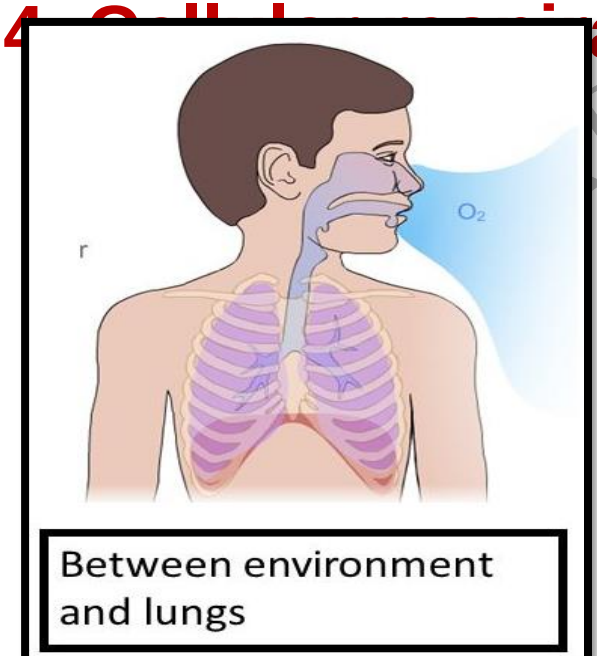
1. **Pulmonary ventilation** :

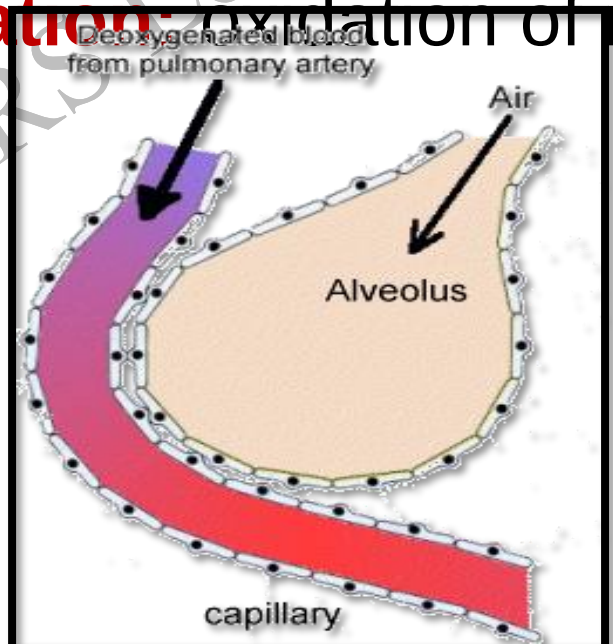
   Inflow & outflow of air between atmosphere and lungs.

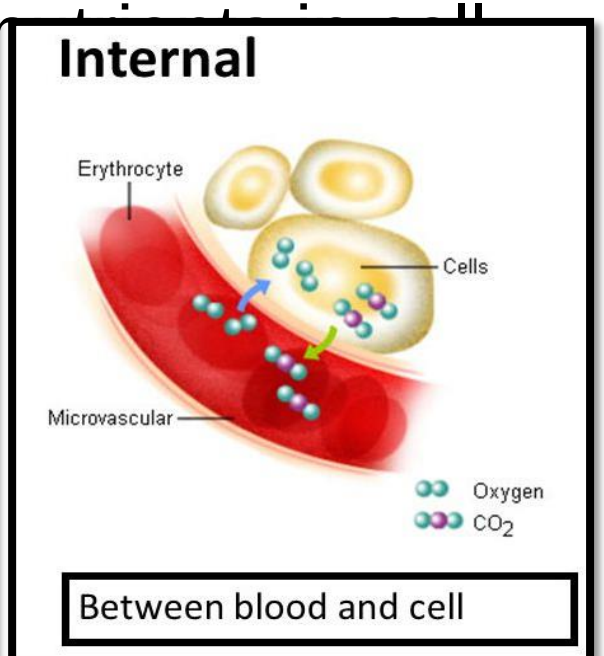
2. **External respiration:** gas exchange between alveoli and blood

3. **Internal respiration:** gas exchange between blood and cells.

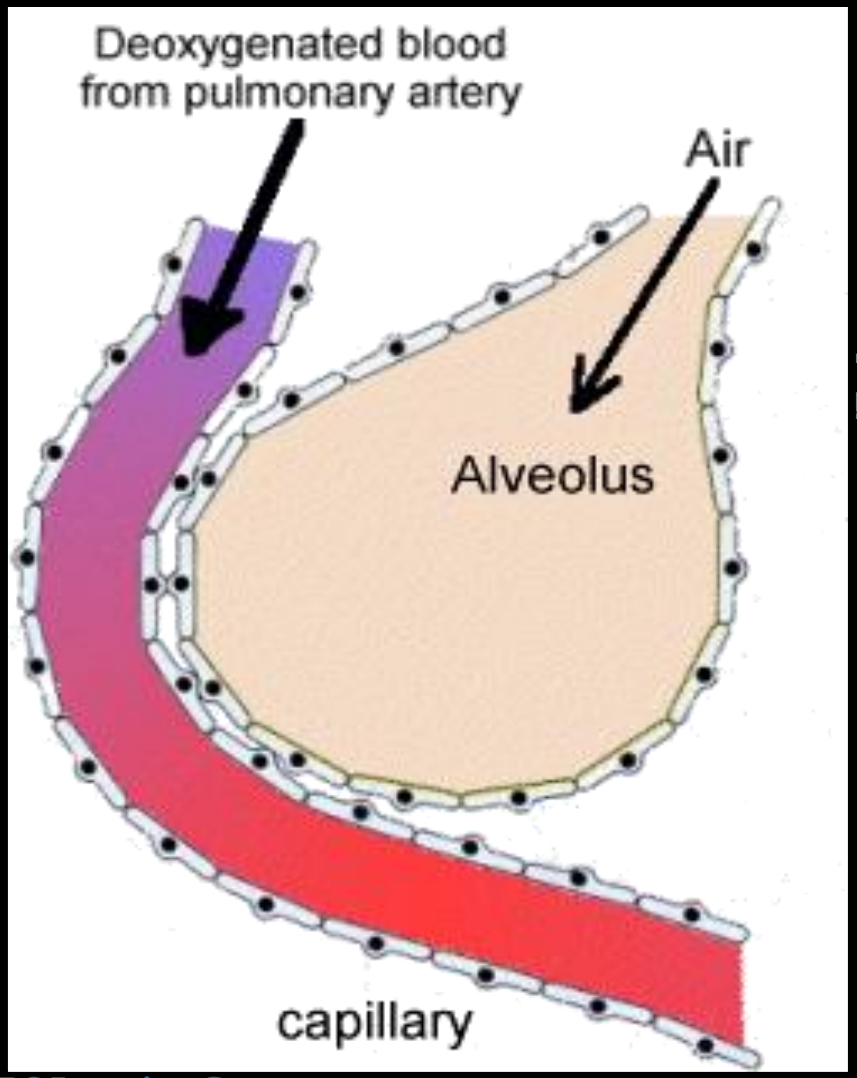
4. **Cellular respiration:** oxidation of [illegible]

