# Unit :-5 (Human Physiology)
## Chapter :- 17
## Breathing and Exchange of Gases

- Normally this breathing and exchange of Gases refer to the aspects of Respiration.
- Respiration means breaking down of respiratory fuel to obtain Energy and this can be taken place in presence of $O_2$ or absence of $O_2$.
- TYPES OF RESPIRATION :- (I classification)

### AEROBIC RES$^N$

- Requires $O_2$ ($O_2$ taken in $CO_2$ is given Out)
- Takes place in mitochondria in Eukaryotic cells of Higher Organisms.

i.e; $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + Energy$

(i) Glycolysis takes place where Glucose is broke down to form 2pyruvate acid.

(ii) Link reaction where 2PA are converted into Acetyl Coenzyme A.

(iii) Kreb Cycle where Acetyl co-enzyme A is broken down further to release $CO_2$.

And in all this processes we keep getting $NADPH_2$ (Nicotinamide adenine dinucleotide Phosphate) and that it is the molecule going to give us ATP (Adenosine Triphosphate)

(iv) ETC (Electron Transport chain) where this $NADPH_2$ is broken down and the e$^-$ run down the gradient and pushing the proton into mitochondria of outer space

(v) Oxydative Phosphorylation this is the actuall step where the production of ATP takes place. (38 ATP's are made up where only 36 are used and rest 2 are used to complete the following steps above)

### ANAEROBIC RES$^N$

- Absence of $O_2$
- Takes place in lower organisms like Yeast. Glucose is broken down into Ethyl alcohol ($C_2H_5OH$) $2CO_2$

$Glucose \rightarrow 2PA \rightarrow C_2H_5OH + 2ATP$

- In Muscles of Human beings during heavy exercised anaerobic Resp$^n$ takes place and also takes place in RBC's as they don't have mitochondria.

Happens that :-

$Glucose \rightarrow 2PA \rightarrow 2Lactic\ acid + 2ATP$

* Lactic acid accumulation in muscles results into muscle fatigue and then this lactic acid has to be send to liver where it can be further broken down.

- In both the cases ie Yeast and Muscles the amount or no. of ATP released are (2)

II Classification [INDIRECT RESP$^N$) :- In which the cell is directly in contact with the gases and the gaseous exchange can take place. i.e; from the atmosphere. This can be seen in the organism like Amoeba.

- Unicellular Organism remains in water and the cell takes the oxygen from the surrounding directly.

* Whereas in Higher Organisms the Method is called INDIRECT RESP$^N$. In this the cells are not in contact with the surroundings directly.

* STEPS REQUIRED FOR GASEOUS EXCHANGE :- • Breathing or Ventillation.

(i) Once the Respiratory gases is reached to the alveoli of Lungs than their is going to be Exchange of Respiratory gases bet$^n$ alveoli and Blood

(iii) Transport of these gases through Blood

(iv) Exchange of Respiratory gases bet$^n$ the blood and tissues. (B ⇄ T : $+O_2$, $+CO_2$)

(v) Using this Respiratory gases ($O_2$) to break down glucose to release energy

***Characteristics features of Respiratory Surface :-**

- Because gaseous exchange have to takes place it should be very Thin.
- Gaseous exchange takes place through Liquid medium that means $O_2$ should be dissolve in water, then only dissolved oxygen is taken in. So the surface area should always be Moist.
- In most of the cases the surface area is kept Moist with the help of Mucus
- R.S should be Highly Vascular means should be sufficient blood Supply
- Presence of Respiratory pigments which can bind with Oxygen or $CO_2$ and help in their transport.
- Large Surface area more would be the exchange.

* Respiratory Pigments :- (i) Haemoglobin :- iron containing pigment and found in Human being in RBC's but in case lower organisms like earthworm Haemoglobin is dissolved in plasma.

(ii) Haemoerythrin :- also iron containing pigment and found in Annelida

(iii) Haemocyanin :- it is a Copper containing blue pigment found in Molluscs

(iv) Echinochrome :- iron containing pigment, found in the members of Echinodermata.

(v) Vanadium :- have element Vanadium and it is found in Celomic fluid of Protochordates.

***Various Organs helps in Respiration :-** (i) Skin :- Resp$^n$ process is known as Cutaneous Resp$^n$ and it is seen in Earthworm and frogs.

(ii) Tracheal :- Resp$^n$ process is known as Tracheal Resp$^n$ and it is seen in insects (Arthropods) like Cockroaches

(iii) Gills :- Resp$^n$ process is known as Branchial Resp$^n$ and are found in Fishes and some among arthropods also like prawns

(iv) Lungs :- Resp$^n$ process is known as Pulmonary Resp$^n$ and is seen in higher Vertebrates. (Amphibians, Reptiles, Aves and Mammals)

(v) Book-lungs :- Respiratory organs found in Scorpions and Spiders.

