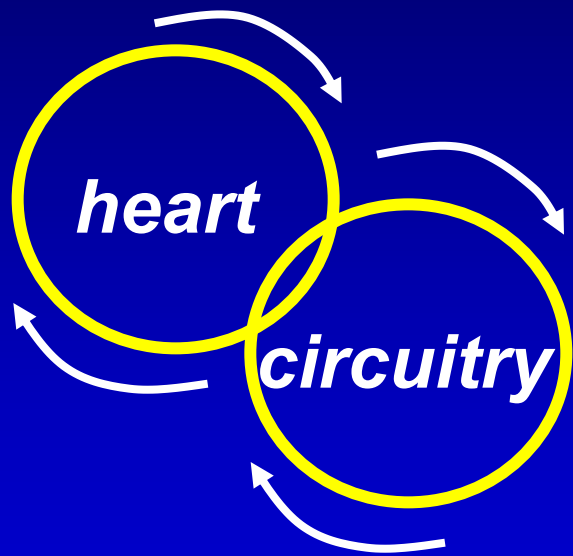
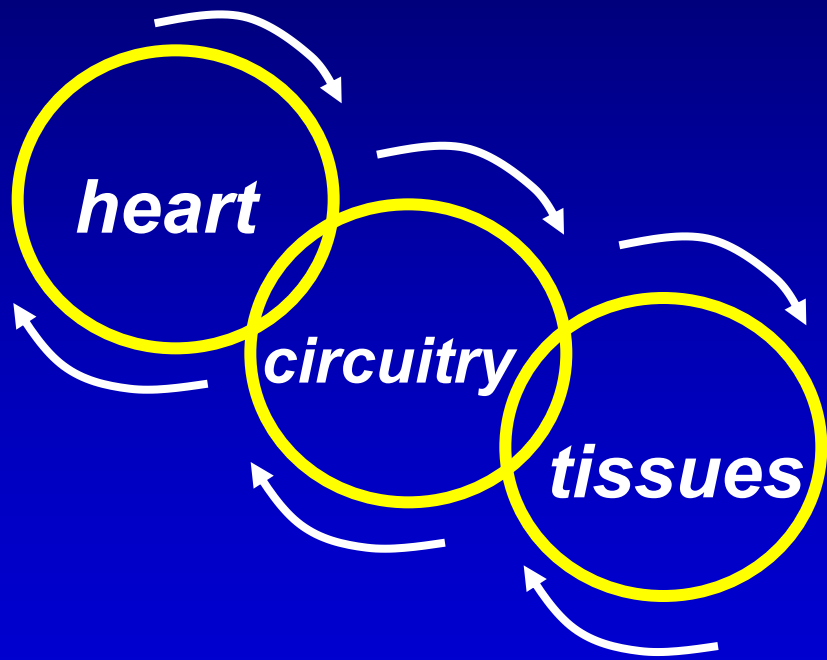
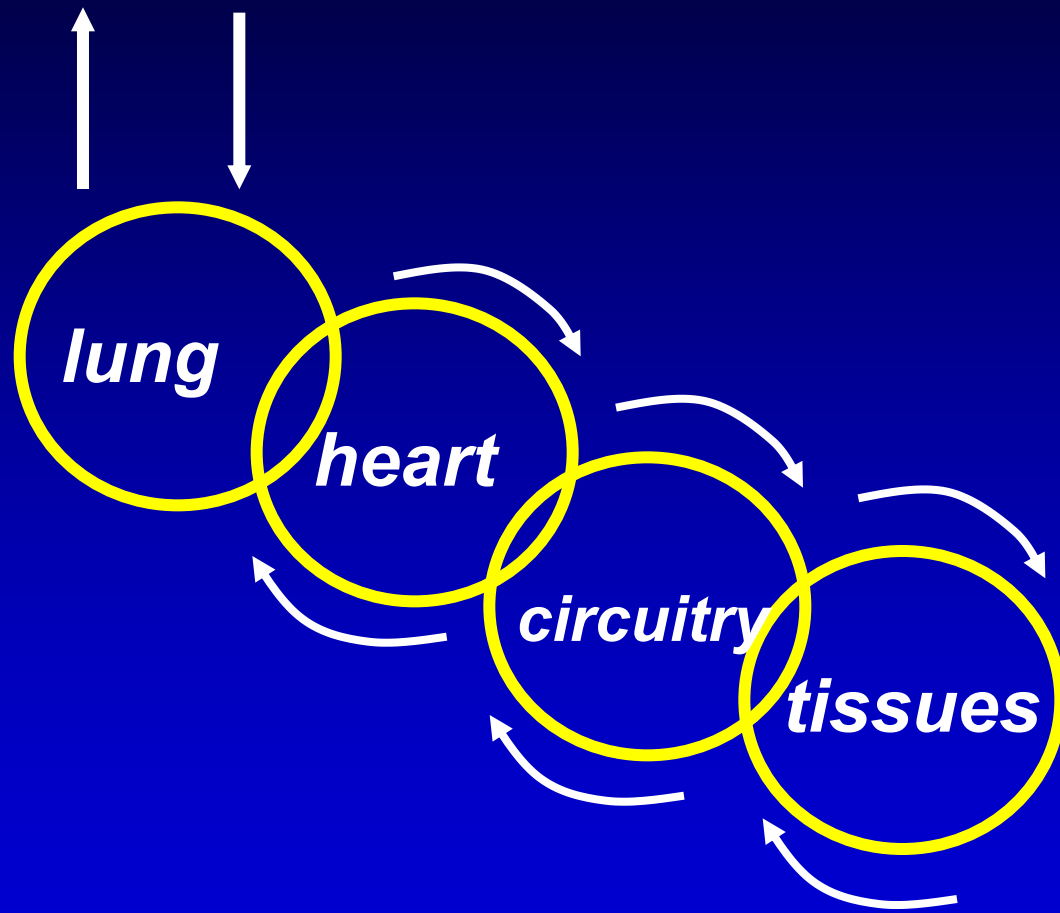


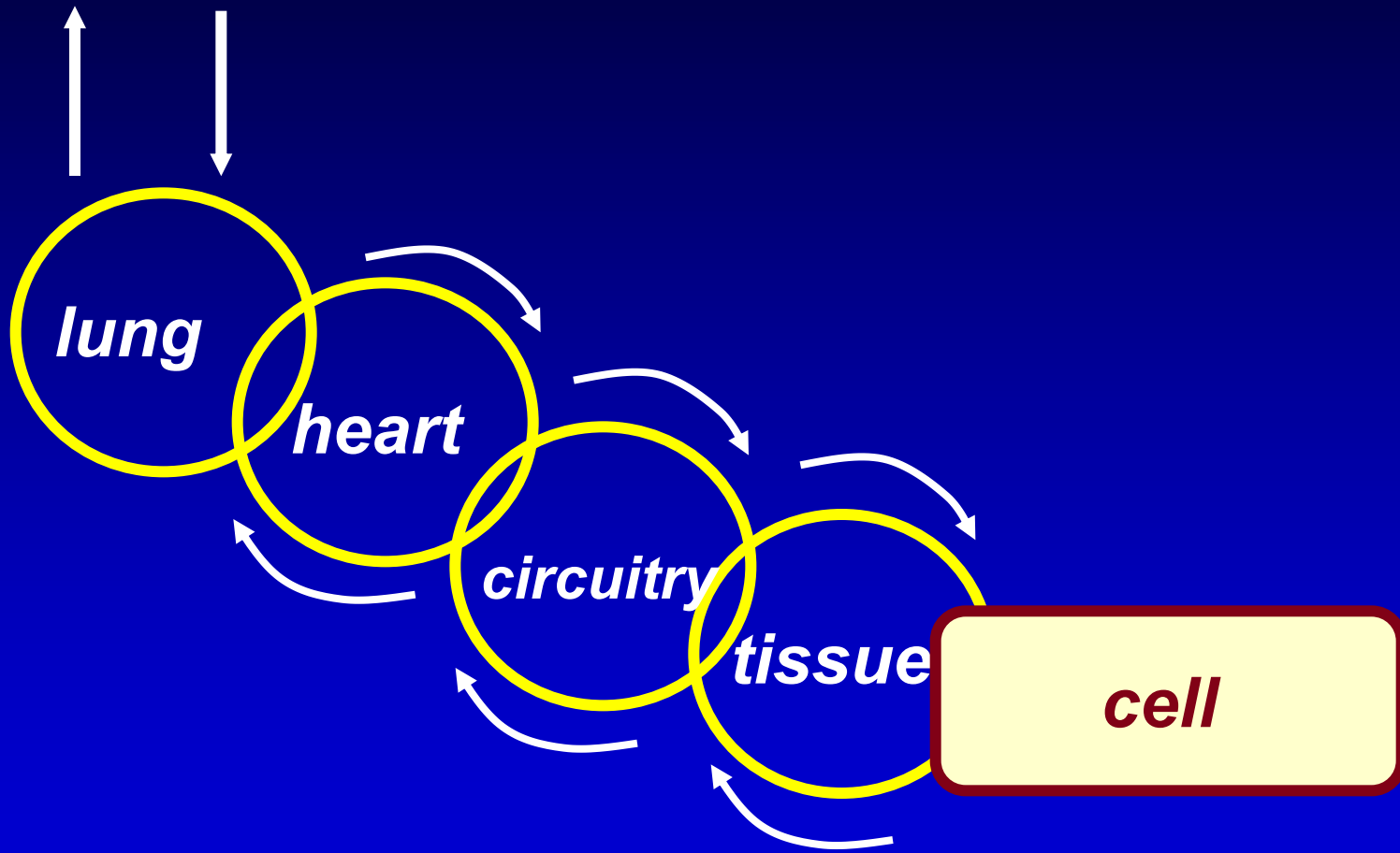
Respiratory Physiology

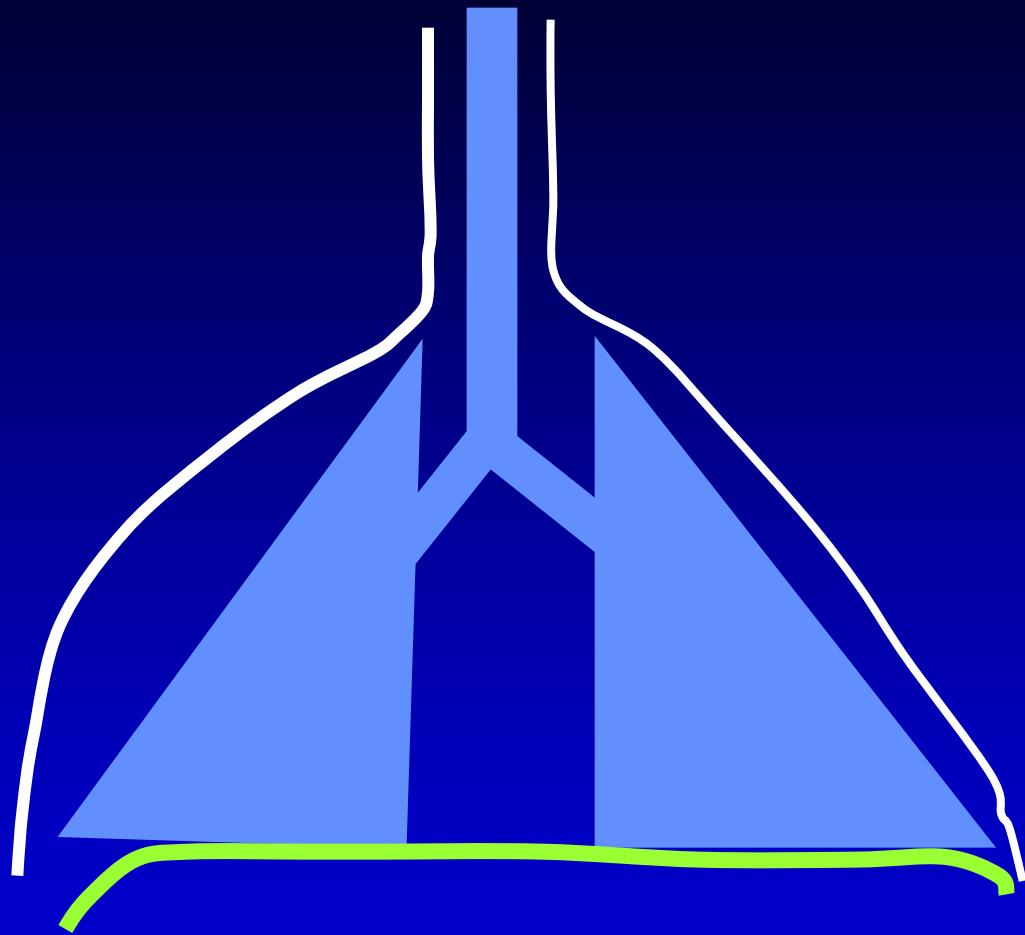






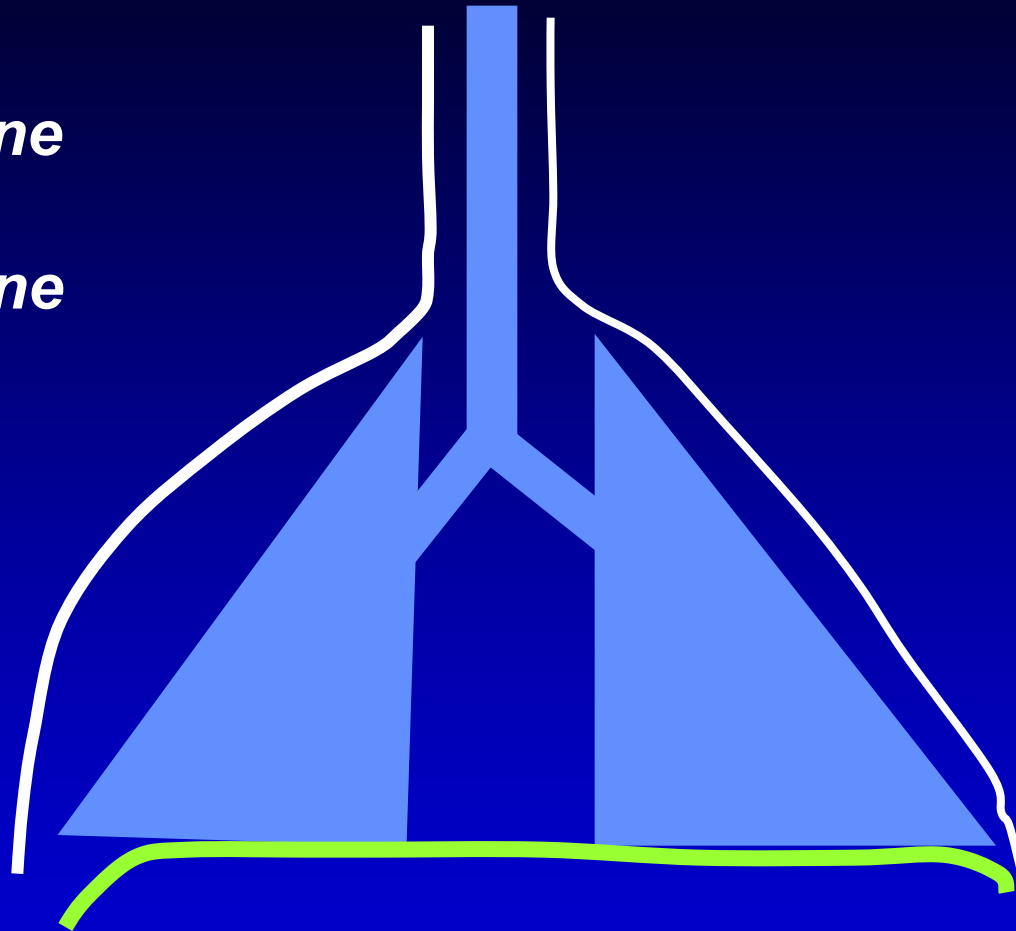






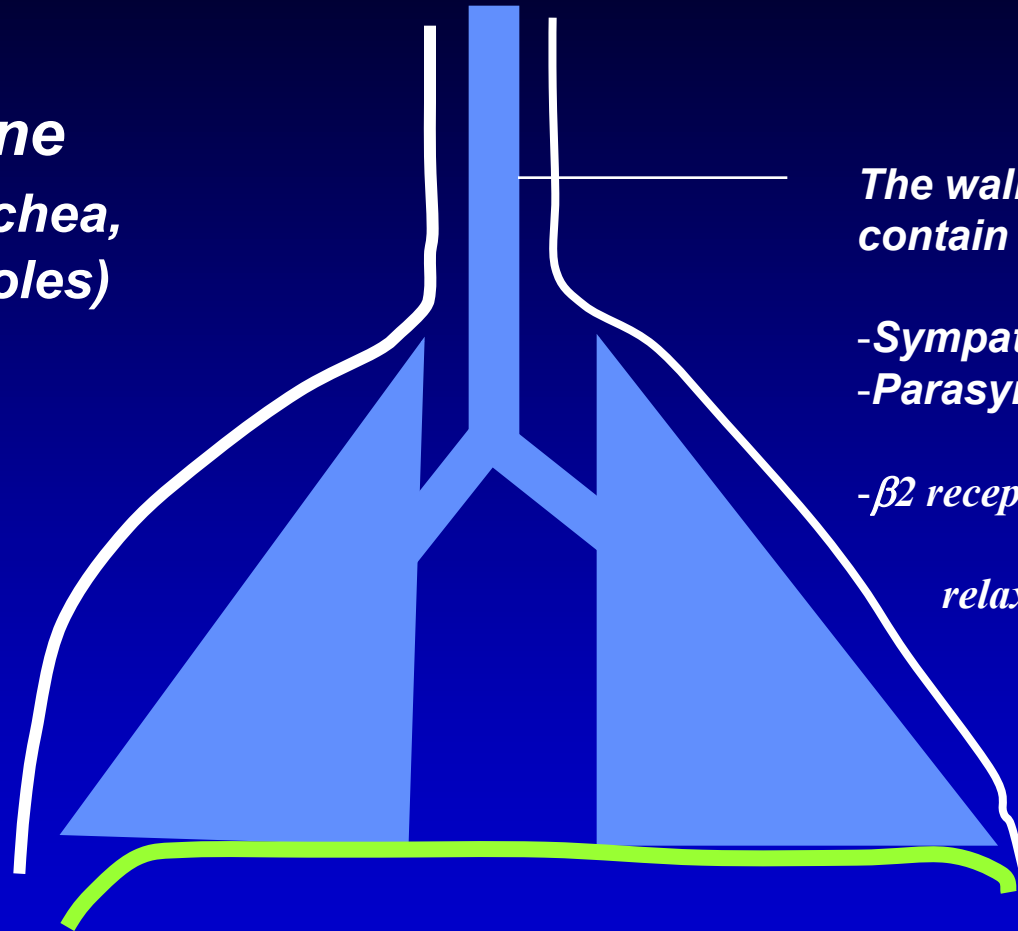
STRUCTURE of respiratory system

- ***Conducting zone***
- ***Respiratory zone***



STRUCTURE of respiratory system

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



The walls conducting airways contain smooth muscle

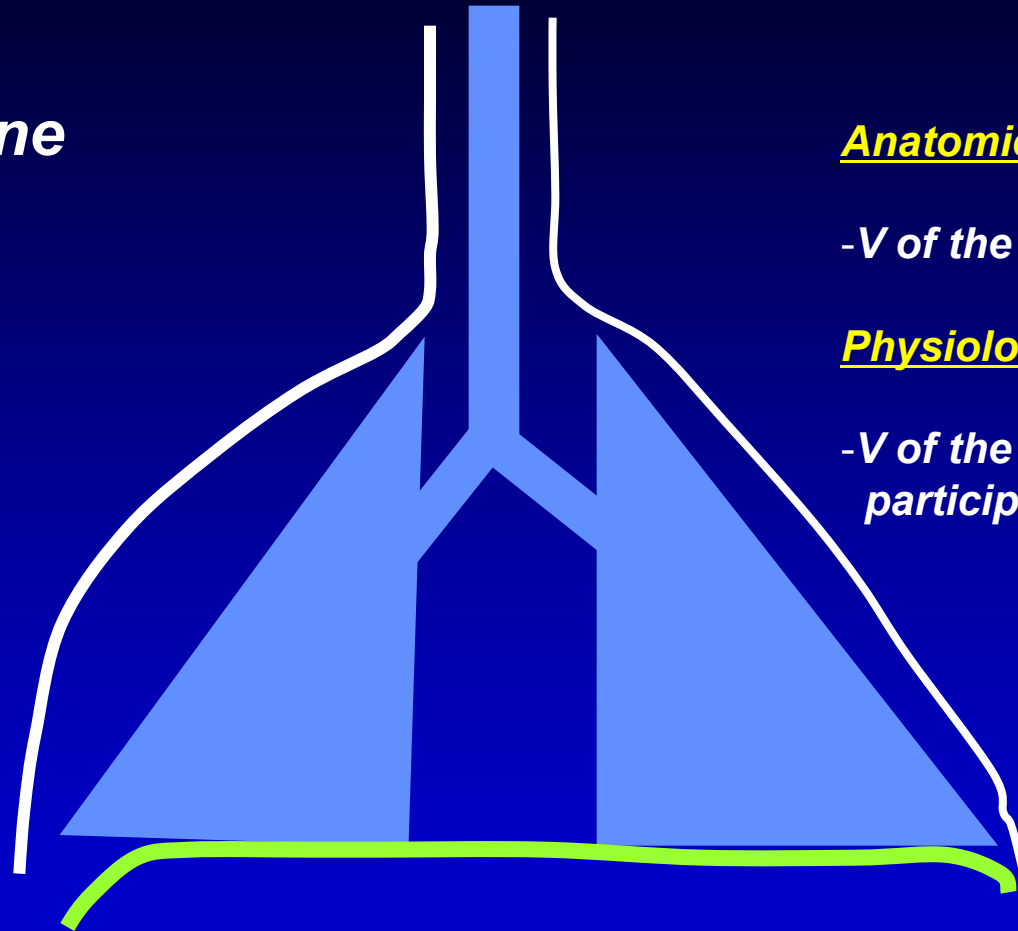
- Sympathetic
- Parasympathetic

- β 2 receptors

relaxation, dilatation of the airway

STRUCTURE of respiratory system

- **Conducting zone**



Anatomic dead space

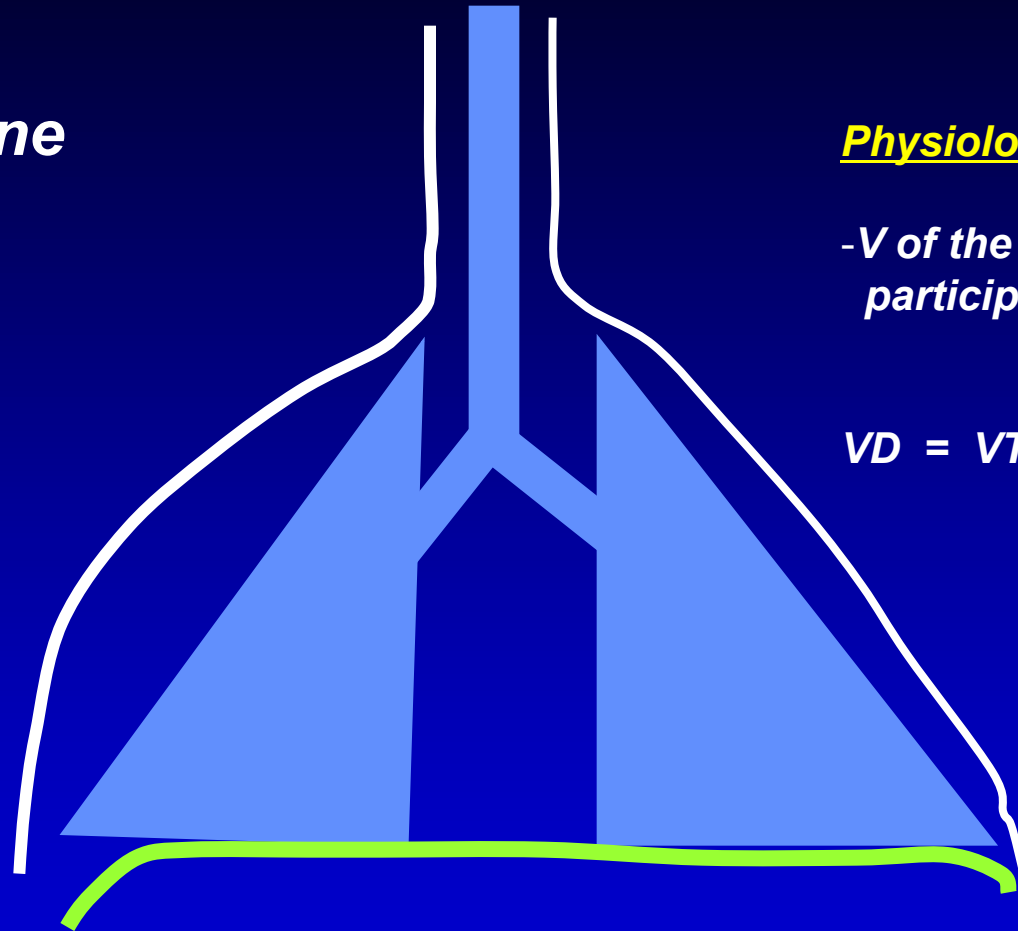
-V of the conducting airways

Physiologic dead space

-V of the lungs that does not participate in gas exchange

STRUCTURE of respiratory system

- **Conducting zone**



Physiologic dead space (V_D)

-V of the lungs that does not participate in gas exchange

$$V_D = V_T \times \frac{P_{a_{CO_2}} - P_{E_{CO_2}}}{P_{a_{CO_2}}}$$

V_T – tidal volume

$P_{a_{CO_2}} - P_{CO_2}$ of arterial blood

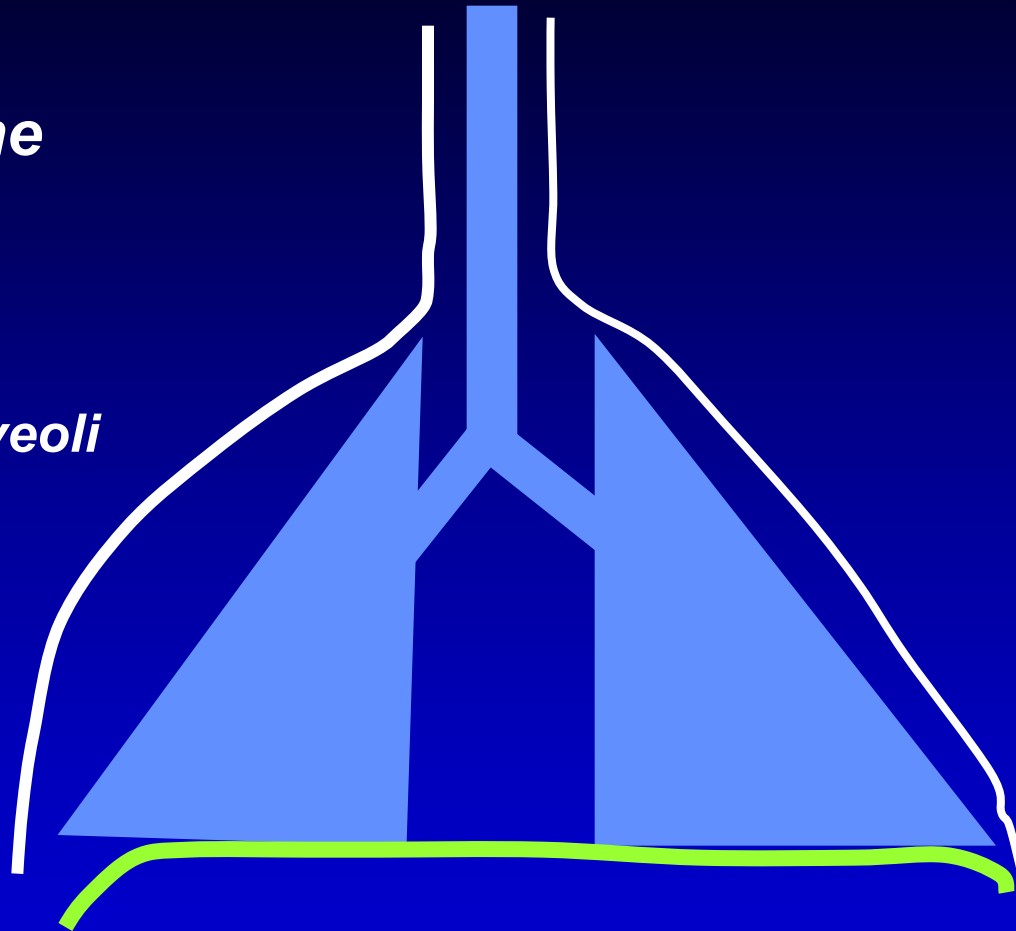
$P_{E_{CO_2}} - P_{CO_2}$ of mixed expired air

