

RESPIRATION

Key Concepts

- 14.1 Properties of respiratory surfaces
- 14.2 Human respiratory system
- 14.3 Lung volumes and capacities
- 14.4 Control of breathing
- 14.5 Mechanism of transport of gases
- 14.6 Respiratory pigments:
- 14.7 Respiratory disorders

EXERCISE

SECTION I: Multiple Choice Questions

Select the correct answer from the following choices.

1. When blood leaves the capillary bed most of the carbon dioxide is in the form of:
 - (a) carbonate ions
 - (b) bicarbonate ions
 - (c) hydrogen ions
 - (d) hydroxyl ions
2. When you inhale, the diaphragm?
 - (a) relaxes and moves upward
 - (b) relaxes and moves downward
 - (c) contracts and moves upward
 - (d) contracts and moves downward
3. With which other system do specialise respiratory systems most closely interface in exchanging gases between the cells and the environment?
 - (a) the skin
 - (b) the excretory system
 - (c) the circulatory system
 - (d) the muscular system
4. Which of the following is the respiratory surface in human respiratory system?

- 5. How is most of the oxygen transported in the blood?**
(a) dissolved in plasma (b) bound to haemoglobin
(c) as bicarbonate (d) dissolved in water
- 6. The lateral walls of the chest cavity of man are composed of the:**
(a) ribs
(b) intercostals muscles
(c) ribs, intercostals muscles
(d) ribs, intercostals muscles and diaphragm
- 7. Which of the following factors is the most effective in accelerating the rate of breathing in man?**
(a) a lack of oxygen in the blood
(b) a lack of oxygen in the tissues
(c) an excess of carbon dioxide in the lungs
(d) an excess of carbon dioxide in the blood
- 8. Which of the following changes will increase the bodys rate of carbon dioxide excretion into the alveoli?**
(a) holding the breath
(b) the breakdown of alveolar tissue as a result of disease
(c) a decrease in the partial pressure of carbon dioxide in the alveolar air
(d) a decrease in the pulmonary circulation
- 9. Breathing is an example of:**
(a) counter current exchange (b) cellular respiration
(c) ventilation (d) diffusion
- 10. Which event is not associated with the activity of expiration?**
(a) contraction of diaphragm (b) more dome like shape of diaphragm
(c) backward and downward movement of rib cage
(d) Relaxation of external intercostals muscles
- 11. Respiratory pigments:**
(a) combine reversibly with only oxygen
(b) all have four haem groups
(c) attach to the alveolar wall
(d) none of them
- 12. Which sequence most accurately describes the sequence of airflow in the human respiratory system?**
1. pharynx 2. Bronchus 3. Trachea 4. Larynx 5. Alveolus 6. Bronchiole
(a) 4, 1, 3, 2, 5, 6 (b) 1, 4, 3, 2, 5, 6
(c) 4, 1, 3, 2, 6, 5 (d) 1, 4, 3, 2, 6, 5

(c) tidal volume

(d) vital volume

14. Pulmonary emphysema:

(a) characterised by loss of elasticity of the alveolar walls

(b) results from bacterial infection

(c) results from bronchial constriction

(d) is uncommon in cigarette smokers

Answer

1	(b)	2	(d)	3	(c)	4	(d)	5	(b)
6	(c)	7	(a)	8	(c)	9	(c)	10	(a)
11	(d)	12	(d)	13	(c)	14	(d)		

SECTION II: Short Questions**Give short answers of the following questions.**

Q1. List any two properties of respiratory tract that help to trap dust particles and microbes in inhaled air.

Answer

- i) **Hairs:** present inside the nostrils
- ii) **Mucous membrane:** Inside the nose secretes a sticky substance called mucus.
- iii) **Cilia:** Originate from internal lining of nasal cavity filter the air and prevent the entry of foreign particles such as micro-organisms, dust and particulate matter inside the respiratory system.

Q2. List the properties of respiratory surface.

Answer**Properties of Respiratory Surfaces**

The area where gaseous exchange with the environment actually takes place is called the respiratory surface. Gaseous exchange takes place in all organisms by the physical process of diffusion. For effective diffusion the respiratory surface must have the following properties.

- It must be permeable, so that gases can pass through it.
- It must be thin for efficient diffusion, because diffusion is only efficient over distance of 1 mm or less.
- It should possess a large surface area so that sufficient amounts of gases are able to be exchanged according to the organism's need.
- It should possess a good blood supply.
- There should be a good ventilation mechanism to maintain a steep diffusion gradient across the respiratory surface.

Q3. What organs constitute the respiratory system?

Answer

- i) Nose ii) Nasal cavity iii) pharynx iv) larynx
 v) trachea vi) bronchi viii) bronchioles ix) Alveoli
 x) Lungs

Q4. How nose and nasal cavity function in filtering incoming air?

Answer

Nose

The nose is only externally visible part of the respiratory system. The structure of a human nose is composed of bones, cartilage and fibro fatty tissues. The external feature of a nose depends upon the ethmoid bone and the cartilages.

Hairs are present inside the nostrils that help in the filtration of air. Hence, nose hair serve as a defense mechanism against the harmful pathogens and solid particulate matter present in the air. Both the nostrils and nasal cavities are lined by mucous membranes along with cilia. The mucous membrane secretes a sticky substance called mucus. The mucus and cilia filter the air and prevent the entry of foreign particles such as microorganisms, dust and particulate matter inside the respiratory system. The mucus also helps in moistening the air. Cilia move the trapped substances to the pharynx for their removal.

Q5. How lungs contract and relax?

Answer

Humans have two lungs, a right and left, which are located in the thoracic cavity.

The lungs neither draw in air nor push it out the diaphragm, abdominal muscles and the intercoastal muscles provide help in contraction and relaxation of lungs.

Q6. Differentiate between haemoglobin and myoglobin.

Answer

Haemoglobin		Myoglobin	
1	It consists of four polypeptide chain.	1	Consists of one polypeptide chain.
2	Each molecule possesses four iron containing haem groups.	2	Each molecule possesses one iron containing haem group.
3	Four oxygen molecules can bind to each haemoglobin molecule.	3	Only one oxygen molecule can bind to each myoglobin molecule.
4	It is found in RBCs.	4	It is found in muscles.
5	It transports oxygen.	5	It stores oxygen.
6	It has less affinity with oxygen.	6	It has more affinity with oxygen.
7	It loses oxygen at PO_2 60 mmHg.	7	It loses oxygen at PO_2 20 mmHg.

Q7. What is the role of respiratory pigments?

Answer

A respiratory pigments molecule that involves in transport or storage of respiratory gases. In humans haemoglobin that increases the oxygen carrying capacity of blood and

Q8. Define oxygen carrying capacity and list the factors that affect upon it.

Answer

The ability of haemoglobin to bind with oxygen is called oxygen carrying capacity of blood.

Factors

Following are the factors which affect oxygen carrying capacity of haemoglobin:

- i) Partial pressure of oxygen PO_2 and carbon dioxide PCO_2
- ii) Amount of haemoglobin
- iii) Body temperature fluctuations
- iv) Drop in pH of blood

Q9. Differentiate between sinusitis and otitis media.

Answer

Sinusitis

Sinusitis is an inflammation of the nasal sinuses that may be acute (symptoms last 2 – 8 weeks) or chronic (symptoms last much longer). The sinuses are holes in the skull between the facial bones.

Otitis media

Otitis media is an inflammation of middle ear (a cavity between the ear drum and the inner ear). Inflammation of the middle ear causes the Eustachian tubes to close causing the fluid to become trapped. Bacteria from the back of nose travel through the Eustachian tube directly into the middle ear cavity and multiply in the fluid. Otitis media that fails to clear up after three months or more is called chronic otitis media.

Q10. What is chloride shifts or Hamburgers phenomenon?

Answer

The phenomenon of balancing of ions in two opposite directions by the help of proteins, which result in maintainance of balance of ions on either side is called shifts or Hamburgers phenomenon.

For example from inside the erythrocytes (RBC) negatively charged HCO_3^- ions diffuse to plasma. This is balanced by the diffusion of the chloride ions (Cl^-), in opposite direction. This is achieved by special bi-carbonate-chloride carrier proteins that are present in RBC membrane.

Q11. What is the amount of oxygen contained by each 100 ml of arterial and venous blood?

Answer

Maximum oxygen carrying capacity of arterial blood is 20 ml / 100 ml of blood (100% saturation) which is achieved at 100 ml mmHg PO_2 . This is because the amount of haemoglobin is 15 gms/100 ml of blood but in our body each 100 ml/of arterial blood contains 19.4 ml of oxygen (97% saturated so PO_2 is 97 mmHg.

While 100 ml of venous blood contains 14.4 ml O_2 (75% saturated) So PO_2 is 40

Q12. What is spirometry?**Answer**

Spirometry is the process of measuring volumes of the air that moves into and out of the respiratory system and a spirometer is a device to measure these pulmonary volumes.

Q13. Define pneumonectomy and resuscitation.**Answer****Pneumonectomy**

To avoid spreading of lung cancer in healthy part of lungs and operation is done to remove a lobe or the lung completely before secondary growths have time to form. This operation is called pneumonectomy.

