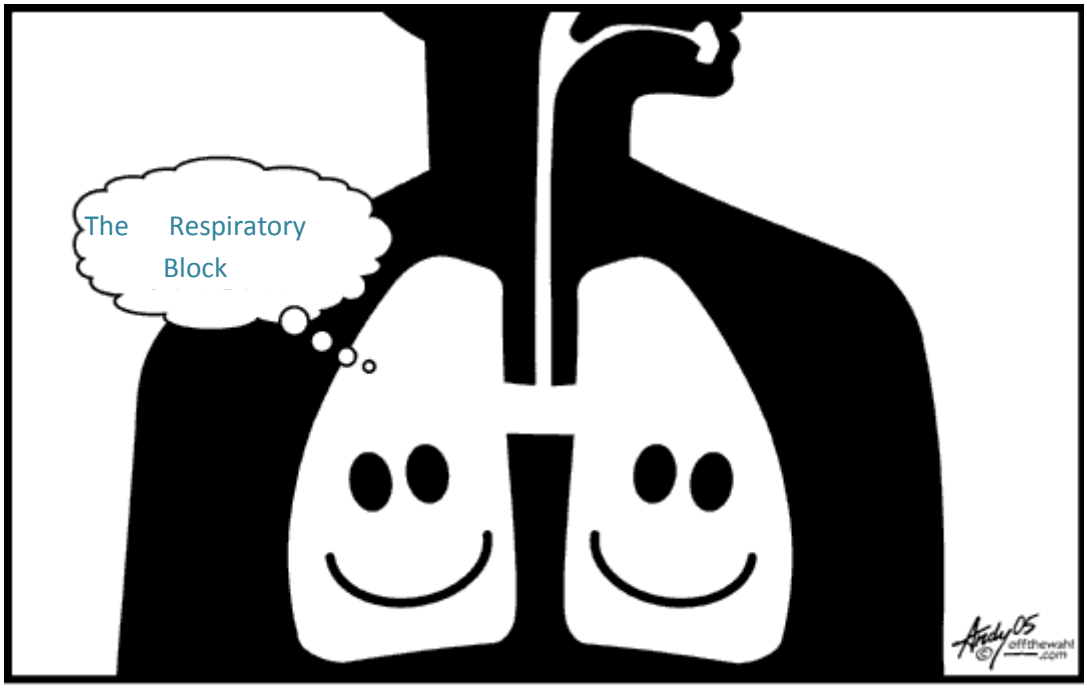
The Physiology Team



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هذه المذكرة للمذاكرة قبل الاختبار وهي تقريبا شاملة لكل شيء في المحاظرة

We did our best and I hope our best is enough

Gas exchange

The next step after alveolar ventilation is the diffusion of O_2 and CO_2

* the exchange of gases occurs via passive diffusion

*the energy responsible for the diffusion is the kinetic energy
(because molecules are in continues movement)

*** Factors affecting diffusion:**

1- pressure difference

2-solubility

3- molecular weight

- **Partial Pressure**
  Each gas in atmosphere contributes to the entire atmospheric pressure in **direct proportion** to its concentration, independent of other gases **(Dalton's law).**
- **Gases in liquid**
  Gas enters liquid and dissolves in proportion to its partial pressure "from high PP to low PP" and solubility coefficient
  (Henry's law)
- The partial pressure of different gases

Po_2 = 160 mmHg PN_2= 600 mm Hg

" the partial pressure is affected by altitude"

- In inspiration 21% of the air inspired is O_2 , while in expiration it is 16%

- When the O_2 passes through the conductive zone it PP= 160, and after passing the dead zone it become =149 " due to water vapor "
- CO_2 is 20 times more soluble than O_2

- PO2 is **104** mmHg in alveoli and **40** in alveolar capillaries
- PCO2 is **45** in alveolar capillaries and **40** in alveoli

- **Factors Affecting Rate of Gas Diffusion Through Respiratory Membrane:**
  1-Partial pressure differences :
  (Gases move from high to low PP).
  2-Surface area of gas exchange:
  (**Increase** surface area will **increase** the diffusion &vice versa).
  3-Diffusion distance:
  (**Increase** thickness of RM will **decrease** the diffusion &vice versa).
  4-Molecular weight & gas solubility :
  (O_2 has low mw than co_2)(Co2 more soluble than o_2 so co_2 diffusion is faster than o_2 diffusion with 20x) .

