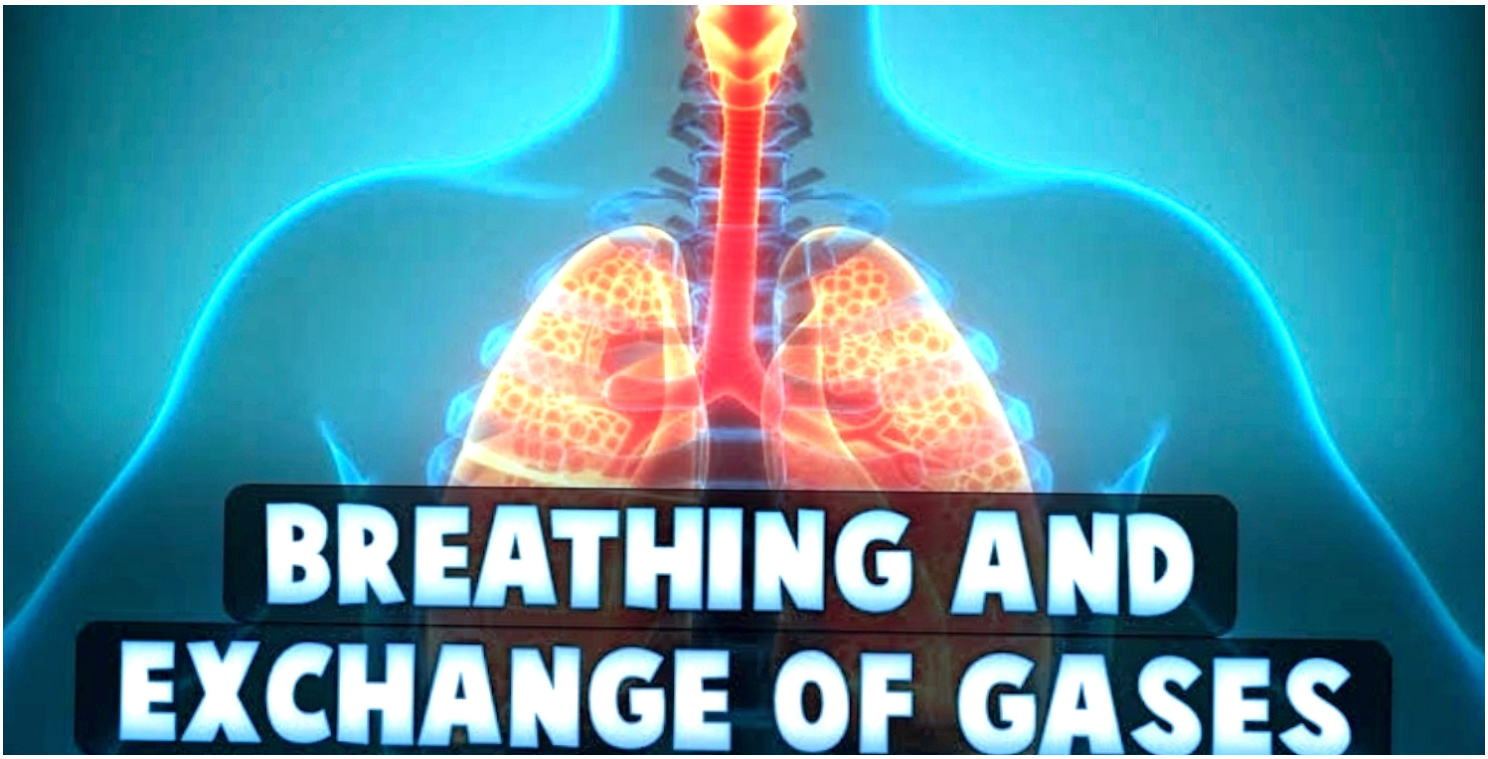

BREATHING AND
EXCHANGE OF GASES

BREATHING AND EXCHANGE OF GASES

* Breathing means inhalation & exhalation.
* Exchange of gaus takes place through respiration
* Oxygen rich air enter into the lungs is called inhalation.
* CO_2 air expelled air out of the lungs is called exhalation.
* Breathing is one of steps of respiration.
* Respiration completed into 4 steps :-

1. Breathing
2. external respiration
3. Internal respiration
4. Cellular respiration

- Respiration is the biological process through which oxidised of food occur & procedure energy for ATP synthesis
- Respiration is of two types.
  1. Anaerobic respiration
  2. Aerobic respiration

- Anaerobic respiration :-

  Respiration takes place absence of O_2 is called anaerobic. take place in bacteria, yeast, helminths.
  * anaerobic respiration in yeast called Fermentation

- aerobic respiration :-

  Respiration takes presence of O_2 is called aerobic respiration.
  * takes place in bacteria, plants & animal etc.
  * glycolysis & Krebs cycle are necessary for aerobic respiration.
  * in human muscle & RBC shows anaerobic respiration.
  * end product of aerobic CO_2 & lactic acid.
  * CO_2 is harmful for human.
  * internal parasite of blood shows aerobic respiration.
  * parasite in elementary canal shows anaerobic resp while parasite of small Shows aerobic

* Respiratory membrane :-

The surface through which gaseous exchange occur in ~~which~~ is called respiratory membrane Respiratory membrane should have property like.