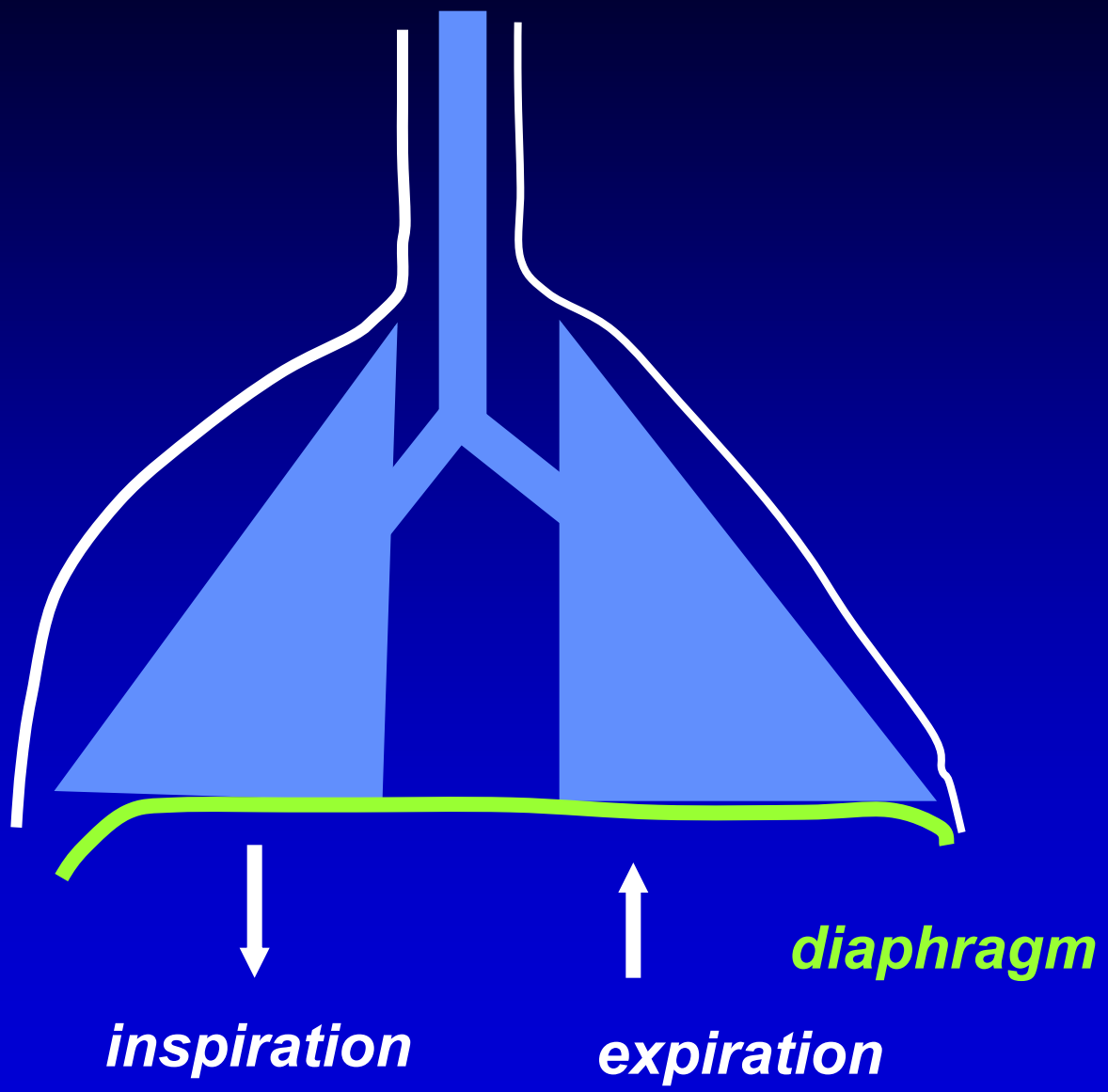
STRUCTURE of respiratory system

Respiratory zone

Alveoli

Lung ~ 300 x 10⁶ alveoli





inspiration – mm. intercostales externi

expiration – mm. intercostales interni

inspiration – mm. intercosales externi

expiration – mm. intercosteles interni

***i*nspiration – mm. intercosales externi**
***e*xpiration – mm. intercosteles interni**

inspiration – mm. intercostales externi

expiration – mm. intercostales interni

inspiration – mm. intercosales externi

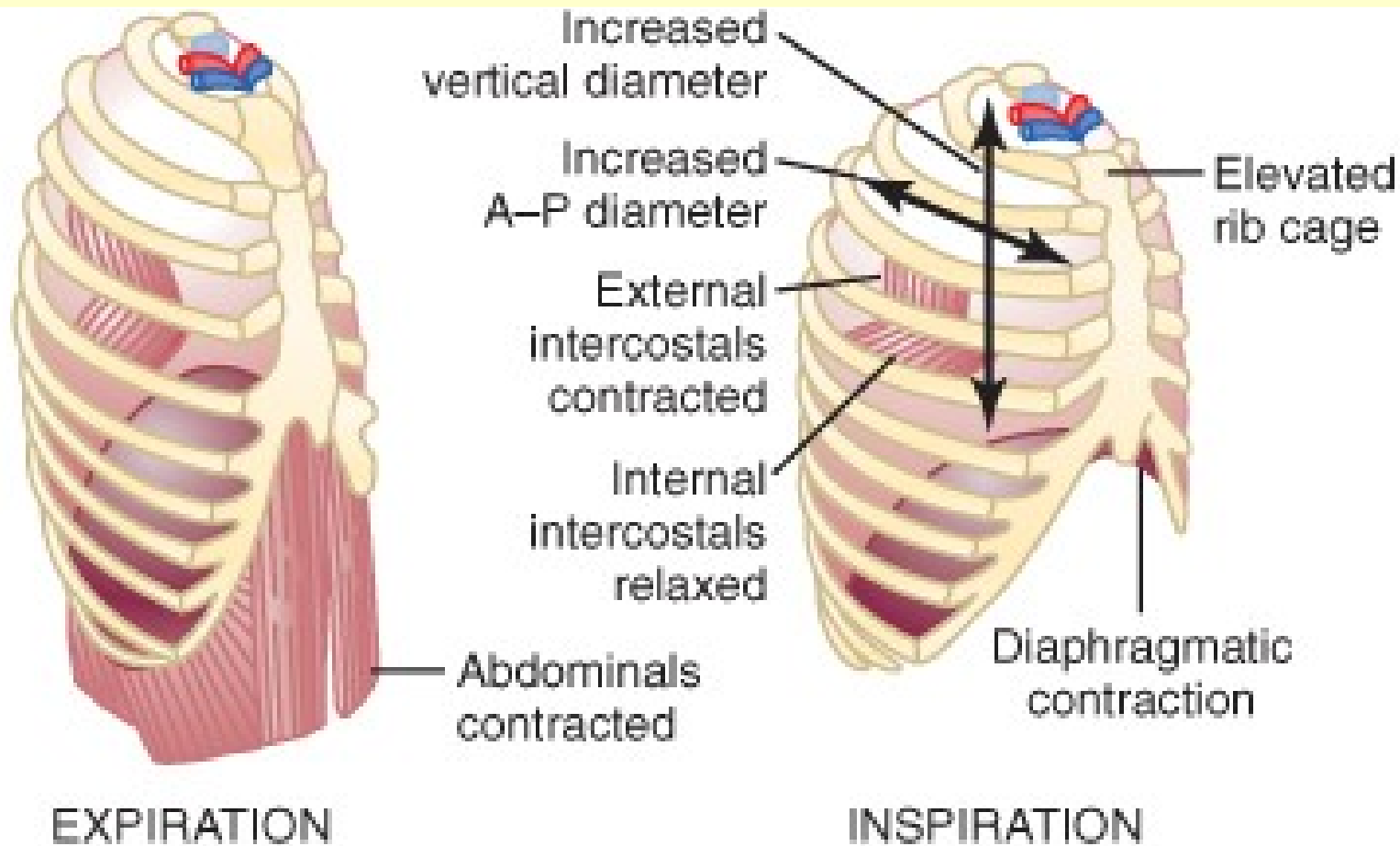
expiration – mm. intercosteales interni

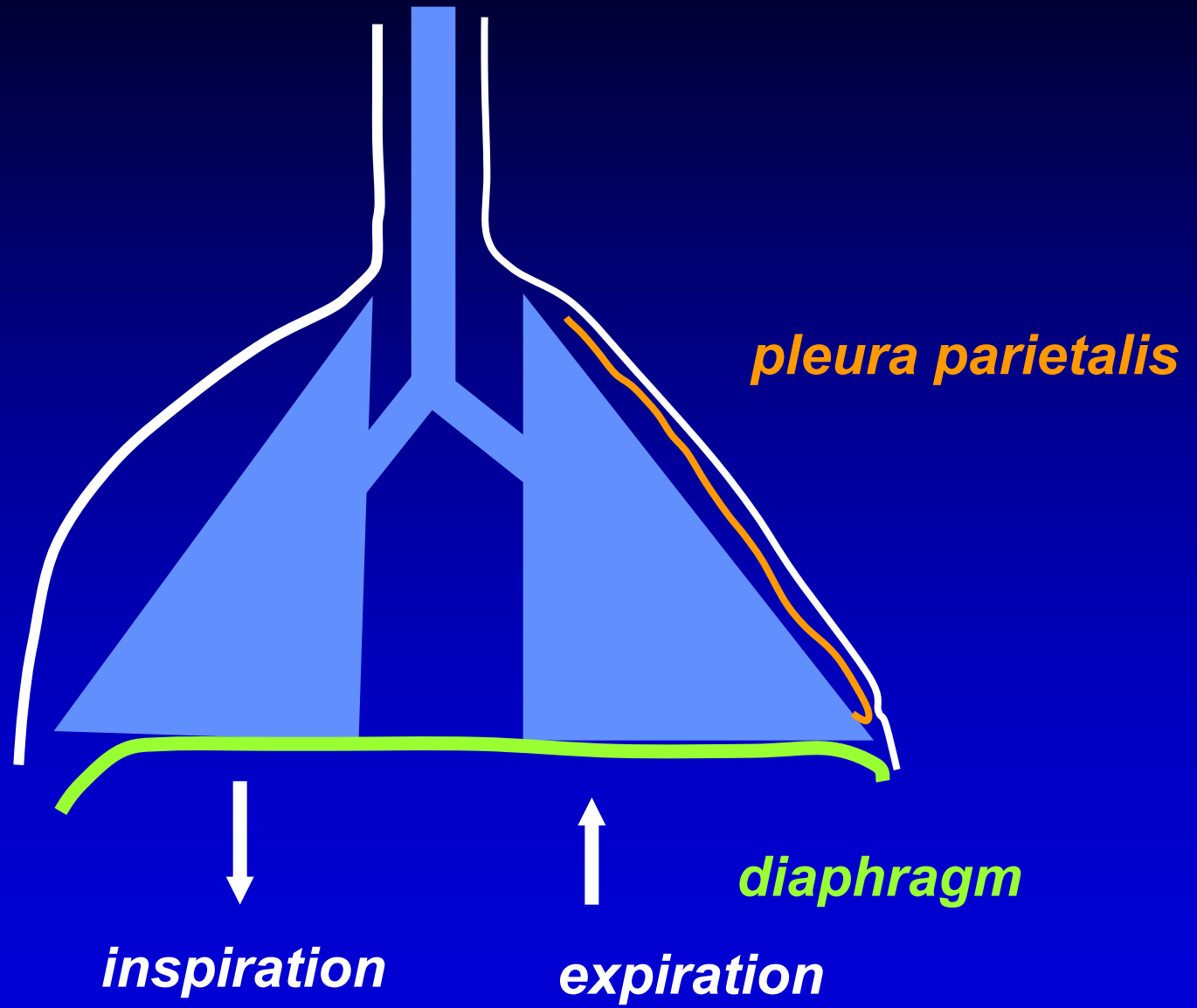
inspiration – mm. intercostales externi

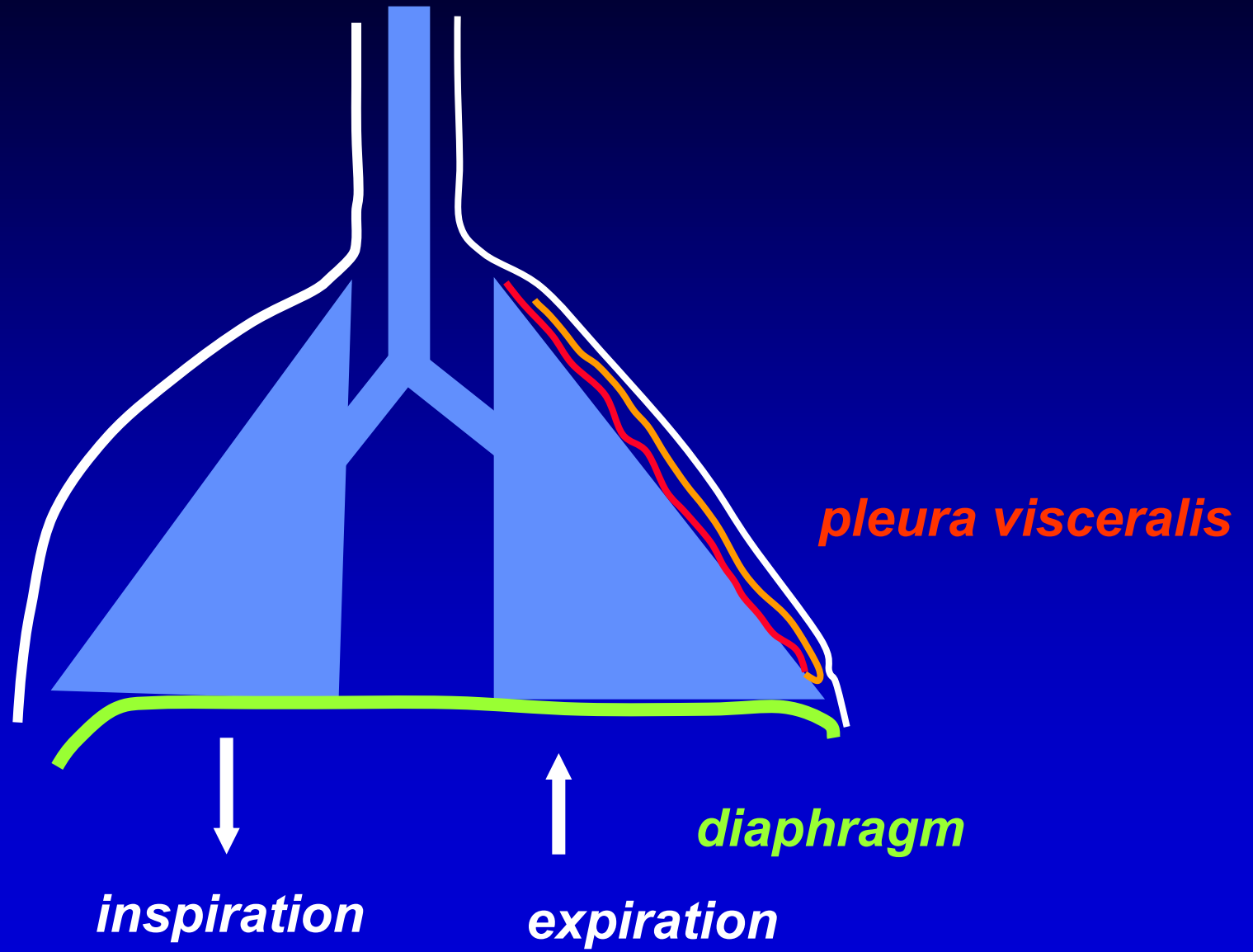
expiration – mm. intercostales interni

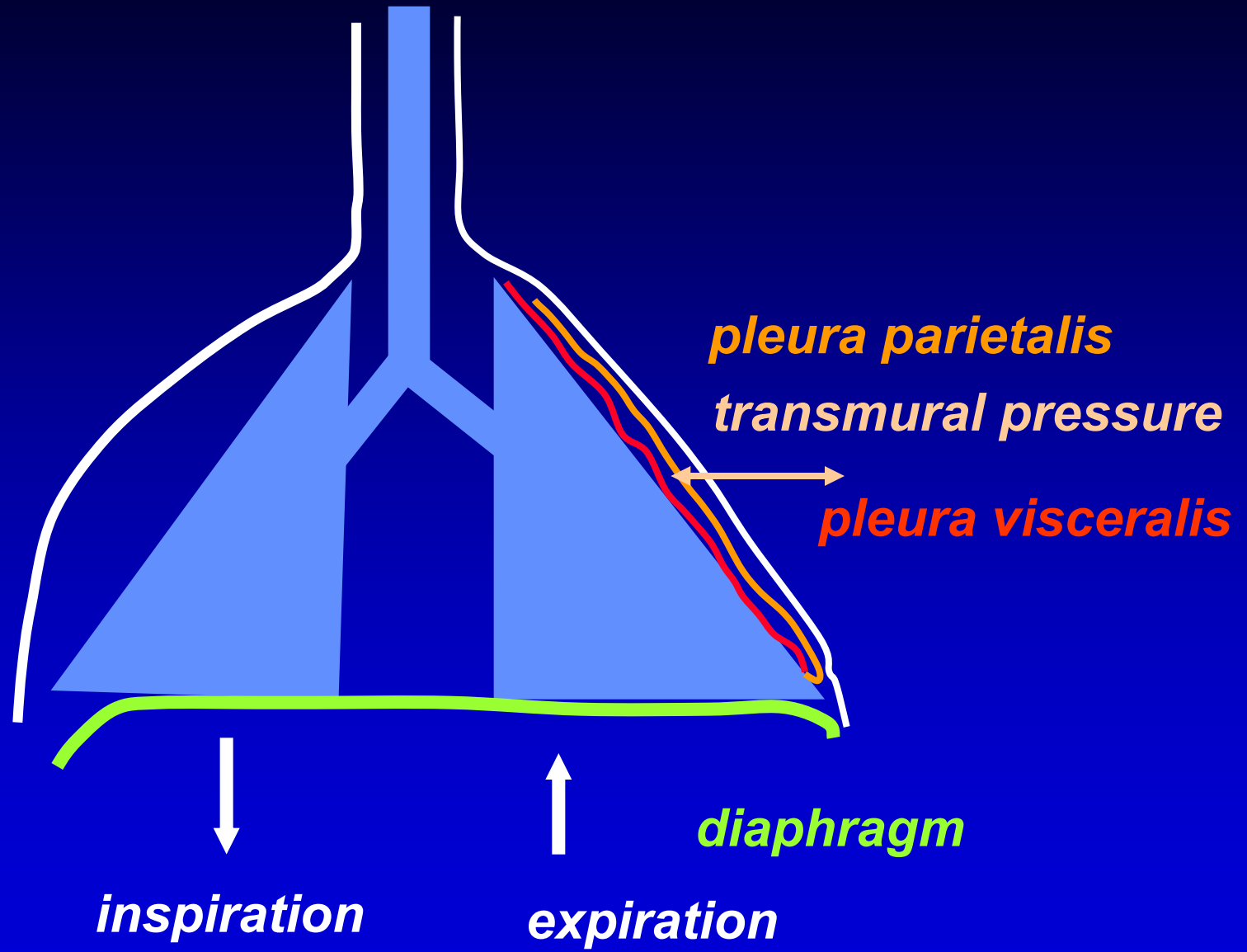
inspiration – mm. intercostales externi

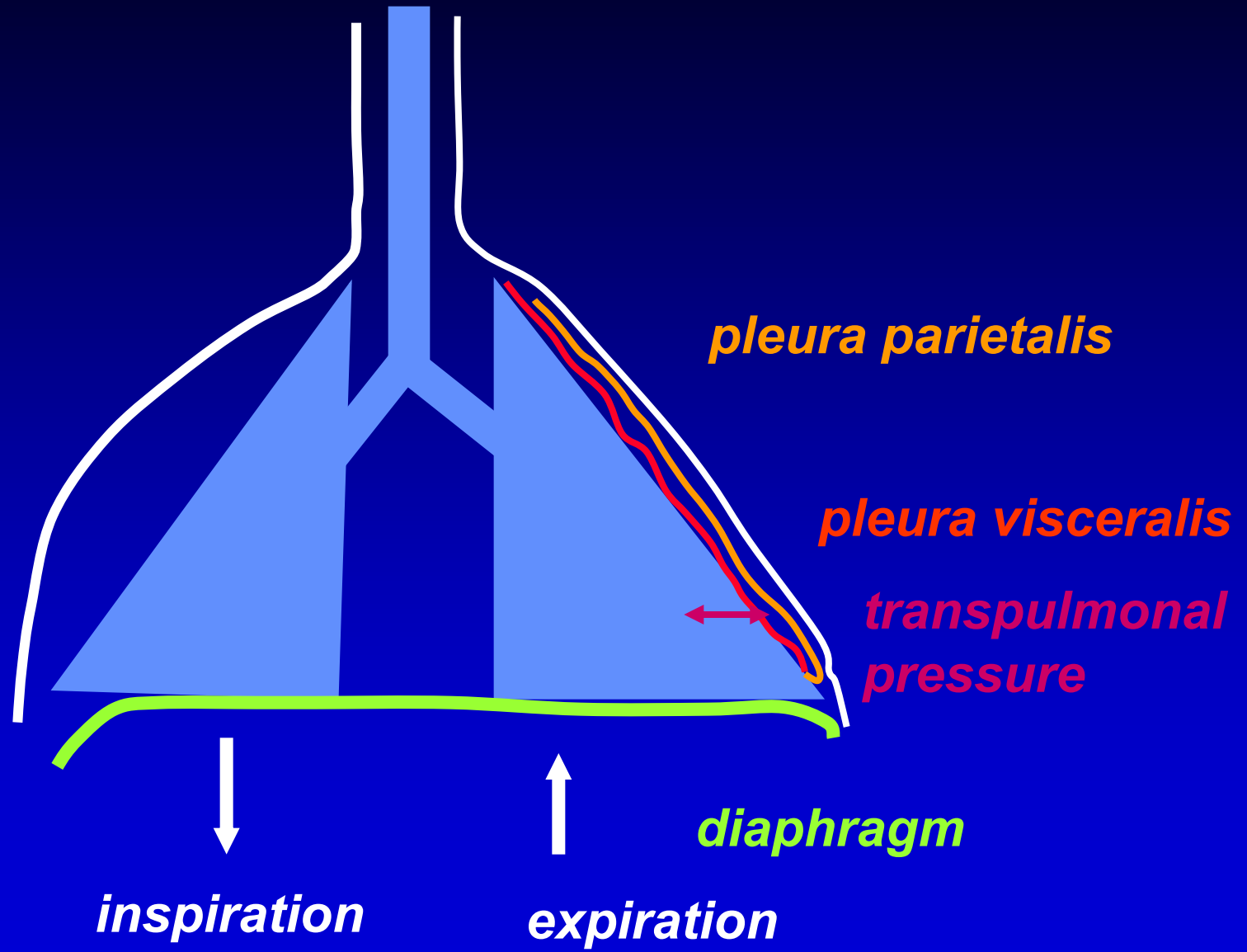
expiration – mm. intercostales interni

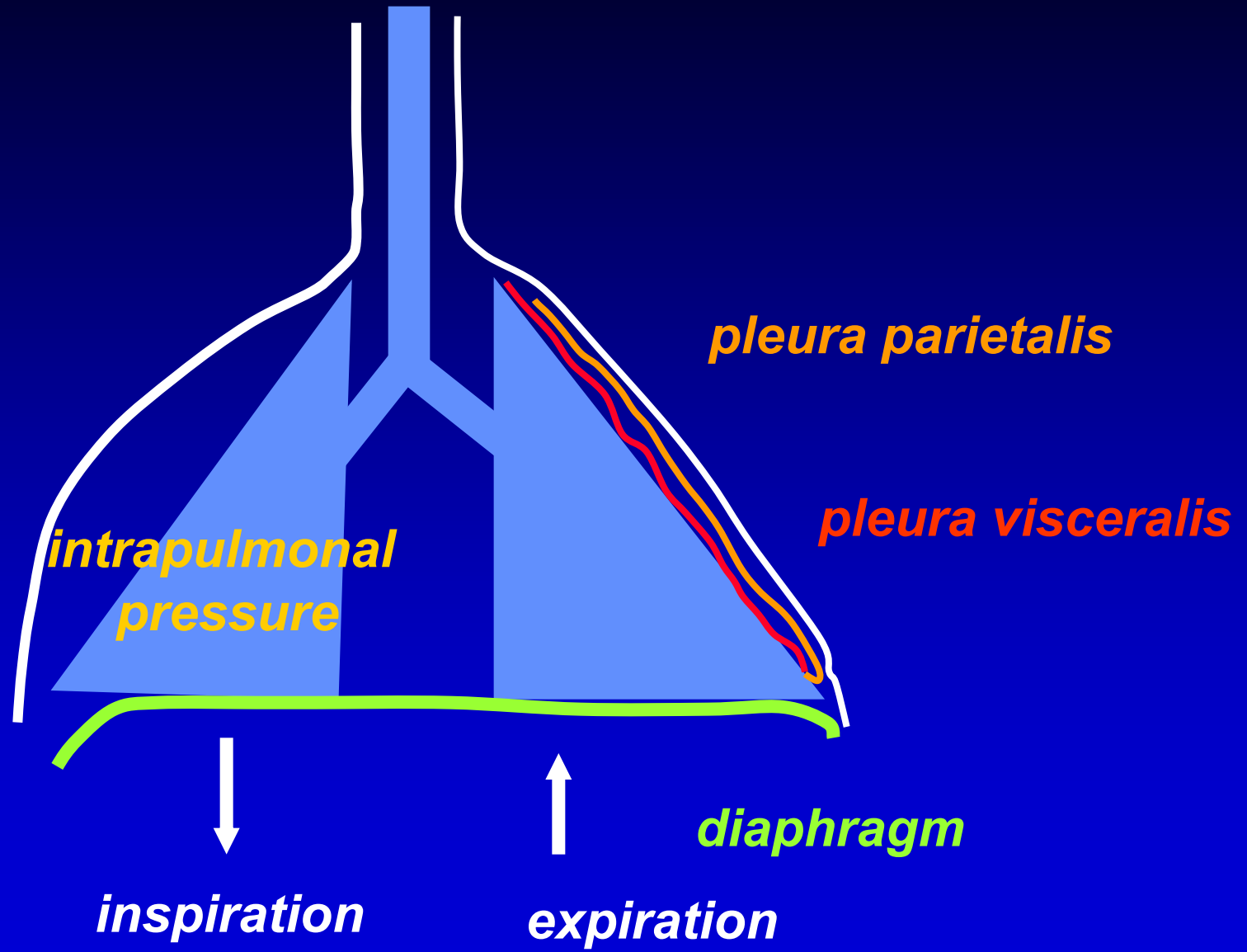


