

Chapter = 14

Gaseous Exchange

GASEOUS EXCHANGE:

When O_2 is taken in and CO_2 is given out this process is called "Gaseous Exchange".

**RESPIRATION:**

When food molecule is oxidized with oxygen and converted into CO_2 and H_2O & by this process energy ATP is released this process is called Respiration.

VENTILATION:

The movement of air from the atmosphere into the lungs and back into the atmosphere is called "Ventilation".

RESPIRATORY SURFACE:

The surface where the exchange of gases takes place with its environment is "Respiratory Surface" our respiratory surface is alveoli.

CHARACTERS OF RESPIRATORY SURFACE:

MOIST: It must be moist to allow dissolved gases through them.

PERMEABLE: It must be permeable to gases like O_2 , CO_2 etc.

THIN: It must be thin to reduce the different distance.

LARGE SURFACE AREA: The respiratory surface should be large a/c to the body size b/c millions of alveoli want several folds of surface.

FUNCTIONS OF RESPIRATORY SURFACE:**SIGNIFICATION BLOOD SUPPLY:**

Respiratory surface supply oxygenated blood away from lungs and CO_2 rich blood back to lungs.

A-LARGE DIFFUSION GRADIENT:

For continuous breathing high concentration of oxygen in alveoli move to capillaries and CO_2 from capillaries to alveoli by diffusion.

RESPIRATORY SYSTEM OF MAN:

In man pulmonary respiration is present.

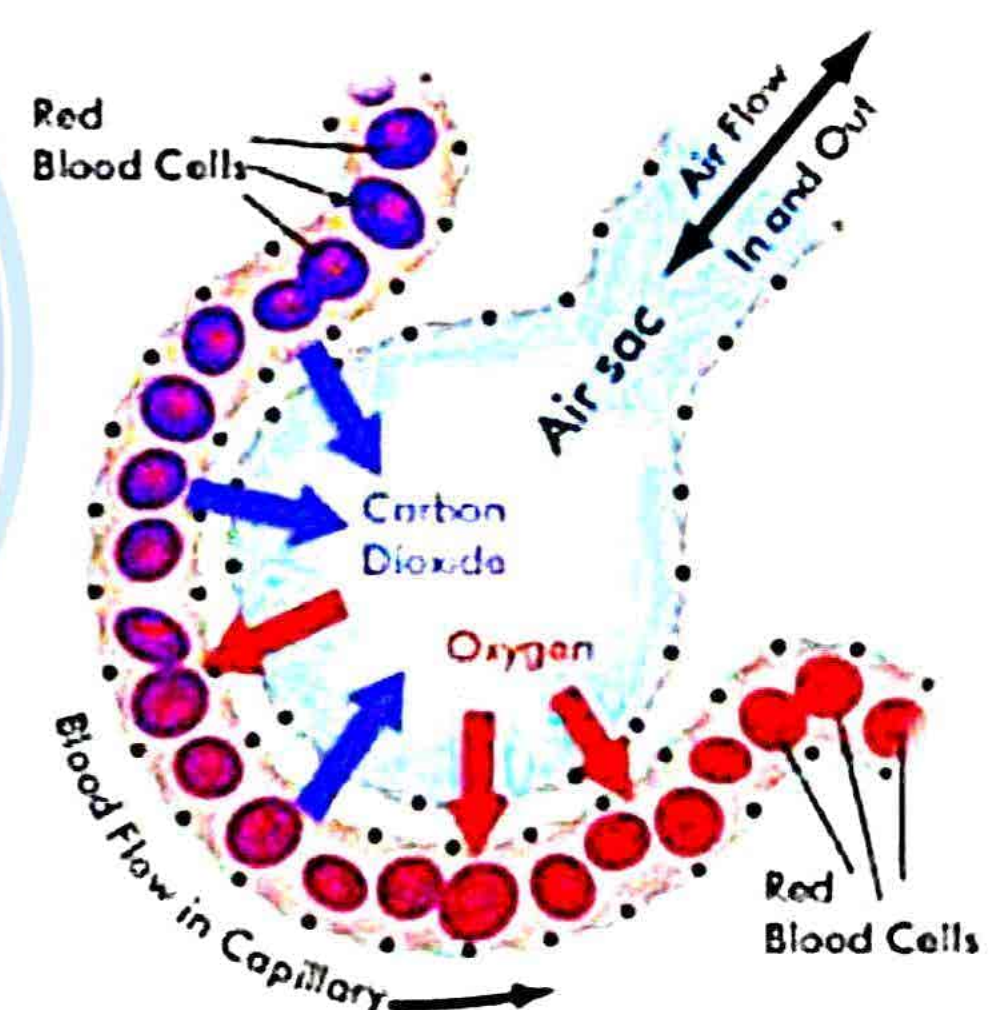
In man the organs which take part in the process are as follows.

a) UPPER RESPIRATION TRACT:

It includes.

- i. A pair of external nostrils
- ii. Nasal Cavities
- iii. A pair of internal nostrils
- iv. Pharynx.

An Alveolus (al-VEE-oh-lus)



b) LOWER RESPIRATORY TRACT:

It includes.

- i. Larynx ii. Trachea iii. Branchi.

UPPER RESPIRATORY TRACTS:

- External nostrils, Nasal cavity & Internal nostrils.
- During respiration air is enter into the nose through opening called External nostrils or Nares.
- Interiorly nose consist of nasal cavity, having two chamber and separated by cartilaginous nasal septum.
- These cavities have glands which moist the cavities. The nasal cavities open into the pharynx through Internal nostrils.

PHARYNX:

- It is Muscular tube about 13cm long & serve as common path way of respiratory and digestive system.
- It has opening Glottis which open into larynx and having valve called epiglottis.
- The volve prevent to enter food particles into the glottis.

UPPER RESPIRATORY TRACT:

- This is the upper part of Trachea and also called voic box, it have flap like pair tissues called Vocal cold They produce sound.

TRACHEA:

- Larynx leads into long tube called trachea about 10-11 cm long.
- It is externally covered by incomplete ring like C-shaped cartilaginous plate.
- It provide rigidily and prevent trachea collapsing.
- Internal Lining of trachea have cilia.

BRONCHI:

- The trachea runs through the neck when it enters the thorax.
- It divides into two branches, called bronchi. Each bronchi open into lungs of its own side.
- Each bronchi branched into smaller bronchioles, these bronchioles ends at the alveoli.
- Alveoli are air sac where gas exchanged b/w air and blood by a network of blood capillaries.

LUNGS:

- The lungs are two pink spongy organs & present in the thoracic cavity & bounded by ribs muscles called intercoastal coastal muscles.
- These muscles attached with a bony cage, made up of 12 pairs of ribs, vetetral column and sternum bones.
- Both lungs covered with thin membrane known as Pleuva in the cavity called pleural cavity.
- The pleura in thoracic region is called visceral pleural and in inside the chest wall called parietal pleura.
- Thorax and abdomen are separated by thin wall called diaphragm.
- Both lungs consist on smaller units called lobes.
- Three lobes are in right lungs called superior, middle and inferior lobes.
- Two Lobes are found in left lungs called superior & inferior lobes.