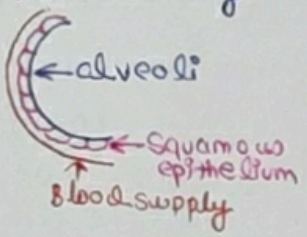
(vi) Book-Gill :- " " " in aquatic Arachnids like Limmulus

(vii) Pulmonary Sac :- modified mental cavity found in Molluscs

*Respiration in Humans :- Pulmonary Respiration → termed given to the ③ structure where it is Lungs and seen in all higher Vertebrates Amphibians, Reptiles, Birds and mammals.

•Skin is not effective structure in Humans. Reas :- ① Thick as made of two layers :- (↳ to prevent $H_2O$ loss by evaporation)
*Epidermis *Dermis. ② Surface area of skin is about 1.5-2 sq metres.

*Characteristics of lungs where it shows Respiratory Surfaces :-
• They have alveoli where exchange of gases takes place, very thin lined by only simple Squamous epithelium. (Cell are in one layered)
• Alveolar Surface is moist
• Each Alveolious their is blood supply due to highly Vascular.
• Presence of Respiratory Pigment in Blood - Haemoglobin.
• Surface area of alveoli of lungs would be 50-75 sq metres
• Respiratory System in Humans is classified into 3 category :-

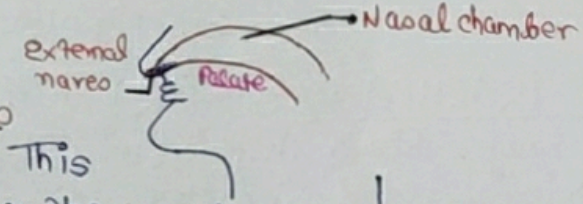



① Respiratory Tract :- all those tubes and passages. i.e; *External nares, *Nasal passage, *Inner opening (Internal nares), *Nasopharynx, *Larynx (Voice box), *Trachea, *Bronchi, *Bronchioles, *Alveoli.

② Lungs :- Bronchi, Bronchioles and Alveoli actually becomes the part of lungs.

③ Diaphragm :- Muscular membranous structure.

*RESPIRATORY TRACT :- The anterior opening in the nose region (two openings) are called External nares and these external nares leads into a passage. This passage has lower surface as Palate which divides the nasal cavity and the oral cavity.




• Each Nasal chamber is divided into 3 area :-

① Vestibular chamber :- While the gas enters through nose, its the 1st layer where it reaches and helps in the filtration of air because it lined with Mucus membrane and hair.

② Respiratory chamber :- it is also lined with mucus membrane and it is highly vaxular means blood supply to this chamber is more. Main function of this chamber is that it acts as air conditioner. As it have to bring air to particular temperature. (Cold air → should get warmer as more↑ blood supply increases) (If we inhale warm air, here mucus secretion is more where mucous evaporates and heat is taken from hot air)

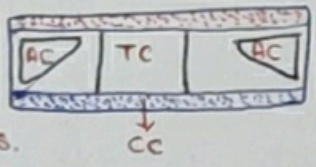
③ Olfactory chamber :- this chamber is responsible for the Smell. It is lined with a sensory membrane which have Olfactory sense/cells known as "Schneideri-an membrane"

• This Nasal chamber opens known as Internal nares which helps in opening and closing while intake of air with the help of small bulb like structure known as Uvula.
• This Internal nares opens into an area known as Nasopharynx (Part of ③ digestion)

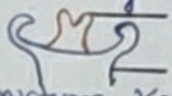
• Laryngopharynx :- This is the lower part which is going to lead into the trachea (the wind pipe) and just above it is the voice box known as Larynx also known as adams apple

• Larynx is made up of 4 Cartilages (1 in no.) ① Thyroid Cartilage → biggest → supports larynx via front, upper and lower
② Cricoid Cartilage → Ring like cartilage and supports only the lower parts.
(1 in no) ③ Arytenoid Cartilage (2 in no.) → Smallest. Triangular in shape, supports back of larynx

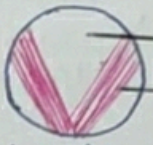
• Larynx is internally lined with Ciliated Columnar epithelium




• From the anterior side of Thyroid Cartilage arises a bilobed structure known as Epiglottis