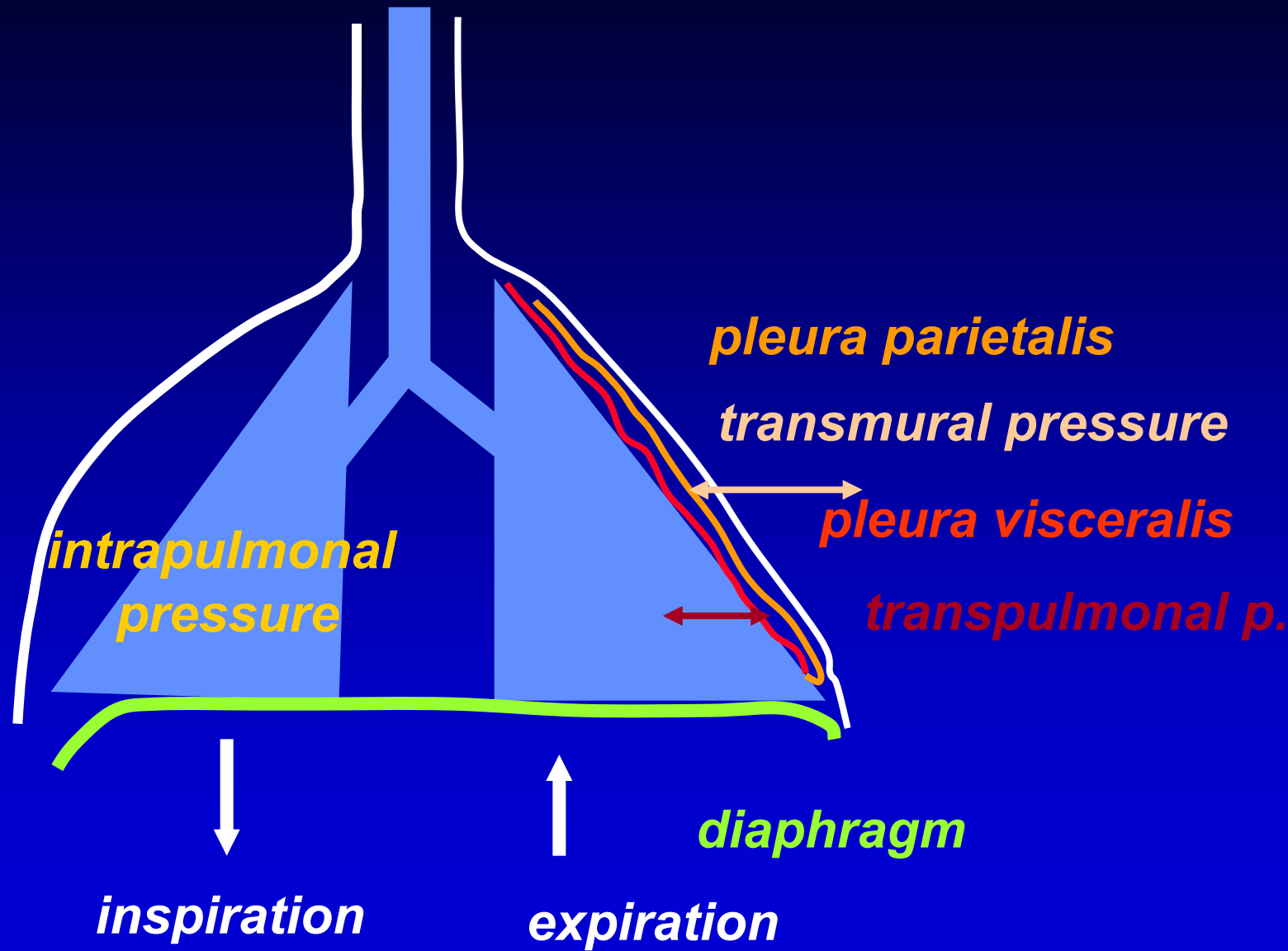


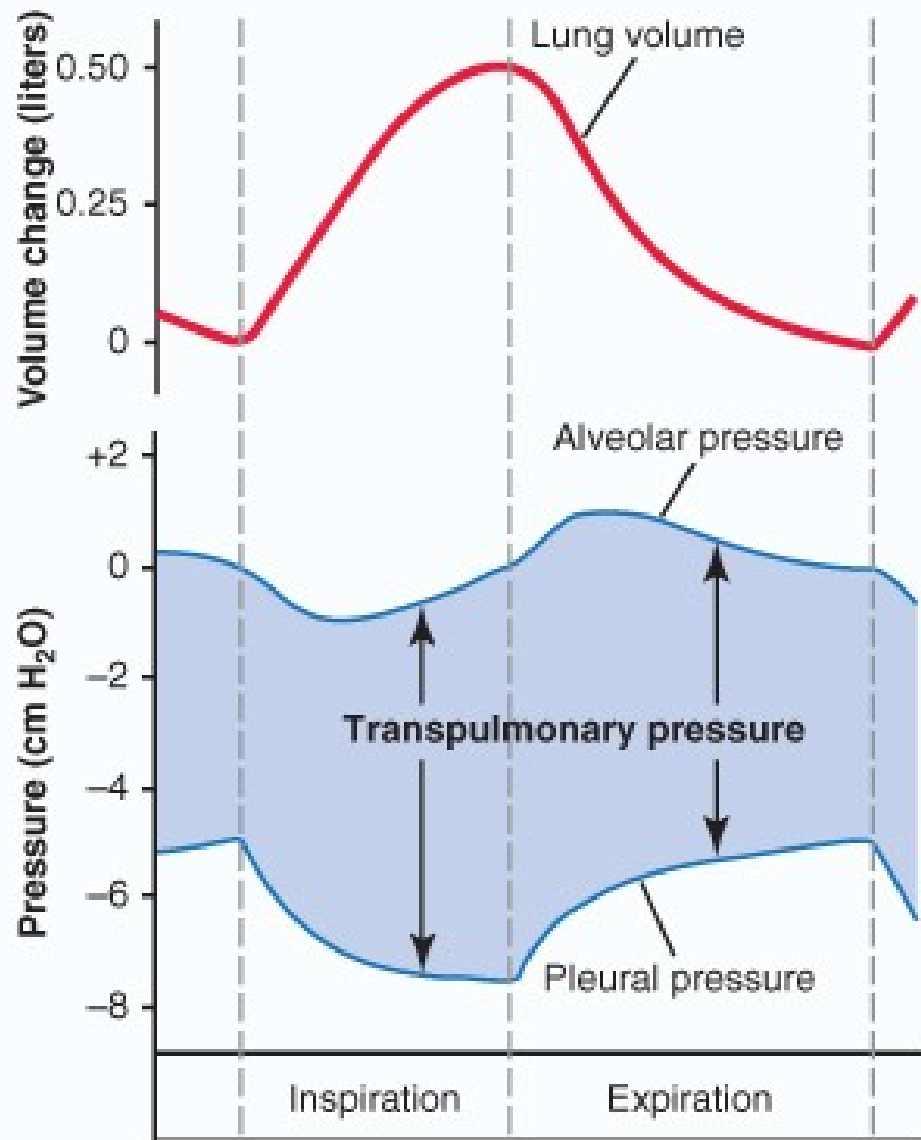


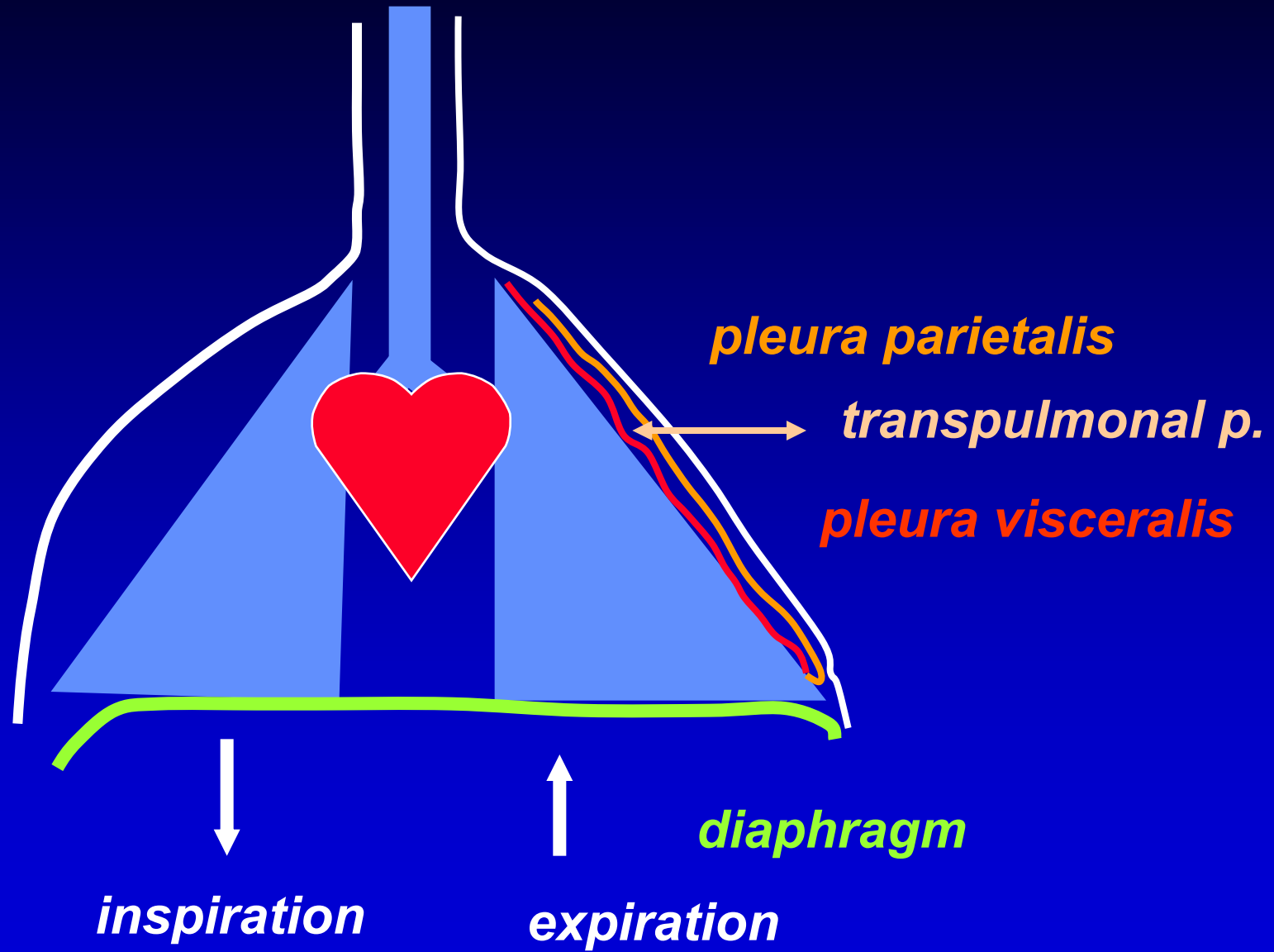




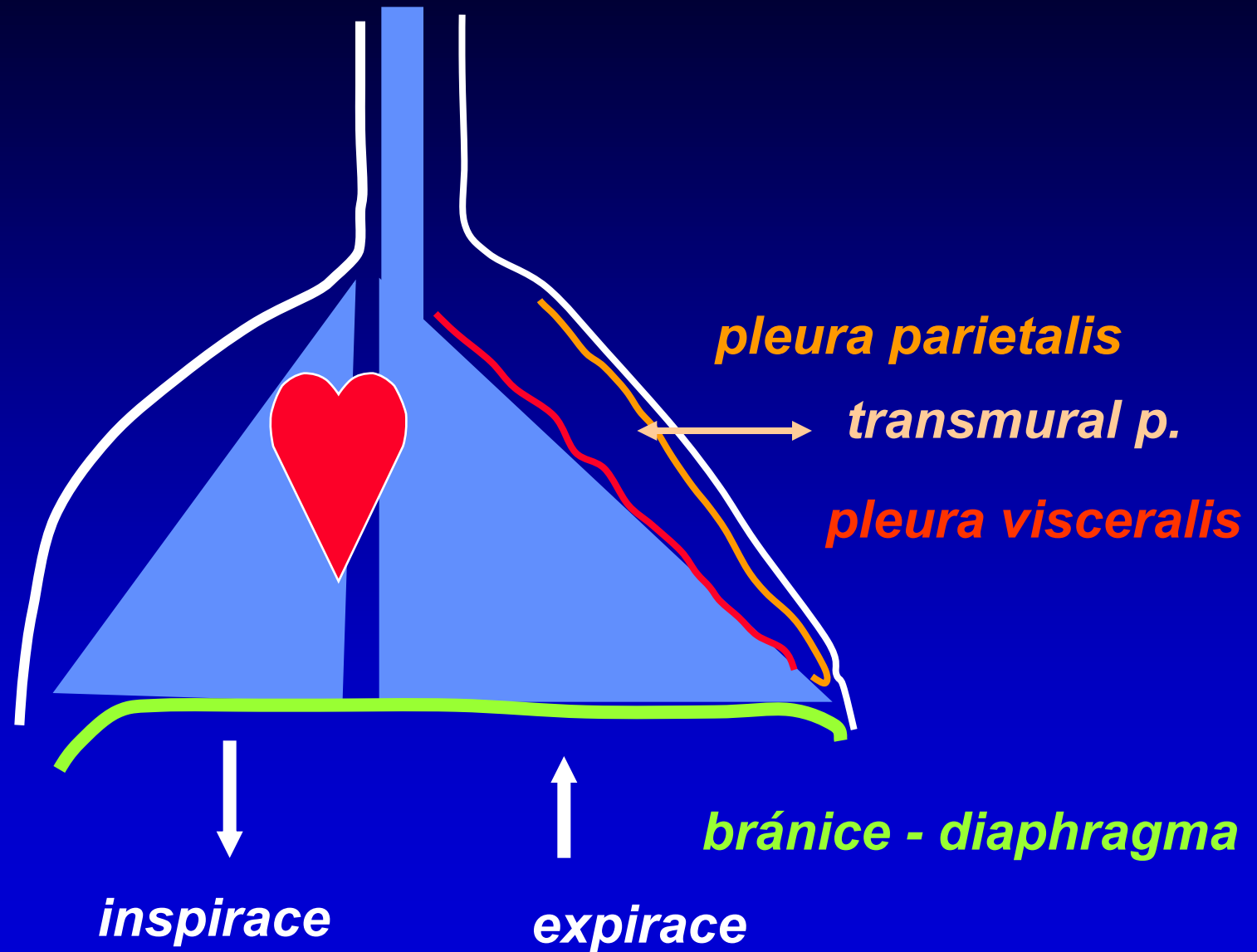


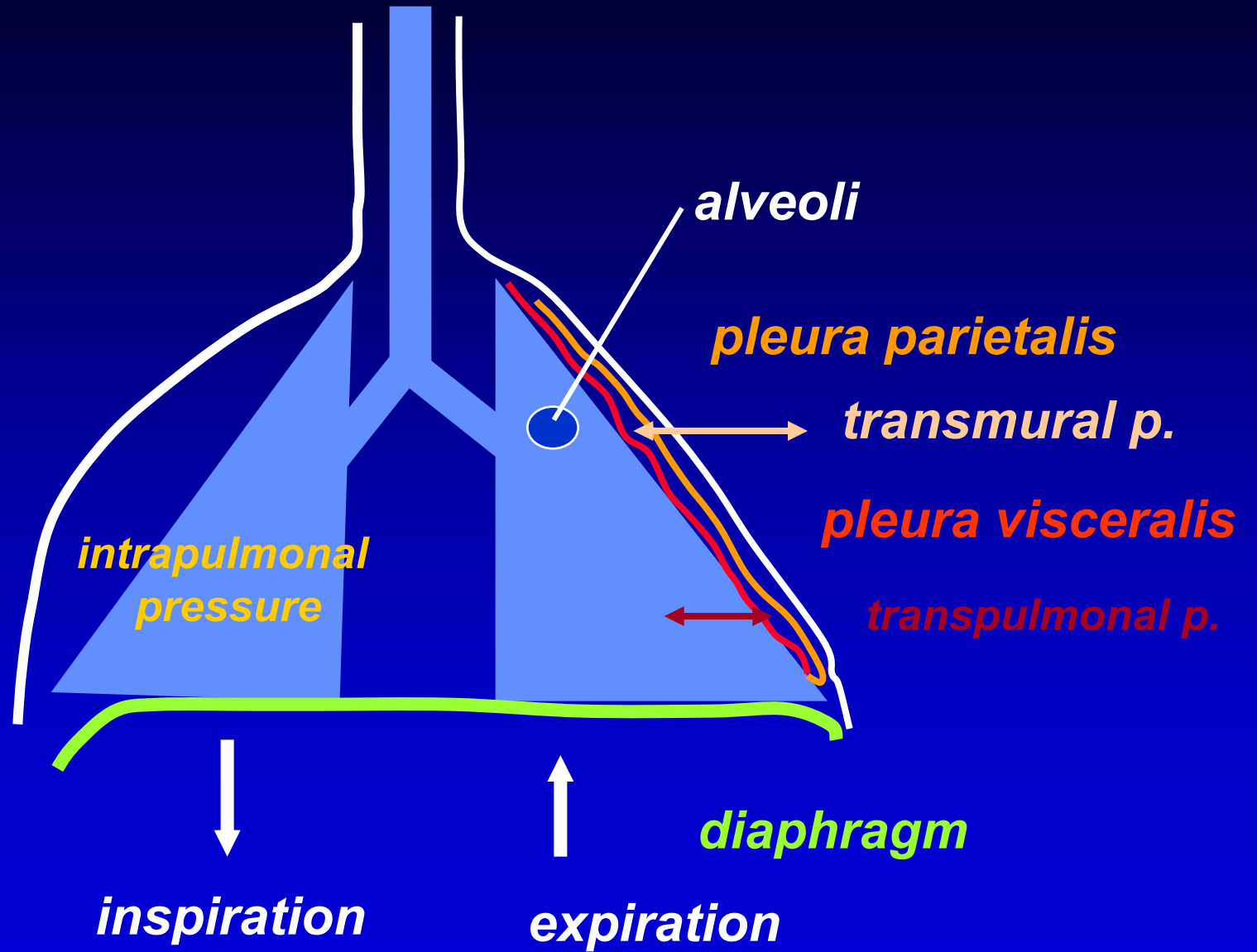


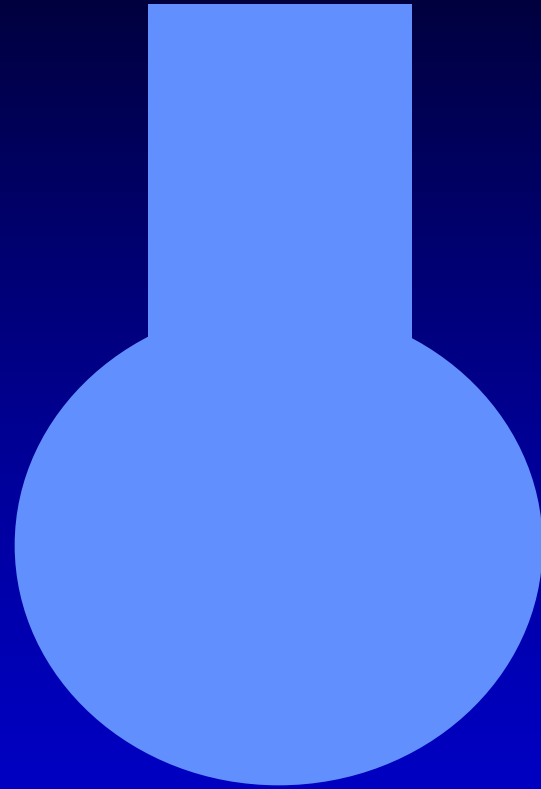


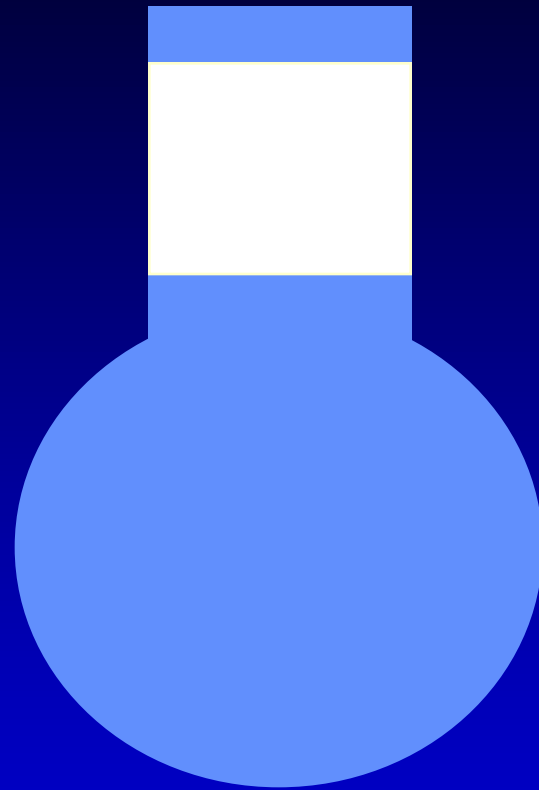


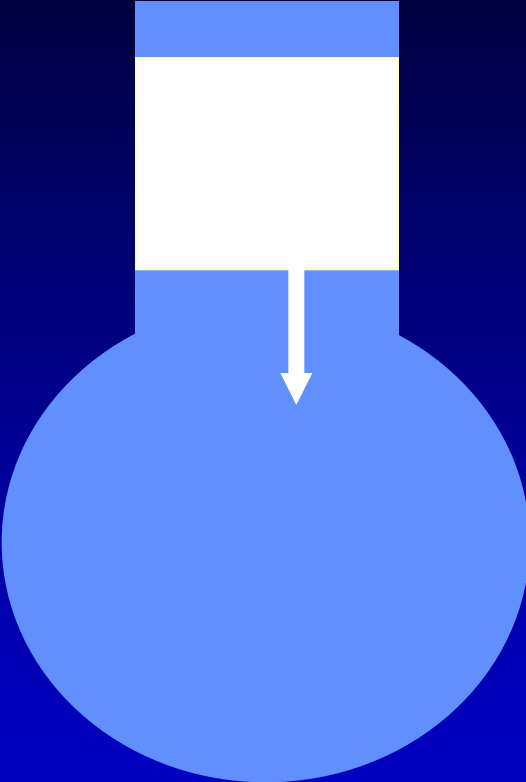
PNEUMOTHORAX

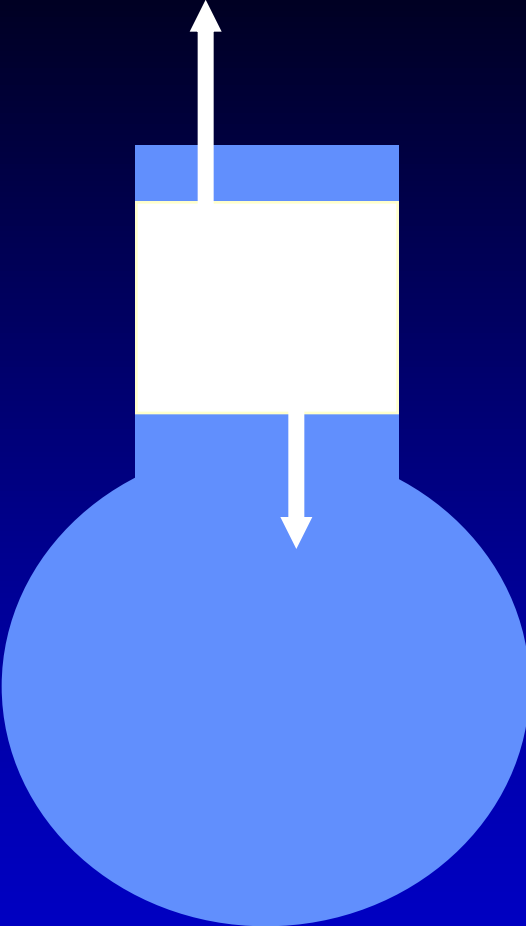


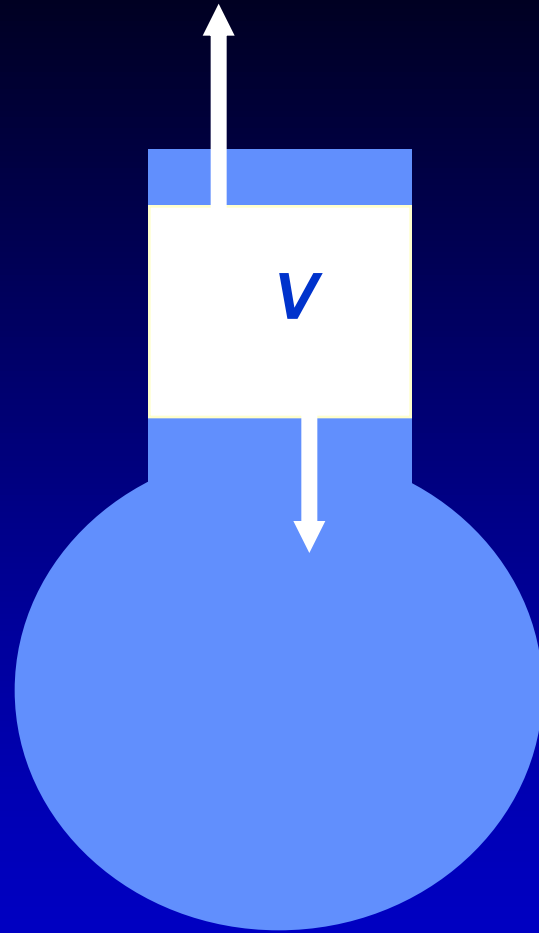












ventilation

Physiologic dead space

Is the volume of air in the lungs that does not participate in gas exchange (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 exchange (alveoli that are ventilated, but are not perfused by pulmonary capillary blood)

Physiologic dead space

$$V_D = V_T \times \frac{P_{aCO_2} - P_{ECO_2}}{P_{aCO_2}}$$

V_D – physiologic dead space (mL)

V_T – tidal volume (mL)

P_{aCO_2} – P_{CO_2} of arterial blood (mmHg)

P_{ECO_2} – P_{CO_2} of expired air (mmHg)