MECHANISM OF BREATHING: BREATHING (VENTILATION):

The movement of air from the atmosphere into the lungs and back into the atmosphere is called "Breathing or Ventilation".

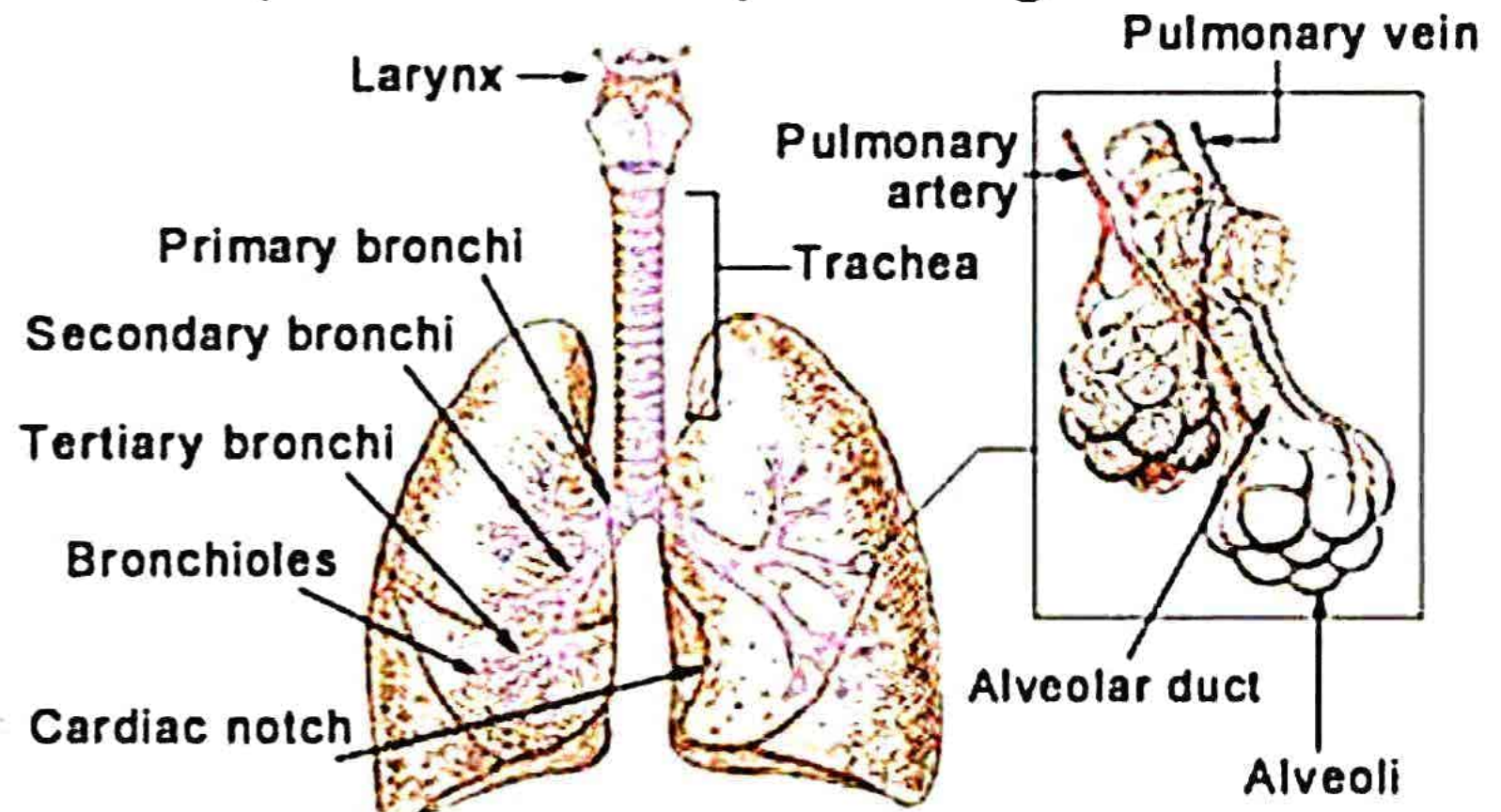
Breathing consists of two phases.

i. Inhalation or Inspiration

ii. Exhalation or Expiration

During the process of breathing the air is taken due to negative pressure i.e. air pressure in thoracic cavity is less as compared to atmosphere, so this type of breathing is called negative pressure breathing.

