

# Breathing and Exchange of Gases

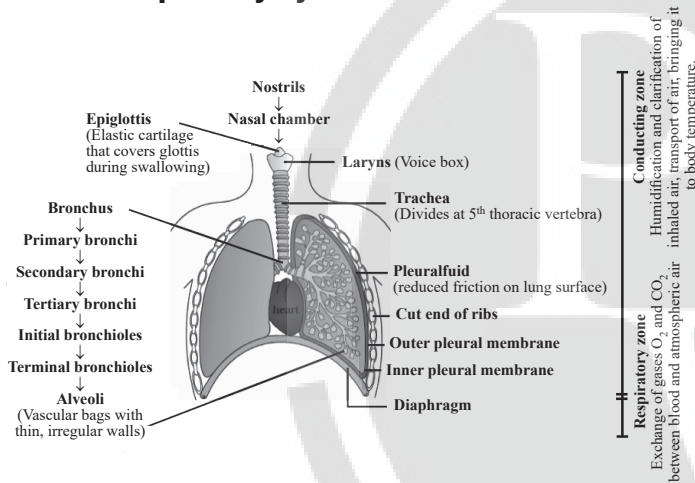
## SHORT NOTES

### Breathing/Respiration

- Atmospheric oxygen  $\xrightleftharpoons{\text{Exchange}}$  CO<sub>2</sub> produced by cells.

RESPIRATORY ORGANS (Based on: Level of Organisation and Habitats)	
Organisms	Mechanism
Sponges, coelenterates flatworms	Simple diffusion
Earthworms, frogs	Moist skin (Cutaneous)
Insects	Tracheal tubes
Aquatic arthropods, molluscs, fishes	Branchial/gills
Amphibians, reptiles, mammals	Pulmonary/lungs

### Human Respiratory System



- Thoracic Chamber made up of
  - Dorsally by the vertebral column
  - Ventrally by the sternum
  - Laterally by ribs
  - Lower side by dome shaped diaphragm
- Any change in the volume of the thoracic cavity will be reflected in the lung (pulmonary) cavity.
- Forceful expiration achieved
  - Internal intercostal muscles
  - Abdominal muscles
 Contracts
  - Volume decreases
  - Pressure increases
  - Air forcefully exhale

### Mechanism of Breathing

Inspiration	Expiration
Diaphragm contracts (Flat-shape)	Diaphragm relaxed Dome shape
External intercostal muscles contract	External intercostal muscle relax
Ribs and sternum moves outward and inward	Ribs and sternum moves downward and inward
Volume inside increase and pressure decrease	Volume inside decrease and pressure increase
Active process	Passive process

### Exchange of Gases

- Partial pressure drives respiration.
- Site of exchange:
  - Alveoli (primary)
  - Between blood and tissues
- Diffusion membrane comprises of 3 layers
  - Thin squamous epithelium of alveoli
  - Endothelium of capillaries
  - Basement substance in between

Respiratory gas	Atmospheric air	Alveoli	Blood (Deoxygenated)	Blood (Oxygenated)	Tissue
O <sub>2</sub>	159	104	40	95	40
CO <sub>2</sub>	0.3	40	45	40	45

### Respiratory Volumes and Capacities

- Instrument - Spirometer
- Significance - Clinical assessment of pulmonary functions.
- Residual volume cannot be measured by spirometer.

Standard volumes	Value in ml	Standard capacities	TLC = TV + IRV + ERV + RV VC + RV
1. Tidal volume (TV)/ air inhaled or exhaled per breath.	500	IC = TV + IRV	
2. Inspiratory reserve volume (IRV)/ forceful inhalation.	2500-3000	VC = TV + IRV + ERV	
3. Expiratory reserve volume (ERV)/ forceful exhalation.	1000-1100	FRC = ERV + RV	
4. Residual volume (RV)/air left in lungs after forceful exhalation.	1100-1200	EC = TV + ERV	

- Minute volume: TV × respiratory rate i.e.  
500 × 12 = 6000 – 8000 ml

## Transport of Gases



## Haemoglobin

- ❖ Comprises globin and heme.
- ❖ Globin – Protein molecule
- ❖ Heme – Prosthetic group
  - Imparts red colour
- ❖  $\text{Fe}^{2+}$  present in the centre of each heme.

Oxygen	Carbon dioxide
5 ml of $\text{O}_2$ is delivered to the tissues by 100 ml of oxygenated blood	4 ml of $\text{O}_2$ is delivered to alveoli by 100 ml of deoxygenated blood
3% dissolved in plasma	7% dissolved in plasma
97% as oxyhaemoglobin	20-25% as carbamino Hb, 70% as bicarbonate
Binding of $\text{O}_2$ with Hb is primarily related to $\text{pO}_2$	Binding of $\text{CO}_2$ with Hb is related to $\text{pCO}_2$ as well as $\text{pO}_2$

- ❖ Asthma, Emphysema, Occupational Respiratory disorders (eg. silicosis, asbestosis)