Physiologic dead space

$$V_D = V_T \times \frac{P_{aCO_2} - P_{ECO_2}}{P_{aCO_2}}$$

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

$$= 500 \times 0.25$$

$$= 125$$

Alveolar ventilation

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

V_A - alveolar ventilation (mL/min)

V_T - tidal volume (mL)

V_D - physiologic dead space (mL/min)

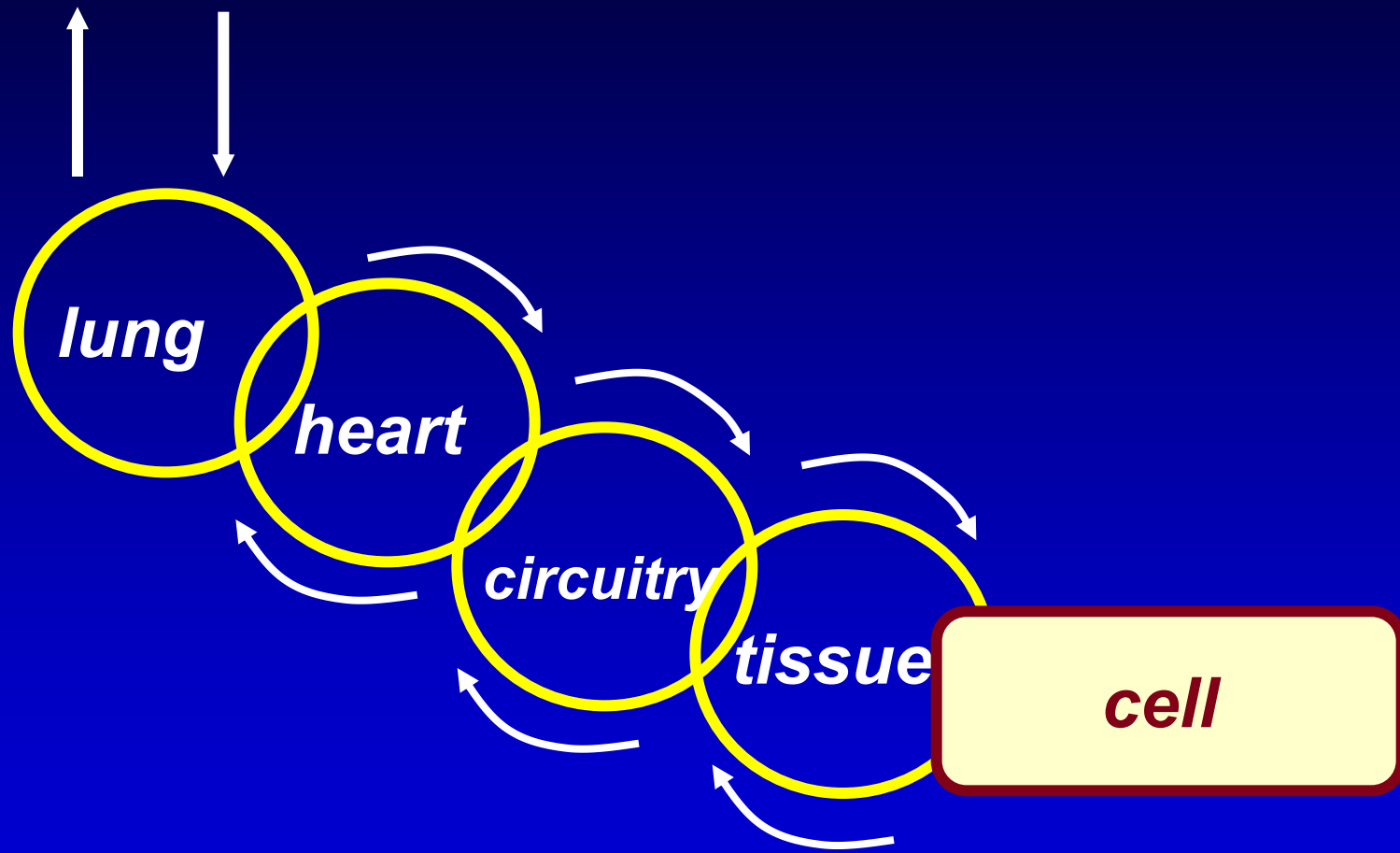
Alveolar ventilation

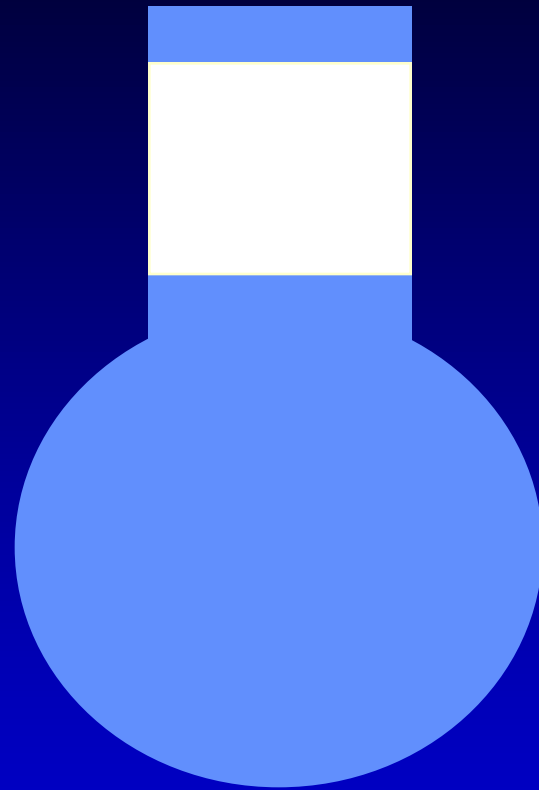
$$V_A = (V_T - V_D) \times \text{breaths/min}$$