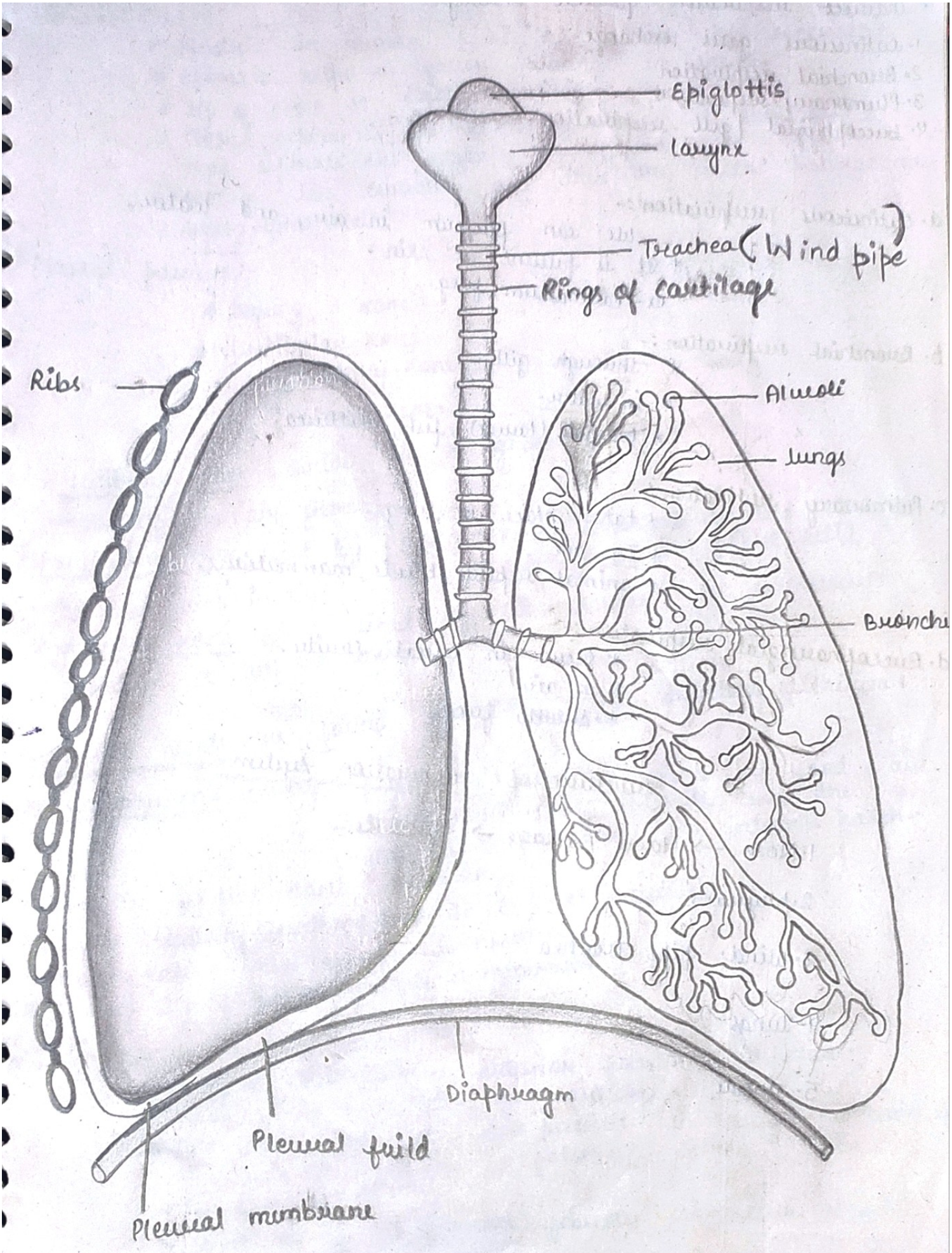
* Thin
* highly Vascular
* Moist
* large surface area.

* Mammalians are not adopted for respiratory through skin. since their skin dry due to absence of mucus gland.

* Mucus ~~gland~~ is secreted by globlete cell.
* goblet cells are single cellular gland.
* frog can respiration through their skin pharynx cavity gills (in larva stage) lungs.
* respiratory Organ in lungs.
* respiratory earthworm skin.
* respiratory spider scorpion book lungs.
* in fish counter current flow of water affect their blood. & water increase their respiratory efficiency.
* Presence of accessories air sac in birds increase the respiratory efficiency.

Types of respiration

Direct respiration	Indirect respiration
gaseous exchange occur directly through surface	• gaseous exchange occur through respiratory Organ.
blood dont play role in gaseous exchange.	• blood play great role in gaseous exchange.
lower level Org. like porifera coelenterata & flatworm.	• animal like human.


Epiglottis
Larynx
Trachea (Wind pipe)
Rings of cartilage
Ribs
Alveoli
Lungs
Bronchi
Diaphragm
Pleural fluid
Pleural membrane

* indirect respiration possible through.

1. cutineous gases exchange.
2. Buonchial respiration
3. Plumonary respiration
4. buccophyngial / gill respiration

a. cutinicous respiration :-

We can perform in air and water.

* It is present at skin.

ex- earthworm, frog.

b. Buonchial respiration :-

* through gills.
* in water.
* tadepole (larva), fish, mollusca.

c. Pulmonary respiration :-

* takes place in lungs.
* In air
* animal, reptile, birds, mammalians.

d. Buccopharyngial respiration :-

* occurs in buccal cavity.
* in air
* ~~Scarlet~~ frog.