Resuscitation

Mouth to mouth artificial respiration is called resuscitation.

Q14. How can we prevent the spread of tuberculosis?**Answer**

The spread of TB can be controlled by some preventive measures like:

- 1) Living room should be well ventilated and bright.
- 2) Always cover the mouth with cloth during coughing and sneezing.
- 3) Avoid spitting openly.
- 4) Always bury or burn the sputum of patient.
- 5) The patients should spit in a utensil with lime powder to prevent the spread of disease.
- 6) The use of masks and other respiratory isolation procedures to prevent spread to medical personal is also important.

Q15. What are the causes of lung cancer?**Answer**

Smoke is a main cause of lung cancer because tobacco smoke contains many carcinogens (Cancer causing substance). In addition to this, asbestos, arsenic radiation such as gamma and x-ray, the sun and compounds in car exhaust fumes are all examples of carcinogens.

Q16. What are the advantages of having millions of alveoli rather than a pair of simple balloon like lungs?**Answer**

- i) The alveoli form the gas exchange surface.
- ii) The wall of each alveolus is only 0.1 μm thick.
- iii) On outside the alveoli there is a dense network of blood capillaries.
- iv) Living of each alveolus is moist which increase the absorption ability of alveolus.

It is estimated that there are over 700 million alveoli present in the lungs, representing a total surface area of 70-90 m.

Answer

In between alveoli gaps/spaces are present called alveolar spaces, which contain special W.B.C called scavenger cells. These macrophages engulf the foreign material which enters in lungs through the airways. When smoke with many impurities is inhaled, the alveolar spaces of smokers containing scavenger cells that are filled with engulfed particles of impurities and debris, become gray/black.

SECTION III: Extensive Questions

Q1. Describe the main structural features and functions of the components of human respiratory system.

Answer**Respiratory System of Man**

The body system which is responsible for the exchange of gases between body fluid and outer environment is called **respiratory system**. The human respiratory system can be divided into two regions, upper respiratory tract and lower respiratory tract.

Upper Respiratory Tract

The upper respiratory tract includes nostrils, nasal cavity and pharynx.

Nose

The nose is only externally visible part of the respiratory system. Human nose is composed of bones, cartilage and fatty tissues. The external openings of nose are called nostrils and the inner hollow spaces are called nasal cavities. There are two nasal cavities which are partitioned by means of nasal septum (the part of nasal bone). The anterior parts of nasal cavities near the nostrils are called vestibules which contain a network of hairs. Both the nostrils and nasal cavities are lined by mucous membrane alongwith cilia.

Nose hairs, mucus and cilia serve as a defence mechanism against the harmful pathogens and solid particulate (relating to particles) matter present in the air. The mucus and cilia filter the air and prevent the entry of foreign particles such as microorganisms, dust and particulate matter inside the respiratory system. The mucus also helps in moistening the air. Cilia move the trapped substances to the pharynx for their removal. Underneath the mucous membrane, there are blood capillaries that help to warm the air to about 30°C, depending upon the external temperature.

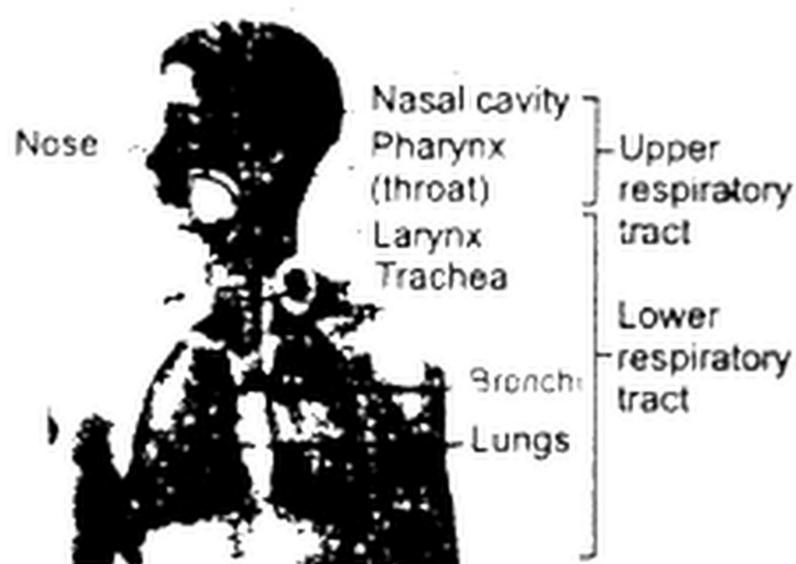


Fig. Human respiratory tract

Pharynx

Pharynx is cone-shaped passageway leading from the oral and nasal cavities to the esophagus and larynx.

The pharynx is part of the digestive system and also the respiratory system. It is also important in vocalization. The human pharynx is conventionally divided into three sections: the nasopharynx, the oropharynx, and the laryngopharynx.



Lower Respiratory Tract

The lower respiratory tract includes the larynx, trachea, bronchi and lungs.

Larynx

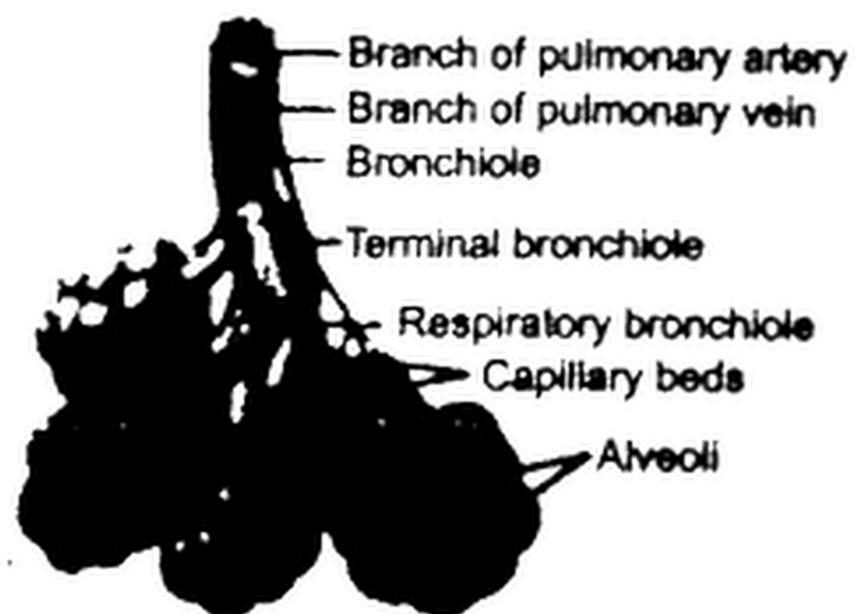
The larynx (voice box) is composed of an external skeleton of cartilage plates that prevent collapse of the structure. The plates are fastened together by membranes and muscle fibres. The front set of plates, called thyroid cartilage, has a central ridge and elevation commonly known as the Adams apple. The plates tend to be replaced by bone cells beginning from about 20 years of age onward. Two fibrous bands called vocal cords are located in the larynx. The vocal cords are composed of twin infolding of mucous membrane stretched horizontally across the larynx. Larynx serves for dual function: as an air canal to the lungs and controller of its access, and the organ of phonation (voice production).

Trachea

The trachea or windpipe is a membranous tube. It consists of dense regular tissue and smooth muscle reinforced with 15-20 C shaped pieces of cartilage. The trachea has an inside diameter of 12mm and a length of 10-12 cm. It descends from the larynx to the level of the 5th thoracic vertebra.

Bronchi and Bronchioles

The trachea divides to form two smaller tubes called **primary bronchi**. The primary bronchi divide into secondary bronchi with each lung. There are two secondary bronchi in the left lung and three in the right lung. The secondary bronchi, in turn, give rise to tertiary bronchi. The bronchi continues to branch, finally giving rise to bronchioles which are less than 1mm in diameter. The bronchioles also subdivide several times to become



cartilages are replaced with cartilage plates but the bronchioles and their terminal branches have no cartilage structures.

Alveolar Ducts and Alveoli

The terminal bronchioles divide to form respiratory bronchioles. The respiratory bronchioles give rise to alveolar ducts. These alveolar ducts contain tiny air filled chambers called alveoli which are the sites of gas exchange between the air and the blood. There are over 700 million alveoli present in the lungs, representing a total surface area of 70-90m². The wall of each alveolus is only 0.1 μm thick. On its outside is a dense network of blood capillaries. Lining each alveolus is moist squamous epithelium. This consists of very thin, flattened cells, reducing the distance over which diffusion must occur. Collagen and elastin proteins are also present in their walls which allow the alveoli to expand and recoil easily during breathing.

External Structure of Lungs

The lungs are the principal organs of respiration. Each lung is conical in shape, with its base resting on the diaphragm and its apex extending superiorly to a point approximately 2.5 cm superior to the clavicle. The right and left lungs are separated medially by the heart and mediastinum, which is the area between the lungs.

