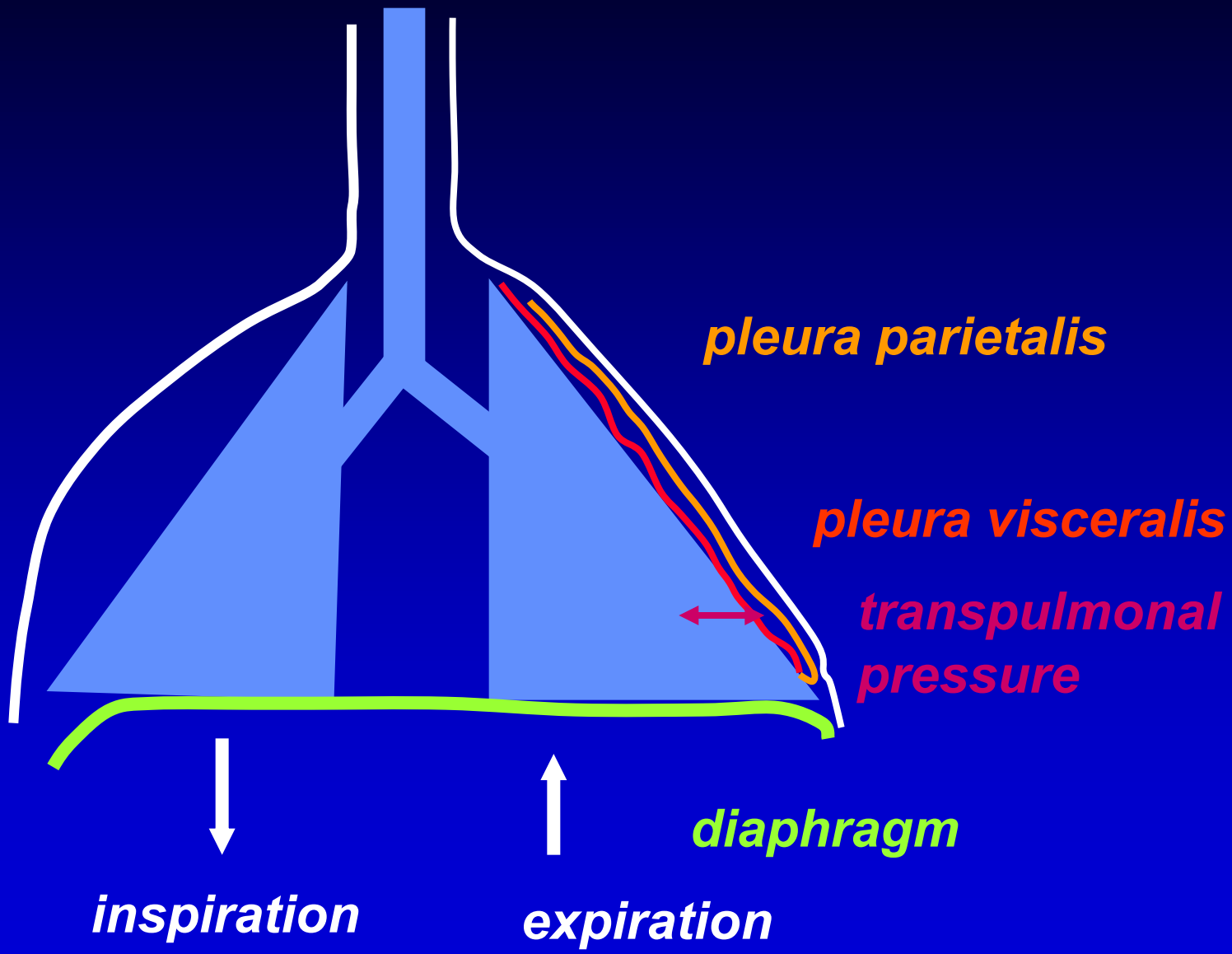
expiration – mm. intercosteles interni

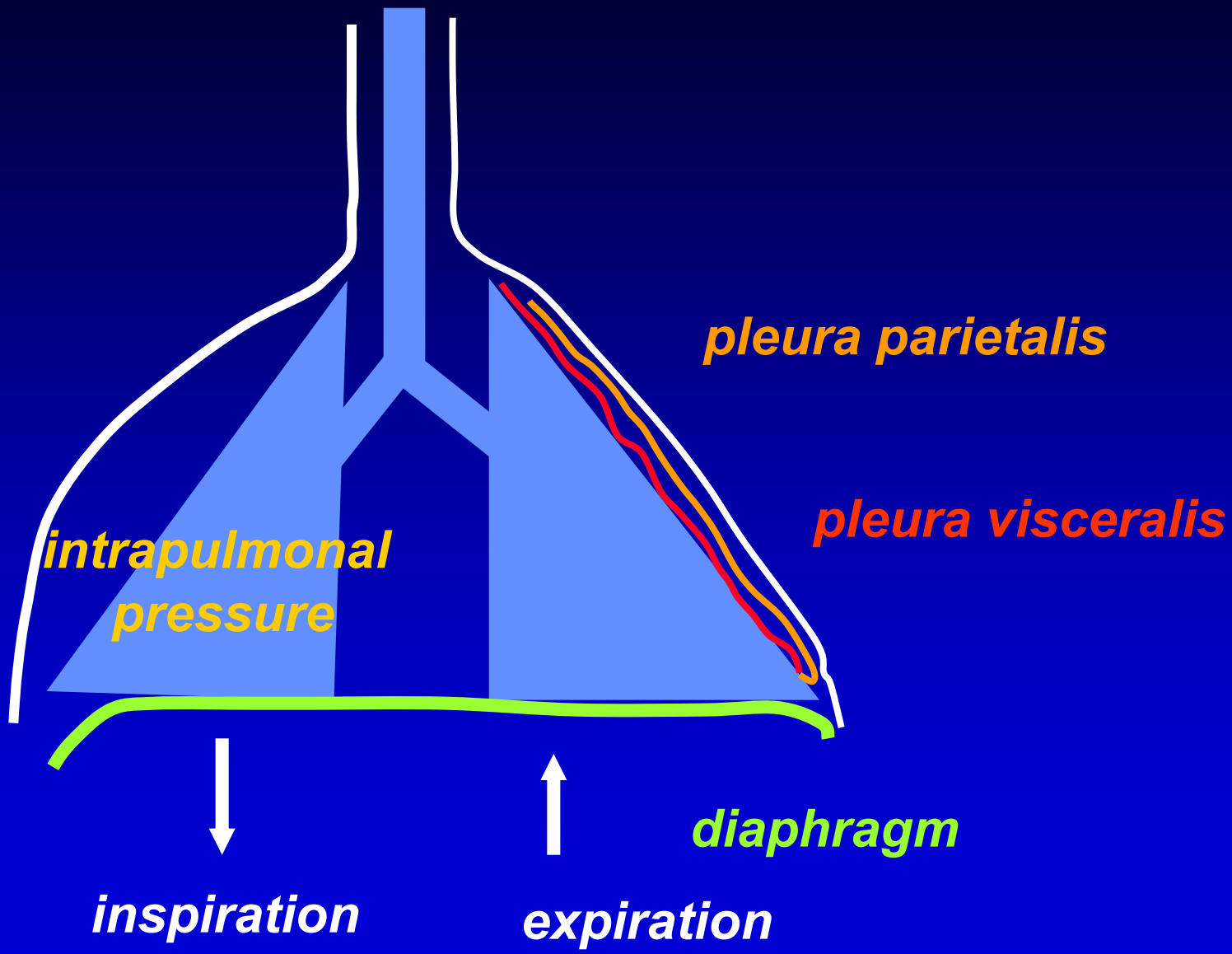


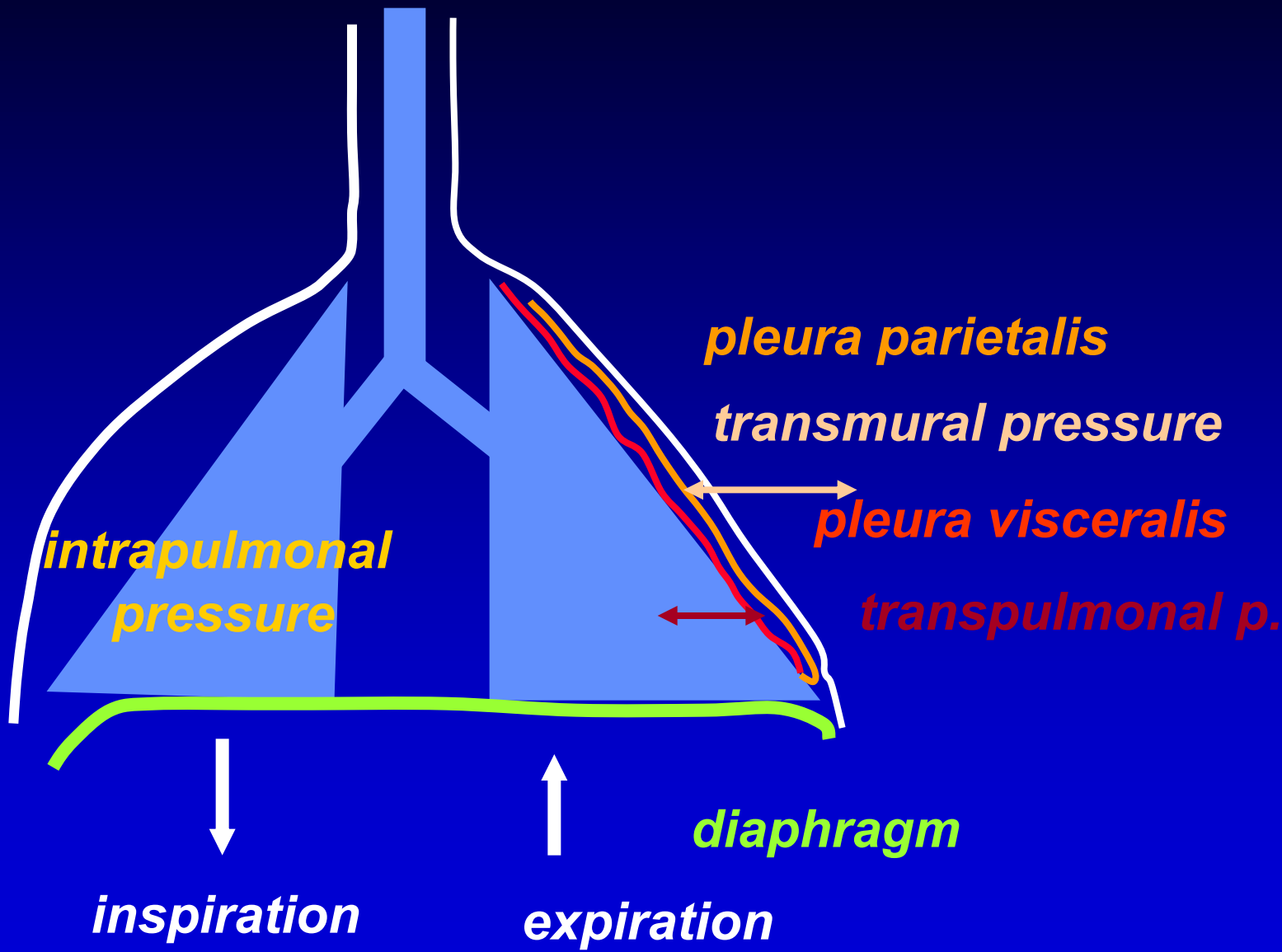

pleura parietalis
diaphragm
inspiration
expiration

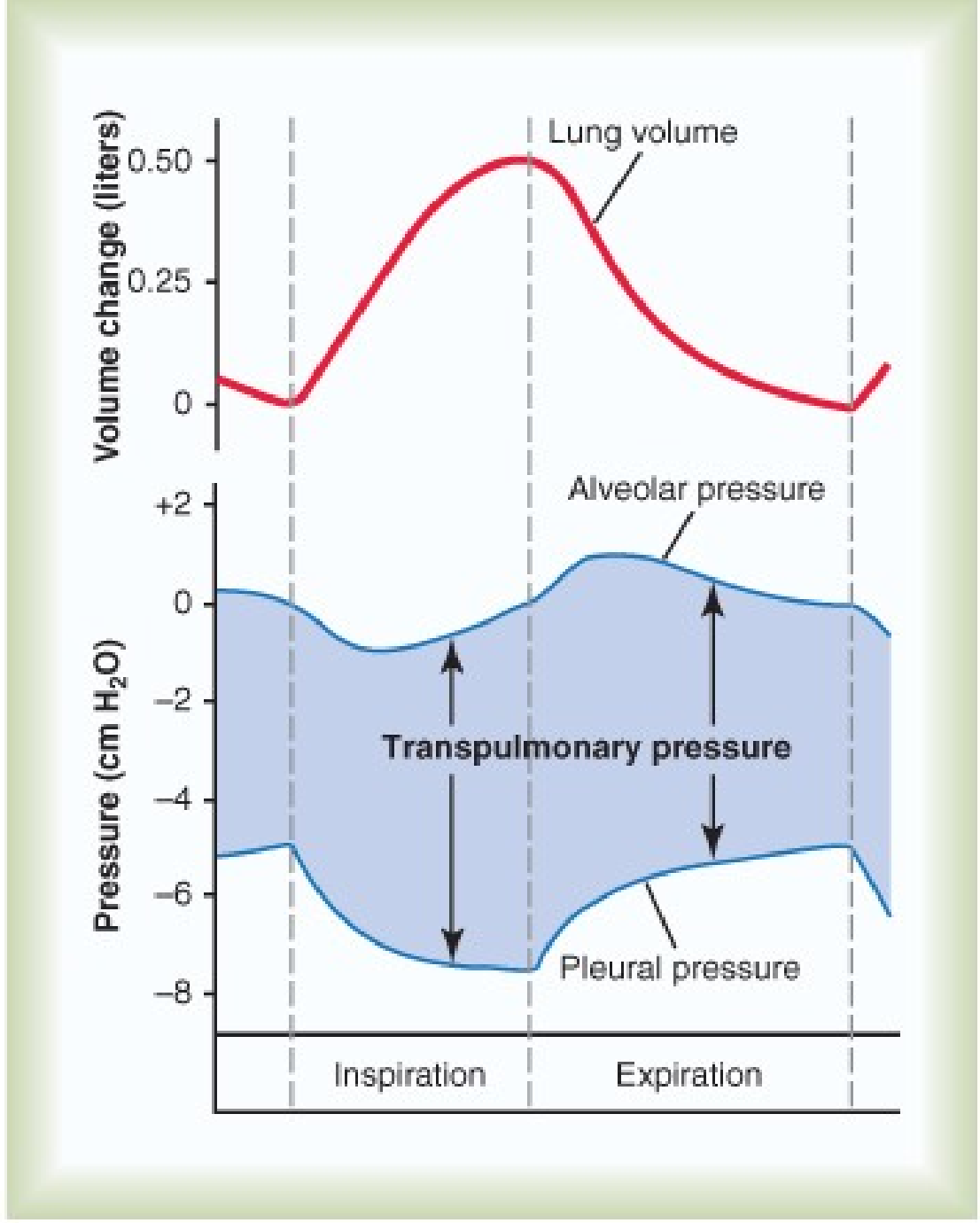

pleura visceralis
diaphragm
inspiration
expiration

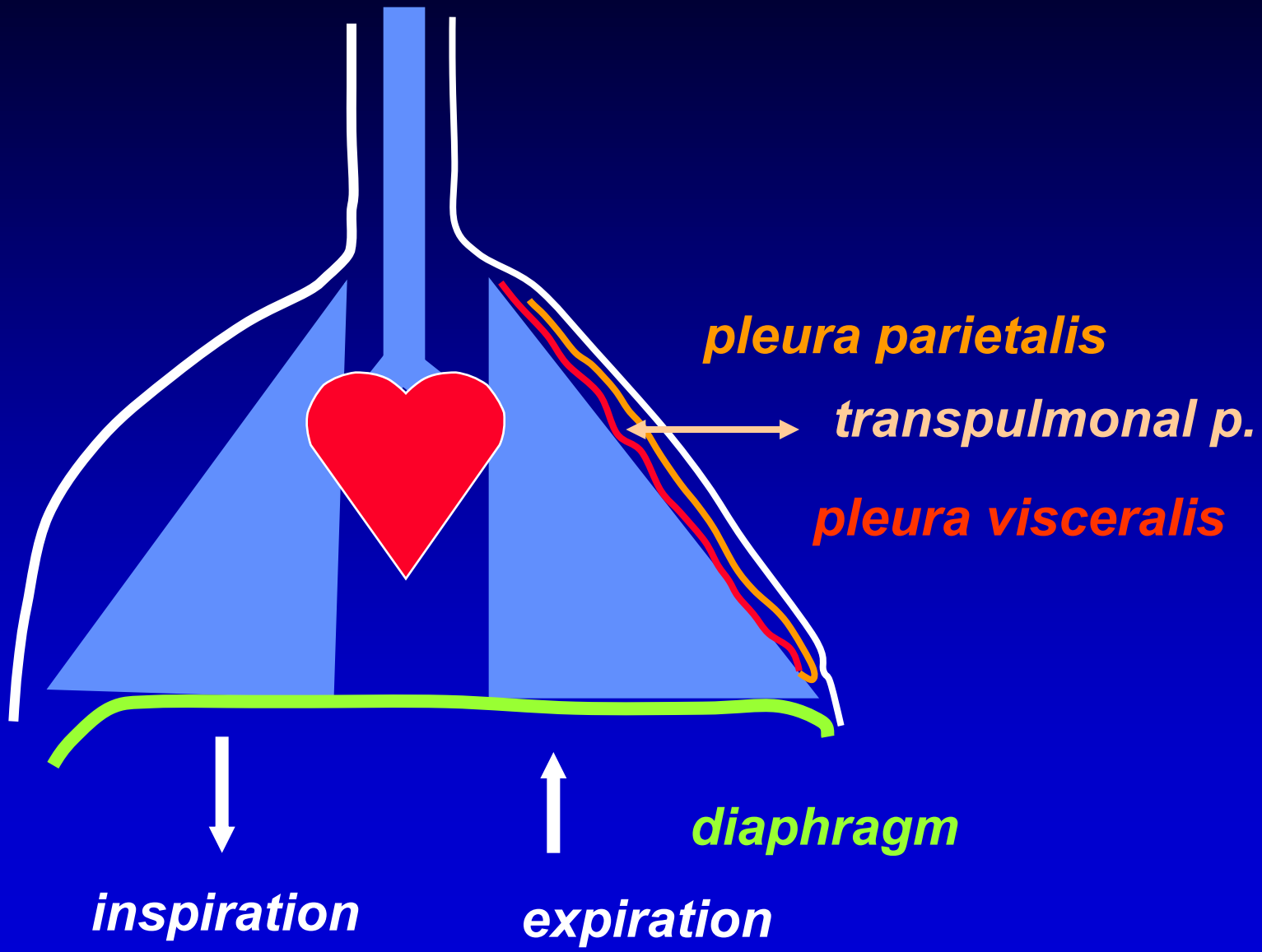

pleura parietalis
transmural pressure
pleura visceralis
diaphragm
inspiration
expiration


pleura parietalis
pleura visceralis
transpulmonal pressure
diaphragm
inspiration
expiration

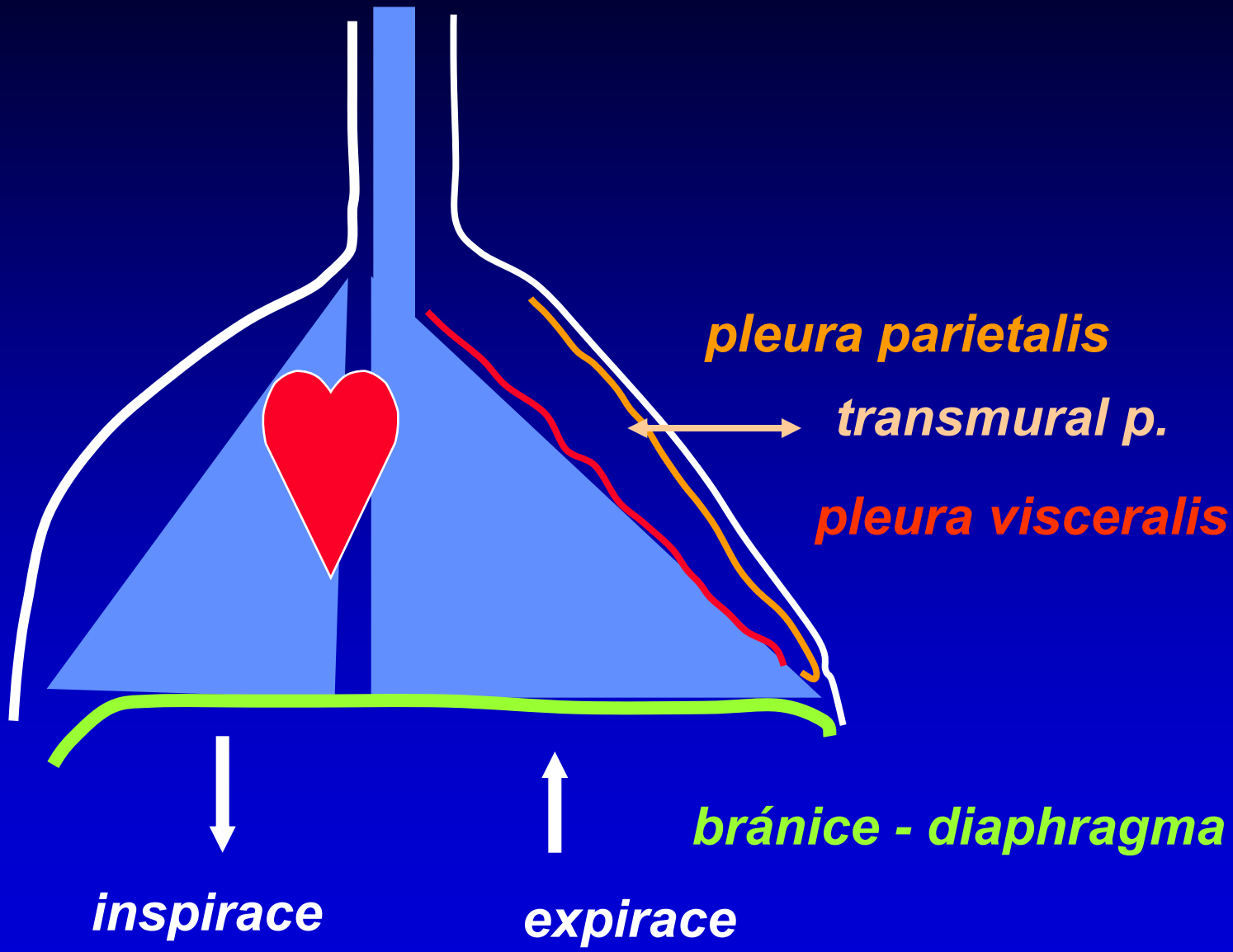

pleura parietalis
pleura visceralis
intrapulmonal
pressure
diaphragm
inspiration
expiration