Bronchi, Bronchial Tree, and Lungs

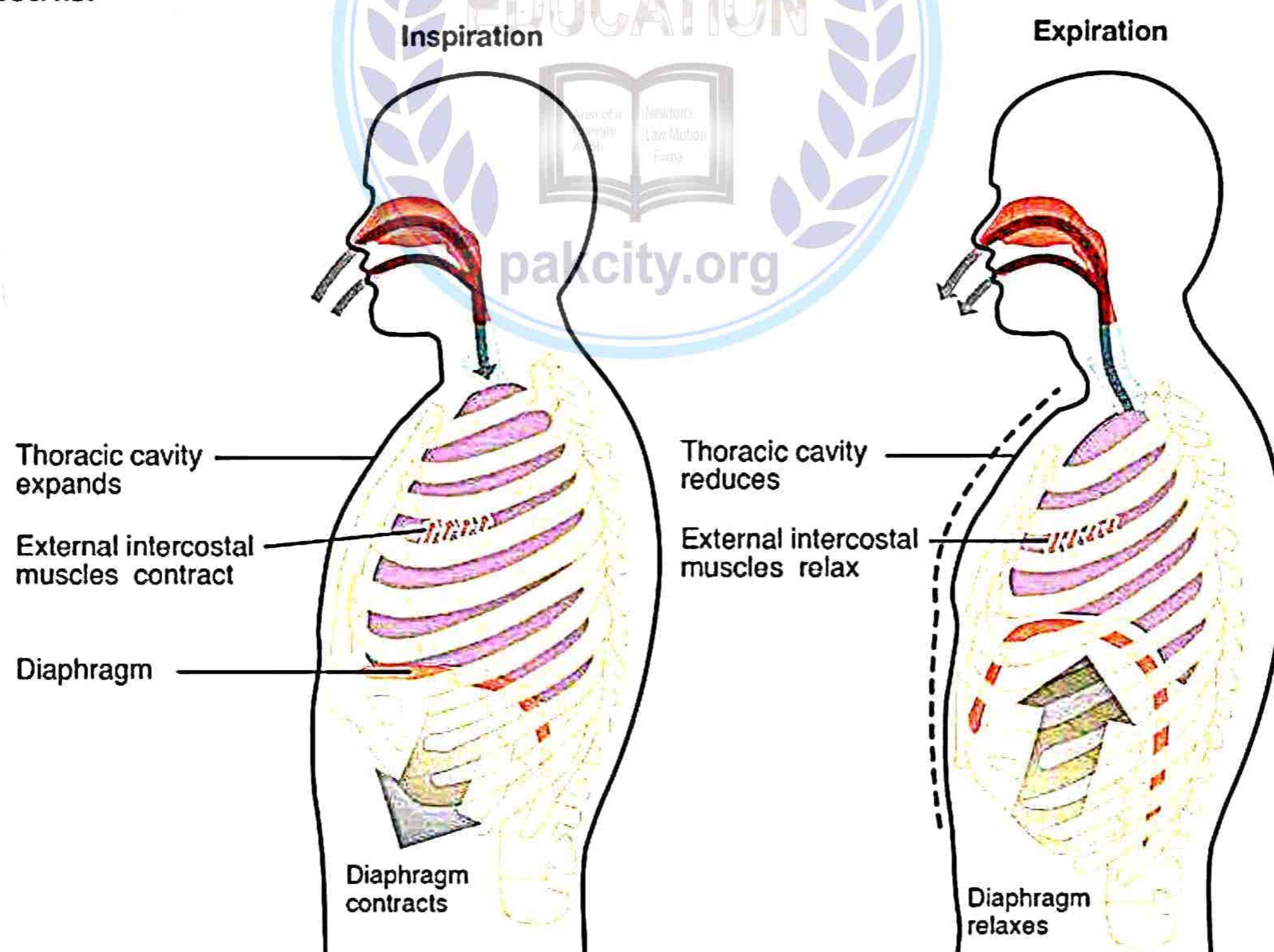


i. INHALATION OR INSPIRATION:

In this process the diaphragm moves downward and due to contraction of intercostal muscles the ribs move forward. In this way the pleural cavity increases in size, so lungs are expanded and air enters the body through external nostrils. It passes through the nasal cavity, pharynx, larynx, trachea, bronchi and fills several million alveoli of lungs. The oxygen diffuses into the blood running in the capillaries of alveoli. The oxygen combines with hemoglobin and CO_2 diffuses into the air.

ii. EXPIRATION:

After the exchange of gases the diaphragm moves upward and ribs move inward by the relaxation of inter-coastal muscles. The volume of thoracic cavity decreases due to which the lungs contract. The air is compressed and it is forced out of the lungs. It passes through the bronchioles, bronchi, trachea, external nostrils.



THE MAJOR FUNCTIONS OF THE RESPIRATORY SYSTEM:

The respiratory system performs the following major function.

OXYGEN SUPPLIER:

It provides a continuous supply of oxygen to all tissues.

WITHDRAWAL:

Removal of by-product, carbon dioxide (CO₂).

CONVERSATION OF GAS:

The mechanism of gas exchange between the internal and external environment of the body is regulate through respiratory surfaces.

HUMIDIFIER:

The respiratory system performs as a humidifier. It has the capability to humidify and keep the air warm which inhale from the external environment.

RATE OF BREATHING:

The person breath how much in every minute is called breathing rate.
In human being there are two types of breathing.

i. VOLUNTARY CONTROL BREATHING**ii. IN VOLUNTARY CONTROL BREATHING****i. VOLUNTARY CONTROL BREATHING:**

In this breathing, will power of man is involved. The man can hold breath for a short period of time.

ii. INVOLUNTARY CONTROL BREATHING:

It is automatic breathing. I cannot be controlled by coil. In this breathing there is a proper co-ordination of respiratory and cardiovascular system.

FACTORS OF RATE OF BREATHING: (MECHANISM OF CONTROL BREATHING):

The rate of breathing depends upon the concentration of CO₂ and (H⁺) ion in blood, and their concentration is controlled by chemo-receptor called aortic bodies and carotid bodies.

When the concentration of H⁺ and CO₂ increased the medulla oblongata quickly sends messages to inter-coastal muscles of ribs to increase the rate of breathing and when their concentration is less, automatically the rate of breathing decreased.

LUNG CAPITIES:

Respiratory volume is called Lung volume. Lung volume is measured by a special instruments spirometry.

- The lung of human have the capacity of about 6 Litre (6000 ml).

TIDAL VOLUME:

During normal breathing half of litre air (450 to 500 ml) is taken in & given out this is called Tidal volume.

VITAL VOLUME:

When deep breath is taken, the maximum volume of air coming in and giving out is called vital volume. It is about (5 Litre) or (5000 ml).

EXPIRATORY RESERVE VOLUME:

It is the amount of air which is energetically respire. It is about 1200 to 1500 ml.

**INSPIRATORY RESERVE VOLUME:**

It is the extra volume of air in lungs. It is about 2000 ml.

RESIDUAL VOLUME:

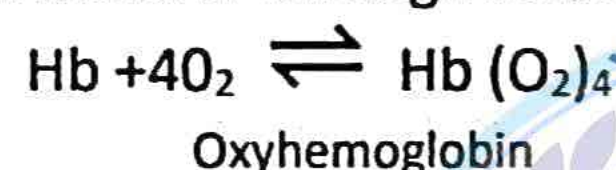
After breathing the remaining air in the lungs is known as. It is remain in the lungs about 1000 ml and cannot allow the thorax to collapse.

TRANSPORT ATOM OF GASES IN MAN:

The exchange of O₂ and CO₂ take place by simple diffusion.

TRANSPORT OF O₂:

- The inhaled air into lungs have high concentration of O₂ and oxygen transfer into blood capillaries around the alveoli.
- Now blood is oxygenated & converted into bright red colour.
- O₂ molecules attached to heamoglobin molecules of RBCs and form oxygen to all body cell..
- Diffuse oxygen oxidize food & release energy & CO₂.
- About 97% oxygen transfer through RBCs and 3% transported through blood plasma oxygen.

**TRANSPORT OF CO₂:**

There three ways to transport carbon dioxide into bloodstream.

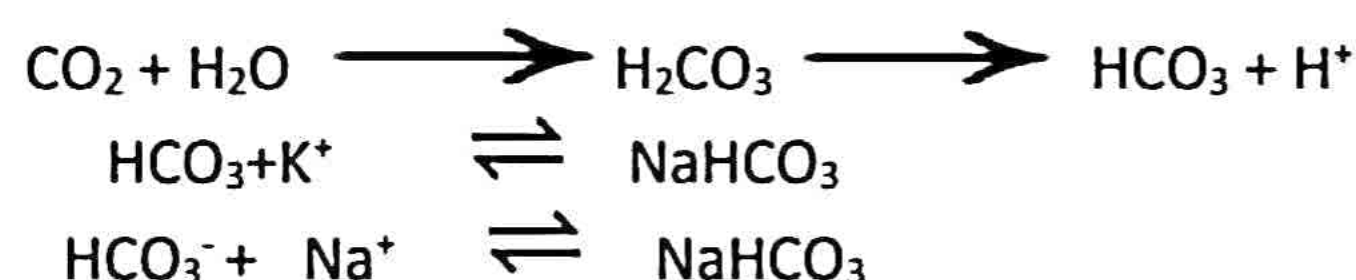
1. As dissolve gas.
2. As bicarbonate.
3. As carbaminohaemoglobin.