The left lung has two lobes, superior lobe and inferior lobe separated by the oblique fissure. The right lung

has three lobes. The hilum is a triangular shaped depression on the concave medial surface of the lungs. A membrane called pleura surrounds each lung. It is a double membrane; consists of an inner and an outer layer. The inner membrane is called visceral pleuron which is firmly attached to the lungs while the outer is called parietal pleuron which lines the chest wall and covers the superior surface of the diaphragm. The space between the visceral and parietal pleuron is called pleural cavity. The cavity is filled by a film of fluid. The fluid enables them to slide over one another. The lungs are spongy due to presence of alveoli. Each alveolar sac is made up of simple squamous epithelium.

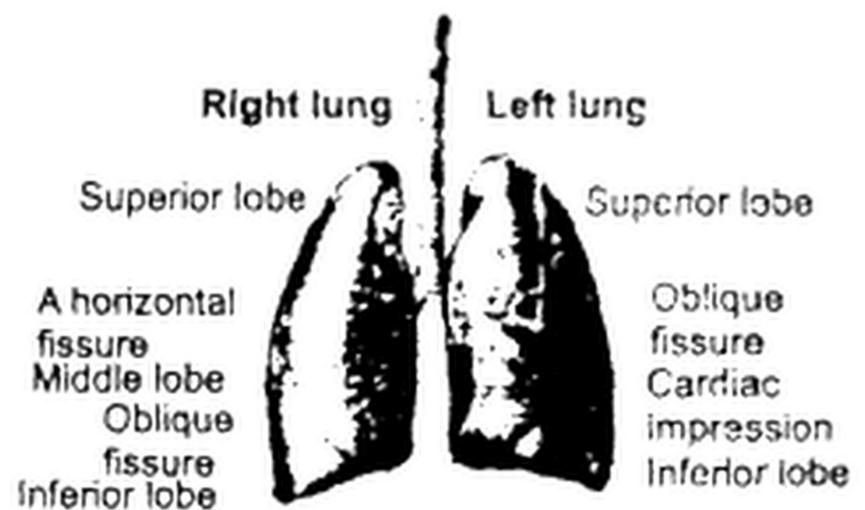


Fig. Human lungs

Q2. Explain Ventilation Mechanisms in humans.

Answer

The Mechanism of Breathing (Ventilation)

The lungs themselves neither draw in air nor push it out. The diaphragm, abdominal muscles and the intercostals muscles accomplish the expansion and contraction of the lungs. The diaphragm (meaning, partition) is a large dome of skeletal muscle that

The muscle fibres run diagonally but in opposite direction in the two sets of muscles.

Breathing takes place in two phases i.e., inspiration and expiration. Inspiration is taking in of air, it is the active phase of breathing. During inspiration contraction of the diaphragm causes its dome shape to flatten (less dome shape) whereas contraction of the external intercostals and relaxation of the internal intercostals causes the rib cage to move upward and forward. Both these events result in increase of inner space of thoracic cavity. Consequently, the pressure in the thorax and hence in the lungs, is reduced to less than atmospheric pressure. Air therefore enters the lungs and alveoli become inflated.

Expiration is the removal of air out of the lungs; it is the passive phase of breathing. During expiration relaxation of the diaphragm causes it to become more dome shape whereas relaxation of the external intercostals and contraction of the internal intercostals causes the rib cage to move downward and backward. Both these events result in decrease of inner space of thoracic cavity. Consequently, the pressure in the thorax and hence in the lungs, is increased to more than atmospheric pressure, therefore, air is forced to expel from the lungs.

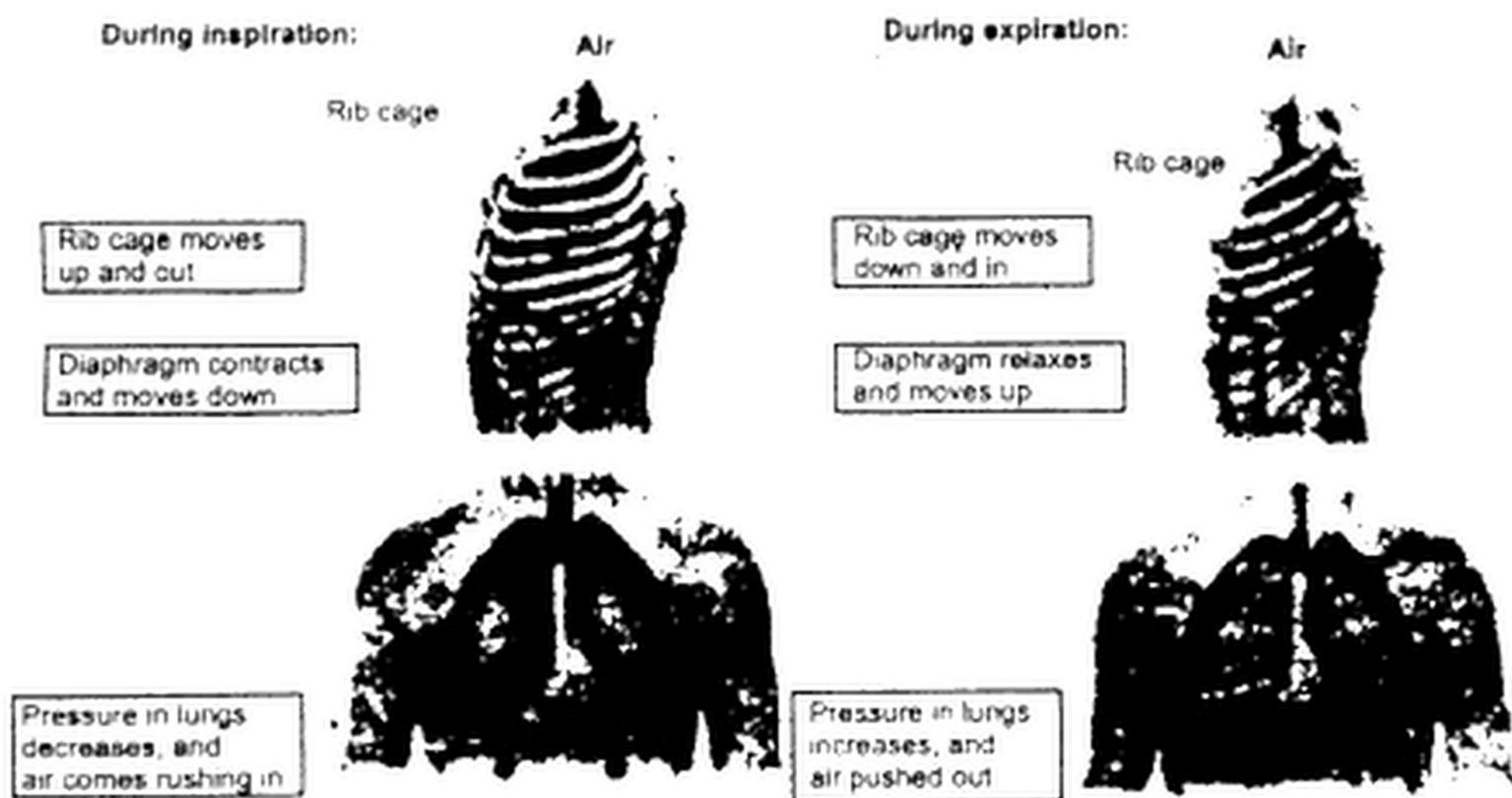


Fig. Mechanism of breathing in human

Q3. Describe the procedure of mouth to mouth artificial respiration.

Answer

Mouth to Mouth Artificial Respiration

Mouth to mouth artificial respiration is called resuscitation. It is a technique used to recover a person who has stopped breathing. In this technique, the rescuer presses his or her mouth against the mouth of the victim and allowing for passive inhalation, forces air into the lungs at intervals of several seconds.



What to Do

- 1) Stretch out victim on his back and kneel close to his side. Loosen any tight clothing around his neck or chest.
- 2) Remove foreign objects if present from victim's mouth and throat by finger sweeping.
- 3) Lift up chin and tilt head back as far as possible, if the head is not tilted, the tongue may block the throat.
- 4) Begin the resuscitation immediately. Pinch the nostrils together with the thumb and index finger of the hand that is pressing on the victim's forehead. This prevents the loss of air through the nose during resucition.
- 5) Inhale deeply.
- 6) Place your mouth tightly around the victim's mouth (over mouth and nose of small children) and blow into the air passage with brief intervals. Continue this activity so long as there is any pulse or heartbeat.
- 7) Watch the victim's chest. When you see it rise, stop blowing, raise your mouth, turn your head to the side and listen for exhalation.
- 8) If patient is revived, keep him warm and do not move him until the doctor arrives, or at least for one-half hour.

Q4. Describe respiratory volume and capacity in man.

Answer

Respiratory Volumes

Respiratory volume or pulmonary volume refers to the amount of air that moves into and out of the lungs while breathing. Spirometry is the process of measuring volumes of the air that move into and out of the respiratory system, and a spirometer is a device to measure these pulmonary volumes.

When we breath, the amount of air moved in and out with each breath is called the tidal volume. Normally, the tidal volume is about 500 ml, but we can increase the amount inhaled and exhaled by deep breathing.