Structure of respiration system

1. Nose → Nasal passage → Nostrils
2. phyuanx
3. Wind pipe Trachea
4. lungs
5. alveoli

Nose :-

* Nostril in human same as spaukle of cockroach.
* Spiracle helps in gaseous exchange in insect.
* tip of Nose is elastic cartilage.
* Nasal septum is the bone / cartilage in the nose that separate the nasal cavity into two nostril.
* Septum lies centually and thus the nasal passage are ~~syst~~ symetrical.

Nasal passage :-

* having 3 zone.
1. Vestibular zone
2. respiratory zone
3. olfactory zone.

* Vestibular zone divide by oil gland & hair.
→ It helps in air filter.
* Respiratory zone lined by PSCCGrC (Psudo stratified ciliated Columnar epithelium with goblet cell)
→ It main temp in air.
* olfactory zone It is lined by Schenederian or olfactory epithilium It help in smell.

* Bowels glands are found in nose below olfactory epithilium.
* Buccophynx cavity :- phynx is common place of food & air
→ during swallowing epiglotis cover the glotis & uvula covers the internal nasih.
* epiglotis is flat elastic cartilage.
* During swalloing breathing rate is 0 (not possible)
* During eating breathnig rate is normal
* During sleping breathing rate is minimum

lynx :- Sound box
→ Modified cartilaginous interior part of trachea.
→ Made up of 6/4 types of cartilage.
→ Two pair Vocal cord are present in Lanyns. in which one pair is true one is false.
→ Produce sound.
→ Made up of yellow or fibrous connective tissue

Cartilage in larynx:-

1. Thyroid
2. Cricoid
3. epiglottis
4. Arytenoid
5. Corniculate sentosini cartilage
6. Cuniform

Number	Shape	types of cartilage	Name
1	C Shape	hyline	Thyroid
1	Signature ring sh	hyline	cricoid
1	leaf shape	~~keyline~~ elastic	epiglotis
2	pyramidal	hyline	Arytenoid
2	conical	elastic	
2	W or wedge shape.	elastic	

* speech is very special feature of human having two process.

1. Phonation → by larynx
2. Articulation → by lips, soft plate, cheek, tongue, jaw.

Adam's Apple :-

In male lumps of cartilage that streaks out from the throught is adam's apple.

→ It serve non specific function.

→ In female adam's apple is absent

→ It develop during puberty & not present in pre puberty stage

Trachea :-

→ windpipe

→ lined by PSCCE GC

→ Tracheal cilia process mucus outward & nasal cilia cause mucus inward.

→ on trachea many doubly in complete cartilage of hyline are found.

→ On ventrle surface that protect from collapsing.

→ The similarity b/w human & cockroach trachea is present of cartiligenous rings

→ at mid the thoracic region trachea divide into left & Right Primary bronchi.

→ at dorsal side tracheary muscle is foum which support the (as involuntary muscle) of trachea

trachea is divided into

trachea
1° Bronchi
2° Bronchi
3 Bronchi
Bronchioles
alveolar duct
terminal alveoli

intra pulmonary bronchi rebranching of 1° Bronchi foum a tree like str ie called Bronchial Tree.

Respiratory tubules :- divided into 2 zone.

1. Bronchial tree
2. Respiratory tree

Bronchial tree:-
- lumen is wider cartilage ring is present.
- → gas exchange absent.
- → dead space volume present.
- → lined by PSCCEGC

Respiratory tree:-
- → Narrow lumen.
- → Rings of cartilage absent.
- → gaseous exchange present.
- → lined by simple cartilegenous epithelium

Pathway of air

Nostril
↓
Nasal passage
↓
Internal nose
↓
Pharynx
↓
Larynx
↓
Trachea
↓
Bronchus
↓
1° Bronchi
↓
2° Bronchi
↓
3° Bronchi
↓
intra pulmonary bronchiole
↓
terminal bronchioles
↓
Respiratory bronchioles
↓
alveolar duct
↓
antria ⟶ alveolar sac ⟶ alveoli

Respiratory tree:-

ALVEOLI
↓
ALVEOLAR SAC
↓
ARTIA
↓
DUCT
↓
RESPIRATORY BRONCHIOLES

BRONCHIOLIAL TREE:-

TERMINAL BRONCHIOLE
↓
INTRA PULMONARY
↓
TERTIARY BRONCHI
↓
SECONDARY BRONCHI
↓
PRIMARY BRONCHI
↓
BRONCHUS
↓
TRACHEA

LUNGS:-

lungs in endomesodermal in origin but in actual it is called endodermal in origin but pleural dermal is mesodermal in origin.

→ mammalian lungs are solid, spongy without of lumen & sucken type muscle are absent in lungs.
→ basic unit of lungs called alveoli.
→ approx 300 millions of total alveoli is present.
→ Total surface area of lungs is $100 m^2$
→ alveoli is surrounded by 2 layer.
1. outer layer 2. inner layer

→ Outer is made of yellow fibre connective tissue.
→ Inner layer made of simple squamous epithelium tissue.
→ Right lungs larger & having three lobes.
→ Left lungs having 2 lobes
→ lungs surround by pleural membrane & found in pair.
→ Space b/w inner & outer is called pleural cavity.
→ It is filled with pleural fluid.
→ pleural cavity is celome with filled with filled serous fluid that cementing the both membrane.
→ Lapithene is found in alveoli which prevent alveoli from collapsing by reducing surface tension

Diaghpram :-
→ It is muscular membrane.
→ Present b/w thoracic & abdominal cavity.
→ made up of radial muscle.
→ diagphram only found in crocodile & mamalian.
→ during normal condition it is dome shape.
→ after contraction it is flat.
→ b/w rib intercolstal muscle is found.

intercolstal is of two type
1. external intercolstal muscle internal colstal muscle.