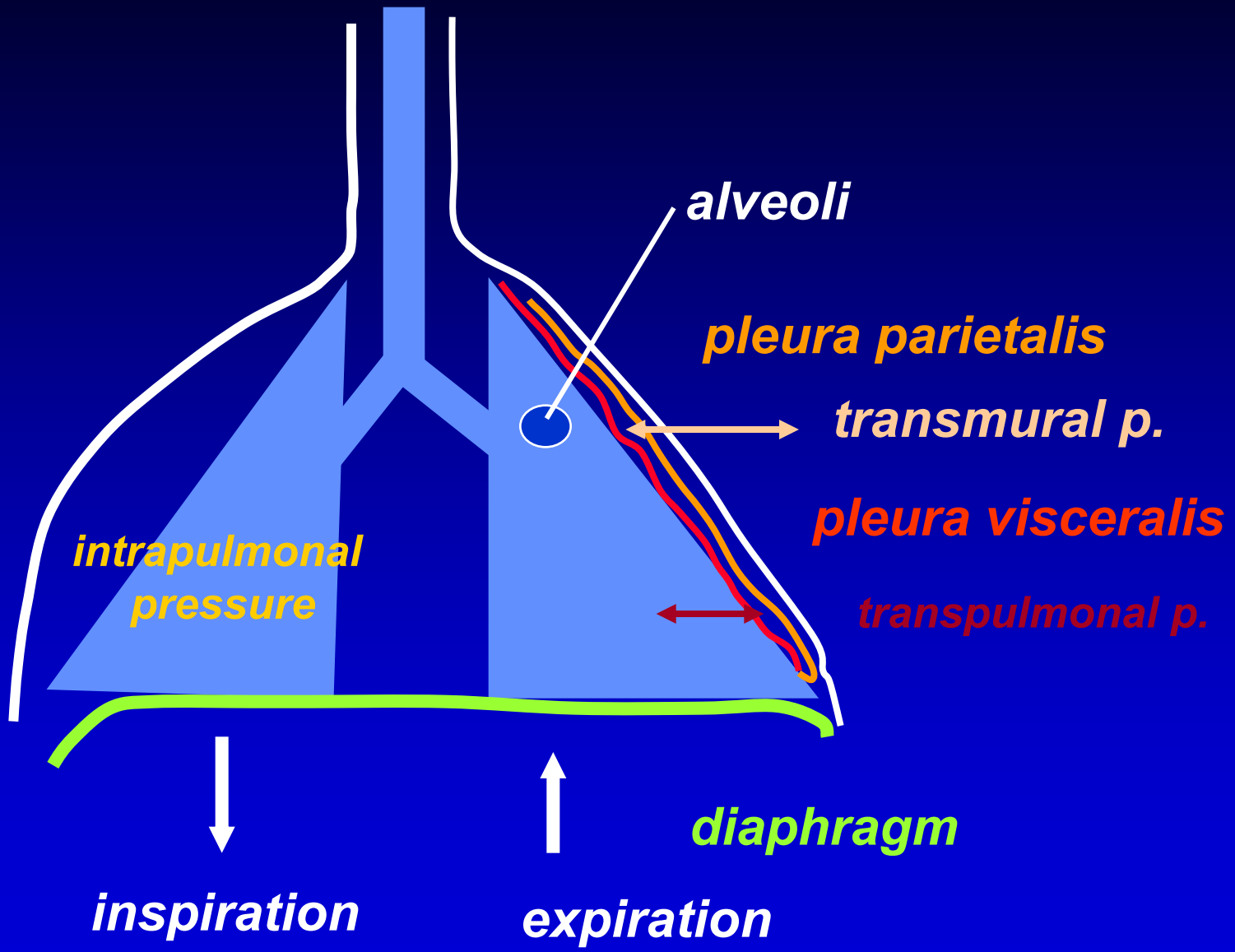

pleura parietalis
transmural pressure
pleura visceralis
transpulmonal p.
intrapulmonal
pressure
diaphragm
inspiration
expiration

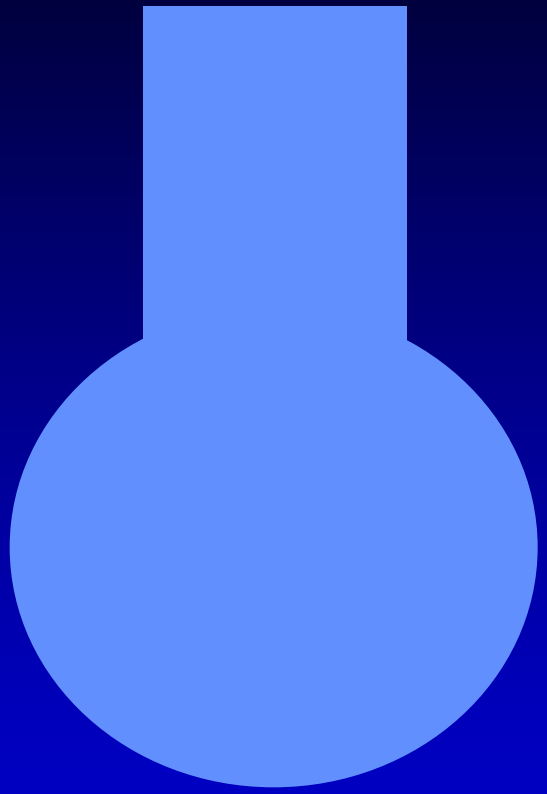


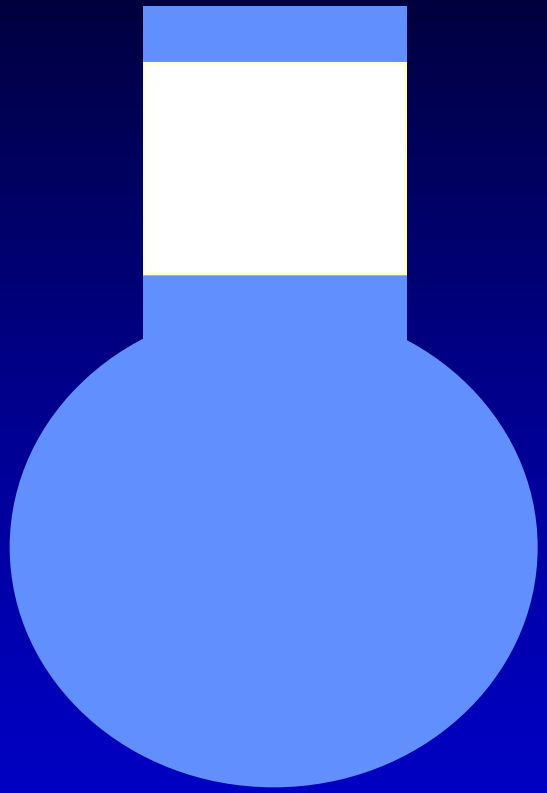

pleura parietalis
transpulmonal p.
pleura visceralis
diaphragm
inspiration
expiration

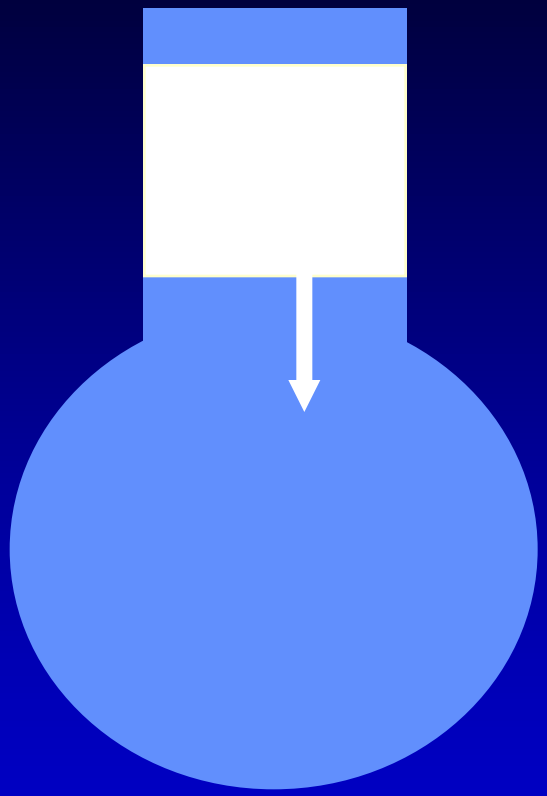
PNEUMOTHORAX

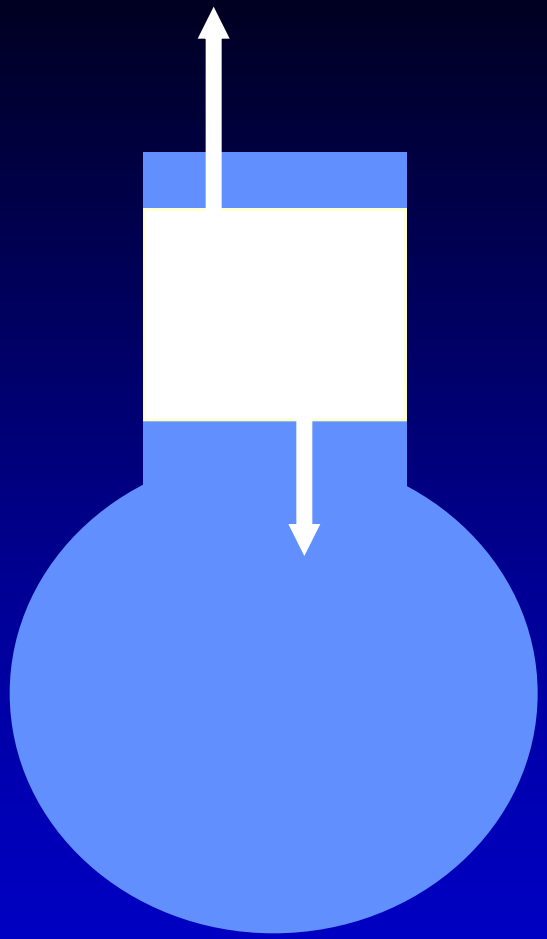


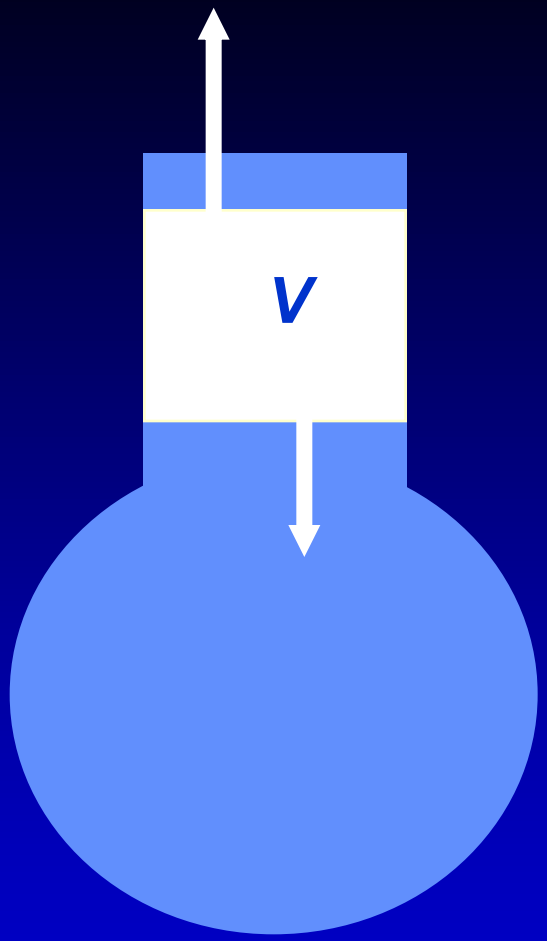

alveoli
pleura parietalis
transmural p.
pleura visceralis
transpulmonal p.
intrapulmonal
pressure
diaphragm
inspiration
expiration











ventilation

Physiologic dead space

Is the volume of air in the lungs
that does not participate in gas exchance (i.e.e it is dead)

Anatomic dead space – is the volume of conducting airways

Functional dead space volume – which is made up of alveoli
that do not participate in gas exchance
(alveoli that are ventilated,
but are not perfused by pulmonary capilary blood)

Physiologic dead space

$$V_D = V_T \times \frac{P_{aCO2} - P_{ECO2}}{P_{aCO2}}$$

V_D – physiologic dead space (mL)
V_T – tidal volume (mL)
P_{aCO2} – P_{CO2} of arterial blood (mmHg)
P_{ECO2} - P_{CO2} of expered air (mmHg)

Physiologic dead space

$$V_D = V_T \times \frac{P_{aCO2} - P_{ECO2}}{P_{aCO2}}$$

$$V_D = 500 \times \frac{40 - 30}{40}$$

$$= 500 \times 0.25$$

$$= 125$$

Alveolar ventilation

$V_A = (V_T - V_D) \times \text{breasths/min}$

V_A - alveolar ventilation (mL/min)

VT - tidal volume (mL)

VD - physiologic dead space (mL/min)

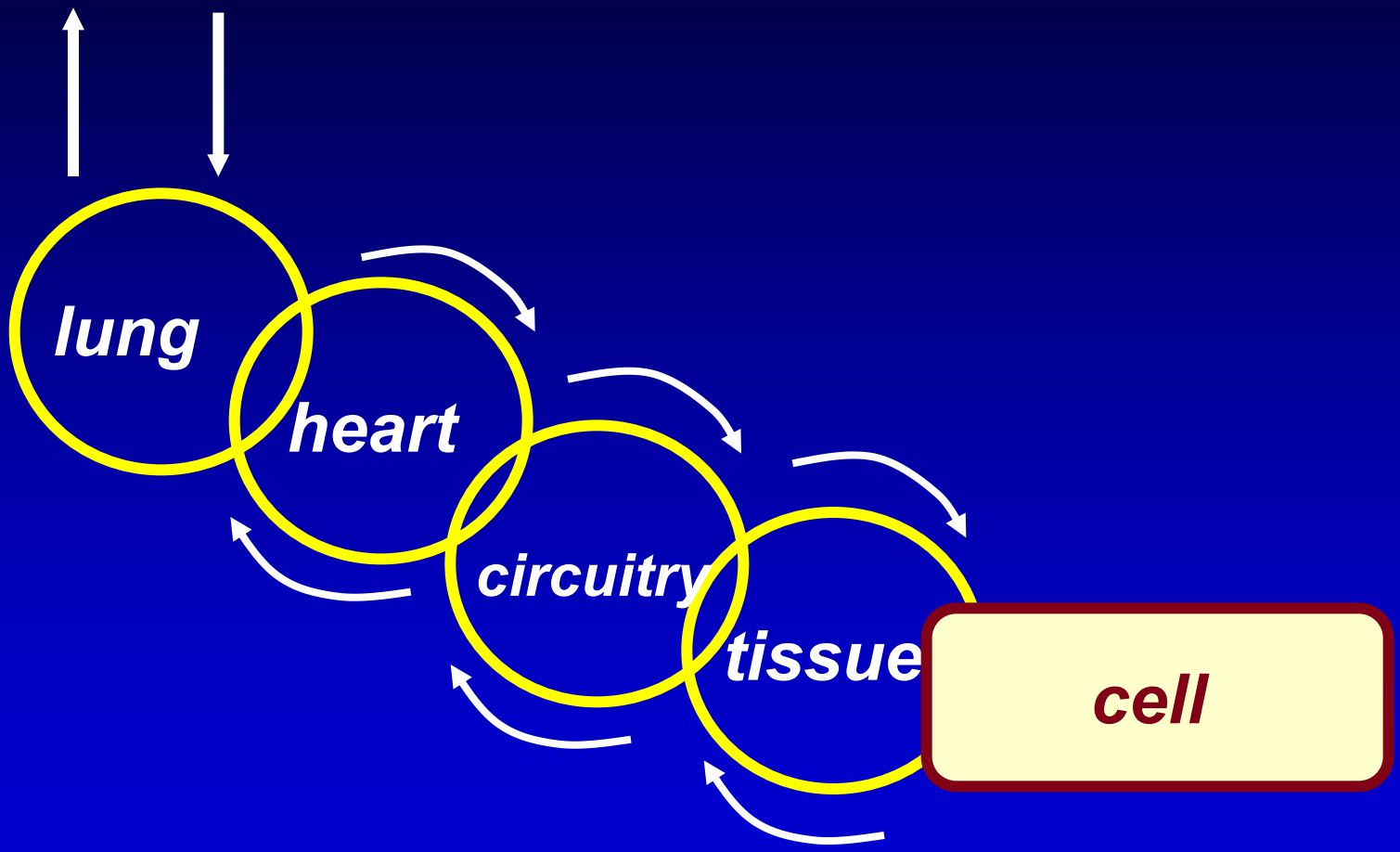
Alveolar ventilation

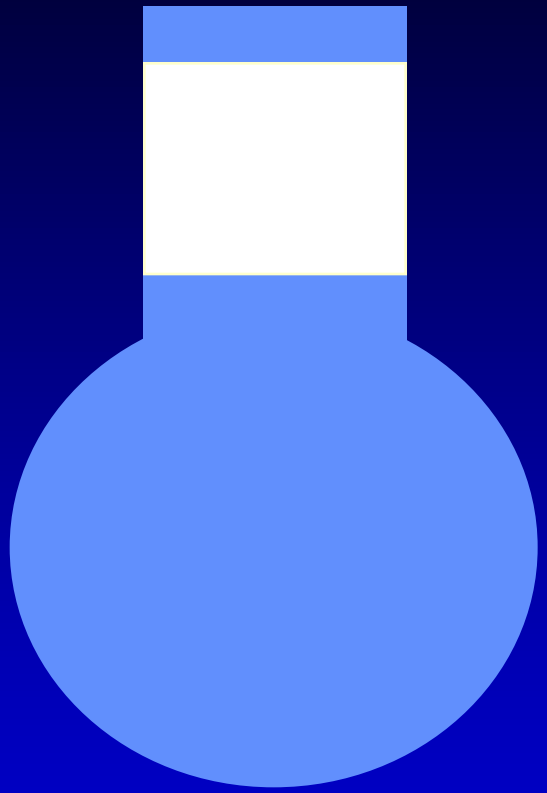
$V_A = (V_T - V_D) \times \text{breasths/min}$