We can increase the inspiration by as much as 3000 ml of air by forced inspiration. This is called the inspiratory reserve volume. Similarly, we can increase expiration by contracting the abdominal and thoracic muscles. This is called expiratory reserve volume and it measures approximately 1100 ml of air. Even after very deep breathing

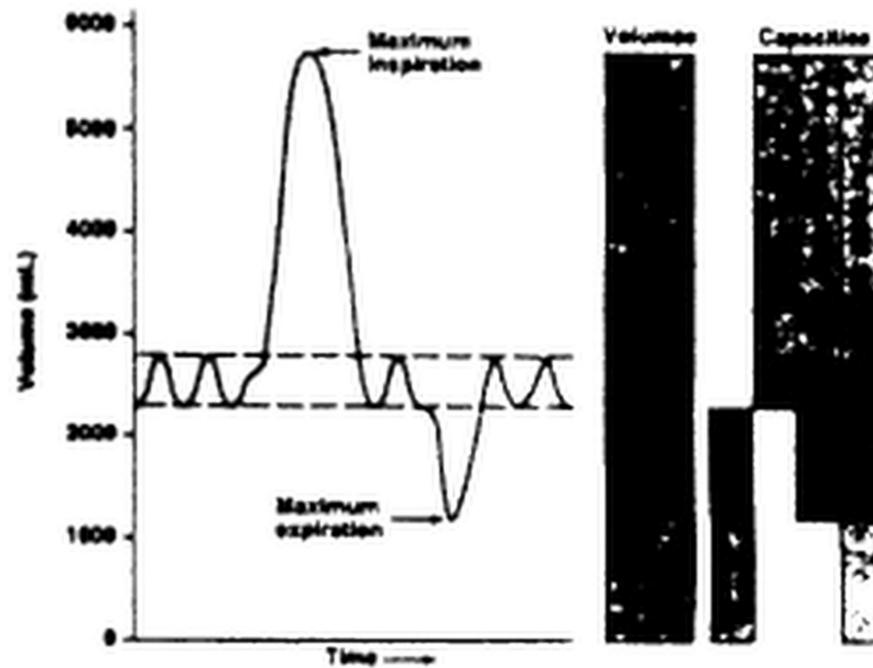


Fig. Respiratory volume

Pulmonary capacities are the sum of two or more pulmonary volumes. Inspiratory capacity is the sum of tidal volume and inspiratory reserve volume (approximately 3500 ml). Functional residual capacity is the sum of expiratory reserve volume and the residual volume (approximately 3200 ml). Vital Capacity is the sum of tidal, inspiratory reserve and expiratory reserve volumes (approximately 4600 ml). Total lung capacity is the sum of the inspiratory and expiratory reserve volumes plus the tidal volume and the residual volume (approximately 5800 ml).

Q5. Explain how breathing is controlled?

Answer

Control of Breathing (Ventilation)

Normally we are not conscious of our breathing because it is controlled involuntarily. A breathing centre located in the medulla of the brain carries out involuntary control of breathing. The ventral (lower) portion of the breathing centre acts to increase the rate and depth of inspiration and is called inspiratory centre. The dorsal (top) and lateral (side) portions inhibit inspiration and stimulate expiration. These regions form the expiratory centre.

Through the cerebral cortex it is possible to consciously or unconsciously increase or decrease the rate and depth of the respiratory movement. A person may also stop breathing voluntarily. Occasionally people are able to hold their breath until the blood partial pressure of oxygen declines to a level low enough that they lose consciousness. After consciousness is lost, the respiratory centre resumes its normal function in automatically controlling respiration. Emotions acting through the limbic system of the brain can also affect the respiratory centre.

Q6. Describe how oxygen is transported in blood?

Answer

Transport of Oxygen In Blood

oxygen, oxygen binds with haemoglobin. This binding is a reversible reaction that occurs in the alveoli of the lungs in the presence of enzyme carbonic anhydrase. Each molecule of haemoglobin can bind with four molecules of oxygen to form oxyhaemoglobin.

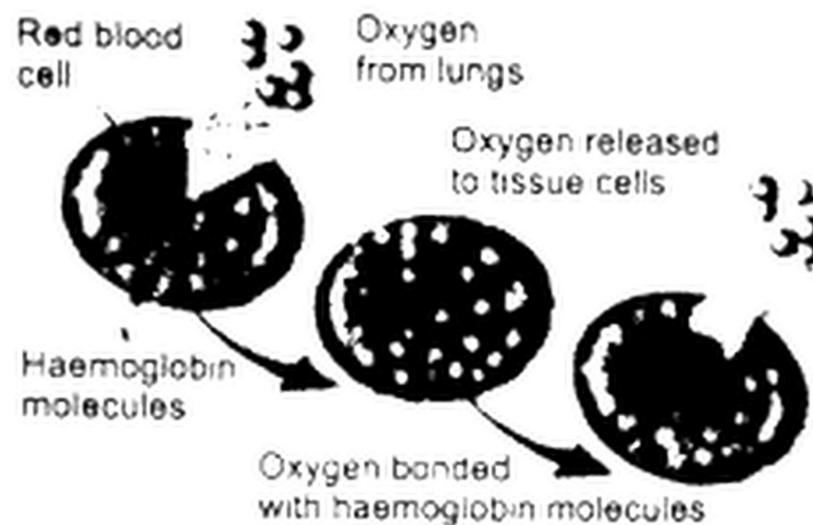


Fig. Transport of oxygen



The ability of haemoglobin to bind with oxygen is called oxygen carrying capacity of blood. The oxygen carrying capacity of blood is directly proportional to the partial pressure of oxygen (PO_2). Maximum oxygen carrying capacity of arterial blood is 20 ml/100 of blood (100% saturated) which is achieved at 100 mmHg PO_2 . This is because the amount of haemoglobin is 15 gms/100 ml of blood.

Since 1gm Hb can combine with 1.34 ml of O_2 , therefore 100 ml blood combines with 20 ml O_2 (100 % saturated). Normally each 100 ml of arterial blood contains 19.4 ml O_2 (i.e., it is 97% saturated; PO_2 is 95 mmHg), while 100 ml of venous blood contains 14.4 ml O_2 (i.e., it is 75% saturated; PO_2 is 40 mmHg). Thus, 5 ml of O_2 is released to the tissues by each 100 ml blood.

Oxygen carrying capacity is sensitive to a variety of environmental conditions like rise in body temperature, drop in pH of blood and partial pressures of carbon dioxide and oxygen.

Q7. Describe how carbon dioxide is transported in blood.

Answer

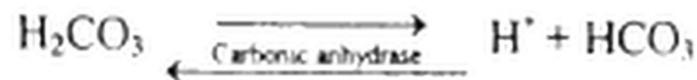
Transport of Carbon Dioxide In Blood

Carbon dioxide is transported in the blood in three main ways: a) In the form of bicarbonate ions. (b) In the form of carboxyhaemoglobin. (c) Dissolved in plasma.

i) As Bicarbonate Ions

Approximately 70% of carbon dioxide is carried in the blood as bicarbonate ions. Carbon dioxide diffuses into the blood and enters the red blood cells and combines with water to form carbonic acid in the presence of enzyme carbonic anhydrase. The chemical reaction can be depicted as follows:

Carbonic acid, H_2CO_3 is an unstable compound and dissociate to form hydrogen ions and bicarbonate ions.



Accumulation of H^+ ions increases acidity in the blood, i.e., it leads to the decrease in pH. This does not occur since haemoglobin buffers the hydrogen formed. The hydrogen ion readily associates with oxyhaemoglobin (Hb4O_2) to form haemoglobinic acid (HHb) and oxygen is released to the tissue.

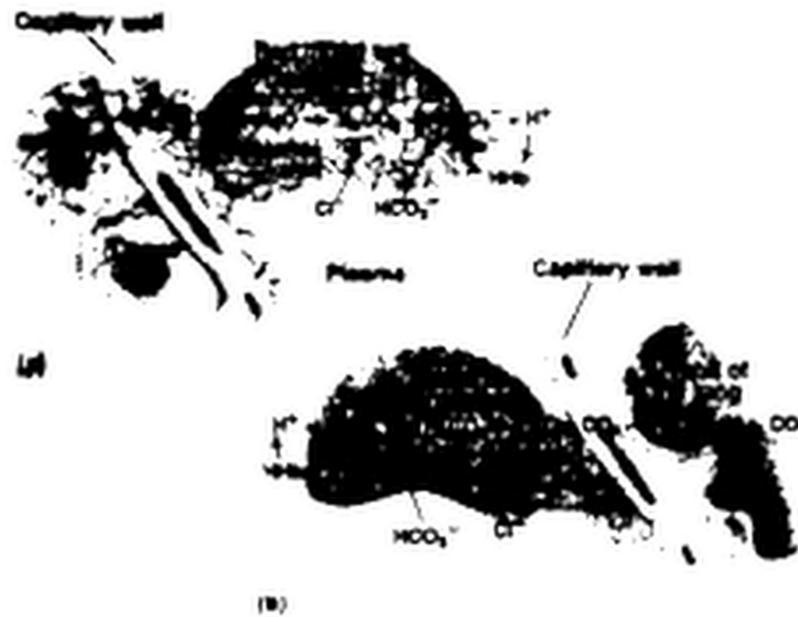


Fig. Transport of CO_2 as bicarbonate ions (a) Transfer of CO_2 from tissues to blood (b) Transfer of CO_2 from blood to lungs

From inside of the erythrocytes negatively charged HCO_3^- ions diffuse to the plasma. This is balanced by the diffusion of chloride ions, Cl^- , in the opposite direction. This is achieved by special bicarbonate-chloride carrier proteins that exist in the RBC membrane. This protein moves the two ions in opposite directions, maintaining the balance of ions on either side. This is called the chloride shifts or Hamburgers phenomenon.