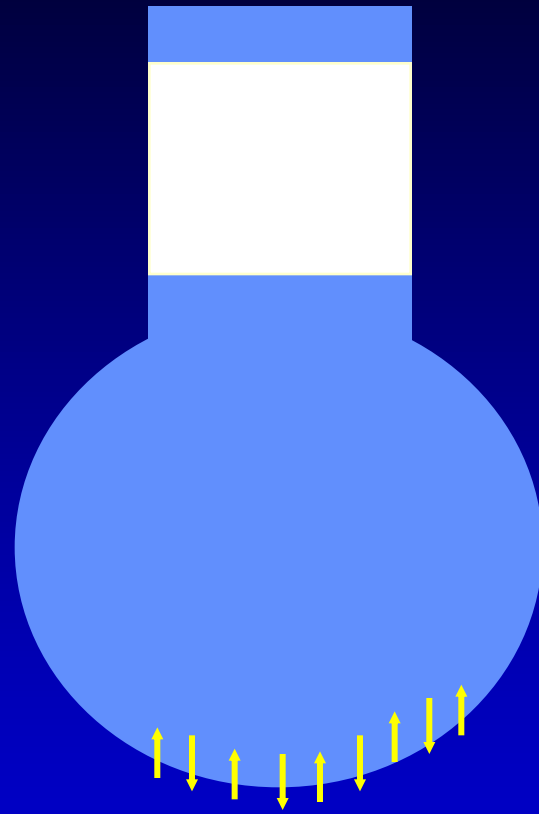
$$V_A = (500 - 125) \times 16$$

$$= 375 \times 16$$

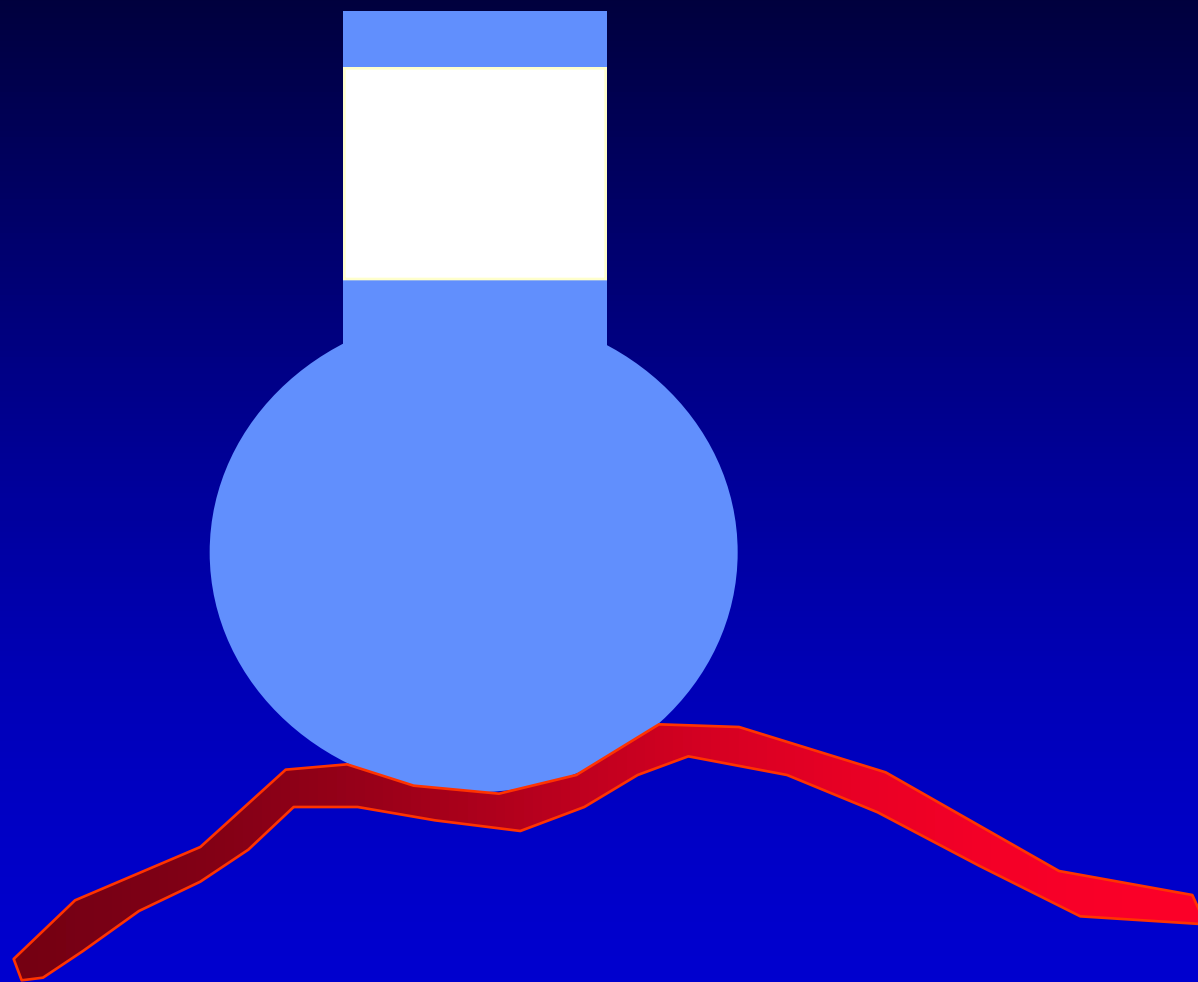
$$= 6000 \text{ mL/min}$$

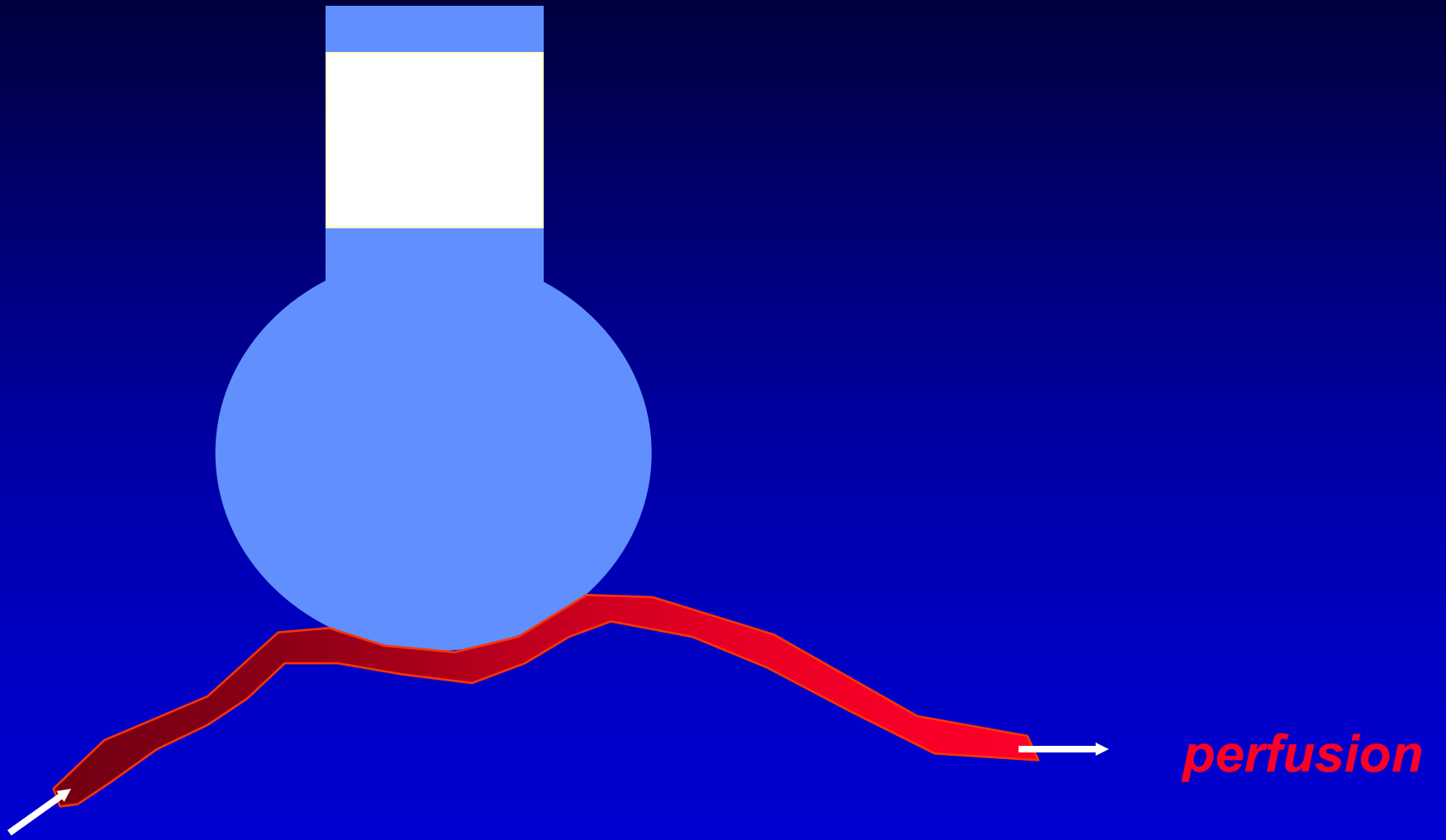


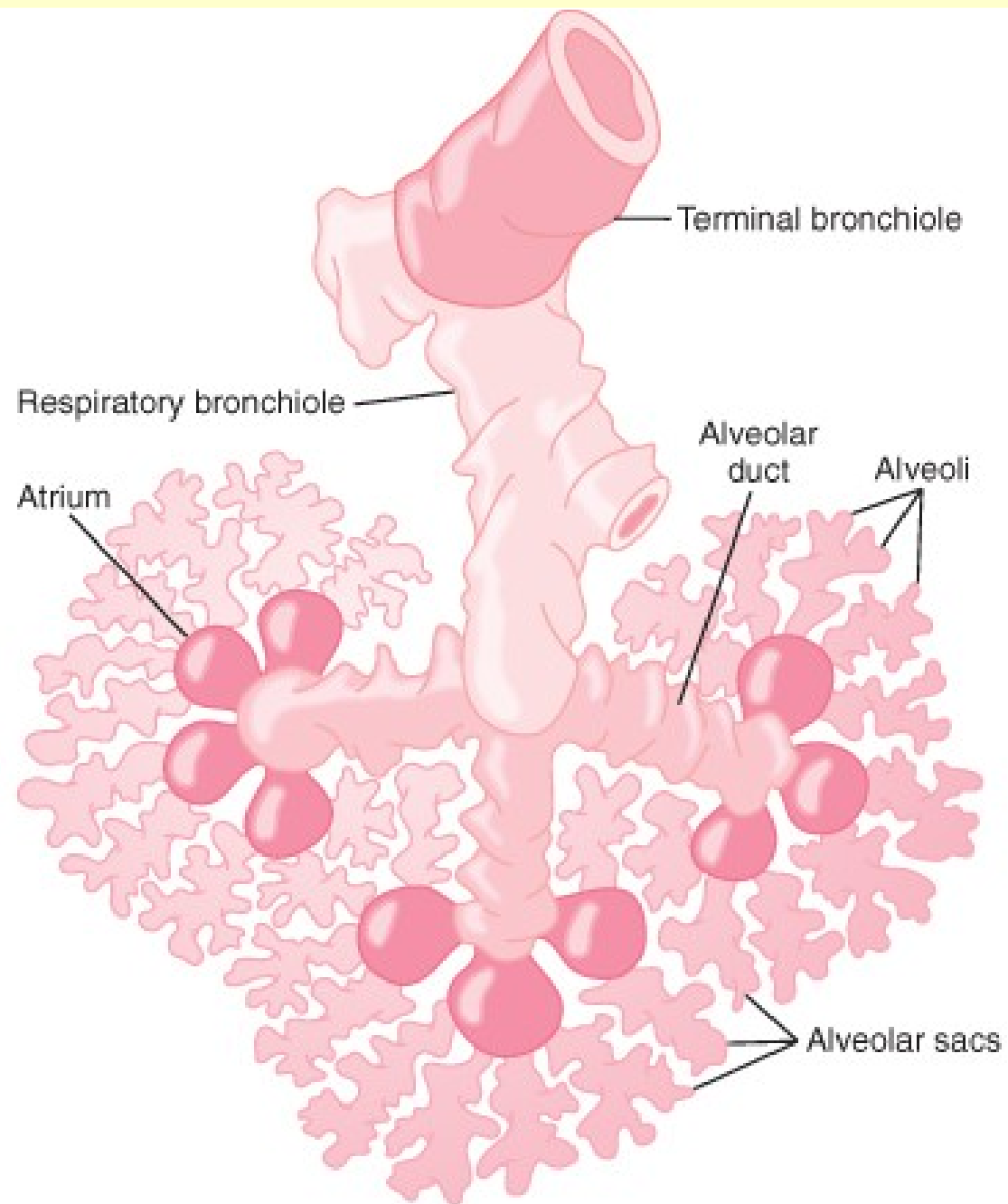




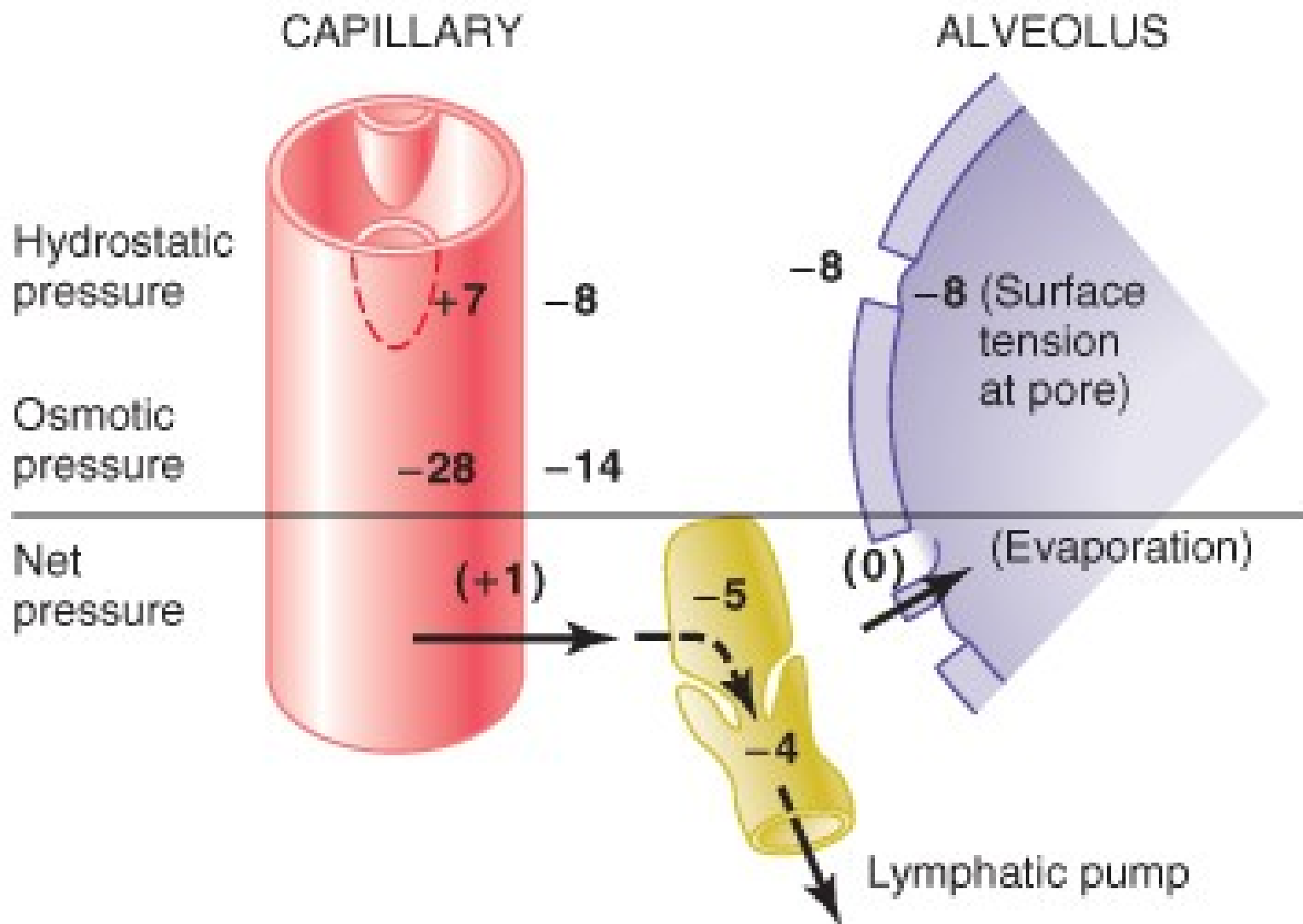
diffusion

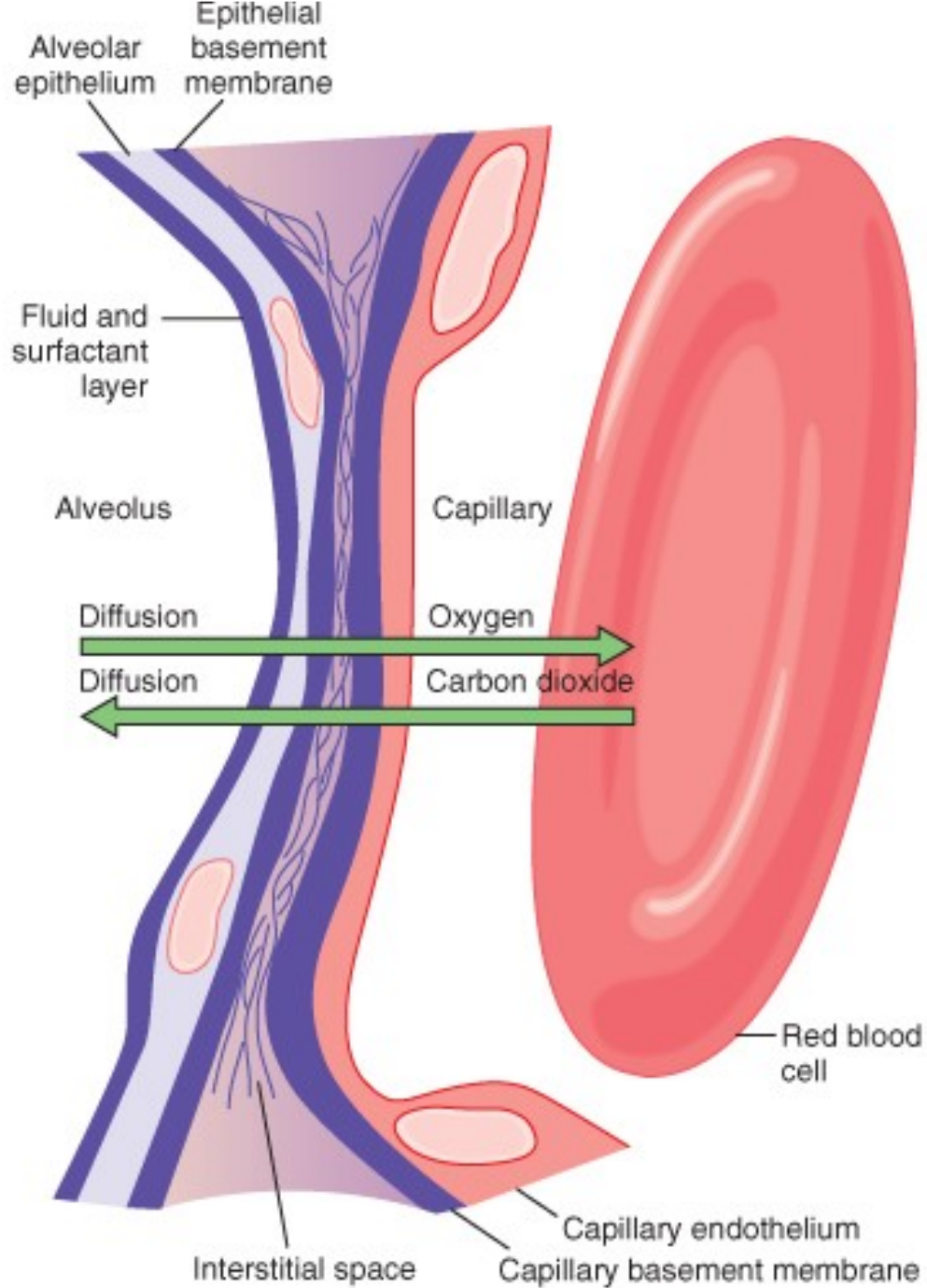


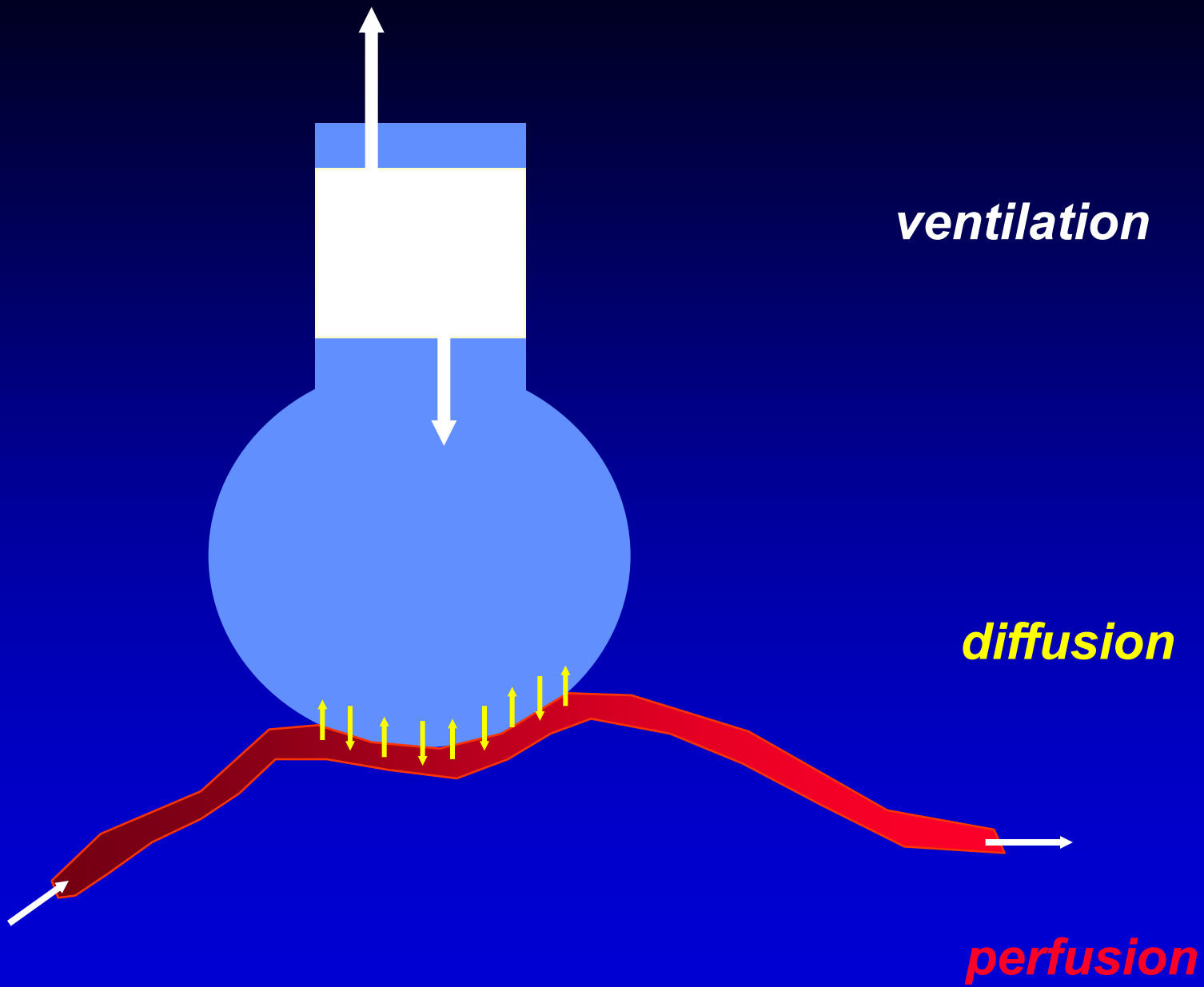


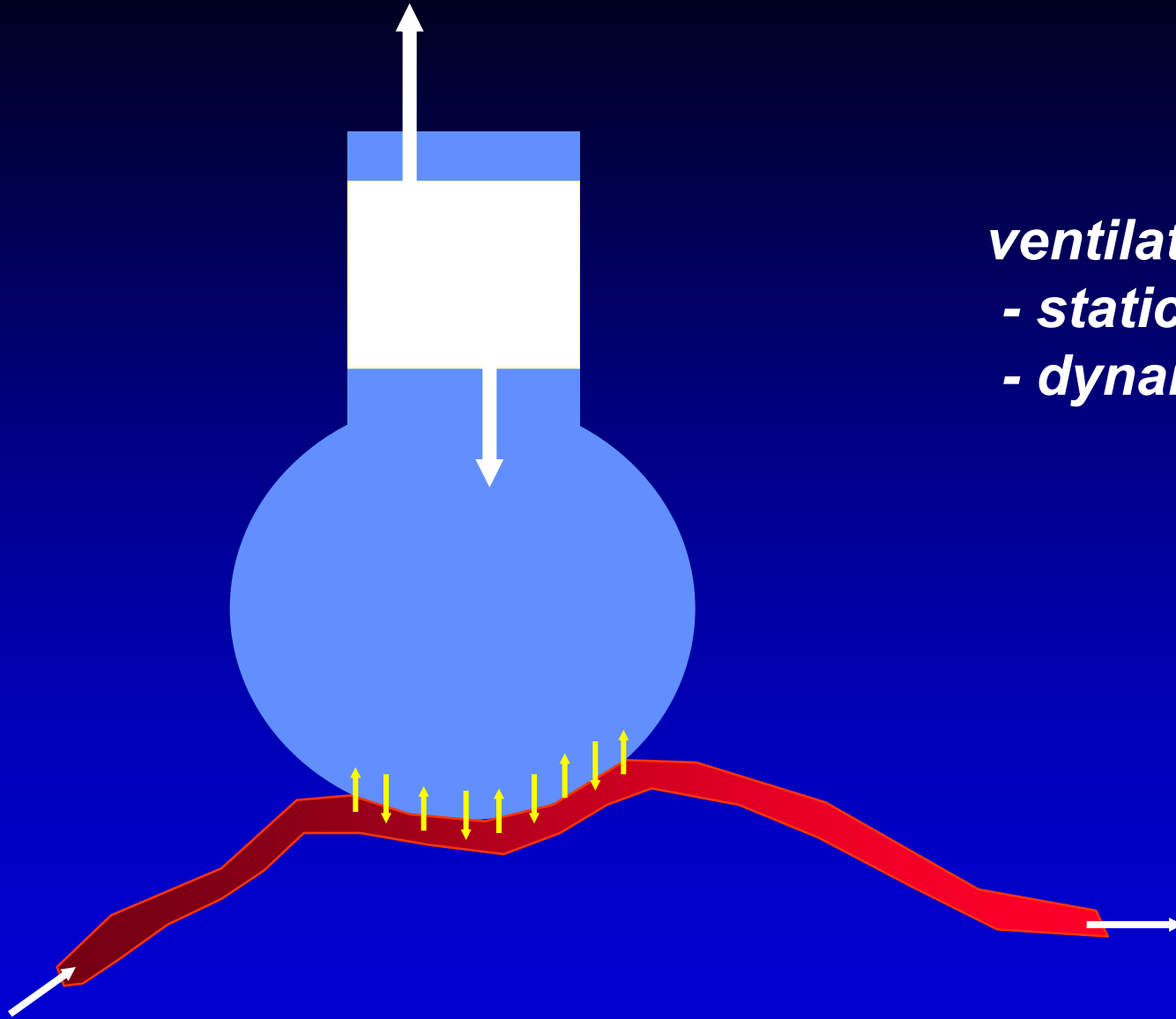


Pressures Causing Fluid Movement





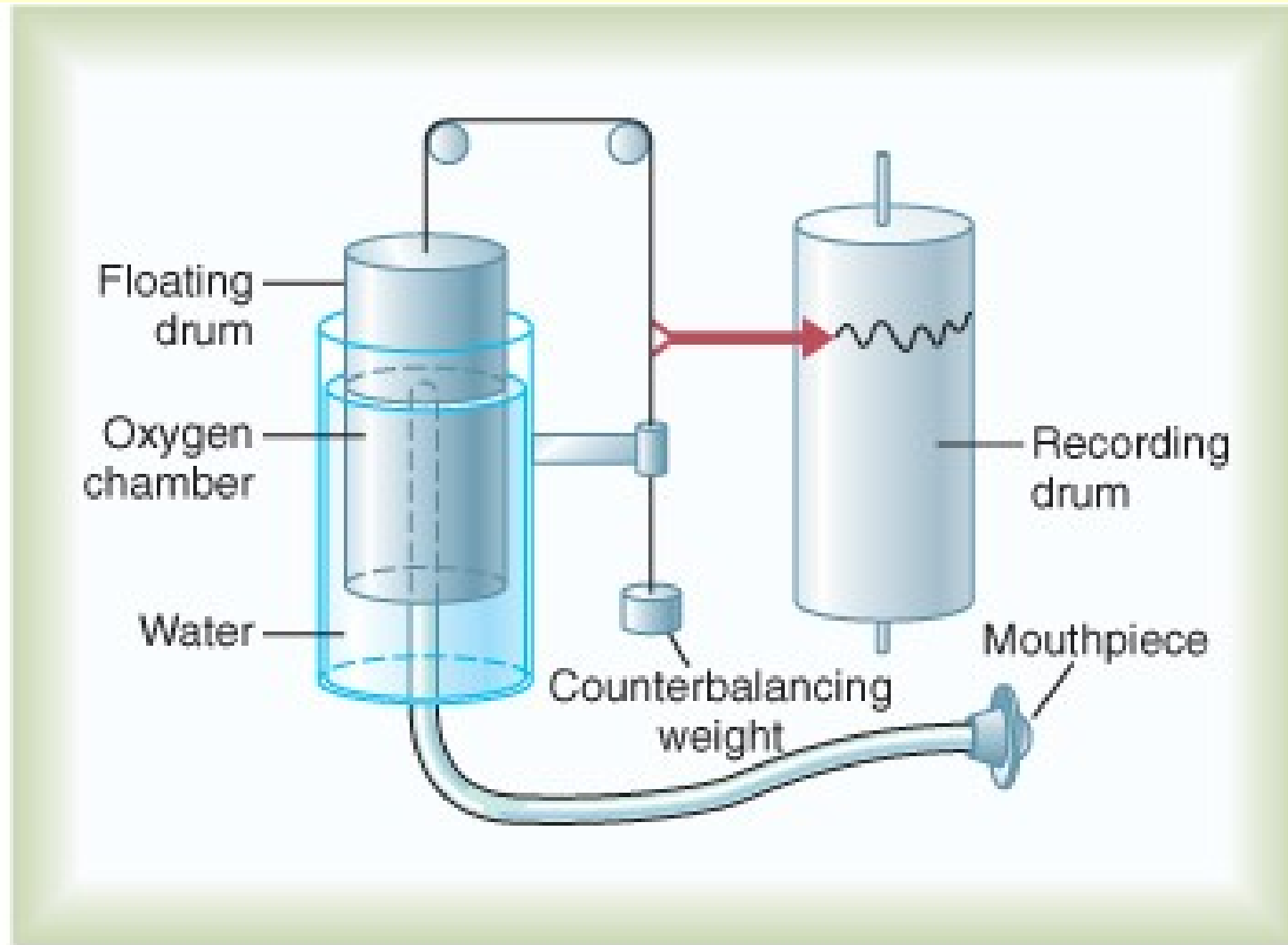




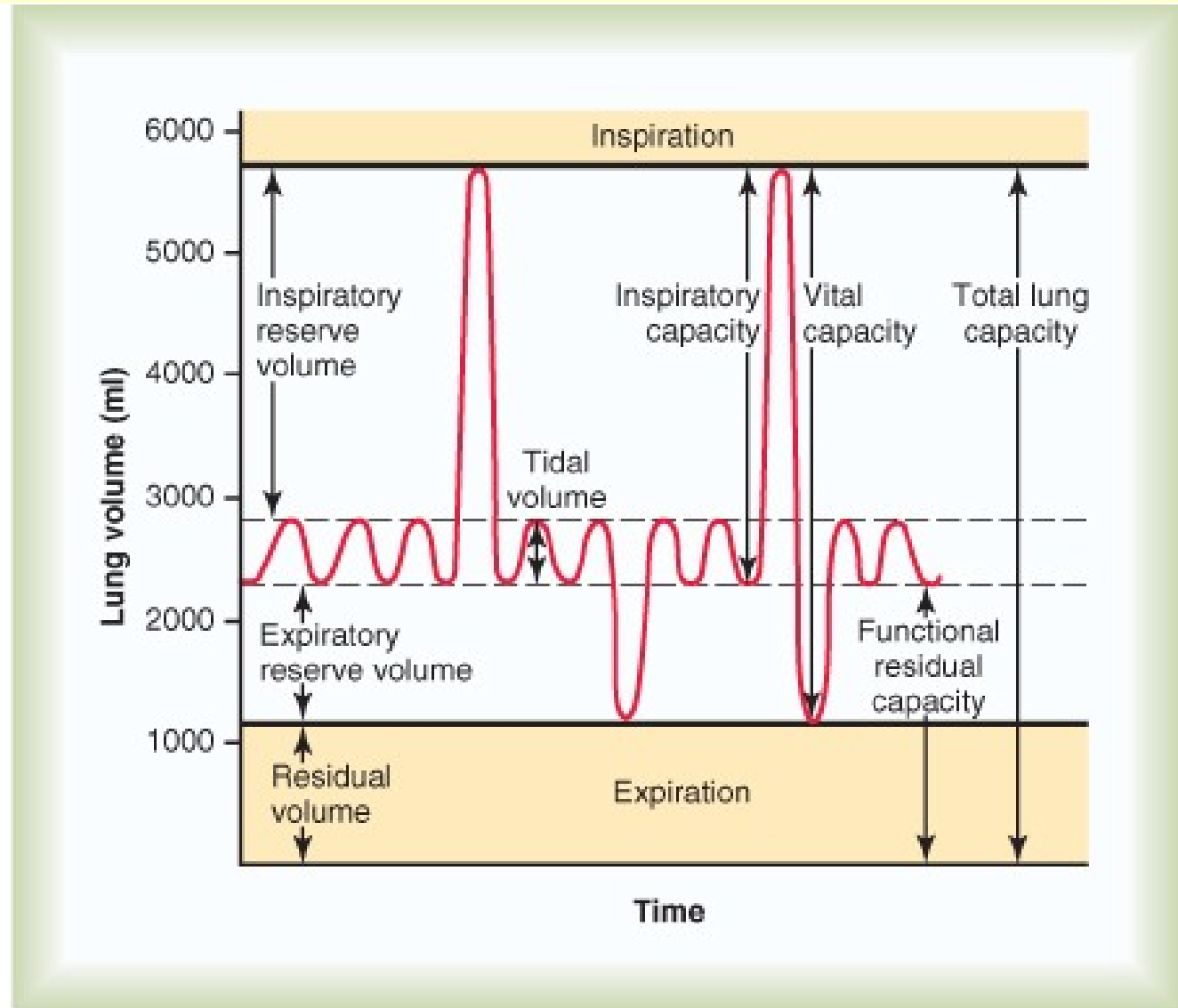
ventilation

- static volumes

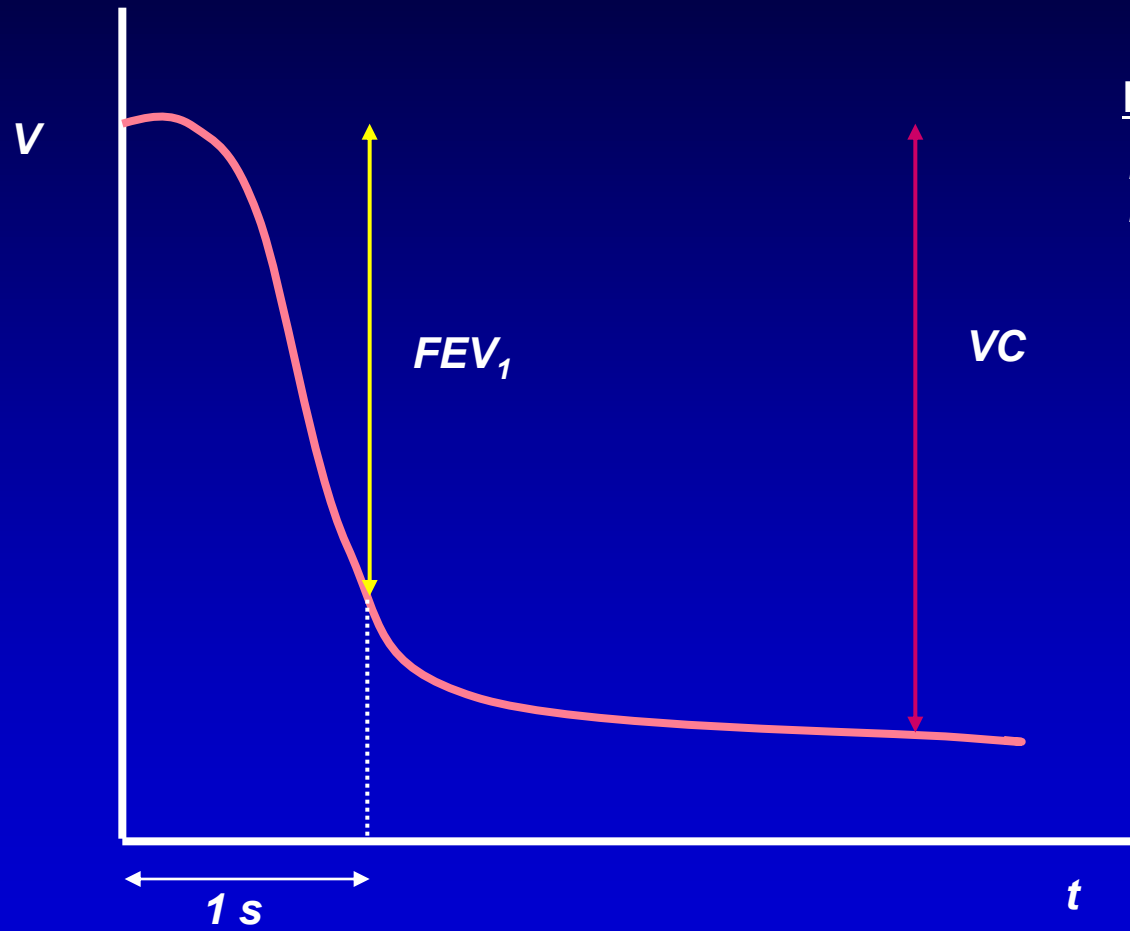
- dynamic volumes



STATIC VOLUMES



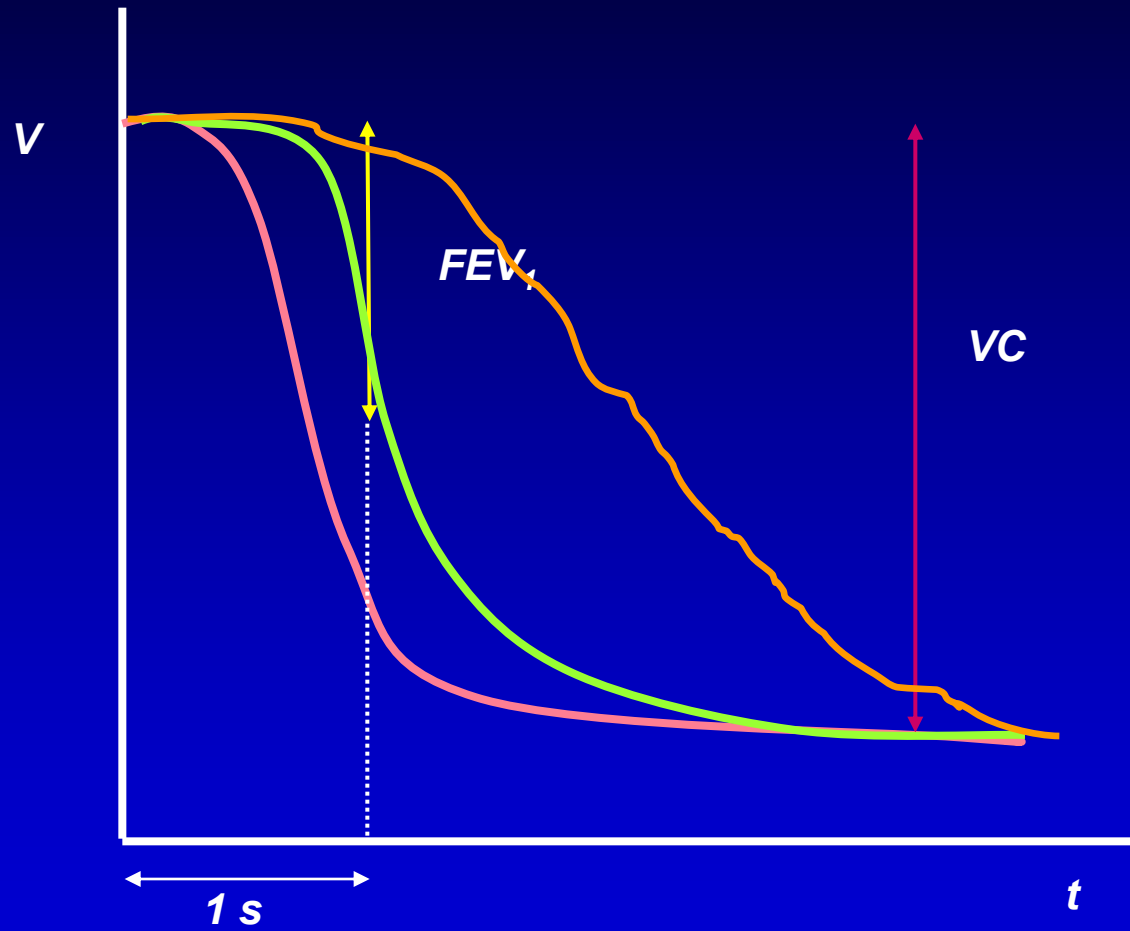
DYNAMIC VOLUMS



Physiological value:

$$\frac{FEV_1}{VC} \times 100 > 80\%$$

DYNAMIC VOLUMS



OBSTRUCTION

↓ FEV_1
= VC

Restriction

↓ VC
= FEV_1



▲ Blue bloater

F. Natter
© NOVARTIS

Triggers

Infection

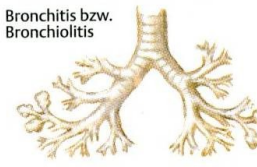
Erkältungs-
krankheiten
und Virus-
infektionen



Sinusitis

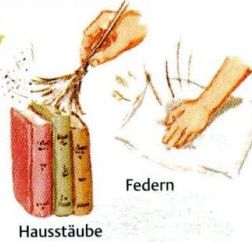
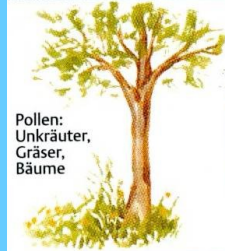


Bronchitis bzw.
Bronchiolitis



inhaled allergens

Pollen:
Unkräuter,
Gräser,
Bäume



Federn



Tierhaare



Möbel-
polsterung



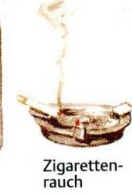
Pilz-
sporen

inhaled irritants

Farben
und Lacke



Benzin



Zigaretten-
rauch



Industrie-
chemikalien

Schadgase



Kaltluft



Schadstoffe
in der Luft

food allergens



Milch



Eier



Nüsse



Schokolade



Fische

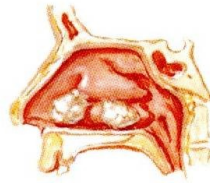


Schalen-
tiere



Tomaten,
Erdbeeren

inducing stimuli



Nasenpolypen



Lachen



Temperatur-
schwankungen



körperliche
Belastung

mental stress medicines



G.
Medika-
mente



Vakzine



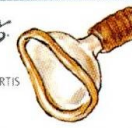
Penicilline



verschiedene
Medikamente



Aspirin



Anästhetika

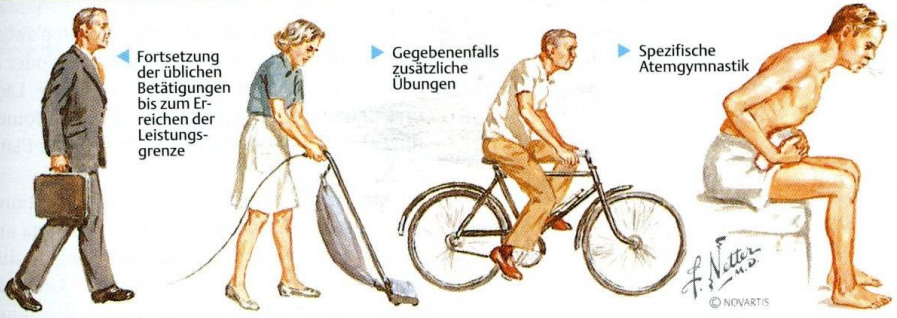


▲ Rauchstopp

▲ Meiden von Luftverunreinigung (umwelt- oder arbeitsbedingt) und von Temperatur-extremen

▲ Installation von Luftfiltern und Klimaanlage

A. Meiden von auf die Atemwege wirkenden Reizstoffen

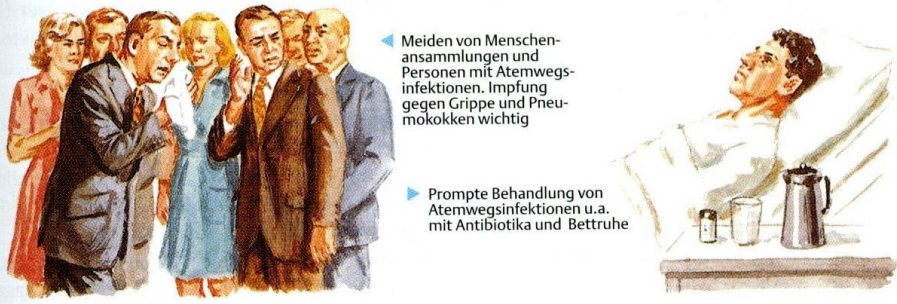


▶ Fortsetzung der üblichen Betätigungen bis zum Erreichen der Leistungsgrenze

▶ Gegebenenfalls zusätzliche Übungen

▶ Spezifische Atemgymnastik

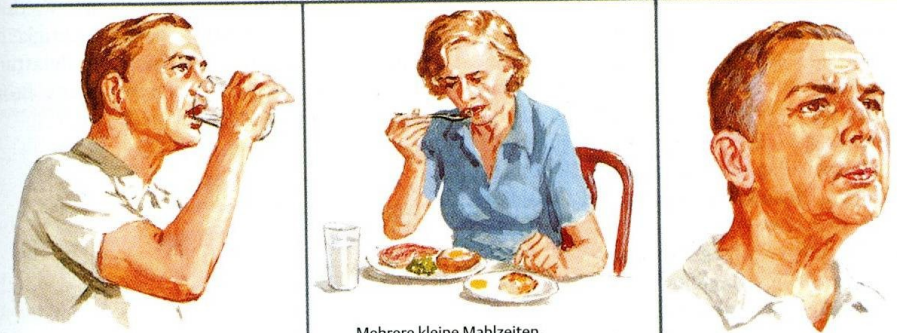
B. Körperliche Betätigung



▶ Meiden von Menschenansammlungen und Personen mit Atemwegsinfektionen. Impfung gegen Grippe und Pneumokokken wichtig