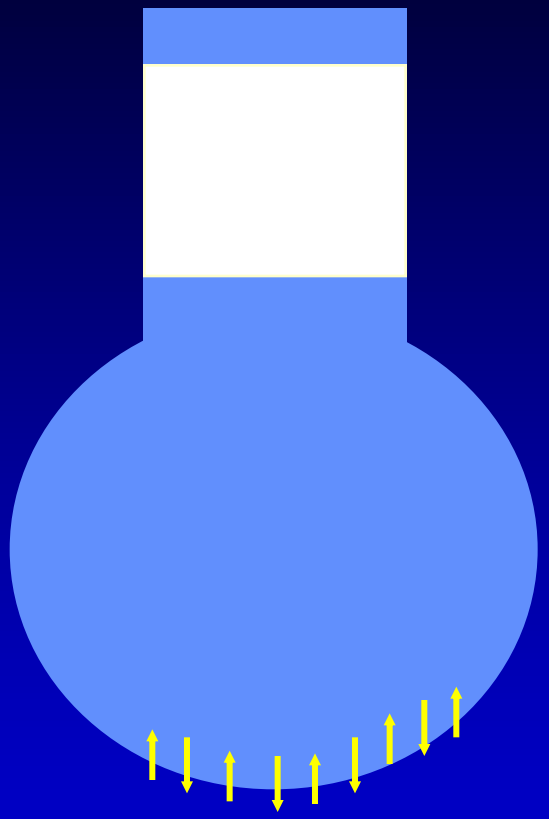
$V_A = (500 - 125) \times 16$

$= 375 \times 16$

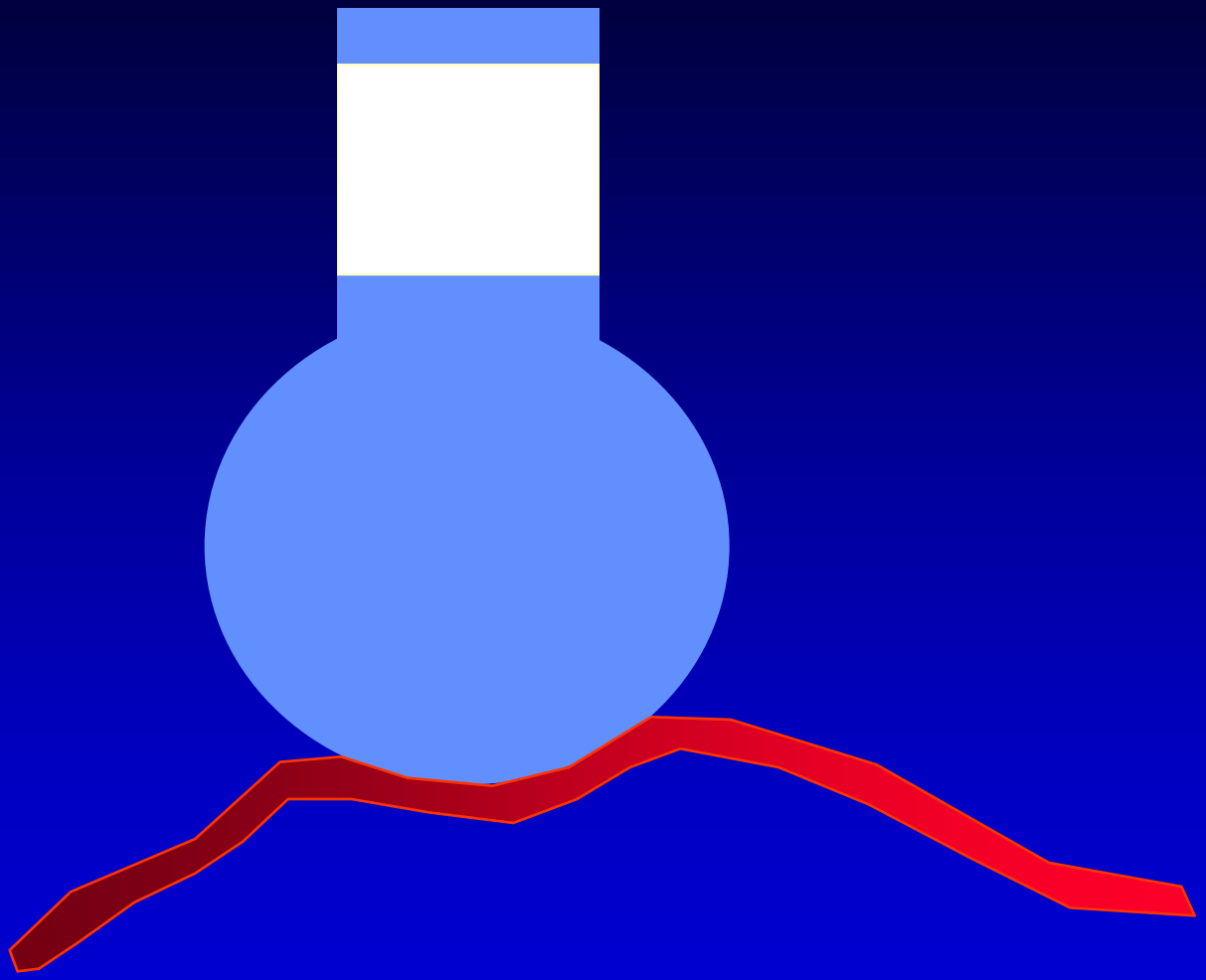
$= 6000 \text{ mL/min}$

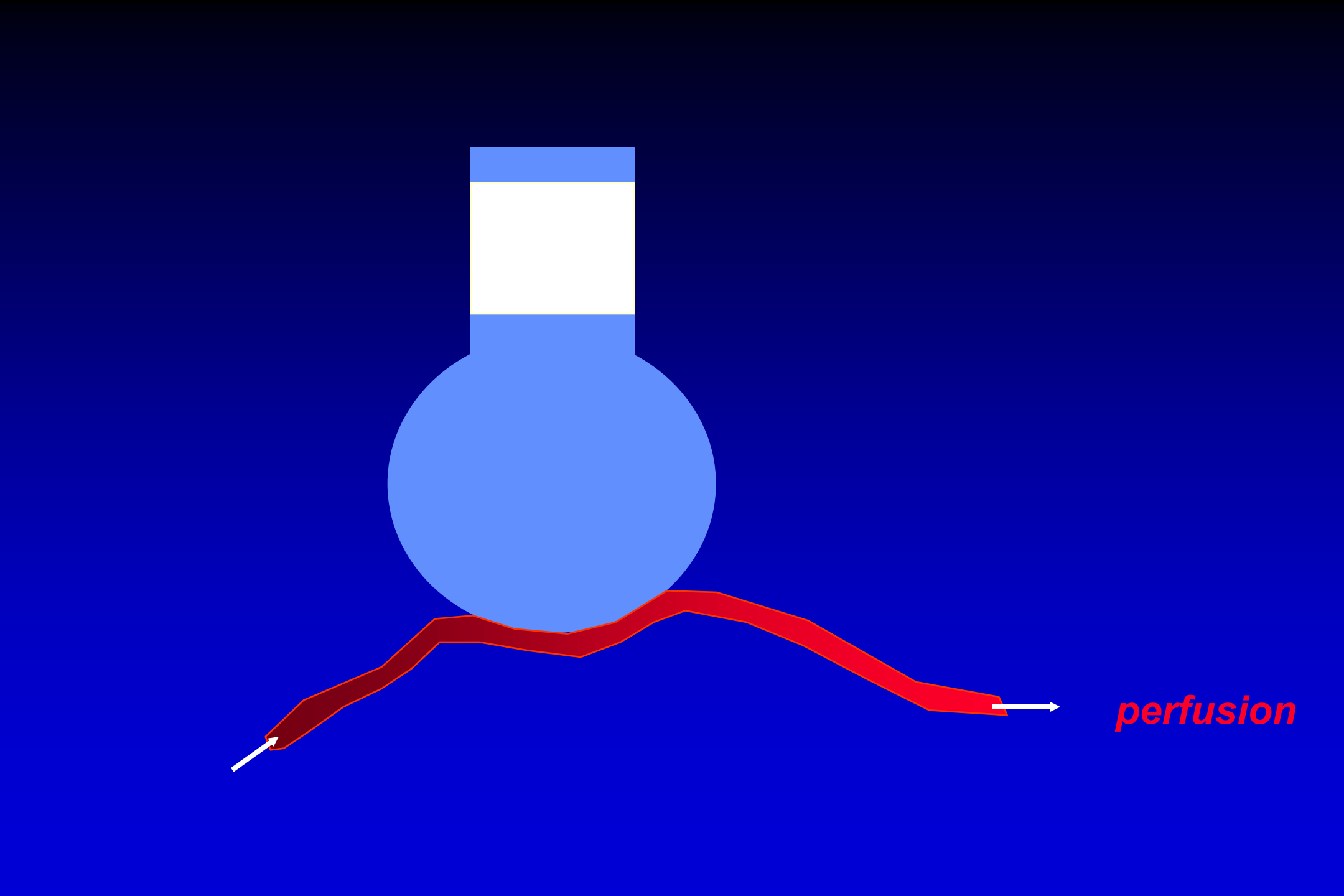

lung
heart
circuitry
tissue
cell

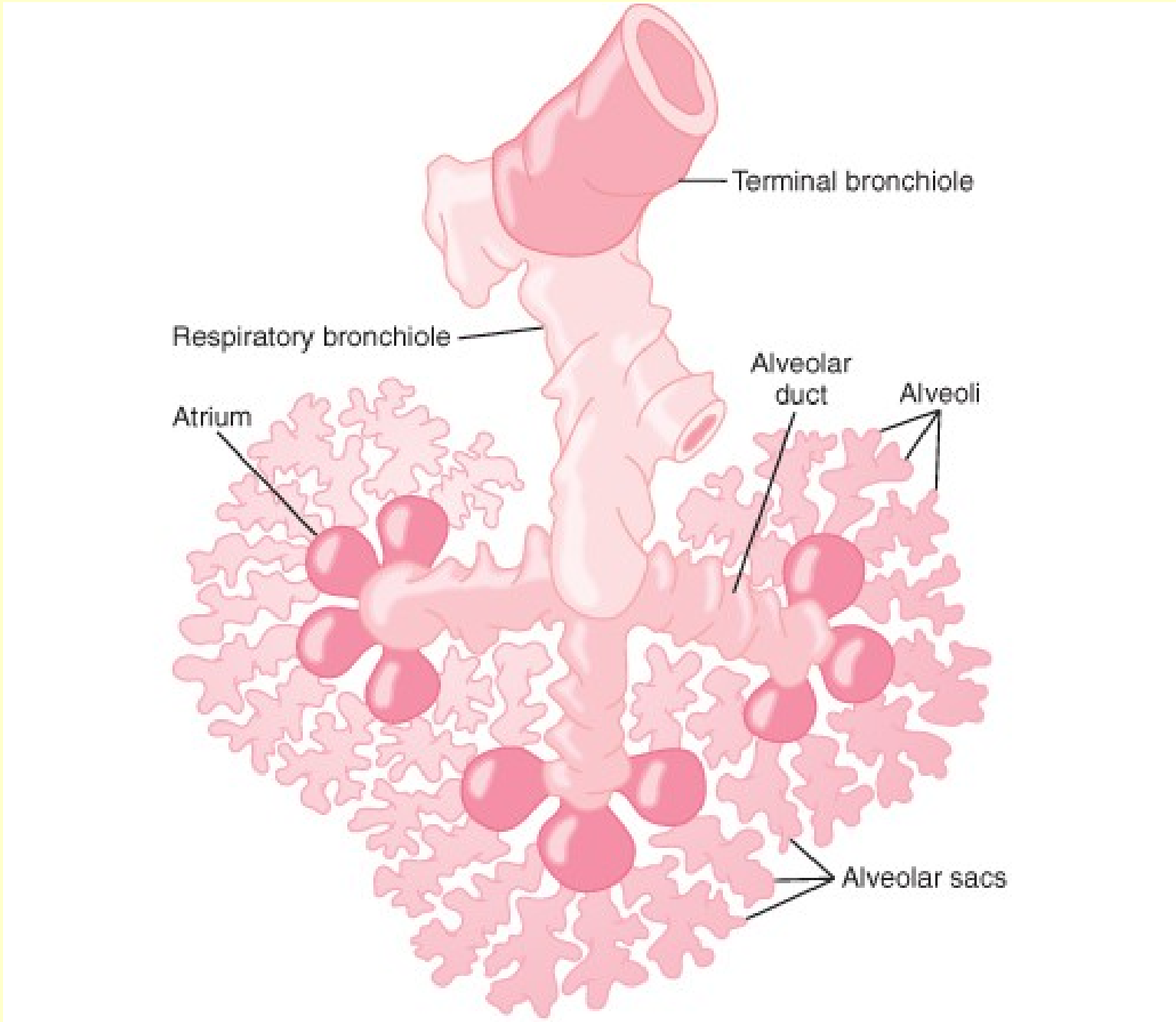




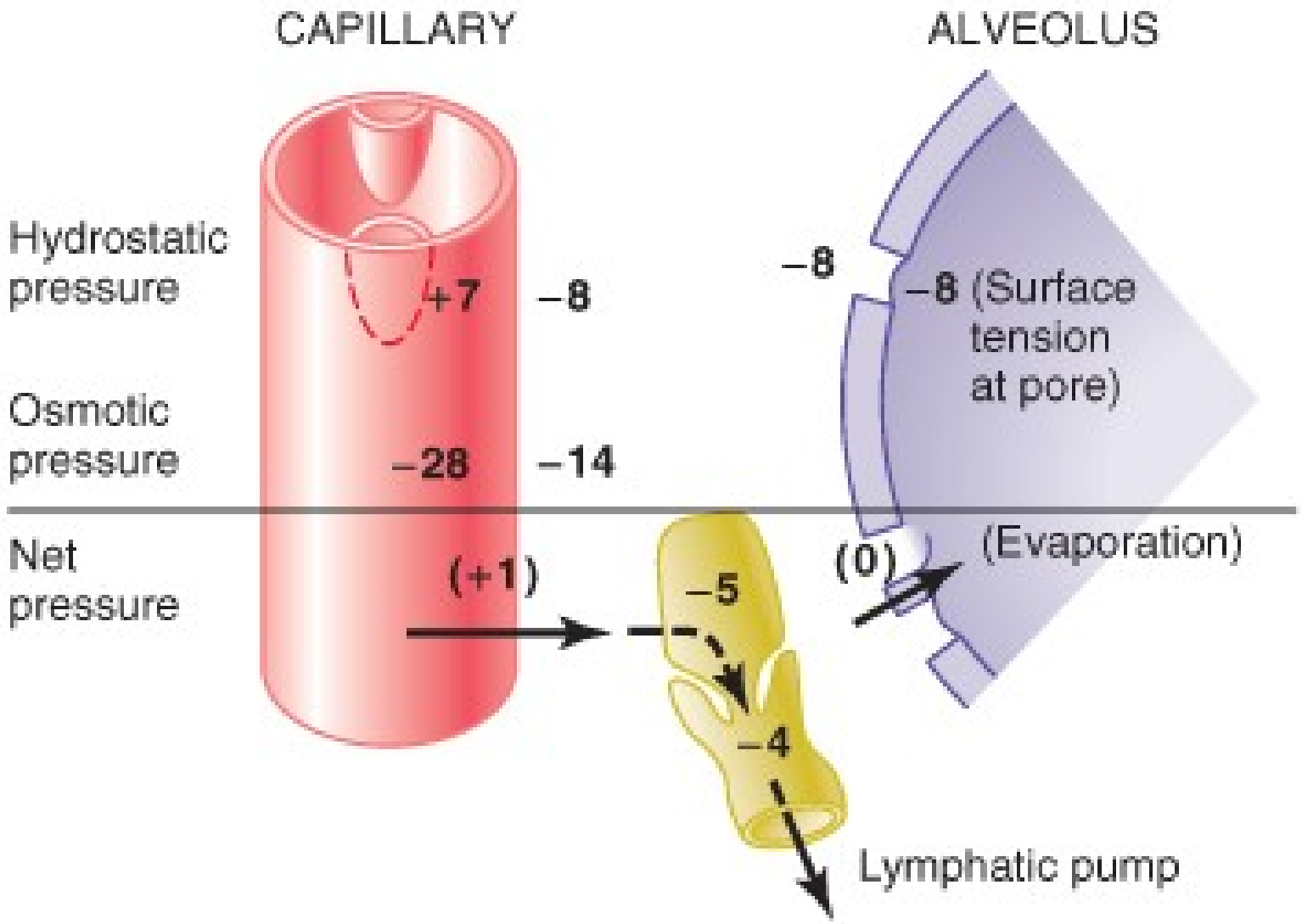
diffusion

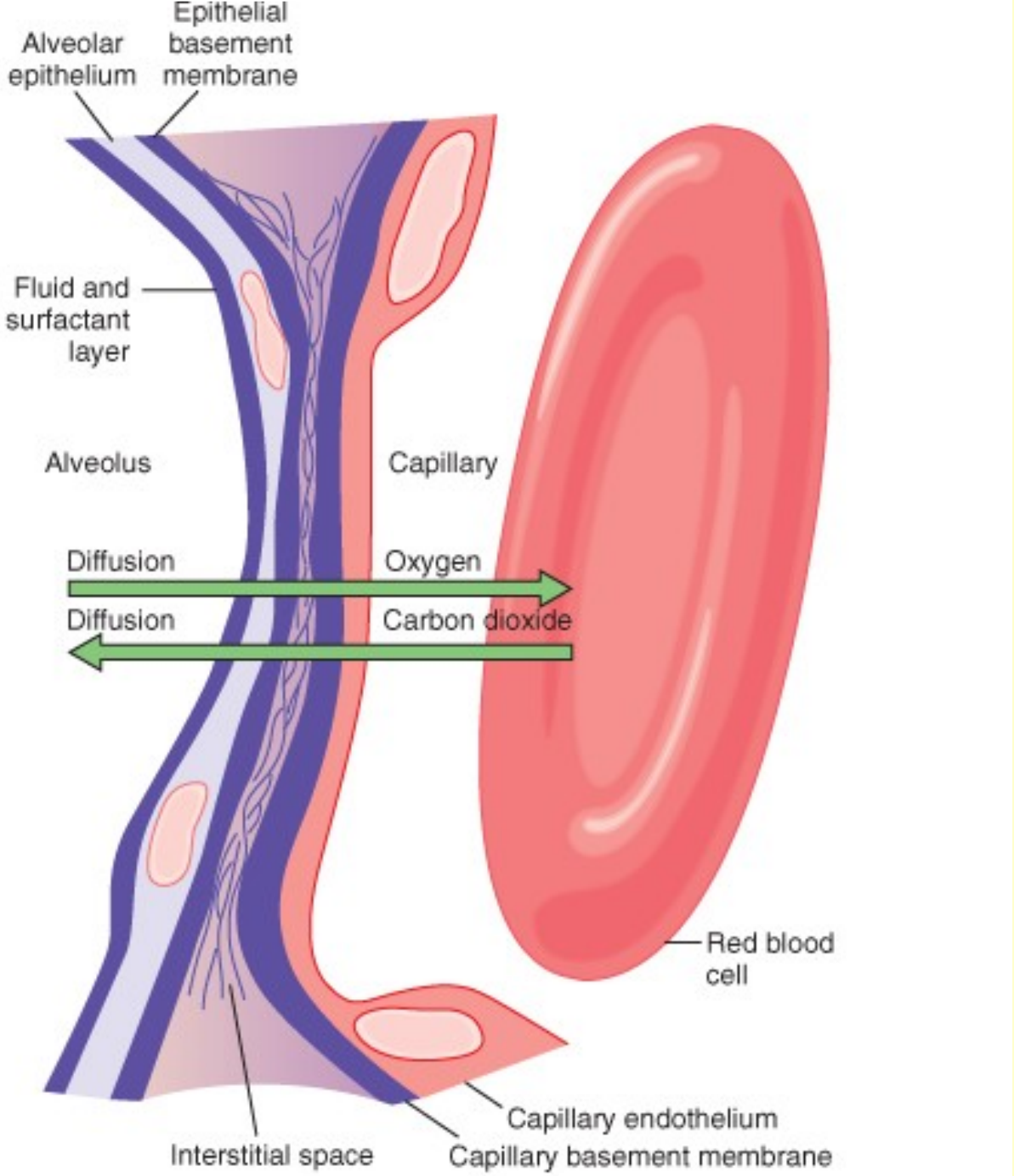


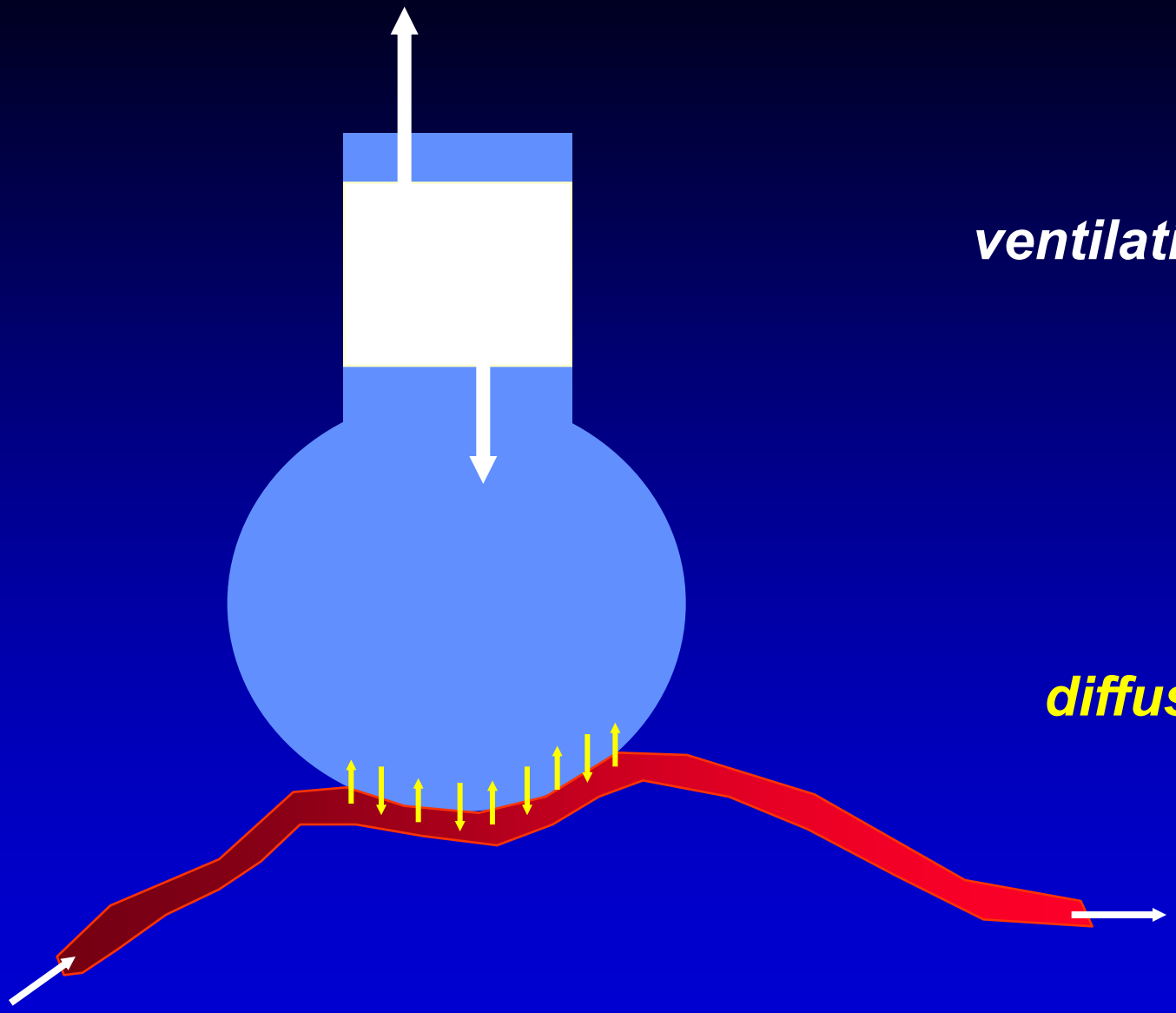

perfusion

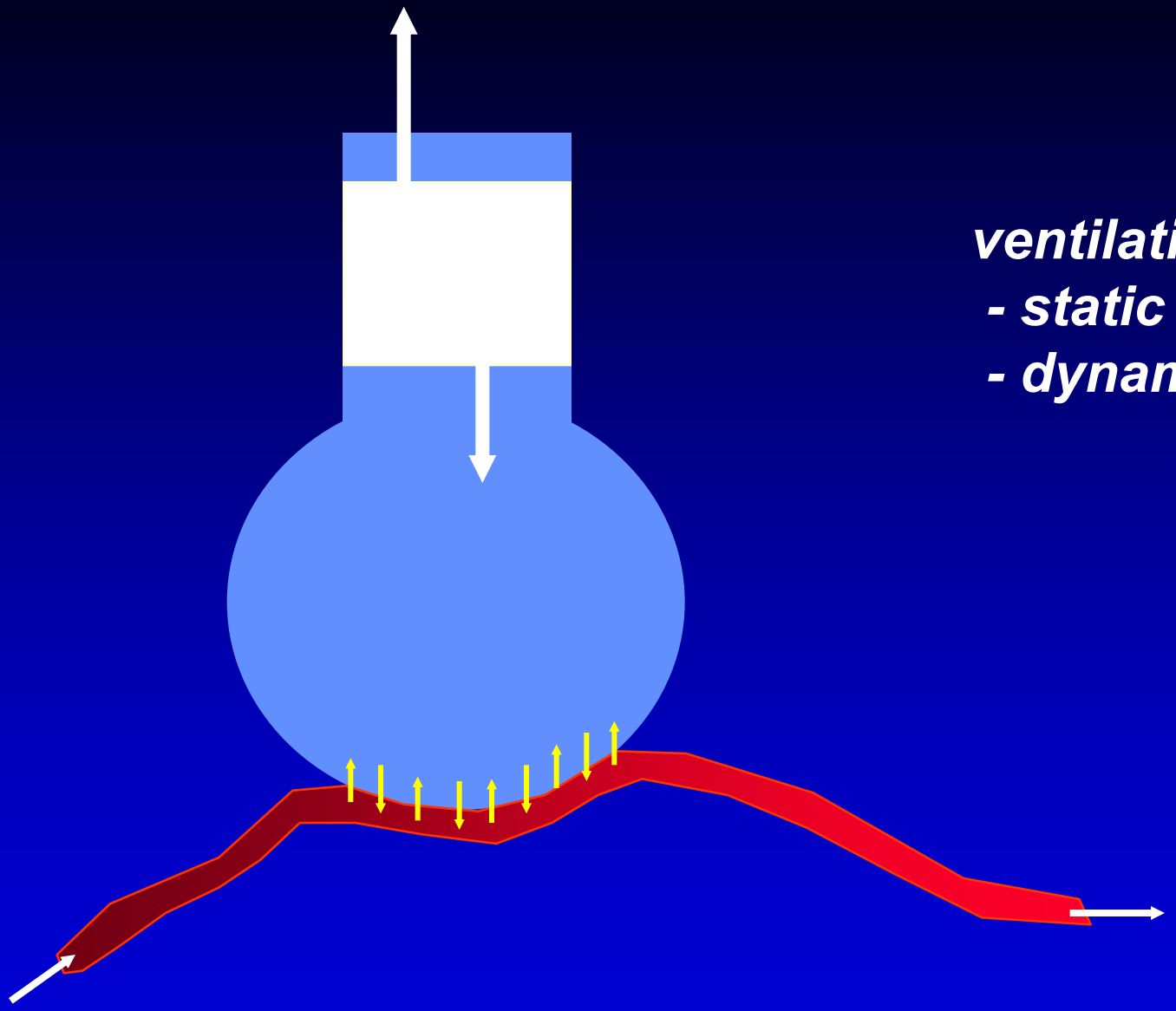


Pressures Causing Fluid Movement

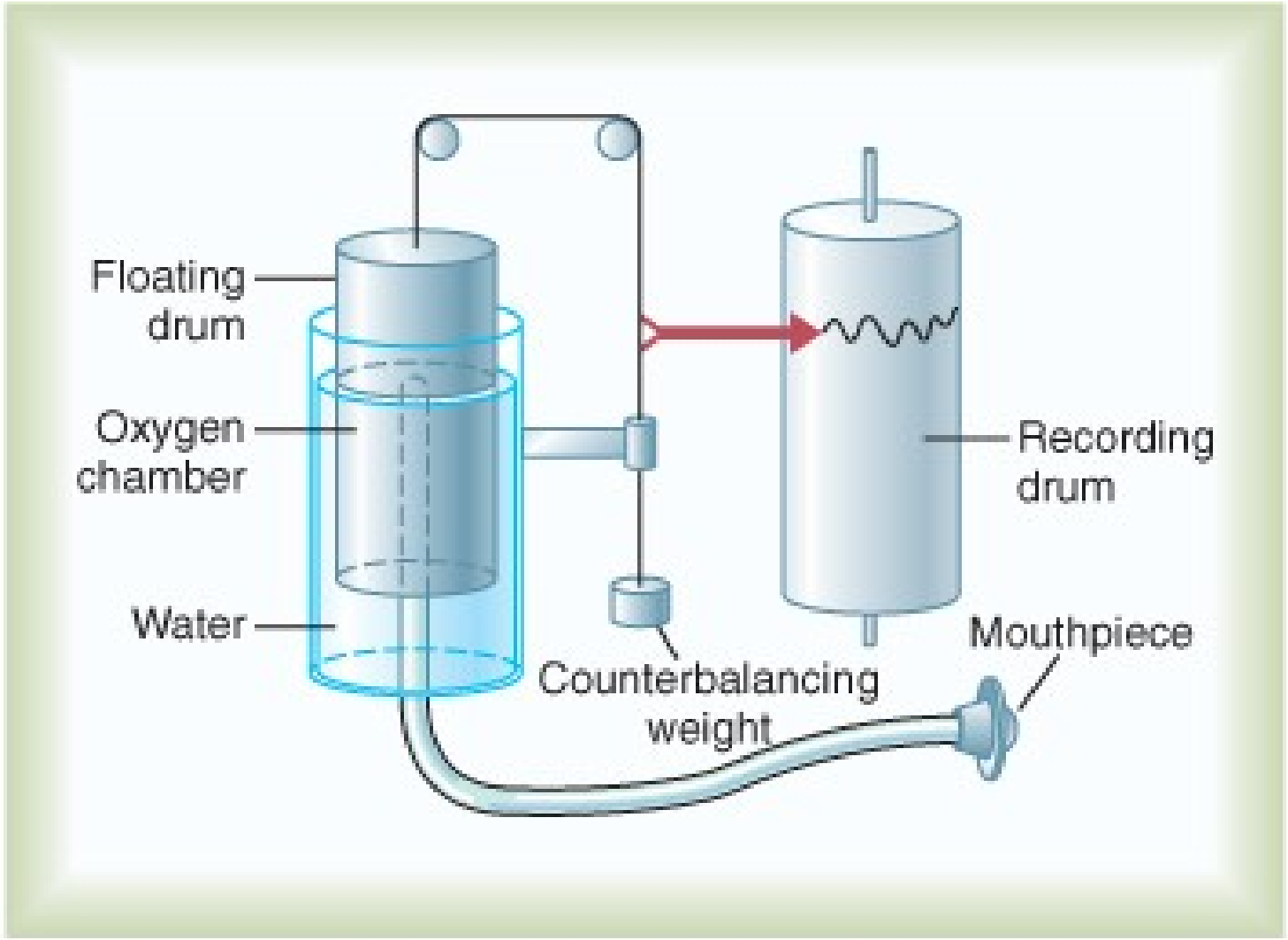




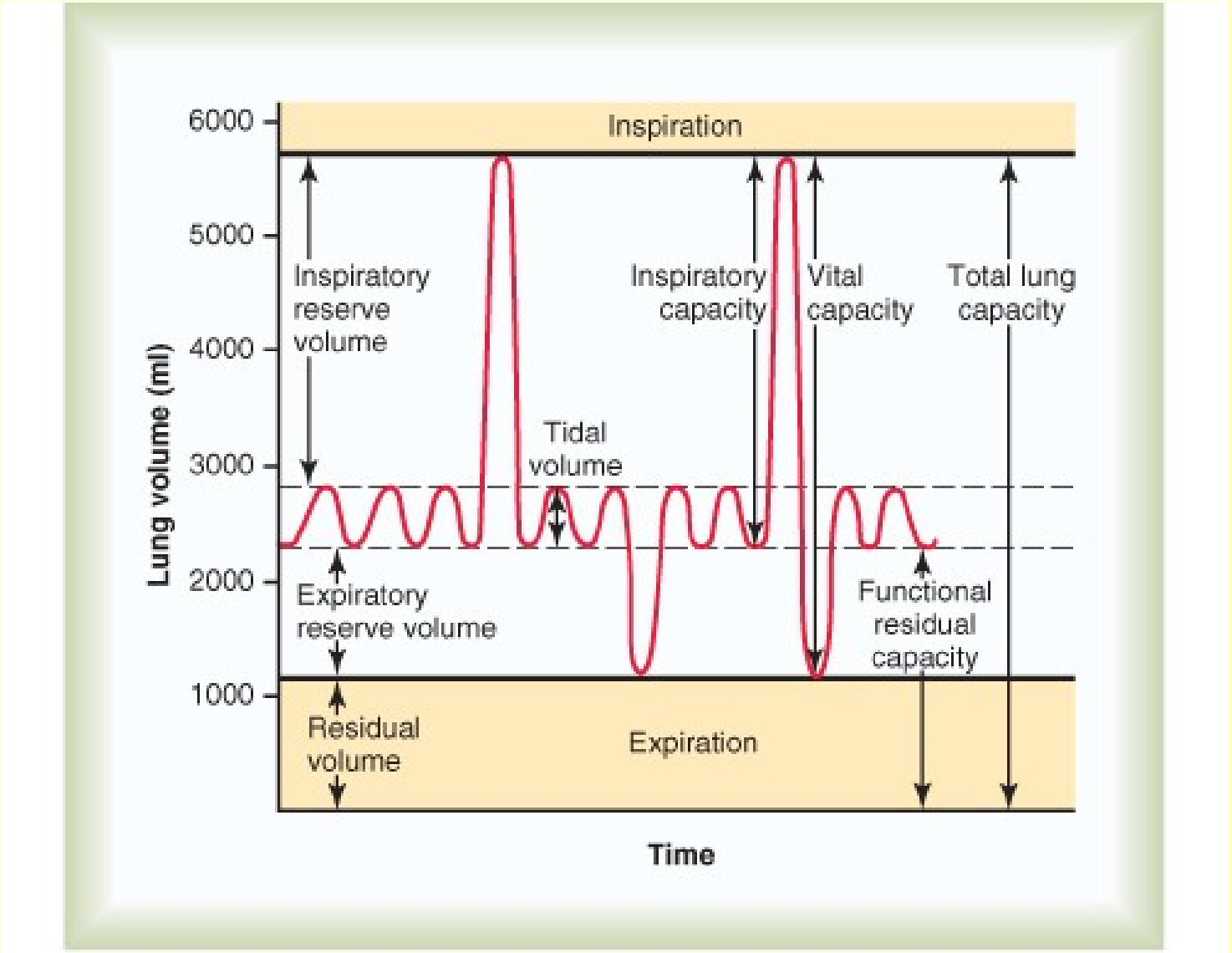

ventilation
diffusion
perfusion



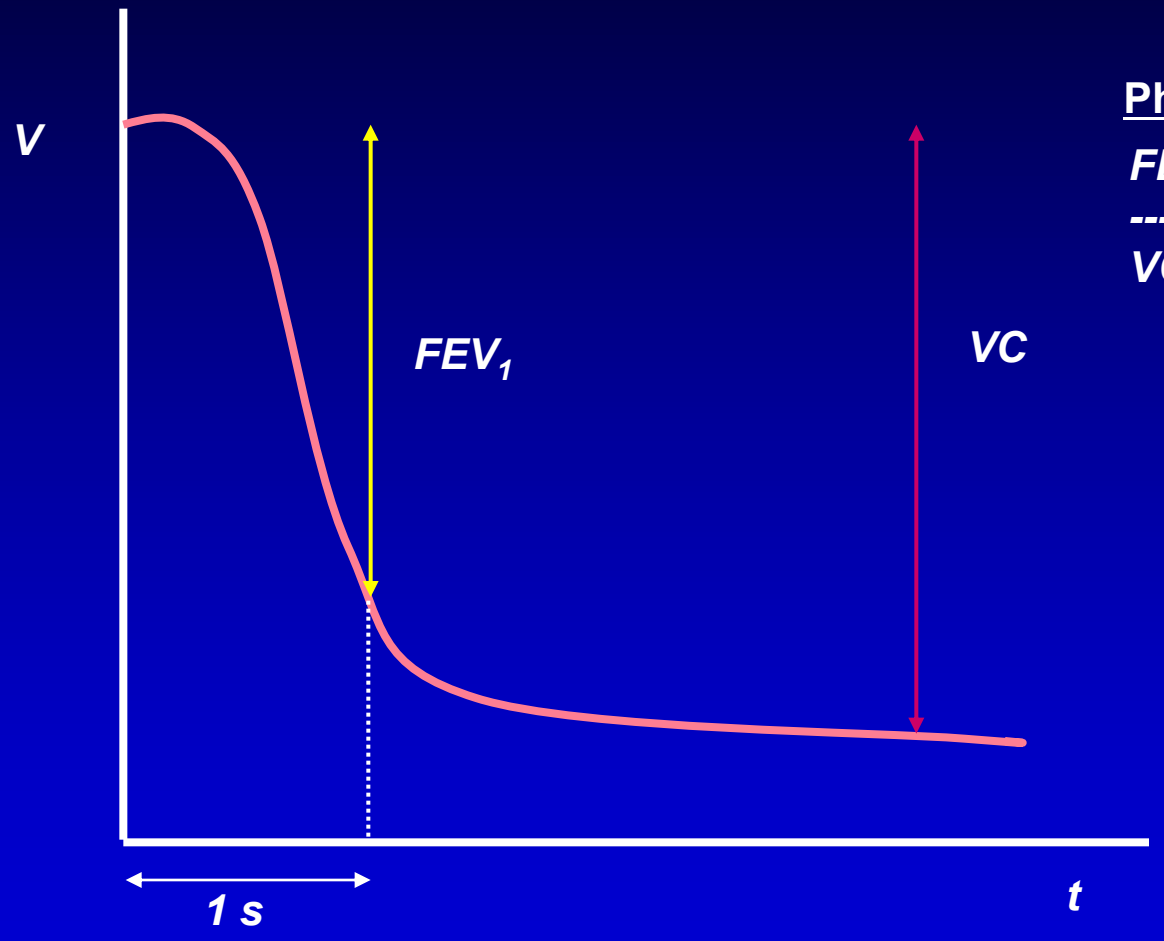
ventilation
- static volums
- dynamic volums



STATIC VOLUMS



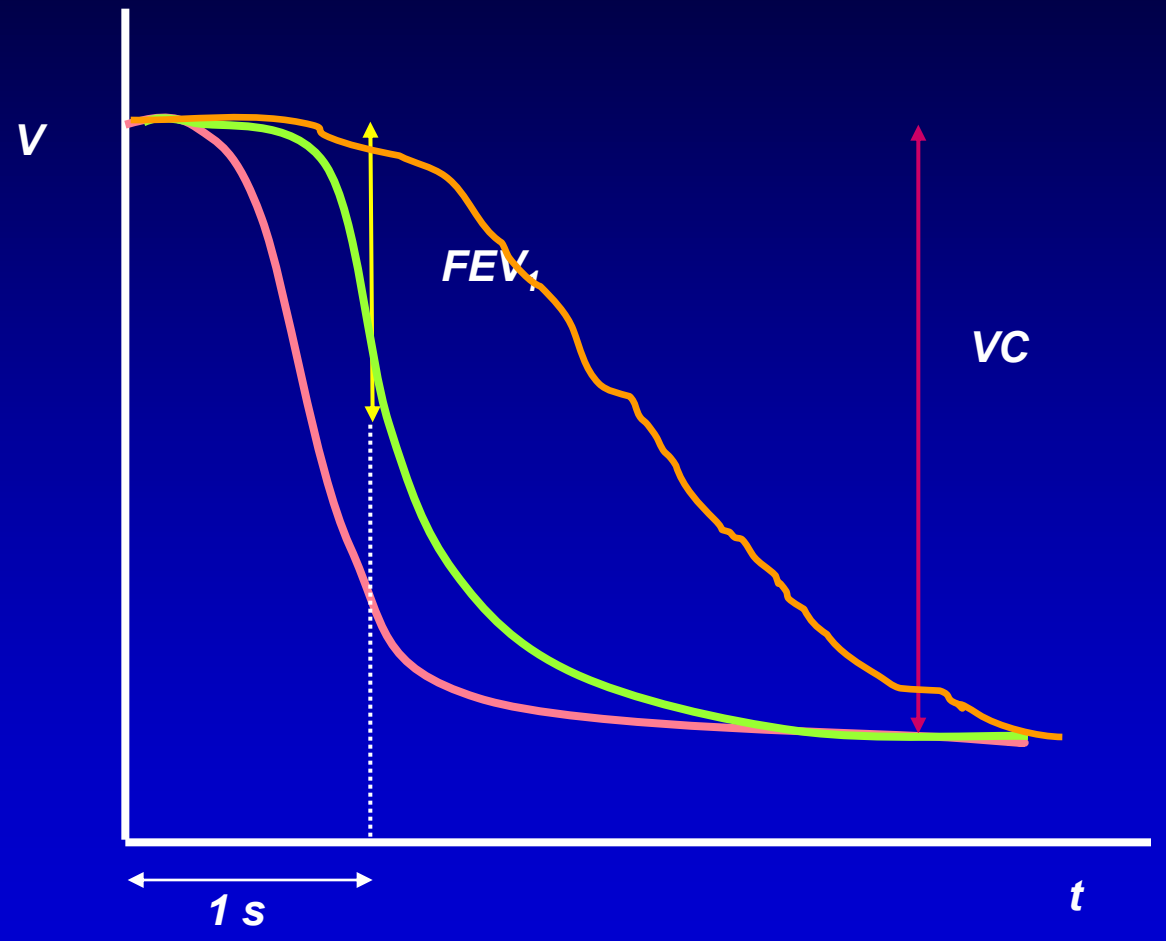