The chloride ions that enter the RBC combine with potassium (K^+) to form potassium chloride, whereas bicarbonate ions in the blood plasma combines with Na^+ to form sodium bicarbonates. The blood pH is thus maintained at approximately 7.4 by the buffer mechanism that exists in blood.

Transport of CO_2 depends on the partial pressure of CO_2 . In case the partial pressure of CO_2 is higher in tissues than blood, the reaction proceeds as drawn in figure 14.9. However, in case the partial pressure of CO_2 is higher in the blood than outside of the blood (As in case of the lungs), the equation reverse and bicarbonate ions with hydrogen ion to release carbon dioxide and water.

ii) As Carboxyhaemoglobin

About 23% of carbon dioxide is carried as carboxyhaemoglobin. CO_2 combines with the globin part of haemoglobin. The reaction depends upon the partial pressure of CO_2 . When the PCO_2 is higher in the tissues than blood, formation of carboxyhaemoglobin

iii) As Dissolved CO₂ in Plasma

Only 7% of carbon dioxide is carried with way. This is rather in efficient way to carry carbon dioxide, but is does occur.

Q8. Describe the role of respiratory pigments?

Answer

Respiratory Pigments

Respiratory pigments are coloured molecules, which act as oxygen carriers by binding reversibly to oxygen. All known β chain respiratory pigments contain a coloured non-protein portion e.g., haem (heme) in haemoglobin. The two well-known respiratory pigments are haemoglobin and myoglobin.

Haemoglobin

Haemoglobin is the iron-containing oxygen-transport metalloprotein in the red blood cells of almost all vertebrates. Haemoglobin in the blood carries oxygen from the respiratory organs (lungs or gills) to the rest of the body (i.e., the tissues). Here it releases the oxygen to burn nutrients to provide energy. This énergy is used to power the functions of the organisms, and collects the resultant carbon dioxide to bring it back to the respiratory organs to be dispensed from the organism.

Myoglobin

It consists of one polypeptide chain. This chain is associated with an iron containing ring structure. This iron can bind with one molecule of oxygen. It is found in skeletal muscles and is the main reason why meat appears red. It serves as an intermediate compound for the transfer of oxygen from haemoglobin to aerobic metabolic processes of the muscle cells. Myoglobin releases oxygen when the partial pressure of oxygen is below 20 mmHg. In this way it acts as a store of oxygen in resting muscle, only releasing it when supplies of oxyhaemoglobin have been exhausted.



α-Chain

Fig. Haemoglobin

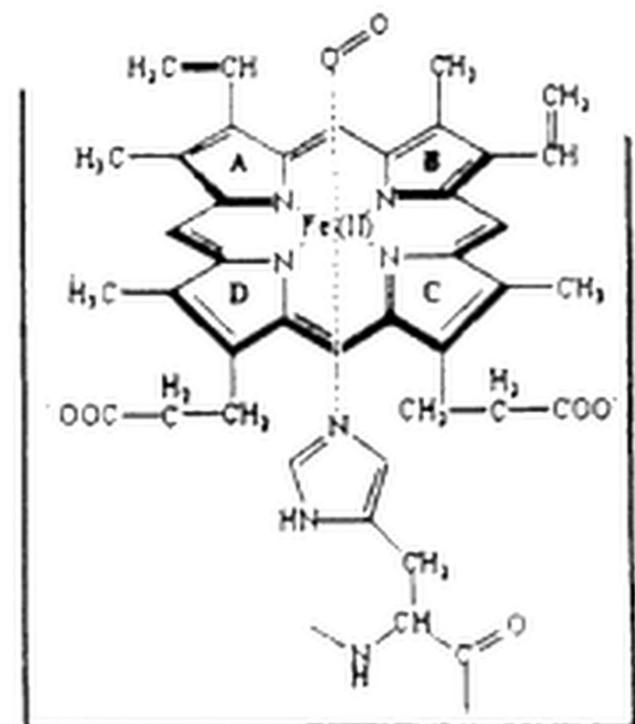


Fig: Chemical structure of haemoglobin



Fig. Myoglobin

Table 14.1 Differences between Haemoglobin and Myoglobin

Haemoglobin		Myoglobin	
1.	It consists of four polypeptide chain.	1.	It consists of one polypeptide chain
2.	Each molecule possesses four iron containing haem groups.	2.	Each molecule possesses one iron containing haem group.
3.	Four oxygen molecules can bind to each haemoglobin molecule.	3.	Only one oxygen molecule can bind to each myoglobin molecule.
4.	It is found in RBCs.	4.	It is found in muscles.
5.	It transports oxygen.	5.	It stores oxygen
6.	It has less affinity with oxygen.	6.	It has more affinity with oxygen.
7.	It loses oxygen at PO_2 60 mmHg.	7.	It loses oxygen at PO_2 20 mmHg.

Q9. Discuss causes, symptoms and treatments of sinusitis and otitis media as upper respiratory tract infection.

Answer

Upper Respiratory Tract Infection

The infection of the upper respiratory tract includes sinusitis, otitis media etc.

Sinusitis

Sinusitis is an inflammation of the nasal sinuses that may be acute (symptoms last 2 – 8 weeks) or chronic (symptoms last much longer). The sinuses are holes in the skull between the facial bones.

Aetiology: Sinusitis is generally caused by cold and wet climate. Atmospheric pollution, smoke, dust overcrowding, dental infections, viral infections etc. also cause sinusitis.

Symptoms: Fever, nasal obstruction, raspy voice, pus-like (purulent) nasal discharge, loss of sense of smell, facial pain or headache that is sometimes aggravated by bending over.

Treatment: If a bacterial infection is present, antibiotics are usually prescribed. Beside it your doctor may also prescribe nebulisation (steam inhalation) which can be useful in reducing inflammation in the sinuses and nose and to accelerate recovery

Otitis Media

Otitis media is an inflammation of the middle ear (the cavity between the eardrum and the inner ear). Inflammation of the middle ear causes the Eustachian tubes to close causing the fluid to become trapped. Bacteria from the back of the nose travel through

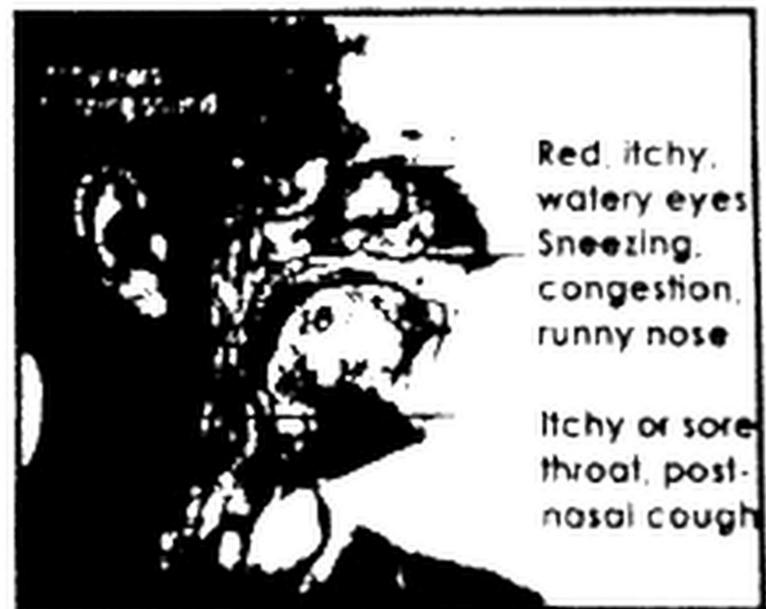


Fig: Some of the symptoms of sinusitis

Red, itchy,
watery eyes
Sneezing,
congestion,
runny nose

Itchy or sore
throat, post-
nasal cough

Aetiology: It could be: recurrent attacks of common cold, measles, sinusitis, nasal allergy etc..

Symptoms: Acute otitis media causes sudden, severe earache, deafness, and tinnitus (ringing or buzzing in the ear), sense of fullness in the ear, fever, headache, fluid leaking from the ear. Occasionally, the eardrum can burst, which causes a discharge of pus and relief of pain.

Treatment: Around 80% of cases of acute otitis media clear up within three or four days without treatment. Perforated eardrums also usually heal on their own without the need for treatment. However, for complicated cases, antibiotics and painkillers are prescribed by the physician.