AS DISSOLVE GAS:

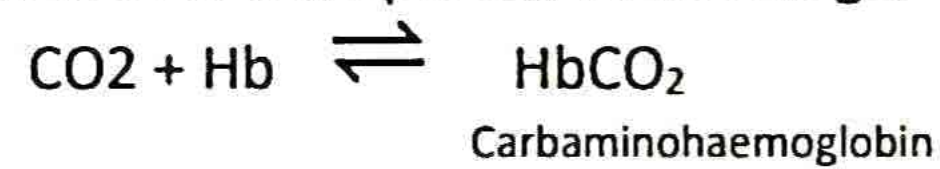
- When high concentration of CO₂ diffuses into blood, Now blood is deoxygenated & dark moroon in colour.
- CO₂ is transported by RBC's enzyme called carbonic anhydrase enzyme.

AS BICARBONATE:

- Carbonic anhydrase react with CO₂ and form Carbonic acid (H₂CO₃).
- Carbonic acid breaks into (H⁺) ion and bicarbonate (HCO₃⁻) ions.
- This bicarbonate ions combine with Na⁺ and K⁺ ion to form respective bicarbonate.

**AS CARBAMINOHAEMOGLOBIN:**

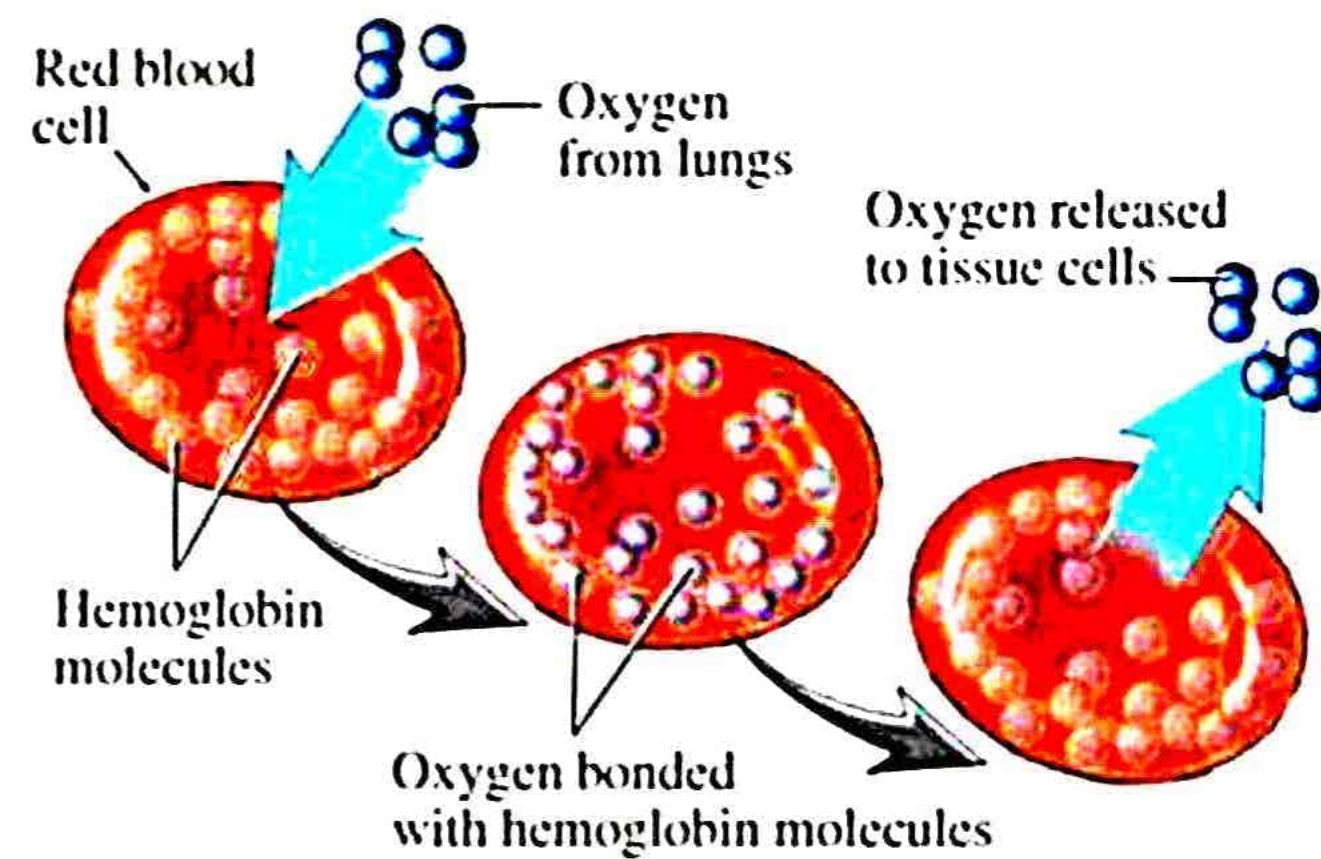
About 20% CO₂ combine with hemoglobin to form carbaminohaemoglobin & remaining 10% CO₂ dissolve in plasma of blood & then transported to the lungs.



ROLE OF TRANSPIRATORY PIGMENT:

ROLE OF HAEMOGLOBIN:

- It is red colour Iron containing protein in RBCs containing four iron group.
- Each Haemoglobin with four oxygen molecule & form oxyhaemoglobin.
- It is a bright red and undurable compound & transferred oxygen in the tissues.
- Haemoglobin rings back CO₂ from the tissues back to the lungs.



ROLE OF MYOGLOBIN:

- It is single globular protein and smaller than haemoglobin.
- It also absorb O₂ very strongly.
- The red colour of muscles is also due to Myoglobin.

SINUSES:

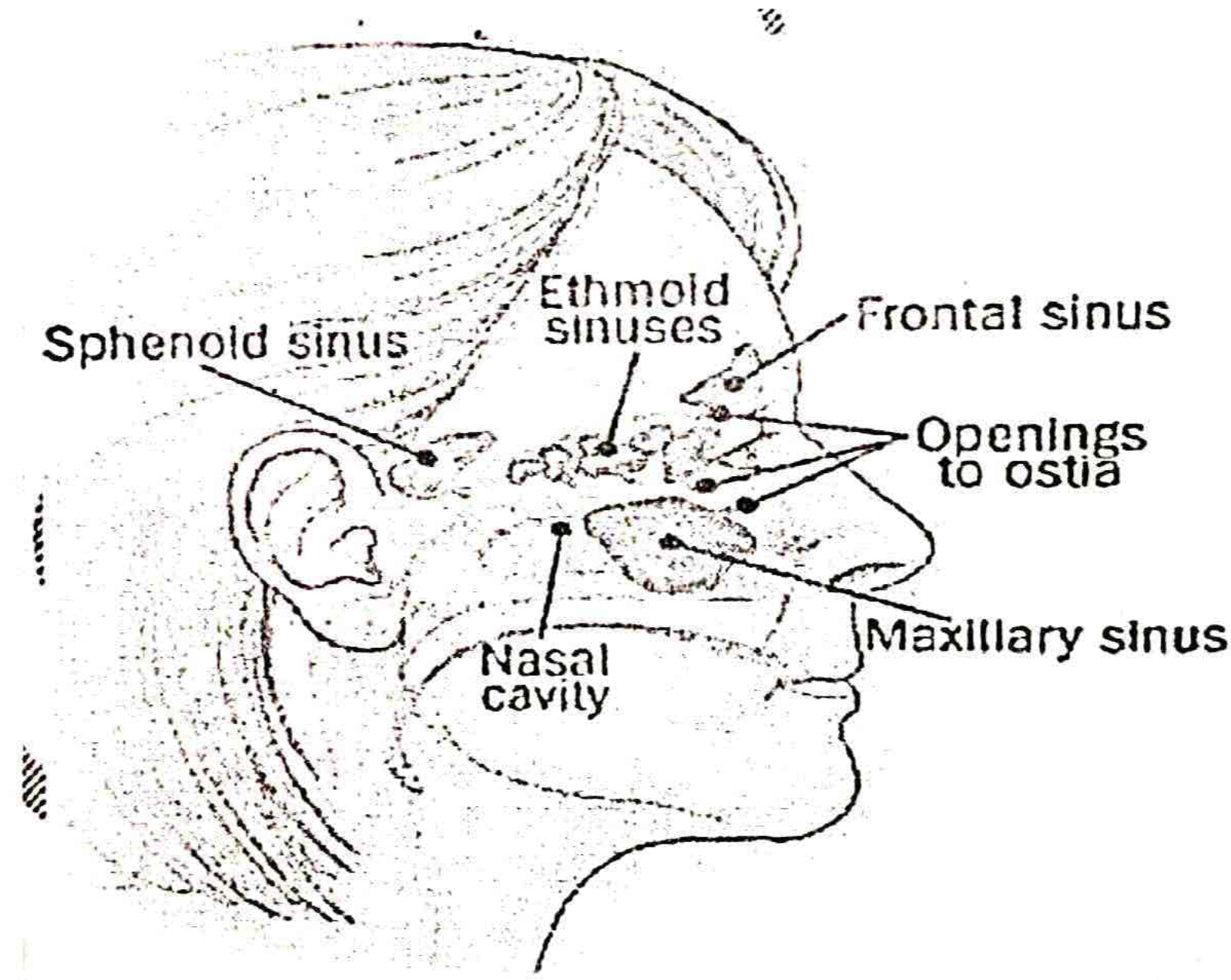
- A cavity within a bone & other tissue especially one in the bones of the face or skull connecting with the nasal cavities.

Human has four pairs of nasal cavities.

1. Frontal sinus, in the forehead region.
2. Maxillary sinus, in the behind cheeks.
3. Ethmoid sinus, between the eyes.
4. Sphenoid sinus, located in deep behind the ethmoids.

FUNCTION:

They connect nasal passage in a complex network of air flow and drainage passage. They also produce mucus that coats & lubricant nasal passages.



RESPIRATORY DISORDERS:

OPPER UPPER RESPIRATORY TRACT INFECTION:

SINUSITES:

It is inflammation of sinuses, sinuses are filled with fluid due to this it may harbor pathogen. Some reason of sinus blockage are:

- i. Common cold.
- ii. Allergic, rhinitis, swelling in the lining of nose.
- iii. Nasal polyps (Nose Lining small growth).
- iv. Nasal septum deviation causes dislocation of Nasal septum.

SYMPTOMS:

- Headache, fever, congestion, cough, tooth pain ear pain, eye pain & fatigue.

TREATMENT:

- Use steam and saline nasal spray to wash nasal passage.
- Consult physician.

OTITIS MEDIA:

- It is infection of middle ear.
- Cold, sore throate, upper respiratory infection can cause This infection result a failure of the Eustachian tube, this disease this tube maintain balance b/w outer and middle ear.

SYMPTOM:

Fever, unblacing, heaving, ear pain.

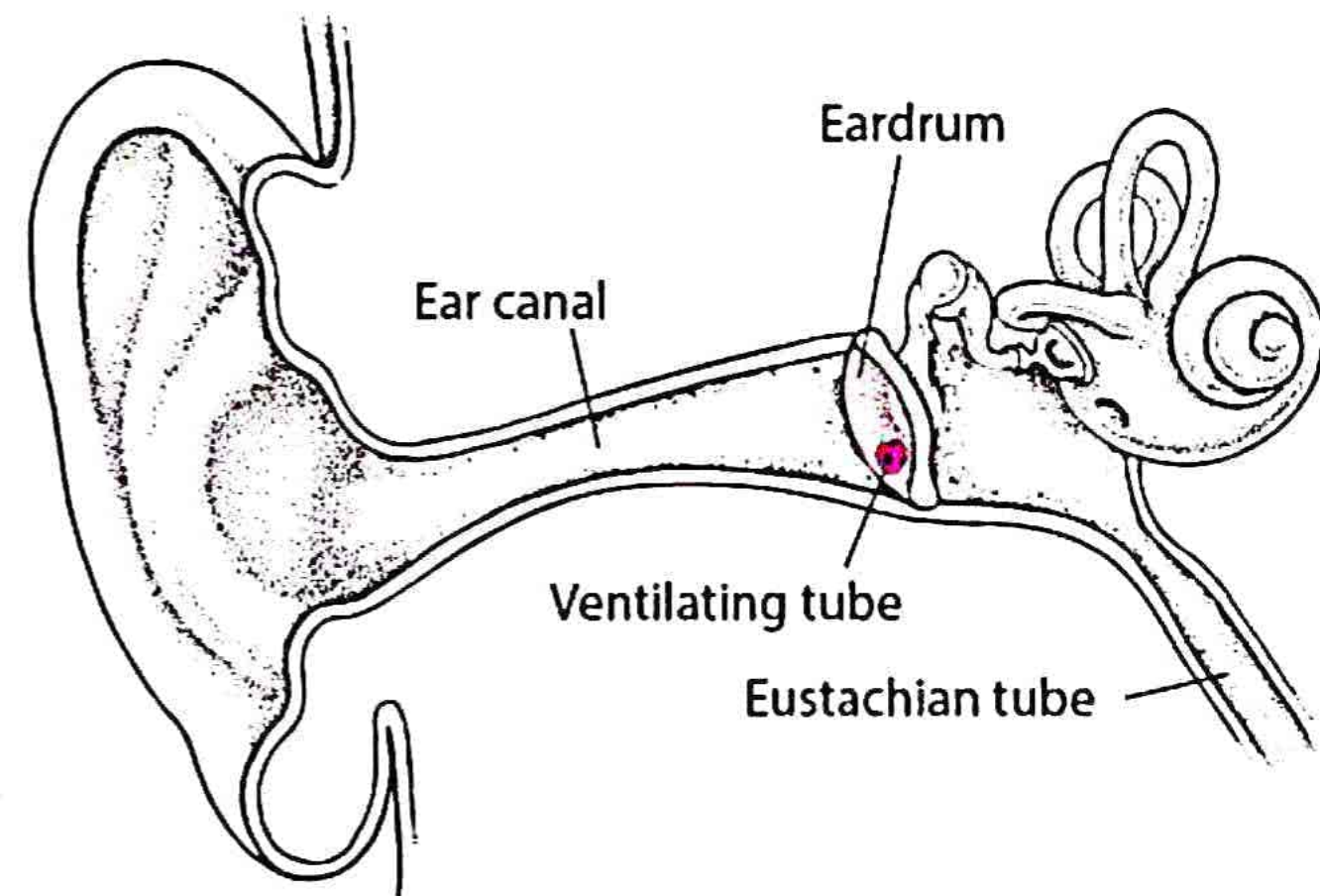
TREATMENT:

Usually antibiotic by ear drops can suggested by consultant.