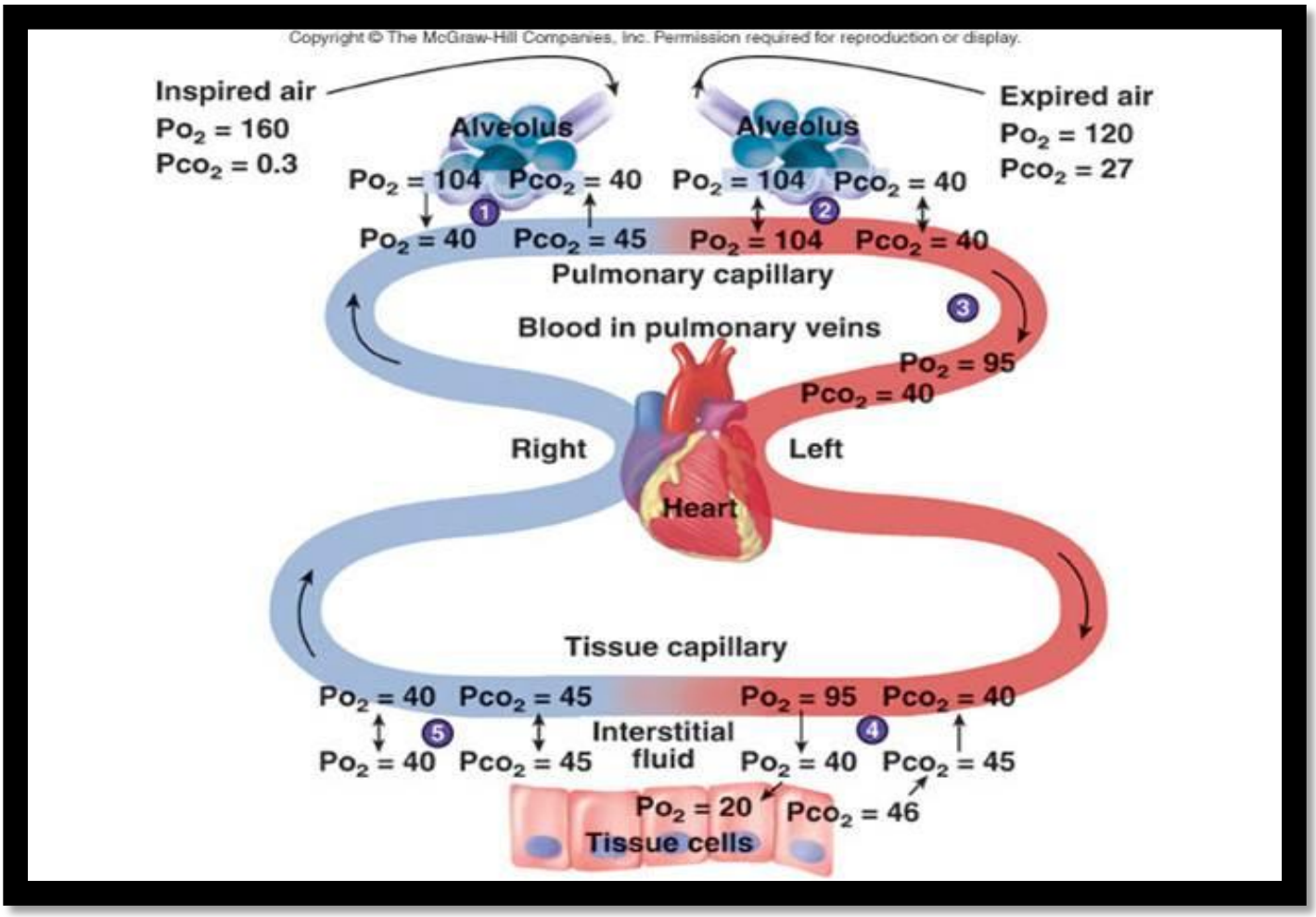
- The atmospheric air becomes totally humidified as it pass throw he respiratory passages by the **water vapor** which is about **47mmHg** in normal body temperature ,its function is to dilutes the gases in the inspired air
- **Factors control o_2 concentration :**
  1- Rate of absorption
  2- Rate of entry of new o_2 to the blood

