

BREATHING AND EXCHANGE OF GASES

○ Oxygen [O_2] is utilised to indirectly break down nutrient molecule glucose for Energy for performing various activity.

CO_2 is released during Catabolic reaction which is harmful.

○ Respiration :

Process of Exchange of O_2 from atmosphere with CO_2 produced by Cell is called breathing, commonly known as Respiration.

RESPIRATORY ORGANS

○ Mechanism of breathing is depend on Habitate and level of Organisation

○ Lower invertebrates like sponge, Flatworms etc. Exchange O_2 with CO_2 by simple diffusion.

- ① Earthworm Use moist Cuticle and insect have network of tubes [Tracheal tubes] to transport atmospheric air in body.
- ① Gills used by most of aquatic arthropods and Molluscs
eg: Fishes. [Vertebrates]
- ① Lungs are used by terrestrial form for exchange of gaseous.
eg: Coleoptiles, birds, mammals.
- ① Amphibians like frog respire through their ~~mo~~ moist skin.

① HUMAN RESPIRATORY SYSTEM

- ① Have a pair of nostrils which leads to a nasal chamber through nasal passage
- ① Nasal chamber opens into Nasopharynx
- ① Nasopharynx opens into Trachea through glottis.
- ① Larynx is Cartilaginous box, help in sound production, Hence Called sound box

① Trachea is straight tube Extending upto mid - thoracic Cavity:

Divides at level of 5th thoracic Vertebra into right and left primary bronchi

② Each bronchi Undergoes repeated division to form Secondary and Tertiary bronchi and bronchioles ending up in very thin terminal bronchioles

③ Each bronchioles give rise to very thin, irregular walled and bag like structure Called ~~ate~~ alveoli.

④ Lungs : Covered by a double layered pleura with pleural fluid b/w them

pleural fluid : Reduce friction on lung surface.

⑤ Conducting part : External Nostil to ~~tan~~ terminal bronchioles.

⑥ Respiratory/Exchange part : Alveoli and their ducts

→ Site of actual diffusion of O_2 and CO_2 b/w blood and atmospheric air.

① Lungs are situated in thoracic chamber.

② Thoracic chamber is formed dorsally by Vertebral Column, Ventrally by Sternum, laterally by ribs and lower side by dome-shaped Diaphragm.

③ STEPS IN RESPIRATION

[i] Breathing or pulmonary Ventilation by which atmosphere is drawn in and CO_2 is released out.

[ii] Diffusion of gases across alveolar membrane.

[iii] Transport of gases by blood.

[iv] Diffusion of O_2 and CO_2 b/w blood and tissue.

[v] Utilisation of O_2 by cells for Catabolic reaction and resultant release of CO_2 .

MECHANISM OF BREATHING

- ① Involves two Processes : Inspiration and Expiration.
- ② Inspiration Occurs when pressure within lungs [Intra-pulmonary pressure] is less than atmospheric pressure.
- ③ Expiration takes place when Intra-pulmonary pressure is higher than atmospheric pressure.
- ④ Diaphragm and specialised set of muscles — External and Internal intercostals b/w ribs help in generation of such gradient.

Inspiration :

- ① Initiated by contraction of diaphragm which increases Volume of thoracic Chamber.
- ② Contraction of external inter-costal ~~chamber~~ muscles lift up the rib and the sternum causing an increase in thoracic chamber.

- ① Increase in thoracic Volume Cause increase in pulmonary Volume which decreases the intra pulmonary pressure to less than atmospheric pressure.
- ② This force air from outside to move into lungs i.e. Inspiration

EXPIRATION

- ① Relaxation of diaphragm and inter-Costal muscles returns the diaphragm and sternum to their normal position.
- ② This reduces the thoracic Volume and thereby pulmonary Volume.
- ③ This lead to increase in intra-pulmonary pressure to ~~st~~ above the atmospheric pressure causing expulsion of air from lungs i.e. Expiration.
- ④ A Healthy human breathes 12-16 times/minutes.
- ⑤ Volume of air involved in breathing movement is estimated by Spirometer

Respiratory Volumes And Capacities

① Tidal Volume [TV] : Volume of air inspired or expired during a normal respiration

approx $\rightarrow$ 500 ml

Healthy man $\rightarrow$ 6000 - 8000 ml per minute.

② Inspiratory Reserve Volume [IRV]

Additional Volume of air, a person can inspire by a forcible inspiration.

Averages : 2500 - 3000 ml

③ Expiratory Reserve Volume [ERV]

Additional Volume of air, a person can expire by a forcible expiration.

Average : 1000 ml to 1100 ml.

④ Residual Volume [RV] : Volume of air remaining in lungs even after a forcible expiration.