DYNAMIC VOLUMS



Physiological value:

$$\frac{FEV1}{VC} \times 100 \quad > 80\ \%$$

DYNAMIC VOLUMS



OBSTRUCTION

↓ FEV1
= VC

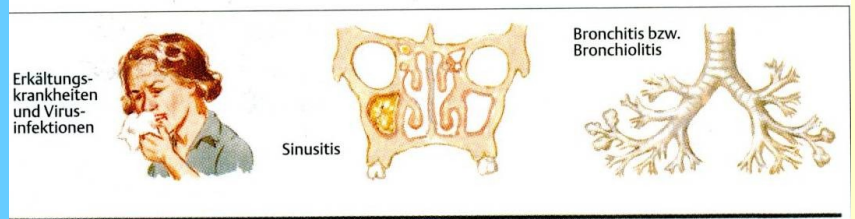
Restriction

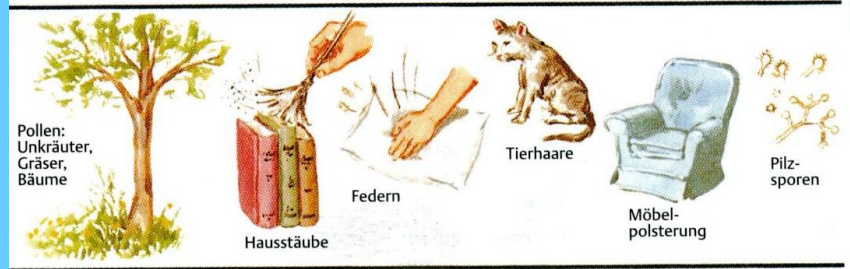
↓ VC
= FEV1

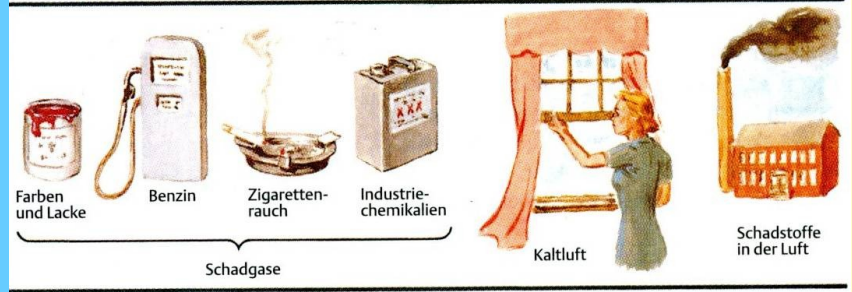
▲ Blue bloater

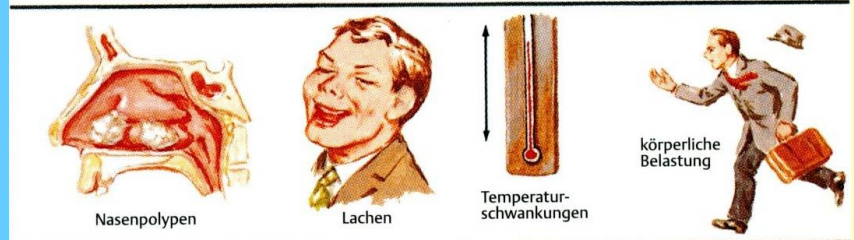
Triggers

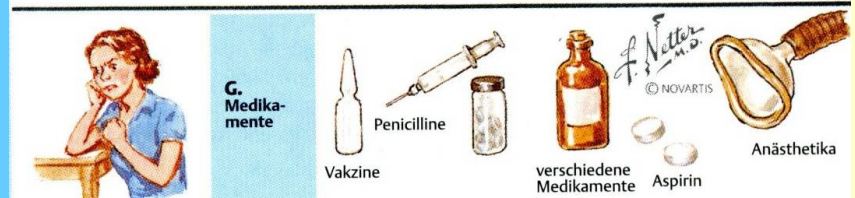
- ***Infection***
- ***inhaled allergens***
- ***inhaled irritants***
- ***food allergens***
- ***inducing stimuli***
- ***mental stress***
- ***medicines***

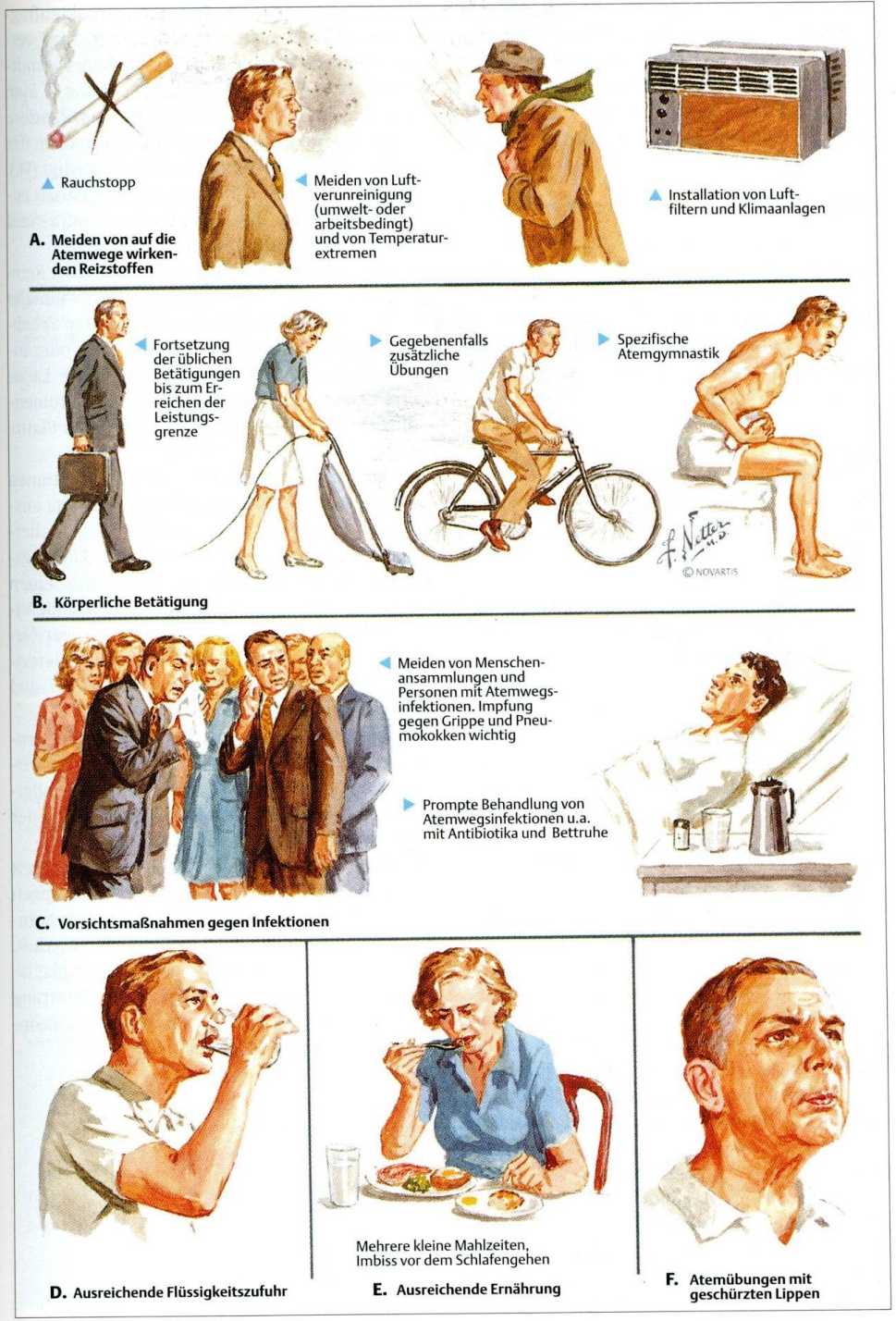












respiratory irritant factors

physical activity

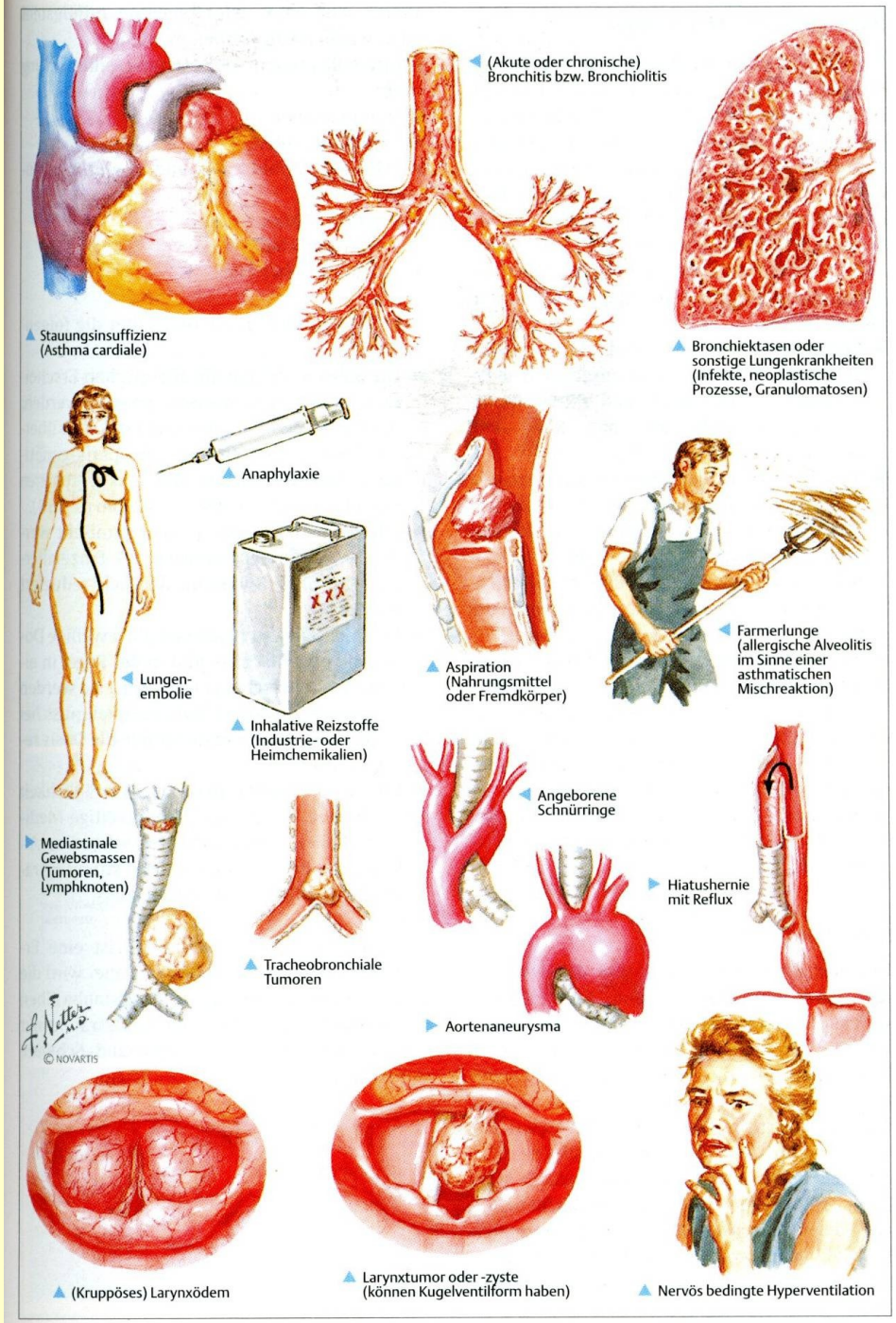
preventing infection
sick people, vaccination, intensive treatment