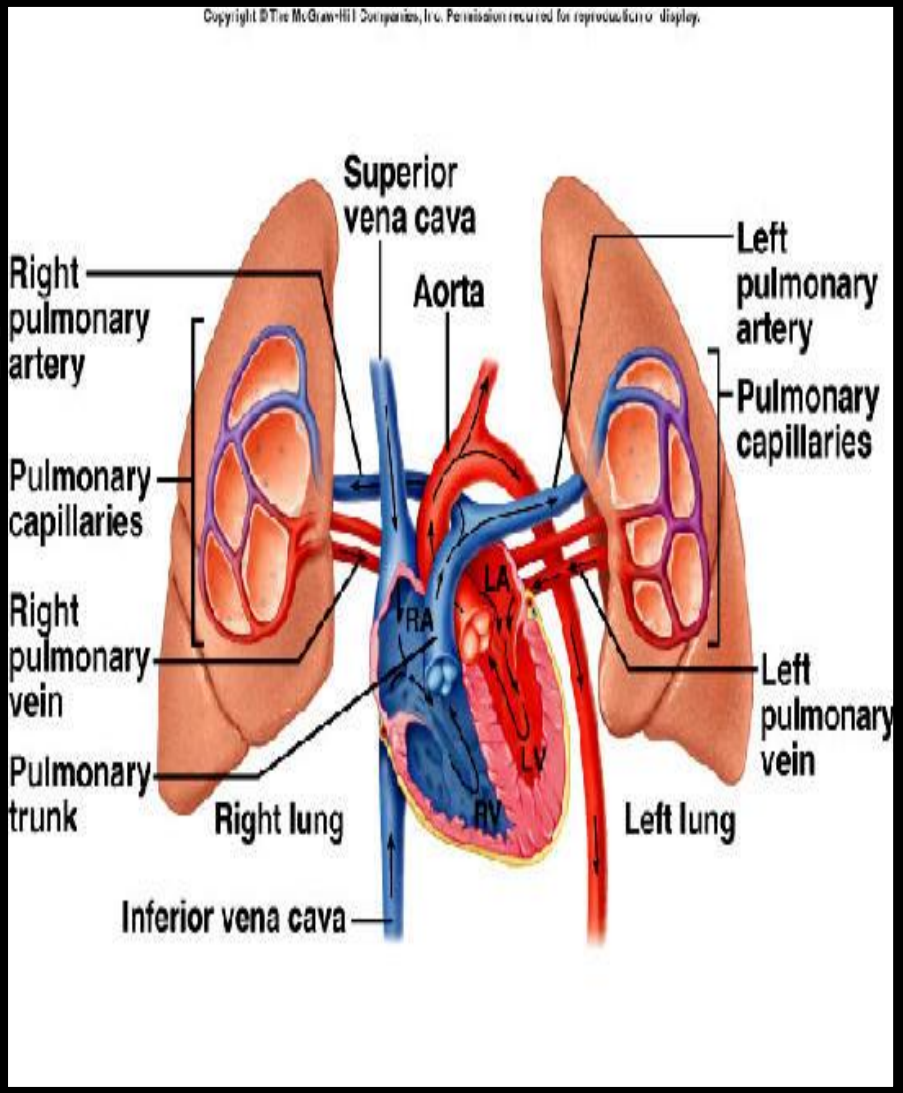


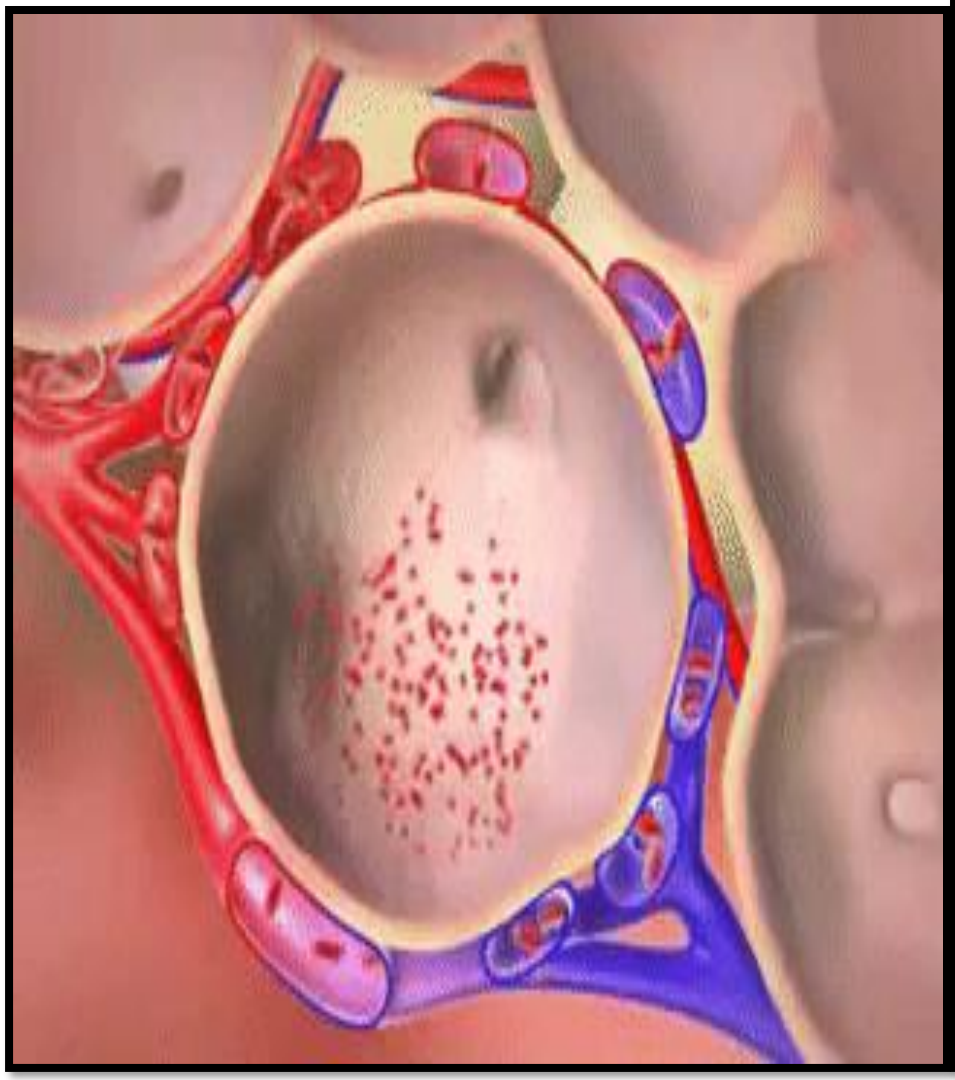


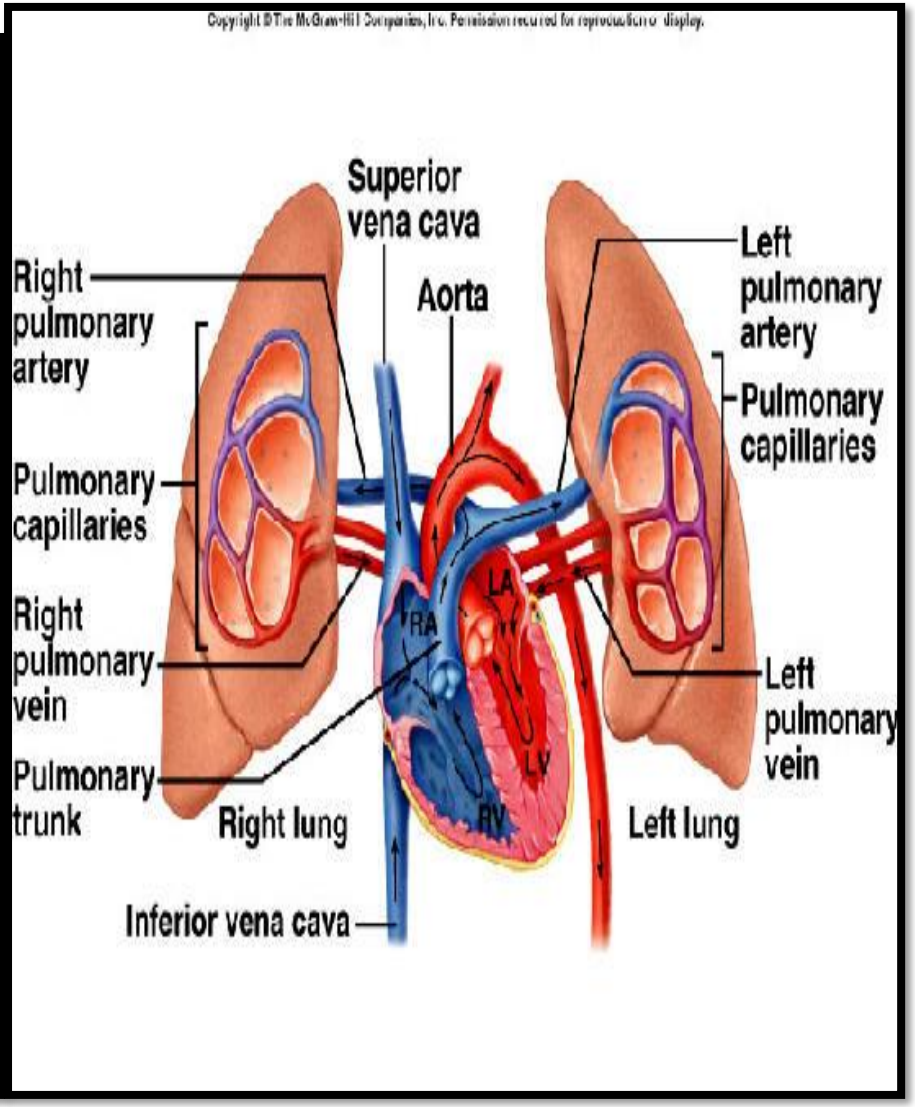


Gas exchange in pulmonary capillary







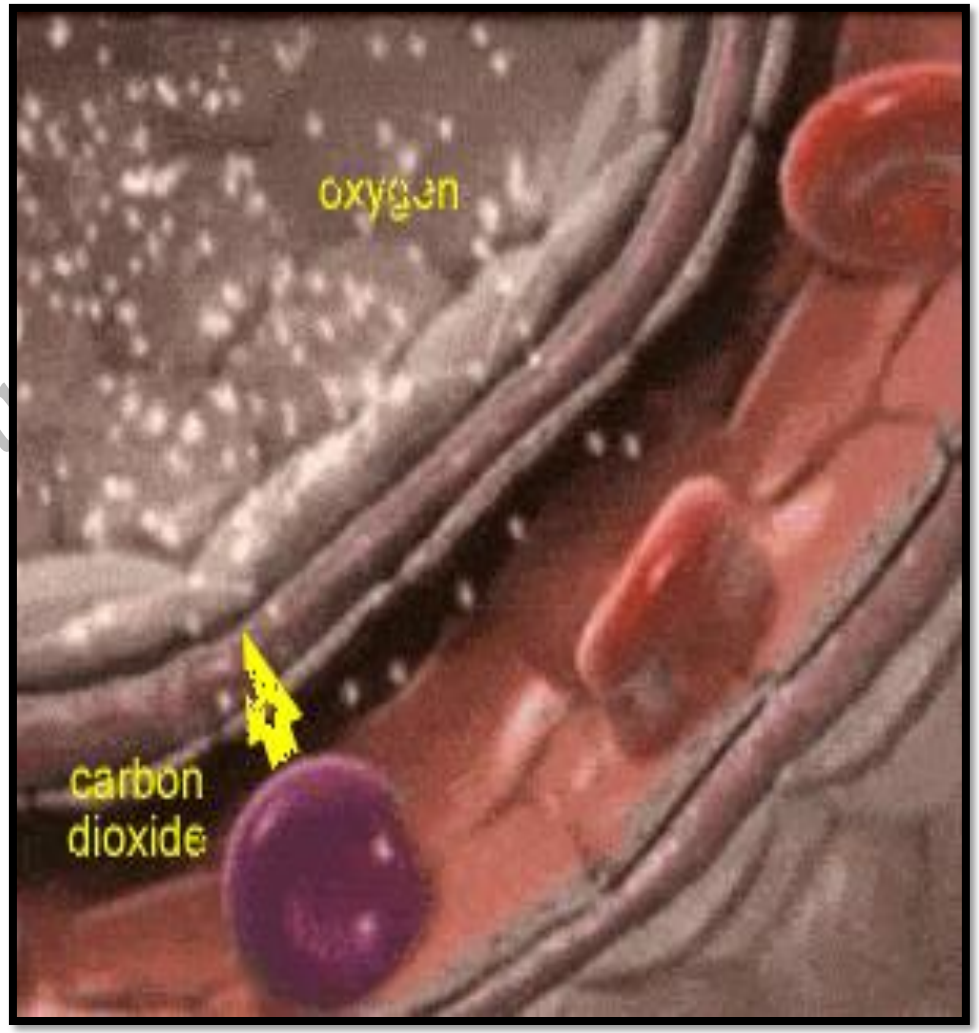


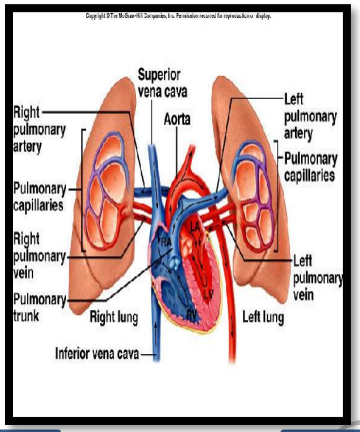
Pulmonary artery starts from Right ventricle carries deoxygenated blood to lungs