Mechanism of breathing

Process	Inspiration	Expiration
• Types of Process	Active	Passive
• EICM + Diaghpra	contract	Relax
• Vol of T cavity	↑	↓
• atmospheric P	> 1 atm more than	< 1 less than
• air	inward	outward
• Time	2 seconds	3 seconds

* normally breath is also called abdominal in which diaphragm play 75% Role & 25%
* In pregnancy thoracic breathing is more than normal
* inspiration muscle = EICM + Diaghpram.
* forcefull inspiration is also called thoracic breathing in which ribs play more in normal breathing
* during forcefull expiration contraction of IICM and abdominal muscle occur
* During forcefull expiration:-
  1. Diaghpram relax
  2. EICM Relax
  3. abdominal ~~cont~~ muscle contract
  4. IICM contract

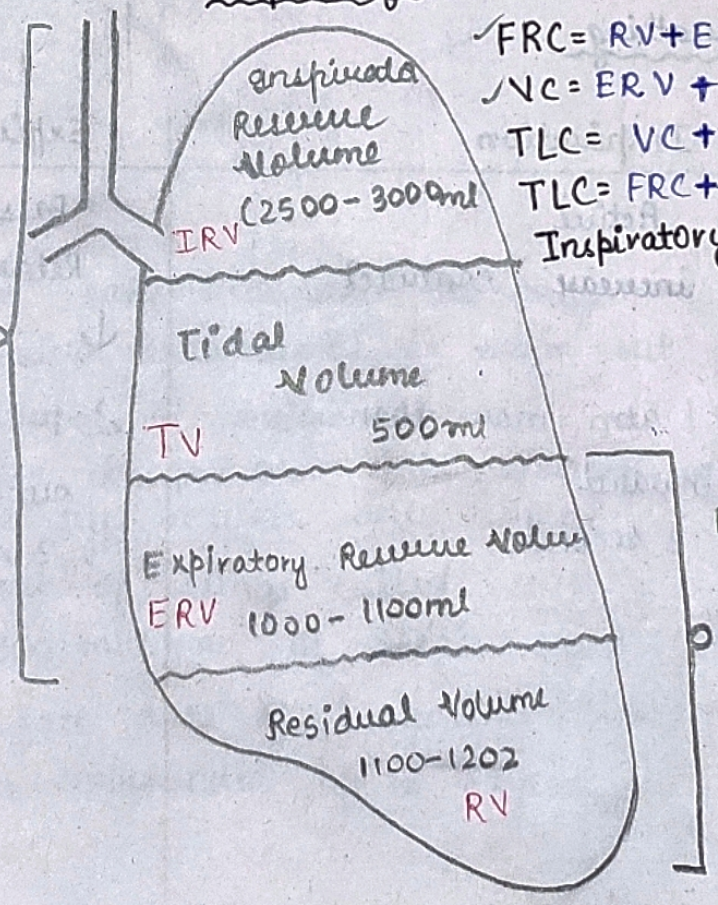
~~in~~ expiratory muscle = IICM + abdominal cavity

* mammalian shows negative pressure breathing in also called sucssion pressure we can expiration and breath at same time etc.
* frog shows positive pressure breathing it is also called pressure pump mechanism

Respiratory Volume & Capacity

FRC = 21,00 to 2300

Vital capacity 4000 to 4600



FRC = RV + ERV
VC = ERV + TV + IRV
TLC = VC + RV
TLC = FRC + TV + IRV
Inspiratory capacity = TV + TRV

Ques:- If VC = 7000 ml then find out TLC=

VC = 7000 ml

TLC = ?

TLC = 7000 + 1200

= 8200 ml

Ques:- If ERV = 4000 ml then find FRC

ERV = 4000

FRC = 4000 + 1200

= 5200 ml

Ques If TV = 3200 then find TLC, VC, FRC, IC

* TLC = (1100 + 1200) + 3200 + 3000)

TLC = 8400

* VC = 1100 + 3200 + 3000

VC = 7300

* FRC = 1200 + 1100

FRC = 2300

* IC = TV + TRV

= 3200 + 3000

IC = 6200

* a heathy person can inspirat or expire 6000 to 8000 air in a minute.
* 150 ml of air remain in our bronical tree and donot participate in exchange of gase ie called dead space Volume.
* VC Vital capacity depends on.
  - age
  - sex
  - height
  - Physiological value

  It is more in athelits & non smoker.

Breathing Rate

in human child = 25
adult = 12 to 16
infant = 44
embryonic stage = Zero
Rabbit = 38
frog = 64

- Breathing rate $\propto$ concentration
- concentration $\propto$ proton gradient.
- Breathing rate $\frac{1}{\propto}$ PH (potency of hydrogen)
- Breathing rate $\frac{1}{\propto}$ size
- Breathing rate $\propto$ temp & Bp.