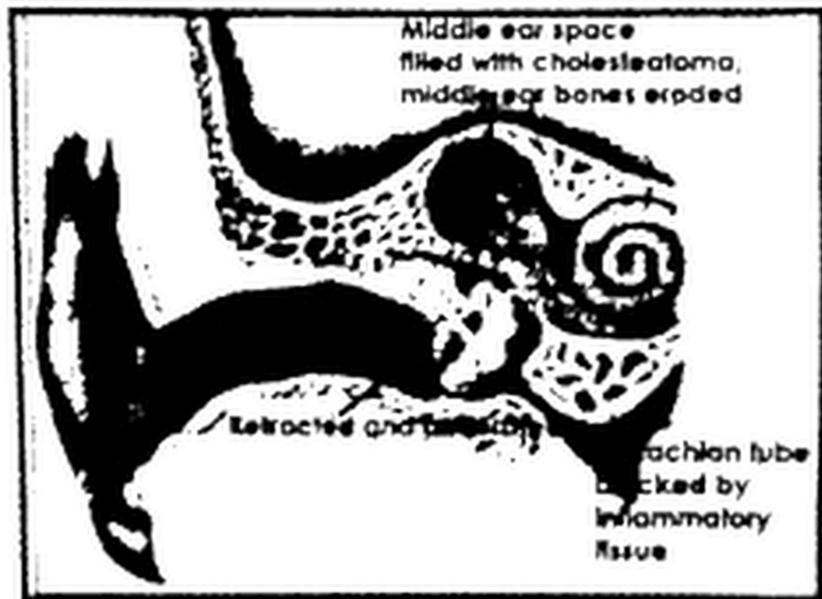


Fig: Internal structure of ear showing region of middle ear.

Q10. Explain cause symptoms and treatment of pulmonary tuberculosis.

Answer

Pulmonary tuberculosis (TB) is highly contagious chronic bacterial infection of lungs. Although about 15 percent of TB patients may develop the disease in an organ other than lung, such as the lymph nodes, GI tract bones and joints. When people have pulmonary tuberculosis, the alveoli burst and are replaced by inelastic connective tissue. The cells of the lung tissue build a protective capsule around the bacilli and isolate them from rest of the body. This tiny capsule is called tubercle. The tubercles can rupture, releasing bacteria that infect other parts of the lung.

Aetiology: Pulmonary tuberculosis is caused by *Mycobacterium tuberculosis*.

Symptoms: There is a low-grade intermittent fever usually in the evening, night sweats, weight loss, anorexia, malaise (depression), weakness and dry cough with sputum, dull ache in the chest due to pleurisy (Inflammation of the pleura of the lungs).

Treatment: Taking medicines for 9 months regularly can cure T.B disease. This is called Daily Observed Treatment Short Course (DOTS). This treatment is given to patients under supervision to ensure that the medicines intake completely cures the patient.

Q11. Explain cause, symptoms and treatment of pneumonia.

Answer

Pneumonia is a serious disorder of lower respiratory tract which is characterized by inflammation of alveolar wall and presence of fluid and pus in alveolar sacs of one or both lungs.

Causes and Risk Factors of Pneumonia

There are over 30 different causes of pneumonia, but usually pneumonia is caused by

through the mouth, nose and eyes. If the body's resistance is down, the natural immunity against diseases is weakened then microorganisms are free to spread into the lungs. Thus, alveoli become filled with fluid and pus from the infectious agent, making it more difficult for the body to get the oxygen it needs, and the person may become sick.

The bacteria that cause bacterial pneumonia are *Streptococcus pneumoniae*, *Hemophilus influenzae*, *Legionella pneumophila*, *Staphylococcus aureus*, and *Mycoplasma*.

If pneumonia is not treated timely, some complications may arise that include pleura effusion (fluid around the lung), empyema (pus in the pleural cavity), hyponatremia (low blood sodium) and rarely, an abscess in the lung.

Symptoms of Pneumonia

Symptoms vary, depending on the type of pneumonia and the individual.

- With bacterial pneumonia the person may experience shaking, chills, chattering teeth, severe chest pain, very high fever, sweating, rapid breathing, rapid pulse rate.

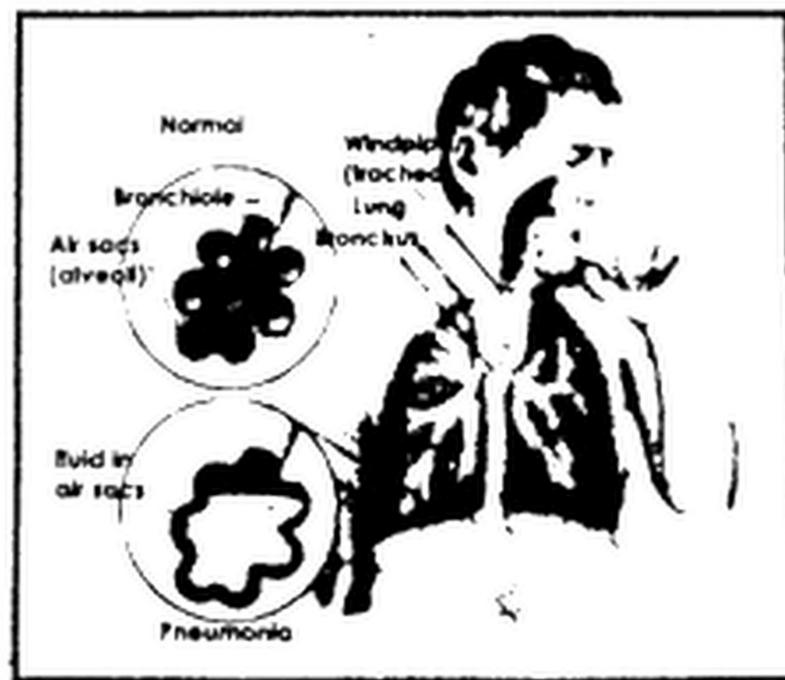


Fig: In pneumonia body is unable to get proper amount of oxygen due to Fluid in the air sacs.

- With viral pneumonia, the person may experience fever, dry cough, headache, muscle pain and weakness. These flu-like symptoms may be followed within one or two days by increasing breathlessness, dry cough becomes worse and produces a small amount of mucus, higher fever, bluish color to the lips.
- With mycoplasma pneumoniae, the person may experience violent cough in attack, chills, fever, nausea, vomiting, slow heartbeat, and breathlessness, bluish color to lips and nail beds, diarrhoea and muscle aches.

Treatment of Pneumonia

Treatment depends on the severity of symptoms and the type of organism causing the infection. Mostly antibiotics are prescribed.

Q12. Discuss emphysema and lungs cancer as the disorder of human lungs.

Answer

Emphysema

Emphysema is a lung disease which is characterized by:

- Shortness of breath with exertion, eventually breathlessness all the time
- Coughing
- Fatigue
- Cyanosis (a blue tinge to the skin) due to lack of oxygen

The exchange of oxygen and carbon dioxide takes place in the small air sacs of the lungs (alveoli). In a person with emphysema, the alveoli are damaged. The main tubes leading into the lungs (the bronchi) are also damaged and narrowed. The airways of the lungs are elastic. After repeated exposure to chemical irritants, such as cigarette smoke, the alveoli and bronchioles lose their elasticity.

The movement of oxygen from the air to the blood becomes more difficult. Emphysema is generally caused by cigarette smoking or long-term exposure to certain industrial pollutants or dust.

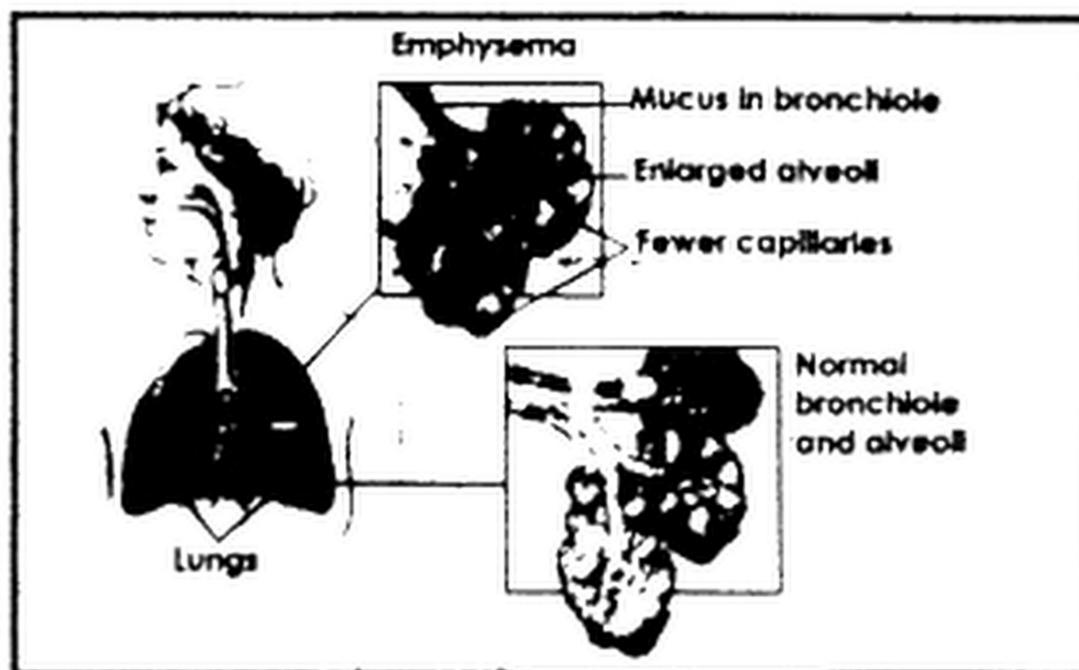


Fig: Emphysema results in damaging the bronchiole and alveoli.