LOWER RESPIRATORY:**PNEUMONIA:**

This infection due to number of virus, bacteria & fungi. In this infection alveoli filled with fluid. This infection may be Lobe pneumonia in lobes of lungs Bronchial pneumonia, patches appear in both lungs.

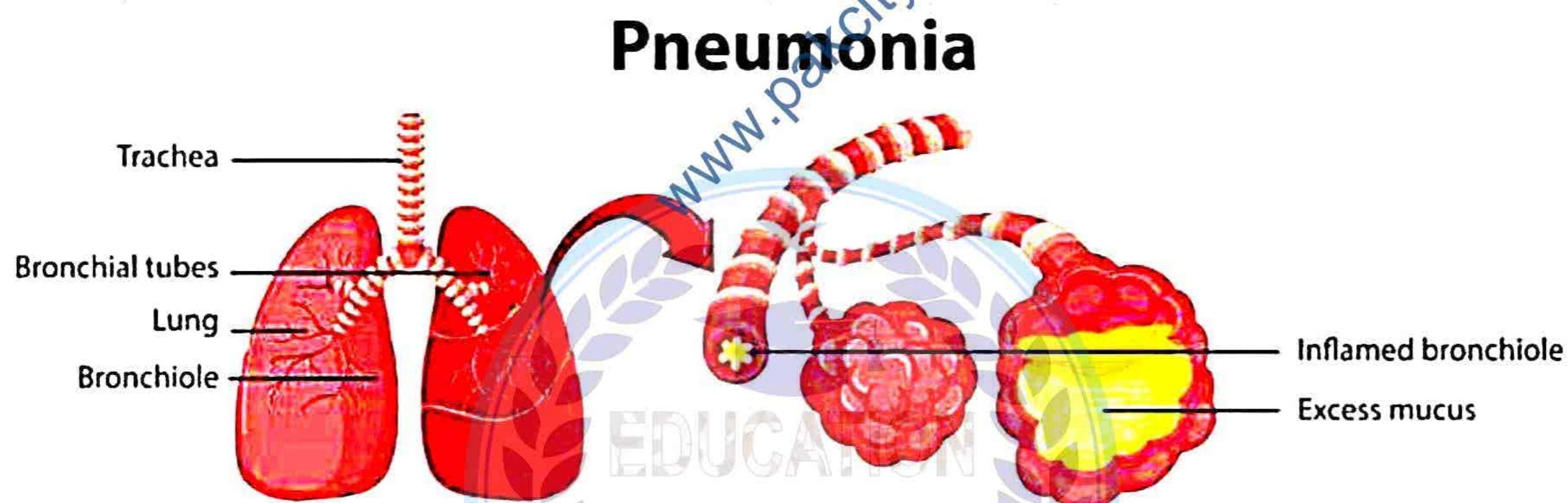
**SYMPTOMS:**

- Headache, fever with cough with bloody mucus.
- Lips and fingernail become bluish.
- Confuse mental state loss of appetite.
- Rapid and shortness of breath.
- In Mycoplasma pneumonia symptoms are acute cough with mucus.

TREATMENT:

In bacterial pneumonia use antibiotics, but antibiotic medication don't use in viral infection.

- Patient take Humidification and steamy bath for easy breathing.

**PULMONARY TUBERCULOSIS:**

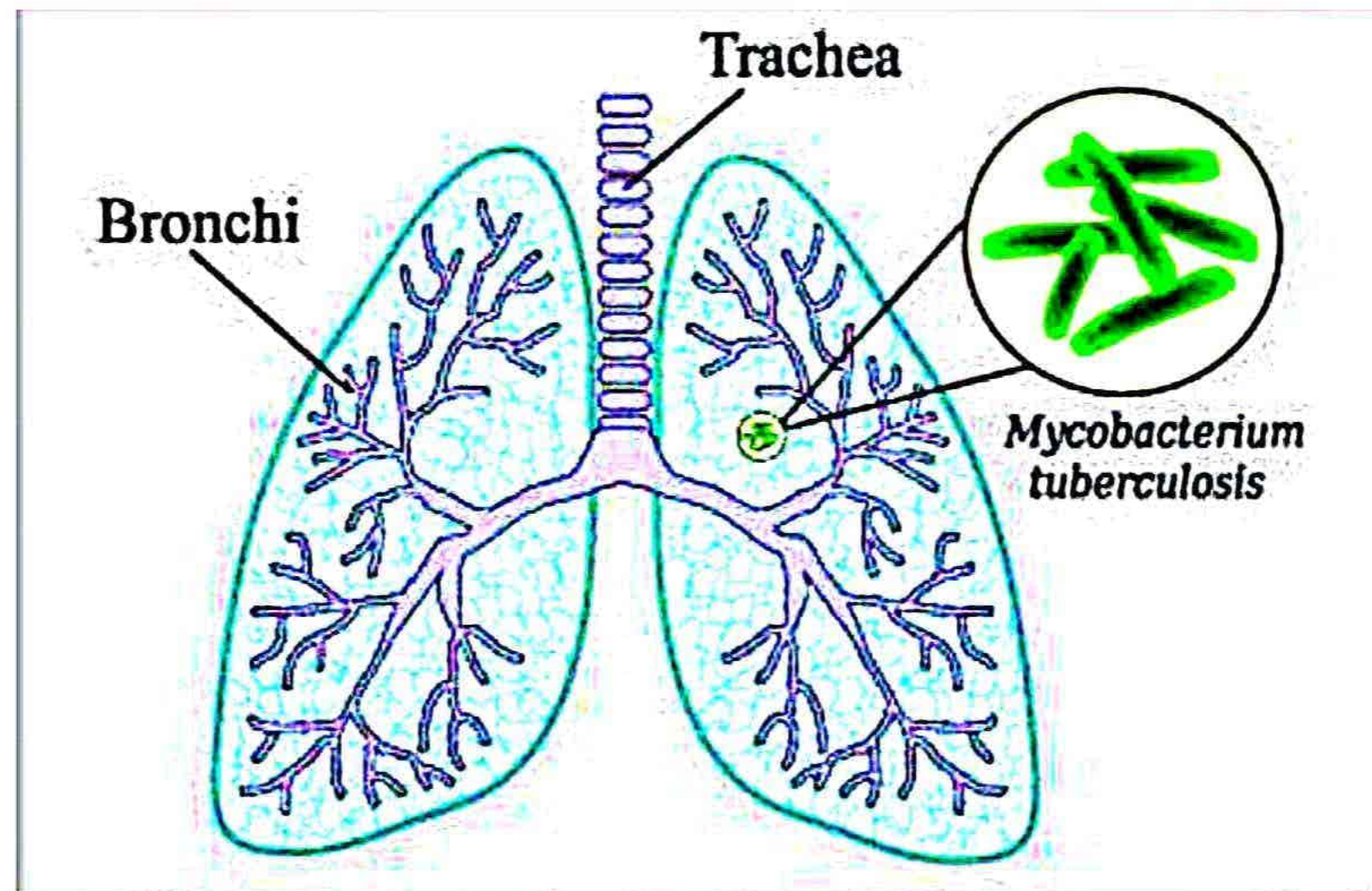
- It is bacterial chronic infection caused by Mycobacterium Tuberculosis.