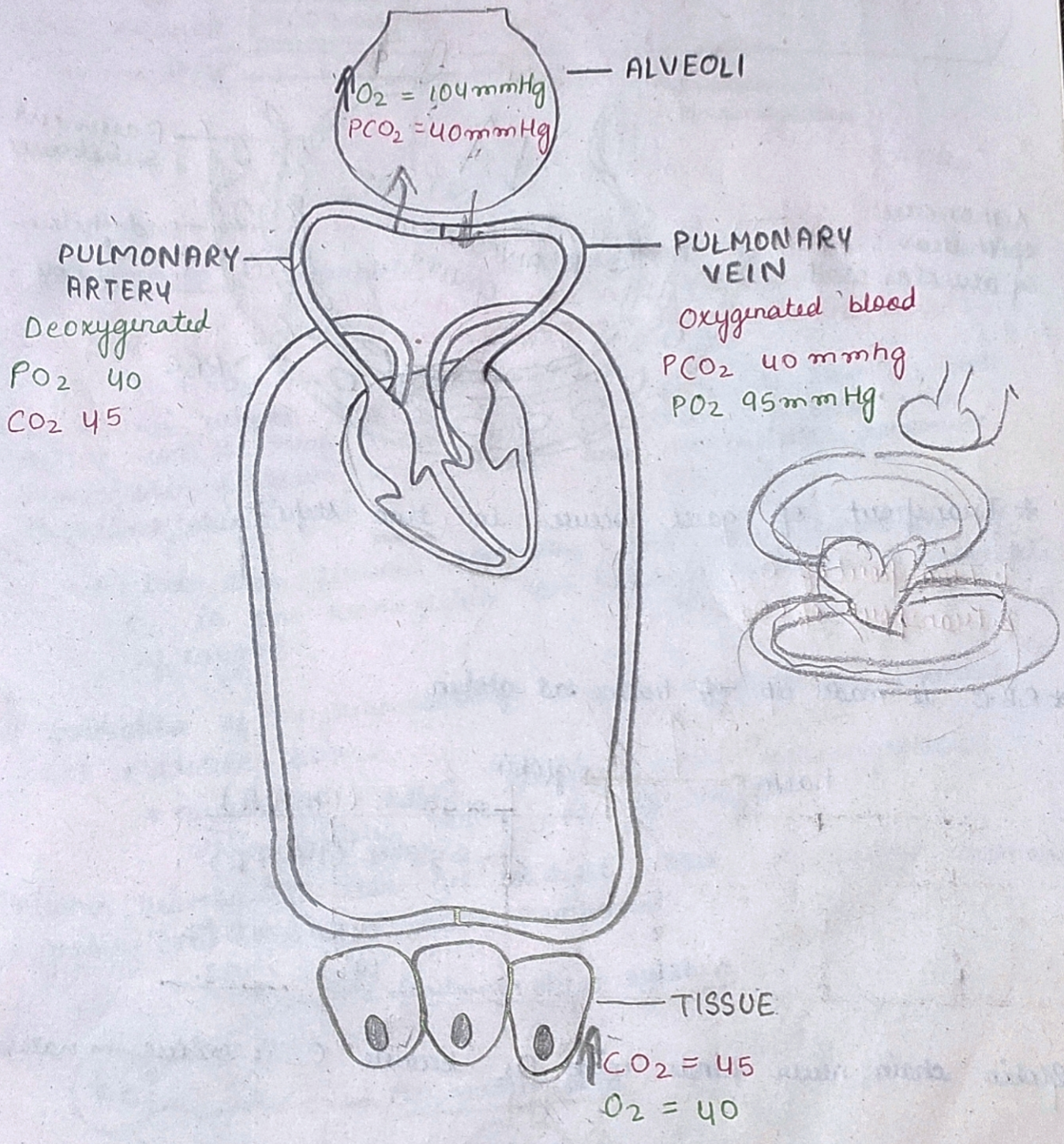
* at high altitude (height) due low ~~to~~ O_2 density O_2 supply to the tissue decrease ie called hypoxia in this condition kidney secret erythropoten that increase RBC production.