Lung Cancer

Lung cancer is one of the most common cancers in the world. Cigarette smoking is one of the major causes of most lung cancer. The more cigarettes you smoke per day and the earlier you started smoking, the greater is the risk of lung cancer. High levels of pollution, radiation and asbestos exposure may also increase risk.

Common Symptoms of Lung Cancer Include

- A cough that doesn't go away and gets worse over time
- Constant chest pain
- Coughing up blood
- Shortness of breath

- Repeated problems with pneumonia or bronchitis
- Swelling of the neck and face
- Loss of appetite or weight loss
- Fatigue

There are many types of lung cancer. Each type of lung cancer grows and spreads in different ways and is treated differently. Treatment also depends on the stage, or how advanced it is. Treatment may include chemotherapy, radiation and surgery.

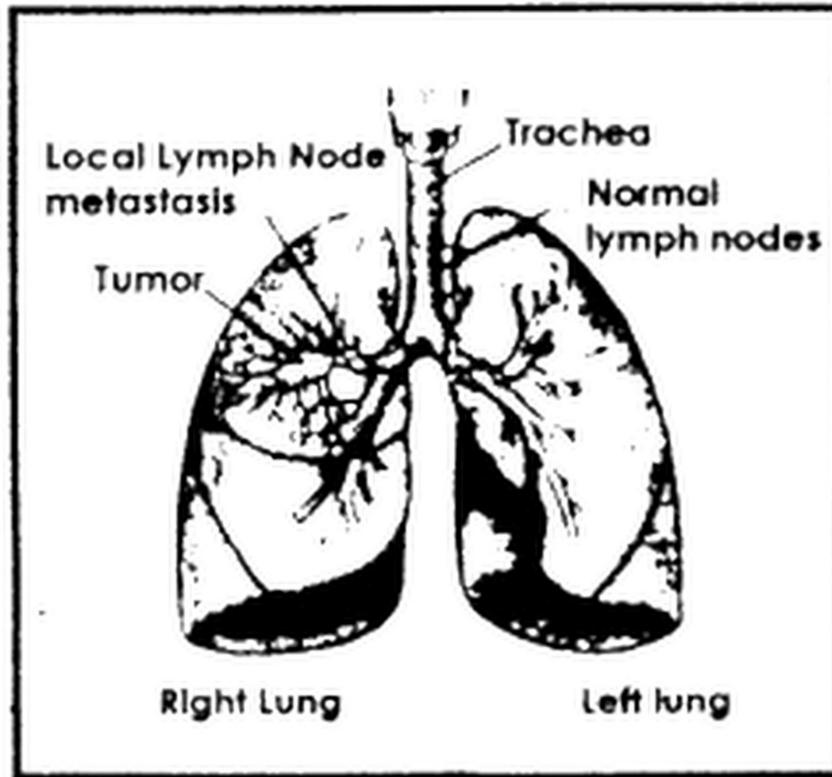


Fig: Tumor in the lungs can develop at any place causing lung cancer.

Q13. Describe the external structure of human lungs.

Answer

External Structure of Lungs

The lungs are the principal organs of respiration. Each lung is conical in shape, with its base resting on the diaphragm and its apex extending superiorly to a point approximately 2.5 cm superior to the clavicle. The right and left lungs are separated medially by the heart and mediastinum, which is the area between the lungs.

The left lung has two lobes, superior lobe and inferior lobe separated by the oblique fissure.

The right lung has three lobes. The hilum is a triangular shaped depression

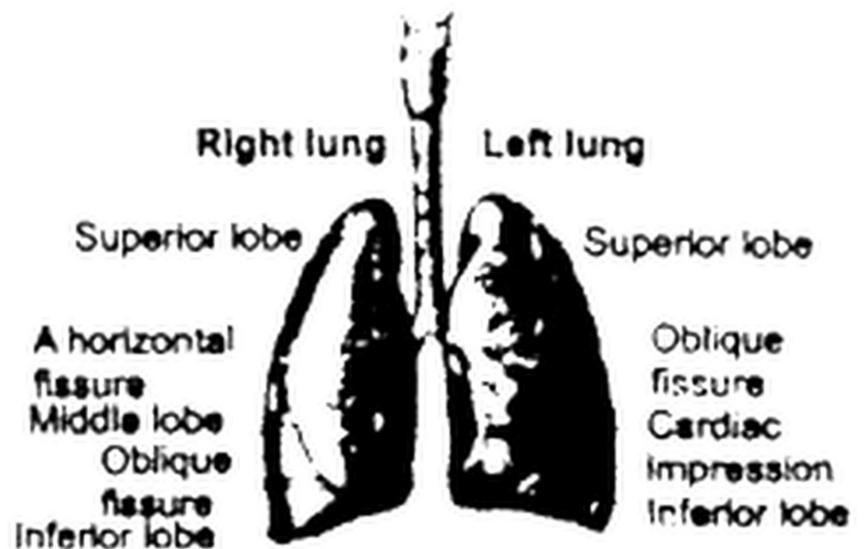


Fig. Human lungs

membrane is called visceral pleuron which is firmly attached to the lungs while the outer is called parietal pleuron which lines the chest wall and covers the superior surface of the diaphragm. The space between the visceral and parietal pleuron is called pleural cavity. The cavity is filled by a film of fluid. The fluid enables them to slide over one another. The lungs are spongy due to presence of alveoli. Each alveolar sac is made up of simple squamous epithelium.

Q14. List the effects of smoking on lungs.

Answer

Effects of Smoking on the Respiratory System

The effects of tobacco smoke on the respiratory system include:

- Irritation of the trachea (windpipe) and larynx (voice box)
- Reduced lung function and breathlessness due to swelling and narrowing of the lung airways and excess mucus in the lung passages.
- Impairment of the lungs' clearance system, leading to the build-up of poisonous substances, which results in lung irritation and damage.
- Increased risk of lung infection and symptoms such as coughing and wheezing.
- Permanent damage to the air sacs of the lungs.
- Almost immediately, smoking can make it hard to breath. Within a short time, it can also worsen asthma and allergies

Q15. Justify why birds perform much better than man at high attitude.

Answer

Respiration In Birds

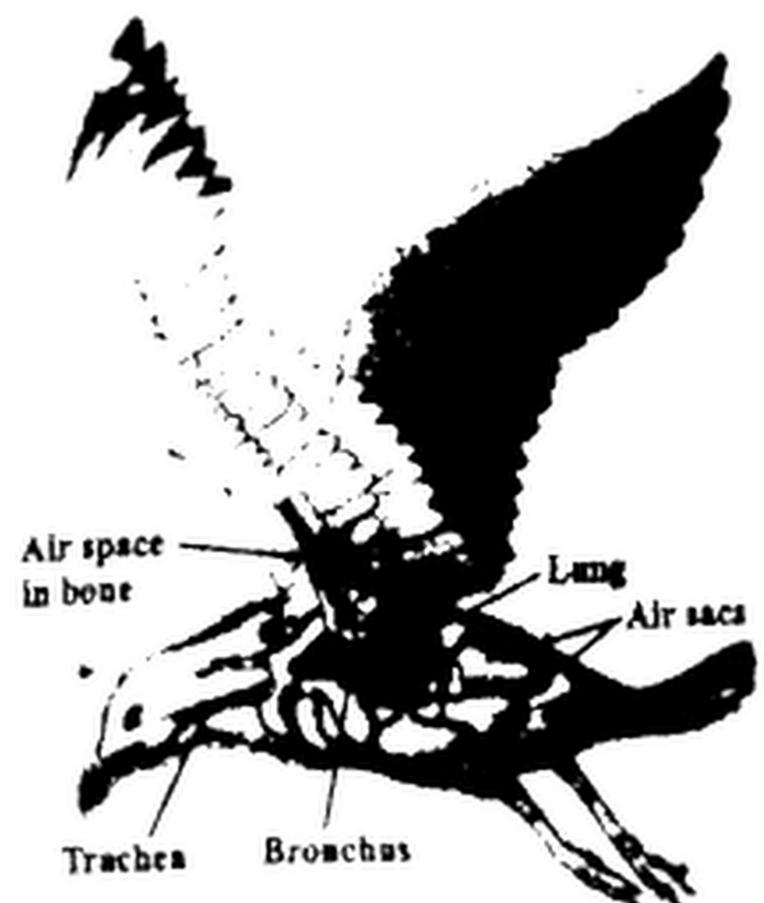
Respiration system in birds is the most efficient and elaborate. The birds are very active animals with high metabolic rate, and thus need larger amount of oxygen.

One Way Flow of Air

The respiratory system in the birds is arranged: so that there is one way flow of the air through the lungs and the air is renewed after inspiration. In the lungs of birds instead of alveoli tiny thin walled ducts are present called parabronchi.

Parabronchi

These parabronchi are open at both ends and the air is constantly ventilated. The walls of the parabronchi are chief sites of gaseous exchange. The direction of the blood in



Respiratory system of Birds

increases the amount of oxygen, which enters the blood. Lungs in the birds are very efficient in this respect as well, because no stale air remains in the parabronchi.