▶ Prompte Behandlung von Atemwegsinfektionen u.a. mit Antibiotika und Bettruhe

C. Vorsichtsmaßnahmen gegen Infektionen



D. Ausreichende Flüssigkeitszufuhr

E. Ausreichende Ernährung

Mehrere kleine Mahlzeiten, Imbiss vor dem Schlafengehen

F. Atemübungen mit geschürzten Lippen

respiratory irritant factors

physical activity

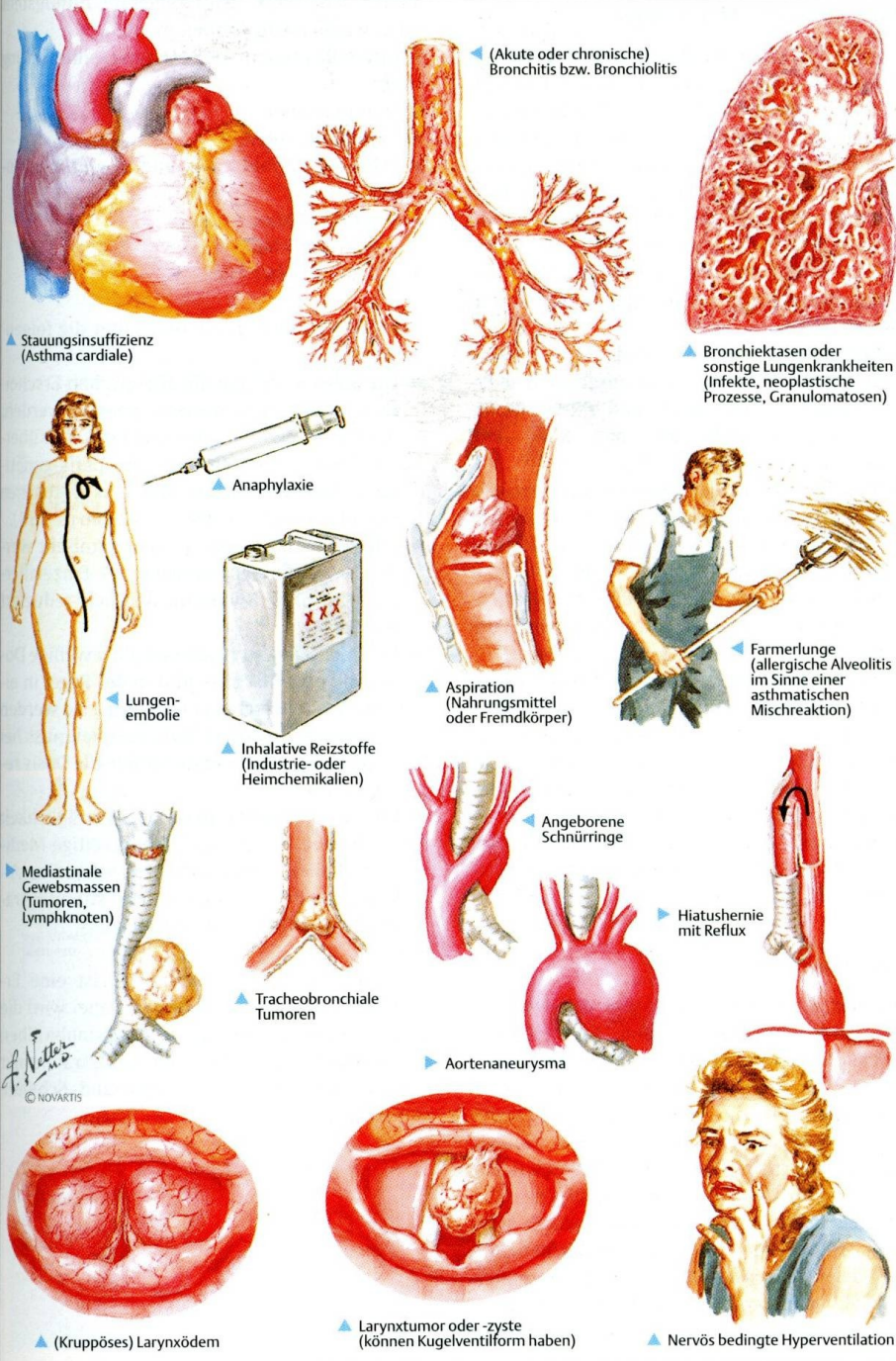
**preventing infection
sick people, vaccination, intensive treatment**

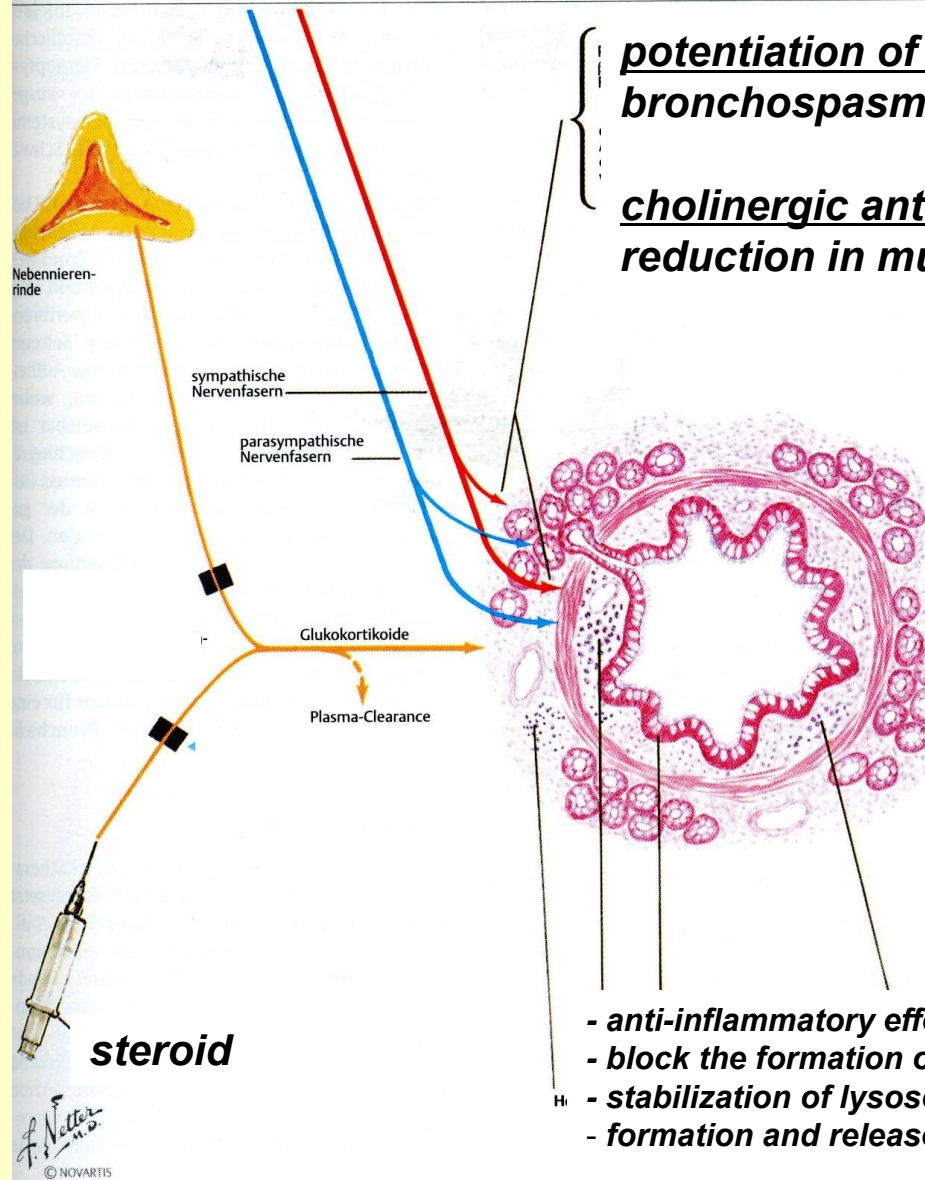
sufficient fluid intake

eat small portions

breathing exercises

Differential diagnosis



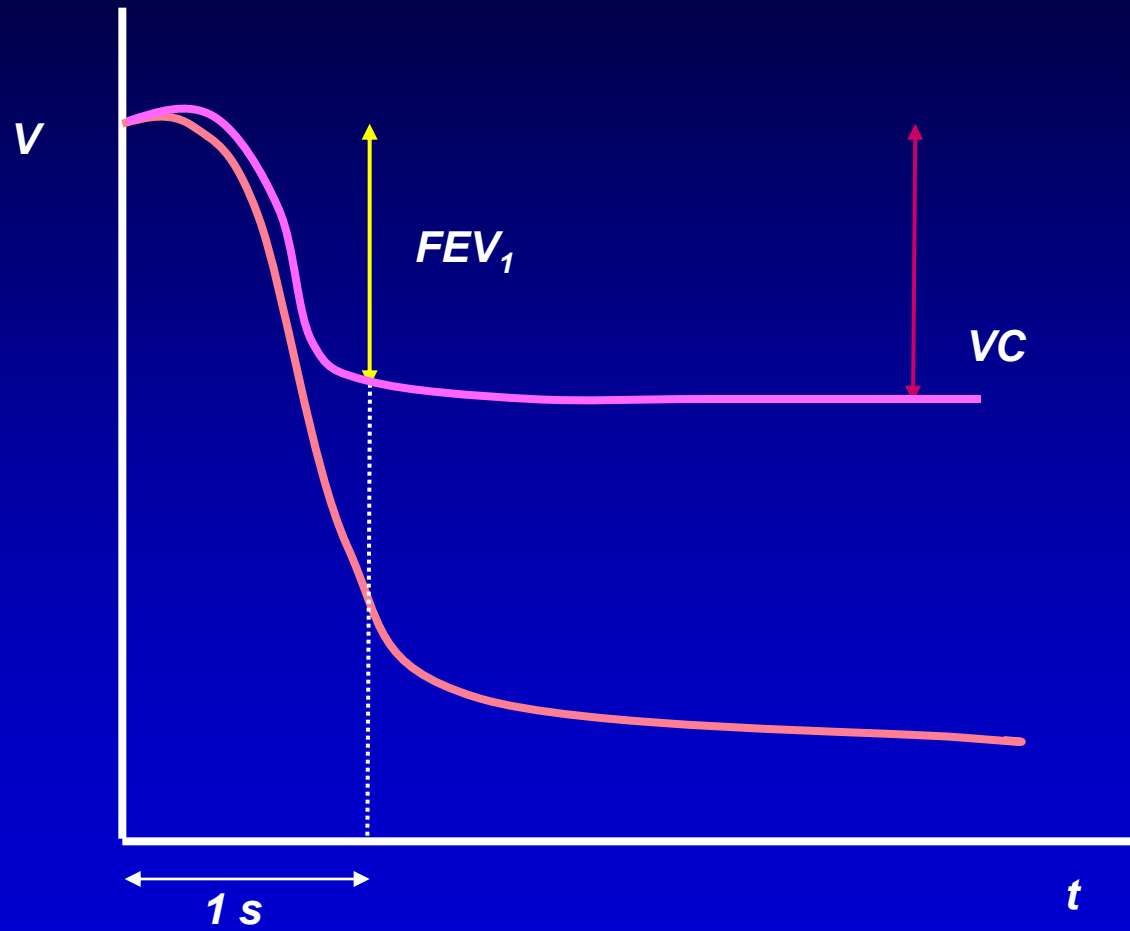


potentiation of beta-adrenergic receptor
bronchospasmolytic effect

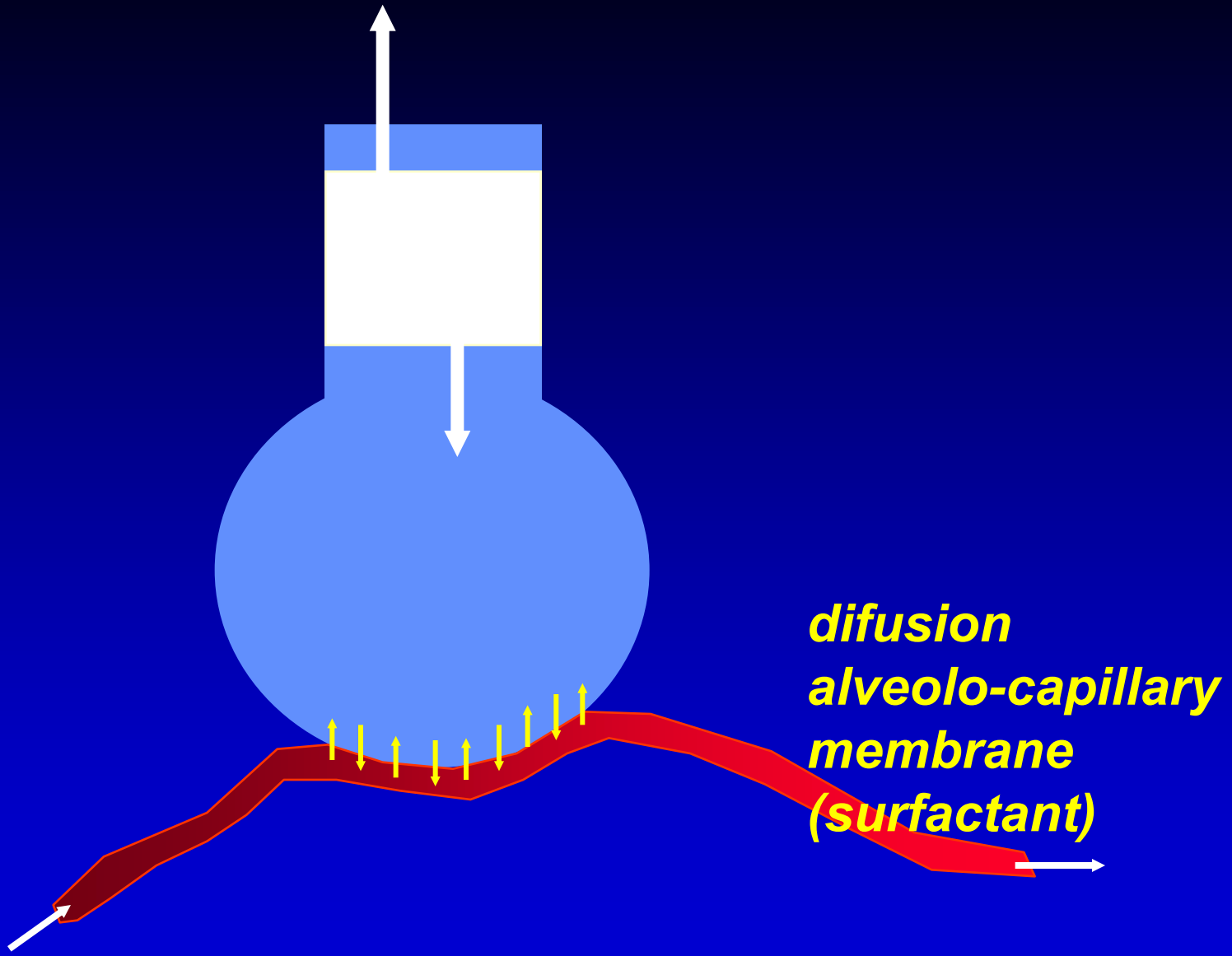
cholinergic antagonism
reduction in mucus production

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

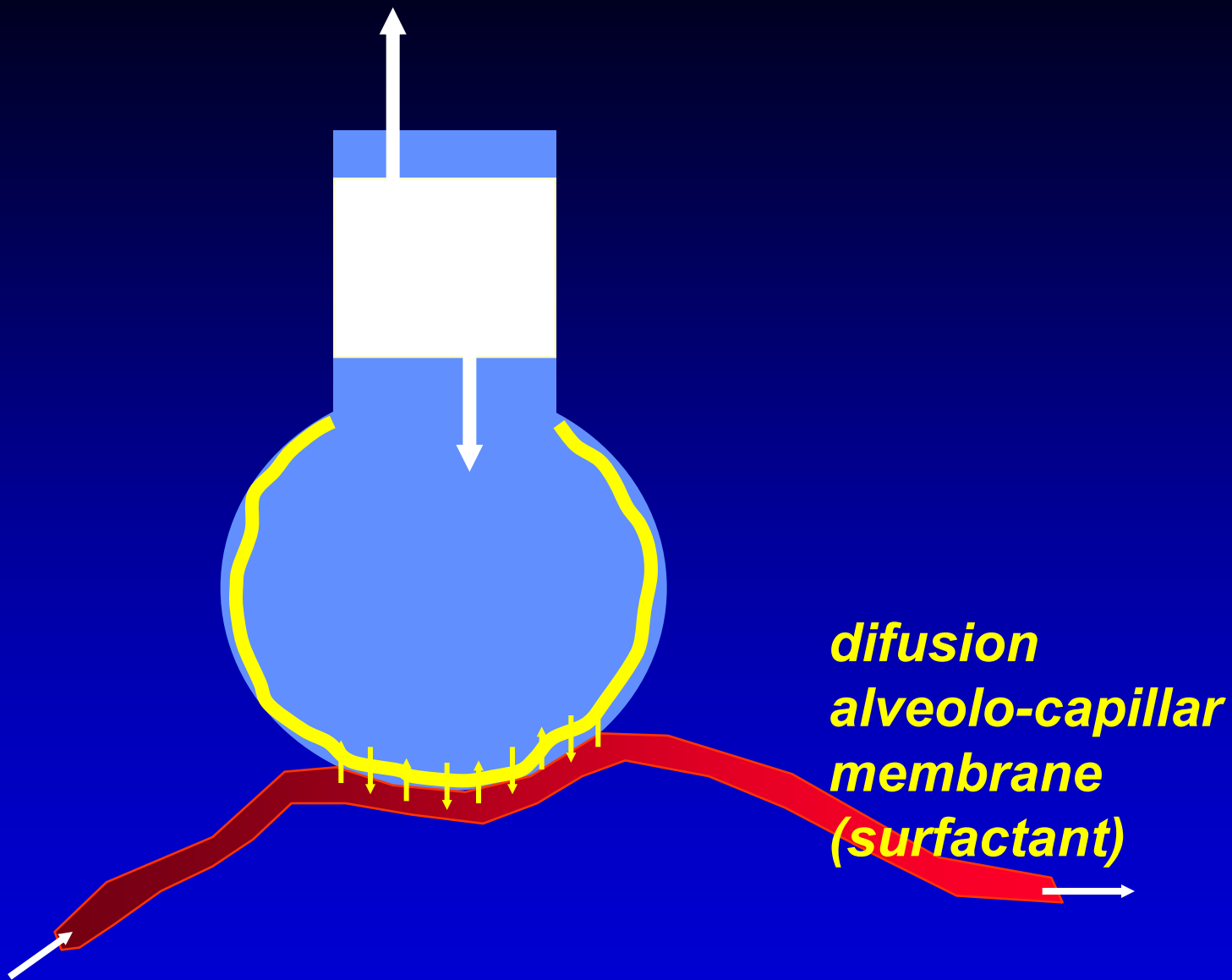
DYNAMIC VOLUMS

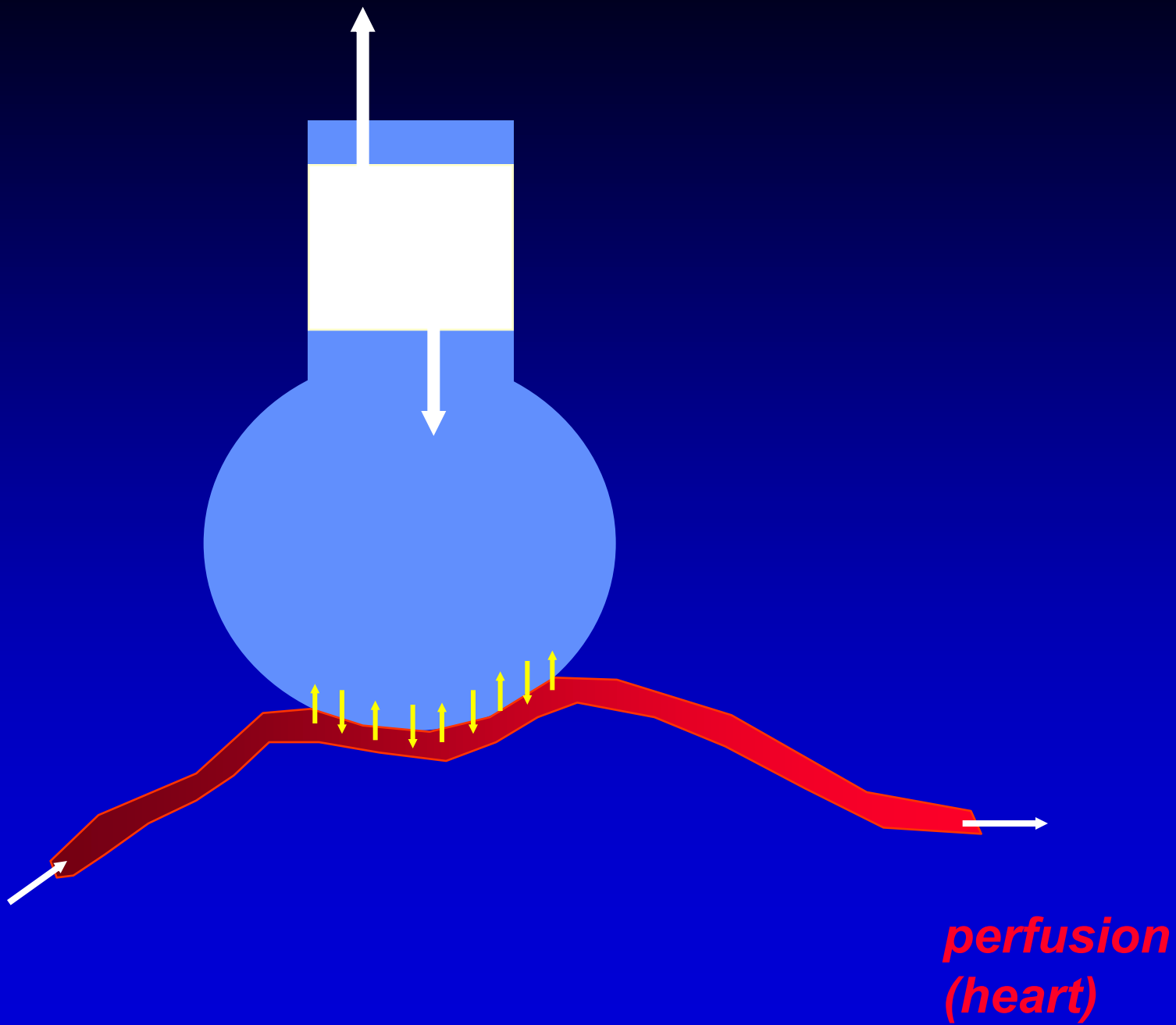


RESTRICTION
= FEV_1
↓ VC

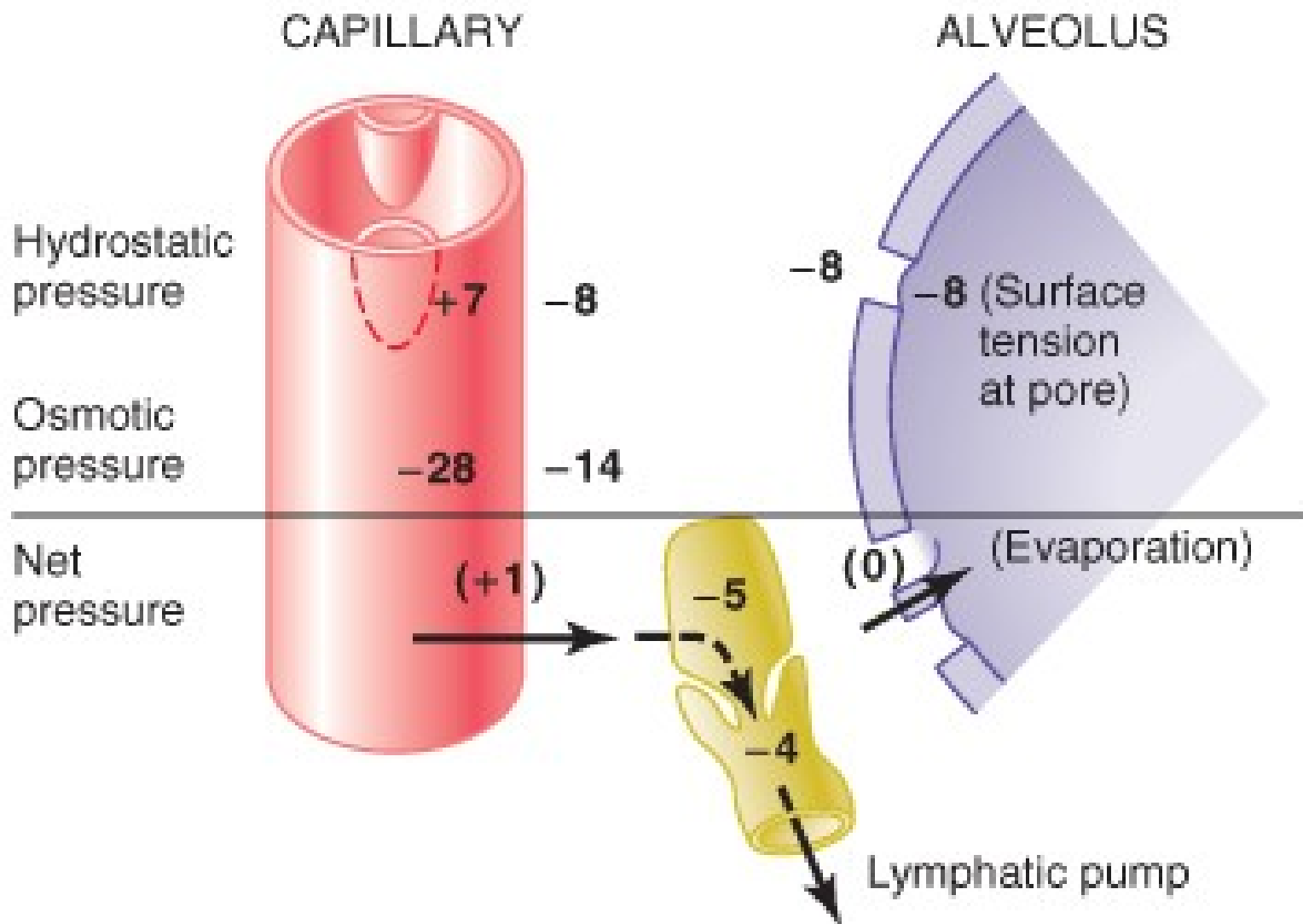


*difusion
alveolo-capillary
membrane
(surfactant)*

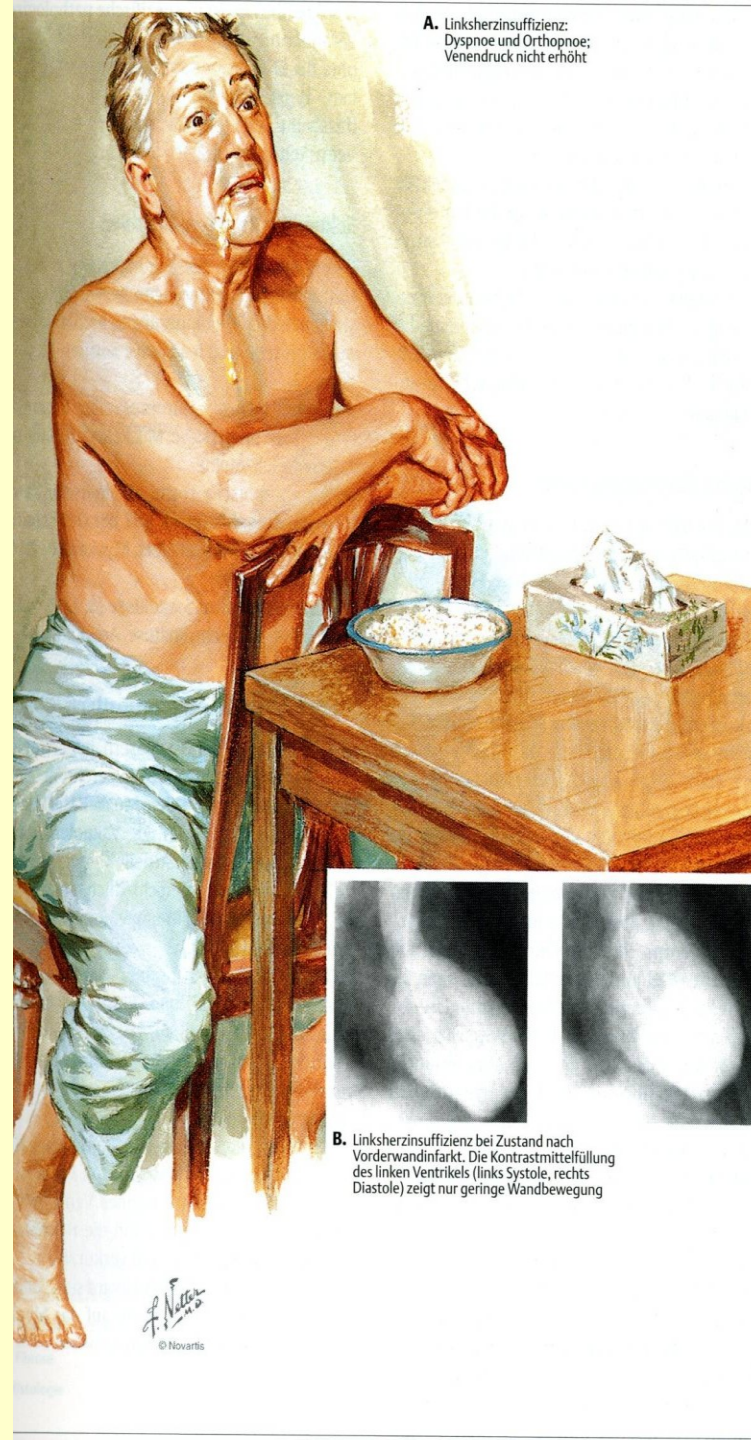




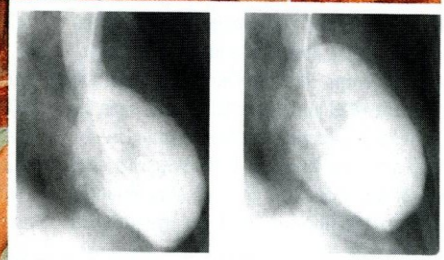
Pressures Causing Fluid Movement



Pulmonary edema
- cardiogenic
- noncardiogenic



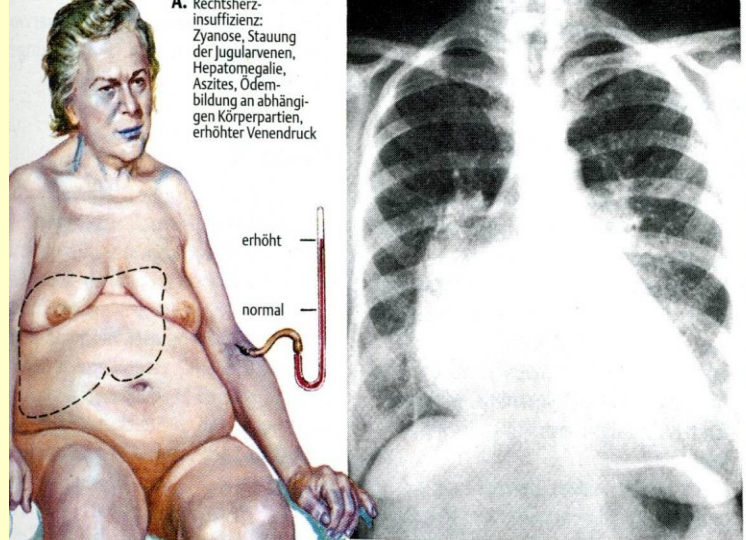
A. Linksherzinsuffizienz:
Dyspnoe und Orthopnoe;
Venendruck nicht erhöht