- **Pulmonary vein starts from pulmonary capillaries carries oxygenated blood to left atria**

External Respiration

- Exchange of oxygen & carbon dioxide between alveoli and pulmonary blood
- **Gases diffuse from high pressure to low pressure area**





Alveolar air

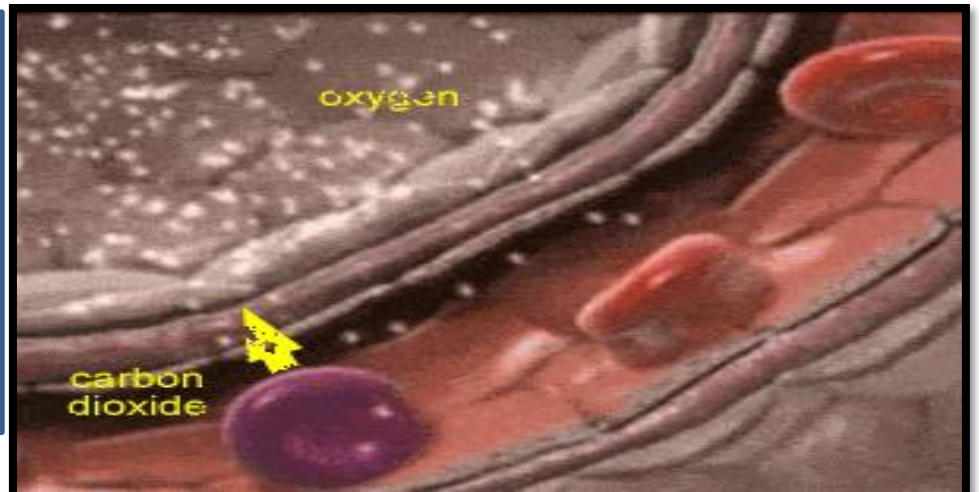
Pulmonary artery blood

PO2 = 105mmHg → **PO2 = 40mmHg**

PCO2 = 40mmHg ← **PCO2 = 45mmHg**

PO_2 – partial pressure of oxygen

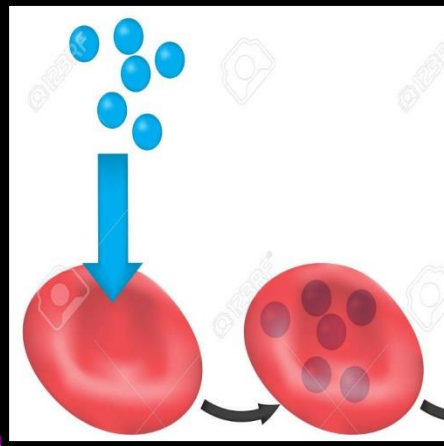
PCO_2 - partial pressure of CO_2



Composition	Inhaled Air	Exhaled Air
Nitrogen	78%	78%
oxygen	21%	17%
Carbon dioxide	0.04%	4.0%
Argon	1%	1%
water vapour	little	more

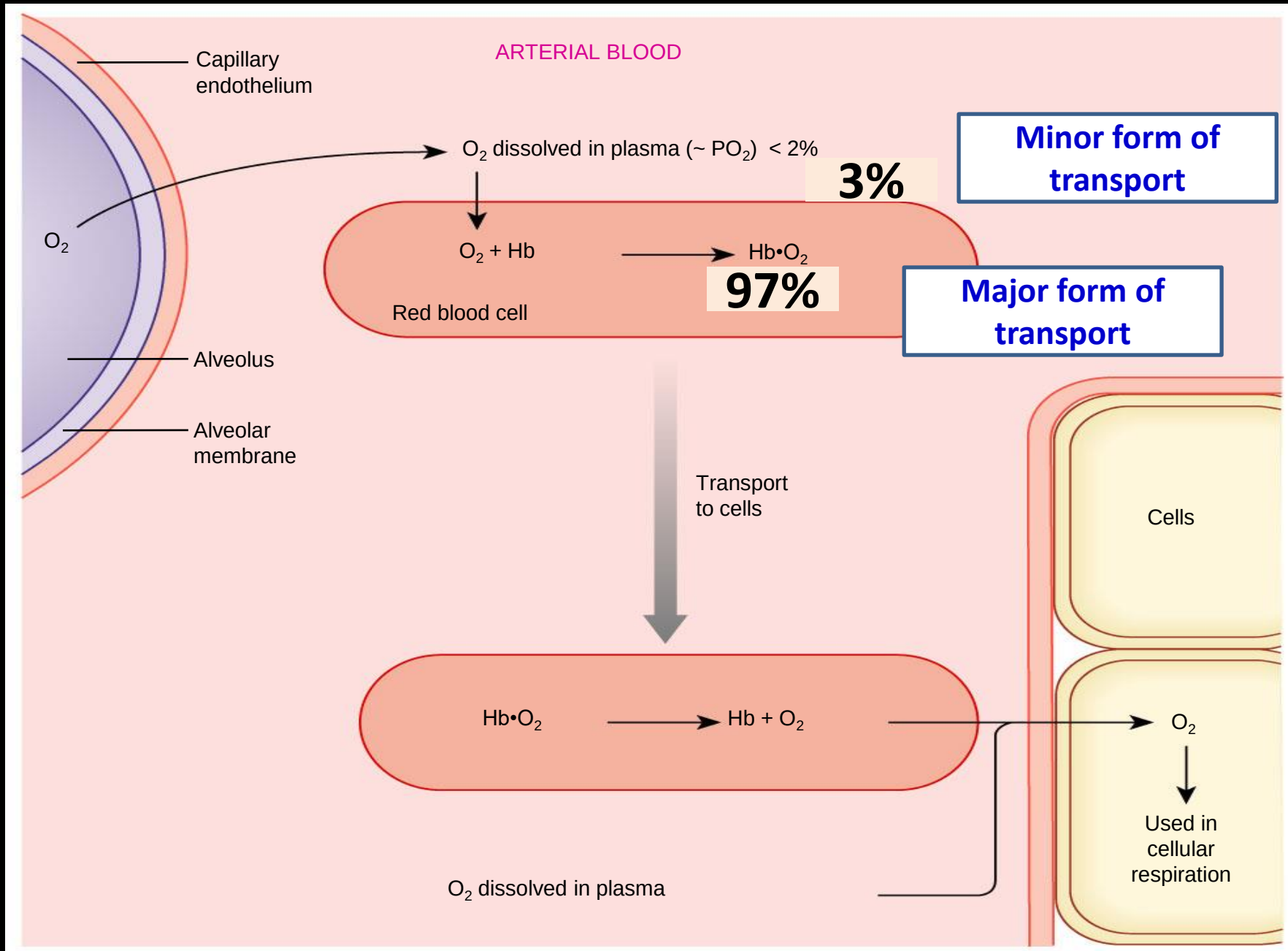
Oxygen Transport

2 Forms of O2 Transport



Physical -
Dissolved in Plasma

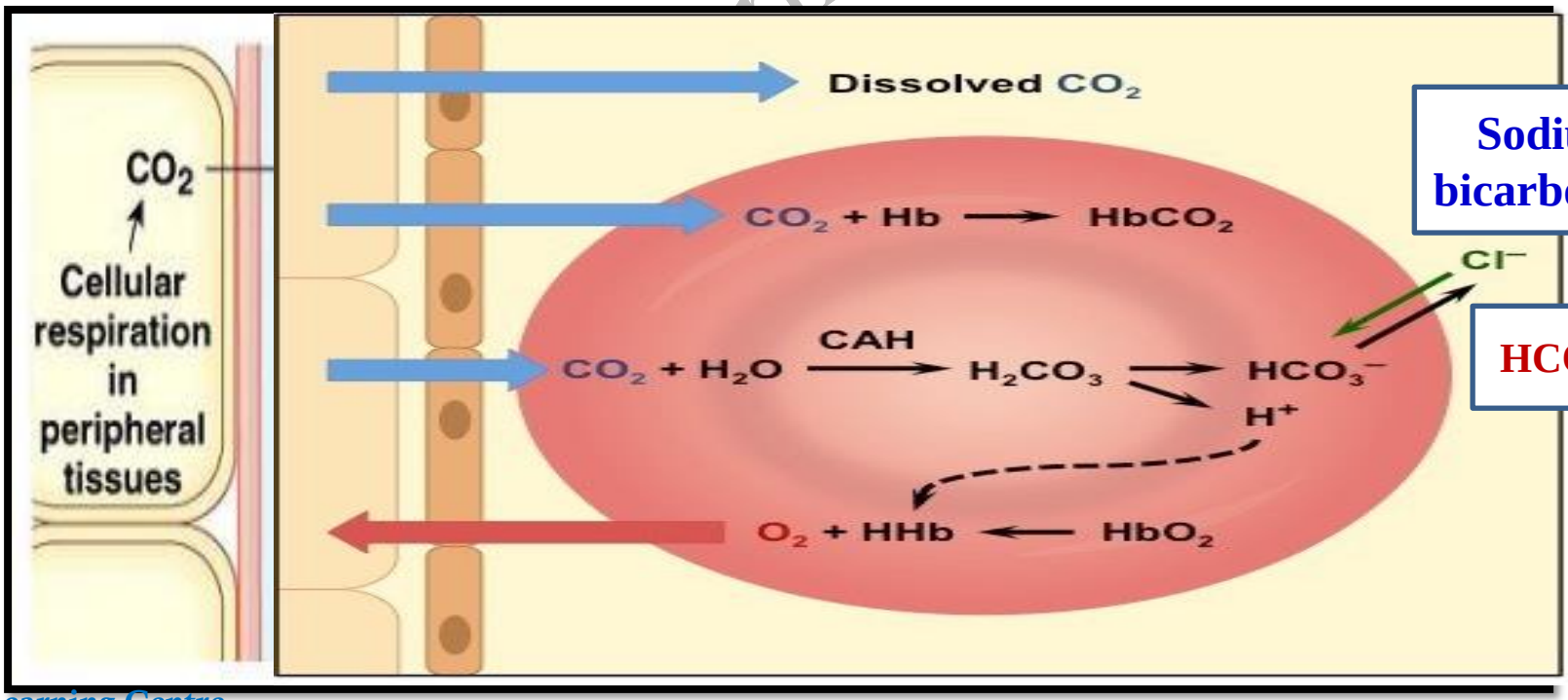
Chemical –
combination with Hb


ARTERIAL BLOOD
Capillary endothelium
O_2
O_2 dissolved in plasma (~ PO_2) < 2%
3%
Minor form of transport
O_2 + Hb
$Hb•O_2$
97%
Red blood cell
Major form of transport
Alveolus
Alveolar membrane
Transport to cells
Cells
$Hb•O_2$
Hb + O_2
O_2
Used in cellular respiration
O_2 dissolved in plasma

