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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 Habitats and Level of Organisation
- Lower invertebrates like Sponge, Flatworms etc. exchange O_2 with CO_2 by simple diffusion.

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

HUMAN RESPIRATORY SYSTEM

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

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⊙ Trachea is straight tube extending upto mid-thoracic cavity.

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

⊙ Each bronchi undergoes repeated divison to form secondary and Tertiary bronchi and bronchioles ending up in very thin terminal bronchioles

⊙ Each bronchioles give rise to very thin, irregular walled and bag like structure called ~~ele~~ alveoli.

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

pleural fluid: Reduce friction on lung surface.

⊙ Conducting part: External Nostril to ~~tran~~ terminal bronchioles.

⊙ Respiratory/Exchange part: Alveoli and their ducts

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

⊙ lungs are situated in thoracic chamber.

⊙ thoracic chambered is formed dorsally by Veritebral Column, Ventrally by sternum, laterally by ribs and Lower side by dome-shaped Diaphragm.

⊙ STEPS IN RESPIRATION

[i] Breathing or pulmonary Ventillation 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

- Involves two Process : Inspiration and Expiration.
- Inspiration Occur when pressure within lungs [Intra-pulmonary pressure] is less than atmospheric pressure.
- Expiration take place when Intra-pulmonary pressure is higher than atmospheric pressure.
- Diaphragm and Specialised of set of muscles — External and Internal intercostals b/w ribs Help in genration of such gradient.

Inspiration :

- Initiated by Contraction of diaphragm which incsease Volume of thorsaic Chamber.
- Contraction of external inter-costal ~~chamber~~ muscles lift up the rib and the sternum Causing an incsease in thorsaic chamber.

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

EXPIRATION

- Relaxation of diaphragm and inter-Cos muscles returns the diaphragm and sternum to their normal position.
- This reduces the thoraic Volume and thereby pulmonary Volume.
- This lead to increase in intra-pulmo pressure to ~~st~~ above the atmosphe pressure Causing Expulsion of air from lungs i.e Expiration.
- A Healthy human breathes 12-16 times/ minutes.
- Volume of air involved in breathing movement is estimated by Spirometer

Respiratory Volumes And Capacities

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

approx → 500 ml

Healthy man → 6000 - 8000 ml per minute.

⊙ Inspiratory Reserve Volume [IRV]

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

averages : 2500 - 3000 mL

⊙ Expiratory Reserve Volume [ERV]

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

Average : 1000 mL to 1100 mL.

⊙ Residual Volume [RV]: Volume of air remaining in lungs Even after a forcible Expiration.

Average → 1100 mL to 1200 mL

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

$$IC = TV + IRV$$

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

$$EC = TV + ERV$$

⊙ Functional Residual Capacity [FRC]: Volume of air that will remains in Lungs after a normal expiration.

$$FRC = ERV + RV$$

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

$$VC = ERV + TV + IRV$$

⊙ Total lungs 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 CO_2.
- Diffusion membrane is made up of three major layer.

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

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TRANSPORT OF GASES

⊙ Medium → Blood.

⊙ 97% O_2 by blood and 3% O_2 is by plasma

⊙ 20 - 25 % CO_2 is transported by RBCs
70 % Carried as bicarbonate.
7 % of CO_2 is through plasma.

TRANSPORT OF OXYGEN

⊙ O_2 bind with haemoglobin to form Oxyhaemoglobin.

1 haemoglobin Carry 4 Oxygen molecule.

⊙ 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.

→ High pO_2 and low pCO_2
→ less H^+ Concentration
→ 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 is in tissue more binding of CO_2 occur.

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

⊙ Enzyme Carbonic anydrase Facillitates following Reaction in both direction.

$$CO_2 + H_2O \underset{\text{anhydrase}}{\overset{\text{Carbonic}}{\rightleftharpoons}} H_2CO_3 \underset{\text{anhydrase.}}{\overset{\text{Carbonic}}{\rightleftharpoons}} HCO_3^- + H^+$$

⊙ Every 100 ml of deoxygenated blood deliver 4 ml of CO_2 to alveoli.

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REGULATION OF RESPIRATION

- Respiratory rhythm Centre primary responsible for regulation of Respiration.

  Present in Medulla

- Pneumotaxic Centre moderate the function of respiratory rhythm Centre.

  Present in Pons region of brain.

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

- Cheomosensitive area situated adjacent to rhytm Centre which is highly sensitive to CO_2 and H^+.

- 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.