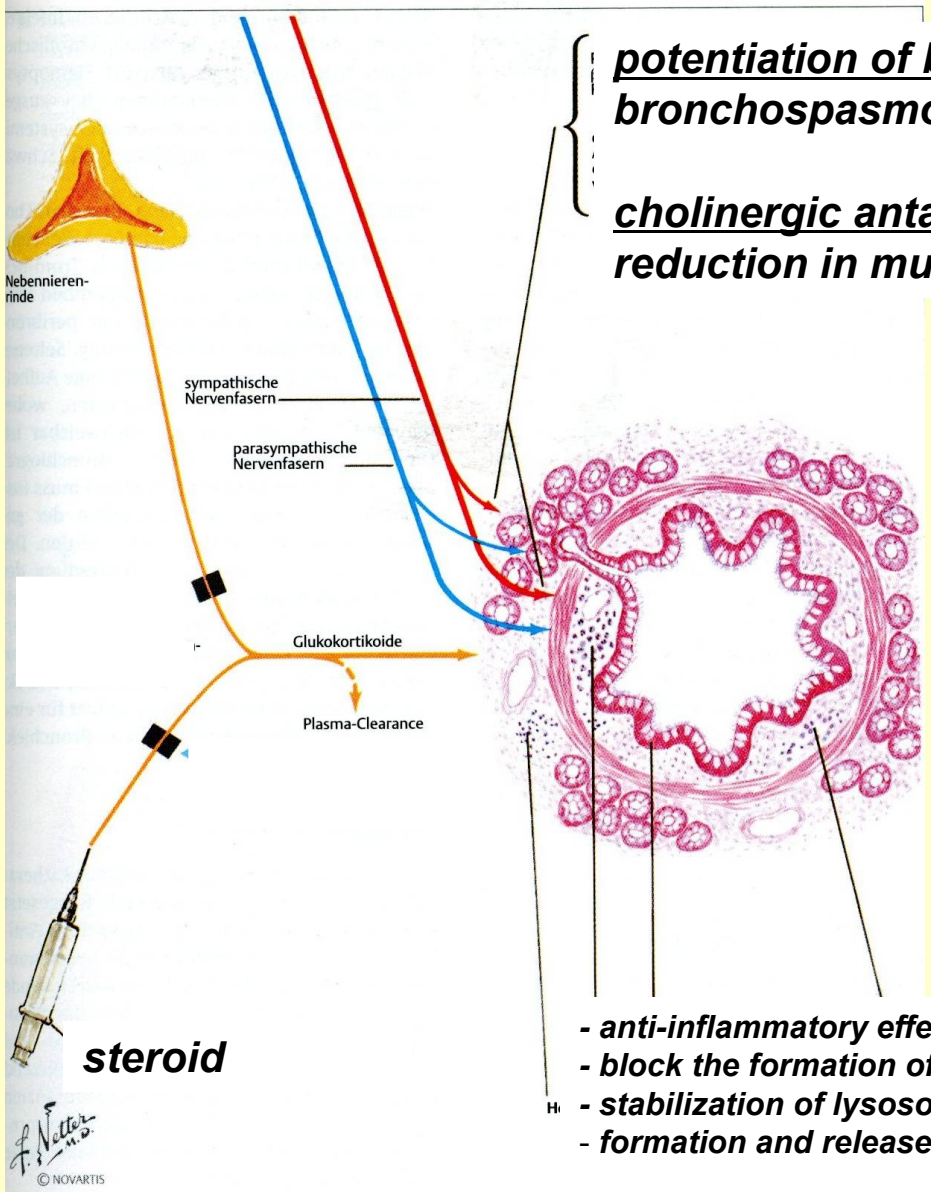
sufficient fluid intake

eat small portions

breathing exercises

Differential diagnosis





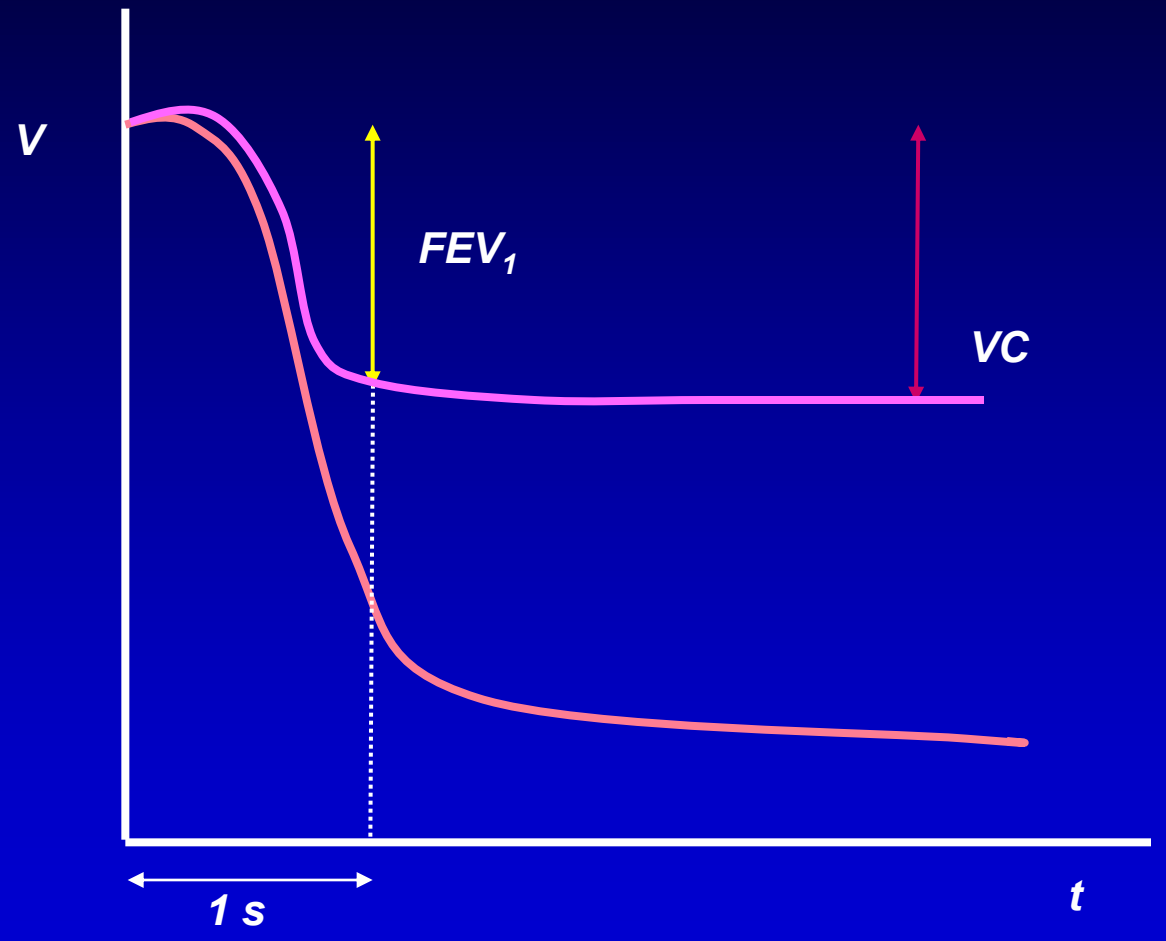
potentiation of beta-adrenergic receptor
bronchospasmolytic effect

cholinergic antagonism
reduction in mucus production

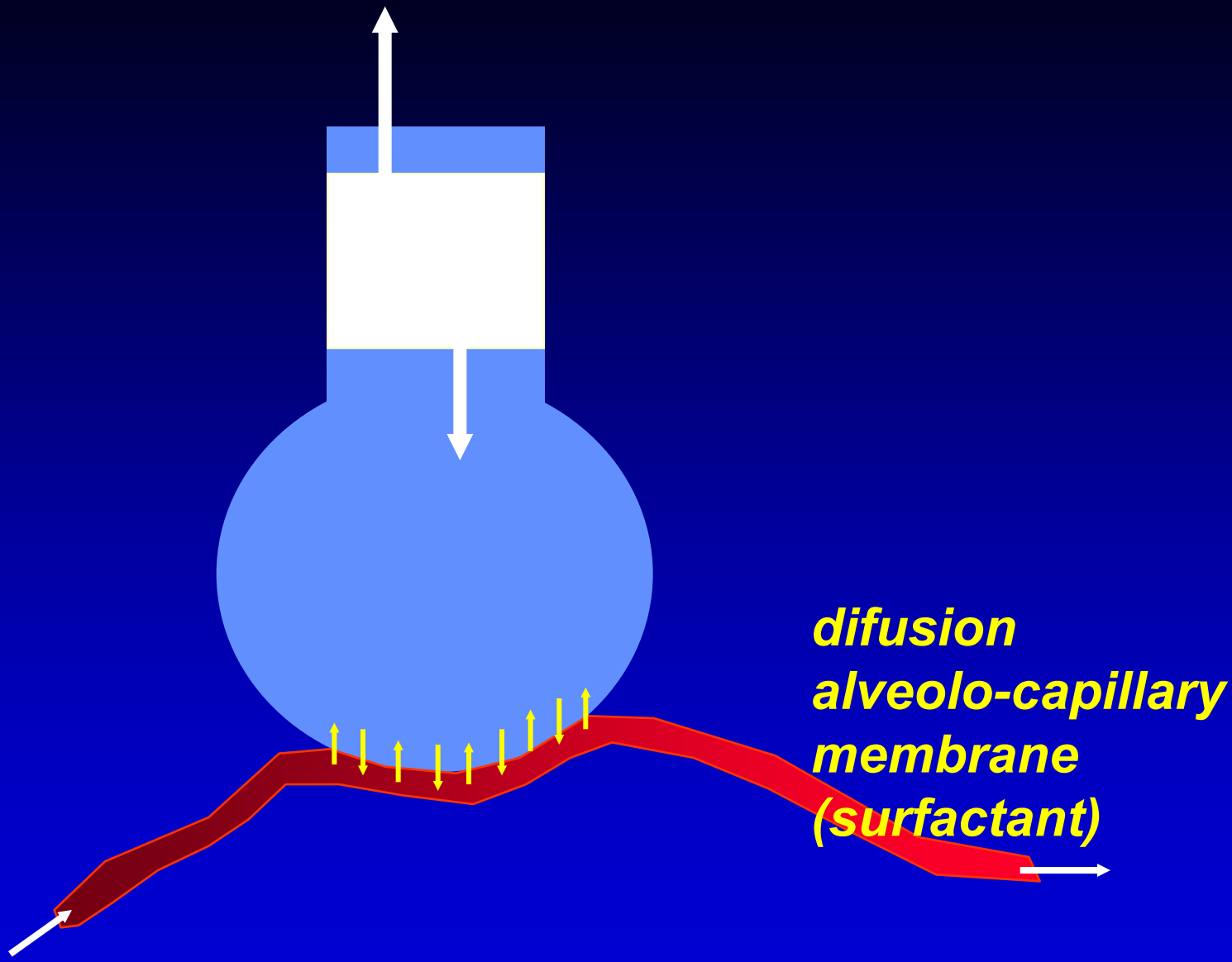
steroid

- ***anti-inflammatory effect***
- ***block the formation of antibodies***
- ***stabilization of lysosomes block***
- ***formation and release of histamine***

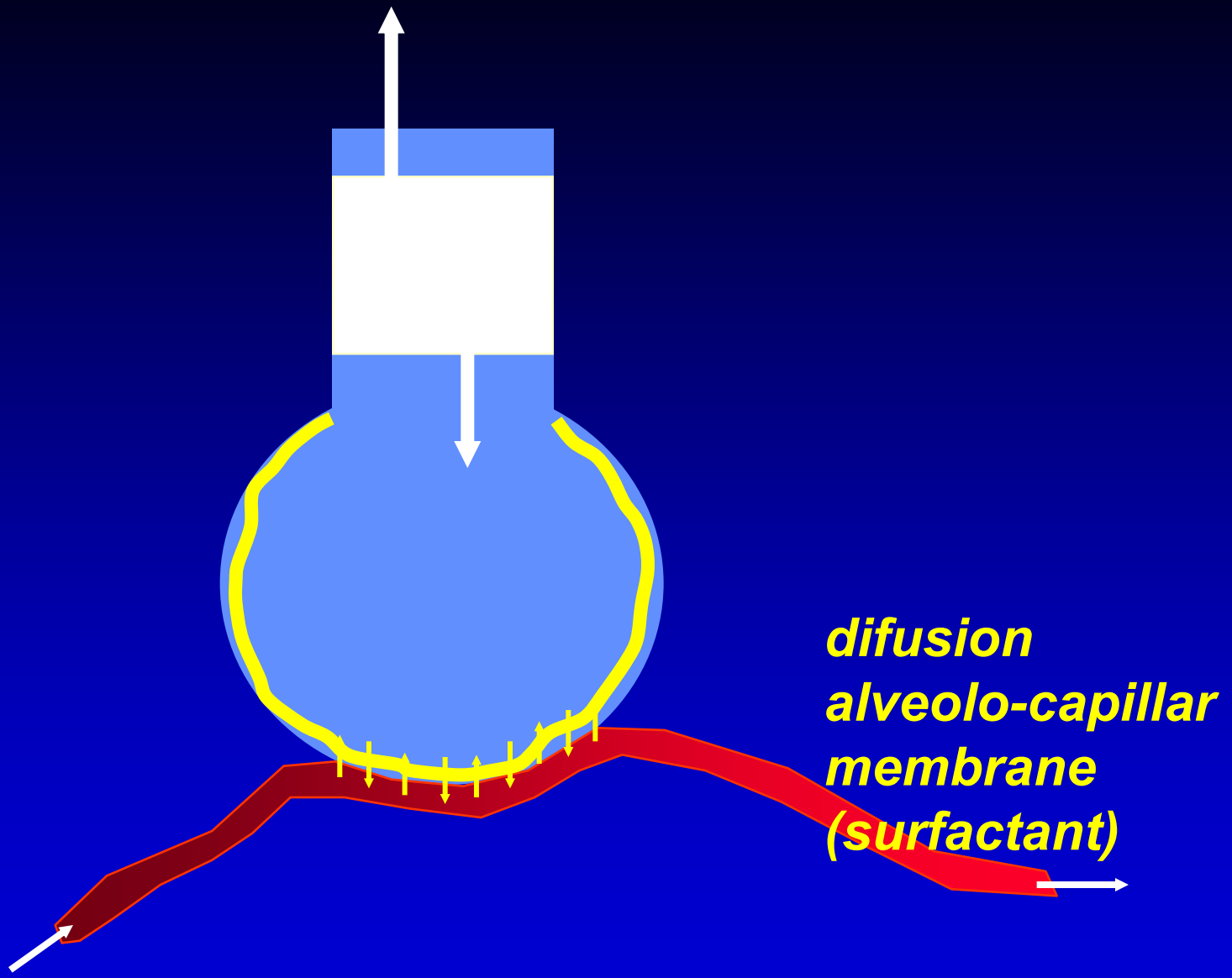
DYNAMIC VOLUMS

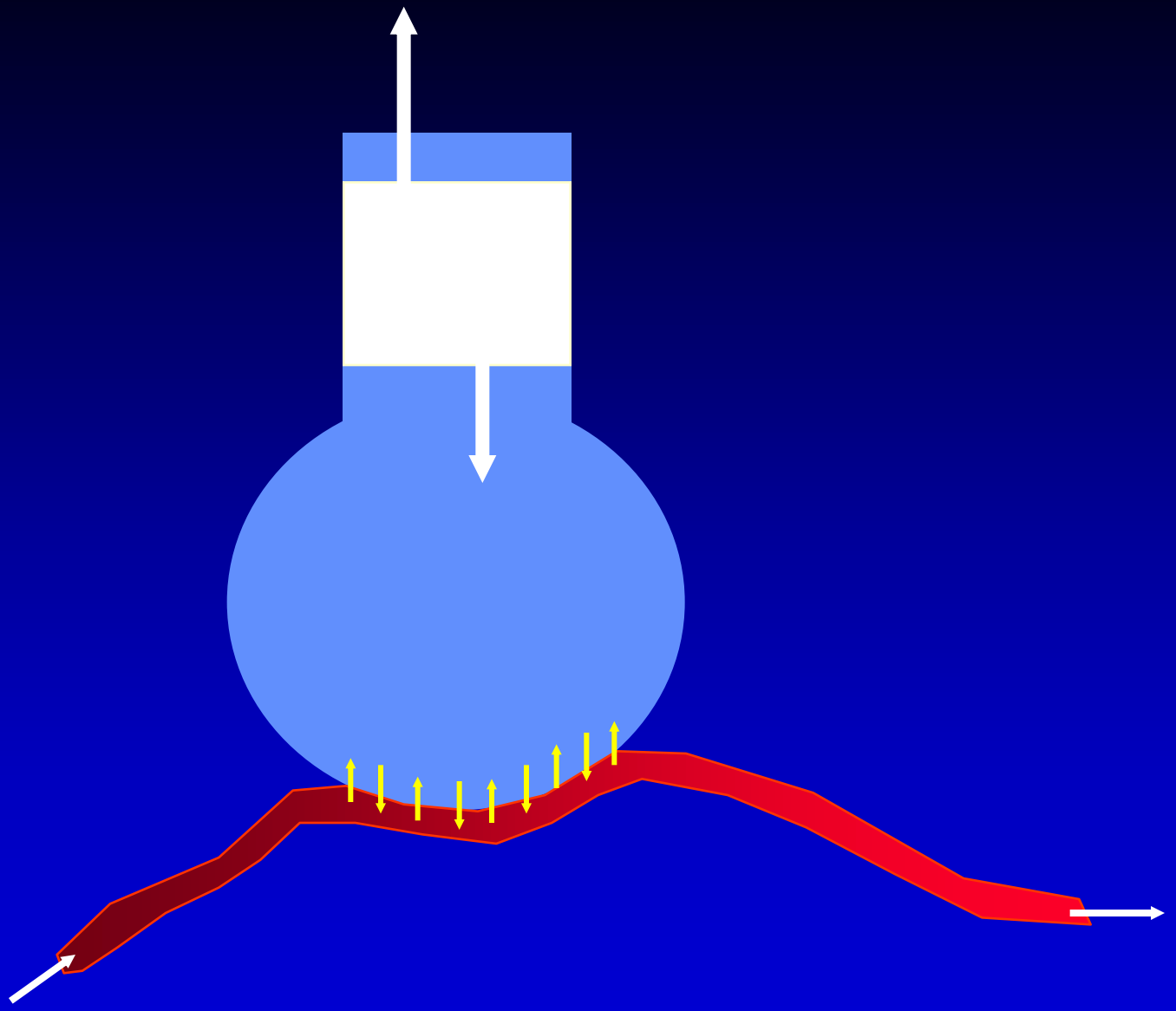


RESTRICTION
= FEV1
↓ VC



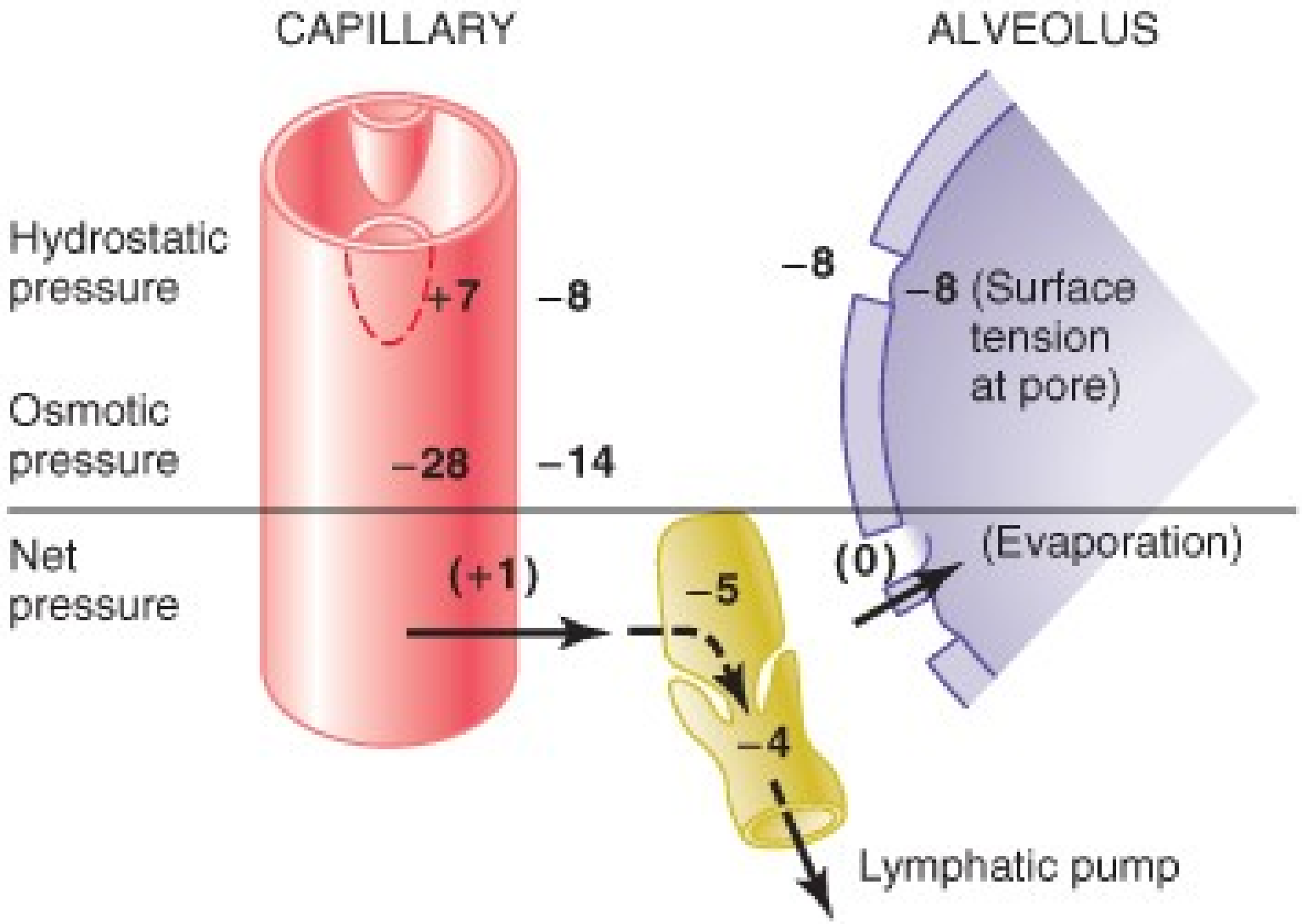
difusion alveolo-capillary membrane (surfactant)


difusion
alveolo-capillar
membrane
(surfactant)