SYMPTOMS:

- Cough with mucus (Phelgm) & blood.
- Low grade fever, chest pain, weight loss.

TREATMENT:

- Treatment of early pulmonary T.B is curable with antibiotics.
- Late treatment of patient may get life threatening situation.

**EMPHYSEMA:**

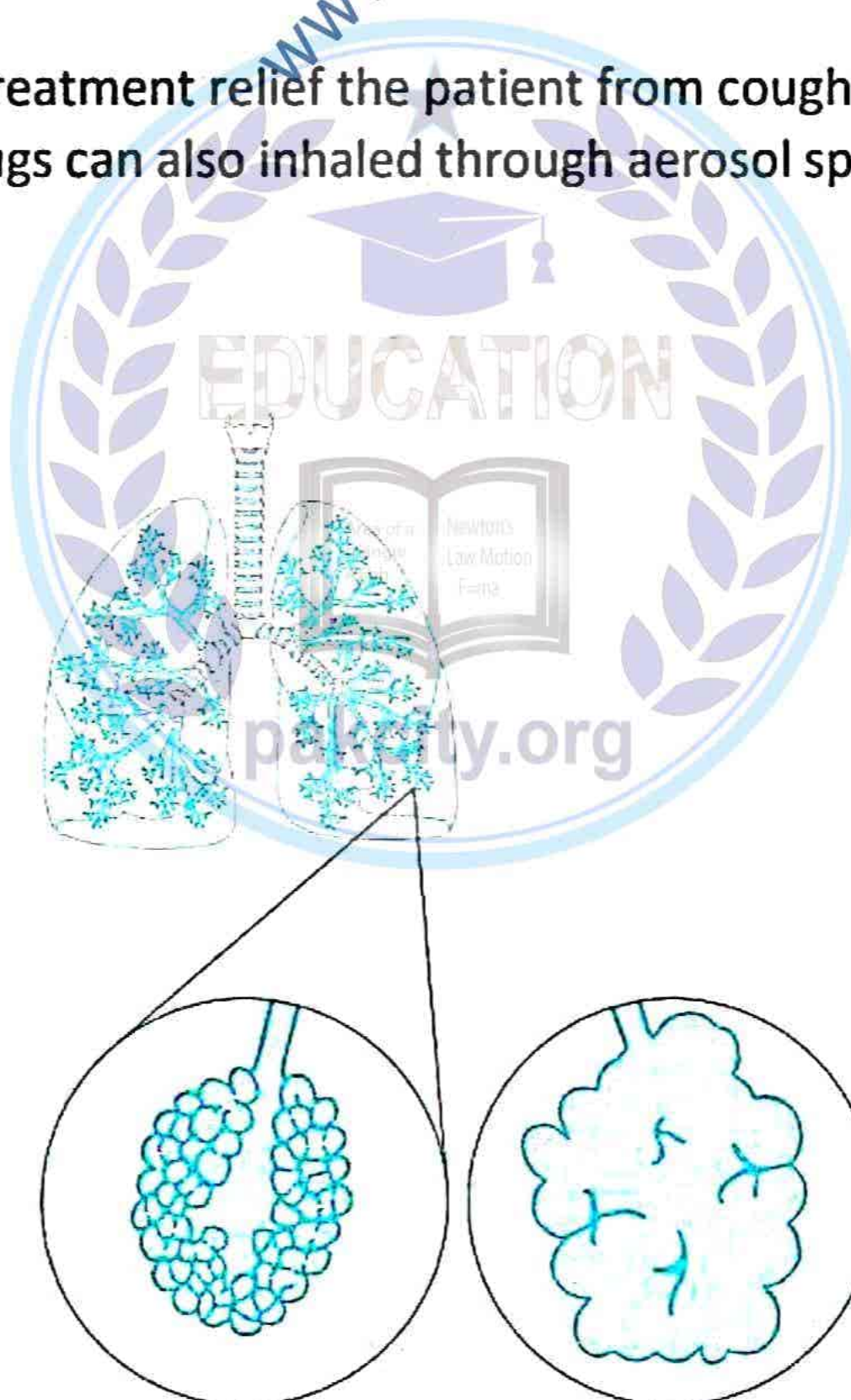
It is a disorder in which alveoli of lungs are damaged, & their cells are degenerated. It is known as chronic obstructive pulmonary disease (COPD).

SYMPTOMS:

- Initially patient have no symptoms but in later stage, shortness of breath, tightness of chest, frequent coughing and mucus produce with cough.
- Some people have cold & flue.
- In severe condition weakness in lower body muscles & weight loss.

TREATMENT:

- Bronchodilations medicinal treatment relief the patient from coughing and short breathing.
- Antibiotics & steroid type drugs can also inhaled through aerosol spray which reduce swelling and help in easy breath.

**LUNG CANCER:**

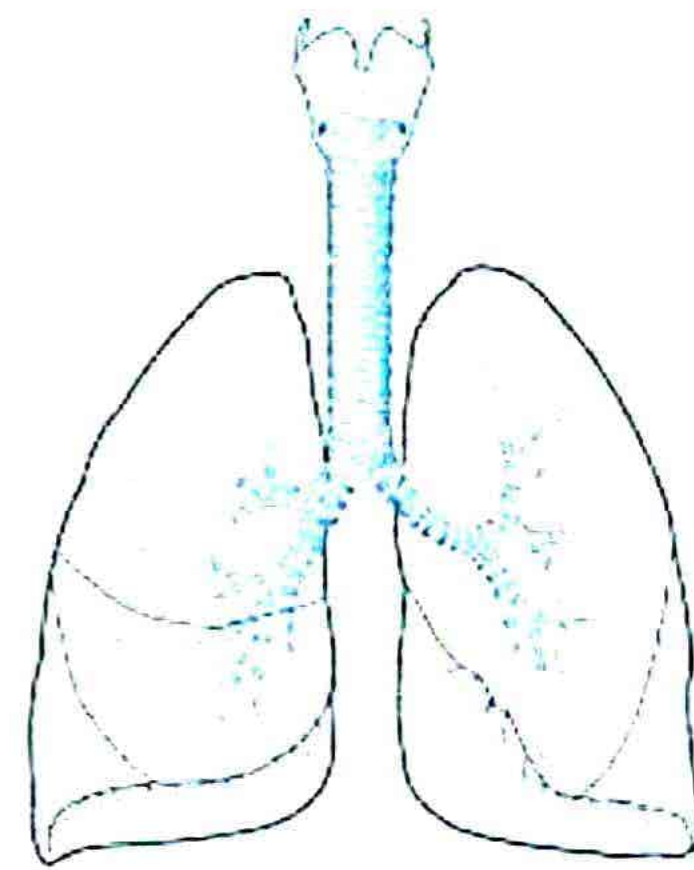
It is abnormal proliferation of affected tissues in lungs and mostly due to smoking.