Average $\rightarrow$ 1100 ml to 1200 ml

- ① Inspiratory Capacity [IC] : Total Volume of air a person can inspire after a normal expiration.

$$IC = TV + IRV$$

- ② Expiratory Capacity : Total Volume of air a person can expire after a normal inspiration.

$$EC = TV + ERV$$

- ③ Functional Residual Capacity [FRC] : Volume of air that will remain in lungs after a normal expiration.

$$FRC = ERV + RV$$

- ④ Vital Capacity [VC] : Maximum Volume of air a person can breathe in after a forced expiration.

$$VC = ERV + TV + IRV$$

- ⑤ Total Lung Capacity : Volume of air accommodated in lungs at end of forced inspiration.

$$TLC = VC + RV$$

EXCHANGE OF GASES

- Primary site - Alveoli
- also b/w blood and tissue.
- O_2 and CO_2 Exchanged by Diffusion.

○ Partial pressure: Pressure contributed by an individual gas in a mixture of gases is called partial pressure.

P_{pO_2} = Partial pressure of Oxygen
 P_{pCO_2} = Partial pressure of Carbon di-Oxide

○ Pressure gradient is present for CO_2 in opposite direction i.e. Tissue to blood and blood to alveoli.

○ Solubility of CO_2 is higher than O_2 . Hence Amount of CO_2 diffuse is much higher than O_2 .

○ Diffusion membrane is made up of three major layer.

- i thin Squamous Epithelium
- [ii] Endothelium
- [iii] Basement substance in b/w them.

TRANSPORT OF GASES

- ① Medium $\rightarrow$ Blood.
- ① 97% O_2 by blood and 3% O_2 is by plasma
- ① 20-25% CO_2 is transported by RBCs
70% Carried as bicarbonate.
7% of CO_2 is through plasma.

TRANSPORT OF OXYGEN

- ① O_2 bind with haemoglobin to form Oxyhaemoglobin.
1 haemoglobin carry 4 Oxygen molecule.
- ① Sigmoid Curve is obtained when percentage saturation of haemoglobin with O_2 is plotted against pO_2 . The Curve is called Oxygen dissociation Curve
- * Factors favourable for formation of Oxyhaemoglobin in alveoli.
 - $\rightarrow$ High pO_2 and low pCO_2
 - $\rightarrow$ less H^+ Concentration
 - $\rightarrow$ Low temperature.

* Factor favourable for dissociation of Oxygen from Oxyhaemoglobin in tissue.

- Low pO_2 and high pCO_2
- High H^+ Concentration
- High temperature.

○ Every 100 ml of Oxygenated blood can deliver around 5ml of O_2 to tissue under normal condition.

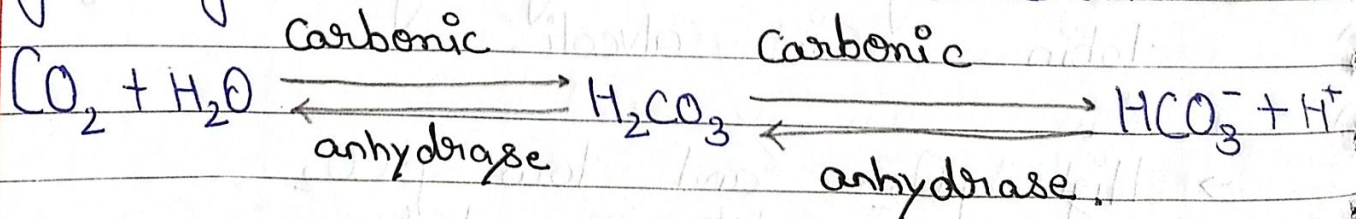
TRANSPORT OF CARBON DIOXIDE

○ CO_2 is carried by haemoglobin as Carbamino - haemoglobin.

When pCO_2 is higher than pO_2 in tissue more binding of CO_2 occurs.

When pCO_2 is low and pO_2 is high as in alveoli dissociation takes place.

○ Enzyme Carbonic anhydrase facilitates following reaction in both directions.



○ Every 100 ml of deoxygenated blood delivers 4 ml of CO_2 to alveoli.

REGULATION OF RESPIRATION

- ① Respiratory Rhythm Centre primary responsible for regulation of Respiration.

Present in Medulla

- ② Pneumotaxic Centre moderate the function of Respiratory Rhythm Centre.

Present in Pons region of brain.

- ③ Neural signal from Pneumotaxic Centre reduce the duration of inspiration and alter the respiratory rate.

- ④ Chemosensitive area situated adjacent to Rhythm Centre which is highly sensitive to CO_2 and H^+ .

- ⑤ Increase in CO_2 and H^+ activate this Centre which in turn signal the Rhythm to make necessary adjustment.

DISORDERS OF RESPIRATORY SYSTEM

1. Asthma: It is difficult in breathing causing wheezing due to inflammation of bronchi and bronchioles.

2. Emphysema: Chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased.

3. Occupational Respiratory Disorders:

In industries, especially those involving grinding or stone breaking, so much dust is produced that the defense mechanism of body cannot cope with situation.

Long exposure give rise to inflammation leading to Fibrosis.