Air Sacs

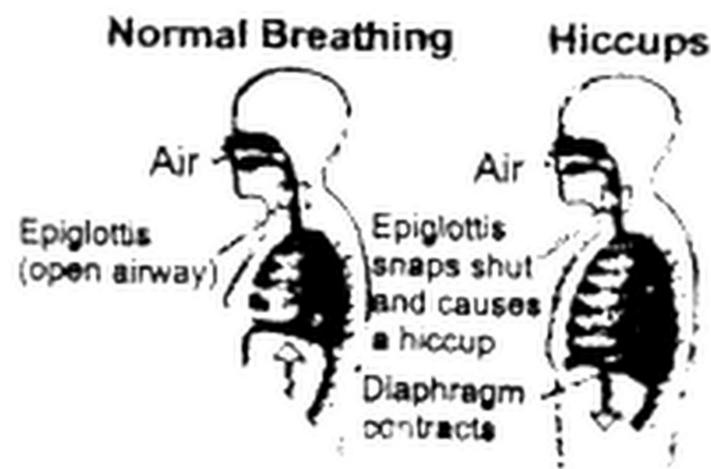
The lungs has also developed several extension known as air sacs which reach into all parts of the body and even penetrate some of the bones. In most birds the air sacs are nine in number which become inflated by atmospheric pressure when the ribs articulate, are rotated forward and upward. The inflated air sacs act as bellows and send air into the parabronchi for gaseous exchange.

Q.16 Relate the transportation of gases to hiccups, sneezing and snoring.

Answer

Hiccups

It is the spasmodic contraction of the diaphragm while the glottis is closed, producing a sharp respiratory sound. It is reflexive and serves no known functions.



Sneezing

Deep inspiration is followed by a closure of the glottis. The forceful expiration that results abruptly opens the glottis, sending a blast air through the nasal cavity. The eyelids close reflexively during sneeze. Sneezing is a reflexive response to irritating stimulus of the nasal mucosa. Sneezing clears the upper respiratory passages.

Snoring

It is a rough, raspy noise that can occur when a sleeping person inhales through the mouth and nose. The noise usually is made by vibration of the soft palate which may occur as a result of vocal cord vibration.

Q.17. Describe the Carbon monoxide poisoning.

Answer

Gases that have undergone incomplete combustion produce CO and toxic fumes (hydrogen cyanide). In carbon monoxide poisoning caused by gas heaters, left on overnight in closed environments, CO binds to haemoglobin preventing the uptake of oxygen by haemoglobin. The symptoms of CO poisoning are nausea, vomiting, headache, mental status changes, and cherry-red lips. CO binds to haemoglobin with affinity 249 times greater than that of oxygen.

haemoglobin to release oxygen to tissue.

Q.18. Write the differences between haemoglobin and myoglobin.

Answer

A respiratory pigment is a molecule that involves in transport or storage of respiratory gases. In human, haemoglobin that increases the oxygen-carrying capacity of the blood and myoglobin that stores oxygen in muscles are referred as respiratory pigments.

Haemoglobin

Haemoglobin is the iron-containing oxygen-transport metalloprotein in the red blood cells of almost all vertebrates.

Haemoglobin in the blood carries oxygen from the respiratory organs (lungs or gills) to the rest of the body (i.e., the tissues). Here it releases the oxygen to burn nutrients to provide energy. This energy is used to power the functions of the organism, and collects the resultant carbon dioxide to bring it back to the respiratory organs to be dispensed from the organism.

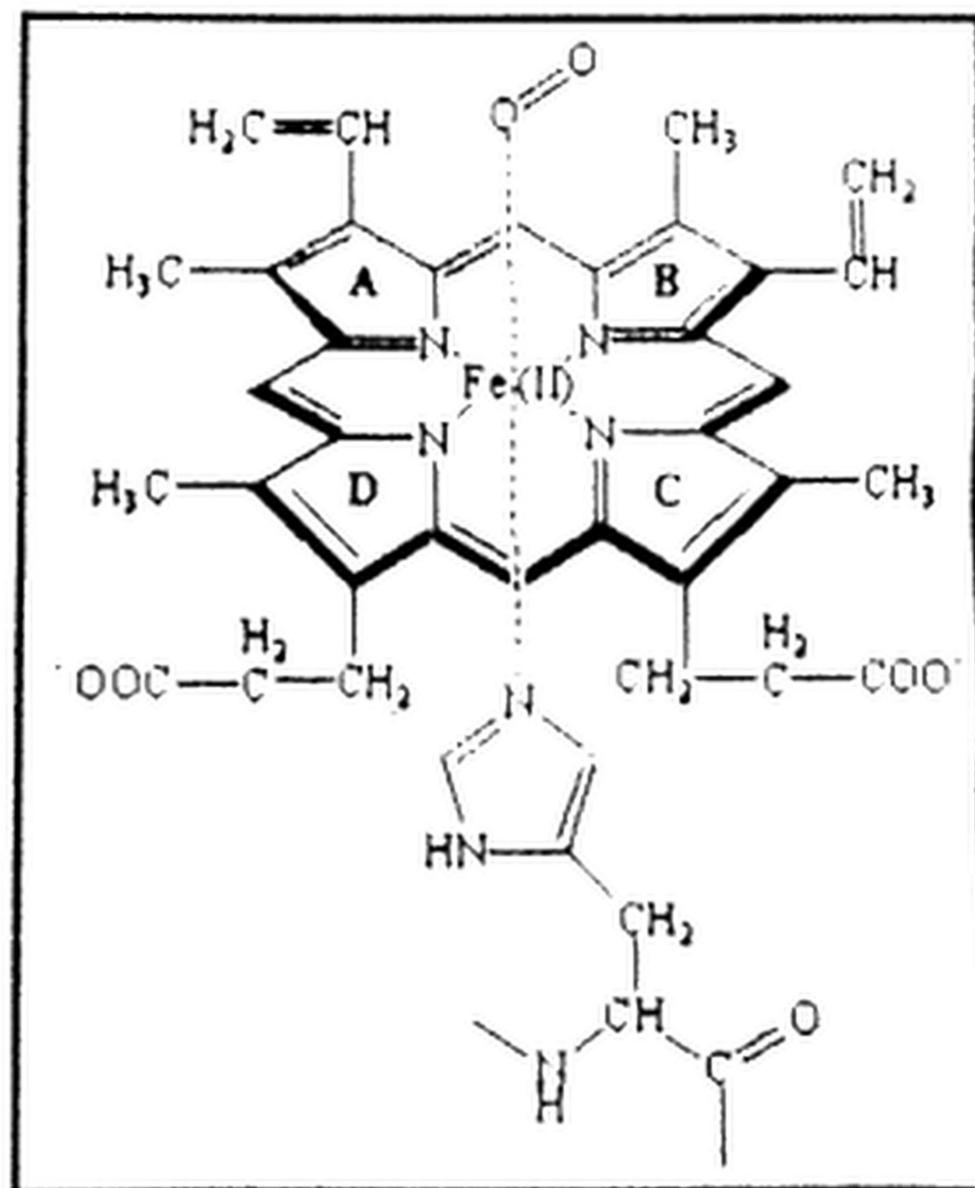


Fig: Chemical structure of haemoglobin.

All vertebrates use the haemoglobin as respiratory pigment that transports gases in the body, where as invertebrates have respiratory pigment like haemocyanin (in molluscs) haemoerythrin (in some marine animals) and chlorocruorin (in annelids).

Haemoglobin is bright red when oxygenated and dark red when deoxygenated.

Oxygenated chlorocruorin turns green whereas oxygenated haemoerythrin has a violet to pink colour and clourless when deoxygenated.

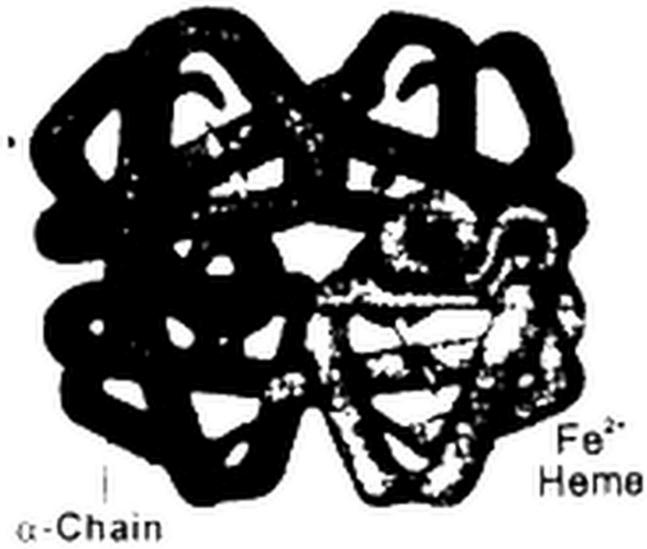


Fig. Haemoglobin

Myoglobin: Myoglobin (Mb) is an O_2 carrying protein that binds and releases oxygen with changes in the cytoplasm of muscle cells.



Fig. Myoglobin