B. Linksherzinsuffizienz bei Zustand nach Vorderwandinfarkt. Die Kontrastmittelfüllung des linken Ventrikels (links Systole, rechts Diastole) zeigt nur geringe Wandbewegung

F. Netter
© Novartis

Cyanosis (right ventricle)



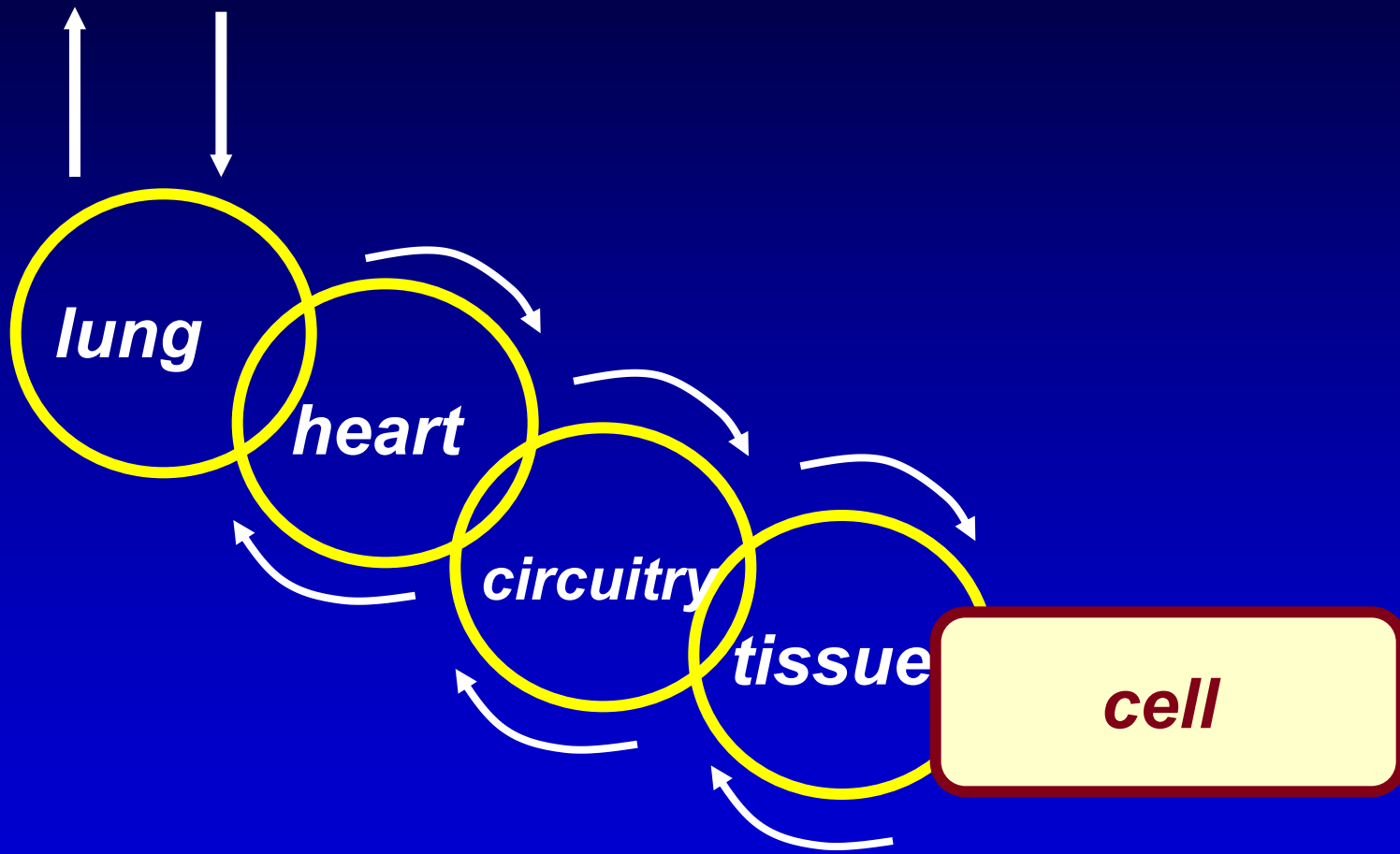
Causes of cyanosis

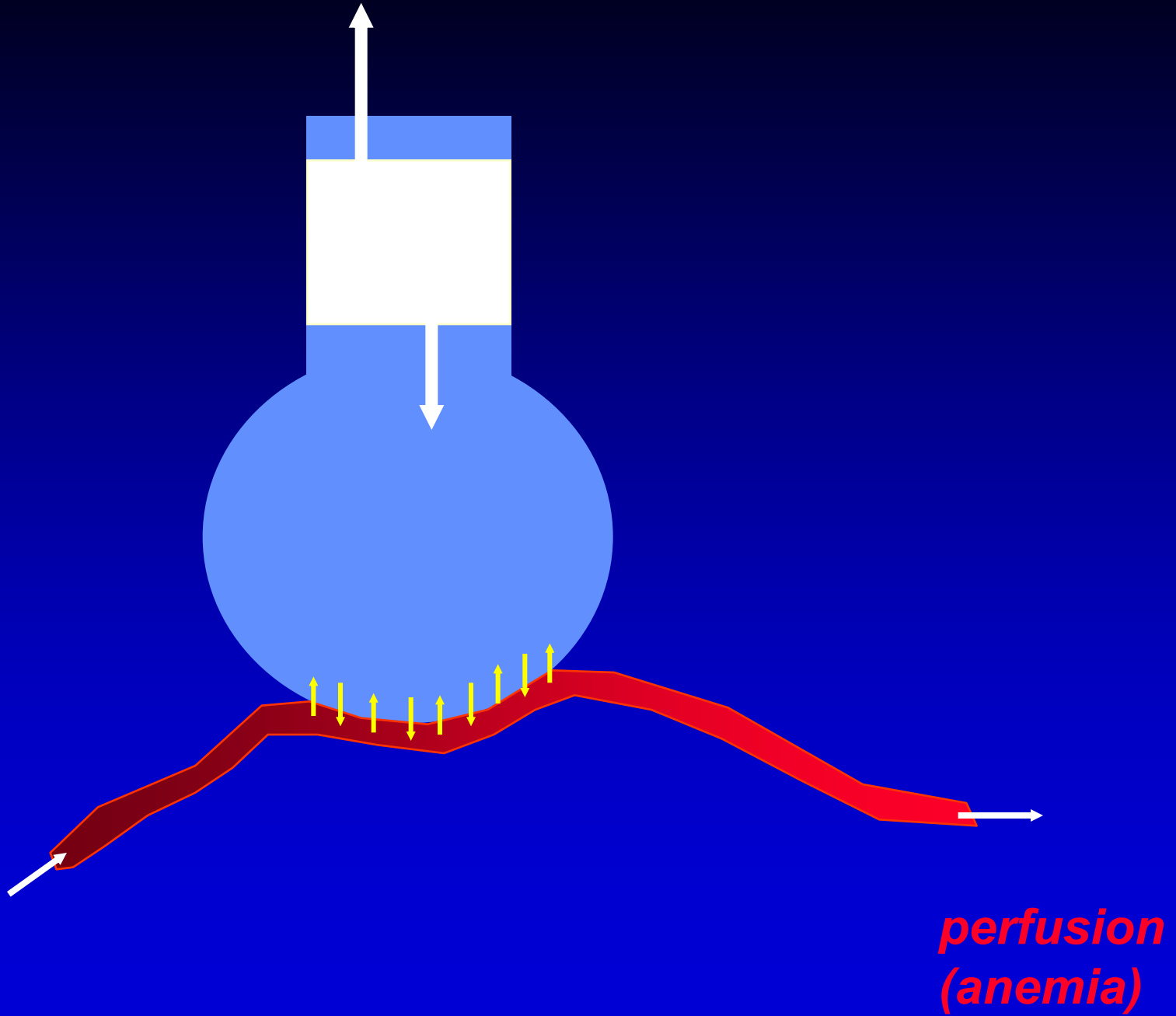
Central cyanosis

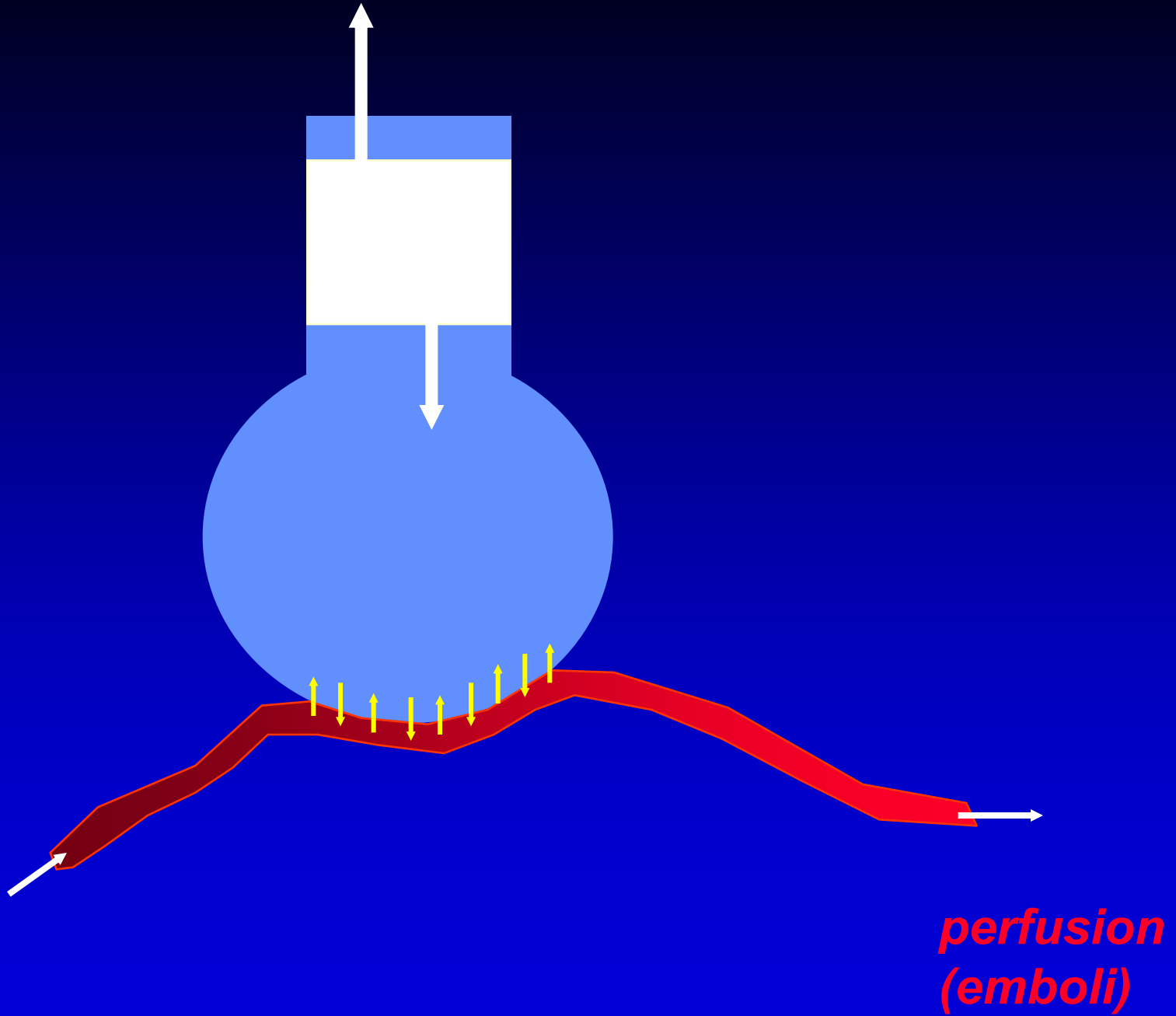
Decreased arterial saturation
Hemoglobin abnormalities