SYMPTOM:

- Coughing with blood, chest infection.
- Pain when breathing.
- Persistent breathlessness and tiredness.

TREATMENT:

- Chemotherapy, radiation therapy, targeted therapy & surgery.

**SMOKING EFFECTS:**

- Smoking effects on larynx and tracheal passage irritation.
- Smoke contains Nicotine & SO₂ and may cause lung infection and damage alveoli.

REASONS:

Q1: Why Rate of breathing increase in human?

RATE OF BREATHING:

When concentration of CO₂ and H⁺ is increased, the Medulla oblongata quickly send messages to the intercostal muscles of ribs to increase the rate of breathing.

Q2: Why Breathing of human being called negative pressure breathing.

NEGATIVE PRESSURE BREATHING:

During the process of breathing the air is taken in due to negative pressure. i.e. in thoracic cavity the pressure decreased as compared to atmospheric pressure, this type of breathing is called negative pressure breathing.

Q3: Why muscles are red?

MUSCLES ARE RED:

In muscles a small globular protein Myoglobin is present, it binds oxygen more strongly & due to this Myoglobin the color of muscles become red.

Q4: Why do the walls of trachea not collapse when there is less air in it?

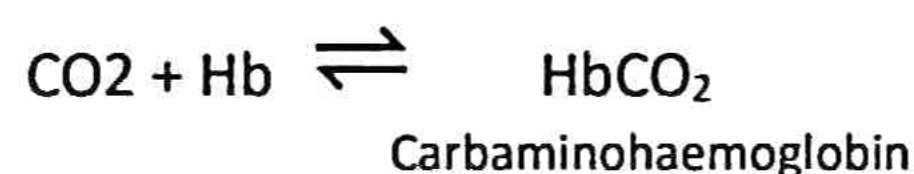
WALL OF TRACHEA:

The walls of trachea do not collapse due to presence of cartilage rings when there is less air in it.

Q5: Why the higher amount of carbon dioxide transport by RBCs as compared of water of plasma?

TRANSPORT OF CO₂:

B/c RBCs contain an enzyme carbonic anhydrase which facilitate the reaction b/w carbon dioxide water.



Q6: Why air is better respiratory medium than water?

AIR AS RESPIRATORY MEDIA:

B/c air is less denser and contains more oxygen than water so air is better respiratory medium.

Q7: Why haemoglobin transport in oxygen?

ROLE OF HAEMOGLOBIN:

B/c each haemoglobin contain four iron groups which has ability to combine with four oxygen molecules.

Q8: How CO₂ can transported from cell to lungs?

CO₂ TRANSPORTED FROM CELL TO LUNGS:

CO₂ diffuse from cells to blood and transported by three ways:

- As bicarbonate 70% of CO₂ is transported by the water of RBC in the presence of carbonic anhydrase.
- AS Carbamino hemoglobin 20% CO₂ combine with combine with Hb and form carbaminohaemoglobin.
- As dissolved gas 10% CO₂ dissolve in plasma water of blood and transported to lungs.

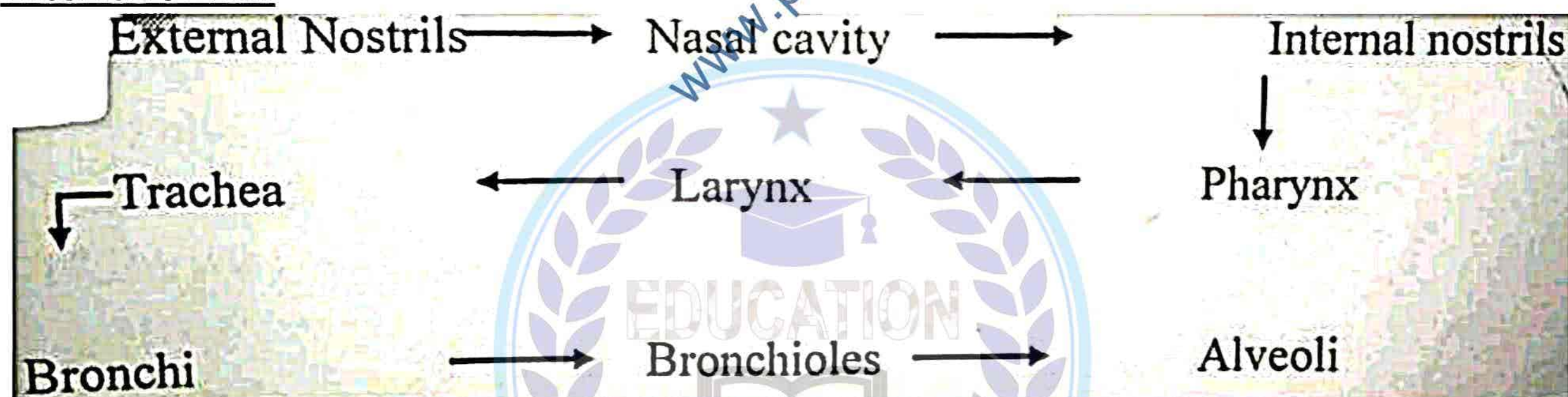
Q9: Which of the pigment is called respiratory pigment?

RESPIRATORY PIGMENT:

(Hb) hemoglobin is called respiratory pigment because it is mainly involved in the transport of oxygen from lungs to tissues. Hb is present in the RBC of all vertebrates. Each Hb molecule is able to transport 04 O₂ molecules by forming oxyhaemoglobin.

Q10: Draw a flow chart for the passage of air from external waves to alveoli?

PASSAGE OF AIR:



Q11: How exchange of gases occur at the alveoli level?

EXCHANGE OF GASES:

Exchange of gases occurs in the alveoli by simple diffusion process. Oxygen diffuse across the alveoli into blood by simple diffusion because the blood is O₂ deficient on the other hand CO₂ diffuse into alveoli from the blood because the concentration of CO₂ is high in blood.

Q12: Why hair and mucus glands are present in nostrils and trachea?

MUCUS GLANDS PRESENT IN NOSTRILS AND TRACHEA:

The hairs of nasal cavity and its ciliated cells trap the dust particles and decontaminate the gas. Mucus also traps smaller particles like pollen or smoke.

Q13: What type of ventilation occur in human?

TYPE OF VENTILATION:

Human have pulmonary ventilation which is commonly called breathing. It is completed in 02 steps.

- Inhalation:** In which air is taken from atmosphere.

ii. **Exhalation:** in which CO_2 is given out from alveoli to atmosphere.

Q14: When breathing develop in animals?

BREATHING DEVELOP:

Pneumodesmus newmani (millipede) which was thought to have been breathing air on solid ground during the late Silurian period