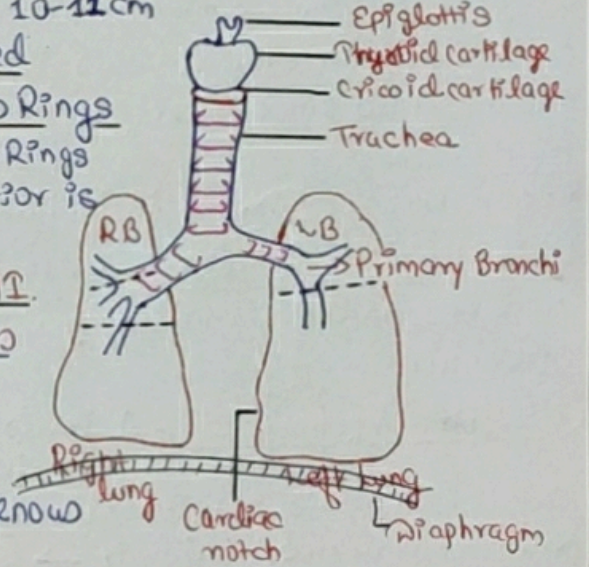

• Larynx have two elastic flap like structure known as Vocal cords made up of elastic fibres and are lined by Stratified Squamous epithelium. Vocal cords are more develop in males are about 2.5cm. Slightly smaller in females. Vocal cords are stretchables.




• During inhalation vocal cords are relaxed due to which the glottis is wide and exhalation due to contraction of Laryngeal muscle glottis get narrow -er as vocal cords come closer and that is where vibration is created and sound is produced.

• Glottis is closed by epiglottis when we are swallowing

* TRACHEA :- (Windpipe) Tube like structure about 10-11 cm long. This trachea is lined with Ciliated epithelium and supported by 'C' shaped Cartilegenous Rings → not complete Rings




• Rings of 'C' shaped, anterior is complete but posterior is not connected. No. of Rings it vary from 16-20

• Trachea divided into two branches known as BRONCHI.

i.e; Right Bronchus
- 2.5cm long
- Wider
- more vertical
- Have 'C' shaped Cartilegenous Rings.

Left Bronchus
- 5 cm long
- Narrower
- more Horizontal
- Have 'C' shaped Cartilegenous Rings.

• Primary Bronchi they enters into the lungs and they are going to divided into branches i.e; Right lung have 3 lobes, Superior, middle and lower and these are termed as together Secondary bronchus.

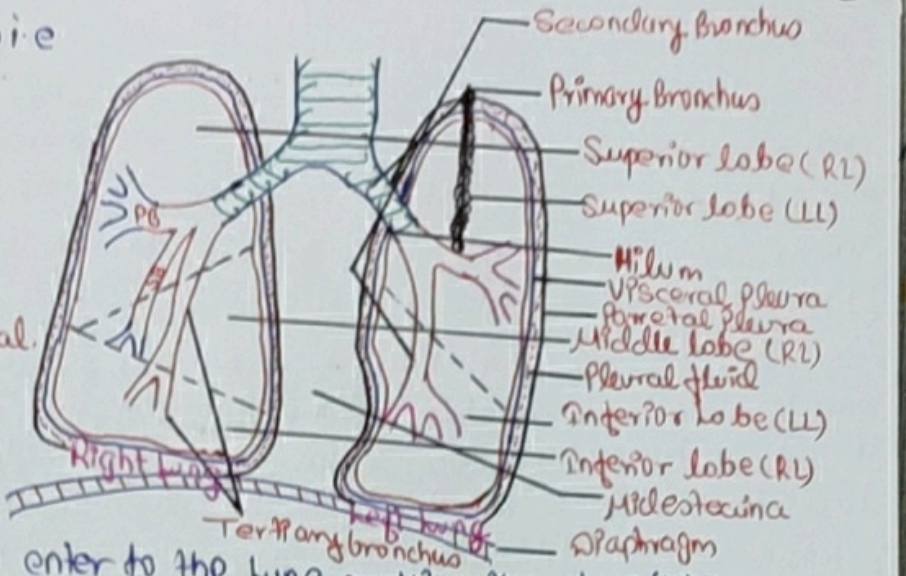
• Whereas in the left Primary Bronchi, they are going to divide into 2 branch of lobes Superior and lower lobe.

• A depression can be observed on the left lung which is known as Cardiac notch where the Heart is placed.

• Below the lung presence of Muscular Diaphragm which separte the Thoracic cavity from Abdominal cavity.