CO_2 transport in blood

- 3 forms of CO_2 transport
- Dissolved state in plasma (7%)
- CO_2 + Hb ----- **carbaminohemoglobin** (23%)
- **Sodium Bicarbonate (70%**

Major form of transport



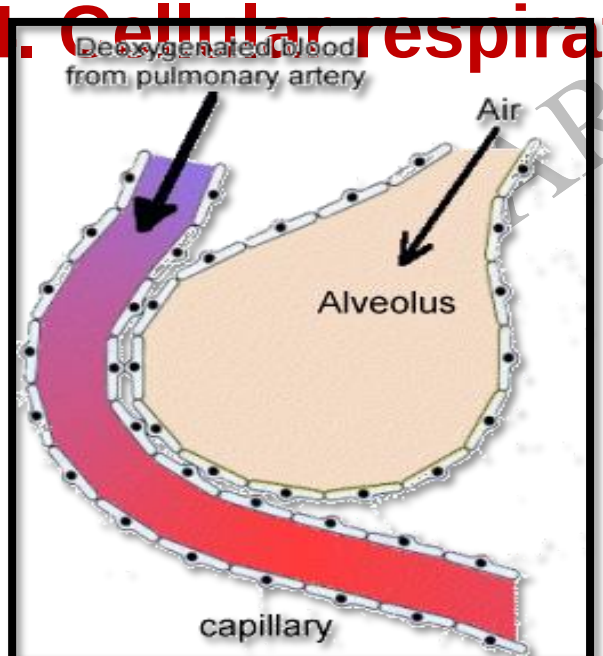
1. **Pulmonary ventilation** :

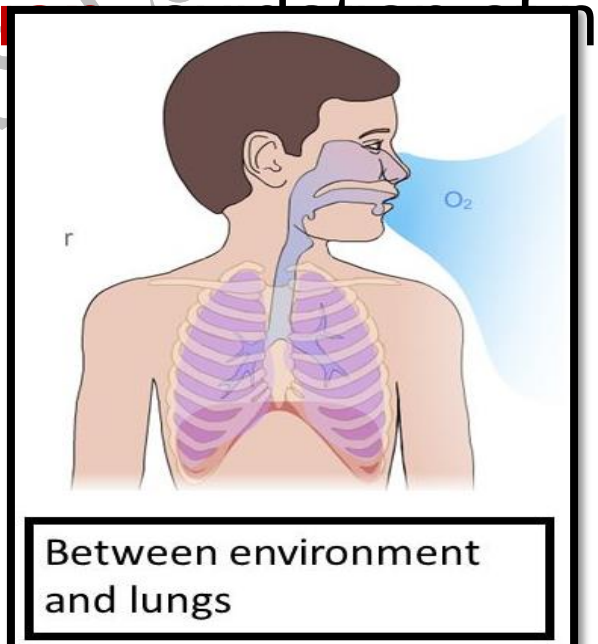
   Inflow & outflow of air between atmosphere and lungs.

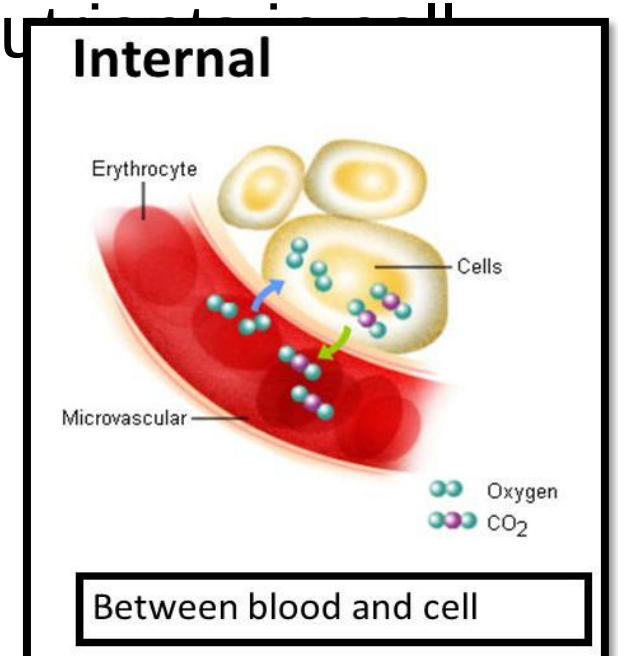
2. **External respiration:** gas exchange between alveoli and blood

3. **Internal respiration:** gas exchange between oxygenated blood and tissue cells.

4. **Cellular respirati**

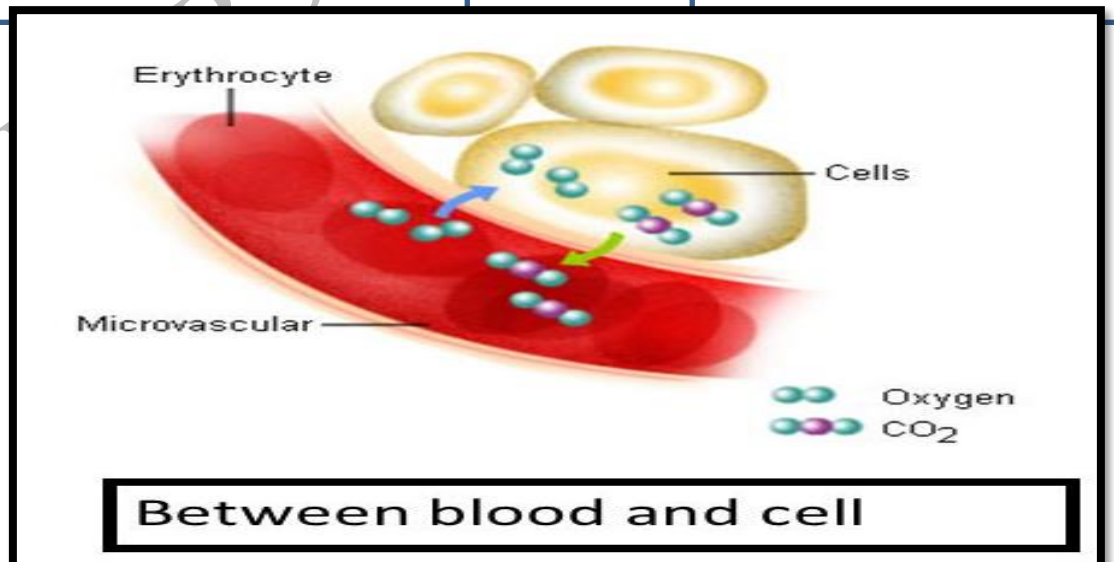






Internal Respiration

Tissue capillaries	Tissue cells
PO2 = 105mmHg	PO2 = 20mmHg
PCO2 = 40mmHg	PCO2 =45 mmHg



Between blood and cell

1. **Pulmonary ventilation** :