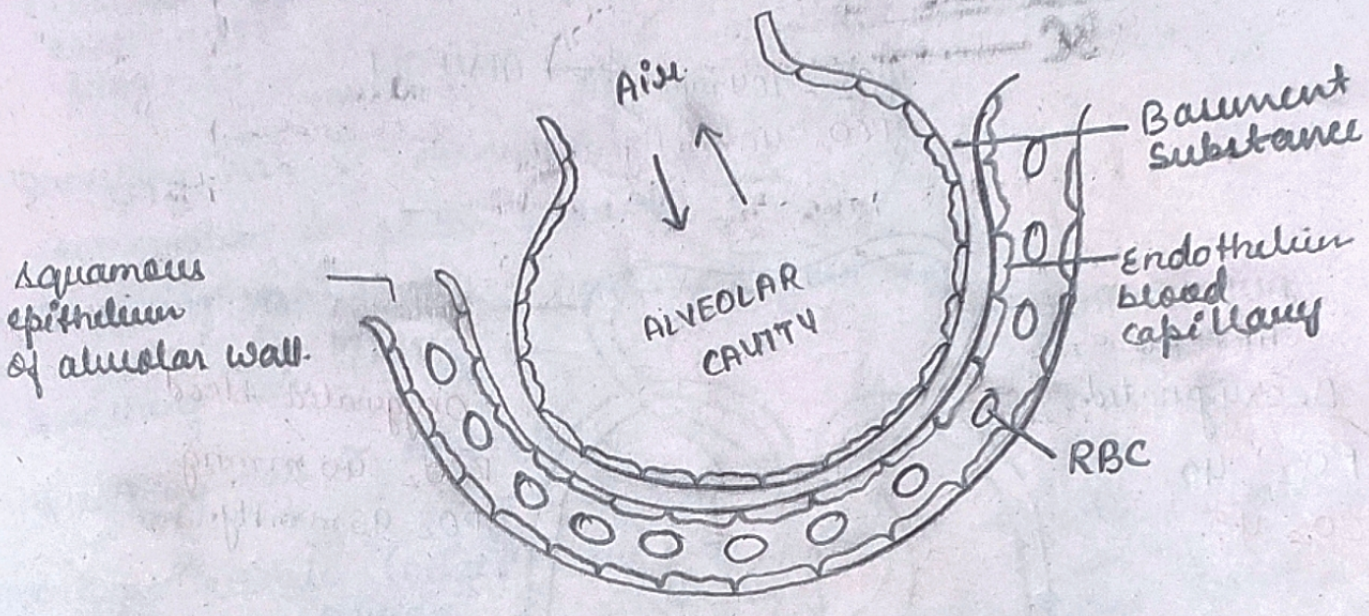
Exchange of gases

* Partial pressure of O_2 & CO_2 diff part involve in diffusion to those in atmosphere.

O_2	159	104	40	95	40
CO_2	0.3	40	45	40	45

* at alveolar site gaseous exchange occur b/w alveolar air & DO_2 blood pulmonary artery through respiratory membrane
* Respiratory layer membrane.
  - squamous epithelium / alveolar tissue.
  - basement membrane.
  - Endothelium of blood capillary.
* all 3 combine & form RM where all together thickness is less than 1 mm.


ALVEOLI
O_2 = 104 mmHg
PCO_2 = 40 mmHg
PULMONARY ARTERY
Deoxygenated
PO_2 40
CO_2 45
PULMONARY VEIN
Oxygenated blood
PCO_2 40 mmHg
PO_2 95 mmHg
TISSUE
CO_2 = 45
O_2 = 40



* Transport of gases occur in two steps :-

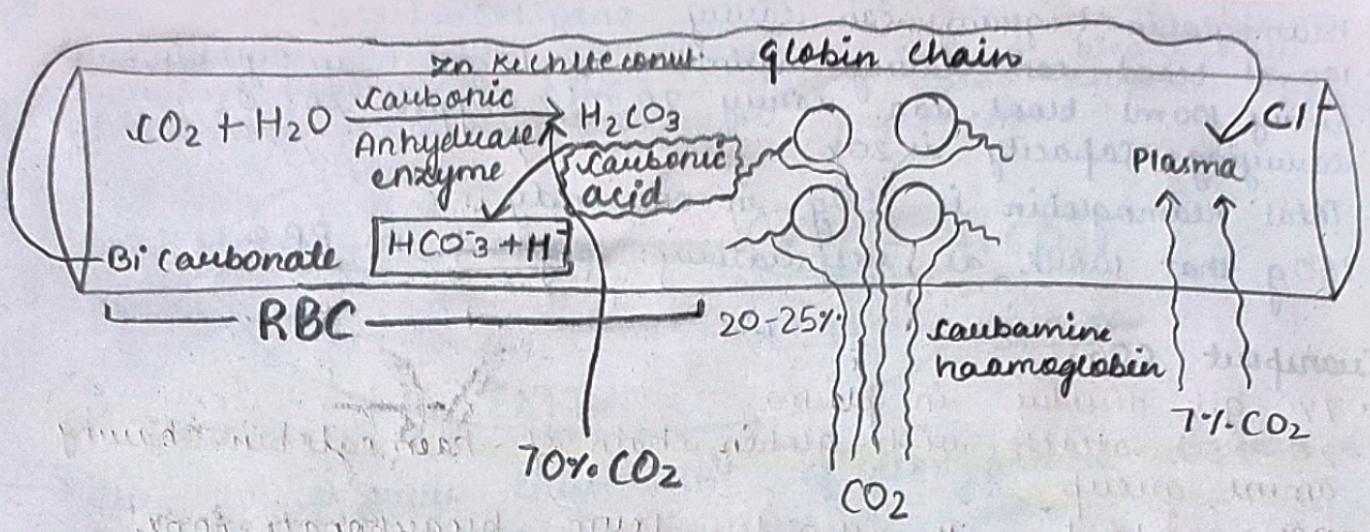
1. Transport of O_2
2. Transport of CO_2

* R.B.C is made up of haem and globin

haem ⟷ globin
- α_2 globin (141 A.A)
- β_2 globin (146 A.A)

$141 \times 2 = 282$
$146 \times 2 = 292$.

* Globin chain never binds with O_2 because O_2 is oxidise in nature.