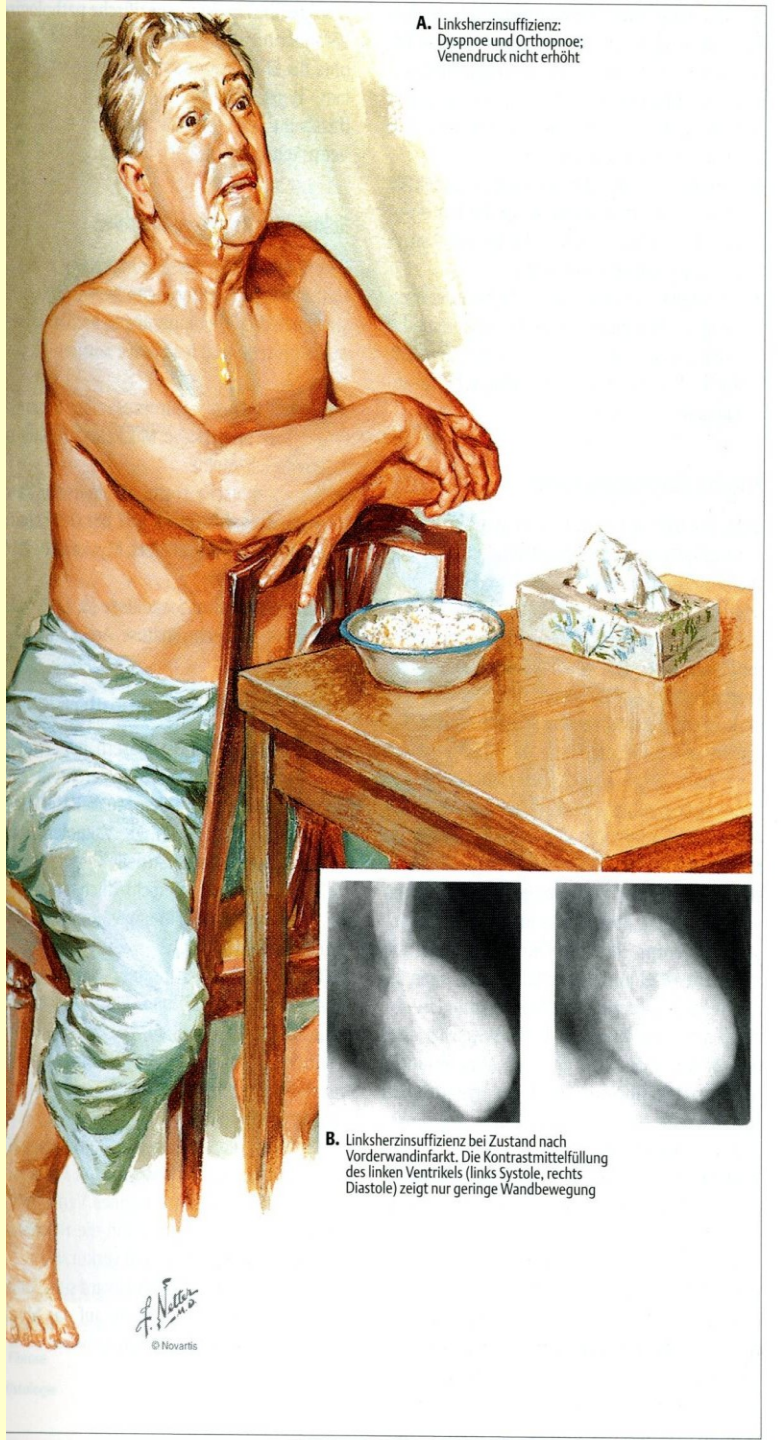


perfusion (heart)

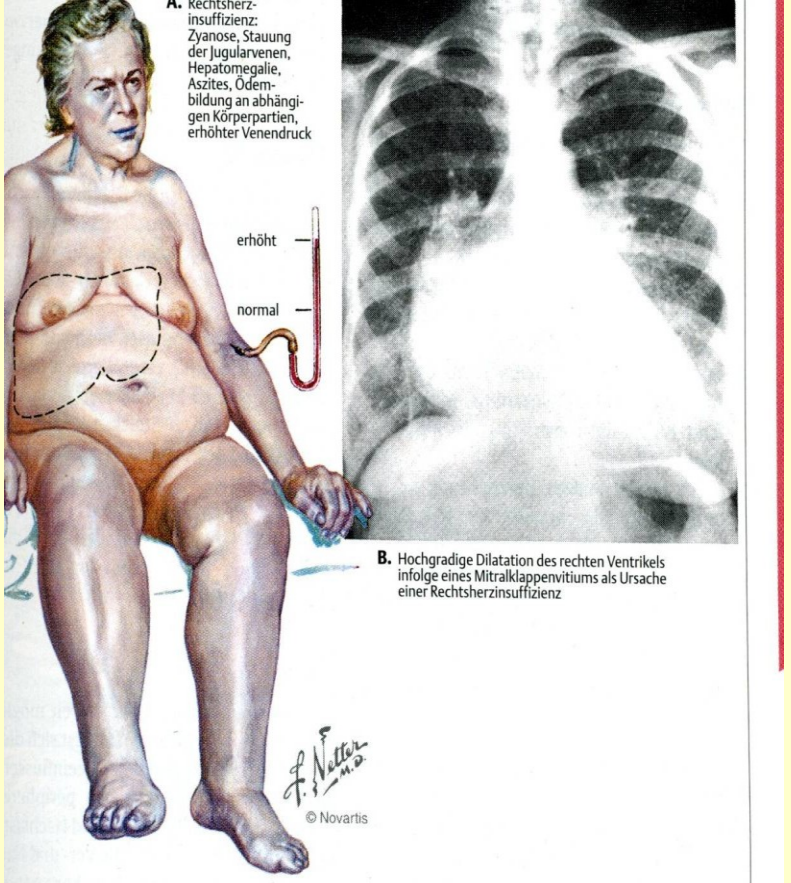
Pressures Causing Fluid Movement



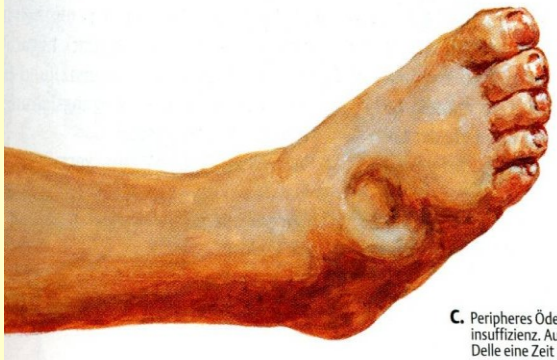
Pulmonary edema
- cardiogenic
- noncardiogenic



Cyanosis (right ventricle)



B. Hochgradige Dilatation des rechten Ventrikels infolge eines Mitralklappenvitiums als Ursache einer Rechtsherzinsuffizienz



C. Peripheres Ödem bei Rechtsherzinsuffizienz. Auf Druck bleibt eine Delle eine Zeit lang bestehen

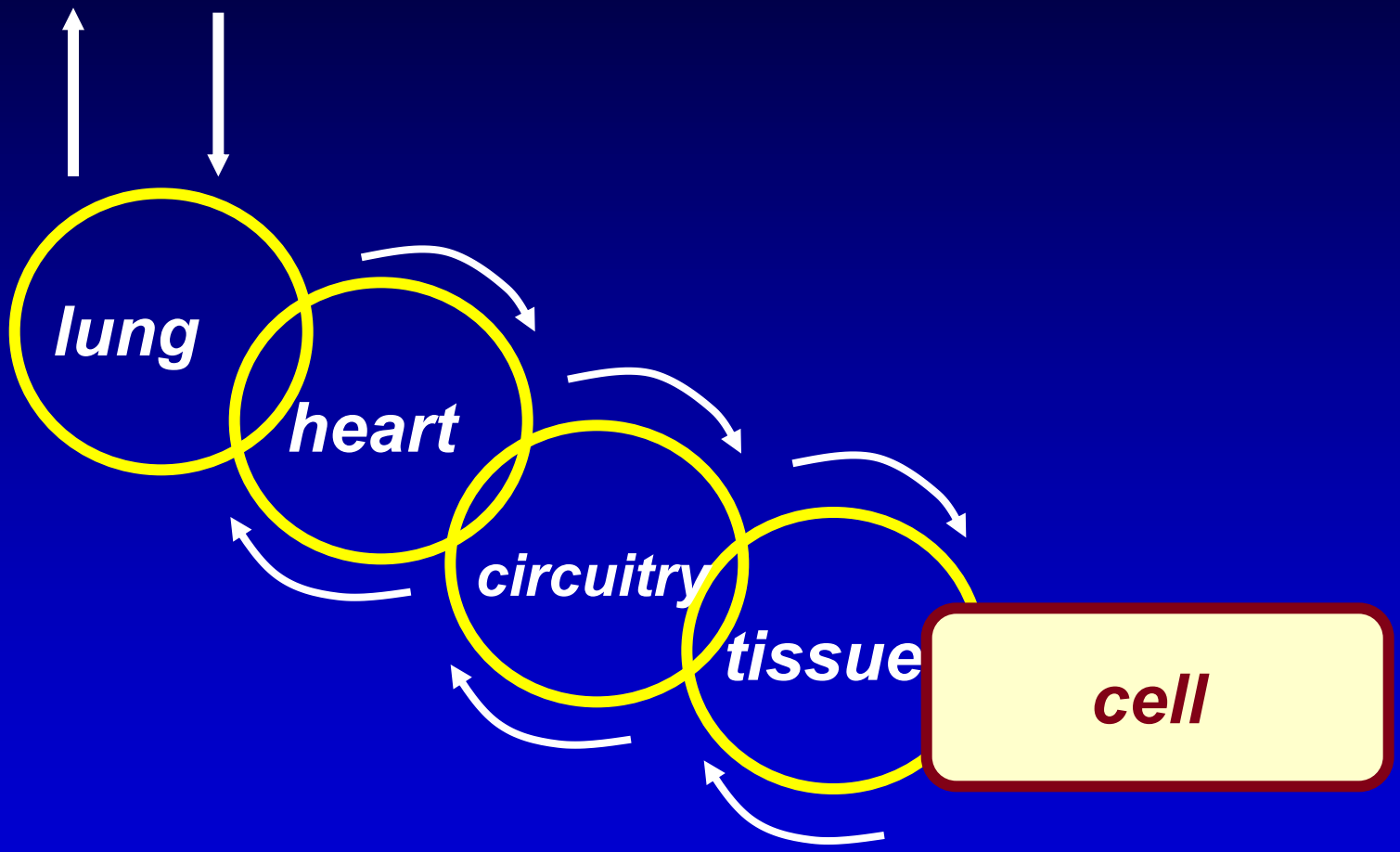
Causes of cyanosis

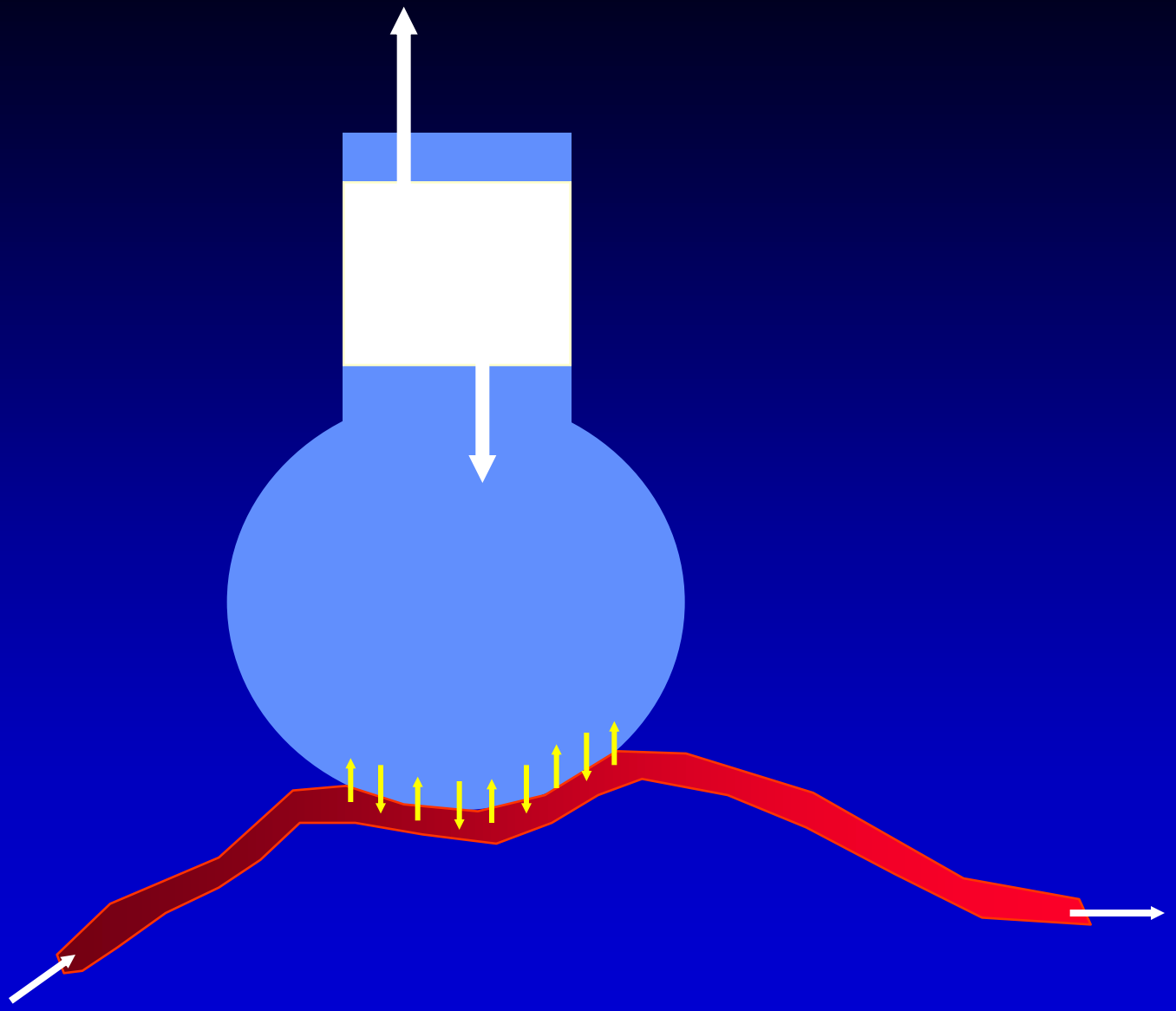
Central cyanosis

Decreased arterial saturation
Hemoglobin abnormalities

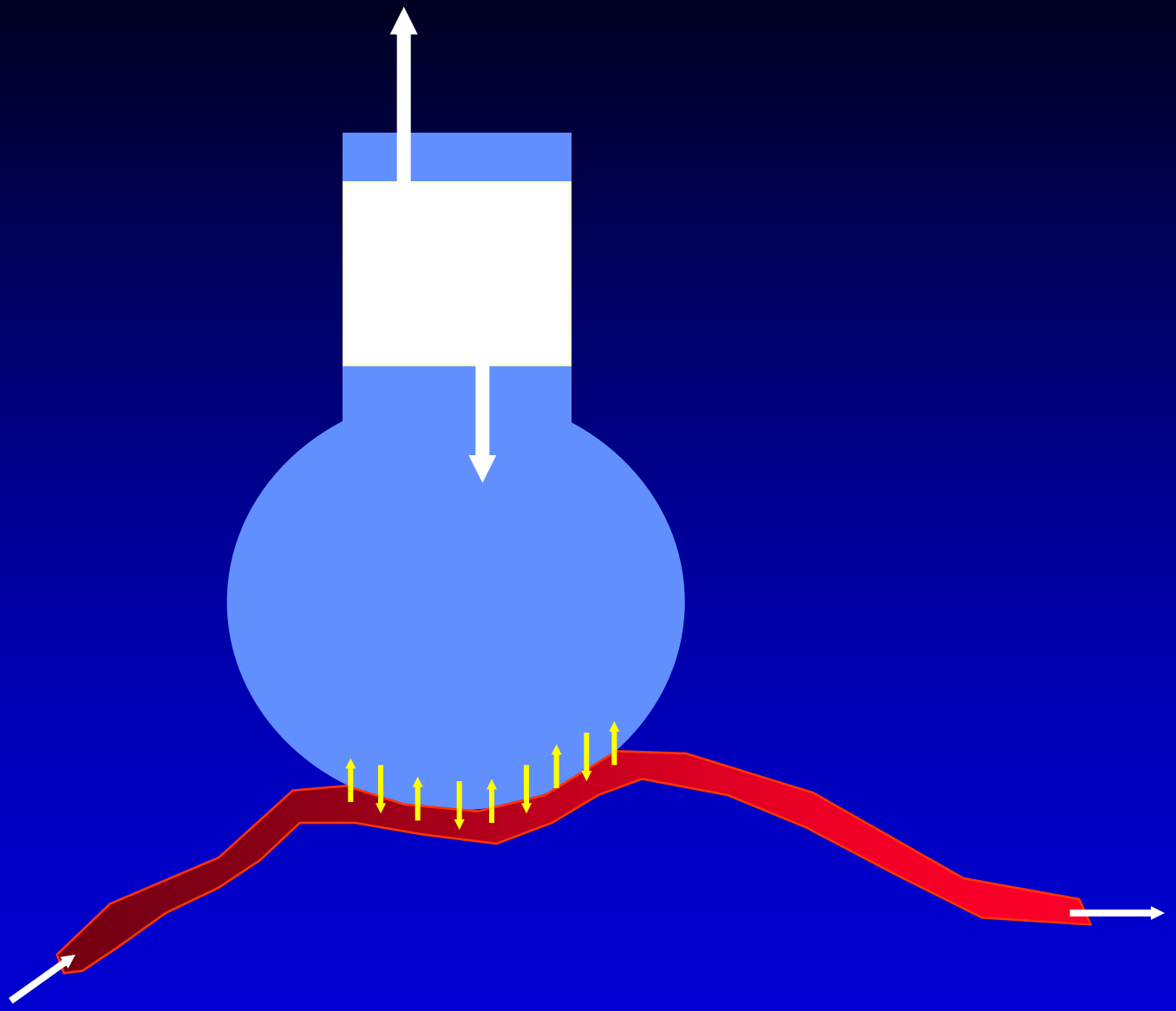
Peripheral cyanosis

Reduced cardiac output
Cold exposure
Redistribution of blood flow from extremities
Arterial obstruction
Venous obstruction

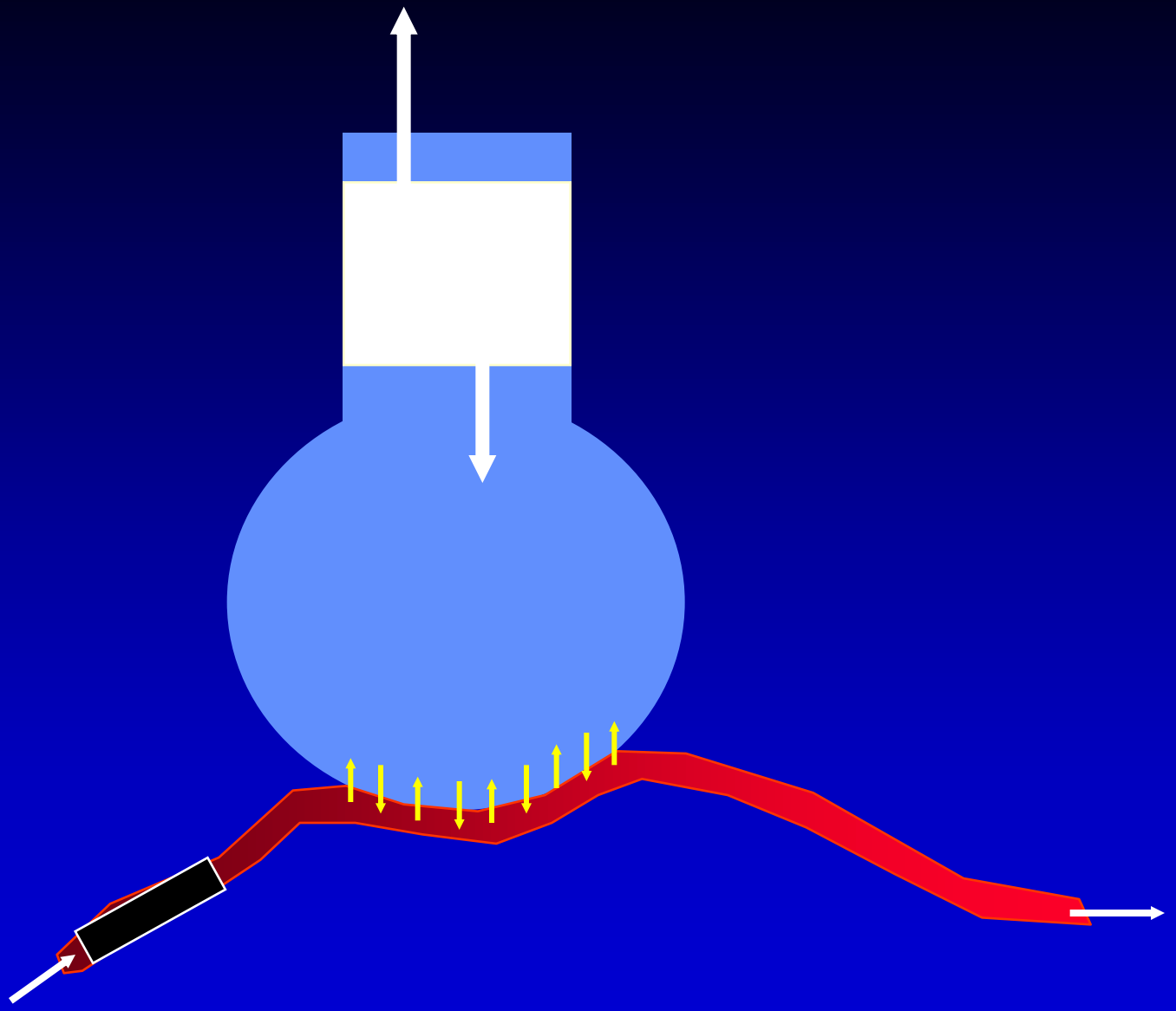

lung
heart
circuitry
tissue
cell



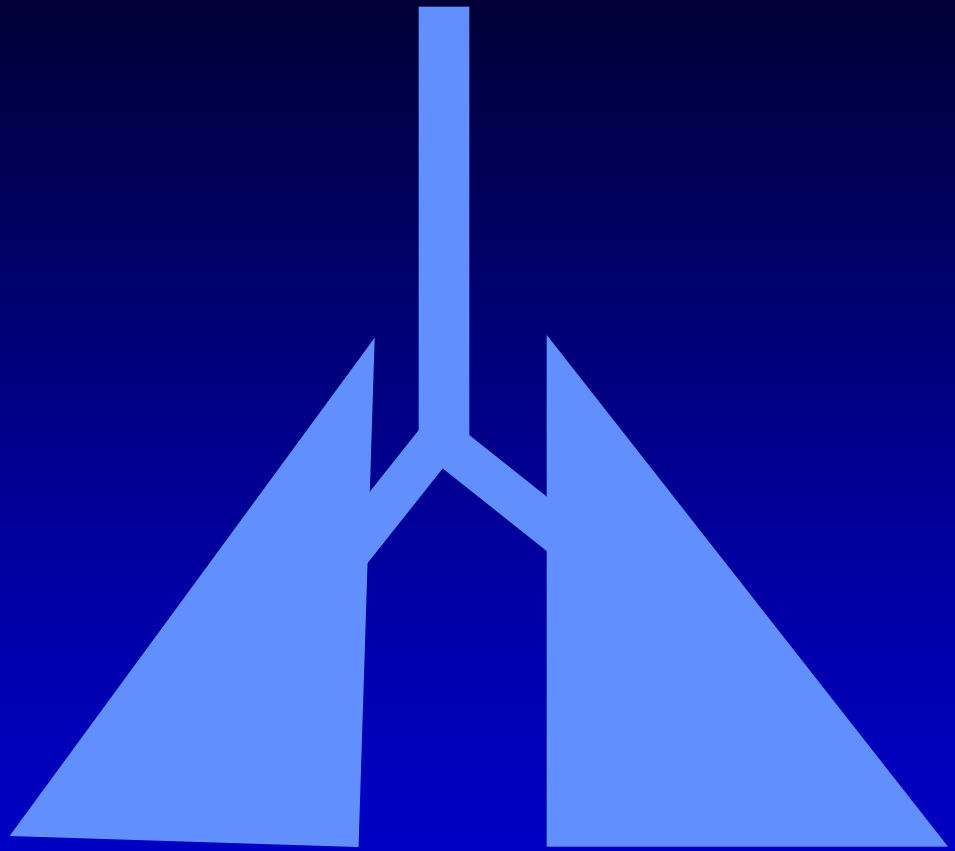
perfusion
(anemia)