## *STRUCTURE OF LUNGS :-

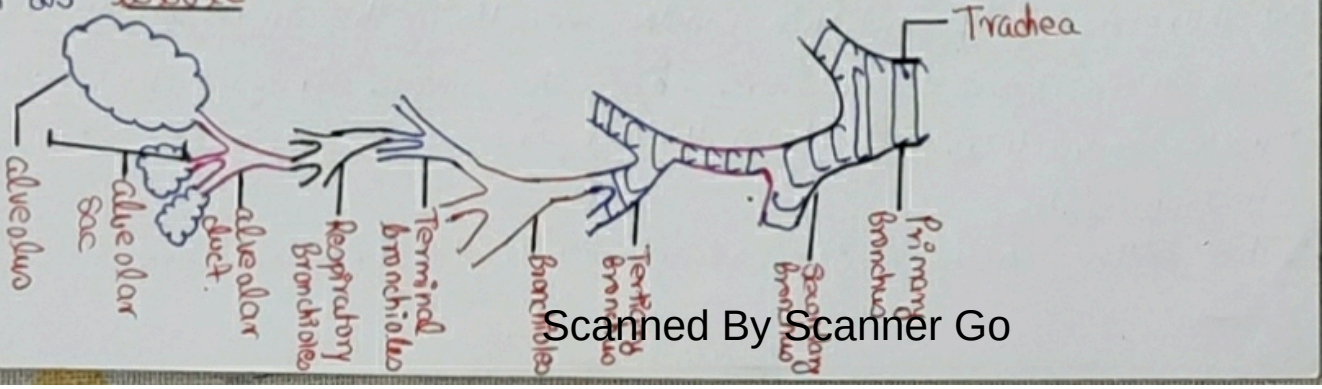
- Trachea, it divides into two branches i.e Bronchi (Right Bronchi → Right lung) (Left bronchi → Left lung) and each bronchus leads to lung.
- Right bronchus is more wider and more vertical, Left bronchus is narrower and more Horizontal.
- Each lung is Triangular where upper end is pointed and lower end is wider.




- The area through which the bronchus enter to the lung making the shap 'V' known as Hilum.
- Both the lungs are surrounded by a double layer membrane known as Pleural membrane or Pleural (Inner membrane Visceral Pleura, Outer membrane Parretal Pleura).
- Between these two membrane, presence of fluid known as Pleural fluid.

| Right lung | Left lung |
|---|---|
| - Bigger | - Smaller |
| - 3 lobes | - 2 lobes |
| - 620 gm | - 560 gm |

- Pleural fluid functions as the lubricant, protects the lung from mechanical shocks, and holds the both the membrane together.
- In the left lung, presence of depression known as Cardiac Notch where the heart is placed. Right lung absence of cardiac Notch.
- Middle part of lungs is known as Midestecina and the entire part is in the Thoracic cavity.
- Primary Bronchi In each lung is 2 in no. 2ndry Bronchi In case of Right lung is 3 in no, incase of left lung is 2 in no. Tertiary bronchi their are 10 in Right lung, and 8 in Left lung.
- Tertiary bronchi further divides in the lungs and gives rise to Bronchioles and these bronchioles are the widest passage without Cartilegenous Rings. 1mm in diameter.
- Bronchioles are further divided into tubes known as Terminal Bronchi and next tube divides into Respiratory Bronchioles and then formation of alveolar duct and each alveolar duct opens into sac like structure and this sac is made up of many semi circular shape known as Alveolus and alveolus is the actual place where the exchange of gases takes place. And entire this structure is known as lobule



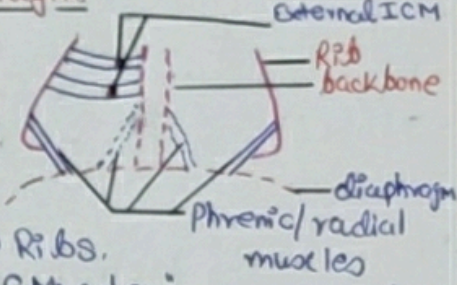
# MECHANISM OF BREATHING :- This mechanism is held by two steps or process i.e; Inhalation/Inspiration and Exhalation/Espiration.

↓ Active Process (means muscle contraction, ATP is required)

↓ Passive Process (means during this time muscles are going to relax and no ATP is required)

* Inhalation/Inspiration in Detail :-

- Their are two inspiratory muscles for inhalation that are :- (a) Diaphragm (b) External Interlostal muscles.
- The structure of lungs have neglible muscalature itself and that is why above two muscles are required. We known that lungs are tightly packed in Thoracic cavity, they don't have their muscalature that can help in their expansion so that air can come in and that is where these above two muscles required.
- Thoracic cavity, it is supported or guarded by the ribs and the lower side b/w the thoracic cavity and the abdominal cavity is the diaphragm.
- Diaphragm is normally dome shaped where the muscles are attached to the peripheral part going to the ribs known as Phrenic muscles or radial muscles