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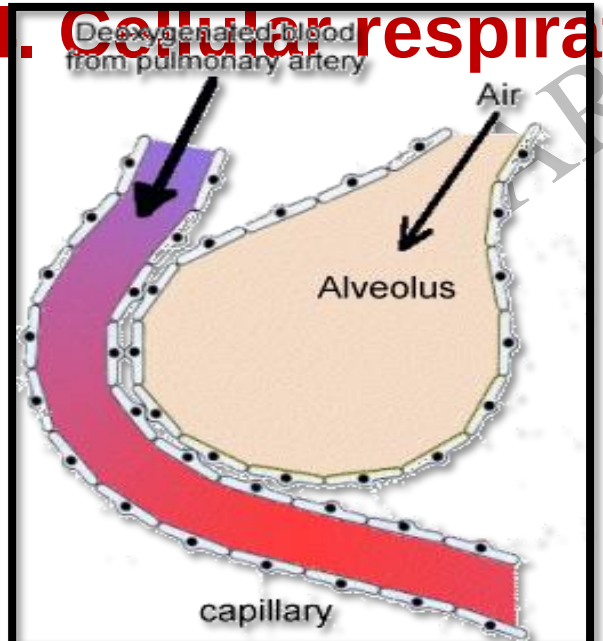
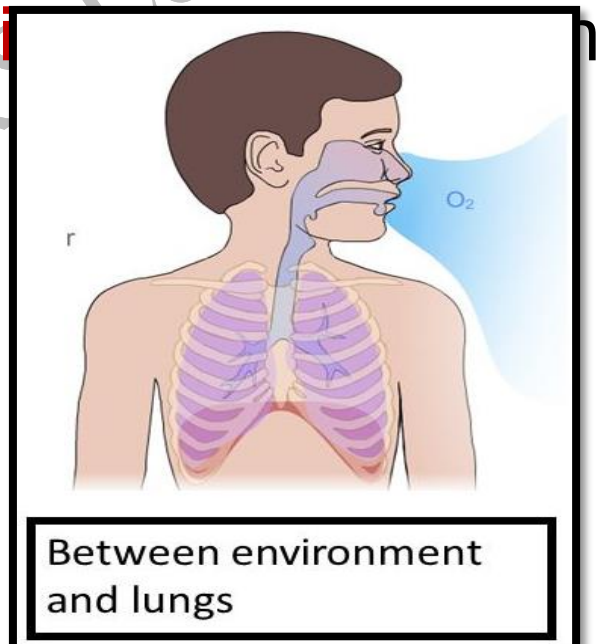
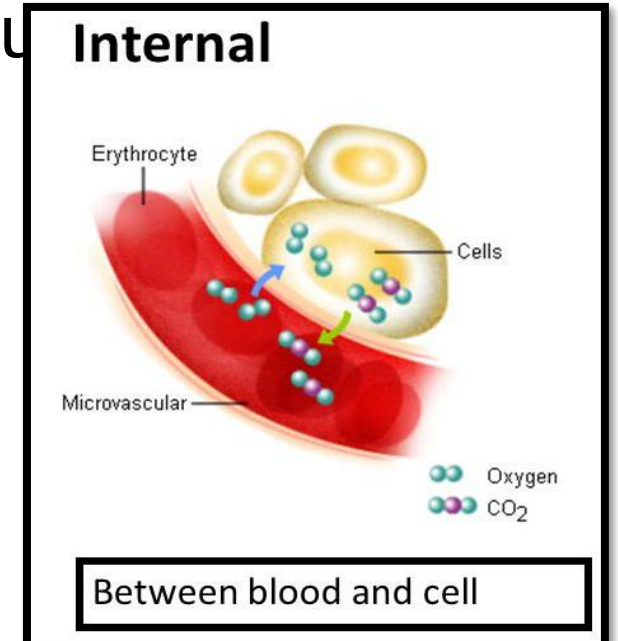
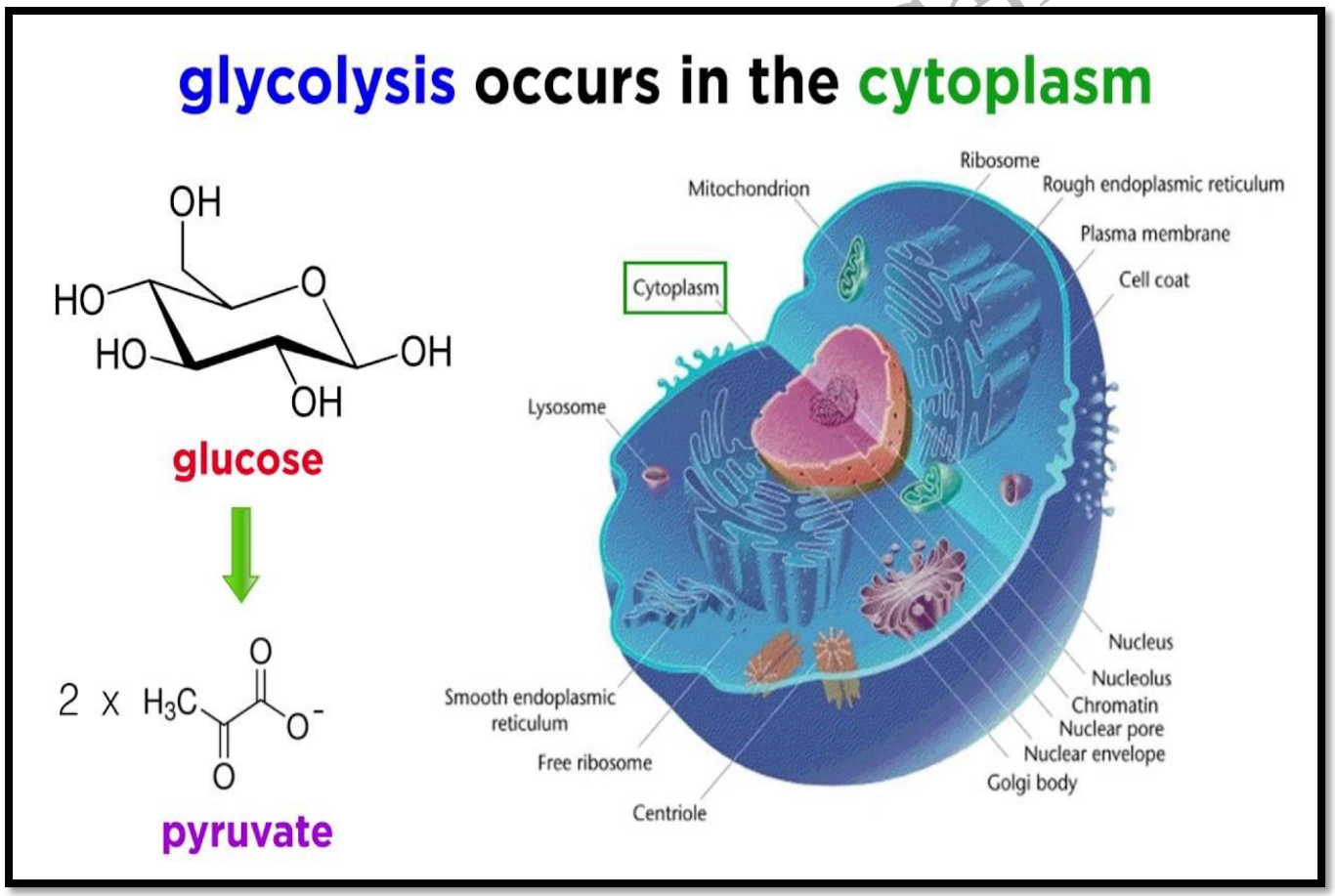






Cellular Respiration

- Process of breakdown of nutrient substrates inside the cell to release energy.



Glucose

Glycolysis

Process of breakdown of glucose inside cells to release ATP

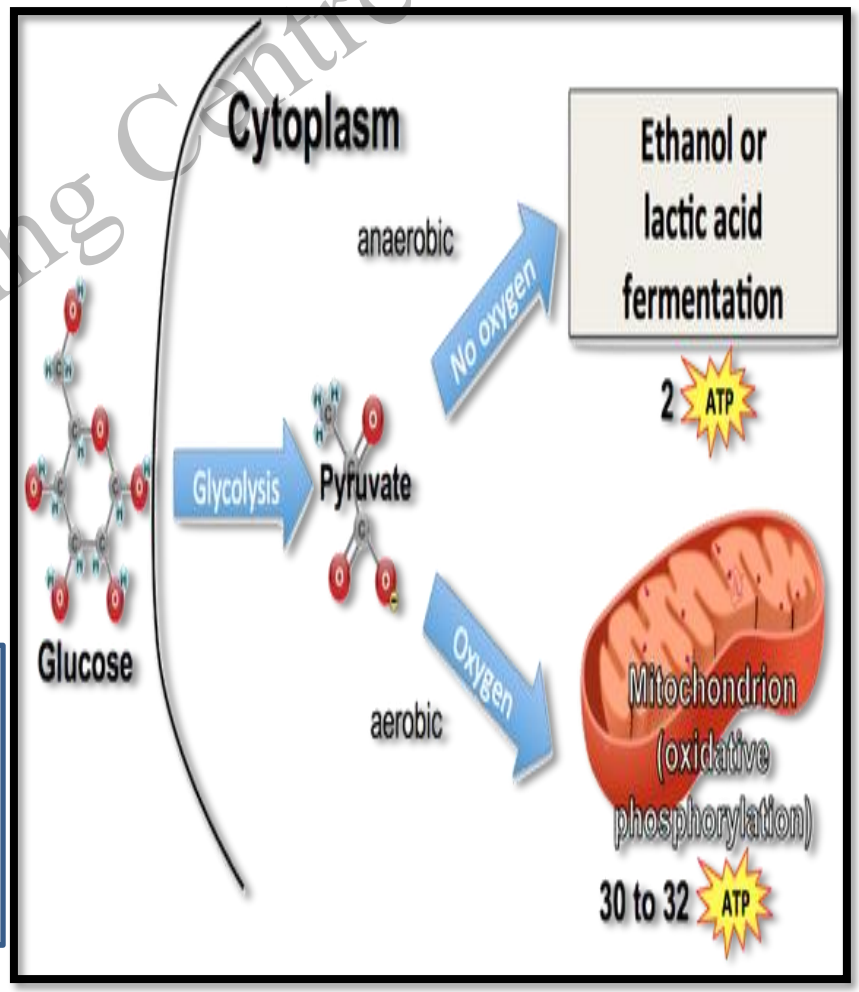
Pyruvate

No oxygen

- Ethanol
- Lactic Acid
- CO_2
- Energy – 2 ATP

oxygen

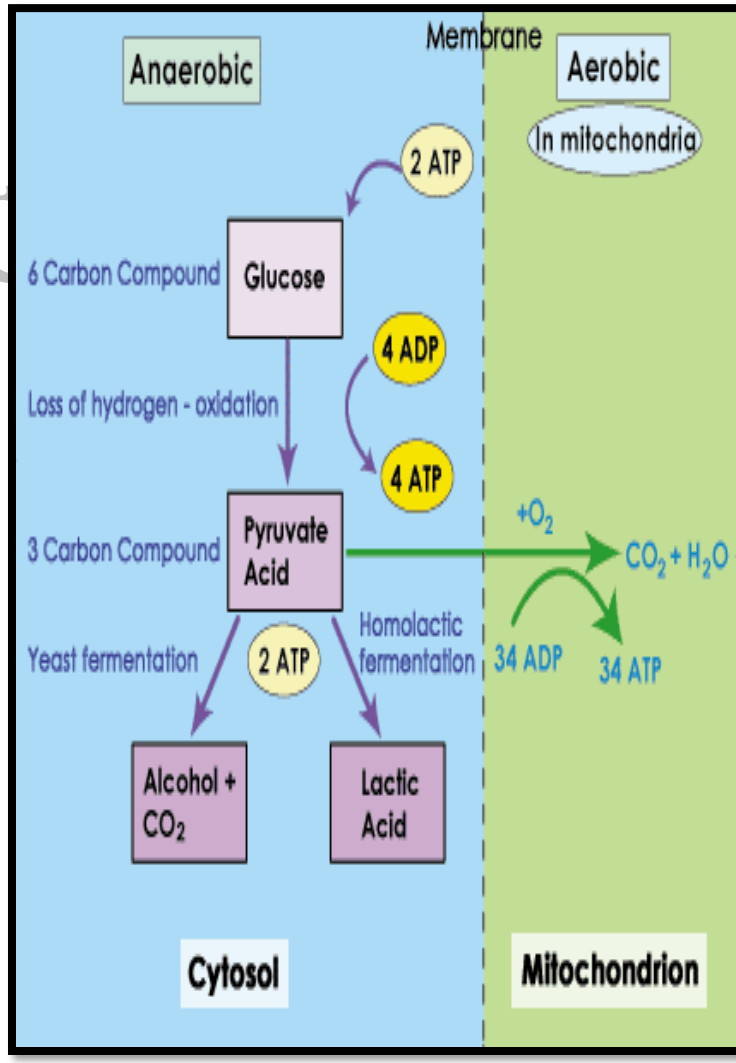
- CO_2
- water
- Energy
  - 32 ATP



Anaerobic Respiration

- **In absence of oxygen**
- In yeast , Bacteria , exercising muscle
- **Pyruvate ---- ethanol + lactic acid**
- **[illegible] cumulation**