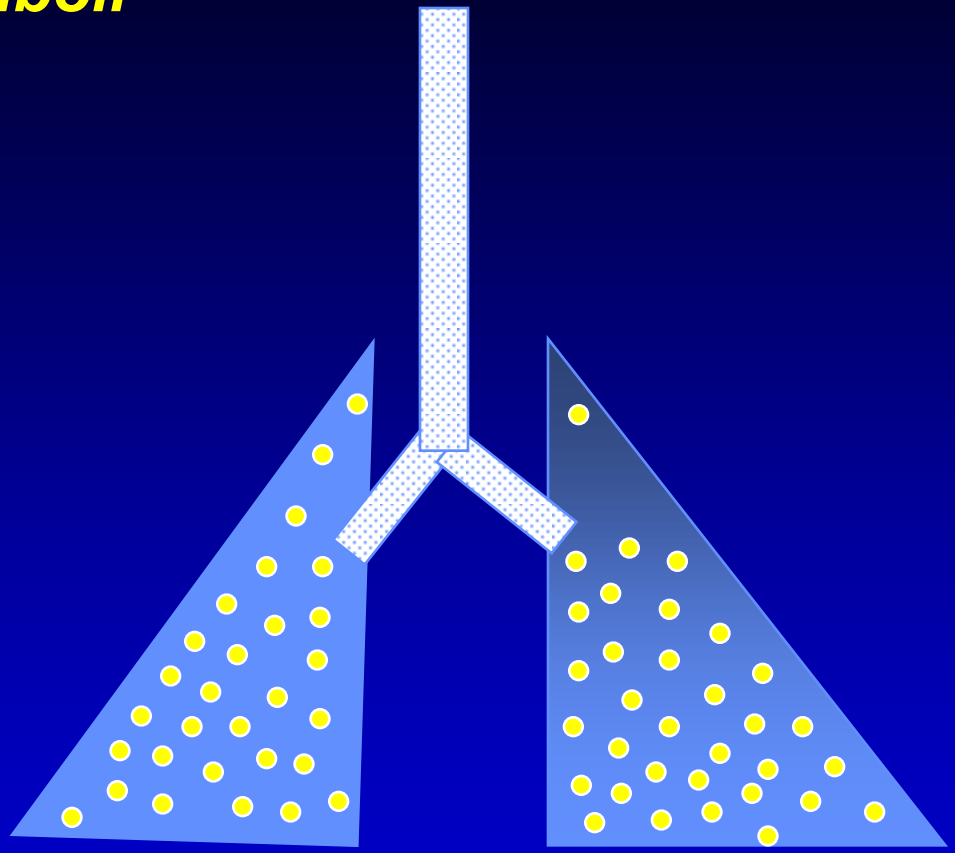
perfusion
(emboli)



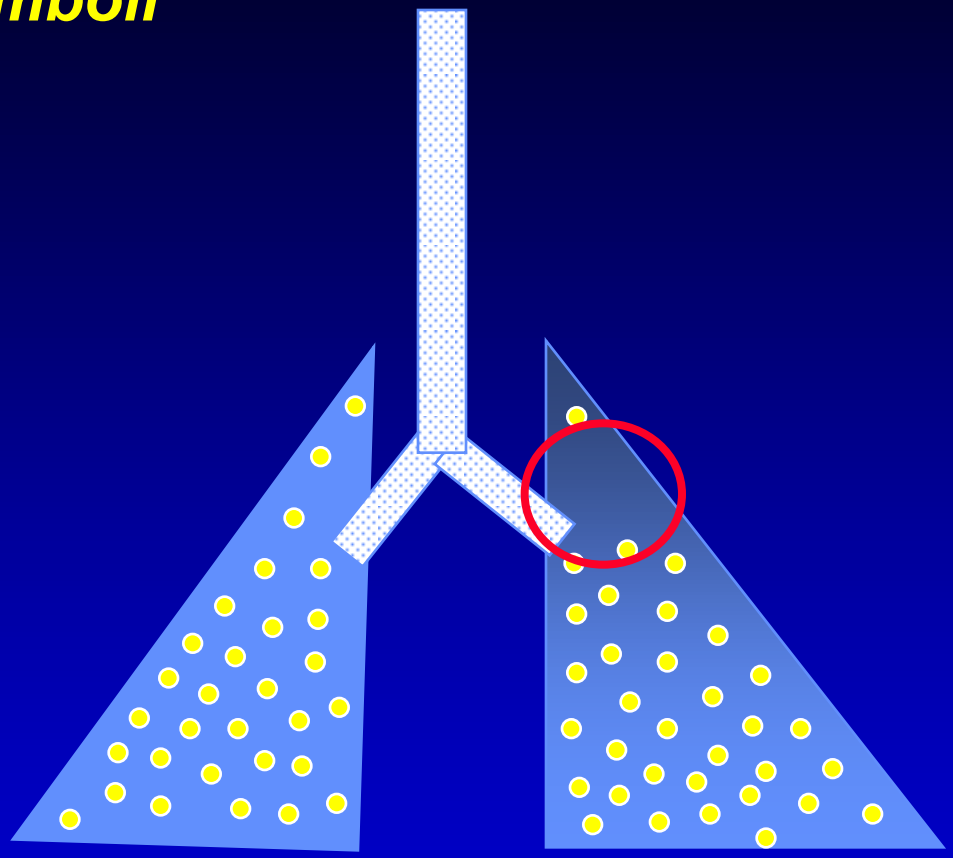
perfusion
(emboli)



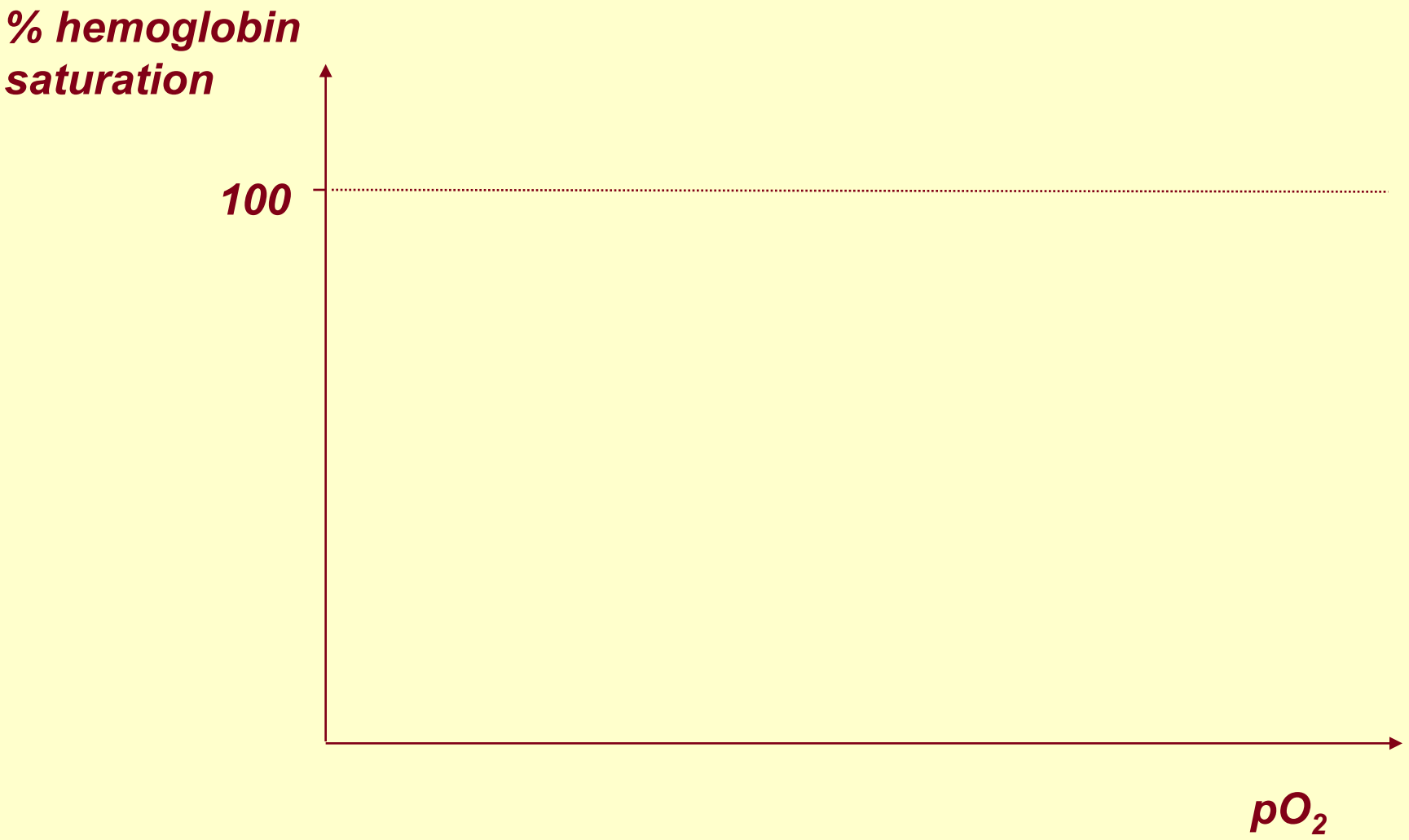
dg. pulmonal emboli



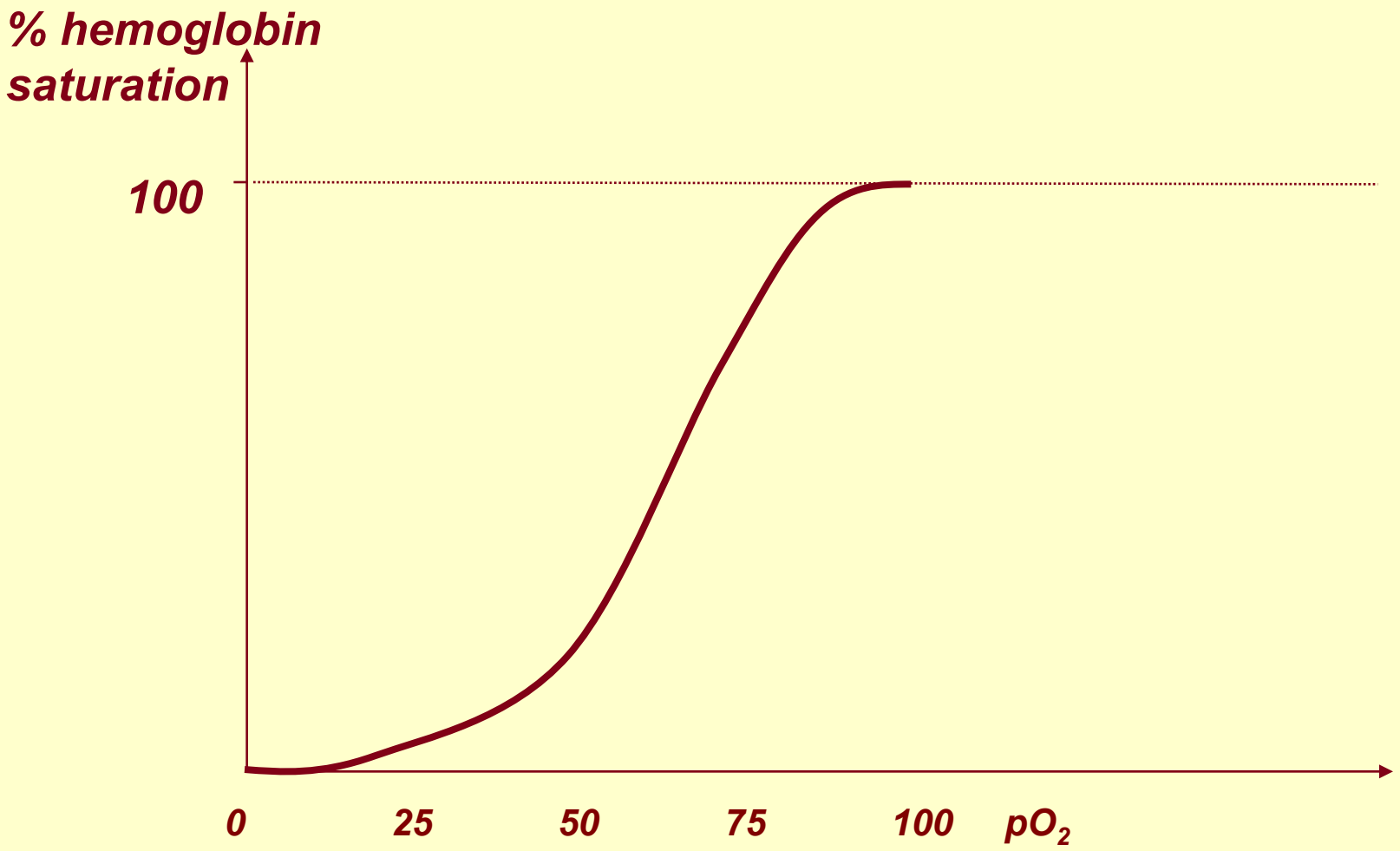
Dg. pulmonal emboli



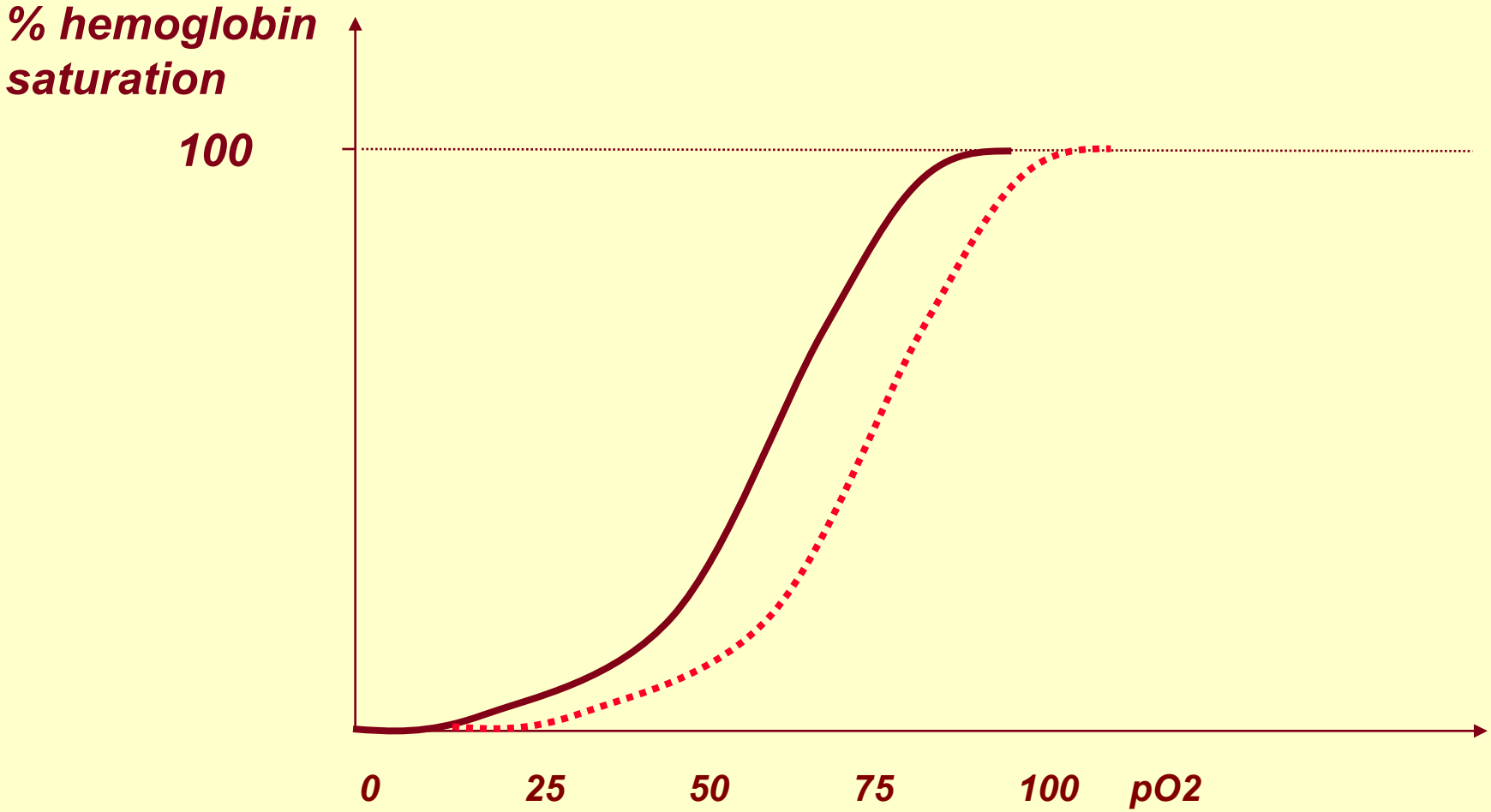
Bohrs effects



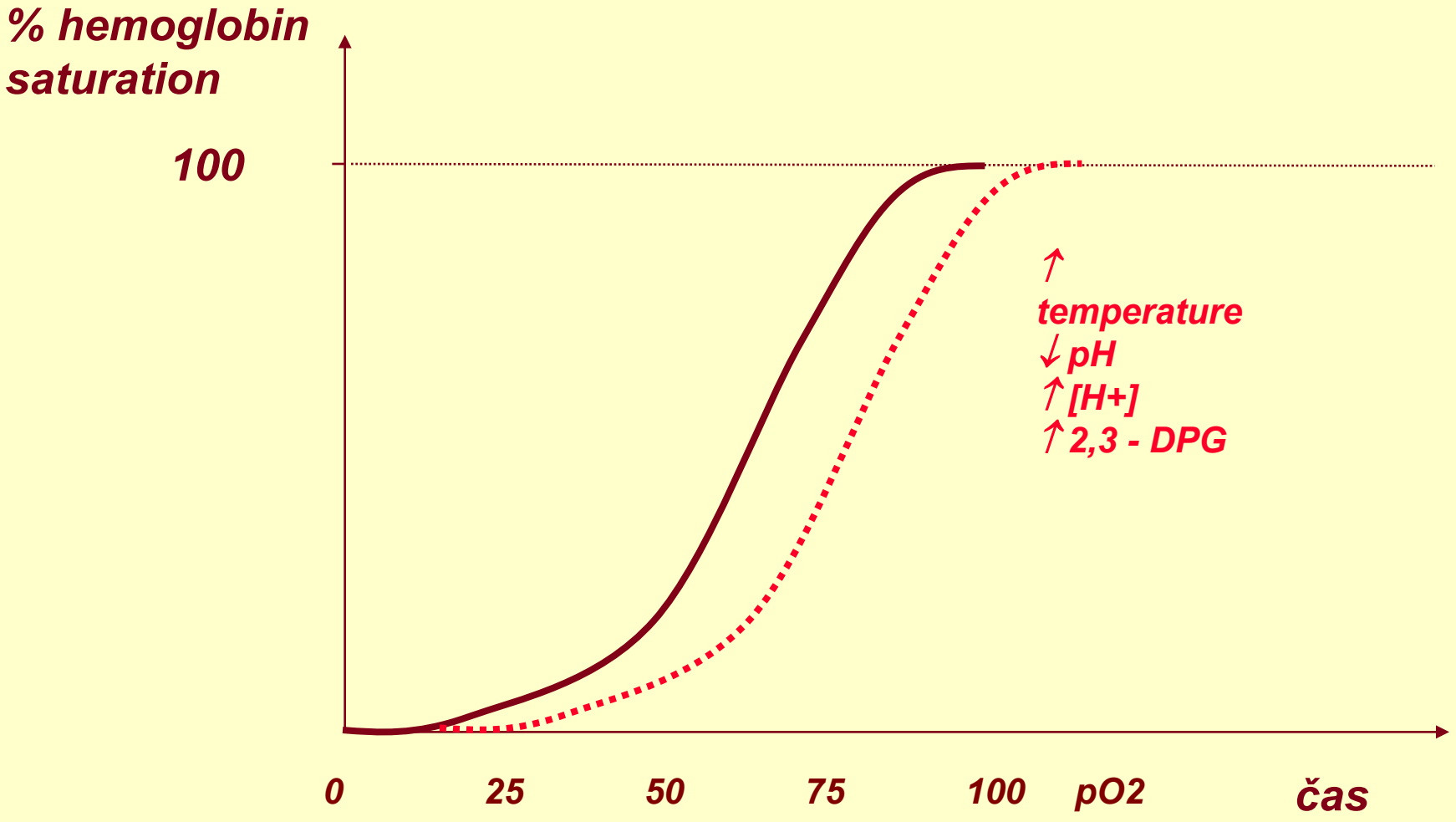
Bohrs effect – O_2 hemoglobin dissociation curve