- External Interlostal muscles are present between the Ribs. We have "12 pairs of Ribs" where "11 pairs of this EIC Muscles" are present
- Thoracic cavity is the Right compartment as on the side their are rib cages so when this Phrenic muscles contract, this diaphragm which is dome shaped it get pulled from side muscles and makes diaphragm flat and as it become flat the volume of Thoracic cavity would increase.
- Also contraction of EIC Muscles causes Rib cage to move up and out. due to which volume of Thoracic cavity increases.
- we known that when the Volume increases, Pressure decreases (-ve Pressure) in lungs by (-2 to -6) mm of Hg as compared to atmospheric pressure.
- From above we can observe that air from higher pressure of atmospheric moves to lower pressure to lungs and this entire process constitutes Inhalation

* Exhalation/Espiration (Passive Process) :- No muscles contraction takes place All the muscles are going to Relax. As when the Radial muscles they relax, the diaphragm becomes shape of Dome.

- Shape of Dome of diaphragm results in the decrease of Volume of lungs of Thoracic cavity and this would results in the increase of Pressure of lungs
- Due to increase of Pressure inside the lungs, air goes out without any muscle contraction. (Air from Higher Pressure ⟶ lower pressure i.e atmosphere).
- This entire above statement constitutes the process known as Exhalation.

## *Pulmonary Air Volumes / lung Capacities :-

① **Tidal Volume** :- is that volume of air which is normally inhaled or exhaled. (TV) Volume is 500 millilitres. that is inhaled normal resting position.

- Out of this 500ml of volume of air 350ml reaches upto alveoli and 150ml remains in the tract. (is not available for gaseous exchange)
- 350 ml of volume reaching to alveoli is known as alveolar volume and 150ml volume remains in tract known as Anatomical dead space / Dead space volume.
- Physiological dead space / volume is actually Anatomical dead space/volume + Non functional alveoli

↳ Forceful inhalation.

② **Inspiratory Reserve Volume (IRV)** :- The volume of air which can be taken inhaled after normal inhalation (500ml) constitutes Inspiratory Reserve Volume and Volume is about (2000ml - 3000ml or 2l - 3l)

- This quantity of air is inhaled due to large surface area in our lungs.

③ **Inspiratory Capacity (IC)** :- Only inhalation (Here sum of TV + IRV)
500ml + 2000ml - 3000ml
⇒ 2500ml - 3500ml
⇒ 2.5l - 3.5l

④ **Expiratory Reserve Volume (ERV)** :- this means that after normal exhalation if we can exhale some more, that volume of air which is exhaled after normal exhalation is called ERV.

- Volume Ranges from (1000ml - 1500ml) (average 1100ml) during ERV and this is done forceful exhalation.

⑤ **Vital Capacity (VC)** :- It is the maximum or forceful exhalation after forceful inhalation. i.e; TV + IRV + ERV

= 500ml + 2000 - 3000ml + 1100ml

= 3500ml - 4500ml

= 3.5l - 4.5l of air comes under Vital Capacity

⑥ **Residual volume (RV)** :- Volume of air that remains in the lungs after forceful exhalation. Volume is about 1500ml

⑦ **Functional Residual Volume (FRV)** :- General how much of volume of air is in the lungs as functional. i.e, RV + ERV = 1100 ml + 1500ml = 2500ml (approximately) of air is available as functional RV.

⑧ **Total lung Capacity (TLC)** :- (VC + RV) = (3500ml - 4500ml) + 1500ml

= 5000 ml - 6000ml

= (5l - 6l) is the total lung capacity

- average is 5800ml of TLC.

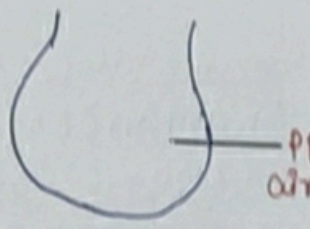
*IMP POINT :- All these Pulmonary Air Volume / lung Capacities, they are about 25-30% less in case of females as [illegible] in Athletes)

* Exchange of Gases :- During breathing Oxygen Rich air reaches the alveoli and that is where exchange of gases starts.

- Exchang of Gases takes place at two levels :-

① Pulmonary Exchange / External Respiration :- ② Tissue level exchange / Internal Respiration or gaseous exchange.

