

* Breathing & Exchange of Gases *



* Process of exchange of O_2 from the atmosphere with CO_2 produced by the cells is called Breathing (Respiration)

* Respiratory Organs of different Animals:

- Lower invertebrates like sponges, Coelenterates, Flatworms respire by simple diffusion over their entire body surface.
- Earthworm use their moist cuticle
- Insects have network of tubes
- Fishes use gills whereas amphibians, reptiles, birds and mammals respire through lungs.
- Amphibians like frogs use their moist skin.

→ Common Passage for food and air is Pharynx

→ Cartilaginous box which help in sound production is Larynx.

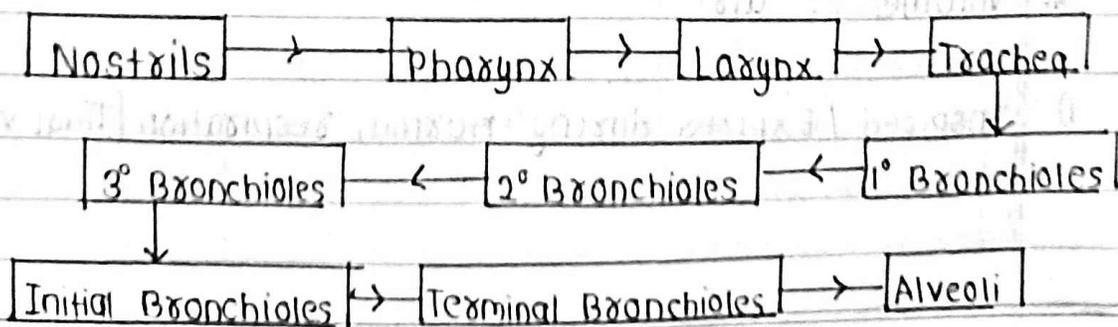
→ Opening of wind pipe is Glottis

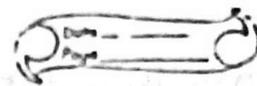
→ Opening of food pipe is Gullet

→ Human Respiratory System consist of:
Nostriils + Pharynx + Larynx + Trachea + Lungs.

→ During swallowing glottis can be covered by a cartilaginous Flap called Epiglottis.

* Respiratory System:





→ Incomplete Cartilagenous rings are supported by upto initial bronchioles.

→ Lungs are covered by a double layered membrane called Pleura.

Conducting part → External nostrils to Terminal bronchioles.

Respiratory part → Alveoli and their duct.

*		Inspiration	Expiration:
	Intrapulmonary pressure	Decrease	Increase
	Muscles (Diaphragm & Intercostal)	Contraction	Relaxation.

→ We have ability to increase the strength of inspiration and Expiration with the help of Abdominal muscles.

Average breathing rate of healthy human is 12-16 times/minute.

→ Volume of air involved in breathing movements can be estimated by Spirometer.

* Thoracic chamber is made up of:

Dorsally - vertebral column # Laterally - Ribs

ventrally - Sternum # Lower side - Diaphragm.

* Volume of air:

1) Inspired / Expired during normal respiration [Tidal volume, 500 ml]

- 2) Additional volume of air, a person can inspire by a forceful inspiration [Inspiratory Reserve volume (IRV) - 2500-3000 ml]
 - 3) Additional volume of air, a person can expire by a forceful expiration [Expiratory Reserve volume (ERV) - 1000-1100 ml]
 - 4) volume of air remaining in the lungs even after a forceful expiration [Residual volume (RV) - 1100-1200 ml]
 - 5) Total volume of air a person can inspire after a normal expiration [Inspiratory capacity (IC) = TV + IRV]
 - 6) Total volume of air a person can expire after a normal inspiration [Expiratory capacity (EC) = TV + ERV]
 - 7) Maximum volume of air person can breathe in after a forced expiration [vital cap. (vc) = TV + IRV + ERV]
 - 8) Total volume of air accommodated in lungs at the end of forced inspiration [Total lung cap. (TLC) = vc + RV]
- * Partial pressure of 'Oxygen' and 'CO₂' at different parts : (in mm Hg)

Gases	Atmospheric Air	Alveoli	Deoxy. Blood	Oxy. Blood	Tissue
O ₂	159	104	40	95	40
CO ₂	0.3	40	45	40	45

→ Solubility of CO_2 is 20-25 times higher than that of O_2 .

* Diffusion membrane is made up of:

3 major layers → * Sq. epithelium of alveoli

* Endothelium of alveolar capillaries

* Basement membrane

* Transport of gases [O_2 & CO_2]

O_2 Transport [97% [RBC]
[3% [Plasma]

CO_2 Transport [70% [Bicarbonate]
[23% [Carbamino-Hb]
[7% [Dissolved]

* Factor affecting Oxygen dissociation curve

Factors	Favourable For Oxy-Hb	Unfavourable For Oxy-Hb
PCO_2	Low	High
PO_2	High	Low
H^+	Less	High
Temp	Low	High

→ Average Hb in 100 ml of Blood → 12-16 gm

→ 1 Hb molecule can carry → 4 O_2 molecules

→ 1 gm Hb can carry → 1.34 ml of O_2

→ 100 ml of Blood can carry → $1.34 \times 12-16 \approx 20.1$ ml of O_2

Every 100 ml of blood (oxy) delivers 5ml of O_2 to tissues

Every 100 ml of blood (deoxy) delivers 4 ml of CO_2 to Alveoli

* Regulation of Respiration:

Respiratory Rhythm Centre.

→ Present in Medulla region of brain

→ Primarily responsible for respiratory regulation.

Pneumotoxic Centre.

→ Present in Pons region of brain.

→ Can moderate the functions of Resp. Rhythm Centre.

Chemosensitive Area.

→ Situated adjacent to 'Rhythm centre'.

→ Highly sensitive to CO_2 & H^+

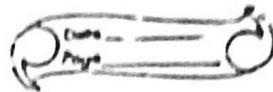
→ This centre send signal to 'Rhythm - centre' on increase of CO_2 & H^+

Receptors of Aortic Arch & Carotid Artery.

→ Can recognise changes in CO_2 & H^+ concentration.

→ Send signal to the 'Rhythm - centre' for action

** Role of oxygen is quite insignificant in regulation



* Disorders of Respiratory System:

1) Asthma → Difficulty in breathing; wheezing

- Inflammation of Bronchi & Bronchioles.

2) Emphysema → Chronic disorder; Alveolar walls get damaged (which reduce surface area); major cause is Cigarette Smoking.

3) Occupational → Seen in Industry workers [Stone, dust]

- Long exposure to dust cause Inflammation leading to Fibrosis

- Fibrosis is proliferation of Fibrous tissue.