Fatigue , cramps



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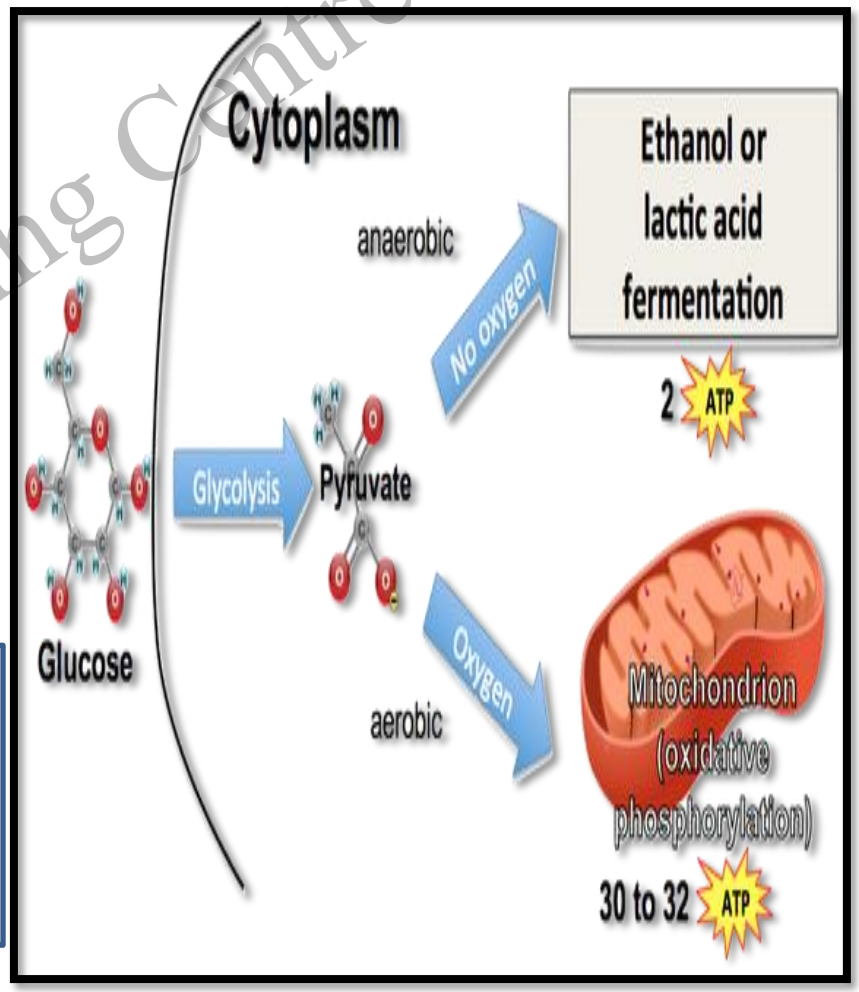
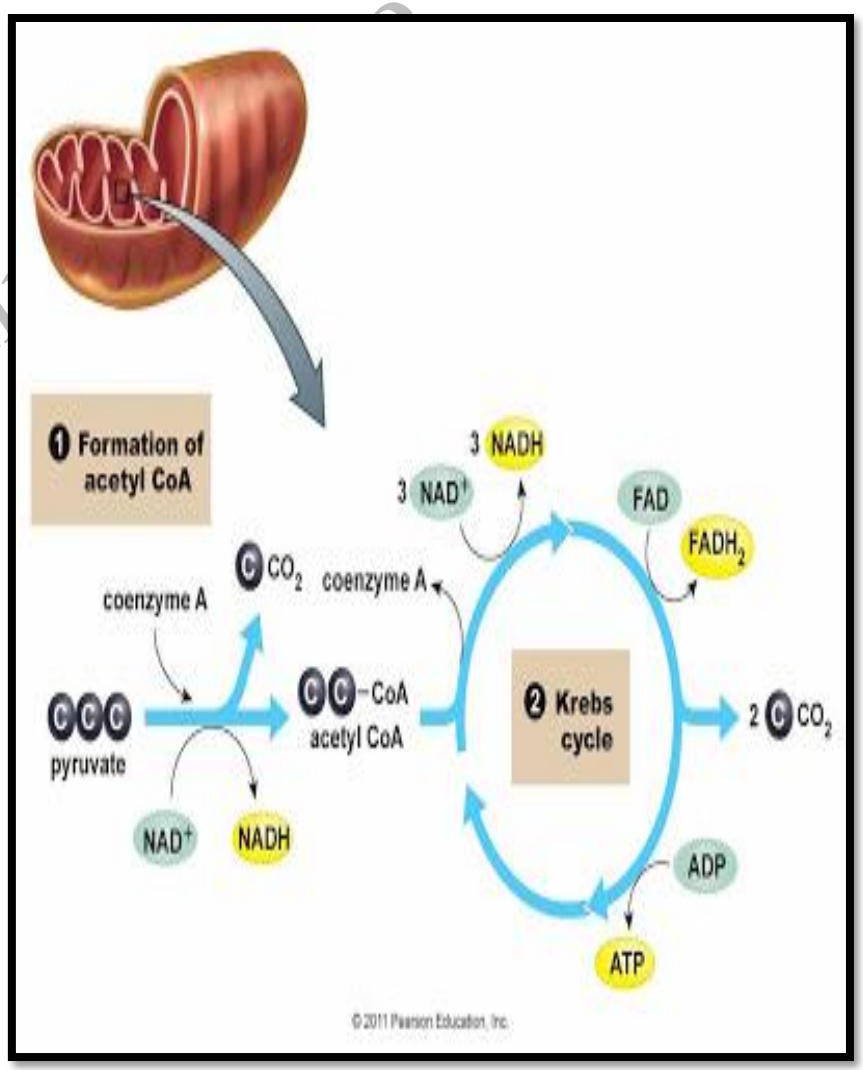


Aerobic respiration ----Krebs Cycle

- **Tricarboxylic acid cycle**
- **Citric acid cycle**
- Pyruic acid

Further processed in **mitochondria** in presence of oxygen

ATP + CO2



Respiratory rate

- Age influences respiratory rate.
- **Reasons:**

1)Infants grow rapidly so the metabolic activity is high.

2) Lung volumes are lower compared to adult lungs.

Rate of respiration

Measured by volume of CO_2 exhaled

Factors affecting

Internal Factors

- Respiratory Enzyme
- Type of substrate (nutrient) being oxidized

External Factors

- Oxygen
- Water
- Temperature

Type of substrate oxidized

- Estimated by Respiratory quotient

- R.Q = $\frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of } O_2 \text{ consumed}}$

- R.Q for carbohydrates = 1
- R.Q for Proteins = 0.9 [O2 consumption is more]
- R.Q for Fat & oil = 0.7

Rate of respiration

Measured by volume of CO_2 exhaled

Internal Factors

- Respiratory Enzyme
- Type of substrate oxidized

External Factors

- Oxygen
- Carbon dioxide
- Temperature

External Factors affecting respiration

1. Temperature: $30 – 35^0C$ - ideal for respiration

   $0 - 10^0C$ -- Respiration reduced

   $> 50^0C$ Cellular activities

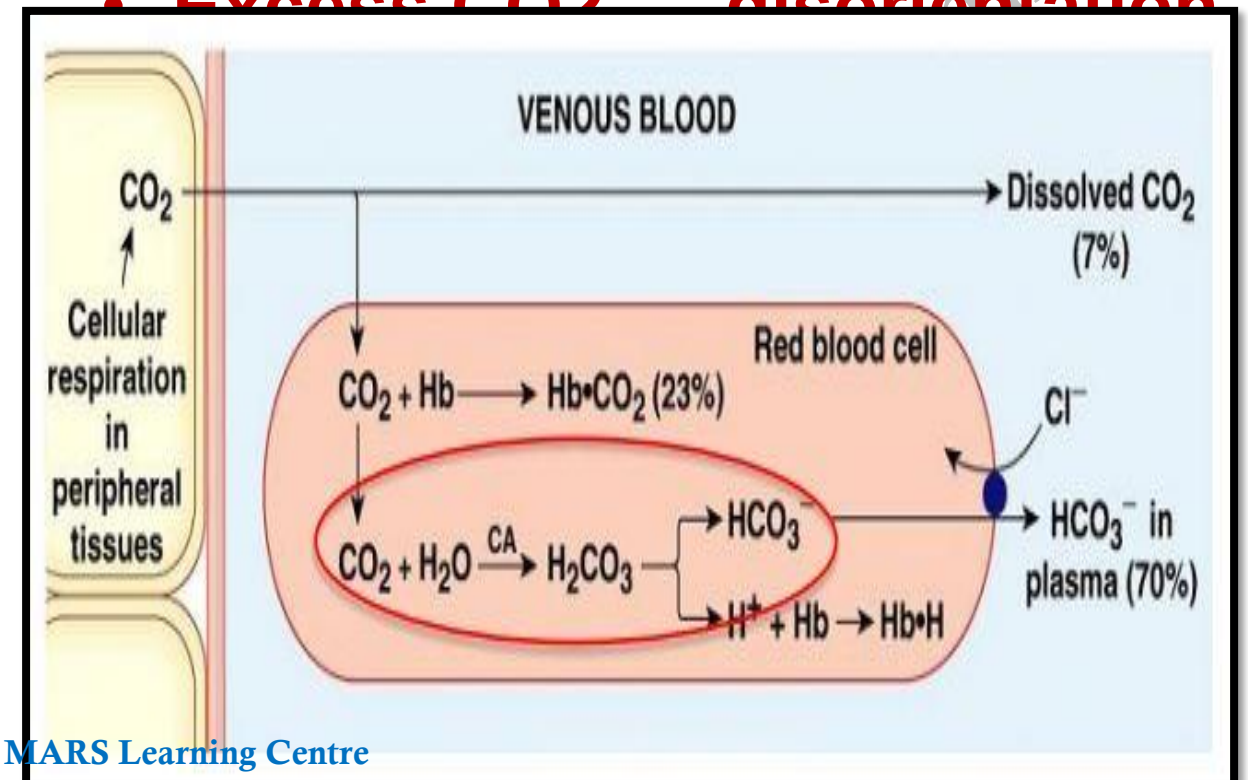
reduced enzyme activity decreases metabolism and CO_2 production