- Partial Pressure (PP) :- It is defined as the pressure exerted by the gas in a mixture of gases irrespective of the concentration of other gases.
- PP of inhaled air of $O_2$ is 159 mm of Hg and of $CO_2$ is 0.3mm of Hg ↓ PP inhaled air of $PO_2$ and $PCO_2$
- The air when it comes in alveoli is called as alveolar air
- PP in inhaled air and PP in alveolar is different is the reason as we talked about Anatomical dead space where out of 500ml of air that we inhale during normal inspiration (Tidal volume) it is only 350 ml reaching to the alveoli and 150ml remains in the respiratory tube. After exhale their some again gas left and the gaseous exchange is taking place.



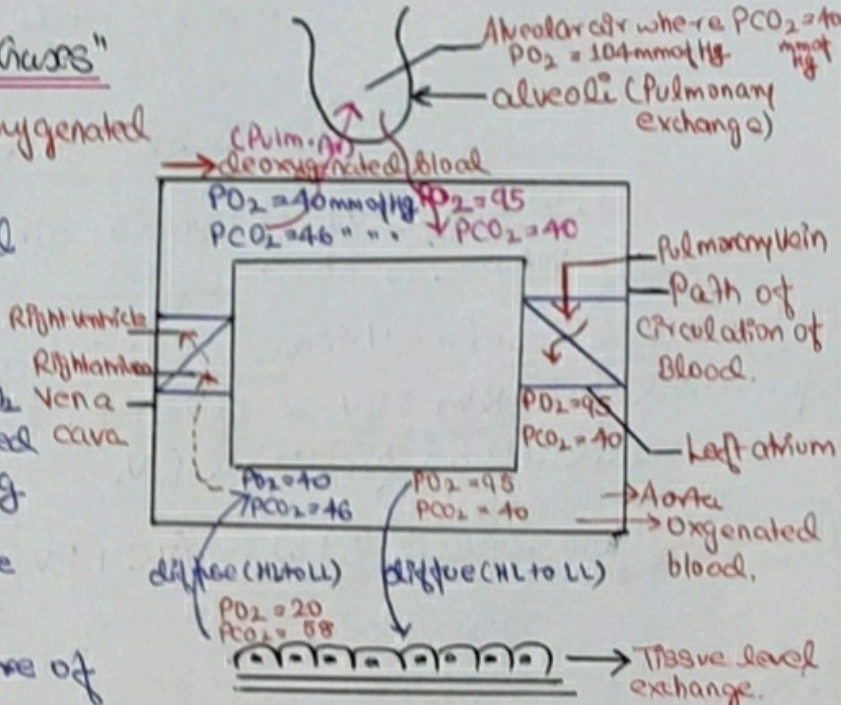

- That means when fresh air enters to alveoli it mixes with the air that is already present in our respiratory tract and that gas/air has more of $CO_2$ because exchange is taking place continuously and less of $O_2$ and due to which after Reaching $O_2$ in alveoli PP changes (written as $PO_2$) is 104mm of Hg Similarly $PCO_2$ will be 40 mm of Hg
- Two values of $PO_2$ and $PCO_2$ while inhaled and after reaching to alveoli. is different.

* Schematic Diagram "Exchange of Gases"

- Blood coming near to the lung is deoxygenated blood (Rich in $CO_2$) which is brought by Pulmonary artery and also this blood have some $PO_2$ and $PCO_2$

$PO_2$ : Coming from tissue level this $O_2$ have been used up mostly but some remains having 40mm of Hg.

$PCO_2$ : Blood coming from the tissue have more $CO_2$ which have diffused from tissue having 46 mm of Hg depends how active the tissue is.



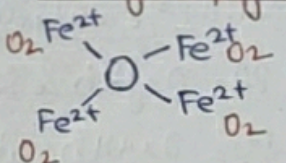

- Alveoli having higher Partial pressure of $O_2$ ($PaO_2$) i.e 104 mm of Hg and we know that gases diffuse from their higher PP to lower PP. and because of diffusing [illegible] to change will be 95 mm of Hg

- The diffused $O_2$ entering to blood making $PO_2$ change of 95mm of Hg constitutes Oxygenated blood
- Now $CO_2$ is going to diffuse from its higher PP i.e $PCO_2$ of 46mm of H to lower PP i.e $PCO_2$ of 40mm of Hg and now $PCO_2$ in the blood of Oxygenated become decrease around 40 mm of Hg ($PCO_2$)
- Oxygenated blood from the lungs is brought to the heart by Pulmonary Veins and PV open in the heart on the left atrium and after that $PO_2$ comes to left ventricle and from there this $O_2$ blood will be carried by Aorta to the various organ of the body.
- Oxgenated blood comes to the tissues and tissues are "active" and they are continuously using $O_2$ and releasing $CO_2$. and due to maximum consumption of $O_2$, $PO_2$ level will be very less in Tissue and level of $PO_2$ vary (20 mm of Hg = $PO_2$) and due to Tissue are active $PCO_2$ level increases i.e ($PCO_2$ = 58 mm of Hg)
- Values of $PO_2$ and $PCO_2$ are different in different tissue level. depending upon active and inactive.
- At the tissue level $PO_2$ = 95 diffuse to tissue from (Higher leve to lower level) and $PCO_2$ = 58 diffuse back to blood making $PCO_2$ = 46 (HL to LL) while in the blood leve of $PO_2$ = 40 and $PCO_2$ = 46 this constitutes the blood making deoxygenated blood.
- This deoxygenated blood is brought into the heart by Super or Inferior Vena Cava where they open into Right atrium and then laterpassed to Right Ventricle. and from RV this blood is taken by Pulmonary artery to the lungs