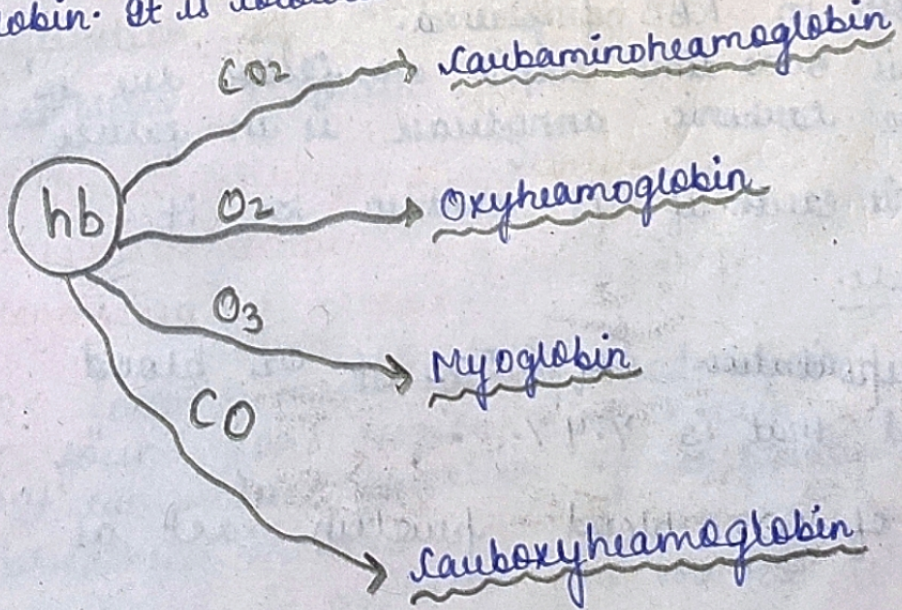
* Transport of O_2 completed in 2 steps :-
  1. 3% O_2 get dissolved with plasma and transported
  2. 97% dissolve RBC & form oxyhaemoglobin & transported

$$Hb + 4O_2 \longrightarrow Hb(O_2)_4$$

* In alveoli where PO_2 is high and PCO_2 is low as well as H^+ conc & temp should also low then O_2 binds with haemoglobin & form an unstable and reversible compound. Oxyhaemoglobin.

→ 1 Iron atom ferrous condition and carry 1 molecule of O_2 ie one haemoglobin can carry maximum 4 molecule of oxygen

* formation of Oxyhaemoglobin is an oxygenation process not oxidation process.
  * oxygenation means binding with haemoglobin while Oxidation means use of oxygen.
* when haemoglobin can get oxidised then it form methano globin. It is colourless stable compound.



* haemoglobin 1 gram can carry only
* 100 ml blood can carry maximum of 15 gm haemoglobin.
* Every 100 ml blood can carry 20 ml oxygen so O_2 carrying capacity is 20%.
* Total haemoglobin is 750g in our body
* 750 g that work as respiratory pigment in RBC

Transport CO_2.

1. 7% get dissolve in plasma
2. 20-25% attach with globin chain of haemoglobin having amine group
3. 70% combined with H_2O & form bicarbonate ions.

$$CO_2 + H_2O \xrightarrow[\text{Anhydrase enzyme}]{\text{carbonic } Zn} H_2CO_3 \xrightarrow{\text{carbonic acid}} HCO_3^- + H^+$$

Bicarbonate

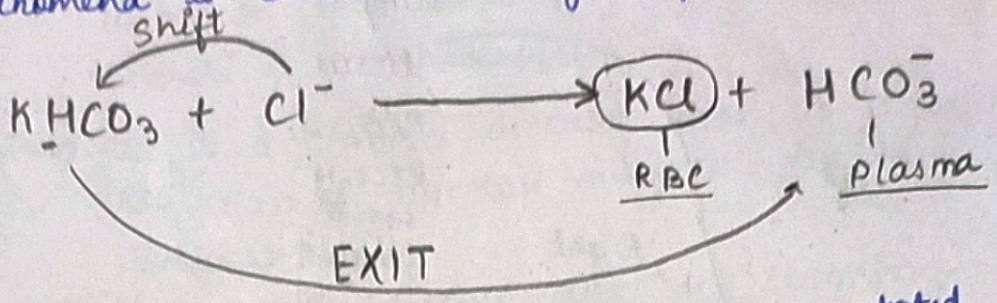
* carbamine haemoglobin formation condition

→ In RBC
- PCO_2 ↑
- PO_2 ↓
- Carbamino is unstable compound. ∞

→ In alveoli
- PO_2 ↑
- PCO_2 ↓
- then carbamino haemoglobin is dissociated & CO_2 release into alveoli

* This rec^n occur both in RBC & plasma.
* but in RBC it is 5000 time rapid or faster due to presence of enzyme carbonic anhydrase is an fastest known enzyme of this earth. if it contain Zn it rec^n ⇆ Reversible.
* for proper transportation of CO_2 & O_2 blood alkinity is need that is 7.4%.
* during transport of CO_2 blood protein act as buffer

* When much more bicarbonate in RBC & more Cl in plasma then chloride transport from plasma to RBC & bicarbonates transport from RBC to plasma & this is called chloride shift phenomena is called Hamburger phenomena.



→ due to chloride shift RBC of deoxygentated decrease & RBC of Oxygenated blood increases.

→ at alveolar site conc of PO_2 increases so dissolution of compound occur & it is called heldane effect.

→ every 100 ml of deoxygenated blood diliver 4ml CO_2 from CO_2 to lungs.