- Alveolar ventilation should be 4.2 l /min

  In resting we inhale 250 ml of O_2

In exercise it can reach 1000 ml

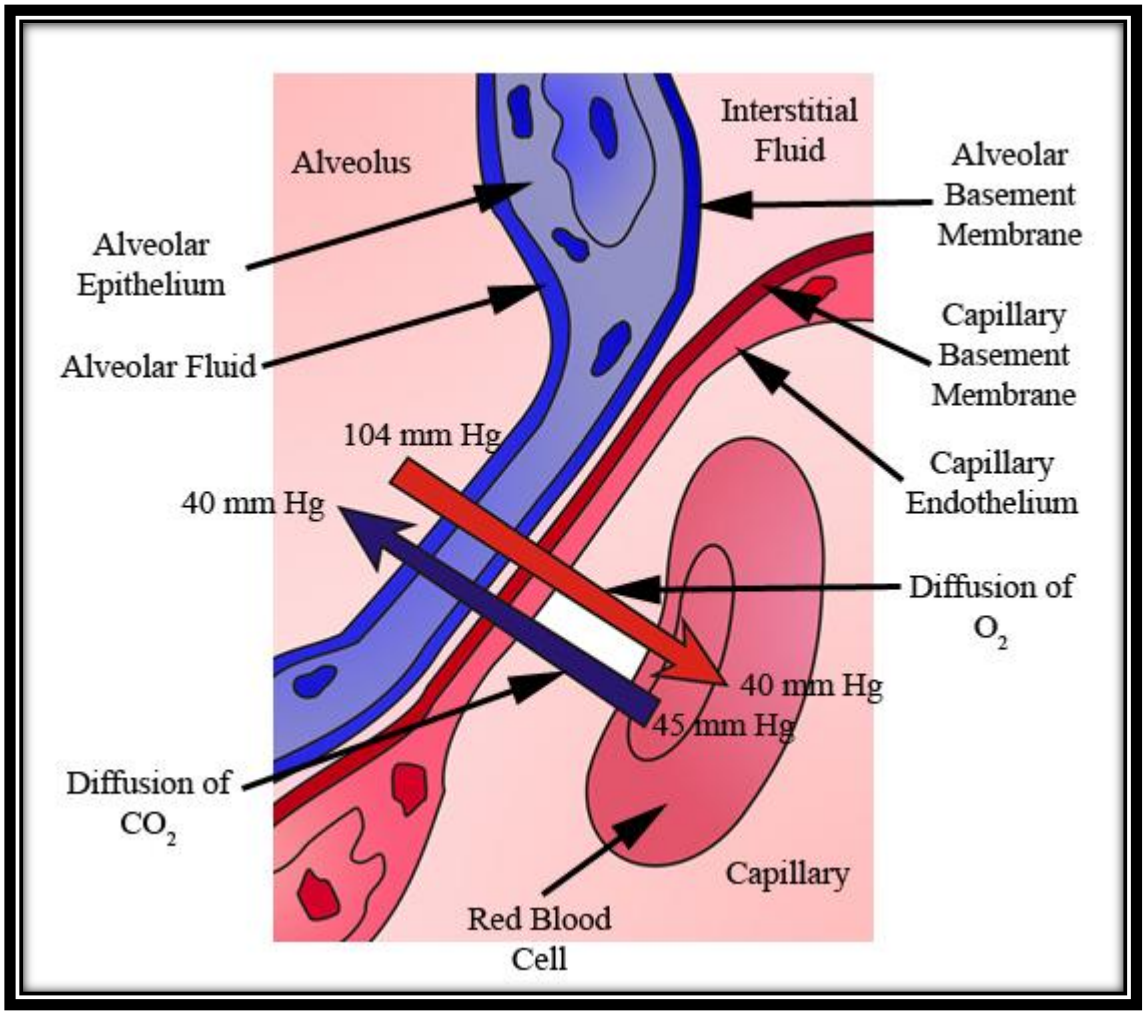
	Atmospheric Air* (mm Hg)		Humidified Air (mm Hg)		Alveolar Air (mm Hg)		Expired Air (mm Hg)	
N_2	597.0	(78.62%)	563.4	(74.09%)	569.0	(74.9%)	566.0	(74.5%)
O_2	159.0	(20.84%)	149.3	(19.67%)	104.0	(13.6%)	120.0	(15.7%)
CO_2	0.3	(0.04%)	0.3	(0.04%)	40.0	(5.3%)	27.0	(3.6%)
H_2O	3.7	(0.50%)	47.0	(6.20%)	47.0	(6.2%)	47.0	(6.2%)
TOTAL	760.0	(100.00%)	760.0	(100.00%)	760.0	(100.0%)	760.0	(100.0%)



NOTE:

- The **arterial end** of the pulmonary capillary has a **venous blood** from pulmonary trunk.
- The **venous end** of the pulmonary capillary has an **arterial blood** which is already have more oxygen after diffusion with alveoli and it goes to the 4 pulmonary veins to the left side of the heart.
- The PP of O_2 changes from 104 to 95 when it passes through the pulmonary veins because some venous blood is drained to it by the bronchial veins and this is called a physiological shunt.
- The alveolar air is not renewed in each breath. Only small amount of the functional residual capacity changes because the residual volume goes to the alveoli to prevent fluctuating of the gases.

Term	Definition
Lung Volumes	The four nonoverlapping components of the total lung capacity
Tidal volume	The volume of gas inspired or expired in an unforced respiratory cycle
Inspiratory reserve volume	The maximum volume of gas that can be inspired during forced breathing in addition to tidal volume
Expiratory reserve volume	The maximum volume of gas that can be expired during forced breathing in addition to tidal volume
Residual volume	The volume of gas remaining in the lungs after a maximum expiration
Lung Capacities	Measurements that are the sum of two or more lung volumes
Total lung capacity	The total amount of gas in the lungs after a maximum inspiration
Vital capacity	The maximum amount of gas that can be expired after a maximum inspiration
Inspiratory capacity	The maximum amount of gas that can be inspired after a normal tidal expiration
Functional residual capacity	The amount of gas remaining in the lungs after a normal tidal expiration


Alveolus
Interstitial Fluid
Alveolar Basement Membrane
Alveolar Epithelium
Alveolar Fluid
Capillary Basement Membrane
104 mm Hg
Capillary Endothelium
40 mm Hg
Diffusion of O_2
40 mm Hg
45 mm Hg
Diffusion of CO_2
Capillary
Red Blood Cell