# TRANSPORT OF RESPIRATORY GASES: ① Transport of Oxygen :- $O_2$ when diffuses in, its taken in two forms (a) $O_2$ dissolved in Plasma = % is very less hardly (1-3%) of the total $O_2$ which is to be transported goes in this form because very less $O_2$ is dissolved.

(b) $O_2$ transported as a complex with Haemoglobin (Oxyhaemoglobin) ($O_2$ + Hb ↓) magorly of about (97-99)% of the total $O_2$ which is transported.

* Haemoglobin :- made of two parts < Protein – globin; Iron containing (Fe) having Porphyrin Ring (have pyrol Rings (1) $Fe^{2+}$)
* 1 Hb binds or can carry 4 $O_2$ molecules
* 1gm of Hb can transport 1.34 ml of $O_2$




- 100ml of blood have 15 gms of Hb then 20.1 ml of $O_2$ is transported.
- Oxyhaemoglobin is a temporary/short lived complex. and the factor which is helping this complex to form is High $PO_2$ in alveolar air and due to ~~low~~ High $PCO_2$ in blood
- Haemoglobin is the Respiratory pigment

• All this are seen in the Higher organism posessing Higher metabolic rate. and the lower organism having lower metabolic rate maximum $O_2$ is transported by Plasma where is going to take time and diffusion with slow process as due to low metabolic rate.

# TRANSPORT OF CARBONDIOXIDE:- Generally we know that $CO_2$ is produced at the Tissue level and then it is to be transported so that it can be thrown out when we exhale.

• It is transported by Plasma as well as RBC with Haemoglobin.

• 1 decilitres i.e; 100ml of blood transports 3.7ml of $CO_2$ and this $CO_2$ transported in 3 forms. ① As Carbonic acid :- transportation is through plasma. but actually carbonic acid is formed inside RBC i.e; $CO_2 + H_2O \xrightarrow{\text{Enzyme :- Carbonic anhydrase}} H_2CO_3$ (Reaction taking place in RBC) → comes into the plasma

(Zinc activated enzyme ($Zn^{2+}$) ions are required for activation.)

• In Carbonic acid amount of $CO_2$ transported is 7% of $CO_2$

• Out of 3.7ml of $CO_2$ only 0.3ml of $CO_2$ is transported as $H_2CO_3$.

② As bicarbonates of Na and K :- 70% of $CO_2$ is transported as bicarbonates of Na and K. Here, the Reaction takes place in RBC

• $CO_2$ from the tissue diffuses into RBC where it Reacts with $H_2O$ molecules in presence of enzyme Carbonic anhydrase in presence of $Zn^{2+}$ ions giving Carbonic acid ($H_2CO_3$). This Carbonic acid it dissociates into $H^+$ ions and $HCO_3^-$ (bicarbonates ions)

• Bicarbonates ions they diffuse into plasma and in the plasma presence of Na ion / K ion, here $HCO_3^-$ either it combine with $Na^+$ ions to form NaHCO₃ (Sodium bicarbonates) or $K^+$ ions to form $KHCO_3$ (Potassium bicarbonates) and these are the two form in which maximum carbondioxide is transported.

③ Transported as Carbaminohaemoglobin :- Carbaminohaemoglobin is temporary or short lived complex and 23% of $CO_2$ gets transported as CarbaminoHb.