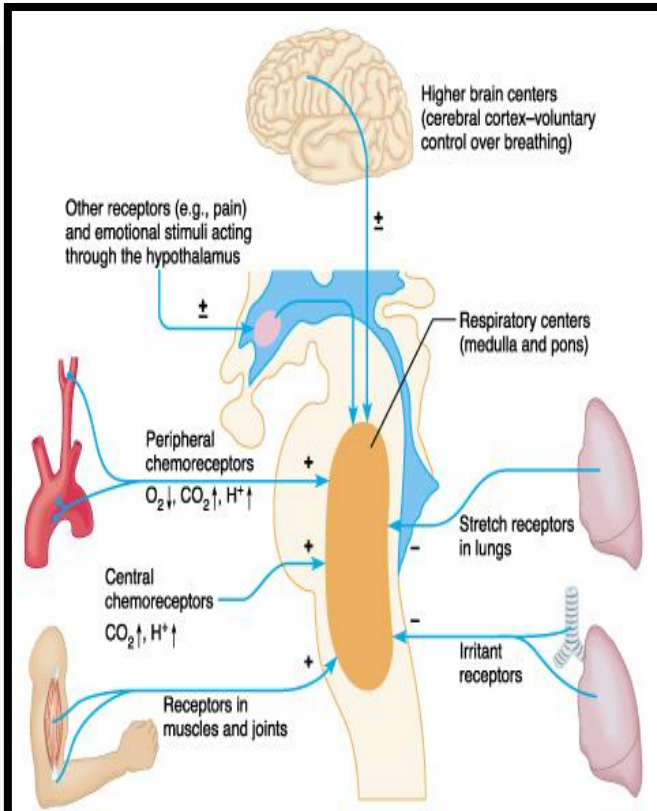
2. Oxygen α Respiration

Directly proportional to

3. Carbon dioxide initially increases respiratory rate

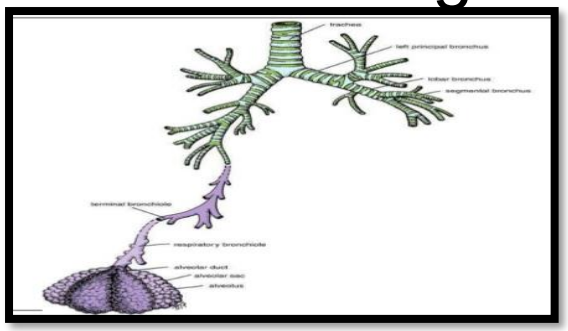
- CO2 in blood forms carbonic acid
- Makes blood acidic
- Chemoreceptors stimulate respiratory centers in brain
- Respiratory rate increases.
- Excess CO2 ---- disorientation

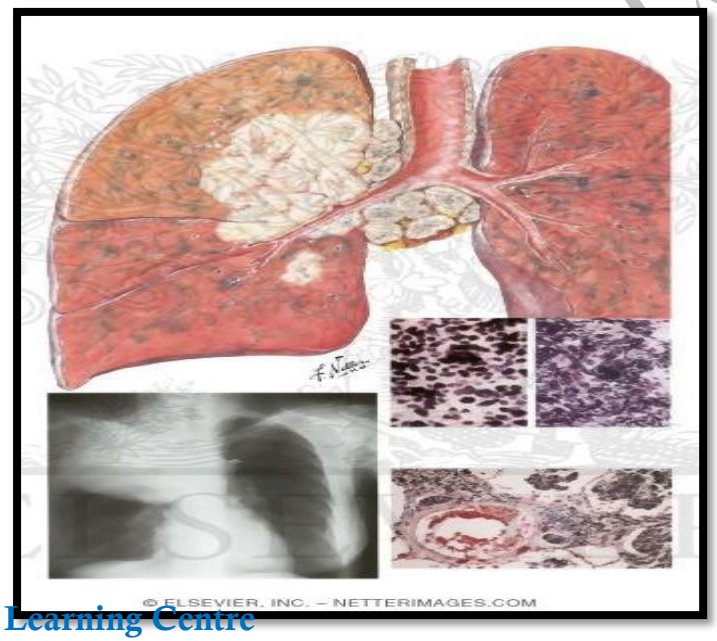


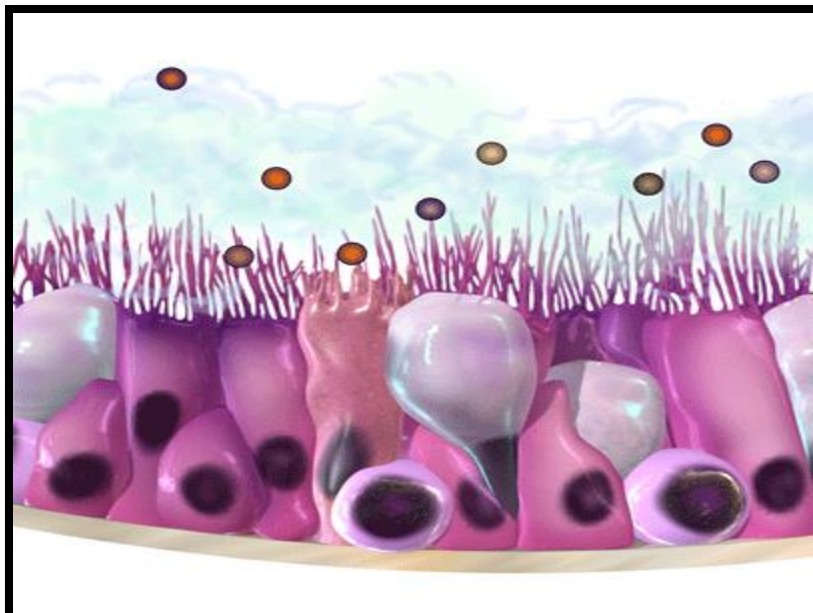


Disorders of Respiratory system

- Bronchogenic Cracinoma (tumor)
- Uncontrolled multiplication of epithelial cells lining bronchial tree.
- **Ex : smoking**