→ in this way sodium ion in plasma & HCO_3 in RBC become free. & form sodium bi carbonate.

$$NaCl \longrightarrow Na^+ + Cl^-$$

$$Na^+ + HCO_3^- \rightleftharpoons NaHCO_3$$

* MYOGLOBIN is also respiratory pigment found in muscle
* Iron containing pigment it can carry only on molec of O_2
* if affinity of ~~haemoglo~~ of O_2 is more than haemoglobin
* it is a ~~poi~~ poisonous molecules.
* during heavy workout pO_2 ↓ ie 15 to 20% so haemoglobin can diliver 75% O_2 ie 3 molecules of O_2 & rest of $1 O_2$ remain in tissue ie 25%.

* **Regulation of breathing:-**

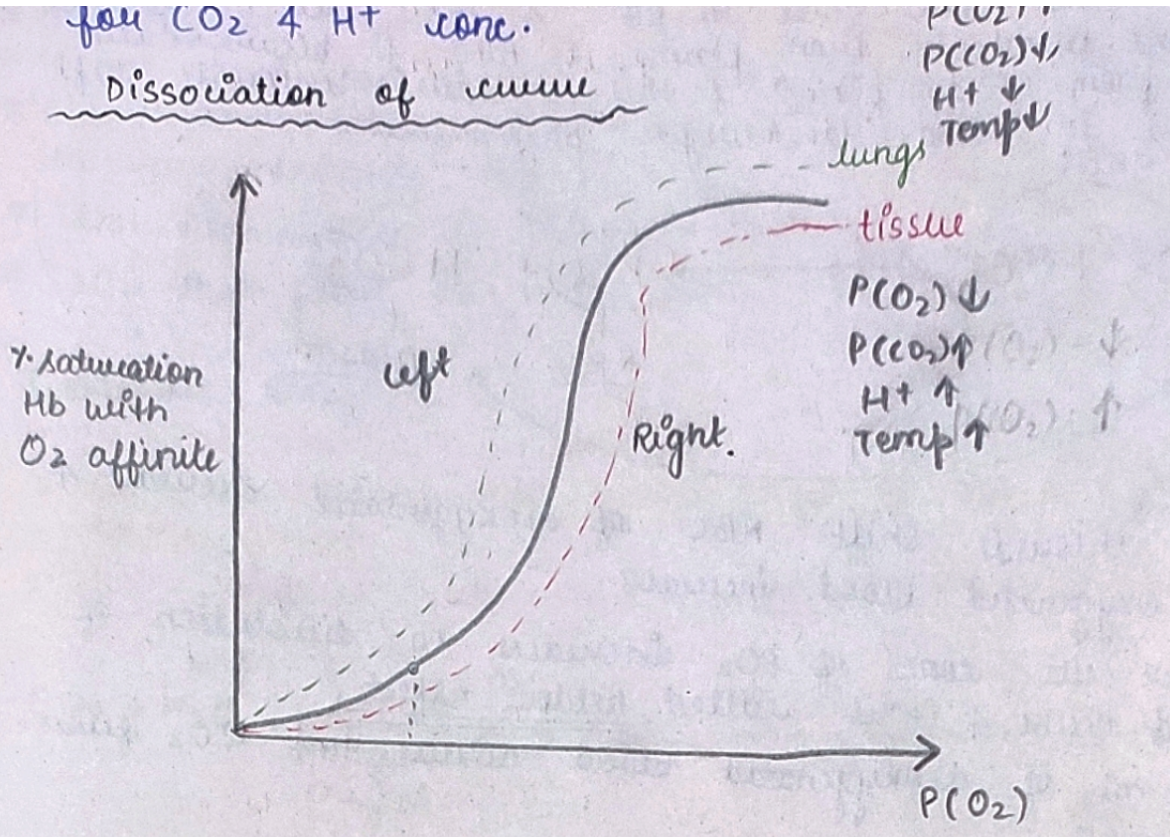
→ completed 3 centre

1. Respiratory rhythmic centre
2. Pneumatic centre
3. Chemosensative centre.

1. RRS found medulla of hind brain.
2. PC found pon's region hind brain.
   → It can reduce duration of inspiration so rate of breathing increase
3. KSA found in adjacent to the RS it is highly sensa

for CO_2 & H^+ conc.

Dissociation of curve



* O_2 dissociation curve plotted b/w % haemoglobin & PO_2 saturation with O_2
* DOC sigmoid graph.
* In DC right shifting represent tissue curve with oxygenation.
* While left shift represent lungs Oxygenation
* When PO_2 increase oxyhaemoglobin form so haemoglobin saturation increase
* When PO_2 decrease then %age of hb saturation decrease and Oxyhb dissociation occur.
* Shifting of curve toward leftside represents the more affinity of hb with O_2 so %age of hb saturation ↑ & that occur in lungs.

→ factor affect dissociation of Oxyhb or shifting curve toward Right

* high CO_2 conc
* low PO_2
* high H^+
* low PH value
* high temp
* high conc PGA.

Disorder of Lungs

Asthama:- It is an allergic disease. It is characterise by diffulti in breath that cause Weezing due to inflamation of bronchi & bronchioles Wall.

Emphisima:- It is a chronic disease that is characterise by Reduction of alveolar surface due to damage of alveolar wall.

→ It is mostly occur due to smoking.

ORD :- Occupational respiratory disorder

→ These disorder mainly occur in those person who are working grinding on stone breaking, yarn formation industries.

→ long exposure can give rise to leads to inflamation in fibrosis & cause severe lung disease.

Precautions

→ Should use protective mask as well as dust removal devices.