• Here the $CO_2$ binds with the amino group of Haemoglobin molecules giving complex ($Hb-CO_2$) :- $CO_2$ + amino group of Hb ⟶ Carbaminohaemoglobin ($Hb-CO_2$)

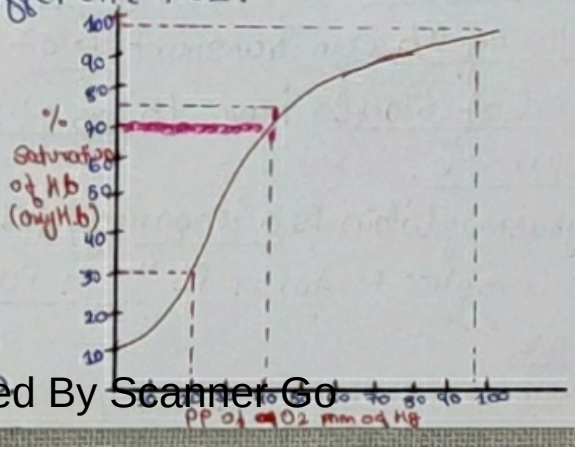
# OXYGEN DISSOCIATION CURVE:- Oxygen Dissociation Curve of Hb is a graph representing % saturation of Hb with $O_2$ at different $PO_2$.

• at 20 $PO_2$ OxyHb % is 30%.

• at 40 $PO_2$ OxyHb saturation % is 75%

• at 95 $PO_2$ " " " % is 97%

• Three values and interpretations is taken in phase making Sigmoid Curve graph and these 3 values can be related to exchange of Gases



#Factors affecting Oxygen Dissociation Curve :- (i) $CO_2$ Conc/ $PCO_2$ :- With inc. in $PCO_2$ Oxygen dissociation curve turns or bends towards right that means Oxyhaemoglobin complex is going to dissociate. and this is known as Bohr's effect

(ii) Temperature :- As the temp. inc. the oxygen dissociation curve bends towards right and Oxyhaemoglobin complex is going to dissociate.

(iii) PH :- as pH gets low or acidic, curve bends towards right and oxyhb complex is going to dissociate.

#CONTROL OF RESPIRATION :- Controlled by two ways i.e; (i) Nervous Control (ii) Chemical Control

*Nervous Control

- associated with Nervous system.
- There are 3 Respiratory control centres, out of which 2 are in Medulla and 1 is on Pons.
- This respiratory control centres together are known as Rhythmicity Center

* 3 Respiratory Control Centres :-

(i) Inspiratory Center - located on Medulla
- Responsible for normal inhalation

(ii) Expiratory Centre - located on Medulla
- It normally remains inactive or dormant during normal breathing and gets stimulated when we are required forcefully inhale/exhale. (During exercise)

(iii) Pneumotaxic Center :- located on Pons Varolii.
- works during exercise when the breathing rate has to be faster as it inc. rate of breathing but the amount of air get less (shallower)

*Chemical Control

- associated with chemical system and control by chemosensitive bodies and these bodies are two.

(i) Carotid body - located at the base of Carotid Sinus

(ii) Aortic body - located at the base of Aorta

- Both bodies are sensitive to $PO_2$ and $PCO_2$
- $PCO_2$ → carotid and Aortic bodies are more sensitive to $PCO_2$. If $PCO_2$ ↑ both this body gets stimulated and this body stimulate expiratory muscles through which more no. of $CO_2$ is released
- $PO_2$ → both this bodies are very very less sensitive to $PO_2$.

#RESPIRATORY DISORDERS :- Certain conditions which affect the Respiratory System
- They are categorised into 3 main heads :-

(1) Infectious Respiratory disorders :- we include all those diseases which are caused due to some pathogens and that pathogens could be bacterium or virus.

(a) Tuberculosis (b) Pertussis (c) Pneumonia (d) Diphtheria

(2) Tumours/lung Cancers :- Carcinogen - Benzpyrene which is present in tobacco smoke, consider for carcinogen lung cancer.

(3) Obstructive Respiratory disorders :- we look about allergies, bronchitis, asthma, Emphysema etc.

* Allergies :- any allergies can be defines as hypersensitivity of a person to an allergen → an allergen is that substance that causes allergy.

eg :- dust, pollen grains, chemicals, some food items.

Symptoms :- stimulation (Sensatatization) by an allergen which binds to mast cells which are stimulated or attached to with antibodies where mast cells rupture releasting Histamine. And Due to Histamine action, can be Inflamation, running nose, watery eyes, sneezing etc.

Treatment :- Antihistaminic Drugs are taken.

* Asthama :- Their is Bronchial Spasm means those tubes that are carrying air to lungs, they undergo spasm (contract) and when they contract the lumen decreases decreasing in lumen than breathing became heavy or difficult. ese pipe become narower. Sputum is more. → a mixture of saliva and mucus coughed.

* Bronchitis :- is normally consider as allergeic bronchitis where problematic is weezing, heavy breathing, No or negligible Sputum.

↓ sound in chest

* Emphysema :- In which the alveolar surface reduced. Reason → Tobacco Smoking