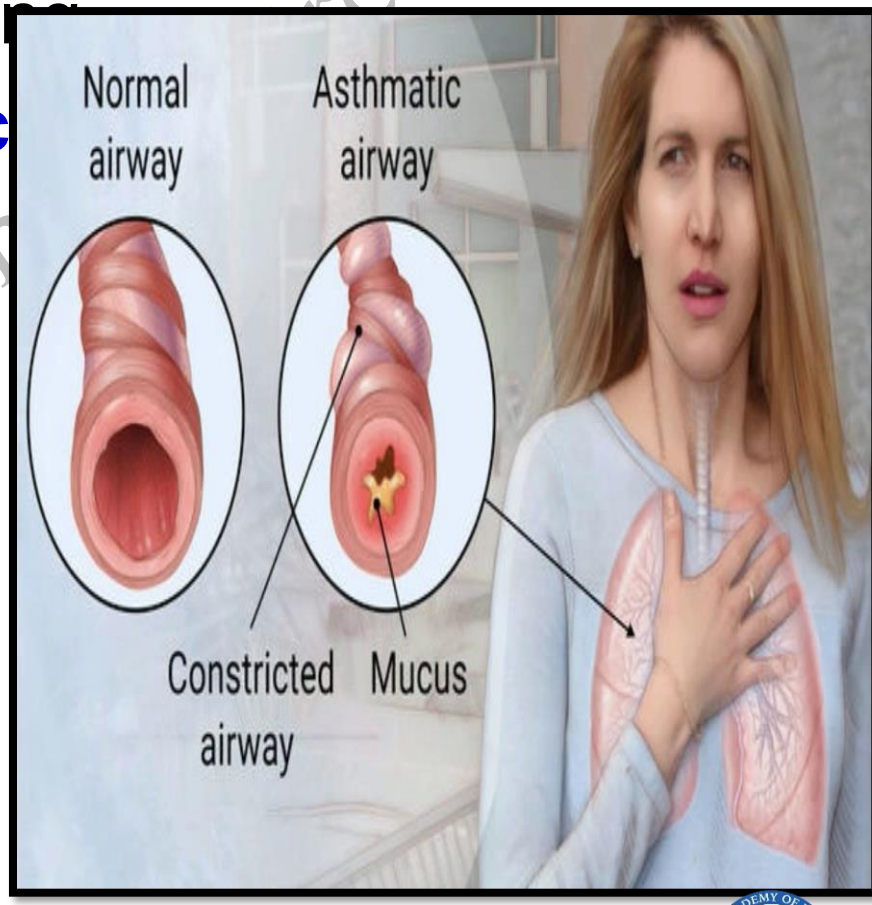


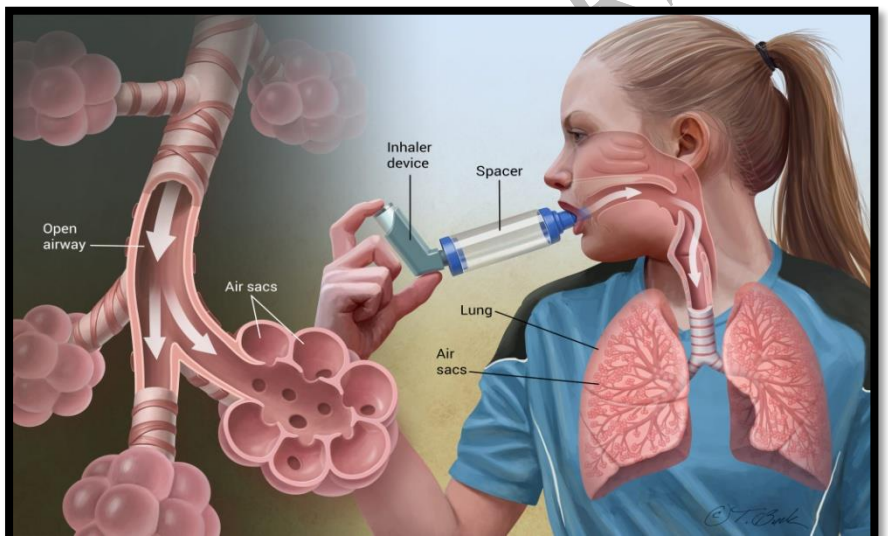




Bronchial asthma

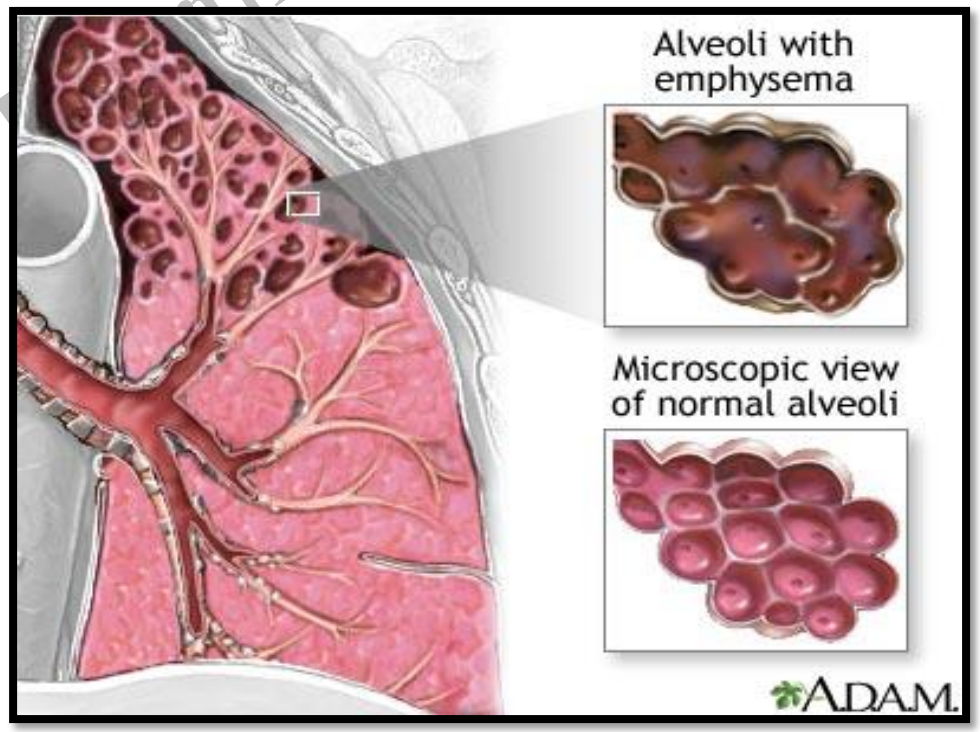
- Breathlessness and wheezing
- **Cause : constricted bronc**
- **Ex: allergic reaction**
- Trt: -avoidance of allergens
  - Bronchodialators





Emphysema

- Enlarged & damaged alveolar sacs.
- Difficulty in breathing
- **Smoking , air pollution**



Mountain sickness

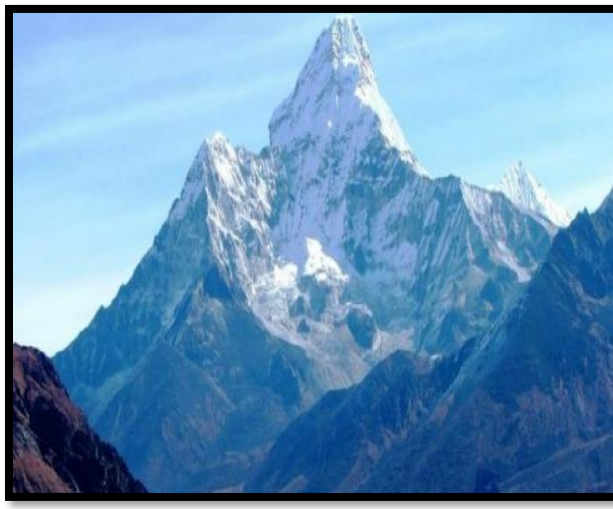
- Due to shortage of oxygen at high pressure.
- **Atmospheric pressure falls with increasing altitude**
- **At 10,000ft (3000m)** alveolar PO_2 is 60 mm Hg
- **At 12,000ft – 15,000ft** alveolar PO_2 is 40 mm Hg

at sea level - PO_2 is 160 mm Hg

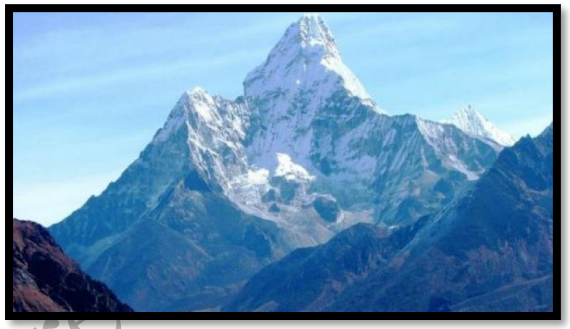
- **Reduced oxygen supply**

↓

Hypoxia



Physiology of high altitude



- **Barometric pressure falls with increasing altitude**

- Concentration of gases everywhere in the atmosphere is same
- Whereas at high altitude partial pressure of the gas reduces.

- partial pressure of oxygen is proportionally reduced
- **This leads to hypoxia**

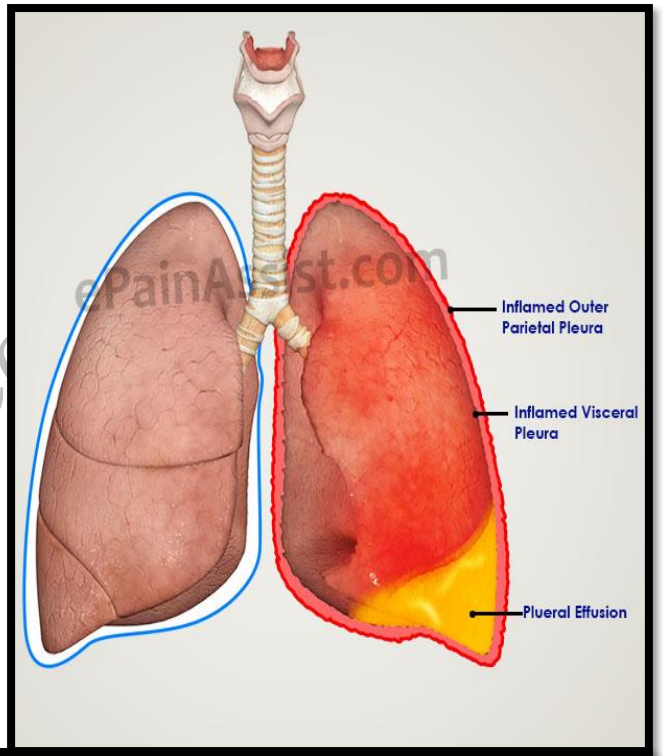
Pleurisy

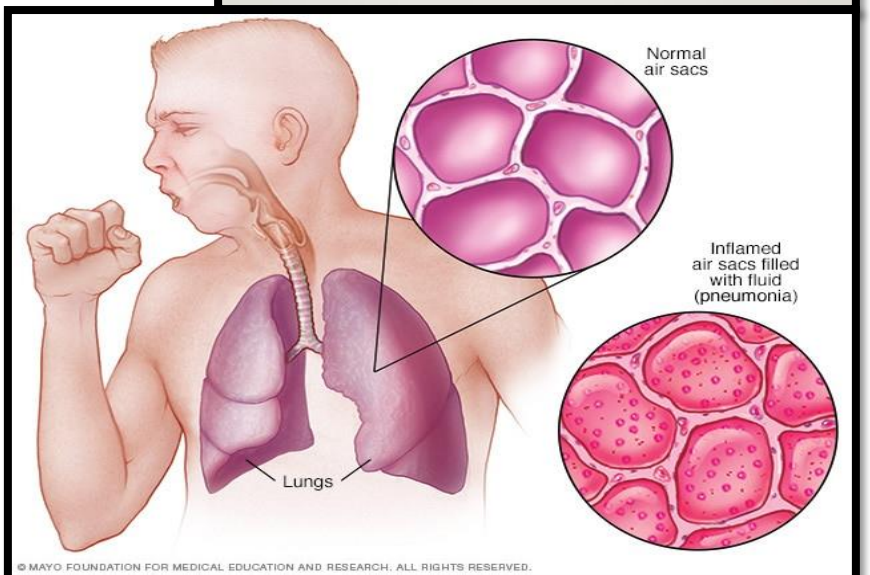
- Inflammation of Pleura
- Excess fluid in pleural cavity
- Pleural Effusion
- Leads to difficulty in breathing
- **Cause : viral infection**

Tuberculosis

Pneumonia

chest injury





THANK YOU