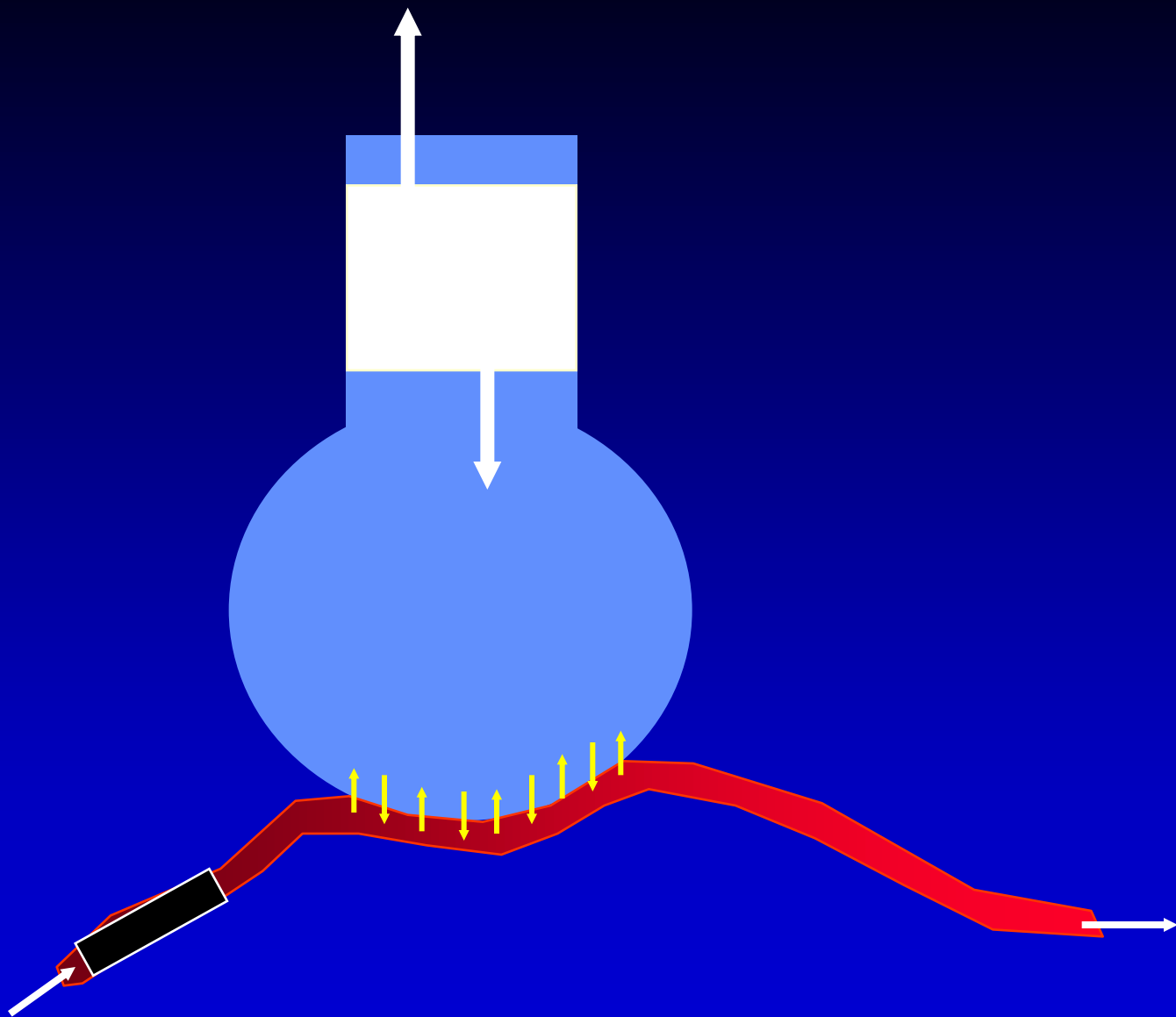
Peripheral cyanosis

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

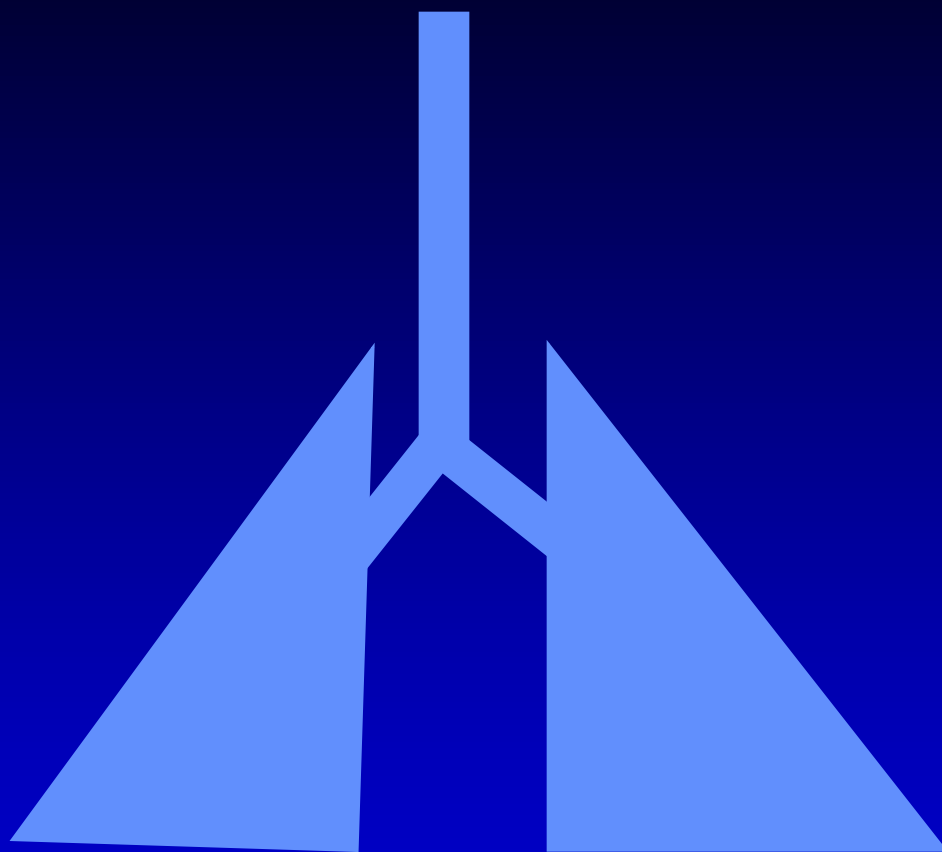




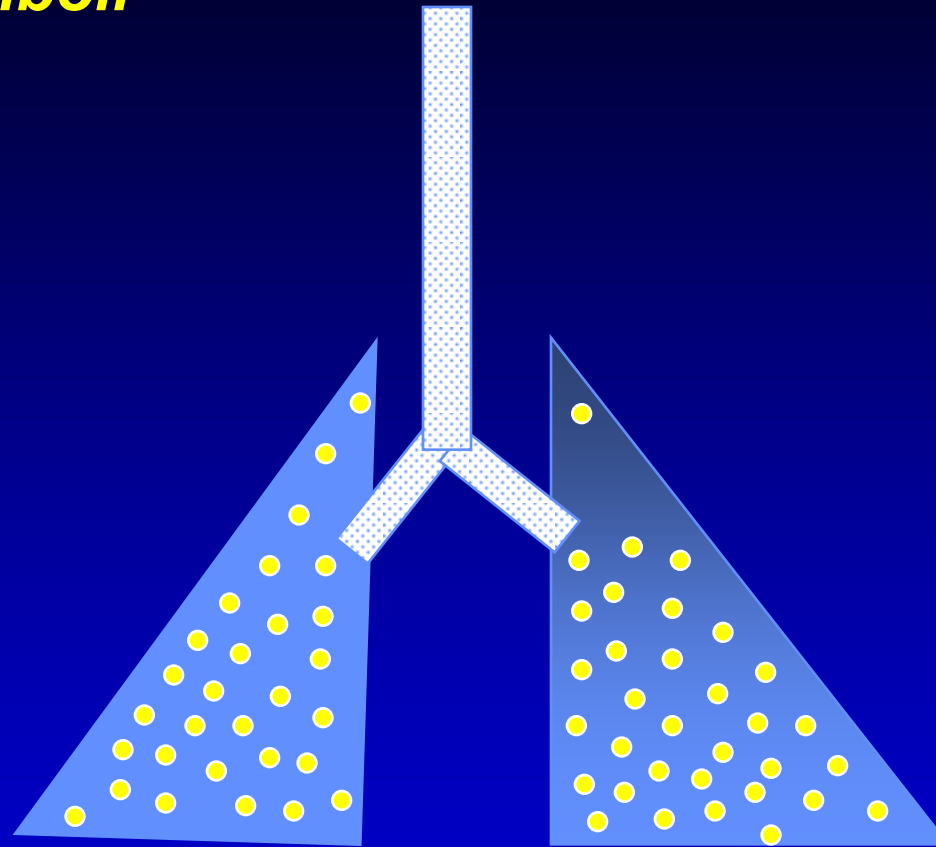




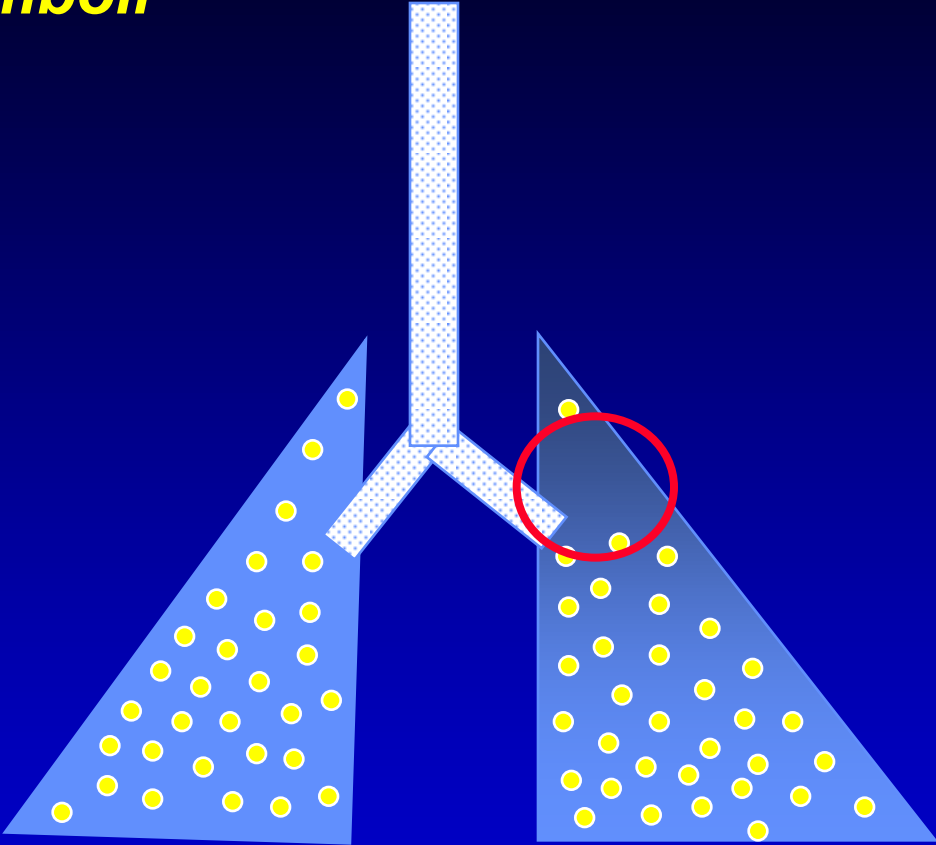
*perfusion
(emboli)*



dg. pulmonal emboli



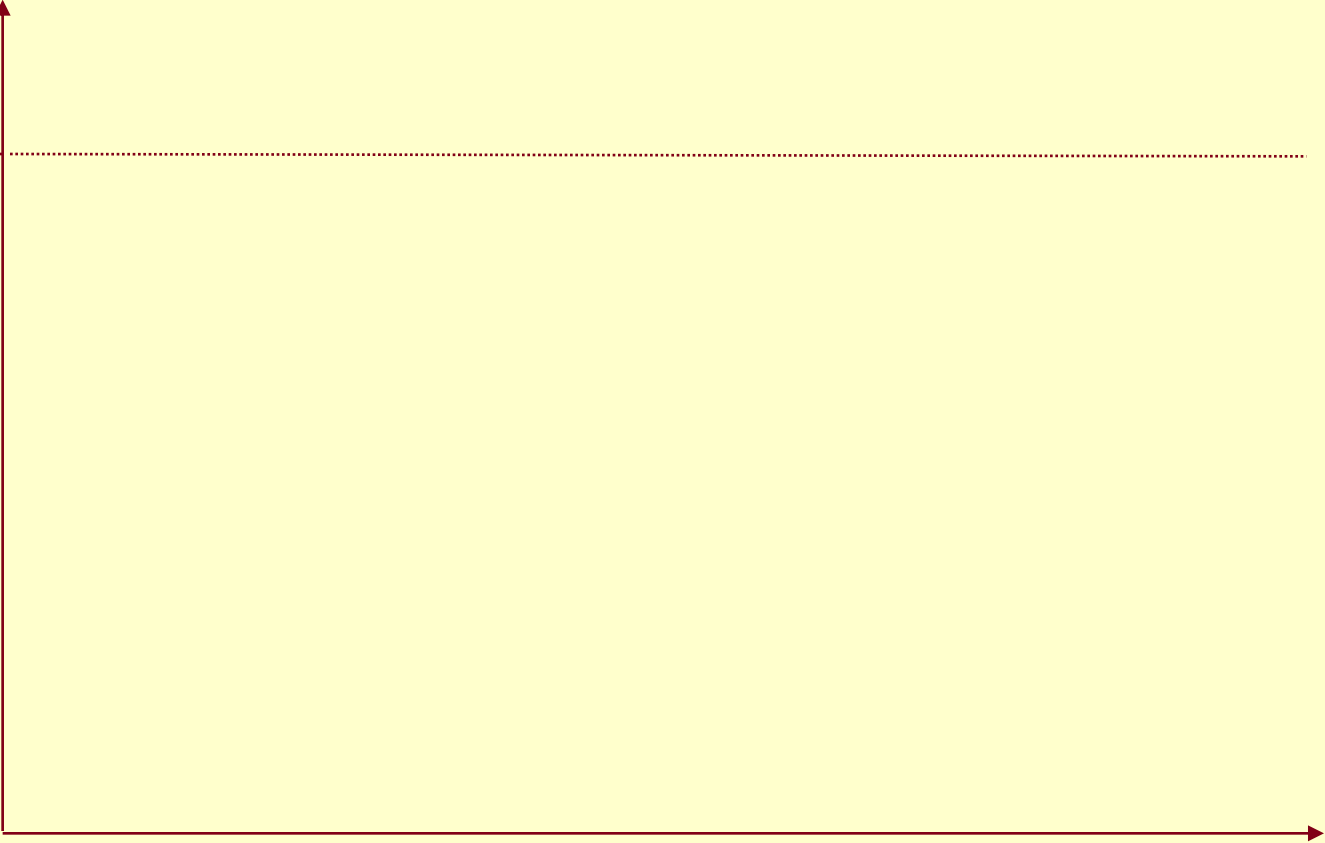
Dg. pulmonal emboli



Bohrs effects

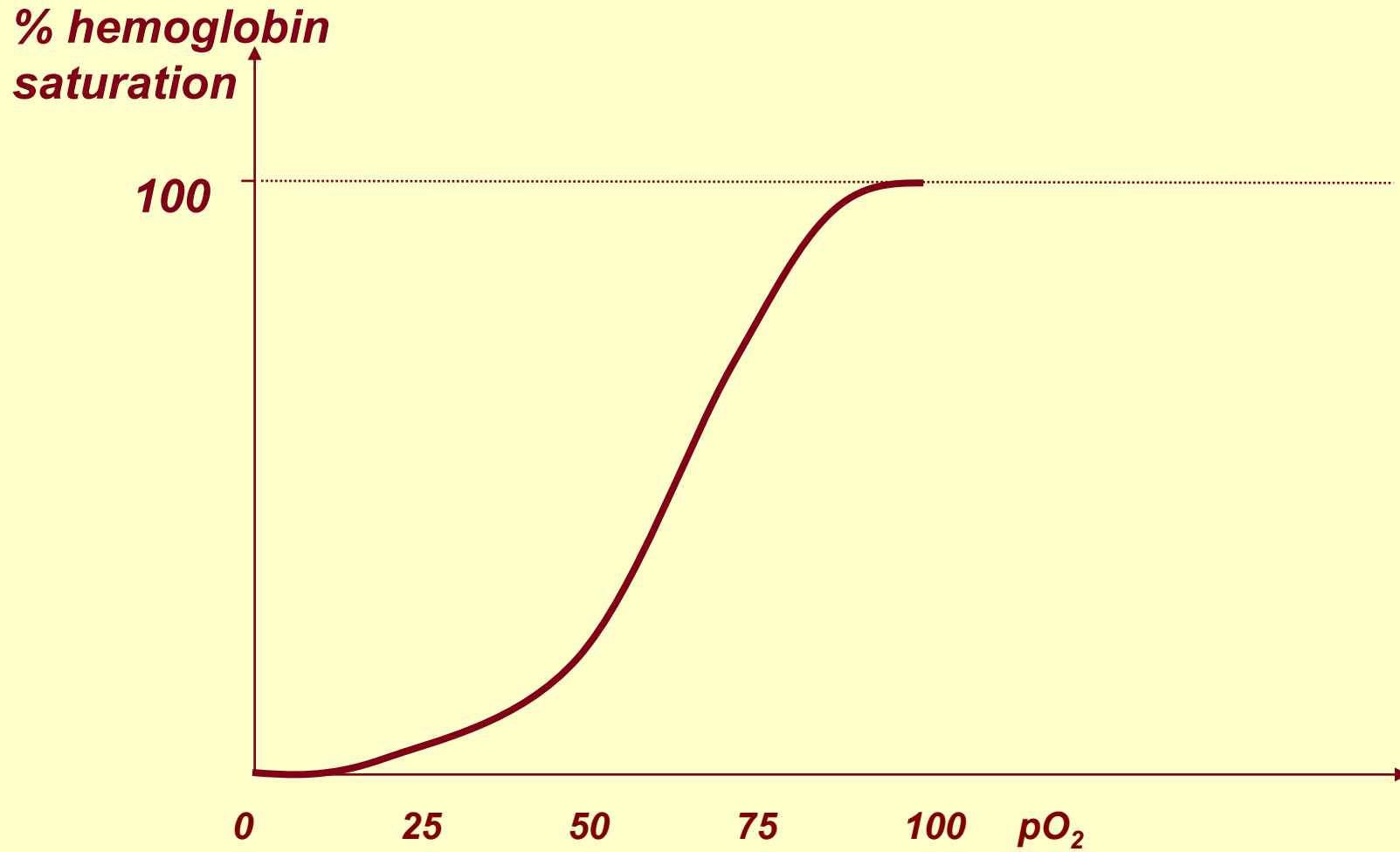
***% hemoglobin
saturation***

100



pO₂

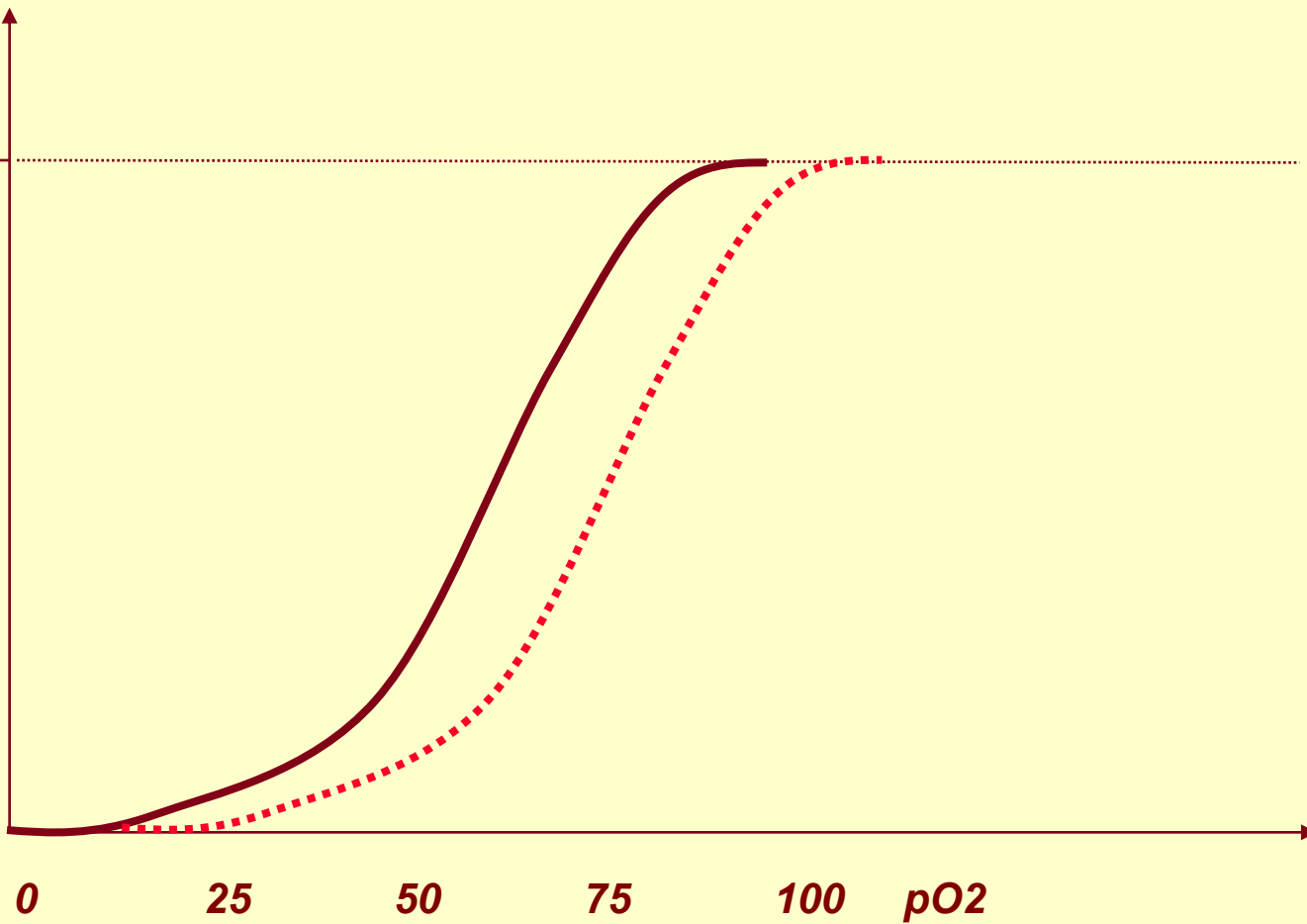
Bohrs effect – O₂ hemoglobin dissociation curve



Shift to the right

**% hemoglobin
saturation**

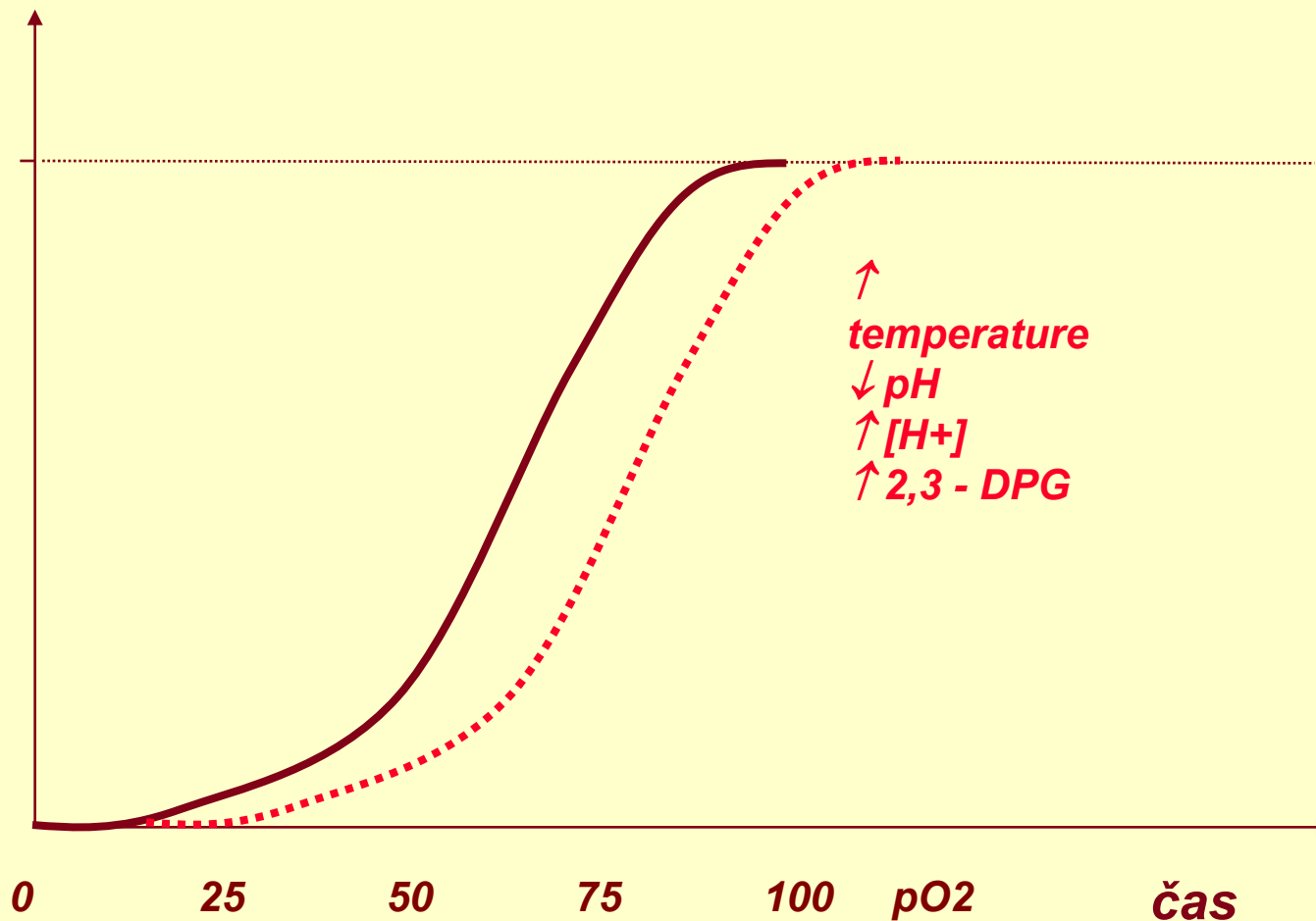
100



Shift to the right

**% hemoglobin
saturation**

100



Shift to the left

**% hemoglobin
saturation**

100

↓ temperature

↑ pH

↓ [H⁺]

↓ 2,3 - DPG

0

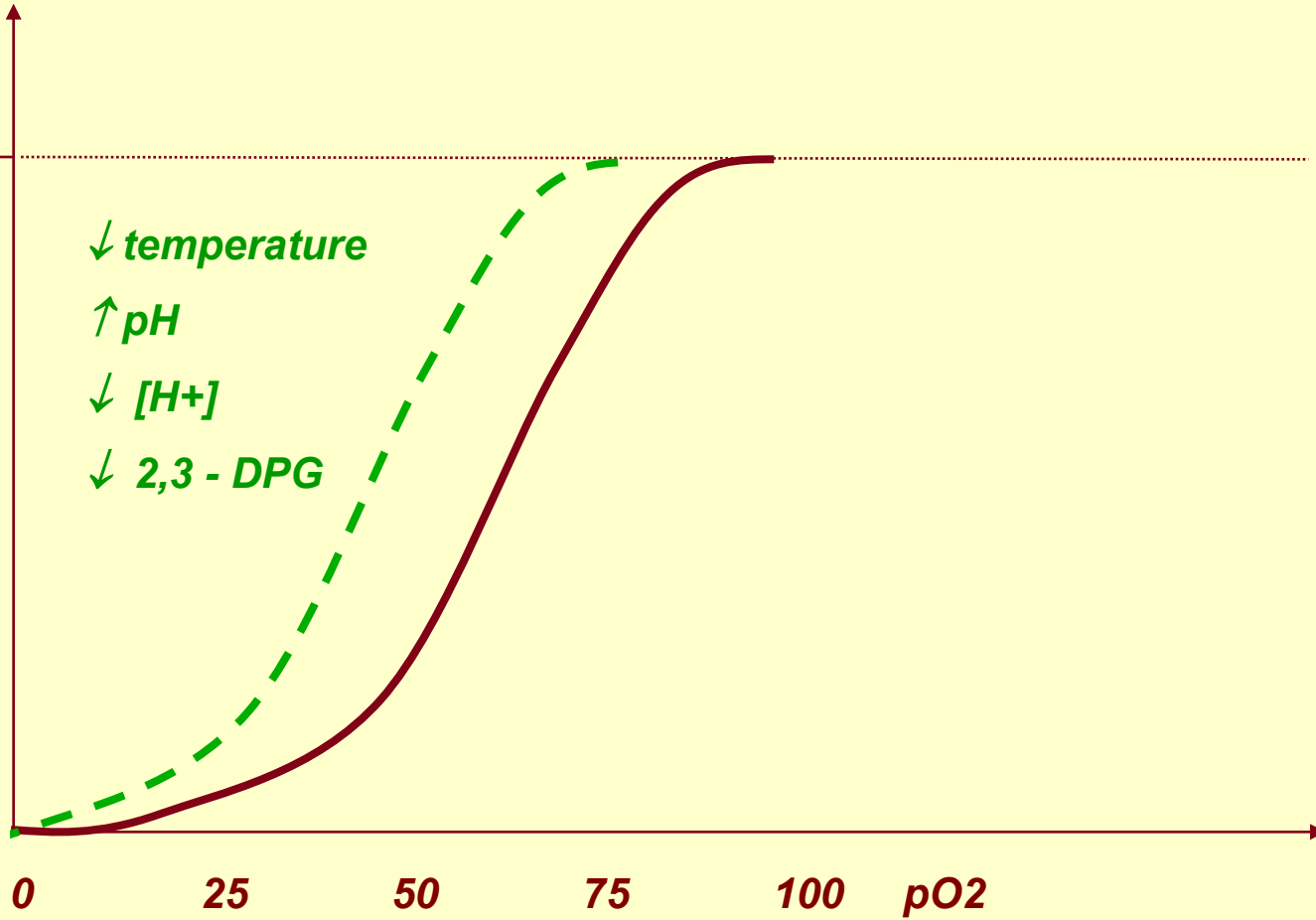
25

50

75

100

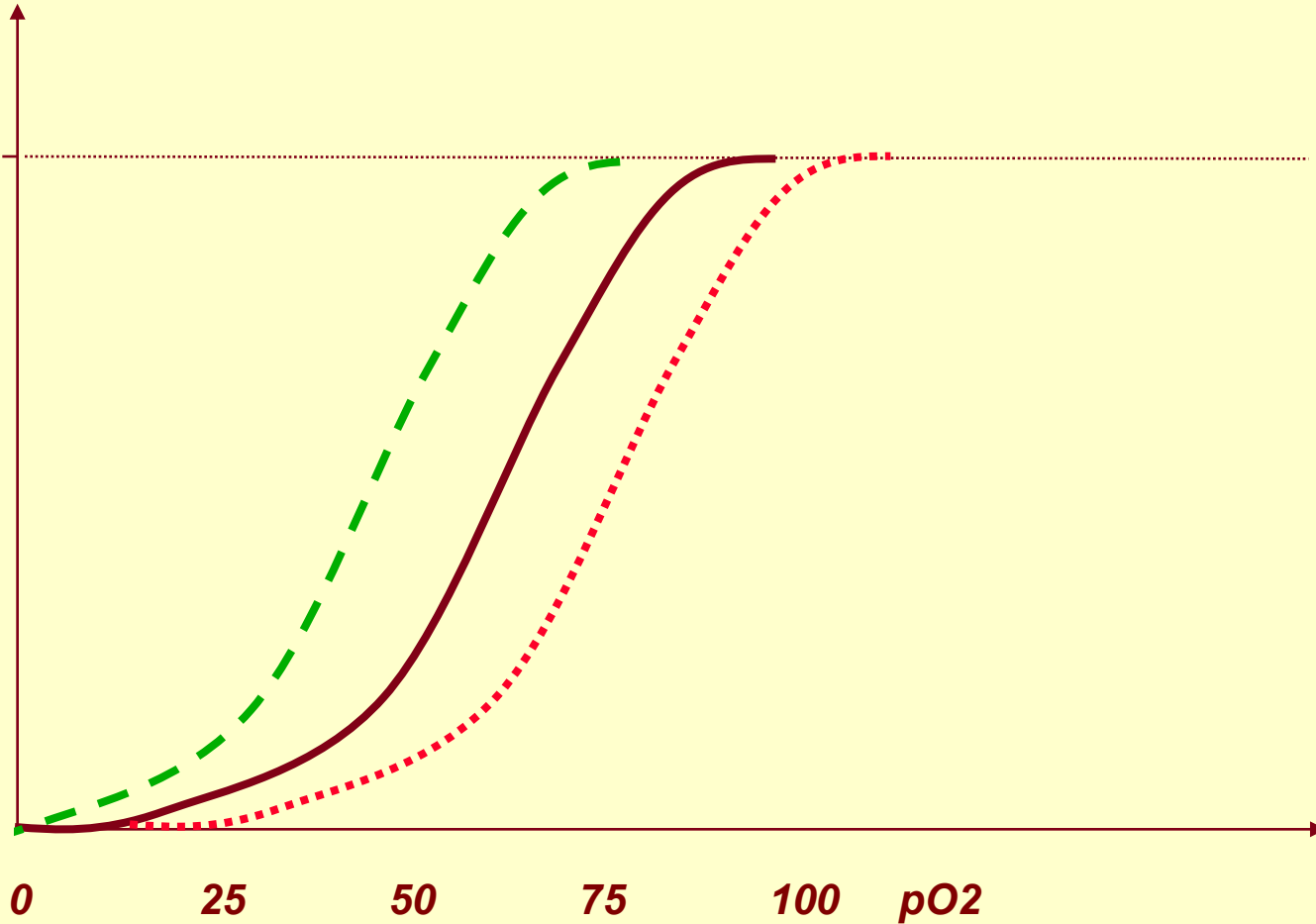
pO₂



Bohr effect

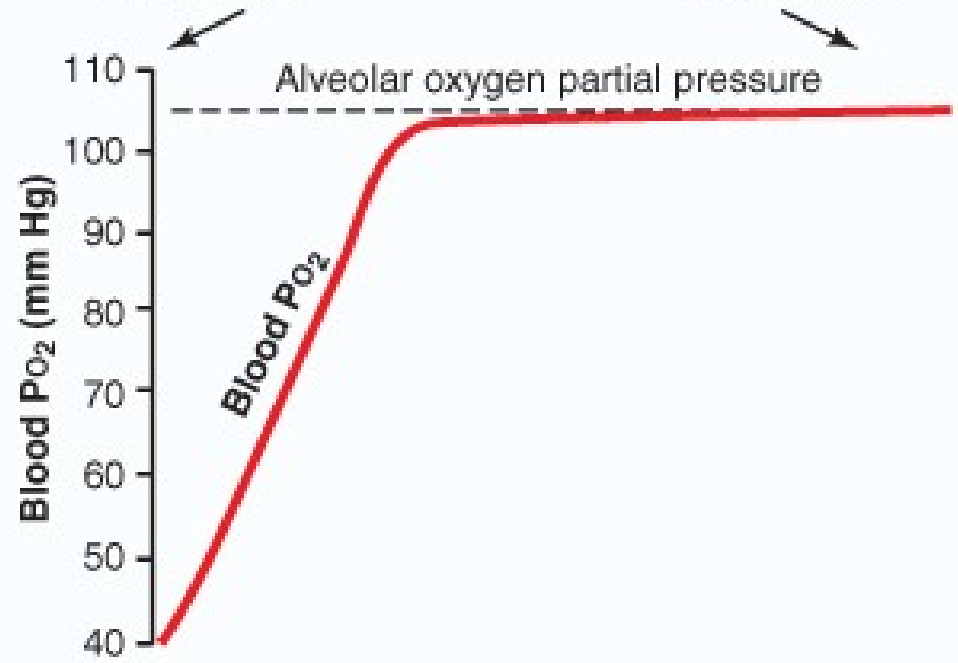
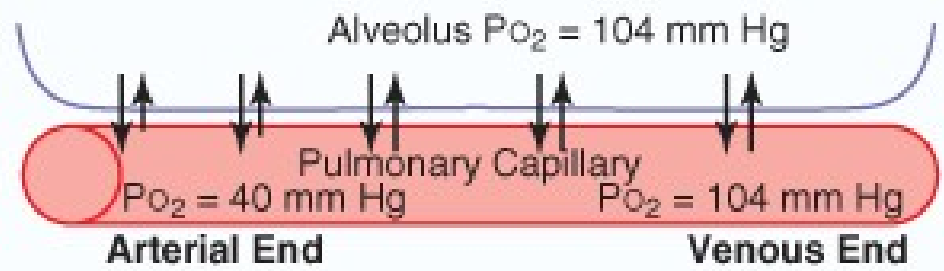
% hemoglobin
saturation

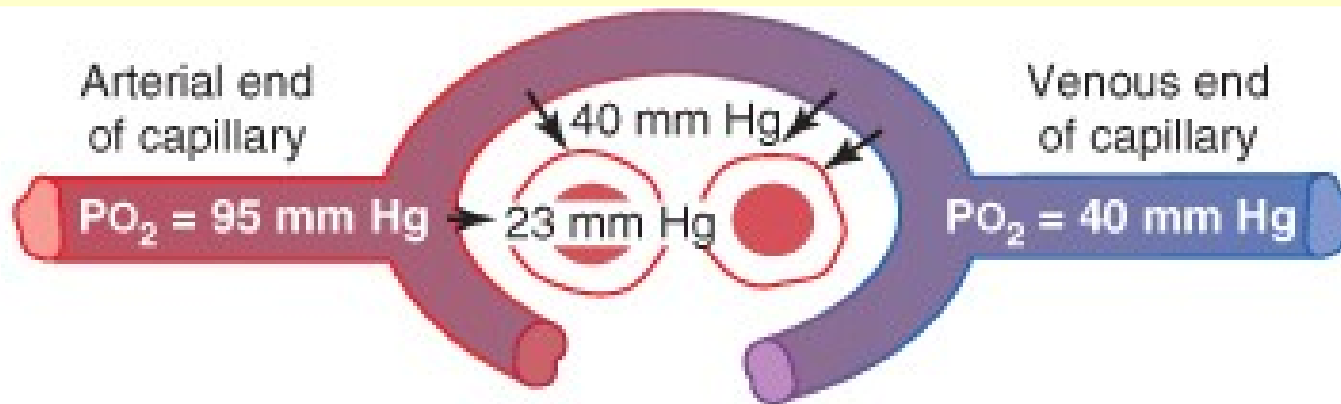
100



***Values of pO₂ and corresponding values
of percent saturation of hemoglobin***

pO₂ mmHg	saturation (%)
10	25
20	35
25	50
30	60
40	75
50	85
60	90
80	96
100	98





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