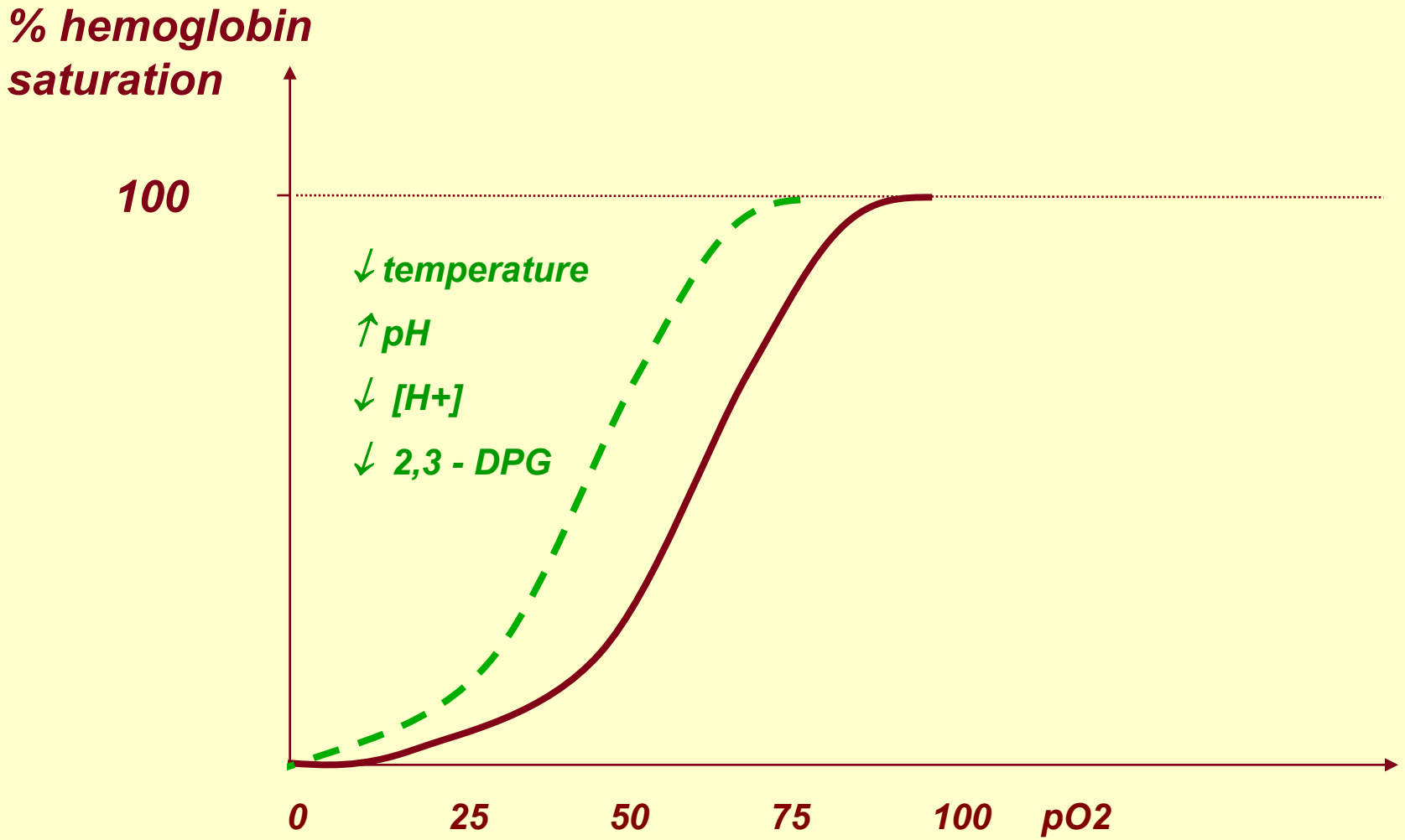
Shift to the right



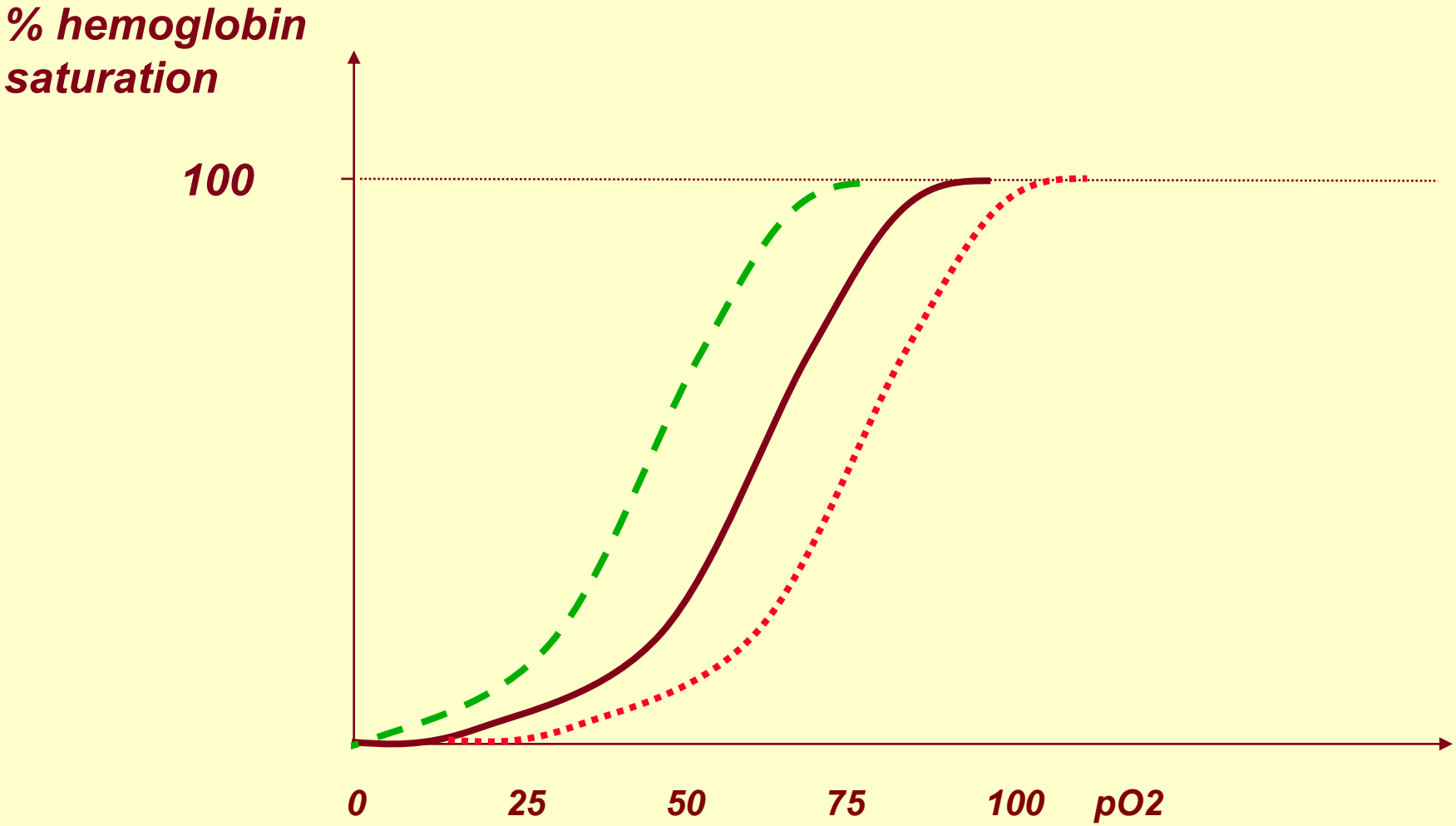
Shift to the right



Shift to the left

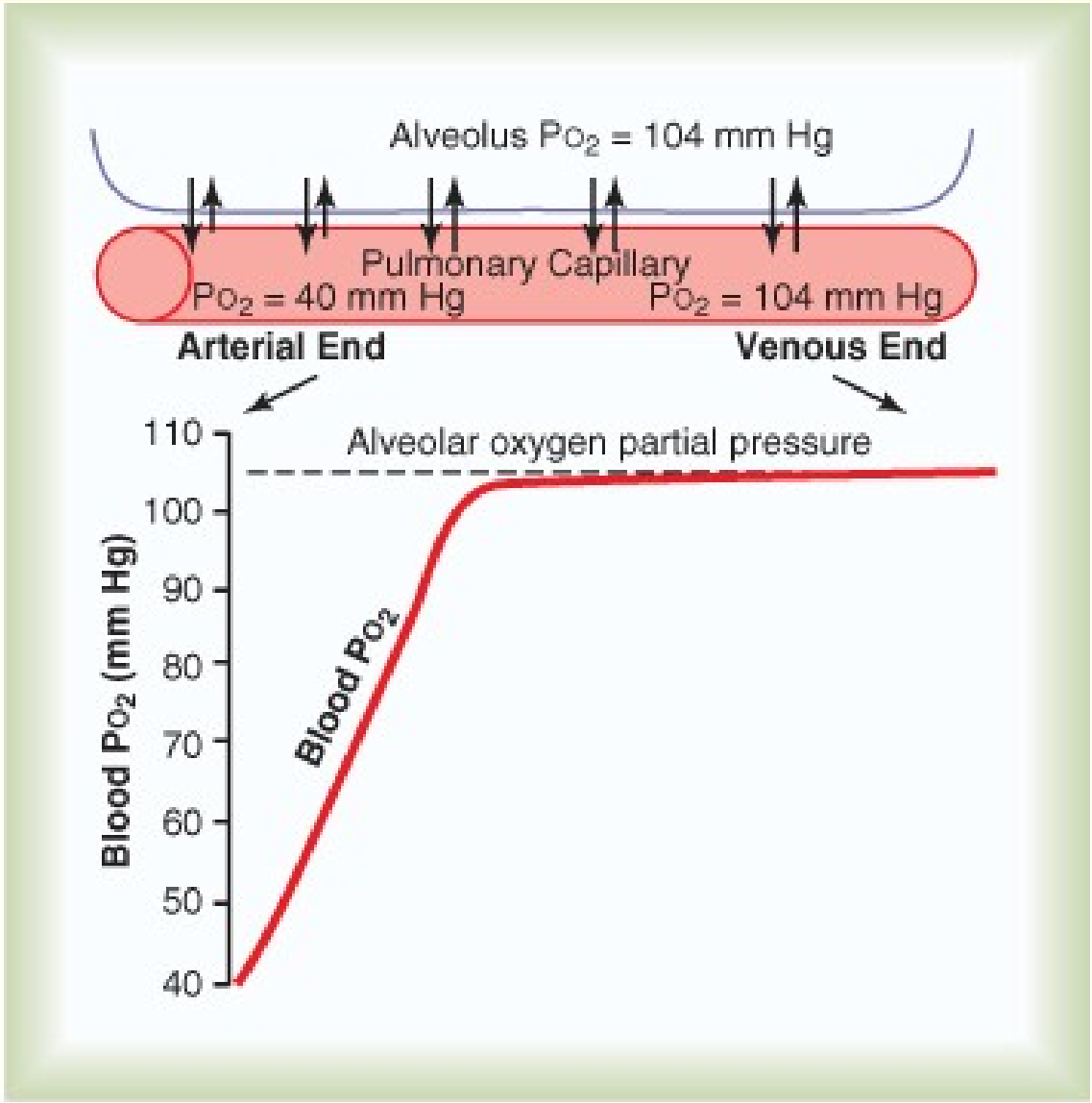


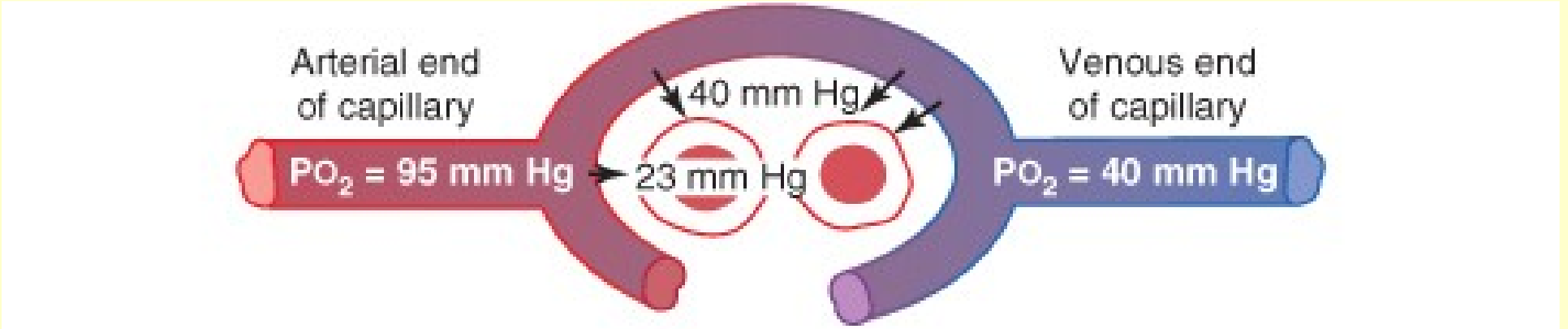
Bohr effect

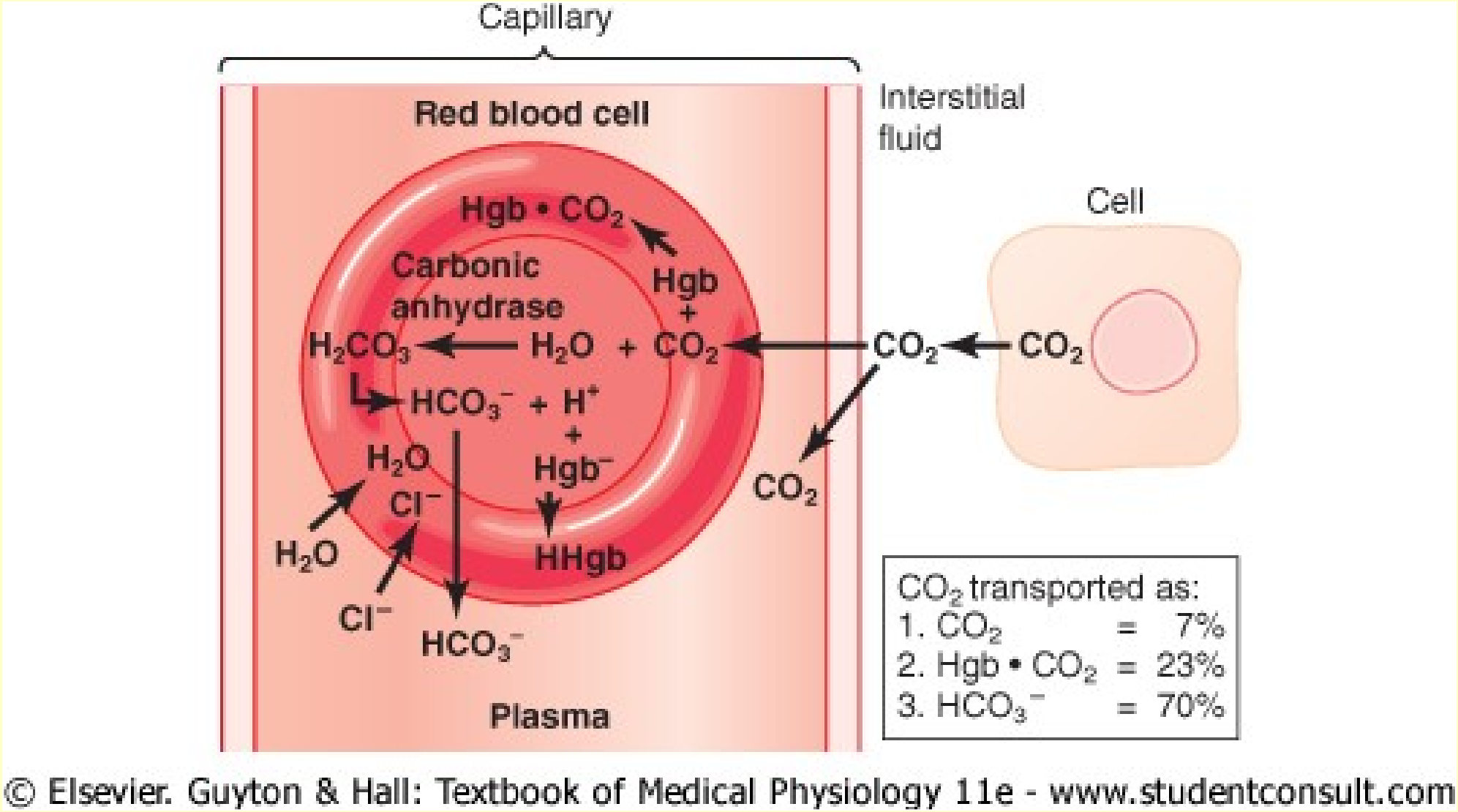


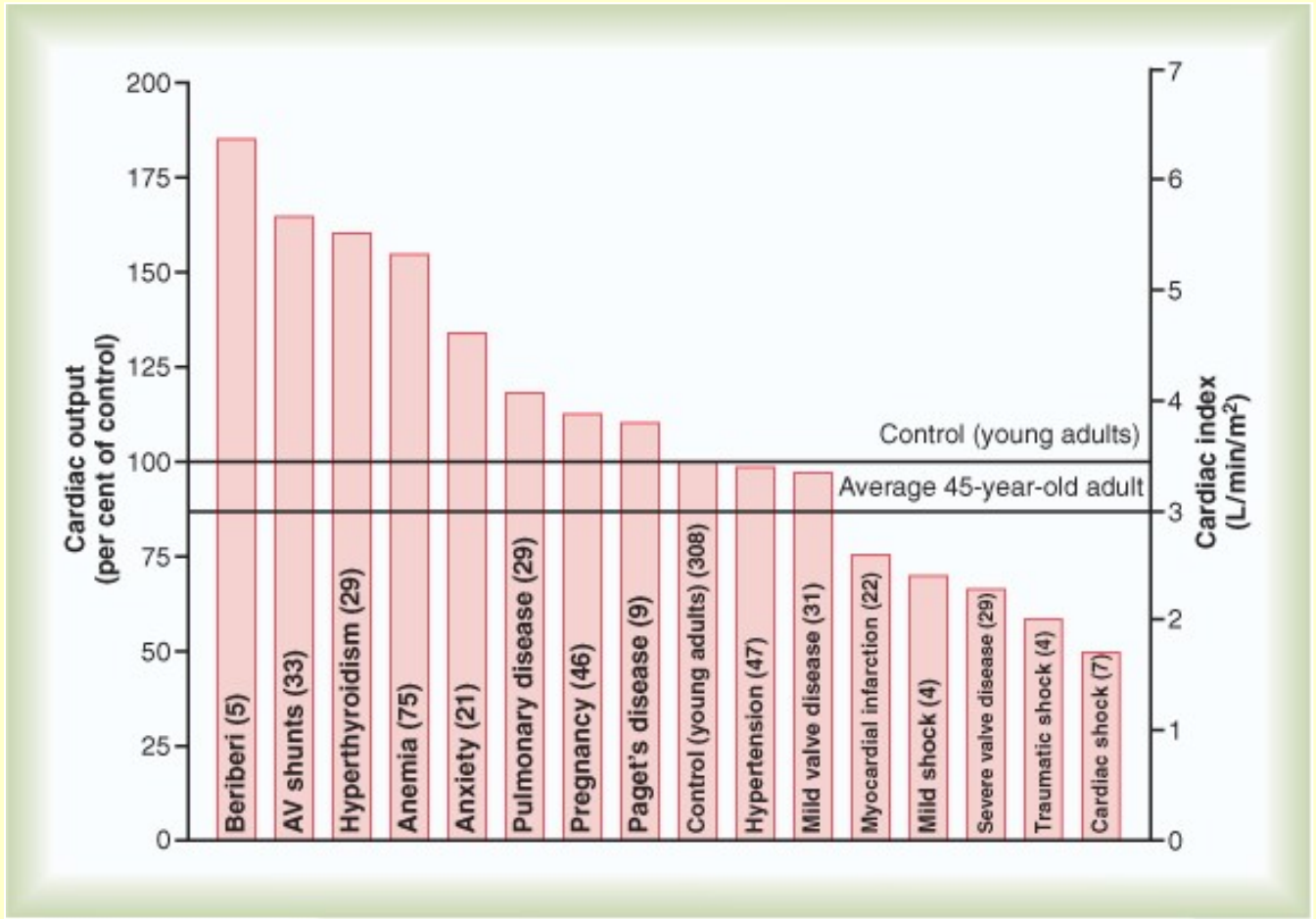
Values of pO_2 and corresponding values of percent saturation of hemoglobin

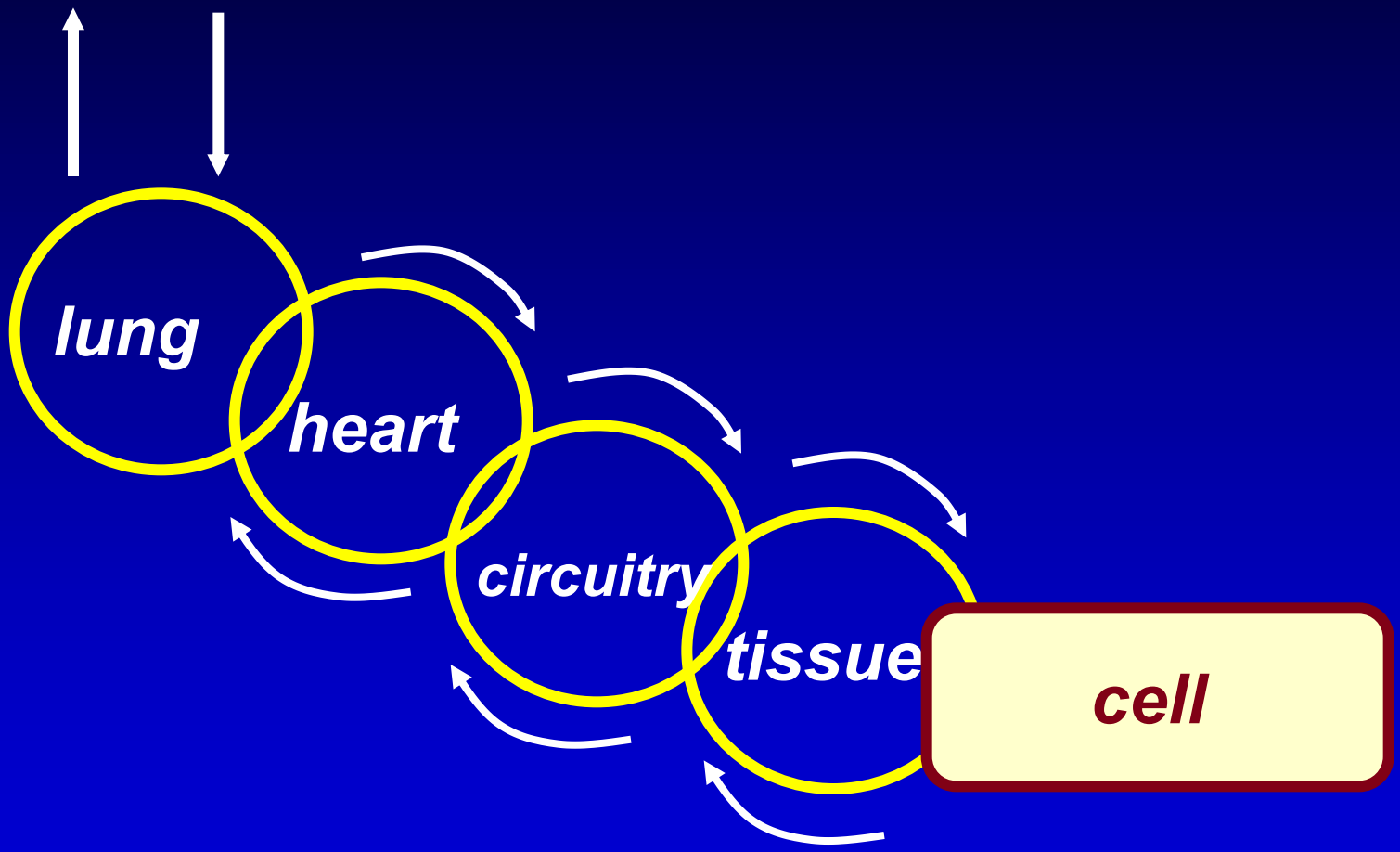
pO_2 mmHg	saturation (%)
10	25
20	35
25	50
30	60
40	75
50	85
60	90
80	96
100	98










lung
heart
circuitry
tissue
cell